AlazarDSO

Version 2.1.5
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AlazarTech

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LICENSE AGREEMENT

GETTING STARTED

2.1 Introduction

AlazarDSO is a program that allows you to acquire, view, and save data from AlazarTech PCI / PCIe digitizer boards. It has the following capabilities:

- It can display up to 64 input and 8 reference channels.

- It can calculate and display up to 8 math channels.

- It can draw records as time or frequency domain charts, or calculate statistics and displays them as text.

- It can display horizontal and vertical cursors.

- It can save and load records to and from files.

- It can be extended with plugin modules.

Note that AlazarDSO identifies input channels as follows in board systems with 2 analog input channels per board:

Name	Board ID	I/O Connector
Ch 1	1	A
Ch 2	1	B
Ch 3	2	A
Ch 4	2	B
Ch 5	3	A
Ch 6	3	B
Ch 7	4	A
Ch 8	4	B
Ch 9	5	A
Ch 10	5	B
Ch 11	6	A
Ch 12	6	B
Ch 13	7	A
Ch 14	7	B
Ch 15	8	A
Ch 16	8	B

AlazarDSO identifies input channels as follows in board systems with 4 analog input channels per board:

Name	Board ID	I/O Connector
Ch 1	1	A
Ch 2	1	B
Ch 3	1	C
Ch 4	1	D
Ch 5	2	A
Ch 6	2	B
Ch 7	2	C
Ch 8	2	D
Ch 9	3	A
Ch 10	3	B
Ch 11	3	C
Ch 12	3	D
Ch 13	4	A
Ch 14	4	B
Ch 15	4	C
Ch 16	4	D

2.2 Making Acquisitions

Connect input signals to your board's IO connectors.

If it is necessary to adjust the input impedance or probe attenuation of an input channel, select the channel from the **Input** item of the **Configure** menu to display the **Configure Input** dialog box.

Press the **Start** button to start acquiring sample data. The **Start** button is located in the **Acquire** group box at the top right of the main window.
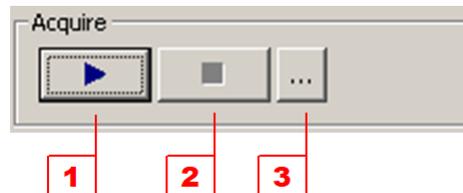
Fig. 1: Acquire controls

1. Start acquisitions

2. Stop acquisitions

3. Display the **Configure Acquire** dialog box.

Change the time scale to expand or contract the signal horizontally. Select a time scale in seconds per horizontal division from the horizontal scale combo box, or by pressing the buttons to expand or contract the horizontal scale. The horizontal controls are located in the **Horizontal** group box at the right side of the main window.
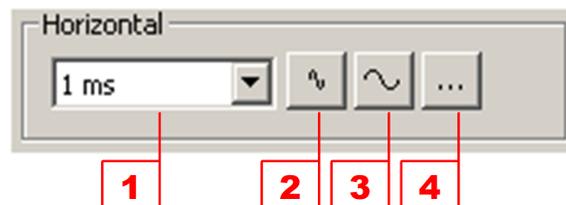
Fig. 2: Horizontal controls

1. Select the time scale in seconds per horizontal division from the horizontal scale combo box.

2. Contract the horizontal scale by selecting the next item from the horizontal scale combo box.

3. Expand the horizontal scale by selecting the previous item from the horizontal scale combo box.

4. Display the **Configure Horizontal** dialog box.

Once you have a suitable trigger level, select trigger mode from the trigger mode combo box to stabilize the waveform within a sample record. The trigger mode combo box is located in the **Trigger** group box at the top right of the main window, just below the **Acquire** controls.
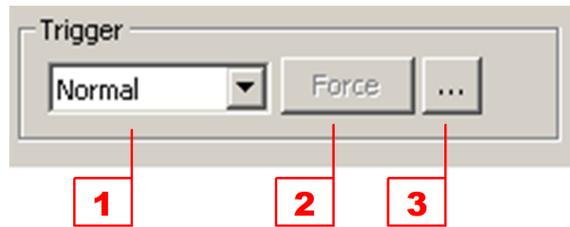
Fig. 3: Trigger controls

1. Trigger mode combo box.

2. Force trigger button.

3. Display **Configure Trigger** dialog box.

To change acquisition parameters such as the number of samples per record, and the number of records per acquisition, select the **Acquire** item from **Configure** menu to display the **Configure Acquire** dialog box.

To change the sample rate, add a trigger delay, or change the number of pre-trigger samples, select the **Horizontal** item from the **Configure** menu to display the **Configure Horizontal** dialog box.

2.3 Making Measurements

There are several ways AlazarDSO can help you make measurements once you have acquired sample waveforms.

- Move the mouse pointer over a waveform to display a popup window with the value and time with respect to trigger of the sample under the cursor. Note that acquisitions must be stopped in order to view information about **Input** and **Math** waveforms.
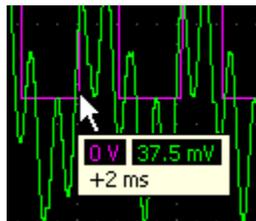

Fig. 4: Waveform ToolTip window

- Move the expansion point horizontally to display the time with respect to the trigger position of samples at the expansion point.

1. Horizontal scroll bar.

2. Expansion point in view.

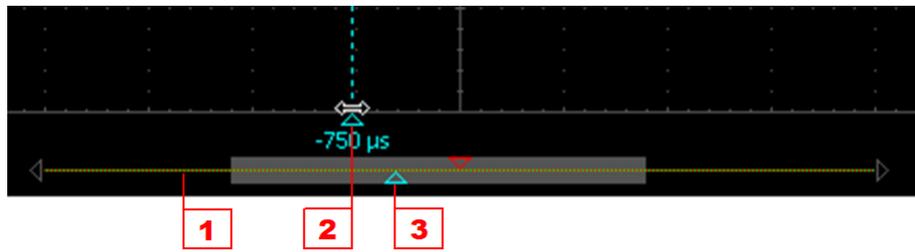3. Expansion point in horizontal scroll bar.

Fig. 5: Expansion point in view

- Change the horizontal scale to expand or contract the waveform around the expansion point. Select a time scale in seconds per horizontal division from the horizontal scale combo box, or press the buttons to expand or contract the horizontal scale.

- Select **Show Horizontal** from the **Cursors** menu to display horizontal cursors. The software shows the time from the trigger position of each cursor, and the difference between these times, at the bottom left of the display area. Note that if you hold down the control key while pressing the left-mouse button, the horizontal cursor furthest from the mouse pointer will move to the pointer position.
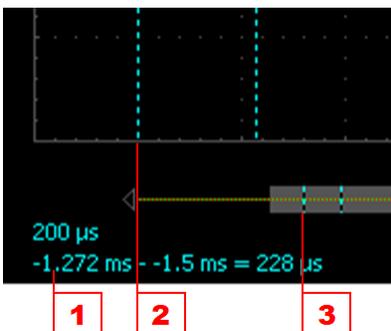

Fig. 6: Horizontal axis cursors

1. Time from each cursor to trigger position, and difference between times.

2. Horizontal cursor in view.

3. Horizontal cursor in horizontal scroll bar.

- Select a vertical channel from the **Cursors** menu to toggle the vertical cursors on or off. The software displays the voltage at each cursor, and the voltage difference between cursors at the bottom right of the display area. Note that if you hold down the shift key while pressing the left-mouse button, the vertical cursor furthest from the mouse pointer will move to the mouse pointer position. Hold down the control key before dragging a channel cursor to move both cursors at the same time.

1. Drag the cursor with the left-mouse button to move it up or down.

2. The channel marker arrowhead is drawn filled to indicate that the channel is the anchor for the vertical cursors; otherwise it is drawn outlined. Drag it with the left-mouse button to move the channel position up or down. Press the shift key and drag the channel marker to increase
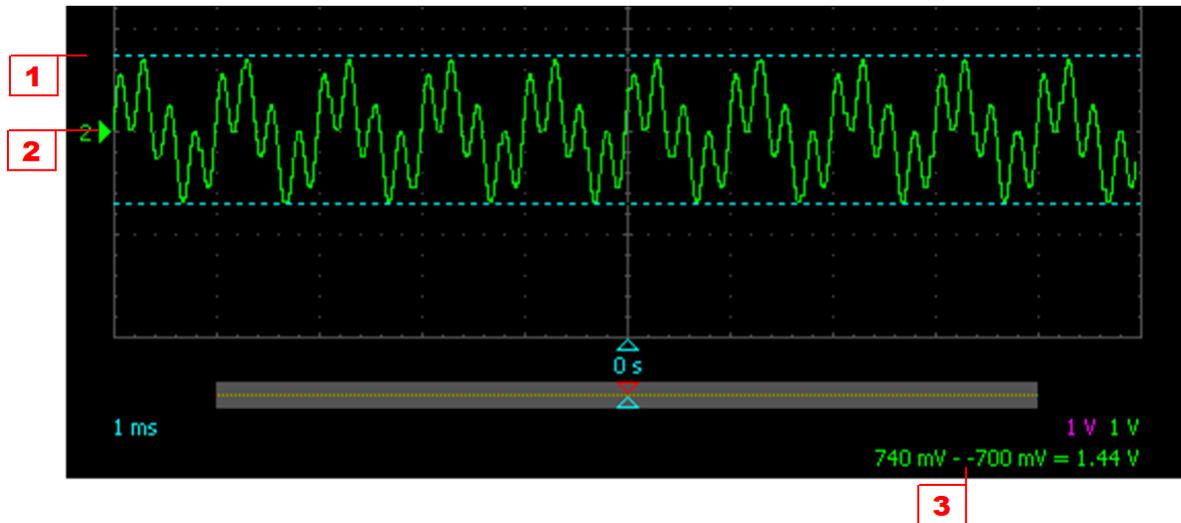
Fig. 7: Vertical axis cursors

or decrease the offset between the channel marker vertical position and the waveform zero level vertical position.

3. This text displays the voltage at each cursor, and the difference between these voltages.

- Select **Spectrum Analyzer** from the **View** menu to display the frequency components of the acquired waveforms. AlazarDSO displays the relative magnitude of the frequency components as a function of frequency of each enabled waveform.

- Select **Voltmeter** from the **View** menu to display the minimum, maximum, average, and RMS values of the current record of each enabled channel.

Fig. 8: Voltmeter view

1. Average value in volts of the samples in this record.

2. Maximum value in volts of the samples in this record.

3. Minimum value in volts of the samples in this record.

4. RMS value in volts of the samples in this record.

Right click on the text to display the input channel context menu.

Note that AlazarDSO accumulates values before displaying their averages on screen. By default, values are accumulated for 1000 milliseconds. To change this time, select **Display** from the **Con-**

figure menu to display the **Configure Display** dialog box, and change the voltmeter accumulate time.

2.4 Configuring Input Channels

Input channels display sample records digitized from board IO connectors. They are labeled **Ch 1** through **Ch 16** in the main window. There are two input channels for each board in the active board system.

To change the display or hardware settings of an input channel, select an **Input** channel from the **Configure** menu to display the **Configure Input** dialog box. Note that if an input channel is disabled, AlazarDSO does not transfer or display sample data for that channel.

AlazarDSO draws an arrowhead marker in the left margin of the graticule to indicate the vertical position of each enabled input channel. For example, the marker for input channel 2 is labeled **X** in the following figure.

Fig. 9: Input channel vertical position marker

Drag the marker vertically with the left-mouse button to move the channel up or down, right click on it to display the channel context menu, or double click on it to display the **Configure Input** dialog box for the channel.

AlazarDSO draws a tab control in the **Vertical** group box on the right side of the main window to allow single-click control of input channels. Each tab controls one input channel from the active board system.
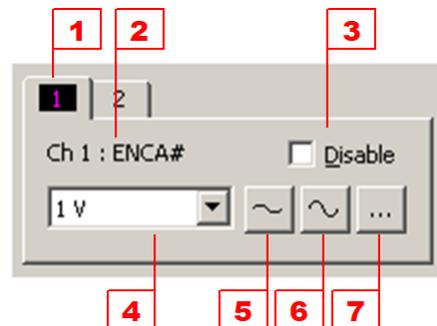
Fig. 10: Input channel controls

1. Select the channel to control.

2. This text displays the name and label of the currently selected channel.

3. Check this box to disable the selected channel.

4. This combo box displays the current scale factor. Select a scale factor from the combo box list to change the vertical scale factor.

5. Press this button to decrease the height of the selected channel's waveform by selecting the next vertical scale factor from the combo box.

6. Press this button to increase the height of the selected channel's waveform by selecting the previous vertical scale factor from the combo box.

7. Display the **Configure Input** dialog box for the selected channel.

2.5 Configuring Math Channels

Math channels display the sum, product, or difference between two input channels, or the event distribution histogram of one input channel. They are labeled **Ch A** through **Ch H** in the main window.

To modify the function, function parameters, or display parameters of a math channel, select the math channel from the **Math** popup menu of the **Configure** menu.

To change the number of math channels available, select **Display** from the **Configure** menu and change the math channels value in the **Options** section of the **Configure Display** dialog box. The minimum number is 1, and the maximum 8.

AlazarDSO draws an arrowhead marker in the left margin of the graticule to indicate the vertical position of each enabled math channel. For example, the marker for math channel A is labeled **X** in the following figure.
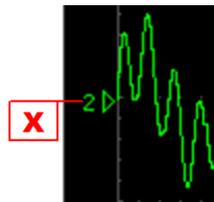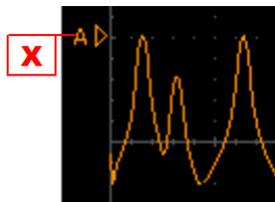

Fig. 11: Math channel vertical position marker

Drag the marker vertically with the left-mouse button to move the math channel up or down, right click to display the channel context menu, or double click to display the **Configure Math** dialog box.

AlazarDSO draws a tab control in the **Vertical** group box on the right side of the main window to allow single-click control of math channels. Each tab controls one math channel.

1. Select the channel to control.

2. This text displays the name and function of the selected channel.

3. Check this box to disable the calculation and display of the selected channel.

4. This combo box displays the current scale factor per vertical division of the selected channel.

Fig. 12: Math channel controls

5. This button selects the next vertical scale factor from the combo box to decrease the height of the selected channel's waveform.

6. This buttons selects the previous vertical scale factor from the combo box to increase the height of the selected channel's waveform.

7. Display the **Configure Math** dialog box for the selected channel.

2.5.1 Using Histograms

AlazarDSO can calculate the times between certain events in a record, group this times into time ranges, and display the number of items in each time range in the form of a histogram. The width of each bin in the histogram is the time for a record divided by the total number of bins.

To display a histogram for an input channel:

- Open the **Configure Math** dialog box for a math channel.

- Select **HIST X** from the **Function** combo box.

- Select the input channel from the **X** combo box.

- Select an event type from the **Event type** combo box. Events include: rising edge to rising edge, falling edge to falling edge, rising edge to falling edge, edge to edge, rise time, and fall time.

- Press the **OK** button to apply the changes.

Note that when AlazarDSO displays one or more histograms, it displays the time range of the bin at the expansion point.

2.6 Configuring Reference Channels

Reference channels display waveforms from sample values stored in files. They are labeled **Ch R** through **Ch Y** in the main window.

To select the file displayed by a reference channel and configure its display properties, select the reference channel from the **Reference** popup menu of **Configure** menu to display the **Configure Reference** dialog box.

To change the number of reference channels available, select **Preferences** from the **Configure** menu, and change the number of reference channels valuei in the **Configure Preferences** dialog box. The minimum number is 1, and the maximum 8.

AlazarDSO draws an arrowhead marker in the left margin of the graticule to indicate the vertical position of each enabled reference channel. For example, the marker for reference channel R is labeled **X** in the following figure.

Fig. 13: Reference channel vertical position marker

Drag the marker vertically with the left-mouse button to move the position of the channel up or down, right click on it to display the channel's context menu, or double click on it to display the **Configure Reference** dialog box.

AlazarDSO draws a tab control in the **Vertical** group box on the right side of the main window to allow single-click control of reference channels. Each tab controls one reference channel.

Fig. 14: Reference controls

1. Select the channel to control.

2. This text displays the name and label of the selected channel.

3. Check this box to disable the display of the selected channel.

4. This combo box displays the current scale factor of the selected channel. Use the combo box to change the vertical scale factor.

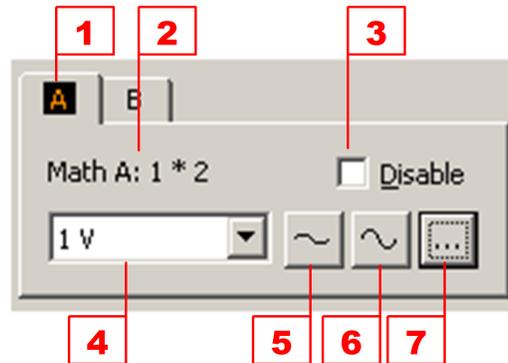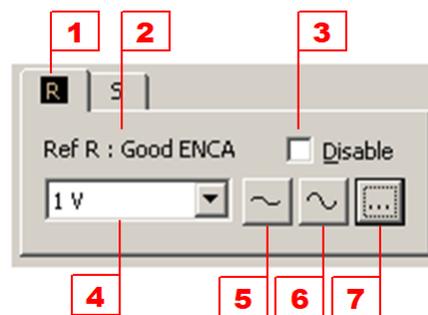5. Press this button to select the next vertical scale factor from the combo box to decrease the height of the selected channel's waveforms.

6. Press this button to select the previous vertical scale factor from the combo box to increase the height of the selected channel's waveforms.

7. Display the **Configure Reference** dialog box.

2.7 Saving and Loading Files

AlazarDSO can save and load records, entire acquisitions, or a series of acquisitions to file.

- Load a record from a file to a reference channel

  Select **Open** from the **File** menu to display the **Open** file dialog box. Enter a file name or select one from the list control, select a reference channel from the **Display as** combo box, then press the **Open** button.

- Save the current acquisition to file

  Select **Save As. . .** from the **File** menu to open the **Save File** dialog box. Select the channels, records, and samples of interest, and the format in which you'd like to save these samples, then press the **Save** button.

- Save a record from the current acquisition as a reference.

  Right click on the channel marker or waveform and select **Save as reference** from the channel context menu. This saves the waveform to file, and loads the file as a reference channel with one mouse click.
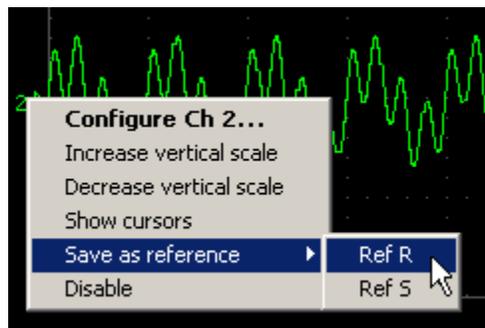
Fig. 15: Channel context menu

- Save a sequence of acquisitions.

  Select **Acquire To File** from the **Tools** menu to display the **Acquire To File** dialog box. Enter the number of acquisitions you wish to save, check the **Display file after acquisition**, and press the **Acquire** button.

  AlazarDSO displays a progress window during the acquisitions, and then displays the **Browse File** dialog box, which allows you to view the acquisition one record at a time.

- Stream to disk.

  This module has been deprecated starting in version 1.1.70. From this point on, Stream to Disk module will only be sold as part of a complete data streaming system, such as AlazarStream.

  Users should use the Stream to Memory feature provided in the Tools menu as a standard feature to acquire data into motherboard memory and eventually into a file on the disk volume of their choice.

Note that if you close the **Browse File** dialog, you can display it again by selecting **Browse File** from the **View** menu until you make another acquisition or exit the program. If you make another acquisition or restart the program, then select **Open** command from the **File** menu and select the file by name.

REFERENCE

This chapter provides AlazarDSO reference information.

3.1 Windows

This section describes main window controls, menus, and menu shortcuts.

3.1.1 Main Window

A. Title

The window title displays the active board system, view mode, and program version. Note that if the active board system contains multiple boards, then the title displays the board type followed by the number of boards in the board system.

B. Acquire

The controls in the Acquire group box allow you to start or stop acquisitions.

1) Press the Start button to start acquisitions.

2) Press the Stop button to stop acquisitions.

3) Press the Configure button to display the **Configure Acquire** dialog box.

C. Trigger

The controls within the Trigger group box allow you to control the trigger operation. To configure trigger sources, select **Trigger** from the **Configure** menu to display the **Configure Trigger** dialog box for a board.

1. The trigger mode combo box allows you to select one of the following triggering modes:

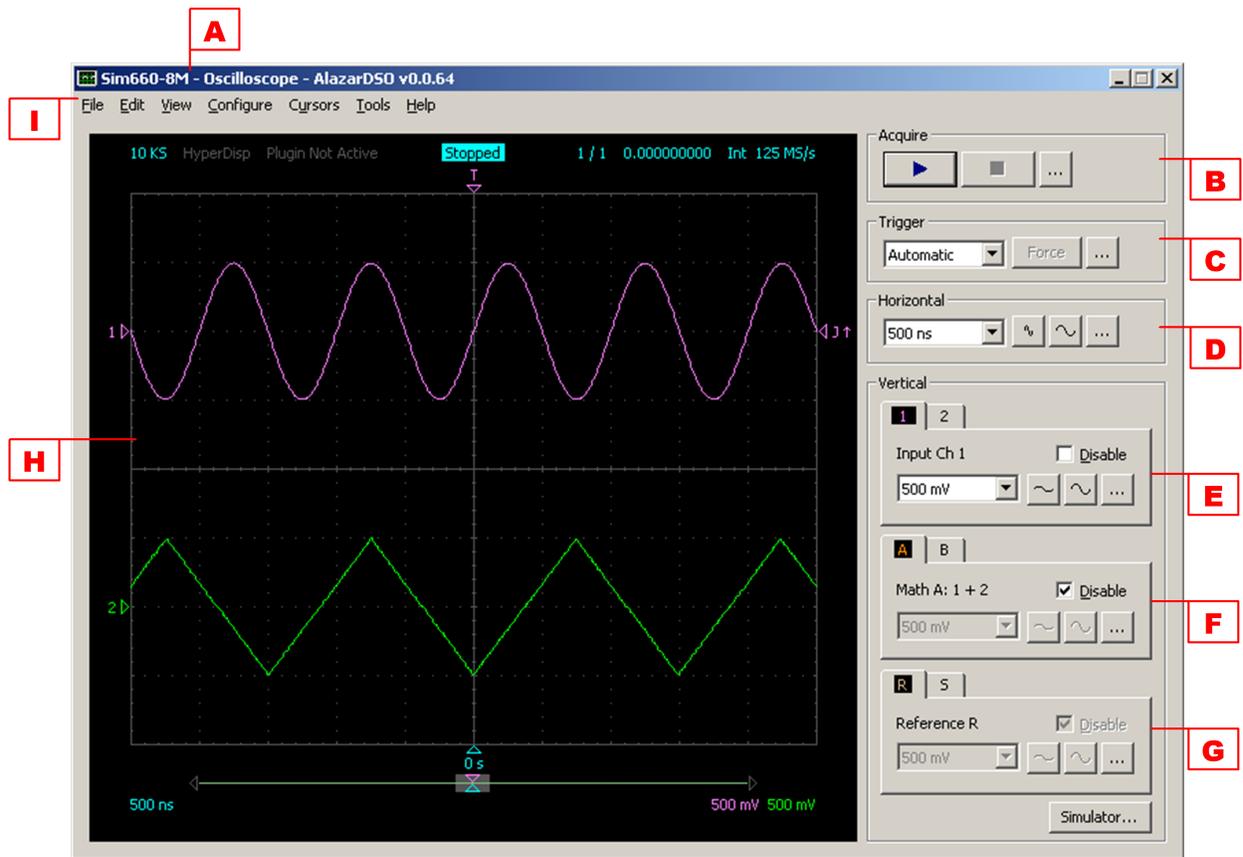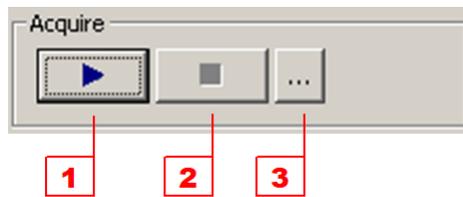| Mode	Wait for trigger event
Automatic	No
Normal	Yes
Single	Yes

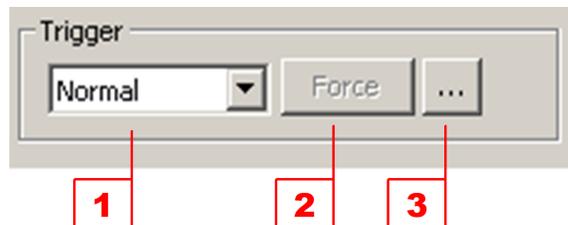Fig. 1: Main window

Fig. 2: Acquire controls

Fig. 3: Trigger controls

2. The force trigger button allows you to immediately force a trigger event if the board is waiting for a trigger. This button is enabled only when the system is acquiring data, and the acquisition mode is normal.

3. Press this button to display the **Configure Trigger** dialog box.

D. Horizontal

The controls in the Horizontal group box allow you to change the horizontal scale. The units depend on the current view mode: oscilloscope mode units are seconds, and spectrum analyzer mode units are Hertz.
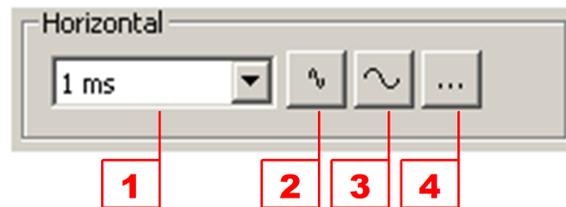
Fig. 4: Horizontal controls

1. The horizontal scale combo box lets you select the time or frequency per horizontal division.

2. Press this button to select the next value per horizontal division from the horizontal scale combo box.

3. Press this button to select the previous value per horizontal division from the horizontal scale combo box.

4. Press this button to display the **Configure Horizontal** dialog box.

Note that, by default, when you change the time per horizontal division AlazarDSO changes the sample rate so that, if possible, the record width in seconds equals the period displayed in the 10 divisions of the graticule. To select a fixed sample rate, select the **Horizontal** item from the **Configure** menu to display the **Configure Horizontal** dialog box.

E. Inputs

These controls allow you configure input channels.

1. Click on a tab to select the input channel you wish to control.

2. This text displays the currently selected input channel. If you have set a label for this input channel, it is displayed following the channel's name.

3. Check this button to disable the transfer and display of data of the selected input channel.

4. Select the scale factor for the selected input channel.

Fig. 5: Input channel controls

5. Select the next item from the vertical scale factor combo box to reduce the vertical size of the selected input channel's waveform.

6. Select the previous item from the vertical scale factor combo box to increase the vertical size of the selected input channel's waveform.

7. Display the **Configure Input** dialog box to configure the selected input channel.

F. Math

These controls allow you to configure math channels.

AlazarDSO can display up to 8 math channels. To change the number of math channels available, select **Display** from the **Configure** menu and change the math channels value in the **Options** section of the **Configure Display** dialog box. The minimum number is 1, and the maximum 8.

Fig. 6: Math channel controls

1. Click on a tab to select the channel you wish to control.

2. This static text control displays the name of the currently selected math channel, and the math function.

3. Check this button to disable the calculation and display of the selected math channel.

4. Select the scale factor for the selected math channel.
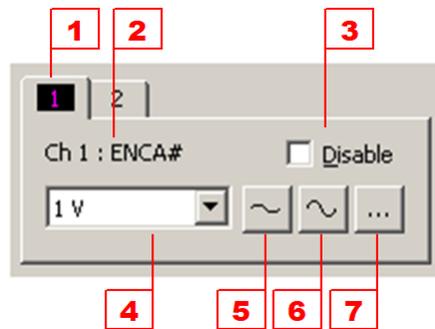
5. Select the next item from the vertical scale factor combo box to reduce the vertical size of the selected input channel's waveform.

6. Select the previous item from the vertical scale factor combo box to increase the vertical size of the selected channel's waveform.

7. Display the **Configure Math** dialog box.

G. Reference

These controls allow you to configure reference channels. AlazarDSO can display up to 8 reference channels. To change the number of reference channels available, select **Display** from the **Configure** menu, and change the reference channel value in the **Options** section of the **Configure Display** dialog box. The minimum number is 1, and the maximum 8.
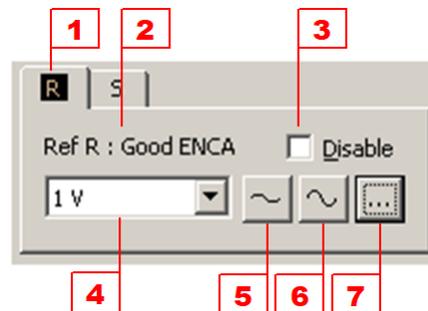
Fig. 7: Reference channel controls

1. Click on a tab to select the reference channel you wish to control.

2. This static text displays the currently selected reference channel. If you have entered a label for this reference channel, it is displayed after the channel's name.

3. Check this button to disable the display of the selected reference channel.

4. Select the scale factor for the selected reference channel.

5. Select the next item from the vertical scale factor combo box to reduce the vertical size of the selected reference channel's waveform

6. Select the previous item from the vertical scale factor combo box to increase the vertical size of the selected reference channel's waveform

7. Display the **Configure Reference** dialog box to configure the selected reference channel.

G. Graticule

The graticule area is both an input and output control. It responds to left mouse clicks, right mouse clicks, left mouse double-clicks, and mouse hover events so that you can interact with the object under the mouse pointer.

1. This control displays the number of samples per record of each channel. Right click on it to display the acquisition context menu, or double click to display
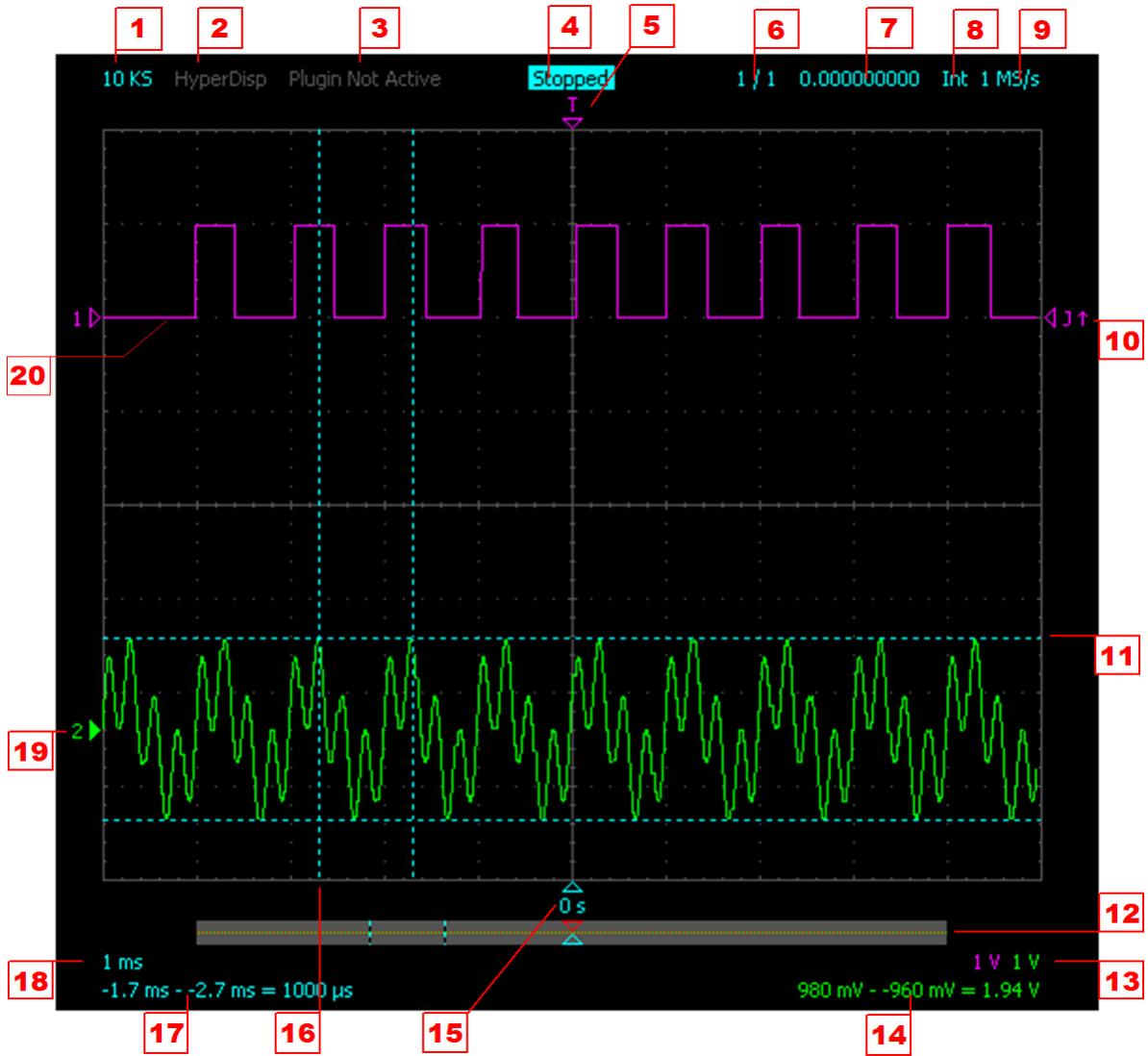
Fig. 8: Graticule controls

the **Configure Acquire** dialog box.

2. This control displays the transfer mode of the current acquisition. Transfer modes are:

Normal
Sample data was transferred from the board using the AlazarRead API function, or read from a file.

HyperDisp
Sample data was transferred from the board using the HyperDisp API function.

AutoDMA
Sample data was transferred from the board using the AutoDMA API functions.

Right click on this control to display the acquisition context menu, or double click to display the **Configure Acquire** dialog box.

3. This control displays the state of the plugin interface. The states are:

Not active
Plugin modules are disabled.

Active
One ore more plugin modules are enabled and returned with `PLUGIN_SUCCESS` to the `PLUGIN_DISPLAY` message for this acquisition.

Ignore
One or more enabled plugin modules returned `PLUGIN_IGNORE` to the `PLUGIN_DISPLAY` message for this acquisition.

Right click on the control to display the plugin module context menu, or double click to display the **Configure Plugins** dialog box.

4. This control displays the state of the acquisition controller, which implements a state machine that manages writing to, and transferring data from, the board system.

The controller can be one of the following states:

Startup
The controller is initializing.

Config
The controller is writing configuration settings to the board system.

Ready
The controller is arming the board system for a capture.

Trigger?
The controller is waiting for the board system to receive a trigger event.

Busy

The controller is waiting for the board system to complete a capture.

Read

The controller is transferring sample data from the board system to host memory.

Write

The controller is writing sample data from host memory to a file.

Pause

The controller is pausing after it has completed a capture.

Display

The controlled has completed a capture, but is waiting for records from the previous capture to be drawn on screen before displaying the current capture.

Display

The controller is drawing records from the current capture to screen.

Error

The controller has detected an error during this capture.

Stopped

The controller is not active.

Right click on this control to display the acquisition context menu, or double click to display the **Configure Acquire** dialog box. Note that if the controller remains in any one active state for a second or more, it displays the time it has been in that state to the right of the state name.

5. This marker indicates the trigger position within a record. Samples to the left of this marker are pre-trigger samples.

If no waveforms are displayed, you may drag the marker change the trigger position within a record.

If a waveform is displayed and the trigger position is outside of the current view, AlazarDSO draws an arrowhead beside the marker to indicate that the trigger position sample is either to the left or right of the current view.

Right click on this control to display the horizontal controls context menu, or double click on it to display the **Configure Horizontal** dialog box.

6. This control displays the current record displayed followed by the total number of records in an acquisition.

To view a different record from the current acquisition, select **Browse Records** from the **View** menu. This menu item is active only when an acquisition is displayed, and there is more than one record in the acquisition.

Right click on this control to display the acquisition context menu, or double click on it to display the **Configure Acquire** dialog box.

7. This control displays the timestamp of the currently displayed record.

   Right click on this control to display the acquisition context menu, or double click on it to display the **Configure Acquire** dialog box.

8. This control displays the sample clock source. The possible values are:

   Int
   > The sample clock source is the board's internal oscillator.

   Ext
   > The sample clock source is an external clock signal.

   Ext-F
   > The sample clock source is an external clock signal, and the specified frequency is within the fast-external frequency range.

   Ext-M
   > The sample clock source is an external clock signal, and the specified frequency is within the medium-external frequency range.

   Ext-S
   > The sample clock source is an external clock signal, and the specified frequency is within the slow-external frequency range.

   Ext-P
   > The sample clock source is an external clock signal, and the specified frequency from the PLL.

   File
   > The acquisition data is from a file; there is no clock source.

   Right click on this control to display the horizontal controls context menu, or double click on it to display the **Configure Horizontal** dialog box.

9. This control displays the current sample rate.

   Right click on it to display the horizontal controls context menu, or double click on it to display the **Configure Horizontal** dialog box.

10. This marker shows the trigger level and slope of a trigger source. The marker is drawn relative to, and in the same color as, the source input channel

    Hover the mouse over this control to display the trigger level, drag it vertically to increase or decrease the trigger level, right click on it to display the trigger context menu, or double click on it to display the **Configure Trigger** dialog box.

11. This dashed line is one of two cursors anchored to a vertical channel. The cursors allow the measurement of signal levels with respect to a vertical channel.

    Drag it vertically to the move cursor up or down. Note that you can move the cursor furthest from the mouse pointer to the vertical position of the mouse pointer by holding down the shift key while left-clicking.

12. This control is a horizontal scroll box. If the record width in seconds is longer than the view width as set by the horizontal scale combo box, this scroll box shows the part of the record that is currently visible.
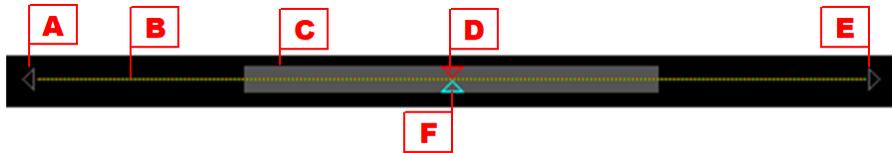
Fig. 9: Horizontal scroll bar

A. Left scroll button.

Click with the left-mouse button to view samples closer to the start of the record. Hold down the left-mouse button to automatically scroll towards the start of record.

B. Record width indicator.

This line indicates the record width, and is drawn in the colors of the enabled channels.

C. View width indicator.

This rectangle indicates the part of the record that is currently visible in the graticule.

Drag this rectangle with the left-mouse button to view a different part of the record. Click to the left of the view rectangle with the left-mouse button to scroll the view towards the start of the record, and to the right of the view rectangle scroll the view toward the end of the record.

Note that when the record width is greater than the view width, you may also scroll the view horizontally by left-clicking on the graticule background and dragging it the left or right.

D. Trigger position in record.

This arrowhead marks to the relative position of the trigger within the record.

If the view rectangle does not cover the trigger marker, hover the mouse cursor over the marker to display the current trigger position, right click to display trigger context menu, and double click to display the **Configure Horizontal** dialog box. If no waveforms are displayed, you may also drag the marker to change the trigger position.

E. Right scroll button.

Click with the left-mouse button to view samples closer to the end of the record. Hold down the left-mouse button to automatically scroll towards the end of record.

C. Expansion point.

This arrowhead marks the position of the expansion point within the view.

If the view width is greater than or equal to record width in seconds, you may drag this marker to change the position of expansion point in the view. If a waveform is displayed and you change the horizontal scale, the waveform will expand or contract around this point.

This text displays the vertical scale of each enabled input, math, and reference channel in units per vertical division. The text is drawn in the color of the channel.

Hover the mouse over the text to display the channel name, units, and input range; right click to display the channel context menu; or double click to display the **Configure Input**, **Configure Math**, or **Configure Reference** dialog box.

13. This text displays the signal values at the vertical cursors with respect to the channel anchoring the cursors, and the difference between these values. The text is drawn in the color of the channel anchoring the cursors.

    Hover the mouse over the text to display the name of the channel anchoring the cursors, right click to display the vertical channel context menu, or double click to display the **Configure Channel** dialog box.

14. The arrowhead marks the position of the expansion point in the view, and the text indicates the time from this point to the trigger position in the record.

    Drag this marker to change the position of expansion point in the view. If a waveform is displayed and you change the horizontal scale, the waveform will expand or contract around this point.

15. This vertical line is one of two horizontal cursors.

    Drag the cursor horizontally with the left-mouse button to move within a record. Note that if you left-click while holding the control key, the cursor furthest from the mouse pointer will move to the mouse pointer position.

16. This text shows the time from each horizontal cursor to the trigger position, and the difference between these two times.

    Right click on this control to display the horizontal context menu, or double click on it to display the **Configure Horizontal** dialog box.

17. This text shows the horizontal scale in seconds per horizontal division.

    Right click on this control to display the horizontal context menu, or double click on it to display the **Configure Horizontal** dialog box.

18. This arrowhead marker shows the vertical position of an input, math, or reference channel. Note that the arrowhead is filled when channel anchors the vertical cursors; otherwise the arrowhead is drawn as an outline.

    Drag this marker vertically with the left-mouse button to move the channel's waveform up or down, right click to display the vertical channel context menu, or double click to display the **Configure Input**, **Configure Math**, or **Configure Reference** dialog box.

19. This is a channel waveform.

    If acquisitions are stopped and you move the mouse over a sample in the waveform, you may:

    - Hover the mouse to display a ToolTip showing the sample's value.

    - Drag vertically with the left-mouse button to move the waveform up or down.

    - Press the shift-key and drag vertically with the left-mouse button to increase or decrease the offset between the channel marker vertical position and the waveform zero level.

    - Right click to display the channel context menu.

    - Double click to display the **Configure Input**, **Configure Math**, or **Configure Reference** dialog box.

    Note that these mouse operations work with reference channels while acquisitions are running or stopped.

3.1.2 Menu

The main window menu provides access to all AlazarDSO functionality.
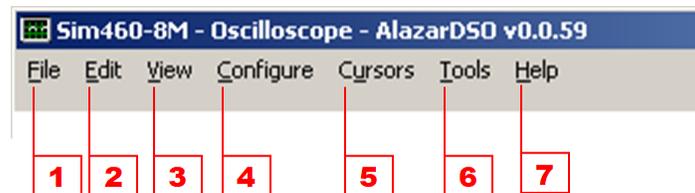
Fig. 10: Main menu

File

- Open

    Display the **Open** file dialog box to select a file containing a record to display as a reference channel, or to select a file containing an acquisition, or acquisition sequence to view.

- Save As

    Display the **Save As** dialog box to save records from the current acquisition to disk in one of several formats.

- Print

    Display the **Print** file dialog box to print the graticule to a printer attached to the system.

- Exit

  Close AlazarDSO.

Edit

- Copy Screen

  Copy the graticule as a bitmap image to the Clipboard. From there, you can paste the image into applications such as Microsoft Paint or Microsoft Word.

- Clear Acquisition

  Erase the current acquisition.

View

- Oscilloscope

  Draw records as waveforms.

- Spectrum Information

  Calculate and display the frequency components of an input channel, math, or reference channel.

- Voltmeter

  Display the minimum, maximum, average, and RMS values of records as text.

- Full Screen

  Expand the graticule to fill the screen display area. To exit full screen mode, press the Escape key, Ctrl + U, or right click in the graticule area and select **Full screen** from the context menu.

- Browse Records

  Display the **Browse Records** dialog box, which allows you to select the record from a multi-record acquisition to view in the graticule.

- Browse File

  Display the **Browse File** dialog box, which allows you to select the record from a multi-acquisition file to view in the graticule.

- Log File

  Display the program log file. This file records any errors that the program generates, and supplemental information that might help to determine the cause of the error.

Configure

- System

    Display the **Configure System** dialog box, which allows you to change the active board system, show board information, and set advanced parameters.

- Acquire

    Display the **Configure Acquire** dialog box, which allows you to set acquisition and data transfer parameters.

- Trigger

    Display the **Configure Trigger** dialog box for the selected board in the active board system. The **Configure Trigger** dialog box allows you to select a board's trigger parameters.

- Horizontal

    Display the **Configure Horizontal** dialog box, which allows you to set parameters including: trigger delay, trigger position in a record, sample rate, and clock source.

- Input

    Display the **Configure Input** dialog box for the selected input channel. The **Configure Input** dialog box allows you to select the hardware and display parameters of the board system's IO channels.

- Math

    Display the **Configure Math** dialog box for the selected math channel. The **Configure Math** dialog box allows you to select the function and display parameters of a math channel.

- Reference

    Display the **Configure Reference** dialog box for the selected reference channel. The **Configure Reference** dialog box allows you to select a file containing samples from an acquisition, and the file's display parameters.

- Plugins

    Display the **Configure Plugins** dialog box, which allows you to enable the plugin interface, and enable plugin modules.

- Display

    Display the **Configure Display** dialog box, which allows you select display related parameters such as: the graticule colors, the waveform display style, the user interface language, and the number of math and reference channels.

- Load

    Display the **Open** file dialog, which allows you to load AlazarDSO settings previously saved to a file.

- Load Recent

   Load one of the recently used settings files.

- Load Default

   Restore the system default settings.

- Save

   Save the current settings file to disk now.

- Save As

   Save the current settings to a new settings file.

Cursors

- Hide Vertical

   Don't show the vertical cursors.

- Input

   Show the vertical cursors anchored to the selected input channel.

- Math

   Show the vertical cursors anchored to the selected math channel.

- Reference

   Show the vertical cursors anchored to the selected reference channel.

- Show / Hide Horizontal

   Show the horizontal cursors if they are hidden, or hide them if they are shown.

Tools

- Benchmark | Hard Disk

   Display the Disk Benchmark wizard, which allows you to measure the sequential write speed of your hard drives.

- Benchmark | Bus

   Display the Bus Benchmark wizard, which allows you to measure the average sustained transfer rate from your AlazarTech digitizer boards to host memory.

- Coprocessor

   Display the Coprocessor dialog, which allows you to configure and control the coprocessor FPGA on boards with a user-programmable FPGA. This menu item is enabled only if your board has a user programmable FPGA.

- Digital Signal Processing | Digital Filter

Display the Digital Filter dialog, which allows you to insert a digital filter in the signal path.

- Digital Signal Processing | Spectrum Information

Display the properties a currently displayed waveform in Spectrum Analyzer View mode.

- Debugging | Start logging calls made to ATSApi.dll.

Select this menu item to enable logging functions calls into ATSApi.dll.

Note that this setting affects all applications that call into the ATSApi.dll, and that you must restart you application for changes in this setting to take effect.

- Acquire To File

Display the **Acquire To File** dialog box, which allows you to save acquisitions from single-ported memory to file.

- Stream To Memory

Display the **Stream To Memory** wizard, which allows you to save acquisitions from dual-ported memory to memory.

Help

- Contents

Display the local help system.

- Remote Support

Launch TeamViewerQS.exe which allows you to share your desktop so that AlazarTech can provide remote support.

- On the Web

Launch your default web browser to visit AlazarTech on the web, or open your default email program to send us an email.

- About

Display the **About** dialog box which allows you to view AlazarDSO version and copyright information.

3.2 Keyboard Shortcuts

3.2.1 General keyboard shortcuts

F1	Display on-line help
F4 or I	Display **Board Properties** dialog box
F5	Display **Coprocessor** dialog box
F6	Display **Board Calibration** wizard
F8	Display **Stream To Disk** wizard
F9	Display **Spectrum Information** dialog box
F10	Display **Configure Preferences** dialog box
Ctrl + B	Display **Browse File** dialog box
Ctrl + C	Copy graticule area to clipboard
Ctrl + F	Display **Find Sample** dialog box
Ctrl + O	Display **Open File** dialog box
Ctrl + P	Display **Print File** dialog box
Ctrl + Q	Switch to oscilloscope view
Ctrl + R	Display **Browse Records** dialog box
Ctrl + S	Display **Save As** dialog box
Ctrl + U	Toggle full screen mode
Ctrl + V	Toggle view mode
	Clear waveforms

3.2.2 Record navigation shortcuts

UP ARROW	Display next record in transfer
DOWN ARROW	Display previous record in transfer
CTRL+UP ARROW	Display last record in transfer
CTRL+DOWN ARROW	Display first record in transfer
LEFT ARROW	Scroll current record division left
RIGHT ARROW	Scroll current record division right
HOME	Scroll current record to trigger position
PAGE UP	Scroll current record graticule width right
PAGE DOWN	Scroll current record graticule width left
CTRL+LEFT ARROW	Scroll current record to first sample
CTRL+RIGHT ARROW	Scroll current record to last sample

3.2.3 Cursor keyboard shortcuts

1	Show or hide Ch 1 cursors
2	Show or hide Ch 2 cursors
3	Show or hide Ch 3 cursors
4	Show or hide Ch 4 cursors
5	Show or hide Ch 5 cursors
6	Show or hide Ch 6 cursors
7	Show or hide Ch 7 cursors
8	Show or hide Ch 8 cursors
9	Show or hide Ch 9 cursors
0	Show or hide Ch 10 cursors
Shift + 1	Show or hide Ch 11 cursors
Shift + 2	Show or hide Ch 12 cursors
Shift + 3	Show or hide Ch 13 cursors
Shift + 4	Show or hide Ch 14 cursors
Shift + 5	Show or hide Ch 15 cursors
Shift + 6	Show or hide Ch 16 cursors
A	Show or hide Math Ch A cursors
B	Show or hide Math Ch B cursors
C	Show or hide Math Ch C cursors
D	Show or hide Math Ch D cursors
E	Show or hide Math Ch E cursors
F	Show or hide Math Ch F cursors
G	Show or hide Math Ch G cursors
H	Show or hide Math Ch H cursors
R	Show or hide Reference Ch R cursors
S	Show or hide Reference Ch S cursors
T	Show or hide Reference Ch T cursors
U	Show or hide Reference Ch U cursors
V	Show or hide Reference Ch V cursors
W	Show or hide Reference Ch W cursors
X	Show or hide Reference Ch X cursors
Y	Show or hide Reference Ch Y cursors
Shift + H	Show or hide horizontal cursors
Shift + V	Hide vertical cursors
Ctrl + drag horizontal (timebase)	Move both horizontal cursors together.
Ctrl + drag vertical (channel)	Move both vertical cursors together.
Ctrl + left mouse click	Move the horizontal cursor furthest from the mouse to it.
Shift + left mouse click	Move the vertical cursor furthest from the mouse to it.

3.3 Dialogs

This section describes each AlazarDSO dialog box.
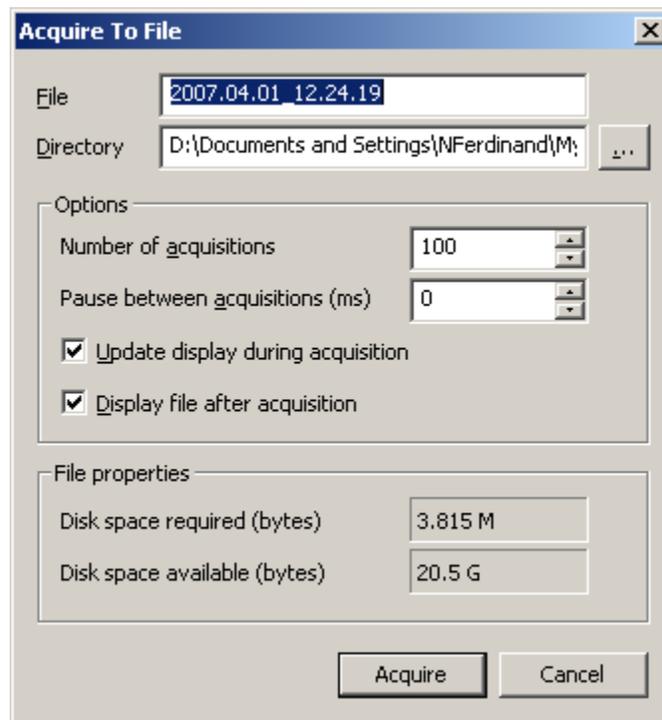
3.3.1 Acquire To File

Fig. 11: Acquire to File dialog box

The **Acquire to File** dialog allows you to save a sequence of acquisitions to a file, and optionally view the saved acquisitions. The acquisitions are made with your current acquisition settings.

File
> Enter the file name. The software creates a default file name from the current date and time, and will automatically append the extension ".ATB" to the file name.

Directory
> Enter the name of the directory in which to create the file, or press the "..." button to display a directory chooser dialog box which will allow you to select a directory.

Number of acquisitions
> Enter the total number of acquisitions to save.

Pause between acquisitions
> Enter the time in milliseconds to pause between each acquisition.

Update display during acquisition
> Check this box to view records as they are acquired.

Display file after acquisition

Check this box to display the **Browse File** dialog box after the acquisition has completed. The **Browse File** dialog allows you to view the acquisition file, one record at a time.

Note that if you close the **Browse File** dialog, you can display it again by selecting **Browse File** from the **View** menu until you make another acquisition or exit the program. If you make another acquisition or restart the program, then select **Open** command from the **File** menu and select the file by name.

Disk space required

The disk space in bytes that is required for the file.

Disk space available

The disk space in bytes that is available on the volume containing the selected directory.

Acquire

Press the **Acquire** button to save your settings and start the acquisition.

Note that this button is disabled when the number of acquisitions would create a file requiring more disk space than is available. If the button is disabled, consider reducing the number of acquisitions, or changing the directory to one on a different physical volume with more available disk space.

Cancel

Press to discard your settings and return to the main window.

3.3.2 Advanced Options

The **Advanced Options** dialog box allows you to control the board simulator, memory usage, and internal program options.

Note that AlazarDSO may cease to startup or function correctly if you change memory or system options from their default values. If this occurs, please rename or delete the "AlazarDSO.ini" file in the "My Documents\AlazarTech" folder. AlazarDSO will create a new "AlazarDSO.ini" configuration file with default parameters the next time it is started.

Enable board simulator

AlazarDSO includes a board simulator that generates sample data when no physical boards are installed. Check this box to enable the board simulator. It is disabled by default.

The simulator creates two board systems. Board system 1 is made up of one ATS460-8M. This board system can't be modified, and is selected by default when no physical boards are installed. However board system 2 is fully programmable. You can select the board type, number, and maximum samples per channel in order to simulate any possible AlazarTech board system.

Board type

Select the board type for simulated board system 2 from the list of available boards.

Number of boards

Enter the number of boards in simulated board system 2. The minimum value is 1 and the maximum is 8.
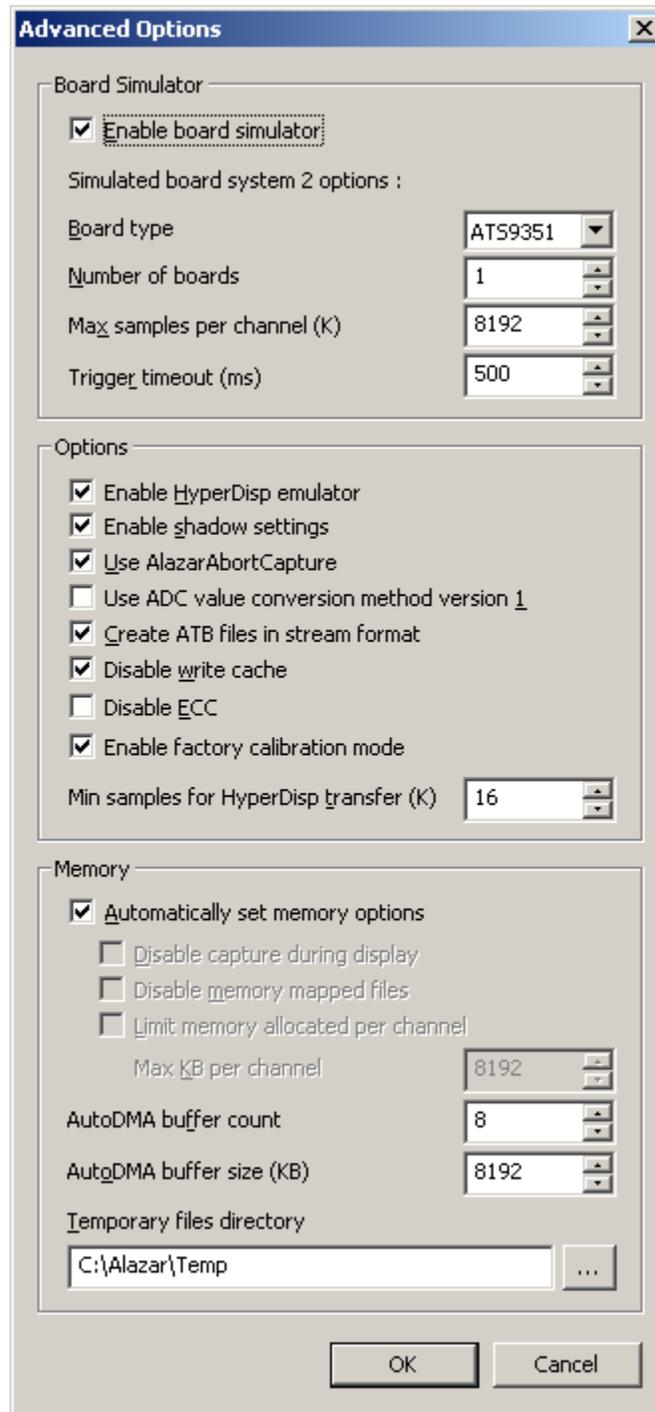
Fig. 12: Advanced Options dialog box

Max samples per channel

Enter the maximum number of kilo-samples per channel in simulated board system 2. The minimum value is 1 kilo-sample, and the maximum is 131072 kilo-samples (i.e. 128 mega-samples).

Trigger timeout

Enter the time in milliseconds between the start of capture and the trigger event in a simulated acquisition sequence.

Enable HyperDisp emulator

The HyperDisp emulator is software that post-processes acquisition data into a form that is efficient for drawing on screen. Check this box to enable this option. Under most conditions, the time required to draw a waveform on screen will decrease significantly when this option is enabled.

Enable shadow settings

AlazarDSO maintains a copy in host memory of the configuration parameters last written to each board in the active board system. If this option is enabled and the board configuration changes, the software only writes the configuration parameters that have changed to the board. If this option is not enabled, the software writes all board configuration parameters to the board. Check this box to enable this option.

Use AlazarAbortCapture

Select between using AlazarAbortCapture or AlazarForceTrigger to abort an in-progress capture. Check this box to use AlazarAbortCapture.

Use ADC value conversion method version 1

The ADC calibration method determines how AlazarDSO should convert ADC sample values into volts. Check this box if your AlazarTech boards were last calibrated using method 1.

- Version 1

   The sample zero level is $2 \wedge (BitsPerSample - 1)$ and the maximum amplitude is $(2 \wedge (BitsPerSample - 1)) - 1$. This method was used on boards calibrated June 30, 2007 or earlier.

- Version 2

   The sample zero level is $2 \wedge (BitsPerSample - 1) - 0.5$ and the maximum amplitude is $2 \wedge (BitsPerSample - 1) - 0.5$. This method was used on boards calibrated July 1, 2007 or later.

Create ATB Files in stream format

Check this option to allow the "Stream To Disk" wizard to create ATB files in raw stream data format. If not checked, AlazarDSO will create "Stream To Disk" files in record contiguous format.

Disable write cache

Check this option to disable intermediate buffering and caching by the system while writing to file.

Disable ECC

Some digitizer models include ADCs that require error correction circuits (ECC) for operation

at their highest rated sampling frequencies. However, the ECC may introduce artifacts at lower sample frequencies.

Check this option to disable ADC error correction. Note that this control is disabled if the digitizer does not use ECC.

Enable factory calibration mode
Check this option to display of advanced calibration options in the board calibration wizard. These advanced options require specialized equipment that is not normally available outside the factory. A password is required to enable this option.

Min samples for HyperDisp transfers
Enter the minimum number of kilo-samples required to activate on-board HyperDisp. On-board HyperDisp pre-processes capture data into a form that is efficient for transfer to host memory, and display on screen. Note that for HyperDisp transfers to be activated that Hyper-Disp must be enabled in the **Configure Acquire** dialog box, and the number of samples per record must be greater than or equal to this value.

Automatically set memory options
Enable this option to allow AlazarDSO to automatically set memory allocation options based on the amount available physical memory in your system. This option is enabled by default.

Disable capture during display
AlazarDSO can acquire data in one of two modes:

- Acquire and transfer sample data from the board system to host memory, and then display it on screen.

- Acquire and transfer sample data from the board system to host memory while, at the same time, displaying data from the previous acquisition on screen.

Capture during display should improve acquisition rates under most conditions, but requires at least two buffers for acquisition data. It is enabled by default if there is sufficient physical memory available.

Disable memory mapped files
AlazarDSO can allocate memory backed by the system page file, or create temporary files that the system maps into memory as needed. Using memory mapped files removes the risk of running out of space in the system page file, but requires disk space for the temporary files. By default, memory mapped files are enabled if the "limit memory allocated per channel" option is not enabled.

Limit memory allocated per channel
AlazarDSO can limit amount of memory that it allocates to store sample data from each transfer in an acquisition.

If this option is enabled and the number of samples per transfer is greater than the number of samples that can fit entirely into memory, AlazarDSO will split the data transfer into segments that can fit entirely into memory. It will write these segments to a temporary file during the board to host memory data transfer. After the board to host data transfer is complete, it will read segments from the temporary file into memory to process and display the sample data.

This option enables AlazarDSO to work with board systems that have one or more digitizers with 128MS per channel or greater under 32-bit operating systems. These board systems re-

quire more virtual memory to store all of the samples possible in one transfer than is available under a 32-bit operating system.

Max KB per channel
Enter the maximum amount of memory to allocate per channel when the "limit memory allocated per channel" option is enabled. AlazarDSO will allocate this amount of memory per channel if the maximum number of samples per channel of a board in the current board system is greater than the number of samples that can fit into this amount of memory.

AutoDMA buffer count
Enter the number of buffers to allocate for continuous AutoDMA transfers. The minimum value is 2, the maximum value is a function of the amount of physical memory available, and the default value is 3.

Max bytes per AutoDMA buffer
Enter the maximum number of kilobytes per AutoDMA transfer. This value is used to limit the size of AutoDMA transfers in the **Configure Acquire** dialog box and **Stream To Disk** wizard.

Temporary files directory
Select a folder to create temporary files. The free disk space on the volume containing this folder must be at least two times the on-board memory size in bytes of all of the digitizer boards in the board system.

OK
Press this button to save the current settings, and close this dialog box.

Cancel
Press this button to discard any changes and close this dialog box.

3.3.3 AutoDMA Options

The **AutoDMA Options** dialog box allows you to select the transfer mode and options for acquisitions from dual-ported memory.

Data source
The data source defines the source of sample data on the digitizer board.

- **Dual-ported memory**

  Sample data is buffered in dual-ported memory before being transferred to host memory.

- **FIFO**

  Sample data is transferred directly from an on-board FIFO to host memory.

Transfer method
The transfer method defines how DMA transfers are made from on-board to host memory.

- **AlazarAsyncRead**

  The system queues several DMA transfer buffers to each board, and waits for hardware interrupts to indicate when the transfers have completed.
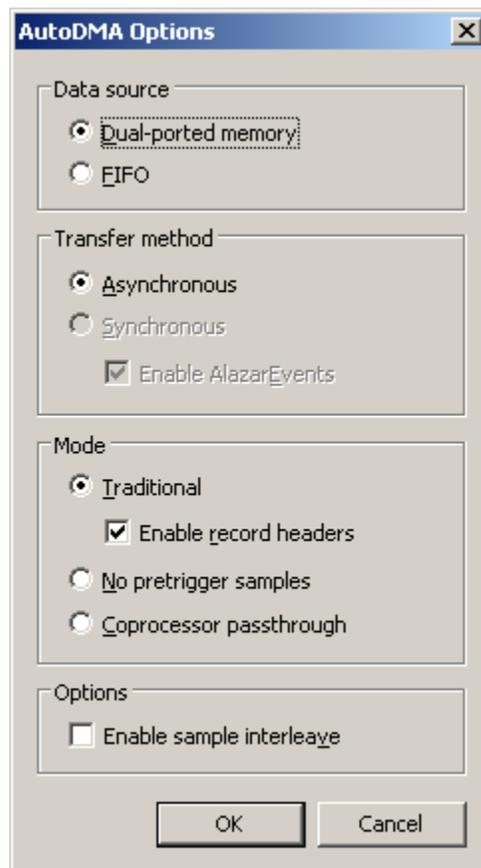
- **AlazarGetNextAutoDmaBuffer**

Fig. 13: AutoDMA Options dialog box

The system queues a single DMA transfer buffer, and polls to determine when a transfer has completed.

Enable AlazarEvents

When synchronous transfers are selected, enable this option to reduce CPU usage by waiting on an event rather than polling for the end of a DMA transfer. Note that AlazarEvents is used only with the AlazarGetNextAutoDmaBuffer API.

AutoDMA mode

The AutoDMA mode selects how the digitizer organizes samples from its ADC converters into records and buffers.

- **Traditional**

  Acquire multiple records (one per trigger event), optionally with samples before each trigger event and record headers and timestamps.

- **No pre-trigger samples (NPT)**

  Acquire multiple records (one pre trigger event) without pre-trigger samples or record headers. Select this mode for faster trigger repeat rates than possible in traditional AutoDMA mode.

- **Coprocessor pass-through**

  Transfer data for processing by a co-processor FPGA.

Enable record headers

Check to enable the board firmware to add a header to each record.

Note that record timestamps are transferred with the record header. As a result, record timestamps will not be available unless this option is enabled.

Enable sample interleave

This option controls how a board transfers records from on-board to host memory. When this enabled, a board transfers one sample from a record of CH A followed by the corresponding sample from the corresponding record of CH B. This method produces higher transfer rates from on-board to host memory, but requires that software de-interleave samples.

When this option is not enabled, the board transfers all of the samples from a record of CH A, followed by the all of samples from the corresponding record of CH B. This method produces lower transfer rates from on-board to host memory than sample interleaved records.

OK

Press this button to save the current settings, and close this dialog box.

Cancel

Press this button to discard any changes and close this dialog box.
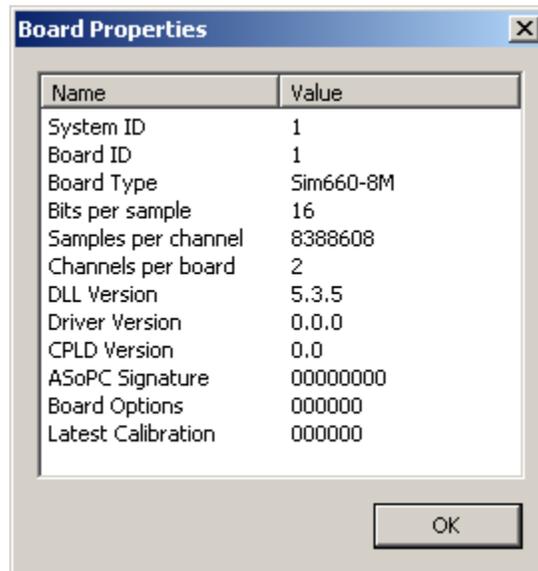
3.3.4 Board Properties

Fig. 14: Board Properties dialog box

The board properties dialog box allows you to view hardware and software properties of the selected board. Note that you can display this dialog box by pressing the "Ctrl + I" hotkey.

System ID
> This value is the system identifier to which the selected board belongs.

Board ID
> This value is the board identifier of the selected board in its board system.

Board Type
> This value shows the model and maximum samples per channel of the board.

Driver Version
> This value shows the board's device driver version.

Bits per sample
> This value shows the sample width in bits.

Sample per channel
> This value shows the memory depth in samples per channel.

Channels per board
> This value shows the number of input channels on the board.

DLL version
> This value shows the version of the AlazarTech system file ATSApi.dll used by this board.

Driver version
> This value shows the version of the board's device driver.

CPLD Version
> This value shows the board's CPLD version.

ASoPC Signature

This value shows the board's FPGA version.

Serial Number

This value is the board's serial number.

PCB Revision

This value shows the board's PCB revision, if the firmware is capable of reporting this information.

Board Options

This value shows the board's installed option code.

Latest Calibration

This is the date when the board was last calibrated.

OK

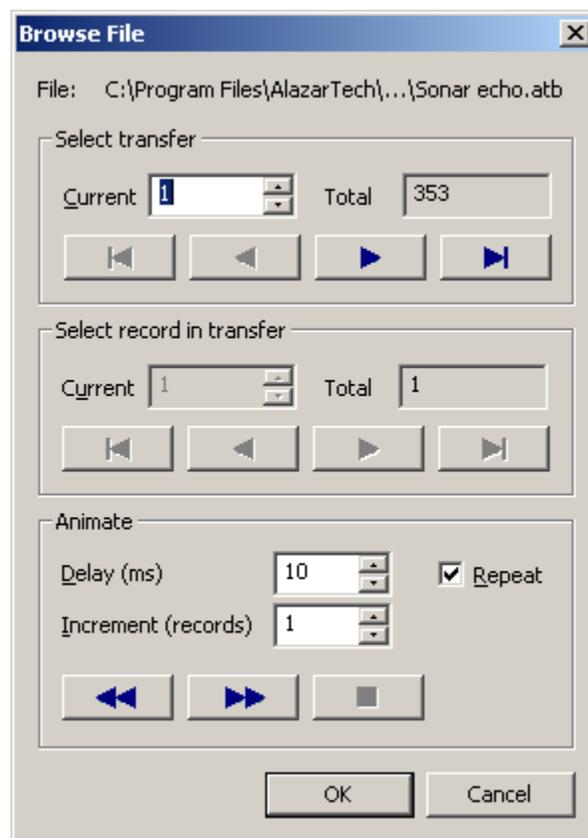Press to close the dialog box.

3.3.5 Browse File

Fig. 15: Browse File dialog box

The **Browse File** dialog box allows you to select a record to display from all the records in a multi-record, multi-acquisition file. It also allows you to automatically scan forward or backward through

the records in the file.

Hover the mouse over an icon button to display a ToolTip window with a description of its function.

Path
>   This control shows current file path. If the full path is too long to be displayed in the control, hover the mouse over the abbreviated path to display a ToolTip window containing the full path.

Current Acquisition
>   Enter an acquisition, or use the up- or down-buttons to select the next or previous acquisition from all the acquisitions in the file.

Total Acquisitions
>   Shows the total number of acquisitions in the file.

Display First Acquisition
>   Display the current record from the first acquisition in the file.

Display Previous Acquisition
>   Display the current record from the previous acquisition in the file.

Display Next Acquisition
>   Display the current record from the next acquisition in the file.

Display Last Acquisition
>   Display the current record from the last acquisition in the file.

Current Record
>   Enter a record, or use the up- or down-buttons to select the next or previous record in the current acquisition.

Total Records
>   Shows the total number of records in the current acquisition.

Display First Record
>   Display the first record from the current acquisition.

Display Previous Record
>   Display the previous record from the current acquisition.

Display Next Record
>   Display the next record from the current acquisition.

Display Last Record
>   Display the last record from the current acquisition.

Delay
>   Select the time in milliseconds to pause between each record in animation mode.

Increment
>   Select the number of records to add to the current record between screen updates in animation mode.

Repeat
>   Check this button to continue the animation in a loop until you press the **Stop** button.

Scan Backward

>   Scan backwards to display all the records in the current acquisition. After the first record of the current acquisition has been displayed, continue from the last record the previous acquisition. After the first record of the first acquisition has been displayed, continue from the last record of the last acquisition if the **Repeat** box is checked, or stop if the **Repeat** box is not checked.

Scan Forward

>   Scan forward to display all the records in the current acquisition. After the last record of the current acquisition has been displayed, continue from the first record the next acquisition. After the last record of the last acquisition has been displayed, continue from the first record of the first acquisition if the **Repeat** box is checked, or stop if the **Repeat** box is not checked.

Stop

>   Stop the scan through the records.

OK

>   Press this button to save the current settings, and close this dialog box.

Cancel

>   Press this button to discard any changes and close this dialog box.
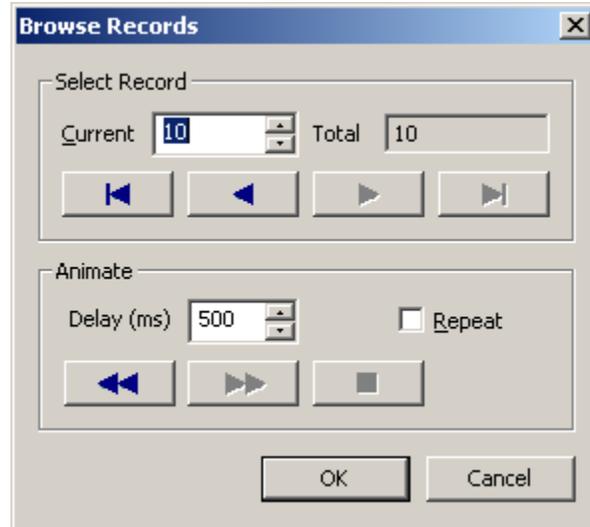
3.3.6 Browse Records

Fig. 16: Browse Records dialog box

The **Browse Records** dialog box allows you to select a record to display from all the records in a multi-record acquisition. It also allows you to automatically scan forward or backward through the records in the acquisition.

Hover the mouse over an icon button to display a ToolTip window with a description of its function.

Current

>   Enter a record to display, or use the up- or down-buttons to select the next or previous record.

Total

Shows the total number of records in the acquisition.

Display First Record

Display the first record in the acquisition.

Display Previous Record

Display the previous record in the acquisition.

Display Next Record

Display the next record in the acquisition.

Display Last Record

Display the last record in the acquisition.

Delay

Select the time in milliseconds to display each record in animation mode.

Repeat

Check this button to continue the animation in a loop until you press the **Stop** button.

Scan Backward

Scan backwards to display all the records in the acquisition. After the first record in the acquisition has been displayed, continue from the last record in the acquisition if the **Repeat** box is checked.

Scan Forward

Scan backwards to display all the records in the acquisition. After the last record in the acquisition has been displayed, continue from the first record in the acquisition if the **Repeat** box is checked.

Stop

Stop the scan through the records.

OK

Press this button to save the current settings, and close this dialog box.

Cancel

Press this button to discard any changes and close this dialog box.

3.3.7 Configure Acquire

The **Configure Acquire** dialog box allows you to set the system's acquisition and data transfer parameters.

Samples per record

Enter the number of samples points per record per channel.

Enable single-ported memory

Check this radio button for the system to acquire samples to on-board memory and then, once the acquisition is complete, transfer the sample data to host memory.

Records per acquisition

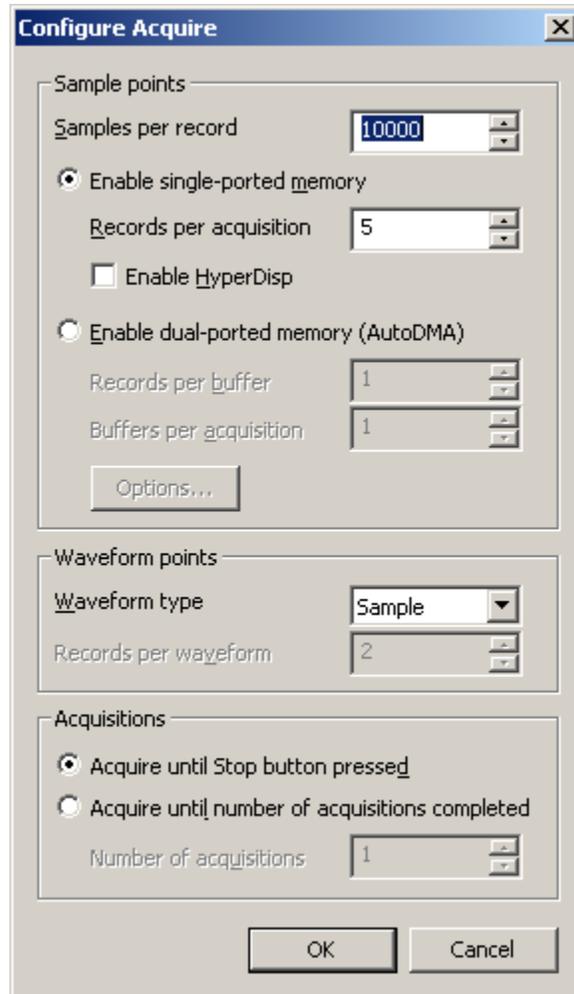Enter the number of records in each acquisition. The board system acquires this number of

Fig. 17: Configure Acquire dialog box

records to on-board memory without intervention from the host PC. The minimum value is 1 and the maximum value is board dependent.

Enable HyperDisp

Check to enable **HyperDisp** transfers from on-board to host memory. When enabled, the board's firmware pre-processes sample data into a form that reduces the amount of data that is transferred over the PCI / PCIe bus, and that must be further processed for display by host software.

Enable dual-ported memory

Check this radio button to enable the system to acquire samples to on-board memory at the same time that data from the previous acquisition is transferred from on-board to host memory. Note that this option is available only if the boards in your board system have optional dual ported memory.

Records per buffer

In dual-ported memory mode, an acquisition is split into DMA transfers that move sample data from on-board to PC host memory while, at the same time, on-board memory is filled with acquisition data.

Enter the size of each DMA transfer in records that will be moved from on-board to host memory with each DMA transfer. The minimum value is 1, the maximum is the number of records in an acquisition, and the value must be a factor of the records per acquisition.

Buffers per acquisition

In dual-ported memory mode, the total number of records per acquisition is the product of the records per buffer and the buffers per acquisition. Enter the number of number of buffers per acquisition.

Options

Press this button to display the **AutoDMA Options** dialog box, which allows you to configure dual-ported memory acquisition and data transfer settings.

Waveform type

AlazarDSO can process sample records into waveform records before displaying the waveform record on screen. Select a waveform type from the combo box.

- Sample

  Each waveform point corresponds to one sample point from an acquisition record.

- Average

  Each waveform point is the average of the samples points from a number of consecutive records in a multi-record acquisition.

Records per waveform

Enter the number of acquisition records used to calculate one average record.

Note that in single-ported memory mode, the number of records must be less than or equal to the number of records per acquisition, and must be evenly divisible into the number of records per acquisition.

In dual-ported memory mode, the number of records per waveform must be less than or equal to the number of records per buffer, and must be evenly divisible into the number of records

per buffer.

Acquire until stop button pressed

Check this radio button to continue acquiring data until you press the **Stop** acquisitions button at the top-right of the main window.

Acquire until number of acquisitions completed

Check this radio button to stop acquiring data automatically after the specified number of acquisitions have completed.

Number of acquisitions

Enter the number of acquisitions to complete before automatically stopping data acquisition.

OK

Press this button to save the current settings, and close this dialog box.

Cancel

Press this button to discard any changes and close this dialog box.

3.3.8 Configure Horizontal

The Configure Horizontal dialog box allows you to control timebase and time delay parameters.

Trigger delay

Enter the delay, in seconds or samples, between a trigger event and the trigger position in a within a record.

Position in record

Enter the trigger position in a record as percent of the record width.

Pre-trigger samples

This control displays the number of pre-trigger samples per record. Note that the number of pre-trigger samples is rounded so that it is a multiple of 64 samples.

Internal clock source

Check this radio button to enable the board's internal crystal oscillator as the timebase clock.

- **Automatically set sample rate**

  Check the radio button to allow the software to automatically select a sample rate based on the current number of samples per record, and the time per horizontal division.

- **Select sample rate**

  Check this radio button to select a sample rate from the sample rate combo box.

- **Select clock frequency**

  Check this radio button to select a custom sample clock frequency in MHz. This option configures the digitizer to use "Internal 10 MHz PLL" clock mode, if available, and the sample frequency must be one of the frequencies supported by the digitizer in this mode.

External clock source

Check this radio button to use an external clock as the timebase clock.
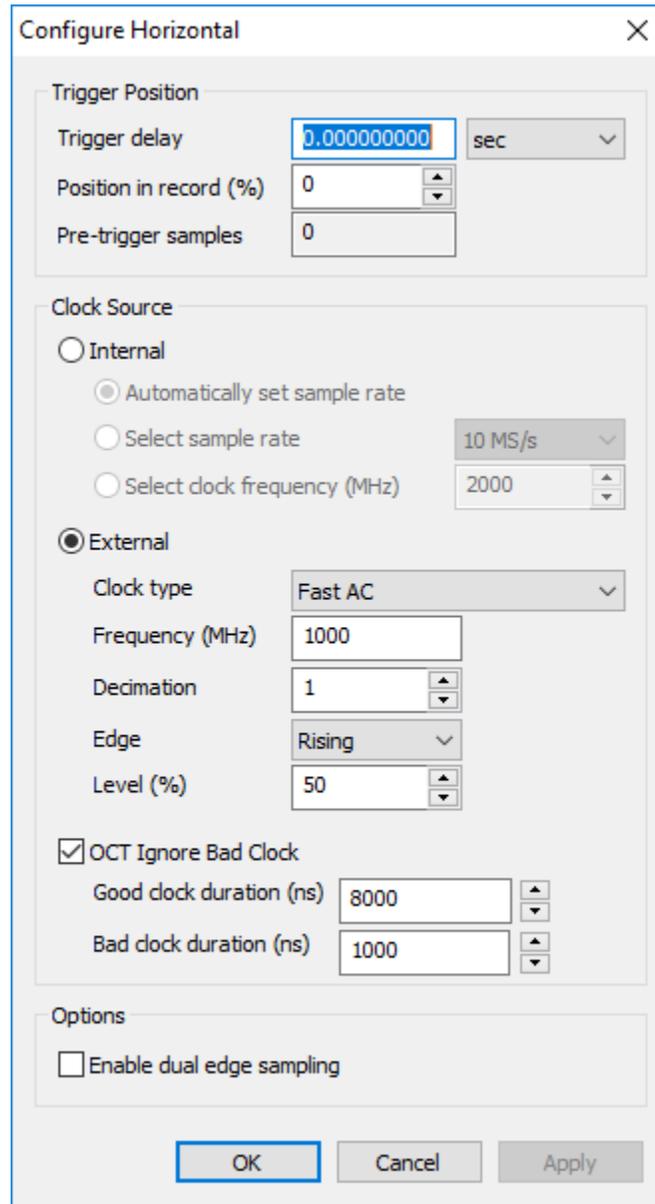
Fig. 18: Configure Horizontal dialog box

Note that you should select this option only if your board has the optional external clock input, and you have connected a suitable external clock signal to this input.

- **Frequency**

  Enter the nominal frequency of the external clock signal in megahertz.

  Note that this value is used to scale sample values for display and, if the *10 MHz PLL* external clock source is selected, to set the sample clock frequency.

- **Decimation**

  Enter a for the programmable clock divider.

- **Edge**

  Select the rising or falling edge as the active edge of the external clock from the edge combo box.

- **Level (%)**

  Select the external clock threshold level as a percent of full range input.

OCT Ignore bad clock
   The OCT Ignore bad clock option enables the digitizer to use an internally generated clock signal to drive its ADCs at specified times during an acquisition. Applications should consider enabling that mechanism and setting a bad and a good clock duration if the external clock signal is unusable for a period of the acquisition.

Good clock duration (ns)
   When OCT Ignore bad clock is enabled, specify the 'good clock' duration in nanoseconds, i.e. when the extern clock is valid. The digitizer will switch to an internal clock at the end of the 'good clock' duration and use it during 'bad clock' duration. After the 'bad clock duration' is over, the digitizer will switch back to using the external clock signal.

Bad clock duration (ns)
   When OCT Ignore bad clock is enabled, specify the bad clock' duration in nanoseconds, i.e. when the extern clock is not valid.

Enable dual edge sampling
   Check this button to increase the sample rate by two by acquiring two samples per ADC clock pulse. Note that only one channel per board can be enabled when this option is selected.

OK
   Press this button to save the current settings, and close this dialog box.

Cancel
   Press this button to discard any changes and close this dialog box.

Apply
   Press this button to apply the current settings without closing the dialog box.
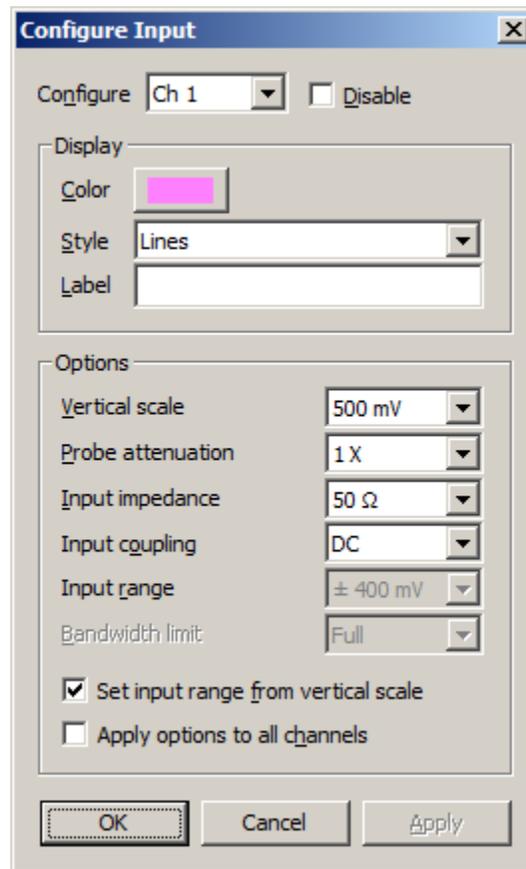
3.3.9 Configure Input

Fig. 19: Configure Input dialog box

The **Configure Input** dialog box allows you to change display and hardware settings of an input channel.

Note that AlazarDSO identifies input channels as follows in a board system with 2 analog inputs channels per digitizer:

Name	Board ID	I/O Connector
Ch 1	1	A
Ch 2	1	B
Ch 3	2	A
Ch 4	2	B
Ch 5	3	A
Ch 6	3	B
Ch 7	4	A
Ch 8	4	B
Ch 9	5	A
Ch 10	5	B
Ch 11	6	A
Ch 12	6	B
Ch 13	7	A
Ch 14	7	B
Ch 15	8	A
Ch 16	8	B

AlazarDSO identifies input channels as follows in a board system with 4 analog input channels per digitizer:

Name	Board ID	I/O Connector
Ch 1	1	A
Ch 2	1	B
Ch 3	1	C
Ch 4	1	D
Ch 5	2	A
Ch 6	2	B
Ch 7	2	C
Ch 8	2	D
Ch 9	3	A
Ch 10	3	B
Ch 11	3	C
Ch 12	3	D
Ch 13	4	A
Ch 14	4	B
Ch 15	4	C
Ch 16	4	D

Configure

This combo box shows the currently selected input channel. To configure another input channel, select the channel from the combo box.

Disable

Check this box to disable the transfer and display of data from this channel. Note that the

channel may still be used by the trigger system depending on this board's trigger configuration.

"…"

Press this button to display the "Configure Input Enables" dialog box to enable or disable other inputs.

Color

This button displays the color used to draw the channel's marker, waveform, and vertical scale in the graticule, and in the tab in the input channel tab control. Press this button to display **Color** dialog box to select another color.

Style

Select a display style to use when drawing this channel's waveform.

- Select **Points** to draw each waveform sample as a single pixel.

- Select **Lines** to draw line segments between waveform points.

- Select **Lines with points** to draw line segments between waveform points, and markers at each point.

- Select **Wide lines** to draw wide line segments between waveform points.

- Select **Extra-wide lines** to draw very wide line segments between waveform points.

Label

Enter a text label to associate with this channel. The text is displayed in the channel marker ToolTip, and in the channel tab control. The label can be up to 20 characters.

Vertical scale

Select a value in volts per vertical division from the combo box. This value is used to scale sample values when drawing the channel's waveform.

Probe attenuation

Select a value from the combo box that matches the ratio by which this channel's probe attenuates input signals. AlazarDSO uses this value to scale waveforms to their size before attenuation by the probe.

Input impedance

Select a value in Ohm from the combo box. The value is used to select the programmable input impedance of the input channel.

Input coupling

Select a coupling value from the combo box. The value is used to select the programmable coupling of the input channel.

Input range

Select the input range at the channel IO connector from the combo box.

The input range at the probe is this value multiplied by the probe attenuation. Note that this combo box is disabled when the **Set input range from vertical scale** button is checked.

Bandwidth limit

Select a bandwidth limit from the combo box. Note that this combo box is disabled when boards in the current board system don't have a programmable bandwidth limit.

Set input range from vertical scale

> Check this box to allow AlazarDSO to automatically select the input range from the current vertical scale value. If checked, AlazarDSO selects an input range greater than or equal to four vertical divisions at the current vertical scale, if possible.

Apply options to all input channels

> Check this box to apply the following options to all input channels, not just the currently selected channel, when you press the OK or Apply buttons.

> - disabled state
> - set input range from vertical scale value
> - vertical scale value
> - probe attenuation value
> - input range value
> - input impedance value
> - input coupling value

OK

> Press this button to apply changes to the configuration of the selected channel, save the position of the dialog box on screen, and close the dialog box.

Cancel

> Press this button to discard any changes and close this dialog box.

Apply

> Press this button to apply changes to the configuration of the currently selected channel immediately.

3.3.10 Configure Input Enables

The **Configure Input Enables** dialog box allows you to enable the acquisition, transfer and display of sample data from input channels. It performs the same function as the "Disable" button on the "Configure Input" dialog, but allows you to control all channel enables from a single location.

Channels 1-16

> Check these buttons to enable selected inputs channels.

Enable All

> Check this button to enable all input channels.

Invert

> Check this button to invert the current state of each input enable.

Enable 1

> Check this button to enable only channel 1.

Enable 2

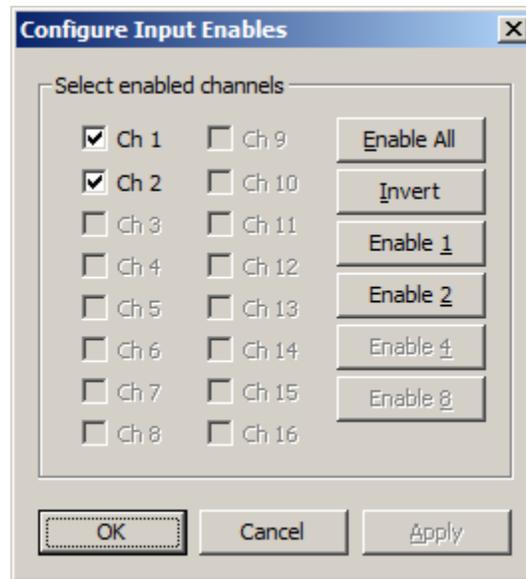> Check this button to enable only channels 1 and 2.

Fig. 20: Configure Input Enables dialog box

Enable 4

Check this button to enable only channels 1 through 4.

Enable 8

Check this button to enable only channels 1 through 8.

OK

Press this button to apply the current settings, save the position of the dialog box on screen, and close the dialog box.

Cancel

Press this button to discard any changes and close this dialog box.

Apply

Press this button to enable the selected channels.

3.3.11 Configure Math

The **Configure Math** dialog box allows you to select the function, function parameters, and display properties of a math channel.

Configure

This combo box shows the currently selected math channel. To configure another math channel, select the channel from the combo box.

Disable

Check this button to disable the calculation and display of this math channel.

Color

This button displays the color used to draw the channel's waveform and vertical scale in the main window. Press the button to display **Color** dialog box and select another color.
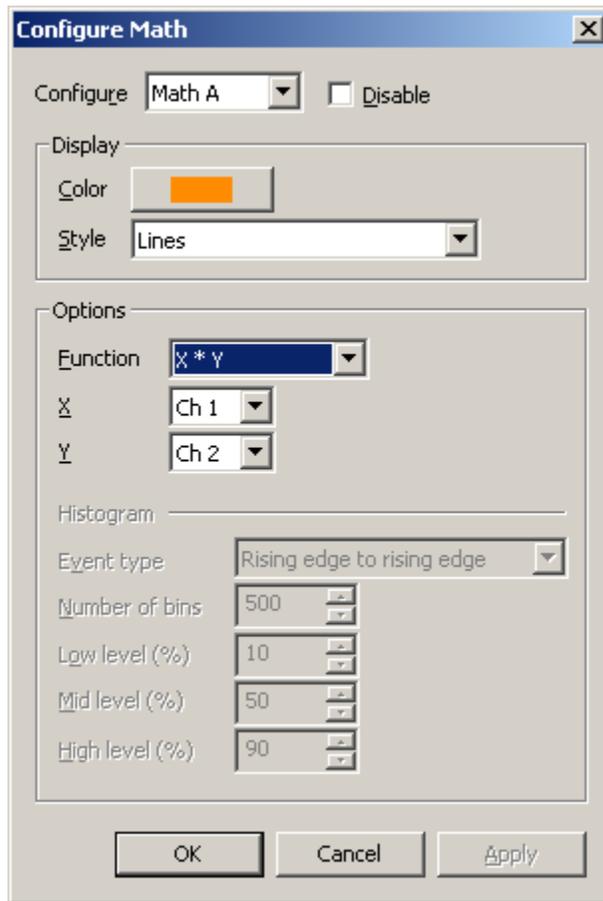
Fig. 21: Configure Math dialog box

Style

Select a display style to use when drawing this channel's waveform points.

- Select **Points** to draw each waveform sample as a single pixel.

- Select **Lines** to draw line segments between waveform samples.

- Select **Lines with markers** to draw line segments between waveform points, and markers at each point.

- Select **Wide lines** to draw wide line segments between waveform points.

- Select **Extra-wide lines** to draw very wide line segments between waveform points.

Function

Select a math function from the function combo box.

The available math functions are:

- **X + Y**

  Display the sum of two input waveforms

- **X – Y**

  Display the difference between two input waveforms

- **X * Y**

  Display the product of two input waveforms

- **Histogram**

  Calculate the times between events in an input waveform, and display the result in the form of a histogram.

- **LSB 0**

  Display the least-significant bit of each sample in an input waveform.

- **LSB 1**

  Display the second least-significant bit of each sample in an input waveform.

X

Select one of the two operands for the sum, product, or difference functions, or the one operand for the FFT or Histogram functions from the list of input channels.

Y

Select the second operand for the sum, product, or difference functions from the list of input channels. Note that this combo box is disabled if the selected function takes only one operand.

Event type

Select an event type from the combo box. AlazarDSO calculates the times between all events of this type in a waveform, groups these times into time ranges, finds the number of events in each range, and displays the result in the form of a histogram.

The software calculates the peak-to-peak amplitude of the waveform and assumes that:

- A rising edge is a transition from below to above the mid level.

- A falling edge as a transition from above to below the mid level.

- The rise time is the time required for a transition from below the low level to above the high level.

- The fall time is the time required for a transition from above the high level to below the low level.

The available event types are:

- **Rising edge to rising edge**

  Find the times between a rising edge and the next rising edge in the waveform.

- **Falling edge to falling edge**

  Find the times between a falling and the next falling edge in the waveform.

- **Rising edge to falling edge**

  Find the times between a rising edge and the next falling edge in the waveform.

- **Falling edge to rising edge**

  Find the times between a falling edge and the next rising edge in the waveform.

- **Edge to edge**

  Find the times between a rising or falling edge, and the next rising or falling edge in the waveform.

- **Rise time**

  Find the times for transitions from low to high level in the waveform.

- **Fall time**

  Find the times for transitions from high to low level in the waveform.

Number of bins
Select the number of bins into which you would like to group the event times. The width of each bin in the histogram is the total time of the waveform divided by this number of bins.

Low level
Select the low level as a fraction of the waveform's peak-to-peak amplitude.

Mid level
Select the mid level as a fraction of the waveform's peak-to-peak amplitude

High level
Select the high level as a fraction of the waveform's peak-to-peak amplitude

OK
Press this button to apply the current settings, save the position of the dialog box on screen, and close the dialog box.

Cancel
Press this button to discard any changes and close this dialog box.

Apply

Press this button to apply changes to the configuration of the currently selected channel immediately.
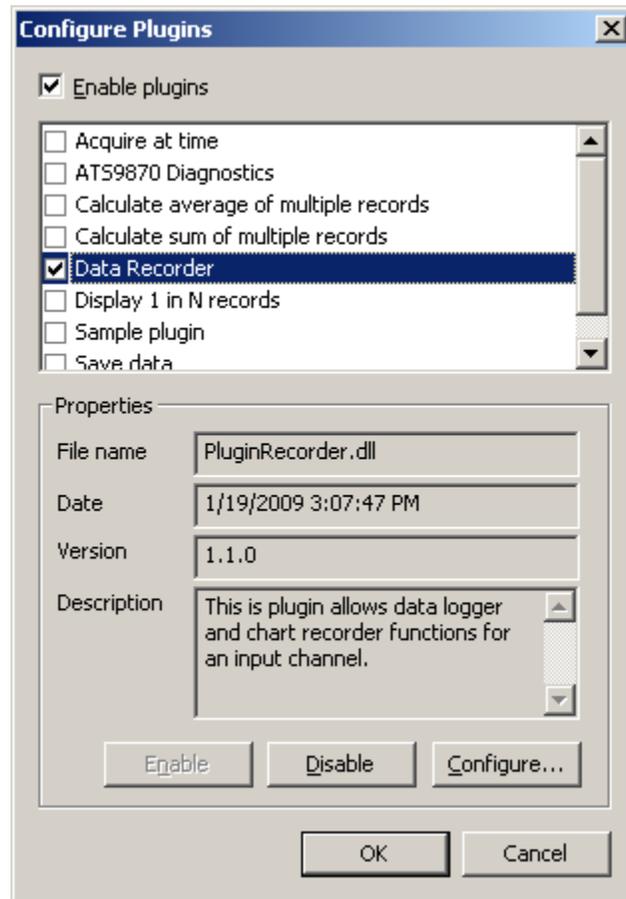
3.3.12 Configure Plugins

Fig. 22: Configure Plugins dialog box

The **Configure Plugins** dialog box allows you activate the plugin interface, and enable one or more plugin modules.

Enable plugins

Check this button to activate the plugin interface. When checked, the program sends several messages to each enabled plugin modules during every acquisition cycle.

Plugin list

This list box displays the name of all of the plugin modules found at program startup. Enabled plugin modules are displayed with check mark to the left of their names.

- Left click on a plugin name to select a plugin module from the list.

- Left click on a check box to enable or disable the selected plugin module.

- Double click with the left mouse button to both select a plugin module, and display its configuration dialog box.

Note that AlazarDSO searches for plugin modules in the following directories on program startup.

- "%Program Files%\AlazarTech\AlazarDSO\Plugins"

- "%My Documents%\AlazarTech\Plugins".

If you add or remove a plugin module, you must restart AlazarDSO to see the changes in the plugin list.

File name
This text displays the file name of the selected plugin module.

Date
This text displays the modification date and time of the selected plugin.

Version
This text displays the version information of the selected plugin.

Description
This text displays a brief description of the selected plugin.

Enable
Press this button to enable the selected plugin.

Disable
Press this button to disable the selected plugin.

Configure
Press this button to display the configuration dialog box of the selected plugin, if supported by the plugin.

OK
Press this button to save the current settings, and close this dialog box.

Cancel
Press this button to discard any changes and close this dialog box.

3.3.13 Configure Preferences

The **Configure Preferences** dialog box allows you to select the user interface language and general display properties of the program.

Language
Select a language from the list of available languages. AlazarDSO displays its user interface in this language.

Math channels
Enter the maximum number of math channels available for use. The minimum is 1, and the maximum is 8.

Fig. 23: Configure Preferences dialog

Reference channels

　　Enter the maximum number of reference channels available for use. The minimum is 1, and the maximum is 8.

Show ToolTips

　　Check this button to enable the display of ToolTips in the main window when you hover the mouse over a control. The ToolTip shows a brief description of the purpose of the control.

Note: Waveform ToolTip windows in the graticule area are always enabled, independent of this setting.

Show frame rate

　　Check this button to show the number of screen updates per second in the top left corner of the graticule area.

OK

　　Press this button to save the current settings and close this dialog.

Cancel

　　Press this button to discard the current settings and close this dialog.

3.3.14 Configure Reference

The **Configure Reference** dialog box allows you to select the file and display properties of a reference channel.

Configure

　　This combo box shows the currently selected reference channel. To configure another reference channel, select the channel from the combo box.

Disable

　　Uncheck this box to enable the display the selected file as reference channel.
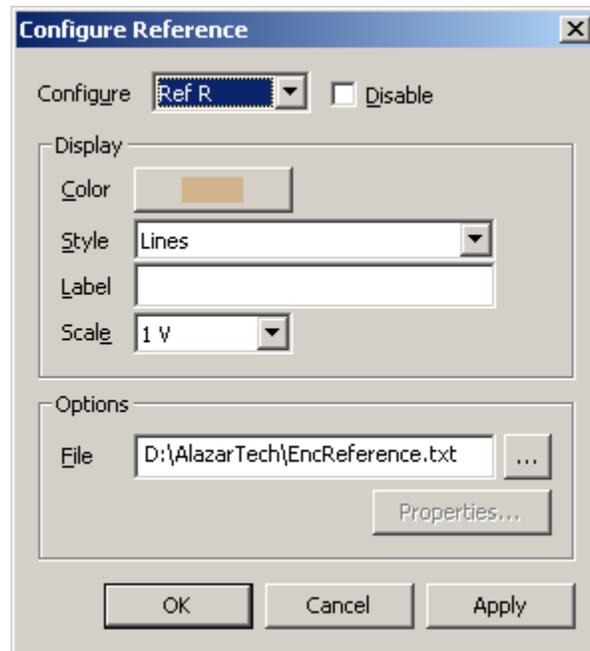
Fig. 24: Configure Reference dialog box

Color

 This button displays the color used to draw the channel's waveform and vertical scale in the main display area. Press the button to display **Color** dialog box and change this color.

Style

 Select a display style to use when drawing the channel's waveform points.

- Select **Points** to draw each waveform sample as a single pixel.

- Select **Lines** to draw line segments between waveform samples.

- Select **Lines with markers** to draw line segments between waveform samples, and markers at each sample point.

- Select **Wide lines** to draw wide line segments between waveform points.

- Select **Extra-wide lines** to draw very wide line segments between waveform points.

Label

 Enter a text label to associate with this channel. The text is displayed in the channel marker ToolTip, and in the channel tab control. It can be up to 20 characters.

File

 Enter the full path to a file, or press the "**. . .**" button to display a file chooser dialog and select a file from the list control.

Supported file types are:

- AlazarTech text and binary records.

- APIPanel text and binary records saved with or without headers.

- FlexPro® records saved as text or samples.

- MATLAB® 2-D numerical arrays with no imaginary component.

- ASCII text files with one value per line per entry in volts or samples

- Binary files with one or two bytes per sample.

Properties
Press this button to display the Import File dialog box in order to view and modify the file's properties.

OK
Press this button to apply the current settings, save the position of the dialog box on screen, and close the dialog box. When this button is pressed, AlazarDSO loads the file, validates its contents, and prompts for any missing parameters if necessary.

Cancel
Press this button to discard any changes and close this dialog box.

Apply
Press this button to apply changes to the configuration of the currently selected channel immediately.

3.3.15 Configure Simulator

The **Configure Simulator** dialog allows you to control how AlazarDSO generates waveforms in simulation mode.

Configure
Select the simulator channel that you wish to configure from the list.

Signal Function
Select a function from the list. The available functions are: Sine, Square, Ramp, or Triangle.

Signal Frequency
Enter the frequency of the simulated input signal in the selected units.

Signal Amplitude
Enter the peak-to-peak voltage of the simulated input signal in the selected units.

Signal Offset
Enter the DC offset voltage of the simulated input signal in the selected units.

Signal Noise
Enter the maximum amplitude of the noise added to the simulated input signal in the selected units.

Modulation
Check this box to enable modulation of the simulated input signal.

Modulation Mode
Select a modulation mode from the combo box. AlazarDSO can modulate the signal amplitude, frequency, or period as a function of time.
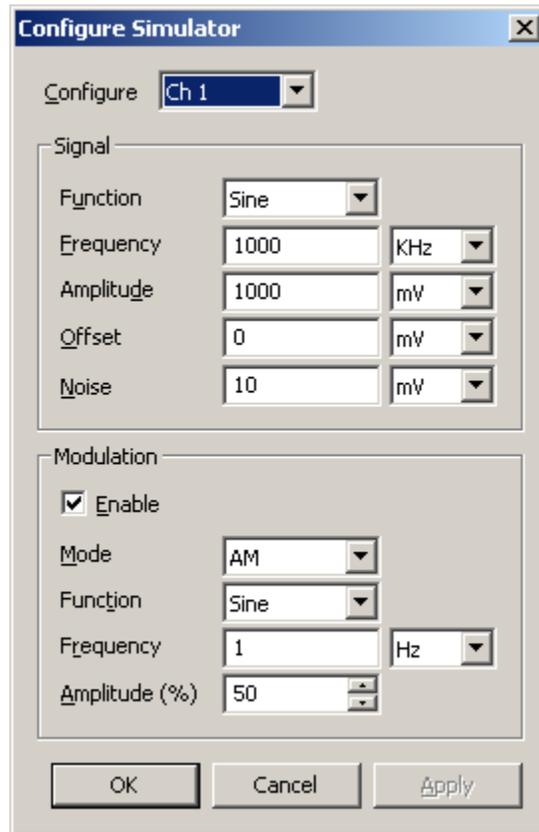
Fig. 25: Configure Simulator dialog box

Modulation Function

Select a modulation function from the combo box. This value defines how the modulation changes with time.

Modulation Frequency

Enter the frequency of one modulation cycle in the selected units.

Modulation Amplitude

Enter the relative modulation amplitude as a fraction in percent of the signal amplitude.

OK

Press this button to apply and save the current settings, and close the dialog box.

Cancel

Press this button to discard the current settings and close the dialog box.

Apply

Press this button to apply the current settings immediately

3.3.16 Configure System
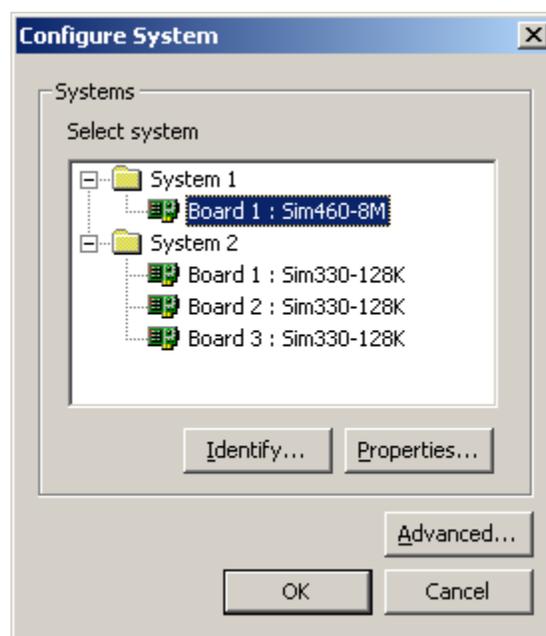
Fig. 26: Configure System dialog box

The **Configure System** dialog box allows you to select the current board system from all the available board systems, identify boards and view their properties, and change advanced settings.

Identify

Display the **Identify Board** dialog box. The **Identify** button is enabled when you select a board from the tree control.

Properties

Display the **System Properties** dialog box if board system is selected from the tree control,

or the **Board Properties** dialog box a board is selected.

Advanced

Display the **Advanced Options** dialog box. These options control memory usage and internal program operation.

OK

Press this button to save the current settings, and close this dialog box.

Cancel

Press this button to discard any changes and close this dialog box.

3.3.17 Configure Trigger
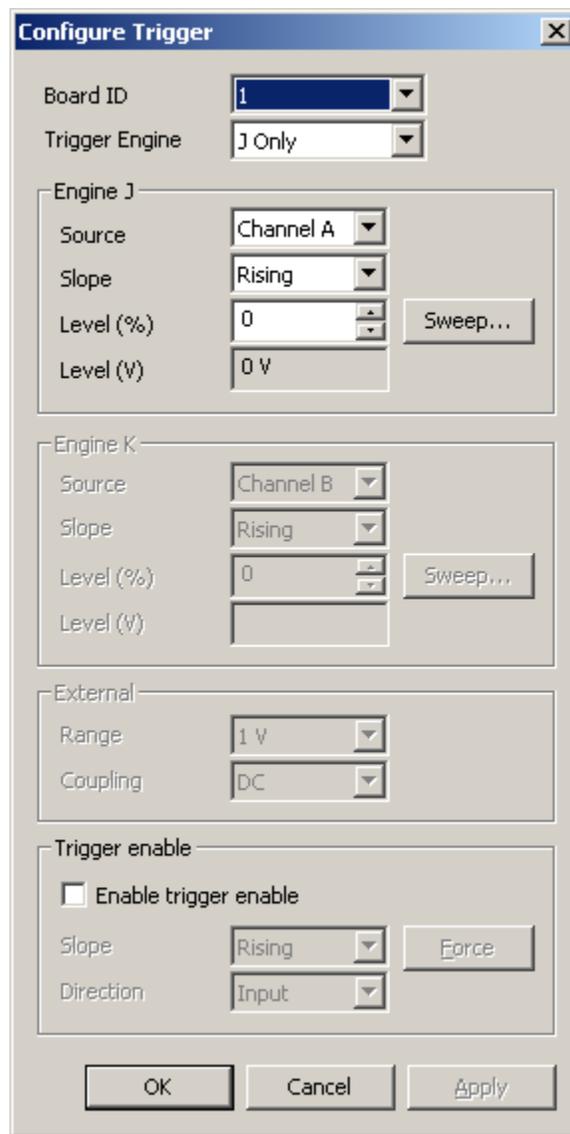
Fig. 27: Configure Trigger dialog box

The Configure Trigger dialog box allows you to control a board's trigger parameters.

Board ID

Select the board from all the boards in the current board system whose trigger parameters you wish to modify.

Trigger Engine

Select a logical combination of the two trigger engines from the list box.

The logical combinations of trigger engines are:

- J only
- K only
- J OR K
- J AND K
- J XOR K
- J AND NOT K
- NOT J AND K

Engine J Source

Select the source for trigger engine J. The available options are:

- Input channel A
- Input channel B
- External trigger input
- Disabled

Engine J Slope

Select the active edge of the trigger engine J from the slope combo box.

Engine J Level (%)

Enter the trigger level for engine J as a percent of the full range input voltage.

Note: Engine J source, slope, and level settings are only active if trigger engine J is one of the trigger engines in the logical combination of trigger engines selected.

Engine J Level (V)

This control displays the current trigger level in volts of engine J.

Sweep (Engine J)

Press this button to display the **Trigger Sweep** dialog box and perform an automated trigger level sweep test of trigger engine J.

Engine K Source

Select the source for trigger engine K. The available options are:

- Input channel A

- Input channel B

- External trigger input

- Disabled

Engine K Slope
Select the active edge of the trigger engine K from the slope combo box.

Engine K Level
Enter the trigger level for engine K as a percent of the full range input voltage.

Note: Engine K source, slope, and level settings are only active if trigger engine K is one of the trigger engines in the logical combination of trigger engines selected.

Engine K Level (V)
This control displays the current trigger level in volts of engine K.

Sweep (Engine K)
Press this button to display the **Trigger Sweep** dialog box and perform an automated trigger level sweep test of trigger engine K.

Select the programmable input range of the external trigger signal from the range combo box.

External Coupling
Select the external clock coupling from the coupling combo box.

Note: The external trigger range and coupling settings are only enabled if either engine J source or engine K source is an external trigger.

Enable trigger enable
Check this box to configure the AUX I/O connector on your board as a trigger enable input or output. When this option is enabled and you start an acquisition, the board will not trigger until you supply a pulse on the AUX I/O connector.

Trigger enable slope
Select the active edge of the trigger enable pulse from the slope combo box.

Trigger enable direction
Select the direction of signals on the AUX I/O connector. Options are: input, or output.

   Input
   Select "input" to configure the AUX I/O connector to receive trigger enable pulses. When the board receives the specified edge of a trigger enable pulse, it arms itself to wait for sufficient trigger events to fill one AutoDMA buffer. The application must supply suitable "trigger enable" pulses to the AUX connector.

   Output
   Select "output" to enable trigger enable mode, but configure the AUX I/O connector as a trigger output signal. Software must call AlazarForceTriggerEnable when it wishes to arm to wait for sufficient trigger events to fill one AutoDMA buffer.

Force

Generate a software trigger enable event. This enables a board to wait for sufficient trigger events to complete one AutoDMA buffer.

OK

Press this button to save the current settings, and close this dialog box.

Cancel

Press this button to discard any changes and close this dialog box.

Apply

Press this button to apply the settings to the selected board without closing the dialog box.

3.3.18 Configure View

The **Configure View** property sheet allows you to control the appearance of the data display views.

Oscilloscope View
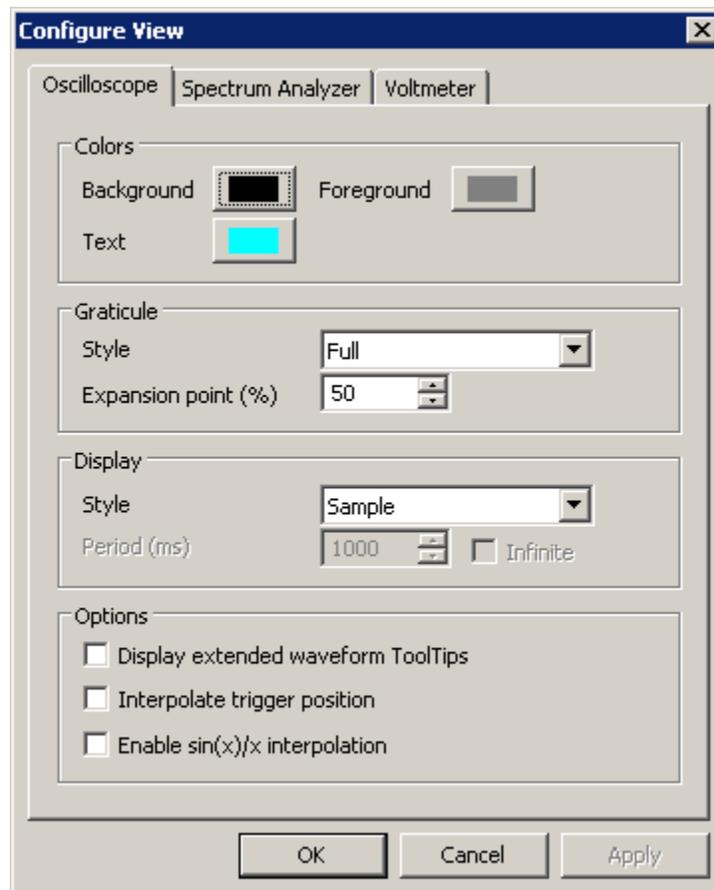
Fig. 28: Configure Oscilloscope View property page

The **Oscilloscope** property sheet page allows you to control the appearance of the main window when you select **Oscilloscope** from the **View** menu.

Background

This button shows the color used to fill the background of the graticule area. Press the button to display a color chooser dialog box and select another color.

Foreground

This button shows the color used to draw grid lines, inactive text, and the horizontal scroll bar in the graticule area. Press the button to display a color chooser dialog box and select another color.

Text

This button shows the color used to draw cursors, horizontal cursor text, active text, and the horizontal scale. Press the button to display a color chooser dialog box and select another color.

Graticule Style

Select a style from the style list box to control how the grid lines are drawn in the graticule. The available styles are:

Full

Select this style to draw the outer frame using solid lines with dotted lines between divisions, and hash marks within each division.

Grid solid

Select this style to draw the outer frame and lines between divisions using solid lines.

Grid dotted

Select this style to draw the outer frame and lines between divisions using dotted lines.

Cross hairs

Select this style to draw the small cross hairs at the intersection of vertical and horizontal divisions.

Expansion point

Enter the position of the expansion point as fraction in percent of the graticule width from the left edge of the graticule.

Display style

Select a style from the combo box to control how the waveforms are drawn in the graticule area. The available styles are:

Sample

Draw the current waveform after erasing the previous waveform.

Accumulate

Draw the current waveform on top of the previous waveform. Erase the waveforms when the accumulate time has elapsed or a change is made to any waveform's vertical position, vertical scale, or horizontal scale.

Accumulate time

Enter the period in milliseconds to accumulate waveforms. Note that this control is enabled only when the oscilloscope **Accumulate** display style is selected.

Display extended waveform Tooltips

Check this box to add the following information about the sample under the mouse pointer to a waveform ToolTip:

- The number of samples from the start of acquisition
- The number of samples from the trigger position in the acquisition.
- The number of samples per column on the screen.

Interpolate trigger position

Check this box to enable AlazarDSO to correct for jitter caused by trigger events occurring between samples points in a record. When enabled, the program calculates the actual sub-sample trigger position within a record, and draws waveforms shifted horizontally as required to correct for the sub-sample error.

Enable sin(x)/x interpolation

Check this box to enable AlazarDSO to display sin(x)/x interpolated curves between sample points. Uncheck this box to display line segments between sample points.

Note: When sin(x)/x interpolation is enabled, AlazarDSO may not be able to display the first few samples at the start of a record, and the last few samples at the end of a record.

OK

Press this button to save the current settings and close this dialog.

Cancel

Press this button to discard the current settings and close this dialog.

Apply

Press this button to apply changes to the view immediately.

Spectrum Analyzer View

The **Spectrum Analyzer** property sheet page allows you to control the appearance of the main window when you select **Spectrum Analyzer** from the **View** menu.

Background

This button shows the color used to fill the background of the graticule area. Press the button to display a color chooser dialog box and select another color.

Foreground

This button shows the color used to draw grid lines, inactive text, and the horizontal scroll bar in the graticule area. Press the button to display a color chooser dialog box and select another color.

Text

This button shows the color used to draw cursors, horizontal cursor text, active text, and the horizontal scale. Press the button to display a color chooser dialog box and select another color.
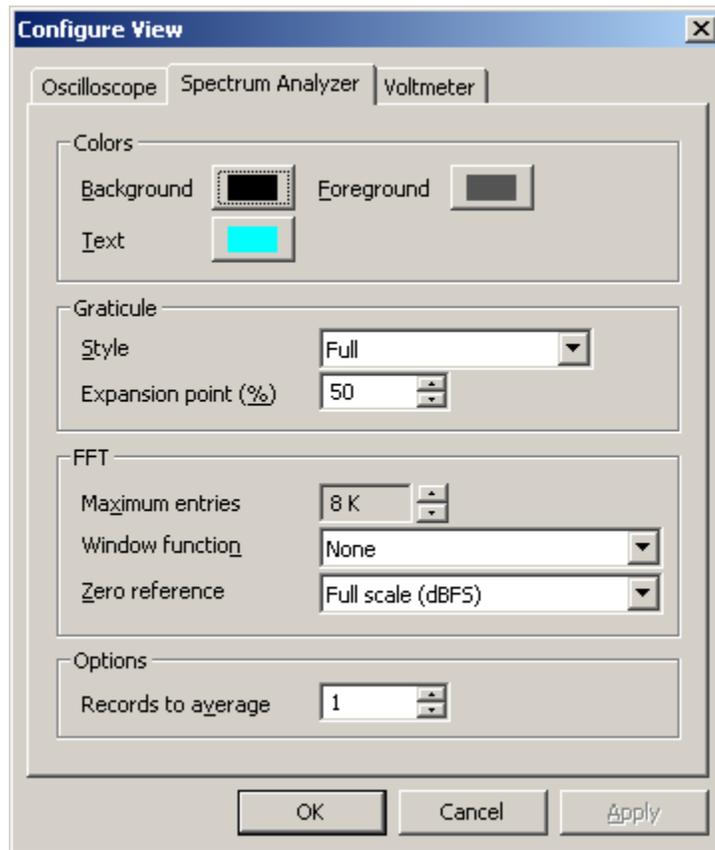
Fig. 29: Configure Spectrum Analyzer View property page

Graticule Style

Select a style from the style list box to control how the grid lines are drawn in the graticule. The available styles are:

Full

Select this style to draw the outer frame using solid lines with dotted lines between divisions, and hash marks within each division.

Grid solid

Select this style to draw the outer frame and lines between divisions using solid lines.

Grid dotted

Select this style to draw the outer frame and lines between divisions using dotted lines.

Cross hairs

Select this style to draw the small cross hairs at the intersection of vertical and horizontal divisions.

Expansion point

Enter the position of the expansion point as fraction in percent of the graticule width from the left edge of the graticule.

Maximum entries

Select the maximum number of entries used to calculate an FFT. If there are fewer samples in the input record than entries, the unused entries will be zero filled. If there are more samples than entries, only this number of samples from the start of the waveform will be used in the calculations.

Window function

Select the weighting function applied to the record data before calculating the FFT.

The available window functions are:

None

$$W(n) = 1$$

Bartlett

$$\begin{cases} W(n) = \frac{2n}{N-1}, & 0 \leq n \leq N/2 \check{} 1 \\ W(n) = 2 - \frac{2n}{N-1}, & N/2 \leq n < N \end{cases}$$

Hamming

$$W(n) = 0.5 * (1 - \cos(\frac{2 * \pi * n}{N - 1}))$$

Hanning

$$W(n) = 0.54 - 0.46 \cos(\frac{2\pi n}{N - 1})$$

Blackman

$$W(n) = 0.42323 - 0.49755 \cos(\frac{2\pi n}{N-1}) + 0.07922 \cos(\frac{4\pi n}{N-1})$$

Blackman-Harris

$$W(n) = 0.35875 - 0.48829 \cos(\frac{2\pi n}{N-1}) + 0.14128 \cos(\frac{4\pi n}{N-1}) - 0.01168 \cos(\frac{6\pi n}{N-1})$$

Zero Reference

Select the 0 dB reference level for the FFT display. The available options are:

Full scale (dBFS)
Display power relative to a full scale input signal.

Maximum signal (dBc)
Display power relative to the power of the largest harmonic in a waveform.

Records to average
AlazarDSO can accumulate the power entries from a sequence of one or more records, and display the average power from the records. Enter the number of records that the software should accumulate before displaying.

OK
Press this button to save the current settings and close this dialog.

Cancel
Press this button to discard the current settings and close this dialog.

Apply
Press this button to apply changes to the view immediately.

Voltmeter View

The **Voltmeter** property sheet page allows you to control the appearance of the main window when you select **Voltmeter** from the **View** menu.

Background
This button shows the color used to fill the background of the graticule area. Press the button to display a color chooser dialog box and select another color.

Foreground
This button shows the color used to draw a rectangle around each channel's text in the display area. Press the button to display a color chooser dialog box and select another color.

Text
This button shows the color used to draw active text and the horizontal scale. Press the button to display a color chooser dialog box and select another color.

Accumulate time
Enter the period in milliseconds to accumulate statistics before updating the voltmeter display.
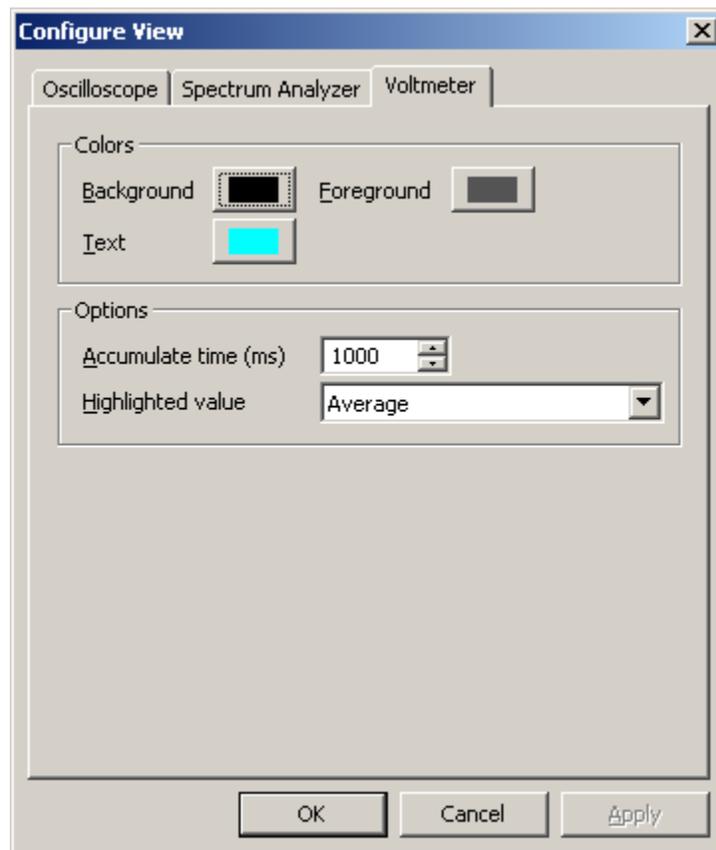
Fig. 30: Voltmeter View property page

Highlighted value

> Select a value from the list to display on the right hand side of the display area using a larger font that the other values. By default, AlazarDSO highlights the RMS voltage.

OK

> Press this button to save the current settings and close this dialog.

Cancel

> Press this button to discard the current settings and close this dialog.

Apply

> Press this button to apply changes to the view immediately.

3.3.19 Coprocessor
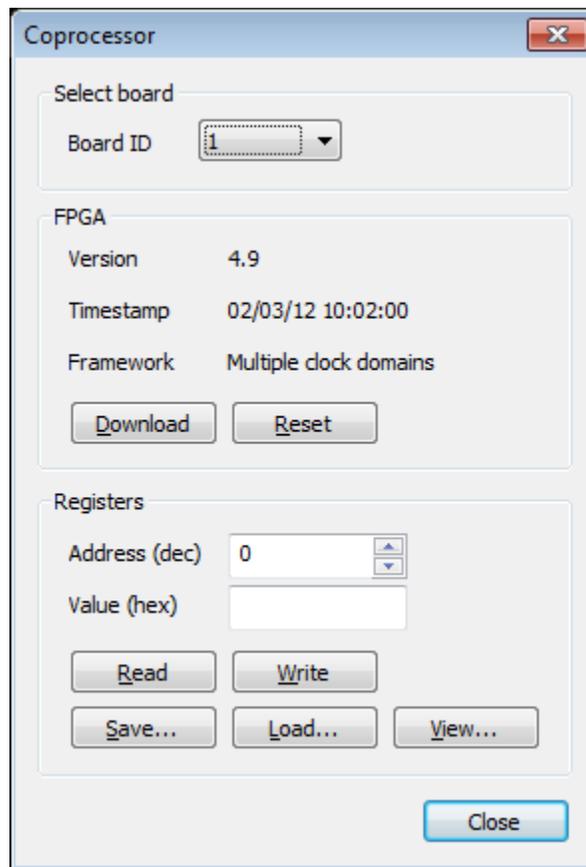
Fig. 31: Coprocessor dialog

The Coprocessor dialog allows you configure and control the coprocessor of AlazarTech digitizers with user-programmable FPGAs.

Version

> This read-only field displays the contents of coprocessor register 1, the version register. Its value is the coprocessor major and minor version numbers.

Timestamp

This read-only field displays the contents of coprocessor register 2 [15:0] and coprocessor register 3, the compilation timestamp.

Framework

This read-only field decodes the contents of coprocessor register 2, the CPF variant register. The following variants are currently supported:

Single clock domain

The data path uses a single clock domain clocked by the ADC clock.

Multiple clock domains

The data path uses FIFOs to connect multiple clock domains.

Download

Press this button to download an FPGA image to the coprocessor FPGA. The program prompts you to select an RBF (raw binary file), then downloads and configures the coprocessor FPGA with the file's contents.

Reset

Press this button to download to reset the co-processor FPGA. This button sets coprocessor register 5 (cpf_config) bit 0 to reset user circuitry.

Address

Enter the address of the coprocessor register that you wish to read from, or write to.

Value

This field allows you to enter the value that you wish to write to a coprocessor register, or displays the value read from a coprocessor register.

Read

Press this button to read the value from the specified coprocessor register address.

Write

Press this button to write the specified value to the specified coprocessor register address.

Save

Press this button to read coprocessor FPGA registers, and save their values to a text file.

Restore

Press this button to read coprocessor register values from a text file, and write these values to the coprocessor FPGA.

Note: Registers are written in the same sequence as they appear in the text file. If you wish to pause before writing to a register, add a "% SLEEP n" comment at the line where you wish to pause. The sleep time (n) is specified as an integer between 0 and 9999 ms.

View

Press this button to read coprocessor FPGA registers, and display their values on screen.

Close

Press this button to save the current settings and close this dialog.

3.3.20 Digital Filter
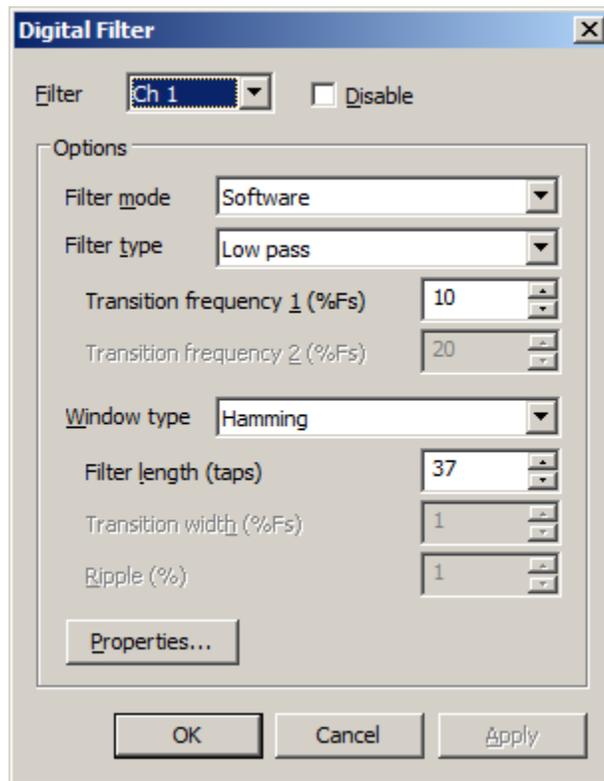
Fig. 32: Digital filter dialog box

The **Digital Filter** dialog allows you to add a digital filter to the signal path of an input channel. Hardware filters are available if supported by your digitizer.

Filter channel

> Select the filter associated with an input channel.

Disable

> Check this box to disable the digital filter for this channel.

Filter mode

> Select how to process sample data.

> **Software**

> > Use CPU resources to implement FIR filters.

> **Hardware (FPGA)**

> > Use FPGA resources of your digitizer to calculate FIR filters if this feature is supported by your digitizer and FPGA.

Filter type

> Select the frequency response of the filter.

> **Low pass**

> > Pass frequencies below transition frequency 1.

High pass

Pass frequencies above transition frequency 1.

Band pass

Pass frequencies between transition frequencies 1 and 2.

Band stop

Block frequencies between transition frequencies 1 and 2.

Transition frequency 1 (%Fs)

Enter the first transition frequency of a filter as percentage of the sampling rate.

Transition frequency 2 (%Fs)

Enter the second transition frequency of a filter as percentage of the sampling rate if required.

Window type

Select the window function for the FIR filter.

- Rectangular

- Bartlett

- Hamming

- Hanning

- Blackman

- Kaiser

Filter length (taps)

Select the filter length in taps.

Transition width (%Fs)

Enter transition width of a Kaiser window a as a percentage of the sample rate.

Ripple (%)

Enter gain ripple of a Kaiser window in percent.

Properties

Press this button to display the *Filter Properties* dialog box to view detailed information about the current filter.

OK

Press this button to save the current settings and close this dialog.

Cancel

Press this button to discard the current settings and close this dialog.

Apply

Press this button to apply the current settings without closing this dialog.

3.3.21 Digital Filter Properties
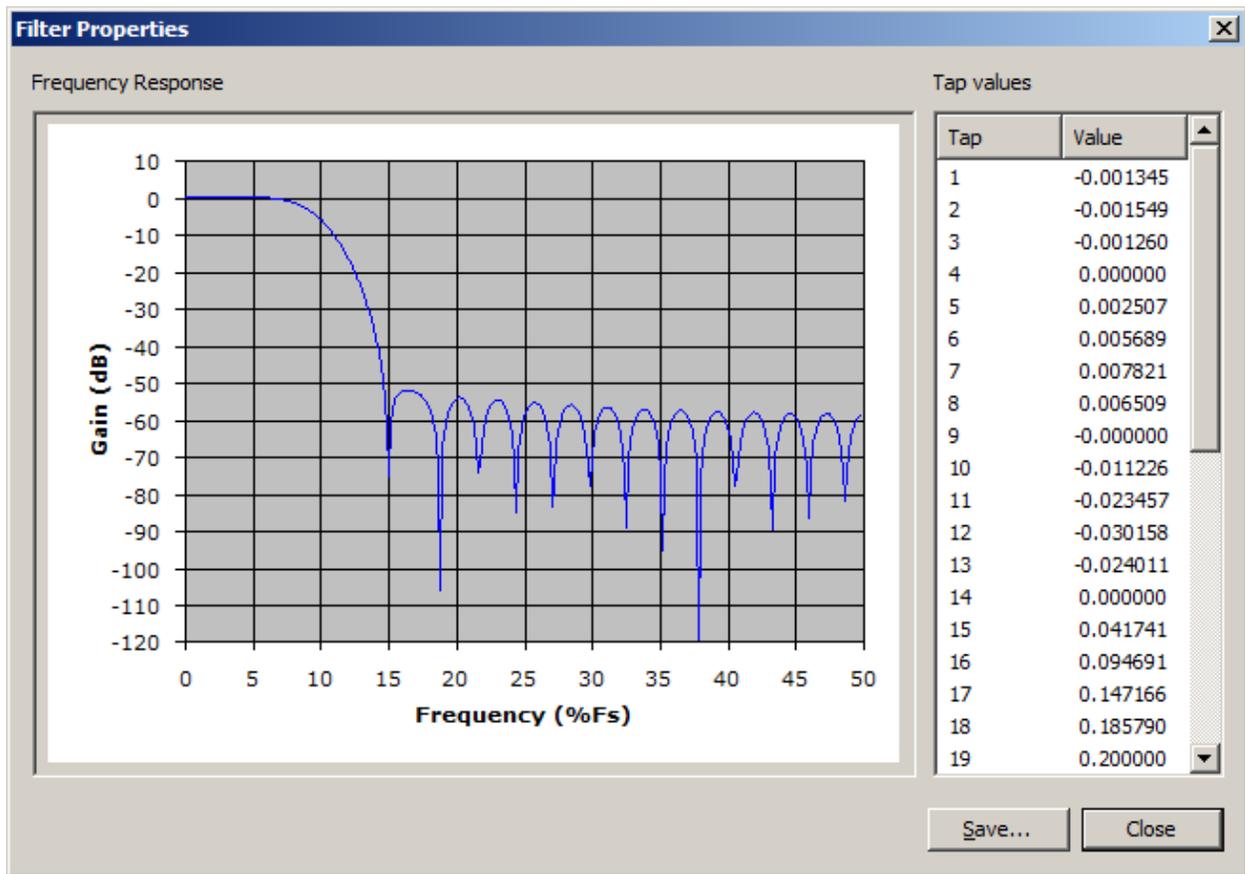
Fig. 33: Filter properties dialog box

The **Digital Filter Properties** dialog displays a frequency response chart and the coefficients of the current filter configuration.

Save

>   Press this button to save filter data to file.

>   Use the "Save as type" combo box to select the data format.

>   **Text**

>   >   Save filter coefficients to a text file.

>   **Bitmap**

>   >   Save the frequency response chart to a bitmap file.

Close

>   Press this button to close this dialog.

3.3.22 Find
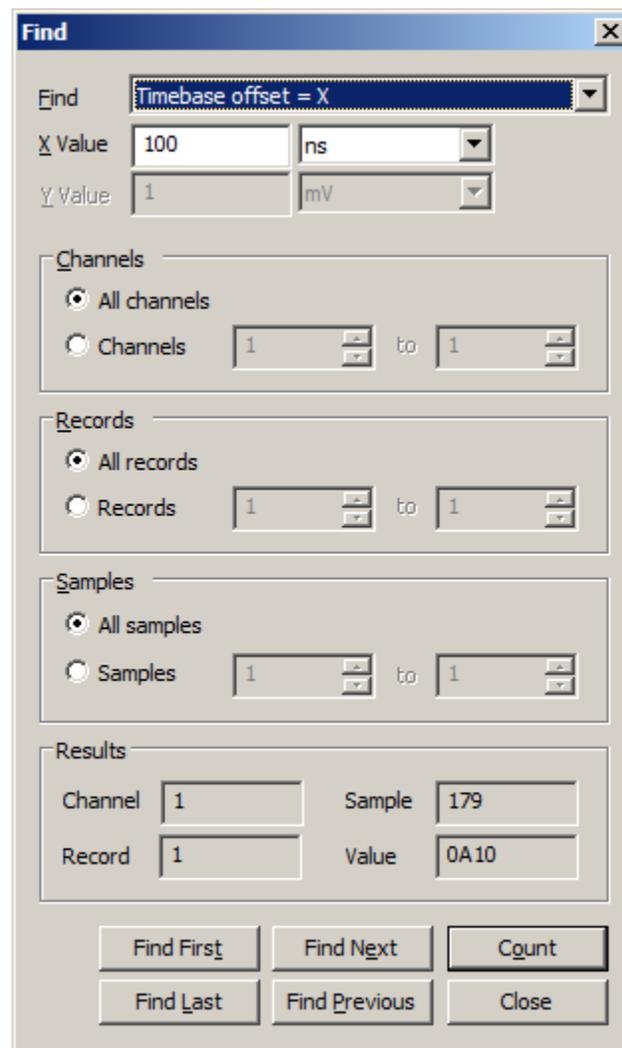
Fig. 34: Find dialog box

The **Find** dialog box allows you to search for samples in currently displayed buffer.

Find type

Select the search criteria.

- **Time-base offset = X**

  Enter a time-base offset in samples or seconds in the X edit control. Use the "Find first" button to find the sample point at the specified X offset relative to the first sample of the first record in the currently displayed buffer, and the "Find Next" button to find the sample at the specified X offset relative to the current sample position.

- **Sample value = Y**

- **Sample value > Y**

- **Sample value < Y**

  Enter a vertical offset in volts or ADC units (LSBs) in the Y edit control. Use the "Find first" and "Find next" buttons to find sample points with vertical values equal to, less than, or greater than the specified Y value.

- **Rising edge threshold = Y**

- **Falling edge threshold = Y**

  Enter a vertical offset in volts or ADC units (LSBs) in the Y edit control. Use the "Find first" and "Find next" buttons to find sample points where a waveform rises above or falls below the specified Y value.

- **Positive pulse width = X threshold = Y**

- **Positive pulse width > X threshold = Y**

- **Positive pulse width < X threshold = Y**

  Enter a pulse width in samples or seconds in the X edit control, and a vertical offset in volts or ADC units (LSBs) in the Y edit control. Use the "Find first" and "Find next" buttons to find pulses whose widths are equal to, greater than, or less than the specified X value, and whose edges rise above then fall below the specified Y value.

- **Negative pulse width = X threshold = Y**

- **Negative pulse width > X threshold = Y**

- **Negative pulse width < X threshold = Y**

  Enter a pulse width in samples or seconds in the X edit control, and a vertical offset in volts or ADC units (LSBs) in the Y edit control. Use the "Find first" and "Find next" buttons to find pulses whose widths are equal to, greater than, or less than the specified X value, and whose edges fall below then rise above the specified Y value.

Channels

Select the channels that you wish to include in the search.

- Select the **All** radio button to search all enabled input channels.

- Select the **Channel** radio button to select a range of input channels.

Records

Select the records in each channel that you wish to include in the search.

- Select the **All** radio button to search all records from each selected channel.

- Select the **Records** radio button to select a range of records from each selected channel.

Samples

Select the samples in records that you wish to include in the search.

- Select the **All** radio button to search all samples from each selected record.

- Select the **Range** radio button to specify a range of samples from each selected record.

Results

These edit controls show the channel, record in channel, sample in record, and sample value of the currently highlighted sample.

Find first

Find the first sample of the first record of the first channel matching the search criteria.

Find last

Find the last sample of the last record of the last channel matching the search criteria.

Find next

Find the next sample relative the current sample matching the search criteria.

Find previous

Find the previous sample relative the current sample matching the search criteria.

Count

Display the number of samples matching the search criteria.

Close

Close the dialog box.

3.3.23 Identify Board
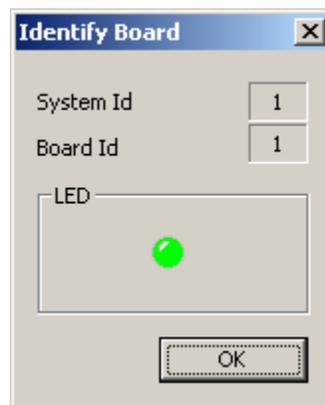
Fig. 35: Identify Board dialog box

The **Identify Board** dialog allows you to physically identify a board by the LED visible on its PCI / PCIe mounting bracket. AlazarDSO flashes this LED as indicated by the icon on screen. This tool may be useful if you have several boards installed in a PC.

System Id

This is the system identifier of the selected board.

Board Id

This is the board identifier of the selected board.

LED

This is the current state of the board's LED.

OK

Press to close the dialog box.

3.3.24 Import File
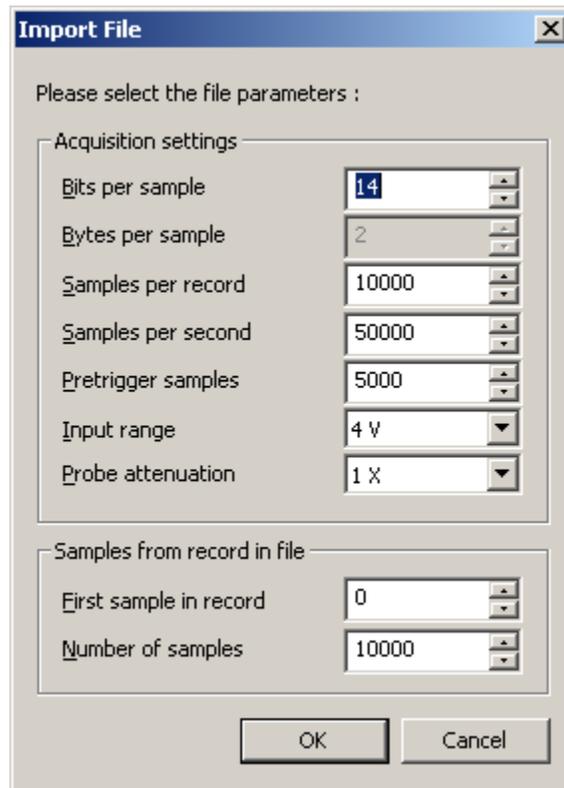
Fig. 36: Import File dialog box

AlazarDSO displays the **Import File** dialog when you select **Open** from the **File** menu and select a file containing sample data in one of the following formats:

- FlexPro® records in samples

- MATLAB® arrays

- Text records in volts

- Text records in samples

- Binary records in samples

The **Import File** dialog allows you to specify the parameters needed to display a reference channel when a file does not contain these parameters.

Bits per sample

Enter the resolution of each sample in bits. AlazarTech PCI / PCIe digitizer boards have 8, 12, 14, or 16-bit resolution.

Bytes per sample
>   This field displays the size of each sample in bytes as calculated from the bits per sample. AlazarTech boards generate1 or 2 bytes per sample.

Samples per record
>   Enter the number of samples in an entire record.

Samples per second
>   Enter the sample rate used to digitize the record.

Pre-trigger samples
>   Enter the number of samples before the trigger position in the record.

Input range
>   Enter the input range in volts represented by the maximum sample value.

Probe attenuation
>   Enter the probe attenuation factor so that AlazarDSO can scale the sample values back to their pre-probe levels.

First sample in record
>   If the number of sample points in the file is less than the number of samples in a record, then enter the offset of the first sample in the file from the first sample in a record.

Number of samples
>   Enter the number of samples points in the file.

OK
>   Close the dialog box and use these parameters to display the file as a reference channel.

Cancel
>   Close the dialog box.

3.3.25 Open

The **Open** dialog allows you to load individual record files as reference channels, or load complete acquisition files containing multiple acquisitions, multiple records per acquisition, or multiple transfers per acquisition.

File name
>   Enter the file name, or select one from the list control.

Files of type
>   Select the file type by file extension to display in the list control.

Display as
>   Select the reference channel where the record file will be displayed. Note that this combo box is disabled if you select a file containing multiple acquisitions, or multiple records per acquisition.

Open
>   Load the selected file.
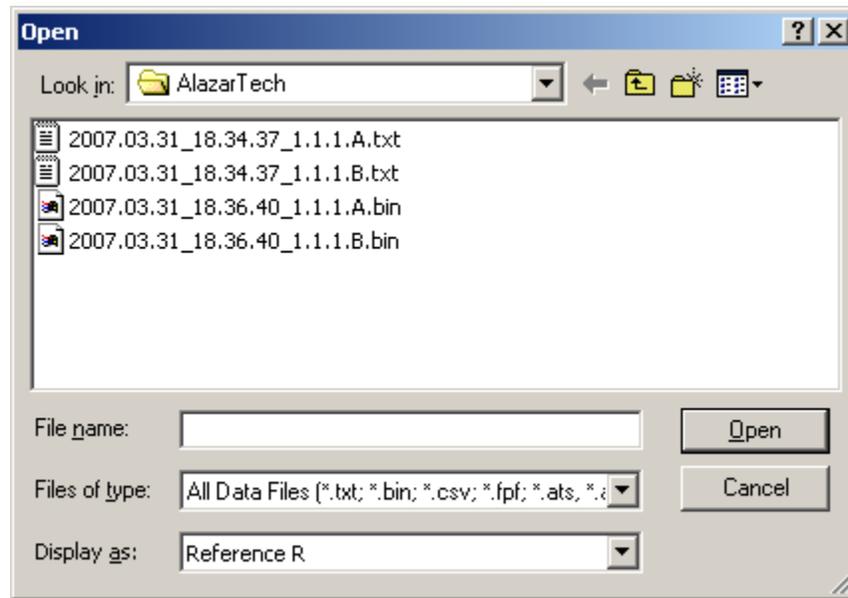
Fig. 37: Open file dialog box

Note: If the file contains a single-record then it will be loaded as the selected reference channel.

If the file contains multiple acquisitions, multiple records per acquisition, or multiple transfers per acquisition, then the program loads the first record or transfer of the first acquisition, and then displays the **Browse File** dialog to allow you to view the other records or transfers in the file.

Cancel
Press to return to the main window.

3.3.26 Save As

The **Save As** dialog box allows you to save an acquisition in several file formats.

File
Enter the file name. The program creates a default file name from the current date and time.

Directory
Enter the name of the directory in which to create the file (or files), or press the "..." button to display a directory chooser dialog box which will allow you to select a directory.

Format
Select a file format from the list box.

The supported file formats are:

- Text records in samples (*.txt)
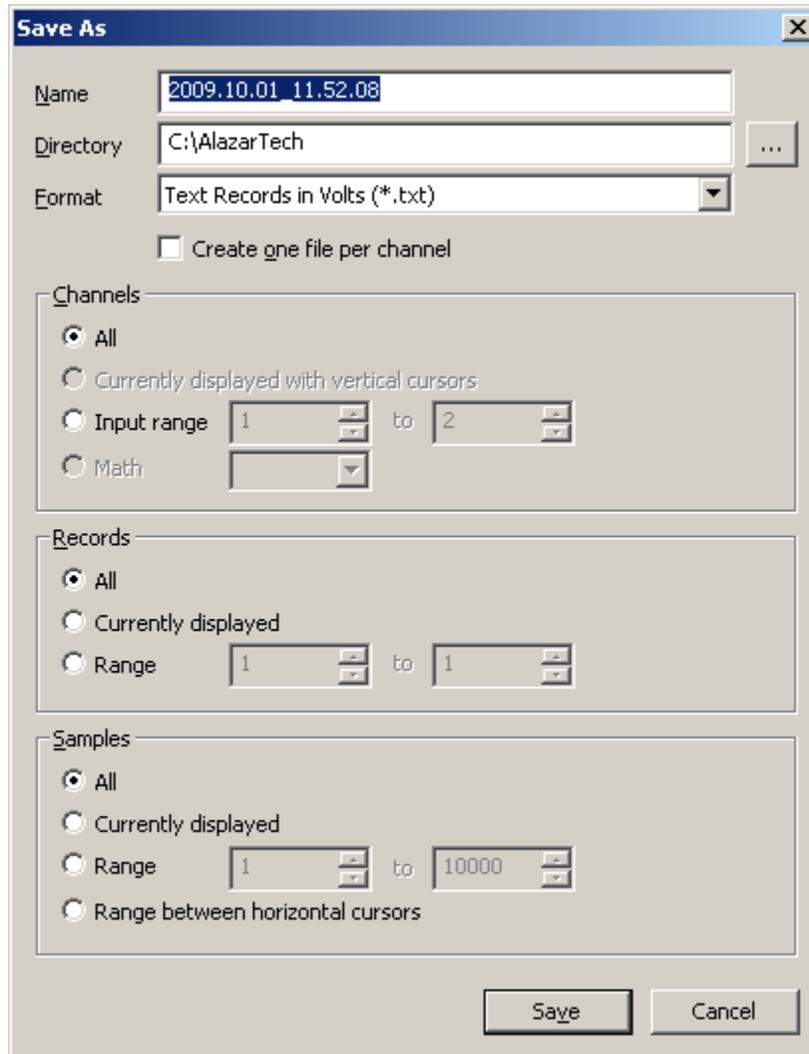
Fig. 38: Save As dialog box

- Text records in volts (*.txt)

  These formats save each sample as one line of ANSI text followed by a carriage return. Aside from the sample data, no other information about the acquisition is saved in the file.

- Binary records (*.bin)

  This format saves each sample as a binary value. Aside from the sample data, no other information about the acquisition is saved in the file.

- Alazar Text Records (*.txt)

  This format has comma-separated parameter values and sample data saved as ANSI text. These files can be opened in text editors like Notepad, or by programs that can import comma separated value files like Microsoft Excel.

- Alazar Binary Records (*.bin)

  This format has comma-separated parameter values saved as ANSI text, and sample data saved in binary form. The data in these files is not human readable, but the files require less disk space than files created text formats, and are well suited for use by software specifically written to process them.

- Alazar Acquisition Files (*.ats)

  This format has comma-separated parameter values saved as ANSI text, and sample data saved in binary form. AlazarDSO creates one file containing all the records from all the channels in an acquisition. This format is useful if you wish save and later restore an entire acquisition.

- Alazar Binary Acquisition Files (*.ats)

  This format saves acquisition parameters and sample data entirely in binary form. AlazarDSO creates one file containing all the records from all the channels in an acquisition. This format is useful if you wish save and later restore an entire acquisition.

- FlexPro Records in volts (*.fpf)

- FlexPro Records in samples (*.fpf)

  These formats save files in a format suitable for import by FlexPro® graphing and analysis software from Weisang GmbH. The sample values are saved in volts or as ADC sample values.

- MATLAB Records in volts (*.mat)

- MATLAB Records in samples (*.mat)

  These formats create MATLAB® MAT-Level 4 files. AlazarDSO creates files that contain an array of sample values, and an array of sample time values.

- Screen Capture (*.bmp)

  This format saves the drawing area as a Windows bitmap file.

Please see section 4 "File Formats" below for more information about supported file formats.

Create one file per channel

Check this box to save all of records from one channel to a single file. If this box is not checked, then the program will save each record of each channel to a separate file.

Channels

Select the channels that you wish to save.

- Select the **All** radio button to save all enabled input and math channels.

- Select the **Currently displayed with vertical cursors** radio button to save the one input or math channel that is currently displaying the vertical cursors. This radio button is disabled if no input or math channel is displaying the vertical cursors.

- Select the **Input range** radio button to select a range of input channels to save.

- Select the **Math** radio button to select a math channel to save. This radio button is disabled if no math channels are enabled.

Records

Select the records in the channels that you wish to save.

- Select the **All** radio button to save all the records in the acquisition.

- Select the **Currently displayed** radio button to save the currently displayed record.

- Select the **Range** radio button to specify a range of records from each acquisition.

Samples

Select the samples in records that you wish to save.

- Select the **All** radio button to save all the samples in each record.

- Select the **Currently displayed** radio button to save the range of samples currently displayed from each record.

- Select the **Range** radio button to specify a range of samples from each record.

- **between horizontal cursors** to save the range of sample values between the horizontal cursors.

Save

Press this button to save the acquisition in the selected format. AlazarDSO displays a progress dialog while it creates the file(s).

Cancel

Close this dialog box and return to the main window.

3.3.27 Select Record

Fig. 39: Select Record dialog box

The **Select Record** dialog box allows you to select an array from all of the arrays stored in a MATLAB file to import as a reference waveform.

Record List
> This list box displays the name, size, and type of all of the arrays stored in the MATLAB file. Click on a row to select an array.

OK
> Close the dialog box and import the selected array.

Cancel
> Close the dialog box.

3.3.28 Spectrum Information

The **Spectrum Information** dialog box allows you to view the properties of an input, math, or reference waveform in Spectrum Analyzer view.

Channel
> Select an input, math, or reference channel from the list.

Fundamental
> This value displays the frequency, and amplitude relative to full-scale input, of the FFT bin with the largest value.

Harmonic N
> This value displays the Nth harmonic of the fundamental frequency, and its amplitude relative to the amplitude of the fundamental.
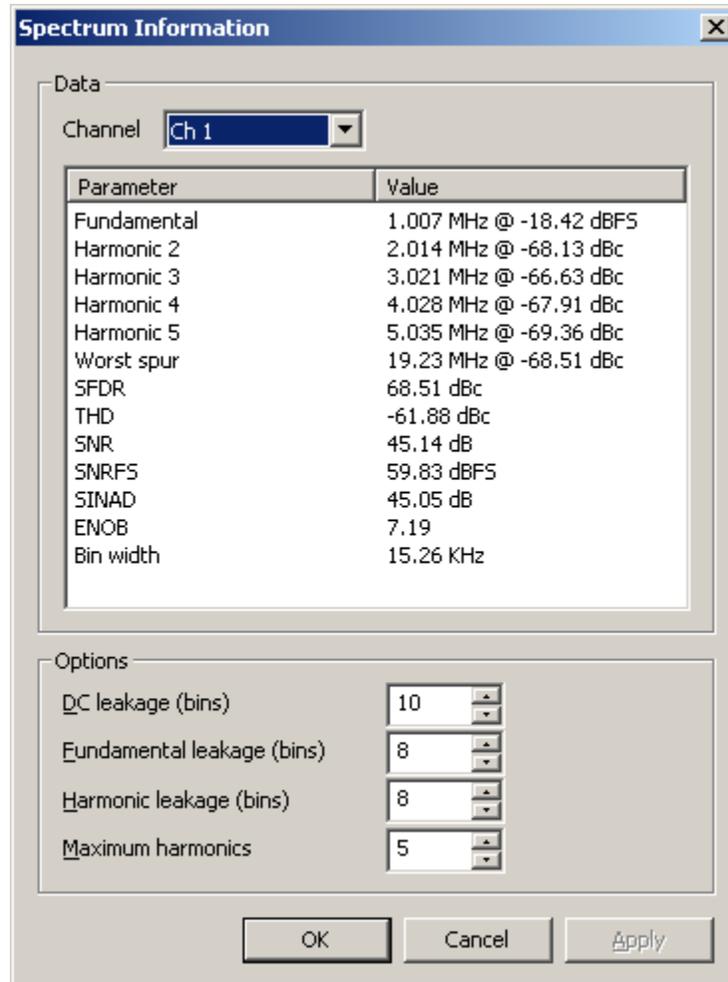
Fig. 40: Spectrum Information dialog box

Worst Spur

This value displays the frequency of the bin with the largest value excluding the fundamental, harmonic, and DC leakage bins. It also displays the amplitude of the bin's value relative to the fundamental amplitude.

SFDR

This value displays the spurious-free dynamic range relative to the fundamental amplitude.

SNR

This value displays the signal-to-noise ratio.

SNRFS

This value displays the full scale input to noise ratio.

THD

This value displays the total harmonic distortion.

SINAD

This value displays the signal to noise and distortion.

ENOB

This value displays the effective number of bits.

Bin Width

This value displays the size of each FFT bin in Hz.

DC Leakage

Enter the number of bins above DC that are not used in calculating the SNR, SINAD, and ENOB.

Fundamental Leakage

Enter the number of bins on either side of the fundamental frequency not used in calculating the SNR, SINAD, and ENOB.

Harmonic Leakage

Enter the number of bins on either side of a harmonic of the fundamental frequency not used in calculating the SNR, SINAD, and ENOB.

Max Harmonics

Enter the number of harmonics of the fundamental frequency to be displayed.

OK

Press this button to save the current settings and close this dialog.

Cancel

Press this button to discard the current settings and close this dialog.

Apply

Press this button to re-calculate results using the current options.

3.3.29 Trigger Sweep
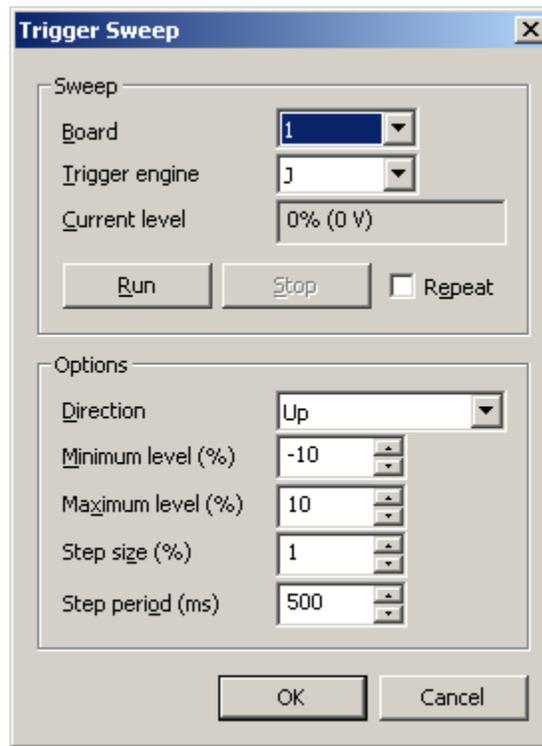
Fig. 41: Trigger Sweep dialog box

The **Trigger Sweep** dialog box allows you to automate trigger level tests. The software automatically changes the trigger level in the selected direction between the minimum and maximum levels, pausing the between each step. The test can optionally repeat until you press the stop button.

Board

Select a board within the current board system that you wish to control.

Trigger engine

Select a trigger engine from the current board whose trigger level you wish to control.

Current Level

This control displays the current trigger level in both percent of full-range input, and volts.

Run

Press this button to begin the trigger level sweep test using the selected parameters.

Stop

Press this button to stop the test in progress.

Repeat

Check to continue the test until you press the **Stop** button.

Direction

Select how the trigger level is changed after each step in the test. The options are:

Up

Increase the trigger level until the maximum level is reached. If the repeat option is checked, continue from minimum level.

Down

Decrease the trigger level until the minimum level is reached. If the repeat option is checked, continue from the maximum level.

Up and down

Increase the trigger level until the maximum level is reached, then reduce until the minimum level is reached.

Down and up

decrease the trigger level until the minimum level is reached, then increase until the maximum level is reached.

Minimum level

Enter the minimum trigger level in the test range in percent of full range input voltage.

Maximum level

Enter the minimum trigger level in the test range in percent of full range input voltage.

Step size

Enter the amount in percent of full range input to increase or decrease the trigger level after each step.

Step period

Enter the time in milliseconds to hold the trigger level at the current value during each step of the test.

OK

Save the current settings and close the dialog.

Cancel

Discard the current settings and close the dialog.

3.4 Stream To Memory Wizard

The **Stream To Memory Wizard** displays a series of property pages that allows you to configure **AlazarDSO** to stream sample from the dual-port memory of your digitizer to the system memory of your computer.

If your computer has sufficient RAM then the software should be capable of streaming sample data to system memory and saving it to disk at a data acquisition rate that is independent of the maximum write speed of your disks. This allows the use inexpensive desktop drives for data streaming rather than RAID, SSD, or RAM disks.

The wizard displays the following property pages.

3.4.1 Welcome

Fig. 42: Welcome Page

This is the first page of the Stream To Memory Wizard.

Do not show this Welcome page again
> Check this button to start this wizard from the mode page the next time it is run.

Next
> Press this button to go forward to the next page

Cancel
> Press this button to discard the current settings and close this wizard.

Help
> Press this button to display on-line help with more information about this property sheet page.

3.4.2 Mode
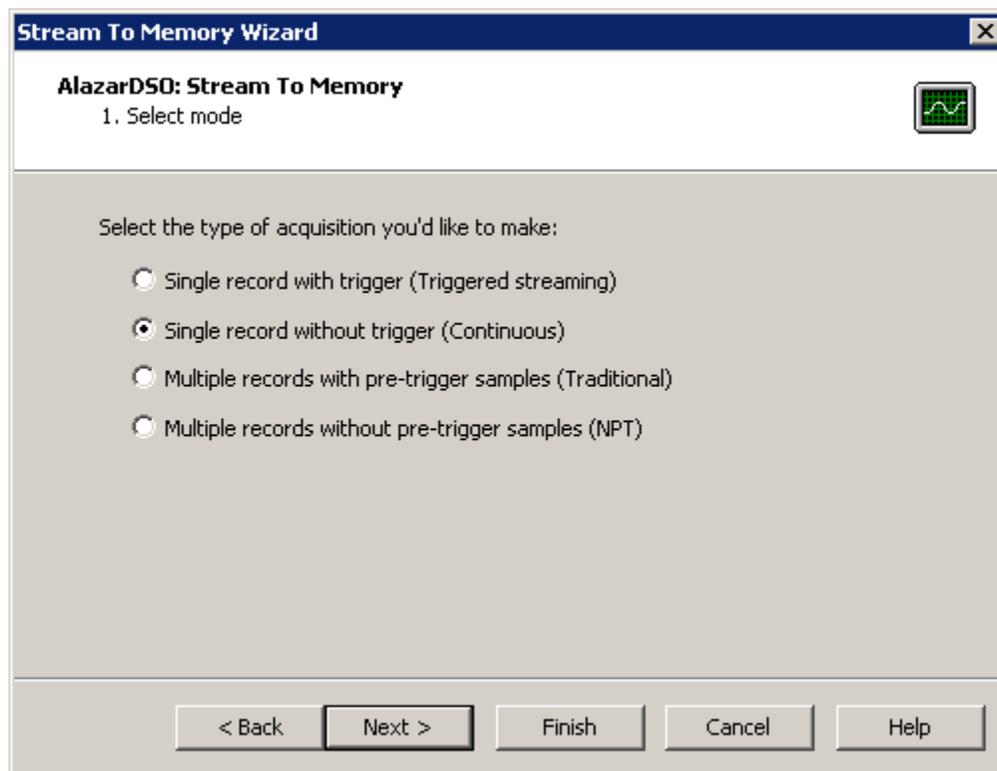
Fig. 43: Mode Page

The **Configure Mode** page allows you to select the type of acquisition that you'd like to perform.

Single record with trigger (Triggered streaming)
> Check this radio button to acquire a single, continuous record per enabled channel. The system will wait for a trigger event before beginning the acquisition, and the acquisition will contain no pre-trigger samples.

Single record without trigger (Continuous)
> Check this radio button to acquire a single, continuous record per enabled channel. The system will not wait for a trigger event before beginning the acquisition.

Multiple records with pre-trigger samples (Traditional)
> Check this radio button to acquire one or more records per enabled channel. The system will wait for a trigger event before each record, and the records may contain pre-trigger samples.

Multiple records without pre-trigger samples (NPT)
> Check this radio button to acquire one or more records per enabled channel. The system will wait for a trigger event before each record, but the records contain no pre-trigger samples.

Back
> Press this button to go back to the previous page

Next
> Press this button to go forward to the next page

Finish

>   Press this button to apply the current settings, close this wizard, and begin the acquisition.

Cancel

>   Press this button to discard the current settings and close this wizard.

Help

>   Press this button to display on-line help with more information about this property sheet
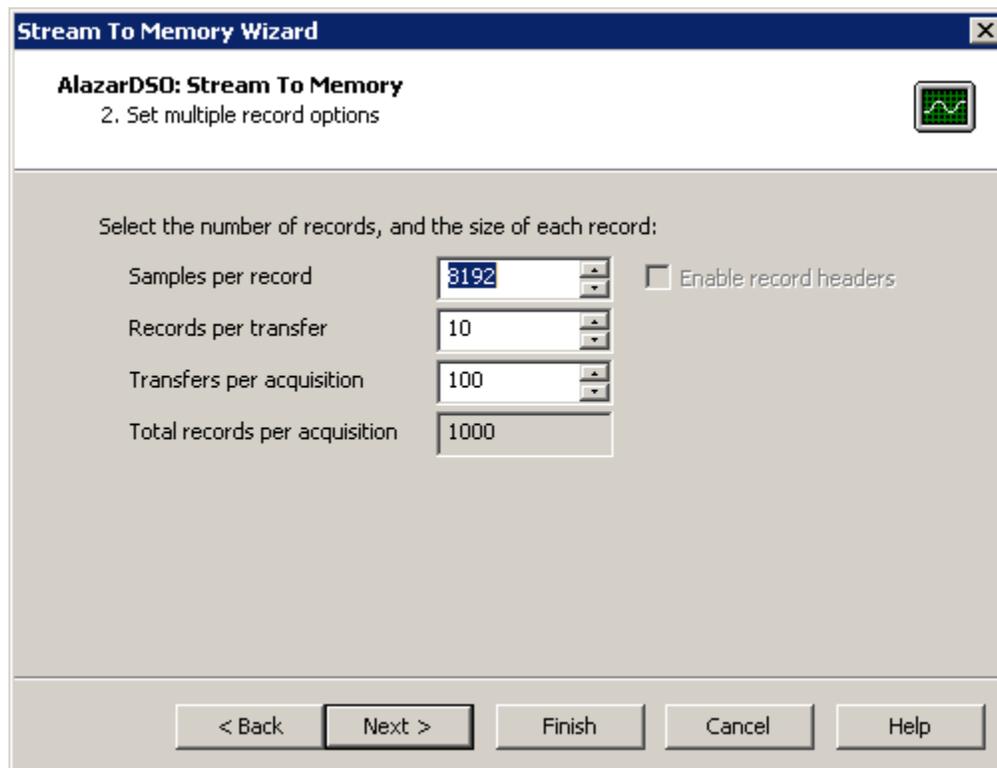>   page.

3.4.3 Single Record
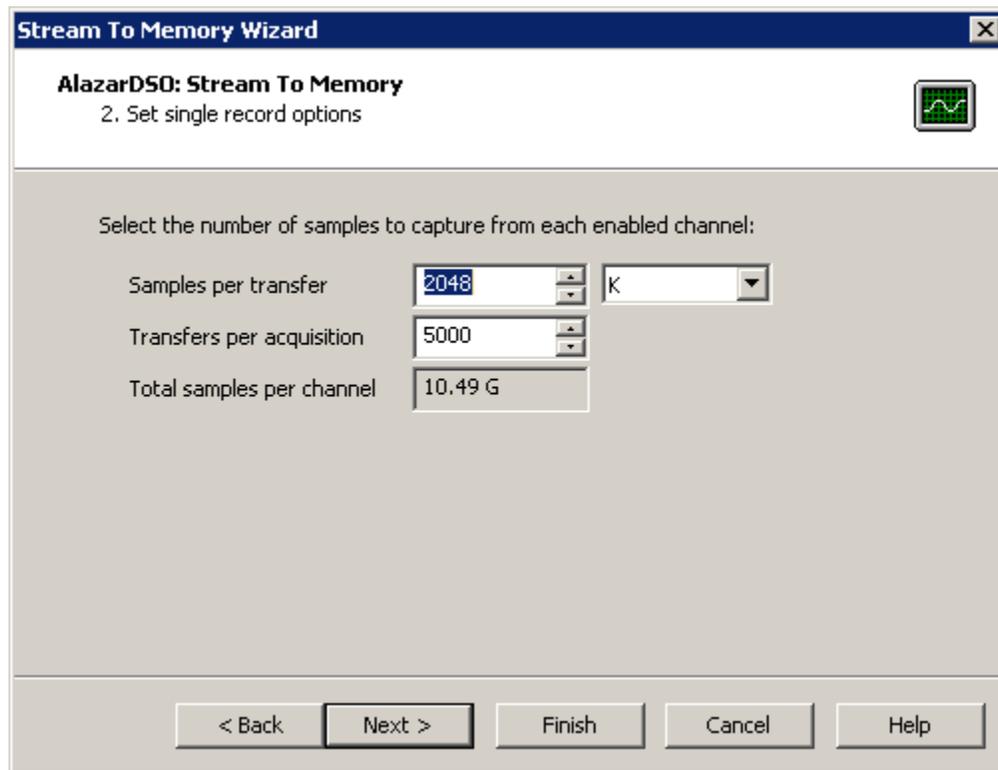
Fig. 44: Single Record Page

This property page allows you to define the acquisition length in single record acquisition modes.
Note that the acquisition length is limited only by the available system memory.

Samples per transfer

>   In dual-ported memory mode, an acquisition is split into DMA transfers that move sample
>   data from on-board to PC host memory while, at the same time, on-board memory is filled
>   with acquisition data.

>   Enter the size of each DMA transfer in samples. It is important to keep this value as large as
>   possible to reduce the risk of buffer overrun errors. The default value is 2048 K samples.

Transfers per acquisition

>   Enter the number of DMA transfers per acquisition.

Total samples per channel

This value is the product of the **Samples per transfer** and **Transfers per acquisition** values. It defines the total number of samples transferred from the board per enabled channel during the acquisition.

Back

Press this button to go back to the previous page

Next

Press this button to go forward to the next page

Finish

Press this button to apply the current settings, close this wizard, and begin the acquisition.

Cancel

Press this button to discard the current settings and close this wizard.

Help

Press this button to display on-line help with more information about this property sheet page.

3.4.4 Multiple Records

Fig. 45: Multiple Record Page

This property page allows you to define the acquisition length in multiple record acquisition modes. Note that the total acquisition length is limited only by the available system memory.

Samples per record

Enter the size of each record in samples.

Enable record headers

Press this button to transfer headers with each record. Note that record headers contain record timestamp data. If record timestamps are desired, then the "enable record headers" check box must be checked.

Records per transfer

In dual-ported memory mode, an acquisition is split into DMA transfers that move sample data from on-board to PC host memory while, at the same time, on-board memory is filled with acquisition data.

Enter the size of each DMA transfer in records.

Transfers per acquisition

Enter the number of number of DMA transfers per acquisition.

Total records per channel

This value is the product of the Records per transfer and Transfers per acquisition values.

Pause between acquisitions

Enter the time in milliseconds to pause between each transfer in the acquisition.

Back

Press this button to go back to the previous page

Next

Press this button to go forward to the next page

Finish

Press this button to apply the current settings, close this wizard, and begin the acquisition.

Cancel

Press this button to discard the current settings and close this wizard.

Help

Press this button to display on-line help with more information about this property sheet page.

3.4.5 Board Configuration

This property page allows you to verify and, if necessary, modify board configuration settings.

Sample rate

This control displays the current sample rate. If necessary, press on the "…" button to display the **Configure Horizontal** dialog box to change the sample rate.

Total sample time

This control displays the total sample time calculated from the sample rate and total number of samples in the acquisition. If the acquisition contains multiple records, then total acquisition time will be longer than the total sample time.
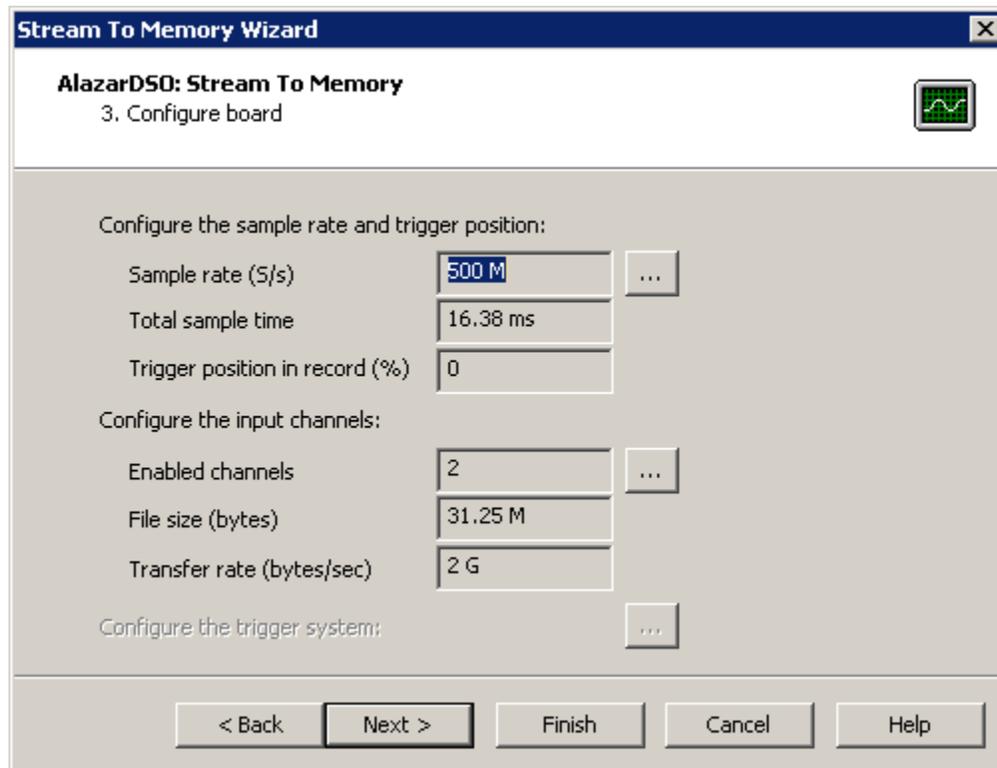
Fig. 46: Board Configuration Page

Trigger position in record

> This control displays the trigger position in each record as a percent of the record length in samples. If necessary, press on the "…" button to display the **Configure Horizontal** dialog box to change the trigger position in each record and the resulting number of pre-trigger samples.

Enabled channels

> This control displays the total number of enabled channels from all the boards in the active board system. Press the "…" button to display the Configure Input dialog box in order to enable or disable input channels.

File size

> This control displays the file size in bytes estimated from the total number of samples in the acquisition. The acquisition cannot proceed if the amount of free disk space on the volume containing the output directory is less than this value.

Transfer rate

> This control displays the transfer rate in bytes per second. Single record continuous acquisitions may fail with buffer overrun errors if the required transfer rate is greater than the maximum rate that the digitizer can transfer data from on-board memory, across the host bus, to system memory.

Configure trigger system

> Press the "…" button in order to display the Configure Trigger dialog box to view or modify the current trigger engine settings.

Back

Press this button to go back to the previous page

Next

Press this button to go forward to the next page

Finish

Press this button to apply the current settings, close this wizard, and begin the acquisition.

Cancel

Press this button to discard the current settings and close this wizard.

Help

Press this button to display on-line help with more information about this property sheet page.

3.4.6 Options
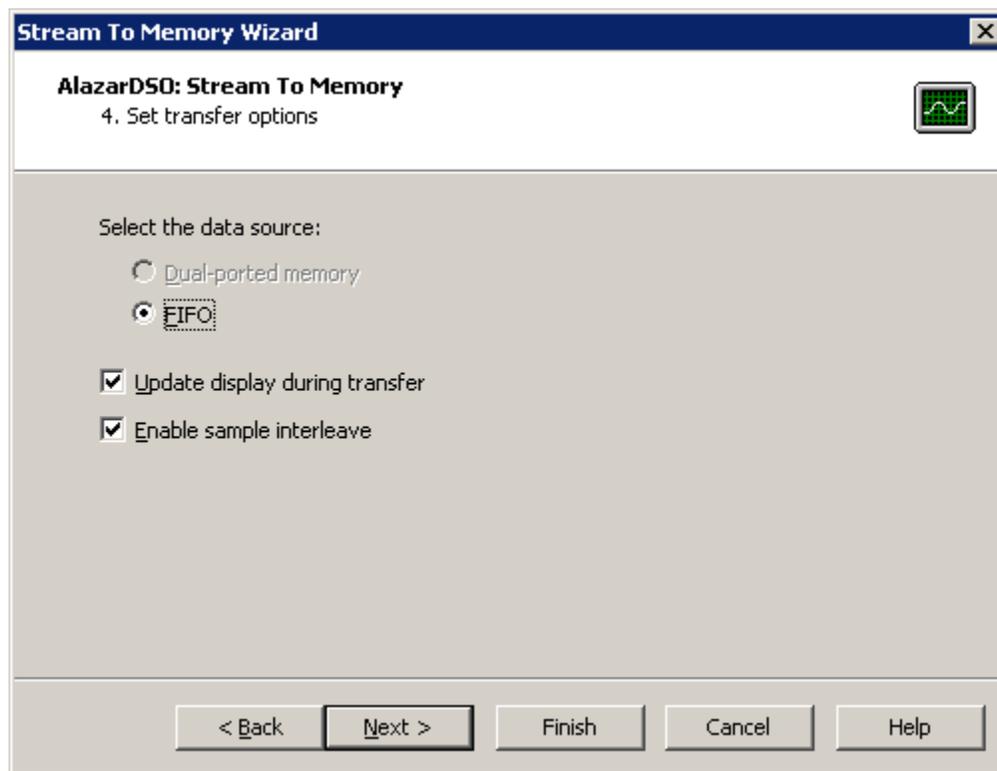
Fig. 47: Transfer Options Page

This property page allows you to select data transfer options.

Select data source

The data source defines the source of sample data on the digitizer board.

Dual-ported memory

Sample data is buffered in dual-ported memory before being transferred to host memory.

FIFO
Sample data is transferred directly from a FIFO to host memory.

Update display during transfer
Check this box to draw records on screen as they are transferred to host memory. This option should be disabled to reduce the risk of buffer overflow errors.

Enable sample interleave
This option controls how a board transfers records from on-board to host memory. When this enabled, a board transfers one sample from a record of CH A followed by the corresponding sample from the corresponding record of CH B. This method produces higher transfer rates from on-board to host memory, but requires that software de-interleave samples.

When this option is not enabled, the board transfers all of the samples from a record of CH A, followed by the all of samples from the corresponding record of CH B. This method produces lower transfer rates from on-board to host memory than sample interleaved records.

Back
Press this button to go back to the previous page

Next
Press this button to go forward to the next page

Finish
Press this button to apply the current settings, close this wizard, and begin the acquisition.

Cancel
Press this button to discard the current settings and close this wizard.

Help
Press this button to display on-line help with more information about this property sheet page.

### 3.4.7 System memory

This property page allows you to select the amount of system memory to reserve for the acquisition.

System memory for acquisition (% memory free)
Set the amount of system memory to reserve for acquisition data as a percentage of the amount of free memory. Reduce this value to increase the amount of memory available for other applications.

System memory free
This control displays the total amount of system memory available to store acquisition data.

Maximum transfers for system memory
This control displays the maximum number of DMA transfers that can fit in system memory based on current acquisition settings. The entire acquisition must fit in system memory.

Transfers in acquisition
This the desired number of transfers in the acquisition as set on page 2 "Set single record options" or "Set multiple record options" of the wizard.
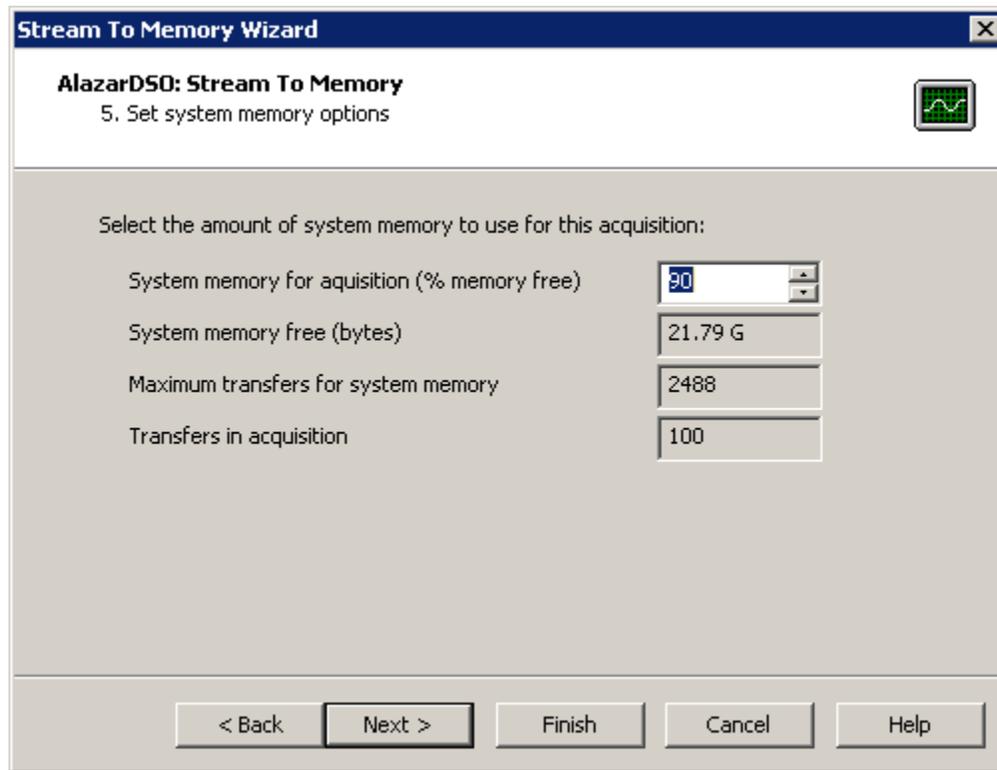
Fig. 48: System memory selection

Back
> Press this button to go back to the previous page

Next
> Press this button to go forward to the next page

Finish
> Press this button to apply the current settings, close this wizard, and begin the acquisition.

Cancel
> Press this button to discard the current settings and close this wizard.

Help
> Press this button to display on-line help with more information about this property sheet page.

3.4.8 File
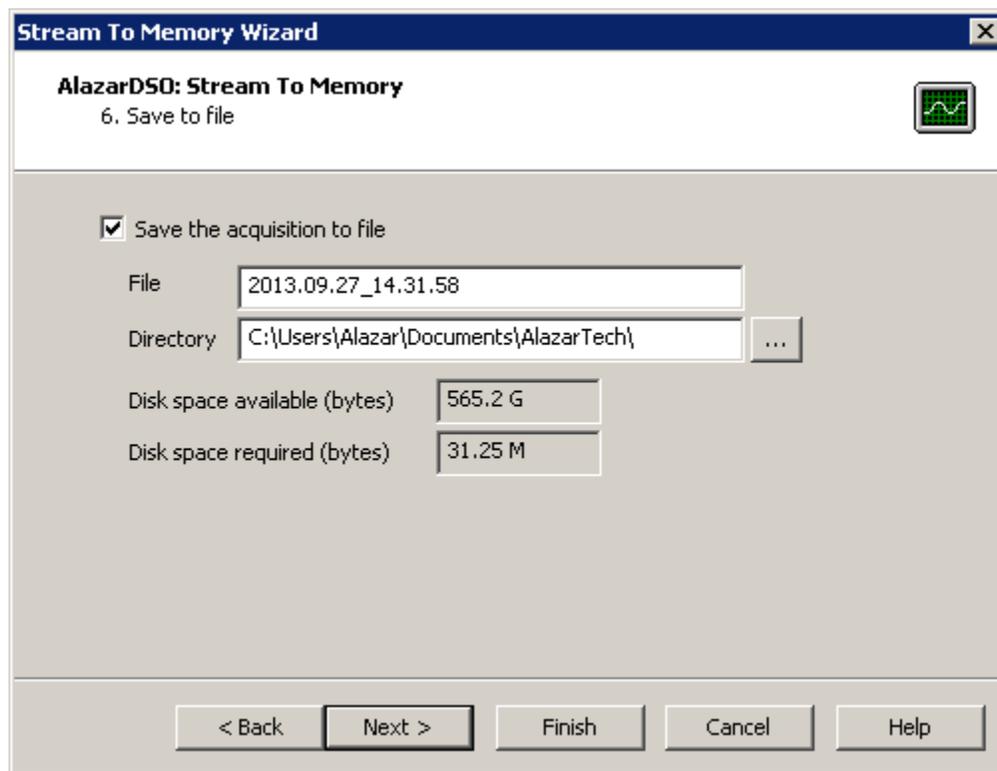
Fig. 49: File Page

This property page allows you to select the output file and directory.

Save the acquisition to file
Press this button to save the acquisition data to file. If not checked, the system will transfer data from on-board to host memory, but not save the data to file.

File
Enter the file name. AlazarDSO creates a default file name from the current date and time, and automatically appends the extension ".ATB" to the file name.

Directory
Enter the name of the directory in which to create the file, or press the "..." button to display a directory chooser dialog box which will allow you to select a directory.

Disk space available
This control displays the available disk space in bytes on the volume containing the selected directory.

Disk space required
This control displays the required disk space in bytes for the file.

The wizard cannot continue if the disk space required is greater than the disk space available. Consider changing the directory to one on a volume with more available disk space.

Back

Press this button to go back to the previous page

Next

Press this button to go forward to the next page

Finish

Press this button to apply the current settings, close this wizard, and begin the acquisition.

Cancel

Press this button to discard the current settings and close this wizard.

Help

Press this button to display on-line help with more information about this property sheet page.

3.4.9 File Options
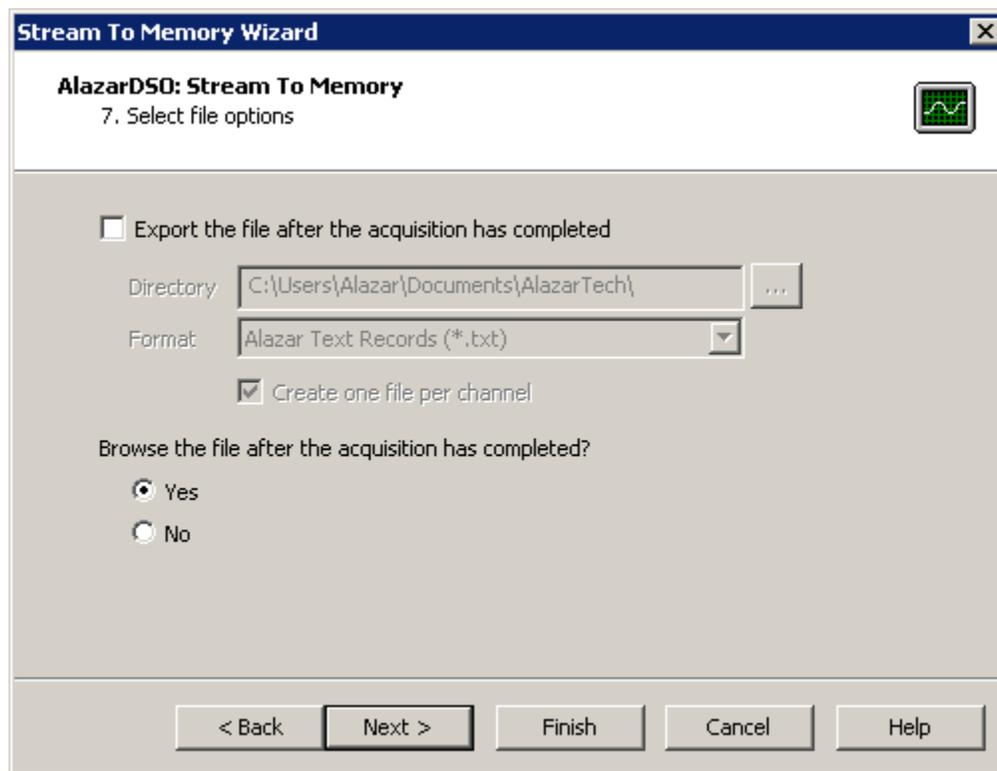
Fig. 50: File Options Page

This property page allows you to process and view the file saved during an acquisition after the acquisition has completed.

Export the file after the acquisition has completed

Check this box to export the file created during an acquisition as one or more files in the in the selected format. This option allows you to create files from sample data that can be opened directly in applications such as MATLAB® or FlexPro®.

AlazarDSO saves sample data transferred during an acquisition to a file stored in the AlazarTech ATB file format. If this option is selected, AlazarDSO exports the ATB file to one or more files in the specified format. It creates one output file for each record of each active channel from the ATB file.

Directory

Enter the name of the directory in which to create the output files, or press the "..." button to display a directory chooser dialog box which will allow you to select a directory.

AlazarDSO creates files in the selected directory using the same base file name as the ATB file. It adds a series of numbers and a letter to base file name to indicate the board number, acquisition sequence number, record number, and channel letter. It also appends an extension according to the selected format.

Format

Each exported file contains an array of sample values from one record of an active channel. Multi-byte binary values are stored in little-endian byte order. Select the type of files that you wish to create from the list.

Binary records in volts

Convert each sample value to volts and save as a binary number in IEEE 754 double precision floating point format with 8-bytes per value.

Binary records in samples

Save each sample value as a 1- or 2-byte binary number where the sample bits are right aligned in the sample bytes.

Alazar Binary records

This file format contains an ASCII text header followed by binary sample data. The file begins with an ASCII text record header that stores information about the program, board, acquisition, and channel. This header is followed by sample data as binary values. Each sample value is stored as one or two bytes sample entries depending on board's sample size in bits. Sample bits are right aligned in sample bytes, and multi-byte values are stored least significant byte first.

Text records in volts

Convert each sample value to volts and save as an ASCII text number with one sample value per line.

Text records in samples

Save each sample value as an ASCII text number with one sample value per line.

Alazar Text records

This file format contains an ASCII text header followed by ASCII text sample data. The file begins with an ASCII text record header that stores information about the program, board, acquisition, and channel. This header is followed by sample data with one sample value per line. Each line stores the index of the sample in the record, the time in seconds of the sample from the trigger point in the record, the sample value as an ADC code, and the sample value in volts.

FlexPro Records in volts or samples

Save each sample time and value from a record in FlexPro® "FPF" format.

MATLAB arrays in volts or samples
> Save each sample time and value from a record as pair of 2-D numerical arrays in MAT-LAB® Level-4 MAT file format.

Create one file per channel
> Check this box to save all of records from one channel to a single file. If this box is not checked, then the program will save each record to a separate file.

Browse file after the acquisition has completed
> Check to display the "Browse File" dialog box after the acquisition has completed. The "Browse File" dialog allows you to view the acquisition file one transfer at a time.

> Note that if you close the "Browse File" dialog box, you can display it again by selecting "Browse File" from the "View" menu until you make another acquisition or exit the program. If you make another acquisition or restart the program, then select "Open" command from the "File" menu to display the "Open File" dialog box and select the file by name.

Back
> Press this button to go back to the previous page

Next
> Press this button to go forward to the next page

Help
> Press this button to display on-line help about this dialog box.

Finish
> Press this button to apply the current settings, close this wizard, and begin the acquisition.

Cancel
> Press this button to discard the current settings and close this wizard.

Help
> Press this button to display on-line help with more information about this property sheet page.

3.4.10 Finish

This is the last page of the **Stream To Memory Wizard**.

Back
> Press this button to go back to the previous page.

Finish
> Press this button to apply the current settings, close this wizard, and begin the acquisition.

Cancel
> Press this button to discard the current settings and close this wizard

Help
> Press this button to display on-line help with more information about this property sheet page.

Fig. 51: Finish Page

3.5 Stream To Disk

Stream to Disk module of AlazarDSO has been deprecated starting in version 1.1.70. From this point on, Stream to Disk module will only be sold as part of a complete data streaming system, such as AlazarStream.

Users should use the Stream to Memory feature provided in the Tools menu as a standard feature to acquire data into motherboard memory and eventually into a file on the disk volume of their choice.

3.6 Disk Benchmark Wizard

The **Disk Benchmark Wizard** displays a series of property pages that allows you measure the write speed of your drives. This wizard may be used to verify that your disks are capable of the sustained write speed required for streaming.

The wizard displays the following property pages.

3.6.1 Welcome

Fig. 52: Welcome Page

The Welcome Page displays a brief introduction to the Disk Benchmark wizard.

Next
> Press this button to go to the next page.

Cancel
> Press this button to exit the wizard.

Help
> Press this button to display on-line help with more information about this property sheet page.

3.6.2 Options

The Options Page allows you to select the drive to benchmark, and the properties of the file used to benchmark this drive.

The wizard will measure the time required to create a test file on the selected drive. The test file will be composed of a number of segments that will be written sequentially to the drive.

Drive
> Select a drive from the combo box.
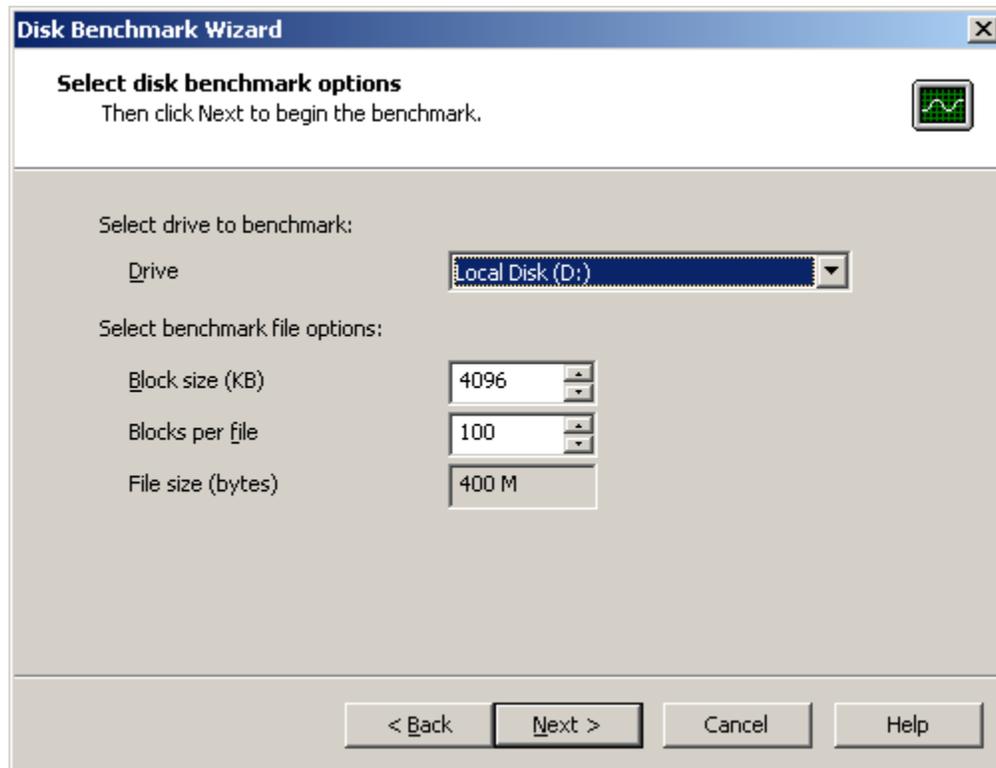
Fig. 53: Options Page

Block size
    Enter the size of each segment of the benchmark file in kilobytes.

Blocks per file
    Enter the number of segments in the benchmark file.

File size
    This edit control displays the size of the benchmark file in bytes. The selected drive must have at least this much free space in order to perform the benchmark.

Back
    Press this button to go back to the previous page

Next
    Press this button to begin the benchmark test.

Cancel
    Press this button to exit the wizard.

Help
   Press this button to display on-line help with more information about this property sheet page.

3.6.3 Progress
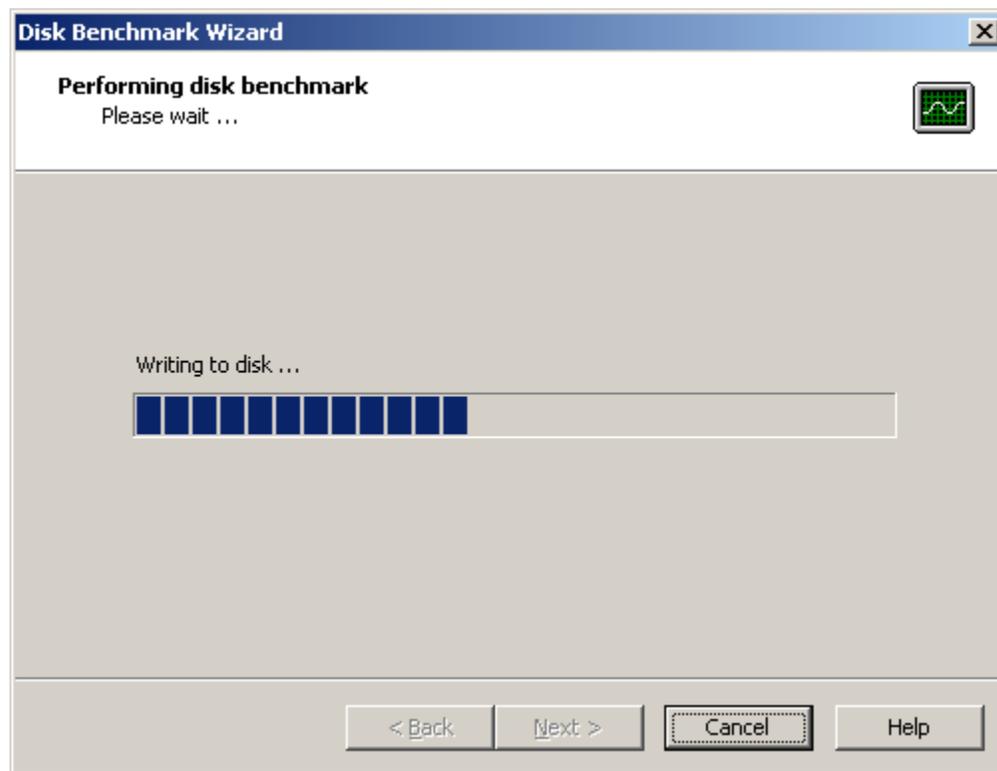
Fig. 54: Progress Page

The Progress Page displays progress information during the test. When the benchmark completes, the wizard will move to the finish page.

Cancel
> Press this button abort the test and move to the finish page.

Help
> Press this button to display on-line help with more information about this property sheet page.

3.6.4 Finish

This is the last page of the Disk Benchmark wizard. It displays the write speed of the selected drive, as well as general information about the drive.

Report
> Press this button to display the benchmark report file.

> By default, the wizard saves benchmark report files in the "%Documents and Settings%\AlazarTech\Benchmark" folder. It automatically generates a file name from drive name, block size, and current date and time.

Fig. 55: Benchmark Finish Page

Back
> Press this button to go to the Options page to benchmark another drive.

Finish
> Press this button to exit the wizard.

Cancel
> Press this button to exit the wizard.

Help
> Press this button to display on-line help with more information about this property sheet
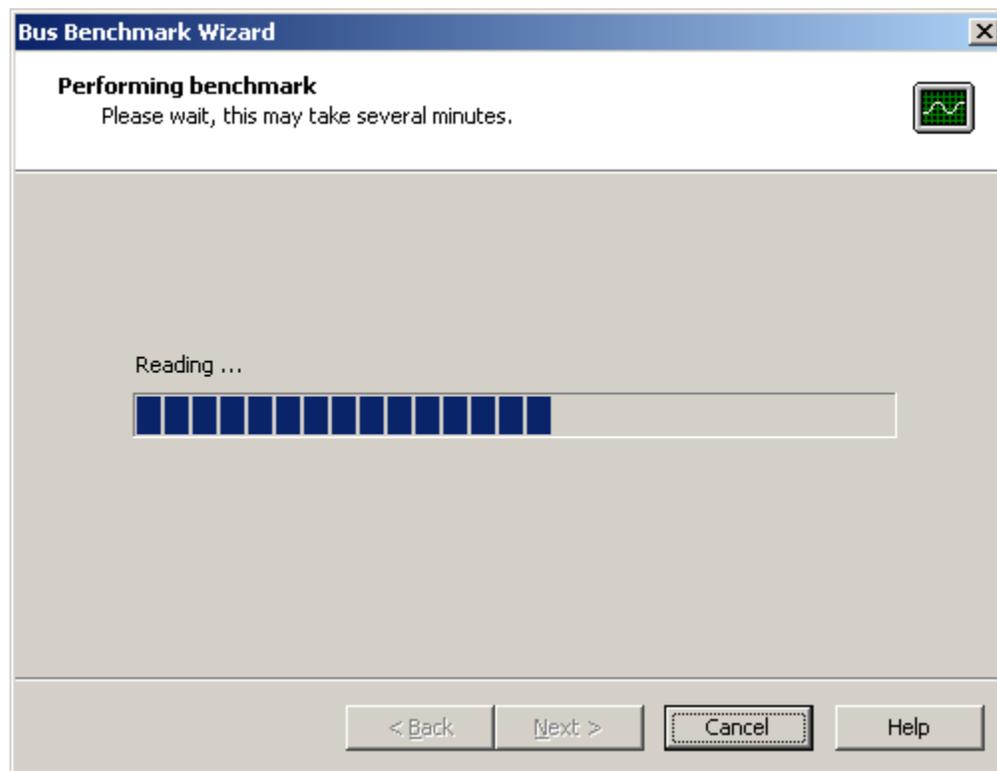> page.

3.7 Bus Benchmark Wizard

The **Bus Benchmark Wizard** displays a series of property pages that allows you measure the average transfer rate from your AlazarTech digitizer boards to host memory. This wizard may be used to verify that your computer is capable of the sustained transfer rates required for streaming.

***

Note: The digitizer board does not transfer data from its analog-to-digital converters during this test. The board generates data internally, and transfers this data to host memory at a rate that is

***

limited only by the speed of the host bus interface and memory controller.

The wizard displays the following property pages.

3.7.1 Welcome

Fig. 56: Welcome Page

The Welcome page displays a brief introduction to the Bus Benchmark wizard.

Next

Press this button to go to the next page.

Cancel

Press this button to exit the wizard.

Help

Press this button to display on-line help with more information about this property sheet page.

3.7.2 Options
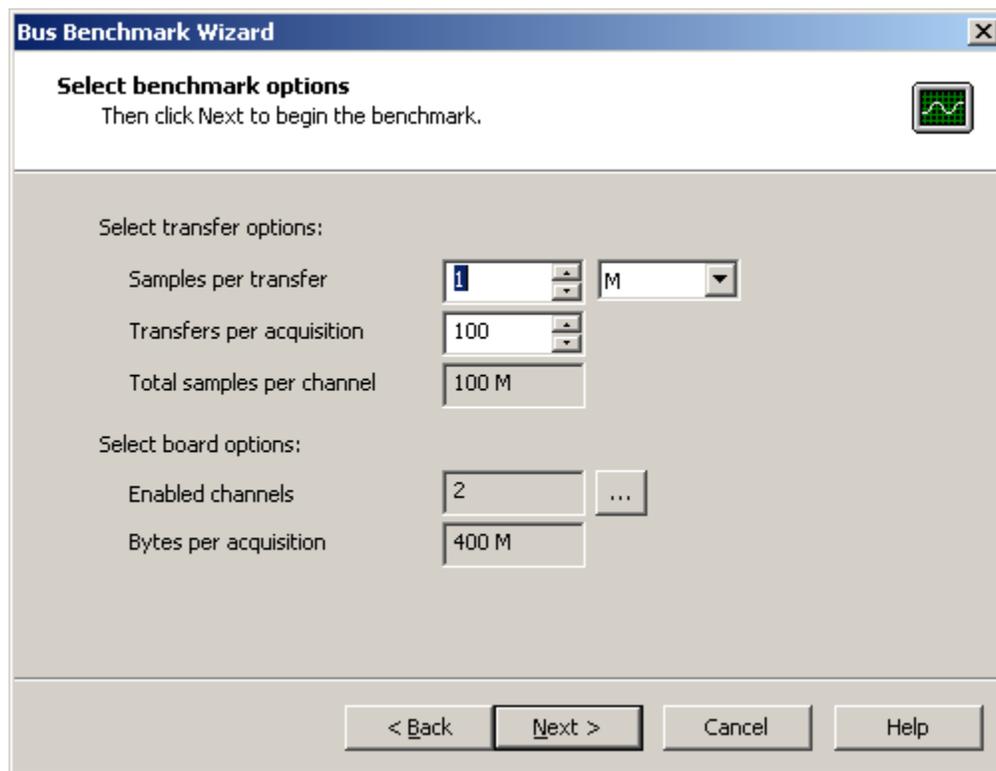
Fig. 57: Options Page

The Options page allows you to select the amount of data to transfer from the boards during the benchmark. The wizard measures the time required to transfer the specified amount of data.

Samples per transfer

In dual-ported memory mode, an acquisition is split into DMA transfers that move sample data from on-board to PC host memory while, at the same time, on-board memory is filled with acquisition data.

Enter the size of each DMA transfer in samples, and select the units from the "units" combo box.

Transfers per acquisition

Enter the number of DMA transfers per acquisition.

Total samples per channel

This value is the product of the **Samples per transfer** and **Transfers per acquisition** values. This is the total number of samples that will be transferred per enabled channel during the acquisition.

Enabled channels

This edit control displays the current number of enabled channels. Press the "..." button to display the "Configure Input" dialog where you can enable or disable input channels.

Bytes per acquisition

This edit control displays the total number of bytes of sample data that will be transferred from the board to host memory during the benchmark test.

Back

Press this button to go back to the previous page

Next

Press this button to begin the benchmark test.

Cancel

Press this button to exit the wizard.

Help

Press this button to display on-line help with more information about this property sheet page.

3.7.3 Progress

Fig. 58: Progress Page

The Progress Page displays progress information during the test. When the benchmark completes, the wizard will move to the finish page.

Cancel

Press this button abort the test and move to the finish page.

Help

Press this button to display on-line help with more information about this property sheet page.

3.7.4 Finish
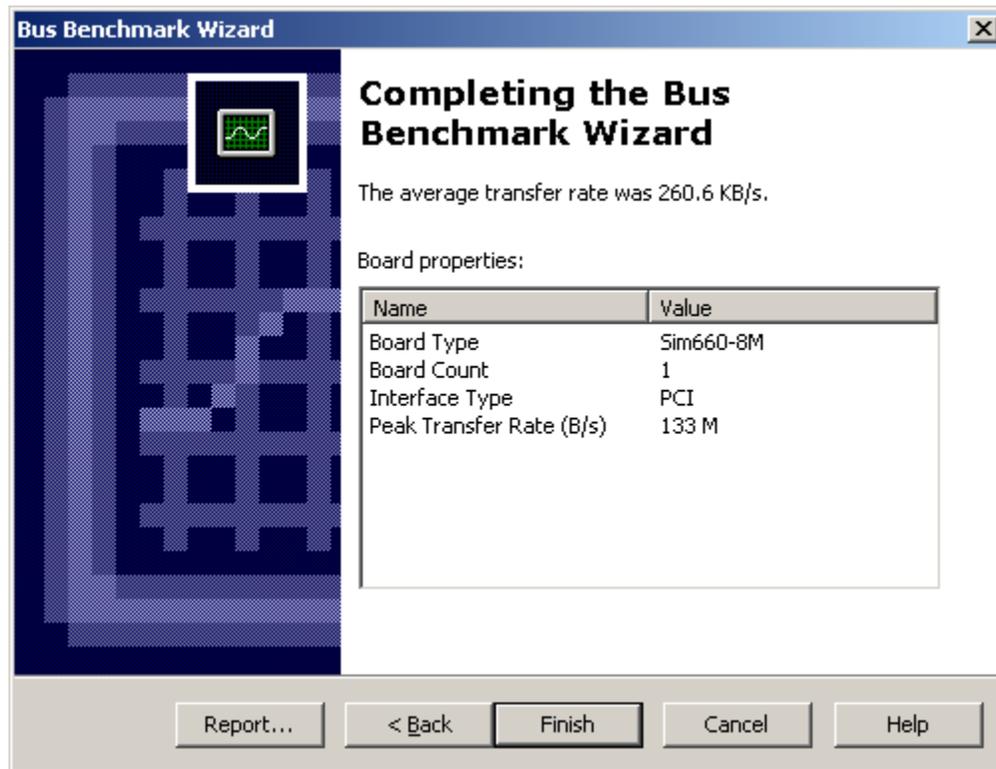
Fig. 59: Benchmark Finish Page

This is the last page of the Bus Benchmark wizard. It displays the average sustained transfer rate from the board to host memory, as well as general information about your boards.

Report

Press this button to display the benchmark report file.

By default, the wizard saves benchmark report files in the "%Documents and Settings%\AlazarTech\Benchmark" folder. It automatically generates a file name from the system name, board serial numbers, and current date and time.

Back

Press this button to go to the Options page to begin another benchmark.

Finish

Press this button to exit the wizard.

Cancel

Press this button to exit the wizard.

Help

Press this button to display on-line help with more information about this property sheet page.

3.8 Board Calibration Wizard

The **Board Calibration Wizard** displays a series of property pages that allow you to verify the calibration of AlazarTech digitizer boards, and optionally recalibrate the digitizer boards.

The wizard controls signal generator devices using plugin modules. A calibrator plugin receives messages from the calibration wizard, translates them into device specific commands, sends the commands to the device, and receives responses from the device.

AlazarDSO includes a manual calibrator plugin. This plugin allows you to manually control a signal generator to supply the voltage levels, sine, and square waveforms necessary to calibrate your digitizer boards. The plugin prompts you to configure your signal generator as required by the software.

AlazarDSO can automatically control signal generators that have a remote control interface. Plugins are available a number of devices including: Agilent 33220A and 33522A Function Generator, Agilent N9310A RF Signal Generator, Fluke 5500A and 5820A Oscilloscope Calibrators, HP 8656A Signal Generator, and Stanford Research Systems SG384 RF Signal Generator. Contact support@alazartech.com for more information.

The board calibration wizard displays the following property pages.

3.8.1 Welcome

This is the first page of the Board Calibration Wizard. It displays a brief introduction to the wizard.

Next
Press this button to go to the next page.

Cancel
Press this button to exit the wizard.

Help
Press this button to display on-line help with more information about this property sheet page.

3.8.2 Mode

This page allows you to select a basic calibration operation.

Verify calibration
Check this radio button to verify the DC gain and offset calibration of one or more input channels.

Calibrate input channels
Check this radio button to recalibrate the DC gain and offset one or more input channels.

Fig. 60: Welcome Page
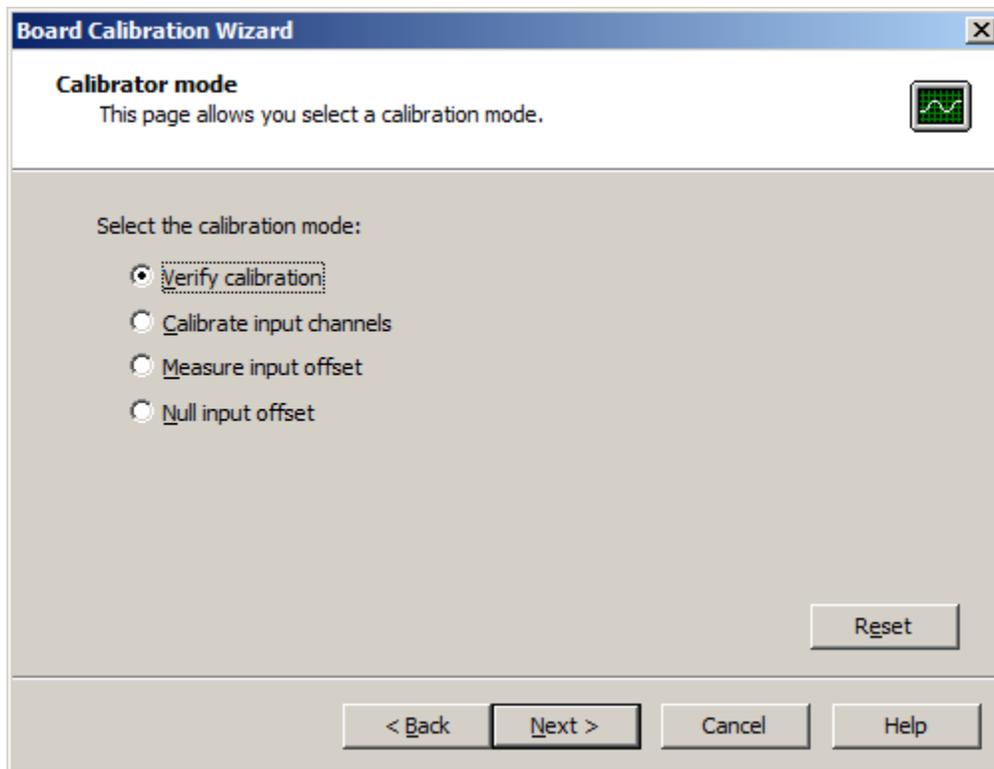
Fig. 61: Mode Page

Measure input offset

Check this radio button to measure the offset error of one or more input channels using AC or DC coupling.

Null input offset

Check this radio button to calibrate out offset errors on one or more input channels using either AC or DC coupling.

Reset

Press this button to restore default calibration settings.

3.8.3 Options
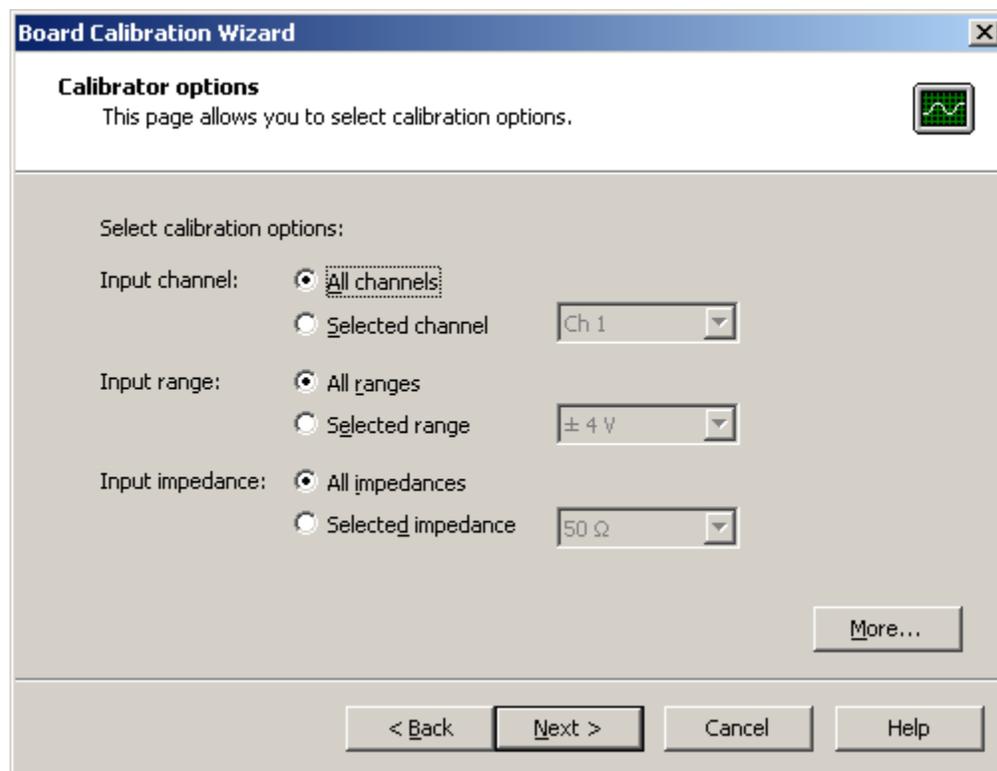
Fig. 62: Options Page

This page allows you to specify the analog input channels, ranges, impedances, and couplings to include in the measurements, and to select advanced calibration options.

Input channels

These radio buttons let you select the input channels to include in the calibration.

All channels

Calibrate all of the input channels in the active board system.

Selected channel

Calibrate the input channel selected from the channel list box.

Input range

    These radio buttons let you select the input ranges of the selected input channels to include in the calibration.

    All ranges

        Calibrate all available input ranges.

    Selected range

        Calibrate the input range selected from the input range list box.

Input impedance

    These radio buttons let you to select the input impedances of the selected input ranges of the selected input channels to include in the calibration.

    All impedances

        Calibrate all available input impedances.

    Selected channel

        Calibrate the input impedance selected from the impedance list box.

Note: The impedance radio buttons are disabled in "measure capacitance" mode because this mode requires $1\text{M}\Omega$ input impedance.

Input coupling

    These radio buttons let you select the input couplings of the selected input impedances of the selected input ranges of the selected input channels to include in the calibration.

    All couplings

        Calibrate all available input couplings.

    Selected coupling

        Calibrate the coupling selected from the coupling list box.

Note: The input coupling radio buttons are enabled only in "measure frequency response mode". All other modes require DC coupling.

"Verify" and "Calibrate" modes always use DC coupling.

Back

    Press this button to go back to the previous page

Next

    Press this button to begin the benchmark test.

Cancel

    Press this button exit the wizard.

Help

    Press this button to display on-line help with more information about this property sheet page.

More

Press this button to display the **Calibration Options** dialog box, which allows you to set advanced calibration options.

Calibration Options
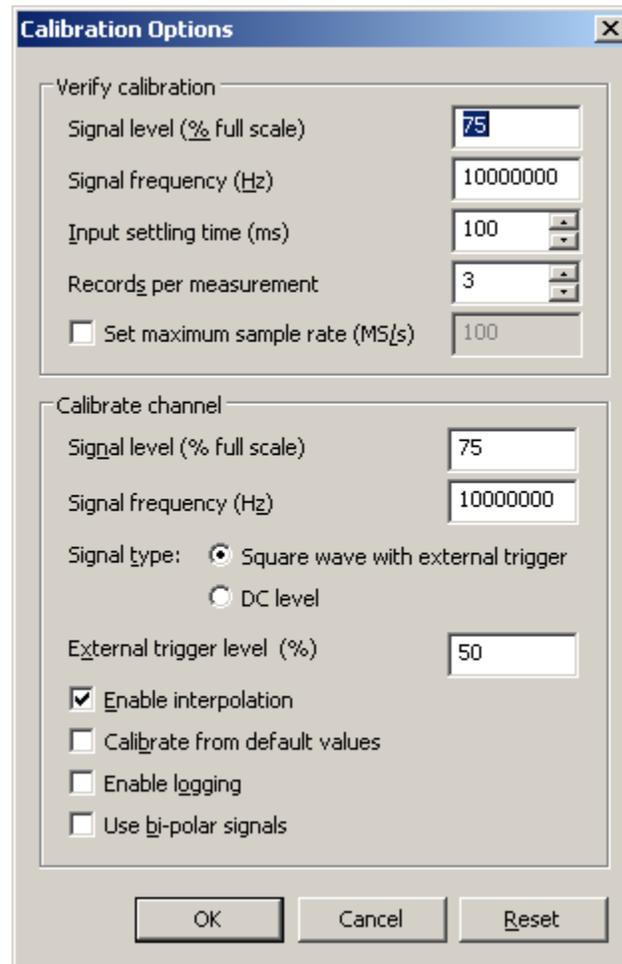
Fig. 63: Calibration Options dialog

The **Calibration Options** dialog box is displayed when you select "Verify calibration" or "Calibrate input channel" on the **Mode** page. It allows you to select advanced options for calibration and verification operations.

Signal level (Verify)

Enter the signal level that will be used to verify the DC accuracy of a channel's input range. This value is specified in percent of the input range's full-scale voltage.

Signal frequency (Verify)

Enter the frequency in Hertz of the sine waveform that will be used to verify the AC gain of a channel's input range. This value is only used on boards without DC coupled inputs.

Input settling time (ms)

Enter the amount of time in milliseconds to wait between configuring a digitizer board and making a measurement. This delay may be required to allow on-board relays to settle if they change output state.

Records per measurement

Enter the number of records to acquire during each measurement. The program will use samples from the last record for the calibration.

Set maximum sample rate (MS/s)

Check this box and enter a sample rate in millions of samples per second to set the internal sample rate used for board calibration and verification tests to value that is less than or equal to the specified sample rate.

Signal level (Calibrate)

Enter the signal level that will be used to calibrate a channel's input range. This value is specified in percent of the input range's full-scale voltage.

Signal frequency (Calibrate)

Enter the frequency in Hertz of the sine waveform that will be used to calibrate the AC gain of a channel's input range. This value is only used on boards without DC coupled inputs.

Signal type (Calibrate)

Select the type of signal you wish to use to calibrate a channel's input range.

Square wave with external trigger

Check this radio button if the calibrator can provide a square wave signal and external trigger output.

DC level

Check this radio button if the calibrator can not provide a square wave output signal or external trigger output, or the digitizer does not have an external trigger input.

External trigger level

Enter the external trigger level as a percent of the external trigger range supported by the calibrator device.

Enable interpolation

Check this box to allow the software to calculate the rate of change of error with respect the change in a control parameter, and use this value to estimate the ideal control value required to reduce the error to zero.

When enabled, this option should reduce calibration times.

Calibrate from default DAC values

Check this box to start the calibration from default calibration settings, rather than the calibration data currently stored in the NVRAM of the digitizer board.

If the current calibration data is valid, un-check this option to shorten calibration times. If current calibration data is invalid, check this option to shorten calibration times.

Enable logging

Check this box to allow the software to log detailed information during the calibration procedure. This option may be useful for debugging problems with the board calibration wizard.

Use bi-polar signals

> Check this box to enable the software to calibrate using signals that are symmetrical with respect to ground. Uncheck this box to calibrate using signals whose low level is 0 volts.

OK

> Press this button to save the current settings, and close this dialog box.

Cancel

> Press this button to discard any changes and close this dialog box.

Reset

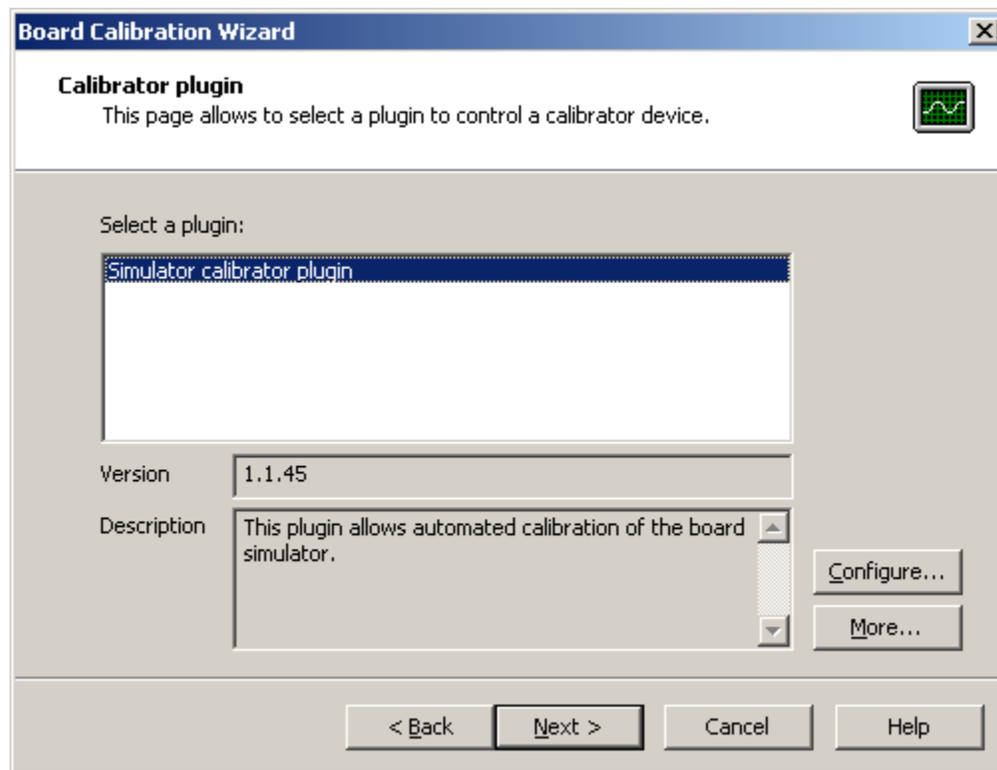> Press this button to reset all settings to their default values.

3.8.4 Plugin

Fig. 64: Calibrator Plugin Page

This page allows you to select the calibrator device that will use during the calibration. A calibrator plugin allows the wizard to control a function generator to supply the signals and waveforms required during the calibration process.

Select a plugin

> The plugin list displays the names of the calibrator plugin modules detected. You must select a plugin module to continue with the board calibration wizard.

Version

> This control displays the version of the selected plugin.

Description

This control displays a brief description of the selected plugin.

Configure

Press this button to display a calibrator plugin specific configuration dialog box. For example, this dialog might allow you to specify the GPIB address of a GPIB connected device.

Back

Press this button to go back to the previous page

Next

Press this button to begin the benchmark test.

Cancel

Press this button exit the wizard.

Help

Press this button to display on-line help with more information about this property sheet page.

More

Press this button to display advanced calibrator plugin options configuration dialog.

Manual Calibrator Plugin Options

The manual calibrator plugin allows you to use a function generator to supply the signals required to calibrate your digitizer boards. The calibration wizard will prompt you to connect the outputs from your function generator to the inputs of a digitizer, and to configure the function generator to supply the signals required by the digitizer.

Manufacturer

Enter the name of the manufacturer of your function generator. This text will appear in the report generated by the calibration wizard.

Model

Enter the model name of your function generator. This text will appear in the report generated by the calibration wizard.

Serial number

Enter the serial number of your function generator. This text will appear in the report generated by the calibration wizard.

Minimum level

Enter the minimum DC voltage level that your function generator is capable of supplying.

Maximum level

Enter the maximum DC voltage level that your function generator is capable of supplying.

Minimum frequency

Enter the minimum sine or square wave frequency that your function generator is capable of supplying.
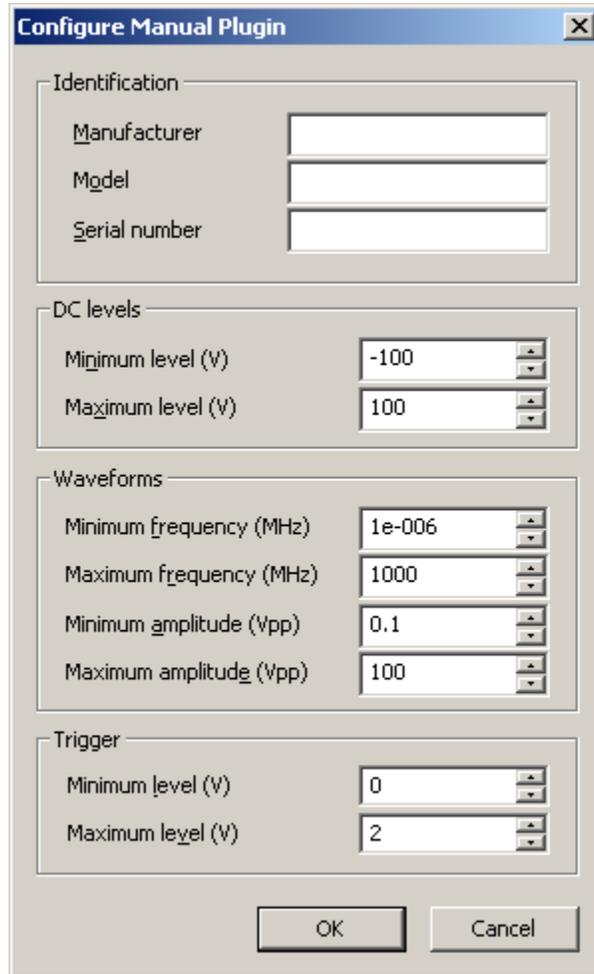
Fig. 65: Configure Manual Plugin

Maximum frequency

Enter the maximum sine or square wave frequency that your function generator is capable of supplying.

Minimum amplitude

Enter the minimum amplitude of the sine or square wave that your function generator is capable of supplying in volts peak-to-peak.

Maximum amplitude

Enter the maximum amplitude of the sine or square wave that your function generator is capable of supplying in volts peak-to-peak.

Trigger minimum level

Enter the minimum voltage level of the trigger signal that your function generator is capable of supplying.

Trigger maximum level

Enter the maximum voltage level of the trigger signal that your function generator is capable of supplying.

OK

Press this button to apply the current settings and close the dialog box.

Cancel

Press this button to discard the current settings and close the dialog box.

Simulator Calibrator Plugin Options
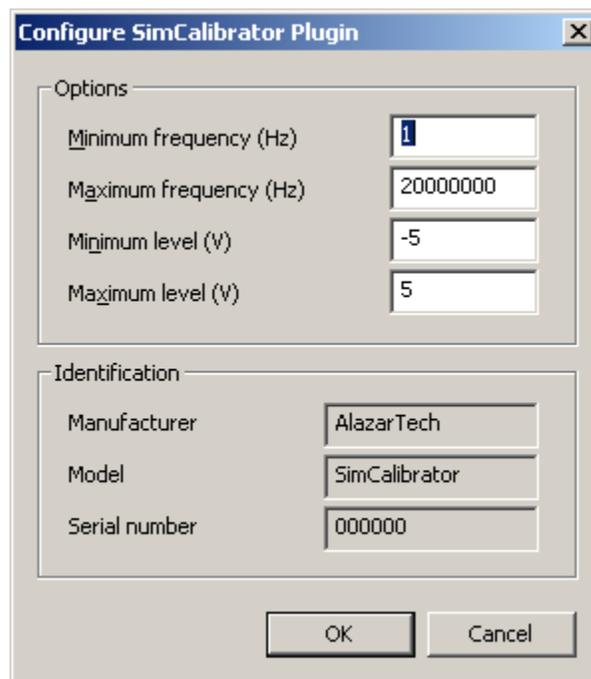
Fig. 66: Configure Simulator Calibrator Plugin dialog box

The calibrator simulator plugin is a plugin module that controls the simulated waveform generator used to create signals when AlazarDSO is operating in simulation mode. The **Configure SimCalibrator Plugin** dialog allows you to set the capabilities of this waveform generator.

Minimum frequency

Enter the minimum frequency that the simulated waveform generator will report that it is capable of supplying.

Maximum frequency

Enter the maximum frequency that the simulated waveform generator will report that it is capable of supplying.

Minimum level

Enter the minimum DC level that the simulated waveform generator will report that it is capable of supplying.

Maximum level

Enter the maximum DC level that the simulated waveform generator will report that it is capable of supplying.

Manufacturer

This read-only field displays the manufacturer that the plugin will report to the calibration wizard.

Model

This read-only field displays the model number that the plugin will report to the calibration wizard.

Serial number

This read-only field displays the serial number information that the plugin will report to the calibration wizard.

OK

Press this button to apply the current settings and close the dialog box.

Cancel

Press this button to discard the current settings and close the dialog box.

3.8.5 Report

The wizard creates report files containing the details of the tests performed during the calibration. This page allows you to select calibration report options.

Directory

Enter the folder path where the wizard should store its calibration report files, or press the "..." button to display a directory chooser dialog box that allows you to select a folder graphically.

By default, the wizard stores these file in the "%My Documents%\AlazarTech\Calibrator\Reports" directory.
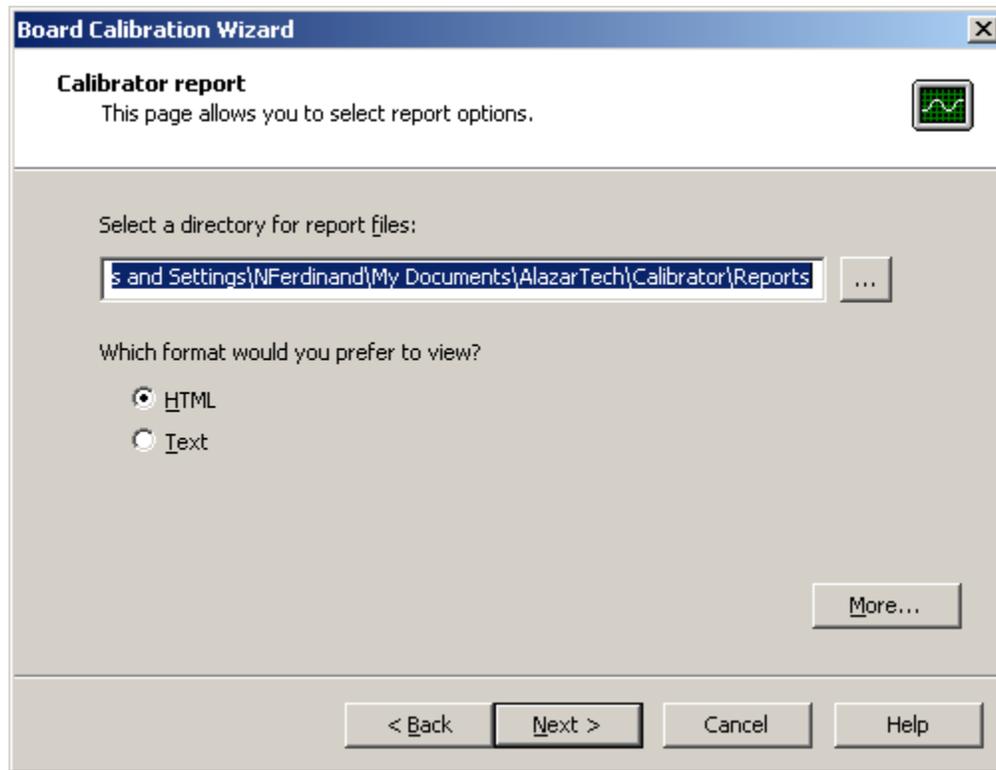
Fig. 67: Calibrator Report Page

Format
> These radio buttons allow you to select the type of file displayed when you press the "Report" button on the "Finish" page of the wizard.

> **HTML**
>> These files open in your default web browser, and use color to make visual analysis easier.

> **Text**
>> These tab separated text files are formatted for analysis in spreadsheet programs.

Back
> Press this button to go back to the previous page

Next
> Press this button to begin the benchmark test.

Cancel
> Press this button exit the wizard.

Help
> Press this button to display on-line help with more information about this property sheet page.

More
> Press this button to go display the "Calibration Report Options" dialog. This dialog allows

you to configure advanced report options.

Calibration and Verification Report Options
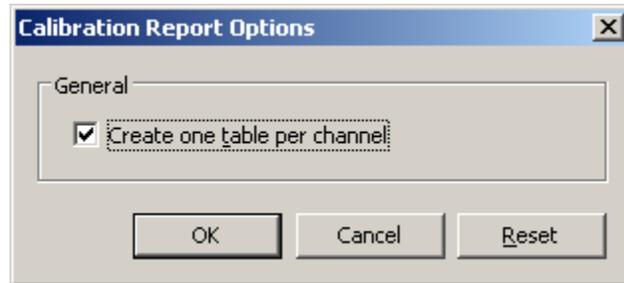
Fig. 68: Calibration Report Options

This dialog box allows you to set advanced report options in modes that generate tables but no charts.

Create one table per channel
> Check this button to create reports files with one table per input channel. Uncheck this button to create report files with a single table containing results from all input channels.

OK
> Press this button to apply the current settings, and close this dialog box.

Cancel
> Press this button to discard any changes and close this dialog box.

Reset
> Press this button to reset all values to their default values.

3.8.6 Confirm

This page displays a summary of your selections, and allows you to verify that these selections are correct before beginning the calibration procedure.

Next
> Press this button start the calibration operation.

Back
> Press this button to return to the previous page.

Cancel
> Press this button exit the wizard.

Help
> Press this button to display on-line help with more information about this property sheet page.
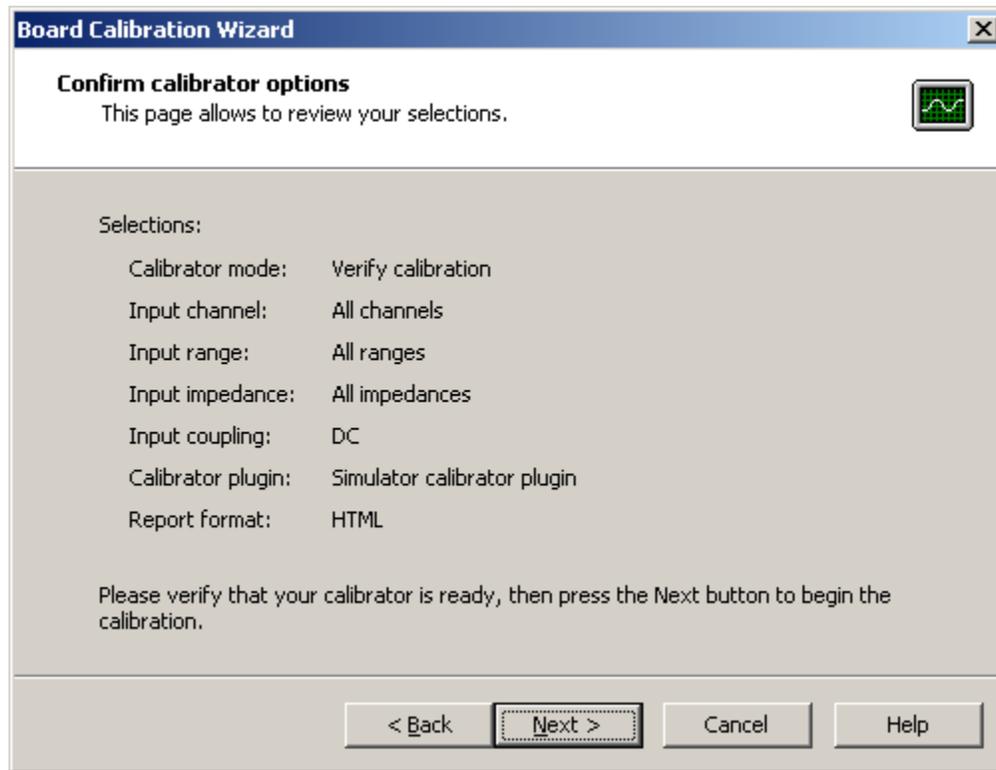
Fig. 69: Confirm Calibrator Options Page

3.8.7 Progress

This page displays a progress bar showing the current position in the calibration operation, and a log window with information about the current calibration task.

Cancel

Press this button abort the calibration operation.

Help

Press this button to display on-line help with more information about this property sheet page.

3.8.8 Finish

This is the last page of the Board Calibration Wizard. This page displays the calibrator completion status, and a summary of the calibration results.

Report

Press this button to display the calibration report file.

By default, the wizard saves calibration report files in the "%Documents and Settings%\AlazarTech\Calibrator\Reports" folder. It automatically generates file names from the board type, serial number, and current date and time. You can change the report format and output directory in the "Configure Calibrator" dialog box.
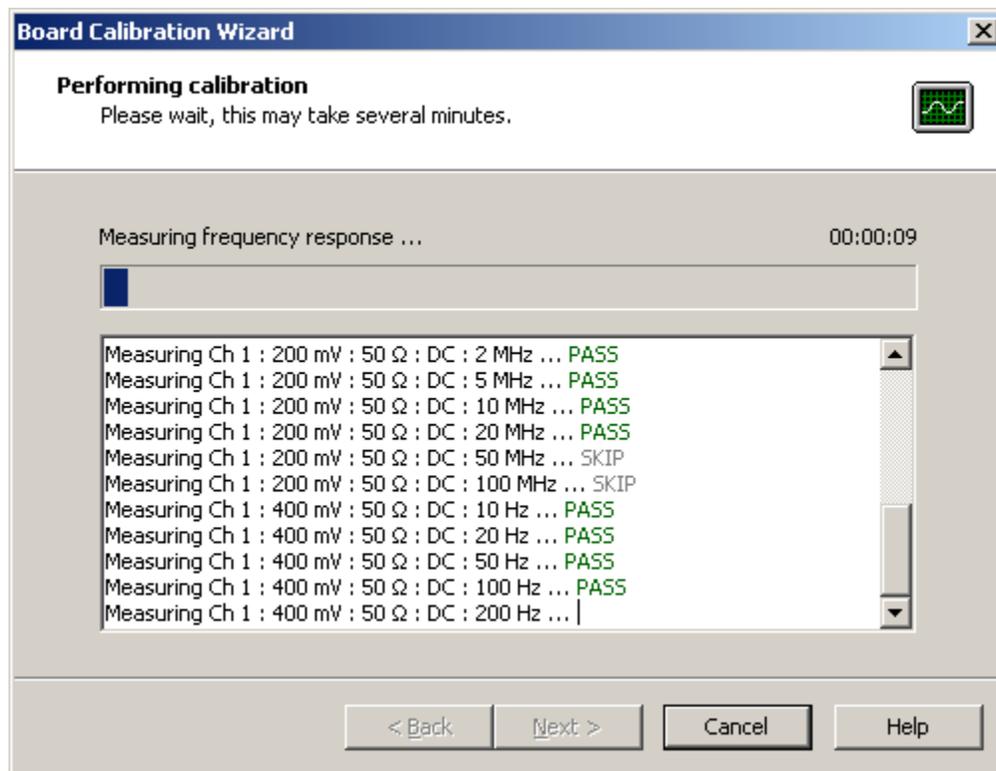
Fig. 70: Progress Page
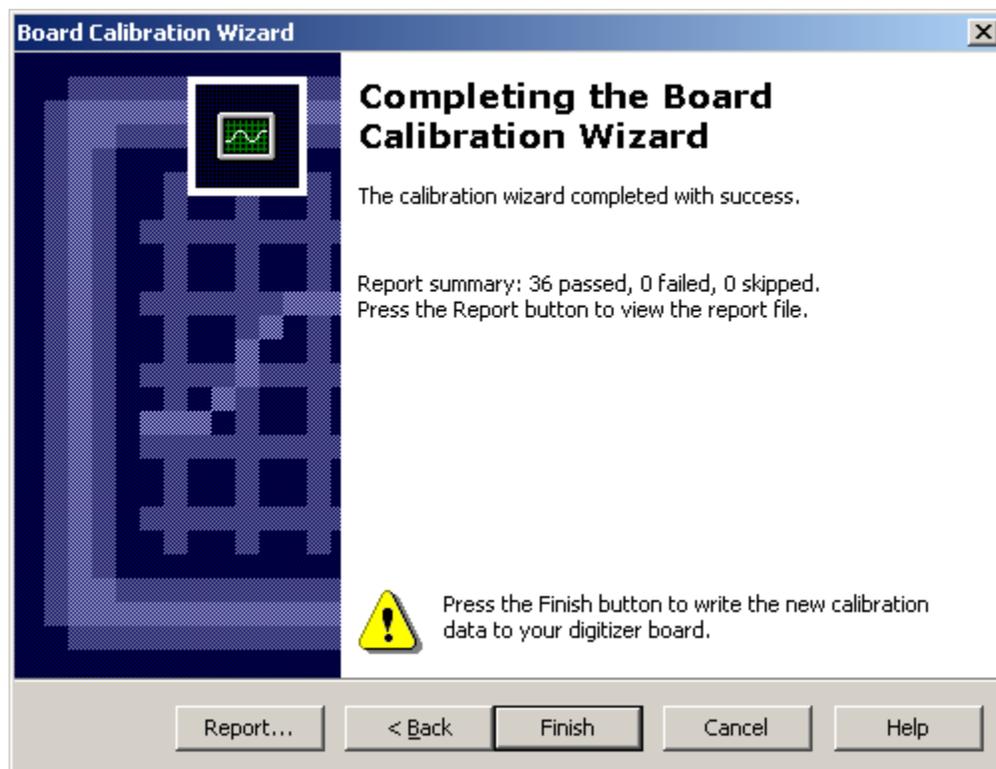
Fig. 71: Finish Page

Back

Press this button to restart the calibration wizard from the Mode page.

Finish

If new calibration data was found, Press this button to save the new calibration data to NVRAM on the digitizer board. If new calibration data was not found, then press this button to exit the wizard.

Cancel

Press this button to exit the wizard.

Help

Press this button to display on-line help with more information about this property sheet page.

PLUGIN MODULES

AlazarDSO can be extended with plugin modules. These modules can examine and modify configuration settings and acquisition data gathered by AlazarDSO while it is running.

4.1 Plugin interface

A plugin is a dynamic link library that exports a function declared by name as follows:

```
extern "C" int AlazarPlugin(int message, void *parameters);
```

AlazarDSO searches the "%Program Files%\AlazarTech\AlazarDSO\Plugins" directory for files with the extension ".dll" when it is started. If it finds a loadable module that exports the function AlazarPlugin, this module is added to the available plugin list.

The plugin list can be viewed in the **Configure Plugins** dialog box. Select **Plugins** from the **Configure** menu to display the **Configure Plugins** dialog box. This dialog box also allows you to enable the plugin interface, and select one ore more plugin moduels from the list of available plugins that will be called while acquisitions are running.

AlazarDSO calls each active plugin several times during each acquisition with a message indicating its progress in the acquisition, and a message specific parameter. For example, before it writes configuration data to a board, AlazarDSO sends enabled plugins the PLUGIN_CONFIG message, and a pointer to a structure containing the configuration parameters as the message parameter. After each acquisition is completed, but before the data is displayed, AlazarDSO sends enabled plugins the PLUGIN_DISPLAY message, and a pointer to a structure containing the sample data as the message parameter.

The enabled plugins can examine and modify the acquisition settings and sample data, and return a value back to AlazarDSO. AlazarDSO displays the value returned from the plugin in the plugin state field on the status line at the top of the graticule. Plugin states are: plugin inactive, plugin active, and plugin ignore.

AlazarDSO draws the sample data returned from the plugin on screen where it can be processed by a math channel, saved as a reference channel, or exported to file.
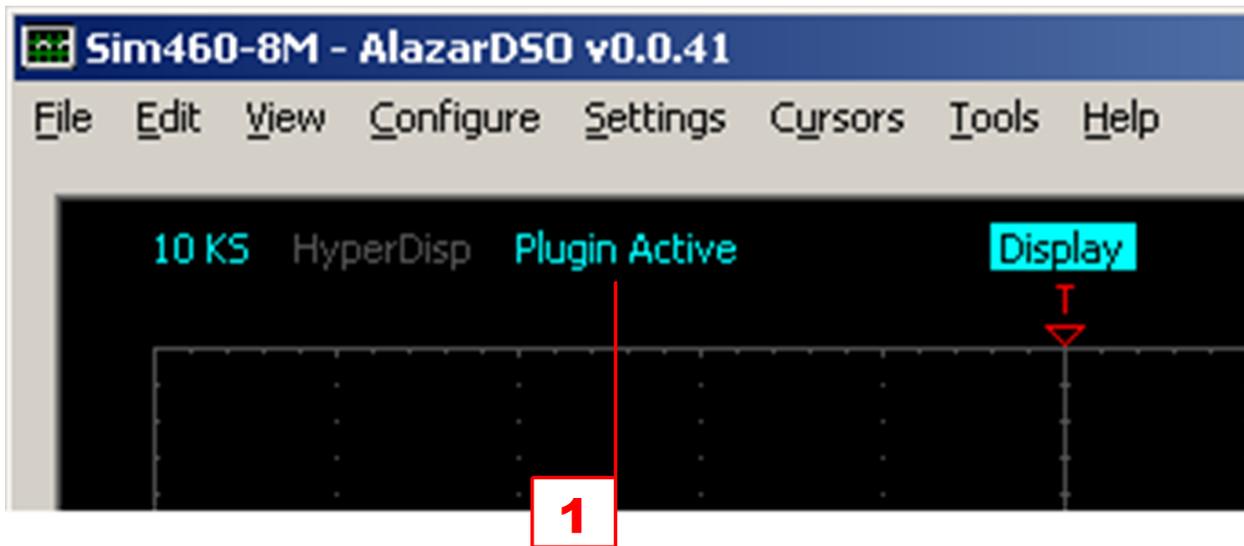
Fig. 1: Plugin state control

4.2 Using plugins

AlazarDSO includes sample plugins to demonstrate the plugin interface.

4.2.1 Save data

This plugin demonstrates how to access configuration and acquisition data by writing all of the configuration and sample data it receives to a file.

To enable this plugin, display the **Configure Plugins** dialog box, check the **Enable** box to enable the plugin interface, select the plugin named "Save data" from the list.

When enabled and acquisitions are started, this plugin creates a file named "AlazarPlugin %date% %time%.txt" in the "My Documents\AlazarTech" folder, and writes the acquisition settings and sample data that it receives from AlazarDSO to this file.

Remember to disable this plugin when it is not needed. Since it writes data to a file with every acquisition, it will reduce the acquisition rate and fill the %My Documents% directory with data files.

Press the "Configure" button to display the "Configure Save Data" plugin dialog box.

The "Configure Save Data" plugin dialog box allows you to specify the number of samples from each record to save file.

All the samples
> Click on this radio button to save all the samples from each record to the file.

The following number of samples
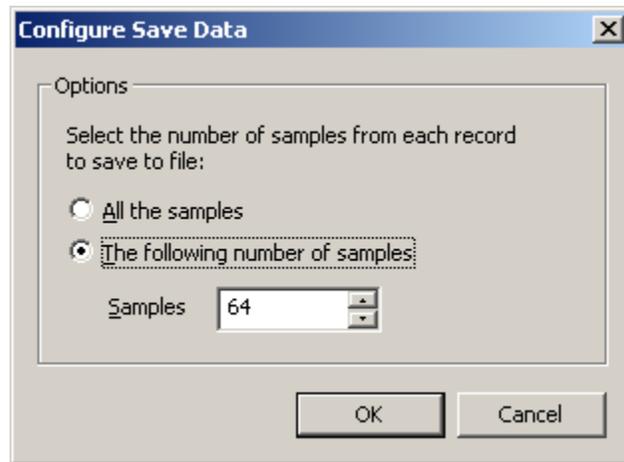
Fig. 2: Configure Save Data

Click on this radio button to specify the number of samples from the start of each record to
save to file.

OK
Press to accept these settings and close the dialog box.

Cancel
Press to discard these settings and close the dialog box.

4.2.2 Calculate average of multiple records

This plugin calculates the average sample value from each record in the selected number of records,
and modifies the capture buffer to contain one or more records with these average values. The
number of records to average can span multiple acquisitions in an acquisition sequence.

To enable this plugin, display the **Configure Plugins** dialog box, check the **Enable** box to enable
the plugin interface, select the plugin named "Calculate average of multiple records" from the list,
and press the **OK** button to accept these changes.

To configure the plugin, double click on the plugin name in the plugin list, or select the plugin from
the plugin list and press the "Configure" button.

Record count
Enter the number of records to average. AlazarDSO calculates the average of this number
of records, and writes the average record into the capture buffer for display. Note that the
record count may span multiple acquisitions in an acquisition sequence.

OK
Press this button to apply the current settings and close the dialog box.

Cancel
Press this button to discard the current settings and close this dialog box.
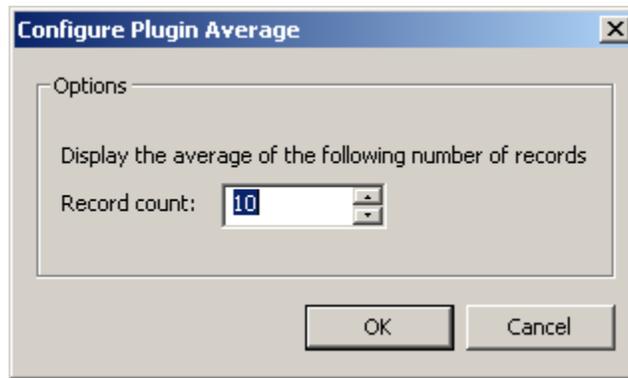
Fig. 3: Configure Plugin Average dialog box

4.2.3 Display 1-In-N Records

This plugin draws one out of a specified number of records captured during an acquisition sequence.

To enable this plugin, display the **Configure Plugins** dialog box, check the **Enable** box to enable the plugin interface, select the plugin named "Display 1 record in N" from the plugin list.

To select the number of records to discard between each record displayed, press the **Configure...** button to display the "Configure Display 1-In-N Records" dialog box.
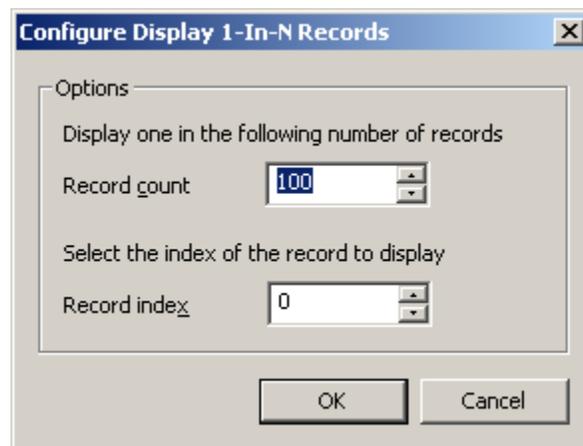
Fig. 4: Configure "Display 1-In-N Records" plugin

The "Configure Display 1-In-N Records" dialog box allows select the number of records to display from the records acquired.

Record count
> Enter a number of records. AlazarDSO displays only one of this number of records captured.

Record index
> Enter the zero-based index of a record. AlazarDSO displays this record from each group of "record count" records.

> For example, if you wish to display the last of every tenth record acquired, then enter "10"

for the "Record count" value and "9" for the "Record index" value.

OK

Press this button to apply the current settings and close the dialog box.

Cancel

Press this button to discard the current settings and close this dialog box.

4.2.4 Acquire At Time

This optional plugin module allows you to specify the date and time at which to start an acquisition sequence. It can also repeat acquisitions at a specified interval, and retrieve time information from a Trimble® Mini-T™ GPS Disciplined Clock Module.

Note: You must purchase this optional plugin module. Please contact support@alazartech.com for more information.

To enable this plugin, display the **Configure Plugins** dialog box, check the **Enable** box to enable the plugin interface, select the plugin named **Acquire At Time** from the plugin list.

To select the date and time of the capture, press the **Configure...** button to display the **Configure PluginAcquireAtTime** dialog box.

Controls in the **Configure PluginAcquireAtTime** dialog box are divided into the following groups:

- The "Date and Time" group allows you to specify the date, time, and time scale at which you'd like to start an acquisition sequence.

- The "Repeat" group allows you to wait a specified amount of time after the start of the previous acquisition before starting the next acquisition.

- The "Options" group allows you to obtain date and time information from a Trimble® Mini-T™ GPS Disciplined Clock Module connected to a serial port of the host PC. It also allows you to generate text files containing acquisition parameters, and binary files containing sample data.

Date

Select the acquisition start date from the date control.

Time

Select the acquisition start time from the time control.

Time Scale

Select the time scale from the list box. The current available time scales are

Local

The selected date and time values are in the time zone specified in the Windows "Date / Time Properties" settings on the local PC.

UTC

The selected date and time are UTC times
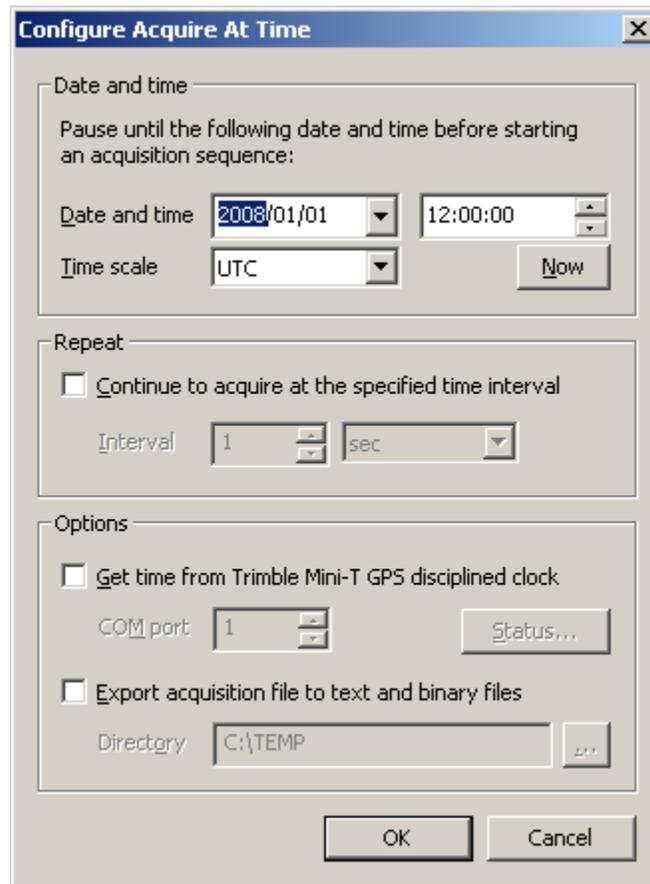
Fig. 5: Configure Acquire At Time plugin

GPS

The selected date and time are GPS times. Note that if the difference between UTC and GPS time is unknown, it is assumed to be zero.

Now

Press this button to set the start date and time to the current date and time in the selected time scale.

Continue to acquire at the specified interval

Check this button to delay the start of the next acquisition in the acquisition sequence until the current time is the specified interval after the time at the start of the previous acquisition.

Note that if you start an acquisition sequence with a requested start time has already past, then:

- If the "Continue to acquire at the specified interval" button is not checked, the acquisition will begin immediately.

- If the "Continue to acquire at the specified interval" button is checked, then acquisition will start as soon as the current time is an integer number of intervals after the requested start time.

Also note that you specify the total number of acquisitions in the acquisition sequence in the "Configure Acquire" dialog box. To open the "Configure Acquire" dialog box, select the "Acquire. . . " command from the AlazarDSO "Configure" menu.

Interval

Select the time interval and units to wait between start of the previous acquisition and the start of the next acquisition.

Get time from Trimble Mini-T GPS disciplined clock

Check this box to enable the plugin to obtain timing information from a Trimble® Mini-T™ GPS Disciplined Clock Module.

COM port

Select the serial port to which the Trimble® Mini-T™ GPS Disciplined Clock Module is attached. Note that the plugin assumes that the device's communication parameters are: 9600 baud, 8 data bits, 1 stop bit, no parity, and no handshaking.

Status

Press this button to display the "Trimble Mini-T GPS Clock Status" dialog box, which shows the current time, position, and GPS status from the device as shown below.

Export acquisition file to text and binary files

Check this box to export an acquisition file to text files and binary files. The text files contain acquisition parameters, and the binary files contain sample data.

When this box is checked, the number of text and binary files created depends on the type of acquisition selected:

- If you run the "Stream To Disk" command, the plugin creates one text file and one binary file for each enabled channel of each board.

- If you run the "Acquire To File" command, the plugin creates one text file and one binary file for each record of each enabled channel of each capture for each board in the
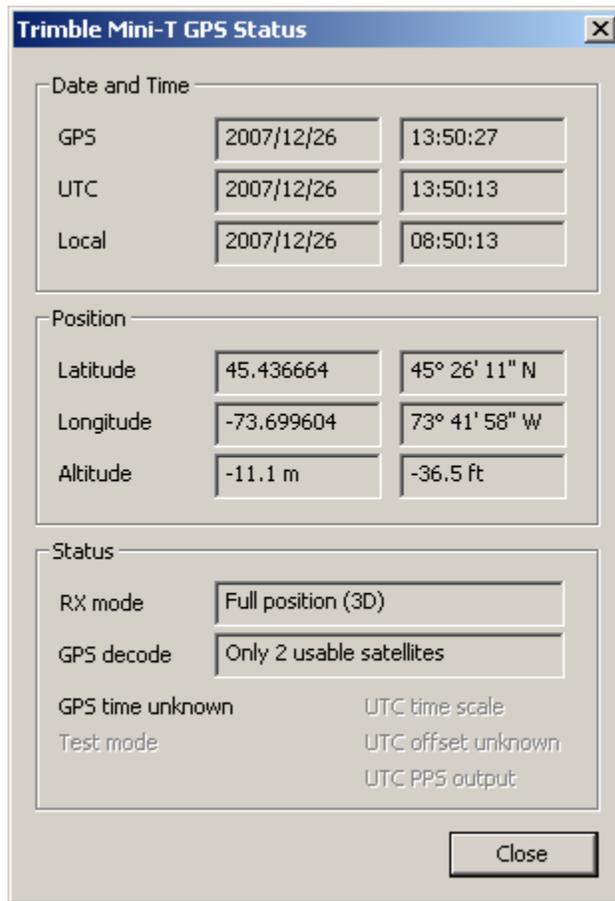
Fig. 6: Trimble Mini-T GPS Status dialog

acquisition file.

Directory

Enter the directory in which to create the export files, or press the "..." button to browse for the directory.

OK

Press this button to save the current settings, and close this dialog box.

Cancel

Press this button to discard any changes and close this dialog box.

Note that while the Acquire At Time plugin holds off the start of an acquisition, the AlazarDSO status bar changes as shown below.
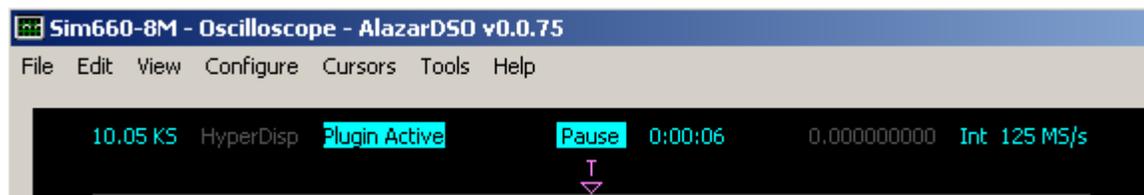

Fig. 7: Status line with Acquire At Time plugin active

- The plugin state message changes to "Plugin Active" in reverse text.

- The acquisition state message changes to "Pause"

- The "Time in state" text displays the elapsed time that the plugin has paused the start of the next acquisition while waiting for the current time to be greater than or equal to the next acquisition time.

Note:

- Use the Trimble DSPMon software to configure the clock module. The Acquire At Time plugin does not allow you to modify the configuration of the Trimble® Mini-T™ GPS Disciplined Clock Module.

- The Acquire At Time plugin disables broadcast packets from the Trimble Mini-T when it connects to the module. If the software exits normally, then it will restore the broadcast mask before exiting.

  The Trimble DSPMon software requires primary and supplemental timing packets broadcasts to operate normally. If AlazarDSO does not exit normally, then either reset the Trimble Mini-T to restore the settings from EEPROM memory, or re-enable the mask using the Trimble DSPMon software.

  To restore the packet broadcast mask using the Trimble DSPMon software, select "Packet Masks and Options..." from the DSPMon "Setup" menu. From the "Packet Masks and Options" dialog, check "Primary Timing (8F-AB)(Bit 0)" and "Supp Timing (8F-AC)(Bit 2)" as shown below, and then click on the "Set Masks" button.
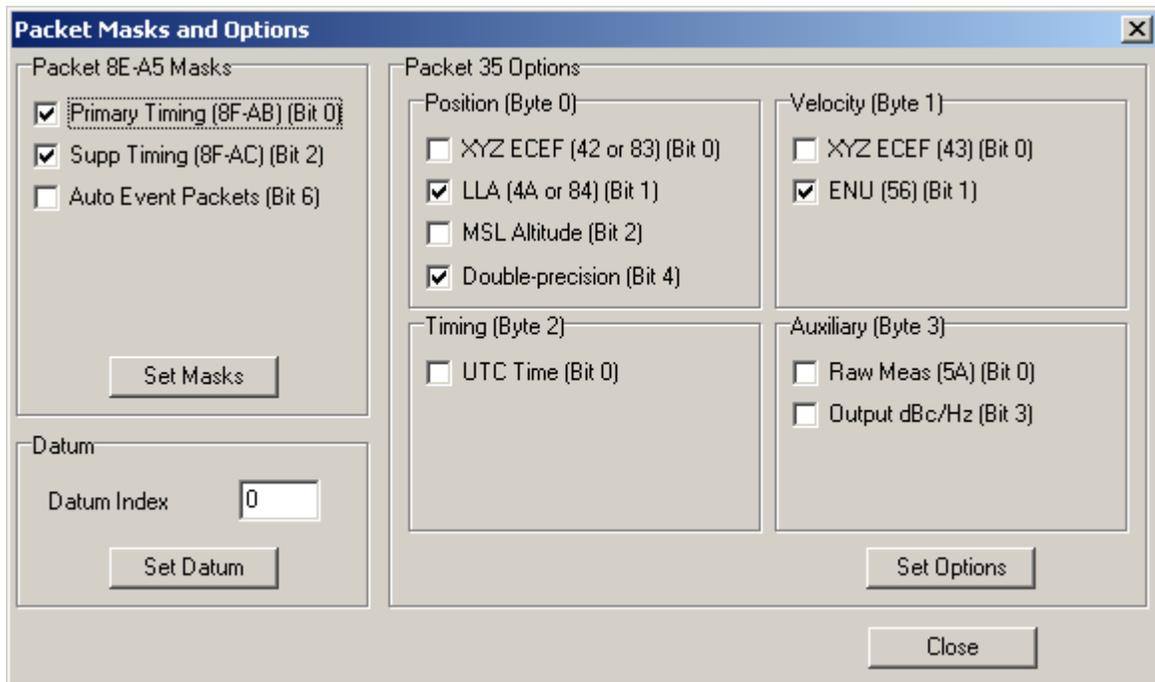
Fig. 8: DSPMon "Packet Masks and Options" dialog

4.2.5 Calculate sum of multiple records (co-addition)

This plugin allows you to accumulate sample values from the records of an acquisition. It can optionally display the sample or accumulated values, and save the accumulated values to a file.

To enable this plugin, display the "Configure Plugins" dialog box, check the "Enable" button to enable the plugin interface, select the plugin named "Calculate sum of multiple records (co-addition)" from the plugin list.

To display the "Configure Co-Addition Plugin" dialog box to configure this plugin, double-click on the plugin name in the list, or highlight the plugin name and press the "Configure..." button.

The "Configure Co-Addition Plugin" dialog box allows you to control how sample records are accumulated, displayed, and saved.

Records to exclude
Enter the number of records from the start of an acquisition sequence whose samples should not be included in the accumulation.

Display
The display mode allows you to control what is displayed while the plugin is accumulating sample records during an acquisition sequence.

Nothing
Disable screen updates during the acquisition.

Sample data
Draw records containing sample data.
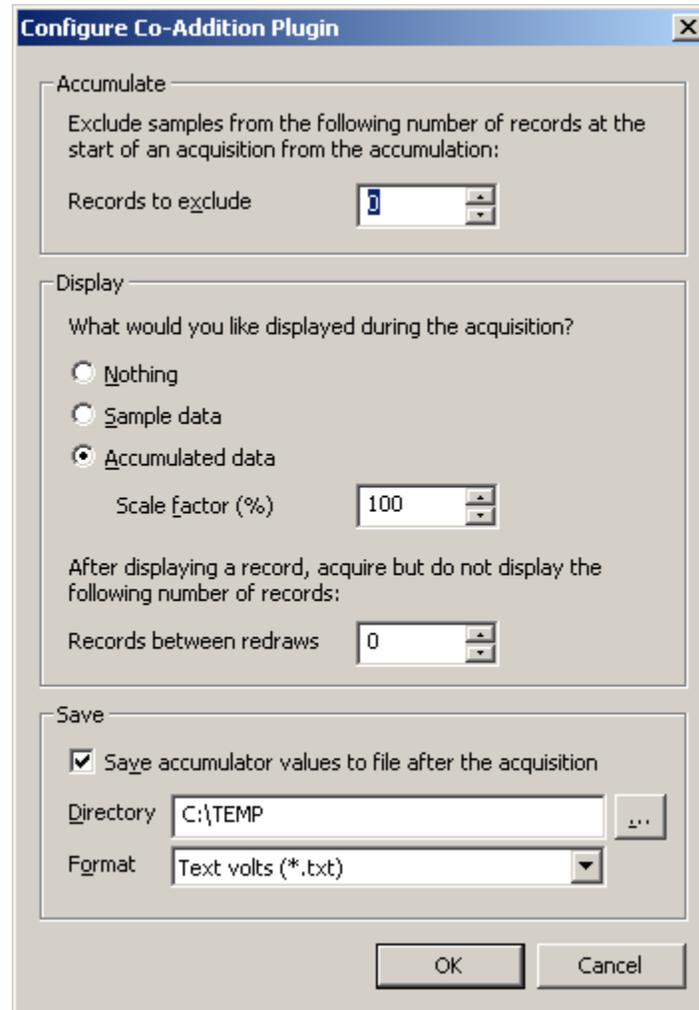
Fig. 9: Configure Co-Addition Plugin dialog box

Accumulated data

Draw a record containing accumulator data.

Scale factor

Enter the amount in percent to scale the display of accumulated sample data. Use this value to reduce the vertical size of the accumulated waveform.

Records between redraws

Enter the number of records to acquire, but not display, after displaying a record on screen. Enter a value that is greater than zero if you do not require that each record be displayed on screen.

Save accumulator values to file after the acquisition

Check this box to enable writing the accumulated sample values to a file after an acquisition sequence completes.

Directory

Enter the directory in which to create the accumulator files, or press the "..." button to browse for the directory.

The plugin creates files named "PluginAccumulate_%date%_%time%_%channel%" in this directory, where %date% and %time% are the date and time at which the file was created, and %channel% is the record channel (A or B). It adds a file extension of ".bin" or ".txt" depending on the file format chosen.

Format

Select accumulated data file format from the list. The file formats include:

Binary volts

Convert each accumulator value to volts and save as a binary number in IEEE 754 double precision floating-point format. There are eight bytes per value stored in little-endian byte order.

Binary samples

Save each accumulator value as a 64-bit binary number where the sample bits are right aligned in the sample bytes. There are eight bytes per value stored in little-endian byte order.

Text volts

Convert each accumulator value to volts and save as an ASCII text number with one sample value per line.

Text samples

Save each accumulator value as an ASCII text number with one value per line.

OK

Press to accept these settings and close the dialog box.

Cancel

Press to discard these settings and close the dialog box.

4.2.6 Power monitor

AlazarTech PCIe digitizers include temperature sensors and A/D converters that allow real-time monitoring of on-board temperatures and power supply voltage levels, where the number of hardware sensors varies by board model. The power monitor plugin allows you to display, chart, and record these sensor values.

To enable the Power Monitor plugin:

- Select the "Configure | Plugins" menu item to display the "Configure Plugins" dialog box,

- Check the Enable button to enable the plugin interface

- Check the box to the left Power Monitor list item in the plugin list to enable the Power Monitor plugin.

The Power Monitor plugin includes a configuration dialog box that allows you to display the values of all on-board sensors, and to select one sensor value to display as strip chart, or save to a file.

To display the "Configure Power Monitor" dialog box:

- Left-click click on the "Power Monitor" list item to select the "Power Monitor" plugin and then press the "Configure" button.

- Double-click on the "Power Monitor" list item.

Board Id

Select the board identifier of the board whose temperatures and voltages to read.

Status

Press this button to display the power monitor "Status" dialog. This dialog box displays values in real-time read from all of the temperature and voltage sensors available on the selected board.

Hover the mouse button over an entry display a tool-tip with the name, ideal value, and limits of that entry.

Check the "Show warning level" check box to display values exceeding warning limits in yellow.

If a value exceeds high or low limit values, then the ADT7411 generates an interrupt that causes a red LED on the digitizer board connected to that ATD7411 to be turn on. Press the "Clear Int." button clear the interrupt and turn off the LED.

Device Id

Each PCIe digitizer board includes a number of Analog Devices ADT7411 temperature and A/D sensor devices, where the number of devices depends on the board model. Select the index of the ADT7411 device to read.

Channel

Select the channel of the selected ADT7411 that you wish to display as a chart, or log to file. This list box displays the channel name, and the temperature or voltage sensor that is connected to it.
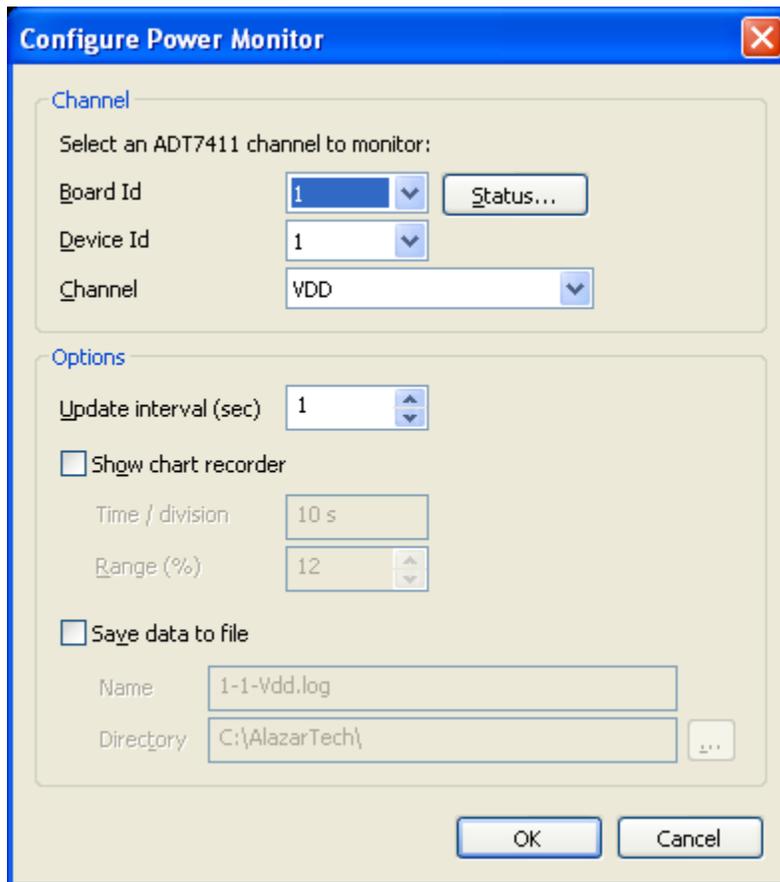
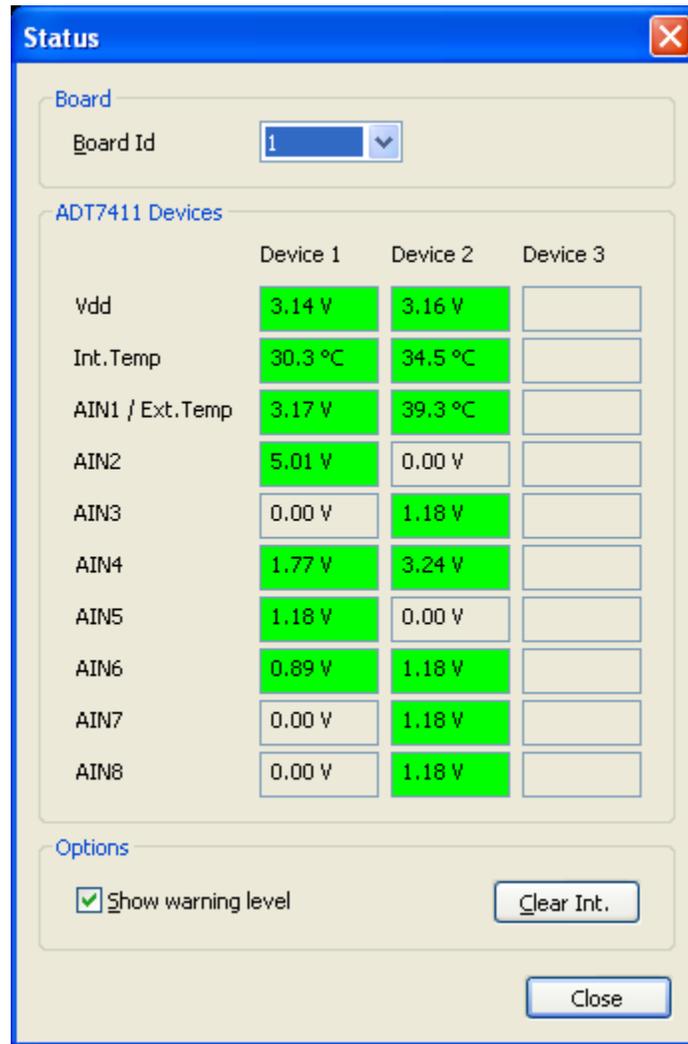Fig. 10: Configure Power Monitor plugin dialog box

Fig. 11: Power Monitor Status plugin dialog box

Fig. 12: Power Monitor Status Tool tip

Update interval

Enter the time, in seconds, between record chart and data logger updates.

Show chart record

Check this button to display the value of the selected ATD7411 device and channel graphically in chart. The most recent measurement is displayed on the right side of the chart, with older values scrolling towards the left.
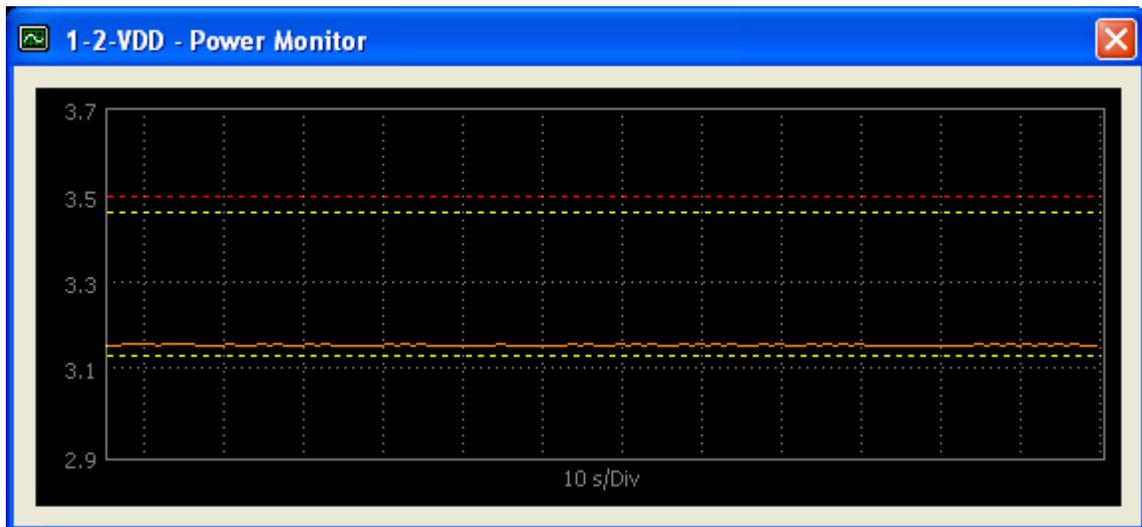

Fig. 13: Power Monitor Recorder Chart

The time per horizontal division is a function of the update interval. Increase the update interval to increase the time per division.

The orange line above shows the sensor value, with the most recent value on the right, and the value about 130 seconds ago on the left. Red dashed horizontal lines show error levels, and yellow dashed horizontal lines show warning levels.

The "Range" edit control specifies the vertical scale of the chart in a percent of the error range, or as a percent around the nominal value if there is no error range. Increase the "Range" value to increase the number of degrees or volts per vertical division to see a larger range of values.

Save data to file

Check this button to save the value of the selected ATD7411 device and channel to a log file. The file format is comma separated text, with one line per entry. Each entry contains the date, time, and value of the selected measurement. For example:

```
2010/10/01, 16:14:16, 3.34277
2010/10/01, 16:14:17, 3.08301
2010/10/01, 16:14:18, 3.28125
```

Name

Select the name of the log file.

Directory

Select the directory in which to create the file.

FILE FORMATS

This section provides reference information about the file formats that can be imported or exported by AlazarDSO.

5.1 Text records in samples

This file format contains lines of 8-bit ASCII text. Each line stores the code of one sample point from a record. Aside from the sample data, no other information about the acquisition is saved in the file.

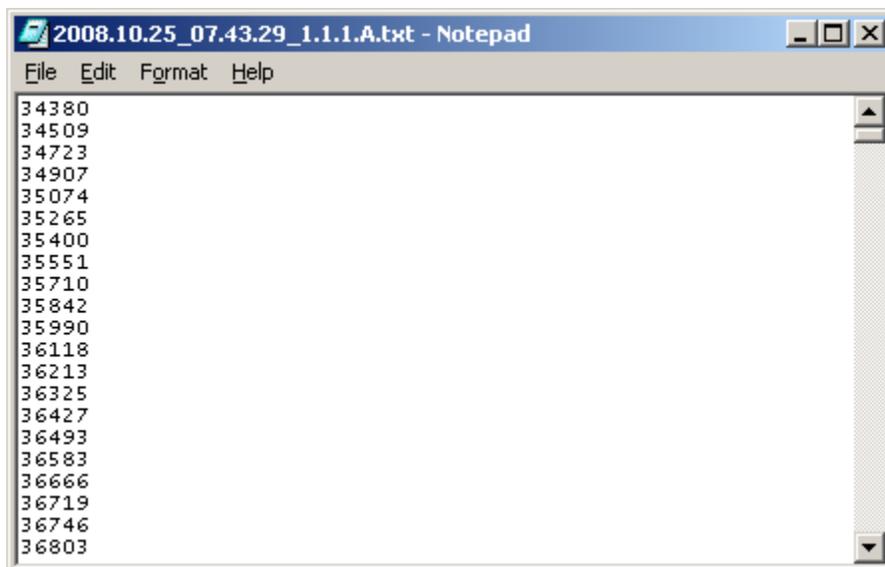The following figure shows the first few lines from a "text record in samples" file.

Fig. 1: Text record in samples file

The following code fragment demonstrates how to convert sample values to volts:

```
double
ConvertSampleValueToVolts (
  int nSampleValue          // sample code value from file
```

```
  )
{
  // board specific constant
  int nBitsPerSample = 16;      // for ATS660
  int nBytesPerSample = (nBitsPerSample + 7) / 8;

  // input range selected for this channel
  double dInputRange_volts = 4.;

  // AlazarTech boards are calibrated as follows
  double dSampleZeroValue = (1 << (nBitsPerSample - 1)) - 0.5;
  double dSampleMaxValue = (1 << (nBitsPerSample - 1)) - 0.5;

  // remove left-shift of sample bits in sample bytes
  int nSampleBitShift = (nBytesPerSample * 8) - nBitsPerSample;
  nSampleValue = nSampleValue >> nSampleBitShift;

  // convert from sample value to volts
  double dSignal_volts =
  dInputRange_volts *
      ((double)(nSampleValue - dSampleZeroValue) / dSampleMaxValue);

  return dSigal_volts;
}
```

5.2 Text records in volts

This file format contains lines of 8-bit ASCII text. Each line stores the value in volts of one sample point from a record. Aside from the sample data, no other information about the acquisition is saved in the file.

The following figure shows the first few lines from a "text records in volts" file.

5.3 Binary records in samples

This file format contains sample data as binary values. Each sample value is stored as one or two bytes in the file. Multi-byte values are stored least significant byte first. Aside from the sample data, no other information about the acquisition is saved in the file.

The following figure displays the first 256 bytes of a "binary record in samples" file from an ATS660 with 16-bit sample values. Note that the first sample value is 0x864C stored in "little-endian" format.

Please see section 4.1 "Text records in samples" above for instructions on converting sample values to volts.
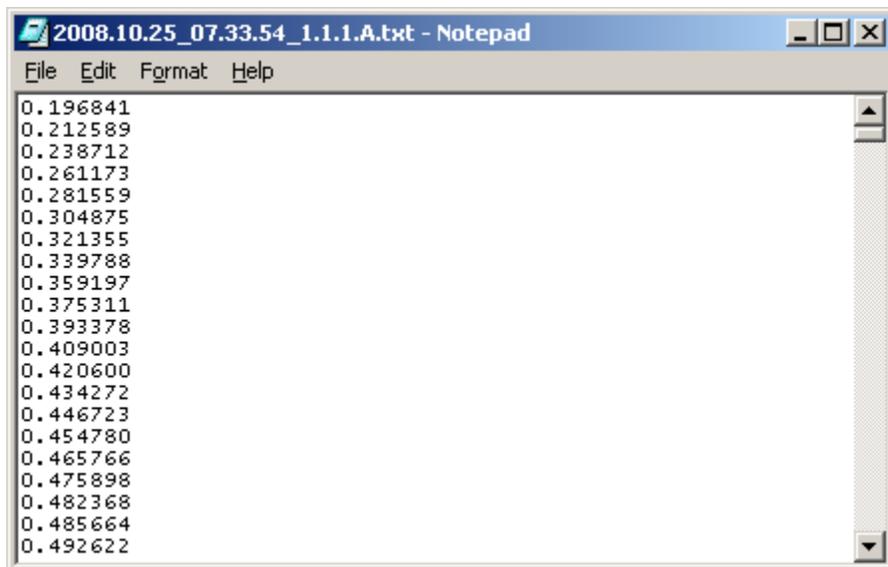
Fig. 2: Text record in volts file

Fig. 3: Binary record in samples file

5.4 Binary records in volts

This file format contains sample data as binary values. Each sample value is converted to volts and stored as an 8-byte IEEE 754 double precision floating-point value. Multi-byte values are stored least significant byte first. Aside from the sample data, no other information about the acquisition is saved in the file.

The following figure displays the first 256 bytes of a "binary record in volts" file. Note that the first sample in the record is 0x3FC6DA16:DA16DA17 in "little-endian" format, or 0.17853055619134814 in decimal when converted from floating-point format.

```
000000  17 DA 16 DA 16 DA C6 3F  1A 9A 19 9A 19 9A C9 3F
000010  1C 4A 1C 4A 1C 4A CC 3F  1F AA 1E AA 1E AA CE 3F
000020  11 95 10 95 10 95 D0 3F  12 85 11 85 11 85 D1 3F
000030  13 C9 12 C9 12 C9 D2 3F  14 FF 13 FF 13 FF D3 3F
000040  15 17 15 17 15 17 D5 3F  16 25 16 25 16 25 D6 3F
000050  17 27 17 27 17 27 D7 3F  18 E9 17 E9 17 E9 D7 3F
000060  19 B3 18 B3 18 B3 D8 3F  1A B7 19 B7 19 B7 D9 3F
000070  1A 37 1A 37 1A 37 DA 3F  1B DB 1A DB 1A DB DA 3F
000080  1B 4D 1B 4D 1B 4D DB 3F  1C CD 1B CD 1B CD DB 3F
000090  1C 49 1C 49 1C 49 DC 3F  1D 93 1C 93 1C 93 DC 3F
0000a0  1D E5 1C E5 1C E5 DC 3F  1D 2D 1D 2D 1D 2D DD 3F
0000b0  1D 13 1D 13 1D 13 DD 3F  1D 3F 1D 3F 1D 3F DD 3F
0000c0  1D 2F 1D 2F 1D 2F DD 3F  1D 17 1D 17 1D 17 DD 3F
0000d0  1D E5 1C E5 1C E5 DC 3F  1D B5 1C B5 1C B5 DC 3F
0000e0  1D 8F 1C 8F 1C 8F DC 3F  1C EB 1B EB 1B EB DB 3F
0000f0  1B 75 1B 75 1B 75 DB 3F  1B 1B 1B 1B 1B 1B DB 3F
```
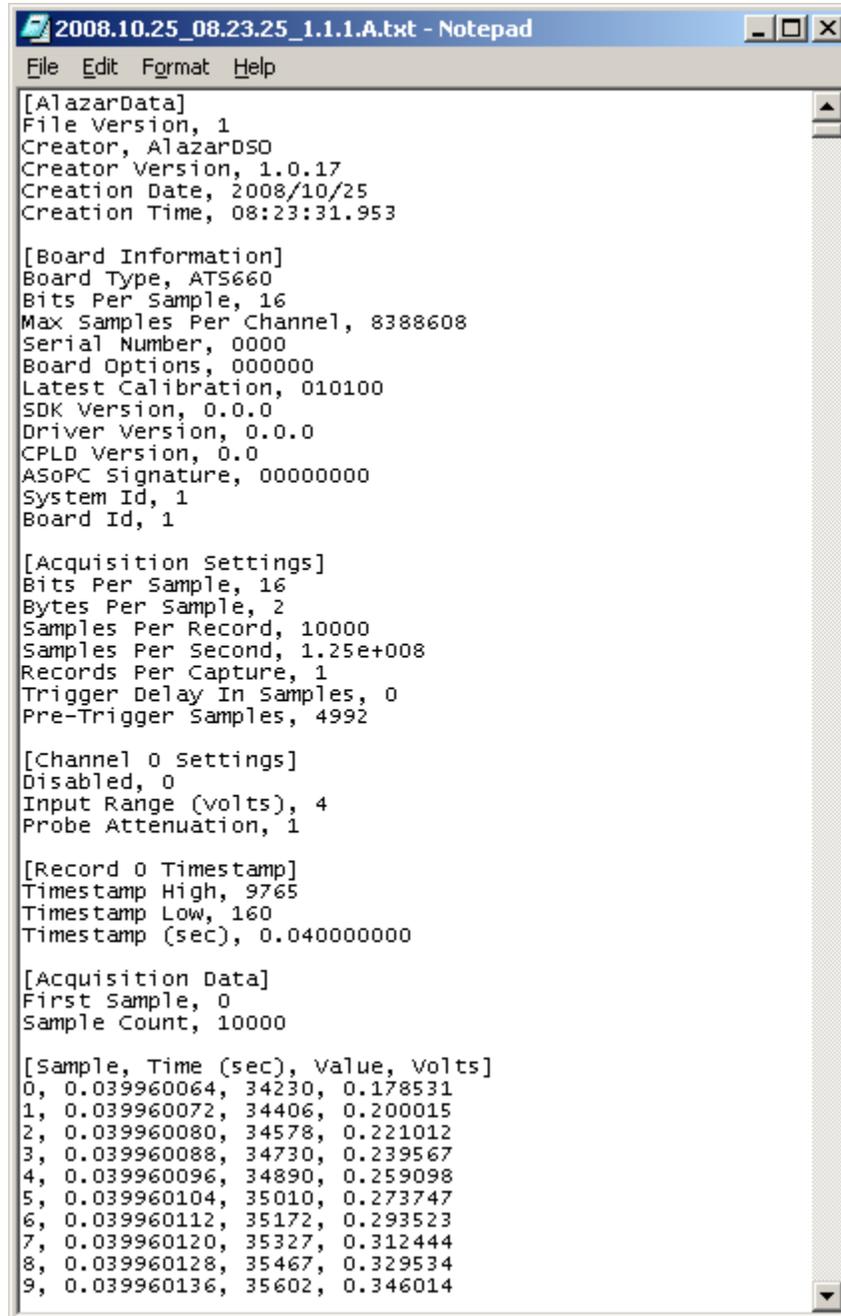
Fig. 4: Binary record in volts file

5.5 Alazar Text Records

This file format contains an ASCII text header followed by ASCII text sample data. The file begins with an ASCII text record header that stores information about the program, board, acquisition, and channel. This header is followed by sample data with one sample value per line. Each line stores the index of the sample in the record, the time in seconds of the sample from the trigger point in the record, the sample value as an ADC code, and the sample value in volts.

The following figure shows the header and first few sample points of an "Alazar text record" file.

These files can be opened in a text editor like Notepad, or a spreadsheet program that can import comma separated value files like Microsoft Excel.

Fig. 5: Alazar text record file

5.6 Alazar Binary Records

This file format contains an ASCII text header followed by binary sample data. The file begins with an ASCII text record header that stores information about the program, board, acquisition, and channel. This header is followed by sample data as binary values. Each sample value is stored as one or two bytes sample entries depending on board's sample size in bits. Sample bits are right aligned in sample bytes, and multi-byte values are stored least significant byte first.

The following figure shows the ASCII header of an "Alazar binary record" file.

These files cannot be opened in a text editor since they contain binary data. But they require less disk space than files created text-only formats, and are well suited for use by software written to process them.

5.7 API Panel Records

This file format is used by AlazarTech API Panel software. AlazarDSO can import these files.

5.8 MATLAB Arrays

This file format is used by MATLAB® numerical computing software to load and store data arrays. AlazarDSO saves records as 2D arrays in MATLAB® Level-4 MAT format. Each file contains an array of sample data, and an array of time data. AlazarDSO can load Level-4 or -5 MAT files containing 2D arrays without imaginary data.

5.9 FlexPro Records

FlexPro® data analysis and presentation software by Weisang GmbH uses this file format. AlazarDSO saves sample values as codes or volts.
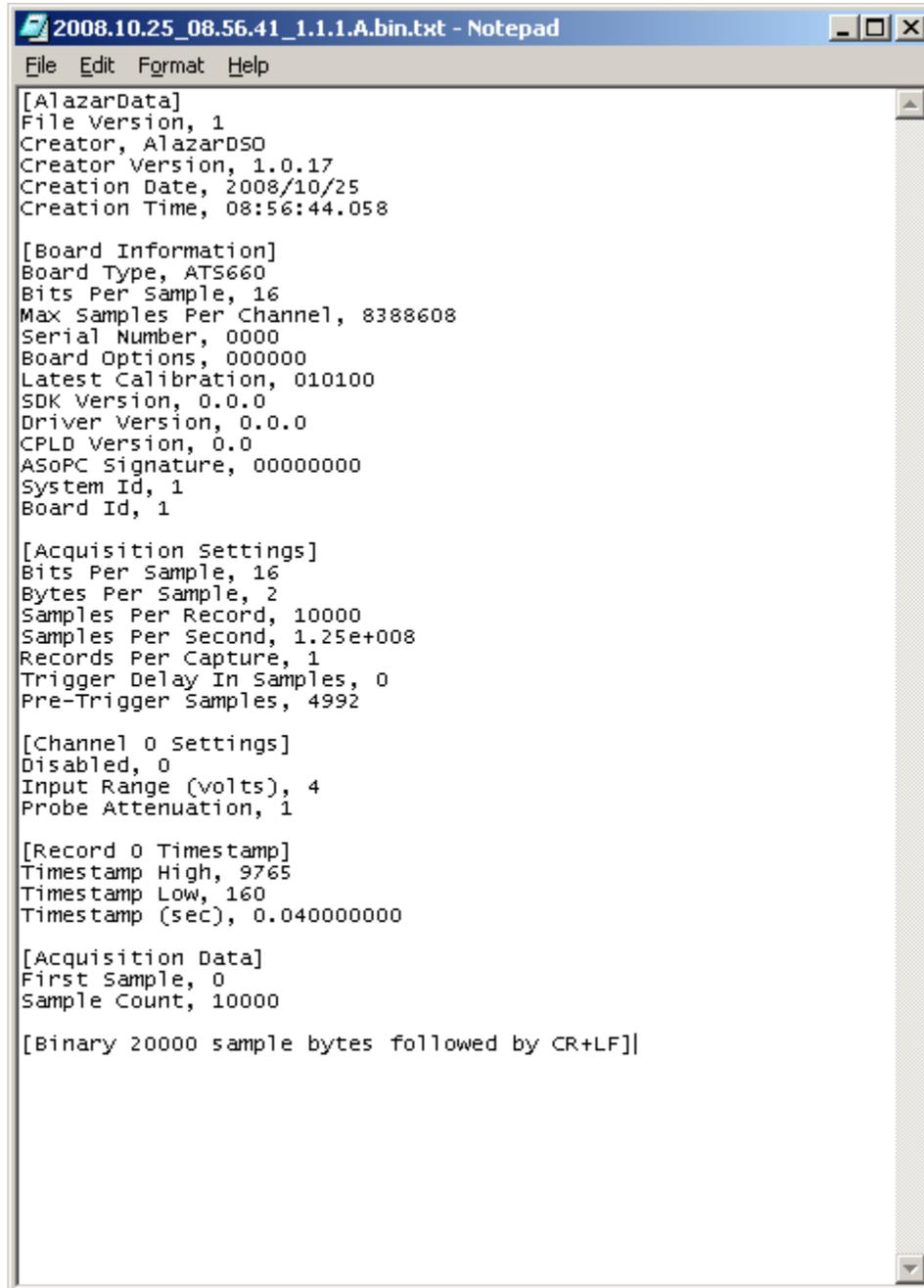
5.10 Binary FFT Data

This file format contains binary samples stored as double-precision floating point numbers.

The following figure displays the first 256 bytes of a "binary FFT Data" file from an ATS9130.

Listing 1: Example of binary FFT data file

```
00000000   E9 A8 2B C4 CD 6D 14 40 4E 4D 05 CC 10 A5 22 40   é¨+ÄÍm.@NM.Ì.¥"@
00000010   44 B1 9D 09 AB 8C 17 40 BD BC EB 07 B6 39 1F 40   D±..«Œ.@½¼ë.¶9.@
00000020   BB 5E 51 3F E4 9F 13 40 3D 78 58 58 1A DA 1C 40   »^Q?äŸ.@=xXX.Ú.@
00000030   FC 23 96 BC 52 B2 15 40 36 0B 5C 27 AB D9 1C 40   ü#–¼R².@6.\'«Ù.@
00000040   EE 2E 03 35 1E DD 13 40 59 C9 12 18 77 88 1B 40   î..5.Ý.@YÉ..w^.@
```

(continues on next page)

Fig. 6: Alazar binary record file

```
00000050  8D FE B4 C6 2B 7F 15 40 21 8B F0 5A C2 EA 1E 40   .þ´Æ+..@!‹ðZÂê.@
00000060  74 E6 DB B2 5B 7A 11 40 E6 7F 00 B1 9B 98 1A 40   tæÛ²[z.@æ..±›~.@
00000070  3E 0F A9 11 C5 D9 13 40 88 4A 59 2D 51 57 1A 40   >.©.ÅÙ.@^JY-QW.@
00000080  09 A9 BC D5 DF 9B 12 40 22 D8 A8 1E 18 94 1C 40   .©¼Õß›.@"Ø¨..".@
00000090  BE D6 D7 A3 6A 4D 13 40 60 9D 43 D4 24 D1 19 40   Ö×£jM.@`.CÔ$Ñ.@
000000A0  F0 0F 0F 6F 6F 8C 14 40 8E B7 CA F8 C4 C4 19 40   ð..ooŒ.@Ž·ÊøÄÄ.@
000000B0  2E 58 27 65 20 23 13 40 A4 62 3A C9 C3 5B 1C 40   .X'e #.@¤b:ÉÃ[.@
000000C0  5A 9A FA 3E 4D AB 15 40 4D A0 C7 E2 D6 53 1B 40   Zšú>M«.@M ÇâÖS.@
000000D0  8D 56 BC 0B 93 12 11 40 EA 0C 6E 9F 7C F8 1A 40   .V¼.“..@ê.nŸ|ø.@
000000E0  B3 EB DD C2 C9 16 14 40 54 58 01 80 89 61 1C 40   ³ëÝÂÉ..@TX.€a.@
000000F0  DB 72 DA B9 7E 7D 01 40 1E 61 4B 5F BF 2E 1B 40   ÛrÚ¹~}.@.aK_¿..@
```

5.11 ATB Acquisition Files

AlazarTech ATB files are binary files that contain a header describing acquisition parameters, followed by sample data. The following figure shows the structure of an ATB file.

| CAPTURE_FILE_HEADER |
| CHANNEL_FILE_HEADER array |
| Binary sample data |
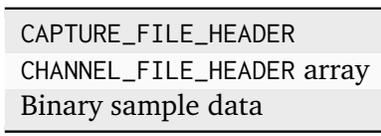
5.11.1 Capture File Header

An ATB file starts with a CAPTURE_FILE_HEADER structure. This structure identifies the file and defines its properties. The following figure displays a capture file header structure.

```
000000  41 54 53 62 C0 00 00 00  10 00 00 00 02 00 00 00   ATSb............
000010  10 27 00 00 00 00 00 00  00 00 00 00 65 CD 9D 41   .'..........e..A
000020  F1 68 E3 88 B5 F8 14 3F  00 00 00 00 80 13 00 00   .h.....?........
000030  01 00 00 00 01 00 00 00  02 00 00 00 00 00 00 00   ................
000040  00 00 00 00 00 00 00 00  00 00 00 00 00 00 00 00   ................
000050  00 00 00 00 00 00 00 00  00 00 00 00 00 00 00 00   ................
000060  00 00 00 00 00 00 00 00  00 00 00 00 00 00 00 00   ................
000070  00 00 00 00 00 00 00 00  00 00 00 00 00 00 00 00   ................
000080  40 03 00 00 00 00 00 00  00 00 00 00 00 00 00 00   @...............
000090  00 00 00 00 00 00 00 00  00 00 00 00 00 00 00 00   ................
0000a0  00 00 00 00 00 00 00 00  00 00 00 00 00 00 00 00   ................
0000b0  00 00 00 00 00 00 00 00  00 00 00 00 00 00 00 00   ................
```

Fig. 7: Capture file header

```
struct CAPTURE_FILE_HEADER
{
DWORD m_dwType;
DWORD m_dwSize;
```

```
int m_nBitsPerSample;
int m_nBytesPerSample;
UINT m_uSamplesPerRecord;
DWORD m_dwReserved_0;
double m_dSamplesPerSecond;
double m_dSecondsPerRecord;
int m_nTrigDelay_samples;
UINT m_uPreTrig_samples;
int m_nRecordsPerCapture;
int m_nCapturesPerFile;
int m_nChannels;
WCHAR m_cComment[32];
DWORD m_dwFlags;
DWORD m_dwDataOffset_bytes;
DWORD m_dwStreamFlags;
DWORD m_nTimestampMultiplier;
DWORD m_dwReserved[12];
};
```

m_dwType
> Specifies the file type. It must be 'bSTA'.

m_dwSize
> Specifies the size in bytes of the CAPTURE_FILE_HEADER structure.

m_nBitsPerSample
> Specifies the acquisition properties.

m_nBytesPerSample
> Specifies the acquisition properties.

m_uSamplesPerRecord
> Specifies the acquisition properties.

m_dSamplesPerSecond
> Specifies the acquisition properties.

m_dSecondsPerRecord
> Specifies the acquisition properties.

m_uTrigDelay_samples
> Specifies the acquisition properties.

m_nPreTrig_samples
> Specifies the acquisition properties.

m_nRecordsPerCapture
> Specifies the acquisition properties.

m_nCapturesPerFile
> Specifies the number of captures in the file.

m_nChannels
> Specifies the total number of CHANNEL_FILE_HEADER structures that follow.

m_cComment[32]
> Specifies a user-defined comment for this acquisition.

m_dwFlags
> Specifies attributes of the file. These attributes may include:

> **CFHF_SAMPLE_INTERLEAVED (0x1)**
>> If this flag is set, samples in a record are channel interleaved (i.e. A-B-A-B). If not set, samples in a record are channel contiguous (i.e. A-A-B-B).

> **CFHF_CONTINUOUS (0x2)**
>> If set, each record is a transfer in a continuous acquisition.

> **CFHF_STREAM (0x4)**
>> This flag indicated how the sample data is organized in the file. See section 4.10.3 below.

m_dwDataOffset_bytes
> Specifies the offset in bytes from the start of file of the sample data.

m_dwStreamFlags
> When the CFHF_STREAM bit is set, then this field contains flags that define how the sample data is organized in the file. See the section 4.10.3 below.

m_nTimestampMultiplier
> This value specifies a board specific multiplier used in the conversion of timestamp values from clock ticks to seconds.

5.11.2 Channel File Headers

A CHANNEL_FILE_HEADER structure specifies the properties of one input channel.

An array of CHANNEL_FILE_HEADERS structures follows the CAPTURE_FILE_HEADER structure in an ATB file. Note that the m_nChannels field from the CAPTURE_FILE_HEADER defines the number of channel file header structures in the file.

```
struct CHANNEL_FILE_HEADER
{
  BOOL m_bDisabled;
  DWORD m_dwReserved_0;
  double m_dInputRange_volts;
  double m_dProbeAttenuation;
  DWORD m_dwReserved[4];
};
```

m_bDisabled
> Specifies if the channel is disabled. If the channel is disabled, then no records from the channel are written to the file.

m_dInputRange_volts
> Specifies the input range of the sample data in volts

m_dProbeAttenuation
> Specifies the attenuation of the probes used during the acquisition.

5.11.3 Sample Data

The first byte of sample data is located at the offset in bytes from the start of the file specified by the m_dwDataOffset_bytes field of the CAPTURE_FILE_HEADER structure.

The CFHF_STREAM (0x00000004) flag in m_dwFlags field of the CAPTURE_FILE_HEADER structure defines how the sample data is organized in the file. If this flag is not set, then the records are arranged as described in section 4.10.3.1 "Normalized records".

If the CFHF_STREAM flag is set, then the records are arranged as described in section 4.10.3.2 "Raw records". The "Raw records" format was introduced with AlazarDSO 1.0.9, and is used by default.

Note that you can enable using "Normalized records" by un-checking the "Create ATB files in stream format" check box in the "Advanced Options" dialog box.

Normalized records

If the CFHF_STREAM (0x00000004) flag in m_dwFlags field of the CAPTURE_FILE_HEADER structure is not set, then AlazarDSO arranges sample data using a normalized format, independent of the method used to transfer data from the digitizer board to host memory.

If the CFHF_CONTINUOUS (0x00000002) flag is set in the m_dwFlags field of the CAPTURE_FILE_HEADER structure, then the file does not include record timestamps. If the CFHF_CONTINUOUS flag is not set, then the file includes record timestamps.

If the CFHF_SAMPLE_INTERLEAVED (0x00000001) flag is set in the m_dwFlags field of the CAPTURE_FILE_HEADER structure, then samples from a record from Ch A and Ch B are interleaved (i.e. A-B-A-B). That is, if both Ch A and B are enabled, then a sample from Ch A is followed by a sample from Ch B.

The sample data is arranged in the following figure.

Board 0 Record 0 Timestamp
Board 0 Record 0 Interleaved Ch A and Ch B samples
Board 0 Record 1 Timestamp
Board 0 Record 1 Interleaved Ch A and Ch B samples
. . .
Board 0 Record N-1 Timestamp
Board 0 Record N-1 Interleaved Ch A and Ch B samples
Board 1 Record 0 Timestamp
Board 1 Record 0 Interleaved Ch A and Ch B samples
. . .

If the `CFHF_SAMPLE_INTERLEAVED (0x00000001)` flag is not set, then samples from each channel are stored contiguously in the file. That is, the samples for one record of Ch A (if enabled) are followed the samples for the corresponding record from Ch B (if enabled).

The sample data is arranged as shown in the following figure.

Board 0 Record 0 Timestamp
Board 0 Record 0 Ch A samples
Board 0 Record 0 Ch B samples
Board 0 Record 1 Timestamp
Board 0 Record 1 Ch A samples
Board 0 Record 1 Ch B samples
...
Board 0 Record N-1 Timestamp
Board 0 Record N-1 Ch A samples
Board 0 Record N-1 Ch B samples
Board 1 Record 0 Timestamp
Board 1 Record 0 Ch A samples
Board 1 Record 0 Ch B samples
...

The `m_nBytesPerSample` field of the `CAPTURE_FILE_HEADER` defines the number of bytes per sample, and the `m_uSamplesPerRecord` field defines the number of samples per record.

Record timestamps, if available, are stored in a record timestamp structure preceding the record. The following code fragment shows how to convert a timestamp value from clock ticks to seconds.

```
struct RECORD_TIMESTAMP
{
  DWORD dwHighPart;
  DWORD dwLowPart;
};

double
TimestampToSeconds (
    RECORD_TIMESTAMP *pRecordTimestamp,
    CAPTURE_FILE_HEADER *pCaptureFileHeader
)
{
    DWORD dwTimestampHigh = pRecordTimestamp->dwHighPart;
    DWORD dwTimestampLow = pRecordTimestamp->dwLowPart;
    INT64 nTimestamp_counts;
    nTimestamp_counts = ((INT64) dwTimestampHigh) << 8;
    nTimestamp_counts |= dwTimestampLow & 0x0ff;
    double dTimestamp_sec = (double) nTimestamp_counts *
        pCaptureFileHeader->m_nTimestampMultiplier /
        pCaptureFileHeader->m_dSamplesPerSecond;
```

```
    return dTimestamp_sec;
}
```

Raw records

AlazarTech digitizer boards support a number of different methods to transfer sample data from on-board to host memory. Each transfer method organizes sample data differently in host memory.

When the CFHF_STREAM (0x00000004) flag in m_dwFlags field of the CAPTURE_FILE_HEADER structure is set, AlazarDSO writes records to an ATB file exactly as the records were arranged in host memory. The m_dwStreamFlags field of the CAPTURE_FILE_HEADER structure defines how the records were arranged in host memory.

CBF_AUTODMA (0x1)
    Specifies the arrangement of sample data in the file.

CBF_NO_PRETRIGGER (0x2)
    Specifies the arrangement of sample data in the file.

CBF_SAMPLE_INTERLEAVED (0x10)
    Specifies the arrangement of sample data in the file.

CBF_HAVE_HEADER (0x4)
    If set, each record is preceded by a record header.

CBF_ADC_CALIBRATION_V_1 (0x8)
    If set, then the sample zero level is 2 ^ (BitsPerSample - 1) and the maximum amplitude is (2 ^ (BitsPerSample - 1)) - 1.

    If not set, then sample zero level is 2 ^ (BitsPerSample - 1) - 0.5 and the maximum amplitude is 2 ^ (BitsPerSample - 1) - 0.5.

Note that the prefix CBF_ stands for "capture buffer flag", where a "capture buffer" is a data structure used by AlazarDSO and its plugins to exchange information about a data transfer from on-board to host memory.

AutoDMA from FIFO

If the CBF_AUTODMA (0x00000001) and CBF_SAMPLE_INTERLEAVED (0x00000010) flags are set in the in m_dwStreamFlags field, the sample data was transferred from the board's FIFO to host memory using an AutoDMA API with the ADMA_FIFO_ONLY_STREAMING option enabled.

In this mode sample data is arranged into a contiguous array of m_nRecordsPerCapture records. Each record consists of one sample from Ch A (if enabled) followed by one sample from Ch B (if enabled).

There are m_uSamplesPerRecord samples from each enabled channel. Each sample occupies m_nBytesPerSample bytes in the buffer, and m_nBitsPerSample sample bits are left aligned within these bytes.

AutoDMA no-pretrigger mode

If the `CBF_AUTODMA` (0x00000001) and `CBF_NO_PRETRIGGER` (0x00000002) flags are set, and `CBF_SAMPLE_INTERLEAVED` (0x00000010) is not set in the in the `m_dwStreamFlags` field, then no-pretrigger sample data was transferred to host memory using an AutoDMA API with the `ADMA_NPT` option enabled.

In this mode sample data is organized into records. An array of `m_nRecordsPerCapture` records for Ch A (if enabled) is followed by an array of `m_nRecordsPerCapture` records for Ch B (if enabled).

Each record contains an array of `m_uSamplesPerRecord` samples. Each sample occupies `m_nBytesPerSample` bytes in the buffer, and `m_nBitsPerSample` sample bits are left aligned within these bytes.

AutoDMA pre-trigger mode

If the `CBF_AUTODMA` (0x00000001) flag is set, but the `CBF_NO_PRETRIGGER` (0x00000002) and `CBF_SAMPLE_INTERLEAVED` (0x00000010) flags are not set in the `m_dwStreamFlags` field, the sample data was transferred using an AutoDMA API with pre-trigger samples.

In this mode sample data is organized into records where a record from Ch A (if enabled) is followed by a record from Ch B (if enabled). In total, there are `m_nRecordsPerCapture` for Ch A (if enabled), and `m_nRecordsPerCapture` records for Ch B (if enabled).

If the `CBF_HAVE_HEADER` (0x00000004) flag is set in the `m_dwStreamFlags` field, then a record header precedes each record in the file.

The `ALAZAR_HEADER` structure is defined in AlazarApi.h as follows:

```
struct _HEADER0 {
  unsigned int SerialNumber:18;
  unsigned int SystemNumber:4;
  unsigned int WhichChannel:1;
  unsigned int BoardNumber:4;
  unsigned int SampleResolution:3;
  unsigned int DataFormat:2;
};

struct _HEADER1 {
  unsigned int RecordNumber:24;
  unsigned int BoardType:8;
};

struct _HEADER2 {
  unsigned int TimeStampLowPart;
};

struct _HEADER3 {
```

(continues on next page)

```
  unsigned int TimeStampHighPart:8;
  unsigned int ClockSource:2;
  unsigned int ClockEdge:1;
  unsigned int SampleRate:7;
  unsigned int InputRange:5;
  unsigned int InputCoupling:2;
  unsigned int InputImpedence:2;
  unsigned int ExternalTriggered:1;
  unsigned int ChannelBTriggered:1;
  unsigned int ChannelATriggered:1;
  unsigned int TimeOutOccurred:1;
  unsigned int ThisChannelTriggered:1;
};


typedef struct _ALAZAR_HEADER {
  struct _HEADER0 hdr0;
  struct _HEADER1 hdr1;
  struct _HEADER2 hdr2;
  struct _HEADER3 hdr3;
} ALAZAR_HEADER, *PALAZAR_HEADER;
```

The following code fragment shows how to convert the record timestamp contained in a record header structure from clock ticks to seconds.

```
double
AlazarHeaderTimestampToSeconds (
  ALAZAR_HEADER *pAlazarHeaderHeader,
  CAPTURE_FILE_HEADER *pCaptureFileHeader
)
{
  DWORD dwTimestampHigh = pAlazarHeader->hdr3.TimeStampHighPart;
  DWORD dwTimestampLow = pAlazarHeader->hdr2.TimeStampLowPart;
  INT64 nTimestamp_counts;
  nTimestamp_counts = (INT64) dwTimestampLow;
  nTimestamp_counts |= (((INT64) (dwTimestampHigh & 0x0ff)) << 32);
  double dTimestamp_sec =
      (double) nTimestamp_counts *
      pCaptureFileHeader->m_nTimestampMultiplier /
      pCaptureFileHeader->m_dSamplesPerSecond;
  return dTimestamp_sec;
}
```

5.11.4 Converting sample values to volts

The following code fragment demonstrates how to convert a sample value to volts.

```
double
ConvertSampleValueToVolts (
  CAPTURE_FILE_HEADER *pCaptureFileHeader,
  CHANNEL_FILE_HEADER *pChannelFileHeader,
int nSampleValue
)
{
  // the board is calibrated as follows
  double dSampleZeroValue =
      (1 << (pCaptureFileHeader->m_nBitsPerSample - 1)) - 0.5;
  double dSampleMaxValue =
      (1 << (pCaptureFileHeader->m_nBitsPerSample - 1)) - 0.5;

  // remove left-shift of sample bits in sample bytes
  int nSampleBitShift = (pCaptureFileHeader->m_nBytesPerSample * 8) -
      pCaptureFileHeader->m_nBitsPerSample;
  nSampleValue = nSampleValue >> nSampleBitShift;

  // convert from sample value to volts
  double dMaxVolts =
      pChannelFileHeader->m_dInputRange_volts *
      pChannelFileHeader->m_dProbeAttenuation;
  double dSignal_volts = dMaxVolts *
      ((double)(nSampleValue - dSampleZeroValue) / dSampleMaxValue);
  return dSigal_volts;
}
```