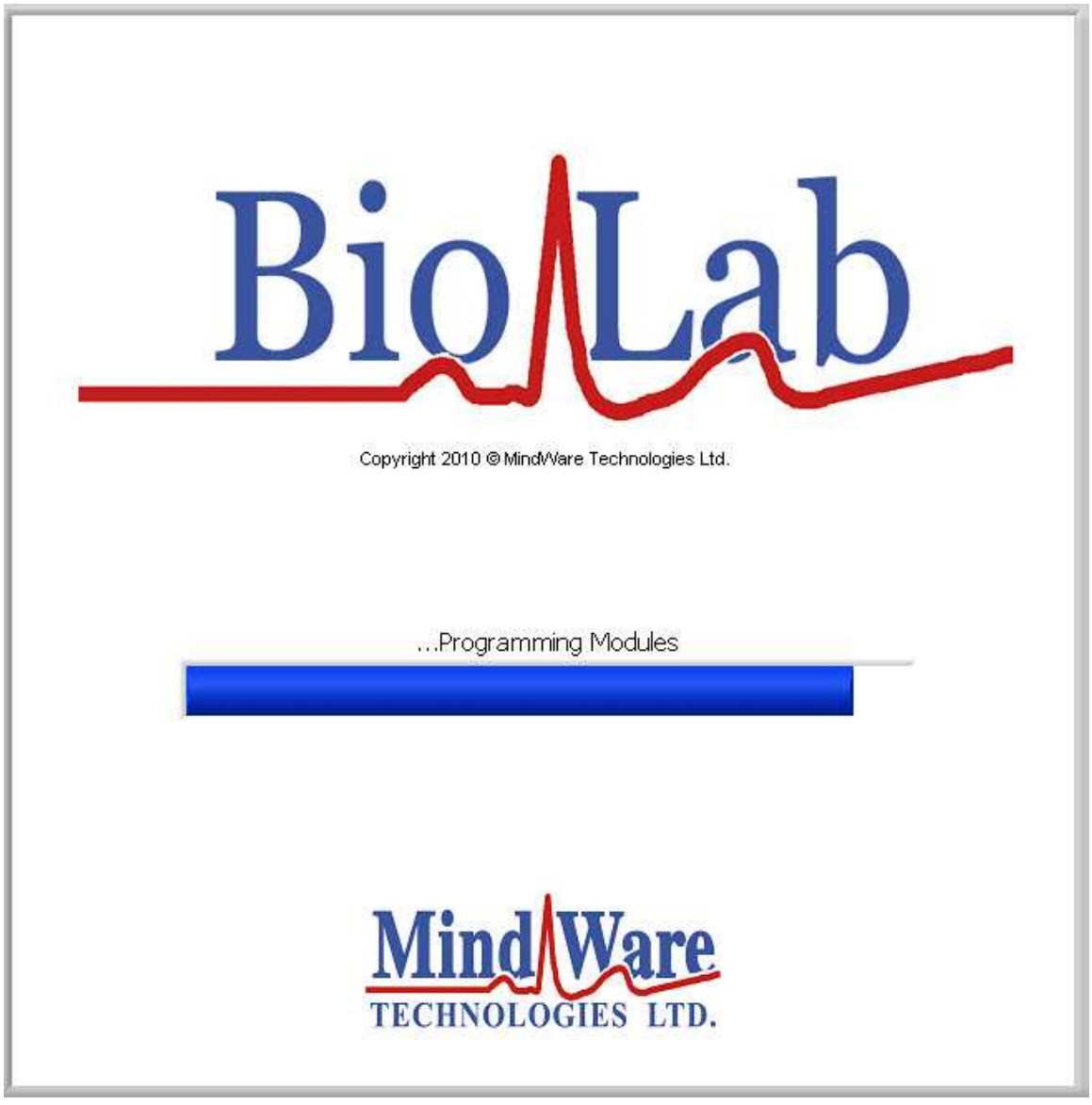
MindWare BioLab User Reference Guide

Version 3.0.4



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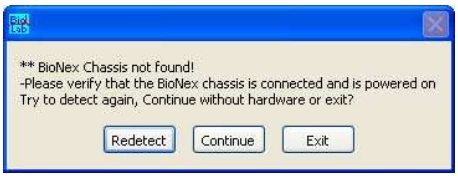
Section 1: Startup

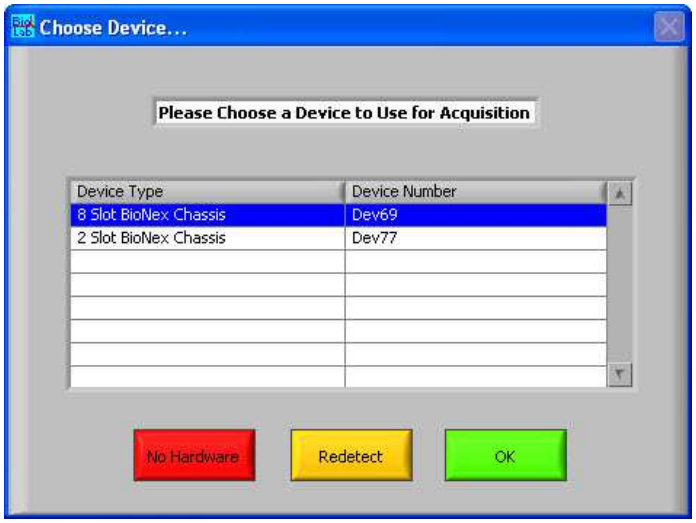
Upon starting the MindWare BioLab software, the following screen will appear as the application the hardware detected in the system.

In the event that no hardware is detected, the option is given to either attempt to detect the hardware again, proceed without hardware connected, or exit the application.



Once the connected hardware is properly initialized (or user has chosen to proceed without hardware), the configuration screen is displayed. If the detected hardware contains no modules in it, a warning will be displayed.

In the event that more than one chassis is detected in the system, the following prompt will appear allowing the user to specify which chassis to use in acquisition:



No Hardware: This button proceeds to the BioLab Configuration screen without selecting any chassis listed for use in acquisition.

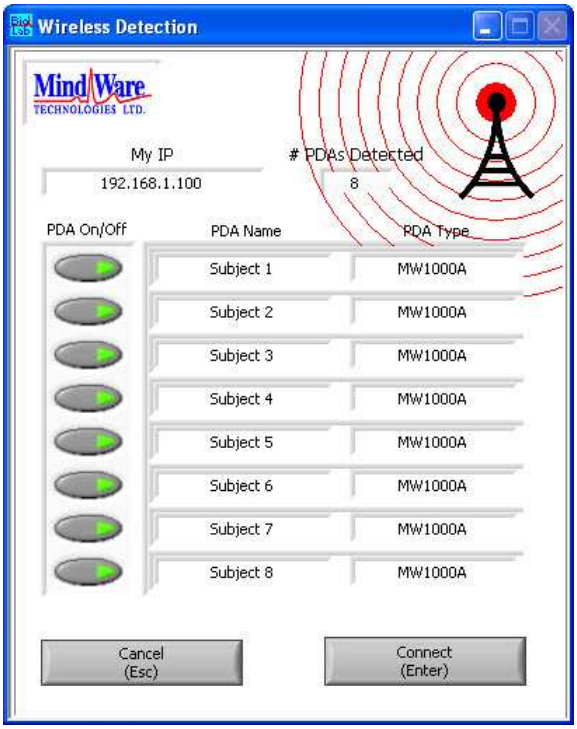
Redetect: This button will redetect new chassis connected to the system since this window has opened and update the list of devices accordingly.

OK: This button chooses the selected chassis for acquisition.

After a chassis has been chosen the first time, it will become the default chassis for acquisition. This screen will no longer appear at the start of BioLab once this is done. To use a different chassis for acquisition in the future, choose **Redetect Devices** from the menu bar on the BioLab Configuration screen (see **Section 2: BioLab Configuration (Acquisition Mode)** pages 10-12).

Wireless Detection

If the acquisition source is currently set to **Ambulatory Wi-Fi** or **BioNex & Ambulatory Wi-Fi**, the Wireless Detection screen will appear prior to entering the BioLab Configuration screen allowing the user to connect up to 8 wireless devices for acquisition.



As MindWare Ambulatory wireless devices attempt to connect to the system, they will appear in the table on this window. Up to 8 connecting wireless devices can be listed simultaneously. The following settings are available:

My IP: This display indicates the host computer's assigned IP address.

 # PDAs Detected: This display indicates the current number of PDAs attempting to connect to the system.

PDA On/Off: Activating this control indicates that the specified PDA will be connected to the system for acquisition. In **Ambulatory Wi-Fi** mode, up to 8 units may be connected at the same time. In **BioNex & Ambulatory Wi-Fi** mode, up to 4 units may be connected at the same time. Attempts to connect more than the allowed number of units will result in an error message.

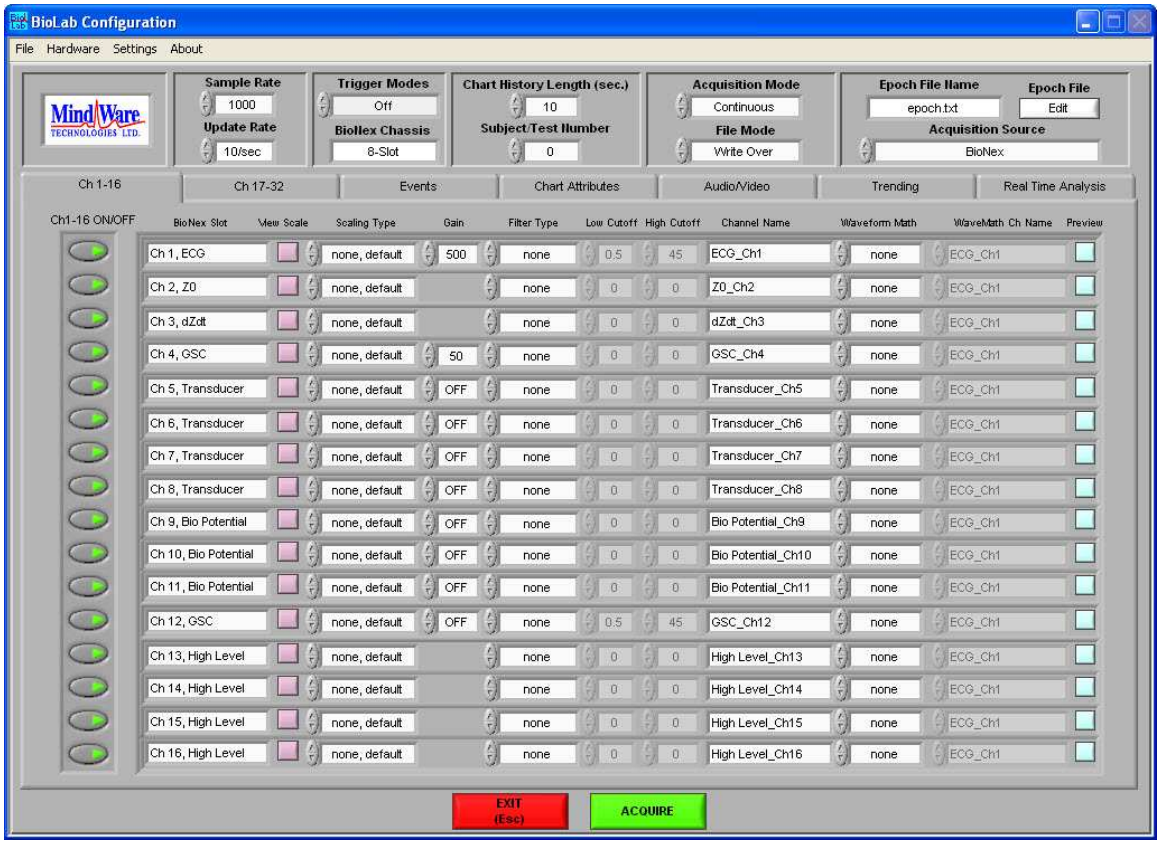
PDA Name: Displays the name of the PDA as specified in the PDA ACQ 3.0 application on the Ambulatory unit.

PDA Type: Displays the type (model number) of the connected Ambulatory unit.

Pressing the **Cancel** button on this screen will proceed to the BioLab Configuration screen without connecting any Ambulatory wireless units. Pressing the **Connect** button will establish a connection between all enabled Ambulatory wireless devices and the host computer, making them available for acquisition.

Note: Connection time may vary based on network speed, network traffic, number of devices, etc. Allow up to a few minutes for connections to be established.

Section 2: BioLab Configuration (Acquisition Mode)



The BioLab Configuration screen contains many of the adjustable program settings. Any changes made to the settings within this screen are automatically saved for future sessions whenever acquisition is initiated or the application is exited. The settings have been divided into three sections: Menu Bar Settings, Main Settings, and Sub Menu Settings.

Menu Bar Settings

The following settings are available from the menu bar:

File:

> **Open File:** This option allows the user to open a MindWare file for viewing in the built in file playback mode (see **Section 6: BioLab Configuration (File Mode)** pages 54-55).

Save MindWare File As: This option allows the user to save the currently opened MindWare file as a new file (see **Section 6: BioLab Configuration (File Mode)** page 54).

Note: This option will be disabled unless a MindWare file has been opened for viewing.

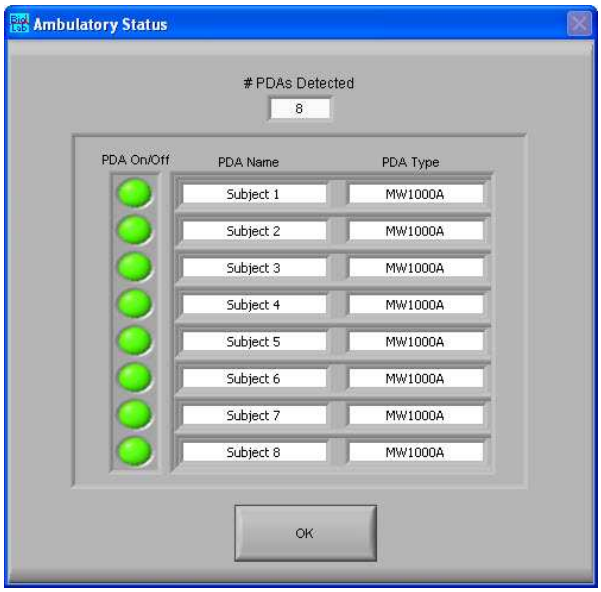
Exit: This option closes the BioLab application.

Hardware:

Redetect Devices: This option restarts the BioLab application, re-initializing all hardware and re-detecting all modules. If a new module or chassis is connected to the system after BioLab has been started, this option will allow BioLab to detect the new component. If multiple chassis are connected to the machine and you would like to select a different chassis for acquisition, selecting this option will allow you to do so.

Note: If Ambulatory wireless devices are connected, selecting this option will result in disconnecting these devices from the system.

Ambulatory Status: This option launches the Ambulatory Status window, which offers detailed information on each of the ambulatories currently connected to the system.



The following information is displayed on the Ambulatory Status window:

 # PDAs Detected: This display indicates the number of PDAs currently connected to the system

PDA On/Off: Indicates whether the specified PDA is still connected to the system.

PDA Name: Displays the name of the PDA as specified in the PDA ACQ 3.0 application on the Ambulatory unit.

PDA Type: Displays the type (model number) of the connected Ambulatory unit.

Note: The Ambulatory Status option will only be available in Ambulatory Wi-Fi or BioNex & Ambulatory Wi-Fi acquisition source modes.

Settings:

Open Configuration: This option allows a previously saved configuration file (.mwcfg) to be opened.

Save Configuration As: This option saves all current settings in the BioLab Configuration screen to a configuration file (.mwcfg) which can later be recalled.

Reinitialize All to Default: This option will return all settings in setup screen to factory default. All configuration files will be renamed to

*Configuration File Name*_old.cfg

and new files will be created in their place.

Note: All configuration files are stored in the Application Data folder of the user currently logged into the computer.

Tools:

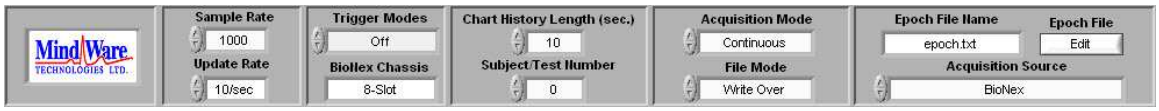
ASCII-MW Converter: The ASCII-MW Converter allows the conversion of any text file containing data in some character-delimited columns to the .mw format so that it may be used in any application (See **Appendix B: ASCII-MW Converter** page 89).

About:

BioLab: This option launches the About window, detailing information about the version of BioLab running.

Show Help: This option toggles on/off the floating help box.

Main Settings



The following main acquisition settings are located across the top of the BioLab Configuration screen:

Sample Rate: This control sets how fast the data is acquired (in samples per second).

Update Rate: This control sets how often the Acquisition screen is updated (in updates per second).

Trigger Modes: This control determines how acquisition is started and stopped. The following trigger modes are available:

Off: In this mode acquisition is started and stopped by manually pressing the Start/Stop button on the Acquisition screen.

Rising: In this mode acquisition is started on a rising edge (low to high) detected on the Trigger In line of the BioNex. It is stopped by manually pressing the Start/Stop button on the Acquisition screen.

Falling: In this mode acquisition is started on a falling edge (high to low) detected on the Trigger In line of the BioNex. It is stopped by manually pressing the Start/Stop button on the Acquisition screen.

Pause Low Level: In this mode acquisition is active when the Trigger In line of the BioNex is high and paused when it is brought low.

Pause High Level: In this mode acquisition is active when the Trigger In line of the BioNex is low and paused when it is brought high.

*Note: The **Pause Low Level** and **Pause High Level** trigger modes are **NOT** available on the 2-slot BioNex unit.*

BioNex Chassis: This display shows the type of BioNex chassis currently connected to the system. If no hardware was found during initialization, this display will read "No Chassis".

Chart History Length: This control specifies how many seconds of data are shown on the Acquisition screen at any given time.

Subject/Test Number: This control specifies the number/label of the current test subject.

Acquisition Mode: This control specifies how data is acquired. The following acquisition modes are available:

> **Epoch:** In this mode data is collected in segments specified in an epoch file. (See the **Epoch File Editor** section, pages 15-16).
>
> **Continuous:** In this mode data is collected without pre-defined pauses or segmentation.

File Mode: This control specifies how the data is saved to a file. The following file modes are available:

> **Append:** In this mode each time acquisition is started and stopped the data collected is appended to the end of the current file being written. Once the Acquisition screen is closed, the file can no longer be appended with additional data.
>
> **Write Over:** In this mode, if acquisition is stopped and restarted, the file will be overwritten with new data.
>
> **Auto Name:** In this mode the user chooses a base name for the file and BioLab automatically adds a number to the end of the filename corresponding to the current acquisition number. Each time acquisition is stopped and restarted this number is incremented by 1.

*Note: The **Append** file mode is **NOT** available on Windows 7/Vista when video recording has been enabled.*

Acquisition Source: This control specifies the source of data acquisition. The following sources are available:

BioNex: This mode uses the detected BioNex chassis for data acquisition.

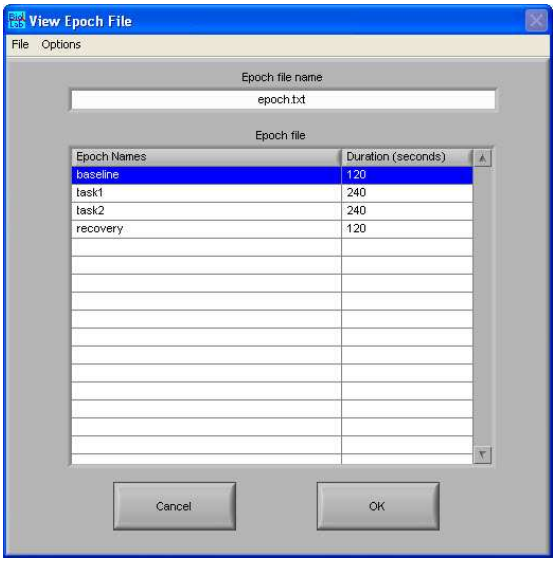
Ambulatory Wi-Fi: This mode uses Ambulatory wireless units for data acquisition.

BioNex & Ambulatory Wi-Fi: This mode uses a combination of the detected BioNex chassis and connected Ambulatory wireless units for data acquisition.

File: This mode opens a MindWare data file for viewing/playback.

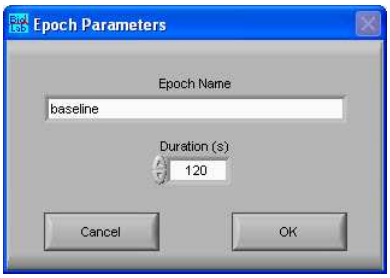
Epoch File Name: This display shows the epoch file currently selected for use when in the **Epoch** acquisition mode.

Epoch File Editor: This control allows the user to select a new epoch file for use in acquisition, or edit the currently selected epoch file. Clicking this button brings up the Epoch File Editor screen.



From this screen, a new epoch file can be loaded or the current epoch file can be edited. By selecting an epoch and right-clicking on the Epoch File table or opening the Options menu, the following options are available:

Edit Epoch: This option launches the Epoch Parameters window and allows the user to edit the currently selected epoch's name and duration.



Insert Epoch Before: This option once again launches the Epoch Parameters window, but allows the user to define a new epoch to be inserted before the currently selected epoch in the file.

Insert Epoch After: This option behaves the same as above, except it inserts the new epoch after the currently selected epoch in the file.

Remove Epoch: This option allows the user to remove the currently selected epoch from the file. User confirmation is required prior to removing the epoch.

From the menu bar in the Epoch Editor the following options are available:

File:

Open: This option is used to open a new epoch file.

Save As: This option allows the user to save changes made to the current epoch file.

Close: This option closes the Epoch Editor and returns to the BioLab Configuration screen.

Options: This menu contains the same epoch editing options as are available through right-clicking the Epoch File table.

If an epoch file has been edited, the user will be prompted to save the changes made prior to opening a new epoch file or returning to the BioLab Configuration screen.

Sub Menu Settings

Below the main settings listed above are several submenus, each containing settings pertaining to a specified aspect of data acquisition. The following submenus are available:

Channels: *Pages 18-26*

The Channels submenus contain adjustable settings for each individual channel present in this system. These settings can apply to the channels available in a BioNex chassis (BioNex acquisition mode), on connected Ambulatory units (Ambulatory Wi-Fi acquisition mode), a combination of the two (BioNex and Ambulatory Wi-Fi acquisition mode), or the channels available in a MindWare file (File acquisition mode).

Events: *Pages 27-32*

The Events submenu contains settings for synchronous and asynchronous digital events as well as keyboard events that can be inserted during the current data acquisition session.

Chart Attributes: *Pages 33-34*

The Chart Attributes submenu allows the user to modify how the data is displayed on the Acquisition screen.

Audio/Video: *Pages 35-37*

The Audio/Video submenu contains settings for the acquisition of video and audio. This tab will not be shown if no MindWare video components are present in the system.

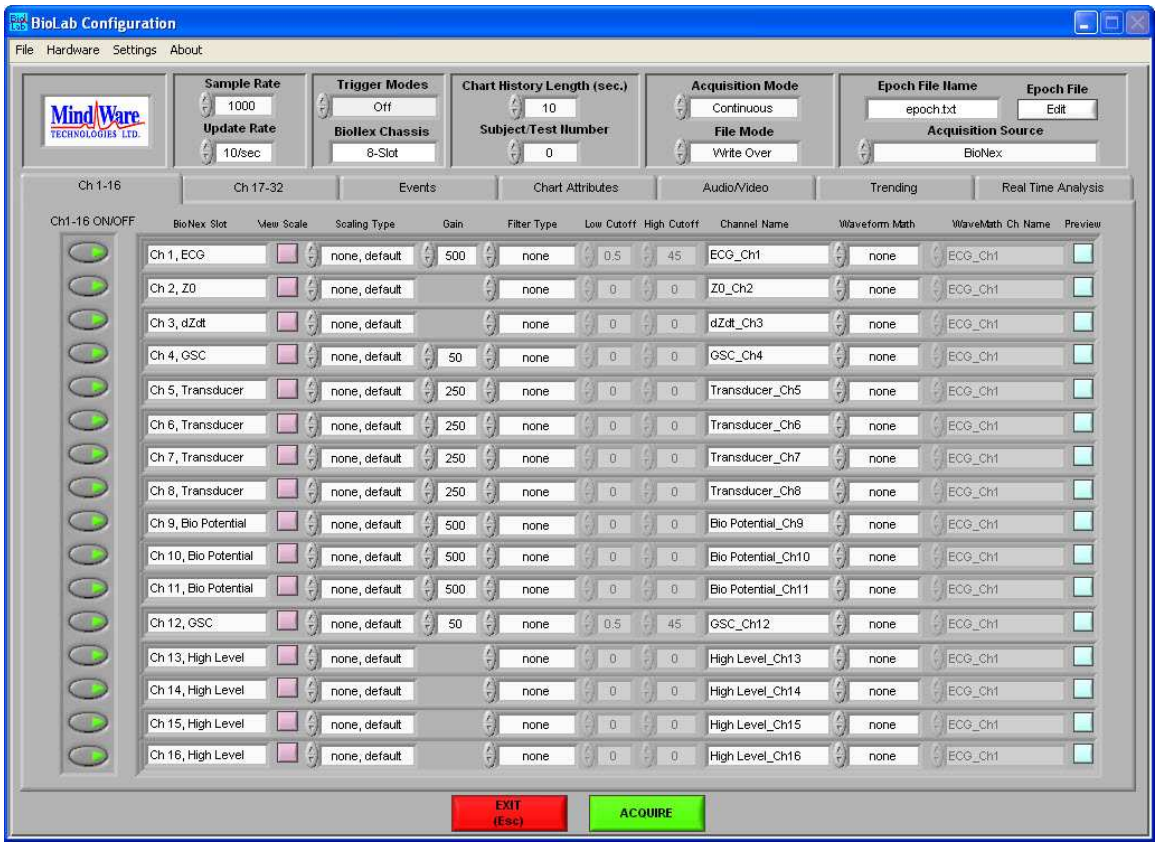
Trending: *Pages 38-39*

The Trending submenu allows users to assign trends (mean, max, min, etc.) to different channels enabled for acquisition that will be calculated and displayed during acquisition.

Real Time Analysis: *Pages 40-42*

The Real Time Analysis submenu contains adjustable settings for the currently installed MindWare Real Time module(s).

Part 1: Channels



The Channels submenu contains settings that are applied to the individual channels present in the system. They are listed in order from the module in Slot 1 – 8 when acquiring from a BioNex chassis, or by the order in which the units were connected when acquiring from an Ambulatory wireless unit. The following settings (from left to right) are available for each channel:

On/Off: This control enables/disables the specified channel for acquisition. In order for the channel to be enabled, there must be a module in the corresponding slot. **The channel must be enabled in order to use it for data acquisition.**

BioNex Slot: This display indicates the type of data that can be collected with the module currently in that position. This is also the formal name of the channel on the module. If there is no module in the corresponding slot, this display will display "empty slot" next to the channel number.

View Scale: This button launches the Preview Scaling screen, which allows users to see the affects of various scaling methods on the channel. This screen is discussed in more detail in **Part 1a** (pages 21-23).

Scaling Type: This control sets the type of scaling to use on the specified channel. By selecting any scaling method other than "None, default" the Preview Scaling screen is automatically launched. There are three scaling methods available:

> **None, default:** No scaling will be used on this channel.
>
> **Map Ranges:** Maps the voltage range to the scaled units (e.g. 1V = 100 mmHg).
>
> **Slope Intercept:** Scales volts to specified scaled units using the equation y = mx + b where *m* is the slope and *b* is the intercept.

Gain: This control adjusts the amount of gain to be applied to each channel. Depending on the type of channel, different gain settings are available. If a channel does not have a programmable gain setting associated with it, this control will not be visible.

Note: The user will be unable to proceed to the Acquisition screen until all enabled channels have a gain setting other than 'OFF' or '0'.

Filter Type: This control specifies the filter that will be used on the channel while acquiring data. Each filter has a default Low and High Cutoff associated with it.

Low Cutoff: This control sets the low cutoff frequency for the specified channel. This control will be disabled when no filter has been selected, or if the selected filter ignores or uses a very specific low cutoff frequency. This value cannot exceed half the value of the sampling frequency, and must be less than the value of the high cutoff frequency.

High Cutoff: This control sets the high cutoff frequency for the specified channel. This control will be disabled when no filter has been selected, or if the selected filter ignores or uses a very specific high cutoff frequency. This value cannot exceed half the value of the sampling frequency, and must be greater than the value of the low cutoff frequency.

Note: The Nyquist Criterion states that "The exact reconstruction of a continuous time-based baseband signal from its samples is possible if the signal is band-limited and the

sampling frequency is greater than twice the signal bandwidth". This is the reason for the limitations on low and high cutoffs as listed above.

Channel Name: This control allows the user to define the channel name. This will be used to identify the channel both on the acquisition screen and in the MindWare file.

Waveform Math: This control sets the type of waveform math to be applied to the specified channel. The following options are available:

> **None:** No waveform math will be applied to this channel.
>
> **Add:** The channel listed in the **WaveMath Ch Name** field will be added to the current channel during acquisition.
>
> **Subtract:** The channel listed in the **WaveMath Ch Name** field will be subtracted from the current channel during acquisition.
>
> **Integrate:** The integral of the current channel will be calculated and displayed during acquisition.
>
> **Differentiate:** The derivative of the current channel will be calculated and displayed during acquisition.

WaveMath Ch Name: Specified the channel that will be added or subtracted from the current channel. All currently enabled channels are available for selection from this list. This control will only be enabled if "Add" or "Subtract" waveform math has been selected.

Preview: This button launches the Preview Scaling and Filtering screen, which allows the user to see the affects of various scaling, filtering, and waveform math settings on the specified channel. This screen is discussed in more detail in **Part 1b** (pages 24 – 26).

Part 1a: Preview Scaling

The Preview Scaling screen is used to see how various scaling methods can affect the channel to which they are being applied. The following settings are available:

Preview Update Rate: This control sets how often the Preview Scaling screen is updated (in updates per second).

Chart Type: This control specifies how the data is viewed on the Preview Scaling screen. There are three different chart options:

> **Stacked Chart:** The option plots unscaled data (volts) and scaled data (scaled units) in separate charts stacked on one another. (*Shown above*)
>
> **Overlay Chart:** This option plots both the unscaled and scaled data on the same plot.
>
> **Mean Chart (Single Point):** This option plots unscaled and scaled data in separate charts stacked on one another, but only plots a single point per update representing the mean value of that update.

Channel Gain: This control specifies the programmable gain setting to be used on this channel. It is initialized to its value on the BioLab Configuration screen and can be changed to see how different gain settings affect signal amplitude, etc.

Scaled Unit: This control specifies the unit that the signal is being scaled to. There is a default list of units available, but by selecting the **New Unit...** option the following window will appear allowing the user to add a custom unit description.

If a new unit is successfully added, it will appear in the list as a selectable unit and saved for use in future sessions.

Note: This control will be disabled if no scaling method has been selected.

Channel Name: This control allows the user to switch between channels which have been enabled for acquisition. When a new channel is selected, the controls on this screen will be updated to reflect that channel's settings.

Scaling Method: This control sets the type of scaling to use on the specified channel. There are three scaling methods available:

> **None, default:** No scaling will be used on this channel.
>
> **Map Ranges:** Maps the voltage range to the scaled units (e.g. 1V = 100 mmHg).
>
> **Slope Intercept:** Scales volts to specified scaled units using the equation y = mx + b where *m* is the slope and *b* is the intercept.

Volts Max: This control is available for the Map Ranges scaling method, and sets the maximum voltage of the signal.

Volts Min: This control is available for the Map Ranges scaling method, and sets the minimum voltage of the signal.

Measure Max: This control is available for the Map Ranges scaling method, and sets the maximum range voltage.

Measure Min: This control is available for the Map Ranges scaling method, and sets the minimum range voltage.

m (slope): This control is available for the Slope Intercept scaling method, and sets the slope of the scaling equation.

b (y-intercept): This control is available for the Slope Intercept scaling method, and sets the y-intercept of the scaling equation.

Acquiring: This button toggles between acquiring a signal from the specified channel and pausing acquisition to examine the data.

Cancel: This button returns to the BioLab Configuration screen without saving any changes made to channel scaling.

OK: This button returns to the BioLab Configuration screen saving all changes made to the channel scaling while in the Preview Scaling window.

Part 1b: Preview Channel

The Preview Channel screen is used to see how various scaling methods can affect the channel to which they are being applied. The following settings are available:

Preview Update Rate: This control sets how often the Preview Channel screen is updated (in updates per second).

Chart Type: This control specifies how the data is viewed on the Preview Channel screen. There are three different chart options:

> **Stacked Chart:** The option plots unscaled data (volts), scaled data (scaled units), filtered data (scaled units), and post-wavemath data (scaled units) in separate charts stacked on one another. (*Shown above*)
>
> **Overlay Chart:** This option plots the unscaled, scaled, filtered, and post-wavemath data on the same plot.

Mean Chart (Single Point): This option plots unscaled, scaled, filtered, and post-wavemath data in separate charts stacked on one another, but only plots a single point per update representing the mean value of that update.

Channel Gain: This control specifies the programmable gain setting to be used on this channel. It is initialized to its value on the BioLab Configuration screen and can be changed to see how different gain settings affect signal amplitude, etc.

Scaled Unit: This control specifies the unit that the signal is being scaled to. There is a default list of units available, but by selecting the **New Unit...** option the following window will appear allowing the user to add a custom unit description.

If a new unit is successfully added, it will appear in the list as a selectable unit and saved for use in future sessions.

Note: This control will be disabled if no scaling method has been selected.

Channel Name: This control allows the user to switch between channels which have been enabled for acquisition. When a new channel is selected, the controls on this screen will be updated to reflect that channel's settings.

Scaling Settings: These settings behave the same way as those found in the Preview Scaling screen.

Filter Settings: These settings behave the same way as those found in the BioLab Configuration screen.

Wavemath Settings: These settings behave the same way as those found in the BioLab Configuration screen.

Acquiring: This button toggles between acquiring a signal from the specified channel and pausing acquisition to examine the data.

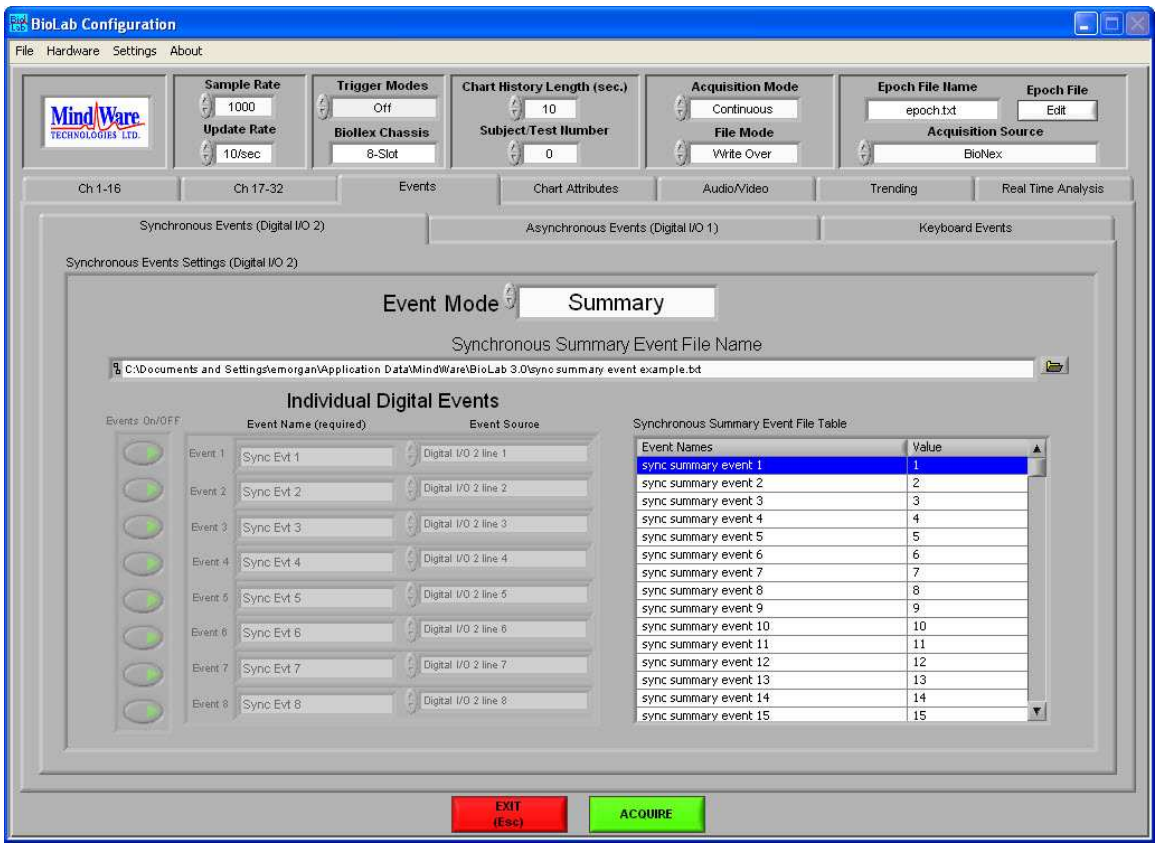
Cancel: This button returns to the BioLab Configuration screen without saving any changes made to channel settings.

OK: This button returns to the BioLab Configuration screen saving all changes made to the channel settings while in the Preview Scaling and Filtering window.

Part 2: Events

The Events submenu contains settings for synchronous and asynchronous digital events as well as keyboard events that can be inserted during the current data acquisition session. Within the Events submenu, there are three additional categories: **Synchronous Events** (pages 27-29), **Asynchronous Events** (pages 30-31), and **Keyboard Events** (page 32).

Part 2a: Synchronous Events



The Synchronous Events submenu contains setup options for configuring the synchronous digital I/O on the BioNex. Synchronous events are sampled at the same sampling frequency, and therefore are in sync with the acquired data. The signals enabled in this submenu are displayed on the Acquisition screen and saved in the MindWare file.

Note: This submenu will not be available for users with a 2-slot BioNex chassis, as it does not support synchronous events.

The following Synchronous Event settings are available:

Event Mode: This control changes the behavior of the synchronous digital lines. There are three event modes:

> **Off:** This mode disables synchronous events from occurring during acquisition.
>
> **Individual:** This mode views each synchronous digital line as a completely separate event channel, allowing for up to 8 distinct events (one for each available digital line).
>
> **Summary:** This mode views the synchronous digital lines as a single event channel, with its value being the sum of all values seen on each digital line. This allows for 2^8 or 256 distinct events. All digital lines will be automatically enabled when in this mode.

Synchronous Summary Event File Name: This control is used to load a summary event file. The contents of the file are shown in the Synchronous Summary Event File Table.

Individual Digital Events: These controls are used to define the parameters used in collecting individual digital events and will only be enabled when in Individual event mode. There are three fields in this section:

> **Events On/Off:** Enables/disables a specific digital line for use during acquisition. **The digital line must be enabled in order to use it for data acquisition.**
>
> **Event Name (required):** This control allows the user to define the digital event name. The name entered in this control will be used not only to identify the channel on the Acquisition screen, but also in the MindWare file and its associated Event file.
>
> **Event Source:** This control specifies the specific digital line on the BioNex that is associated with the current event.

Synchronous Summary Event File Table: This table lists the names and values of the summary events as read from the specified summary event file. By selecting an event on the list and right-clicking, there are three options for editing the current summary event file:

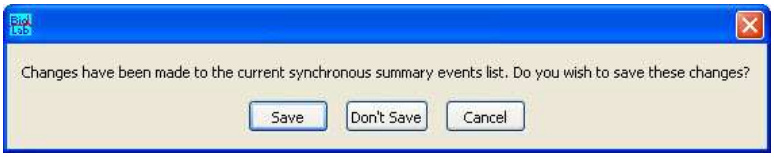
Edit Event: Selecting this option will launch the following window, allowing for the selected event to be given a new name or value associated with it.

If the chosen Event Name or Value has already been used in the summary event file, an error will be given and the event will need to be changed prior to inserting it back into the file.

Add Event: Selecting this option will once again launch the Edit Summary Event screen, this time allowing the user to add a new event to the list. The same requirement that an event not contain duplicate values still applies.

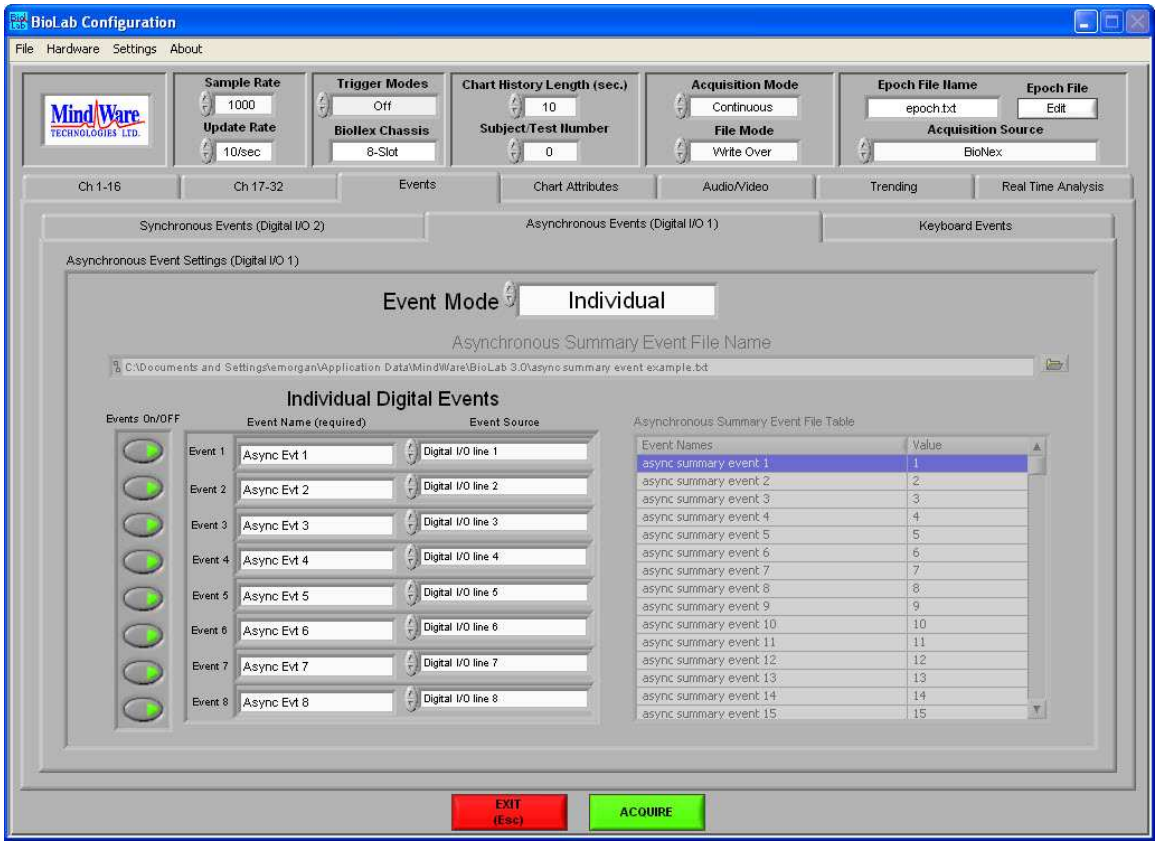
Remove Event: Selecting this value will allow the user to remove a summary event from the list. User confirmation is required prior to actual removal of the event.

If any changes are made to this file through adding, removing, or editing events, the user will be prompted to save these changes prior to acquiring, exiting, or changing the current submenu.



Cancelling at this point will return to the Synchronous Events submenu for the user to re-evaluate the changes made to the summary events.

Part 2b: Asynchronous Events



The Asynchronous Events submenu contains setup options for configuring the asynchronous digital I/O on the BioNex. Asynchronous events are sampled at ~500 samples per second, and are not guaranteed to be in sync with the acquired data. The signals enabled in this submenu are not displayed on the Acquisition screen or saved in the MindWare file, but events detected on these lines will appear in the associated Event file.

Note: Users with a 2-slot BioNex chassis will only have access to four asynchronous digital lines for a total of 4 individual events and 2^4 or 16 summary events.

The following settings are available:

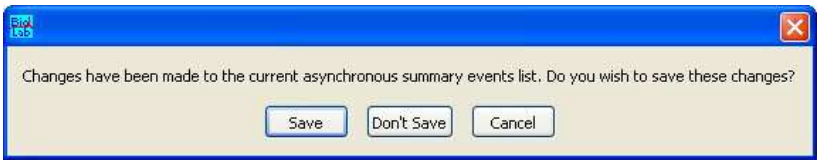
Event Mode: This control behaves the same as it does on the Synchronous Events submenu.

Asynchronous Summary Event File Name: This control is used to load a summary event file. The contents of the file are shown in the Asynchronous Summary Event File Table.

Individual Digital Events: These controls behave the same way as they did on the Synchronous Events submenu with the exception of the **Event Source** field. If there are Rating Response Modules present in the BioNex, the event source can be mapped to the right or left buttons on the rating response controller so that these can be sampled asynchronously.

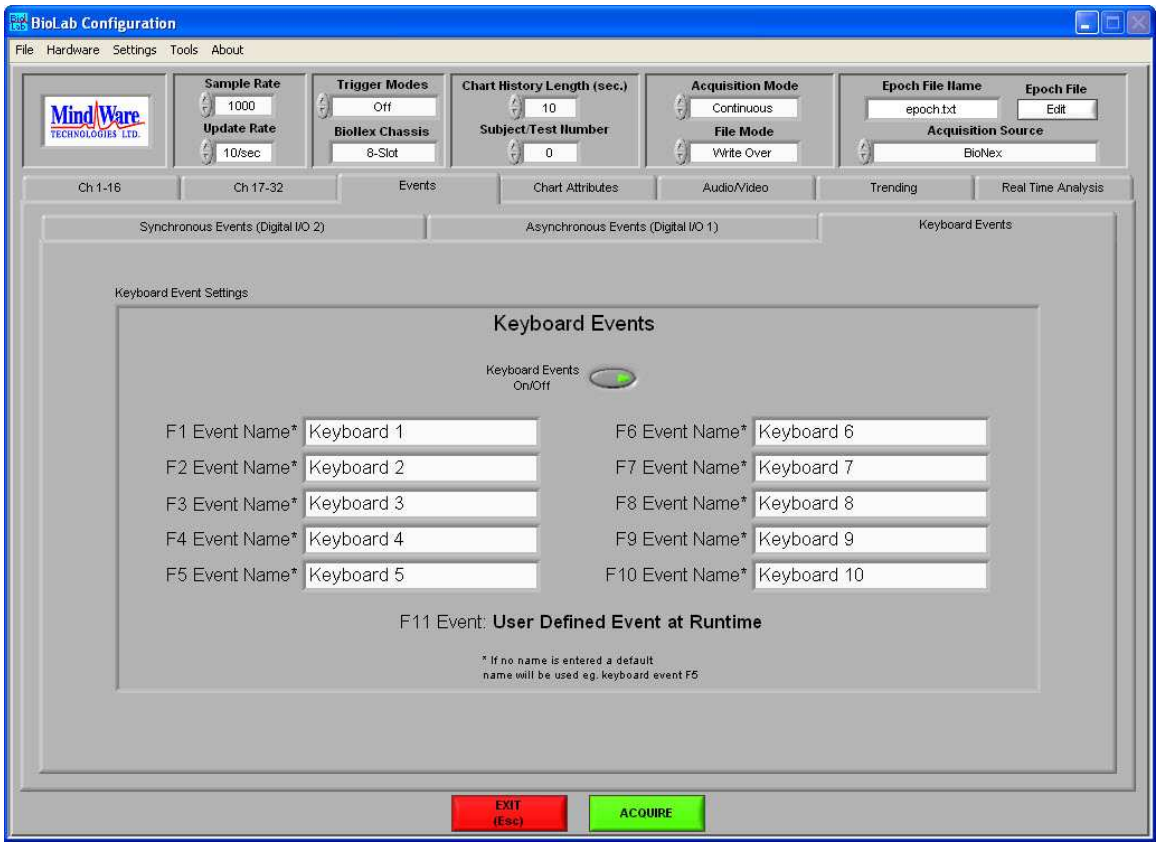
Asynchronous Summary Event File Table: This table behaves the same as the Synchronous Summary Event File Table on the Synchronous Events submenu.

Once again, if changes are made to this file through adding, removing, or editing events, the user will be prompted to save these changes prior to acquiring, exiting, or changing the current submenu.



Cancelling at this point will return to the Asynchronous Events submenu for the user to re-evaluate the changes made to the summary events.

Part 2c: Keyboard Events

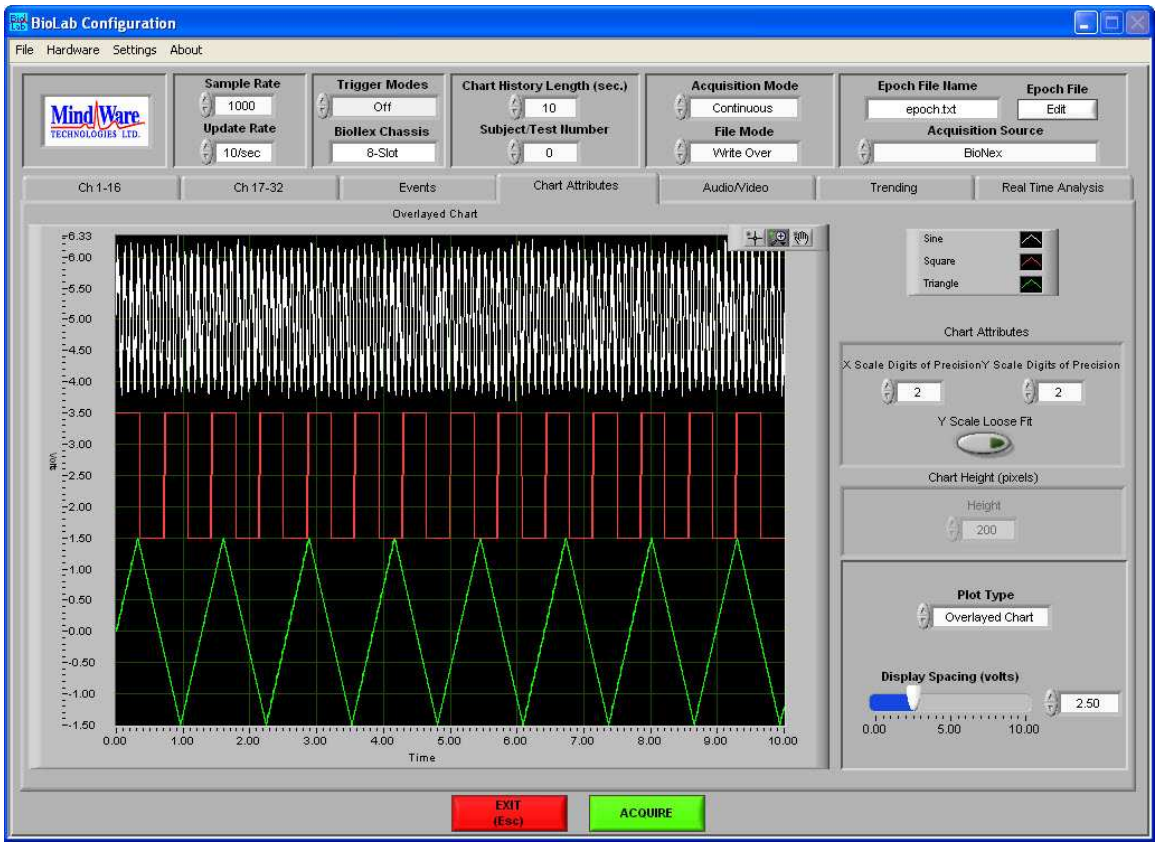


The Keyboard Events submenu contains settings for configuring the keyboard events available to the user during acquisition. The following settings are available:

Keyboard Events On/Off: This control enables/disables use of keyboard events during acquisition.

Keyboard Event Names: These fields describe how the keyboard event will be identified on the Acquisition screen as well as in the Event file saved during acquisition. If there is no name specified, a default name will be used based on the key from which the event was detected.

Part 3: Chart Attributes



The Chart Attributes submenu contains settings for adjusting how the data is displayed on the Acquisition screen. The following settings are available:

Waveform Preview: The display on the left of this submenu is a preview of how the data will be displayed during acquisition. It updates as other parameters on this submenu are changed.

X Scale Digits of Precision: This control sets the number of significant digits the chart will display on the x-axis.

Y Scale Digits of Precision: This control sets the number of significant digits the chart will display on the y-axis.

Y Scale Loose Fit: When this option is disabled, the y-axis automatically scales to the exact digits of precision based on the maximum and minimum values of the waveform. When it is enabled, it will not fit as tightly to the waveform.

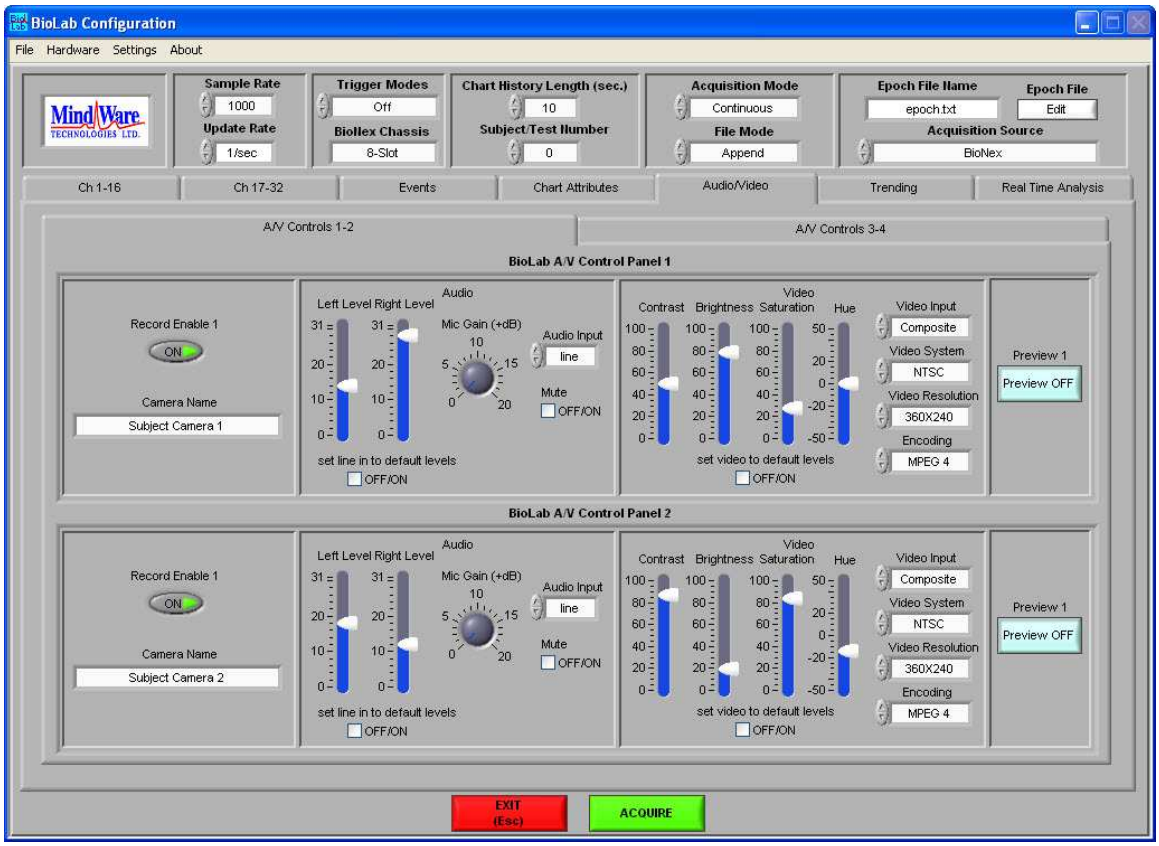
Height: This control sets the height of each plot on a stacked chart. It is only available when using stacked charts, as the other display types auto-size to the Acquisition screen.

Plot Type: This control sets the type of display used to show the data on the Acquisition screen. There are three types of displays available:

> **Overlayed Chart:** This display type plots all acquired signals on a single chart. These signals can be offset from one another to improve visibility through use of the Display Spacing control.
>
> **Stacked Chart:** This display type stacks plots on top of one another, each with its own unique y-axis which is very useful for viewing signals with radically different amplitudes. The height of these plots can be set by changing the Height control.
>
> **Graph:** This display type plots all acquired signals on a single graph, but does not retain a history of previously collected data before the current update.

Display Spacing (volts): This control specifies the amount of offset to be inserted between each channel for easier viewing. This does not affect how the data is written to the MindWare file.

Part 4: Audio/Video



The Audio/Video submenu contains settings for the acquisition of up to 4 A/V streams from the MindWare Video ACQ modules. These settings are only adjustable when 1 or more of these modules are present in the system.

Note: This submenu will only be available if one or more MindWare Video ACQ modules are detected in the system.

This submenu is divided into two sections: one for configuring the first 2 Video ACQ modules detected, and another for configuring the last two modules. The following settings are available for each module:

Record Enable: This control enables/disables the specified Video ACQ module for acquisition. **This must be enabled to acquire audio and video with this device.**

Camera Name: This control allows the user to define the camera name. The camera name is used in identifying the video stream during acquisition (used as window name for video display).

Audio Controls: These controls configure the audio recording on the Video ACQ module. The following audio settings are available:

Left Level: This control allows the user to raise or lower the recording level of the left audio channel.

Right Level: This control allows the user to raise or lower the recording level of the right audio channel.

Mic Gain: This control sets the gain on the microphone audio input.

Audio Input: This control specifies the source of the recorded audio. If there is a microphone plugged into the 1/8" stereo input on the Video ACQ module, this should be set to Mic. If there is an audio source plugged into the Line In inputs, this should be set to Line In.

Mute: This control enables/disables audio collection.

Set Line In to Default Levels: This control resets all audio settings to their default levels. If any changes are made to the audio settings, this option is unchecked.

Video Controls: These controls configure the video recording on the Video ACQ module. The following video settings are available:

Contrast, Brightness, Saturation, Hue: These controls raise and lower the specified video property.

Video Input: This control specifies the source of the recorded video. If there is a video feed plugged into the BNC port on the Video ACQ module, this should be set to Composite. If there is a video feed plugged into the S-Video port, this should be set to S-Video.

Video System: This control specifies type of video feed streaming to the Video ACQ module. The Video ACQ module supports both NTSC and PAL video systems.

Video Resolution: This control specifies the resolution of the acquired video. There are two options available: 360x240 and 720x480. A higher resolution means a clearer picture, but as resolution increases so does the file size of the resulting video file.

Encoding: This control specifies the codec used to encode the video file. The type of encoding has a large impact on the size of the resulting video file.

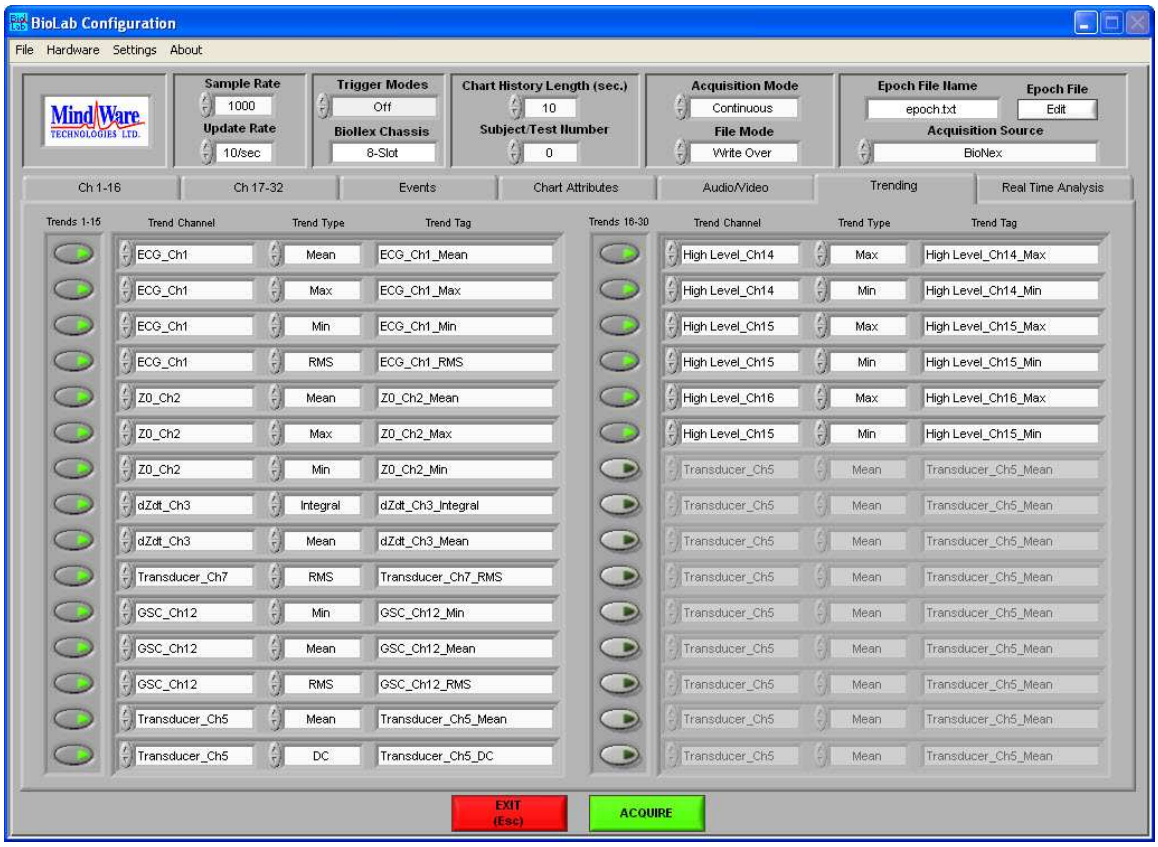
Note: The standard encoding is MPEG 4.

Set Video In to Default Levels: This control resets all video settings to their default levels. If any changes are made to the video settings, this option is unchecked.

Preview: This control launches/closes the preview window for the specified Video ACQ module to verify the video feed prior to acquisition.

Note: Due to performance limitations, video previews when using 3+ cameras are shown in a lower quality. This does NOT reflect the quality of video being recorded, only the preview video feed.

Part 5: Trending



The Trending submenu contains settings for specifying trends to be calculated during acquisition. Trends are basic statistical calculations that are graphed and output to a file real time alongside the standard data acquisition. Up to 30 trends can be computed and displayed simultaneously, and can be applied to any channel enabled for acquisition. The following settings are available:

Trend On/Off: This control enables/disables the specified trend. **The trend must be enabled for it to be calculated and displayed during acquisition.**

Trend Channel: This control specifies the channel to which the trend will be applied. All enabled channels (from the Channel submenu) are available for trending.

Trend Type: This control specifies the type of calculation to be performed. The following calculations are available:

Mean: Calculates the average value of the specified channel.

Max: Measures the maximum value of the specified channel.

Min: Measures the minimum value of the specified channel.

RMS: Calculates the root mean square (RMS) of the specified channel.

Integral: Calculates the integral of the specified channel.

DC: Measures the DC component of the specified channel.

AC: Measures the AC component of the specified channel.

Heart Rate: Measures rate in beats per minute of an ECG channel.

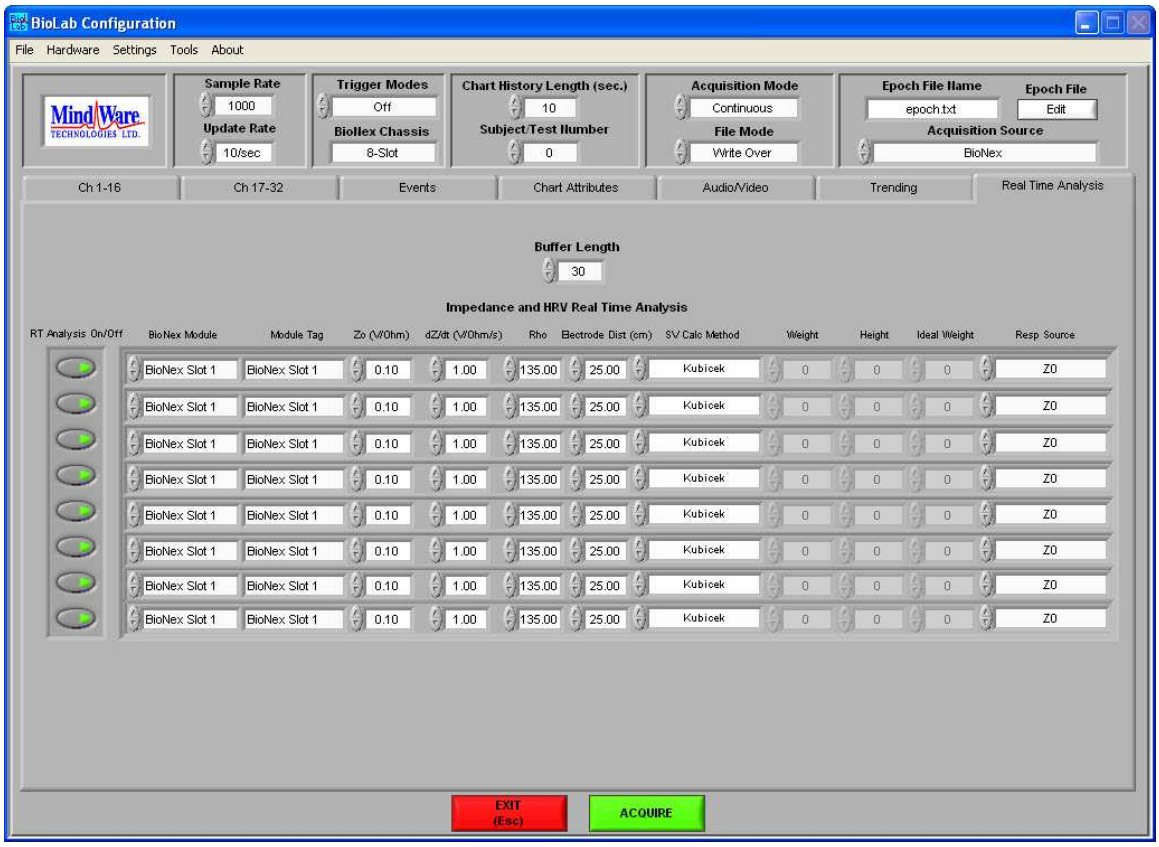
Resp Rate: Measures rate in breathes per minute of a respiration channel.

Trend Tag: This control allows the user to define a tag with which to identify the trend during acquisition. The trend tag is used to identify the trend in both the Trending Acquisition screen and the trend output file. When the Trend Type is changed, this field is automatically set to a default tag with the following format:

Trend Channel Name_Trend Type

If at any time a channel which has a trend applied to it is disabled, all trends applied to that channel will also automatically be disabled.

Part 6: Real Time Analysis (optional)



The Real Time Analysis submenu contains settings for calculating real time Impedance Cardiography and Heart Rate Variability during acquisition. Up to 8 modules (subjects) can be computed and displayed simultaneously. The following settings are available for each module:

RT Analysis On/Off: This control enables/disables the current module for real time analysis. **This control must be enabled for the current module to be used for real time analysis.**

Note: Enabling a module for real time analysis will automatically enable all channels on that module for acquisition on the Channels submenu. Disabling a module, however, will not disable those channels for acquisition on the Channels submenu.

BioNex Module: This control specifies the module to be used in real time analysis. All detected MindWare Impedance Cardio & GSC modules and MindWare Ambulatory 1000A devices will be available for real time analysis.

Module Tag: This control allows the user to specify a tag with which to identify the module during acquisition. For MindWare Impedance Cardio & GSC modules, this control defaults to the slot name. For MindWare Ambulatory 1000A devices, this control defaults to the specified PDA name. The value set in this control is used not only to identify the module during acquisition, but also in the corresponding output files.

Z0 Calibration (Volts/Ohm): This control sets the relationship of volts per one-ohm change of impedance on the Z0 channel. This value should be set to **0.10** for MindWare Impedance Cardio & GSC modules, and **0.05** for MindWare Ambulatory 1000A devices.

dZ/dt (Volts/Ohm per Second): This control sets the relationship of volts per ohms per second change in impedance on the dZ/dt channel. This value should be set to **1.00** for MindWare Impedance Cardio & GSC modules, and **0.80** for MindWare Ambulatory 1000A devices.

Rho (Blood Resistivity Constant): This control sets the blood resistivity constant. It is typically set as 135 ohms.

Electrode Distance (cm): This control sets the distance in centimeters for the front set of electrodes. This is very important in deriving accurate cardiac output and stroke volume.

SV Calc Method: This control defines the method used in determining the real time stroke volume. There are three available methods:

Kubicek: This method uses the following equation:

$$SV = [rho(L/Z0)^2] \times LVET \times (dZ/dt\ max)$$

Sramek-Bernstein: This method is based on the subject's height, weight, and ideal weight and uses the following equation:

$$SV = [(weight / ideal\ weight) \times (0.17 \times height)^3] / 4.2 \times (dZ/dt\ max / Z0) \times LVET$$

Bernstein-Lemmons: This method is based on the subject's weight, and uses the following equation:

$$SV = (Vitbv / Zeta) \times sqrt(dZ/dt\ max / Z0) \times LVET$$

Weight: This control specifies the subject's weight (used in Sramek-Bernstein and Bernstein-Lemmons stroke volume calculations).

Height: This control specifies the subject's height (used in Sramek-Bernstein stroke volume calculation).

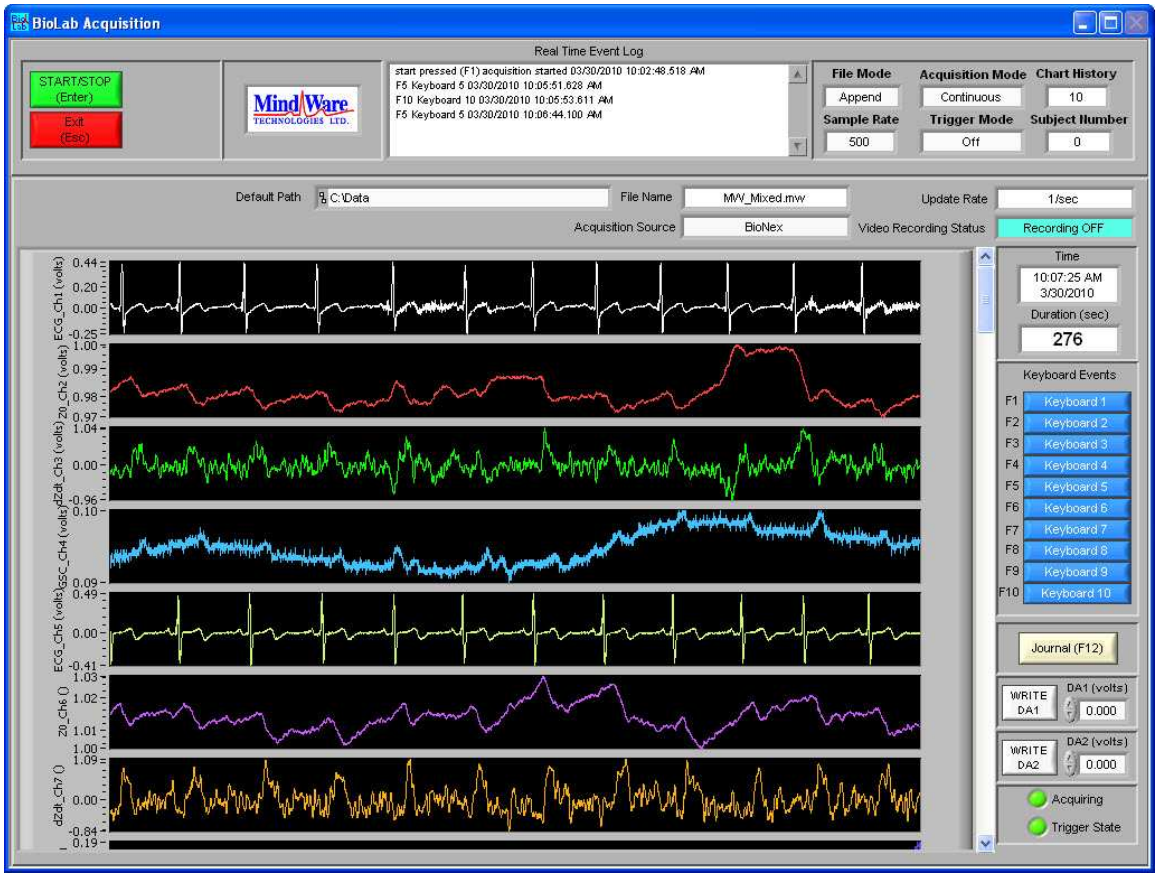
Ideal Weight: This control specifies the subject's ideal weight (used in Sramek-Bernstein stroke volume calculation).

Resp Source: This control specifies the source of respiration. It can be derived from the Z0 or dZ/dt channels present on the selected BioNex module, or from any enabled transducer channel which has a respiration source.

The real time statistics are calculated using a sliding buffer. The **Buffer Length** control at the top of this submenu specifies the length of this sliding buffer window. A buffer of the length specified in this control is collected prior to calculating the real time statistics. Following the initial filling of this buffer, for each consecutive calculation this buffer is shifted 1 second.

Once all settings in the BioLab configuration screen have been appropriately set, press the **Acquire** button below the submenu to proceed to the BioLab Acquisition screen.

Section 3: BioLab Acquisition



The BioLab Acquisition screen is the main acquisition window where all data being acquired will be displayed in real time.

Upon entering the Acquisition screen, the user will be prompted to select a file name for the MindWare file. If the acquisition mode has been set to Epoch, the user will be instead prompted to select a directory for the files to be created (in Epoch mode, file names are predetermined by the name of the current epoch). User confirmation is required prior to writing over any existing files.

In the upper left corner of the screen are the acquisition controls. When in Continuous acquisition mode, following controls are available which control the acquisition:

Start/Stop (Enter): This control starts or stops acquisition. When in Rising or Falling trigger modes, this control will only be able to stop acquisition as it must be started by a rising or falling edge on the trigger in line. When in Pause High Level or Pause Low Level trigger modes, this control will always be disabled as acquisition is entirely controlled through the trigger line.

Exit (Esc): This control exits the BioLab Acquisition screen and returns to the BioLab Configuration screen.

When in Epoch acquisition mode, the following additional controls are available:

Accept: Once the current epoch has been acquired, this control is used to accept the epoch as valid and proceed to collecting the next epoch.

Replay: If the collected epoch is invalid for any reason, this control is used to repeat acquisition of the current epoch.

Epoch List: This table shows the current epoch being collected as well as all future epochs as defined in the specified epoch file.

Beside the acquisition controls is the **Real Time Event Log**. This log details every event detected during acquisition from synchronous digital events, asynchronous digital events, and keyboard events. These events are labeled by event type, event name, and time which the event occurred. All events listed in this log are written to an event file for use in file playback (see **Section 7: File Viewer** pages 67-71) or in the MindWare Physiological Analysis Suite.

To the right of the Real Time Event Log are several acquisition setting displays which indicate how acquisition was configured on the BioLab Configuration screen. If these values do not indicate the desired acquisition settings, they can be altered by returning to the BioLab Configuration screen and making the necessary adjustments.

Directly above the data display are additional acquisition setting displays. The following settings are shown:

Display Spacing (volts): From the Chart Attributes submenu, this control specifies the amount of offset between each channel when using a Waveform Chart or Graph display. This control is defaulted to the value set on the BioLab Configuration screen, but is adjustable.

Note: The display spacing only affects the display on the BioLab Acquisition screen and does not apply to the data written to the file.

Default Path: This display indicates the directory in which the current .mw data file will be saved.

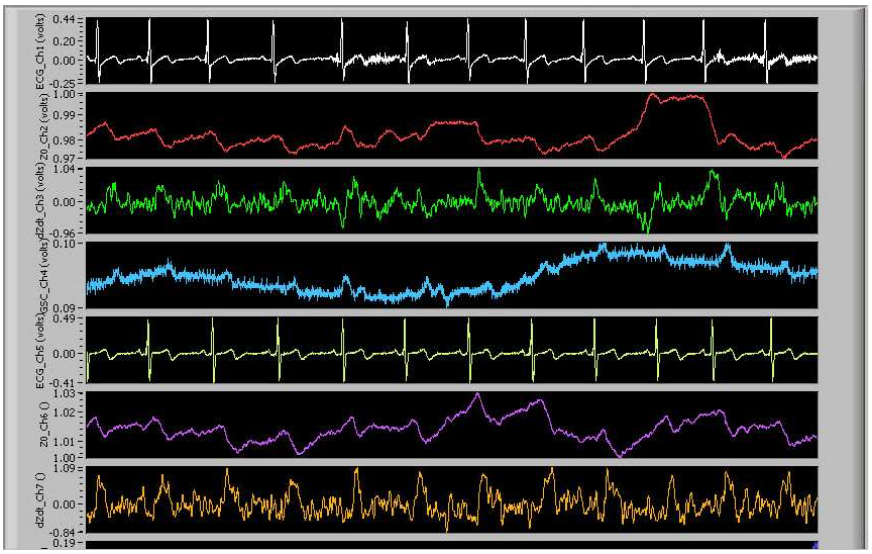
File Name: This display indicates the name of the current .mw file.

Update Rate: This display specifies how often the display will be updated with new values.

Acquisition Source: This display indicates the source of the data being displayed.

Video Recording Status: This display shows the status of the A/V recording. When there is no A/V recording enabled, this will read “Recording OFF”.

The data display shows all data being collected from the enabled channels as well as the enabled synchronous digital event lines. Data is displayed in the chart specified on the Chart Attributes submenu of the BioLab Configuration screen. When using a stacked chart display, the y-axis of each plot is labeled with its corresponding channel name. Otherwise, there is a chart legend immediately to the right of the display listing channel names and their associated plot colors.



By right-clicking on the display, several options are available from the run-time menu:

Copy Data: Copies all data values currently in view to the clipboard.

Description & Tip: Displays the help information on the data display.

Export Simplified Image: Saves current image of graph to an image file.

Autoscale X: When enabled, x-axis is scaled to show full range of data.

Autoscale Y: When enabled, y-axis is scaled to show full range of data in window. Otherwise, only shows data between specified values.

Static Analysis: Performs specified static analysis on data within the current window (see **Section 9: Static Analysis** pages 74-80).

The graph tools in the lower left hand corner of the display have three tools to customize viewing the data. The first tool with the crosshairs can be used when

inserting annotations to specify their location. The second tool, the magnifying glass, can be used to zoom in on a particular location in the display. The third tool, the hand, is used to scroll through the data.

Finally, on the right side of the BioLab Acquisition screen are the Time and Event settings. The following controls and displays are located here:

Time: This display shows the current time and date to the nearest second.

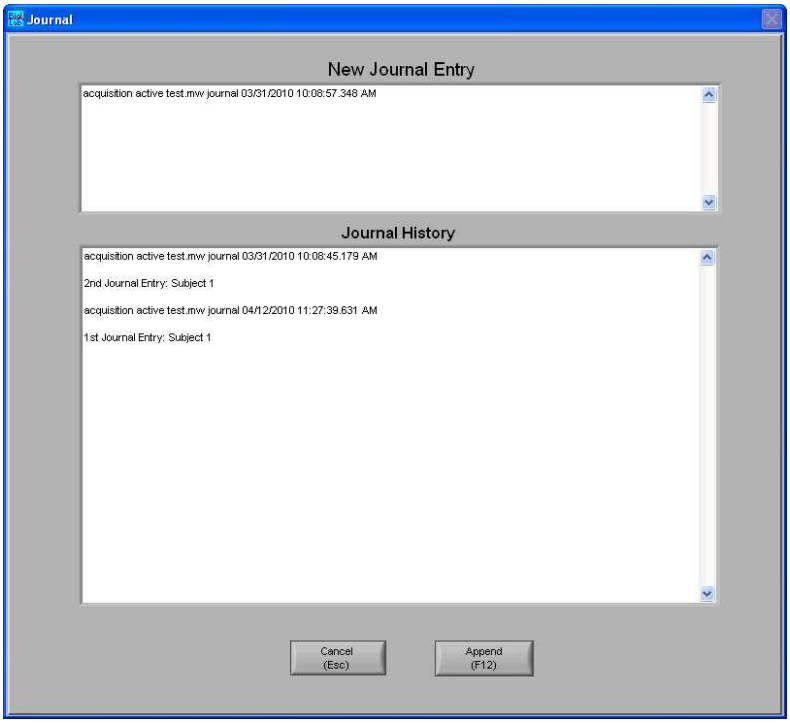
Duration: This display shows the duration of the current MindWare file in seconds.

Keyboard Events: These controls are labeled according to the event names set on the Keyboard Events submenu on the BioLab Configuration screen. These are active buttons which insert the specified keyboard event in the event log when pressed. These buttons can also be activated by pressing the corresponding key on the keyboard. Also, by pressing **F11** a user defined event can be entered.

From this window, an event with any definition can be inserted into the file. Previously used event definitions are saved for future use, and accessible from the drop down entry box. Pressing OK inserts the event. Pressing cancel results in the event not being inserted in the file.

Note: Acquisition does not stop while the User-Defined Event window is open.

Journal (F12): This control opens the journal window to add a new entry.



Within this window, the New Journal Entry field shows the current entry being made to the journal. All previous journal entries, along with the time of each entry, are shown below in the journal history field.

Pressing cancel will exit the journal window without saving the current entry. The OK button will save the current entry to the journal and return to the acquisition screen.

Note: Acquisition does not stop while the journal window is open.

Write D/A 1: This control writes the value specified in the **DA1 (volts)** control to the DA1 port on the BioNex.

Write D/A 2: This control writes the value specified in the **DA2 (volts)** control to the DA2 port on the BioNex.

Acquiring: When this LED is on, acquisition is active.

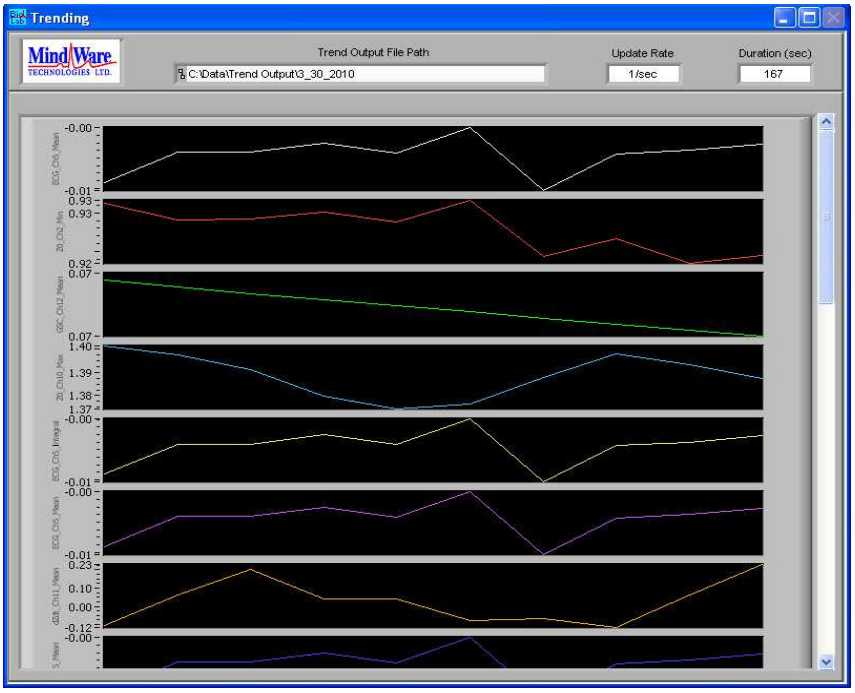
Trigger State: This LED reflects the current state of the Trigger In line on the BioNex chassis.

If running in **Ambulatory Wi-Fi** or **BioNex & Ambulatory Wi-Fi** mode, the connected Ambulatory units will perform a synchronization routine prior to the start of acquisition. The following screen will appear:

The synchronization process takes less than a minute to execute, and ensures that all data is returned synchronously from the wireless devices.

In the event that an Ambulatory unit loses connection with the host computer during acquisition, an error message will be displayed and the channels corresponding to the lost device are filled with '0's for the remainder of acquisition. All other devices currently in use will continue to acquire.

Section 4: Trending



The Trending screen appears during acquisition if at least one trend was enabled on the Trending submenu of the BioLab Configuration screen. The trends are shown in a stacked plot display, with each plot having its own unique y-axis (amplitude) but sharing its x-axis (time) with all other trends. Each trend is labeled along its y-axis with the Trend Tag specified on the BioLab Configuration screen. The graph palette is located in the lower left hand corner.

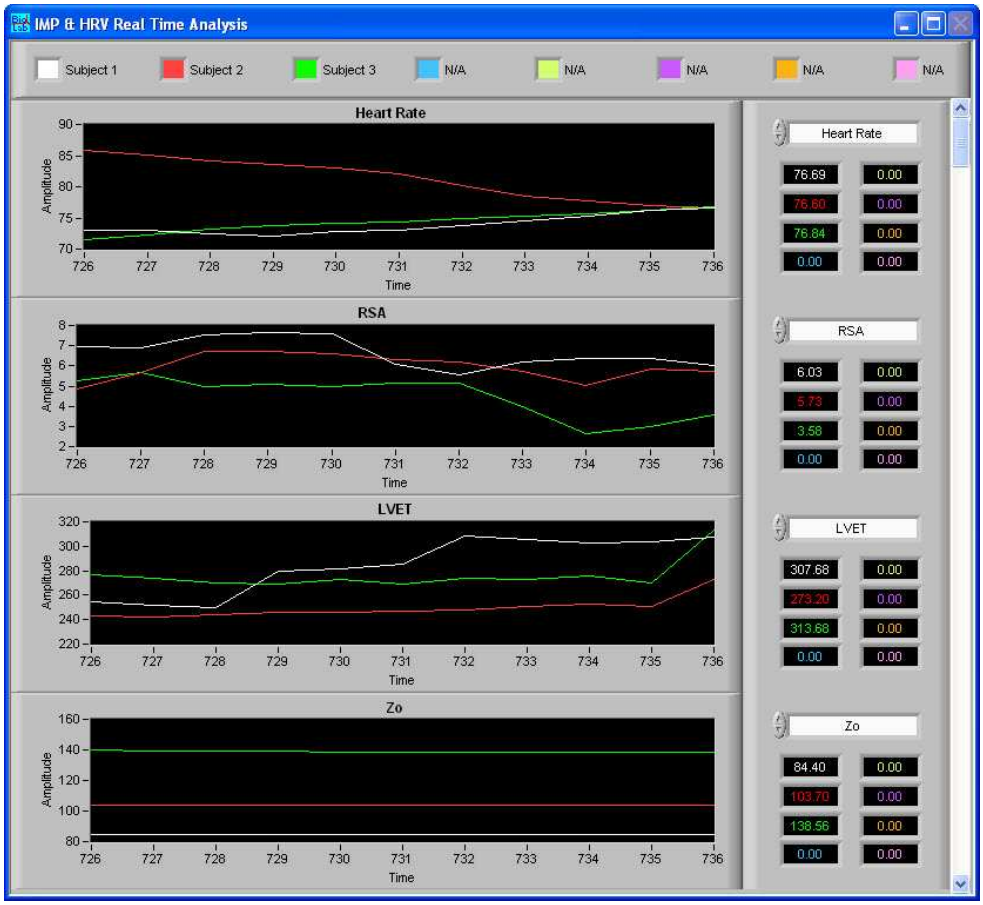
Across the top of the Trending screen, the following parameters are displayed:

Trend Output File Path: This display indicates the location of the trending output file which is being created during acquisition. This file contains a tab-delimited list of the value of each update for all trends being calculated.

Update Rate: This indicates the rate at which the trends are being calculated and displayed (in updates per second). The update rate of the trending screen is set to be the same as that of the acquisition screen as defined on the BioLab Configuration screen.

Duration: This display shows the duration of the current Trending file in seconds.

Section 5: Real Time Analysis



The IMP & HRV Real Time Analysis screen appears during acquisition if at least one module has been enabled for real time analysis. It shows the results of the real time Impedance Cardiography and Heart Rate Variability calculations from the specified modules. Up to 8 modules (subjects) can have real time statistics calculated and displayed simultaneously on this screen. The statistics are calculated once per second regardless of the update rate of the Acquisition screen.

Across the top of the screen are the modules enabled on the Real Time Analysis submenu of the BioLab Configuration screen (labeled with their Module Tag) and their corresponding plot color. Each individual data display shows a specific statistic for all enabled modules. This is very useful for comparing statistics between many subjects.

The value for all statistics will be initialized to '-1' and will remain at this value until the buffer (whose length was specified on the BioLab Configuration screen) has been filled and calculation of these statistics can begin.

For each enabled module, the following statistics are calculated:

Heart Rate: This value represents the average heart rate in beats per minute within the current buffer.

Resp Rate: This value represents the average respiration rate in breaths per minute within the current buffer (respiration is derived from the specified respiration source).

LVET: The Left Ventricle Ejection Time (LVET) is defined as the distance (in ms) between the X point and B point of the dZ/dt ensemble waveform.

Z0: This is the mean impedance and is represented in ohms.

Stroke Volume: The Stroke Volume is the volume of blood pumped from one ventricle of the heart with each beat. It is calculated using the method specified on the BioLab Configuration screen.

Cardiac Output: Cardiac Output (CO) is calculated as Heart Rate (HR) times Stroke Volume (SV).

PEP: The Pre-Ejection Period (PEP) is defined as the distance (in ms) between the B point in the dZ/dt ensemble waveform and the Q point in the ECG ensemble waveform.

RSA: Respiratory Sinus Arrhythmia (RSA) is the naturally occurring variation in heart rate that occurs during a breathing cycle.

Mean SCL: This is the mean Skin Conductance Level (SCL) derived from the GSC channel and displayed in microsiemens.

There is built in artifact detection in the IMP & HRV Real Time analysis calculations. In the event of an artifact, these statistics will still be calculated and displayed, but the Module Tag and associated color box (along the top of the screen) from which the artifact was detected will blink until the artifact is no longer present in the buffer.

An output file is created for each enabled module in the *HRV_IMP Real Time Output* folder in the same directory as the current MindWare file. Each of these files contains a tab-delimited table of each module and its calculated value at the given time, along with additional file information. These files follow the following naming convention:

*MindWare filename*_RT_*module tag_timestamp*.txt

Section 6: BioLab Configuration (File Mode)

Previously recorded MindWare files can be opened in two different ways. Opening a MindWare file by selecting **File >> Open File** or changing the Acquisition Source control in the Main Settings to **File** bring up a window prompting the user to select a file for opening. If the MindWare file to be viewed was just recorded (i.e. just returned from Acquisition screen), clicking on the MindWare logo located in the upper left hand corner of the BioLab Configuration screen will load the most recently recorded MindWare file automatically.

Note: No action will be taken by clicking on the MindWare logo prior to recording a MindWare file during the current session.

When a MindWare file is opened, it is loaded into the BioLab Configuration screen with all of the settings as they were set at the time of the file's recording. All channels which are present in the file are automatically enabled. Also, notice that the button which read "Acquire" has changed to "View". Once again, the configuration screen is divided into three sections: Menu Bar Settings, Main Settings, and Sub Menu Settings.

Menu Bar Settings

The following settings are available from the menu bar:

File:

Open File: This option allows the user to open a new MindWare file for viewing in file playback mode.

Save MindWare File As: This option allows the user to save the currently opened MindWare file as a new file (i.e. if changes have been made to filtering or scaling, channels have been disabled, etc). User confirmation is required prior to writing over any existing MindWare files.

Exit: This option closes the BioLab application.

Hardware:

Redetect Devices: This option restarts the BioLab application using the last acquisition source (thus exiting file playback mode), re-initializing all hardware and re-detecting all modules.

Settings:

Open Configuration: This option allows a previously saved configuration file (.mwcfg) to be opened.

Save Configuration As: This option saves all current settings in the BioLab Configuration screen to a configuration file (.mwcfg) which can later be recalled.

Reinitialize All to Default: This option will return all settings to how they are saved in the currently open MindWare file, discarding any changes made to the configuration since opening the file.

Tools:

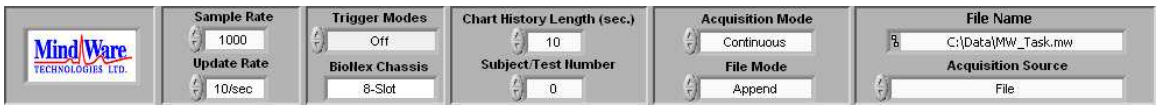
ASCII-MW Converter: The ASCII-MW Converter allows the conversion of any text file containing data in some character-delimited columns to the .mw format so that it may be used in any application (See **Appendix B: ASCII-MW Converter** page 88).

About:

BioLab: This option launches the About window, detailing information about the version of BioLab running.

Show Help: This option toggles on/off the floating help box.

Main Settings



The main settings section appears very similar to the settings on BioLab Configuration screen when setting up acquisition, but in File Playback mode these settings are merely indicators showing how acquisition was set up when the file was created. Detailed descriptions of each of these settings can be found in **Section 2: BioLab Configuration** pages 13-14.

Note: Since these settings are only indicators of how the file was acquired, they are not editable. Only the Acquisition Source control can be changed to switch from File to another source.

The Epoch Editor has been replaced with the **File Name** display, which shows the name of the currently opened MindWare file. Below it, the **Acquisition Source** control behaves the same way as it did previously.

Sub Menu Settings

Below the main settings listed above are several submenus, each containing settings pertaining to a specified aspect of the data in the current file. The following submenus are available:

Channels: *Pages 58-60*

The Channels submenus contain adjustable settings for each individual channel present in the file.

Events: *Pages 61-64*

The Events submenu contains settings for synchronous and asynchronous digital event channels present in the file as well as keyboard events that can be inserted during file playback.

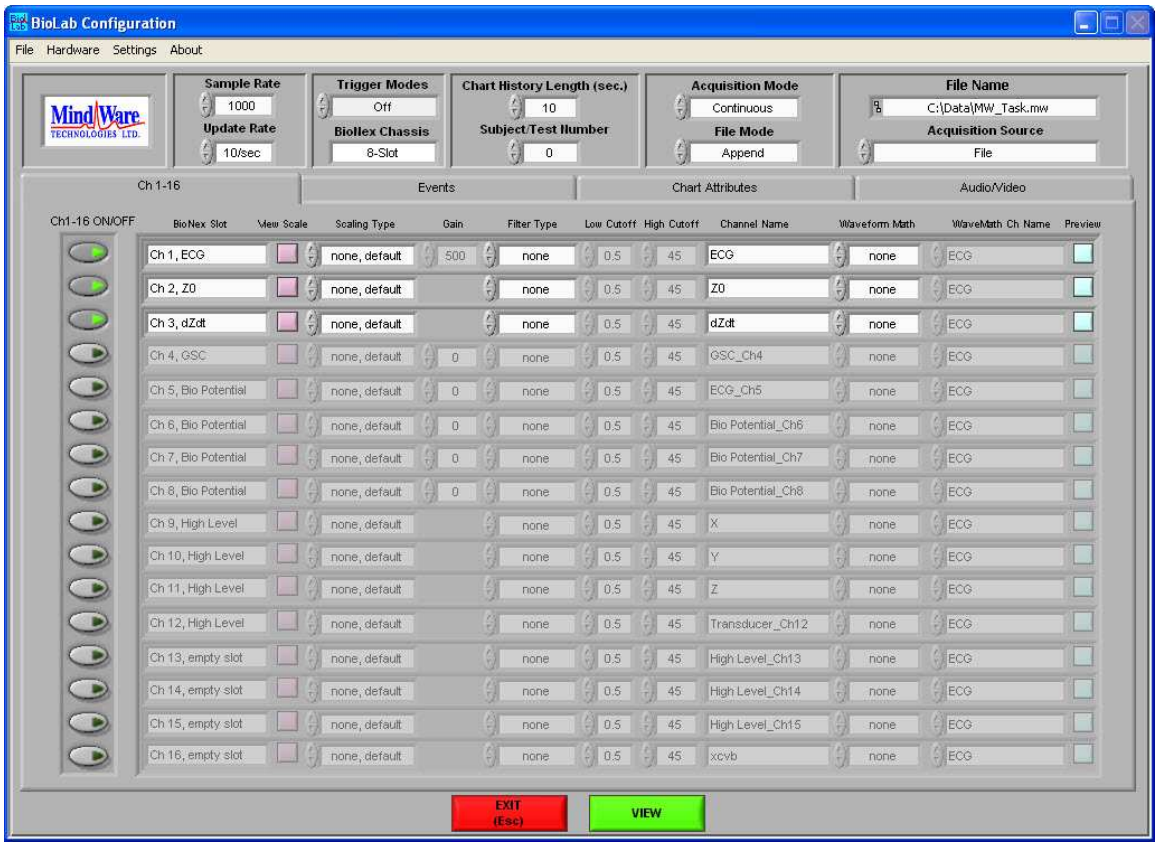
Chart Attributes: *Page 65*

The Chart Attributes submenu allows the user to modify how the data is displayed on the BioLab File Viewer screen.

Audio/Video: *Pages 66-67*

The Audio/Video submenu contains settings for the playback of audio/video files collected with the current MindWare file.

Part 1: Channels



The Channels submenu contains the settings for each channel present in the file. When a MindWare file is first opened, all channels present in the file are enabled for viewing. The following settings are available for each channel in the file:

Channel On/Off: This enables/disables a channel for viewing during file playback. A channel cannot be enabled for viewing if it is not present in the MindWare file.

Note: If a channel is disabled and the MindWare file is saved, the disabled channel's data will not be saved in the new MindWare file.

BioNex Slot: This display indicates the type of data that was collected on the specified channel. This is also the formal name of the channel on the module.

Note: For MindWare files created prior to BioLab 2.4 this information is not available. This field will then read "Not Available" for all files of this type.

View Scale: This button launches the Preview Scaling screen, which allows users to see the affects of various scaling methods on the channel. This screen behaves in the same way as before (see **Section 2: BioLab Configuration Screen** pages 21-23), except the data shown on the displays comes from a file rather than the BioNex chassis.

Scaling Type: The same scaling types are available as in acquisition mode. Once again, the setting of any scaling type other than "none, default" will result in the launching of the Preview Scaling screen.

Gain: This indicates the gain at which the specified channel was collected.

Note: Gain is not reprogrammable post-acquisition, so this field is disabled in file mode.

Filter Type: This control specifies the filter that will be used on the channel while acquiring data. Each filter has a default Low and High Cutoff associated with it.

Low Cutoff: This control behaves in the same way as in acquisition mode, and must abide by the same rules (see **Section 2: BioLab Configuration** page 19).

High Cutoff: This control behaves in the same way as in acquisition mode, and must abide by the same rules (see **Section 2: BioLab Configuration** page 19).

Note: All files created prior to BioLab 3.0 have data saved with the filters already applied. Changes made to the filter type on these files could potentially result in double-filtering the data, and should be done with care.

Channel Name: This control allows the user to define the channel name. This will be used to identify the channel both on the File Viewer screen and in the MindWare file (if changes are saved).

Waveform Math: This control sets the type of waveform math to be applied to the specified channel during file playback. The same options are available as in acquisition mode.

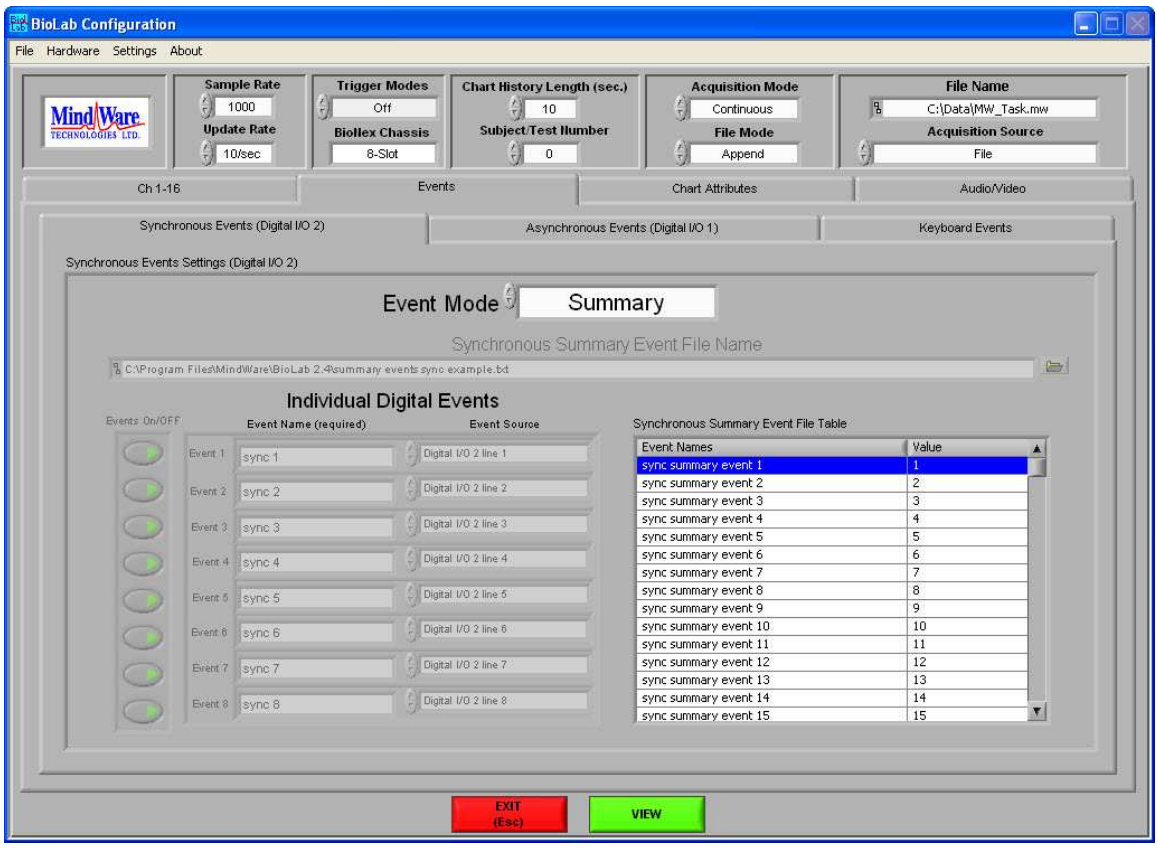
WaveMath Ch Name: Specified the channel that will be added or subtracted from the current channel. All channels present in the file are available for selection from this list. This control will only be enabled if "Add" or "Subtract" waveform math has been selected.

Preview: This button launches the Preview Scaling and Filtering screen, which allows the user to see the effects of various scaling, filtering, and waveform math settings on the specified channel. This screen behaves in the same way as before (see **Section 2: BioLab Configuration Screen** pages 24-26), except the data shown on the displays comes from a file rather than the BioNex chassis.

Part 2: Events

The Events submenu contains settings for synchronous and asynchronous digital event channels present in the file as well as keyboard events that can be inserted during file playback. Within the Events submenu, there are three additional categories: **Synchronous Events** (pages 61-62), **Asynchronous Events** (page 63), and **Keyboard Events** (page 64).

Part 2a: Synchronous Events



The Synchronous Events submenu contains options for configuring the display of synchronous digital event channels present in the MindWare file. The following settings are available:

Event Mode: This control is defaulted to the synchronous digital event mode present in the file. The only options available in file mode are the mode present in the file and **Off**, which will remove the synchronous event channels from the data display during playback.

Synchronous Summary Event File Name: This display shows the path of the synchronous summary event file used at the time the file was acquired.

Individual Digital Events: These controls are used to define the individual synchronous event channels present in the file.

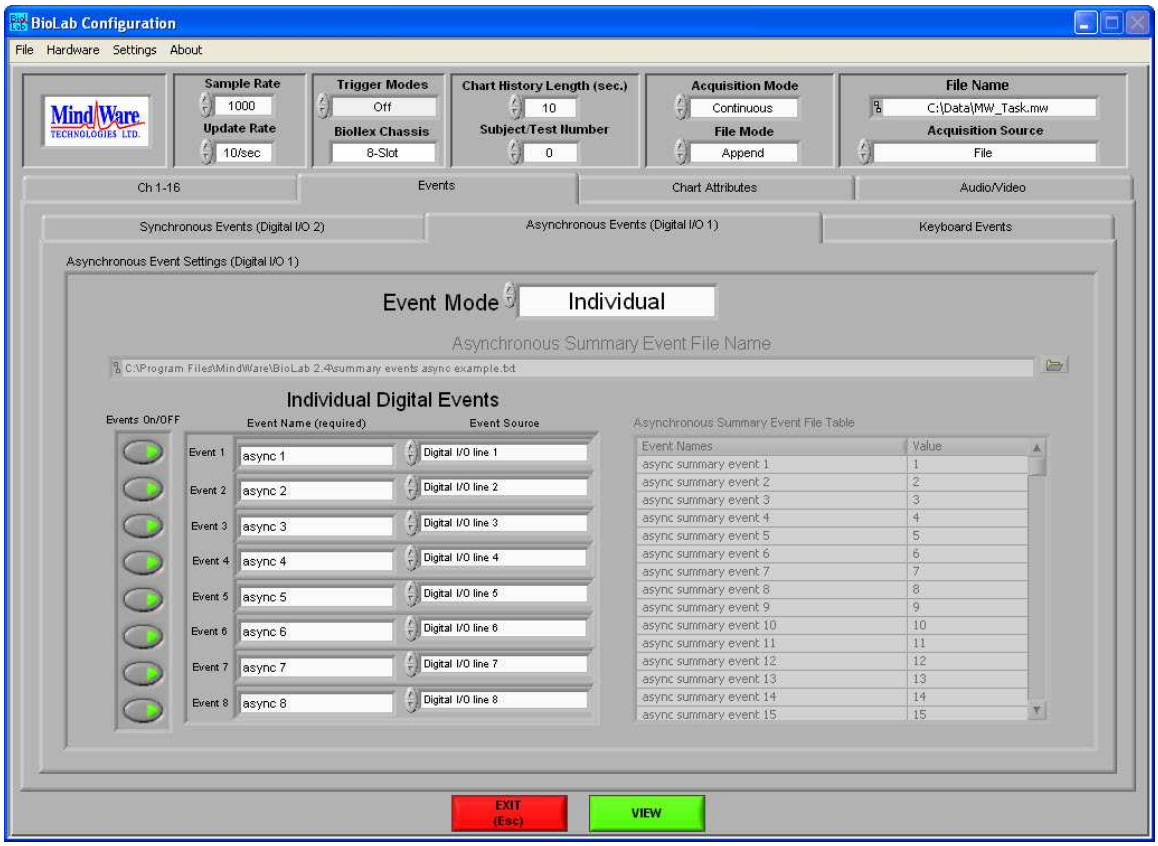
> **Events On/Off:** Enables/disables a specific digital line for viewing during file playback. If an event channel is not present in the file, it cannot be enabled for viewing.

Event Name (required): This control allows the user to define the digital event name. This will be used to identify the channel both on the File Viewer screen and in the MindWare file (if changes are saved).

Event Source: This display shows the source of the synchronous event channel as defined when the file was acquired.

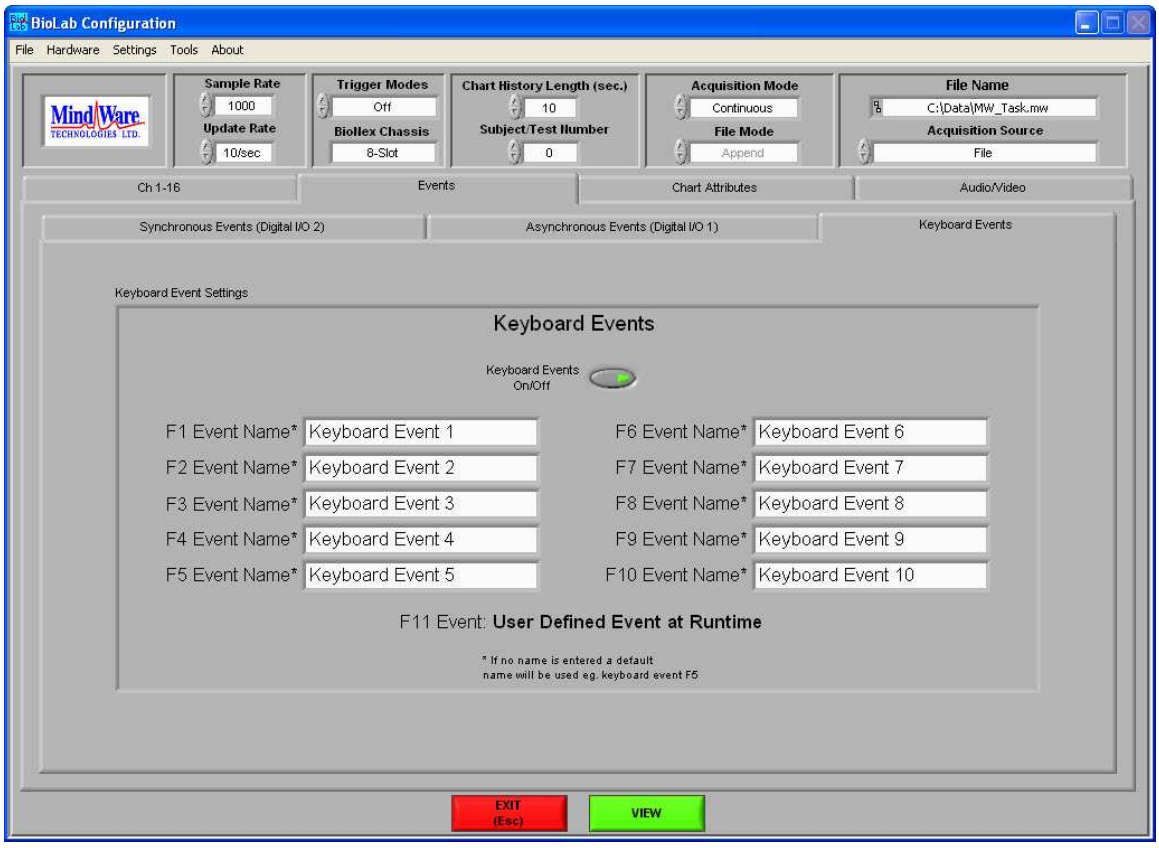
Synchronous Summary Event File Table: This display shows the names of the summary events used when the file was acquired.

Part 2b: Asynchronous Events



The Asynchronous Events submenu indicates how the asynchronous event channels were configured when the file was acquired. This submenu is merely a display and is **not** editable, as changes made here will have no affect on the file playback (since asynchronous event channels are not saved in the MindWare file).

Part 2c: Keyboard Events

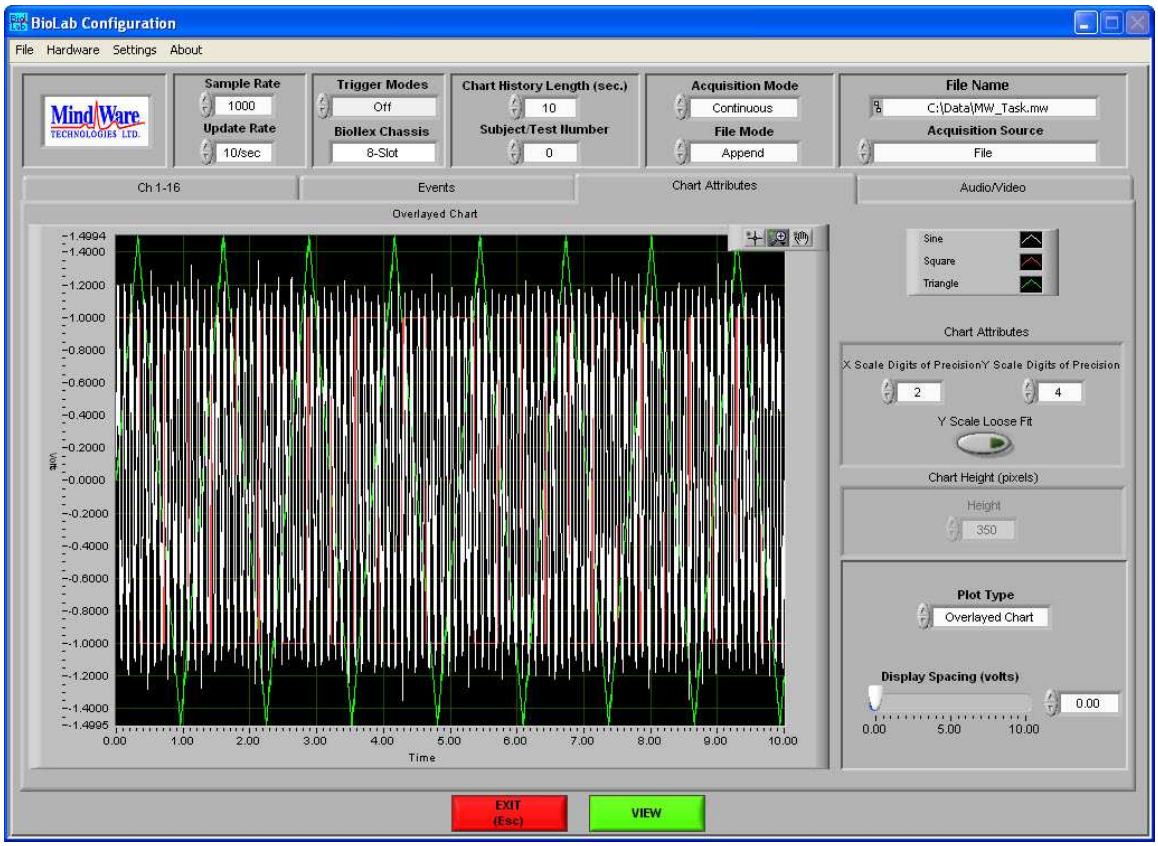


The Keyboard Events submenu contains settings for configuring the keyboard events available to the user during file playback. The settings are initialized to the keyboard event names at the time of acquisition of the current MindWare file. The following settings are available:

Keyboard Events On/Off: This control enables/disables use of keyboard events during file playback.

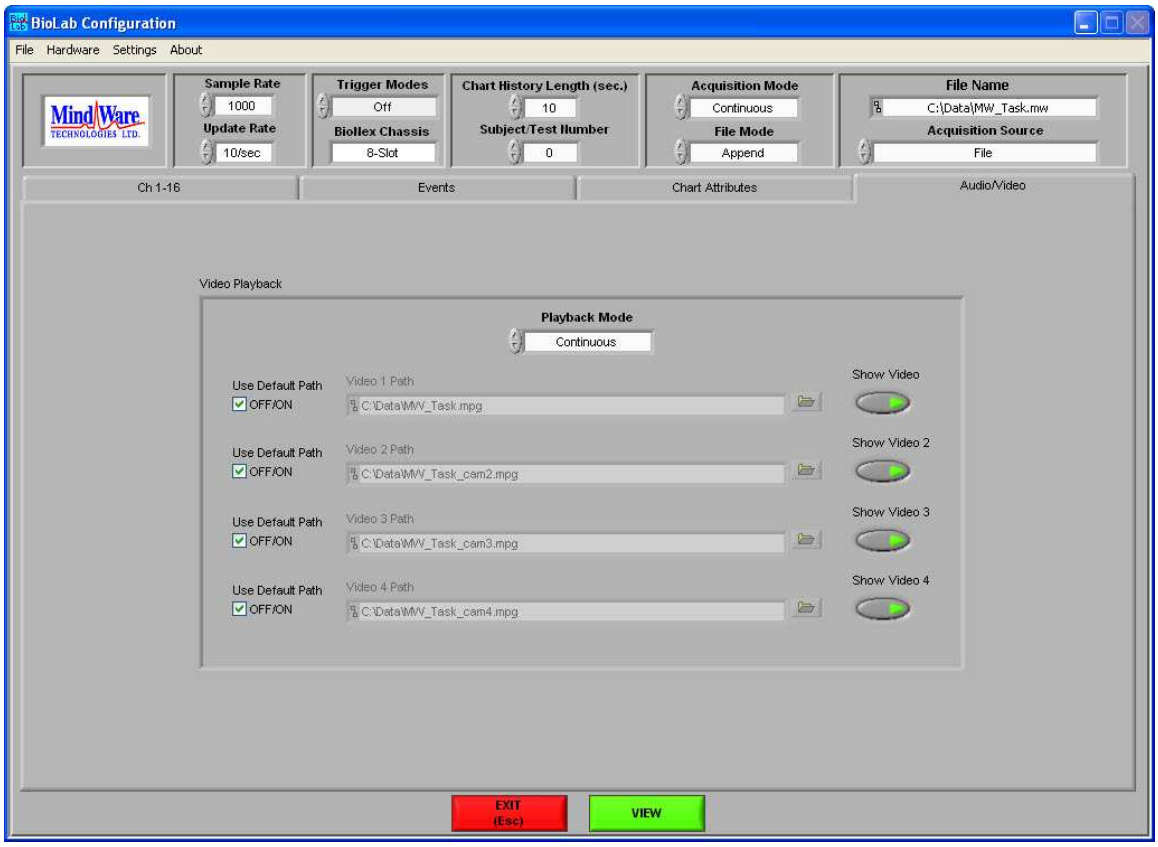
Keyboard Event Names: These fields describe how the keyboard event will be identified on the File Viewer screen as well as in the Event file saved during file playback. If there is no name specified, a default name will be used based on the key from which the event was detected.

Part 3: Chart Attributes



The Chart Attributes submenu contains settings for adjusting how the data is displayed on the File Viewer screen, and behaves the same as it did in acquisition mode (see **Section 2: BioLab Configuration** pages 33-34). The settings are initialized to how they were set that the time of acquisition of the MindWare file, but are fully adjustable in file playback mode.

Part 4: Audio/Video



The Audio/Video submenu allows the mapping of audio/video files acquired with the current MindWare file to be played back on the File Viewer screen. Files with the expected default names in the same directory as the current MindWare file are automatically mapped and enabled for playback. The following controls are available for each video:

Use Default Path: When checked, the video file with the expected name will be loaded and played back. Uncheck this box to custom map a video file for playback.

Video Path: This field represents the file path of the specified audio/video file.

Show Video: Enables/disables the specified video file for playback.

Playback Mode: This control specifies the way the file and its associated videos will be played back. There are two playback modes:

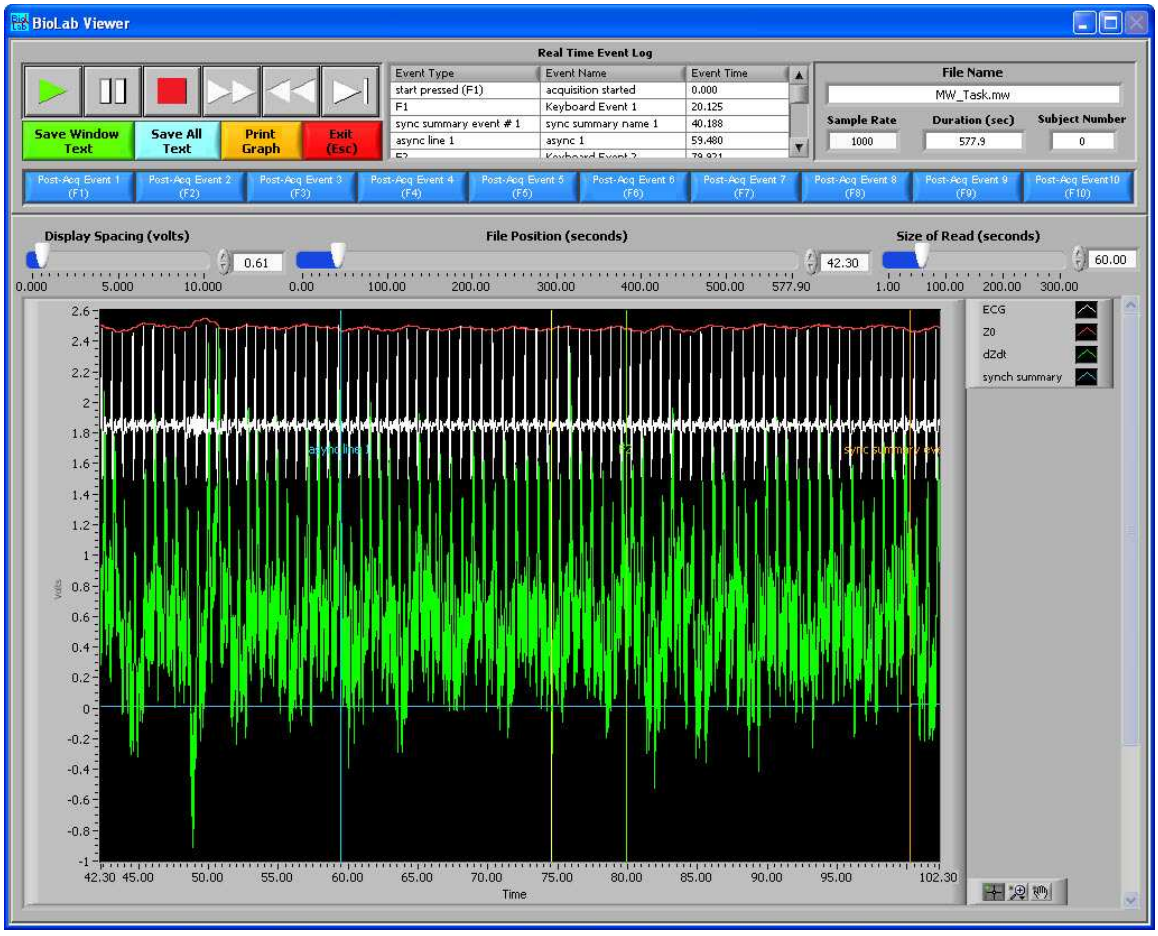
> **Continuous:** When the end of the current time segment has been reached, the next segment will be loaded and playback will continue.
>
> **Segmented:** When the end of the current time segment has been reached, playback will be paused until user starts it again.

All videos mapped on this submenu will appear in floating resizable windows. Each of these windows will be named after the video file being played within it to easily identify video feeds.

*Note: All video files with a **.mpg** file extension will automatically be renamed to a **.avi** file extension for compatibility with video playback.*

Once all settings in the BioLab configuration screen have been appropriately set, press the **View** button below the submenu to proceed to the BioLab File Playback screen.

Section 7: BioLab File Playback



The BioLab File Playback screen is the main file viewing window where file playback can be controlled and post-acquisition event editing can be performed.

Upon launching the BioLab File Playback screen, any video files which were mapped on the Audio/Video submenu on the BioLab Configuration screen will also appear in separate floating windows. These windows can be moved and resized separately from the main playback screen. The titles of these windows correspond to the video file name which is being viewed in them.

The data display on the playback screen is where the data from the selected MindWare file is displayed in the format specified on the Chart Attributes submenu of the BioLab Configuration screen. In addition to the data, this display also displays event markers for all events in the corresponding MindWare Event file (Keyboard = Green, Summary = Orange, Individual = Blue) and contains the position cursor (Yellow) which reflects the current file (and video) playback position. The position cursor can be dragged anywhere within the data set, at which point all videos will be updated to reflect this new position.

By right-clicking on the data display, the following options are available from the run time menu:

Copy Data: Copies all data values currently in view to the clipboard.

Description & Tip: Displays the help information on the data display.

Export Simplified Image: Saves current image of graph to an image file.

Create Annotation: This option allows a custom user cursor to be placed on the data display. This cursor can be labeled to describe its meaning.

Delete All Annotations: This option removes all custom annotations placed on the data display.

Autoscale X: When enabled, x-axis is scaled to show full range of data.

Autoscale Y: When enabled, y-axis is scaled to show full range of data in window. Otherwise, only shows data between specified values.

Static Analysis: Performs specified static analysis on data within the current window (see **Section 9: Static Analysis** pages 75-81).

The following playback controls are available in the upper left hand corner of the playback screen:

 **Play:** This control initiates playback at normal speed from the specified location.

 **Pause:** This control pauses playback at the current location.

 **Stop:** This control stops playback and returns to file position to the start of the file in **Continuous** playback mode, or the beginning of the segment in **Segmented** playback mode.

 **Fast Forward:** This control speeds up playback to 2x normal speed.

 **Rewind:** This control reverses playback at 2x normal speed.

 **Slow:** This control slows down playback to half normal speed.

Save Window Text: This control saves all data currently in view to a tab-delimited text file for use in external applications. Upon pressing this button, the user will be prompted to select a destination and filename for this file.

Save All Text: This control saves all data in the opened MindWare file to a tab-delimited text file for use in external applications. Upon pressing this button, the user will be prompted to select a destination and filename for this file.

Print Graph: This control allows the user to print the current graphical view of the MindWare file to a specified printer.

Exit (Esc): This control exits the playback screen and returns to the BioLab Configuration screen (still in file mode). Upon exiting, if any events were added/removed during the current playback session the user will be prompted to save these changes.

To the right of the playback controls is the **Real Time Event Log** which lists all events found in the corresponding MindWare Event file. These events are all marked on the data display in the colors specified above.

By double-clicking on an event listed in this log, the file position is immediately advanced to the time of the selected event. This is very useful for indexing through a file based on event occurrences.

By selecting an event and right-clicking the event log, there is the option of removing the event from the log. When an event is removed from the log, its corresponding event cursor is also removed from the data display. User confirmation is required prior to removing any event from the log.

Beside the Real Time Event Log in the upper right hand corner of the playback screen are the file settings. The following settings are displayed:

File Name: This display shows the name of the currently opened MindWare file.

Sample Rate: This display shows the rate at which the data was collected (in samples per second).

Duration (sec): This display shows the total length of the MindWare file (in seconds).

Subject Number: This display shows the current subject number as specified when the current MindWare file was created.

Below these settings are the Keyboard Event controls. These controls are labeled according to the event names set on the Keyboard Events submenu on the BioLab Configuration screen. These are active buttons which insert the specified keyboard event in the event log when pressed. These buttons can also be activated by pressing the corresponding key on the keyboard.

While a file is being played back, if at any time a keyboard event is detected (whether by pressing a keyboard event control or its corresponding key stroke), a new event of this type will be added at the location of the position cursor. The new event will appear as both a new entry in the event log and an event cursor on the data display.

Just above the data display are three sliding controls which alter the way the data is viewed. They are as follows:

Display Spacing (volts): This control specifies the spacing between the channels on a Waveform Chart or Graph display. Increasing the display spacing can make it easier to view multiple signals on a single display.

Note: This control will be disabled when viewing a Stacked Chart display, as each signal has its own independent y-axis.

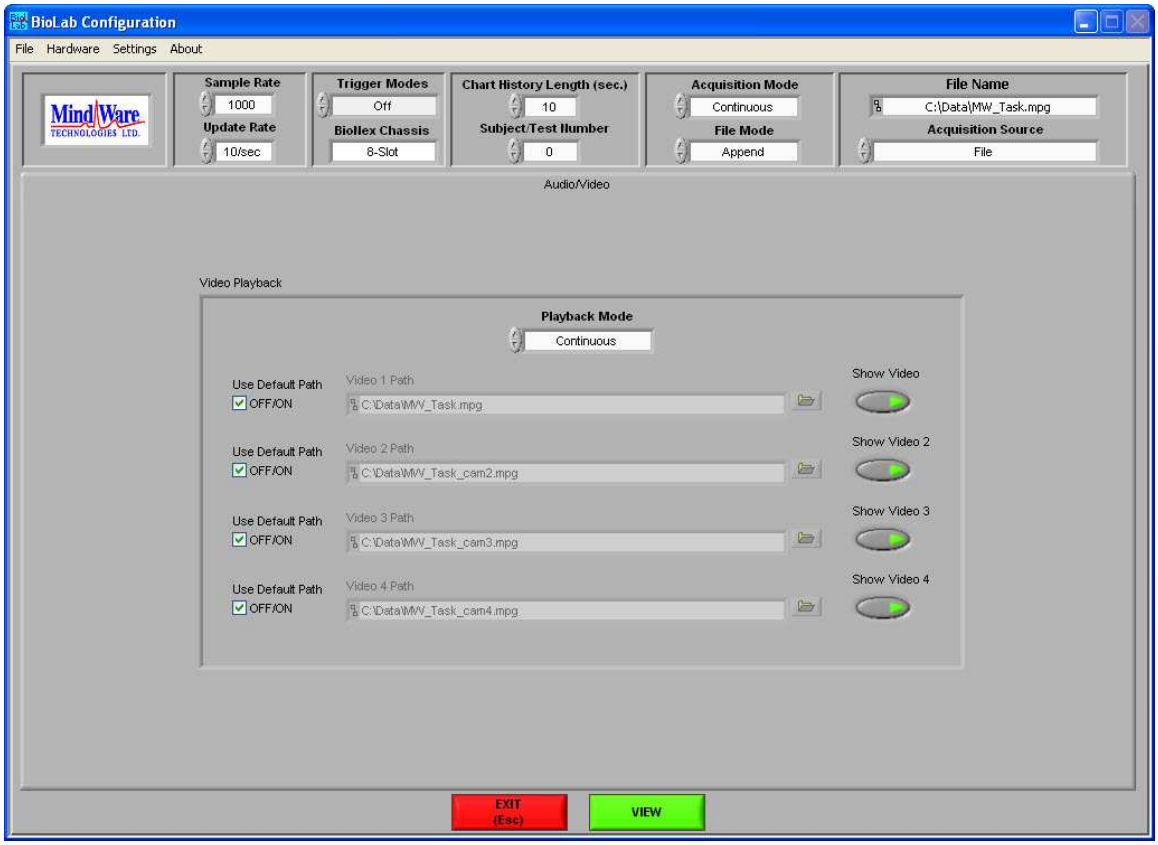
File Position (seconds): This control specifies the file time at which the current segment of data starts. During active playback this control will be disabled. Adjusting this control will also result in offsetting the file position cursor by the same amount.

Size of Read (seconds): This control specifies the amount of data (in seconds) to display at once on the data display. The maximum amount of data that can be loaded at once is 300 seconds.

Section 8: Video Playback

When opening a file on the BioLab Configuration screen, a video file (.mpg or .avi) can be selected for playback instead of a MindWare file. If this is done, the BioLab Configuration is configured for Video Playback.

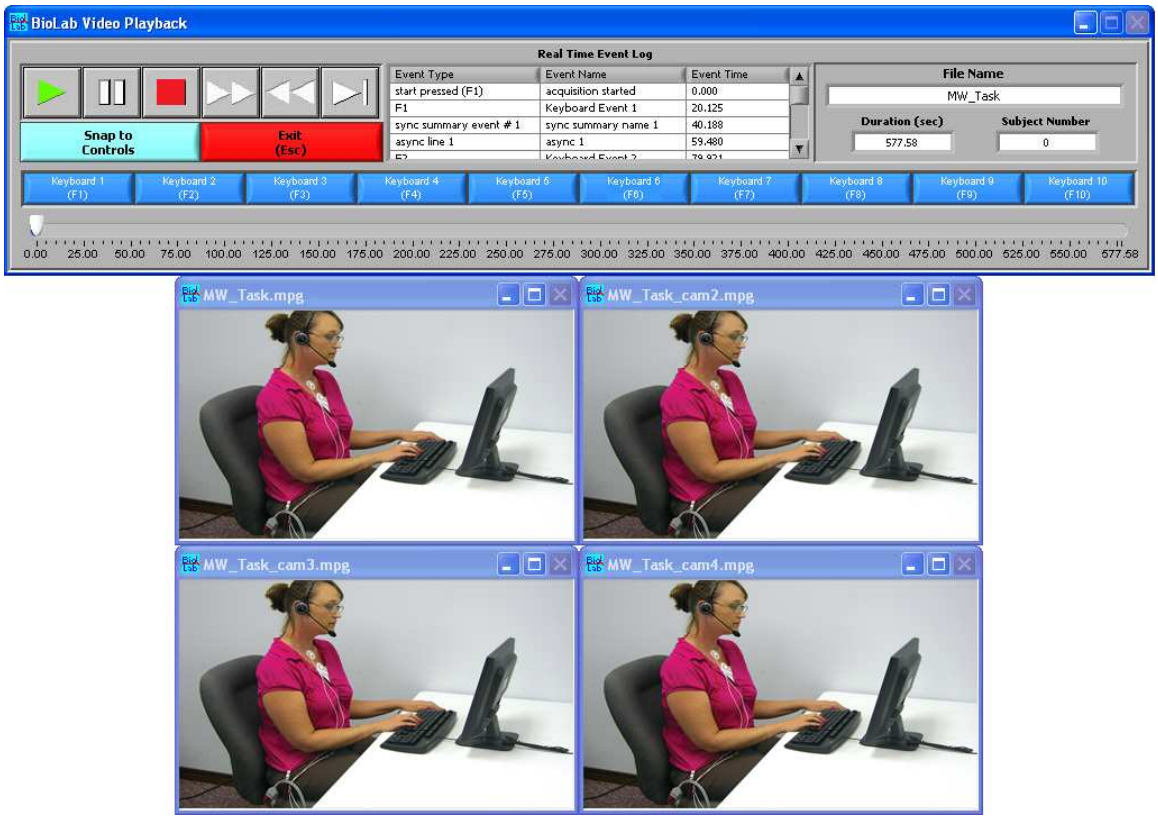
*Note: When selecting a video for playback which has additional videos associated with it (multiple cameras) select the video from the **first** camera for playback and BioLab will automatically recognize the associated videos and map them for playback as well.*



Only the Audio/Video submenu is available when a video file is opened for playback. All videos associated with the selected video file are automatically mapped and enabled for playback. This submenu behaves in the same way as in File Playback mode (see pages 66-67), with the exception that the **Playback Mode** control is fixed to continuous mode.

*Note: All video files with a **.mpg** file extension will automatically be renamed to a **.avi** file extension for compatibility with video playback.*

Pressing the **View** button will proceed to the BioLab Video Playback screen.



The BioLab Video Playback screen is actually made up of several independent floating windows.

The floating control bar contains all playback controls. Below it are up to four video playback windows, one for each video mapped on the BioLab Configuration screen. Each can be moved and resized independently of one another.

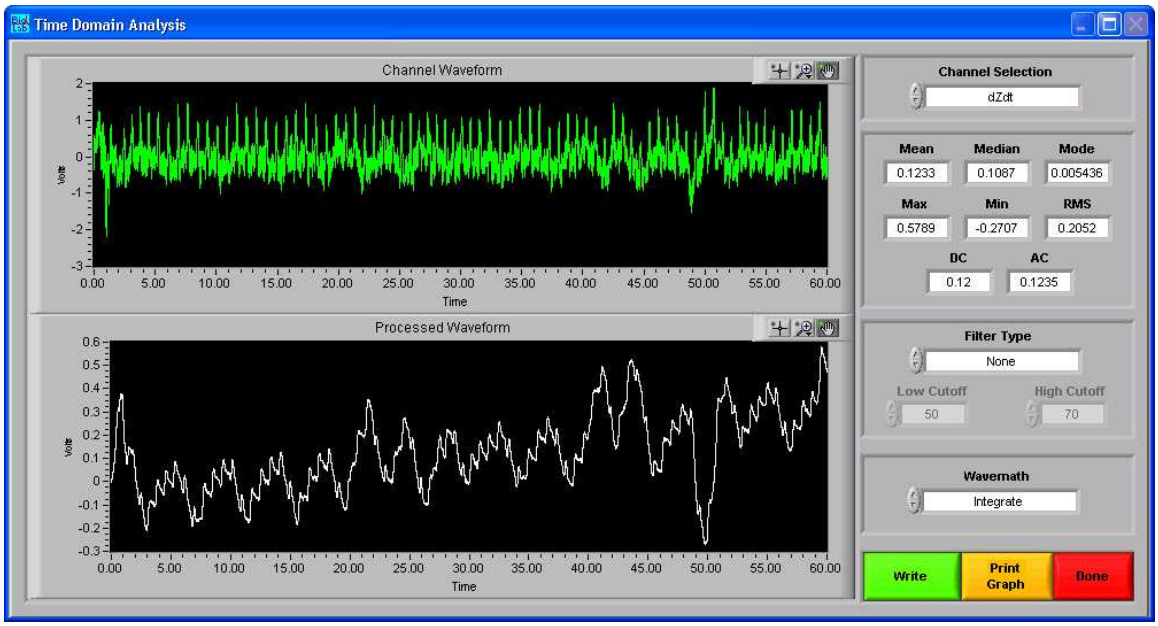
All controls behave in the same way as the BioLab File Playback screen. One additional control is available during video playback:

Snap to Controls: This control snaps each video playback window, regardless of their location or size on the screen, back to its original location under the floating control bar.

Section 9: Static Analysis

Static analysis can be performed on any signal being acquired or viewed by right clicking on the data display and selecting the desired type of analysis. There are three types of static analysis available: Time Domain, Frequency Domain, and Peak Detection.

Part 1: Time Domain



Time domain static analysis allows for various filters and wavemath to be done to the available signals. Two displays are shown on this screen:

Channel Waveform: This display shows the channel data as shown on the original display. The graph palette is available in the upper right hand corner of the display.

Processed Waveform: This display shows the channel data after the selected filters and wavemath have been applied to it. The graph palette is available in the upper right hand corner of the display.

In the upper right hand corner, the **Channel Selection** control allows the user to switch between all available channels for static analysis.

Note: Changing the Channel Selection control will result in the Filter and Wavemath controls resetting to default.

Below the **Channel Selection** control are the basic statistics. The **Mean**, **Median**, **Mode**, **Max**, **Min**, **RMS**, **DC Component**, and **AC Component** are all derived from the processed waveform.

The following waveform processing controls are available below the calculated statistics:

Filter Type: This indicator shows the currently applied filter.

Low Cutoff: This indicator shows the low cutoff of the currently applied filter.

High Cutoff: This indicator shows the high cutoff of the currently applied filter.

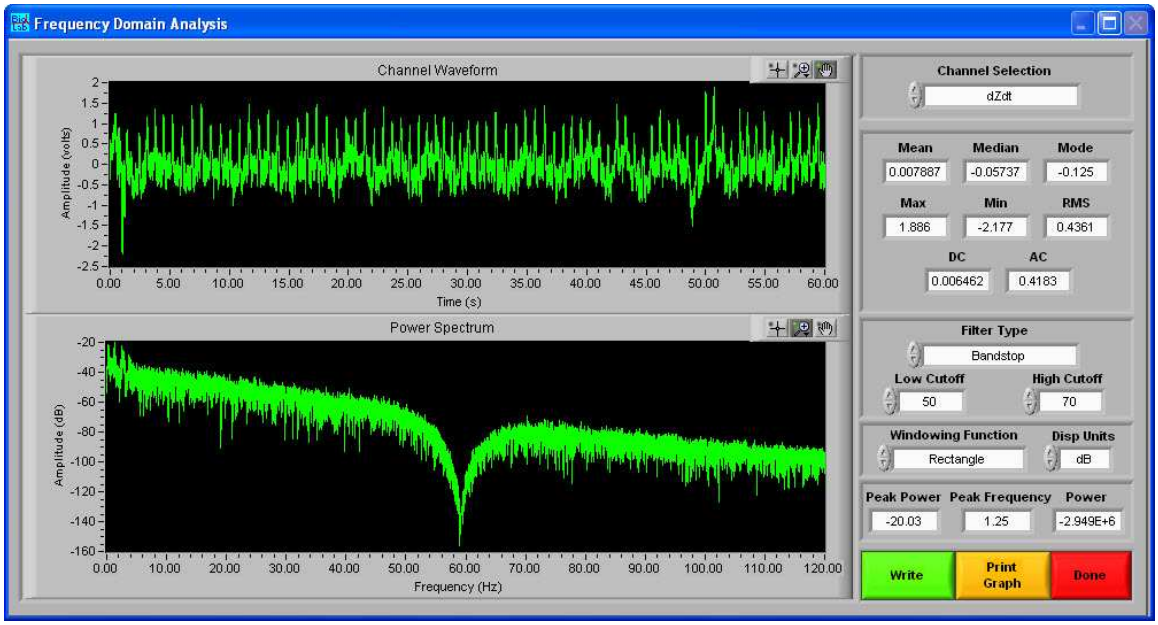
Wavemath: This control applies the specified wavemath to the channel waveform. The wavemath options available are **None**, **Integrate**, and **Differentiate**.

Write: Pressing this button will prompt the user to specify a location for the output file. Upon choosing a destination, the calculated statistics along with current file information will be written to the file.

Print Graph: Pressing this button will print both display graphs along with the calculated statistics using the specified printer.

Done: Exits the Time Domain Analysis window.

Part 2: Frequency Domain



Frequency domain static analysis allows for various filters to be applied to a signal after applying an FFT (Fourier Fast Transform) to the specified channel waveform. This is very useful in determining the effect of noise on different frequency bands on the original signal. There are two display plots shown:

Channel Waveform: This display shows the channel data as shown on the original display. The graph palette is available in the upper right hand corner of the display.

Power Spectrum: This display shows the channel data after the selected filters and FFT have been applied to it. The graph palette is available in the upper right hand corner of the display. This graph is either displayed in Volts (V) or Decibels (dB) versus Frequency (Hz).

In the upper right hand corner, the **Channel Selection** control allows the user to switch between all available channels for static analysis.

Note: Changing the Channel Selection control will result in the Filter and FFT controls resetting to default.

Below the **Channel Selection** control are the basic statistics. The **Mean**, **Median**, **Mode**, **Max**, **Min**, **RMS**, **DC Component**, and **AC Component** are all derived from the power spectrum.

In addition to the basic statistics, the following statistics are also calculated, and are listed below the waveform processing controls:

Peak Power: This displays the measured peak power from the power spectrum waveform.

Peak Frequency: This displays the measured frequency with the highest amplitude from the power spectrum waveform.

Power: This displays the overall power as derived from the power spectrum waveform.

*Note: These values will be displayed in volts (V) or decibels (dB) depending on the selection of the **Disp Units** control.*

The following waveform processing controls are available:

Filter Type: This indicator shows the currently applied filter.

Low Cutoff: This indicator shows the low cutoff of the currently applied filter.

High Cutoff: This indicator shows the high cutoff of the currently applied filter.

Windowing Function: This control specifies the window to use when applying the FFT to the channel waveform.

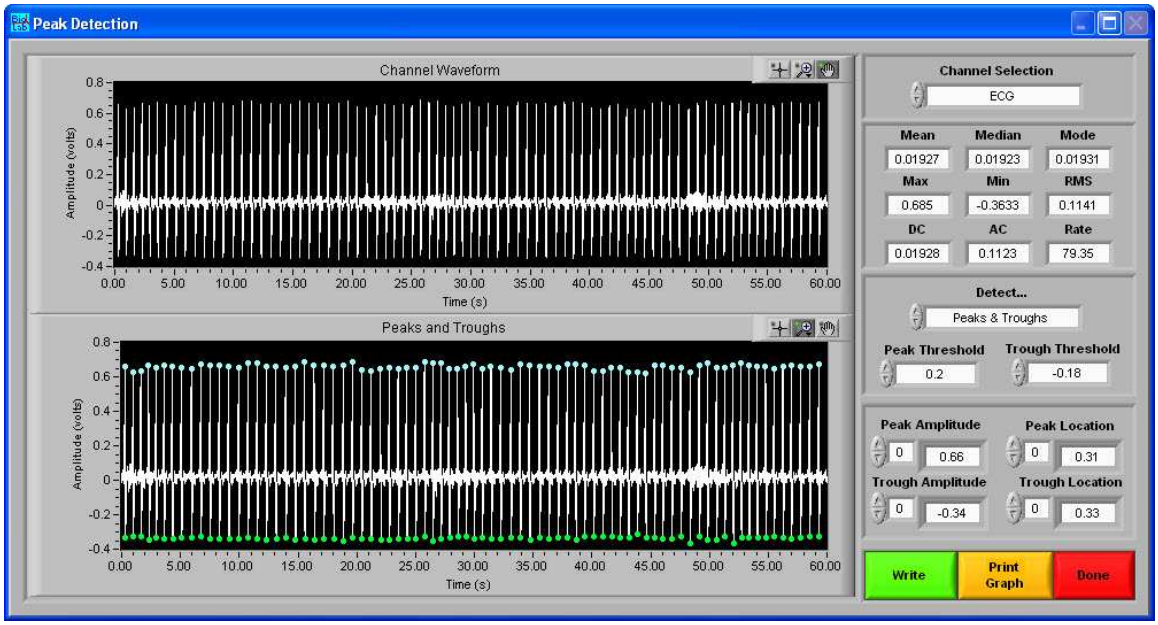
Disp Units: This control specifies the units to display the power spectrum in. **Linear** displays the spectrum in volts, while **dB** displays the spectrum in decibels.

Write: Pressing this button will prompt the user to specify a location for the output file. Upon choosing a destination, the calculated statistics along with current file information will be written to the file.

Print Graph: Pressing this button will print both display graphs along with the calculated statistics using the specified printer.

Done: Exits the Frequency Domain Analysis window.

Part 3: Peak Detection



The Peak Detection window allows for peaks and troughs of the specified waveform to be detected and labeled. There are two display plots shown:

Channel Waveform: This display shows the channel data as shown on the original display. The graph palette is available in the upper right hand corner of the display.

Peaks and Troughs: This display shows the channel data with peaks and troughs marked with cursors (blue = peak, green = trough).

In the upper right hand corner, the **Channel Selection** control allows the user to switch between all available channels for static analysis.

Below the **Channel Selection** control are the basic statistics. The **Mean**, **Median**, **Mode**, **Max**, **Min**, **RMS**, **DC Component**, and **AC Component** are all derived from the channel waveform.

Along with the basic statistics, the following statistics are also calculated:

Peak Amplitude: This indicator lists the amplitude of each detected peak.

Peak Location: This indicator lists the location in time of each detected peak.

Trough Amplitude: This indicator lists the amplitude of each detected trough.

Trough Location: This indicator lists the location in time of each detected trough.

The following Peak Detection settings are available:

Detect...: This control specifies whether to detect peaks, troughs, or both.

Peak Threshold: This control specifies the minimum amplitude of a detected peak. If invalid peaks are being detected, try increasing this value until only valid peaks appear on the Peaks and Troughs display.

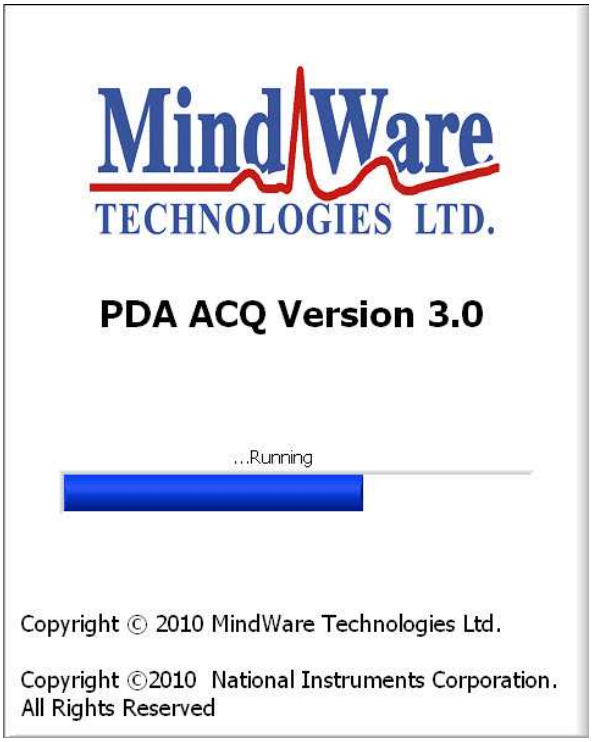
Trough Threshold: This control specifies the maximum amplitude of a detected trough. If invalid troughs are being detected, try increasing this value until only valid troughs appear on the Peaks and Troughs display.

Write: Pressing this button will prompt the user to specify a location for the output file. Upon choosing a destination, the calculated statistics along with current file information will be written to the file.

Print Graph: Pressing this button will print both display graphs along with the calculated statistics using the specified printer.

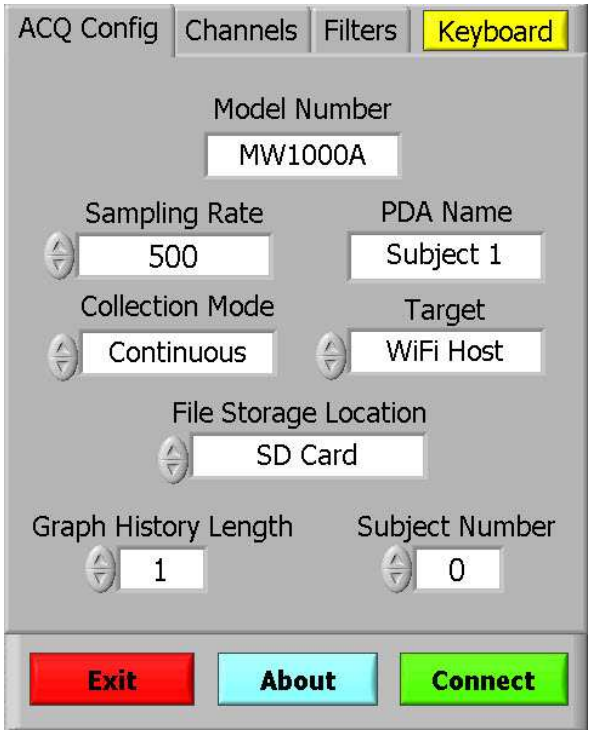
Done: Exits the Peak Detection window.

Appendix A: PDA ACQ 3.0



The PDA ACQ 3.0 application runs on the MindWare Ambulatory devices, and is the interface used to connect the device to the host computer running BioLab. This section details use of the PDA ACQ 3.0 software in Wi-Fi Host mode only. For more on set up and configuration of the device please see the PDA ACQ 3.0 User Guide shipped with the ambulatory unit. Upon starting the PDA ACQ 3.0 software, the unit will initialize while the start up screen is shown (shown above). Once initialization has completed, the PDA ACQ Configuration screen will appear.

Section 1: PDA ACQ Configuration



The PDA ACQ Configuration screen is divided into 3 submenus: **ACQ Config** (pictured above), **Channels**, and **Filters**.

Part 1: ACQ Config

The ACQ Config submenu contains the main acquisition settings for the MindWare Ambulatory device. The following options are available:

Model Number: This display shows the type of ambulatory device currently running (MW1000A, MW3000A, or MW5000A).

Sample Rate: This display shows how fast the data is acquired (in samples per second). The sample rate is fixed at 500 samples/second in Wi-Fi mode.

PDA Name: This control specifies the name of the Ambulatory device. This value is used to identify the PDA in the BioLab software when connected to a host computer.

Collection Mode: This control specifies the method of data collection. There are two collection modes available:

> **Epoch:** In this mode data is collected in segments specified in an epoch file.
>
> **Continuous:** In this mode data is collected without pre-defined pauses or segmentation.
>
> **Time Delay:** In this mode data collection starts at a specified time.

Target: This control sets the location where the data will be streamed to. The following options are available:

> **WI-FI Host:** This option is used when connecting to a host computer running BioLab 3.0 or higher. The data will be streamed wirelessly and saved in an .mw file on that machine.
>
> **PDA:** This option stores all collected data locally on the Ambulatory wireless device.

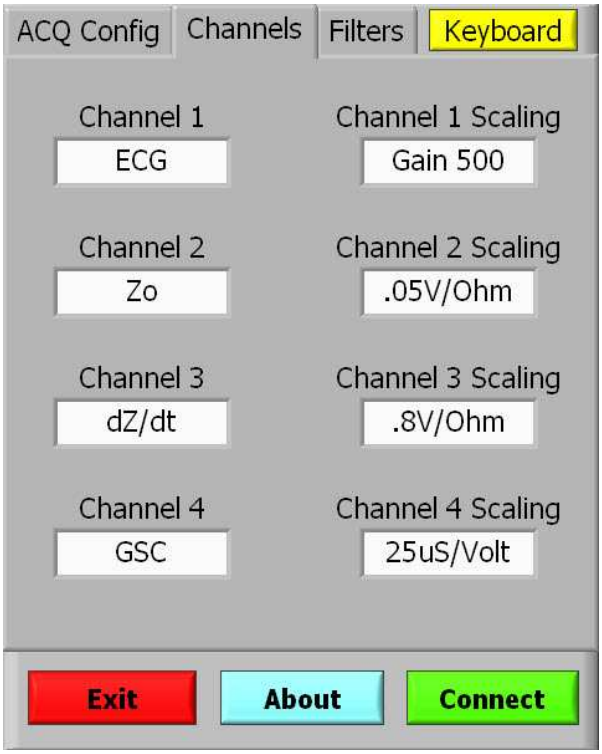
File Storage Location: This control specifies where on the Ambulatory device to save data when in local mode. Data files can be saved either in the IPAQ File Storage or on the currently inserted SD Card.

Graph History Length: This control specifies how much data to show on the data display at any given time when collecting data locally.

Subject Number: This control specifies the current subject's identification number.

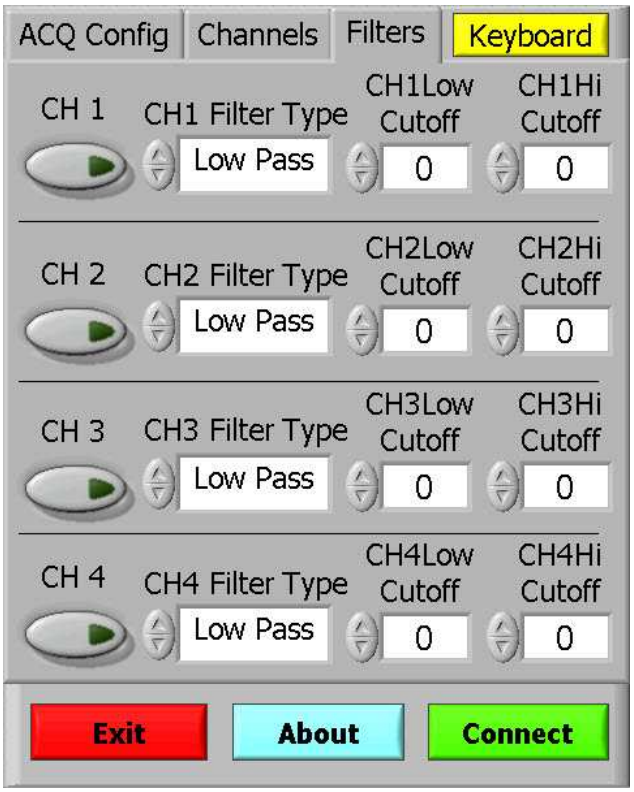
Keyboard: This control opens the keypad on the lower half of the screen allowing the user to input text.

Part 2: Channels



The Channels submenu contains settings for channel names and gains. Depending on the current Ambulatory model, the values displayed on this screen will be different. Depicted above are the channel settings for the MW1000A model. Only the MW3000A and MW5000A models have programmable gains. The left column displays the available channels and their corresponding names. The right column displays the scaling used on each channel, and if applicable a programmable gain setting.

Part 3: Filters



The Filters submenu is used to determine the filter settings for each individual channel. These filter settings are only applied when collecting data locally. In Wi-Fi Host mode, these filters will not be applied. The following controls are available in this submenu:

Filter On/Off: Toggles whether to use the specified channel filter. In WI-FI Host mode, these controls will be disabled as all filters will be applied in BioLab on the host computer.

Filter Type: This control specifies the type of filter to be applied to the channel. There are two types of filters available: Low Pass and Band Pass.

Low Cutoff: This control is used to set the Low Cutoff of the filter. All data with a frequency below the specified cutoff will be filtered out.

High Cutoff: This control is used to set the High Cutoff of the filter. All data with a frequency above the specified cutoff will be filtered out.

Section 2: PDA ACQ Acquisition (WI-FI Host mode)

Once the ambulatory has been properly configured, pressing the Connect button in the lower right hand corner of the ACQ Configuration screen will proceed to attempt to connect to the host computer. While the PDA waiting for the connection to be made, the following dialog box will appear.

Once the user has made the connection to the Ambulatory devices in BioLab (see **Section 1: Startup** pages 8-9) and a connection has successfully been established, the connecting dialog will be replaced by the PDA ACQ Acquisition screen.

Once on this screen, control of the PDA has been transferred to the host computer via BioLab. Synchronization, acquisition, and disconnecting will all be controlled from the BioLab interface.

The following indicators are shown on the PDA ACQ Acquisition screen:

Synchronizing: This LED shows whether the Ambulatory device is currently attempting to synchronize with all other devices in the system. The synchronization will take place once the user has proceeded to the BioLab Acquisition screen.

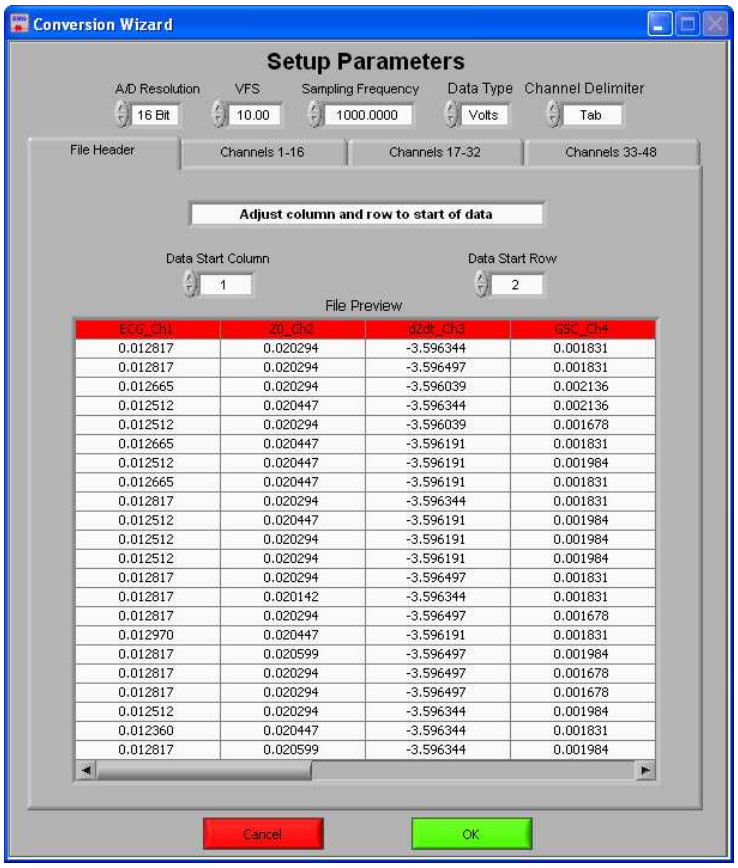
Acquiring: This LED shows whether the Ambulatory device is actively acquiring and transmitting data to the host computer. In the event that the Ambulatory loses connection with the host computer, this LED will blink to indicate it is currently acquiring data and saving to a backup file locally.

Error: This LED shows if an error has occurred on the device. In the event of an error, the host computer will be notified of the error. If the error is communications related, the Ambulatory will continue to acquire data and save to a backup file locally.

Abort: This button aborts the current action being taken by the Ambulatory device and disconnects from the host computer. This button should only be used in the event of an error on the Ambulatory device to return to the PDA ACQ Configuration screen once the device has begun acquiring data to the backup file.

Appendix B: ASCII-MW Converter

The ASCII-MW Converter allows the conversion of any text file containing data in some character-delimited columns to the .mw format so that it may be used in any application. To begin conversion, select a text file containing data by using the browse button on the file path control and pressing Convert. To exit the converter and return to the BioLab Configuration screen, press Exit.



The next screen in the conversion process is the Text File Conversion Wizard. From this screen, details about the data in the text file must be entered in order to properly scale and display the data in the analysis applications. It is extremely important that these values are identical to the way the data was acquired to ensure the correct conversion.

A/D Resolution: This control is the resolution of the A/d converters in the hardware used to acquire the data in the file.

VFs: This control is the volts full scale of the hardware used to acquire the data in the file.

Sampling Frequency (Hz): This control is the sampling frequency at which the data in the file was collected.

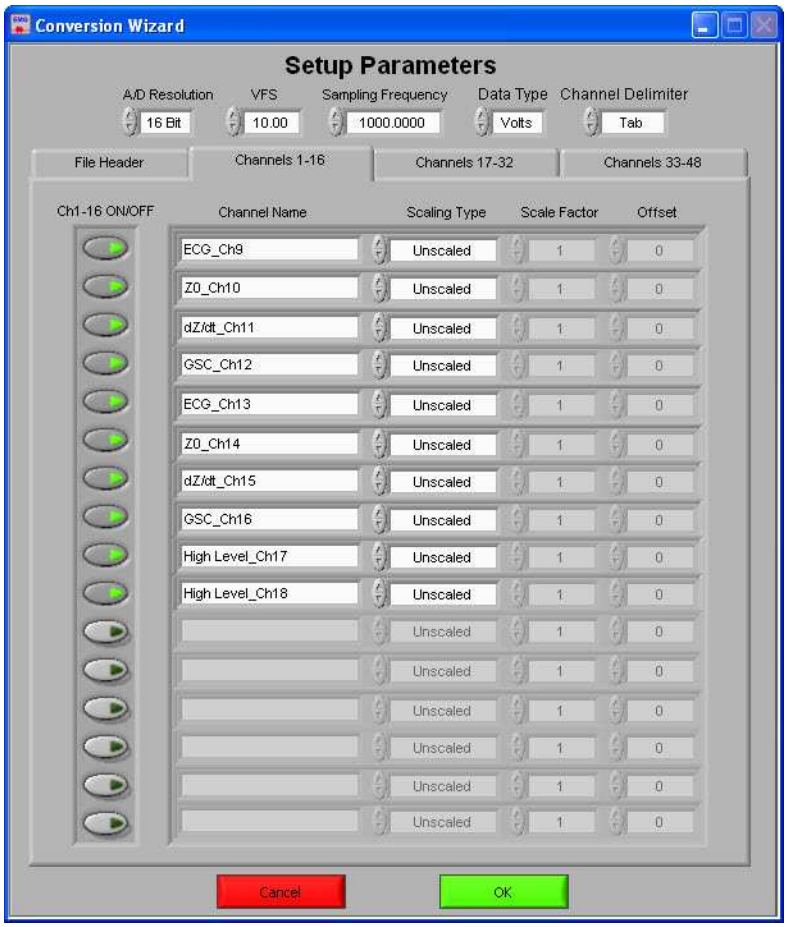
Data Type: This control specifies whether the data in the file is in volts or A/d counts.

Channel Delimiter: This control specifies the character which is used to separate data channels in the file.

Below these settings is the submenu control. The following submenus are available:

File Header: This submenu contains a preview of the beginning of the selected text file. Using the controls **Data Start Column** and **Data Start Row**, select where the data actually begins in the file past any file header information. Rows and columns which will not be included in conversion appear in red.

Channels 1-16: This submenu contains the channels found in the text file and allows for them to be selected/deselected for conversion.



The following controls are available:

Channel Names: This control allows the user to specify a name for the data channel to be saved in the .mw file header.

Scaling Type: This control specifies whether the data in the file is scaled or unscaled. If the data is scaled, the Scale Factor and Offset fields will be enabled for modification.

Scale Factor: If the data in the specified channel is scaled, this control represents the factor by which it is scaled.

Offset: This control represents the offset of the scaled data channel.

Submenus **Channels 17-32** and **Channels 33-48** behave in the same way.

Pressing OK will convert the file to the .mw format (may take several minutes depending on size of data file) and return to the Setup screen. Pressing cancel will return to the file selection window.

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