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Chart™

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Student Quick Reference Guide

How to use this guide

The Chart Student Quick Reference Guide is a resource for PowerLab systems in the classroom laboratory. The topics in this guide are arranged to help you, the student, with many of the most commonly used functions in Chart.

Color coding scheme: Each section in this guide is color coded. Acquisition is blue, Analysis is green, Troubleshooting is red, and the Appendix is violet. You will find words printed in these colors in the text of your experiment protocols to call your attention to the appropriate section of this guide if you need help.

Legend: References to PowerLab hardware and Chart software will often be followed by a number in parentheses. These numbers refer you back to the legend on pages III-V.

The exclamation icon ⚠ indicates a caution or warning. Be sure to carefully read steps marked with this icon before proceeding.

The check mark icon ✓ is used when a graphic represents the way your window should look if everything is adjusted properly.

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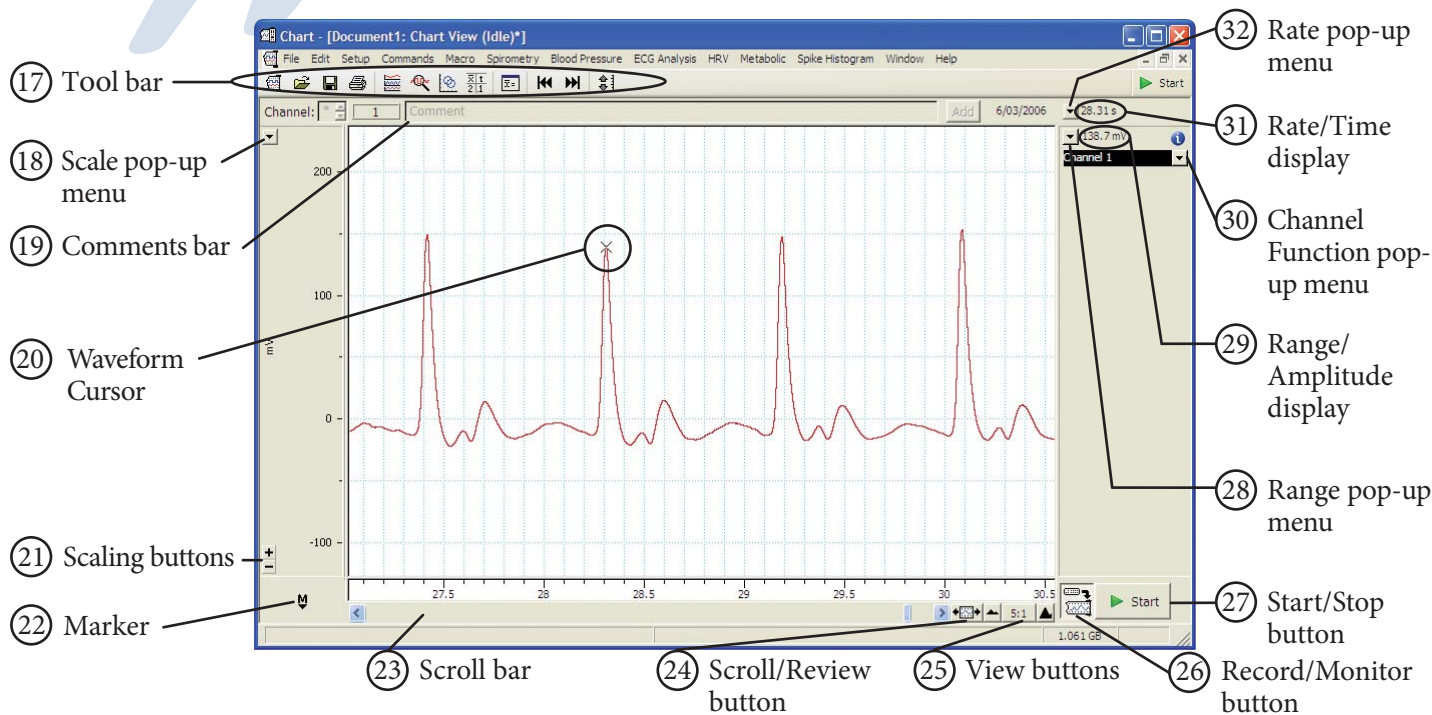
PowerLab Front Panel

① **Power indicator light:** illuminates when PowerLab is turned on.

② **Analog output connections:** provides a voltage output in the range of ±10 V. ⚠ NOT safe for human connection!

③ **Analog inputs (2):** Inputs 1 and 2 on the PowerLab; for connecting transducers and devices with BNC connectors.

④ **Isolated Stimulator status light:** Indicates that the Isolated Stimulator is working properly (green) or out of compliance (yellow).

⑤ **Dual Bio Amp input:** Connects a 5 lead Bio Amp cable to the PowerLab; reads as Inputs 3 and 4. 🧍 SAFE for human connection.

⑥ **Trigger input:** may be used to start or stop a recording event

⑦ **Pod ports (2):** 8-pin connectors for attaching Pods and certain transducers to Inputs 1 and 2. ⚠ NOT safe for human connection!

⑧ **Isolated Stimulator safety switch:** Turns the Isolated Stimulator on and off.

⑨ **Isolated Stimulator outputs:** For connecting stimulating electrodes to the Isolated Stimulator. 🧍 SAFE for human connection.

⚠ Do not connect two devices to the same input. That is, do not connect a device to the Analog BNC Input and to the same Pod port.
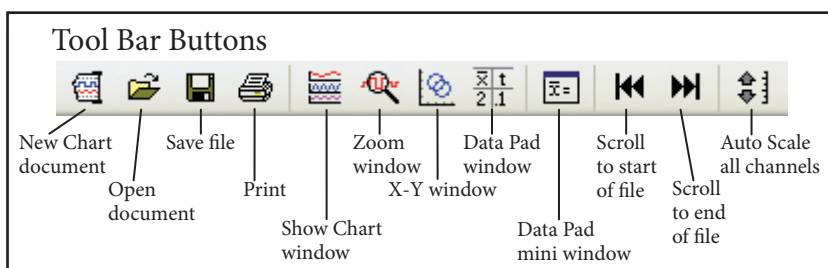
PowerLab Rear Panel
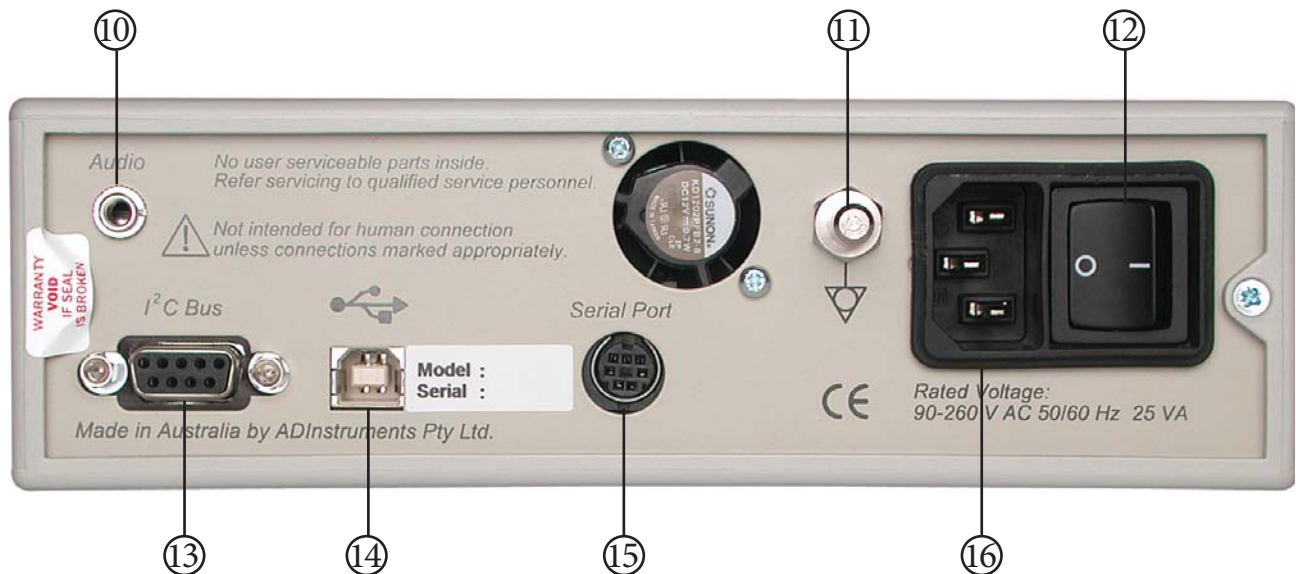
⑩ **Audio output connector:** Standard 1/8″ (3 mm) phono jack for sound output of recordings from the Bio Amp.

⑪ **Earthing post:** Used to ground PowerLab, if grounded power supply is unavailable.

⑫ **Power switch:** Turns PowerLab on and off.

⑬ **I²C connector:** Connects PowerLab to special ADInstruments signal conditioners called Front-ends.

⑭ **USB connector:** Connects a computer to the PowerLab.

⑮ **Serial Port connector:** Connects PowerLab to certain devices.

⑯ **Power cord connector:** Attaches to power cord.

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Chart View Window

17 Tool bar

18 Scale pop-up menu

19 Comments bar

20 Waveform Cursor

21 Scaling buttons

22 Marker

23 Scroll bar

24 Scroll/Review button

25 View buttons

26 Record/Monitor button

27 Start/Stop button

28 Range pop-up menu

29 Range/ Amplitude display

30 Channel Function pop-up menu

31 Rate/Time display

32 Rate pop-up menu

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17 **Tool bar:** A set of buttons used to access common functions in Chart.

18 **Scale pop-up menu:** Allows the Y-axis scale to be adjusted manually or automatically.

19 **Comments bar:** Used to type comments that are then added to the data file during a recording at user-defined times.

20 **Waveform Cursor:** Tracks the waveform in the Chart View window.

21 **Scaling buttons:** Allow the Y-axis to be expanded or compressed to improve the data view.

22 **Marker:** An analysis tool that can be dragged onto the waveform in any channel to mark relative time and amplitude.

23 **Scroll bar:** Allows the user to scroll through the data in the Chart View window.

24 **Scroll/Review button:** Switching this to Review mode allows users to scroll through data while it is still being recorded.

25 **View buttons:** Change the compression of the time (horizontal) axis.

26 **Record/Monitor button:** Enables recording. Monitor mode: Data is visible in the Chart View window but not recorded/saved to the computer.

27 **Start/Stop button:** Used to start or stop a Chart recording.

28 **Range pop-up menu:** Changes the range of the input amplifier.

29 **Range/Amplitude display:** Shows the range (idle) or waveform amplitude (recording) of an input channel.

30 **Channel Function pop-up menu:** Allows the user to access all major channel functions.

31 **Rate/Time display:** Shows sampling rate (idle) or elapsed time (recording).

32 **Rate pop-up menu:** Allows the user to adjust the sampling rate.

Tool Bar Buttons

New Chart document

Open document

Save file

Print

Show Chart window

Zoom window

X-Y window

Data Pad window

Data Pad mini window

Scroll to start of file

Scroll to end of file

Auto Scale all channels

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Experiments Gallery

Overview: The Experiments Gallery contains all of the files that are required to perform classroom experiments. Use this tool to access the experiment protocol files, sample data files, Chart settings files and lab report forms.

**1** Click on the File pop-up menu and select the Experiments Gallery.
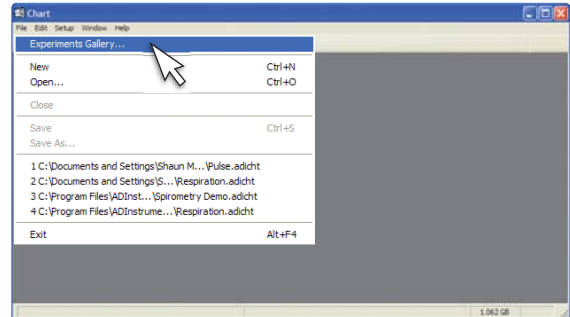
2 Select the experiment that you are going to perform.
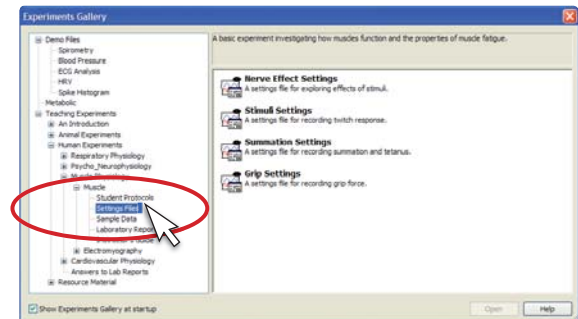
3 Select from the files that are displayed in the right hand screen. Here you will find your experiment protocol file, sample data file, Chart settings file and lab report forms. To open a file "double-click" on its icon.

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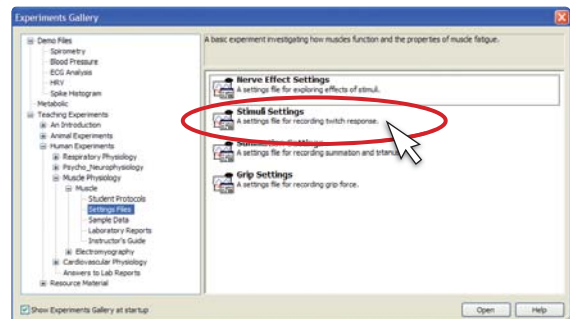
Acquisition
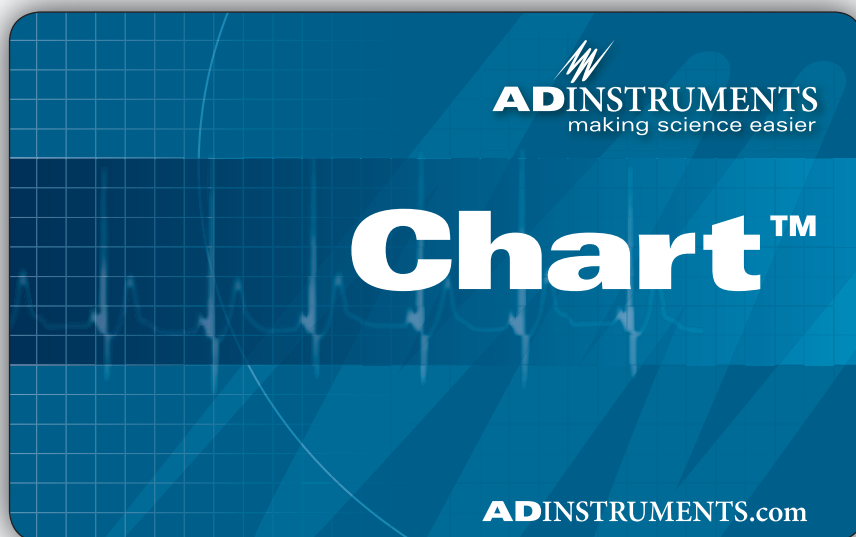
Input Amplifier

Overview: Allows for precise setting of the input range for a recording channel and provides filtering options for specific transducers.

__Note:__ If you already know the output voltage for your transducer, you may skip to the next page "Setting the Range"

1 Click the channel function pop-up menu for the channel you are interested in.

2 Observe the signal in the scrolling window, then click on the range pop-up menu to adjust the signal strength.

3 When the signal occupies 1/3 to 1/2 of the screen, you have found the proper range. Make sure to leave enough room to accommodate the signal. You will have the option to adjust the Y axis once your recording is underway.

4 Other features available from the input amplifier:

Check with your instructor before changing these settings

- Low pass filter: This is a digital filter designed to remove unwanted high frequency "noise" from the signal.
- Single sided vs. Differential input. Specialized transducers will require these settings.
- AC Coupled: Removes any DC component from the signal.
- Mains filter: Eliminates 50 or 60 Hz mains "hum" from the signal
- Invert: The Invert checkbox lets you invert the signal on the screen.
- Units: Opens Units Conversion dialog (page 7)
- Display Offset: Displays the offset of some transducers
- Pod Scan: Used to update the Input dialog if a Pod is plugged in after it is opened.

__Note:__ Front-ends and pods are amplifiers that provide additional amplification, filtering, isolation, and support for special transducers. When they are connected to PowerLab inputs, the Input Amplifier dialog for those inputs may be replaced with a dialog specific to the device.
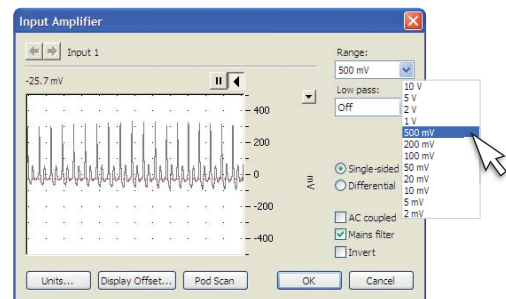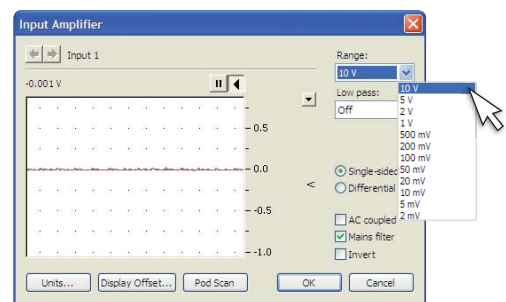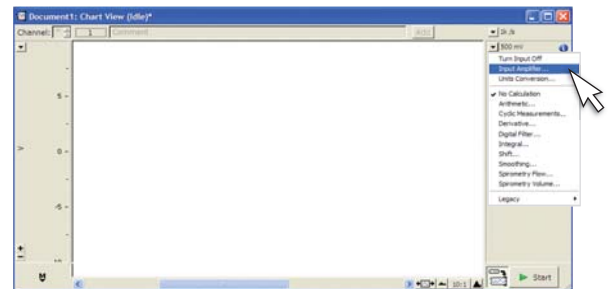
Setting the Range

Overview: Establishes the maximum and minimum range of signal to be recorded in a selected channel.

Note: if you do not know the range of the transducer you are using we suggest you use the input amplifier from the previous page. Skip this step if you have just completed the "Input Amplifier" procedure from the previous page.

1   Click the Range pop-up menu ㉘ next to the channel of interest.
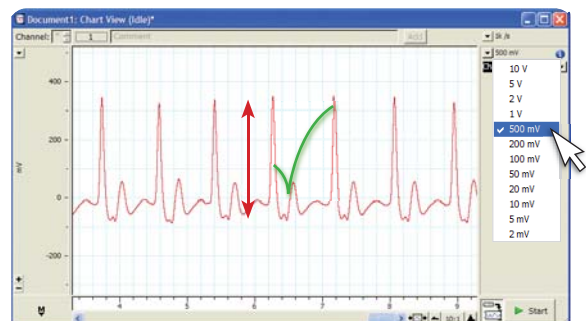
     Note: This procedure can be done while recording.
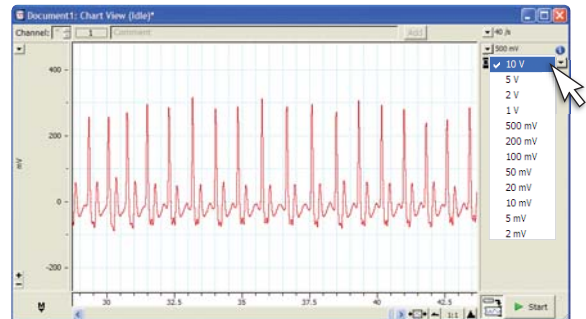
2   Select a new range from the pop-up menu.

3   If you were not already recording, click Start. Verify that the signal is 1/3 to 1/2 of the channel window height. If not, readjust the range as necessary.

     Note: Ensure that the range is sufficient to accommodate changes in signal amplitudes during recording.

4   Scale the Y-axis (amplitude) if desired, using the Scaling buttons ㉑.

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Setting the Sampling Rate

Overview: Sets the number of times per second the PowerLab samples data from your transducer. Use fast sampling rates for rapidly changing signals, such as nerve recordings or ECG. Use slow sampling rates for slow changing signals such as force or temperature measurements.

① Click the Rate pop-up menu ㉜ located at the upper-right of the Chart View window.

Note: This procedure can be performed while recording.
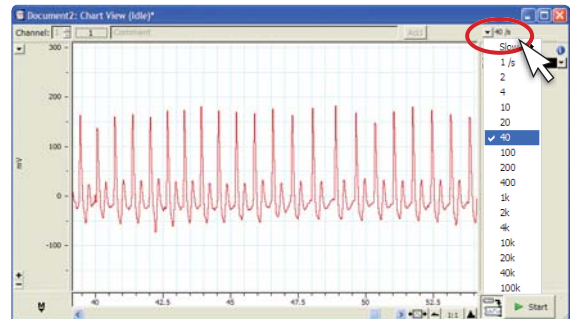
② Use the pop-up menu to select a new rate.
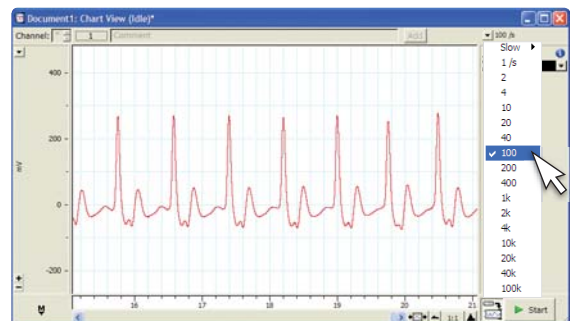
③ Your data will automatically begin recording at the new rate. Adjust time axis compression as needed using the View buttons ㉕.
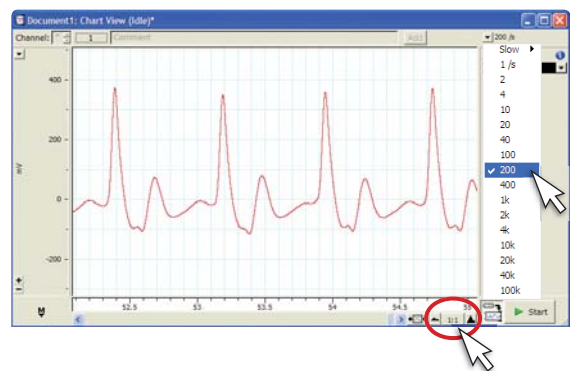
⚠ *Note: Only adjust the Rate if instructed to do so by your instructor. Rate settings affect the quality and size of your data files, an inappropriate rate could adversely affect your results!*

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Y-Axis Scaling/Auto Scale

Overview: Makes the signal appear larger or smaller in the vertical scale. without affecting the Range settings. Options include Auto Scale, manual and interactive scaling.

1 The Scaling buttons ㉑ in the channel window will expand or compress the Y-axis (amplitude) scale.
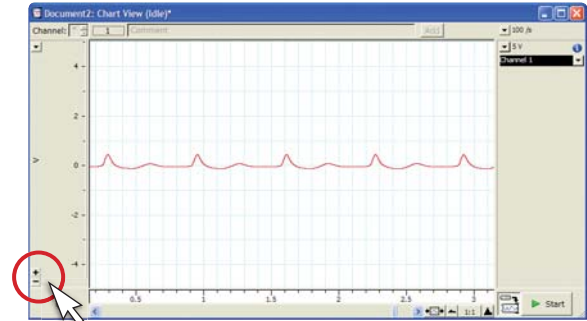
2 The Auto Scale button on the Tool bar ⑰ will automatically adjust the Y-axis scaling on ALL channels.

OR: Double-click on the Y-axis of an individual channel to auto Scale the data in that channel only.

3 Alternatively, you can adjust the scale by dragging the mouse over the Y-axis. You will notice the cursor change to arrow symbols that indicate the direction of axis expansion or compression.

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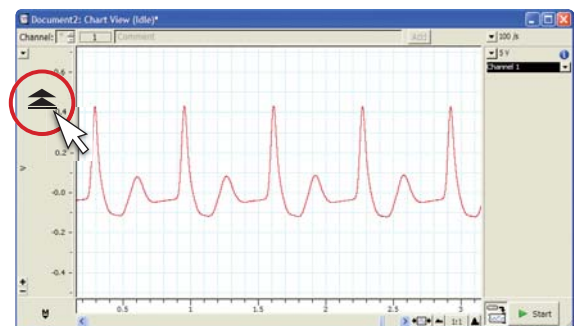
Time Scale Compression

Overview: The View buttons allow you to expand or compress the view of your data in the X-axis.

1 Locate the View buttons ㉕ in the Chart View window.
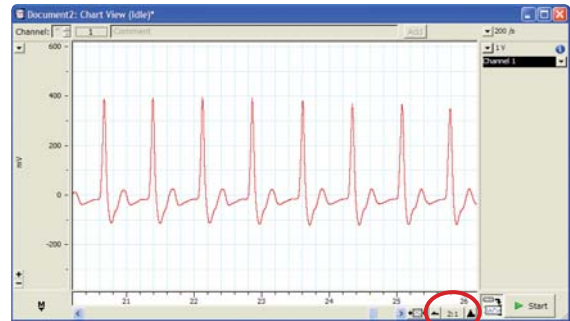
2 The right button ▲ will expand the data timescale.

3 The left button ▲ will compress the data timescale.
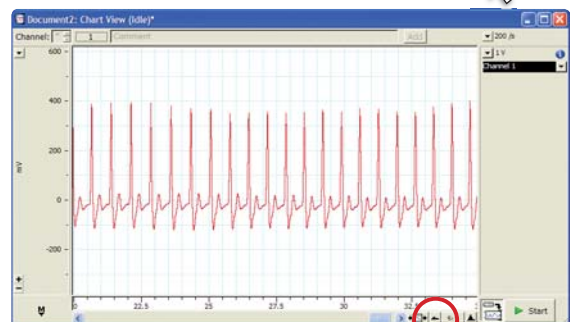
4 The center button is a pop-up menu which will allow you to select a compression ratio manually.

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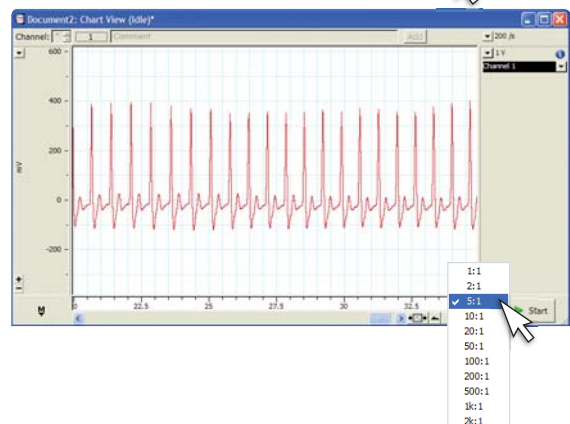
Units Conversion

Overview: Changes the units of the Y-axis from Volts to meaningful units such as %, °C, grams, etc.

1 Using the mouse, select a block of data to use for your calibration. From the Channel Function pop-up menu ㉚, select Units Conversion. The Units Conversion dialog will open.
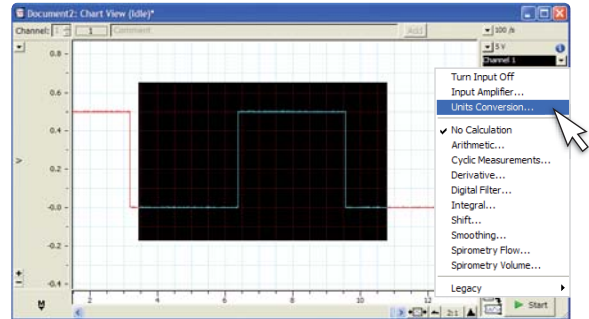
2 Choose the units you want to express your data in from the pop-up menu. Or, select Define Unit to type a new unit.
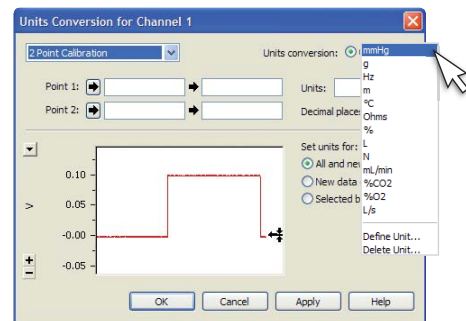
3 In the waveform window click on the waveform corresponding to Point 1 of the calibration. Click the arrow next to Point 1 to add the value. Type the known value of your waveform in the value field (on right).
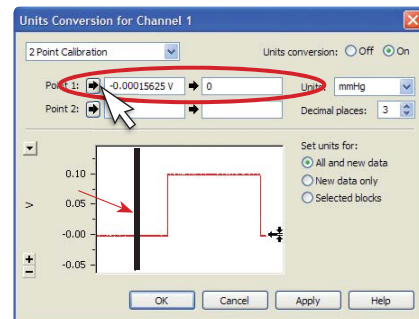
4 Repeat step 3 for the second calibration point.
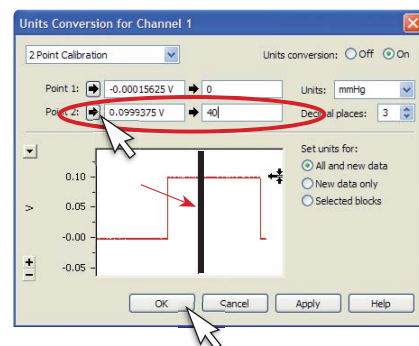
5 Click OK to return to the Chart View window and to a display in your calibrated units.

Adding Comments

Overview: Comments facilitate analysis by marking events on your Chart recording as they occur. You can also add comments to a data file when recording has stopped by selecting data with the waveform cursor.

1   Click the cursor in the Comments bar ⑲ and type in a comment.
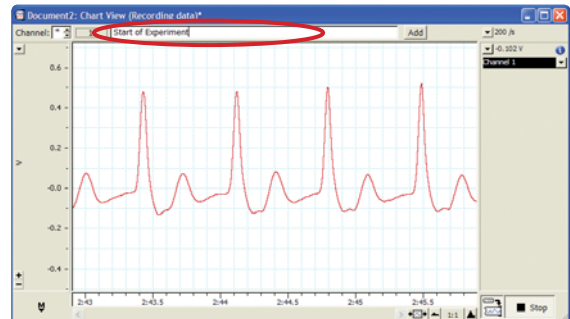
2   When the event takes place, either click the Add button or press Enter/Return on the computer keyboard. Your comment will appear as a vertical dashed line in your data file.
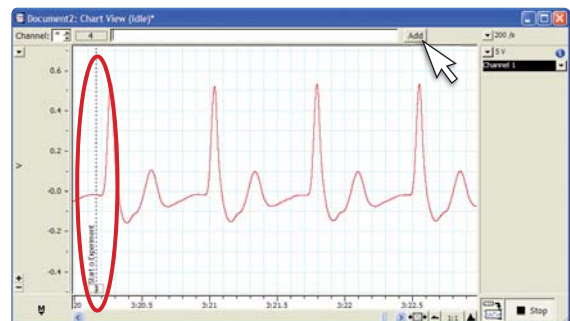
3   Type and add additional comments as necessary. You can type a comment well in advance of the event.

Data Analysis

Selecting Data

Overview: You can use the mouse to select data in one or more channels.

1 From the Chart View window, click and drag the mouse over the data in the channel of interest.
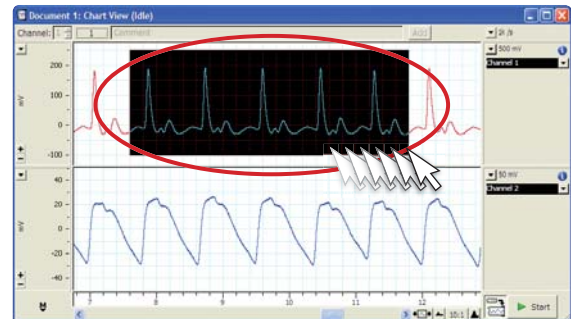
2 To select data in a second channel while retaining the first selection, drag the mouse over the second channel while holding down the Shift key on the keyboard.
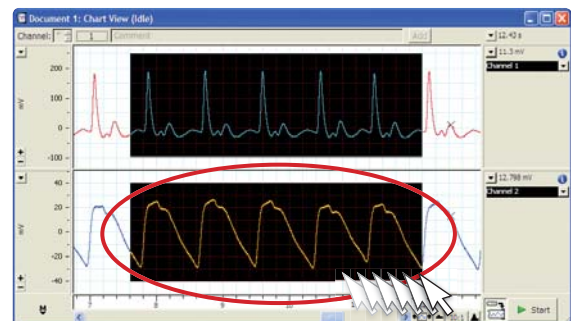
3 To select data in all of the viewable channels, click and drag the mouse along the time axis.

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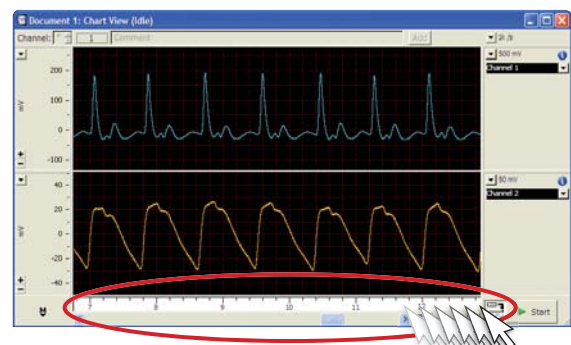
The Waveform Cursor

Overview: The Waveform Cursor scrolls along your data trace in the Chart window or Zoom window. As you move the cursor, the data values (time and amplitude) are displayed in the Channel window.

1 To use the Waveform Cursor ㉇, you must not be recording data or have Chart in Review mode by depressing the Scroll/Review button ㉔.

2 Move the mouse over your data trace. You will see the Waveform Cursor appear on the trace and follow it as you move the mouse.

3 As you move the cursor, values will change at the top of the Channel window. The Rate/Time display ㉛ will show elapsed time, while the Range/Amplitude display ㉙ will show signal amplitude. You can use this information to write down values for specific time points in your data trace.

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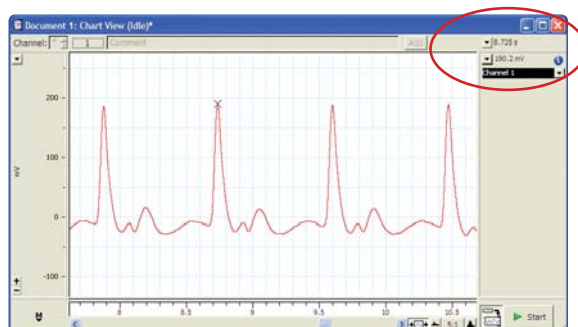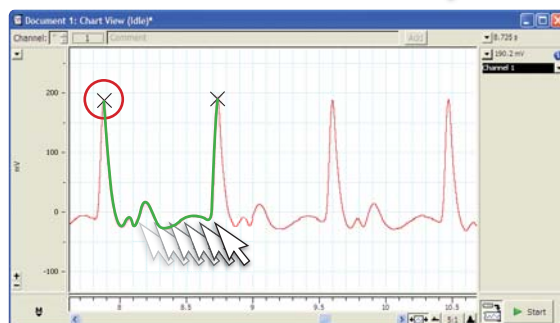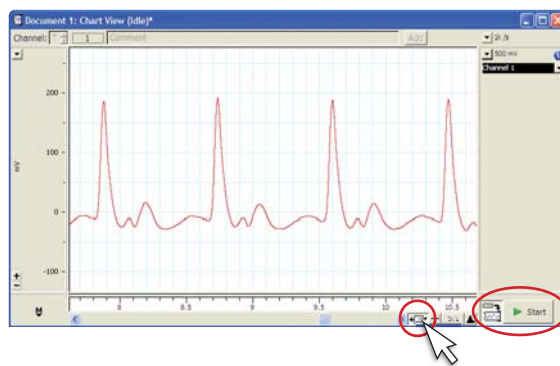
The Marker

Overview: The Marker can be placed on any point on your waveform data trace. When in use, the display output from the Waveform Cursor changes from absolute time and amplitude to relative time and amplitude with respect to the Marker. The Marker can be used in either the Chart or Zoom window.

1 Locate the Marker ㉒ in the lower left corner of the Chart View window or Zoom window as shown right.

Note: If the icon is not there, double-click in the empty Marker box and it will reappear.

2 Using the mouse, drag the Marker along your waveform to the spot you want to place it. Release the mouse button to drop the Marker.

3 If the Marker is not where you want it, reposition it by dragging it with the mouse.

4 The read-out from the waveform cursor will now be displayed as relative (Δ) time and amplitude from that of the Marker point.
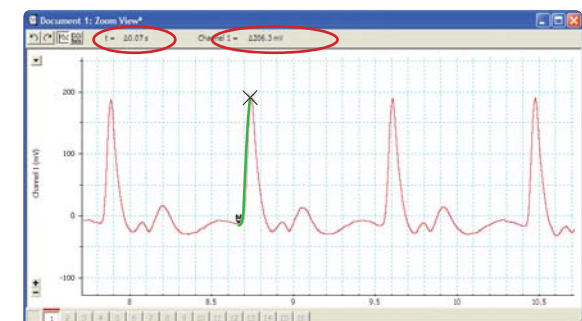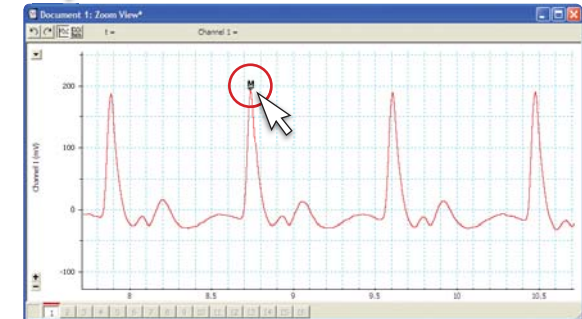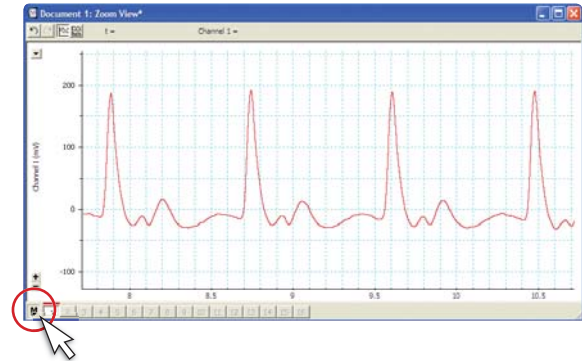
The Zoom Window

Overview: The Zoom window expands the view of your data, facilitating precise measurements with the Marker and Waveform Cursor and the viewing of multiple channels in overlay mode.

1 Select a range of data from one or more channels from the Chart window.

2 Click the Zoom window button from the Tool Bar ⑰.

3 Your data will now appear magnified in the Zoom window. Y-axis (amplitude) scaling is available exactly as in the Chart View window. You can use the Marker ㉒ directly from the Zoom window.

4 To zoom in further, select a new area with the mouse in the Zoom window. The window will automatically zoom to the new view. To revert to the previous view, click the back arrow button.

5 Multiple channels may be superimposed by clicking the overlay button. The waveform cursor will track in the channel selected at the bottom of the Zoom window.

Note: Alternate multichannel display using the stack button.

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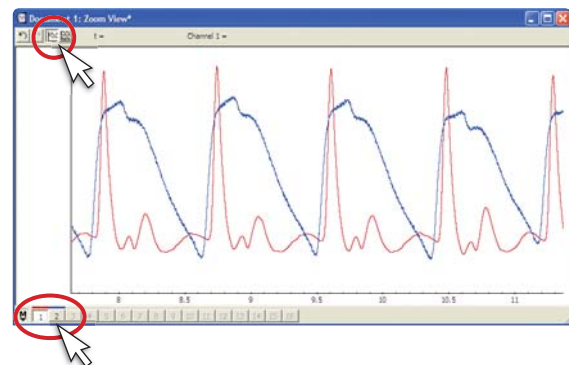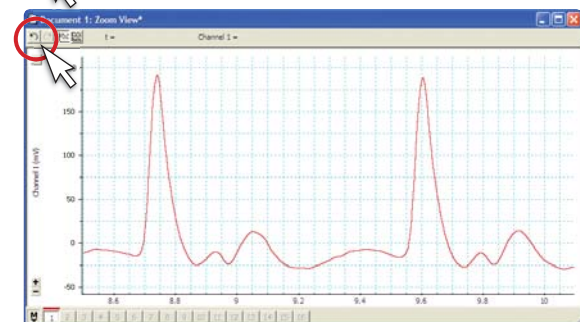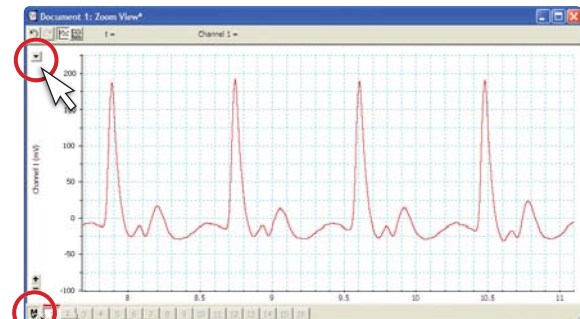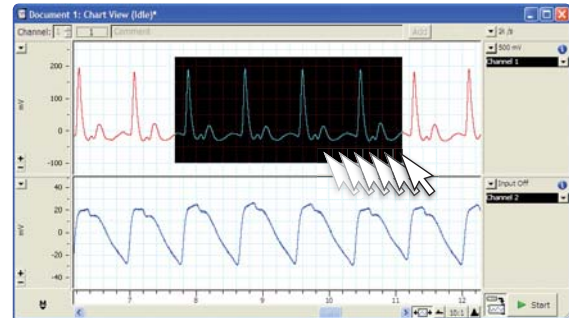
The Data Pad: Setting up

Overview: The Data Pad is a powerful analysis tool that functions like a spreadsheet. The Data Pad can be set up to perform a variety of calculations on your waveform data. The first step is to set up the Data Pad columns with the calculations you want to use.

**1** To access the Data Pad dialog, click the Data Pad button in the Tool bar ⑰.
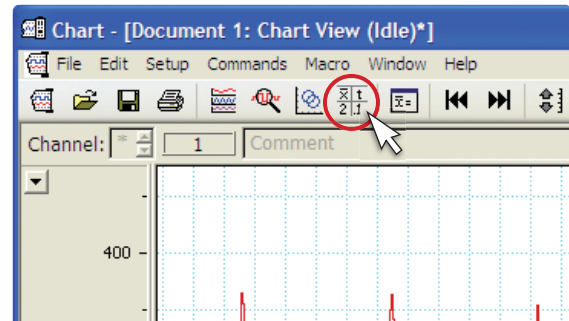
2 Click the column header in the Data Pad window to set up the calculation for the channel of interest. By default, each column number corresponds to the channel of the same number.
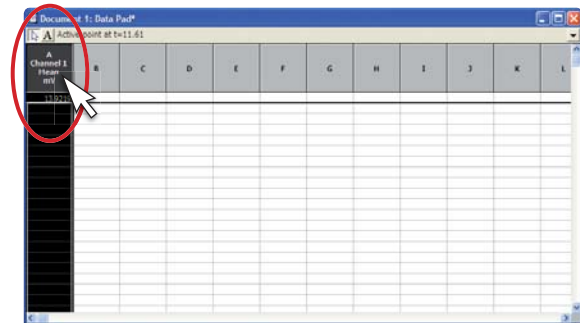
3 First, select the type of calculation you want to perform from the left column. Then select a specific function from the available choices in the right column.

⚠ Make sure that you have selected the correct channel for analysis before you click OK.

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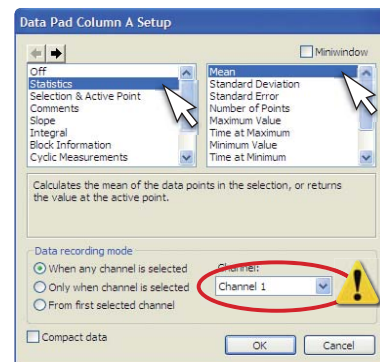
The Data Pad: Adding Data

Overview: Once you have set up the Data Pad columns, you are ready to analyze data from your file. The data in the Data Pad can then be saved as text or as an Excel file (Windows only) for importing into spreadsheets or graphics applications.

1 Drag the mouse to select a range of data in either the Chart View window or the Zoom window.
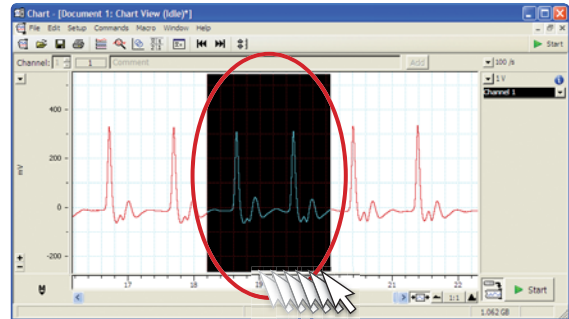
**2** From the Commands pop-up menu, select Add to Data Pad.
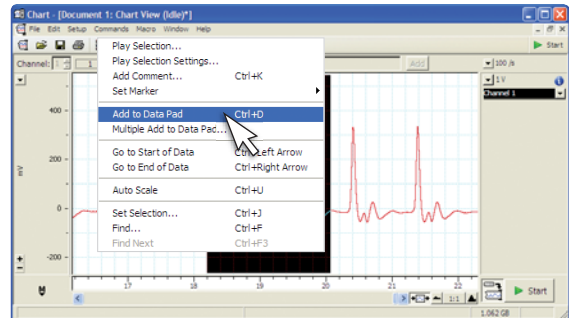
3 Click the Data Pad button in the Tool bar ⑰. Your results will be displayed in the Data Pad window.
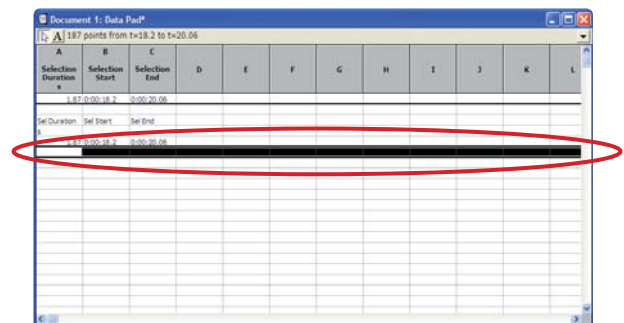
4 To save the Data Pad output as a text file which can be imported into a spreadsheet or graphics program, select Save As... from the File menu, and choose Data Pad Only as Text File (.txt) from the pop-up menu. Select Data Pad Only as Excel File (.xls) to save as an Excel spreadsheet (Windows only).

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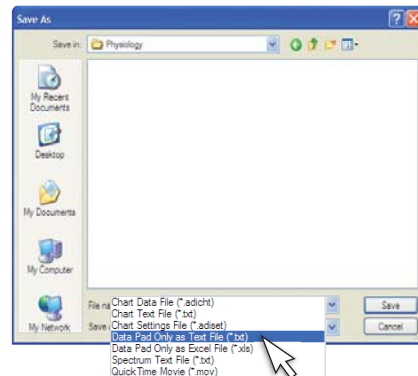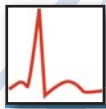
Cyclic Measurements (Win only)

Overview: The Cyclic Measurements feature automatically calculates cyclic parameters of waveform data. These include rate, interval, count, mean and many others.

Note: Users of Chart version 5.2X or below, see "Cycle Variables" in the appendix.

1 Click the channel function pop-up menu for the channel you are NOT recording data in and select Cyclic Measurements.

2 Select the source channel you want to perform the calculation on from the pop-up menu. Next select the parameter you want calculated from the Measurement pop-up menu.

3 Select a detection setting from the preset pop-up menu. Pick a waveform that matches the type of signal you are acquiring or select a general setting.

4 Detection adjustment: Adjust the minimum peak height using the detection adjustment slide bar. A circle will appear above detected peaks in the preview window. Set the minimum amount of Standard Deviation required to detect all peaks of interest whilst skipping unwanted noise. Scroll back and forth in the preview window to make sure you have the optimal setting.

5 Your calculated value will now be displayed in real time on the selected channel.

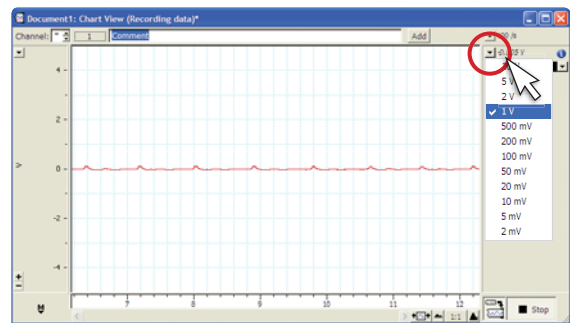*NOTE: Cyclic Measurements is also available from the Data Pad dialog.*
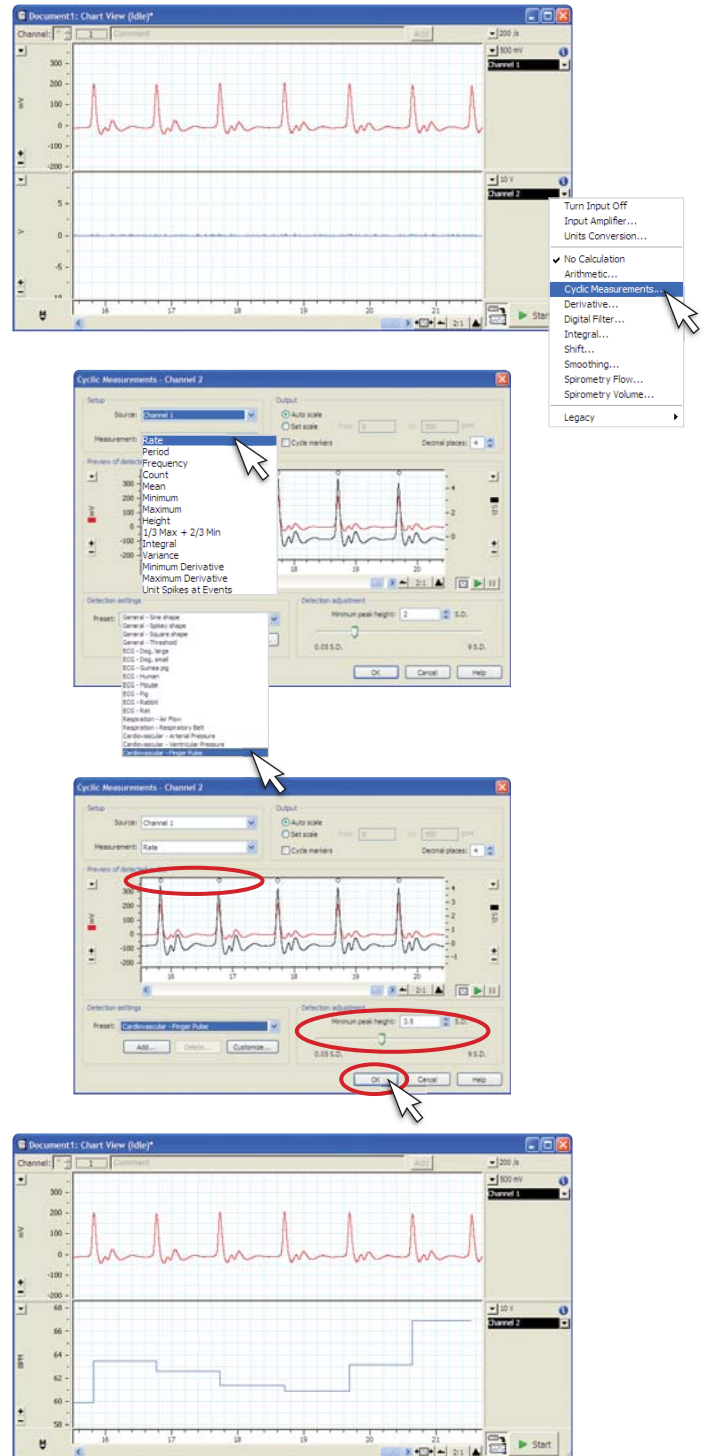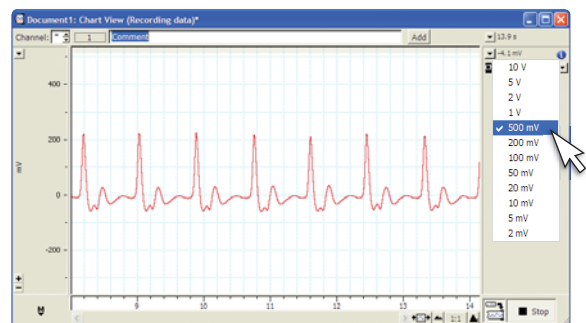
Troubleshooting
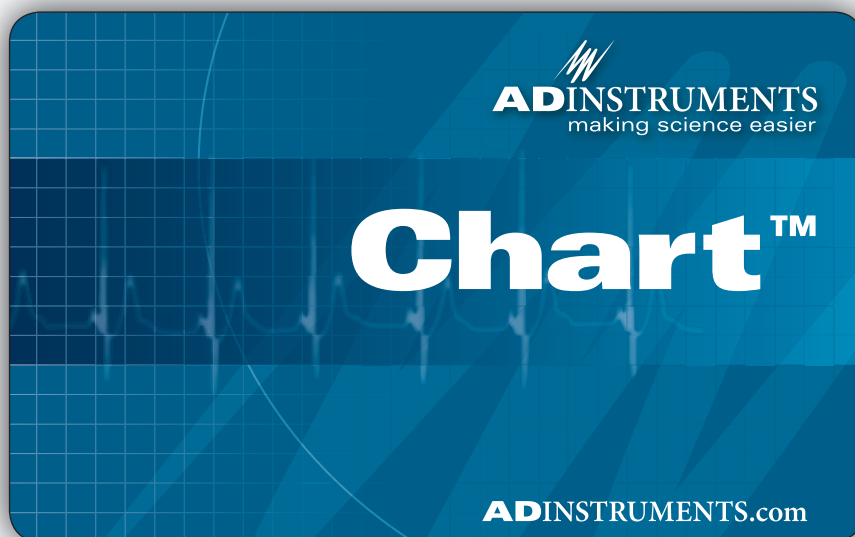
Problem: Signal is too small
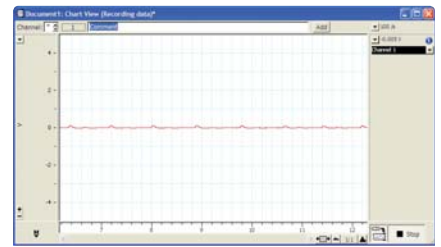
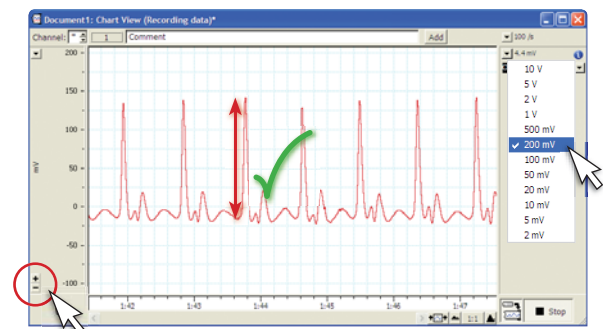## Solution: Decrease range using the Range pop-up menu

1 While recording, click the Range pop-up menu ㉘ .

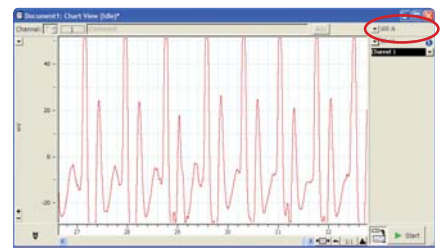**2** Select a smaller range value.

3 Verify the new range is appropriate for your signal. The maximum height should be 1/3 to 1/2 of the total range.

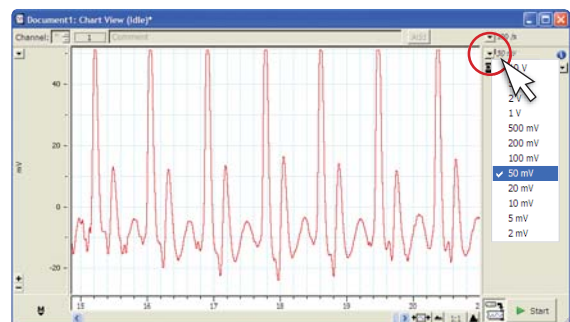**4** Scale the Y-axis (amplitude) if desired, using the Scaling buttons ㉑.

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Problem:
"Out of Range" message appears in Chart View

Solution: Increase range from the Range pop-up menu

1 Click the Range pop-up menu ㉘ in the "out of range" channel.

2 Select a larger range value.
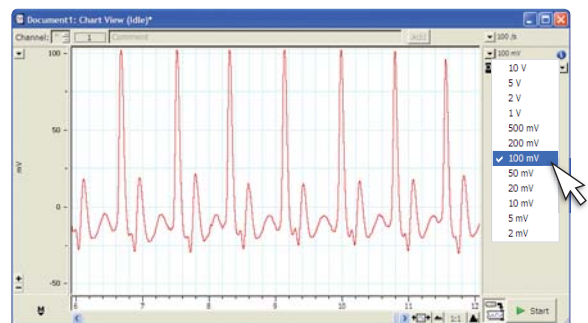
3 Verify that your signal is now 1/3 to 1/2 the window height.

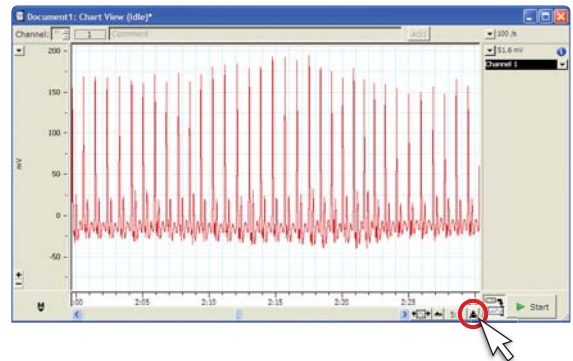**4** Scale the Y-axis (amplitude) if desired, using the Scaling buttons ㉑.

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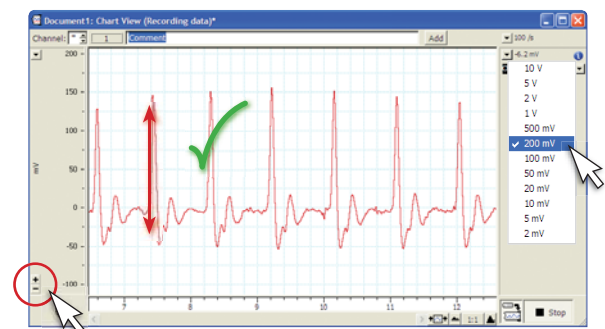
Problem:
Data appears compressed
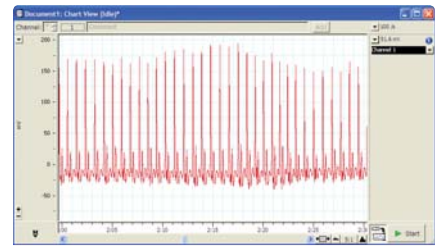
Solution: Adjust time axis scaling using the View buttons

1 From the Chart View window, click the right-hand View button ㉕ to expand the time axis.
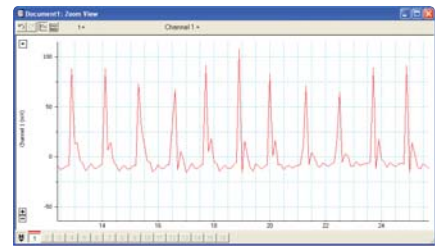

2 Continue to click the View button until the time axis is at a desirable scale.
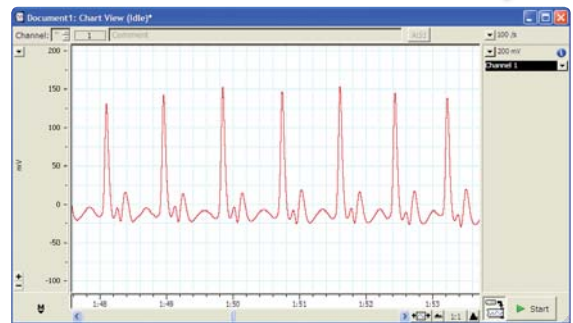
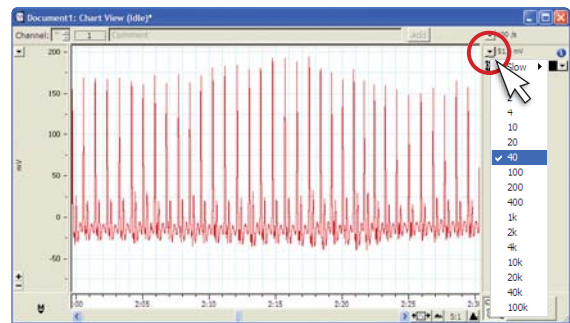**3** **Note:** The View button functions both while recording and when in analysis mode.

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Problem:
Waveform appears choppy or irregular

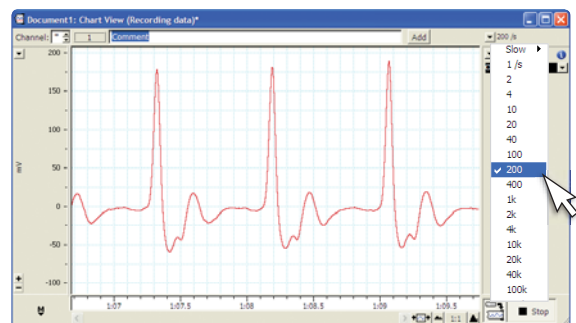## Solution: Increase sampling rate with the Rate pop-up menu

1 Click the Rate pop-up menu ㉜ in the Chart View window.
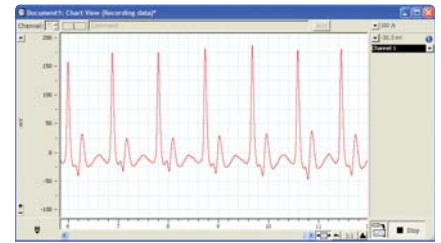

2 Select a faster sampling rate.
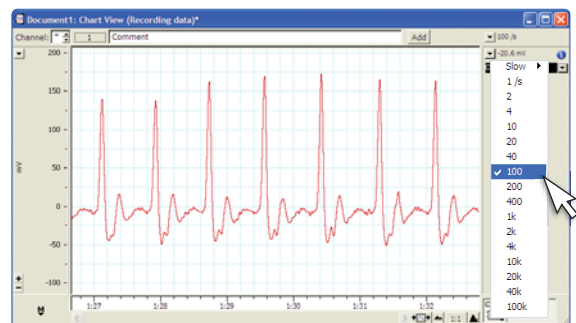
3 Verify that your signal quality has improved. If the signal still looks unusual, ask your instructor for assistance.
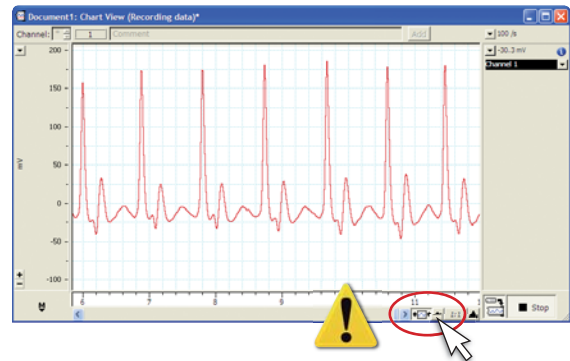

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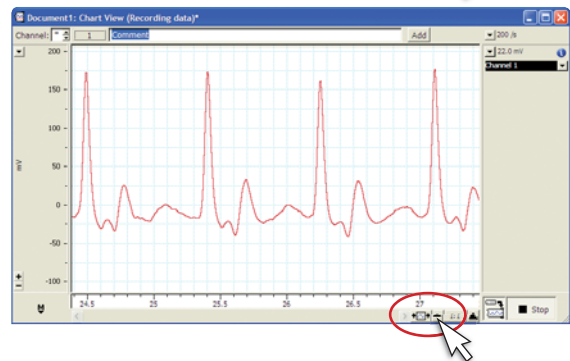# Problem: Data not scrolling after Start button is clicked

Solution: Set the Scroll/Review button to scroll mode

**1** The Scroll/Review button (24) allows the chart data file to be reviewed while data is being recorded.

2 To return to scroll mode, make sure the Scroll/Review button is not depressed.

3 You can return to review mode at any time during your recording by clicking the Scroll/Review button again.
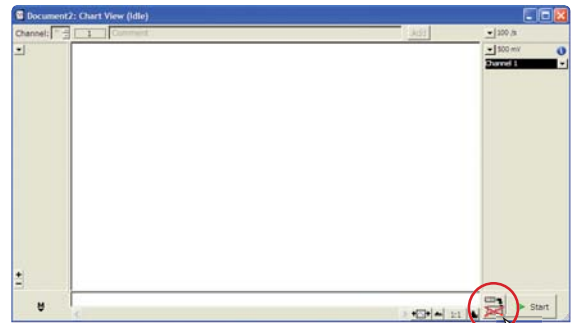
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Problem: Data not present in Chart after clicking Stop
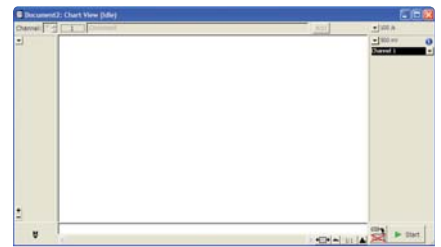
Solution: Click the Record/Monitor button

1 Click the Record/Monitor button so that it does not have a red "X".
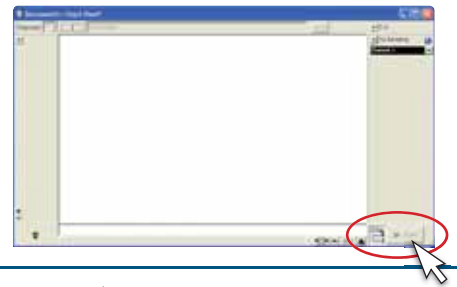
2 If you are not already recording, click Start. Data will now be recorded and remain in the Chart View window when you click Stop.
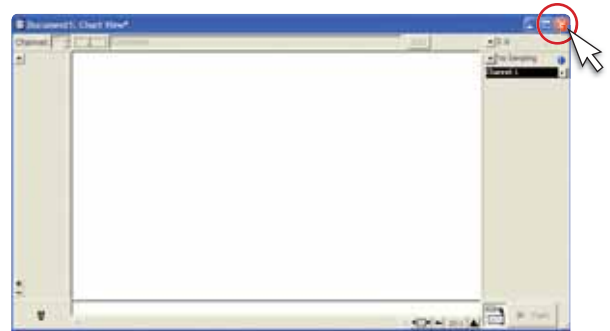
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Problem:
Start button not working
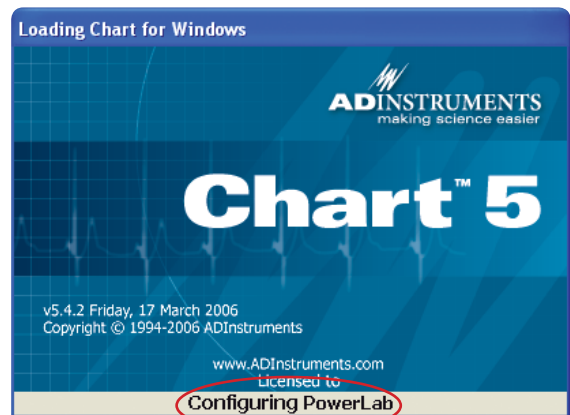
Solution: Restart Chart in acquisition mode

1 Exit Chart by clicking the Exit button in the Chart application window.

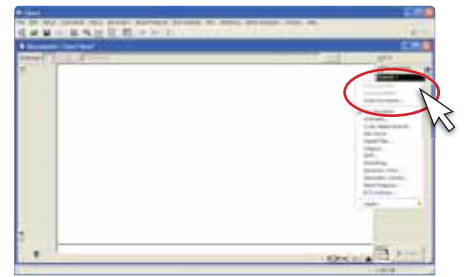**2** Check the USB connection ⑭ between the PowerLab and the computer.

3 Make sure PowerLab is plugged in and turned on. The power indicator light ① should be lit.

4 Restart Chart. Dialog at start up should indicate that a PowerLab is connected.

Loading Chart for Windows

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Chart™ 5

v5.4.2 Friday, 17 March 2006
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Configuring PowerLab

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Problem: Unable to select Input Amplifier



Solution: Restart Chart in acquisition mode

① Exit Chart by clicking the Exit button in the Chart application window.
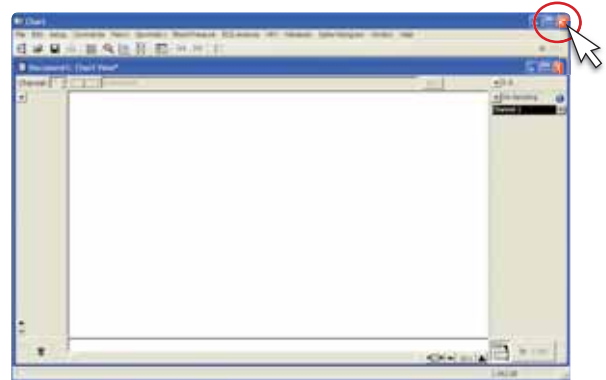
② Check the USB connection between the PowerLab ⑭ and the computer.

③ Make sure PowerLab is plugged in and turned on. The power indicator light ① should be lit.

④ Restart Chart. Dialog at start up should indicate that a PowerLab is connected.
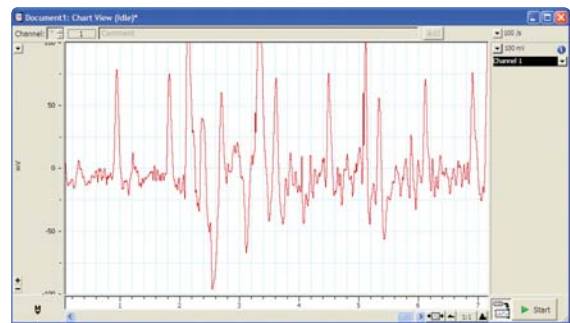

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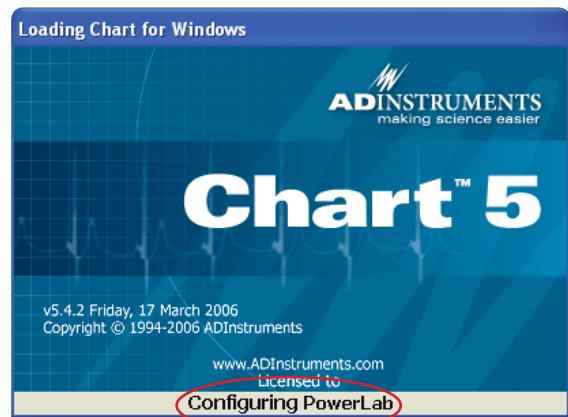
Troubleshooting the MLT1010 Finger Pulse Transducer

The MLT1010 is a very sensitive transducer.
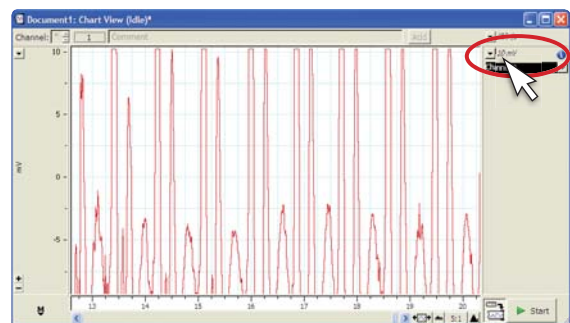Here are some tips to get the best possible signal

1 Noisy signal: The MLT1010 is very sensitive. Try to keep your finger still while recording.
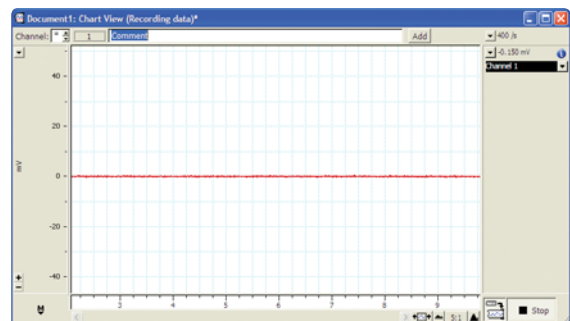

2 Small signal: Adjust the Range. If that doesn't work, readjust transducer strap or try placing the MLT1010 on your thumb.
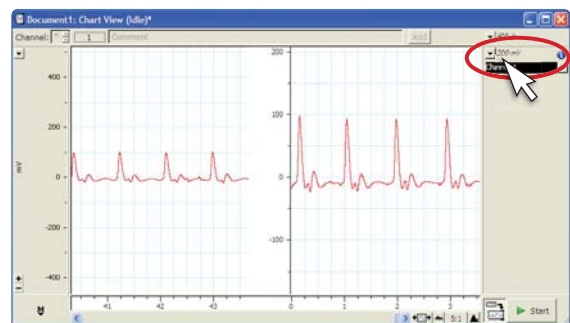
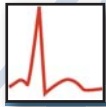**3** Large signal: Increase the range using the Range pop-up menu ㉘.

4 No data: Make sure the MLT1010 is connected to the correct Input channel on the PowerLab.

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Appendix

Cycle Variables

Overview: Cycle Variables calculates cyclical parameters of periodic waveform data. Examples of Cycle Variables functions include rate, frequency and period. Cycle Variables calculations are performed either in a separate channel or in the Data Pad.
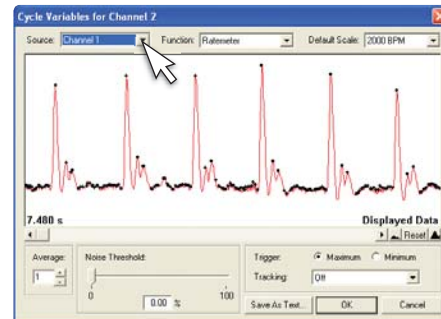
**1** Click the Channel Function pop-up menu ㉚ in an empty channel and select Cycle Variables.

⚠ Be careful to choose a channel that is not being used for data collection!
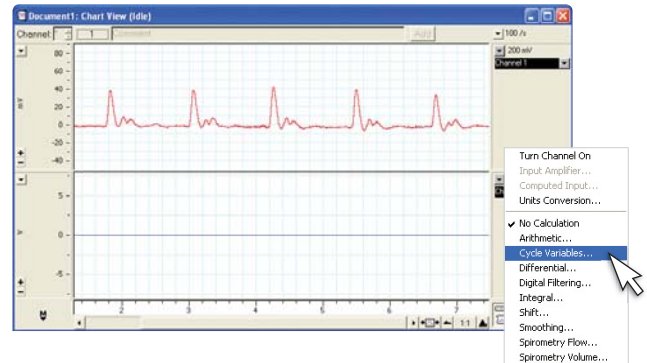
2 The Cycle Variables dialog will appear. Set Source to the channel that you want to perform calculations on.

3 Select a Cycle Variables function from the Function pop-up menu, and select a Scale if necessary.
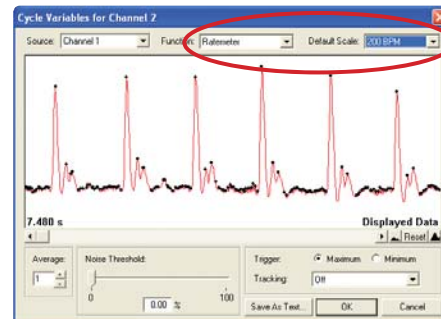
4 Adjust the Noise Threshold with the slider bar so that only the peaks of interest are detected. These will be identified by black dots on the waveform trace. When you are finished, click OK.

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