OpenExplorer User's Guide

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Before You Begin

Requirements

TDT Drivers and either the OpenEx or Synapse Suite must be installed before installing OpenExplorer.

The recommended operating systems for all TDT systems are Windows® 7 and 10.

Organization of the Manual

This manual is organized in the following sections:

- Overview
- Tutorial - Exploring Data
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- Exporting Data and Graphics
- Plot Setting Reference
- Anomalies and Tech Notes

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Overview

Unparalleled in processing power and flexibility, Tucker-Davis Technologies' System 3 is a user-configurable research platform. An almost endless variety of configurations include: stimulus waveform generation and presentation; multi-channel neurophysiology, EEG, and evoked potential recording; and button press, manipulandum, and eye tracker acquisition. Using a single time base for all stimulation and acquisition tasks, our unique TTank data server stores divergent data types into a synchronized, indexed, DataTank format. The TTank data server is the driving force behind our powerful OpenEx and Synapse software suites.

With System 3 hardware and OpenEx or Synapse software, researchers can generate complex data sets that include information about stimulus characteristics and multiple dependent and independent variables. OpenExplorer is the powerful and flexible new data visualization and analysis package that harnesses the power of the TTank server, giving you the tools you need to make sense of complex data sets. With OpenExplorer, you'll be able to quickly hone in on important variables and choose subsets of the data for further analysis. You'll be able to explore complex data sets, plotting the data in many different ways to look for correlations and define the plausible interrelationships.

Designed with TDT's philosophy of building research tools with flexibility and user extensibility in mind, OpenExplorer provides an easy-to-use, drag-and–drop interface for exploring functional relationships in complex data sets. The flexible OpenExplorer format allows a data element to be displayed in a wide variety of plot types. For example, you can switch between spike shape, spike count, Peri-Stimulus Time Histograms (PSTHs), and feature space displays with a just a few mouse clicks.

Sophisticated data filtering capabilities allow you to compare subsets of data based on stored stimulus parameters or external events. Multiple subsets can be filtered and simultaneously displayed as individual plots in a flexible display grid format. The grid axes can easily be changed. For example, you can display activity across an electrode array or a PSTH for each unique combination of stimulus parameters. Once the desired display parameters have been selected, the entire plot grid can be animated for dynamic visualization or exported as a publication quality graphical image.

For run-time visualization, OpenExplorer includes an interactive real-time plotting mode that filters and plots data in the desired format as it is acquired. After data is acquired you can use OpenExplorer's onboard quantification tools for further analysis or export the raw data for analysis with your favorite statistical package.

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Tutorial - Exploring Data

OpenExplorer's flexible visualization environment enables you to view data in ways not possible with OpenScope. For example, data from an array of channels can be organized in a pattern that simulates the channel organization on the electrodes. The flexible environment and dynamic filtering capabilities promote data exploration. You can view the activity of neurons in response to a set of stimulus conditions then quickly modify the configuration to view a Peri-Stimulus Time Histogram (PSTH) that incorporates an aggregate of the same stimulus conditions.

This tutorial will show users how to generate four standard viewing patterns in OpenExplorer:

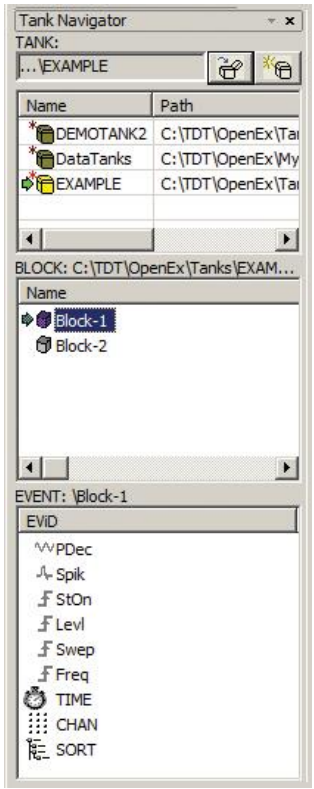
1. A channel matrix
2. Stimulus and pre-stimulus histograms
3. A tuning curve
4. A rate-intensity curve

Launch OpenExplorer

To get started, launch OpenExplorer:

- On the **Start** menu, select **TDT Sys3**, **OpenEx**, **OpenExplorer**.

As you are exploring data, the data and control selection you make can be saved in an OpenExplorer configuration (*.xpr) file:



Select Data

In OpenExplorer, you can use a Tank Navigator, similar to the one found in OpenScope, to select the data you want to explore. The Tank Navigator allows you to select data from Tanks on your PC. The Tank that will be used in this tutorial includes sample data in the legacy format and was added to the registry for you during OpenExplorer Installation.

Note: before you can select data you might need to resize the sub-window so that you can read the tank and block names. To resize the Tank Navigator, drag the pane divider between the Tank Navigator and the Control Panel to the right. To see the details view, which includes information such as path and date, increase the size of the sub-window even further.

To select the data:

- Click **EXAMPLE** in the TANK list then click **Block-2** in the BLOCK list.

The Events in this block are displayed in the EVENT list and you are ready to build the first plot.

Channel Matrix

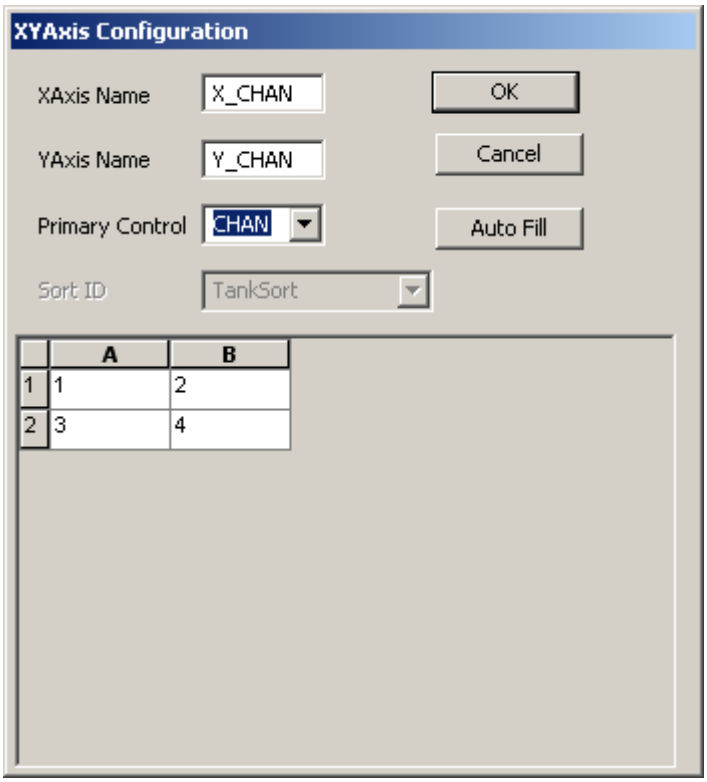
Multi-channel electrodes often consist of a matrix of electrodes that are in a two dimensional or even three dimensional configuration. Visualizing spike activity in a similar matrix makes it easy to identify channels with unit activity and to determine whether the same neuron is detected across several channels. In the initial Explorer configuration you'll divide

the channel (CHAN) event across both axes to create a channel matrix. CHAN is a standard event. Channel information is always included in the data tank and OpenExplorer allows you to access this information without having defined a Store in OpenWorkbench.

Configure the X and Y Axes to Create a Channel Matrix

To configure the axes:

1. Click the **Control Panel** menu and click **Add XY Axis Control**.
2. In the XYAxis Configuration dialog box you can select a primary event of interest to be divided across the x and y axes. In the Primary event drop-down menu, select **CHAN**.



The selected block contains four channels of data. A simple 2 X 2 matrix is generated automatically. Notice that the matrix is displayed here as a spreadsheet with row labels in ascending order from top to bottom and columns ascending from left to right. When the plot is generated, the x and y axes will be generated in a typical plot format with the x-axis ascending from left to right and the y-axis ascending from bottom to top. In both displays, cell A1 contains channel one, cell B1 contains channel two, and so forth. The visual arrangement of the matrix, however, will be slightly different from what you see here.

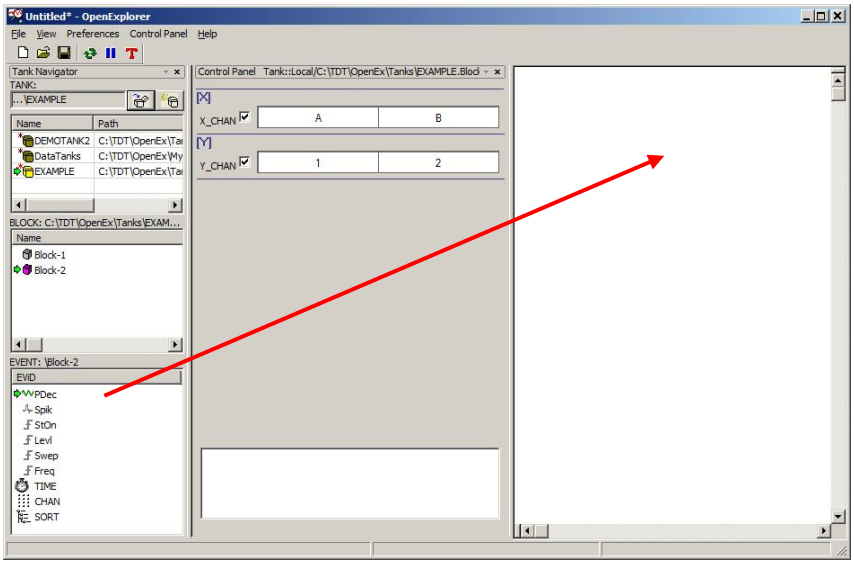
3. Click **OK**.
4. If necessary, drag the control to the [X] and [Y] area of the Control Panel.

Comparing Plot Decimated Data for Each Channel in a Scrolling Plot

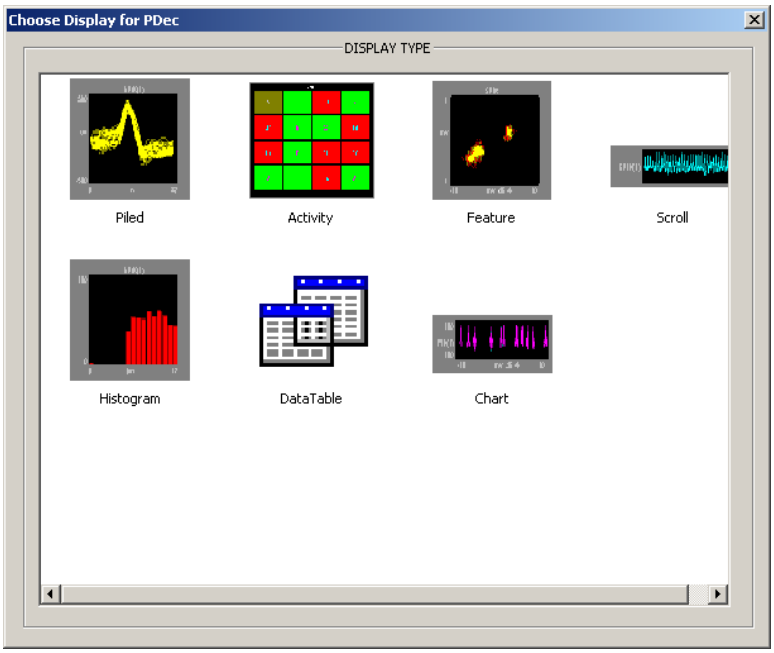
In this phase of exploration you can attempt to determine how the activity is distributed across channels. One way to do this is to compare the plot decimated data for each channel in a scrolling plot.

To create the plot:

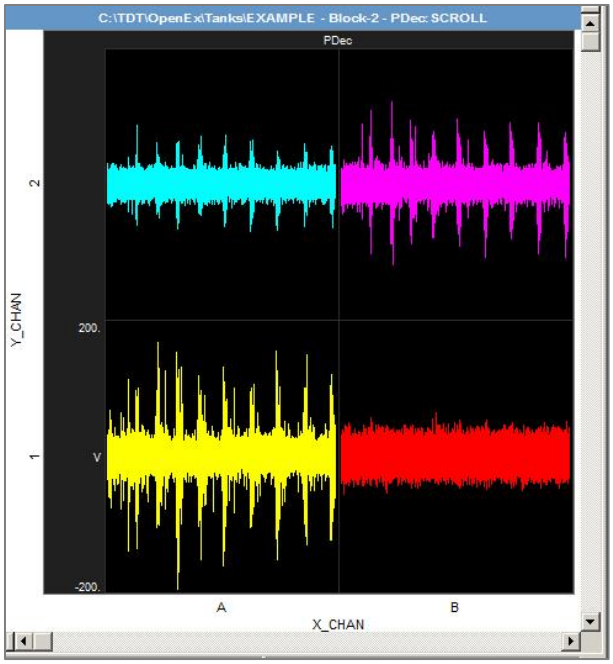
1. Drag the **PDec** event from the EVENT list in the Tank Navigator to the plot area.



2. In the Choose Display window, click **Scroll**.



A four cell plot is generated with each cell representing a single channel. How much detail is shown and how much data is included in the scroll plot is determined by the number of scroll sections displayed along the cell's x-axis. You can adjust this and other plot parameters in the Setup Properties dialog box, which can be opened by double-clicking the plot.



Note: to adjust the plot scale, hold down the shift key and drag your mouse down.

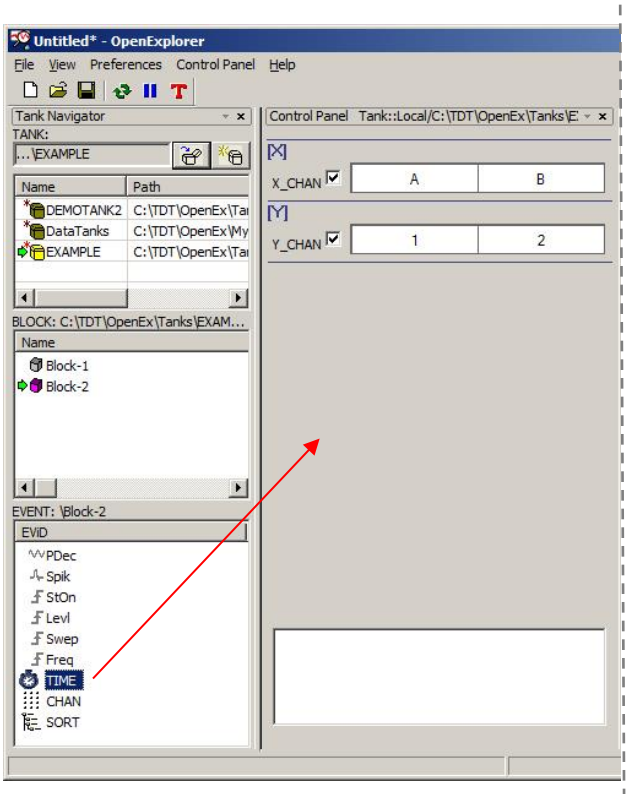
The plot clearly shows a lot of activity in cell A1(lower left corner). As mentioned earlier, cell A1 displays data from channel one. If you need to review which channel is in which cell, simply point to the cell to display the cell value. Further examination of the plot reveals that, although channels three and four have much less activity, the same pattern found on channel one is evident across all three channels. Channel two shows no activity.

Animating the Plot to Compare the Pattern of Activity Over Time

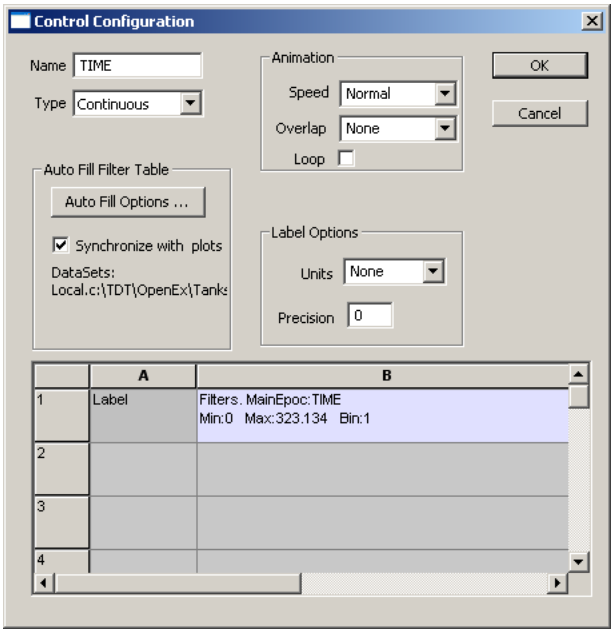
An animation of the scroll pattern can be used to see how tightly the spike activity on channels one, three, and four is correlated. Because you'll be comparing the pattern of activity over time, you'll use another standard event, TIME, to create the animation.

To create the animation:

1. In the Event list, drag TIME to the control panel.

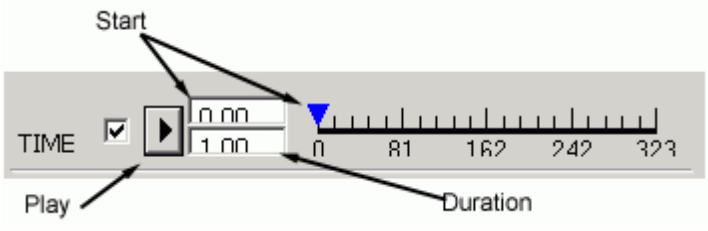


The Control Configuration dialog box opens to allow you to customize the control.



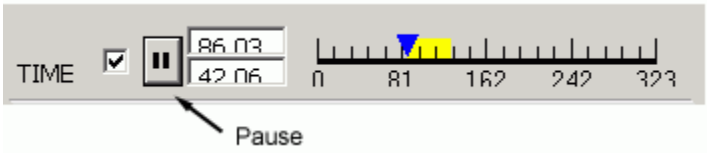
2. To accept the default control type and configuration for TIME, click **OK**.

   The Time control is added as a Continuous type control. This control supports the animation feature and allows you to define a duration of time to view in each animated segment. You can type a start time and duration or drag to select a time range.



3. To select a time range, either type a value in the Duration box or hold down the shift key, point to the blue arrow, and drag to the right until the desired time segment is selected.

4. Click the  **Play** button to begin the animation. Each segment of time will be animated in sequence, so that you can see the data as if you are collecting the data in real-time. For example, if the start time is 0.00 and the duration is 1.00, first you will see data for each channel that occurred after 0 seconds and before 1 second. In the next frame, all data that occurred after 1 second but before 2 seconds is visible, and so on.



5. After animation begins, the Play button toggles to a Pause button. Click the  **Pause** button to halt animation.

Comparing Spikes Across Channels

Plot Decimated Data provides a good, quick picture of activity. For a clearer picture of the neuron(s) response to a stimulus you can use a histogram to plot spike data instead. Histograms plot responses across a time epoch so you will no longer need the Time filter.

To disable the Time filter:

1. Clear the check box.

Next, you'll replace the Scroll plot of the plot decimated data with a histogram of the SPIK event.

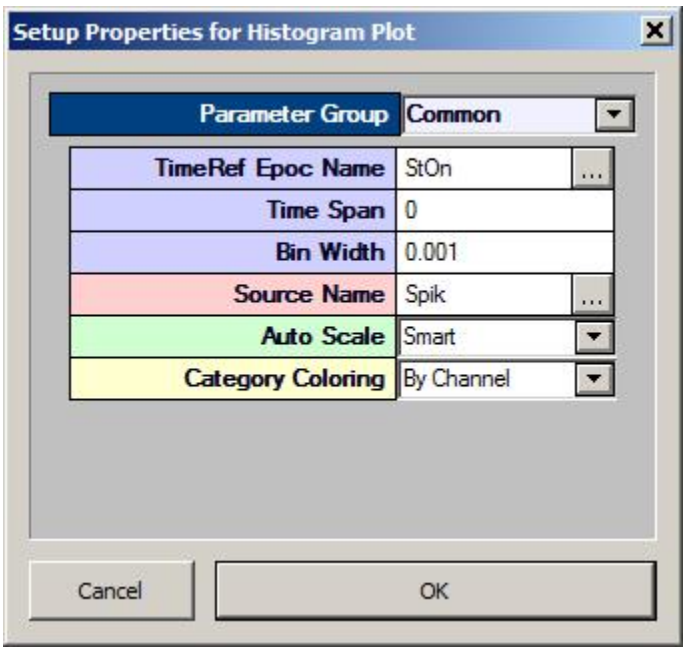
To delete the scroll plot:

2. Right-click the plot area and click **Delete Plot** on the shortcut menu.
3. When you are prompted to confirm the deletion, click **Yes**.

To create a plot using the SPIK event:

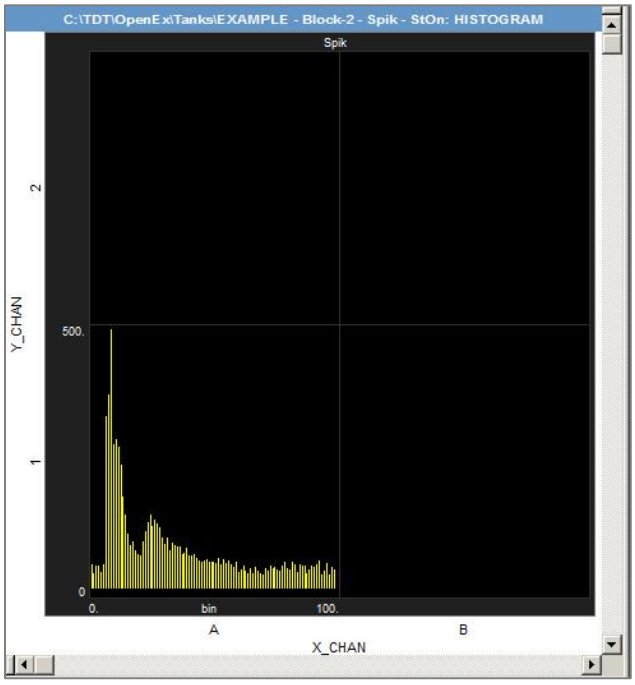
1. Drag **SPIK** from the event list to the plot area.
2. Select **Histogram** in the Choose Display window.

   Each plot type can be customized with a variety of plot property settings. In most cases default values have been defined for each setting. Histograms, however, use a time reference epoch (TimeRef Epoc) that is selected from one of the available epochs. One is chosen at random but OpenExplorer will always prompt you to confirm or change this setting. The time reference epoch is used to determine the time span and bin width for the x-axis within each histogram cell.
3. In the Setup Properties dialog box, ensure that the stimulus onset (StOn) epoch is selected in the TimeRef Epoc Name box.



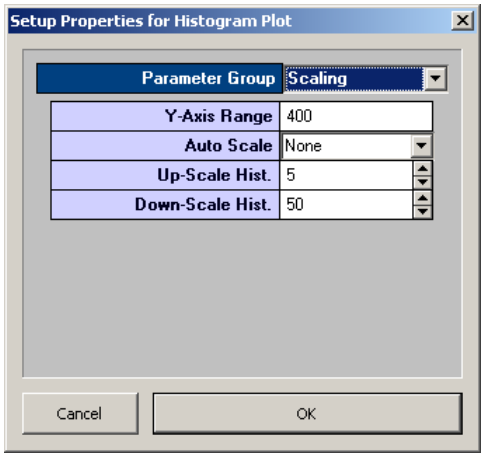
   By leaving time span set to zero, you allow OpenExplorer to determine the time span and bin width automatically. Although the duration of the StOn epoch is about 50 ms, OpenExplorer will use the time span from the onset of one StOn epoch to the onset of the next StOn epoch, about 100 ms. Each bin will represent one millisecond.

4. Click **OK**.



This plot clearly shows that the sorted or detected spikes show up on only one channel, channel one (Matrix A1). This probably indicates that the activity on the other channels is a result of the same neuron being recorded on multiple channels.

Note: you might need to adjust the Y-axis settings to view the data correctly. Double-click on the histogram plot to open the Setup Properties dialog box. Select the Scaling Parameter Group and set the Y-Axis range to 400 for this example.



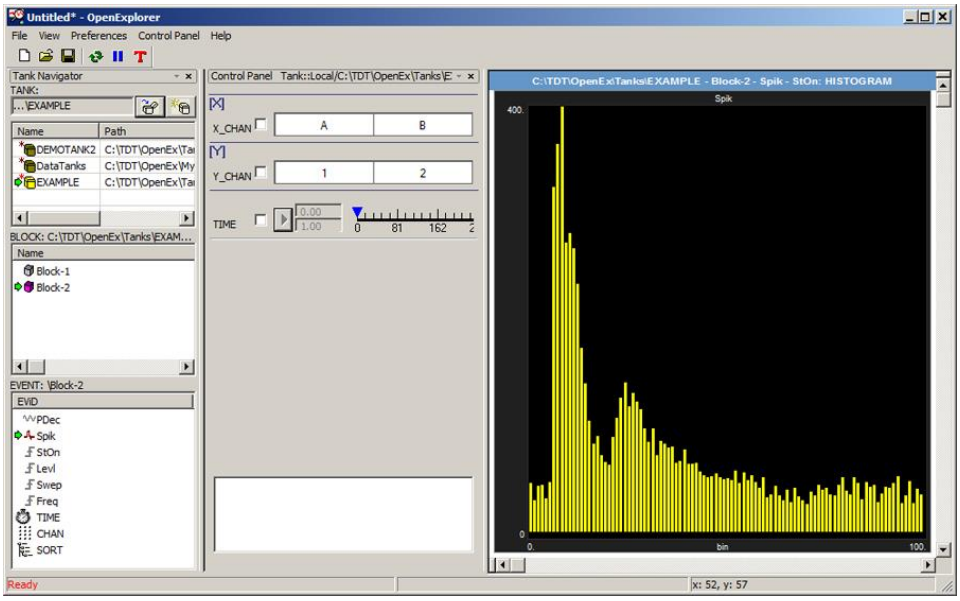
Peri-Stimulus Time Histogram (PSTH)

A channel matrix helps to identify channels of interest. In this case, the spike activity is found only on channel one. Next, you'll explore how that spike activity is related to other events, such as stimulus parameters. For this type of exploration you no longer need the channel matrix.

Removing the Channel Matrix and Filtering by Channel

To clear the Chan event from the x and y axes:

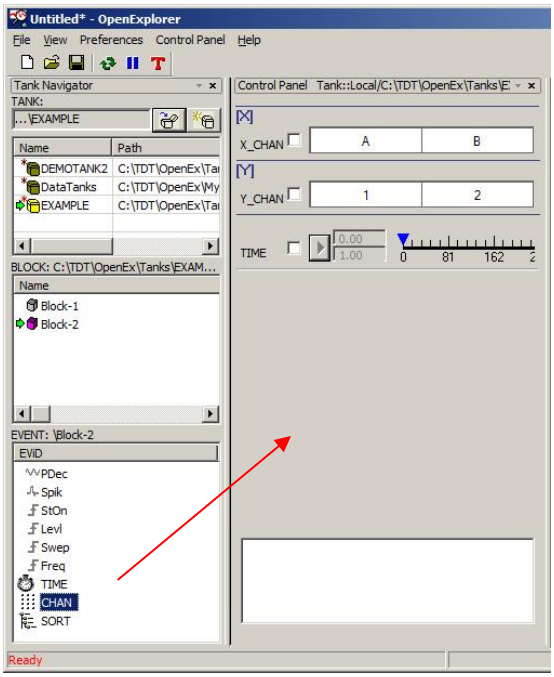
- Clear the check boxes for the XY Axis Control.



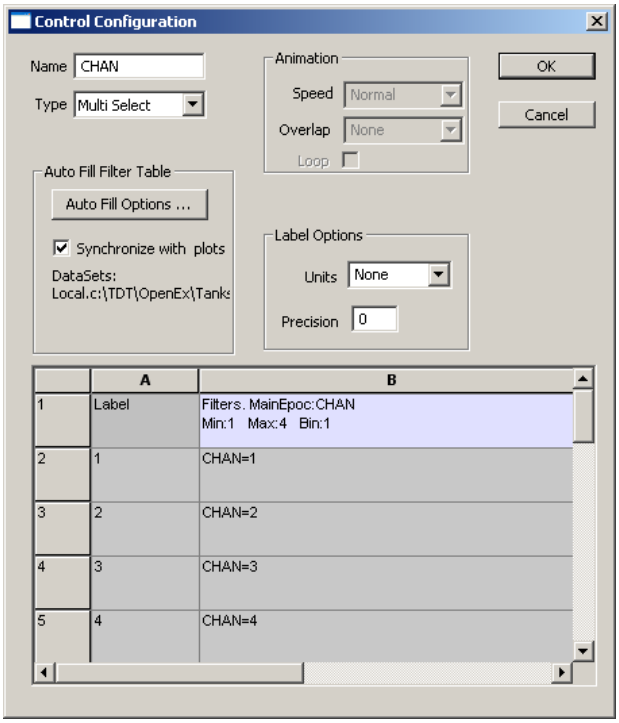
At this point, all data for the Spik event is plotted in a single histogram, using stimulus onset as the time reference epoch. Channel number can now be added as a simple filter control.

To add a filter for channel number:

1. Drag the **CHAN** event from the Event list to the area of the control panel below the XY Axis Control.



2. A Control Configuration dialog box is opened by default. The default control type is Multi Select and the filter criteria spreadsheet is automatically filled with the available values for this event; Chan=1, Chan=2, Chan=3, and Chan=4.



To accept the default configuration, click **OK**.

To filter out channels two, three, and four:

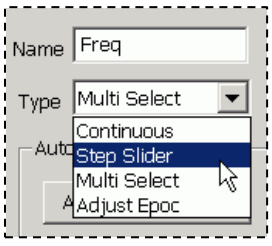
➢ Click the selection box for each of these channels.

Viewing Responses by a Stimulus Parameter

During the experiment, a stimulus was presented at several frequencies. To view the spike activity at each frequency, you'll add a step slider control.

To add a new Step Slider control:

1. Drag the **Freq** event from the Event list to the control panel.
2. In the Control Configuration dialog box, select **Step Slider** from the Type drop-down menu and click **OK**.
3. The Step Slider control shows data for only one frequency at a time. To see what frequencies the cell responded to, you can play through the frequencies or step through the frequencies manually.



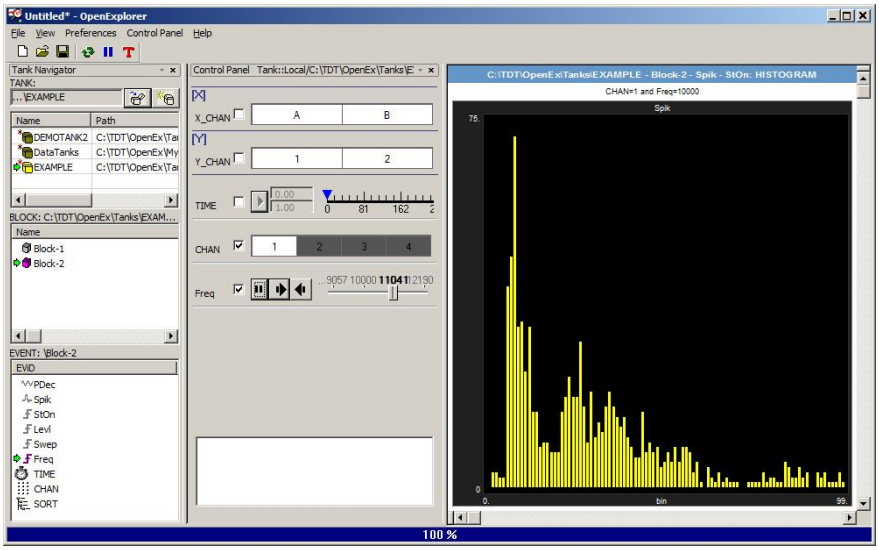
Note: in this data set, data acquired when no stimulus was being presented are sorted as Freq=0. As a result, the Freq=0 data should be disregarded or discarded.

To adjust the Y-axis settings:

1. Double-click on the histogram plot to open the Setup Properties dialog box.
2. Select the **Scaling Parameter Group** and set the **Y-Axis range** to **75**.
3. Click **OK**.

To animate by frequency:

1. Click the  **Play** button in the Freq control.



Remember that the histogram includes all intensities so you are seeing the aggregate response across all intensities for a single frequency.

2. Click the  **Pause** button.

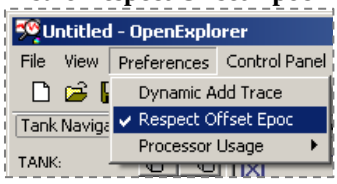
To step through the frequencies:

- Drag the slider from step to step or click the corresponding arrows.

A strong response can be seen at 10 kHz. However, the response might actually occur at a lower frequency. In many cases comparing the pre-stimulus activity and activity during stimulation gives a better idea of whether or not the neuron is responding to the stimulus. To visualize the data before and after the stimulus onset, you can use the stimulus onset event with an Adjust Epoc control.

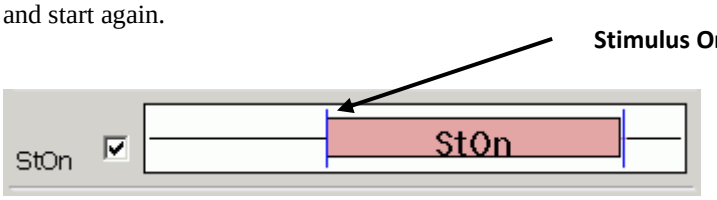
To add an Adjust Epoc control:

1. Ensure **Respect Offset Epoc** in the **Preferences** menu is enabled.



2. Drag **StOn** from the Event list to the Control Panel.
3. In the Control Configuration dialog box, select **Adjust Epoc** in the Type box.

Note: if you do not select Adjust Epoc at this stage you will have to delete the control and start again.



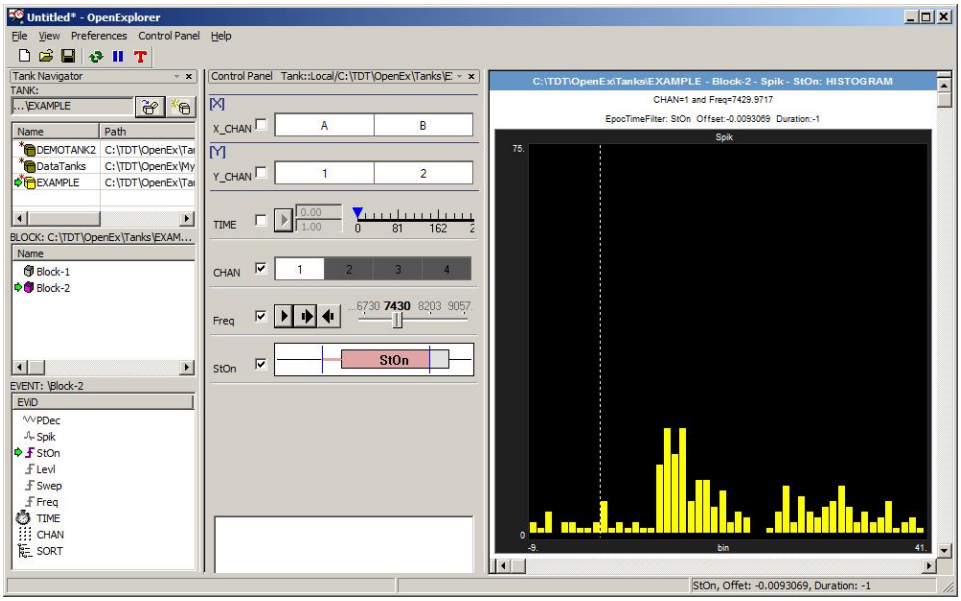
Initially, the control filters the data to include only responses that fall within the original epoch duration. In the plot you will now see that the x-axis extends to about 50 ms, the length of the StOn epoch.

Note: if you wish to see all data from StOn onset to StOn onset, you can set OpenExplorer to disregard the epoch duration. To disregard the epoch duration toggle *Respect Offset Epoc* off on the Preferences menu.

4. In the StOn control, drag the start and duration indicators to the left to change the start position of the epoch.

Note: when you drag using any point between the two blue bars, the epoch is repositioned so that a new start time is defined but the duration of the epoch is fixed (in this case about 50 milliseconds). You can also point to either bar to position it individually, however, you can never make the epoch longer that the original duration of the epoch.

When you move the slider you can get a quick idea of the pre-stimulus duration by looking at the bin number furthest to left (in this case –9 or 9 milliseconds pre-stimulus). To enter precise offset or duration values, double-click the control to display a parameters dialog box.



After the epoch is adjusted, a dotted white line indicates the original start of the epoch (in this case, stimulus onset). Bins that occurred before the onset are negative, bins after the onset are positive values.

A quick check at 7430 Hz (with all intensities summed together) indicates that the neuron fires more often after the stimulus onset.

Using a Cursor to Determine When the Response Occurred

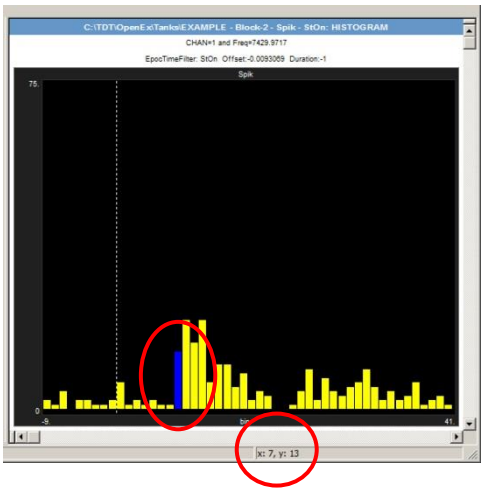
OpenExplorer includes a cursor feature that you can use to more precisely determine when the response occurs.

To use the cursor:

➢ Press and hold down the Ctrl key and drag across the histogram.

As you drag, the histogram bar under the pointer will turn from yellow to blue. This allows you to visually select a bar. The x,y value for the selected bar is displayed in the Status bar.

Using the cursor you can determine that (for Freq=7430) the response onset occurs at around seven milliseconds (X=7) and that the aggregate response shows 13 spikes.



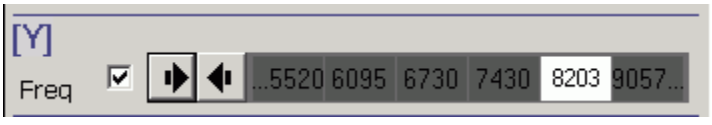
As you step through the stimulus frequencies, exploring the response pattern using the cursor, you can determine that the latency of the response shifted at the higher frequencies.

Instead of animating through the data (viewing responses to one stimulus frequency at a time) you can also look at all frequencies at once.

Plotting Frequencies Along the Y-Axis

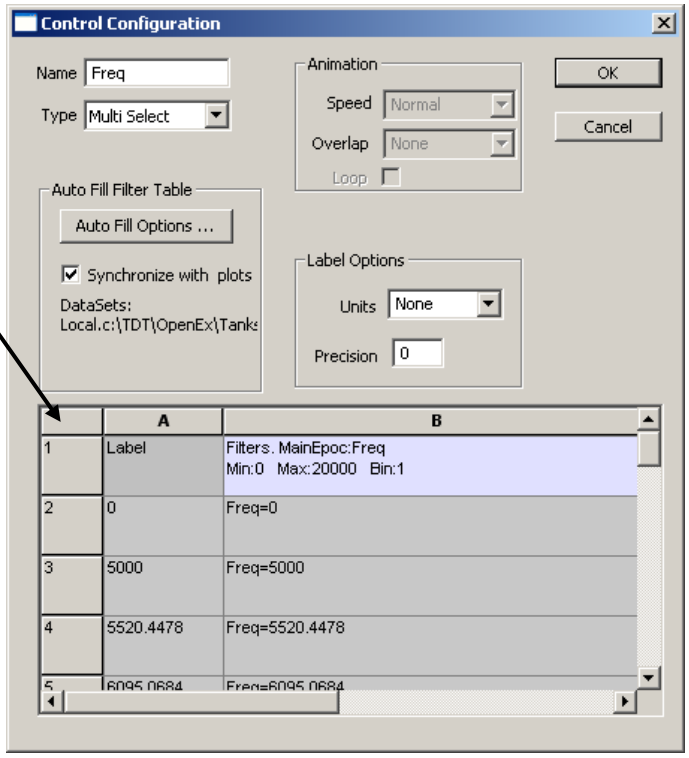
To move frequency to the y-axis:

1. Drag the **Freq** (frequency) filter to the y-axis bar and ensure the check box is selected.



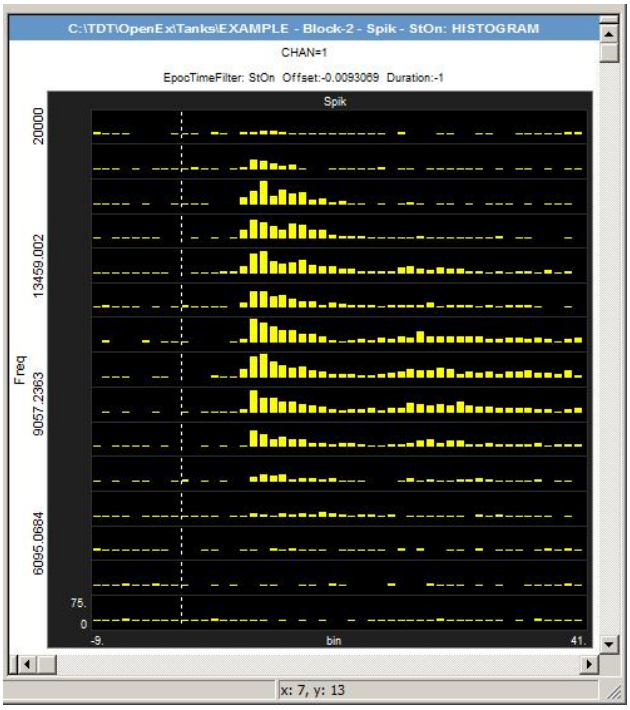
Notice that the control type changes from Step Slider to Multi Select. The x and y axes always use a Multi Select filter type, with each filter criteria representing a point along the corresponding axis. Also notice that all selection values, except one, are filtered out (shown as darkened boxes). That is because OpenExplorer maintained the filtering established when using the Step Slider (always displays only one value at a time). You can enable each selection box by clicking it on the control bar (make sure to use the scroll arrows to display all values) or you can enable all values at once in the Control Configuration dialog box.

2. Double-click the y-axis **[Y]** control.



Select All Button

3. In the spreadsheet area of the dialog box, click the **Select All** button **TWICE**. When no rows are darkened, click **OK**.
4. Click the **0** selection box to filter out those responses. If the 0 selection box is not in view, use the Scroll Left  button to scroll until it is in view.



The new display facilitates a quick visual assessment to determine the frequencies with the best response (between 9 kHz and 15 kHz). Slight differences in the response are also readily apparent. For example, this data shows that the latency to onset is less at lower frequencies and that the response to lower frequencies lacks the second response seen at higher frequencies. At frequencies between 7 kHz and 14 kHz, a more bimodal distribution of neural activity can be seen. This might indicate a slower responding cell or an additional tonic response from the same cell. To explore this idea further you'll need to view the spike shapes.

Viewing the Spike Shapes

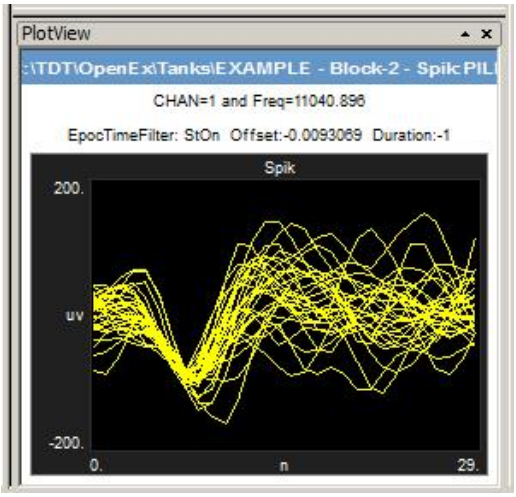
To view a cell in more detail:

- Right-click a cell that shows the bimodal pattern clearly (such as 11041 Hz) and click **View Cell Picture in a New Window** on the shortcut menu.

  The new window displays data from the selected cell only. Viewing the shape of the waveforms represented in the histogram might help to determine if responses from more than one neuron are present.

To quickly change the plot type:

- Right-click the new window and click **Pile** on the shortcut menu.



To view different data in the pile plot:

- Click a different cell in the main plot.

Tuning Curve

After exploring the response to the stimulus frequency alone, you might also want to explore the intensity response at a single frequency or multiple frequencies.

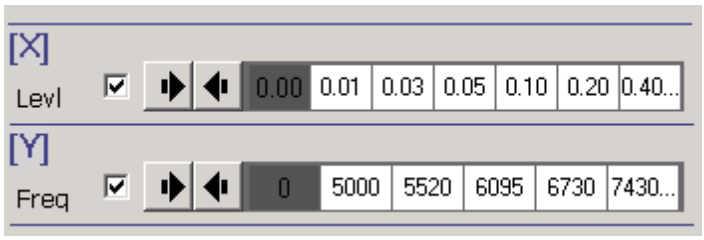
To add an intensity filter:

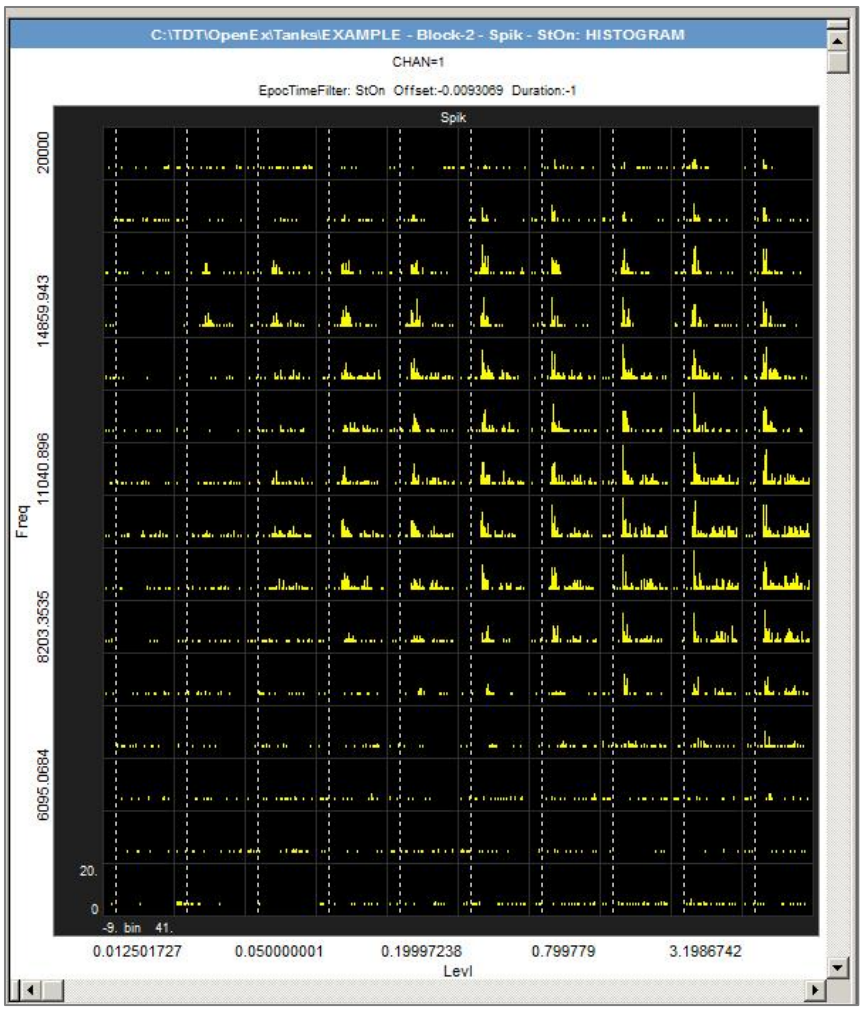
- Drag the **Levl** event from the EVENT list to the x-axis bar of the XY Axes Control and click **OK**.

In this data set, data acquired when no stimulus was being presented are sorted as Levl=0.

To filter out responses to Levl=0:

- Click the **0.00** selection box.

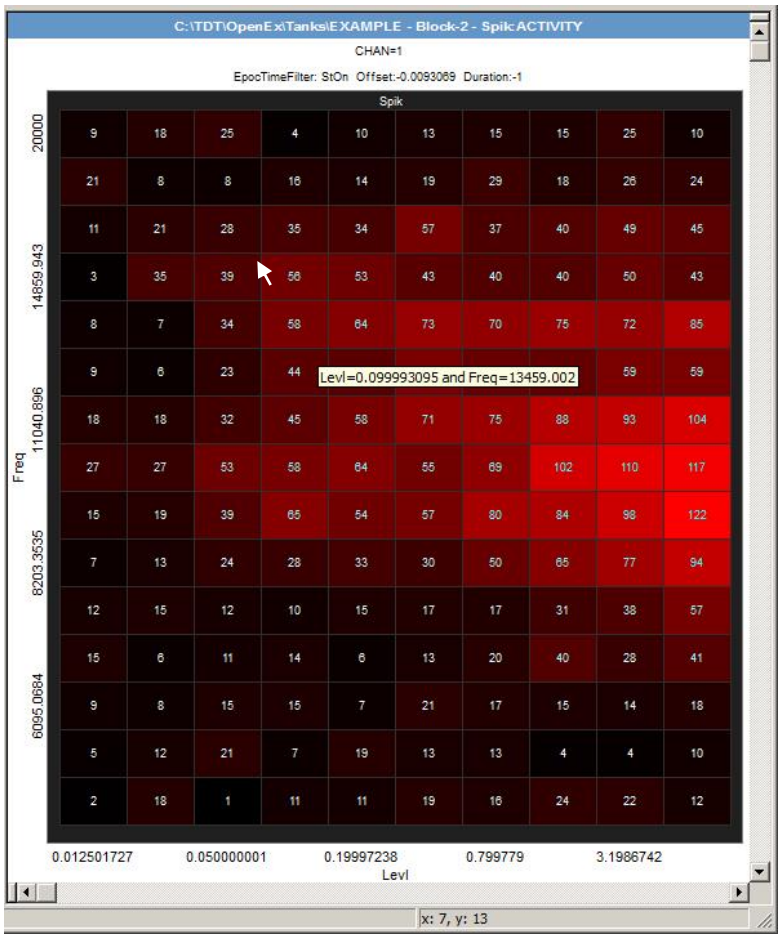




The modified plot allows you to examine the spike activity across all frequencies. By visualizing the data this way you can identify the most sensitive frequencies. However, it might be easier to visualize this by looking at an activity plot.

To quickly change the plot type:

- Right-click the plot area and click **Activity** on the shortcut menu.



In an Activity plot each cell is colored according to the number of responses and the number of responses is displayed clearly in each cell. When you point to a cell the exact X,Y values are displayed. In this Activity plot you can immediately see that, at 13459.002 Hz, the neuron(s) responded to a 0.1 level with 44 spikes.

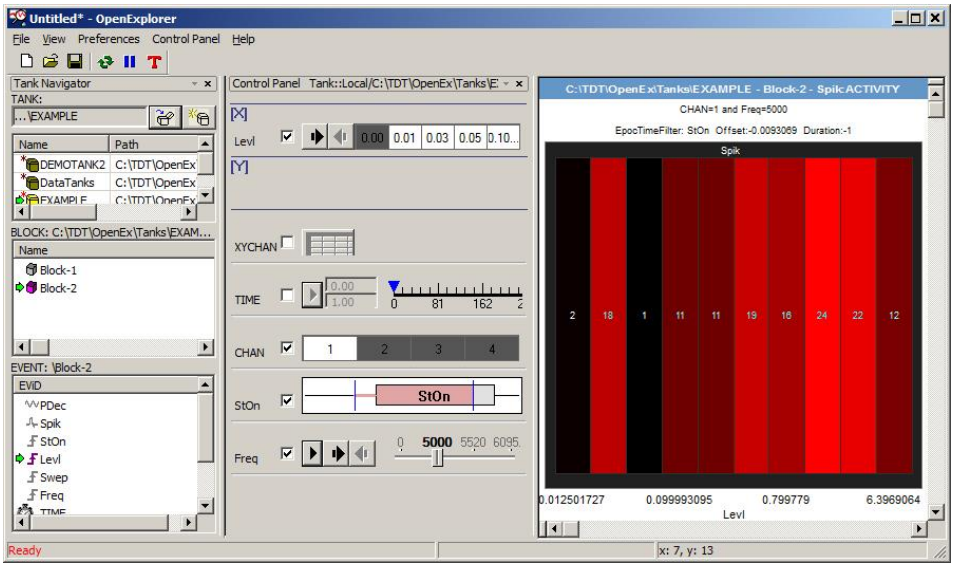
Rate-Intensity Curve

There are many ways to explore the relationship between the spike rate and the stimulus intensity. One way to examine each frequency across multiple intensities is to modify the Activity plot.

To modify the Activity plot:

1. Drag the **Freq** event from the Y-axis bar to an area below the other filters in the Control Panel.
2. Double-click the new **Freq** control, to display the Control Configuration.
3. Select **Step Slider** as the control type.
4. Click **OK**.

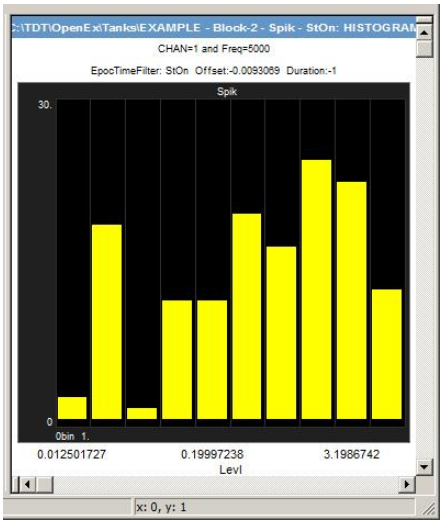
5. Drag the slider to the **5000** Hz position.



With this new plot configuration you can examine the response characteristics for each frequency or use the Play button to animate the plot through a sequence of different frequencies. In the Activity plot, the strength of the response is visually indicated by the color. In this case the strongest response is bright red while a cell with little or no response is black.

To visualize the response another way:

1. Right-click the plot and click **Histogram** on the shortcut menu.
2. In the Setup Properties dialog box, enter **.1** in the Time box and enter **1** in the Bin Width box. This will plot all responses at a given level in a single histogram bar.
3. Click **OK**.
4. Adjust the scale as needed.



5. You can step through or play through each frequency using the step slider.

Summary

In this tutorial you explored sample data using standard viewing patterns such as:

- Channel matrix
- Peri-stimulus histogram
- Tuning curve
- Rate-intensity curve

OpenExplorer was designed to provide the flexibility you need for dynamic exploration of your data. You can view the data while quickly moving from one pattern or filtering configuration to another. In addition to these powerful exploration and visualization tools, OpenExplorer also enables you to export data from any plot at any step of exploration.

~

Auto Tuner Example

The AutoTuner example is an excellent example of how one can visualize and then export vast quantities of data in OpenExplorer. Many neurons, or even groups of neurons, respond preferentially to a limited set of environmental stimuli. In sensory physiology, tuning curves are commonly generated to measure the sensitivity of a neuron (or population of neurons) to some sensory input, such as the orientation of a bar moving across the visual field or the frequency of an auditory signal.

This example demonstrates how the filtering capabilities of OpenExplorer can be used to determine the best frequency response of the cell, how to view histograms that incorporate both pre and stimulus responses, and how you can view the spike characteristics to determine if there was more than one unit responding.

The Example Data

The data that will be used for the explanation is in Tank **EXAMPLE**, **Block-1**. This block contains tuning curve data from a single cell acquired on channel one.

Concepts and Techniques Illustrated

- Tuning Curve
- Peri-Stimulus Time Histogram (PSTH)

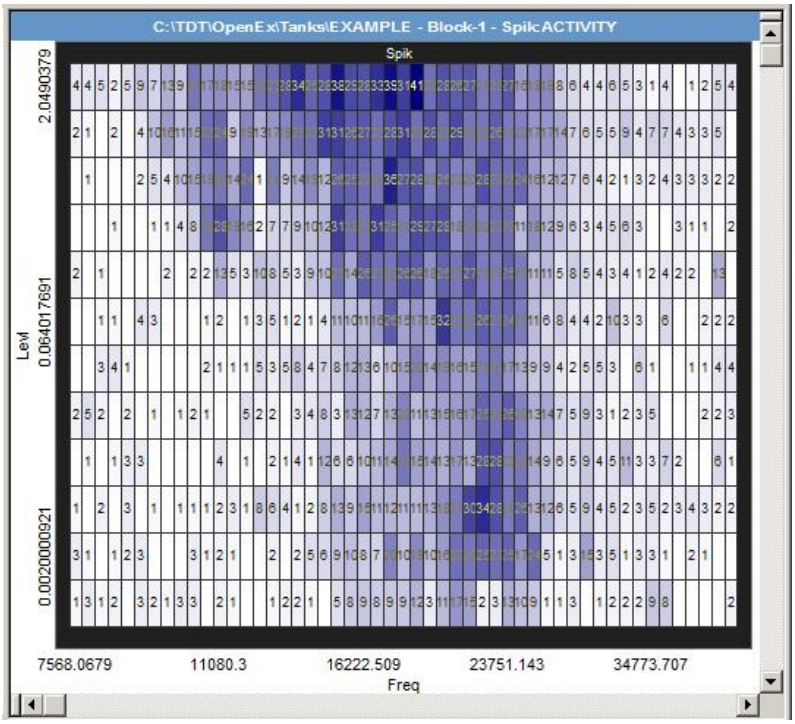
Launching Explorer

1. To get started, launch OpenExplorer:
    a. On the Start menu, select **TDT Sys3**, **OpenEx**, **OpenExplorer**.
2. To create a new configuration (*.xpr) file:
    a. Click the  **New** button on the toolbar.
    b. If you are prompted to save changes to the current configuration, click **NO**.
3. To select the data:
    a. In the Tank Navigator, right-click and select **Show Legacy Tanks.**
    b. Select **EXAMPLE** in the TANK area.
    c. Under BLOCK, click **Block-1**

The EVENT area of the Tank Navigator now displays a list of events in Block-1 of Tank EXAMPLE.

The Tuning Curve

The OpenExplorer activity plot provides an excellent quick visual representation of tuning curve data. The plot is a grid divided into cells according to the X and Y controls, in this case Freq (stimulus frequency) and Levl (stimulus level). Each cell is shaded according the number of spikes that occurred at that frequency and level. By default, the lowest spike count (0) is colored black and the highest spike count (41) is bright red. The counts in between are varying shades between the two colors. In the configuration below a number of modifications have been made to improve visualization. For the example block of data, this plot shows a tuning curve centering around 22.16 KHz.



Creating the Tuning Curve Plot

After data has been selected, a plot can be created by dragging an event to the plot area.

To add an activity plot:

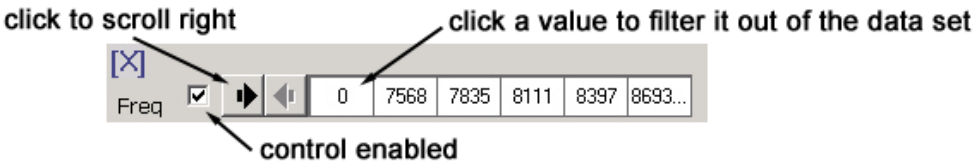
1. Drag the **Spik** event (acquired snippets) from the event list to the plot area.
2. In the Choose Display window click **Activity**.

Defining the X-Axis - Freq

The x-axis is defined using the Freq (frequency) epoch event.

To define the x-axis:

1. Drag the **Freq** event from the Event list to the X-control area.
2. In the Control Configuration dialog box, click **OK**.



The X-axis portion of the XY Axis control is displayed as a sorted list of frequencies. This means that the x-axis is divided into sections based on the values of the Freq epoch, that is, the frequencies presented.

All values might not be visible simultaneously. You can use the  Scroll buttons to scroll left or right to see the remaining values. You can also click individual values in the row to filter out (darken) responses for those values. In this data set, data acquired when no stimulus was being presented is sorted as Freq=0.

To filter out the Freq=0 responses:

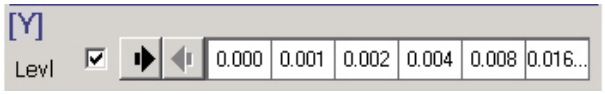
- Click the **0** selection box on the x-axis Freq control.

Defining the Y-Axis - Levl

The y-axis is defined using the Levl (level) epoch event.

To define the y-axis:

1. Drag the **Levl** event form the Event list to the Y-control bar.
2. In the Control Configuration dialog box, click **OK**.



Like the X-control, the Y-control is displayed as a row of values that can be included or removed. In this case, the row of values is a sorted list of level, or amplitude, values at which the stimuli were presented. This means that the y-axis of each plot is divided into sections based on the different values of the Levl epoch, that is, the stimulus levels presented. Again, in this data set, responses acquired when no stimulus was being presented were sorted as Levl=0.000.

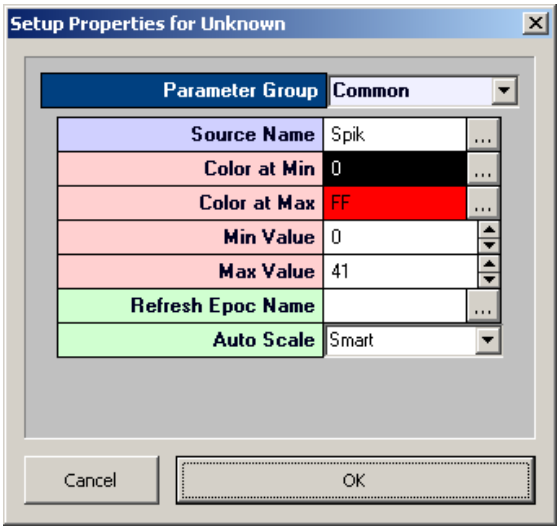
To filter out the Levl=0.000 responses:

- Click the **0.000** selection box on the y-axis Levl control.

Reducing the Visibility of Noise in the Tuning Curve

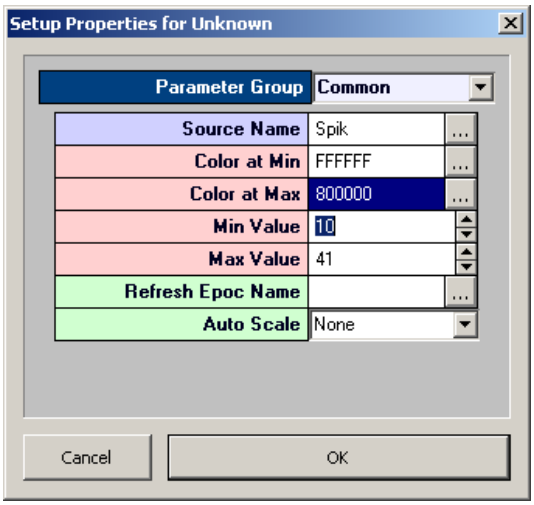
By default, the activity plot varies in color intensity from red to black. However, the color and min/max settings can be modified to improve visualization.

1. Double-click the activity plot to display the plot's property settings.

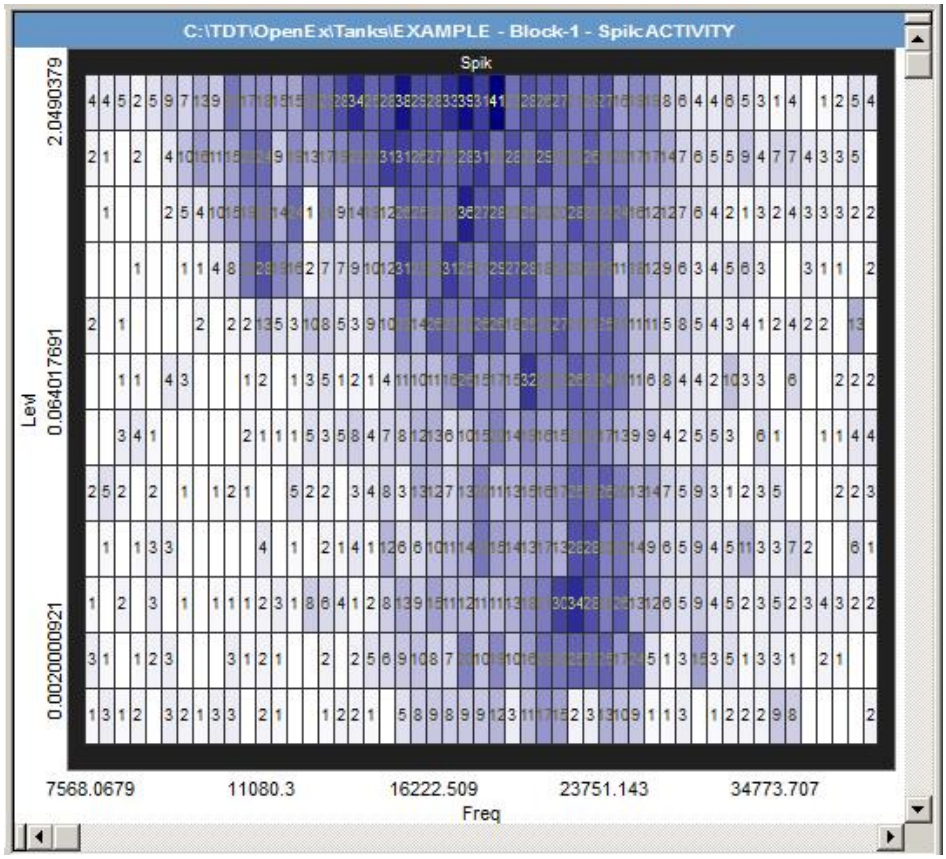


2. Click the … **Look Up** button next to **Color at Min**.
3. Select **white** in the color palette window, and click **OK**.
4. Click the … **Look Up** button next to **Color at Max**.
5. Select **dark blue** in the color palette window, and click **OK**.

6. Set **Auto Scale** to **None**.
7. In the **Min Value** box, enter **10**.



8. Click **OK**.



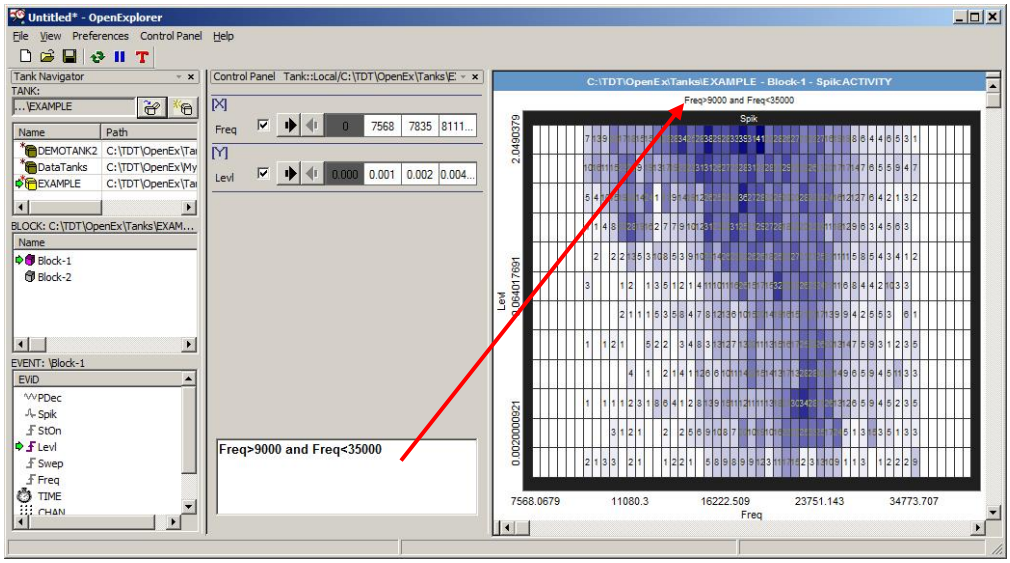
All cells with spike numbers less than 10 are now colored white, reducing the visibility of noise in the tuning curve. The frequencies of interest can now be quickly identified.

Filtering the Data

OpenExplorer provides many ways to filter data. Earlier you filtered out the 0 level and 0 frequency data by simply clicking the corresponding selection box on the control. Text filters provide another way to quickly implement arbitrary filters.

To add a text filter:

1. Click in the **Text Filter Conditions Box**.
2. Type **Freq>9000 and Freq<35000**.
3. Press the **Enter** key.



The extreme areas on the left and right sides of the multi-cell plots are now empty. Frequencies below 9000 Hz and above 35000 Hz have been filtered out giving the figure a cleaner look. Notice, however, that only the responses at those frequencies have been removed from the plot, not the cells themselves. As long as those frequencies are enabled in the x-control, the cells will remain in the figure. A label has been added to the plot to indicate that a filter has been applied.

To remove the text filter:

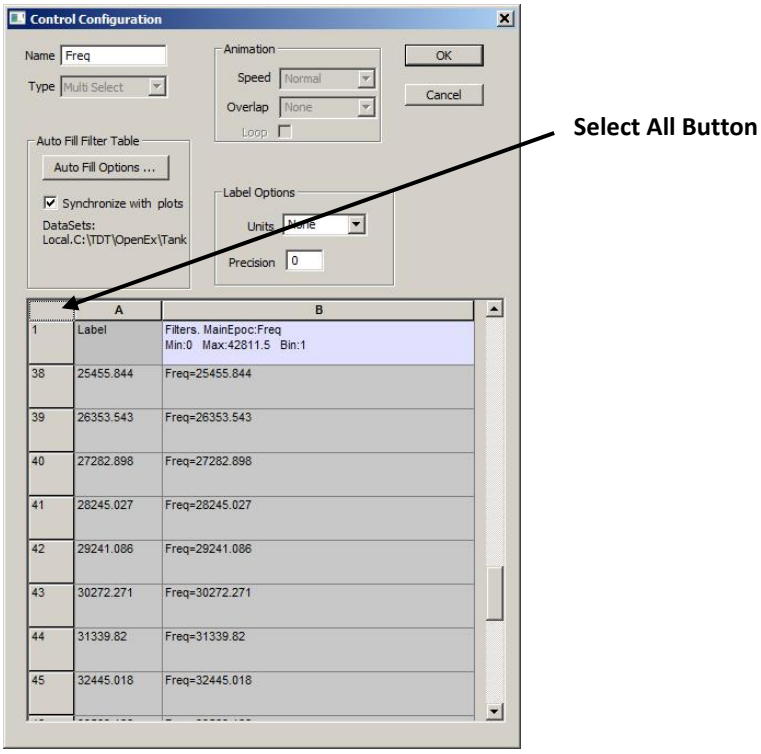
1. Select the text in the text entry area.
2. Press the **Delete** key.
3. Press the **Enter** key.

You can remove the cells as well as the data by modifying the x-axis.

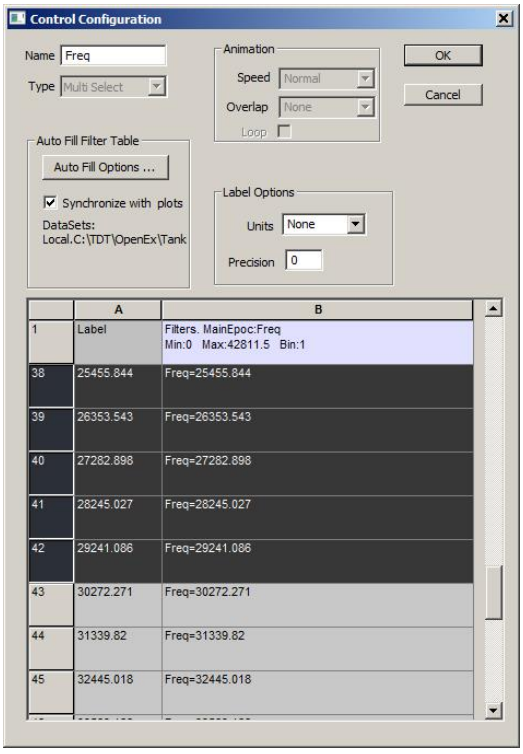
To modify the x-axis:

1. Double-click the x-axis control bar.

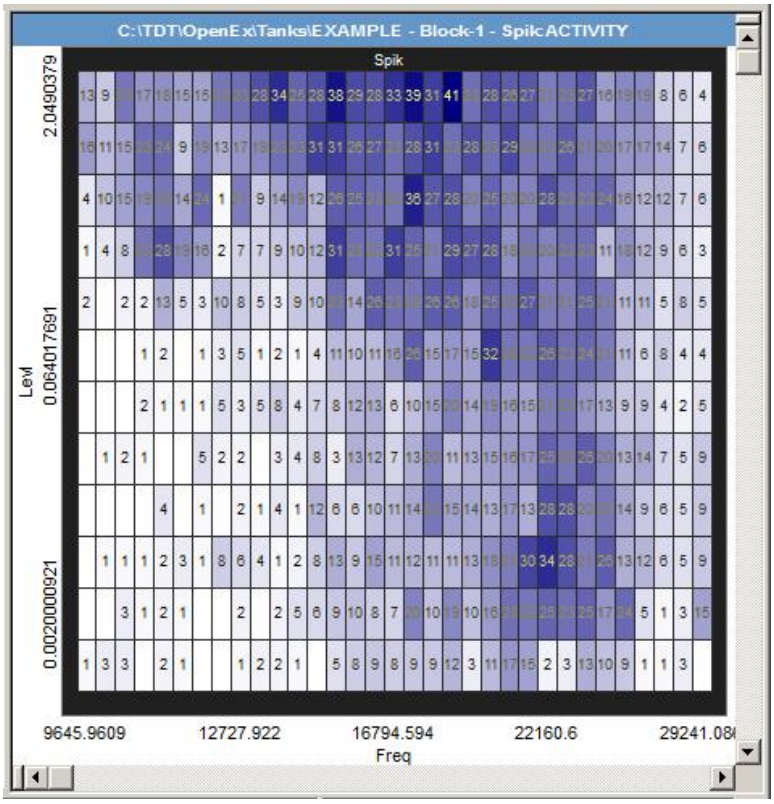
2. In the Control Configuration dialog box, click the **Select All** button **twice**.



3. In the spreadsheet, select rows **10 through 42**.



4. Click **OK.**



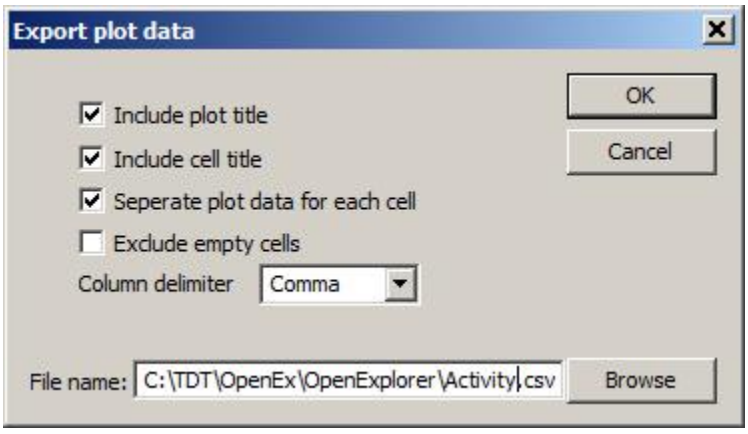
The x-axis has been updated so that the plot shows only the data of interest.

Exporting the Tuning Curve Data

At any point during data exploration, you can export the plot data.

To export the Tuning Curve data from the current activity plot:

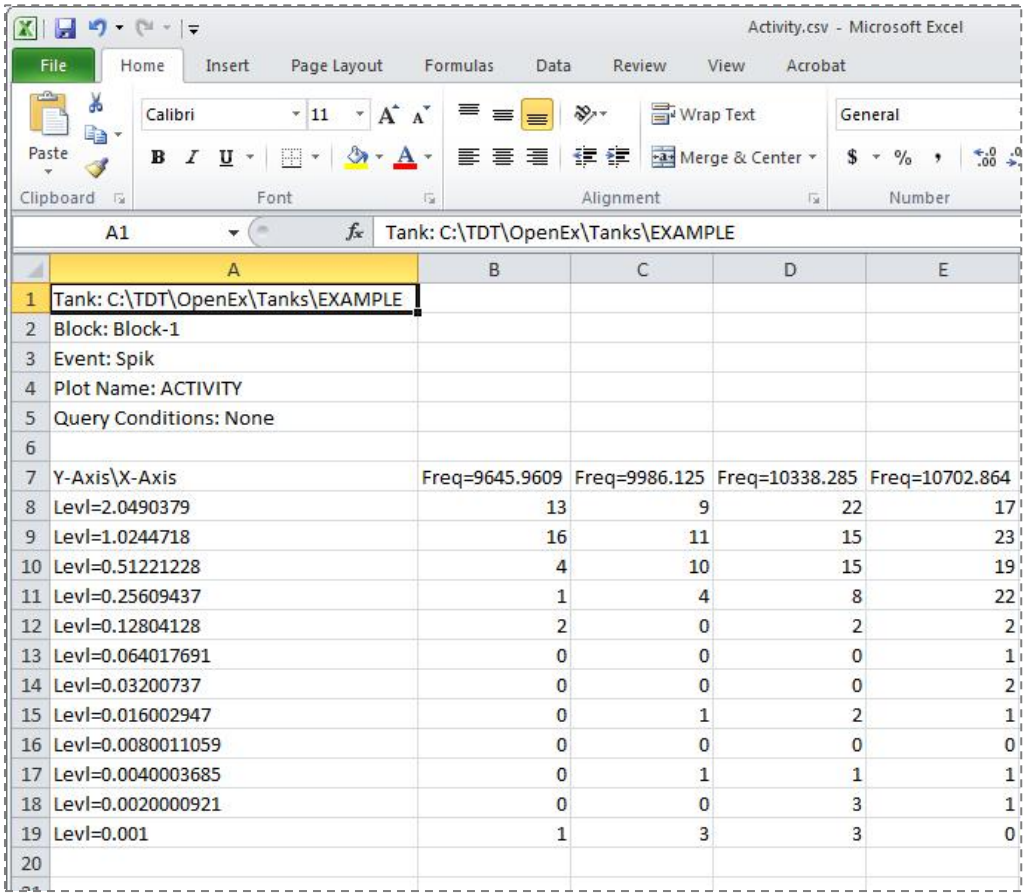
1. Right-click the activity plot.
2. Click **Export Plot Data** on the shortcut menu.
3. In the Export Plot Data dialog box, enter (or browse to) a location and file name.



4. Click **OK**.

The resulting CSV format file can be opened in Microsoft Excel. The file includes header information, such as the Tank name and block number, event name, plot type, and any arbitrary

filters that have been applied. The exported data for the activity plot includes the spike count at each X,Y position in the plot.



Activity.csv - Microsoft Excel

File | Home | Insert | Page Layout | Formulas | Data | Review | View | Acrobat

Calibri 11 | Wrap Text | General | Merge & Center | Paste | Clipboard | Font | Alignment | Number

A1 | Tank: C:\TDT\OpenEx\Tanks\EXAMPLE

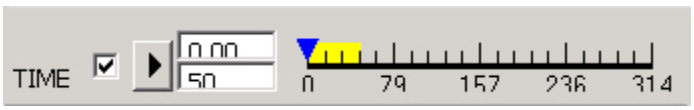
	A	B	C	D	E
1	Tank: C:\TDT\OpenEx\Tanks\EXAMPLE				
2	Block: Block-1				
3	Event: Spik				
4	Plot Name: ACTIVITY				
5	Query Conditions: None				
6					
7	Y-Axis\X-Axis	Freq=9645.9609	Freq=9986.125	Freq=10338.285	Freq=10702.864
8	Levl=2.0490379	13	9	22	17
9	Levl=1.0244718	16	11	15	23
10	Levl=0.51221228	4	10	15	19
11	Levl=0.25609437	1	4	8	22
12	Levl=0.12804128	2	0	2	2
13	Levl=0.064017691	0	0	0	1
14	Levl=0.03200737	0	0	0	2
15	Levl=0.016002947	0	1	2	1
16	Levl=0.0080011059	0	0	0	0
17	Levl=0.0040003685	0	1	1	1
18	Levl=0.0020000921	0	0	3	1
19	Levl=0.001	1	3	3	0
20					

Animating the Tuning Curve

The response of a cell often changes as a function of time. Animating a plot can help you quickly identify time-related changes in cell response such as fatigue, adaptation, or subject boredom. Using the standard Time event and a Continuous type control you can quickly create a control that will enable you to view a series of time line segments. As each segment is animated, only events that take place during the defined time duration are plotted. This type of animation facilitates the detection of changes in the overall response of a cell over time.

To animate the plots:

1. Drag the Time event from the Event list to an empty area of the Control Panel.
2. In the Control Configuration window, select **Continuous** in the Type box and click **OK**.
3. A timeline will appear in the control area. It includes two value entry boxes – one for start time (top) and one for the duration of the time segment (bottom) in view. You can type values in each box. You can also drag the blue arrowhead to specify a start time. The area on the timeline selected will be highlighted in yellow.



4. Enter a duration in the lower text entry box to define a duration or time segment.

5. Click the  **Play** button to begin animation.

To halt the animation:

➢ Click the  Pause button.

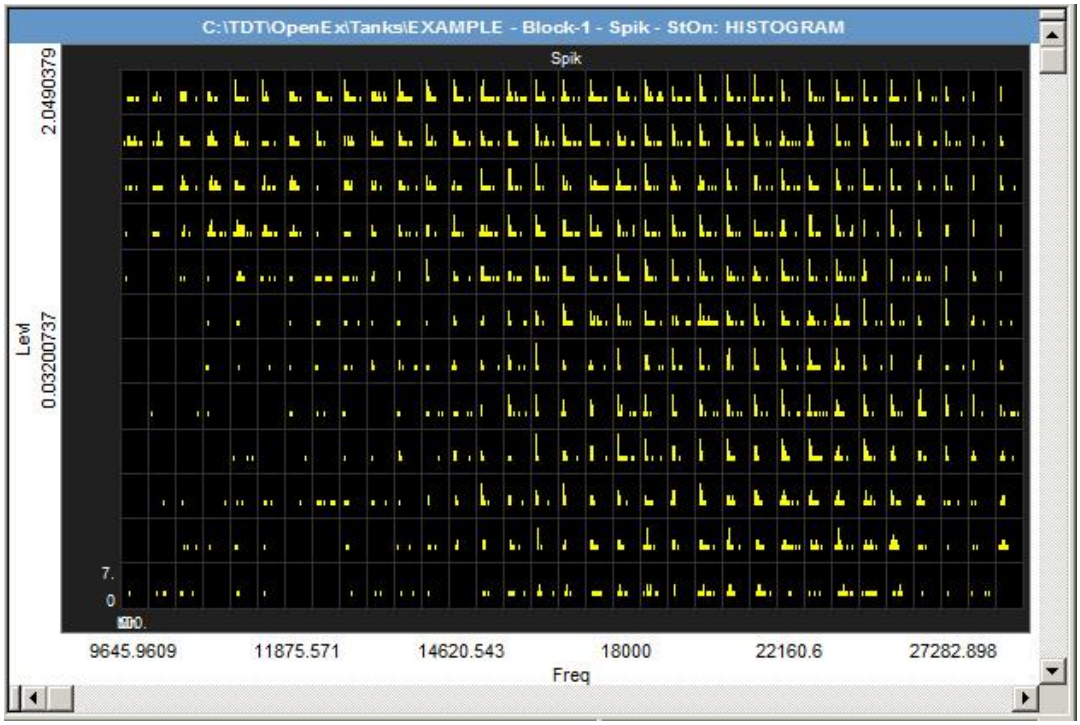
When you want to view all data you need to remove or disable the Time filter control.

To disable the Time filter:

➢ Clear the check box to the right of the control label.

Viewing the Response Over Time

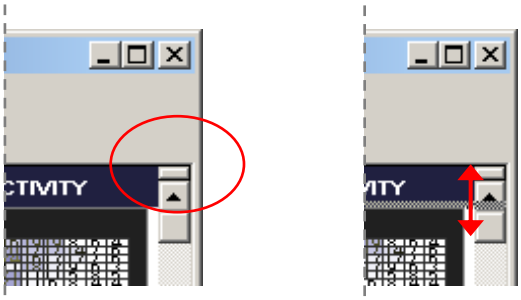
Histograms provide another way to look at responses over time. They plot time stamped values in relation to some defined zero reference. The OpenExplorer histogram plot is also a grid of cells and is formed using the same X and Y controls, in this case Freq (stimulus frequency) and Levl (stimulus level), used for the activity plot. Each cell contains a histogram of spikes recorded at a given frequency and level. The histograms are plotted with StOn (stimulus onset) as the reference epoch. This means that the zero reference of each histogram is the onset of the stimulus onset (StOn) epoch and the duration of the histogram is the time from one StOn onset to the next (about 100 ms).



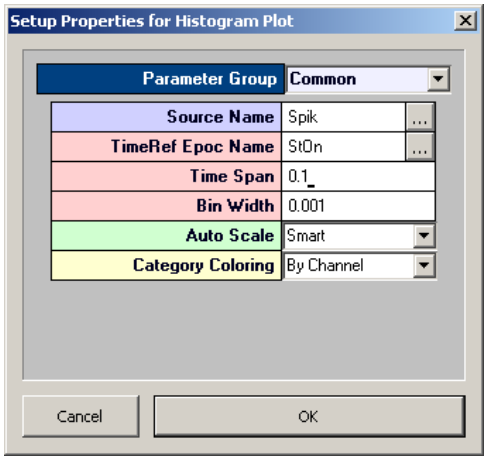
Creating the Histogram Plot

To add the histogram plot:

1. Drag the pane divider bar down to subdivide the plot area.



2. Drag the **Spik** event (acquired snippets) from the event list to the empty plot area.
3. In the Choose Display window, select **Histogram**.
4. In the Setup Properties dialog box, ensure that **StOn** is selected as the reference epoch (TimeRef Epoc Name box).
5. Enter **.1** in the Time Span box.



6. Click **OK**.

   The plot is generated using the onset of StOn as the zero reference and a bin size of one ms.

Viewing the Contents of a Cell

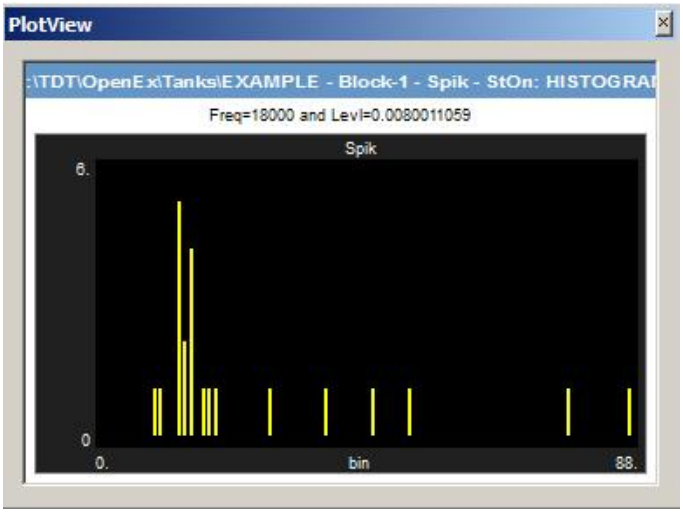
When a multi-cellular plot is built, the size of each individual cell depends on the number of values present in the X and Y controls of the plot. If the number of X and Y values is small, it is easy to view the contents of each cell. If there are many X and Y values, however, the individual cells become too small to give anything but an overview of the response over the stimulus set. Because the plot for this data set includes many cells, the cell contents are difficult to view.

To view the data in each cell in more detail, you can plot an individual cell in a new window. A neat aspect of this feature is that the new window will display the contents of whichever cell you click in the main plot area, consequently, reducing the need to create multiple windows to view different cells.

To view a cell in a new plot window:

1. Right-click a cell in the Histogram plot.
2. Click **View cell picture in a new window** on the shortcut menu.

   A new sub-window is opened and the contents of the selected cell is displayed. By default, the window is added below the control panel. The window can be collapsed, expanded, or floated. Multiple windows can be opened and each window can be dynamically updated from one plot type to another.



Using the Cursor

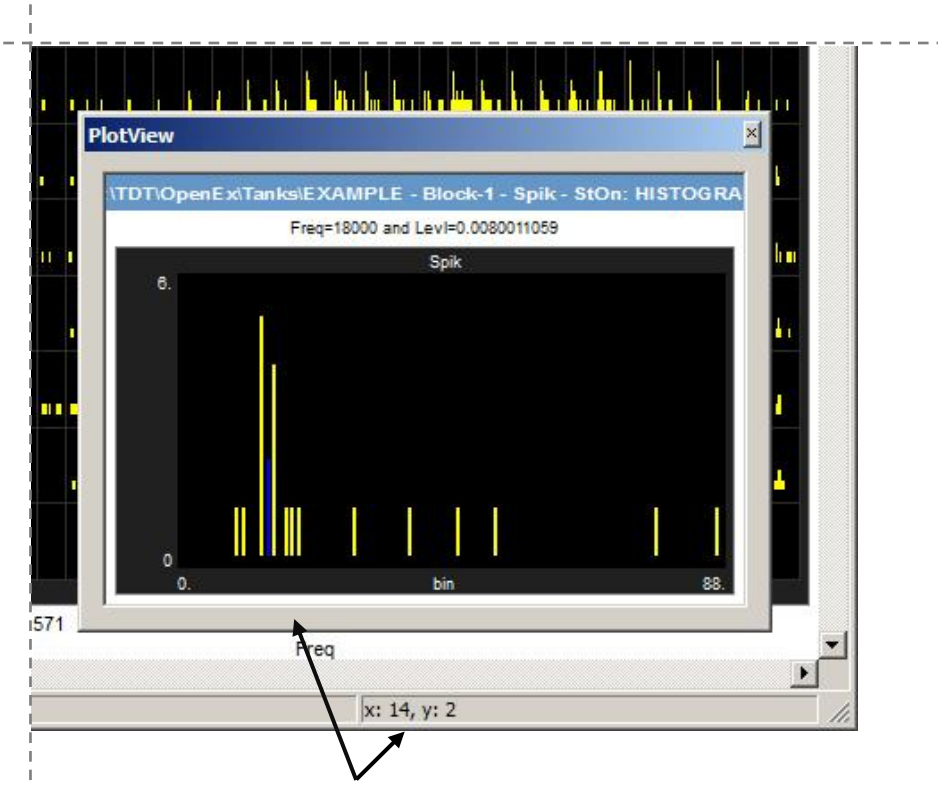
The new window provides a better view of the responses in the selected cell. OpenExplorer includes a cursor feature that you can use to more precisely determine when the response occurs.

To use the cursor:

- Press and hold down the Ctrl key and drag across the histogram.

  As you drag, the histogram bar under the pointer will turn from yellow to blue. This allows you to visually select a bar. The x,y value for the selected bar is displayed in the Explorer Status bar.

Using the cursor you can determine that (for Freq=221606.6) the response onset occurs at around 14 milliseconds (X=14).



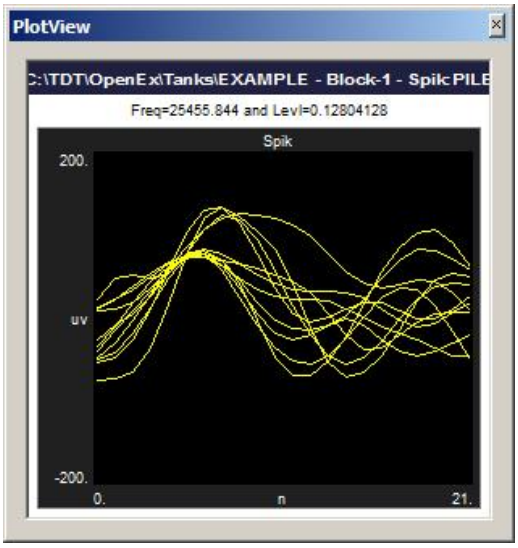
Cursor Position

Viewing the Spike Shapes

There are many times when you might want to see the shape of spikes in a particular cell. OpenExplorer makes it easy to dynamically change plot types.

To view a cell in a new window using a different plot type:

1. Right click the multi-cell histogram plot.
2. Select Pile on the shortcut menu. All the cells in the plot will now become pile plots.
3. Right-click a cell and select View cell picture in a new window, on the shortcut menu. This will open another window with a picture of that cell, this time as a pile plot.



Notice that the earlier "new" window will remain as a histogram plot of the selected cell. Now when you click different cells in the multi-cell plot, the two cell windows will refresh accordingly – one as a histogram plot and one as a pile plot of the selected cell. In other words, the cell plots are frozen to their respective plot types, but not to a cell. You can freeze a new plot to a cell using the Freeze plot command on the shortcut menu.

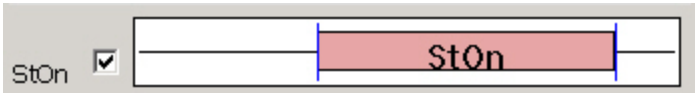
Including Pre-Stimulus Data

In this configuration, the basic histogram plot uses the stimulus onset as a time reference epoch to plot spike responses. This means that only spikes that occur after stimulus onset are included. When viewing data in a histogram it is often desirable to plot the pre-stimulus spikes along with the spikes acquired during the stimulus. In order to do this, you must filter the data to include spikes that occurred within a time window that starts from a point before the onset of the stimulus to a point after that onset. The Adjust Epoch control makes this type of filtering easy by allowing you to specify a start time and duration with reference to the onset of an epoch. After the control has been configured, you can change these values dynamically to view histograms with different zero references.

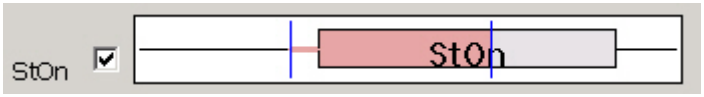
To add an epoch as a time reference filter:

1. Drag the **StOn** (stimulus onset) epoch event from the Event list to an empty area of the Control Panel.
2. In the Control Configuration dialog box, select **Adjust epoch** in the **Type** box and click **OK**.

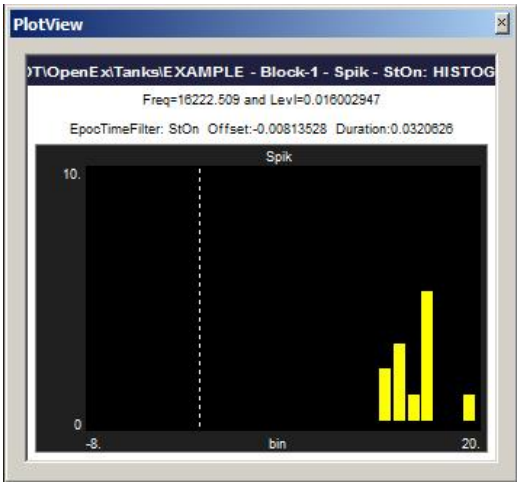
   The StOn control is displayed in the control area. The pink bar represents the duration of the epoch. Two vertical blue bars can be moved along the horizontal axis. Double-clicking the control will open a window that allows you to enter an adjusted offset and duration.



   Note: the duration cannot be longer than the duration of the epoch event.
3. To specify these values visually, drag the bars using the mouse. This applies a filter based on the offset and the duration.



   Adjust these values dynamically to explore the data, including responses before stimulus onset.



Notice that a dotted vertical line appears in the histogram in the new plot window and that the x-axis starts from a negative number. The vertical line is the zero line, in this case the onset of the stimulus. Because the cells in the main histogram plot are so small the zero line might not be displayed. When possible the zero line is added to all affected histograms.

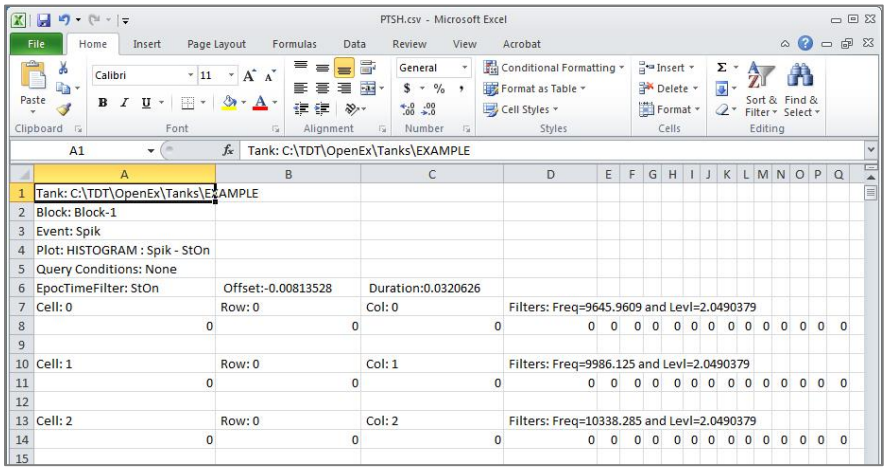
Exporting the PSTH Data

Earlier you exported plot data from the Activity plot. All plot types support export, however, data in the resulting file will be arranged differently according to the plot type.

To export the PSTH data from the current histogram plot:

1. Right-click the histogram plot.
2. Click **Export Plot Data** on the shortcut menu.
3. In the Export Plot Data dialog box enter (or browse to) a location and file name.
4. Click **OK**.

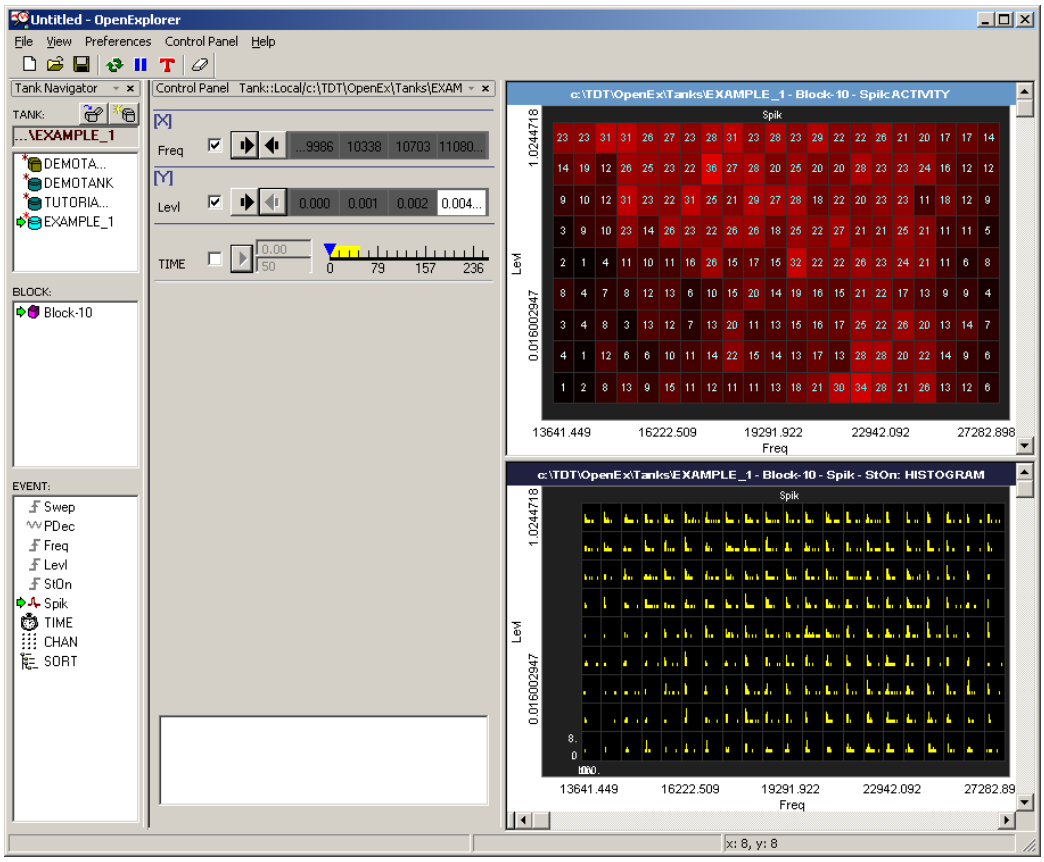
The resulting CSV format file can be opened in Microsoft Excel. The file includes header information, such as the Tank name and block number, event name, plot type, and information about the time offset and duration. The exported data for the histogram plot includes two rows for each cell in the plot. The first row includes information about the cell including the X and Y value (reported as a filter). The second row includes the spike count for each bin of the histogram for that cell.



Workspace Basics

About the Workspace

OpenExplorer provides an interactive workspace that allows users to explore the relationships between recorded data, stimulus parameters, and other defined events. The workspace includes a plot area and two collapsible sub windows: the Tank Navigator and the Control Panel. Commands are available from the menu bar, the toolbar, or context sensitive (right-click) menus.



Tank Navigator

The Open Explorer Tank Navigator is similar to the Tank Select (Tank Navigator) window in OpenScope. Users can select the data to be plotted by selecting a data tank and block. Once the data set has been selected, users can drag events to the plot area or Control Panel to configure the plot. The Events list displays events than were acquired as OpenWorkbench Stores as well as several standard events (Time, Chan, and Sort). Users can also drag a block to the plot area to display new data using a plot that has already been configured.

Control Panel

The Control Panel allows the user to define the plot axes or filter the data dynamically. The Control Panel always includes an XY Axis Control. The user establishes the plot axes by dragging the desired events from the Event list to this preset control. Additional controls can be added to further filter the data set. Controls are added by dragging an event to the control panel. A Control Configuration dialog is automatically opened for every added control to allow the user to determine the type of control and to configure other aspects of the control behavior. Filters in the Control Panel are always applied with AND logic (each new filter further limits or reduces the data viewed.) A text entry area at the bottom of the Control Panel allows users to manually set filters with more complex logic.

Plot Area

The plot area displays the selected data after the filters have been applied. Several plot types are available, including activity, pile, or histogram plots. The plot area can subdivided to allow the user to view the data set in several plot types at the same time and individual cells can be launched in separate sub-windows for further exploration. A data table view is also available. The plot area also displays information about the data being displayed.

Using the Tank Navigator

The Tank Navigator is used to select data in OpenExplorer. The window is divided into three interdependent areas: TANK, BLOCK, and EVENT. When the window is fully expanded, detailed information about tanks, blocks, and events enable users to select desired data for visualization and analysis. Clicking an object in any area selects the object. Right-clicking an area displays a shortcut menu that includes common commands for that area.

TANK

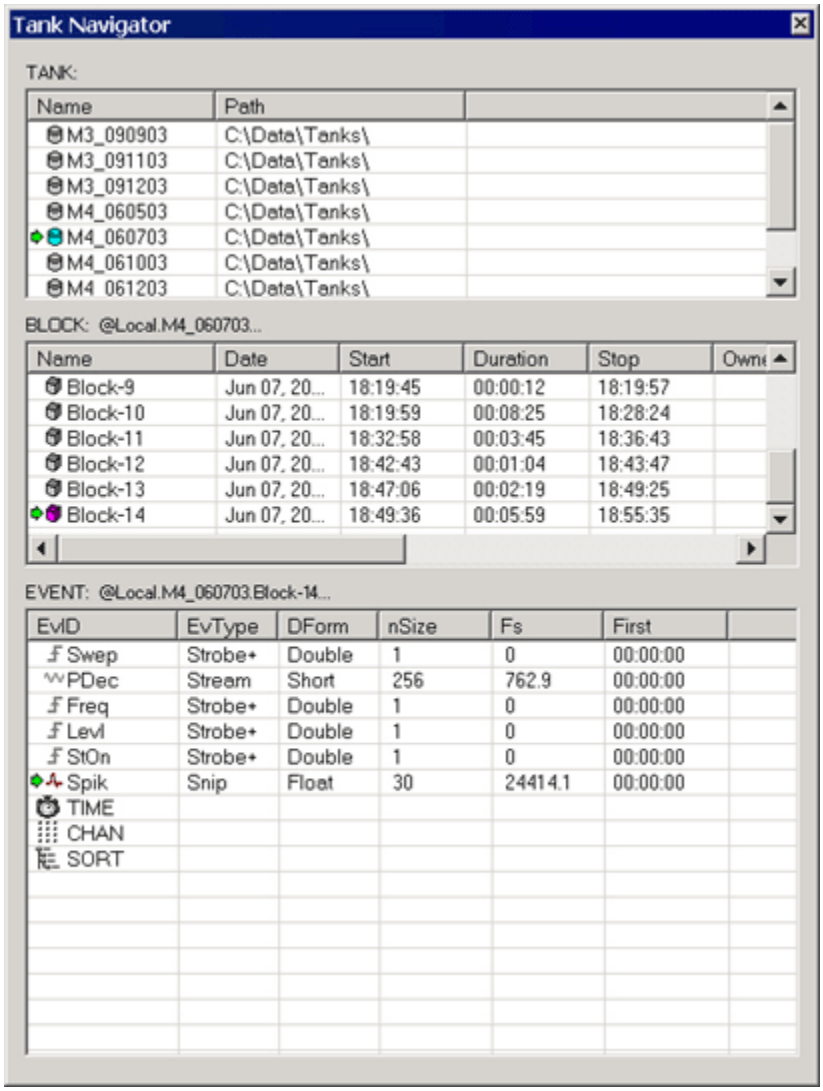
The TANK area lists registered tanks stored in the current data tank format. The right-click, shortcut menu, provides commands to browse for an unregistered tank or to display legacy format data tanks in the list. The Details view displays the name and path for each tank.

BLOCK

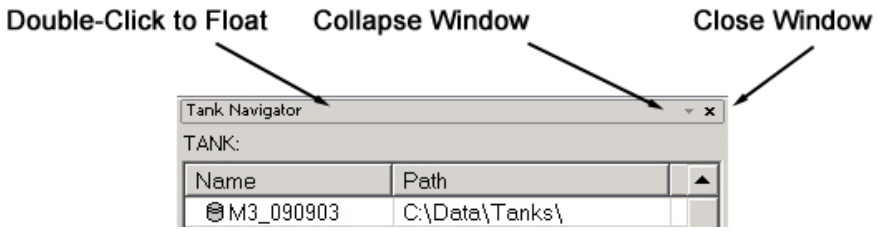
The BLOCK area displays the blocks available in the tank selected in the TANK area. The Details view displays a name, date, and starting time, duration, stop time, owner, and memo area for each block of data in the selected tank.

EVENT

The EVENT area displays information about events for the block selected in the BLOCK area. This list includes user defined data Stores (defined in OpenWorkbench) and standard events such as Time (timestamp), Chan (channel number), and Sort (sort code).



The Tank Navigator is a collapsible sub-window that can be hidden, moved, or resized to suit the user's needs.



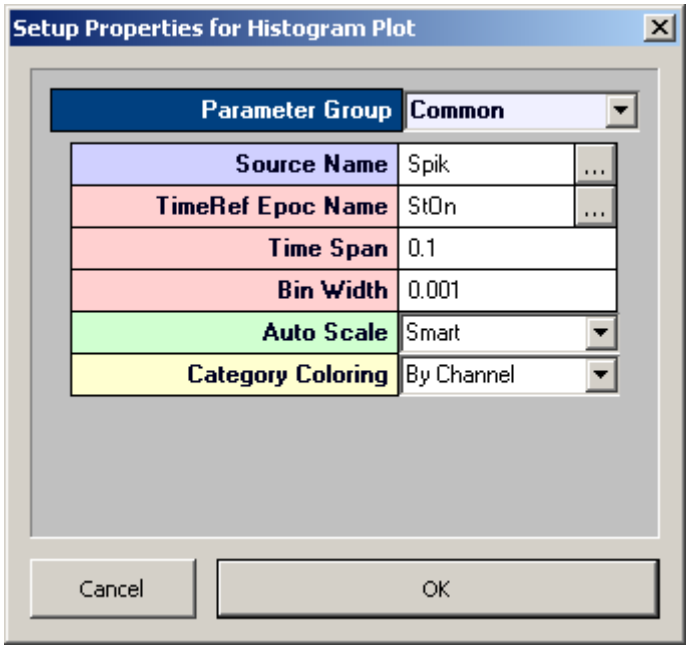
Using the Setup Properties Dialog Box

The appearance and behavior of each plot can be modified using the Setup Properties dialog box. The Setup Properties dialog box contains all of the customizable settings for a selected plot.

While all Setup Properties dialog boxes look and behave in a similar fashion, the settings available depend upon the plot being modified. Most plot settings are similar to those available in OpenScope. See the *OpenScope Plot Settings Reference* for more information on plot settings.

To open the Setup Properties dialog box for a plot:

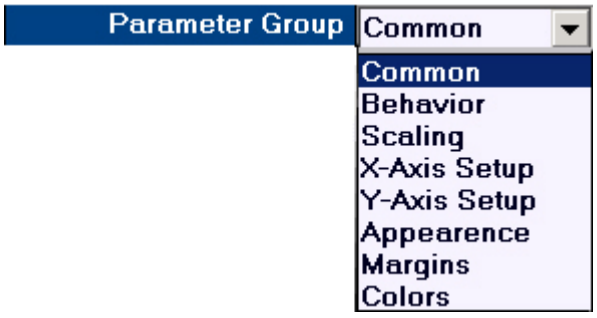
- Double-click the plot.



Plot settings are grouped into parameter groups. The Setup Properties dialog box opens with the most commonly used settings for the selected plot displayed.

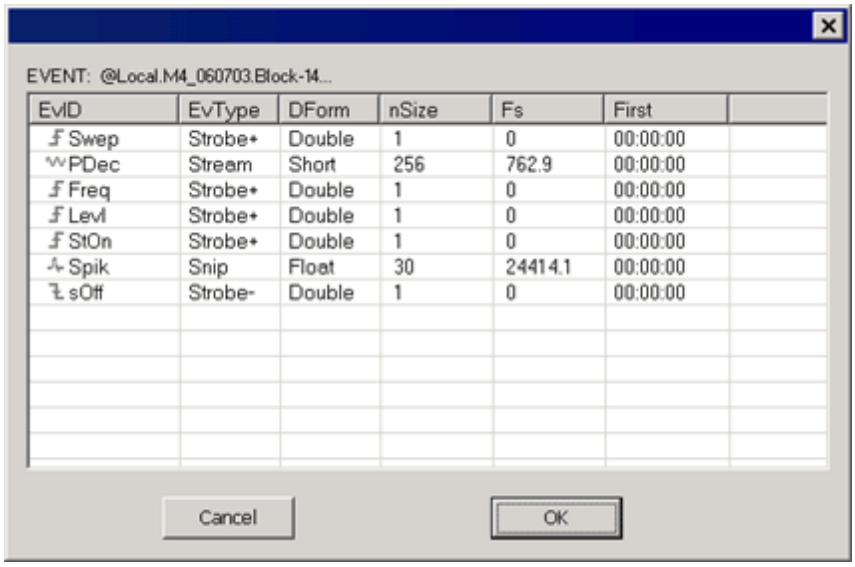
To display the settings available in another group:

- Click the **Parameter Group** value box and select the group from the list.



Source and Reference Epoch Settings

When settings, such as Source Name, must be set using the name of an event a Lookup button ... is located to the right of the value box. Clicking the Lookup button opens an Event Selection window.



In the Event Selection window, a list of available events in the current block is displayed. Events are organized in rows. The EvID (event ID) corresponds to the OpenWorkbench Store name or Tank Code (for secondary tags). The event ID is preceded by an icon to indicate the type of event, such as snippet or continuous waveform. Epoch events are marked with the Epoch icon.

Menus and Toolbars

File Menu

New	Opens a new OpenExplorer file.
Clear All	Deletes all plots, controls, and filters. Also clears the data selection.
Open	Opens the Open dialog box so that an existing OpenExplorer file can be opened.
Save	Saves the current OpenExplorer file (*.xpr) with the current name. If the file has not previously been saved, the Save As dialog box opens so that the file can be named.
Save As	Opens the Save As dialog box so that the OpenExplorer file can be saved with a new name and the .xpr file extension.
Export Image of the Active Plot	Opens the Export Plot Image dialog box to allow exporting of the active plot. The active plot is the plot with a light blue title bar.
Export Data of the Active Plot	Opens the Export Plot Data dialog box to allow exporting data from the active plot. The active plot is the plot with a light blue title bar.
Recent Files List	The third section of the File menu lists recently used files. Clicking a file name opens the file.
Exit	Closes the OpenExplorer application.

View Menu

Toolbar	Toggles display of Toolbar.
Status Bar	Toggles display of Status Bar.
Tank Navigator	Toggles display of Tank Navigator.
Control Panel	Toggles display of Control Panel.

Control Panel Menu

Track Recording	Animates plots with tracked data (that is, the data most recently acquired to the tank) while acquisition is ongoing.
Refresh Plot	If Auto Refresh Plot is toggled off, this command will refresh the plots, applying any changes in the filters or data selection.
Auto Refresh Plot	Toggles on/off automatic plot refreshing after each change to filters or data selection.
Auto Plot New Block	In track mode, when a new block starts automatically adjust the plots to read from the new block
Add New Control	Opens a Control Configuration dialog box so that a new control can be added. This method requires the user to create filters manually. The preferred method is to drag an event to the control panel.
Add XY Axis Control	Opens the XYAxis Configuration Control dialog box allowing users to create an XY matrix based on a single event.

Preferences Menu

Dynamic Add Trace	When toggled on, plot displays will dynamically update whenever a query is in progress. When disabled, any trace plots will not update until the query has been fully computed. This option is useful for large datasets in which access time for a query is important.
Respect Offset Epoch	When this is toggled on and an Adjust Epoch control is added, the duration of the Epoch will define the time axis of any plots. That is, data that falls outside the duration of the offset epoch will not be plotted.
Processor Usage	Allows the user to determine how the display refresh is prioritized. Choices are high, normal, and low.

Toolbar

	New	Opens a new OpenExplorer file.
	Open	Opens the Open dialog box so that an existing OpenExplorer file can be opened.
	Save	Saves the current OpenExplorer (*.xpr) file with the current name. If the file has not previously been saved the Save As dialog box opens so that the file can be named.
	Refresh	If Auto Refresh Plot is toggled off, this command will refresh the plots, applying any changes in the filters or data selection.
	Stop	If in Track Mode, Stop turns tracking off.
	Track	Animates plots using the most recently acquired data as it is being acquired.
	Clear All	Deletes all plots, controls, and filters. Also clears the data selection.

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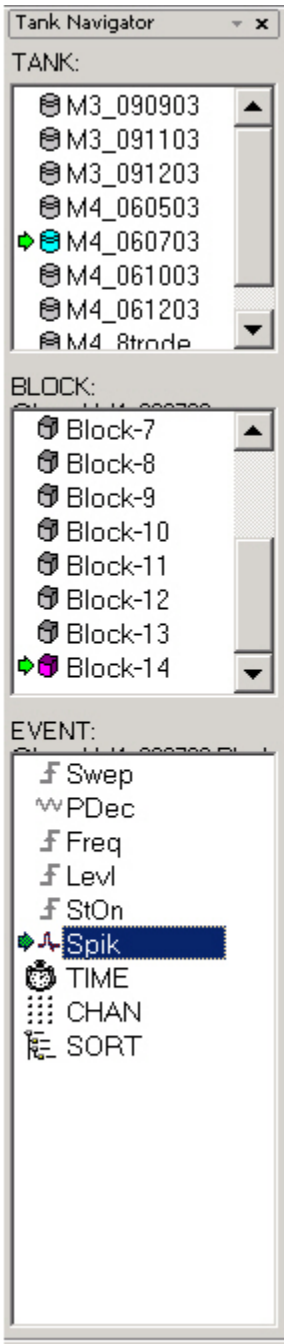
Selecting Data

Before data can be plotted, the tank and block containing the data must be selected using the Tank Navigator window. The window is divided into three interdependent areas: TANK, BLOCK, and EVENT. Clicking an object in any area selects the objects and updates dependent areas.

Dragging Events



The Event list allows the user to configure the plots and filters quickly and easily.

There are three ways that events can be used:

- Dragging an event to the plot area generates a plot using that event data.
- Dragging an Epoch, Channel, or Sort event to the XY Control in the Control Panel defines a plot axis and allows the user to filter data based on that event.
- Dragging an Epoch or Standard event to an empty area of the Control Panel generates a new filter that will be applied to the data being plotted.

When an event is dropped into a plot or control, OpenExplorer automatically launches the appropriate configuration dialogs.

Dragging New Data to the Plot Area

After a plot has been configured, users can select the tank and block in the Tank Navigator then drag the block to the plot to view new data using the existing plot. Keep in mind that the selected tank and block must include the events used to generate and configure the plot and filters.

By default, all controls are configured to automatically synchronize with the plotted data set. This means that when new data is dragged to the plot, the control values (including x and y axes) will automatically be updated to reflect the values available in the new data set.

For example:

A filter is created using the event Levl and the values for Levl are 2, 3, and 4 in the current data set. New data is dragged to the plot. The new data includes the event Levl but the values for Levl are 3, 4, and 5. If the control is synchronized to the plot, the filter values are automatically changed from 2, 3, and 4 to 3, 4, and 5.

Event Types

The EVENTS list in the Tank Navigator includes standard events and user defined events.

Standard Events

The list will always include three standard events, TIME, CHAN, and SORT. These events are automatically included in every block.

 TIME: timestamp

 CHAN: acquisition channel number

 SORT: sort code (if sort code is not assigned this value is set to 0)

If a sortID has been previously generated in OpenSorter, you may use it as a filter control. See *Adding a SortID Filter* for more information, page 72.

These events cannot be plotted. Dragging them to the plot area will generate an error message. The TIME event cannot be used for the x or y axis.

Stores (User Defined)

The remaining events are events that were defined as Stores in the OpenWorkbench acquisition configuration.

Possible event types include:

 Snippets

 Data Streams

 Scalars (Not an Epoch/Strobed Event)

 Scalar (Epoch)

All Store events can be plotted but only Epoch or Standard events can be used to create filters.

Creating Plots

About Plotting

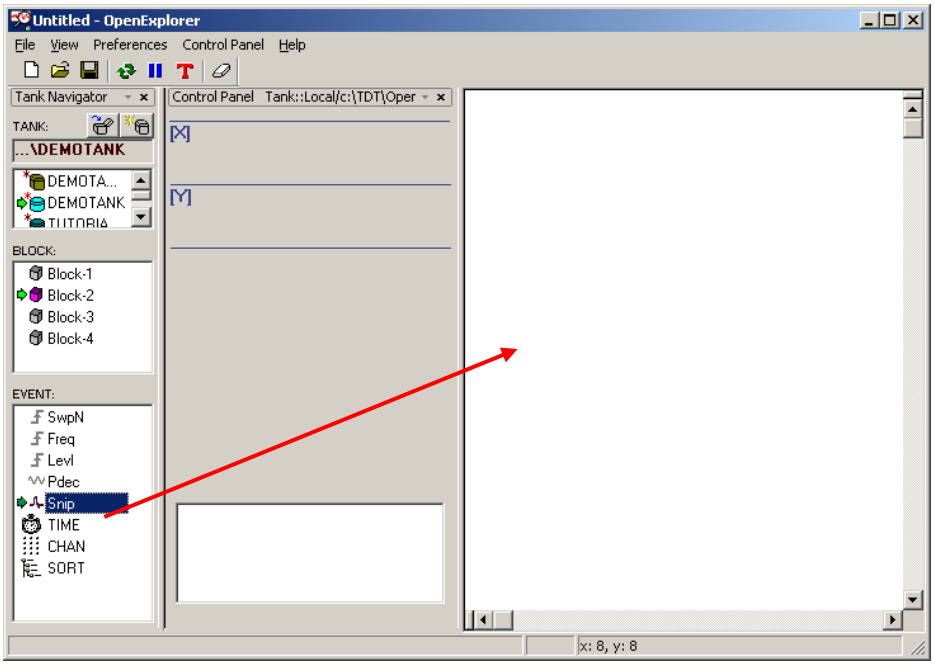
OpenExplorer plots display the selected tank data after user-defined filters have been applied. Because filters can be applied and modified dynamically using TTank's powerful data sorting algorithms, OpenExplorer plots allow for dynamic analysis of stored data. When analysis is complete the plot can also be used to export data subsets or images.

Creating a Plot

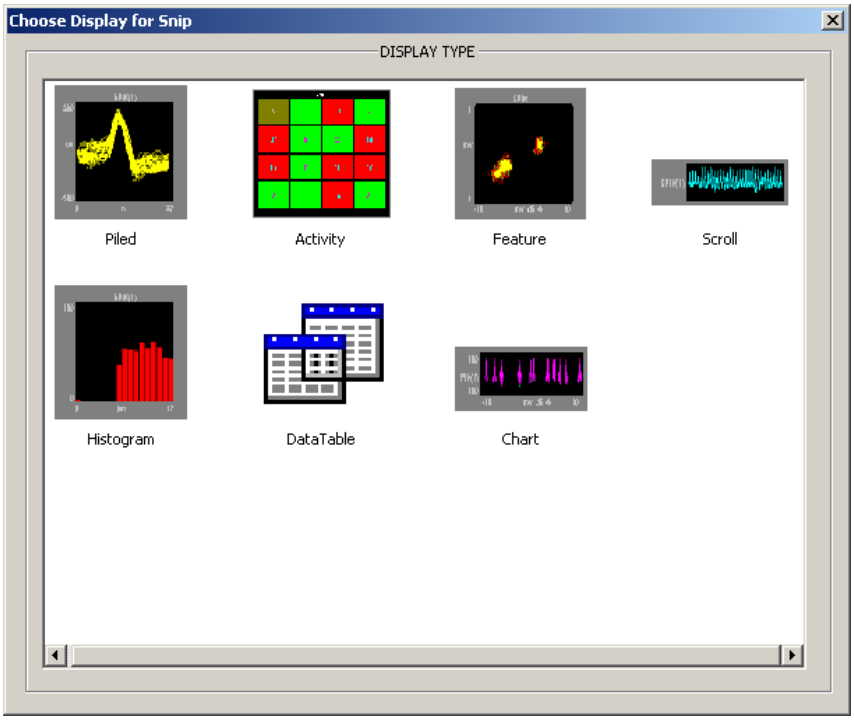
Before a plot can be created the data must be selected using the Tank Navigator.

To create a plot:

1. Drag the desired event to the plot area.



2. A window will open allowing you to select the desired plot type.



Only plot types that are valid for the data will be displayed.

3. The plot will be generated using default values for properties such as appearance and behavior. If a property (such as reference epoch) must be defined before the plot can be displayed, the setup properties dialog box will open automatically.

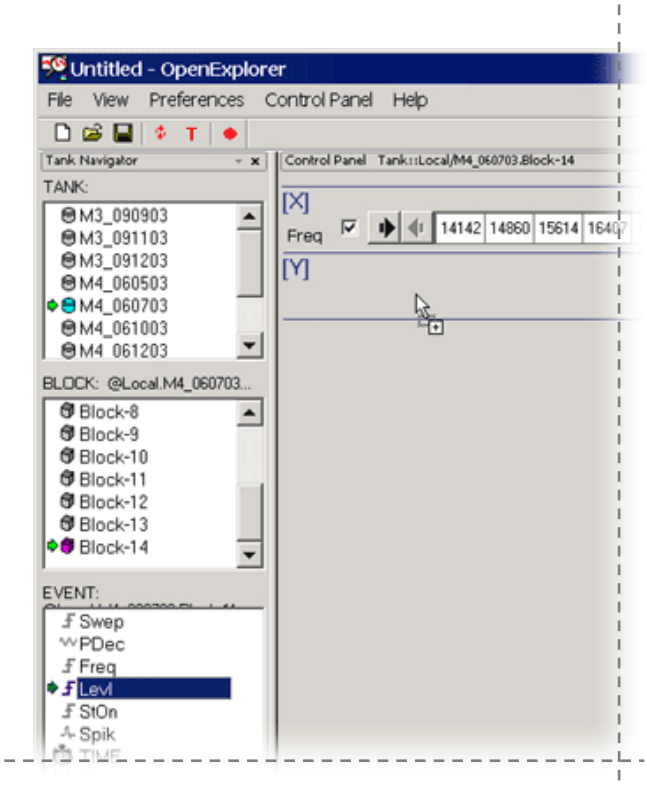
Note: all data will be plotted in a single cell until the X and Y axes are configured.

Configuring the X and Y Axes

The XY Axis control is a special type of filter that is always included in the Control Panel; however, users must configure this control by assigning a standard or stored scalar event for each axis.

To define the x or y axis:

1. Drag the desired event to the [X] or [Y] bar in the Control Panel.



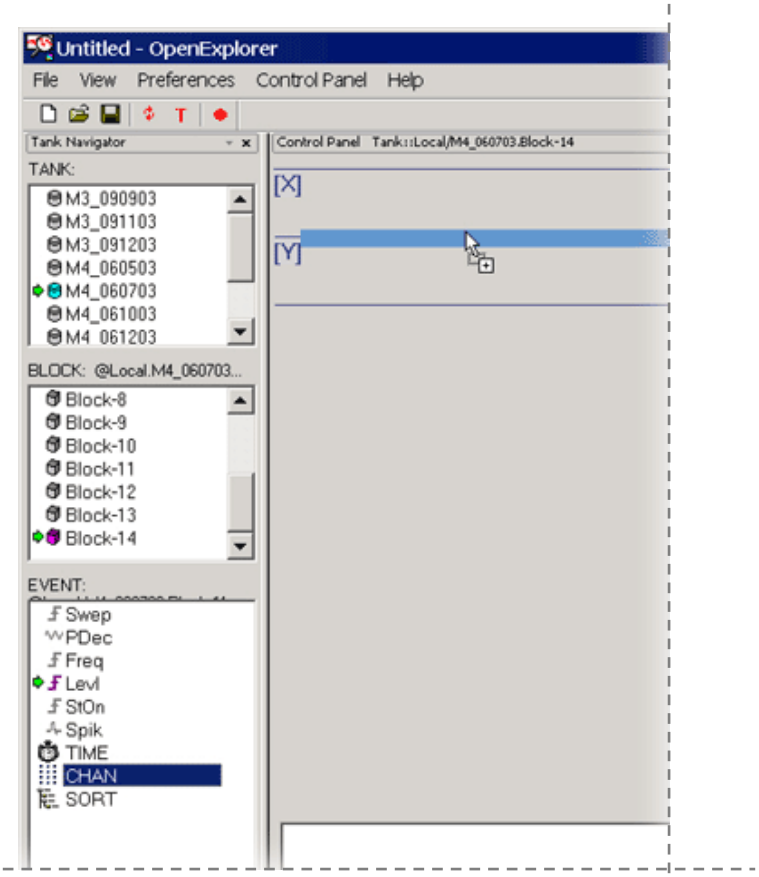
2. A configuration window is opened. In the Control Configuration window, you can modify settings such as the display precision, text label, and values to be included. To learn more about the configuration options see *Using the Control Configuration Dialog Box*, page 81.
3. Click **OK**.

Using the X and Y Axes to Filter Data

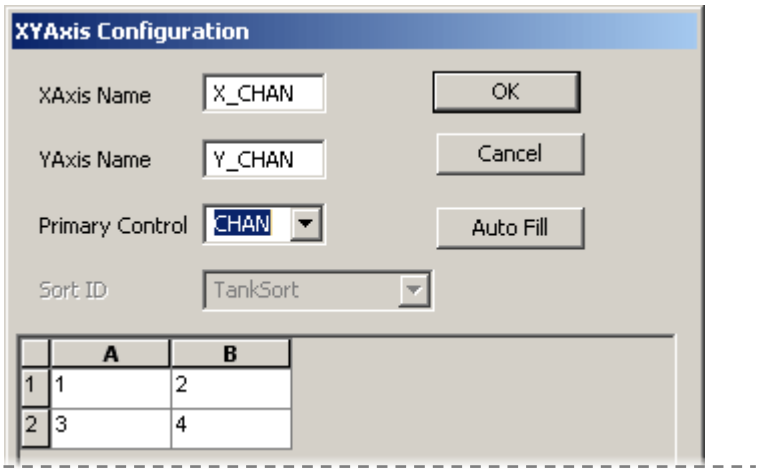
The XY Axis control is automatically configured as a multi-select filter. This gives the user a great deal of control over exactly what data is displayed. Using the control, users can select specific values to include or exclude in the XY Axis configuration, view a specific range of values, group values in linear or logarithmic bins, or create custom groupings using logical operators in text based filters. **Always keep in mind that the multi-select control type is limited to 100 selections. If the desired event includes more than 100 values, by default, the first 100 values will be used.**

Creating the XY Grid Using a Single Event

A single event can be split across the x and y axes. CHAN, for example, is a standard event that stores the acquisition channel number associated with each event in the tank. Chan can be split across the x and y axes to represent electrode array geometry. This can be accomplished by dragging the event to the border between [X] and [Y] or using the Add XY Axis Control command on the Control Panel menu.

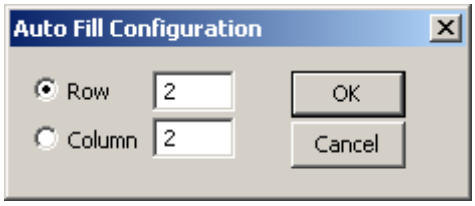


The XY Axis Configuration dialog box provides additional control over the arrangement of values. In the XY Axis Configuration dialog box you can type a label for the x and y axes and select the event from the Primary drop-down menu. A spreadsheet-like grid is automatically generated based on the selected event. The cell values can be edited by typing directly in the cells, however, no error checking is provided. The user must ensure that a valid value is entered.



Note: this dialog box is available from the Add XY Control command on the Control Panel menu.

The grid geometry can be changed in the Auto Fill Configuration, which is available from the Auto Fill button.



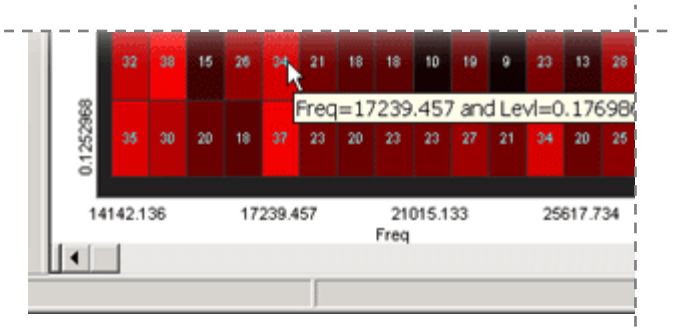
To change the number of rows or columns, type the new value in the corresponding box and click **OK**.

Working with Plots

The plot area allows the researcher to visualize trends and relationships in a data set by displaying the selected data in a user specified plot type. The plot area provides flexible display tools and a variety of customization options to meet the researcher's needs. Users can modify the properties of the current plot, divide the plot area to view the data using multiple plot types, or even launch new windows to examine the data in a particular cell more closely. This level of customization provides the researcher with a flexible canvas for data exploration and display.

The Display Area

The data set and any filters applied are displayed along the top edge of the plot area and responses are grouped into cells according to the user defined x and y axes. The exact x and y values for a particular cell are displayed when the user hovers the pointer over the cell. Most plot types also support the use of a cursor within a cell.



Plot Scaling

Plots can be scaled manually or using an auto scale feature.

- To scale a plot manually, hold down the shift key and drag the pointer up or down to adjust the plot scale.

There are three auto scale settings:

None: auto scale is turned off.

Active: the scale of the plot is automatically adjusted to ensure all values can be shown on the plot

Smart: the scale of the plot is automatically adjusted to ensure values can be shown on the plot only during the first 3 seconds.

These settings are available in the plot setup properties dialog box (see below). The default setting varies across plot types.

Modifying Plots Properties

Many aspects of the plot's appearance, such as axis labels, fonts, plot line width, margins, and colors are part of the plot's setup properties.

- To modify a plot's properties, double-click the plot area.

This opens the setup properties dialog box, which contains all of the customizable settings for a selected plot.

Reversing the Axis

After a plot has been configured with the desired data and filtering properties, users can change the order (ascending or descending) of values along the x or y axis.

- To reverse the order of values, right-click the plot and select **X Axis Reversed** or **Y Axis Reversed** on the shortcut menu.

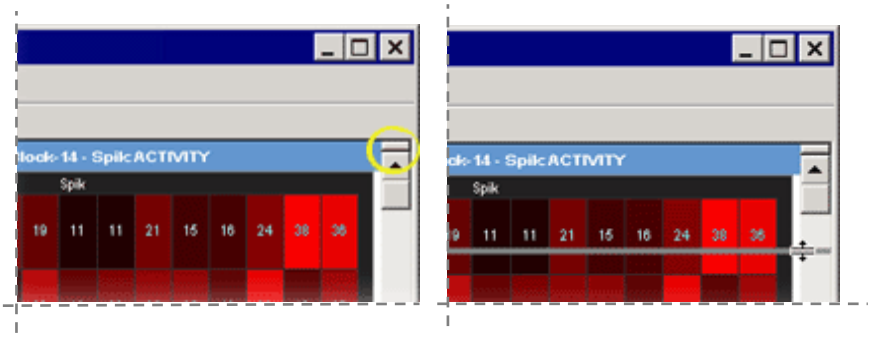
Changing Plot Types Dynamically

After a plot has been configured with the desired data and filtering properties, users can change the plot type quickly and easily.

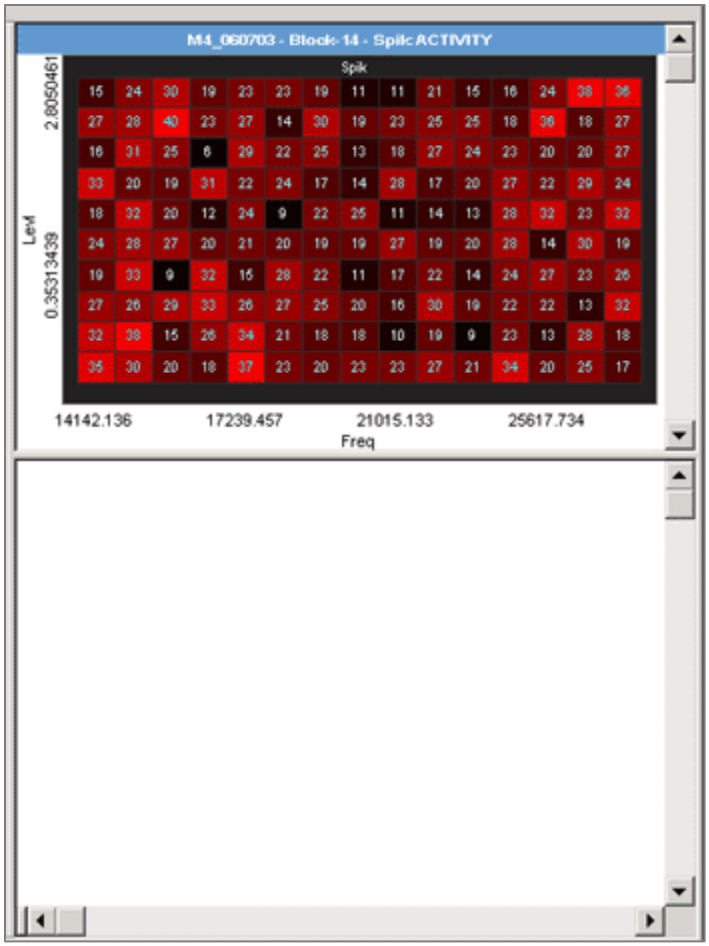
- To change the plot type, right-click the plot and select a new plot type from the shortcut menu.

Subdividing the Plot Area

OpenExplorer is not limited to displaying a single data plot. Users who want to view the same data in several different types of plots at the same time or view several different data events plotted at the same time can subdivide the plot area. The plot area can be divided by dragging the small pane divider bars found at the top right or bottom left corners.



Users can drag a data event from the event list to fill the newly created plot area. **While the event and plot type can be different in each plot area, the x and y axes selections and all filters are applied to all plots.**



Plot Types

OpenExplorer includes eight customizable plot types:

Note: not all plot types can be used with all types of data.

Activity

Activity plots are used to view the amount of spike (or other) activity occurring. Activity plots make it easy to view spike counts or to compare spike rates between acquisition channels. Users can define the minimum and maximum value to be displayed and assign a color to minimum and maximum. As the plot is animated the color of an activity cell varies in intensity across a range corresponding to the minimum and maximum defined values.

Piled

Pile plots are designed to visualize small data buffers (<500) for quick recognition of differences in waveform properties. Pile plots are commonly used when extracellular recordings from neurons are examined to separate out single-unit activity. Users can use pile plots to view time stamped buffers, called snippets, or synchronized buffers. Waveforms are layered over one another and centered along the x-axis. As the buffers pile up, differences in the shape of the waveforms can easily be distinguished.

Histogram

Histograms use time stamped values from a variety of data stores for graphic presentation. The most common of these are snippets, but lists and even scalars can be included as long as a time stamp is part of the acquired value. Users can set up the bin size (size of time divisions for sorting the time stamps) and the parameters for refreshing the plot.

XY

XY plots provide a useful means of looking at changes in two continuously varying values. The y-axis and the x-axis, within each cell of the larger plot, are selected from available data events. The XY plot can be used to plot positional information such as XY coordinates for an animal moving in a tank or it can be used to plot data from an eye or head tracker.

Feature

Feature plots compare two waveform properties, such as the first and second peak voltages of two candidate spikes. They are ideal for determining how many unique waveforms are present in a signal. X-axis and y-axis features can be selected from a drop down list in the setup properties dialog box.

In OpenExplorer the feature plot has been designed for examining patterns of spike waveforms. The plot works best when viewing snippet data. Although other waveforms can be viewed, plotting complex waveforms with many points will require intensive amounts of computer time.

Scroll

Scroll plots provide a useful means of looking at continuous data. Data is presented in segments called scrolls. Looking at one scroll after another gives an effect similar to an oscilloscope or EKG. Within each scroll plot cell the y-axis is voltage and the X-axis is the record size.

Chart

Chart plots are an excellent way of graphing time stamped waveform data such as spike snippets. The chart plot shows the snippet waveform and its exact position in the block of data. Within each cell the y-axis is voltage and the x-axis is time in seconds. When the scale of the x-axis is contracted, the position of a snippet along the x-axis clearly identifies when in time the snippets occurred and patterns of occurrence over time are emphasized. As the scale of the x-axis is expanded, the shape of the waveform becomes more visible.

Data Table

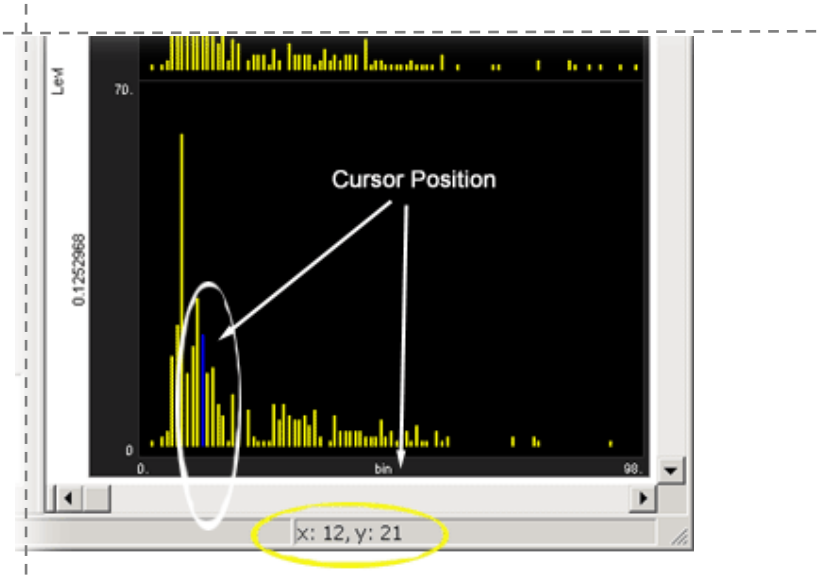
The Data Table displays data in a tabular format and provides a variety of tools and export features unique to this plot type. Data can be cut and pasted to other applications, exported in a text format, or further filtered. The Data Table also provides Find and Mark features to make it easier to work with large data sets in this format.

Exploring a Cell

An OpenExplorer plot is generated by creating a cell for each X and Y value along the axes. In an activity plot each cell contains a simple count of spikes for that XY coordinate. Other plot types display, in effect, a plot within a plot. When the histogram plot type is selected, for example, each cell contains a histogram of the values at that XY coordinate. The number of cells depends upon the number of X and Y values. Whether your plot contains a single cell or many cells, OpenExplorer enables you to further explore the data in each cell.

Using a Cursor

Within a cell, a cursor can be implemented by holding down the control key and moving the pointer across the waveform or histogram. The X and Y coordinates will be displayed in the status bar along the bottom edge of the OpenExplorer window.



Opening a Cell in a New Window

When a multi-cellular plot contains many cells the individual cells become too small to give anything but an overview of the response over the stimulus set. To view the data in each cell in more detail, users can plot the contents of an individual cell in a new window. Multiple new windows can be opened. This allows you to compare a single cell using multiple plot types or to compare multiple cells. Each window is labeled with data source and filtering information.

To open a cell in a new window:

- Right-click the cell and click **View cell picture in a new window** on the shortcut menu.

Viewing a Different Cell in the New Window

The new window will display data from the currently selected cell. The plot type in the new window can be changed from a shortcut (right-click) menu.

To explore the data in a different cell:

- Click the new cell in the main plot. The new window will be updated with the data from the newly selected cell.

Note: changes to the main plot, such as new or different filters, are not reflected in the new window. To update the window, click the cell again.

Freezing a Cell Window

To lock the new window to the current data:

- Right-click the new window and click **Freeze plot** on the shortcut menu.

The new window will be frozen or latched to the current data. Clicking a new cell will have no effect.

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Dynamic Filtering and Analysis

About Filtering

OpenExplorer's feature rich, interactive Control Panel makes it possible to explore the relationships between recorded data, stimulus parameters, and other defined events dynamically. Stored variable events are selected from the Tank Navigator then added to the Control Panel to configure the x and y axes and implement data filters. The Control Panel taps into the powerful data sorting capabilities provided by the TTank data server, allowing users to sort through complex data sets quickly.

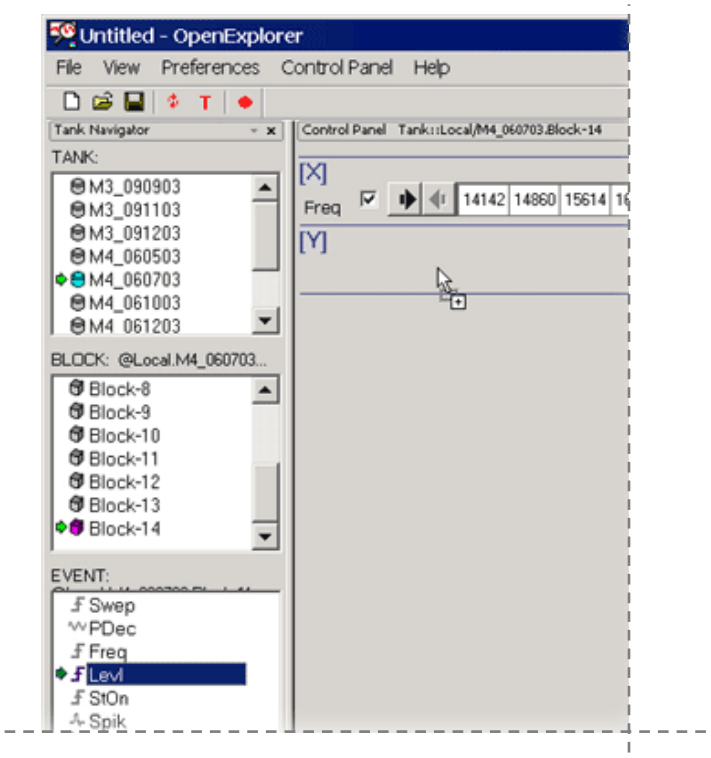
Note: before configuring the x and y axes or implementing filters, the data event to be plotted should be defined. See *Creating a Plot*, page 55.

Configuring the X and Y Axes

The XY Axis control is a special type of filter that is always included in the Control Panel; however, users must configure this control by assigning a standard or stored scalar event for each axis.

To define the x or y axis:

1. Drag the desired event to the [X] or [Y] bar in the Control Panel.



2. A configuration window is opened. In the Control Configuration window, you can modify settings such as the display precision, text label, and values to be included. To

learn more about the configuration options see *Using the Control Configuration Dialog Box*, page 81.

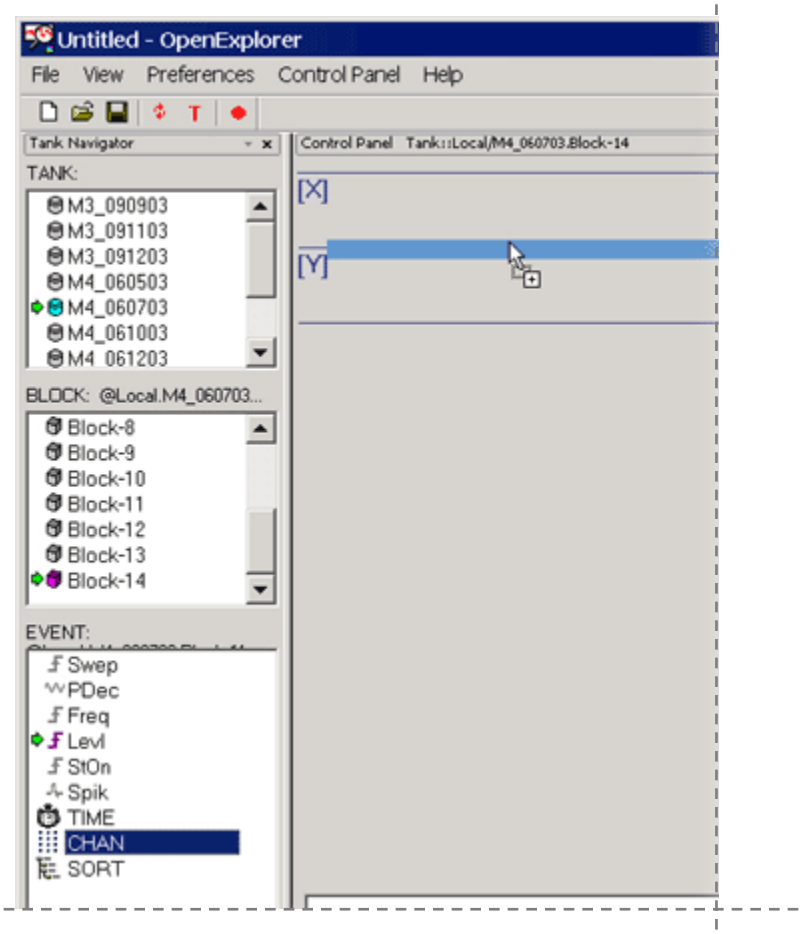
3. Click **OK**.

Using the X and Y Axes to Filter Data

The XY Axis control is automatically configured as a multi-select filter. This gives the user a great deal of control over exactly what data is displayed. Using the control, users can select specific values to include or exclude in the XY Axis configuration, view a specific range of values, group values in linear or logarithmic bins, or create custom groupings using logical operators in text based filters. **Always keep in mind that the multi-select control type is limited to 100 selections. If the desired event includes more than 100 values, by default, the first 100 values will be used.**

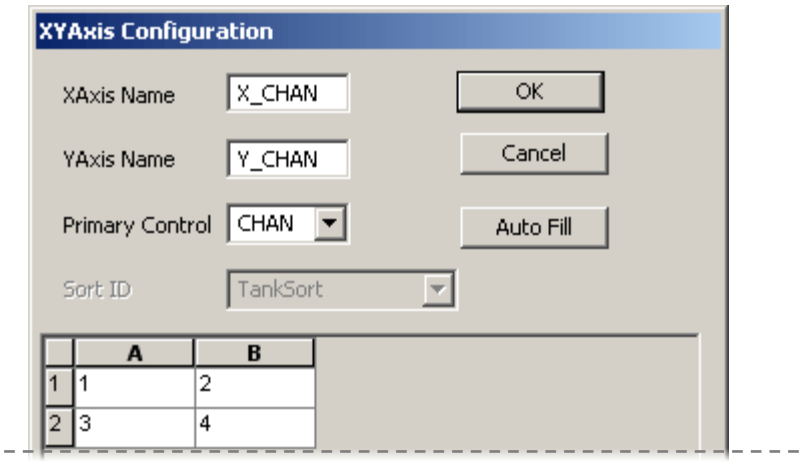
Creating the XY Grid Using a Single Event

A single event can be split across the x and y axes. CHAN, for example, is a standard event that stores the acquisition channel number associated with each event in the tank. Chan can be split across the x and y axes to represent electrode array geometry. This can be accomplished by dragging the event to the border between [X] and [Y] or using the Add XY Axis Control command on the Control Panel menu.



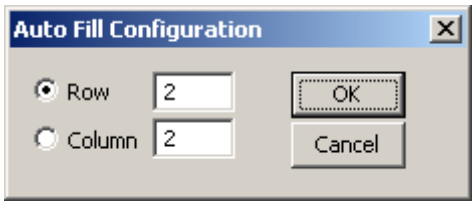
The XY Axis Configuration dialog box provides additional control over the arrangement of values. In the XY Axis Configuration dialog box you can type a label for the x and y axes and select the event from the Primary drop-down menu. A spreadsheet-like grid is automatically

generated based on the selected event. The cell values can be edited by typing directly in the cells, however, no error checking is provided. The user must ensure that a valid value is entered.



Note: this dialog box is available from the Add XY Control command on the Control Panel menu.

The grid geometry can be changed in the Auto Fill Configuration, which is available from the Auto Fill button.



To change the number of rows or columns:

- Type the new value in the corresponding box and click **OK**.

Adding Filters

OpenExplorer makes it easy to create complex filtering quickly and dynamically. Filter controls can be added by dragging an event from the Event list to the Control Panel. Each new filter is added (AND logic) to the existing filters. Filter information is displayed below the plot title in the plot area.

To add a filter:

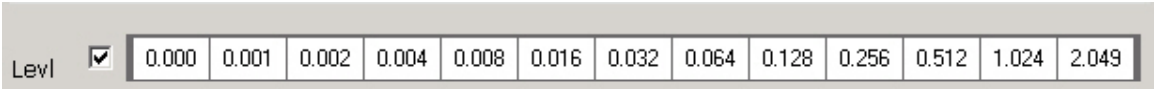
1. Drag the desired event to the Control Panel.
2. In the Control Configuration window, you can modify settings such as the control type and values to be included. Begin by selecting one of four possible control types:
   - Multi Select Filters
   - Step Slider Filters
   - Continuous Filters

- Adjust Epoch Filters.

3. Next, modify the configuration settings as needed. To learn more about the configuration options see *Using the Control Configuration Dialog Box*, page 81.
4. Click **OK**.

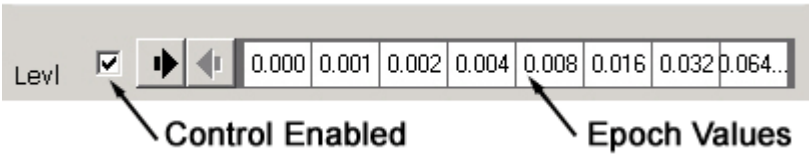
After a filter control has been created, a shortcut (right-click) menu is available with options to delete or configure (modify) the control.

Multi Select Filters



The multi-select option allows users to add controls in the form of a sorted list of values. For example, when a stimulus frequency epoch event is added as a multi-select control it appears as sorted selection bar with each selection box representing a stimulus frequency value. When the default control configuration is used each value is represented by a single block (up to 100 selections) and the user can select or exclude individual values in this list. Excluding a value will result in the elimination of the events that occurred at that epoch value from the plot. The user can also define the filter in more detail in the Control Configuration dialog box. This achieves additional and highly specific filtering.

The Control Configuration opens automatically when a control is added. It can be reopened from a shortcut (right-click) menu. This menu can also be used to enable/disable, or remove a control. The control can also be enabled or disabled using the check box to the left of the control selection bar.

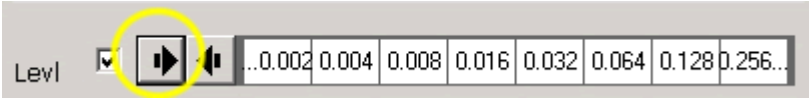


The XY Axis Control

The XY Axis Control is a special control that comprises two multi select filters. When dragging events, keep in mind that the Multi Select filter is limited to 100 selections. This means that the plot axis will be configured to display only the first 100 values when the default configuration settings (one value per selection box) are used. Users can select a different range of values or change the bin size (values represented by each selection box) to ensure that all desired values are included in the plot.

Viewing the Values

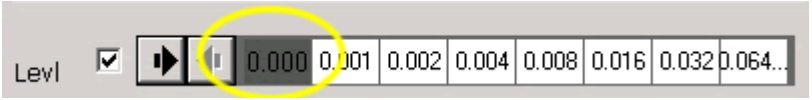
The Control Panel is a sub-window that can be resized to by the user. The controls in the Control Panel are automatically resized to fit the available space. If there are more selection values that can be displayed scrolling arrows are added to the control to allow the user to scroll right or left along the selection bar.



The Control Configuration dialog box enables the user to modify the control label, set selection box label precision, or display value units (such as K, M, p ...).

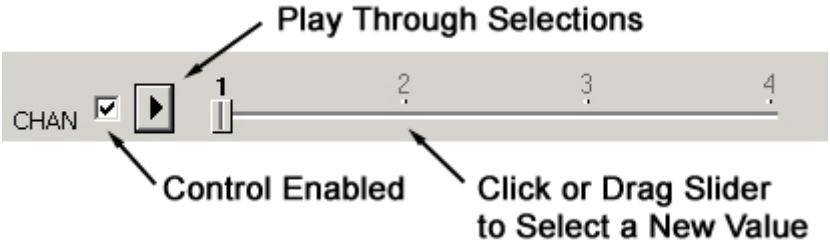
Filtering Values Using the Selection Bar

To remove responses for a particular value from the plot display, click the corresponding value on the selection bar. Multiple values can be selected for filtering. Values that have been removed are darkened to indicate that they are no longer displayed with the data.



Step Slider Filters

The step-slide option allows the user to add controls in the form of a sorted list of values. The values are arranged on a slider, which can be stepped through one by one, either manually or automatically via a Play button. This is especially useful for viewing the data at single values of the event. Although, it could be used to view the response of a cell at every value of, say frequency, it is frequently used to view the data on each channel. It could also be used to view the response of each individual unit by adding the slider control using the sort code event. The user can also define the filter in more detail or change animation settings (such as animation speed or looping) in the Control Configuration dialog box. The Control Configuration opens automatically when a control is added. It can be reopened from a shortcut (right-click) menu. This menu can also be used to enable/disable, or remove a control. The control can also be enabled or disabled using the check box to the left of the control selection bar.



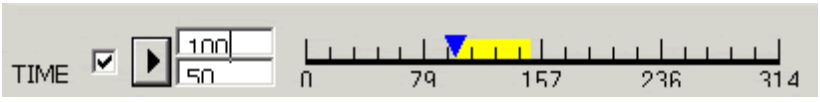
The Step Slider is limited to 100 slider positions. By default, the first 100 values are used. Users can select a different range of values or change the bin size (values represented by each slide position) in the Control Configuration dialog box.

Viewing the Values

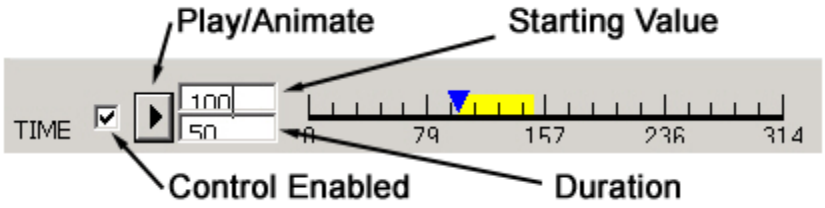
The Control Panel is a sub-window that can be resized to by the user. The controls in the Control Panel are automatically resized to fit the available space. If there are more selection values that can be displayed, scrolling arrows are added to the control to allow the user to scroll right or left along the control bar.

The Control Configuration dialog box enables the user to modify the control label, set selection box label precision, or display value units (such as K, M, p ...).

Continuous Filters

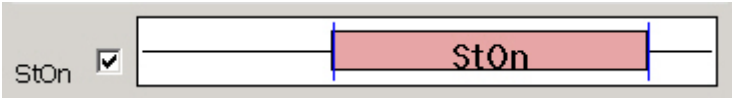


Adding a continuous control results in a continuous scale with all the values (up to 500) of the event in ascending order. The user has control over two values – start and length. A blue arrowhead on the continuous scale represents the start value and the length is denoted by a yellow bar. The starting value can also be specified by clicking the arrowhead and dragging the mouse. The most common use of this type of control is to add Time as a continuous control. Data can be viewed in chunks of time defined by the start and duration values. A play button is also provided to allow viewing the data in successive chunks of time on the continuous timeline. Thus, continuous controls allow the user to play through all values in an animated plot. This is particularly useful when studying the effects of fatigue and boredom on the response of the cell.

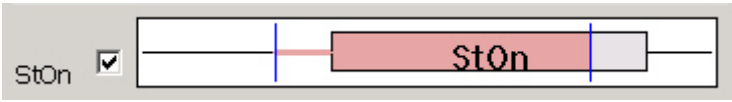


The user can also define the filter in more detail or change animation settings (such as animation speed or looping) in the Control Configuration dialog box. The Control Configuration opens automatically when a control is added. It can be reopened from a shortcut (right-click) menu. This menu can also be used to enable/disable, or remove a control. The control can also be enabled or disabled using the check box to the left of the control bar.

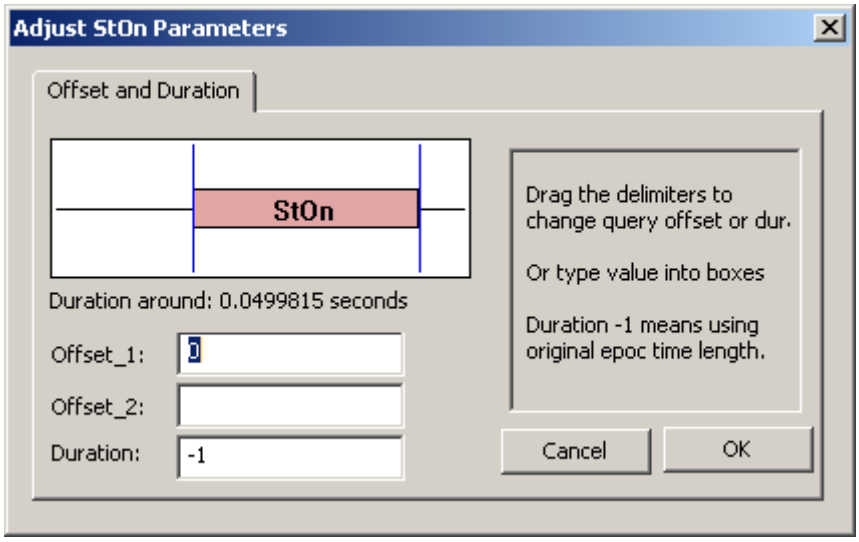
Adjust Epoch Filters



The Adjust Epoch control is used to build a time referenced epoch filter, that is a filter based on (a) offset from the onset of the epoch and (b) duration. On creating this type of control, you will see the epoch event in the control area with two vertical bars that can be moved along the horizontal axis. The vertical bars can be dragged manually to specify offset and duration values. When this filter is enabled, only those values or data that fall within the bounds of this filter will be displayed. This feature is useful when you need to view data with respect to a certain event, such as stimulus. It is particularly useful for viewing pre, peri, or post-stimulus histograms.



A shortcut (right-click) menu can be used to enable/disable, or remove a control. The control can also be enabled or disabled using the check box to the left of the control bar. The Adjust Epoch control can only be selected when the event is initially dragged to the control panel. After it has been added, the standard Control Configuration dialog box is no longer available. Double-clicking the epoch will result in a window where you can specify the offset and the duration precisely.



Changing the Bin Size

In OpenExplorer Bin Size is closely tied to the Auto Fill feature for control configuration. The Auto Fill feature provides several options for setting bin size or users can choose to turn Auto Fill off and create bins manually in the control configuration spreadsheet. Bin size can be set when the control is added or modified later.

To set the bin size:

1. Open the Control Configuration Dialog either by dragging an Event to the Control Panel or by double-clicking an existing control.
2. Click the **Auto Fill Options** button.

   The Auto Fill Options dialog box opens, allowing you to determine how the control configuration spreadsheet will be filled.

   a. If desired, set a range in the Data Source area of the dialog to change the range of values used to fill the spreadsheet.

   b. Select an Auto Fill Method:

      Note: each method can only create a number of bins equal to or less than the maximum number of values supported by the control.

      i. None. - This will allow you to edit the filter criteria manually in the control configuration spreadsheet.

      ii. Fill with multiple values. - This will create bins with one value in each bin.

      iii. Fill with linear bins. - Define a bin size in the box to the right.

      iv. Fill with logarithmic bins. - Define a bin size in the box to the right.

   c. Click **OK**, to close the Auto Fill Options.
3. Click **OK**, to close the Control Configuration dialog.

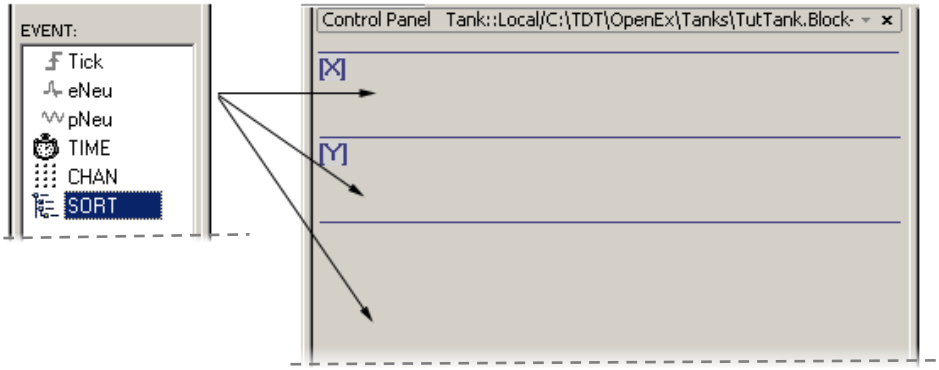
Adding Sort Code Filters

OpenExplorer provides an Event labeled SORT which can be used to create a sort code filter control. Sort code filters may be initialized using a SortID (a set of sort codes that are defined for a block of data) or customized by manually entering a specified range of sort code values.

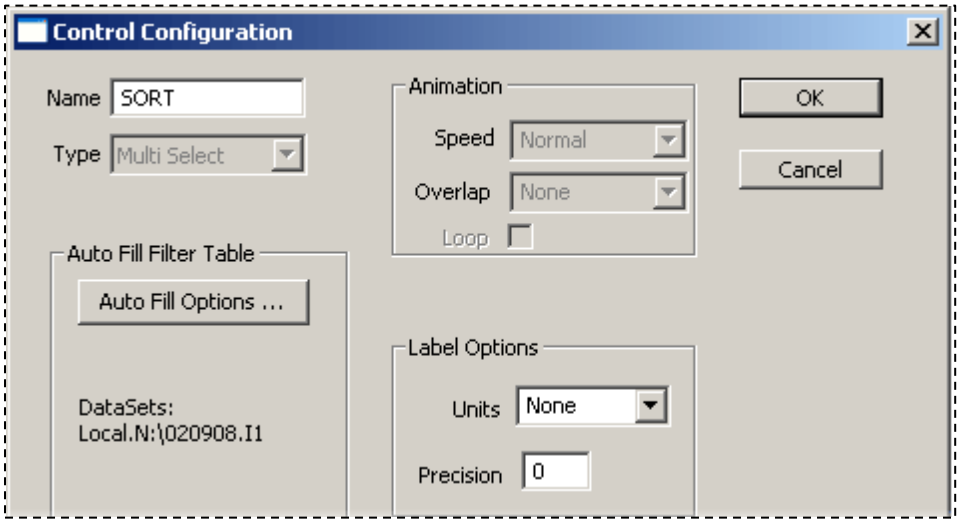
For all data sets, sort codes assigned during acquisition (online) are saved to the default SortID, TankSort. Sort codes can also be assigned offline using OpenSorter and saved to user defined SortIDs. Data sets can be sorted any number of times, resulting in sort codes stored to multiple SortIDs for each data set.

To create a SortID based Sort Code Filter:

1. Drag the event labeled **SORT** to the Control Panel.

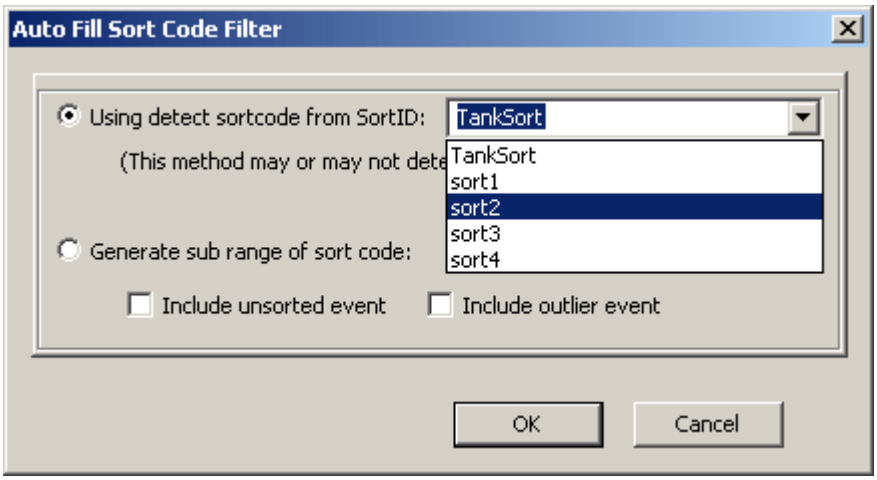


The Control Configuration dialog box is prompted.



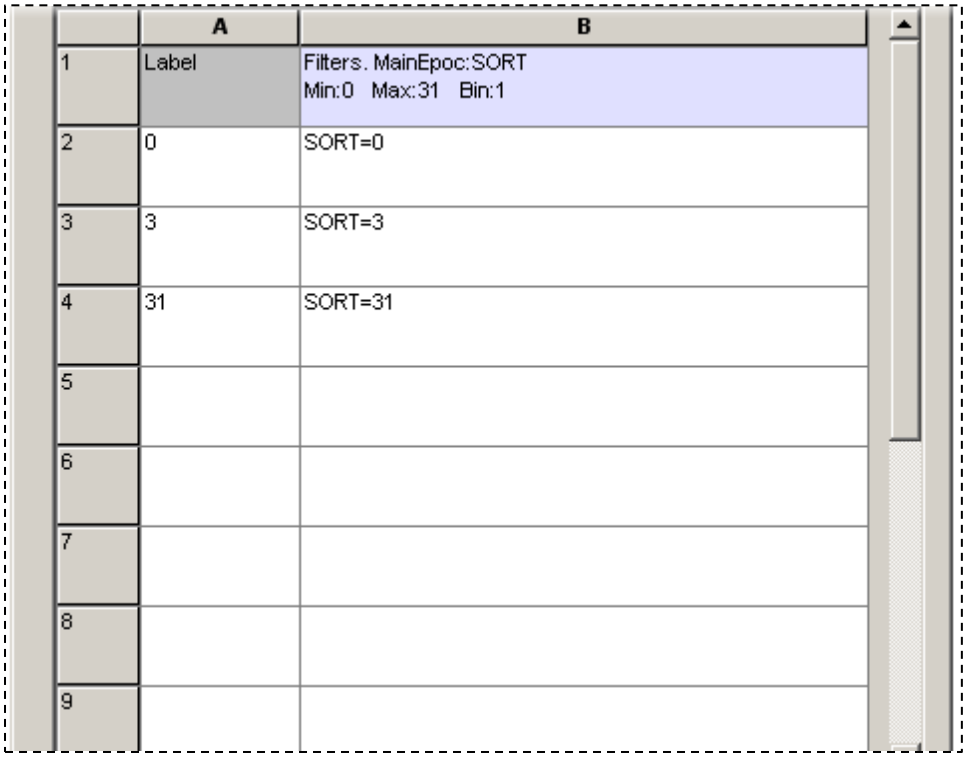
Note: dragging the SORT event to the X or Y axes will enable only the Multi Select control type in the Control Configuration dialog box. Dragging the SORT event below the X or Y axes allows different filter controls to be created such as the Step Slider or Continuous filter types.

2. Click the **Auto Fill Options** button.
3. Click the **Using detect sortcode from SortID** radio button.



Note: OpenExplorer searches through the first 1000 events in the data set for sort codes when a SortID is used to auto fill the sort code range. If your data includes sort codes that appear only after the first 1000 events you can create a custom sort code filter instead.

4. Select the desired SortID from the drop-down menu.
5. Click **OK**.
6. The sort code range is auto filled according to the selected SortID.



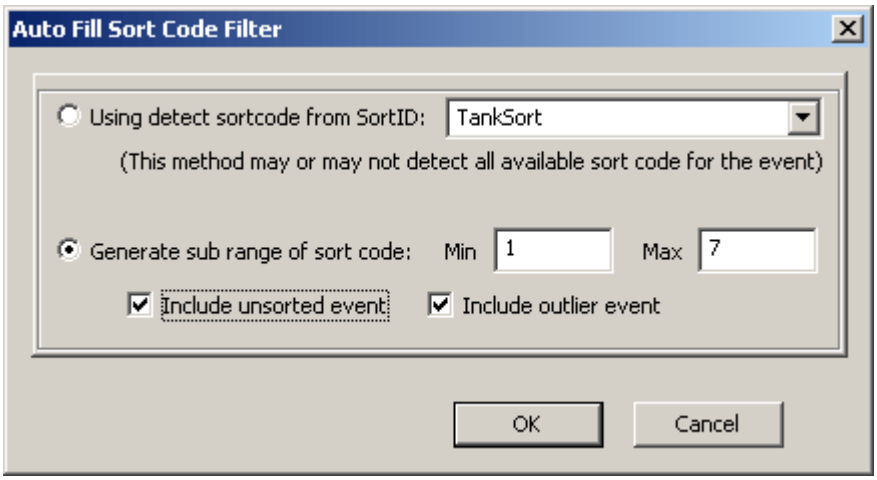
	A	B
1	Label	Filters. MainEpoc:SORT Min:0 Max:31 Bin:1
2	0	SORT=0
3	3	SORT=3
4	31	SORT=31
5		
6		
7		
8		
9		

7. Click **OK** to accept the auto fill options and create the SORT control.

8. The **Generate sub range of sort code** option can also be used to auto fill any sort codes of your choice. This option is useful for large data sets (>1000 events) and can be configured to include any range of sort codes manually.

To create a Custom Sort Code Filter:

1. Drag the event labeled **SORT** to the Control Panel.
2. Click the **Auto Fill Options** button.
3. Click the **Generate sub range of sort code** radio button.



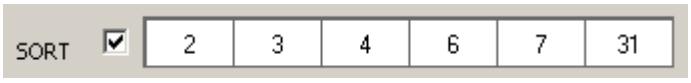
4. Enter the desired range (1 to 30) of sort code values.

   Note: any values entered here may later be removed, so if a unique arrangement of sort codes (e.g. 1, 3, 5, 10) is required select a range that encompasses all the desired values.

   If needed, you may include the reserved sort codes of 0 (unsorted) and 31 (outliers) by checking either of the check boxes available.
5. Click **OK.**
6. The sort code range is auto filled according to the selected range and any selected checkbox options.

	A	B
1	Label	Filters. MainEpoc:SORT Min:0 Max:31 Bin:1
2	0	SORT=0
3	1	SORT=1
4	2	SORT=2
5	3	SORT=3
6	4	SORT=4
7	5	SORT=5
8	6	SORT=6
9	7	SORT=7
10	31	SORT=31

7. Sort codes may be removed by selecting them from the table and pressing the Delete key.
8. Delete any unnecessary sort codes and click OK to accept the auto fill options and create the SORT control.



Using the SORT Control

Once a SORT control is added the sort codes associated with your filter can be enabled/disabled.

A shortcut (right-click) menu can be used to enable/disable, configure, or remove a control. The control can also be enabled or disabled using the check box to the left of the control bar. Each box to the right of the checkbox represents a sort code.

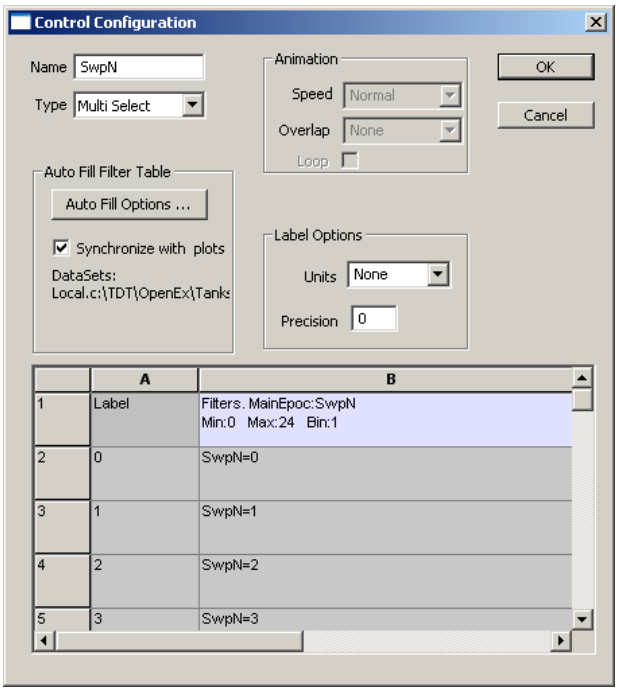
The boxes are used to enable/disable a sort code and will show/hide any snippets that are associated with that sort code. The picture above will filter out any snippets that have a sort code of 0 or 2.

Entering Custom Filters in the Spreadsheet

OpenExplorer Auto Fill options provide several methods for automatically generating filter values. However, users can choose to turn Auto Fill off and create the filter criteria manually in the control configuration spreadsheet.

To create custom filters using the configuration spreadsheet:

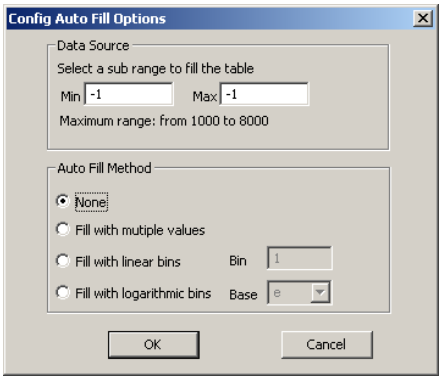
1. Open the Control Configuration Dialog either by dragging an Event to the Control Panel or by double-clicking an existing control.



2. If needed, select the control **Type**.
3. Click the **Auto Fill Options** button.

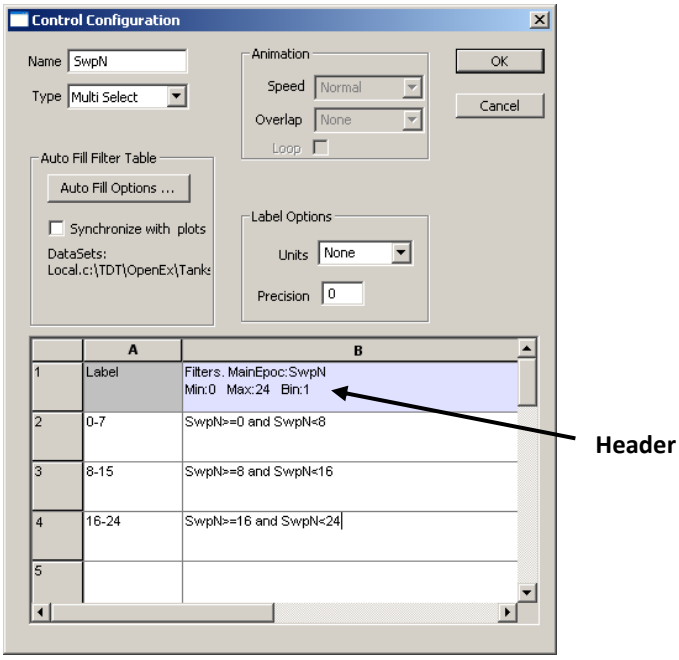
   The Auto Fill Options dialog box opens, allowing you to determine how the control configuration spreadsheet will be filled.

4. Click **None**. This will allow you to edit the filter criteria manually in the control configuration spreadsheet.

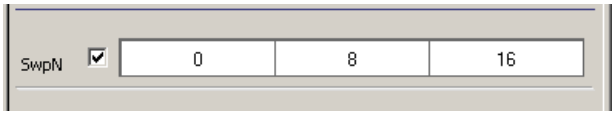


5. Click **OK** to close the Auto Fill Options dialog.
6. Clear the **Synchronize with plots** check box.
7. The editable cells in the spreadsheet will be empty and are colored white. Click in a cell to enter a value (such as *Swep>=0 and Swep<100*)

   The header row contains the epoch name and min/max values for reference.

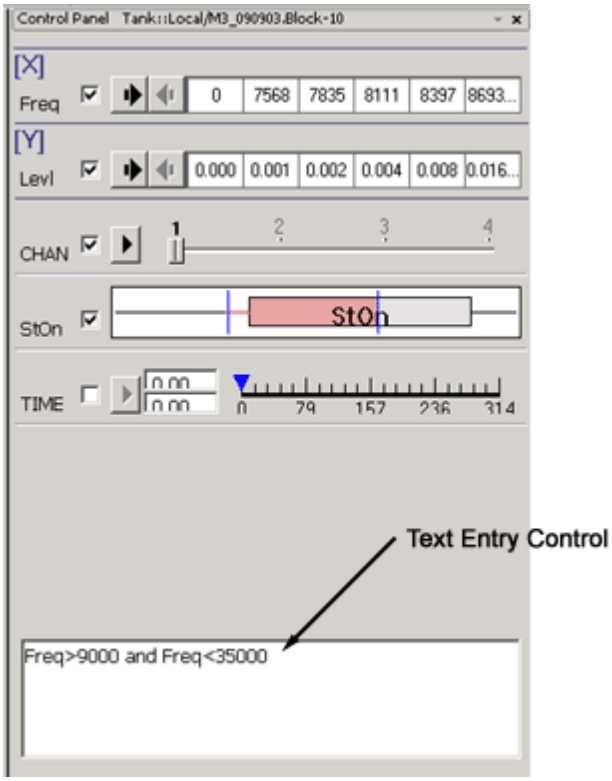


8. After you have entered all of the desired filter criteria, click **OK.**



Adding Filters in the Control Panel Text Box

The control panel text entry box is provided to enable users to quickly apply filters through text entry. This is helpful when a quick arbitrary filter is needed (such as frequencies between 25 kHz and 35 kHz) or when the complex filter logic required can be implemented more quickly using text. The text entry box supports standard logical operators, such as: =, <, >, and, or, not. When text entry is used with controls, the text entry is treated as if it were a control; that is, all logic within the control is completed and the resulting filter is ANDed to other controls.

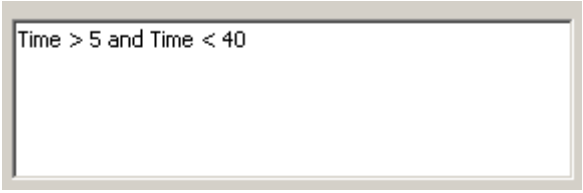


Text Filters in the Data Table

DataTable Query Conditions are provided to enable users to quickly apply filters through text entry. This is helpful when a quick arbitrary filter is needed (such as time Stamp values between 5 and 40) or when the complex filter logic required can be implemented more quickly using text. The Filter Conditions box supports standard logical operators, such as: =, <, >, and, or, not.

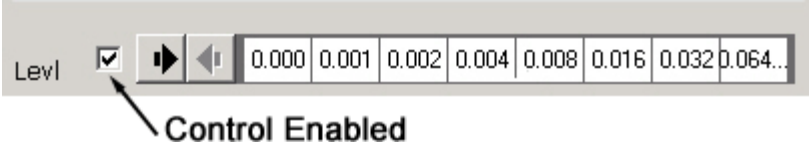
To create a DataTable text filter:

1. Click the **Text Filter Conditions Box** and type the desired conditions.
2. Click **Enter**.



Enabling or Disabling Filters

After filters have been added they can be disabled by clearing the control's check box or using a shortcut (right-click) menu. Clicking the check box again will enable the control.

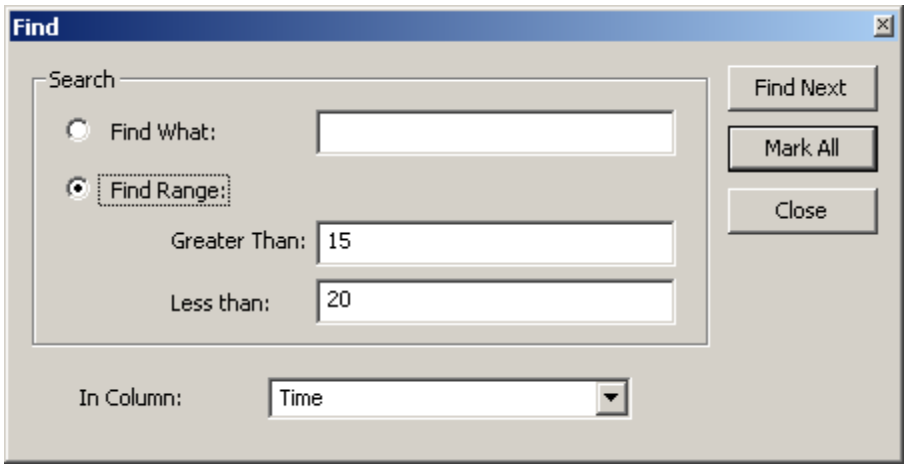


Finding Values in the Data Table

Depending on the filtering implemented and the data gathered, the Data Table might include many values or only a few. When the researcher is interested in a particular value or set of values, the Find feature can be used to quickly find or mark those values of interest.

To open the Find dialog box:

- Click the **Find** icon on the Data Table's toolbar.



Search

Settings in the Search area can be used to define the search criteria.

Find What: Click the radio button and type a value in the text box to define an exact value to match.

Find Range: Click the radio button and type value in the Greater Than and Less Than text boxes to define a range of values to be matched.

In Column

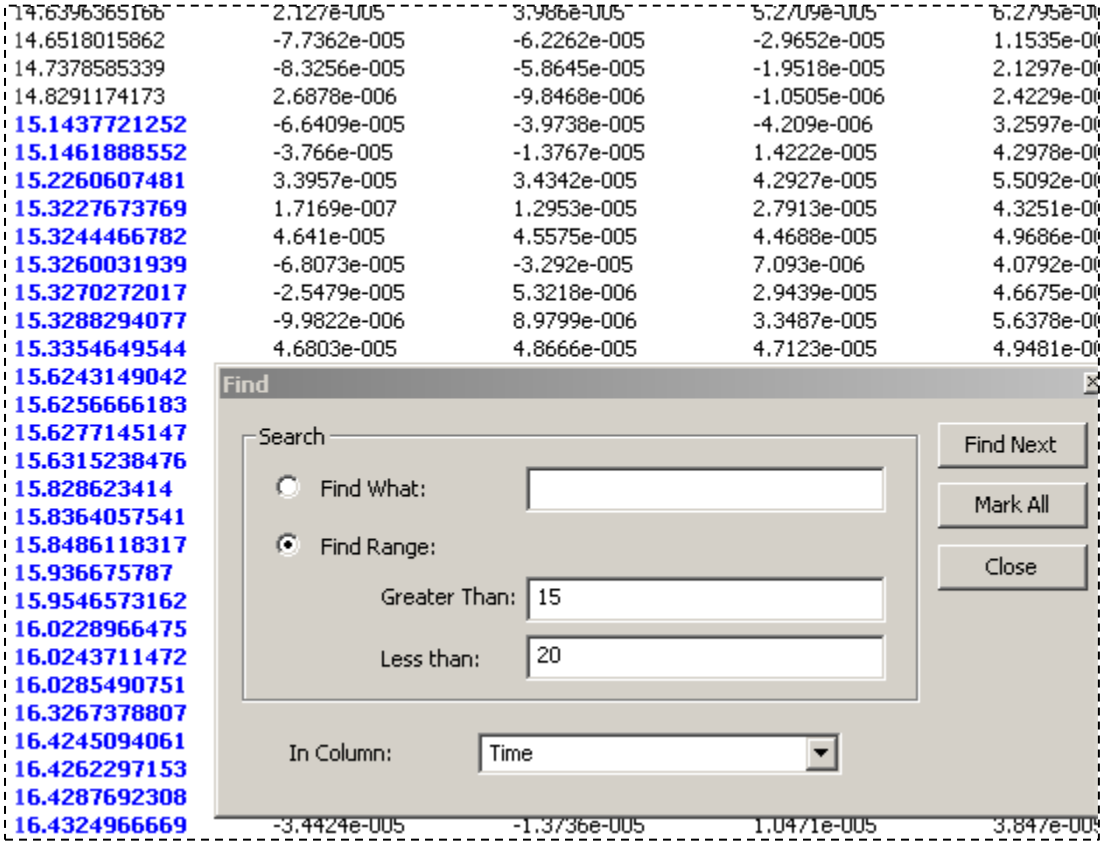
This drop down menu is used to specify a particular column to search. This eliminates potential undesirable matches, such as the inclusion of matches based on ID number when the values of interest are a range of time stamp values. Select a column from the list or select **Any** to find the value(s) in any column.

Find Next

Click the Find Next button to locate the next value that matches your search criteria. This button can be used with a Find What or Find Range search. Each time the button is clicked and a value is found, the value is highlighted. The last found value will continue to be highlighted even after the Find next button is closed. To ensure that you will be able to identify matching values searching through the data, use the Mark All feature.

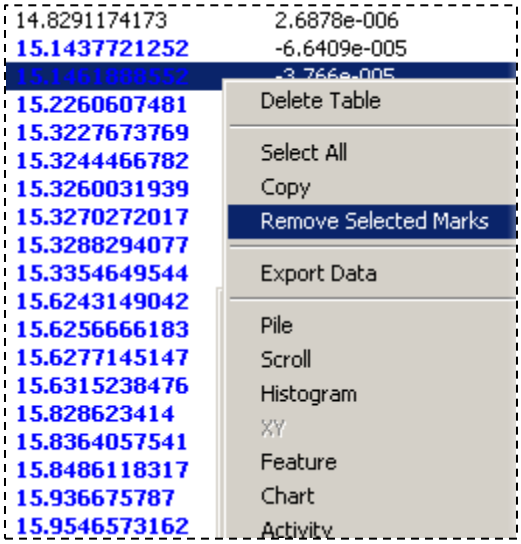
Mark All

Click the Mark All button to mark all values that match the search criteria. These items are marked blue and remain colored until the Mark All button is used again or until the marks are cleared. Mark All can be used with Find What or Find Range.



Clearing the Marks

Marks can be cleared by clicking the **Remove Selected Marks** on the Data Table shortcut (right-click) menu.



Control Configuration Reference

Control Configuration Dialog Box

Name: type a text label for the control. If configuring an x or y axis, this label will also be used on the plot.

Type: select a control type: multi-select, step slider, continuous, or adjust epoch. Adjust epoch is only available when the control is added to the control panel.

Auto Fill Filter Table

Auto Fill Options: launches the Configure Auto Fill Options dialog allowing users to define a range of values and to control how values are filled in the spreadsheet.

Synchronize with plots: configures the control to automatically use whatever values are available for the defined event name in the active data set.

Datasets: displays the current data set including: path, tank, and block name.

Animation

Settings in this group are only available when the continuous or step slider control types are selected. These controls allow the user to view an animated playback of data acquisition.

Speed: select the speed at which data will be animated in the plot: slowest, slower, slow, normal, fast, faster, or fastest.

Overlap: select a percentage of the duration to overlap. For example: if the duration is 100, the initial starting point is 0, and the overlap is set at 10%; then the second segment displayed in the animation sequence will start at 90 (rather than starting at 100 if overlap is set to None).

Loop: select the check box to loop data animation. When all data has been displayed the animation starts over from the beginning.

Label Options

Units: select from common unit labels. This setting does not affect the data. It only affects the appearance of the control, making it easier to read and evaluate the analysis interface.

Precision: type a value to set the number of decimal places to display.

Spreadsheet

Row 1: header information

Rows 2+: filter data

Column a: text label for criteria

Column b: filter criteria

The spreadsheet increases the flexibility of the control configuration. The user can quickly include or remove values from the data set by selecting rows or enter arbitrary filter criteria.

Selecting Rows

Select rows by clicking row headers. Use Shift+Click to select adjacent rows and Ctrl+Click to select non-adjacent rows.

Select all/Clear all

Select or clear all using the select all button in the top left corner of the spreadsheet.

Entering Custom Values

Custom labels or criteria can be entered by typing in a cell when the AutoFill option has been turned off.

Configure Auto Fill Options Dialog Box

Available from the Auto Fill Options button in the Control Configuration Dialog Box, this dialog box allows users to define a range of values and to control how values are filled in the configuration spreadsheet.

Data Source

Type values in the Min or Max boxes to set a range.

Min: enter a minimum value for the range of filter criteria. Use –1 to use the minimum value present in the data set.

Max: enter a maximum value for the range of filter criteria. Use –1 to use the maximum value in the data set.

Minimum range: displays the range of the data found in the current data set.

Auto Fill Method

Click a radio button to choose one of the available auto fill methods.

None: turns auto fill off, allowing user to manually type filter criteria in the filter spreadsheet.

Fill with multiple values: fills the filter criteria spreadsheet with values from the data set using the defined range. The maximum number of values that can be used is 100 for multi-select controls or 500 for continuous and step slider controls.

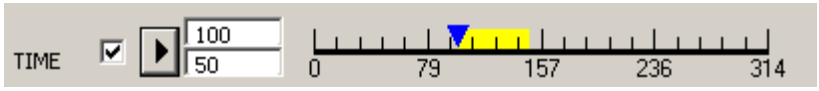
Fill with linear bins: groups criteria values in a linear fashion by the number entered in the Bin box.

Fill with logarithmic bins: groups criteria values in logarithmic fashion according to the value selected in the Base box.

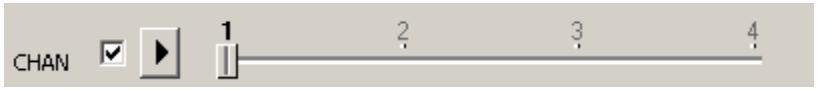
Animating Plots

OpenExplorer enables the user to animate data using the Continuous or Step Slider controls. Each of these controls includes a play button which allows the user to view the data as a series of filtered data sets. Depending on the control configuration, users might view data as it was acquired over time, step through all data on each channel in turn, or view responses to a sequence of stimulus events. Controls that are intended for animation only can be quickly disabled while the researcher explores snap shots of the data using other filters.

Continuous Control



Step Slider Control



Settings to control animation speed and looping are available through each control's Configuration Control dialog box.

~

Exporting Data and Graphics

About Data Export

OpenExplorer provides several methods for exporting data and graphics.

- Exporting Data to CSV Format
- Exporting Data to TXT Format
- Cut and Paste OpenExplorer Data
- Exporting Graphics

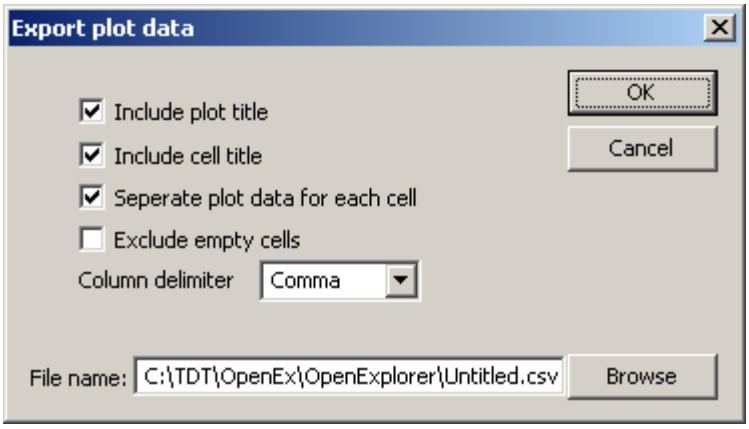
Exporting Data to CSV Format

CSV files, sometimes referred to as flat files, contain values as a series of ASCII text lines. Typically, each line represents a row (or data record) and column values (or data points) are separated by a comma. In the OpenExplorer export, the user can choose to use a comma, space, or tab as the column delimiter. CSV files can easily be opened in Microsoft Excel.

OpenExplorer supports exporting data directly from the plot area to the common CSV format. The data exported differs by plot type. For example, the activity plot export does not include any waveform data. Instead, it includes only counts of responses in each plot cell. The pile plot export includes the waveform data for each response in a plot cell. This export feature is available from the plot area shortcut (right-click) menu.

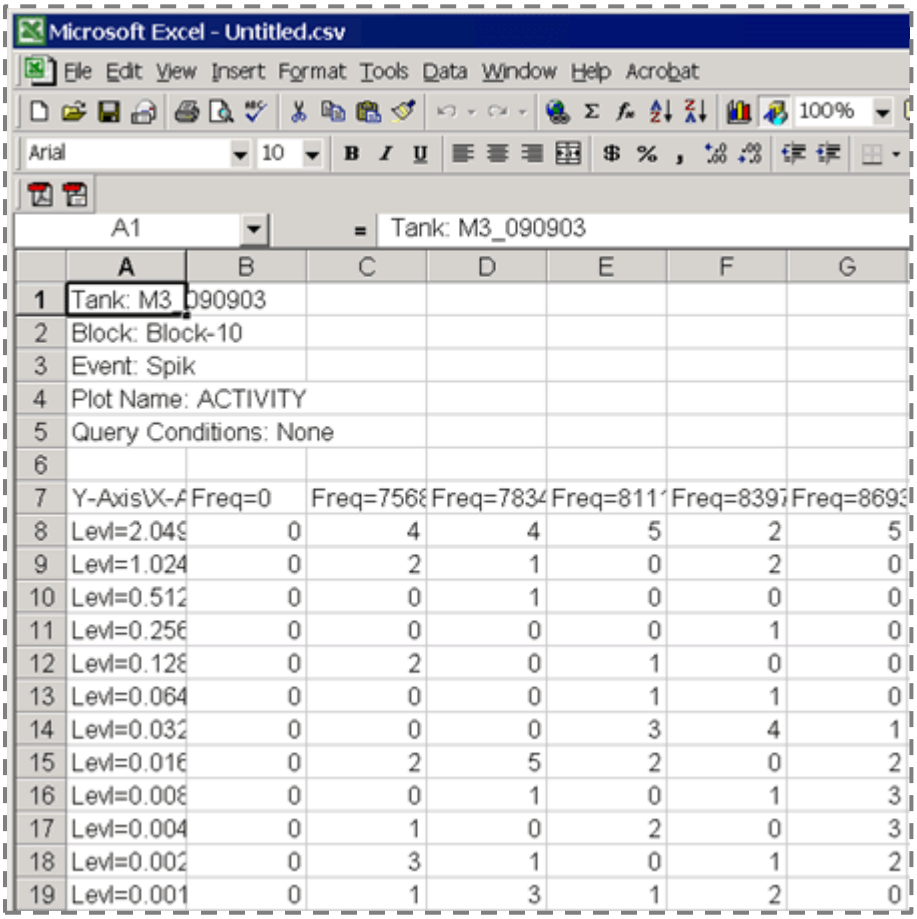
To export plot data:

1. Configure the plot and all filters.
2. Right-click the plot and click **Export plot data** on the shortcut menu.
3. Choose the desired export options.



4. Enter or browse to a path and file name for the data file.
5. Click **OK**.

6. Open the file in software, such as Microsoft Excel, that supports the .CSV format.



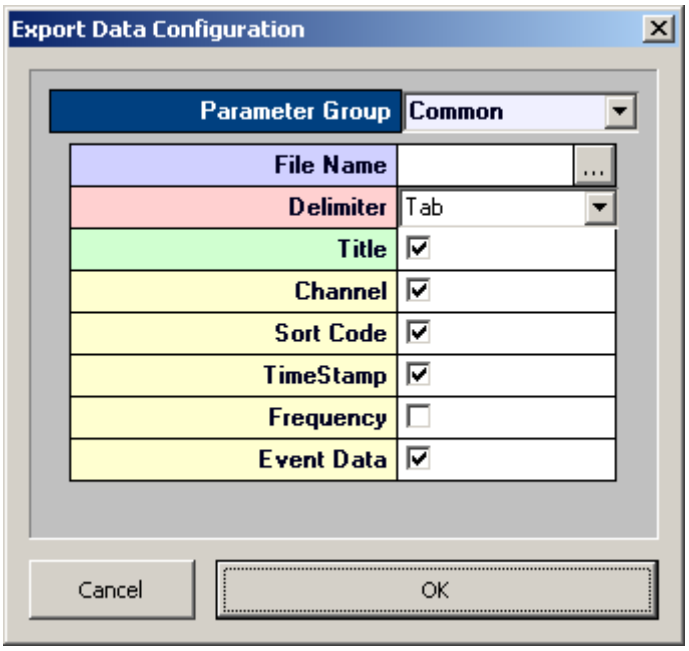
	A	B	C	D	E	F	G
1	Tank: M3_090903						
2	Block: Block-10						
3	Event: Spik						
4	Plot Name: ACTIVITY						
5	Query Conditions: None						
6							
7	Y-Axis\X-A	Freq=0	Freq=756	Freq=783	Freq=811	Freq=839	Freq=869
8	Levl=2.049	0	4	4	5	2	5
9	Levl=1.024	0	2	1	0	2	0
10	Levl=0.512	0	0	1	0	0	0
11	Levl=0.256	0	0	0	0	1	0
12	Levl=0.128	0	2	0	1	0	0
13	Levl=0.064	0	0	0	1	1	0
14	Levl=0.032	0	0	0	3	4	1
15	Levl=0.016	0	2	5	2	0	2
16	Levl=0.008	0	0	1	0	1	3
17	Levl=0.004	0	1	0	2	0	3
18	Levl=0.002	0	3	1	0	1	2
19	Levl=0.001	0	1	3	1	2	0

Exporting Data to TXT Format

Data stored in a txt format can be opened in or imported by a wide variety of analysis applications. OpenExplorer supports exporting to this format from the Data Table. Like the export plot data (csv format) method, this export feature allows the user to determine the delimiter to be used and whether or not header data and/or event data is included in the export. This export method also allows the user to decide if fields such as Channel, Sort Code, and TimeStamp will be included.

To export from the data table:

1. Configure all filters.
2. Click the  **Export** button on the Data Table toolbar. The Export Data Configuration dialog box opens.



3. Click the … **Look-up** button to the left of the File Name box, to open the Save As dialog box.
4. Browse to the desired file location, enter a file name, and click **Save**.
5. Choose the desired export options.
6. Click **OK**.
7. Open the file in software, such as Notepad, that supports the .txt format or import the file into the analysis software of your choice.

exportdatatable.txt - Notepad

File Edit Format Help

```
Tank: M3_090903
Block: Block-10
Event: Spik
Plot Name: DATATABLE
Query Conditions: None

1       0       1.63151872158   24414.0625      -5.2309e-005    -1.5183e-005
1       0       1.63328003883   24414.0625      -4.4988e-005    -5.6086e-005
1       0       1.63504123688   24414.0625      2.021e-005      2.5473e-005
1       0       1.63618814945   24414.0625      -6.9548e-005    -4.4553e-005
1       0       2.319237113     24414.0625      -4.3598e-006    -1.077e-006
1       0       2.32460284233   24414.0625      1.2421e-005     2.6263e-005
1       0       2.33766913414   24414.0625      2.6612e-005     3.4126e-005
1       0       2.34512388706   24414.0625      1.1198e-005     2.2172e-005
1       0       2.35446274281   24414.0625      2.5776e-005     2.993e-005
1       0       5.53095173836   24414.0625      -2.4166e-005    -1.2048e-005
1       0       8.92940282822   24414.0625      -7.203e-006     3.2118e-006
1       0       9.01394426823   24414.0625      -5.4487e-006    1.0515e-005
1       0       9.22599422932   24414.0625      -2.8683e-005    -1.2703e-005
1       0       9.22828805447   24414.0625      2.3694e-005     8.5489e-006
1       0       9.2321382761    24414.0625      3.858e-006      1.3453e-005
1       0       9.23394048214   24414.0625      -2.5232e-005    2.3035e-006
1       0       9.62715649605   24414.0625      -2.2029e-005    -1.6509e-005
1       0       9.62928640842   24414.0625      -1.5797e-005    -2.2497e-005
1       0       13.1350528002   24414.0625      3.5316e-005     3.9534e-005
1       0       13.8251878023   24414.0625      -4.9465e-005    -1.2238e-005
1       0       13.8301849365   24414.0625      5.2682e-005     5.2765e-005
```

Cut and Paste OpenExplorer Data

The OpenExploer Data Table supports a quick and easy copy and paste function. This feature allows users to select, copy, and paste data into a program such as Microsoft Excel. Pasted data can be used to quickly create diagrams for further exploration of the data but does not include header information.

Data Selection

Data must be selected by rows. Rows can be selected by clicking a row header. Use Shift+Click to select adjacent rows and Ctrl+Click to select non-adjacent rows. To quickly select all rows, right-click the data table and click **Select All** on the shortcut menu.

Copy Data

Selected data can be copied using the Copy button on the data table toolbar, from a shortcut menu, or using a standard Ctrl+C key press combination.

Paste Data

After data has been selected and copied, simply open up the intended application and use its paste method or the standard Ctrl+V key press combination.

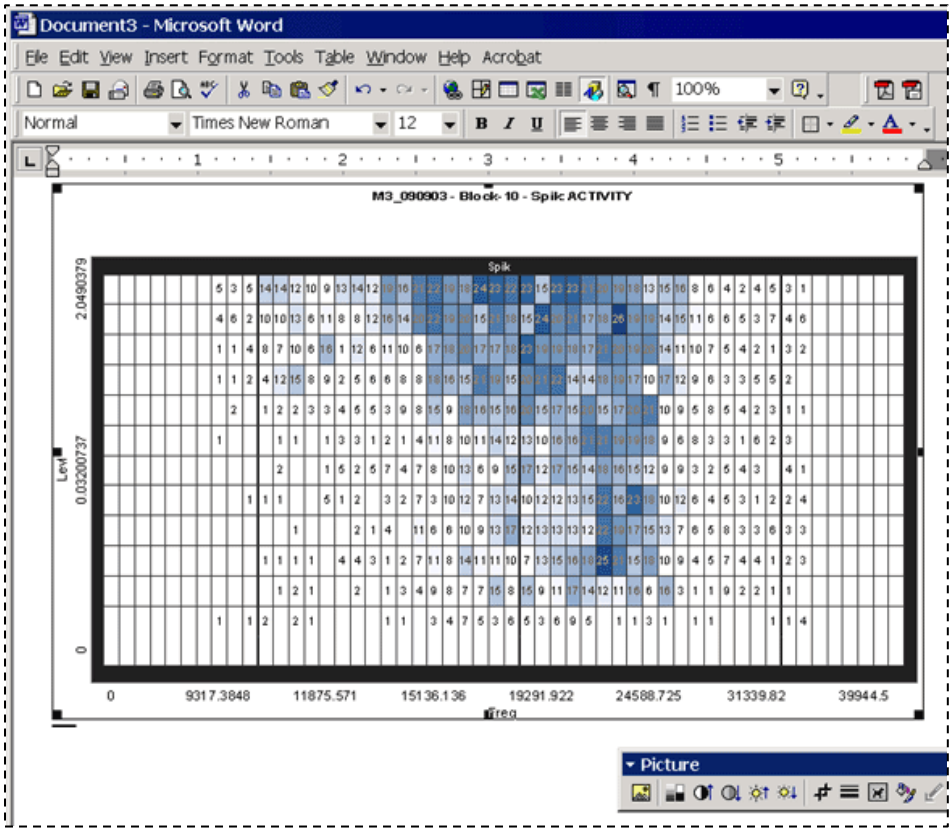
Exporting Graphics

OpenExplorer provides several methods of exporting plots for use in end user documents. Plots can be copied to the Windows Clipboard or exported to a Windows metafile (.emf or .wmf). The shortcut menu in the plot area provides a quick and easy copy and paste method while the File menu export command gives users more control over the export process. Users can choose to copy the image to the Windows Clipboard or export to a file. Users can also choose to include axis labels, plot title, or to export in black and white mode.

To export a plot graphic using the shortcut menu:

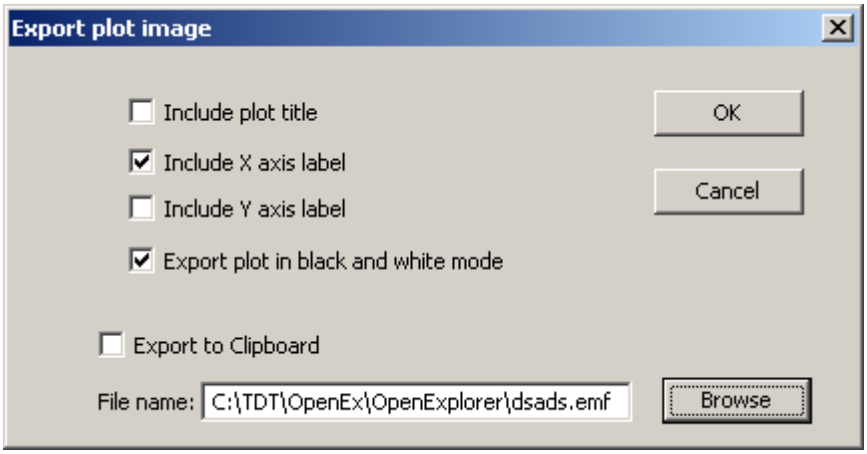
1. Configure the plot and all filters.
2. Right-click the plot and click **Copy plot picture to clipboard** on the shortcut menu.
3. Switch to the destination software, such as Microsoft Word, Microsoft Paint, or Adobe Photoshop.

4. Paste the image (Ctrl+V) into the destination document.



To export a plot graphic using the File menu:

1. Configure the plot and all filters.
2. Click the File menu and click **Export Image of the Active Plot**.



3. In the dialog box, choose the desired options.

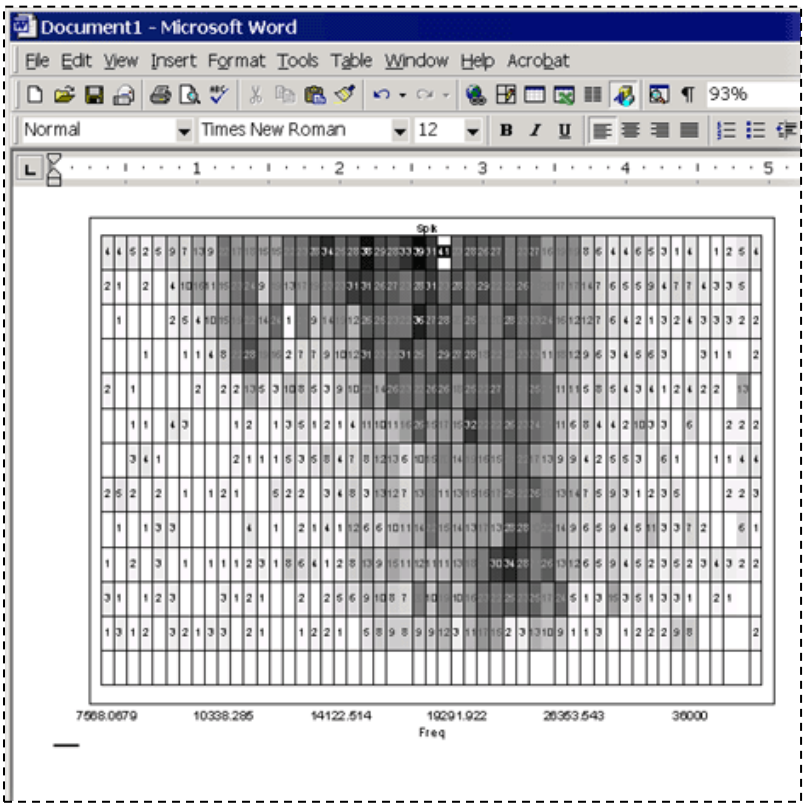
   Note: to enable the File box and Browse button, clear the Export to Clipboard check box.

4. Click **OK**.

5. If you choose to export to the Clipboard:
    a. Switch to the destination software, such as Microsoft Word, Microsoft Paint, or Adobe Photoshop.
    b. Paste the image (Ctrl+V) into the destination document.
6. If you choose to export to a file:
    a. Switch to the end document, such as Microsoft Word and insert the picture file using that application's insert feature.

        For example:

        In Microsoft Word, click the **Insert** menu, click **Picture**, and click **From File**. Browse to the picture, select it, and click **Insert**.



Plot Settings Reference

Appearance Parameter Group

Note: *some settings are not available for all plot types.*

Dot Size: Enter the size, in pixels, of the dots in a feature plot.

Plot Line Width: Enter the size, in pixels, of the plot trace lines in a pile or scrolling plot.

Plot Type: Select the plot type, Line or Dot Only, for a chart plot.

Plot Font Size: Not used.

Show Cell Grid: Select the check box to display grid lines.

Colors Parameter Group

Note: *some settings are not available for all plot types.*

Category Coloring: Selects the trace, dot, or bar coloring method. Can be a single color (None) or one color per channel (By Channel).

Dot Color: Select the dot color from a color palette.

Trace Color: Select the trace color from a color palette.

Plot Border Color: Select the plot border color from a color palette.

Foreground Color: Select the foreground color from a color palette.

Background Color: Select the trace color from a color palette.

Font Color: Select the font color from a color palette. This selection changes the font for the label above the plot only.

Cell Grid Color: Select the grid color from a color palette.

Data Table Appearance Parameter Group

Show Event Name: Select the check box to include a column for event name in the Data Table display.

Show Channel Num: Select the check box to include a column for channel number in the Data Table display.

Show Sort Code: Select the check box to include a column for sort code in the Data Table display.

Show TimeStamp: Select the check box to include a column for the time stamp values in the Data Table display.

Show Event Data: Select the check box to include columns for event data in the Data Table display.

Data Column Width: Enter the desired width of the columns which will display data values. The columns can also be adjusted by dragging the column divider.

Num Data Digits: Enter the number of significant digits to display for values in data columns.

Filtering Parameter Group

Filter On: Select the check box to enable a filter algorithm using FIR parameters provided in CoefB0-4. Clear the check box to disable the filter.

CoefB0: Type a coefficient value.

CoefB1: Type a coefficient value.

CoefB2: Type a coefficient value.

CoefB3: Type a coefficient value.

CoefB4: Type a coefficient value.

Margins Parameter Group

Left Margin: Define the margin, or space, (in pixels) from the left edge of the plot cell matrix to the label frame surrounding the plot.

Right Margin: Define the margin, or space, (in pixels) from the right edge of the plot cell matrix to the label frame surrounding the plot.

Top Margin: Define the margin, or space, (in pixels) from the top edge of the plot cell matrix to the label frame surrounding the plot.

Bottom Margin: Define the margin, or space, (in pixels) from the bottom edge of the plot cell matrix to the label frame surrounding the plot.

Scaling Parameter Group

Note: *These settings refer to the X and Y axes within each cell of the plot matrix. Some settings are not available for all plot types.*

Y-Axis Range: The range of the y-axis.

X-Axis Range: The range of the x-axis.

Y-Axis Symmetry: Select the check box to ensure that a symmetrical y-axis range will be displayed. This is ideal for signals that are expected to be symmetrical.

X-Axis Symmetry: Select the check box to ensure that a symmetrical x-axis range will be displayed. This is ideal for signals that are expected to be symmetrical.

Auto Scale: The plot can be set to automatically scale when refreshed, to ensure that the data can always be viewed in a convenient scale. If manual scaling is used, this setting is automatically set to None.

> **None:** Auto Scale is turned off.
>
> **Active:** The scale of the plot is automatically adjusted to ensure all values can be shown on the plot.
>
> **Smart: I**n track mode, the scale of the plot is automatically adjusted to ensure values can be shown on the plot only during the first 3 seconds.

Up-Scale Hist.: When Auto Scale is used, this value sets the number of points above the y-axis range that the signal must reach before scaling will occur.

Down-Scale Hist.: When Auto Scale is used, this value sets the number of points below half of the x-axis range a signal must fall before scaling will occur.

X-Axis Setup Parameter Group

Note: *These settings refer to the x-axis within the cells of the plot matrix. The x-axis label and units are displayed on the bottom left cell only. Some settings are not available for all plot types.*

Show X Labels: Select the check box to display a unit label for the x-axis. Clear the check box to hide the x-axis label.

X-Axis Unit: Set name for units that will appear as part of the plot label.

X-Axis Units Factor: Define a multiplication factor to convert x-axis units to valid value for units label.

Y-Axis Setup Parameter Group

Note: *These settings refer to the y-axis within the cells of the plot matrix. The Y-axis label and units are displayed on the bottom left cell only. Some settings are not available for all plot types.*

Show Y Labels: Select the check box to display a unit label for the y-axis. Clear the check box to hide the y-axis label.

Y-Axis Units: Set name for units that will appear as part of the plot label.

Y-Axis Units Factor: Define a multiplication factor to convert y-axis units to valid value for units label.

Common Parameter Group

Activity Plot Common Parameter Group

Source Name: Select the data event (Store name) from the currently selected tank.

Color at Min: Select the color to be displayed when activity is at defined Min Value. Color for values between Min and Max Values are generated using a proportional mix of the defined Colors at Min and Max.

Color at Max: Select the color to be displayed when activity is at defined Min Value. Color for values between Min and Max Values are generated using a proportional mix of the defined Colors at Min and Max.

Min Value: Enter the number of spike to be defined as the minimum value, which is represented by the defined Color at Min.

Max Value: Enter the number of spike to be defined as the maximum value, which is represented by the defined Color at Max.

Refresh Epoch Name: Define the refresh epoch, or indexed event that will be used in Track Mode. Click the value box to view a list of events. Valid choices are preceded by an epoch event icon. Valid choices include events that were marked as epoch events on the Stores page of the OpenWorkbench file used to collect the data. When a refresh epoch event is defined the plot will be refreshed based on the epoch value according to the settings in the Refresh Control parameter group.

Auto Scale: The plot can be set to automatically scale when refreshed, to ensure that the data can always be viewed in a convenient scale. If manual scaling is used, this setting is automatically set to None.

None: Auto Scale is turned off.

Active: The scale of the plot is automatically adjusted to ensure all values can be shown on the plot.

Smart: In track mode, the scale of the plot is automatically adjusted to ensure values can be shown on the plot only during the first 3 seconds.

Chart Plot Common Parameter Group

Source Name: Select the data event (Store name) from the currently selected tank.

Time Span: Set the time range, in seconds and according to the time stamp, to be displayed on the X-axis.

Auto Scale: The plot can be set to automatically scale when refreshed, to ensure that the data can always be viewed in a convenient scale. If manual scaling is used, this setting is automatically set to None.

None: Auto Scale is turned off.

Active: The scale of the plot is automatically adjusted to ensure all values can be shown on the plot.

Smart: In track mode, the scale of the plot is automatically adjusted to ensure values can be shown on the plot only during the first 3 seconds.

Category Coloring: Selects the trace or dot coloring method. Traces or dots can be seen in a single color (None) or one color per channel (By Channel).

Data Table Common Parameter Group

Max Cache Size (Bytes):

Show Event Name: Select the check box to include a column for event name in the Data Table display.

Show Channel Num: Select the check box to include a column for channel number in the Data Table display.

Show Sort Code: Select the check box to include a column for sort code in the Data Table display.

Show TimeStamp: Select the check box to include a column for the time stamp values in the Data Table display.

Show Event Data: Select the check box to include columns for event data in the Data Table display.

Data Column Width: Enter the desired width of the columns which will display data values. The columns can also be adjusted by dragging the column divider.

Num Data Digits: Enter the number of significant digits to display for values in data columns.

Feature Plot Common Parameter Group

Source Name: Select the data event (Store name) from the currently selected tank.

Cloud Points: Set the minimum number of points to display. The maximum number of cloud points will be twice the value set. The plot will refresh when the maximum number is reached.

X-Axis Feature: Select from a drop down list. Choices are Total Amplitude, Peak 1, Peak 2, Peak to Peak Time, and Area.

Y-Axis Feature: Select from a drop down list. Choices are Total Amplitude, Peak 1, Peak 2, Peak to Peak Time, and Area.

Auto Scale: The plot can be set to automatically scale when refreshed, to ensure that the data can always be viewed in a convenient scale. If manual scaling is used, this setting is automatically set to None.

None: Auto Scale is turned off.

Active: The scale of the plot is automatically adjusted to ensure all values can be shown on the plot.

Smart: In track mode, the scale of the plot is automatically adjusted to ensure values can be shown on the plot only during the first 3 seconds.

Category Coloring: Selects the dot coloring method. Dots can be seen in a single color (None) or one color per channel (By Channel).

Histogram Common Parameter Group

Source Name: Select the data event (Store name) from the currently selected tank.

TimeRef Epoc Name: Define the epoch, or indexed event, that will be used for the vertical bars. Click the value box to view a list of events. Valid choices are preceded by an strobe/indexed event icon. Valid choices include events that were marked as epoch, or indexed, events on the Stores page of the OpenWorkbench file used to collect the data.

Time Span: Define the time span. The X-axis will be equal to the value set for Time Span divided by the value set for Bin Width.

Bin Width: Define the Bin Width. The X-axis will be equal to the value set for Time Span divided by the value set for Bin Width.

Auto Scale: The plot can be set to automatically scale when refreshed, to ensure that the data can always be viewed in a convenient scale. If manual scaling is used, this setting is automatically set to None.

None: Auto Scale is turned off.

Active: The scale of the plot is automatically adjusted to ensure all values can be shown on the plot.

Smart: In track mode, the scale of the plot is automatically adjusted to ensure values can be shown on the plot only during the first 3 seconds.

Category Coloring: Selects the bar coloring method. Bars can be seen in a single color (None) or one color per channel (By Channel).

Pile Plot Common Parameter Group

Source Name: Select the data event (Store name) from the currently selected tank.

Pile Depth: Set the number of traces that will be displayed.

Auto Scale: The plot can be set to automatically scale when refreshed, to ensure that the data can always be viewed in a convenient scale. If manual scaling is used, this setting is automatically set to None.

None: Auto Scale is turned off.

Active: The scale of the plot is automatically adjusted to ensure all values can be shown on the plot.

Smart: In track mode, the scale of the plot is automatically adjusted to ensure values can be shown on the plot only during the first 3 seconds.

Category Coloring: Selects the trace coloring method. Traces can be seen in a single color (None) or one color per channel (By Channel).

Scroll Plot Common Parameter Group

Source Name: Select the data event (Store name) from the currently selected tank.

Scroll Sections: Selects the number of scroll sections to display.

Auto Scale: The plot can be set to automatically scale when refreshed, to ensure that the data can always be viewed in a convenient scale. If manual scaling is used, this setting is automatically set to None.

None: Auto Scale is turned off.

Active: The scale of the plot is automatically adjusted to ensure all values can be shown on the plot.

Smart: In track mode, the scale of the plot is automatically adjusted to ensure values can be shown on the plot only during the first 3 seconds.

Behavior Parameter Group

Activity Behavior Parameter Group

Color at Min: Select the color to be displayed when activity is at defined Min Value. Color for values between Min and Max Values are generated using a proportional mix of the defined Colors at Min and Max.

Color at Max: Select the color to be displayed when activity is at defined Min Value. Color for values between Min and Max Values are generated using a proportional mix of the defined Colors at Min and Max.

Min Value: Enter the number of spike to be defined as the minimum value, which is represented by the defined Color at Min.

Max Value: Enter the number of spike to be defined as the maximum value, which is represented by the defined Color at Max.

Show Num Trace: Select the check box to display the number of events in each activity cell. Clear the check box to hide the number label.

Chart Plot Behavior Parameter Group

Time Span: Set the time range, in seconds and according to the time stamp, to be displayed on the X-axis.

Feature Plot Behavior Parameter Group

Cloud Points: Set the minimum number of points to display. The maximum number of cloud points will be twice the value set. The plot will refresh when the maximum number is reached.

X-Axis Feature: Select from a drop down list. Choices are Total Amplitude, Peak 1, Peak 2, Peak to Peak Time, and Area.

Y-Axis Feature: Select from a drop down list. Choices are Total Amplitude, Peak 1, Peak 2, Peak to Peak Time, and Area.

Histogram Behavior Parameter Group

TimeRef Epoc Name: Define the epoch, or indexed event, that will be used for the vertical bars. Click the value box to view a list of events. Valid choices are preceded by an strobe/indexed event icon. Valid choices include events that were marked as epoch, or indexed, events on the Stores page of the OpenWorkbench file used to collect the data.

Time Span: Define the time span. The X-axis will be equal to the value set for Time Span divided by the value set for Bin Width.

Bin Width: Define the Bin Width. The X-axis will be equal to the value set for Time Span divided by the value set for Bin Width.

Pile Behavior Parameter Group

Pile Depth: Set the number of traces that will be displayed.

Scroll Plot Behavior Parameter Group

Scroll Sections: Selects the number of scroll sections to display.

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Anomalies and Tech Notes

The latest anomalies and tech notes are always available on the Web at www.tdt.com/technotes/.

Store names that begin with any of the characters listed below will generate an error message, such as "Unable to set cell filter. TTank server Error. Server Call: SetQueryCondition Error:Invalid filter format": "-", "=", "(", ")", "<", ">", "!", a space or any number 0 to 9. When the TTank engine performs filtering of events in the Tank, the above characters will not be parsed correctly, and the store name will not be decoded properly.