

AcqKnowledge Tutorial & Demonstration

For Windows/PC or Mac OS X

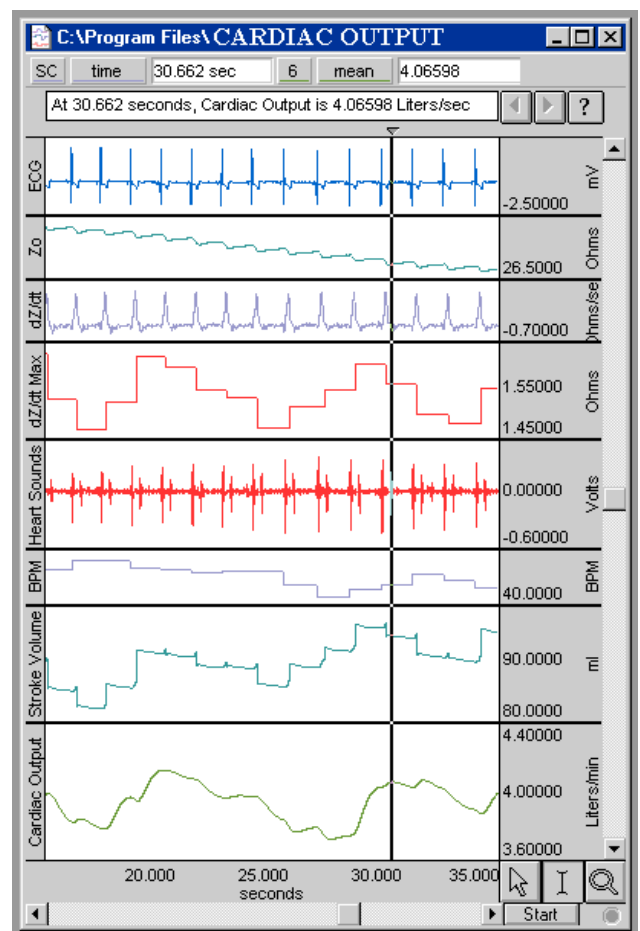
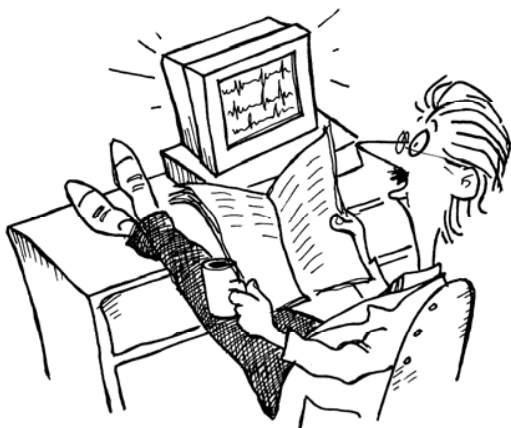


The next generation is here!

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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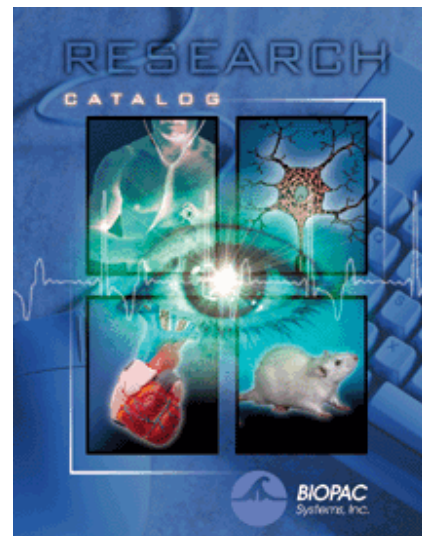
Introduction

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 contact one of 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 minimum 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 or later

Mac 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 MP150 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. The demo does not support: save, print, online averaging, Edit > Clipboard functions, sound option, and some Video menu options. The demo only supports video setup, playback, and synchronization using the [EMGdata.acq](#) data file and the [emg_sync.avi](#) video.

The MP100 is not demonstrated, but software functionality is similar to the MP150. Features that require increased speed, expanded stimulator features, and Ethernet interface options are marked “MP150 only” in the software guide.

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.

➡ See the full line of research products online at www.biopac.com.

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 you can save data in graphical format and place the images into programs such as 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 online calculations during the recording.
- Have complete control over acquisition parameters such as variable sample rates, length of recording, and recording start time.
- 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 InstallShield Wizard).

To begin, open the AcqKnowledge program:

PC: use the **Windows Start** menu

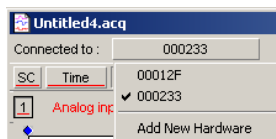
Mac: double-click the AcqKnowledge Demo icon
(and if necessary, select **File > New > Graph**)


An “Untitled” graph window should be generated.

Click 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 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.
- MP150 Only**—The upper left corner may display “Connected to” information, which identifies the MP150 units by serial number; this option is most useful when multiple MP150 units are being used.



Toggle the hardware connection using the  icon on the toolbar.

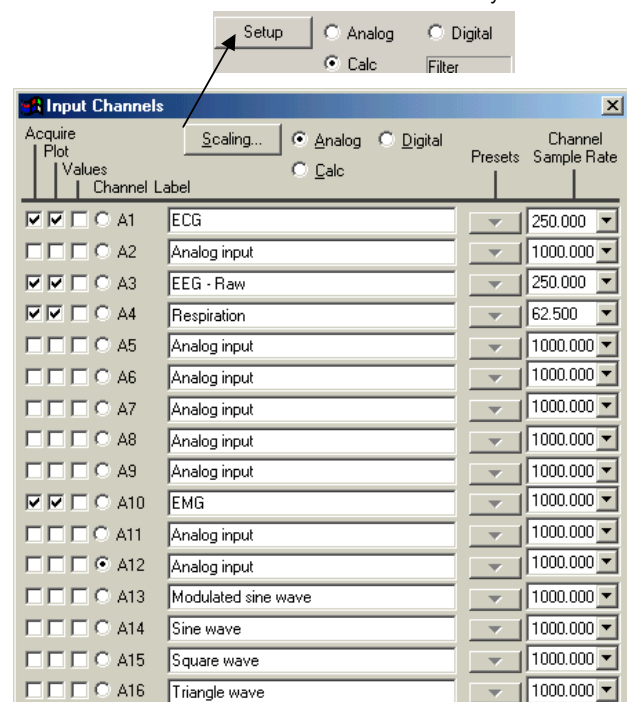
Recording Data

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), when you deselect the Plot boxes for one or all of the Analog channels (which are normally checked for plotting at startup in the sample file) and then click **Start** 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.

Windows users: When the **Calc** option is selected, the “Scaling” button is labeled “Setup...”
Mac users: This button is always labeled “Setup...”

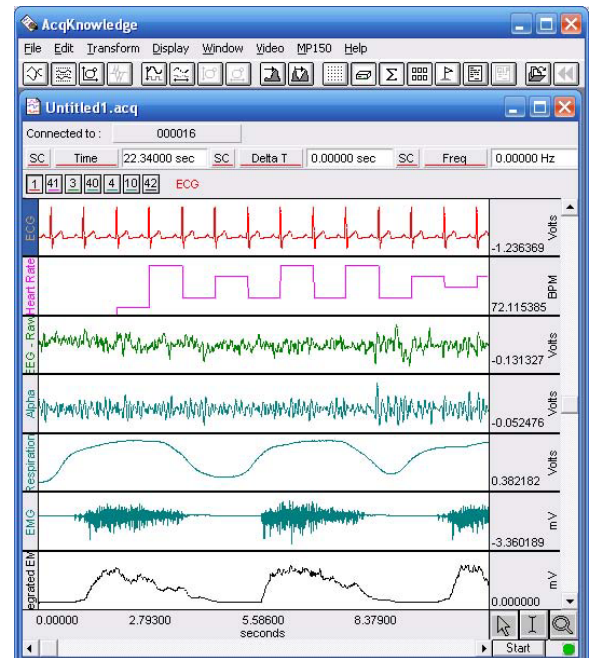


During a recording, when the data plot reaches the right edge of the window, the waveforms continuously scroll from right to left. For long recordings, it may be desirable to view the data collected earlier in the acquisition while new data is coming in.

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

Start the acquisition again.

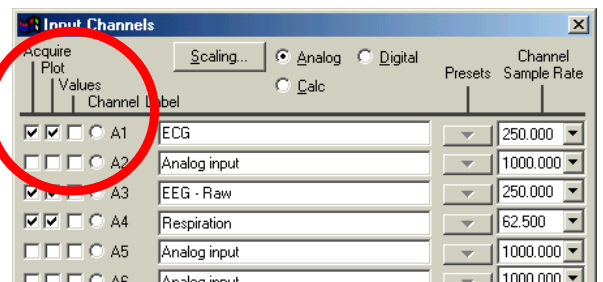
- Now, when the data plot reaches the right limit, the screen will not be re-written.



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 reselect **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.

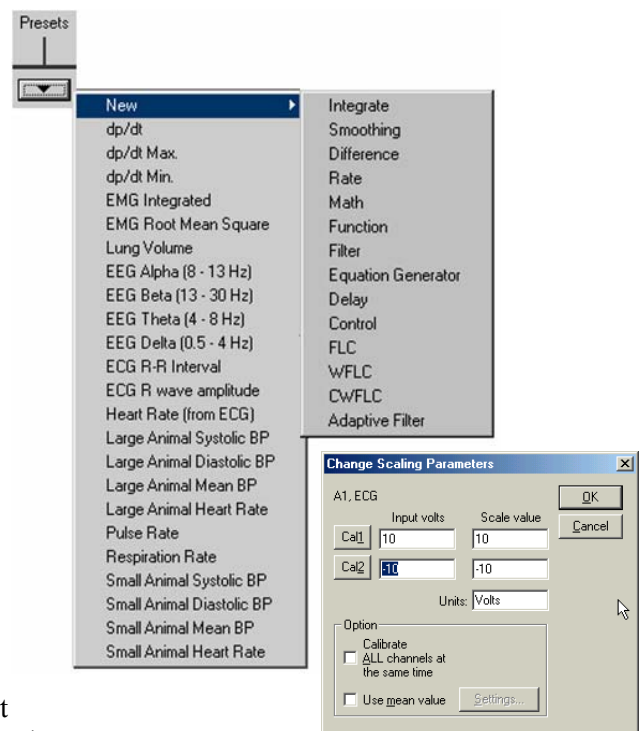
In addition to the ability to collect data in the background, AcqKnowledge also gives you total control over the channel acquisition parameters. To illustrate this, choose **Set Up Channels** from the MP menu. To the left of each channel, the **Acquire** checkbox enables acquisition, and the **Plot** 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



The **Values** checkbox will cause the channel's current value to be numerically displayed in the **Input Values** window. The circle next to the channel numbers indicates the selected **Channel**; when a channel is selected, you can set scaling and other parameters. You can edit each channel **Label** as desired.

Calculation Channel **Presets** offer an easy way to get started. Choose **Calc** in the **Set Up Channels** dialog to activate the **Presets** menu. Click the (arrow icon) to generate a list of preset options. Use an existing preset, or modify it to create a new one. 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. Choose **Analog** in the **Set Up Channels** dialog and click the **Scaling...** (PC) or **Setup...** (Mac) button to generate the **Change Scaling Parameters** dialog. Enter values and a units label to convert incoming signals into other units (such as ft/lbs, millimeters, liters, etc.).

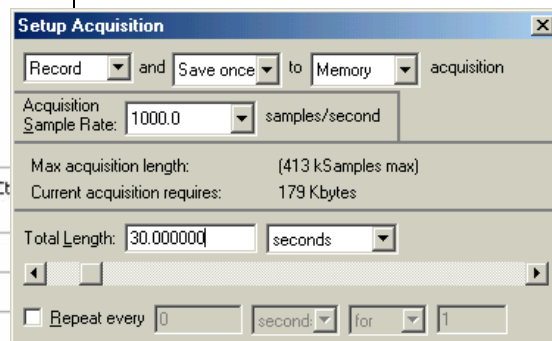
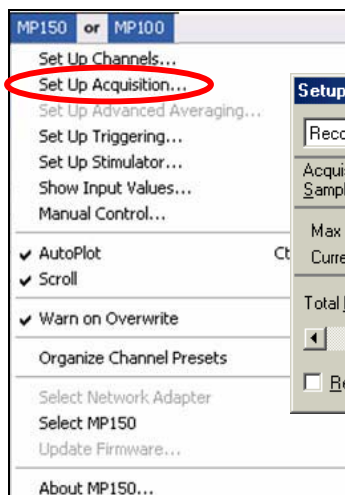
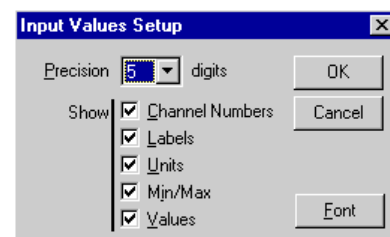
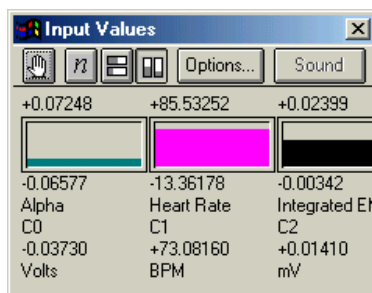


To view the input channel values in numerical and/or bar chart format, choose **Show Input Values...** from the MP menu. This is useful for displaying data as it is being acquired, useful for biofeedback procedures.

Click **Options** 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 **Set Up acquisition** window. This is where you will set up parameters that control data collection. The basic options are **Acquisition Sample Rate** and **Total Length**.

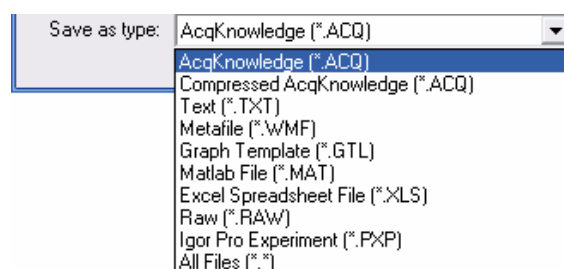
- Acquisition Sample Rate is analogous to the mm/sec setting on a chart recorder. Choose a samples/second rate from the pull-down menu.
- Total Length sets the amount of data to record. Adjust the scroll bar or enter the length value directly.



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 Length value. Beginning the acquisition again (clicking the **Start** button) will cause these new settings to go into effect (the demo is locked to an acquisition sample rate of 1,000 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, etc.). 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 feature allows you to 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.

- **AcqKnowledge (.ACQ)** saves data in a binary file format that uses minimal disk space.
- **Compressed** will generally achieve about 60% compression. Saving small files (less than 200K) may have little effect.
- **Text (.TXT)** is a standard ASCII format that can easily be read by other programs.
- **Metafile (.WMF/Windows)** and **PICT (Mac)** files can be read by most drawing and word processing programs.
- The powerful **Graph Template** feature lets you save predefined experiment parameters. Just open a **Graph Template (.GTL)** and click **Start** to recreate the protocol and acquire data under the same settings. “**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).
- Matlab uses the “MAT-file” binary format to save numerical and textual information as **Filename.mat**.
- **Excel Spreadsheet File (.XLS)** option saves graph data with each channel placed into a spreadsheet column.
- **Raw (.RAW)** saves data for low-level data exchange with options for data type, layout, and endian byte ordering.
- With **Igor Pro Experiment format (.PXP)**, the graph is saved to a single packed experiment file, with each channel saved into a separate Igor wave that preserves the channel label, waveform sampling rate, and unit information.



Easy Viewing

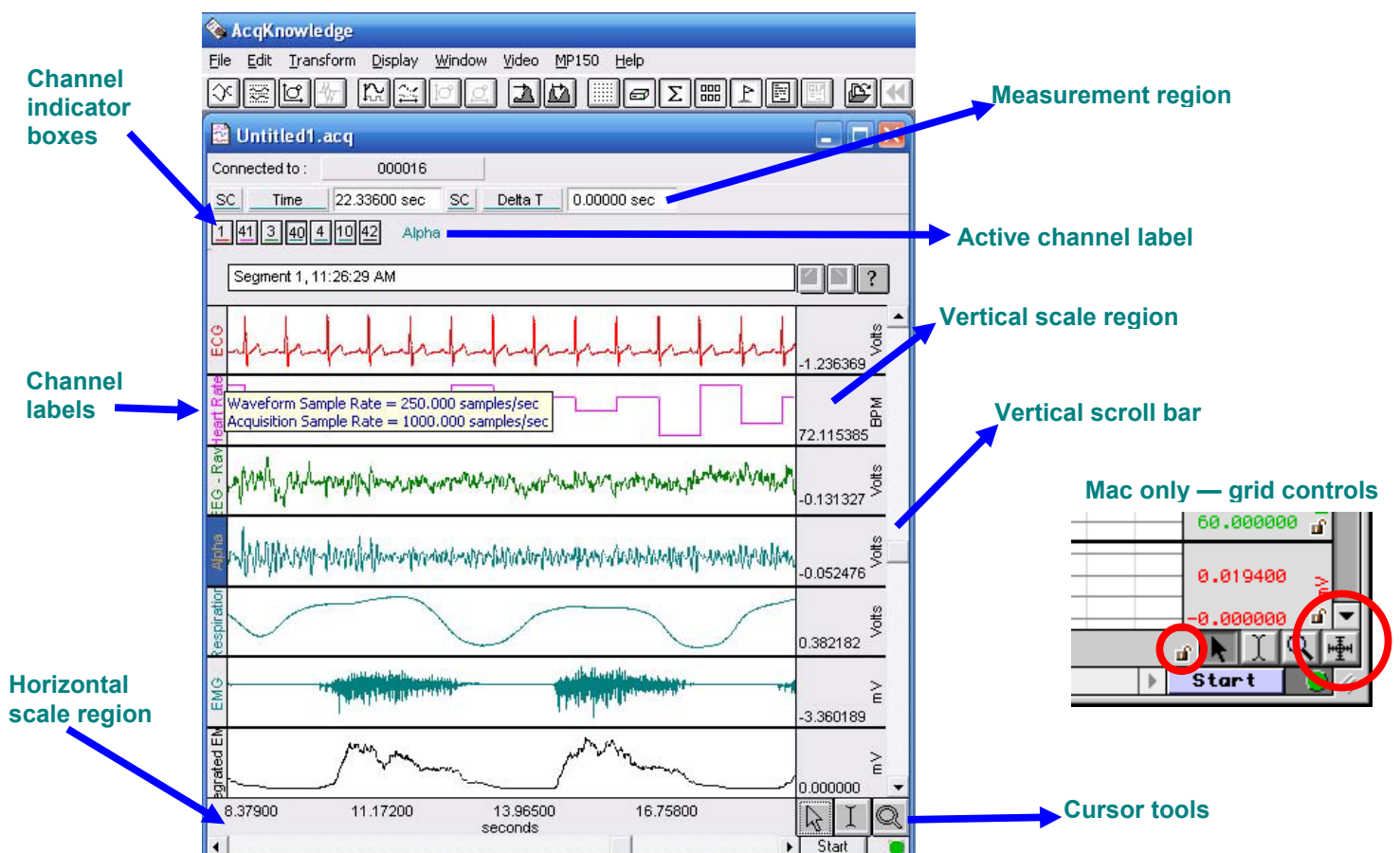
The AcqKnowledge software makes it easy to display and view your data. The software is designed to provide an easy-to-use interface for working with data and displaying information. AcqKnowledge includes...

- 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.
- Editing features 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, a row of small boxes 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 of 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 the waveform using the arrow tool. On 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 Mac.



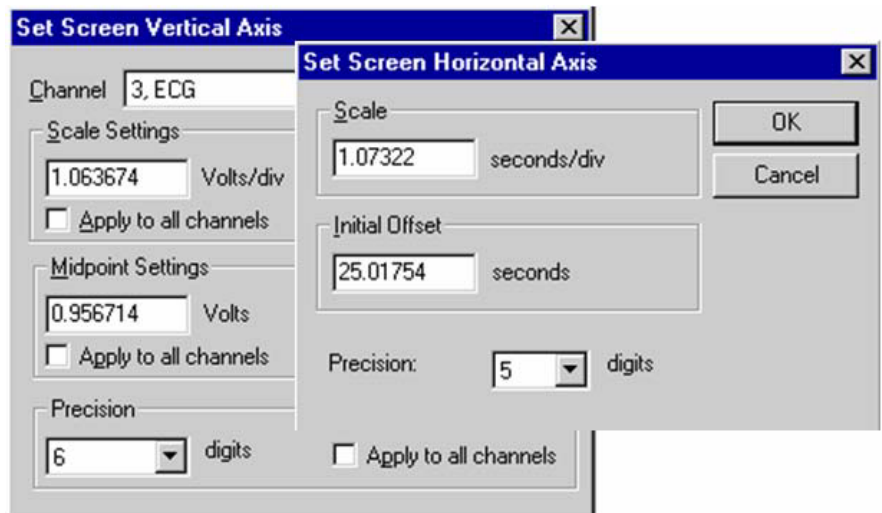
In the preceding screen shot, channel 40 (Alpha) was selected and its indicator box depressed. The label of the selected channel appears to the right of the channel indicator boxes. The vertical scroll bar adjusts the vertical offset of the selected channel. You can use it to slide the selected waveform’s scale up or down.

To adjust the vertical scale of the selected channel, click 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 **OK**. 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 **Display > Autoscale waveforms**. (PC users can also access the Autoscale option by right-clicking the mouse.)

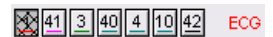
You can also compress or expand the displayed waveforms along the horizontal (time) axis. Simply click anywhere in the horizontal scale region. The horizontal scale box is generated, allowing any entry. After you click **OK**, the screen will be redrawn with the new time scale setting.

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

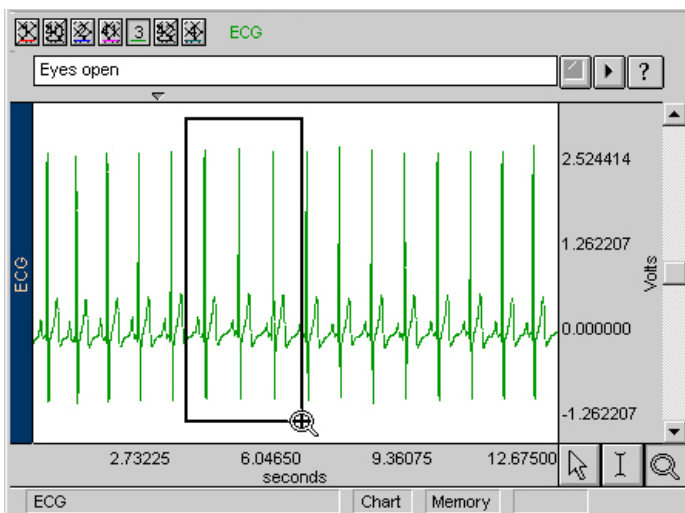


To enlarge a section of interest, use the zoom tool in the lower right hand corner of the window.

You can temporarily hide channels to focus on the channel you will zoom in on by clicking a channel's indicator box (in the upper left of the graph window) 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.




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, select the zoom tool and then click 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 (example below).

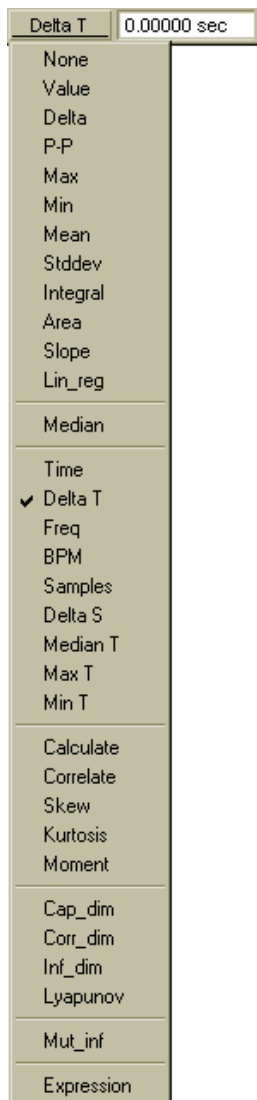


Select **Zoom Back** and **Zoom Forward** from the **Display** menu to move through zoom levels.

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


To take specific measurements, click 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 at right.

In the example at 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.




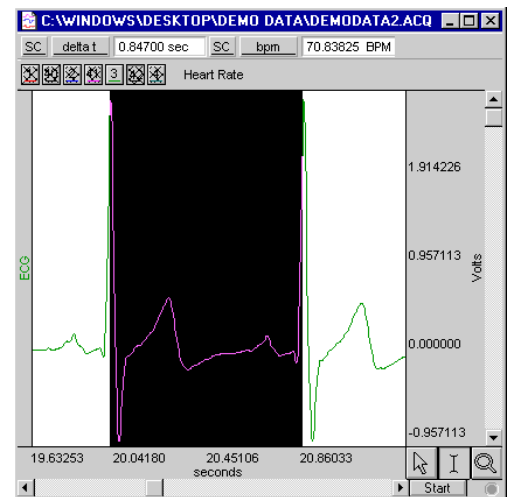
The sample data window shown at right has two measurement popup menus at the top of the window. To increase the number of measurement windows shown, make the window wider or increase the number of measurement rows (8 max) by choosing **Preferences > General** from the **Display** menu.

To change the measurement functions, simply click 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 slected channel (as indicated by **SC**).

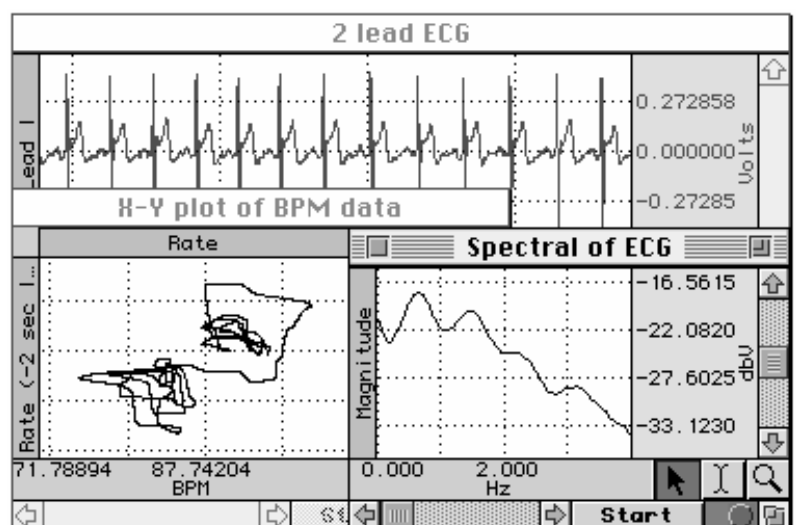
The values will change while the measurement tool  is being dragged over the waveform. You can easily measure absolute functions like value, time, and sample number or use functions that operate over the highlighted area. These include min, max, mean, Delta T, and others.

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.

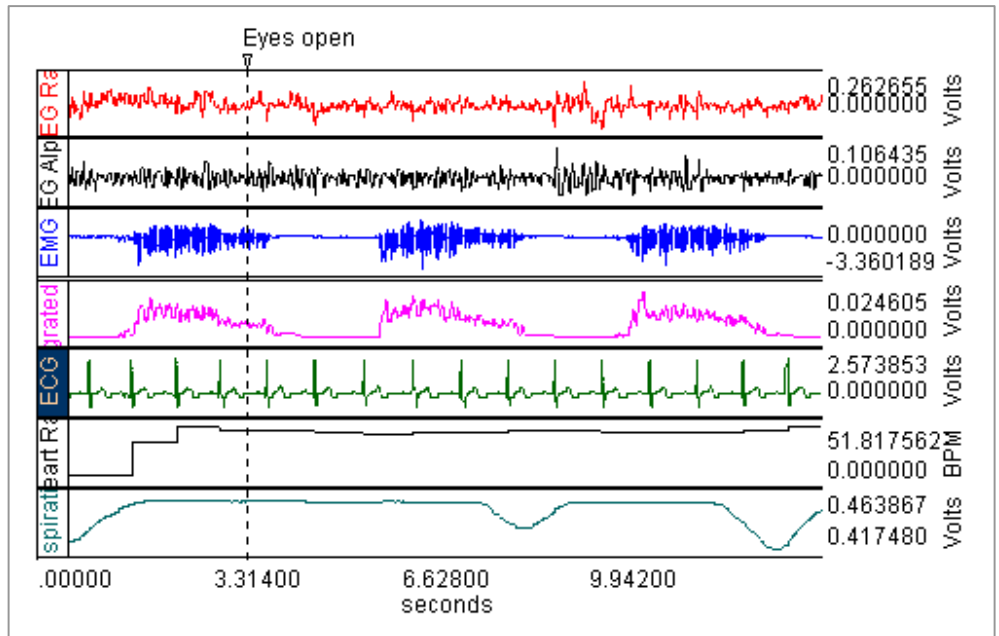
The measurement tool  is also used to edit waveforms. The highlighted area can be cleared, cut, copied, or pasted. Data is edited from the selected waveform only. You can copy a section of one waveform and paste it into another by selecting the destination waveform before pasting it. You can also perform 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 software allows you to display several files on the screen at one time. Simply select **File > Open** 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 **File > Print**. 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

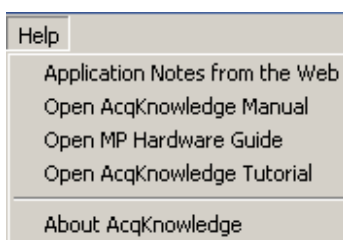
One advantage of saving data on disk is that you can quickly and easily perform post-hoc analyses on your data. AcqKnowledge is as powerful an analytical tool as it is flexible. What's more, the software is designed to provide you with immediate feedback from each operation. Using AcqKnowledge, you will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



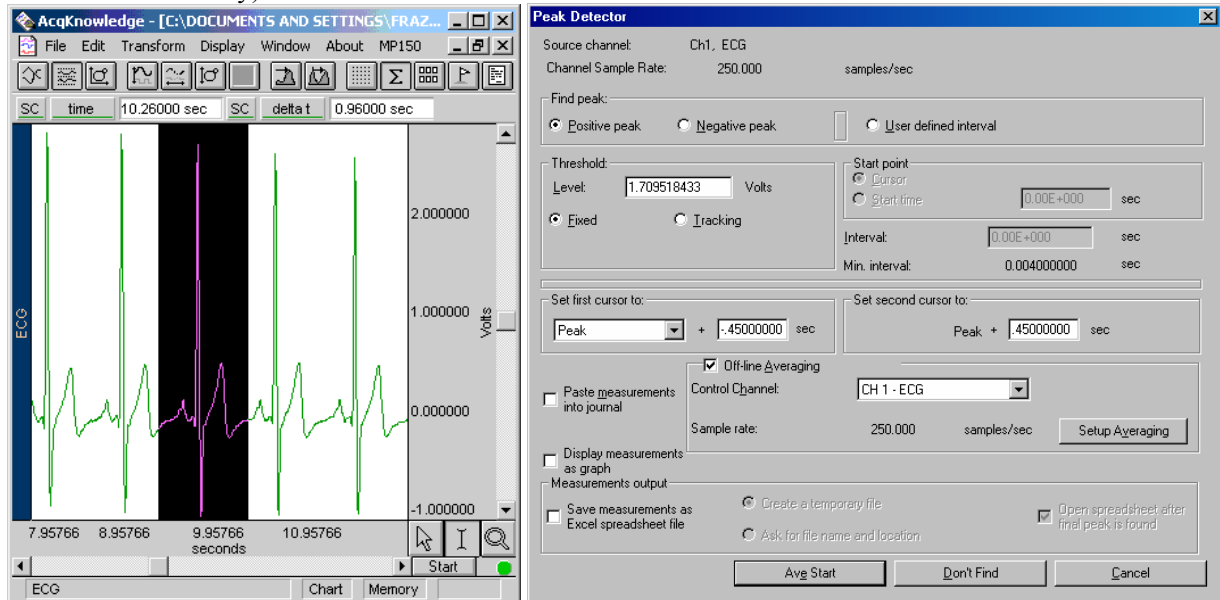
To give you an idea of how *AcqKnowledge* provides immediate feedback, let's walk through a sample transformation:

- Windows Users—see page 12
- Mac users—see page 13

Sample Transformation for Windows/PC:

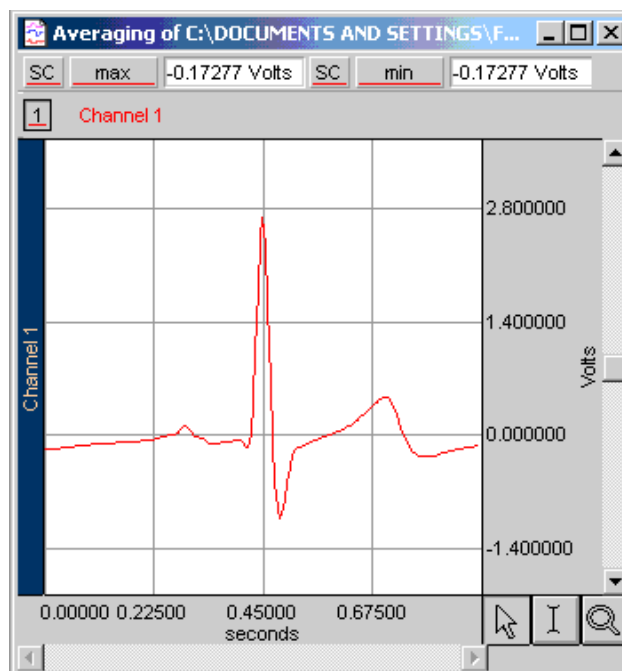
(Mac users—see page 13)

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



- 4) Click the **Transform** menu and scroll to select the **Find Peak** function.
- 5) Check the **Off-line Averaging** option (in bottom half 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.

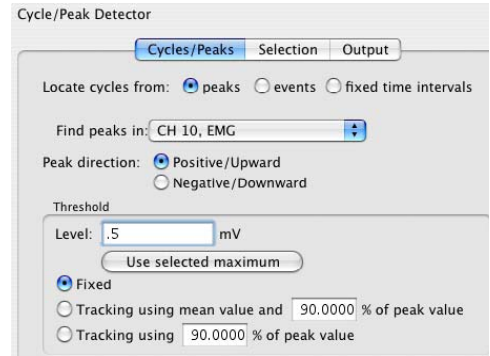


Read more about transformations and event marking in the complete **AcqKnowledge Manual** available under the **Help** menu.

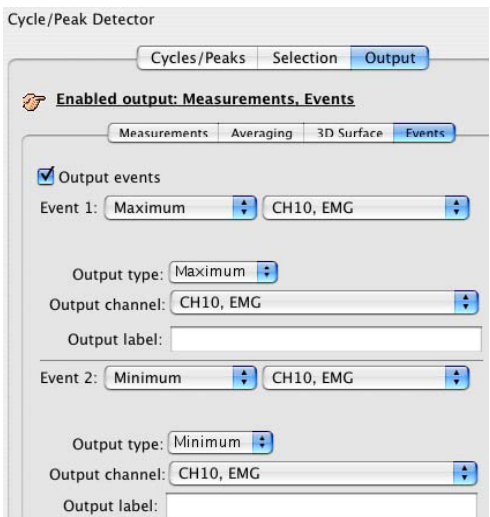
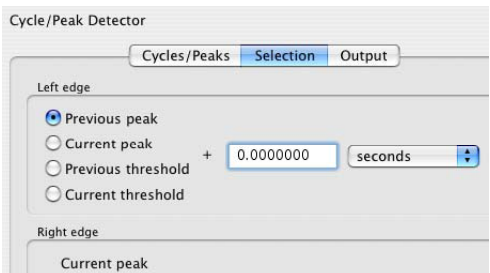
Sample Transformation for Mac:

(Windows Users—see page 12)

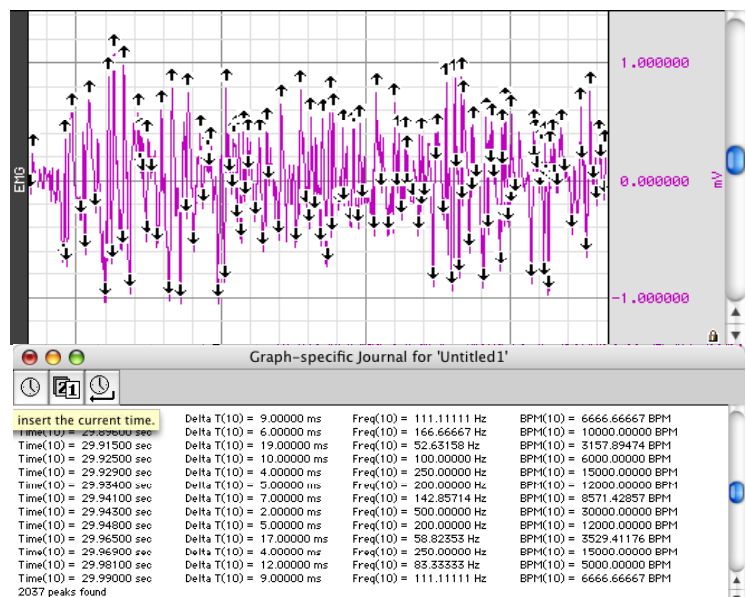
1. Collect at least 30 seconds of sample data (or open **EMGdata.acq** from the “Sample Data” folder).
2. Hide all channels except CH 10 EMG .
3. Zoom in on a burst in CH 10 EMG and then use the I-beam cursor to highlight the area around one typical EMG spike.
4. Select **⌘F** (or **Transform>Find Cycle/Peak**) 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.



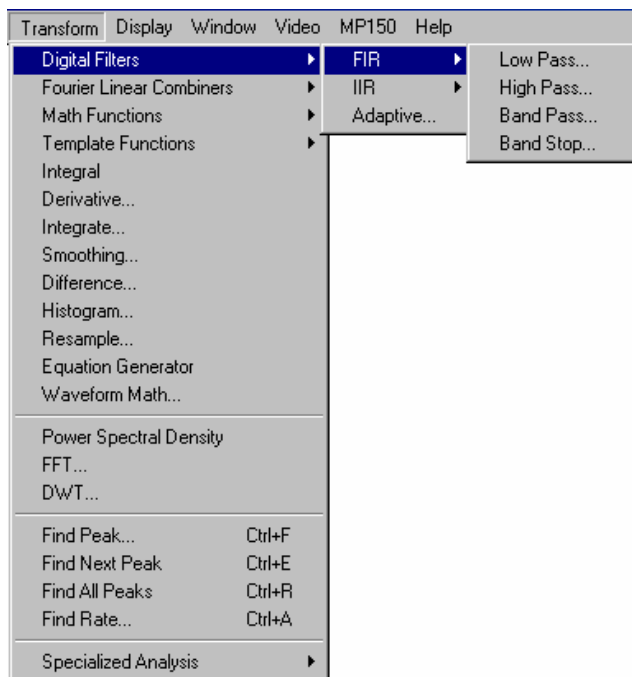
7. Click the **Output** tab.
 - Select the Measurements tab and click **Paste measurements for each cycle to Journal**.
 - Select the **Events** tab.
 - i. Check the **Output events** box
 - ii. Set Event 1 to Maximum on CH 10 EMG for Output type General>Maximum and output on CH10.
 - iii. Set Event 2 to minimum on CH 10 EMG for Output type General>Minimum and output on CH 10.
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 Manual](#) available under the **Help** menu.

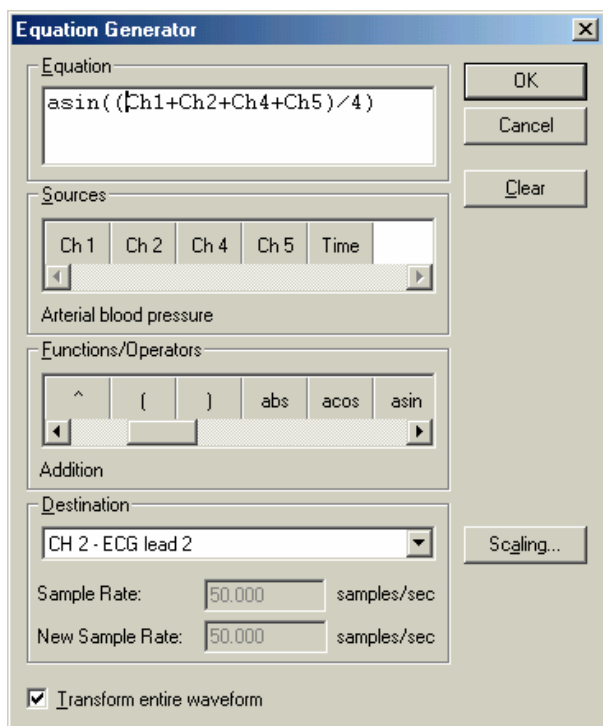


The Transform menu contains a number of functions that modify waveform data.

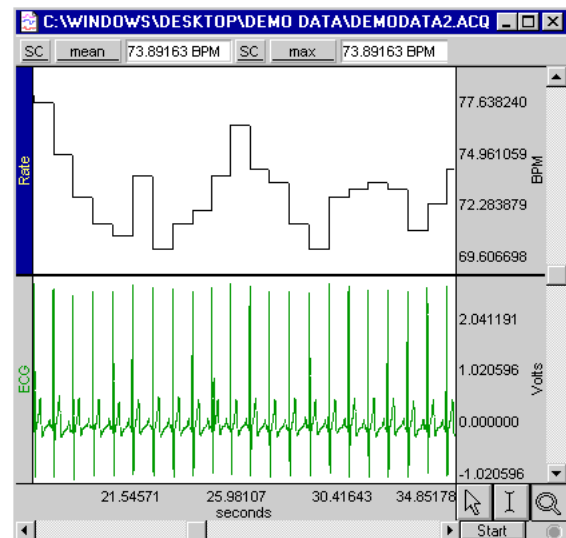
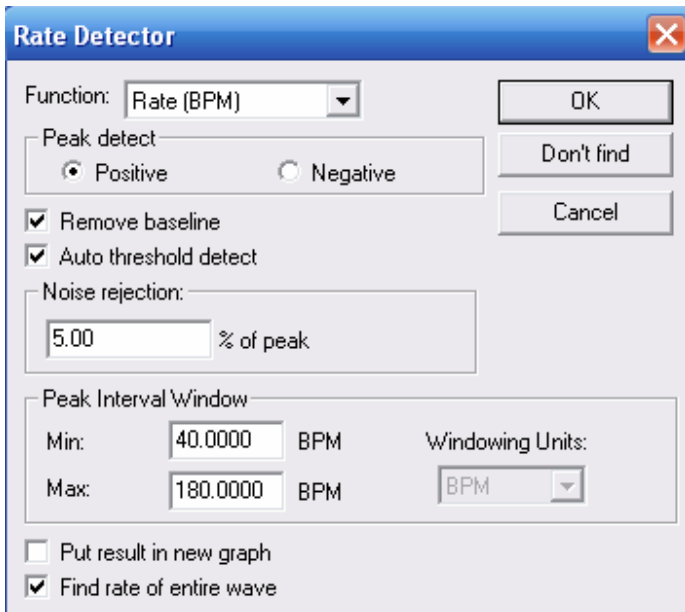
The **Digital Filter** menu item has a sub-menu with both FIR and IIR types of filter operations. For most datasets, the default filter parameters may be used and will produce relatively robust results.

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 number 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.



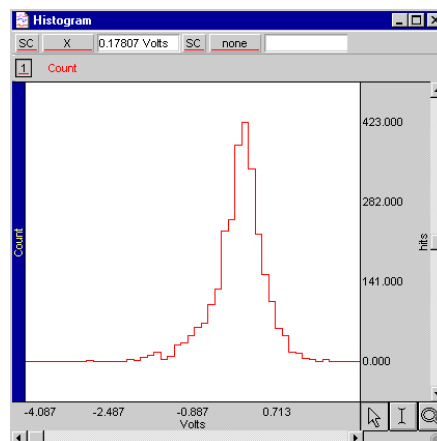
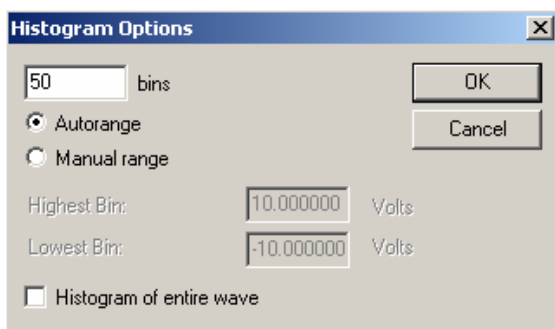
The **Equation Generator (Expression)** option lets you perform a range of mathematical operations, from addition and subtraction to arcsine and log transformations. Now you can perform complex operations in a single step. The example (left) computes the mean of channels 1, 2, 4 and 5, and then arcsine 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 Detector** 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**.

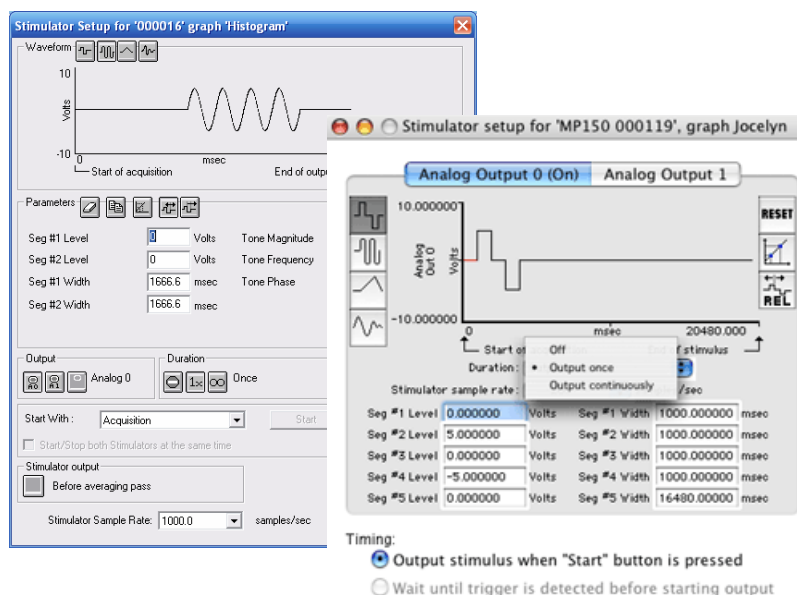
This dialog box prompts you to enter the number of “bins” to sort the values into, and the upper and lower bounds of the data to be sorted. Type “50” in the bins entry and click **OK**. The resulting waveform should resemble the histogram plot shown here.

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 (PC)** or **Output once (Mac)** from the **Duration** menu. 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, etc.), type in new values in the text boxes below the waveform or drag a waveform segment in the dialog display.

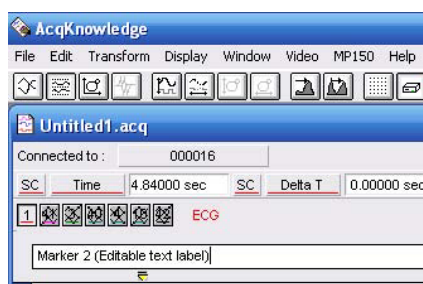
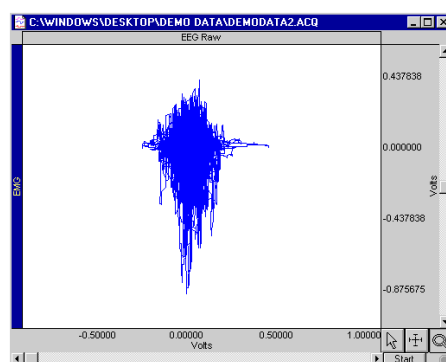


AcqKnowledge offers a number of display options, including **X/Y plotting**. You can switch from one display mode to another using the toolbar icons in the upper left hand corner of the window.



Scope, Chart, X/Y, and Overlap display mode icons

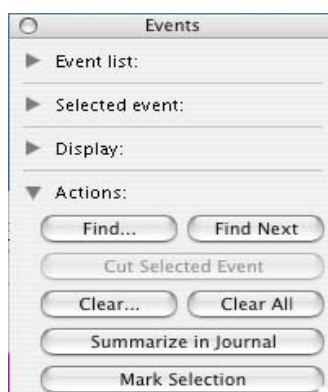
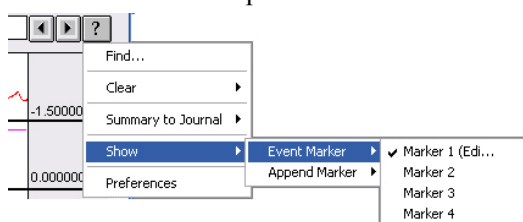
By clicking these icons, your display can alternately emulate a chart recorder or oscilloscope, or you can plot data from one channel against data from another channel. You can also overlap appended data segments to simplify comparison (requires acquisition setup for append). X/Y plots are useful for respiration studies, vectorcardiograms, and investigations into non-linear dynamics.



For some experiments, you may need to mark 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 **Marker** icon on the Toolbar (or choose **Display > Show > Markers** (Windows/PC) or **Events** (Mac) to 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.

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.

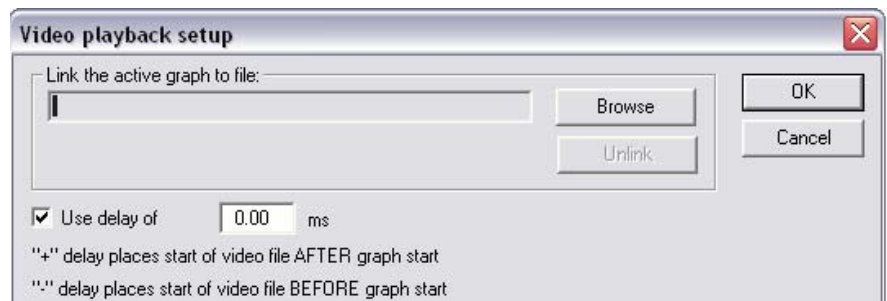
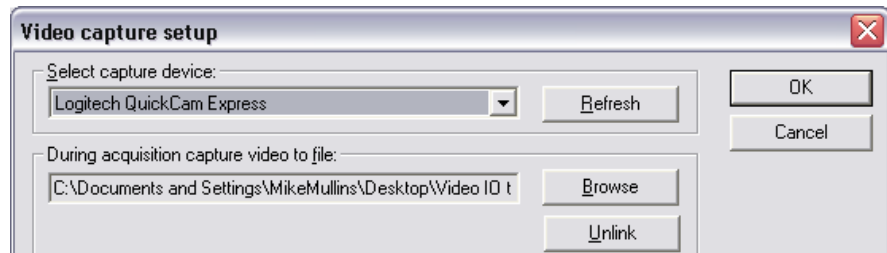


On Mac, event markers can be positioned in the event marker bar, on the waveform, at the top of the plot, on the waveform with an indicator, or on top of the plot with an indicator. Click the Event Palette icon on the right edge of the Event Tools to review event marking options.

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




The **Video** menu options enable *AcqKnowledge* to record and synchronize a video signal with an acquisition.

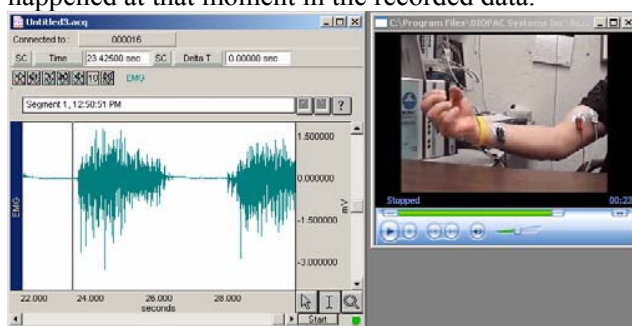
- **AcqKnowledge control of video capture** — Acquisition can be delayed or advanced (with 1 ms resolution) for tight synchronization to the start of a video. Users can view a video file in post-processing and link the video frame to the position of the *AcqKnowledge* data cursor. When the video file frame is advanced, the *AcqKnowledge* data cursor advances to the corresponding period of time (and vice versa).
- **AcqKnowledge synchronization to existing video** — The Video Capture and Playback functions are independent. This permits the user to link otherwise recorded video files to an *AcqKnowledge* data graph. This flexibility permits the user to acquire video in a camcorder, transfer the camcorder video to the computer, and then time sync the digitized video to an *AcqKnowledge* data graph.



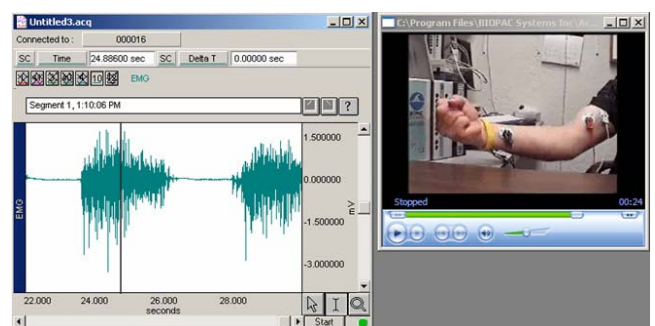
Note The demo only supports video setup, playback, and synchronization using the [EMGdata.acq](#) data file and the [emg_sync.avi](#) video. Some Video menu functions are grayed/disabled in this demo, but you can read more about them in the [AcqKnowledge Manual](#) under the **Help** menu.

To see a sample of the video sync feature, use the [EMGdata.acq](#) data file and the [emg_sync.avi](#) video:

1. Click start on the demo and let it run until the full 30 seconds of data is displayed.
2. If desired, hide the other channels so that only the EMG data is displayed  and use **Display > Autoscale Waveforms** to optimize the signal display.
3. Select the I-beam cursor and click in the graph display. 
4. Select **Video > Playback > Show** . The video will open in the computer's default media player. Adjust the windows so you can see both the graph file and video
 - The demo is set to link the active graph to C:\Program Files\BIOPAC Systems, Inc\AcqKnowledge 3.9 Demo\emg_sync.avi, which was included in the default demo installation.
5. Click in the graph file, and the video will skip to the corresponding time, allowing you to see exactly what happened at that moment in the recorded data.



Sample at 23.425 seconds, hand open



Sample at 24.886 seconds, hand clenched

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 3.9 or better
- Mac version 3.9 or better

Hardware

MP 150 Starter System:

- AcqKnowledge software (specify PC or Mac version)
- MP150 Data 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 MP150 to computer
- AC150A 12 V power supply (USA or Euro)

MP 100 Starter System:

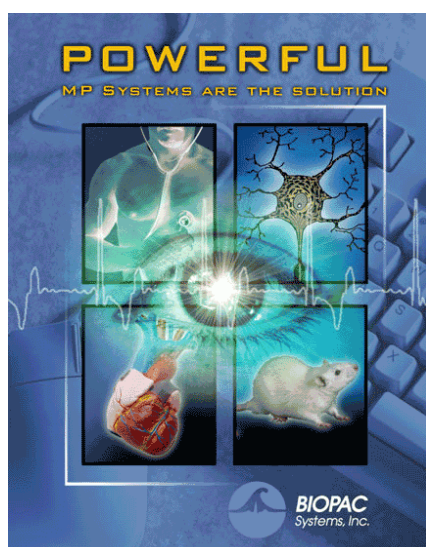
- AcqKnowledge software (specify PC or Mac version)
- MP100 Data Acquisition Unit
- UIM100C Universal Interface Module
- USB1W (PC) or USB1M (Mac) USB Adapter
- CBL100 analog and digital cable set
- CBL100A MP unit to computer cable
- AC100A 12 V power supply (USA or Euro)

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.

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