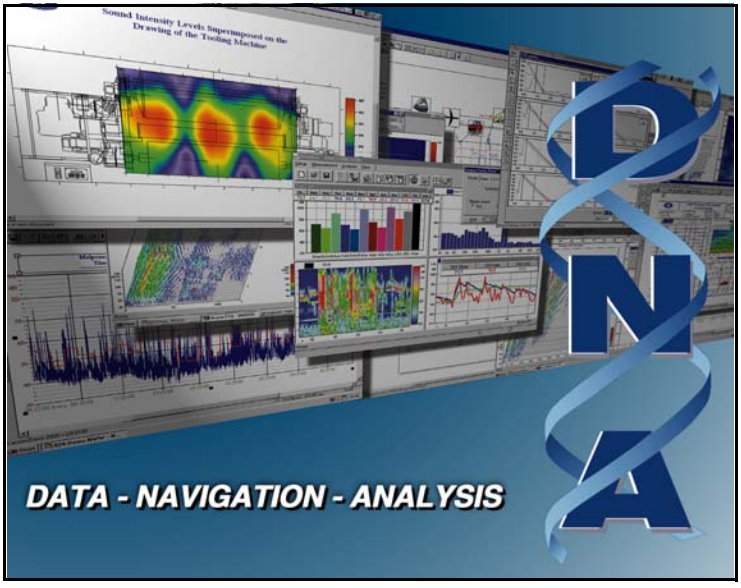
Getting Started with DNA Software



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IDNA.02 Rev A

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CHAPTER

1 Introduction

DNA, What is it?

DNA (Data, Navigation and Analysis) Software is a very powerful and versatile software program which enhances the already significant features of Larson Davis handheld analyzers and sound level meters. A more detailed description is presented in "Overview of DNA" on page 2-1

The Purpose of This Document

Although an extensive user manual is provided with the software (Larson Davis part number IDNA.01 Rev E), we have learned from experience that most technical people prefer to begin working with new software by sitting down in front of the computer and playing with it; *looking in the manual is most frequently a last resort!*

With this document, the author has undertaken a similar activity, albeit guided by a degree of prior experience with the product. Beginning with the most basic activities, you are invited to participate by "playing" DNA, recreating the actions and generating the graphics and other results. By working your way through some or all of the exercises in ***Getting Started with DNA***, you will get a running start in your educational "learn by doing" activity.

The primary goals of this document are as follows:

- Guide the new user in the use of DNA

- Serve as a reference to experienced users wishing to update or sharpen their skills when working with specific software features
- Provide a means for potential purchasers to take a hands-on test drive of DNA using the actual software and demonstration measurement files.

The Process

It is recommended that the reader begin with Chapter 3 "Time History Displays" on page 3-1 and proceed through this guide. There are many repetitive operations used regularly when working with DNA which are described in the early chapters.

As you work your way through this document, the general process will be to "click and go". The teaching process will be by example, not by a detailed description. As you proceed, take time to "look around". As windows are opened and menus "dropped down", take a few moments to note the options and alternative choices before invoking the one directed in the example.

Scope

This document does not address all of the extensive features of DNA, nor does it attempt to illustrate all the various ways in which desired results can be obtained. Users are encouraged to continue exploring, as we have done here, to learn more about DNA and to seek innovative ways to achieve their goals. It is our sincere hope that by working through these exercises you will have developed a sense of the "look and feel" of DNA which will be of benefit in your application of DNA in your professional activities.

Please don't hesitate to call upon our technical support engineers for assistance.

We would also appreciate feedback from you with suggestions for improvement and recommendations of application routines not provided which would be of benefit to you.

And, should you come up with better ways of accomplishing tasks than presented here, please share them with us.

Demonstration Files

Document Files

The typical way to utilize DNA is to download measured data from an instrument into a new or existing document. For the purposes of this exercise, however, we want to make sure you are working with the same data as used in the examples. To do this, we have provided a folder of demonstration documents containing measurement data. Some may also have graphics included as well, though most do not. These have all been made "Read Only" so that they cannot be inadvertently changed by storing them while working through an exercise. If you want to save your work as you proceed, store using a different name.

Color Scale File

Along with the document files, there is also a file named **rainbow. csc**. This is a Color Scale file which will be used to create a color palette for use with 3D graphics such as Sonograms and Waterfall plots.

Copy Demo Documents

As we begin each exercise, we will have you open a particular document which will contain a measurement to work with. So, prior to beginning, copy the folder of demonstration documents onto your computer in an easily accessed location so you can quickly find them when called upon to open one of them. Copy the Color Scale file so it will be available when needed.

CHAPTER

2 Overview of DNA

General Description

DNA is an application designed for the Windows™ environment. Its primary function is to graphically render data from acoustic and vibration measurements downloaded from the following Larson Davis instruments.

- Models 2800, 2900, 3000+ and 3200 Real-time spectrum analyzers. All of these except the 3200 are also capable of performing sound level measurements meeting the specifications of international standards for precision sound level meters.
- System 824 SLM/Real-time Analyzer, combining the features of a single channel real-time analyzer with those of a precision sound level meter meeting the specifications of international sound level meters standards.
- Models 720, 812, 814, 820 and 870 precision sound level meters. These instruments are widely used for environmental noise monitoring and general noise measurement.
- Model HVM100 Human Vibration Meter providing the frequency weighting functionality required for the measurement of Hand Arm, Whole Body and General vibration according to a number of international standards.

From data acquisition, through post-post processing to the generation of report documents, DNA can handle the job with ease.

Get the Data

DNA can read almost all the data types that can be measured by the supported instruments. Data can be acquired

manually, storing the data in the instrument and downloading it to the computer at the end of the measurement session, or the user can control the instrument remotely from the PC via an RS232 or parallel interface (depending on instrument type). When connected to a PC, a multi-window real-time display of measured parameters (sound pressure levels, sound pressure time history and live spectrum) is provided.

Routines are provided to implement instrument control and data download using a modem; a technique often used for long-term environmental noise monitoring. For advanced noise monitoring systems having multiple stations, the optional Remote module can be used for automated polling and data downloading from each station at a user-specified time.

Build the Document

Data is downloaded or imported into a multi-page document, where it may be edited, post-processed and graphed in a variety of 2D and 3D formats using general and specialized templates.

Visualize a time history graph with small text boxes or cartoon graphics added to various time segments to identify the dominant noise sources (e.g. car, truck, motorcycle, aircraft)

Routines are available to perform such tasks as identifying pure tones in frequency spectra graphs or identifying sounds having an impulsive character in time history graphs. The document can be further enhanced by inserting text blocks, importing bitmaps and metafiles and using the basic drawing tools provided.

For noise monitoring activities, event detection routines are provided to identify individual events characterized by levels above a programmed threshold for a programmed time period. In addition, the time history data associated with these events can be extracted into individual measurements for further analysis.

For advanced users, OLE (Object Linking and Embedding) objects can be added to the document.

Post-Process the Data

Recalibration, statistical analysis, signal editing and frequency weighting are some of the post-processing operations available.

Archive Data

All measured data are stored inside the document. An unlimited number of measurements can be stored in a single document. All the document's data (measurements, page layout, images' data, etc.) are stored in a single disk file. You can easily import measurements from another document.

Print Report and Export Data

Once your document is ready, you can print it on any device connected to your computer (printers, fax). Data and graphs can be exported to other applications via the clipboard. You can also send documents by electronic mail.

Optional Modules

A number of optional module are available to expand the capabilities provided by the basic DNA software.

Direct Store and File Audio

This module permits data and audio files to be stored directly on a PC, bypassing the instrument memory. Data files are transmitted digitally over the serial or parallel interface. The analog sound signal is transmitted from the AC output of the measuring instrument via an electrical cable to the sound card in the computer, where it is digitized and saved. Sound files can be attached to a graph or page, permitting the user to playback the sound simply by clicking

on the audio file icon. Saved sound files can also be used to create.WAV files.

Order Tracking

This module extracts order data from FFT spectra which have been autostored as a function RPM using a Model 2800, 2900, 3000+ or 3200.

Building Acoustics

This module is used for the calculation of reverberation time, transmission loss and sound isolation according to ISO and ASTM standards. The reverberation time is determined using the Schroeder backwards integration technique. The building acoustics calculations are in accordance with the following standards:

- EN ISO R 140-4:2000
- EN ISO R 140-5:2000
- EN ISO R 140-7/8:2000
- ASTM E336-97
- ASTM E1007-97

Transmission loss, sound isolation and impact sound isolation can be calculated using either Standard or Wide Frequency Ranges.

Remote

This module is for noise monitoring systems having multiple noise measurement stations. Permits automated polling and data download at a programmed date and time.

CHAPTER

3 Time History Displays

We will start by generating some time history displays, beginning with simple time histories having at most sampled time data for several detectors and moving on to the more complex situations typical of measurements made using the System 824.

Simple Time History: Peak, Fast and Slow

This demo data file contains a time history in which we have stored the peak level, along with the levels from the Fast and Slow detectors, every 0.25 second. All these measurements have been A-weighted.

We have created this demo data to examine the response of a sound level meter to impulsive sounds.

Left click **File/Open,** select **Simple Time History** from the Demo Data Folder, and left click **Open**. This will create a blank page onto which we will create displays of the data contained in that demo data file.

In normal practice, the user will begin with a document which has no measurements contained in it. This document may be blank or it may have embedded headings, logos, etc. previously created by the user. However, since we are working with demo data rather than with an instrument, we have created these demo documents which already contain measurements from Larson Davis instruments. Because the documents we are using for these exercises contain measurement data, we have made them read-only. If you wish to store the results you generate during these exercises, store them as documents with different names.

Left click **Process/Measurement/Information** to obtain a display of the data contained in the document we just opened, shown in FIGURE 3-1

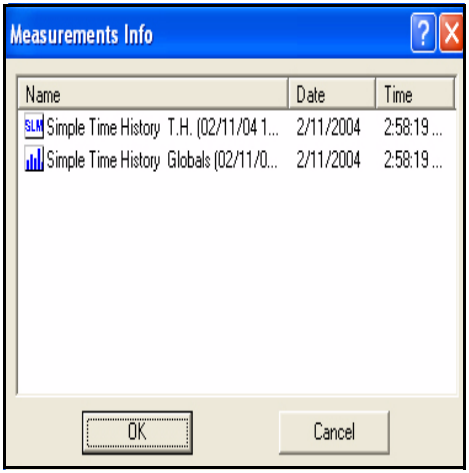


FIGURE 3-1 Measurement Properties; User Info

We can see this contains a time history data block (TH) and a Global data block. The global data block contains data related to the total measurement period. We will be working only with the time history data at this time. Left click **Cancel** to close this window.

Generate a Display

In this section we show how a template is opened to create a data display. In normal practice, the user will download data from an instrument and the menu shown in FIGURE 3-2 "Select Graph Template" will automatically be opened for the selection of a template. In this example, however, we need to open it manually.

Select a Template

Left click **Insert/Graph Template**, which will open the Select Graph Template Menu shown in FIGURE 3-2

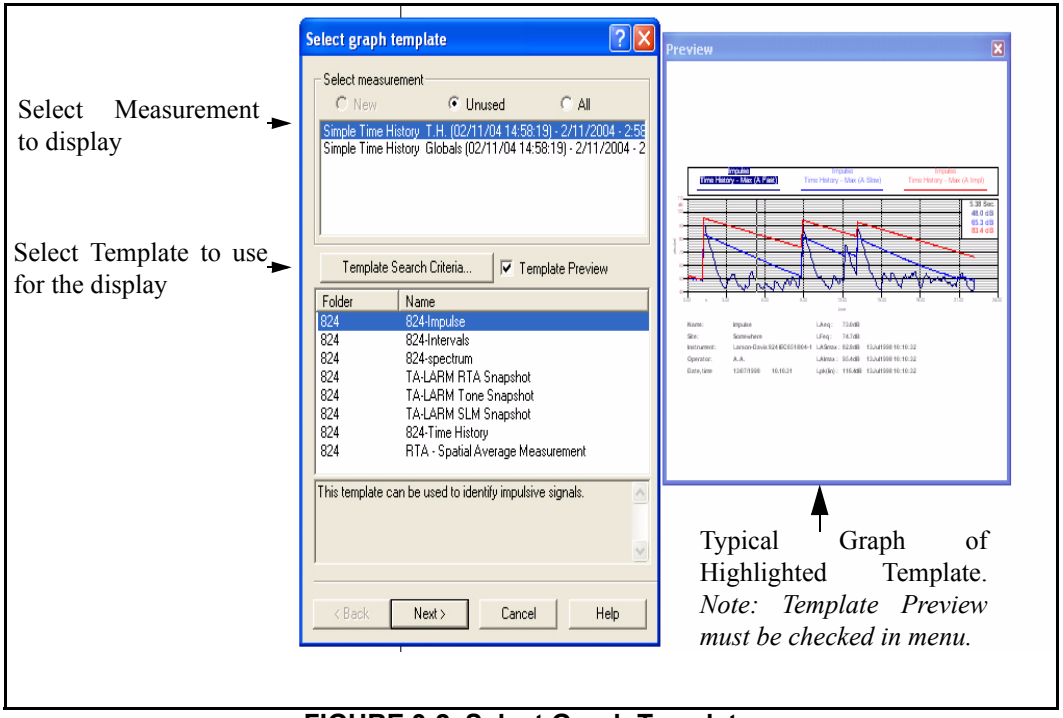


FIGURE 3-2 Select Graph Template

Make sure that the option "All" under "Select Measurement" and "Template Preview" to the right of "Template Search Criteria" have been checked before proceeding.

In the Select Measurement field, highlight Simple Time History TH, the first measurement listed.

In the Select Template field, highlight **Time-History** from the 824_ssa folder. Left click the **Next** button and, when the

Select Template Drawing Position Menu is displayed, left click Finish to produce the display shown in FIGURE 3-3 .

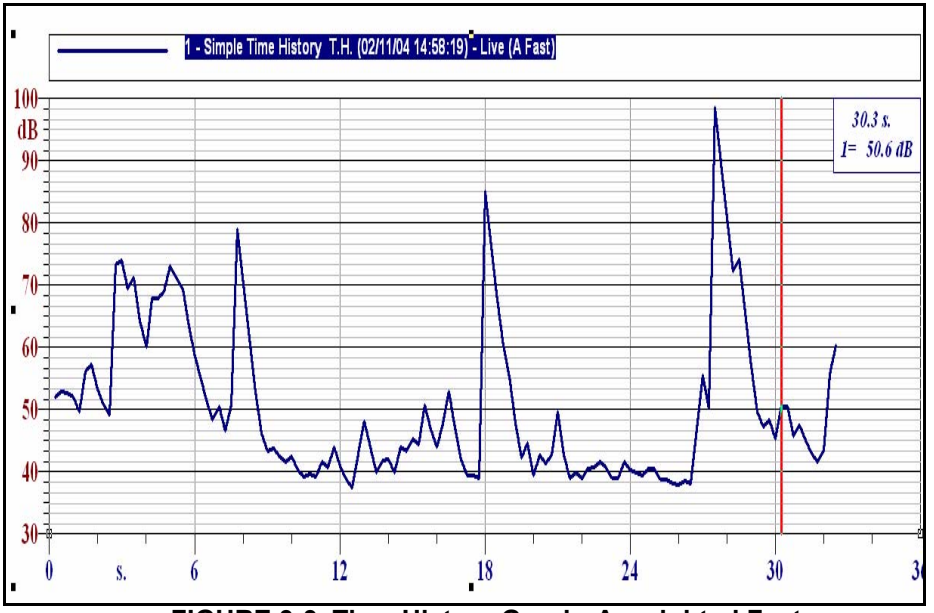


FIGURE 3-3 Time History Graph; A-weighted Fast

To obtain the same graph, it may be necessary to autoscale the x and y axes (position cursor over scale, right click, left click on Autoscale)

The legend above the graph indicates that this curve represents the A-weighted, Fast level as a function of time.

Set the cursor priority to Graph by left clicking the icon shown below in the Toolbar at the top of the screen.

Selection Priority:Graph

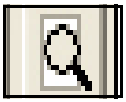
Now you can move the cursor across the graph using left and right arrow keys on the keypad, or click the cursor at different locations along the time axis. The time and level for the Fast detector are shown in the box in the upper right corner of the graph.

Changing the Display Format

There are two possible display formats:

Fit to Page

This format is selected by left clicking the Fit to Page icon contained in the Toolbar on the left of the screen.



which produces a display as shown in FIGURE 3-4

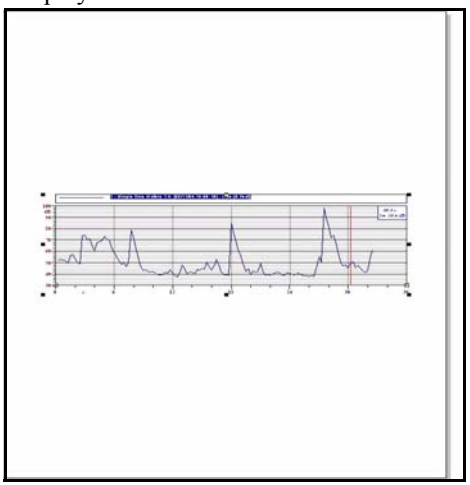
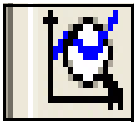


FIGURE 3-4 Fit To Page Display Format

This permits the viewing of a complete document page.

Fit to Graph

This format is selected by left clicking the Fit to Graph icon contained in the Toolbar on the left of the screen.



which produces a display as shown in FIGURE 3-5

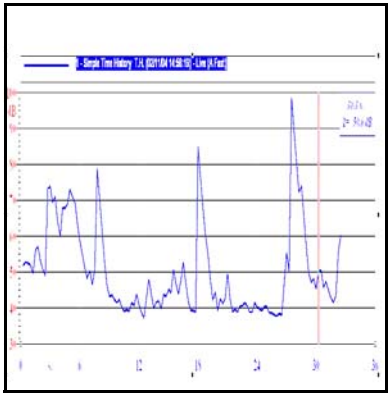


FIGURE 3-5 Fit to Graph Display Format

This view provides much greater resolution than the Fit to Page Format, which makes it the best format for examining data and working with the graph.

Familiarize yourself with these display formats by clicking the two “Fit to” icons to shift between them. In these exercises, it is recommended that you select the Fit to Graph view for most of the work involving graphics.

Left click on the legend above the graph to highlight it, right click, left click **Properties**, then left click the Data Source tab to open the Data Source Properties Menu for this item shown in FIGURE 3-6 .

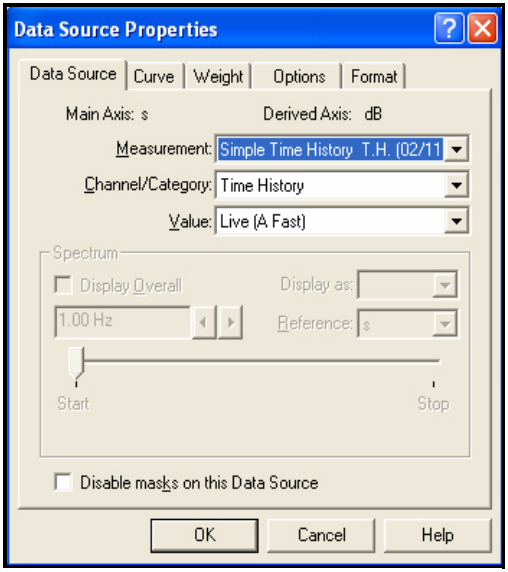


FIGURE 3-6 Data Source Properties Menu

We can see from the fields in the upper portion of this menu that we are working with Simple Time History data and that the curve represents the A-weighted, Fast data.

Left click on the down arrow on the right end of the Value field to open the window shown in FIGURE 3-7 .

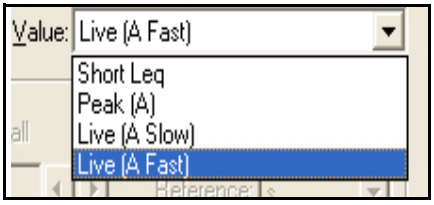


FIGURE 3-7 Value Window

Short Leq levels are always measured as part of the time history even though we did not specify this in the measurement setup.

We now have the choice of changing this curve to represent data corresponding to one of the following levels:

- Short Leq
- Peak (A)
- Live (A Slow)

Highlight Peak (A) and left click **OK** to obtain the graph of the A-weighted Peak level, shown in FIGURE 3-8 .

FIGURE 3-8 Time History; A-Weighted Peak

Autoscale the Amplitude

In this graph, the curves are cut-off by the top of the display. Autoranging the amplitude axis will correct this. Position the cursor over the scale of the amplitude (Y) axis, to the left of the graph, so that a vertical double headed arrow appears. Right click to open the window shown in FIGURE 3-9 .

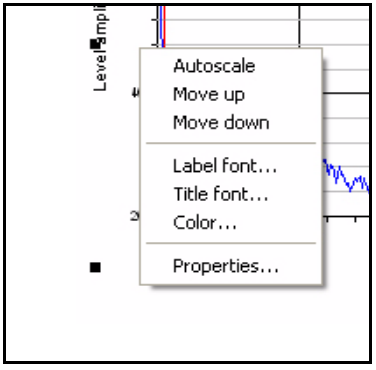


FIGURE 3-9 Y Axis Scaling Window

Left click **Autoscale** to obtain the graph shown in FIGURE 3-10 .

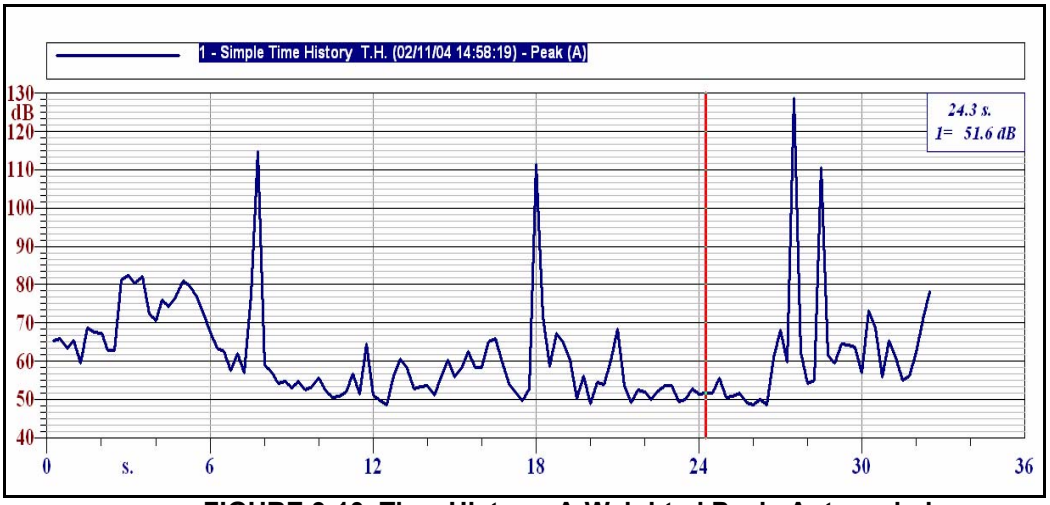


FIGURE 3-10 Time History; A-Weighted Peak, Autoscaled

Add Markers

Markers can be added to any graph. Before inserting the marker, move the cursor to the position along the time axis where the marker is to be placed. For this example, we will place a marker at the first peak, which occurred at 7.8 seconds. Place the cursor at this location.

Left click **Insert/Marker** from the Menu Bar at the top of the screen. This will turn the curser into a rectangle with an arrow (optional).

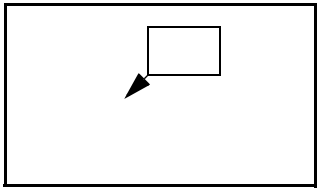


FIGURE 3-11 Marker Logo

There could be more than one graph on the page; dragging and dropping the rectangle defines which graph is to receive the marker.

Slide the cursor over the graph area and left click once more. This will open the Marker Properties Menu. Left click the General tab to obtain the display shown in FIGURE 3-12 .

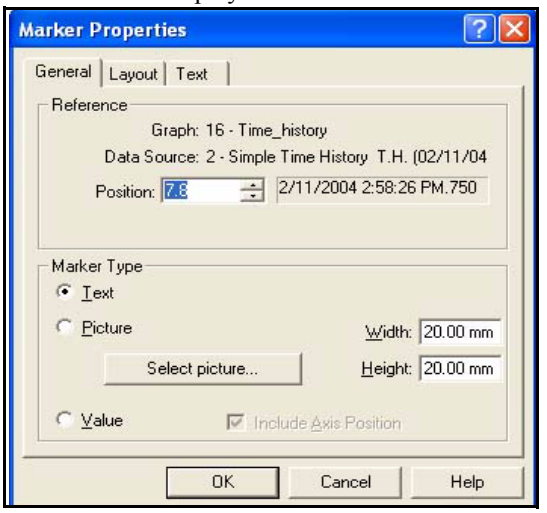


FIGURE 3-12 Marker Properties, General

Note that the position where the cursor will be placed coincides with the cursor position when the **Insert/Marker** activity was initiated; 7.8 seconds. This can be modified by left clicking on the up or down arrows to the right of the Position data field.

Marker Type Selection

The Marker Type (Text, Picture or Value) can be set from this Menu as well as the size of the marker box. Each of these Marker Types is described below.

Text Marker

Check “Text” under “Marker Type” to make this a Text Marker. The only modifications we will make is to change the Width and Height to 20.00 mm. Do not click OK yet.

Left click the Layout tab to obtain the display shown in FIGURE 3-13 .

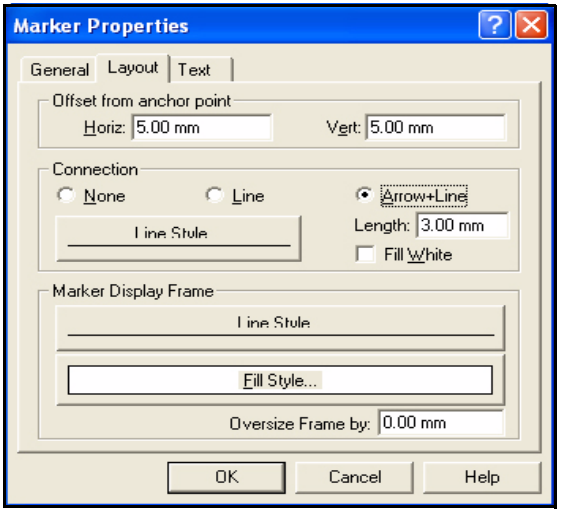


FIGURE 3-13 Marker Properties, Layout

More parameters, including the connection (line, arrow or none), line style, marker display frame line style and fill are set from this menu. The only change we will make from this menu is to set the Line Style to be Red with a length of 0.04 mm. Do not click OK yet.

Left click the Text tab to obtain the display shown in FIGURE 3-14 .

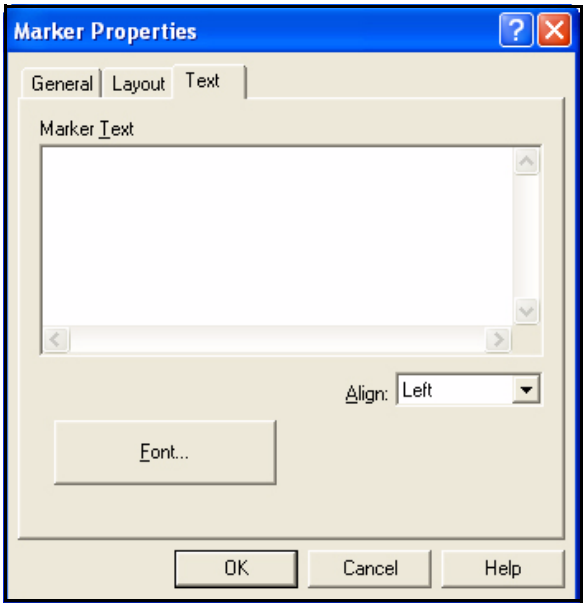


FIGURE 3-14 Marker Properties, Text

Use the Marker Text window to type in the text to appear in the marker box. Alignment and font are also set from this window. For our example, make the text “1st Cycle Impact” and set the font size to be 12.

Left click **OK** to insert the marker as shown in FIGURE 3-15 .

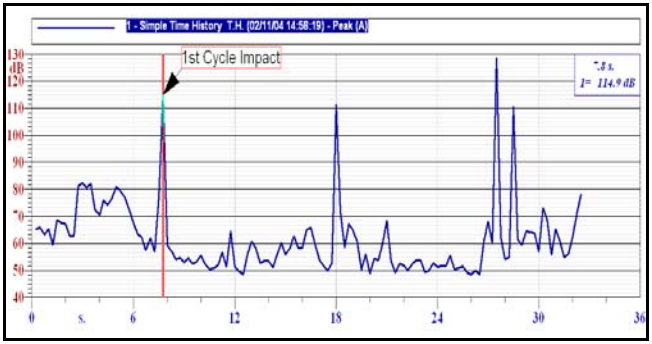


FIGURE 3-15 Time History Graph with Text Marker

Picture Marker

A Picture Marker is created in a manner similar to creating a Text Marker, the difference being that the Marker Type is selected to be Picture instead of Text (see FIGURE 3-12 "Marker Properties, General"). Clicking the box entitled “Select Picture” will open a window to set the path to the desired graphic. The following types of graphics can be used.

- Win Metafile
- Bitmap
- TIFF
- JPEG

Value Marker

A Value Marker is created in a manner similar to creating a Text Marker, the difference being that the Marker Type is selected to be Value instead of Text (see FIGURE 3-12 "Marker Properties, General"). The Value Marker will indicate the amplitude of the curve at the cursor position. To include the marker position, in this case along the time axis, in the marker check “Axis position” as well. Left click **OK** to insert the marker as shown in FIGURE 3-16 .

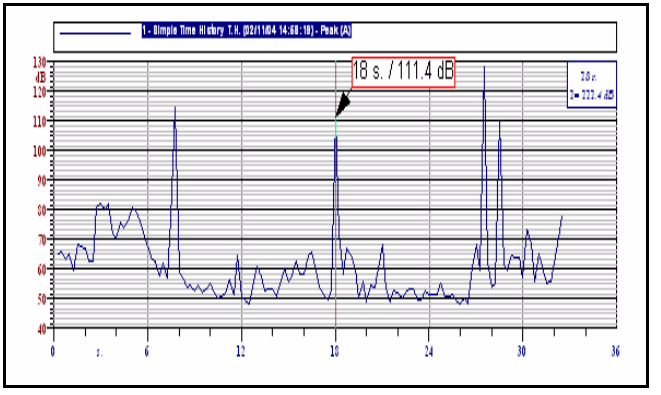


FIGURE 3-16 Time History Graph with Value Marker

Delete Marker

Note: Selection Priority:Graph must be set prior to deleting a marker.

To delete a marker, select it by left clicking on the box, and press the Delete key on the keyboard.

Before proceeding with this example, delete any markers which you may have added to the graph.

Add Curves for Fast and Slow

The graph we have been working with presently shows the Peak(A) data as shown in FIGURE 3-10 "Time History; A-Weighted Peak, Autoscaled" on page 3-9. We will now add to this curves measured using the Fast and Slow detectors. Place the cursor in the center of the graph, right click, then then left click **Properties**, then left click the Axes-Data tab to obtain the menu shown in FIGURE 3-17 .

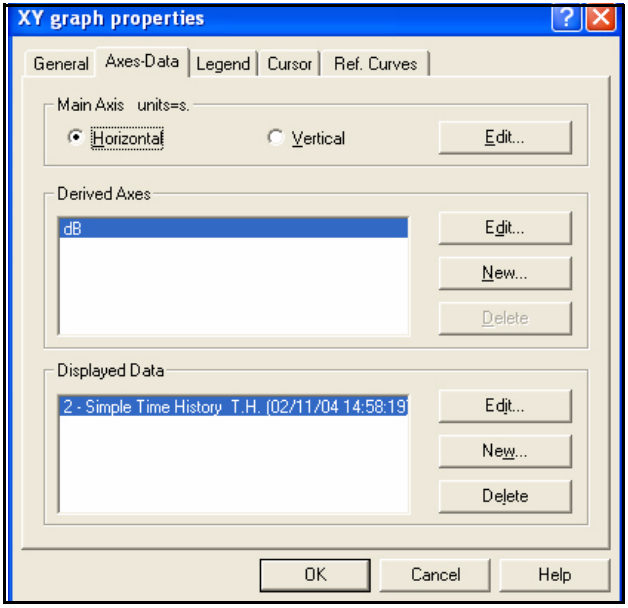


FIGURE 3-17 XY Graph Properties

Left click the **New** button to the right of the Displayed Data field to obtain the menu shown in FIGURE 3-18 .

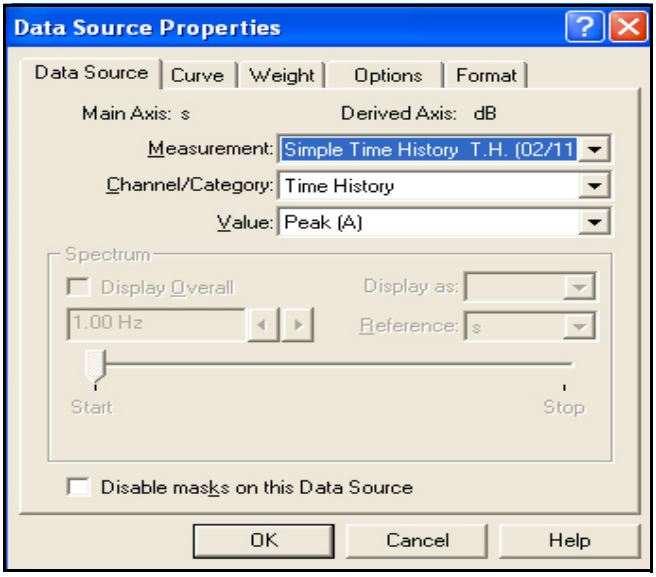


FIGURE 3-18 Data Source Properties

Left click on the down arrow on the right end of the Value field to open the window shown in FIGURE 3-19 .

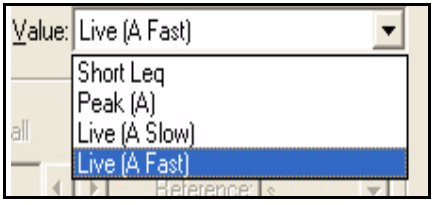


FIGURE 3-19 Selection of New Curve Parameter Menu

Highlight Live (A Slow) and left click **OK** to make the selection.

Repeat the procedure to add another new curve, this time selecting Live (A Fast), then click **OK** to produce the graph shown in FIGURE 3-20 .

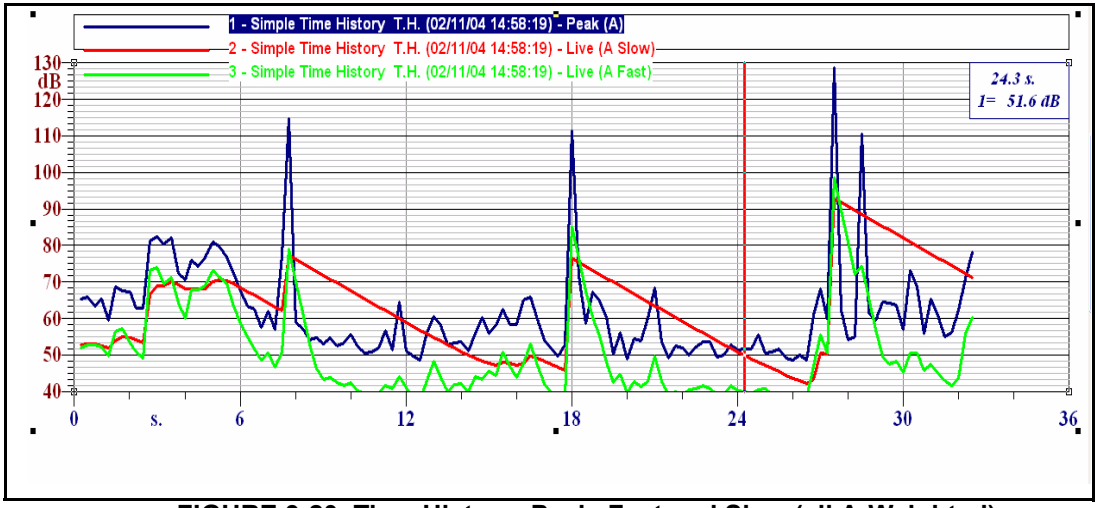


FIGURE 3-20 Time History; Peak, Fast and Slow (all A-Weighted)

Move the Legend

With the addition of these two curves, the legend listing the separate curves by name overlaps the upper portion of the graph. To reposition it, open the Properties Menu (cursor over graph, right click, left click Properties) and left click the Legend tab to obtain the display shown in FIGURE 3-21

.

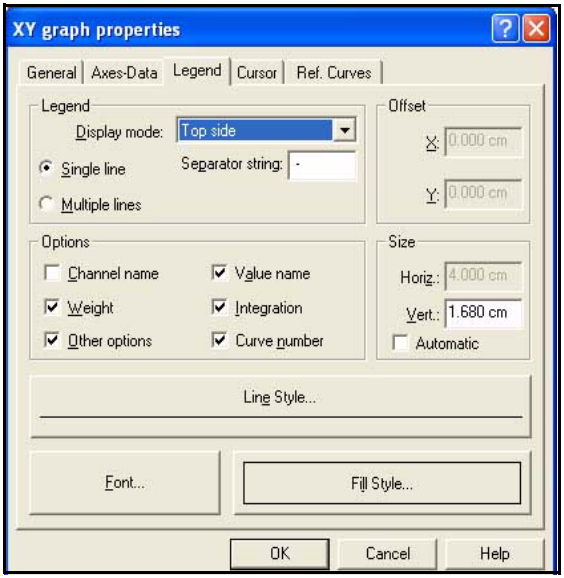


FIGURE 3-21 Properties Menu, Legend

Left click the down arrow to the right of the Display mode field to obtain the display shown in FIGURE 3-22 .

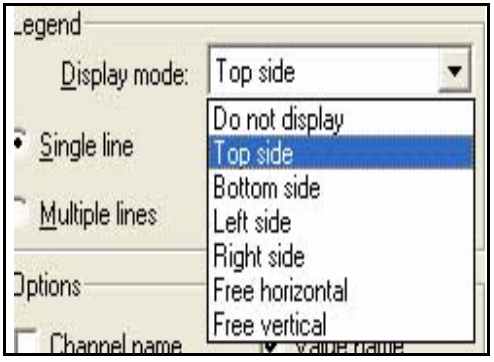


FIGURE 3-22 Legend Positioning Window

A list of positioning choices is presented. The procedure is to left click the desired one and left click **OK** to return to the graph. When Top side or Bottom side have been selected, checking the check box for the Automatic in the Size portion of the menu will automatically position the legend outside the graph area.

Since we have already selected Top side, simply check the check box and left click **OK** to reposition the legend above the graph as shown in **FIGURE 3-23 .**

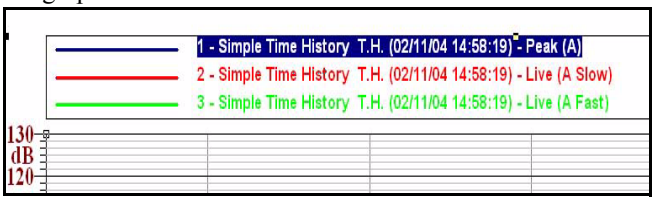


FIGURE 3-23 Legend Repositioned

Use the Cursor

Single Parameter Cursor Box

Move the cursor within the graph by either using the left and right arrow keys at the right of the keyboard, or simply left clicking in the graph at the frequency position desired. Note that one of the three curve titles in the legend above the graph is highlighted to indicate that the parameters (in this case amplitude and time) displayed in the cursor box in the upper right corner correspond to that curve. Also, the color of the curve and the value in the cursor box match the color of the highlighted legend. Left click a different curve in the legend and note that it becomes highlighted and its values now appear in the cursor box.

Multiple Parameter Cursor Box

To display the levels for all curves at the cursor position, open the Properties Menu (cursor over graph, right click, left click Properties) and left click Cursor tab to obtain the display shown in FIGURE 3-24 .

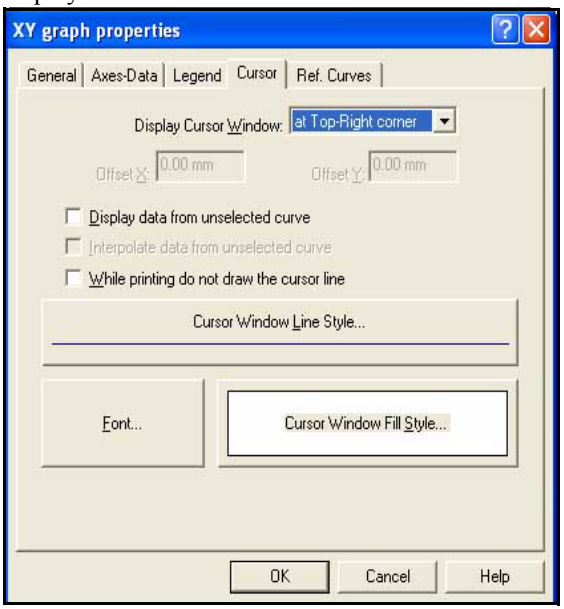


FIGURE 3-24 Properties Menu, Cursor

Left click the check box to the left of the phrase "Display data from unselected curve" and left click **OK** to obtain a cursor box displaying levels for all curves as shown in FIGURE 3-25 .

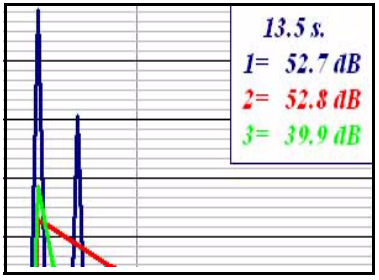


FIGURE 3-25 Multiple Parameter Cursor Box

Time History: All Parameters

The number of parameters which appear in a time history data block depend on the instrument used to make the measurement, and the number of parameters which have been selected to be included in the measurement. Level versus Time graphs are created and modified in the same manner for all of these.

Models 720 and 820

When working with time history data from the Models 720 and 820, there are only two parameters which can be measured; Leq and Peak. The example above describes how to work with graphs of this type.

System 824

A time history data block from a System 824 can include as many as 37 values and a 1/1 or 1/3 octave spectrum for each time point. The level values which can be measured are listed below:

1. Short Leq

2. Each of the following, for A, C and Flat Weighting:

- Leq
- Peak
- Maximum Slow, Fast and Impulse
- Minimum Slow, Fast and Impulse
- Live Slow, Fast and Impulse

3. 2 Battery levels, internal and external

4. Temperature (sensor inside instrument)

Graph Sound Level, Battery and/or Temperature Values

Following the steps from the example above, left click **File/ Open**, highlight the document **Time History_824_All Parameters** from the Demo Data Folder and left click **Open** to open a document containing that measurement. Next, left click **Insert/Graph Template**, select the measurement **Time History Data Block (TH)** and insert the Template **"Time-History** from the 824_ssa folder**"**. Left click **Next**, then **Finish** to produce the graph of Short Leq as shown in FIGURE 3-26 .

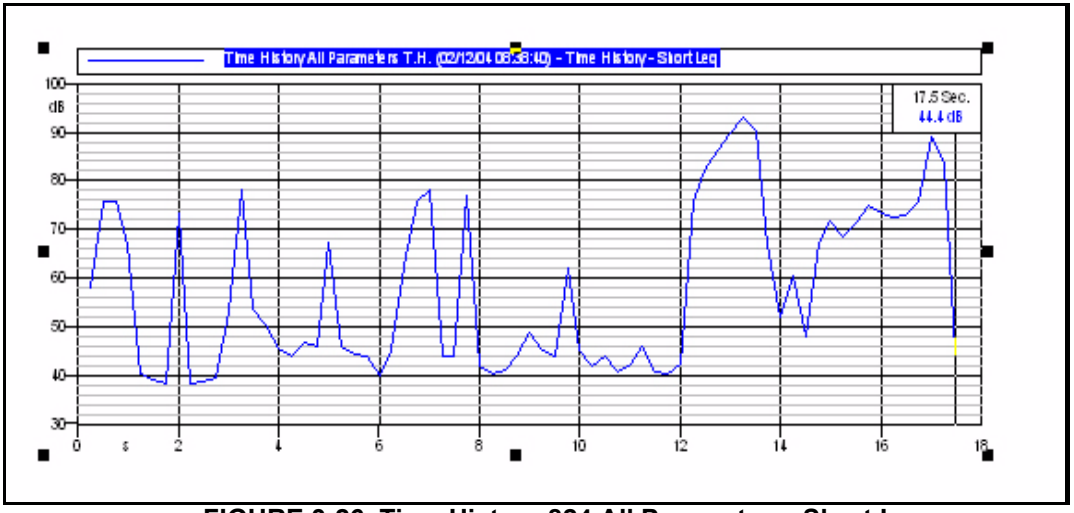


FIGURE 3-26 Time History 824 All Parameters; Short Leq

If your graph displays a curve other than "Time History-Short Leq", it does not really matter for the purposes of this example. However, this could be changed by following the procedure described in the section "Change the Parameter Being Displayed" on page 3-7 .

To obtain the same graph, it may be necessary to autoscale the x and y axes (left click on scale, right click, left click on Autoscale)

Open the Properties Menu (cursor over graph, right click, left click Properties) and left click the Axes-Data tab to obtain the menu shown in FIGURE 3-27 .

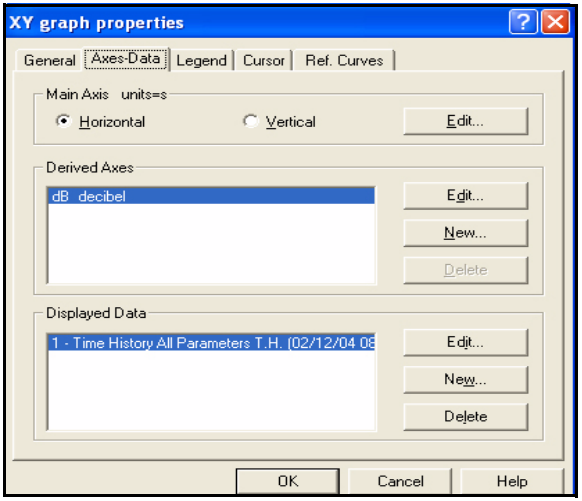


FIGURE 3-27 Properties Menu; Axis-Data

Left click the **Edit** button to the right of the Displayed Data field to obtain the menu shown in FIGURE 3-28 .

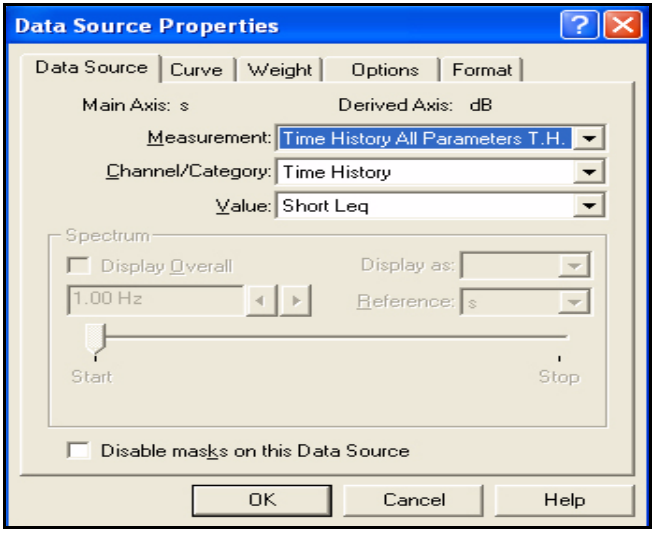


FIGURE 3-28 Time History Data Source Menu

Left click the down arrow on the right side of the Value field to open the window shown in FIGURE 3-29 .

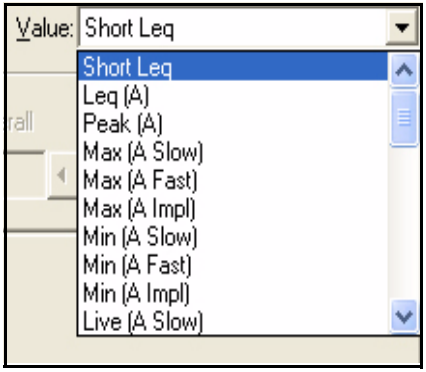


FIGURE 3-29 New Display Data Value Window

Move the slider down to view all the items in the list. A curve can be added to the graph for any of these parameters. Clearly the challenge is to show only those parameters meaningful for the desired result and also to use multiple graphs to present data in meaningful combinations. The user would select items one-by-one as described in the section "Add Curves for Fast and Slow" on page 3-14 to produce a graph with curves for multiple parameter.

Graph Frequency Band Levels

It was mentioned in "System 824" on page 3-20 that the System 824 can measure spectra as a function of time along with the other parameters of a time history. Obviously we cannot add a curve representing level versus frequency to a graph of level versus time. However, we can add to the graph curves presenting the level in a specific frequency band as a function of time.

Open once again the Time History Data Source Menu shown in "Time History Data Source Menu" on page 3-22 . Left click the down arrow on the right of the “Channel/Category” field to obtain the window shown in FIGURE 3-30 .

FIGURE 3-30 Time History Category Window

Up until now we have been working with the category Time History, which was made active by the template which we used to create the display. We can see here that we have a second option, TH Spectrum. Left click that one to obtain the menu shown in FIGURE 3-31 .

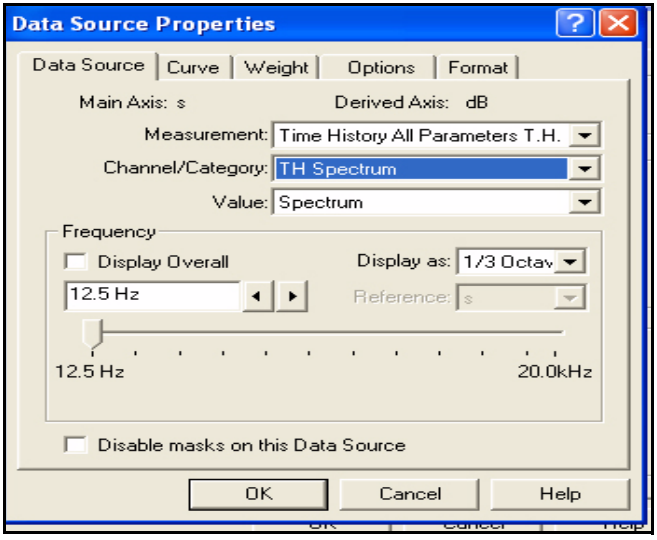


FIGURE 3-31 Data Source Properties; TH Spectrum

Look at the Frequency section of this menu. We can see from the data fields that we are working with a 1/3 octave spectrum and that the 12.5 Hz frequency band is selected. We can either use the left/right arrows alongside the frequency field or the slider beneath it to select the desired frequency for the curve.

Select the 3.15 kHz band and left click **OK** twice to produce the graph. Autoscale the amplitude to obtain the display shown in FIGURE 3-32 .

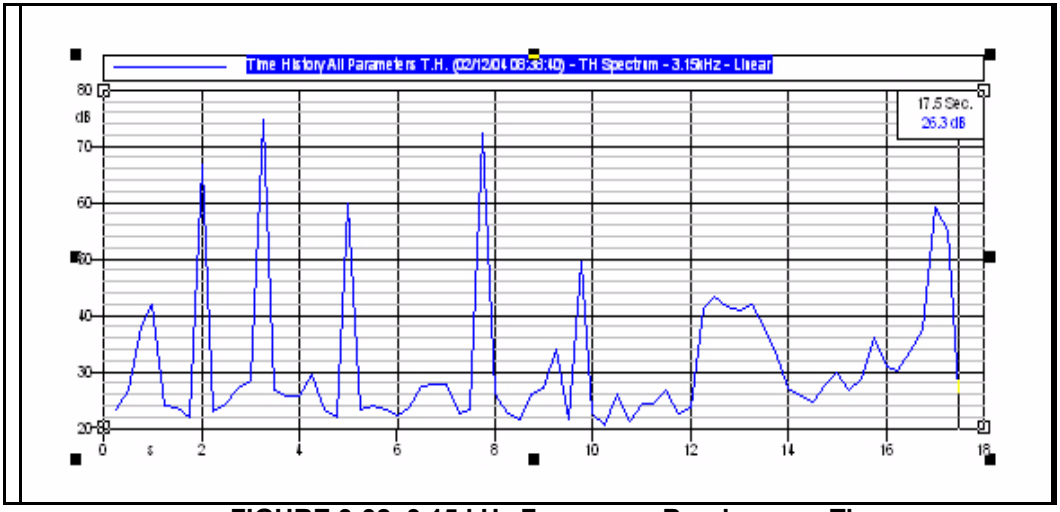


FIGURE 3-32 3.15 kHz Frequency Band versus Time

Graph Spectrum Overall Level

Repeat the steps to display the menu shown in FIGURE 3-31 and check the Display Overall box, which will close the frequency band selection field. Click **OK** twice to obtain a graph of the overall (summation) level of all frequency

bands in the spectrum as a function of time as shown in FIGURE 3-33 ..

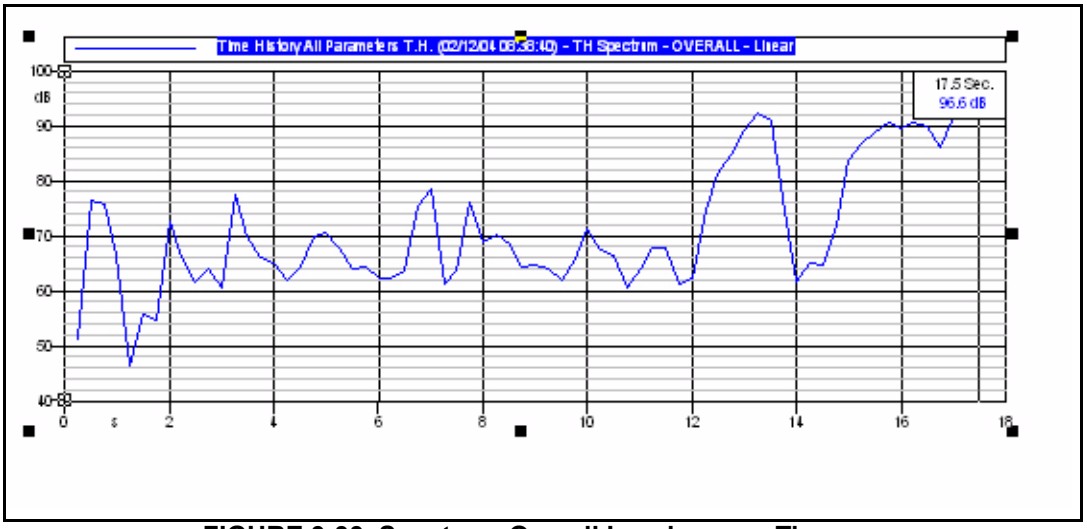


FIGURE 3-33 Spectrum Overall Level versus Time

CHAPTER

4 Single Spectrum Displays

Having worked with time history displays in the preceding chapter, we will now move on to frequency domain data. Spectral data of the type being displayed here can be measured using the Models 2800, 2900, 3000+, 3200 and the System 824.

Open a Document

In normal practice, the user will begin with a document which has no measurements contained in it. This document may be blank or it may have embedded headings, logos, etc. previously created by the user. However, since we are working with demo data rather than with an instrument, we have created these demo documents which already contain measurements from Larson Davis instruments. Because the documents we are using for these exercises contain measurement data, we have made them read-only. If you wish to store the results you generate during these exercises, store them as documents with different names.

Left click **File/Open**, double left click **Third Octave Spectrum** (or highlight with cursor and left click **Open**). This will open a document containing a measurement file. Initially, an empty page will be shown, the first page of the document onto which we will place graphs, table and other object to create a document to be used for reports, archiving of data, etc.

Left click **Process/Measurement/Information** to obtain the display shown in FIGURE 4-1 .

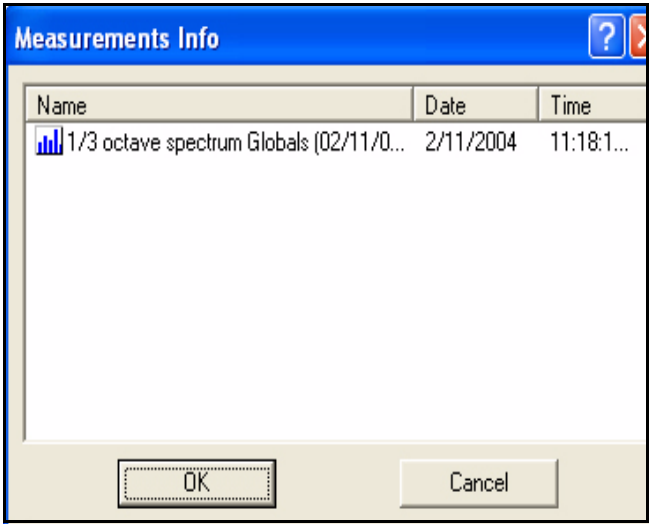


FIGURE 4-1 Measurement Information

This displays the separate measurements contained in this measurement file. In this case there is only a single measurement; a 1/3 octave spectrum. Left click **Cancel** to close this window.

Select a Graph Template

Make sure that the option "All" under "Select Measurement" and "Template Preview" to the right of "Template Search Criteria" have been checked before proceeding.

Left click **Insert/Graph Template** to obtain the display shown in FIGURE 4-2 .

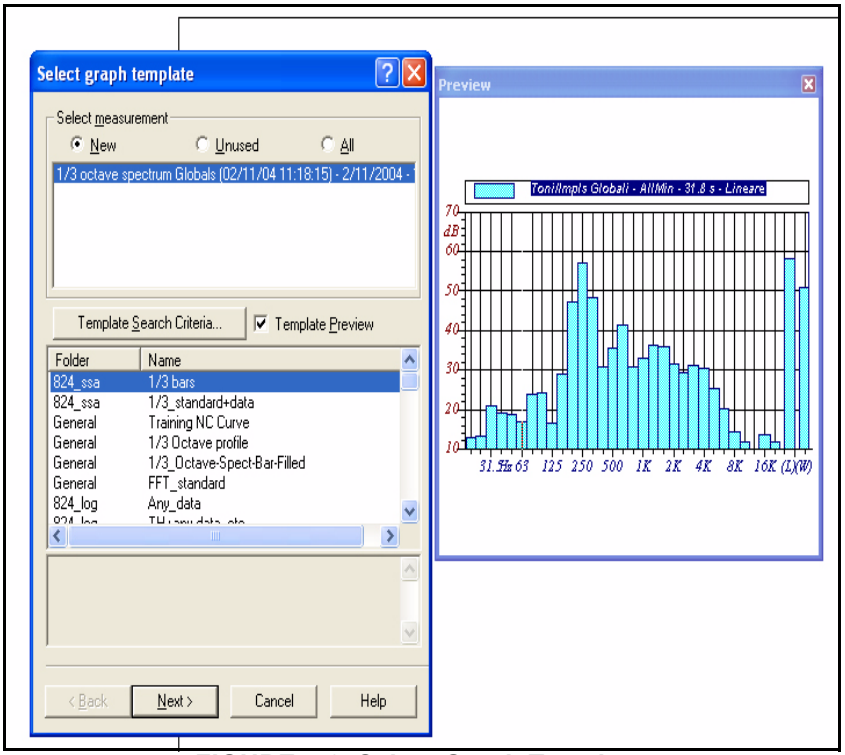


FIGURE 4-2 Select Graph Template

Left click **Template Search Criteria** and left click the down arrow to the right of the “First search in” field to obtain the display shown in FIGURE 4-3 .

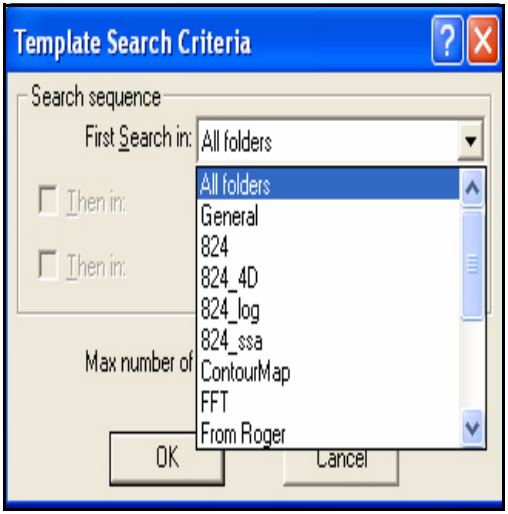


FIGURE 4-3 Template Search Criteria; First Search In Window

When a graph template is created, it is associated with a folder. DNA is delivered with a number of templates placed in several different folders, and user will generally create many of their own. The intention of the folders is to make it easier to identify those templates most likely to be appropriate for use with the measurement we wish to display. We will be using the “all folders” designation, but by selecting specific folder names, the list can be made to show templates from one folder, followed by those of another, followed by those of another, etc.

Highlight “all folders” and left click **OK** to return to the display shown in FIGURE 4-2 . Highlight **1/3 octave profile**

from the General folder and left click **Next** to obtain the **Select template drawing position** window.

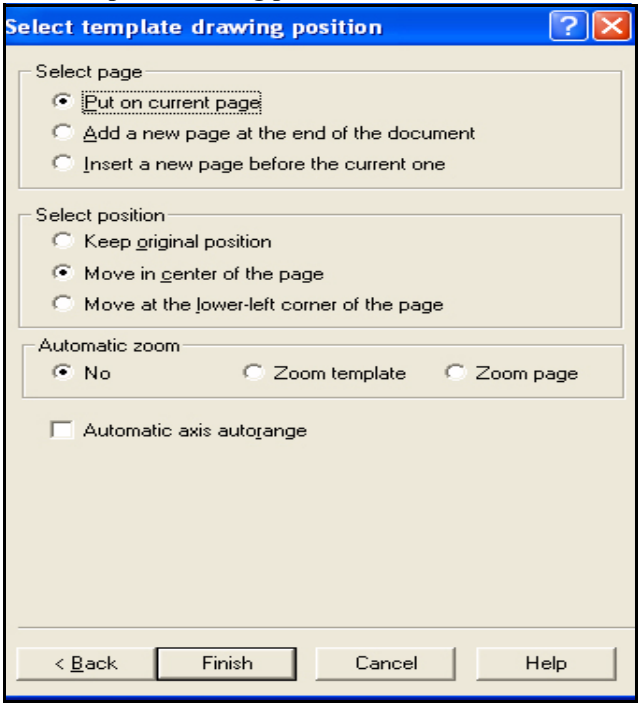


FIGURE 4-4 Select Template Drawing Position

In this case, we will leave the template as is. Left click **Finish** to obtain the display shown in FIGURE 4-5 .

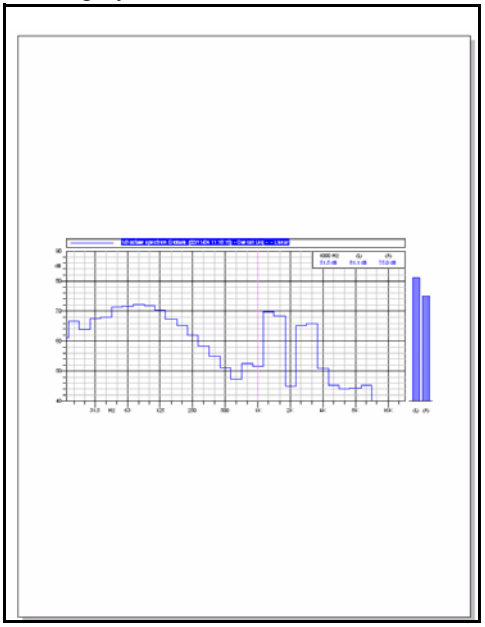
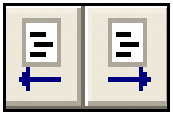


FIGURE 4-5 Document with Third Octave Graph

Page Selection

When displaying the document, we can only display one page at a time. When there are multiple pages, left clicking the icons shown below will shift the displayed page back or forward, respectively.



The graph we see is placed upon a Page Layer. In our work, we will place graphs, tables, objects, etc. on the page layer. Beneath the Page Layer is the Global Layer.

Global Layer

The Global Layer is standard for all pages in the document. In our case we have a plain Global Layer, but for formal documents we can add headers, footers, text and objects such as company logos to this layer in order that they appear on all pages as shown in FIGURE 4-6 .

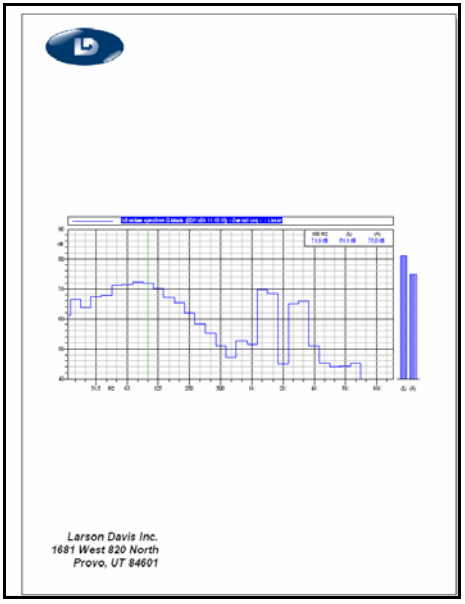
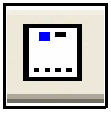


FIGURE 4-6 Logo and Address Added to Global Layer

To work with the Global Layer, left click the Global Layer icon, shown below, in the Toolbar at the top of the screen.



Inserting Graphics

To insert graphics such as logos onto the global layer, left click **Insert/Picture** and use the Insert Picture Window to define the path to the desired graphic.

Inserting Text

To insert text, left click the Text icon, shown below, in the Toolbar at the left of the screen then left click on the document to open the Text Properties Menu.

Page Layer

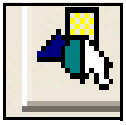
The page layer is where graphs, tables, reports, graphics and saved files are placed onto specific pages of the document. These are treated as objects, which can be resized and moved. Drawn objects can also be created using the drawing icons on the left Toolbar. See the DNA User Manual, IDNA.01 for more details on working with objects.

Cursor Priority

When working on the page layer, the cursor will always be assigned one of two priorities; Object or Graph. Both of the icons used to set the priority are found in the Toolbar at the top of the screen.

Selection Priority: Object

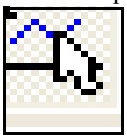
To set the priority to Object, left click the following icon.



With the priority set to Object, the cursor is used to work with objects. This permits an entire graph, for example, to be resize and relocated on the page.

Selection Priority: Graph

To set the priority to Graph, left click the following icon.



If you find that actions using the cursor are not producing the expected results, left click the selection priority icon associated with the task you wish to accomplish; the priority may simply be set to the alternative mode.

With the priority set to Graph, the cursor is used to work within the graph. For example, left clicking within the display of the graph with fix the cursor position and right clicking will open a window for various other actions such as opening the Properties Menu. Right clicking on one of the graph axes will open a window for various actions associated with that axis such as autoscaling or modifying the range.

Cursor

With the cursor priority set to Graph, left click at various places within the graph and note that the cursor moves to the frequency value corresponding to that location along the x axis.

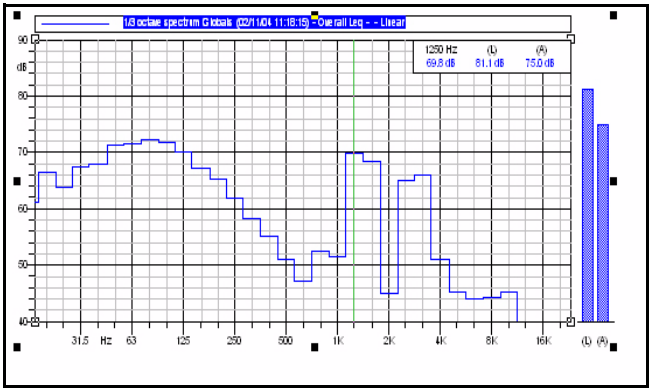


FIGURE 4-7 Third Octave Graph, Cursor at 1 kHz

If there is not already a cursor window in the template, a separate cursor window can be created as described in 'Use the Cursor Control Window" on page 5-9

The template includes a cursor window at the upper right indicating the level at the cursor position as well as the Linear (L) and A-Weighted (A) overall energy levels for the entire spectrum.

The cursor can also be moved using the left and right arrows on the right of the computer keyboard.

Modify Frequency Axis

Techniques for modifying the frequency axis are described in ‘Modify the Frequency Axis” on page 5-11.

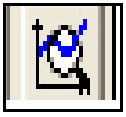
Shift and Autoscale the Amplitude Axis

Techniques for shifting and autoscaling the amplitude axis are described in ‘Shift and Autoscale the Amplitude Axis” on page 5-14.

Generate a Larger Display

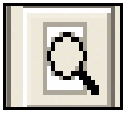
So far we have been working with the display as seen on the full document page. In order to obtain a larger display, left click the **Fit To Graph** icon on the vertical Toolbar on the left of the screen (fourth from the bottom).

Fit To Graph



To return the smaller display seen on the full document page, left click the **Fit to Page** icon.

Fit to Page



This icon is located above the **Fit To Graph** icon

To increase the resolution of a portion of the spectrum graph, first define the section of the spectrum. This is done by placing the cursor at one point in the graph and, while holding down the left mouse button, slide the cursor to another point. This will define a section as shown in FIGURE 4-8 .

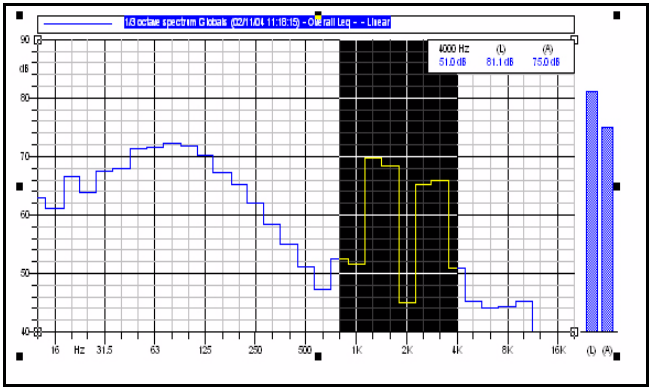


FIGURE 4-8 Third Octave Spectrum, Zoomed

Place the cursor over the shaded section to be zoomed, right click and left click **Zoom**. Left click in the graph area to obtain the graph shown in FIGURE 4-9 .

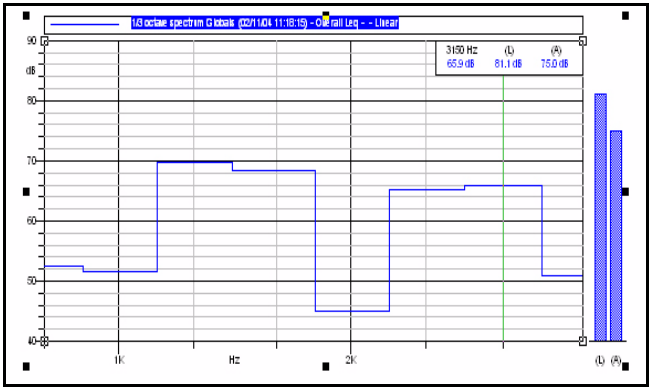


FIGURE 4-9 Third Octave Graph, Zoomed

To return to the original frequency scaling, place the cursor over the frequency scale until a double headed horizontal arrow appears, right click and left click **Autoscale**.

Add Text to Horizontal Scale

Begin by setting the Cursor Priority to Object as described in 'Selection Priority: Object" on page 4-7.

Left click the **Text** icon on the Toolbar at the left of the screen, then left click on the page where the text is to be placed. This will open the menu as shown in FIGURE 4-10 .

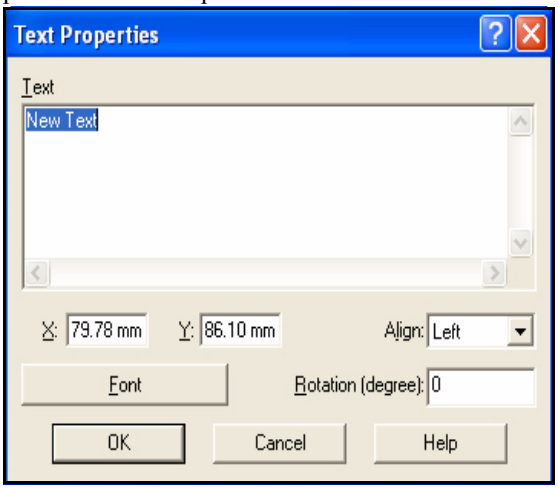


FIGURE 4-10 Text Properties Menu

Text can be placed anywhere on the page; we are adding text to the axes as a simple example of the technique.

Type the desired text into the Text window, left click **Font** to select the font characteristics (size, type, color), define the placement (X, Y), alignment and rotation, then left click **OK** to place the text. For this example, we will place the text "Frequency, Hz" below the x axis and "Sound Level, dB" along the y axis.

The text will appear as a text object, indicated by the small black rectangles at the corners of the box. When working with a text object, simply click inside it's box to select it, as indicated by the appearance of the corner rectangles. To move a text object, left click to select the box, hold down the left mouse button and slide the box to the desired position.

Some experimentation is usually required at first to obtain the desired results, as shown in FIGURE 4-11 .

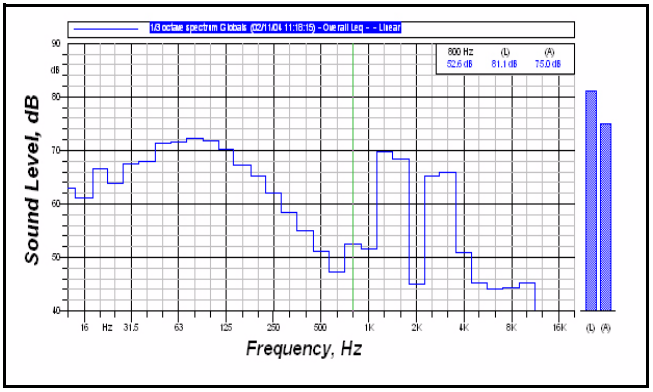


FIGURE 4-11 Graph with Text Added

CHAPTER

5 Multiple Spectrum Displays

In this chapter we will work with data sets consisting of five spectra. In the first example, we will work with five FFT spectra which were measured and stored independently as separate files. This is the type of data one would obtain when measuring FFT or 1/1, 1/3 Octave spectra and storing each spectrum manually.

In the second example, we will work with five 1/3 octave spectra stored in a single data block. In this example, the spectra were measured using a System 824. The spectra were measured and stored automatically as part of a time history, at a rate of one per second. Although we use 1/3 octave spectra in this example, the same techniques would work if the data were FFT spectra.

Multiple FFT Spectra in Separate Data Blocks

This demo data file contains five separate FFT spectra measured using a System 824 in the FFT Mode.

Left click **File/Open,** select **FFT_5 Spectra** from the Demo Data Folder, and left click **Open**. This will create a blank page onto which we will create displays of the data contained in that demo data file.

In normal practice, the user will begin with a document which has no measurements contained in it. This document may be blank or it may have embedded headings, logos, etc. previously created by the user. However, since we are working with demo data rather than with an instrument, we have created these demo documents which already contain measurements from Larson Davis instruments.Because the documents we are using for these exercises contain measurement data, we have made them read-only. If you wish to store the results you generate during these exercises, store them as documents with different names.

Left click **Process/Measurement/Information** to obtain a display of the data contained in the document we just opened shown in FIGURE 5-1

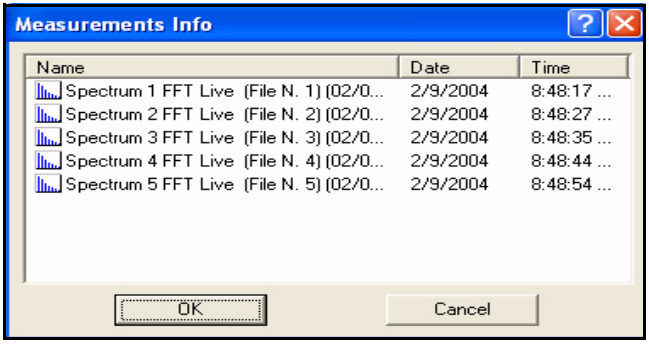


FIGURE 5-1 Measurements Information Menu

Left click **Cancel** to close the display window.

Generate a Display

In this section we show how a template is opened to create a data display. In normal practice, the user will download data from an instrument and the menu shown in FIGURE 5-2 "Select Graph Template Menu" on page 5-3 will automatically be opened for the selection of a template. In this example, however, we need to open it manually.

Select a Template

Make sure that the option "All" under "Select Measurement" and "Template Preview" to the right of "Template Search Criteria" have been checked before proceeding.

Left click **Insert/Graph Template**, which will open the Select Graph Template Menu shown in FIGURE 5-2

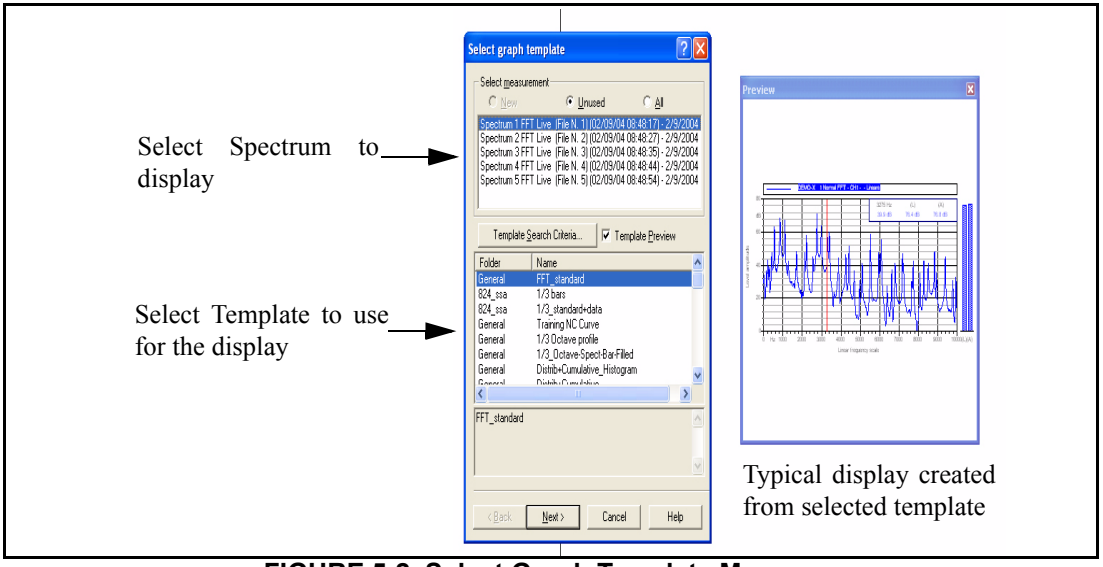


FIGURE 5-2 Select Graph Template Menu

Select a Spectrum

Only one spectrum can be selected. In the section "Select Additional Spectra" on page 5-4 it is shown how to select additional spectra for processing by the same template.

We can select one of the spectra listed in the upper window to display by using the cursor to highlight it.

Select **Spectrum 1**.

The example displays shown for each template do not represent the data contained in the spectrum selected; they are just representative displays which might be seen.

There are many templates listed in the lower window of the menu. To the right is an example of a typical display which is created using the highlighted template. Move the cursor up and down to highlight different templates and see what type of display would be generated if that one were selected.

Further details on templates and their folders are presented in Chapter 8 "Templates" on page 8-1

Select the first; FFT_Standard from the folder General and left click **Next,** which will open the Repeat Insert Template Menu shown FIGURE 5-3 .

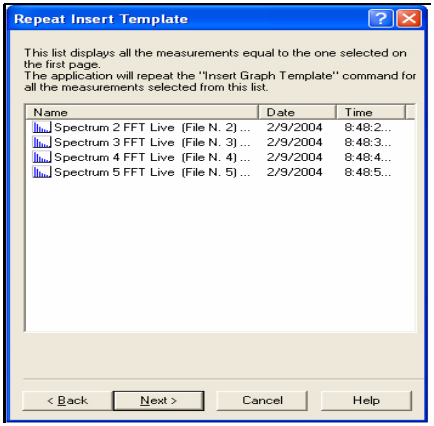


FIGURE 5-3 Repeat Insert Template Menu

Select Additional Spectra

The Repeat Insert Template Menu provides the opportunity to open identical templates for any or all of the additional spectra. To select additional spectra, hold down the Alt key and highlight the desired spectra one-by-one. Or, to select all the spectra listed, highlight the first, then hold down the Shift key and left click on the last to highlight all of them.

Continuing our example, select all spectra.

Left click **Next** to proceed. This will open the Select Template Drawing Position Menu shown in FIGURE 5-4 .

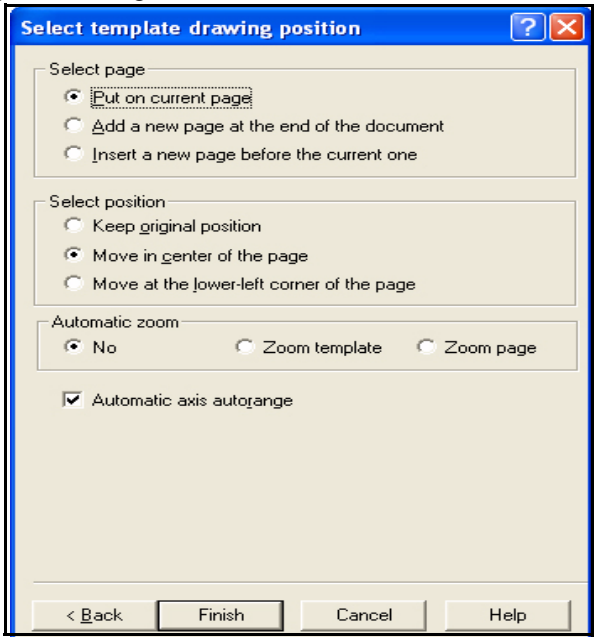


FIGURE 5-4 Select Template Drawing Position Menu

Modify as follows:

- **Select Page:** Put on current page
- **Select Position:** Move in center of the page
- **Automatic Zoom:** No
- **Automatic axis autorange:** check

Left click **Finish.**

This generates five pages, each having one graph.

It may be necessary to Autoscale the horizontal and vertical scales to obtain the graph shown.

The first page remains blank and the spectra appear on each of the following pages. The page initially displayed is the last, as shown in FIGURE 5-5 "Display of Spectrum 5" .

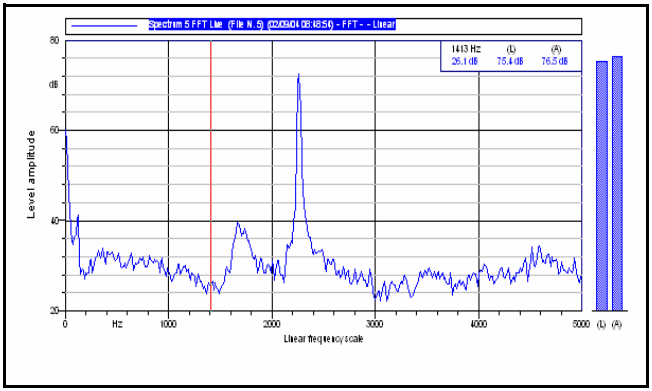


FIGURE 5-5 Display of Spectrum 5

Generate a Larger Display

If these functions do not work, be sure you are in the Selection Priority:Graph mode and have left clicked the graph itself before using them. See section "Set the Cursor Priorities: Object or Graph" on page 5-8.

So far we have been working with the display as seen on the full document page. In order to obtain a larger display, left click the Fit To Graph icon on the vertical Toolbar on the left of the screen (fourth from the bottom).

Fit To Graph

To return the smaller display seen on the full document page, left click the icon above the Fit To Graph icon

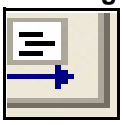
Fit to Page

Display Different Pages

Page Through the Document

There are two keys in the Toolbar at the top of the screen which can be used to move through the pages in the document.

Next Page



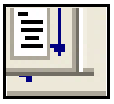
Previous Page

Left clicking these will result in the display of the next, or previous, page.

Go Directly to a Specific Page

To go directly to a specific page, left click the following icon in the Toolbar at the top of the screen.

Go To Page



This will open the Go To Page Menu shown FIGURE 5-6 .

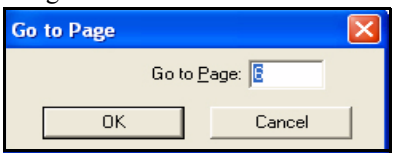


FIGURE 5-6 Go To Page Menu

Enter the desired page number and left click **OK** to display that page.

Experiment with these icons to become familiar with moving between the different pages in this document.

Set the Cursor Priorities: Object or Graph

When working with a particular display, it is important to understand the following:

- The complete display is an object
- The presentation of the data is a graph.

When working with a document, the cursor priority is either Object or Graph, set using icons from the toolbar at the top of the screen as described in the next section.

When the priority is Object, then the user can move it, delete it, and take other actions appropriate to an object.

When the priority is Graph, the user can work with the graph itself, moving the cursor, expanding the scales, etc.

Set the Priority to Object

Set the Selection Priority to Object by left clicking the icon in the Toolbar shown below.

Selection Priority:Object

Left click this icon and place the cursor within the display, hold the left mouse button down and move it. Note that the entire display (defined as an object) moves accordingly. The entire display can be deleted, copied, pasted and any other action typically associated with objects.

Set the Priority to Graph

If you are trying to use the cursor in a graph and it will not work, the document is probably set to Priority:Object. Set it to Priority:Graph, as described in this section.

Set the Selection Priority to Graph by left clicking the icon in the Toolbar shown below.

Selection Priority:Graph

Left click this icon and place the cursor within the display and left click. Note that a graph cursor appears at that position. Left click at other positions and note that the graph cursor moves to that position.

Or, use the left and right arrow keys on the right of the keypad and note that the graph cursor moves accordingly.

For greater control of the graph cursor, left click the icon on the Toolbar shown below.

Use the Cursor Control Window

Left click the Cursor icon in the Toolbar at the top of the screen.

Cursor Control

This will open the cursor control window shown in FIGURE 5-7 above the display.

FIGURE 5-7 Cursor Control Window

Clicking on the individual keys within this window will produce the following results, left to right.

- Jump to the frequency band with the minimum level
- Jump to the lowest frequency band

- Shift left, large steps
- Shift left, one frequency band at a time
- Shift right, one frequency band at a time
- Shift right, large steps
- Jump to the highest frequency band
- Jump to the frequency band with the maximum level

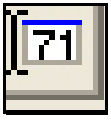
Clicking the box in the upper right corner will close the cursor control window.

Use Cursor Value Window

The template which we have selected to generate this display already includes a window to display the frequency and level corresponding to the cursor position, as can be seen in the upper right corner of. However, to be complete we will show how to open a separate cursor window to display the level.

Left click in the graph area, then left click the **Cursor Value** icon in the Toolbar on the top of the screen.

Cursor Value



This will open the cursor value window shown in FIGURE 5-8 .

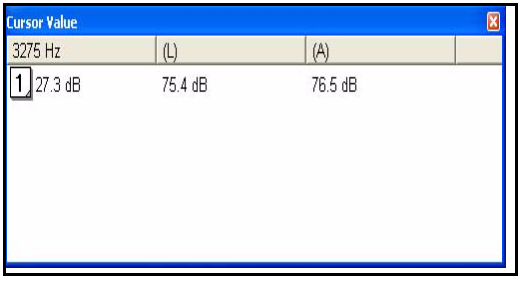


FIGURE 5-8 Cursor Value Window

This displays the frequency and the levels (Linear and A-Weighted) at the cursor position. Move the cursor across the frequency scale and note that the values shown in the Cursor Value Window change accordingly. Clicking the box in the upper right corner will close the cursor value window.

Modify the Frequency Axis

The process of modifying a spectrum display to show greater resolution over a portion of the measured frequency range is frequently referred to as "graphic zoom". This is different from a zoom FFT analysis which refers to the signal processing used to obtain a higher resolution measurement.

To produce a graph showing more resolution for a selected portion of the frequency range, position the cursor over the title of the frequency axis, just below the graph, until a horizontal double headed arrow appears.

Open the Properties Menu for the frequency scaling by right clicking and then left clicking Properties. Left click the Scaling tab to obtain the Frequency Axis Scaling Menu shown in FIGURE 5-9 .

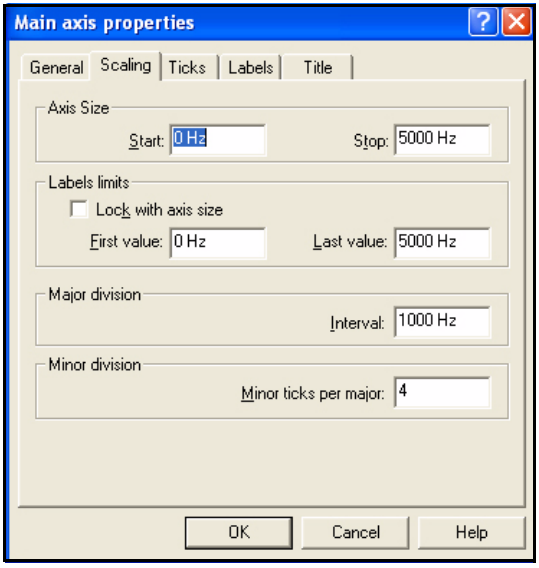


FIGURE 5-9 Frequency Axis Scaling

Rescale the Frequency Axis

Change the properties as follows:

- **Axis Size, Start** = 2000 Hz
- **Axis Size, Stop** = 3000 Hz
- **Label limits:** check Lock with axis size
- **Major Division, Interval:** 100

and left click **OK** to produce the new graph shown in FIGURE 5-10 .

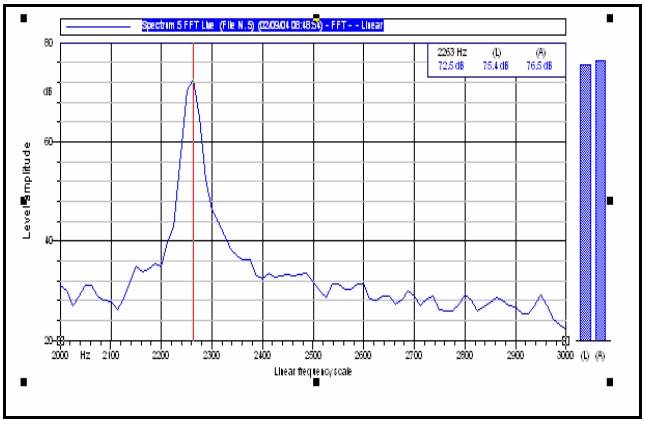


FIGURE 5-10 FFT Spectrum 5 with Graphic Zoom of Display.

Slide the Frequency Scale

Position the cursor over the title of the frequency axis, just below the graph, until a double headed arrow appears. Hold down the left mouse key and drag the arrow left or right to display the portions of the spectrum previously offscale in FIGURE 5-10 . FIGURE 5-11 shows an example where the

graph has been dragged to the right to show the portion of the curve previously offscale on the left side.

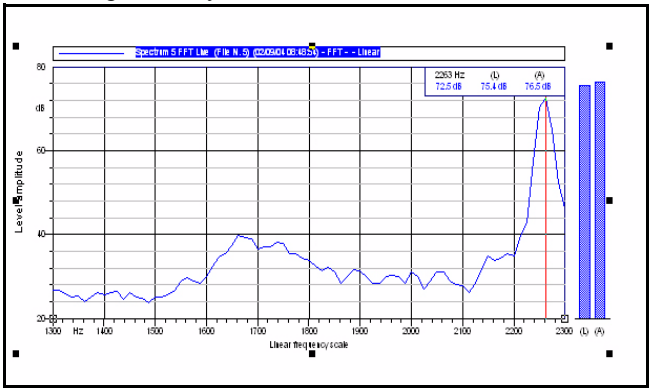


FIGURE 5-11 FFT Spectrum 5 with Graphic Zoom of Display, Dragged to the Right.

Autoscale the Frequency Axis

Position the cursor over the title of the frequency axis, just below the graph, until the horizontal double headed arrow appears. Right click, then left click **Autoscale** to return the frequency axis to that of the original spectrum

Shift and Autoscale the Amplitude Axis

Position the cursor over the title of the amplitude (Y) axis, just to the left of the graph, until a vertical double headed arrow appears. Right click to open the window shown in FIGURE 5-12 .

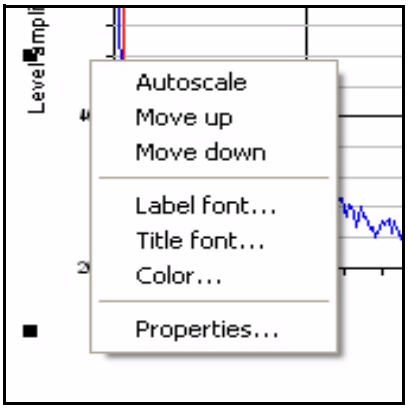


FIGURE 5-12 Y Axis Scaling Window

Shift the Y Axis

Left click on Move up or Move down to shift the axis accordingly. Use this to move the axis so that the curve is near the bottom of the curve or offscale to the top.

If you are trying to use the cursor in a graph and it will not work, the document is probably set to Selection Priority:Object. Set it to Selection Priority:Graph, as described in section "Set the Cursor Priorities: Object or Graph" on page 5-8.

Autoscale the Y Axis

To set the amplitude axis in the best position to display the curve, open the same window shown in FIGURE 5-12 and left click **Autoscale**.

Combine the Spectra into a Single Graph

Suppose, in addition to having a separate display for each spectrum, we wish to generate a graph displaying all five spectra.

We will begin by adding a new page to the end of our present document.

Left click **Insert/Page** to open the Add Page Menu shown in FIGURE 5-13 .

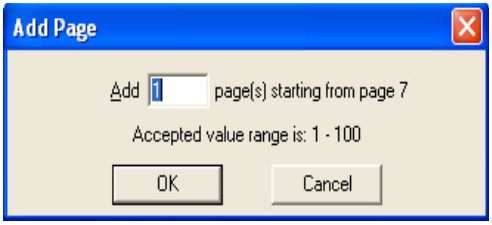


FIGURE 5-13 Add Page Menu

Enter the number of pages desired to be added (in this case 1), and click **OK**.

You will need to left click the Selection Priority: Object icon first if the Selection Priority is presently set to Graphic.

Now move to the display of spectrum 1 on page 2 by either using the **Go To** Page icon or using the Previous Page icon repeatedly.

Copy the display on page 2 (Spectrum 1) by right clicking within the graph area and left clicking **Copy**.

Move back to the blank page on page 7 by either using the **Go To Page** icon or using the **Next Page** icon repeatedly. Then, paste the copy onto this page by left clicking **Edit/ Paste**.

We now have a graph of a single spectrum as shown in FIGURE 5-14 .

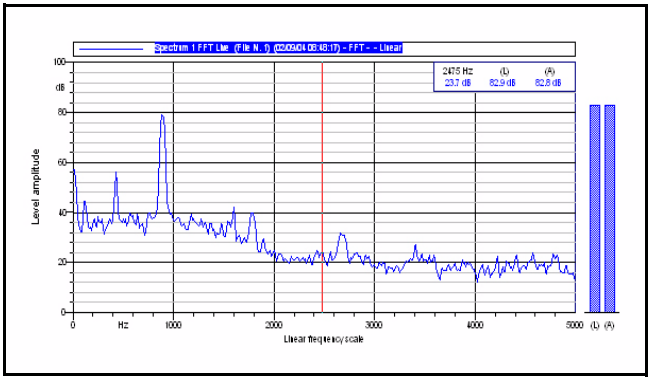


FIGURE 5-14 FFT Spectrum 1

Next, place the cursor in the display area, right click, select Properties to open the XY Properties Menu and left click the General Tab to obtain the window shown in FIGURE 5-15 .

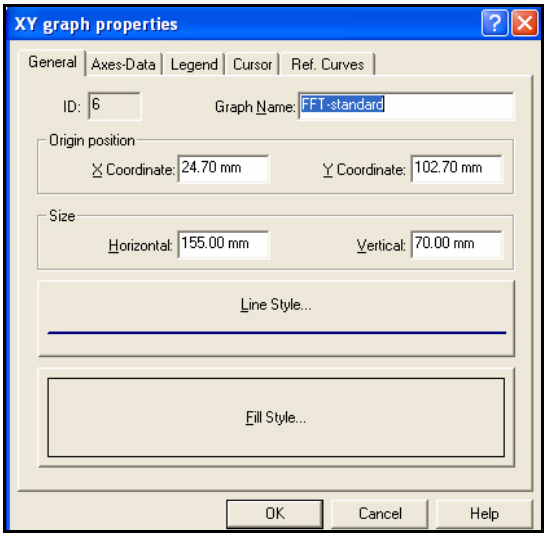


FIGURE 5-15 XY Graph Properties Menu

There are many actions which can be performed from this menu. For now we will concentrate on creating a multiple spectrum graphic.

Left click the Axes-Data tab to open the menu shown in FIGURE 5-16 .

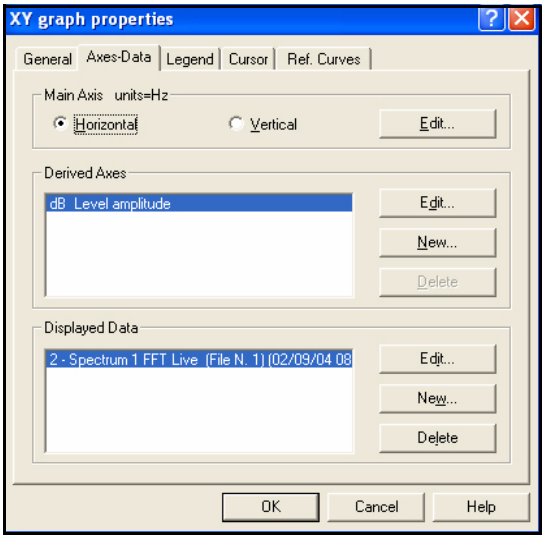


FIGURE 5-16 XY Graph Properties:Axis-Data Tab Menu

Note that Displayed Data field lists only a single spectrum, Spectrum 1 FFT. To add another spectrum, left click the **New** button on the right of the Displayed Data field to open the Data Source Properties Menu shown in FIGURE 5-17 .

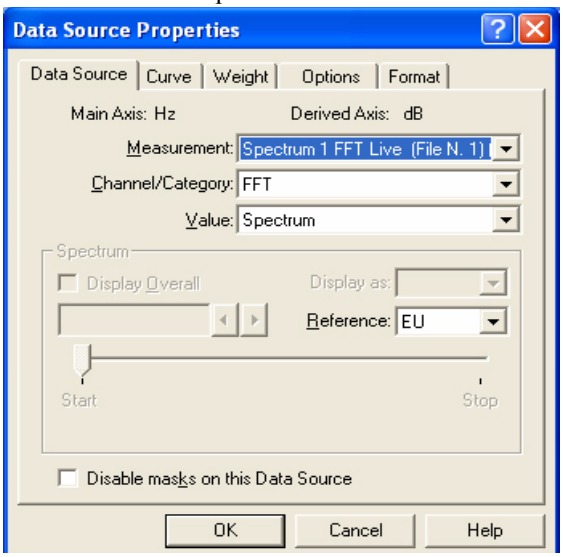


FIGURE 5-17 Data Source Properties Menu

Left click the down arrow on the right side of the Measurement field to open a menu listing the available spectra as shown in FIGURE 5-18 .

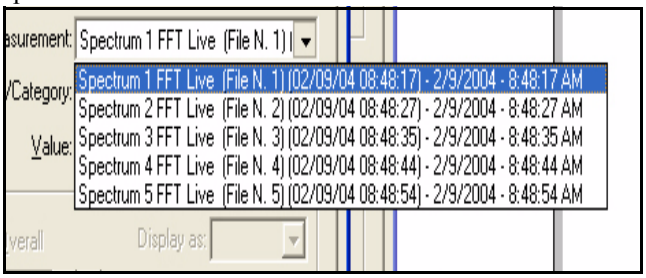


FIGURE 5-18 Spectra Listing

We already have graphed Spectrum 1, so use the cursor to highlight Spectrum 2, left click to make the selection and then click **OK t**o close the Data Source Properties Menu. Left click **OK** again to close the Properties Menu and display the new graph with Spectra 1 and 2 as shown in FIGURE 5-19 .

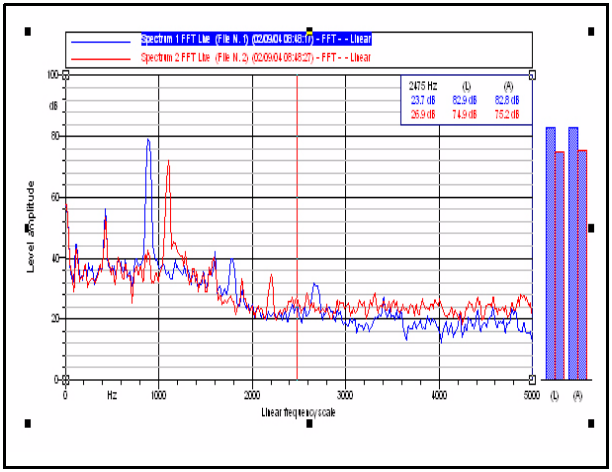


FIGURE 5-19 FFT Spectra 1 and 2

Repeat the technique to add FFT Spectra 3, 4 and 5 to the graph and obtain the graph shown in FIGURE 5-20 .

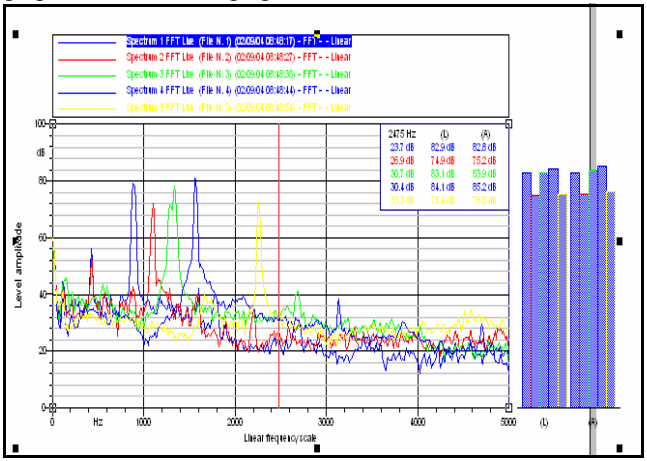


FIGURE 5-20 FFT Spectra 1, 2, 3, 4 and 5

Resize the Display

The vertical bars on the right of the graph show the Linear and A-Weighted values for each spectrum. Note that these are beyond the right edge of the document.

Make sure you are in the Document View by left clicking the **Fit To Page** icon on the Toolbar on the left side of the page. To resize the graph, left click the Selection Priority: Object icon in the Toolbar. Note the small black rectangles defining the corners of this Object. Move the cursor over the rectangle on the lower right until a small diagonal arrow appears. Hold down the left mouse button and move this corner to the left and up or down until the object has the desired size which fits within the document. The other corners can be similarly moved. If necessary, position the cursor over the center of the display, hold down the left mouse button and slide the entire object until it is positioned as desired.

Don't forget to left click the Selection:Priority:Graph icon if you want to work with the graph again; move the cursor, note the levels, etc.

Multiple 1/3 Octave Spectra in a Single Data Block

Left click **File/Open,** select **Third Octave, 5 Spectra in One Block** from the Demo Data Folder, and left click **Open**. This will create a blank page onto which we will create displays of the data contained in that demo data file.

Left click **Insert/Graph Template** to open the Select Graph Template Menu shown in FIGURE 5-21

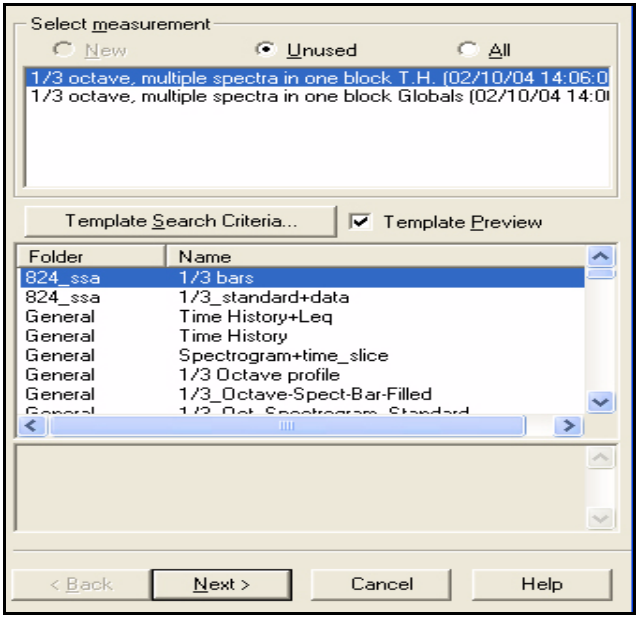


FIGURE 5-21 Select Graph Template, 5 Spectra in One Block

Make sure that the option "All" under "Select Measurement" and "Template Preview" to the right of "Template Search Criteria" have been checked before proceeding.

Two data blocks are listed under **Select Measurement**. The first is a time history data block, which contains the five spectra we measured automatically. This is different from the proceeding example where all five spectra appeared under **Select Measurement**. The second is a global data block with data related to the complete measurement period.

Select the first measurement block (time history) and the first template listed, **1/3 Octave profile,** from the General folder, then left click the **Next** button. When the Select Drawing Position Menu appears, left click **Finish**. This will produce the graph shown in FIGURE 5-22

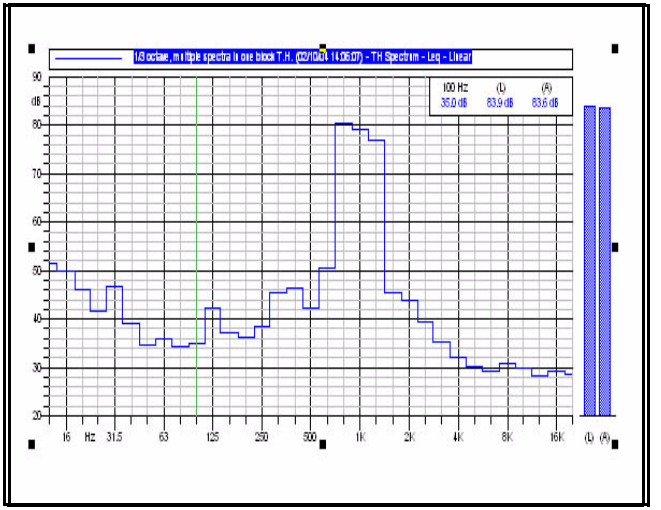


FIGURE 5-22 First Spectrum of Five 1/3 Octave Spectra

Left click **Selection Priority:Graph** to be able to move the cursor and examine the data.

Change Curve to Filled Bars

Open the Properties Menu (cursor over graph, right click, left click Properties), left click the Axes-Data tab and double left click the item in the Displayed Data field (or left click the **Edit** button to the right of the window) and left click the Curve tab to obtain open the menu shown in FIGURE 5-23

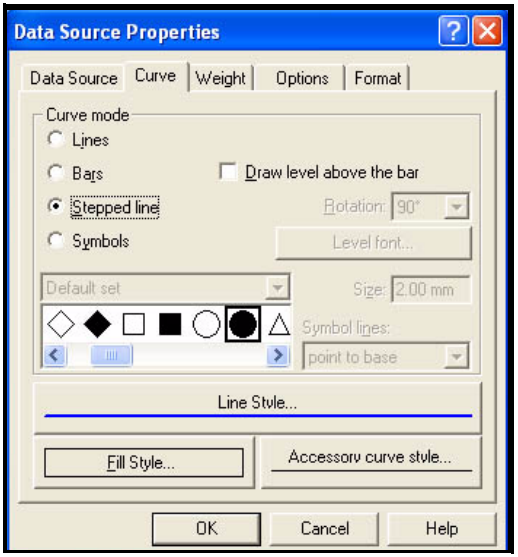


FIGURE 5-23 Data Source Properties, Curve Menu

In the Curve Mode section, select Bars. Left click the Fill Style button to open the menu shown in FIGURE 5-24 .

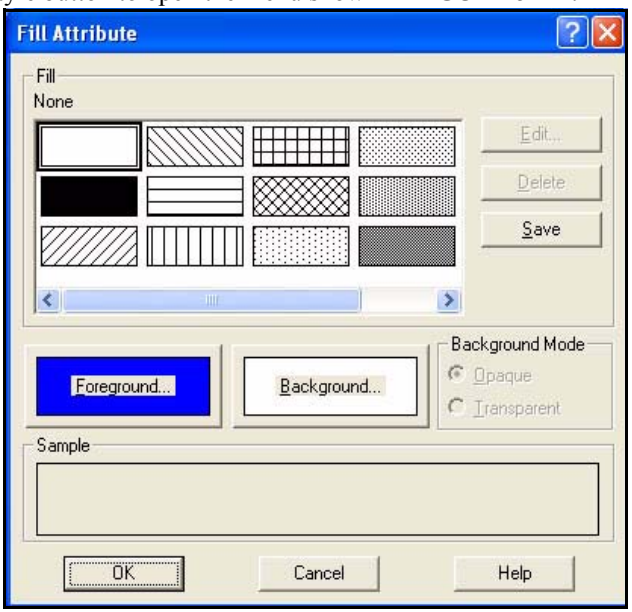


FIGURE 5-24 Fill Attributes Menu

In the upper left corner, we can see that the Fill is presently set to none. The fill is set by selecting any of the sample boxes shown in the rectangle with the slide bar beneath it. For our example, left click the black rectangle on the left side, 2nd down from the top. This will change the fill to solid and open a rectangle showing how the bars will look.

Left click the rectangle labeled Foreground to open a menu of colors, shown in FIGURE 5-25 .

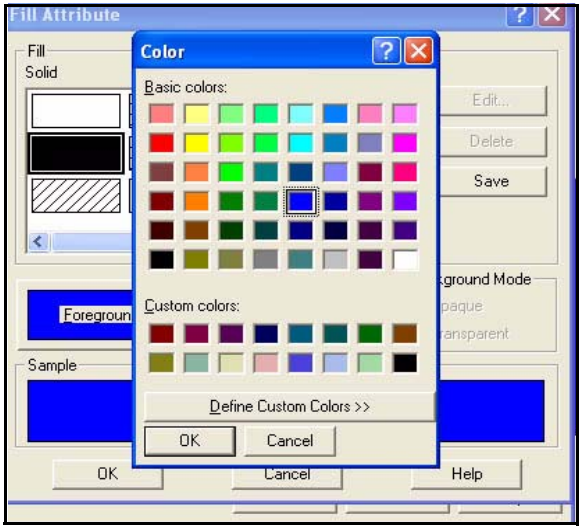


FIGURE 5-25 Fill Color Menu

To continue our example, left click the blue rectangle, 5th column, 4th row and left click **OK** four times to obtain the graph shown in FIGURE 5-26 .,

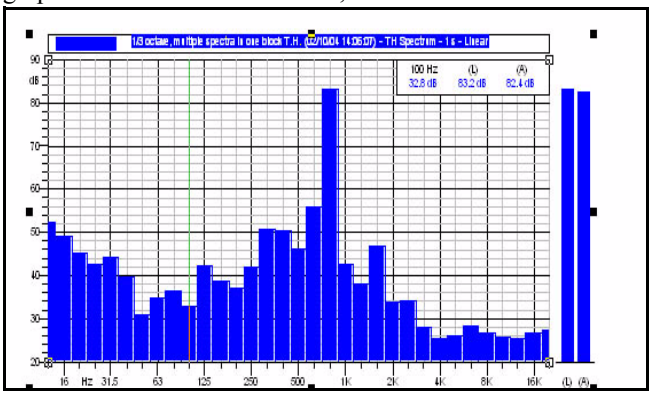


FIGURE 5-26 Third Octave Spectrum, Filled Bars

Display All the Spectra in the Data Block

Position the cursor in the center of the graph, right click and select Properties to open the window shown in FIGURE 5-27 .

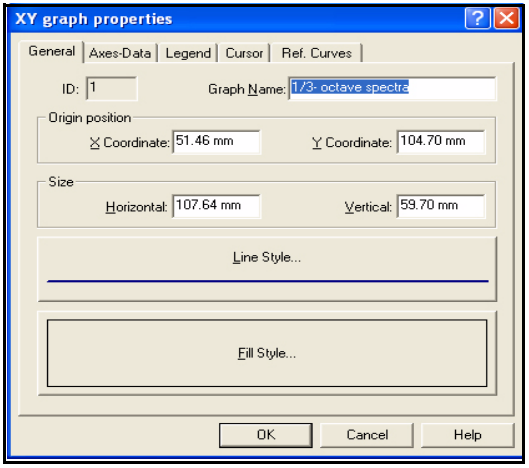


FIGURE 5-27 XY Graph Properties Menu

Left click the Axis-Data tab to open the window shown in FIGURE 5-28 .

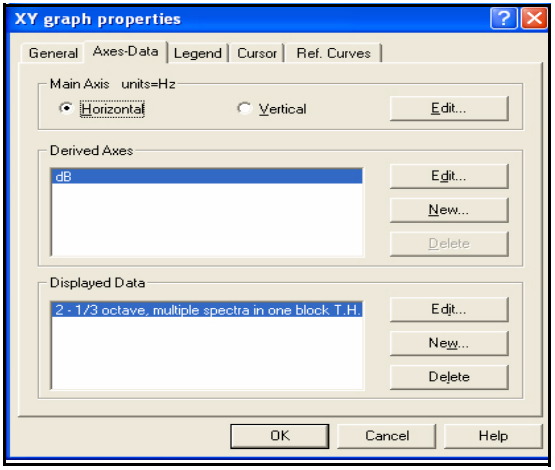


FIGURE 5-28 XY Properties:Axis-Data Tab Menu

We can see that there is one spectrum listed in the Displayed Data field.

To add another spectrum, left click the **New** button to the right of the Displayed Data field and left click the Data Source tab to open the Data Source Properties Menu. as shown in FIGURE 5-29 .

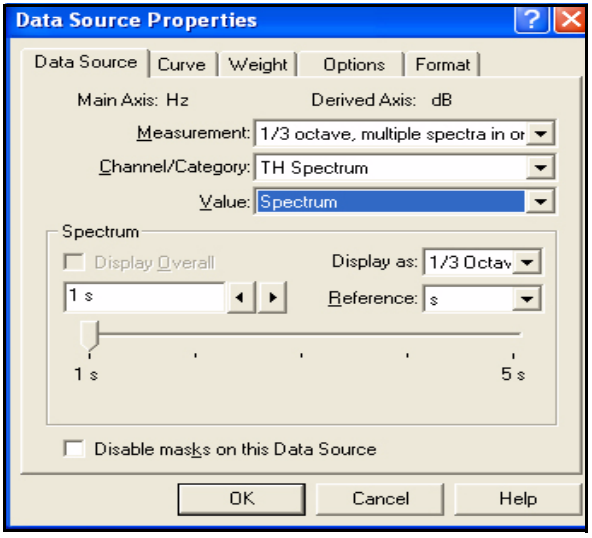


FIGURE 5-29 Data Source Properties

In order to have your display match the above, left click the down arrow in the Value field and, from the drop down window, select “Spectrum”.

Compare this to FIGURE 5-17 which appeared when we were working with five spectra in separate data blocks. In that figure, the field “Spectrum” was greyed out. In this case, the field is active and “1 s” appears to indicate that the present graphic represents the spectrum measured and stored one second after the measurement was begun. Left click the left and right arrows to the right of that data field and note that there are five spectra, one measured each second. Set the field to “2 s”, left click **OK.** This adds a second spectrum to the Displayed Data field as shown in FIGURE 5-30 .

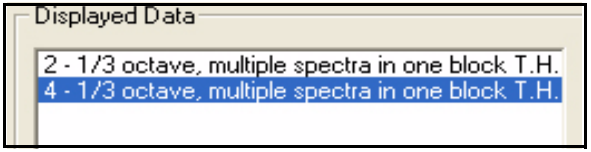


FIGURE 5-30 Displayed Data, 2 spectra

Remember that you can obtain a much larger graph by left clicking the Fit To Graph icon on the lower portion of the toolbar on the left of the screen.

Continue to add spectra until all five have been selected. Then press **OK** to generate the display shown in FIGURE 5-31 .

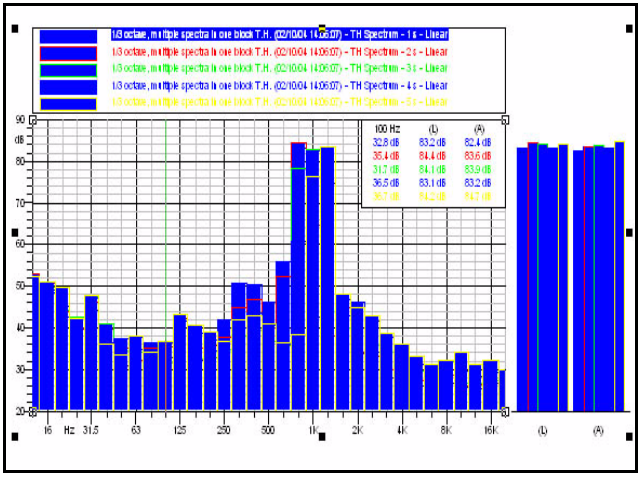


FIGURE 5-31 Multiple Third Octaves, Filled Bars

Modify the Line Style

Due to the filled bars used to indicate the levels, many of the spectra are hidden by those in front. To improve the ability to differentiate the separate curves, we will modify each curve as follows:

- **Curve Mode:** Stepped Line
- **Fill Style:** None
- **Line Thickness:** 0.8 mm

Change these one curve at a time, just as we did in section "Change Curve to Filled Bars" on page 5-21. At that time, however, we did not change the line thickness.

To work with lines, open the menu shown in FIGURE 5-23 (Property Window, Axis Data tab and double left click on the desired displayed data line).

Left click the box entitled “Line Style” to open the Line Attribute Menu shown in FIGURE 5-32 .

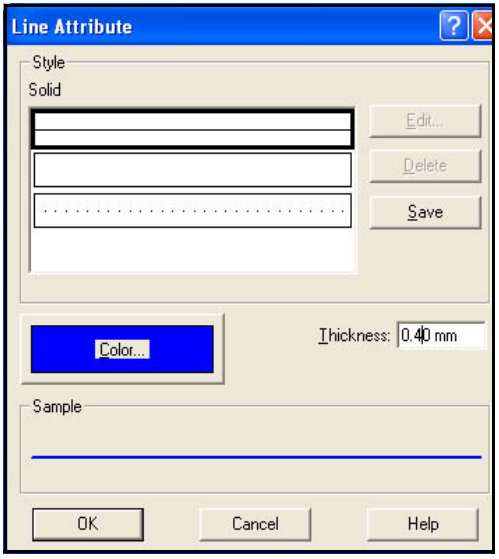


FIGURE 5-32 Line Attribute Menu

Change the line thickness to 0.80 and left click **OK.**

When the Curve Mode, Fill Style and Line Thickness of all curves have been changed, the graph will look as shown in FIGURE 5-33 .

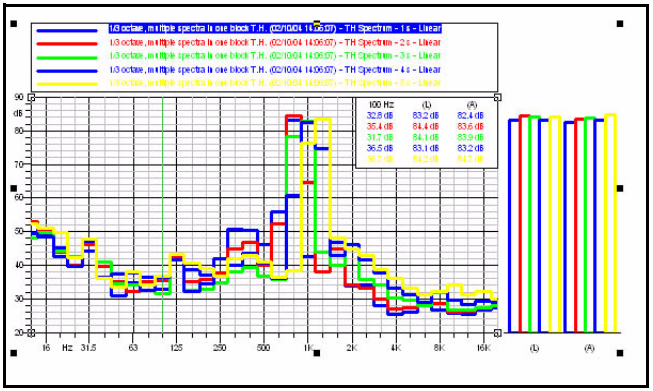


FIGURE 5-33 Multiple Third Octave Spectra, Thicker Lines

The graph can then be resized as described in section "Resize the Display" on page 5-19.

L_N Spectra

L_N is a statistical parameter which represents the value exceeded N percent of the measurement time. Thus, if the value of L_{90} is 35 dB, this means that the measured level was above 35 dB for 90% of the measurement time.

The System 824 can be setup to measure and save L_N spectra (1/1 or 1/3 octaves) as a function of time. This is done as part of the Interval setup by selecting to include Spectral L_N values in the list of parameters to be measured for each interval time period. In our example, we have setup the instrument to measure values of L_5, L_{10}, L_{30}, L_{50}, L_{80} and L_{90} in 1/3 octave bands at time intervals of 5 seconds for twenty seconds.

Left click **File/Open**, select **824 Interval with LNs** from the Demo Data folder and left click **Open**. Then left click **Insert/Graph Template** to obtain the menu shown in FIGURE 5-34 .

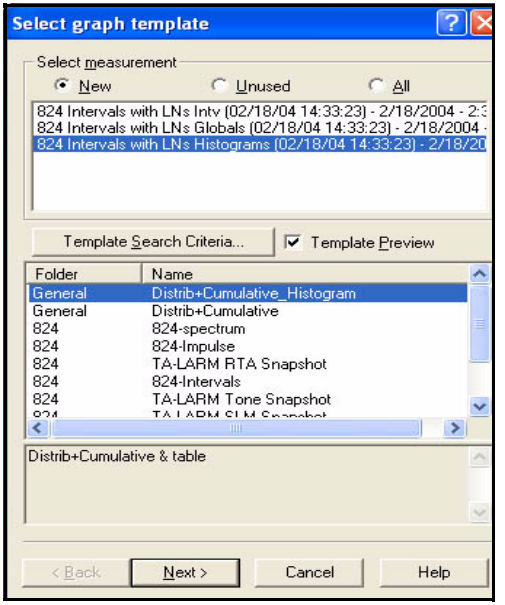


FIGURE 5-34 Select Graph Template

The 1/3 Octave profile template is in the folder General. If templates from this folder do not appear, left click ***Template Search Criteria****, select "All Folders" from the drop down list and left click* ***OK*** *to add all templates from all folders to the list.*

Highlight **824 Intervals with LNs Spectral LN** in the Select Measurement field, highlight the template **1/3 Octave profile**, left click **Next** and then **Finish** to obtain the display shown in FIGURE 5-35 .

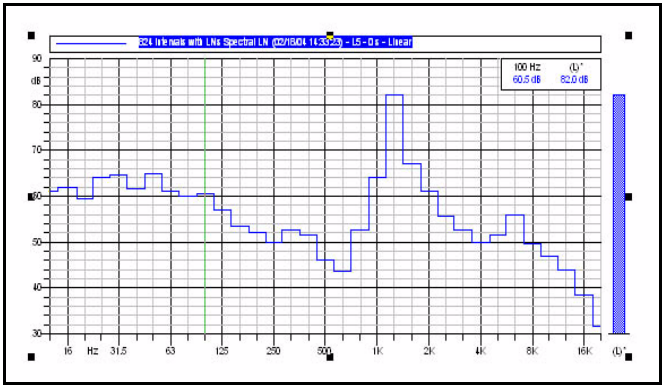


FIGURE 5-35 L_5 1/3 Octave Spectrum Measured at 0 seconds (first interval)

This curve shown represents L_5 for the spectrum measured at 0 seconds as indicated in the header. . Open the Properties Menu (cursor over display, right click, left click Properties) left click the **Axes-Data** tab, left click the **Edit** button to the

right of the Displayed Data window and left click **Data Sources** to obtain the menu shown in FIGURE 5-36 .

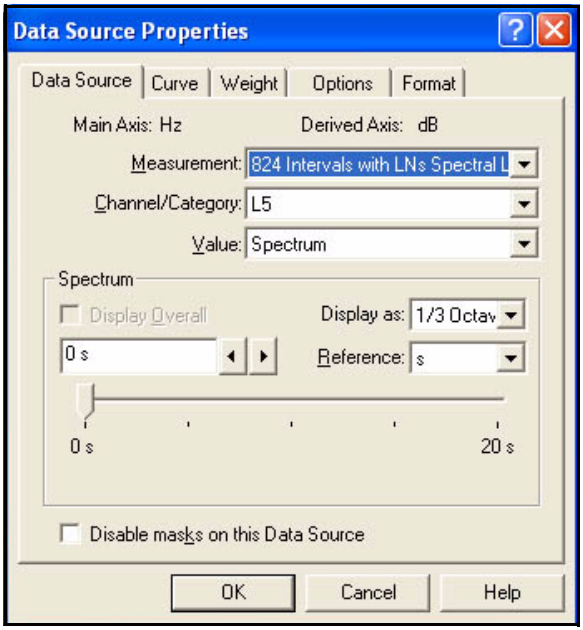


FIGURE 5-36 Data Source Properties, L_N

Left click the down arrow to the right of the Channel/ Category field to obtain the window shown in FIGURE 5-37 .

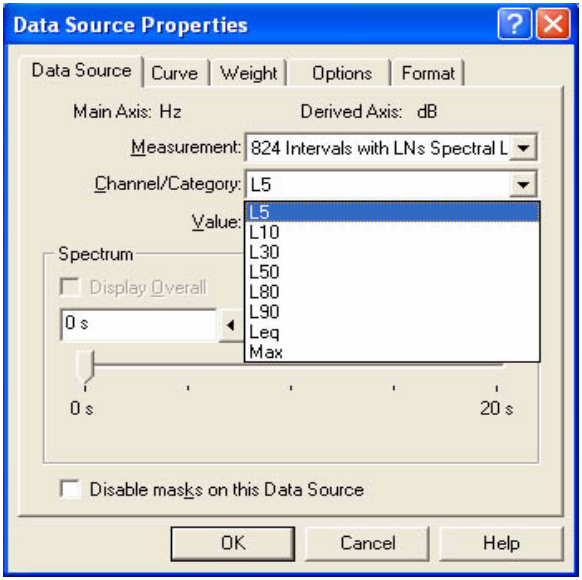


FIGURE 5-37 Channel/Category Menu

In selecting each curve to be included in the graph, we can select both a Value (one of six L_N, Leq or L_{Max}) and a time (0 to 20 seconds in five second steps).

Here we are presented with a choice of eight items; six L_N values as measured by the 824 and the values of Leq and L_{Max}, which are automatically measured when Spectral L_N measurement is selected.

In the Spectrum field to the left of the Value field we can see that a time value of 0 seconds in indicated. Left click the right arrow to the right of that data field, or slide the slider beneath the field, to see that this value can be selected to be 0, 5, 10, 15 or 20 seconds, corresponding to the five different interval steps for which data was measured.

Graph One L_N Spectrum at Different Times

For the first curve in this example, select the Channel/ Category to be L_{90} and the time to be 0 seconds and left click **OK**. To create the second curve, left click the **New** button to the right of the Displayed Data field, leave the Value as L_{90} , select the time to be 5 seconds and left click **OK**. Repeat this procedure to create curves of L_{90} for the 10,

15 and 20 second intervals. The XY Graph Properties window should now look as shown in FIGURE 5-38 .

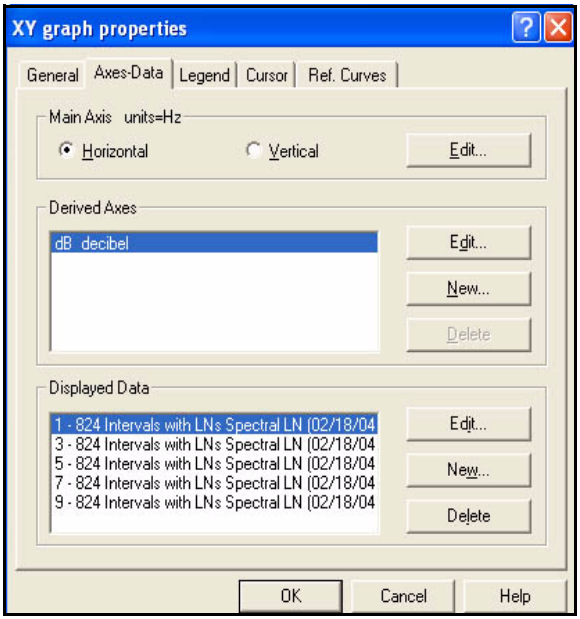


FIGURE 5-38 XY Graph Properties, Five Different L_N Curves

Then left click **OK** to generate the display shown in FIGURE 5-39 presenting the L_{90} spectrum for each of the different 5 second time intervals..

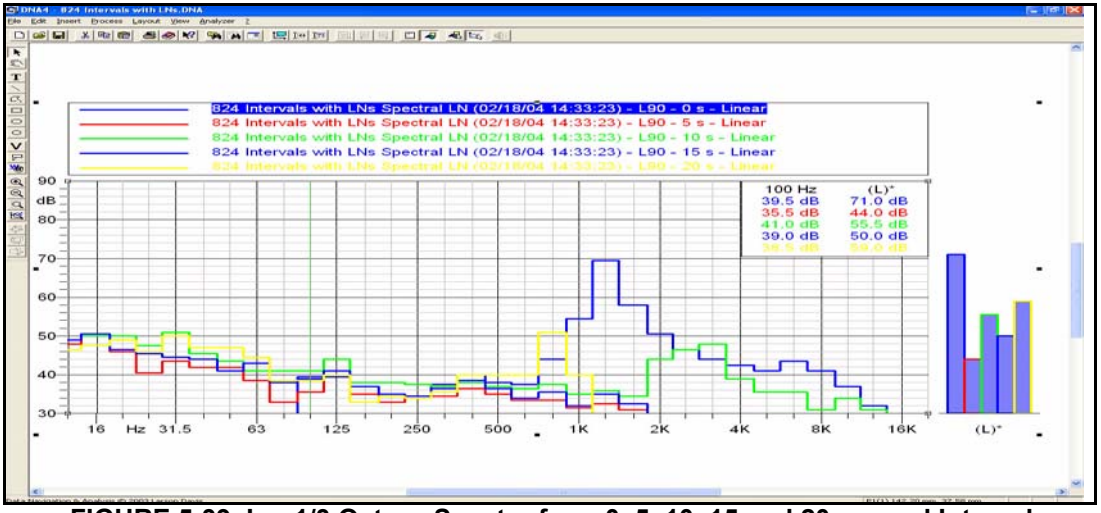


FIGURE 5-39 L_{90} 1/3 Octave Spectra from 0, 5, 10, 15 and 20 second Intervals

It may be necessary to Autoscale the horizontal and vertical axes to obtain the graph shown.

In an environment where dominant noise sources come and go at somewhat random time intervals, such as a highway, the L_{90} value is often used to represent the background sound. This is the sound which might be observed at an instant when there were no vehicles nearby so that other sources, say factories, lawnmowers and vehicles on other roads further away, could be heard. From the graph in FIGURE 5-39 , we can see that low frequency noise (< 2kHz) was fairly stable, except during the 10, 15 and 20 second intervals, when strong components at frequencies above 630 Hz were also present. This indicates a transient event lasting about 15 seconds, possibly the passby of a source radiating high frequency noise.

Graph Multiple L_N Spectra at One Time

For this example, we will continue working with the graph we have already created, shown in FIGURE 5-39 . Open the XY Graph Properties Menu shown in FIGURE 5-38 . For the first curve in this example, double left click the first item listed in the Display Data field; or highlight it and left click the **Edit** button to the right. This will open the Channel/ Category Menu similar to that shown in FIGURE 5-37 . Select Channel/Category to be L_5 and the time to be 10

seconds, then left click **OK**. Utilize the same procedure to modify each of the other four curves, selecting Channel/ Categories to be L_{10}, L_{30}, L_{50}, and L_{80}, respectively, but leaving the time as 10 seconds. Add the last curve by left clicking the **New b**utton to the right of the field. Select the Channel/Category to be L_{90}. Left click **OK** to generate the display shown in FIGURE 5-40 .

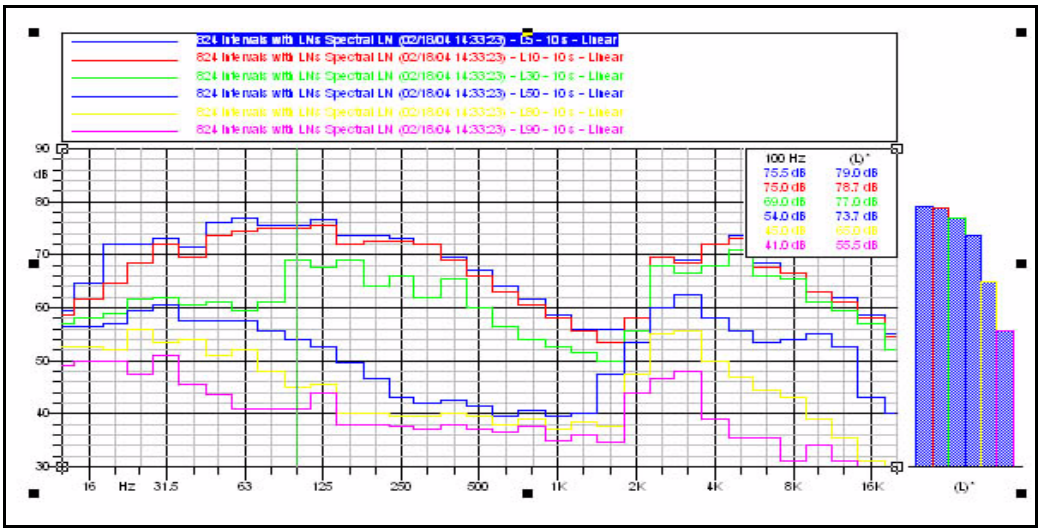


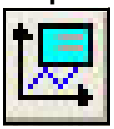
FIGURE 5-40 L_N 1/3 Octave Spectra for the 10 second Interval

This type of a display indicates the temporal variability of the sound, as function of frequency, during the 5 second period of the interval. The wide level difference between the L_5 and L_{90} curves at all frequencies indicates a large amount of variation over time. When there is a steady sound in any frequency band, the L_N curves converge at that frequency. The large level differences between the L_{30}, L_{50}, L_{80} and L_{90} curves indicate that much of the time the noise was variable in all frequency bands. However, the close spacing between the L_5, L_{10} and L_{30} curves indicate there may have been a strong, steady sound for some small period of time producing broadband noise in the frequency ranges 16 Hz - 1.6 kHz and 2 kHz - 20 kHz.

Once a multiple curve graph has been generated, the graph control is very useful for quick modifications of the individual curves without the need to open different menus.

In this example we will contine with the graph shown in FIGURE 5-40 . To open the Graph Control window, left click the Graph Control icon shown below from the Toolbar at the top of the screen.

Graph Control



This will add the graph control window to the display shown in FIGURE 5-41 .

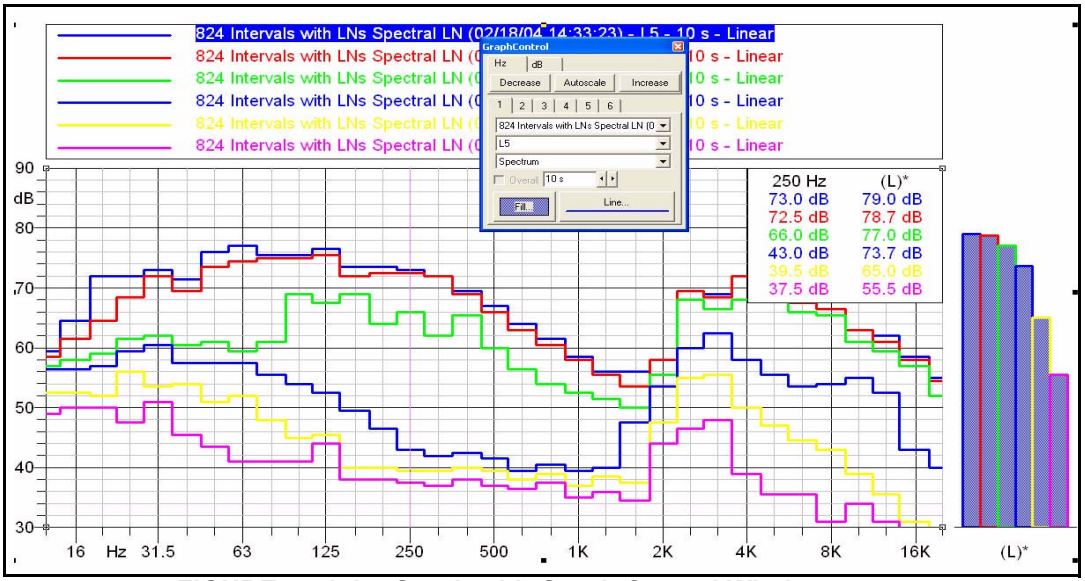


FIGURE 5-41 L_N Graph with Graph Control Window

The Graph Control Window itself is as shown in FIGURE 5-42 .

FIGURE 5-42 Graph Control Window

Moving and Autoscaling the Frequency Scale

With the Hz tab selected as shown in FIGURE 5-42 , the frequency scale can be moved to the right (left) by left clicking the Decrease (Increase) button. Left clicking the Autoscale button will autoscale the frequency axis to best suite the data in the graph.

Moving and Autoscaling the Amplitude Scale

If the dB tab is selected by left clicking it, the amplitude scale can be shifted down (up) in 10 dB steps by left clicking the Decrease (Increase) button. Left clicking the Autoscale button will autoscale the amplitude axis to best suite the data in the graph.

Modify the Curve Parameters

Note the numbered tabs, 1 - 6, each representing one of the curves in the graph. Left click each in turn and note that the present selections of Channel/Category and Time are shown in the corresponding data fields below the tabs. For any selected curve, these values can be changed making a different selection for one or both of these parameters. With only a few mouse clicks, one could convert the graph shown in FIGURE 5-40 to the one shown in FIGURE 5-39 .

Modify the Overall Bars

The vertical bars to the right of the graph represent overall values for each curve. By left clicking on the Fill and Line fields near the bottom of the Graph Control Window, these can be modified. In FIGURE 5-43 , the Fill of each bar has been modified to match the color of the curve to which each is associated.

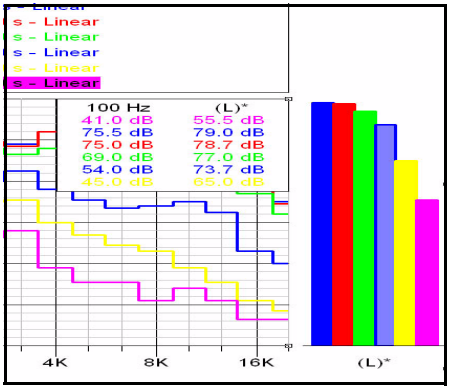


FIGURE 5-43 Fill of Overall Level Bars

Spectrogram

In this example we will work with a data file in which 1/3 octave spectra were stored as part of a time history at the rate of four/second over a time period lasting twenty seconds.

Left click **Files/Open**, select **Time History Spectra 3D** from the Demo Folder, left click **OK** and left click **Finish** to open the empty document containing the measurement.

Left click **Insert/Graph Template** to open the display shown in shown in FIGURE 5-2 "Select Graph Template Menu" on page 5-3.

Left click the box entitled “Template Search Criteria” to obtain the display shown in FIGURE 5-44 .

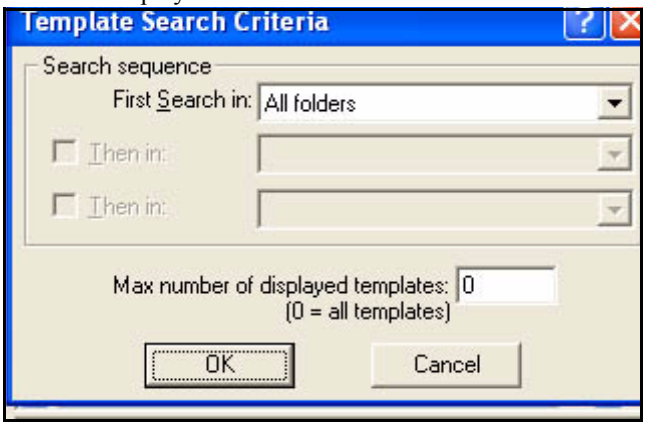


FIGURE 5-44 Template Search Criteria

Left click the down arrow on the right of the First Search in field to obtain the display shown in FIGURE 5-45 .

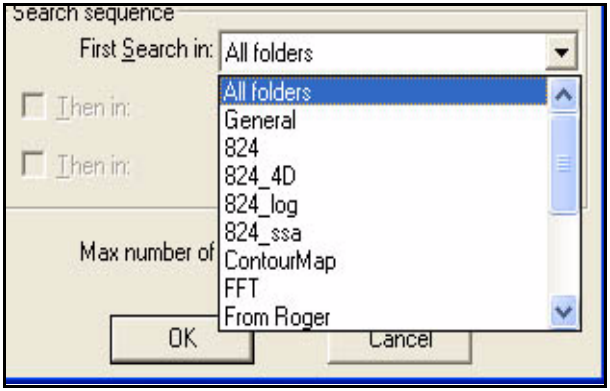


FIGURE 5-45 First Search In Window

Move the slider down until you see “Spectrogram”, left click it to make the selection and left click **OK**. This will open the window shown in FIGURE 5-46 .

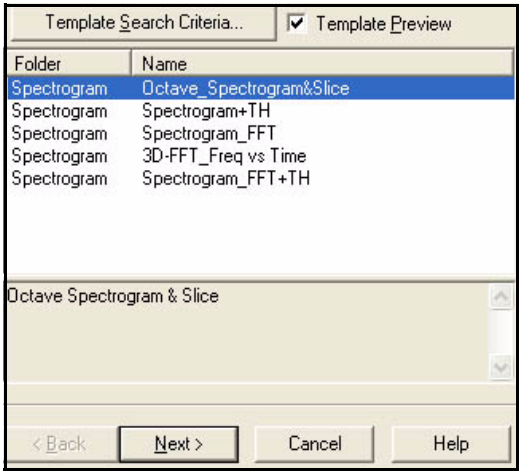


FIGURE 5-46 List of Spectrogram Templates

Use the cursor to highlight the first item in the list, “Octave_Spectrogram&Slice”, left click **OK**, **OK** and **Finish** to produce the display shown in FIGURE 5-47 .

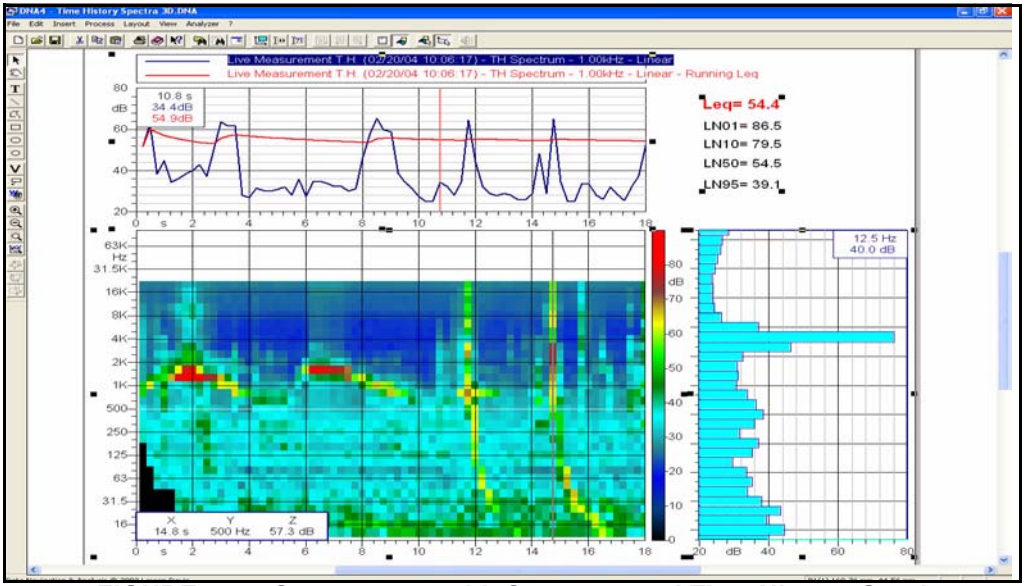


FIGURE 5-47 Spectrogram with Spectrum and Time History Graphs

If the graph generated by your software is not in color, jump to the section "Modify the Color Scale (Z-Axis)" on page 5-44 and follow the procedure described in the section "Load a Color Scale" on page 5-50 before continuing with this example.

The largest graph is a spectrogram showing the level (z axis) as a function of time (x axis) and frequency (y axis). Levels are indicated by color. The key showing color versus level is located to the right of this graph.

Spectrogram Cursors

The cursors can also be placed in the spectogram by left clicking at any desired position (make sure the cursor priority is Graph).

The spectrogram has two cursors; horizontal (frequency) moved by the up and down arrow keys on the keyboard and vertical (time) moved by the left and right arrow keys on the keyboard.

Vertical Slice

The spectrum graph to the right of the spectrogram represents a “cut” through the spectrogram at the position of the vertical cursor. Move it left and right and note that the spectrum changes according to the cursor position, but if moved up and down (same time) there is no change in the displayed spectrum.

Horizontal Slice

Similary, the time history graph above the spectrogram represents a “cut” through the spectrogram at the position of the horizontal cursor. It presents the change in time of the levels corresponding to the frequency band selected by the vertical cursor.

Increase the Spectrogram Color Resolution

Open the Properties Menu (cursor over spectrogram graph, right click, left click Properties)and left click the Axes-Data tab to obtain the display shown in FIGURE 5-48 .

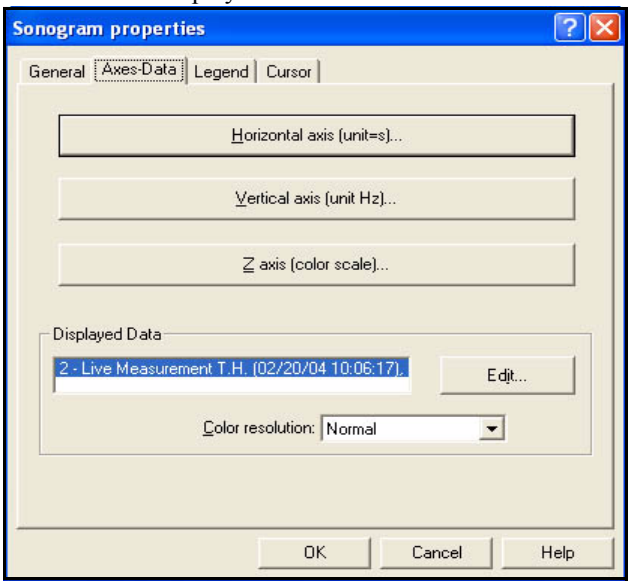


FIGURE 5-48 Spectrogram Properties Menu

Left click the down arrow to the right of the Color Resolution field to obtain the Color Resolution Menu shown in FIGURE 5-49 .

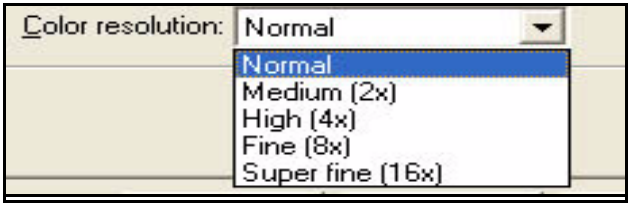


FIGURE 5-49 Color Resolution Menu

Left click Super fine (16X) and left click **OK** to obtain the spectrogram with much higher color resolution shown in FIGURE 5-50 .

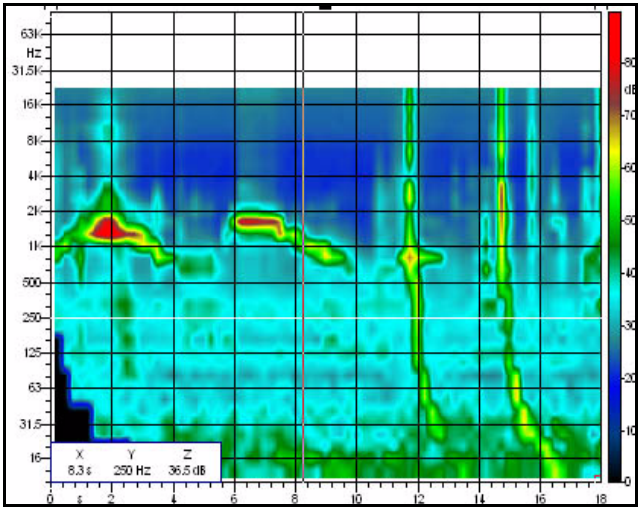


FIGURE 5-50 High Color Resolution Spectrogram

Modify Scaling of Vertical and Horizontal Axes

Reduce Frequency Range

In this section we will reduce the upper frequency range. However, this same procedure can be used to change the upper and lower limits of both the vertical and horizontal frequency axes as described in section section "Graphic Zoom" on page 5-44.

In FIGURE 5-50 , the frequency axis extends beyond the upper frequency for which level data is available. To change this, open the Spectrogram Properties Menu, shown in FIGURE 5-48 "Spectrogram Properties Menu" on page 5-41. Left click the box entitled “Vertical Axis (unit Hz) and

left click the Scaling tab to obtain the menu shown in FIGURE 5-51 .

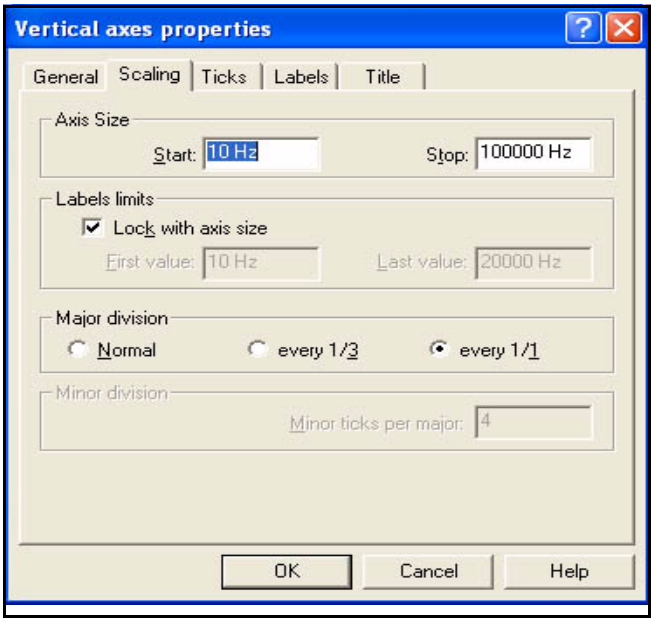


FIGURE 5-51 Spectrogram Vertical Axis Properties

In the Axis Size section, change the Stop value to 20000 and left click **OK** twice to obtain the improved spectrogram shown in FIGURE 5-52 .

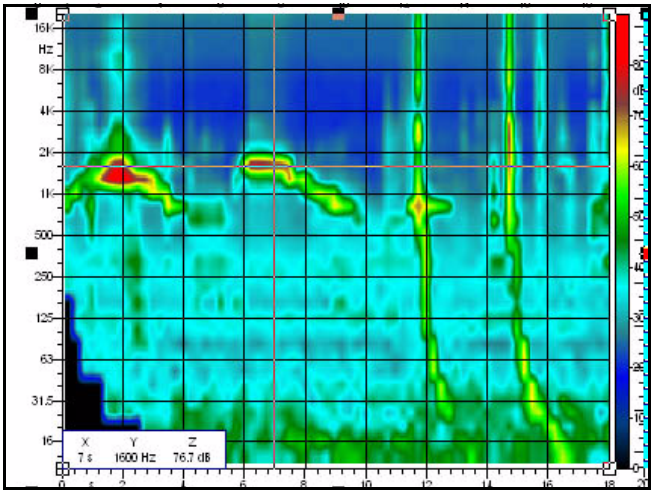


FIGURE 5-52 Spectrogram, Reduced Full Scale Frequency

Graphic Zoom

Modifying both the vertical and horizontal axes, following the technique described in section "Reduce Frequency Range" on page 5-42, as follows:

- Vertical Axis: 500 Hz to 4000 Hz
- Horizontal Axis: 0 s to 10 s

and left click **OK** to obtain the “zoomed” graph shown in FIGURE 5-53 .

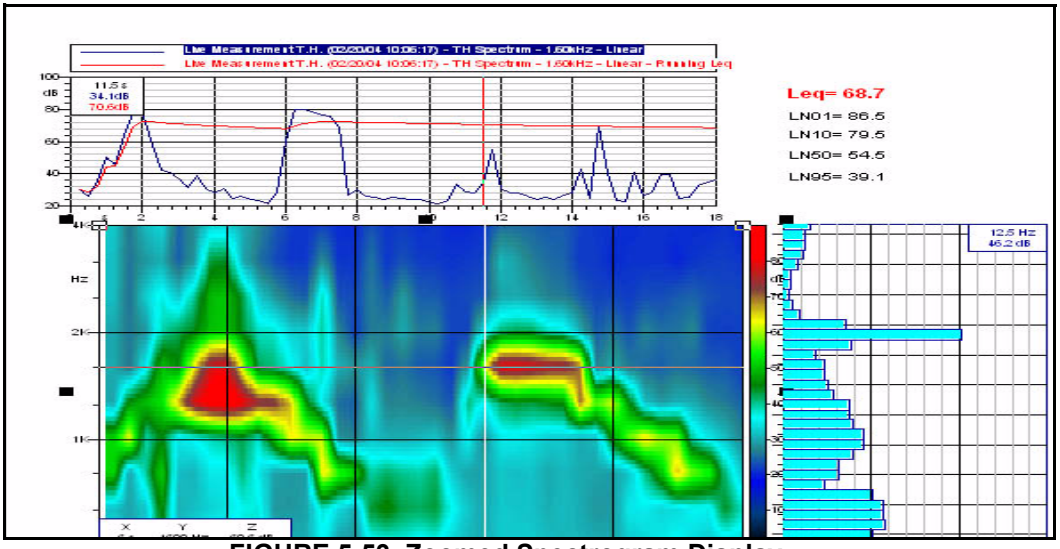


FIGURE 5-53 Zoomed Spectrogram Display

Modify the Color Scale (Z-Axis)

Before proceeding with this exercise, use the Properties Menu and the techniques described in the sections ‘Increase the Spectrogram Color Resolution” on page 5-41 and ‘Modify Scaling of Vertical and Horizontal Axes” on page 5-42 to change the basic display parameters as follows:

- Time: 0 to 18 s
- Frequency: 10 to 20 kHz
- Resolution: Normal

To modify the color scale, open the display shown in FIGURE 5-48 "Spectrogram Properties Menu" on page 5-41 . Left click the box entitled “Z-Axis (color scale)” and left click the Color Scale tab to open the display shown in FIGURE 5-54 .

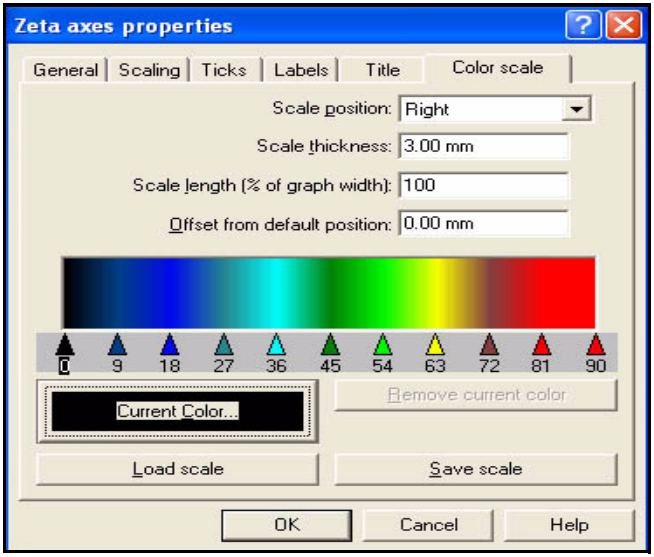


FIGURE 5-54 Z Axis Color Scale Menu

This is the scale as presently set for this example. We can modify this or load a totally different scale if we wish.

Work with Arrowheads and Colors

To simply change the amplitude range, follow the procedure described in the section "Set the Z-Axis Range" on page 5-51

In this scale there are eleven colored arrowheads, each a different color. There is a smooth transition in color between each successive pair of arrowheads over the range 0 - 90 dB. Place the cursor over any arrow, hold down the left mouse button, and slide it to the left or right. This will shorten the transition between colors on one side and lengthen it on the other side. If slid far enough to cross one of the other arrowheads, that color will now be shifted to the other side of the arrowhead which was crossed.

If we left click on any arrowhead and left click the box entitled “Remove current color”, that arrowhead will be deleted.

To continue with this example, take the big step of deleting all but the two arrowheads at each end of the scale, corresponding to 0 and 90 dB. This will leave us with a black -to-red color scale as shown in FIGURE 5-55 .

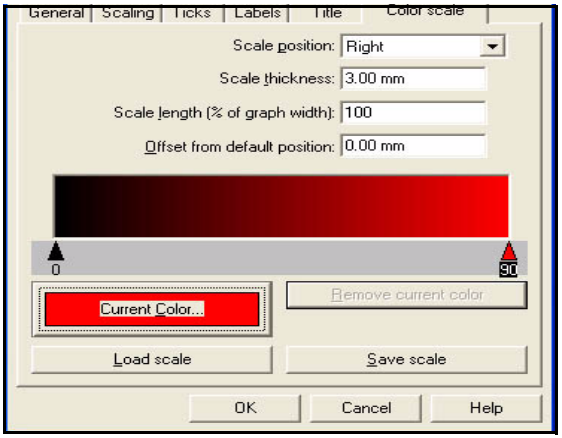


FIGURE 5-55 Black-to-Red Color Scale

Left click the red arrowhead to the right and left click the box entitled “Current Color” to open the color palette shown in FIGURE 5-56 .

FIGURE 5-56 Color Palette

Left click the white color patch at the bottom right and left click **OK** to produce the monochrome black-to-white color scale shown in FIGURE 5-57 .

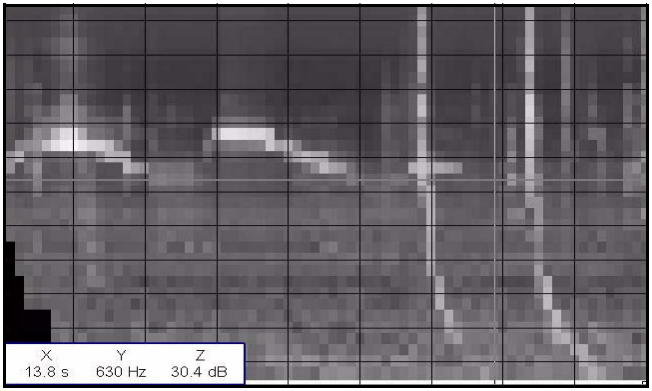


FIGURE 5-57 Black to White Color Scale

Next, hold the cursor over the area just beneath the graph and left click where the arrowhead labeled “30” appears in the graph below to create a new arrowhead in that position. Once the arrowhead is in place, it can be moved by placing the cursor on it and holding the left mouse button down while sliding it to the desired positon. Open the color palette and select a blue color to create the color scale shown in FIGURE 5-58 .

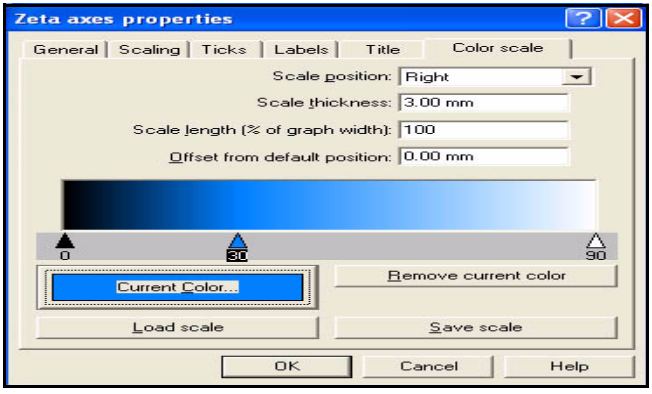


FIGURE 5-58 Black-to-Blue-to-White Color Scale

Use the same technique to add a green arrowhead at 60 and to change the color of the arrowhead at 90 to red to produce the color scale shown in FIGURE 5-59 .

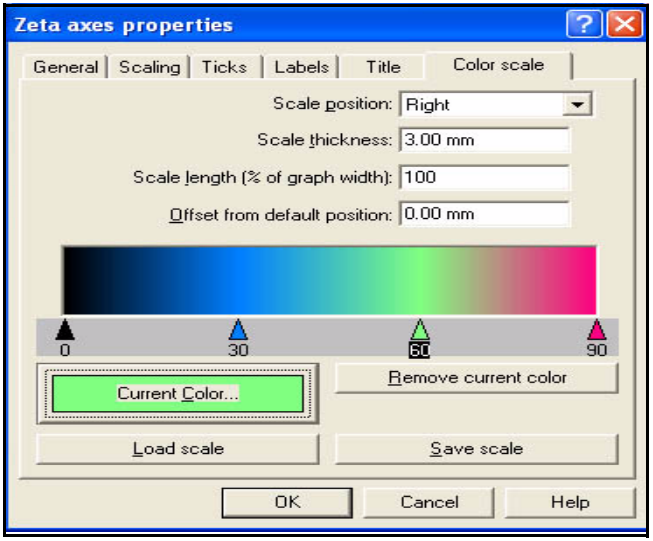


FIGURE 5-59 Black-to-Blue-to-Green-to-Red Color Scale

Left click **OK** twice to produce the display shown in FIGURE 5-60 .

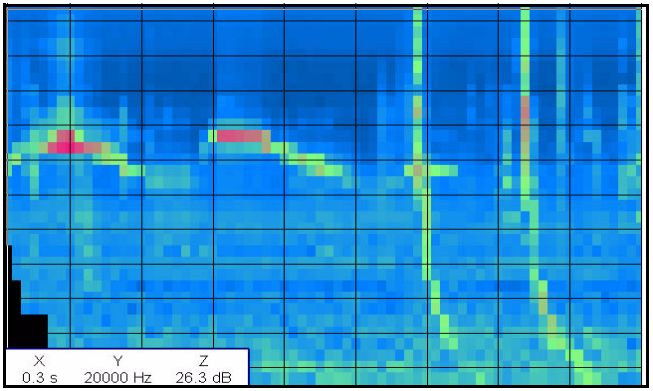


FIGURE 5-60 Multi-Color Graph

If there is a large amount of change over a relatively small dB range, one can slide the arrowheads to obtain a much greater change in colors over a smaller percentage of the total range. For example, if we work with the arrowheads and colors to create the color scale shown in and increase the

color resolution to Super fine X16, we obtain the graph shown in FIGURE 5-61 .

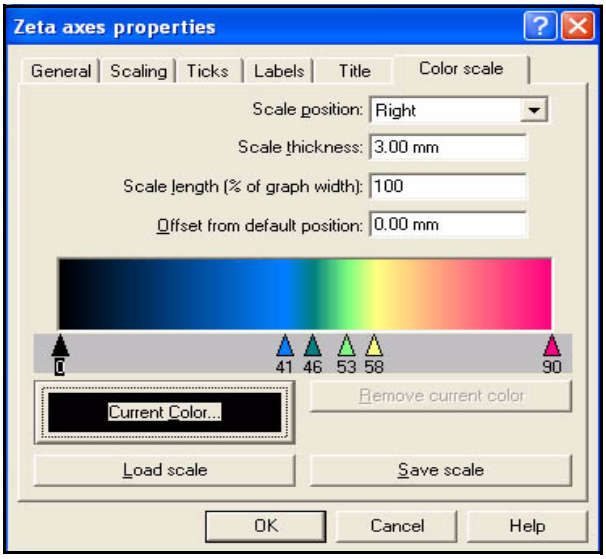


FIGURE 5-61 Color Scale with Transitions Concentrated in the Center of the Range

.

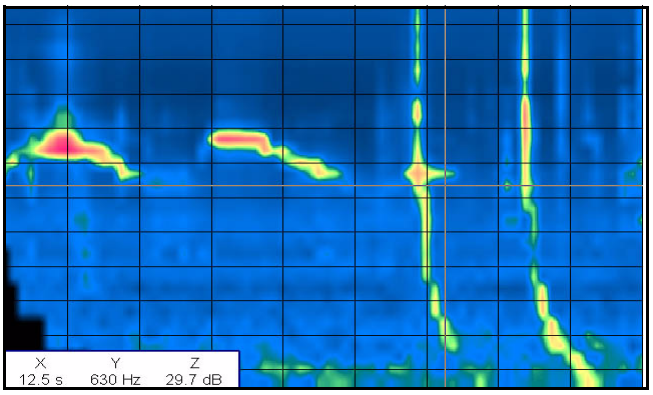


FIGURE 5-62 Spectrogram with Concentrated Areas of Color Transition

Save a Color Scale

To save a color scale which has been created, left click the box entitled “Save scale” shown in FIGURE 5-61 to open the menu shown in FIGURE 5-63 ,

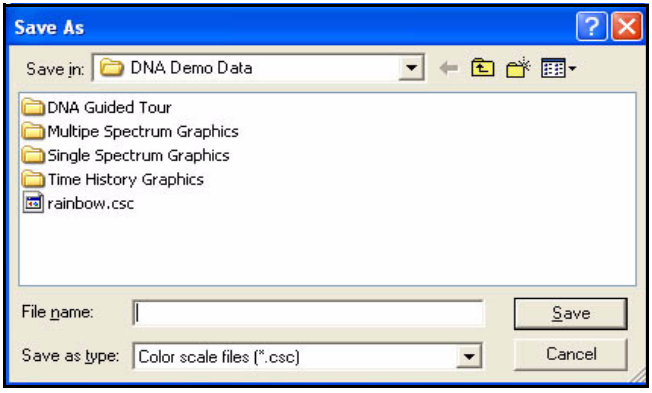


FIGURE 5-63 Save Color Scale Menu

Color Scale files are saved with the extension “.crc”

Use the down arrow at the right end of the “Save In” window to find the folder in which the color scale is to be saved, type a name into the “File Name” field and left click **Open** to save the scale into the selected folder.

Load a Color Scale

To load a color scale which has been previously created and stored, left click the box entitled “Load scale” shown in FIGURE 5-54 to open the menu shown in FIGURE 5-64 .

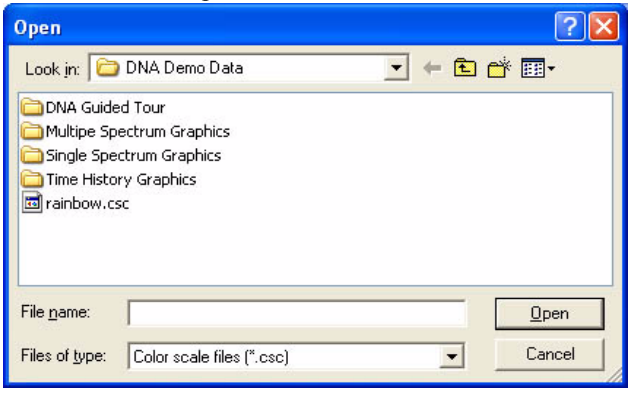


FIGURE 5-64 Loading Color Scale Menu

We have provided a color scale named “rainbow.csc” in the DNA Demo Data folder, as shown above. Use the browser window to the left of “Look in” to locate it (you should have saved this to a known file prior to beginning this exercise). Double left click this file, or highlight it and left click **Open**, to activate the original color scale used in the beginning of this section.

Set the Z-Axis Range

Open the Menu shown in section "Z Axis Color Scale Menu" on page 5-45 and left click the Scaling tab to obtain the display shown in FIGURE 5-65 .

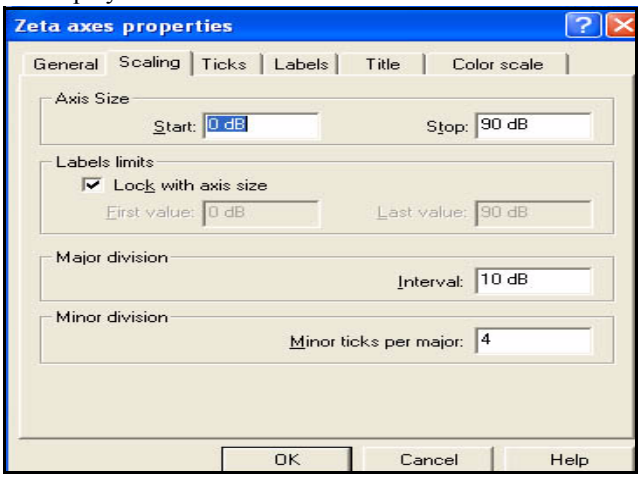


FIGURE 5-65 Z-Axis Scaling Menu

The two data fields in the Axis Size section of this menu, entitled “Start” and “Stop”, are used to enter values for the beginning and end of the Z axis. Left click **OK** to implement the changes.

Waterfall Graph

Left click **Files/Open**, select **Time History Spectra 3D_1** from the Demo Folder, left click **OK** and left click **Finish** to open the empty document containing the measurement.

Instead of using a prepared template, we will begin with a basic graph type.

Left click **Insert/Waterfall** to obtain the graph shown in FIGURE 5-66 .

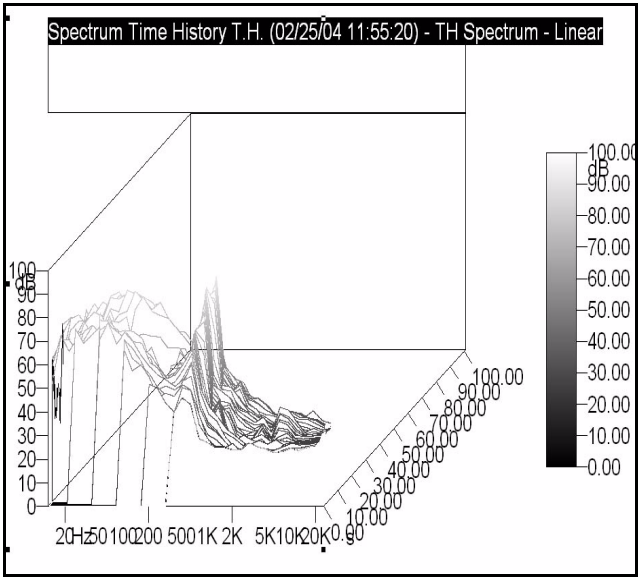


FIGURE 5-66 Waterfall Graph, Default Settings

For a large graph display, be sure to left click the Fit To Graph icon at the bottom of the Toolbar on the left of the screen.

Autoscale the Axes

Autoscale the X, Y and Z axes by left clicking the cursor in the scale portion of each, right clicking and then left clicking **Autoscale**. This will produce the display shown in FIGURE 5-67 .

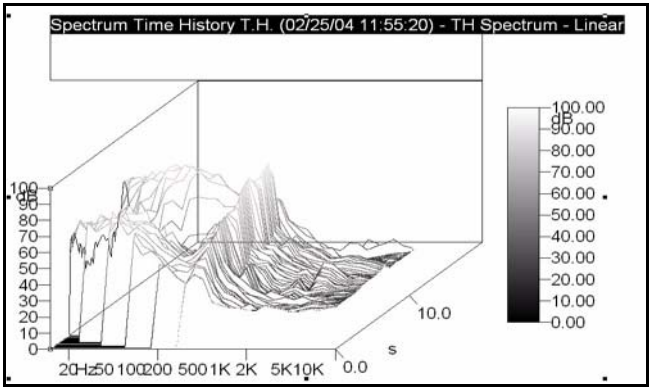


FIGURE 5-67 Waterfall Graph, Autoscaled

Reduce the Font Sizes

Reduce the font size of the numbers in the scaling of each of the axes by left clicking the cursor in the scale portion of each, right clicking and then left clicking **Label font** to open the display shown in FIGURE 5-68 .

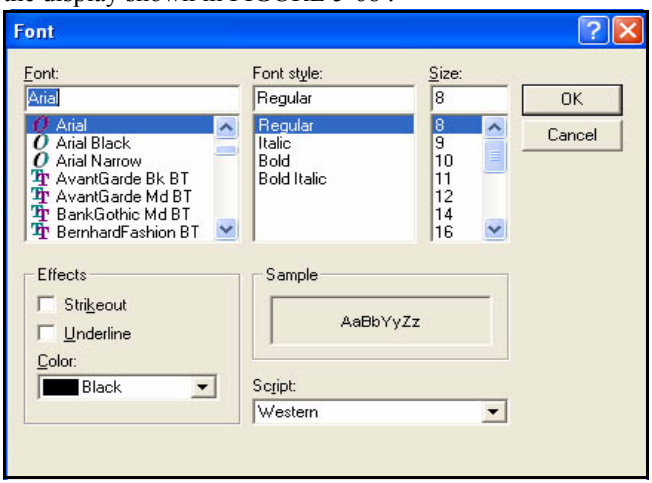


FIGURE 5-68 Font Menu for Z, Y and Z Axes

For each axis, set the font size to 8 and left click **OK**. This make the scales more legible as shown in FIGURE 5-69 .

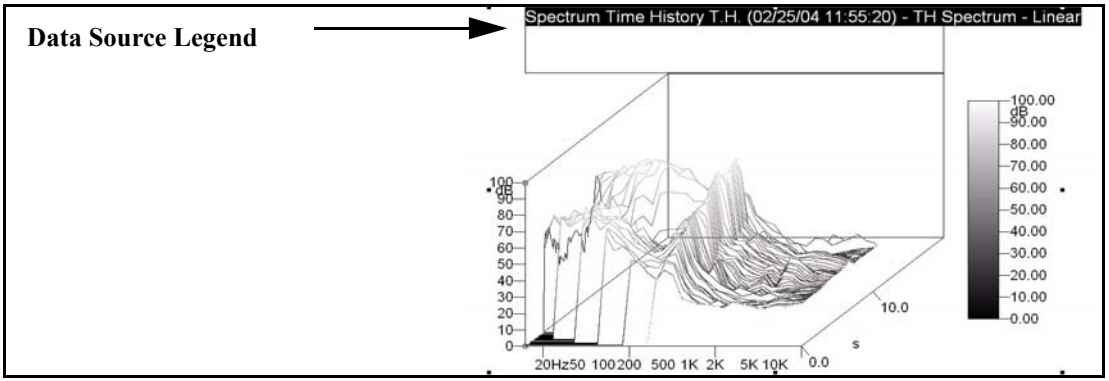


FIGURE 5-69 Waterfall Graph, Smaller Fonts

Rescale the Z (time) Axis

Examing Data in Spreadsheet Format

Left click **View/As Measurements Data** on the left of the upper Toolbar to see the entire dataset in spreadsheet format.

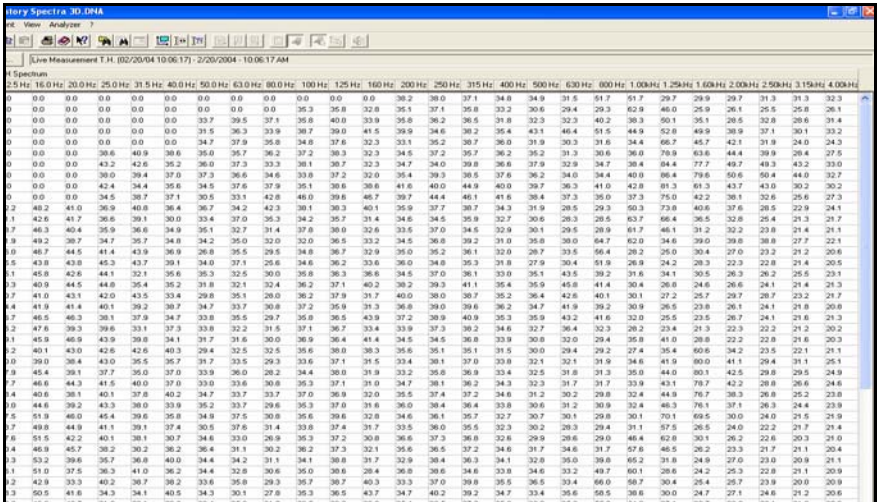


FIGURE 5-70 Measurement Data Viewed in Spreadsheet Format

From this, we can see that the time data only extends to 10.5 seconds. The default graph uses a full scale value of 20 seconds, so we need to change this. Left click **View/As Output Page** to return to the graphic display.

Rescale the Z Axis

Open the Properties Menu again, left click the Axes-Data tab, left click the box entitled " Z Axis Units" and left click the Scaling tab. Change the item **Axis Size, Stop** to 11.5 s, check the box for **Lock with axis size** in the Label limits section and left click **OK** twice to obtain the display shown in FIGURE 5-71 .

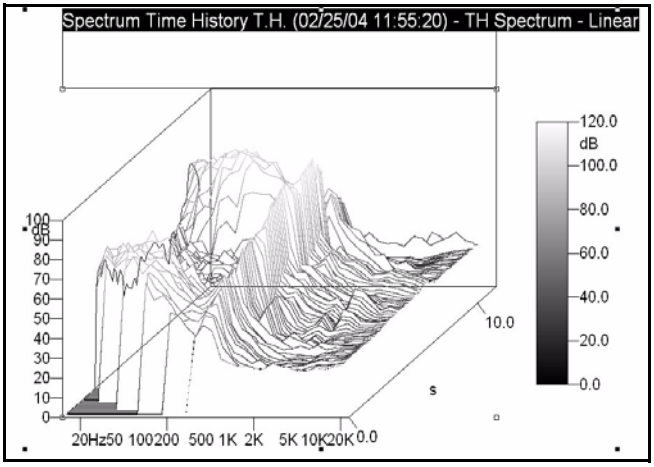


FIGURE 5-71 Waterfall Graph, Z Axis Rescaled

Change to 1/3 Octave Bar Format

The data being graphed are 1/3 octave spectra. The default graph has used lines through the center frequencies of the filter bands; we would prefer to see this data using bars for the filter band levels. Open the Properties Menu, and left click the Axes-Data tab to obtain the display shown in FIGURE 5-72 .

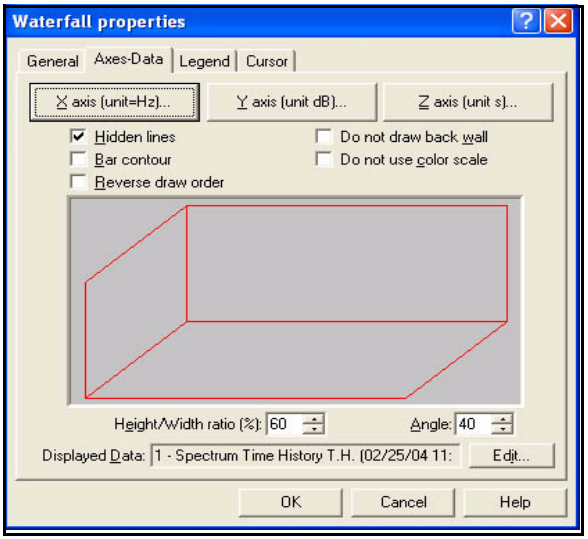


FIGURE 5-72 Waterfall Properties, Axes Data

Beneath the box entitled “X Axis (unit = Hz)”, check the checkbox for Bar Contour and left click **OK** to obtain the display shown in FIGURE 5-73 .

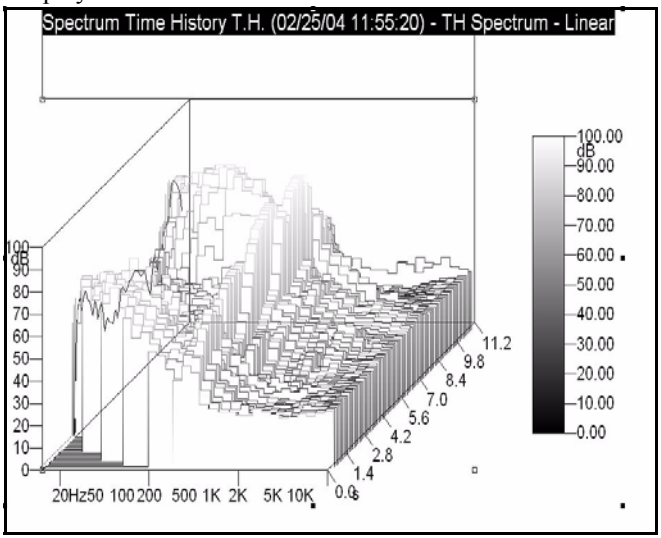


FIGURE 5-73 Waterfall Graph, Bar Format

Set Cursor Color and Thickness

There are two sets of cursors in the graph, one for time and one for frequency, but they are difficult to see in their default settings.

To set the cursor parameters, place the cursor over the data source legend, indicated by the arrow in FIGURE 5-69 , right click, left click **Properties,** and left click the Format tab to open the menu shown in FIGURE 5-74 .

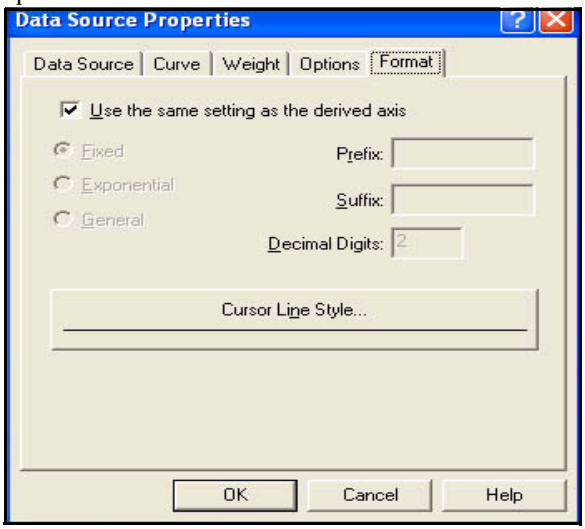


FIGURE 5-74 Cursor Format Menu

Left click the box entitled “Cursor Line Style” to open the menu shown in FIGURE 5-75 .

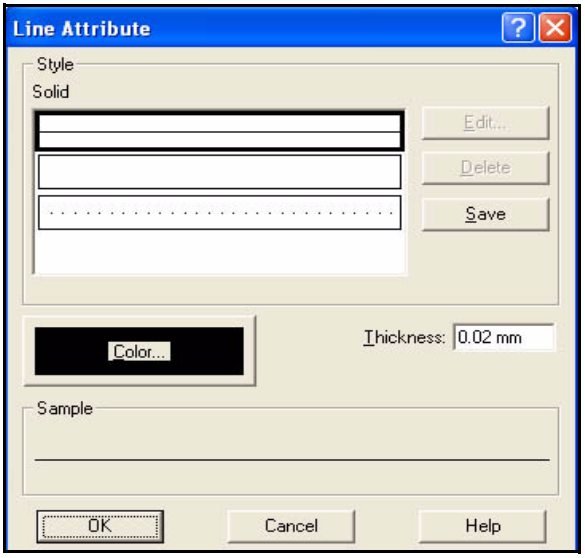


FIGURE 5-75 Cursor Line Style Menu

Change the Thickness to 0.04 by typing a new value in that field, left click the box entitled “Color”, left click a red patch and left click **OK** three times to obtain the graph shown in FIGURE 5-76 .

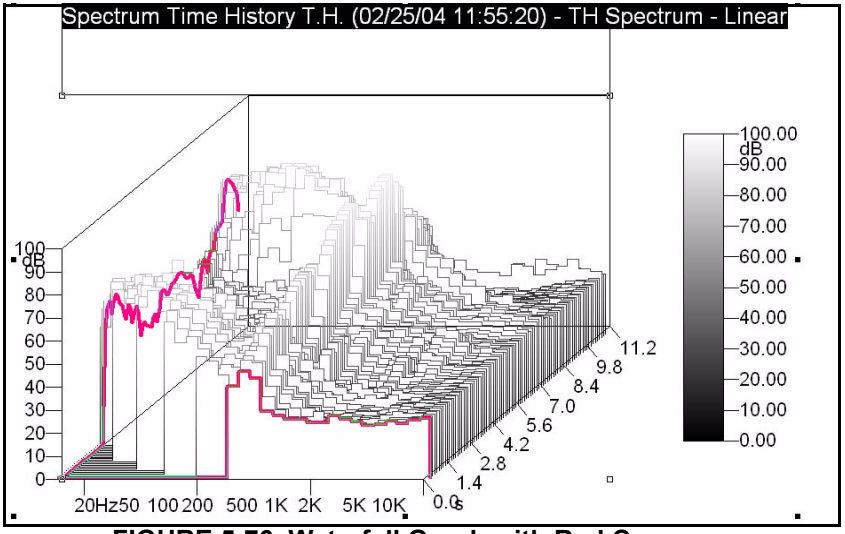


FIGURE 5-76 Waterfall Graph with Red Cursors

The cursors are now more evident. We can see that each is at the lower limit of its range; 0 seconds for the spectrum cursor and 12.5 Hz for the versus time cursor.

Add Display Cursor Window

Before we begin working with the cursors, we will add a Display Cursor Window. Open the Properties Menu (cursor over graph, right click, left click Properties, and left click the Cursor tab to obtain the display shown in FIGURE 5-77 .

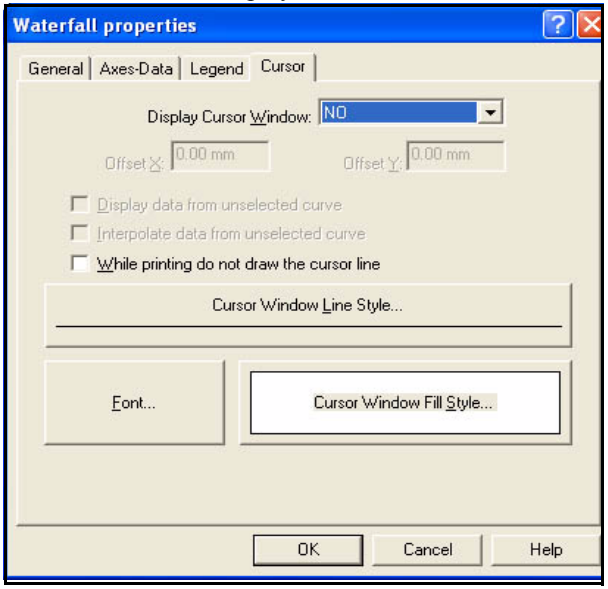


FIGURE 5-77 Waterfall Properties, Cursor Menu

Left click the down arrow to the right of the Display Cursor Window field to obtain the window shown in FIGURE 5-78 .

FIGURE 5-78 Display Cursor Window Menu

Left click “at Top-Left corner” and left click **OK** to place a Cursor Window in the upper left corner of the Waterfall Graph as shown in FIGURE 5-79 .

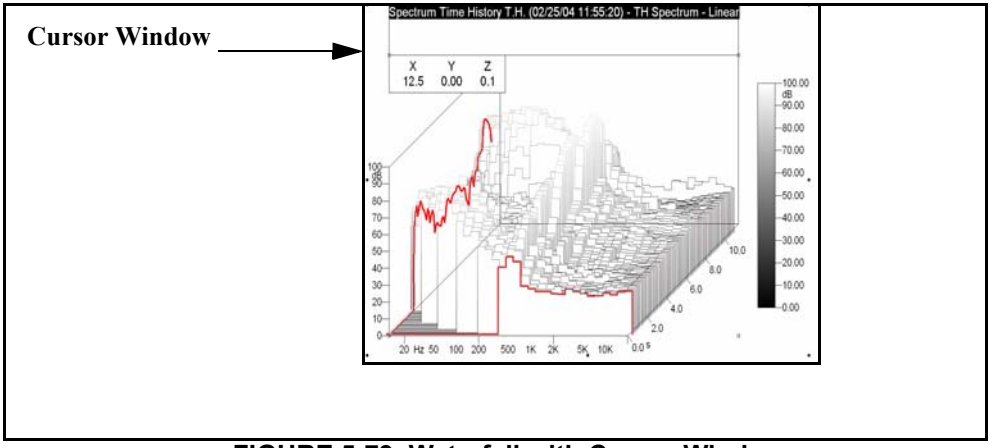


FIGURE 5-79 Waterfall with Cursor Windows

Readout of Cursor Value

As can be seen from FIGURE 5-79 , there are two cursors, perpendicular to one another in the frequency-time plane. The cursor window lists the values of Frequency (X), Amplitude (Y) and Time (Z) corresponding to the intersection of these two cursors.

The cursor line running parallel to the frequency axis presents the frequency spectrum corresponding to a selected value of time. Use the Up (Down) arrows on the keypad to move this cursor towards Higher (Lower) values ot time.

The cursor line running parallel to the time axis presents the level as a function of time corresponding to a selected value of frequency. Use the Left (Right) arrows on the keypad to move this cursor towards Lower (Higher) values ot frequency. In FIGURE 5-80 "Waterfall Graph with Red Cursors, Moved" on page 5-62 both of these cursor have been shifted to higher values of time and frequency to illustrate how cursor values correspond to the point where the two cursors cross.

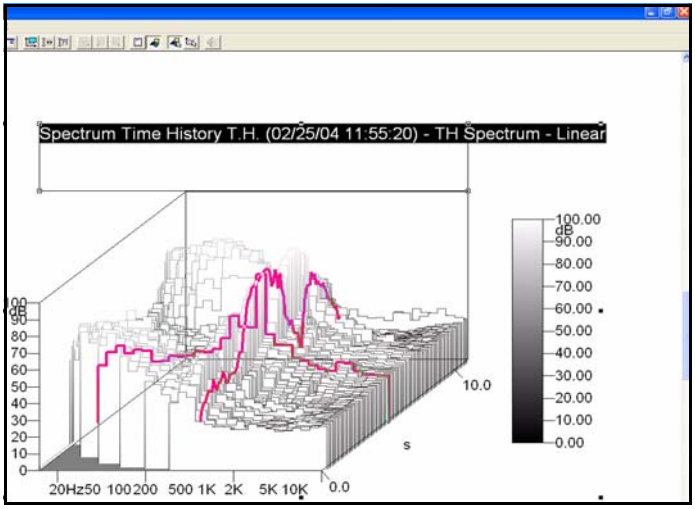


FIGURE 5-80 Waterfall Graph with Red Cursors, Moved

Add Color

Position the cursor over the amplitude scale to the right of the graph, right click, left click Properties and left click the Color Scale tab to obtain the display shown in FIGURE 5-81 .

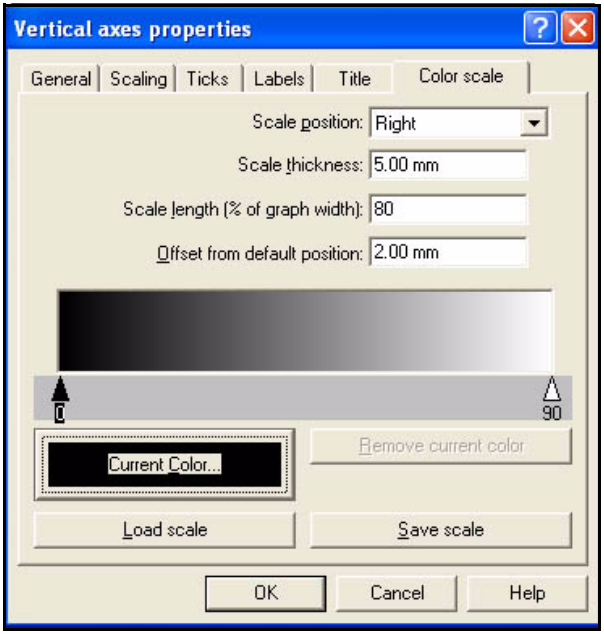


FIGURE 5-81 Vertical Axis Color Properties

Load the color scale “rainbow” following the procedure described in the section "Load a Color Scale" on page 5-50

to produce the color waterfall graph shown in FIGURE 5-82
.

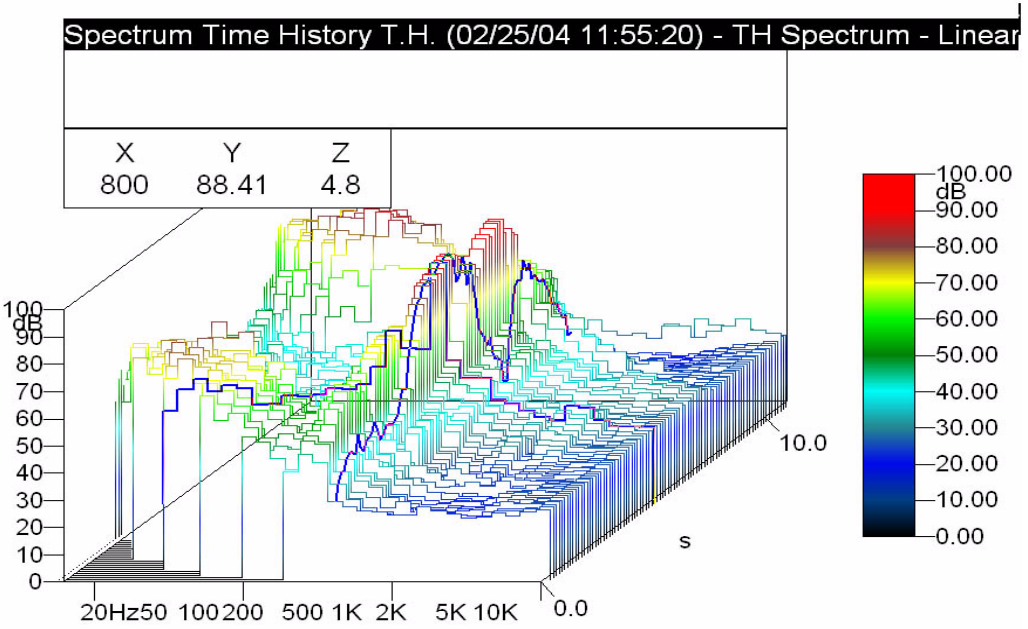


FIGURE 5-82 Color Waterfall Display

Note that the color of the cursors has been changed to blue and the thickness reduced in this display.

Shift Color Scaling

To shift the color scale (dB levels) up or down with respect to the color gradations, place the cursor over the color scale to the right of the display, right click, then left click **Move Up** or **Move Down** to shift the scale in 10 dB steps.

CHAPTER

6 Advanced Cursor Functions

Time History Graphs

Left click **File/Open**, highlight the document **824 Spectra, Time History, Intervals** from the Demo Data Folder and left click **Open** to open a document containing that measurement. Next, left click **Insert/Graph Template**, select the **Time History Data Block (TH)** and insert the Template **"Time-History** from the Folder 824_ssa. Left click **Next**, then **Finish** to produce the graph of Max (A Fast) shown in FIGURE 6-1 . It may be necessary to Autoscale the horizontal and vertical axes to obtain the same graph.

FIGURE 6-1 Time History, Max (A Fast)

Using the Properties Menu, edit this graph to represent Live (A Slow). Then, add new curves to represent Live (A Fast), Live (A Impulse) and Peak (A) as shown in FIGURE 6-2 "Time History: Live A-weighted curves for Slow, Fast, Impulse and Peak" (note that the Peak (A) is found at the top

of the drop down list while the others are found at the bottom.

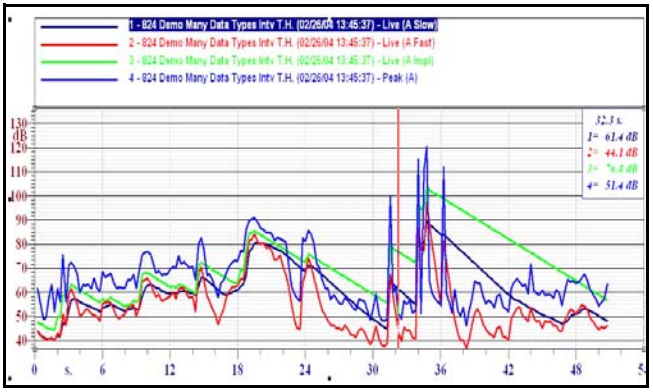


FIGURE 6-2 Time History: Live A-weighted curves for Slow, Fast, Impulse and Peak

To have the same graph seen in FIGURE 6-2 , modify the cursor box on the upper right to be a multiple parameter cursor box as described in "Multiple Parameter Cursor Box" on page 3-19 . It may also be necessary to Autoscale the axes (See "Autoscale the Amplitude" on page 8) and move the legend above the graph area (See "Move the Legend" on page 16).

This graph gives some insight into the time response of the different detectors. The rise time and decay rates for these detectors are very different, as shown in Figure 6-1 .

Detector	Rise Time	Decay Rate
Peak	50 µsec	NA
Fast	125 ms	25 dB/s
Slow	1 s	4 dB/s
Impulse	35 ms	2.9 dB/s

Table 6-1:Rise Times and Decay Rates of Sound Level Meter Detectors

Note that the peak detector is not an rms-type detector, so it's value is always higher than the other detectors, the difference depending on the waveform of the applied signal. Also, it is actually a max-hold detector, so it has no decay as such, but is reset at the end of each sample period. Thus, the level shown for the next sample in time is the maximum peak value for that time interval.

The rise time of the peak detector is extremely fast, so it's curve will respond immediately to even the shortest impulsive sound, such as a bursting balloon, gunshot or hand clap. Compared to that, the rise time of the Fast, Slow and Impulse detectors are relatively slow. An examination of the curves in FIGURE 6-1 shows that most of the time, the four curves follow each other in general. Small variations upward do indicate time variations in the measured signal since the peak and Impulse detectors will respond to an increase in level faster than the Fast and Slow detectors. By the nature of its design, however, the Impulse detector decays extremely slowly so decreases in the signal level cannot in general be seen until sufficient time has passed for the Impulse level to decay down to the level of the input signal.

During the time period between 31.3 s and 36.5 s, we can see that there were four obvious impulsive noise events.

Graphic Zoom Function

To display a portion of the time history graph with greater time resolution, we will use the graphic zoom feature. To look closer at the time interval during which the impulsive noises occur, place the cursor at 31.3 and hold down the left mouse button while sliding the mouse until the entire interval 31.3 - 36.5 in highlighted as shown in FIGURE 6-3 .

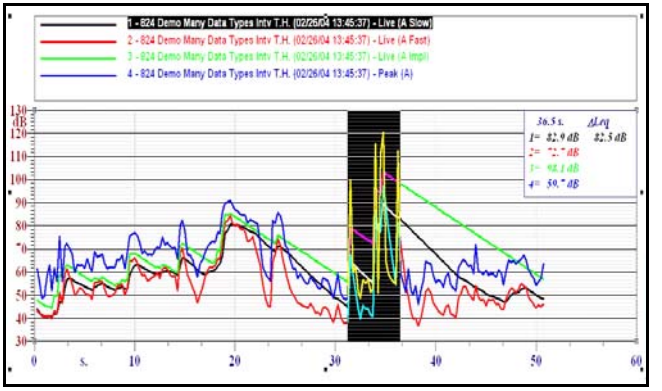


FIGURE 6-3 Highlighted Portion of Time History Graph

Position the cursor over the highlighted section, right click, left click Zoom and left click anywhere in the graph to obtain the display shown in FIGURE 6-4 .

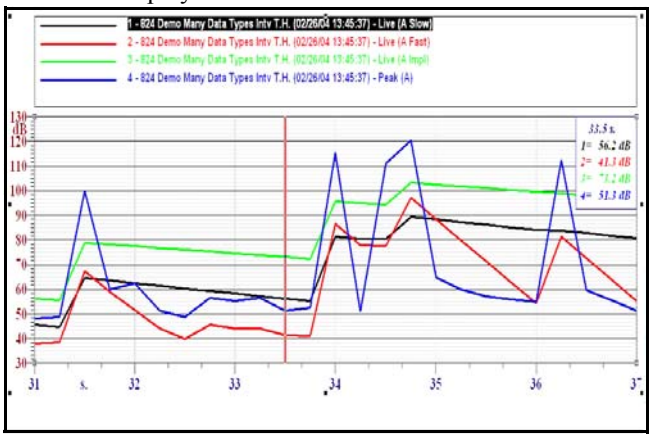


FIGURE 6-4 Graphically Zoomed Display

Any portion of this graph can be further zoomed by repeating the zoom procedure on this graph.

To return to the original graphic, position the cursor over the time scale, right click, then left click Autoscale.

Calculate Leq

The Leq for a time varying signal is defined for a specific time interval. The Leq value is the steady sound level which, over the same time interval, has the same energy as that of the variable signal.

When the 824 measures a time history, it always calculates the Leq (the energy equivalent sound level) for each time interval. Use the Axes-Data tab page of the Properties Menu to add a Short Leq curve to the graph so it appears as shown in FIGURE 6-5 .

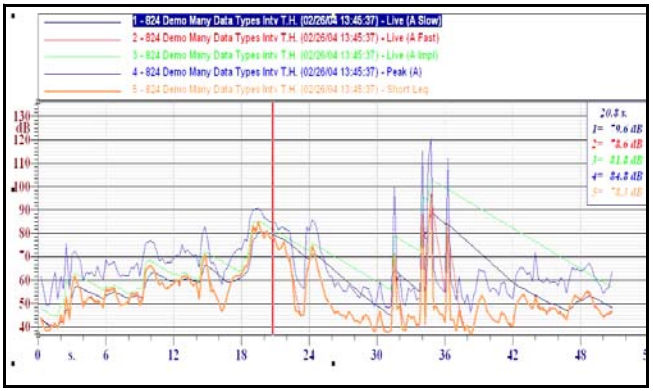


FIGURE 6-5 Short Leq Curve Added

To make the Leq curve more prominent, we made the Leq curve orange in color and reduced the thicknesses of the other curves to 0.02 centimeters.

Move the cursor around and observe that the value of Leq for curve 5 at that time is shown in the cursor box in the upper right corner. The time value appears above the level values.

Instead of the Leq values at each time interval, we may want to know the Leq over a larger time interval. The time interval might be chosen to correspond to a particular noise event in the graph. From an energy viewpoint, the portion of the Leq curve between 16.3 and 23 seconds seems important in the total energy represented by this curve. To determine the Leq value, place the cursor at 16.2 seconds and hold down the left button while sliding the mouse to the right

until the range 16.2 - 23 is highlighted as shown in FIGURE 6-6 .

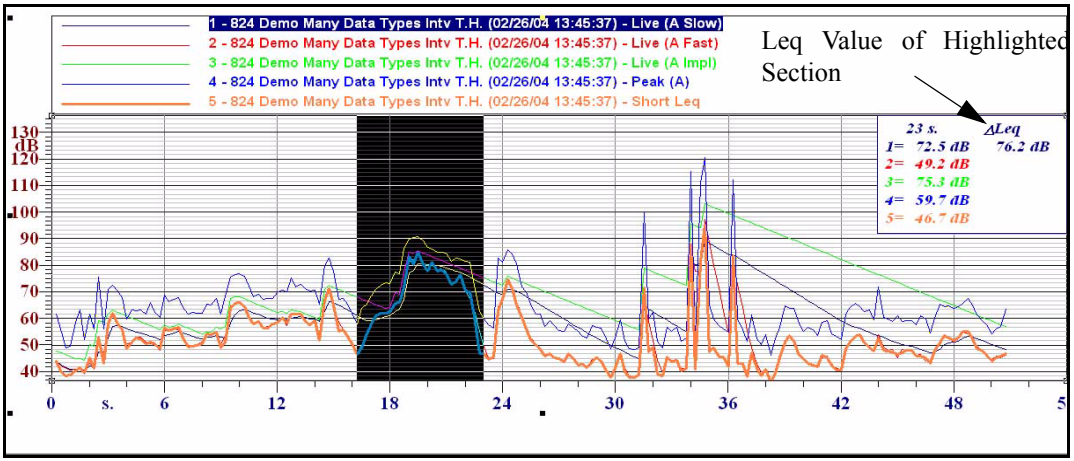


FIGURE 6-6 Highlighted Time Interval

The Leq value, calculated over the highlighted time interval is now displayed in the cursor box as indicated by the arrow.

If the entire time history is highlighted, the Leq value can be determined for the entire time, as shown in FIGURE 6-7 "Full Time History Highlighted"

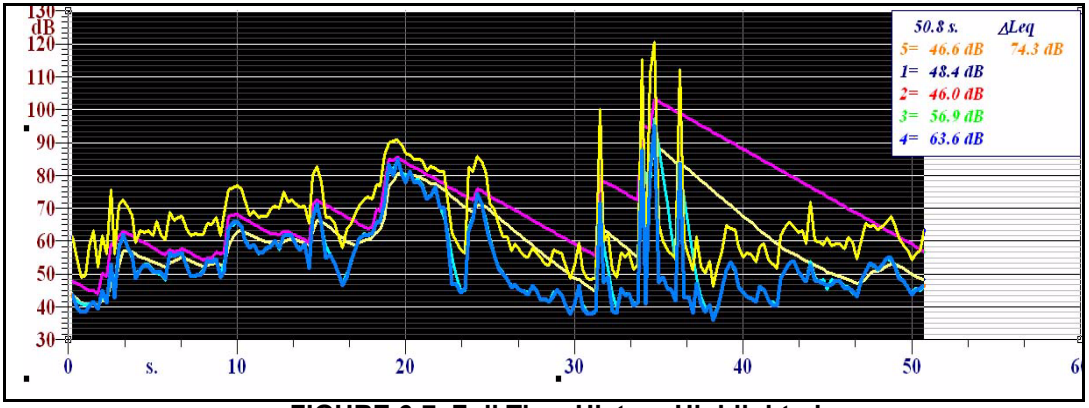


FIGURE 6-7 Full Time History Highlighted

Thus, one can determine the Leq value over the entire time period, or any portion thereof, using the cursor to highlight the desired time interval.

Note that the time and level values indicated in the cursor box correspond to those at the time associated with the position along the time axis to which the highlighted section has been pulled. If it was pulled from left to right, they correspond to the time at the far right of the highlighted section. If pulled from right to left, they correspond to the time at the far left of the highlighted section.

Evaluate Function

When utilizing the Evaluate Function on a graph having multiple curves, the results of the evaluation corresponds to the curve which is highlighted in the legend.

With the section of the time history graph from 16.2 - 23 highlighted, as shown in FIGURE 6-6 "Highlighted Time Interval" , position the cursor over that section, right click and then left click **Evaluate**. This will open the window shown in FIGURE 6-8 .

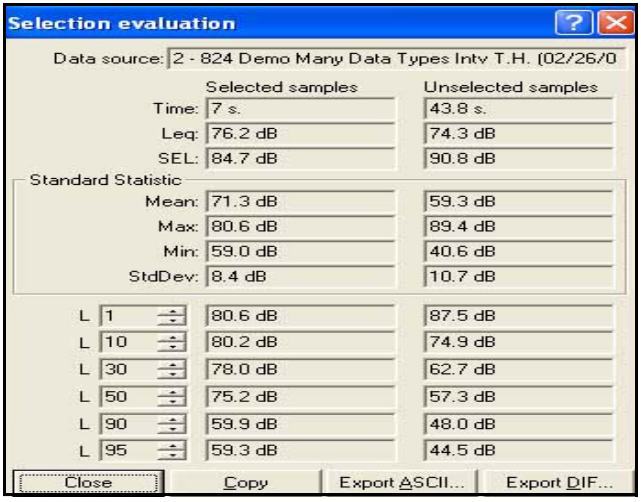


FIGURE 6-8 Selection Evaluation Display

Thirteen parameters have been calculated for each of the following time intervals:

- The highlighted time interval
- The time intervals of the graph not highlighted

Time Periods, Leq and SEL Values

The first three items in the upper half of the window are the time periods, the Leq values and the SEL (Single Event Level) values for each.

Mean, Max, Min, StdDev

The next four are standard statistical parameters for a time series; Mean, Maximum, Minimum and Standard Deviation for each.

L_N Values

The last six for each are values of L_N, a commonly used acoustical parameter. A particular L_N value represents the level which was exceeded N percent of the measurement time. For example, if L_{90} equals 35 dB, this means that the measured level was above 35 dB 90% of the measurement time. The N value for any of the L_N data blocks can be changed by left clicking on the up and down arrows to the right of the N field. Thus, L_N can be determined for all integer values between 1 and 99.

Mask Function

In this section we will use the same data used in 'Evaluate Function" on page 6-7, modifying the graph to show only the Leq curve.

Working with the graph shown in FIGURE 6-5 "Short Leq Curve Added" on page 6-5, delete all curves except Leq, and change the color to black to obtain the display shown in FIGURE 6-9 .

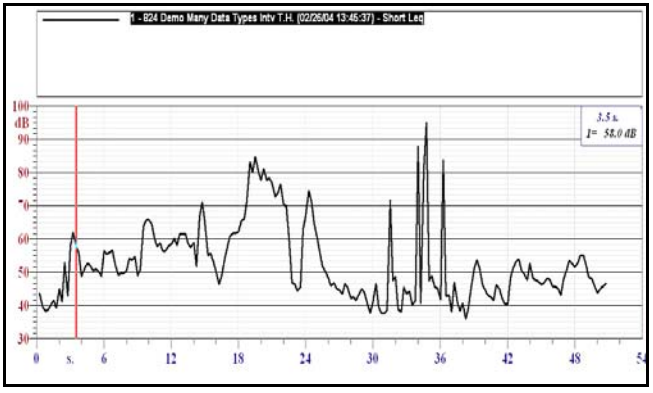


FIGURE 6-9 Leq Graph

Evaluate Parameters for Full Curve

The effects of masks appear in calculations made by the Evaluate Function. So, before creating masks, we will do an evaluation to obtain data to be used as a reference later in this section.

Next, place the cursor at the far left of the graph, hold the left mouse button down and slide it to the far right of the graph. This will highlight the entire time interval of the measurement, from the left end to the right end of the graph. Note that the Leq value for the entire measurement is shown in the cursor box on the upper right, 74.3 dB. Open the Evaluator Function as described in "Evaluate Function" on page 6-7 . This will produce the display shown in FIGURE 6-10 .

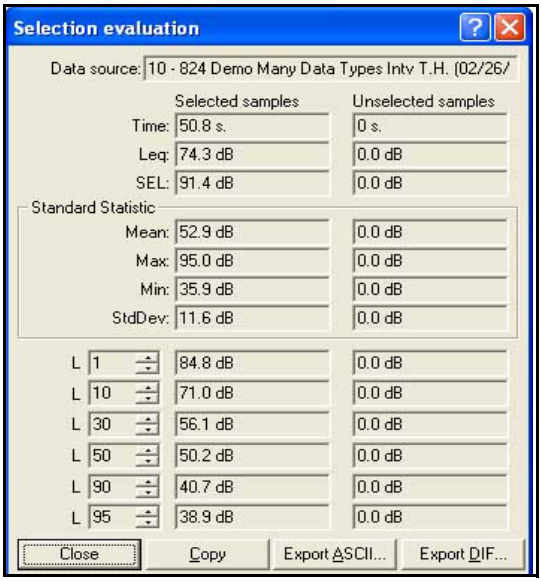


FIGURE 6-10 Evaluation, Complete Measurement

Create a Mask

In this section we will work with a graph having a single curve. When creating a mask on a graph having multiple curves, the mask will be created for the curve highlighted in the legend.

Close the Evaluation window to return to the graph and use the cursor to highlight the range 16.3 s - 23 s as shown in FIGURE 6-11 .

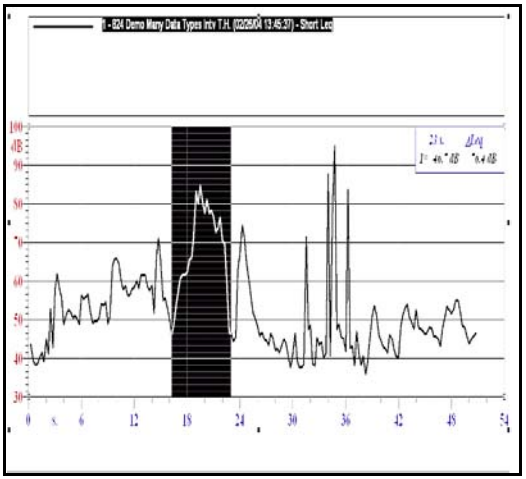


FIGURE 6-11 Leq Graph with Highlighted Section

Place the cursor over the highlighted section, right click and left click “Create Mask” to obtain the window shown in FIGURE 6-12 .

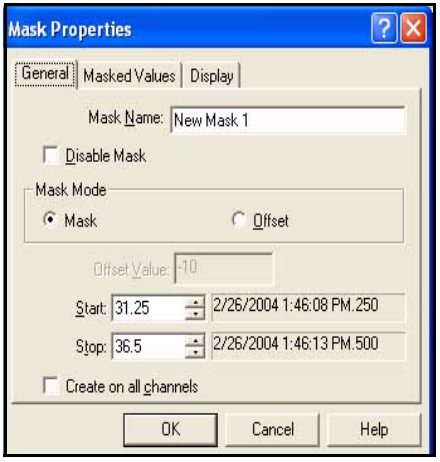


FIGURE 6-12 Mask Properties, General

Name this mask “Impulse Sources” by editing the Mask Name field, and check the check box “Mask” in the Mask

Mode section. Note that the cursor values shown as Start and Stop correspond to the left and right limits of our mask in the graph. We could just as easily have input the time values from this menu. Note that we could apply this mask to all curves of a multiple curve graph by checking the check box labeled “Create on all channels on the lower left”.

Left click the Masked Values tab to obtain the window shown in FIGURE 6-13 .

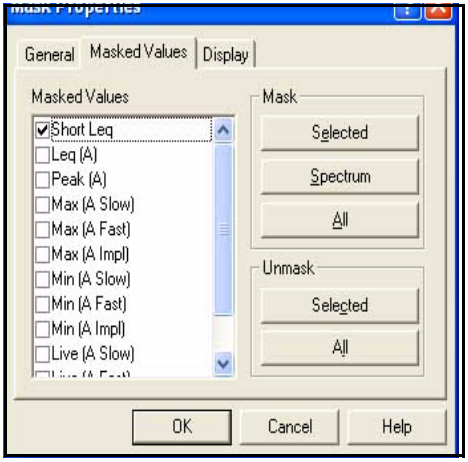


FIGURE 6-13 Mask Properties, Masked Values

This window is used to select which curves we want the mask to apply to. Short Leq is already selected, since we have been working with a graph containing that curve. We need not select any additional curves for this example.

Left click the Display tab to obtain the window shown in FIGURE 6-13 .

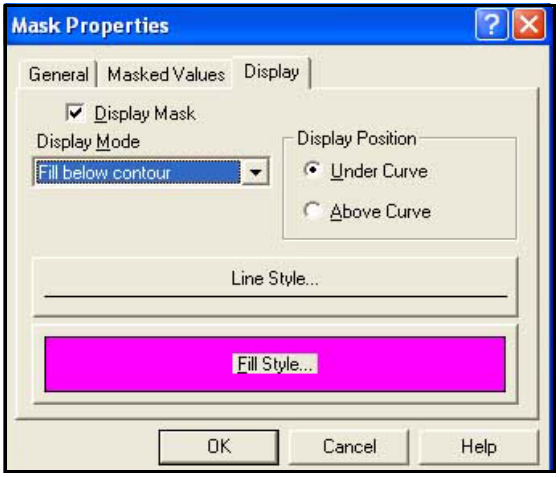


FIGURE 6-14 Mask Properties, Display

Check the check box labeled “Display Mask”, use the Display Mode drop down menu to select “Fill below contour” as the Display Mode and select “Under Curve” as the Display Position. Left click **OK** to obtain the display shown in FIGURE 6-15 .

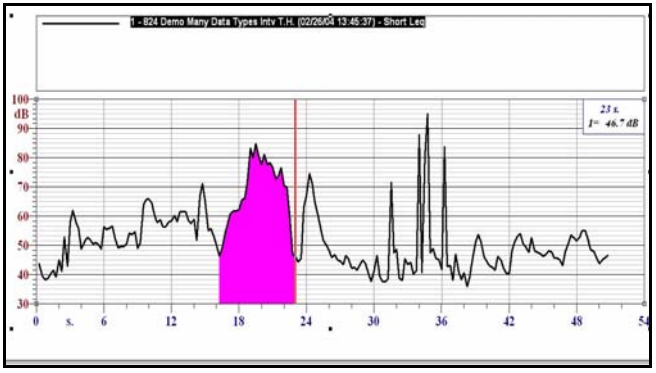


FIGURE 6-15 Leq Graph with Masked Section

Evaluate Parameters for Masked Curve

The act of masking a section removes it from the database used to make calculations. Use the cursor to highlight only the time interval presently masked and note that the calculated Leq is now zero. Highlight the entire graph, left to right, and note that the Leq value for the entire measurement is now 73.9 dB. In section "Evaluate Parameters for Full Curve" on page 6-9 , we calculated the Leq of the original immurement to be 74.3.

With the entire measurement highlighted, open the Evaluation Function as described in section "Evaluate Function" on page 6-7 . This will produce the following display.

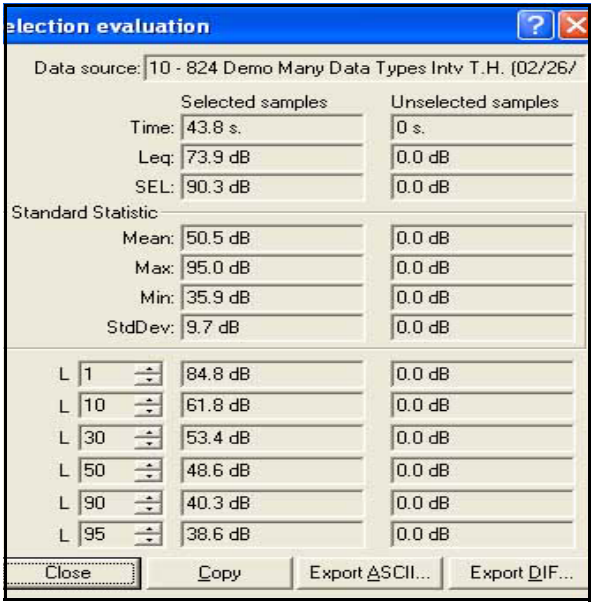


FIGURE 6-16 Evaluation, Complete Measurement with One Masked Section

Compare these data with those in FIGURE 6-10 "Evaluation, Complete Measurement" on page 6-9. We can now see how the removal of the masked section has affected all these parameters.

If one were to add a second mask to the interval 31.3 s - 36.5 s, the Evaluator would produce the results shown in FIGURE 6-17 .

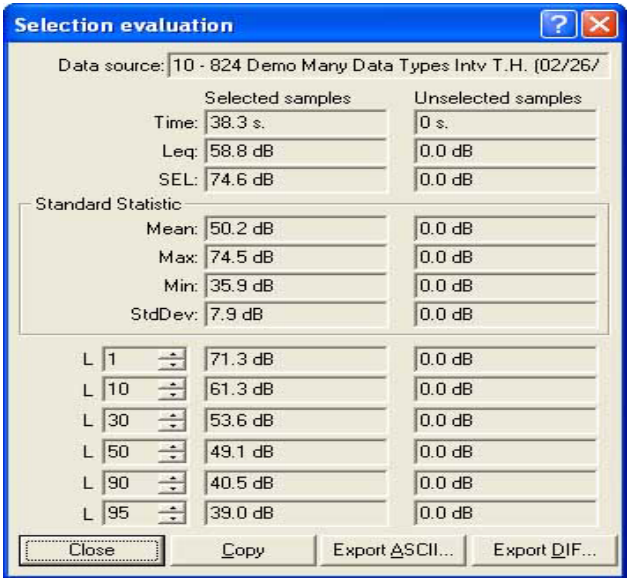


FIGURE 6-17 Evaluation, Complete Measurement with Two Masked Sections

Create an Offset

The Offset is a very useful device in noise control work. It permits the estimation of how the reduction of the sound level for a period of time can change the parameters of a measurement.

In addition to removing a portion of data from calculations, the mask can also be used to add/subtract a constant off-set to a selected portion of the graph. Using the same mask shown in FIGURE 6-15 , place the cursor over the mask, right click, left click “Modify mask” and left click the General tab to obtain the window shown in FIGURE 6-12 . Putting a check in the check box labeled “Offset” in the Masked Mode section will activate the Offset Value field. Type in a number, positive or negative, to assign a value for the offset. Left click **OK** to return to the graph. Continuing

our example, creating on offset of -10 dB will produce the graph shown in FIGURE 6-18 .

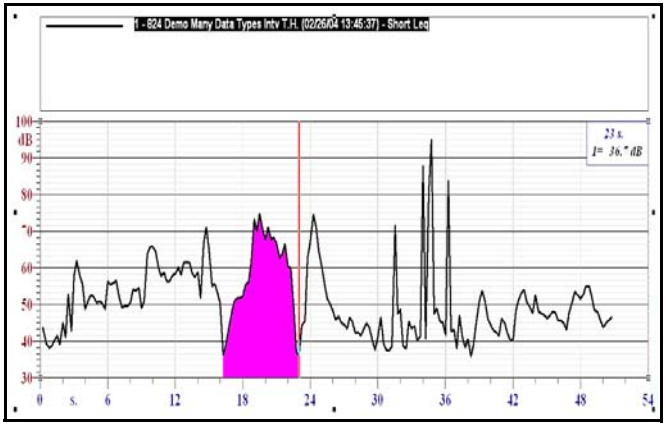


FIGURE 6-18 Leq Graph with One Section Offset by - 10 dB

Note that the levels in the masked portion of the curve have also been reduced by 10 dB.

Multiple offsets having different amounts of offset can be created over the measurement time.

The Evaluation Function can now be utilized to determine how the 10 dB reduction of this portion of the measurement will change the parameters from those of the original measurement.

Also, it is possible to create offsets on top of existing offsets, permitting the user to sculpt level versus time patterns. For example, we can add another offset of - 10 dB to the time interval 20 s - 21.3 s, further modifying the Leq Graph as shown in FIGURE 6-19

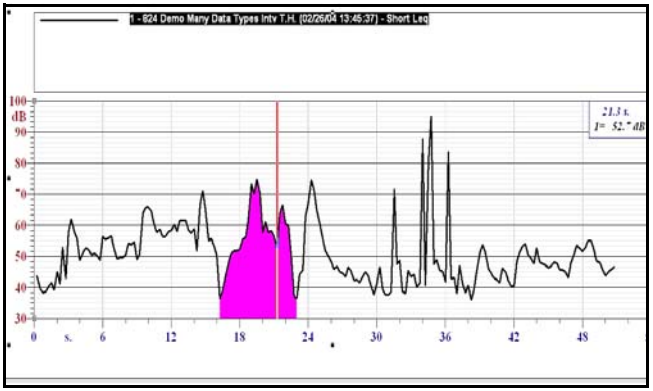


FIGURE 6-19 Leq Graph with an Additional - 10 dB Offset Within the Previous Offset

Modify Mask

Place the cursor over the mask, right click and left click "Modify Mask" to open the Mask Properties window to be used to make modifications to an existing mask.

Disable Mask or Offset

Place the cursor over the mask, right click, left click "Modify Mask" and left click the General tab to obtain the display shown in FIGURE 6-12 "Mask Properties, General" on page 6-10. By putting a check in the check box labeled "Disable Mask", the effect of the mask will no longer have any effect, but it will remain in existence and can be reactivated by removing the Disable Mask check.

Delete Mask

Place the cursor over the mask, right click, left click "Delete Mask". If there is only a single mask, a window will appear for you to confirm that you wish to delete the window. When there are multiple masks, a window will appear listing the masks by name. Select the one to be deleted and left click **OK**.

Left click **File/Open**, highlight the document **Third Octave, 5 Spectra in One Block** from the Demo Data Folder and left click **Open** to open a document containing that measurement. Next, left click **Insert/Graph Template**, select the **Time History Data Block (TH)** and insert the Template **1/3 Octave profile** from the General folder.

When the graph appears, use the Properties Menu to change the curve to represent Spectrum at time of 1 second, as described in "Display All the Spectra in the Data Block" on page 5-24. The graph should look like that in FIGURE 6-20 .

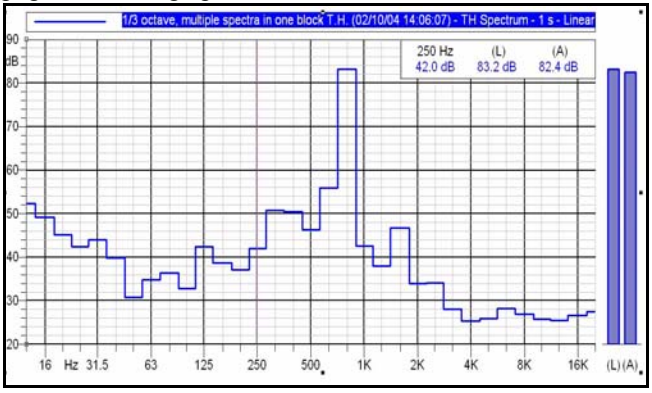


FIGURE 6-20 Graph of Spectrum at 1 second

Place the cursor at 25 Hz, hold down the left mouse button and slide the cursor until it is at 200 Hz, which produces the display shown in FIGURE 6-21 .

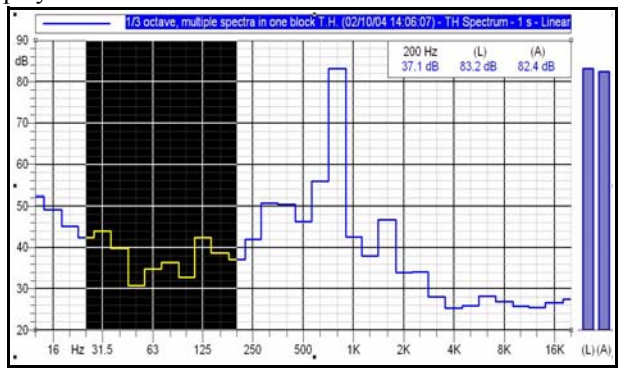


FIGURE 6-21 Spectrum with a Portion of the Frequency Scale Highlighted

Place the cursor over the highlighted region, right click, then left click **Evaluate** to open the window shown in FIGURE 6-22 .

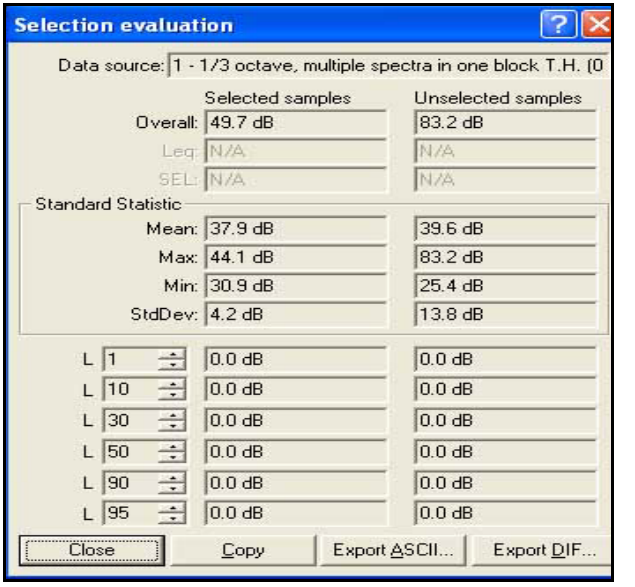


FIGURE 6-22 Selection Evaluation, Frequency Domain

Note: Leq, SEL and L_N values cannot be calculated from spectrum graphs.

Five parameters have been calculated for each of the following:

- The frequency bands within the highlighted region
- The frequency bands outside the highlighted region

Overall (Energy Sum) Level

The overall value for each of these groups of frequency bands appears at the top in the Overall section

Mean, Max, Min, StdDev

The next four are standard statistical parameters calculated from the frequency band levels; Mean, Maximum, Minimum and Standard Deviation.

Left click **Close** to close the Selection Evaluation Window.

Use the Properties Menu to add additional curves of spectra for 2 s, 3 s and 4 s as shown in FIGURE 6-23 .

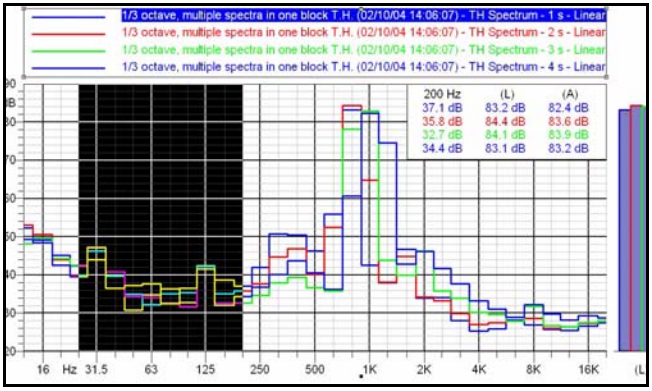


FIGURE 6-23 Spectra with a Portion of the Frequency Scale Highlighted

Evaluation with Multiple Spectrum Graph

When multiple spectra are displayed, the legend has a line for each curve. When using the Evaluate Function, the results correspond to whichever curve has been highlighted. Evaluating using the display shown in FIGURE 6-23 will give the results shown in FIGURE 6-22 because the spectrum at 1 s has been selected. If any other curves is

selected, the results will be different to correspond with the selected curve.

CHAPTER

7 Process Operations

Process/Measurement/Extract Operations

In this graphic, the curve represents the Live (A Fast) signal. This operation can be performed on any time history parameter.

This operation is used to extract portions of a measurement into separate measurements or to split a long measurement into several pieces of the same length. It can also be used to isolate a portion of a measurement in order to perform statistical measurement on that portion only.

Left click **File/Open,** select **Events Time History** from the Demo Data Folder, and left click **Open**. This document already contains a graph, shown in FIGURE 7-9 , which will appear when the document is opened.

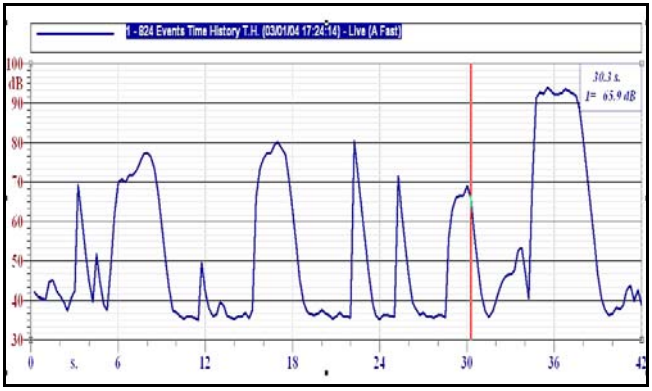
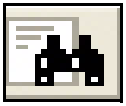


FIGURE 7-1 Time History Graph

Measurements Information

Before we do any extraction, left click the Document Contents icon in the Toolbar at the top of the page.



This will display the contents of the documents which, when expanded, will look as shown in FIGURE 7-2 .

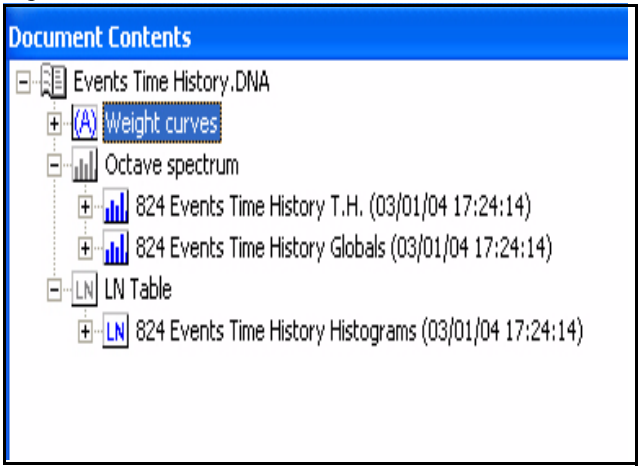


FIGURE 7-2 Measurement Information Prior to Extraction

We can see that this document contains three types of measurements:

- Time history data (824 Events Time History TH), which could include levels values and spectra measured at regular time intervals.
- A set of global measurements (824 Events Time History Globals), determined over the complete measurement time
- Time History statistical data (824 Events Time History Histograms) measured at regular time intervals.

Left click the box in the upper right corner to close this display window.

For this example, use the cursor to highlight the portion of the curves between 5.3 and 10.5 seconds as shown in FIGURE 7-3 .

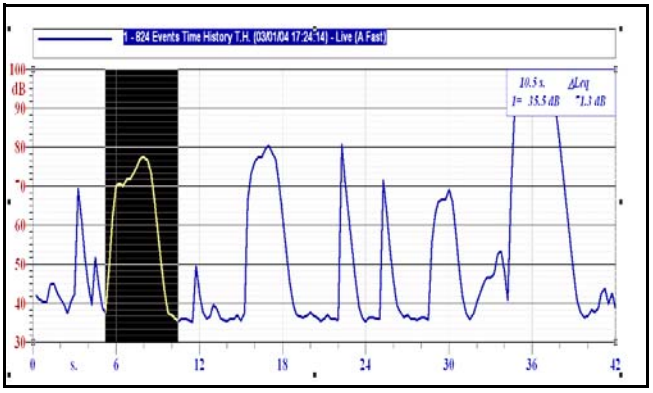


FIGURE 7-3 Portion of Time History Selected for Extraction

Left click **Process/Measurement/Extract** to open the menu shown in FIGURE 7-4 .

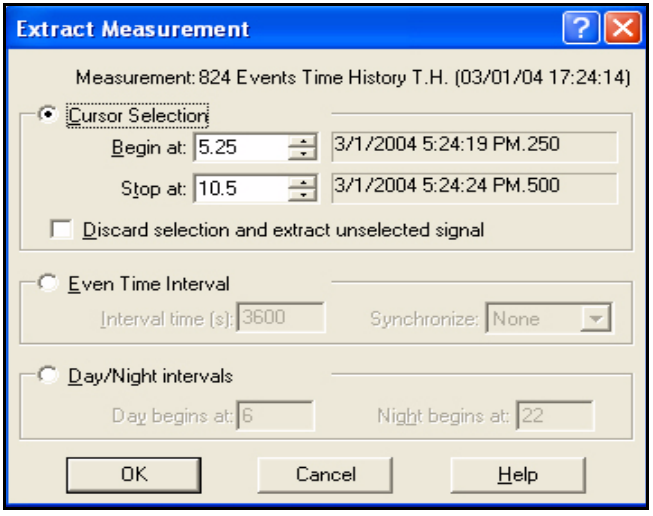


FIGURE 7-4 Extract Measurement Menu, Cursor Selection

There are three general modes of extraction:

- Cursor Selection

- Even Time Interval
- Day/Night Intervals

Cursor Selection

Check “Cursor Selection” to use this mode. The data fields under Cursor Section contain Begin and Stop times corresponding to the time interval highlighted on the graph. Numerical values could be inserted directly into these fields rather than using the cursor on the graph. This defines the section of the time history which will be extracted.

If, however, “discard selected section and extract unselected signal” is also checked, all portions of the time history excepting the cursor defined section will be extracted.

We will extract the highlighted section, so check “Cursor Selection” and left click **OK** to initiate the extraction process. This will open a Measurement Info menu as shown in FIGURE 7-5 .

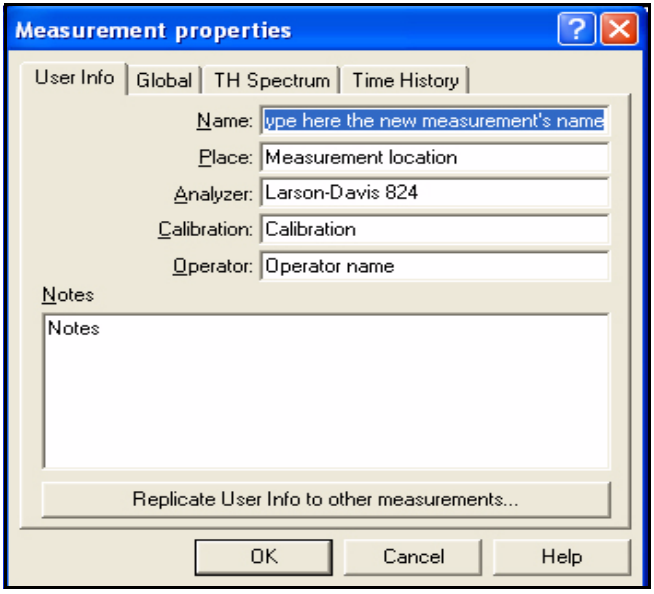


FIGURE 7-5 Measurement Properties Menu for Extracted Measurement

This permits the user to input measurement information for the extracted measurement. For this example, change the name to “Extracted 5.3-10.5 seconds”.

Left click **OK** to implement the extraction. Once again left click the Document Contents Icon to obtain the display shown in FIGURE 7-6 .

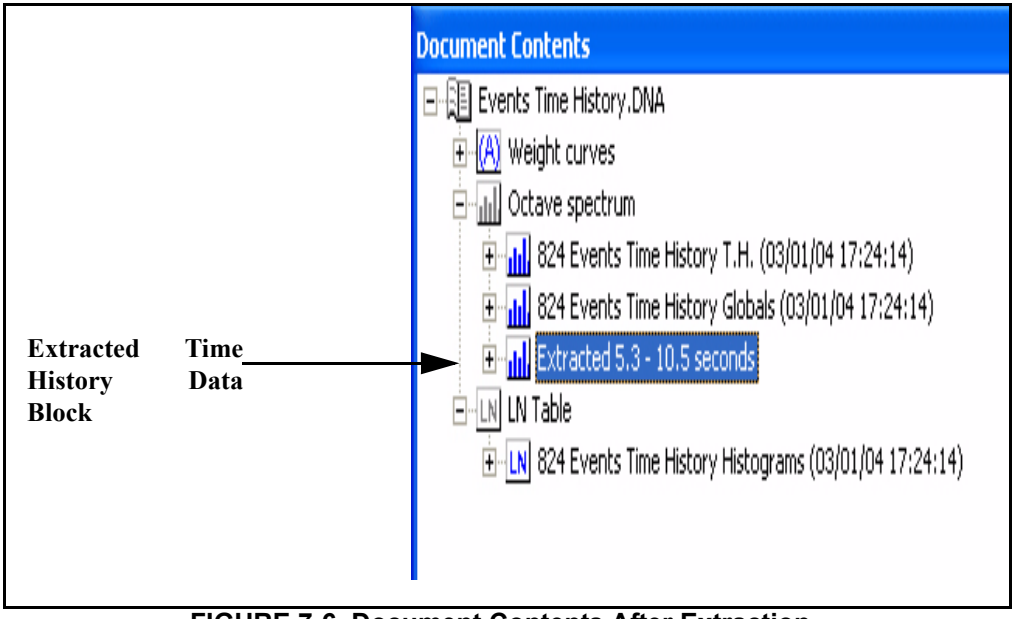


FIGURE 7-6 Document Contents After Extraction

Compare this to FIGURE 7-2 "Measurement Information Prior to Extraction" on page 7-2 and we can see that the extracted time history data block now appears as a separate measurement in the document.

Even Time Interval

Checking “Even Time Interval” modifies the menu as shown in FIGURE 7-7 .

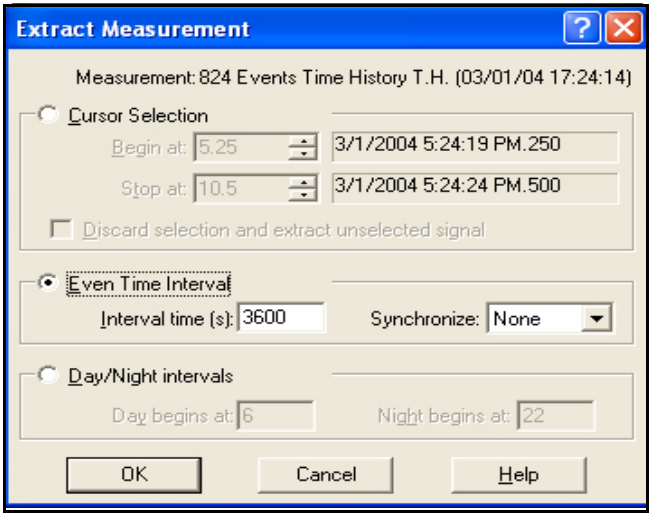


FIGURE 7-7 Extract Measurement Menu, Even Time Interval

The Interval Time is set in seconds. The extraction process can be further specified to be synchronized to integral values of hour, minute or second by making a selection from the drop down menu in the Synchronize data field.

Checking Day/Night intervals modify the menu as shown in FIGURE 7-8 .

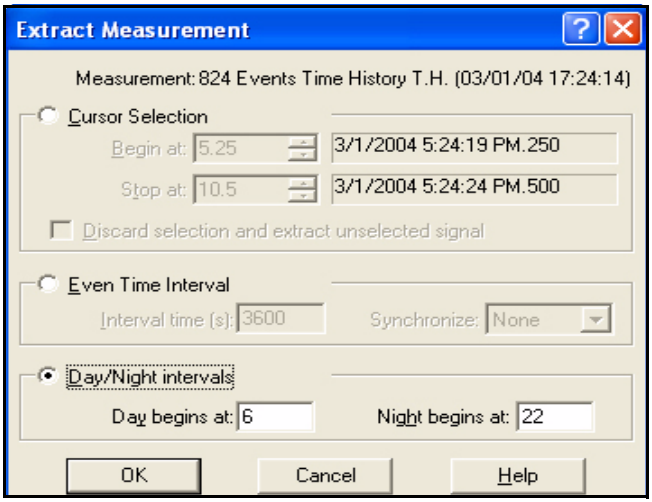


FIGURE 7-8 Extract Measurement Menu, Day/Night Intervals

The Day and Night data fields are used to define the beginning times for each.

Process/Search Operations

Left click **File/Open,** select **Events Time History** from the Demo Data Folder, and left click **Open**. This document already contains a graph, shown in FIGURE 7-9 , which will appear when the document is opened.

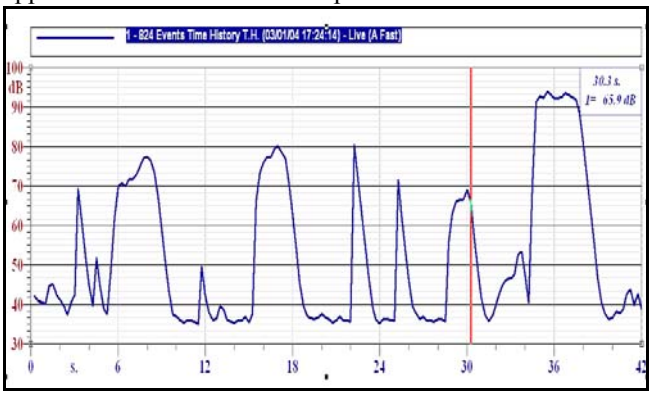


FIGURE 7-9 Time History Graph

In this graphic, the curve represents the Live (A Fast) signal. This operation can be performed on any time history parameter.

Left click on the graph to select it, then left click **Process/ Search** to obtain the window shown in FIGURE 7-10 .

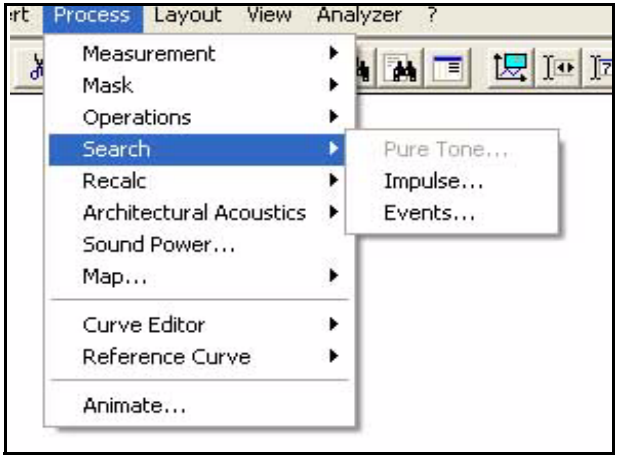


FIGURE 7-10 Process/Search Window

*Since we are working with time history data, **Pure Tone** has been greyed out because it is not applicable. If we were working with a spectral graph, **Impulse** and **Events** would be greyed out as not applicable.*

There are three Process/Search Operations which can be performed:

- Pure Tone: the detection of pure tones in spectral graphs
- Impulse: the detection of sounds having an impulsive character in a time history graph
- Events: the detection of high noise level events in a time history graph.4

Each of these will be discussed in the following sections.

Search Events

Performing an Event Search

Left click on Events to obtain the menu shown in FIGURE 7-11 .

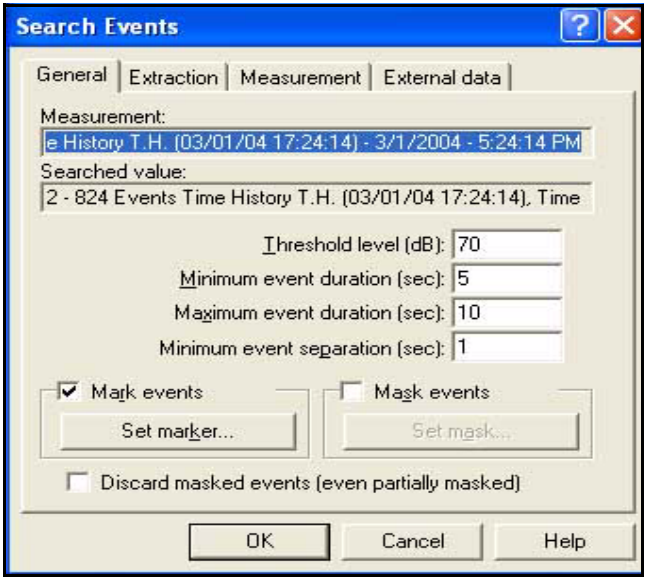


FIGURE 7-11 Search Events Window, General

As can be seen from the menu, each event is first defined by the time interval for which the curve is above a user-defined Threshold level (dB). This criterion can be further refined by requiring that the time interval be within a range set by user-defined values of Minimum and Maximum event durations.

These criteria assist the user to sort for events associated with specific noise sources. For example, if one were specifically interested in the noise from vehicle passbys, the minimum event duration could be used to exclude short duration noises such as horns or dog barks, while the maximum event duration could be used to exclude long duration noises such as aircraft flyovers or train passbys. Minimum event separation can be used to restrict the events to passing vehicles which were not close to other preceding or following vehicles.

Note that check boxes are provided to mark events on the graph and to define a mask for each of them. Left clicking the "Set Marker" and "Set Mask" will open windows for setting the parameters of each.

For this search, set the parameters as follows:

- **Threshold:** 68 dB
- **Minimum Event Duration:** 2 sec
- **Maximum Event Duration:** 10 sec
- **Minimum Event Separation:** 0 s
- **Set Marker:** checked
- **Set Mask:** check
- **Discard Masked Events:** not checked

Left click **OK** to perform the search, resulting in the display shown in FIGURE 7-12 .

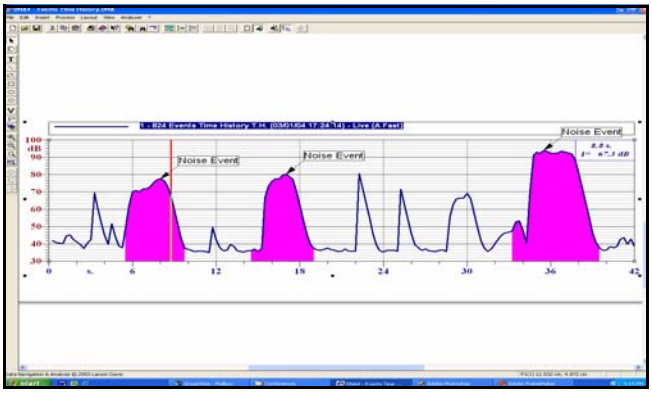


FIGURE 7-12 Event Search Results

Here we can see the results of this search; three events. The user can now modify the text within the marker box for each event as desired. With the masks already defined, the user can immediately use the Evaluate Function to calculate acoustic parameters for this time history with the events excluded from the calculation. Or, the masks can be changed to offsets to be used to estimate the effect of reducing the levels of the events in the evaluation of the total measurement. The use of the Evaluate Function is described in the section "Evaluate Function" on page 6-7 .

Extraction of Measurements

It is possible to have the time waveforms of all events extracted from the time history and stored as separate measurements as part of the event search. Before we do this, we will display the measurements contained in this document. Left click **Process/Measurements/Information** to obtain the Measurement Info window shown in FIGURE 7-13 .

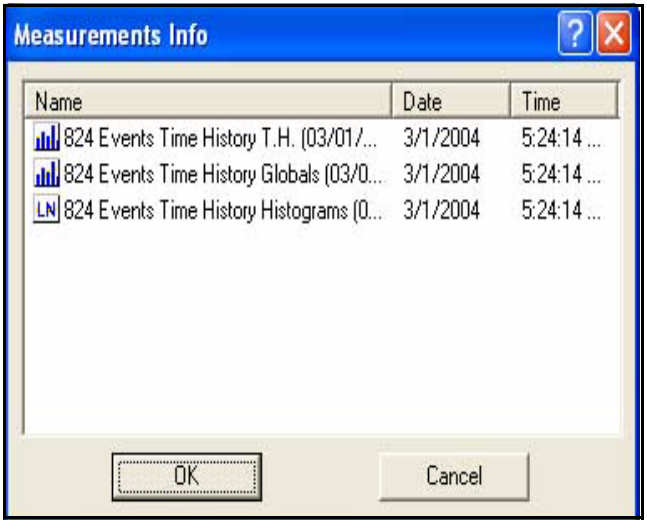


FIGURE 7-13 Measurements Info Window

At this time, the document contains a Time History TH measurement (which we are working with now), a Time History Global measurement and a Time History Histograms measurement.

To setup to have the event measurements extracted, left click the Extract tab in the Search Events menu to obtain the menu shown in FIGURE 7-14 .

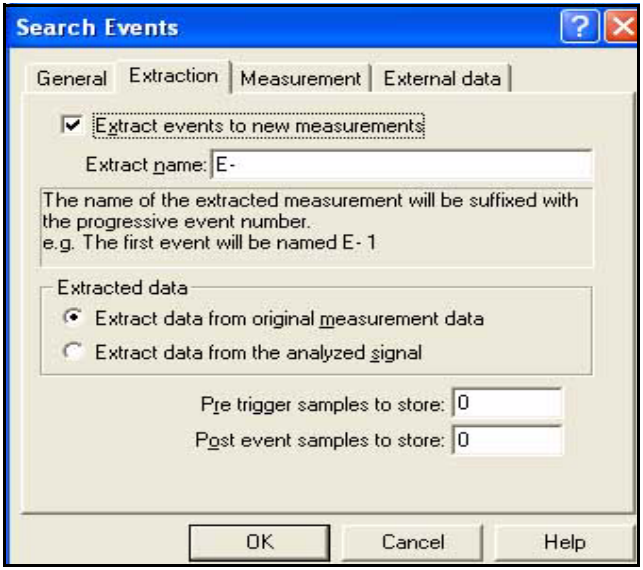


FIGURE 7-14 Search Events Menu, Extraction

The text in this menu will be greyed out until a check is place into the check box labeled "Extract events to new measurement".

The only modifications we will make to this menu is to change the Pre-trigger and Post Event samples to store values to 5, so that our measurements include five samples leading up to the event and five samples following the event. Left clicking **OK** will implement the search and the extraction of the separate event measurements.

Left click **Insert/Graph Template** to get the display shown in FIGURE 7-15 .

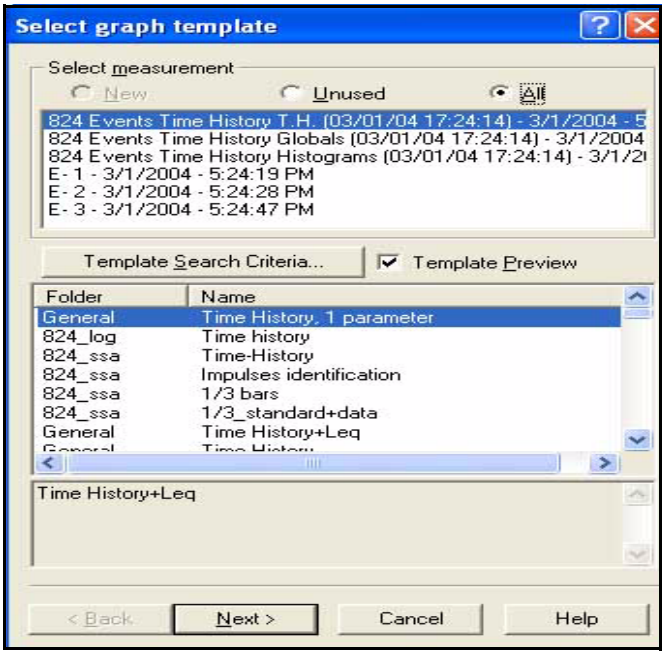


FIGURE 7-15 Select Graph Template Showing Extracted Measurements

In the Select measurement section, "All" must be selected to see all the measurements. Since the first item, Time History TH was already used, it would not be seen if New or Unused were checked.

In the upper section, we see that there are now three more measurements, E-1, E-2 and E-3 corresponding to each of the extracted measurements.

We can now proceed to display these, separately or together. To continue this exercise, highlight E-1 and left click **OK**. This will open the window shown in FIGURE 7-16 .

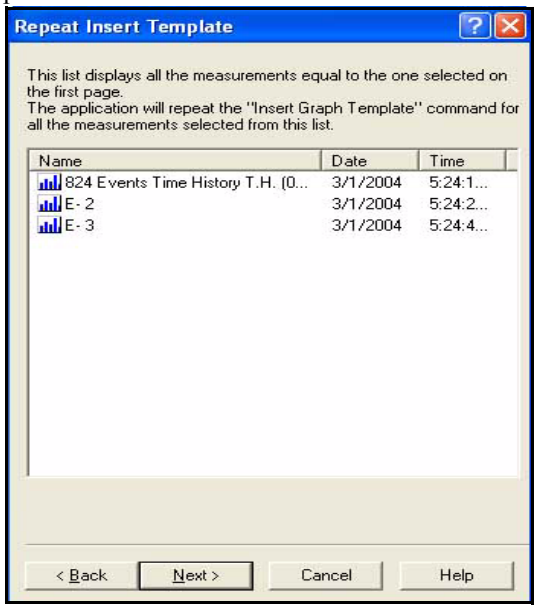


FIGURE 7-16 Repeat Insert Template Menu

Note that one can only select one measurement from the Insert Template Menu; this menu provides the opportunity to select additional ones.

This shows that there are three other measurements of the same type as the one selected, providing the opportunity to select them as well. Hold down the Ctrl key while left clicking E-2 and E-3 and left click **OK**, then **Finish**. The three event graphs will appear on separate pages of the document. Left click the icons in the Toolbar at the top of the screen, shown in FIGURE 7-17 , to change the display from one page to another.

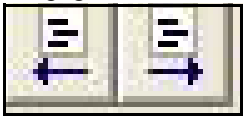


FIGURE 7-17 Paging Through Document

Using the cut and paste features of Window, the event graphs can be moved to the same page as the Event Search Results Graph, as shown in FIGURE 7-18 .

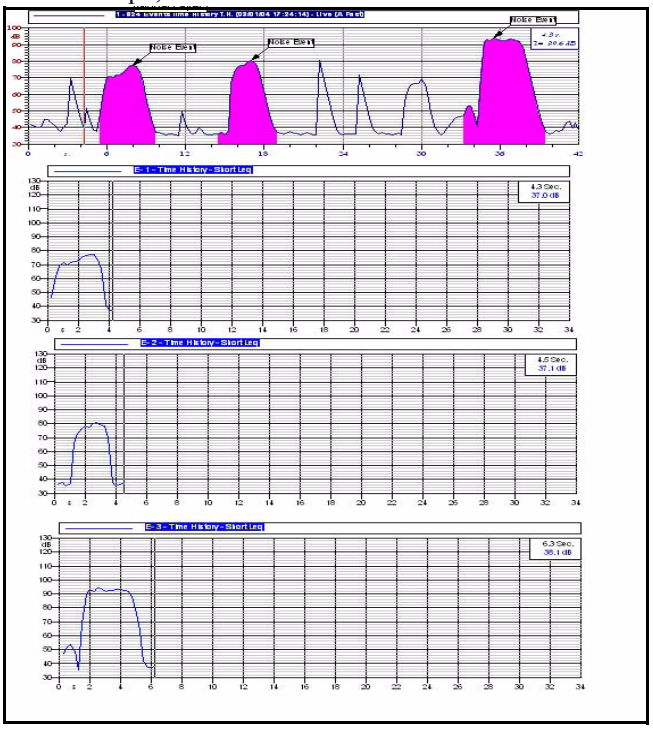


FIGURE 7-18 Search Results and Event Graphs

Evaluate Events in a Separate Measurement

There are a number of parameters associated with events which can be determined as part of the event search. From the Search Events Menu, left click the Measurement tab to obtain the display shown in FIGURE 7-19 .

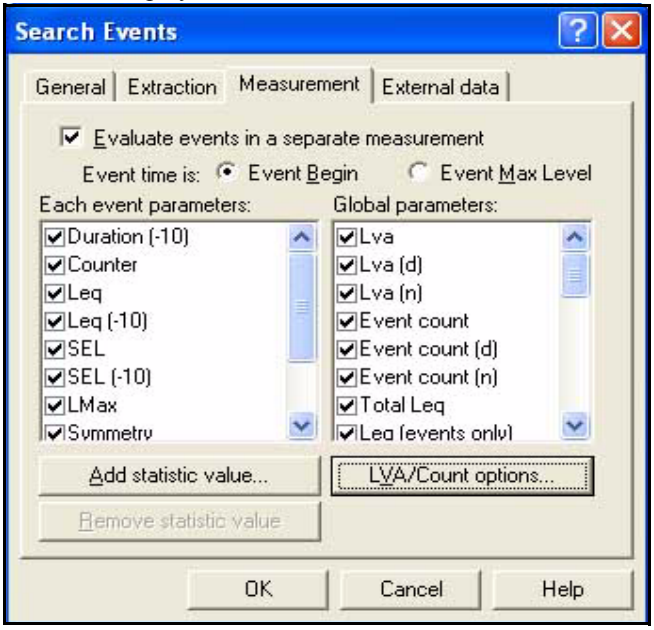


FIGURE 7-19 Search Events Menu, Measurements

When the check box for “Evaluate events in a separate measurement” is checked, another measurement is created with a wide range of possible parameters for each event. The events are identified by time in the measurement; either the beginning time of the event or the time of the maximum level as selected near the top of the menu.

The left window is for the selection of event parameters and the right is for the selection of Global parameters; place checks in the check boxes for those desired. Note that one can also add statistical values, one at a time, to the event parameters by clicking the box entitled “Add statistic value”. Similarly, LVA/Count options can be added to the Global parameters. These are parameters defining the hour when day and night are begun, and whether or not the time is GMT or local.

Left click **OK** to begin the search. When the search is completed, a window will open permitting you to add comments to the Events Evaluation measurement.

Left click **Insert/Graph Template** to obtain the display shown in **FIGURE 7-20 .**

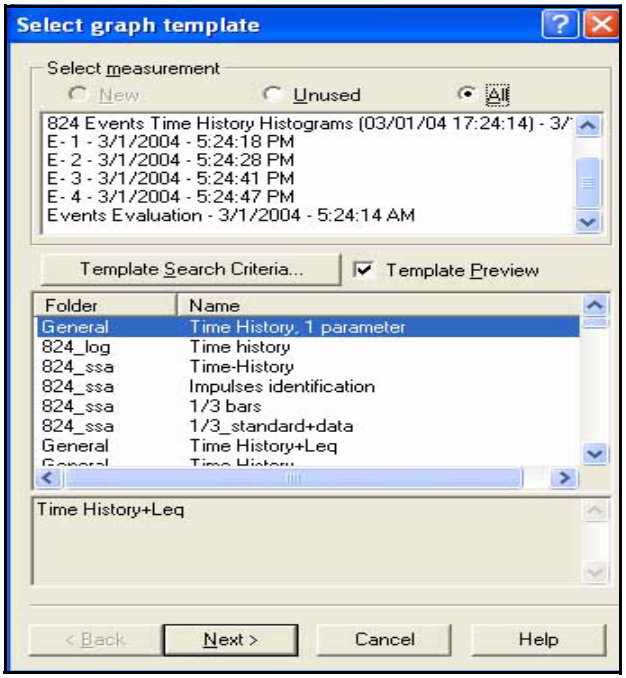


FIGURE 7-20 Select Graph Template Showing Events Evaluation

We now see that an Events Evaluation measurement has been added to the measurements seen in FIGURE 7-15 "Select Graph Template Showing Extracted Measurements" on page 7-14. Highlight this measurement, select the template **Time-History** from the 824_ssa folder, left click

Next, and **Finish** to obtain the graph shown in FIGURE 7-21 "Events Evaluation Graph" on page 7-19.

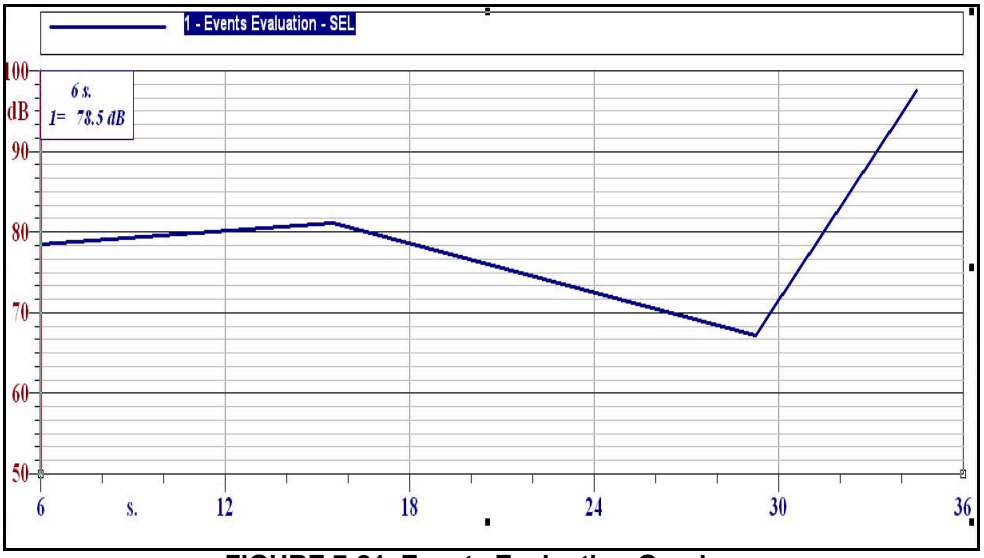


FIGURE 7-21 Events Evaluation Graph

To obtain this graph, we have autoscaled the time axis and moved the cursor display window to the upper left, since it was blocking the third event point.

Using the cursor, it can be seen that there are only three points to this graph; one for each event found, located at the beginning time of the event. The curve seen here represents the SEL value for each.

Open the Properties Menu, then left click the Axes-Data tab, Edit, the Data Source tab, then the down arrow to the right of the Values field to open the window shown in FIGURE 7-22
.

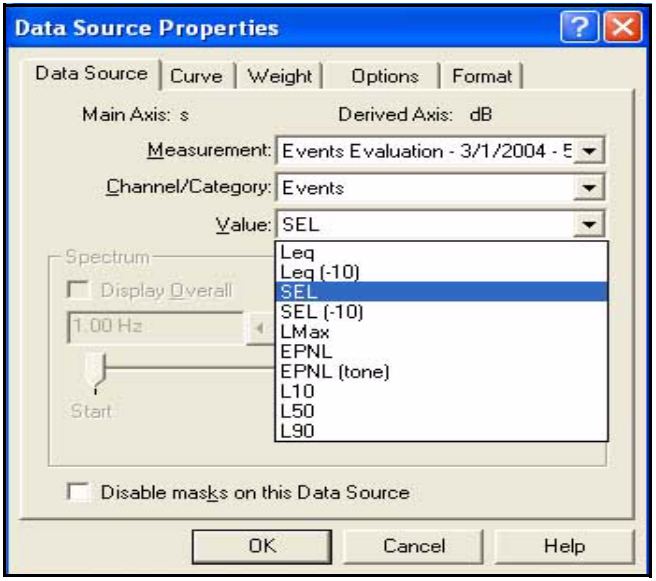


FIGURE 7-22 Data Source Properties Menu, Value Window

This window lists all the parameters available to be added to the graph. Using the standard techniques for creating multi-parameter graphs, a variety of graphs can be created combining several parameters on each.

For example, the display shown in FIGURE 7-22 presents Leq, L_{10}, L_{50} and L_{90} for each event.

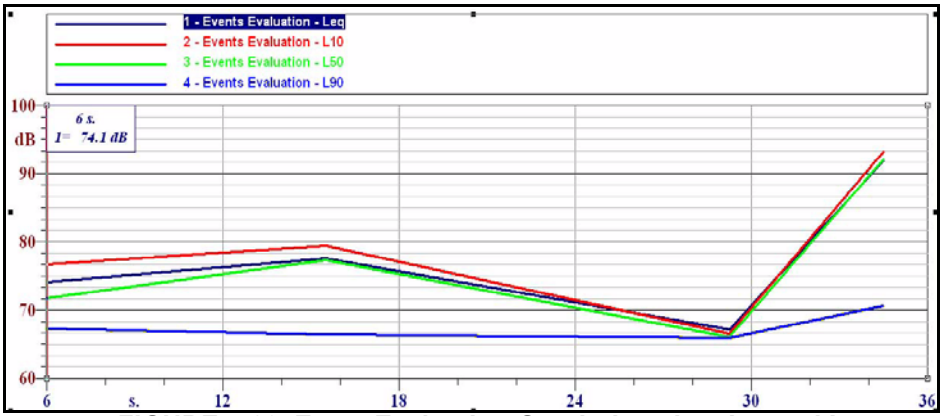


FIGURE 7-23 Event Evaluation Graph; Leq, L_{10}, L_{50} and L_{90}

With this particular graph, curves can be made for the following parameters:

- Leq
- Leq (- 10)
- SEL
- SEL (-10)
- Lmax
- EPNL
- EPNL, tone corrected
- L_{10}, L_{50} and L_{90}

External Data in Events

Although there is an External data tab page associated with the Search Events Window, as shown in FIGURE 7-24 , the functionality of this window is not implemented in the standard version of DNA.

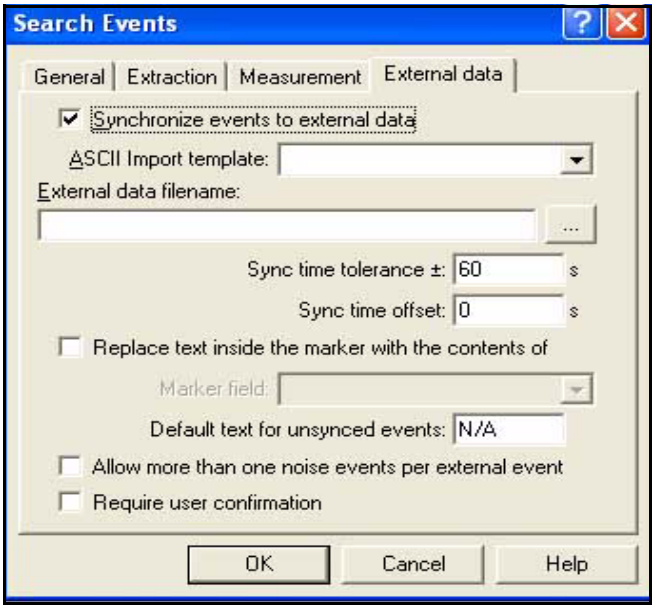


FIGURE 7-24 Search Properties Menu, External Data

We will work with the same measurement we used above for Event Searching. Use the Properties Menu to create a graph presenting curves for Live (A Fast), Live (A Slow) and Live (A Impulse) as shown in FIGURE 7-25 .

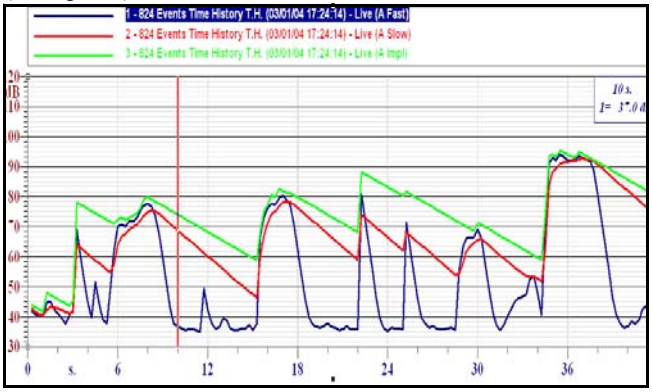


FIGURE 7-25 Time History Graph; Live (A Fast), Live (A Slow) and Live (A Impulse)

Left click Process/Search/Impulse to open the Search Impulse Window.

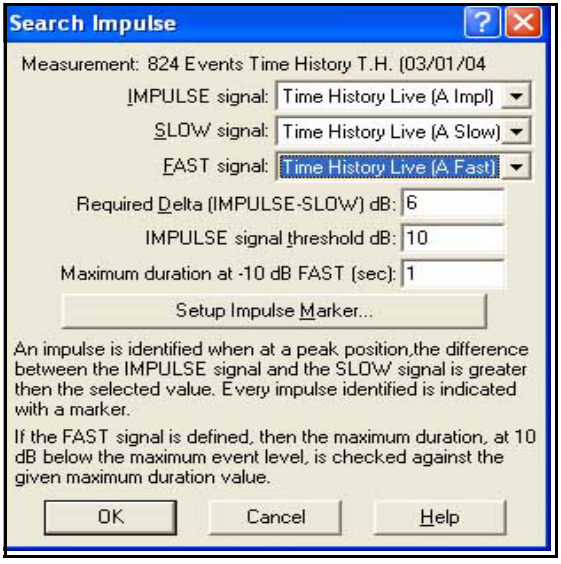


FIGURE 7-26 Search Impulse Menu

Note that in FIGURE 7-26 we have modified the selections in the IMPULSE, SLOW and FAST data field from Max to Live.

The technique employed here is based on the difference between the rise times of three root-mean-square (RMS) detectors, whose rise time are as follows:

- Impulse: 35 ms
- Fast: 125 ms
- Slow: 1 sec

As long as the measured signal does not vary greatly over periods of 1 second, the levels measured by these detectors will be approximately the same. If there is a sudden, sustained increase in the applied signal, the measured level for each detector will rise at a rate (dB/sec) proportional to its rise time. Thus, the Impulse level will rise the fastest, the Fast level slower and the Slow level the slowest. Eventually, though, they will all reach an equal level.

An impulse is characterized by a short burst of energy which initially causes the levels of all detectors to begin rising in the same manner described above for a sudden, sustained level change. However, because the time duration of an impulse is much shorter than the rise time of any of these detectors, typically < 1 ms, each will reach a maximum level and then begin decaying when the energy from the impulse is no long being applied. As a result, in a time history graph an impulsive noise is characterized by short duration spikes in the curves of all detectors, for which the maximum level of the Impulse curve is substantially higher than that of the Fast or Slow detector.

In FIGURE 7-26 , in the field “Required Delta”, we enter the difference in dB between the maximum levels of the Impulse and Slow detectors as a primary indicator of an impulsive signal.

Although the Impulse level rises faster than the Fast level, it has a very slow decay rate so it cannot be used as an indicator of the duration of the noise event.

To verify that the noise is truly impulsive in character, having a short duration, we enter a number in “Maximum duration at - 10 dB Fast”. When performing the search, we essentially draw a horizontal line through the Live (A Fast) curve at a level 10 dB below the maximum level corresponding to the noise event being examined. The difference in time between the rising curve and the decaying

curve at that level is compared to the “Maximum duration at - 10 dB Fast”. If it is larger, it is rejected as an impulse.

When the parameters are set as desired (we will use the same ones shown in FIGURE 7-26), left click **OK** to obtain the display shown in FIGURE 7-27 .

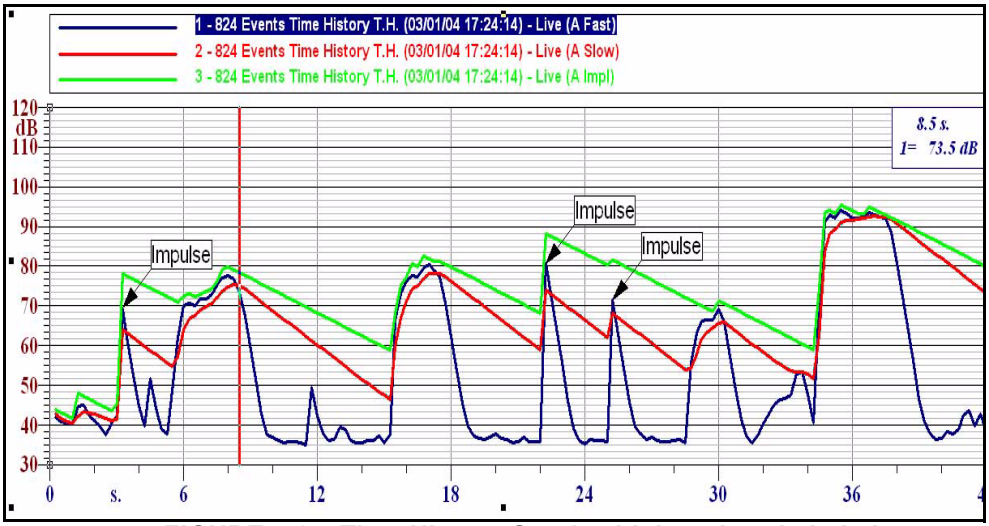


FIGURE 7-27 Time History Graph with Impulses Labeled

The text in the label boxes can be edited if it is desired to denote further information concerning specific impulses.

A frequency spectrum graph is required to demonstrate this. Open the document **Third Octave Spectrum** in the Demo Folder and insert the graph template **1/3 Octave profile** from the General folder to create the display shown in FIGURE 7-28 .

FIGURE 7-28 Third Octave Overall Leq Spectrum

The curve shown on this graph is for Overall Leq. We can obtain a more interesting graph by using the Properties Menu to change to a curve of L_{Max} as shown in FIGURE 7-29 .

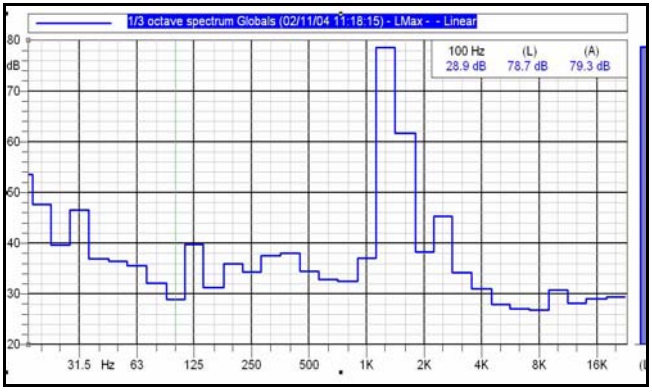


FIGURE 7-29 Third Octave L_{Max} Spectrum

Left click **Process/Search/Pure Tone** to obtain the Search Tones Menu shown in FIGURE 7-30

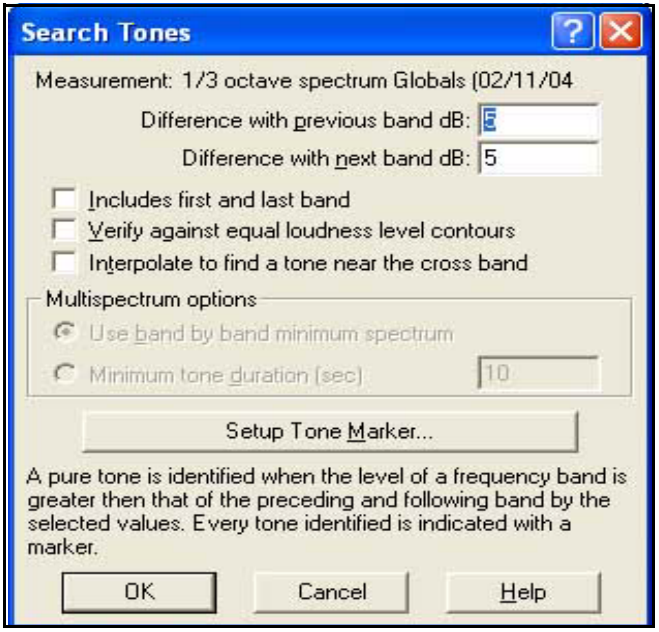


FIGURE 7-30 Search Tones Menu

The technique used to identify pure tones is described in the figure. Leaving the menu configured as shown, left click OK to obtain the display shown in FIGURE 7-31 .

FIGURE 7-31 Spectrum with Pure Tones Marked

The text in each of the markers can be edited by the user. For example, if the noise source responsible for generating one or more particular tones is known, the name could be inserted.

In the Search Tones Menu, left click **Setup Tone Marker** to display the window shown in FIGURE 7-32 .

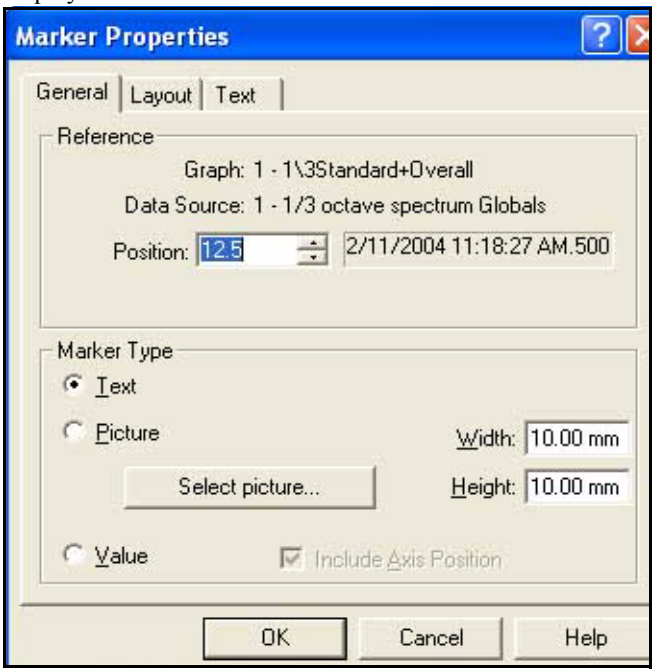


FIGURE 7-32 Setup Tones Marker Menu

The pages in this menu, General, Layout and Text, are used to configure the appearance of the markers, including the text to appear in the marker boxes. In the “Marker Type” section, we can also setup to use a graphic rather than text for the marker.

Pure Tone Search Options

There are a number of options which can be utilized as part of the pure tone search.

Includes First and Last Bands

The check box determines whether the first and last bands are to be included in the search process. This is not usually done because these bands have only one adjacent band.

Verify Against Equal Loudness Contours

If the check box is checked, a pure tone is only recognized when no other band in the spectrum has a phon value greater than that tone. If this option had been selected during the previous search, the results would have been as shown in FIGURE 7-33 .

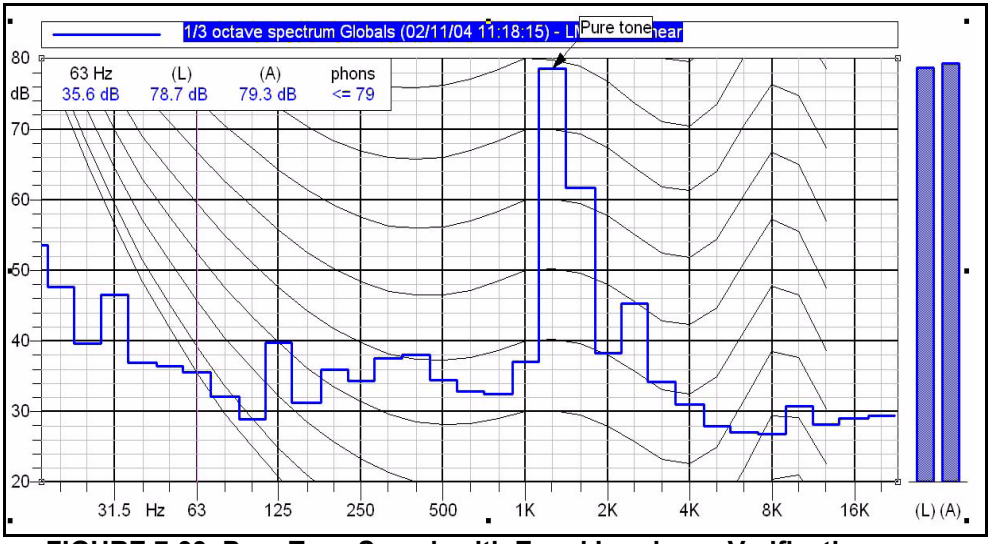


FIGURE 7-33 Pure Tone Search with Equal Loudness Verification

With this option active, we can see that all but one of the pure tones shown in FIGURE 7-31 have been rejected because they have phon values lower than that of the tone shown at the top of the graph.

Search Pure Tones; Multiple Spectra

When performing pure tone searches on multiple spectra graphs, there are two additional options. For this example, open the document **Tone History** from the Demo folder. This document contains two graphs on different pages as shown in the following figures.

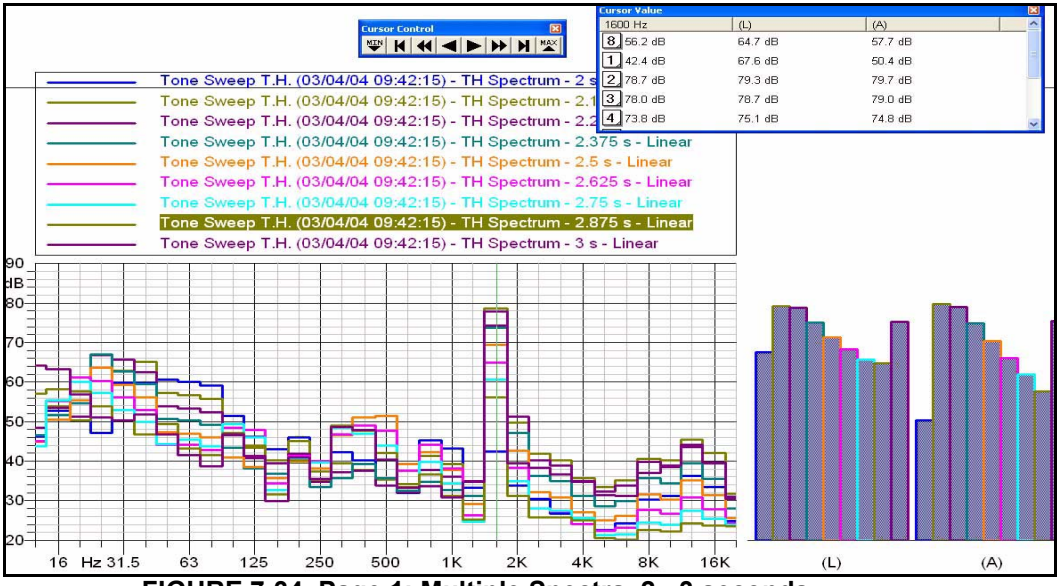


FIGURE 7-34 Page 1: Multiple Spectra, 2 - 3 seconds

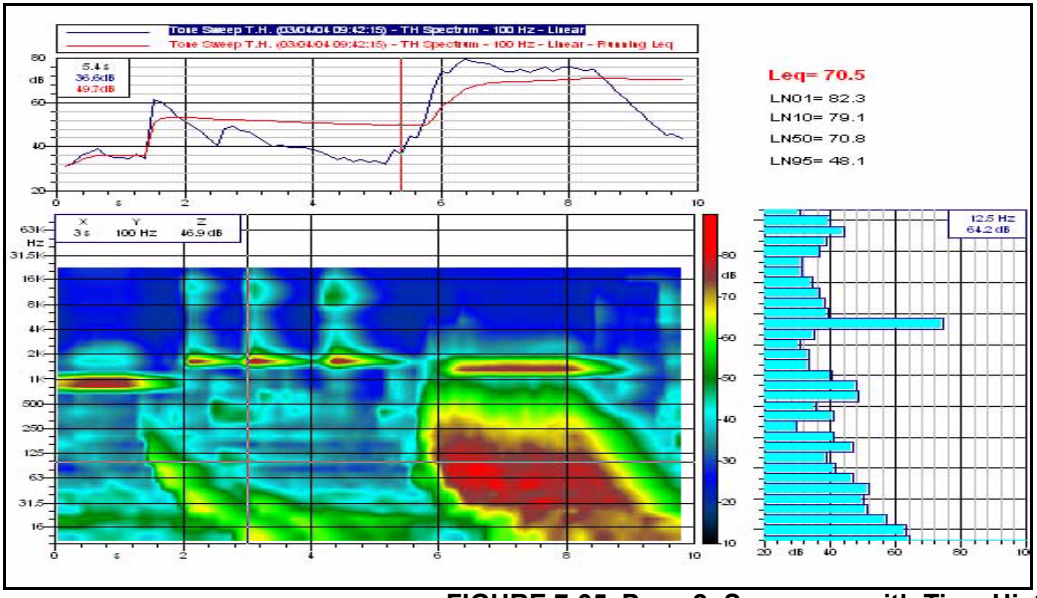


FIGURE 7-35 Page 2: Sonogram with Time History and Slice (Spectra)

The multiple graph in FIGURE 7-35 permits a very detailed examination of this time-varying signal. By moving the cursor left and right along the time axis, the variation of the frequency content with time can be followed from the graph on the right. Move the cursor up and down and the variation of each frequency band with time can be seen in the upper graph.

To change page displays, unitize the icons shown in FIGURE 7-17 "Paging Through Document" on page 7-15

These two illustrate the complexity of searching multiple spectra. From FIGURE 7-35 we can see that the measurement spans a time interval of 9.75 seconds, with a spectrum every 0.125 seconds. FIGURE 7-34 shows spectra only for the time period 2 - 3 seconds.

Left click **Process/Search/Pure Tone** to open the menu shown in FIGURE 7-36 .

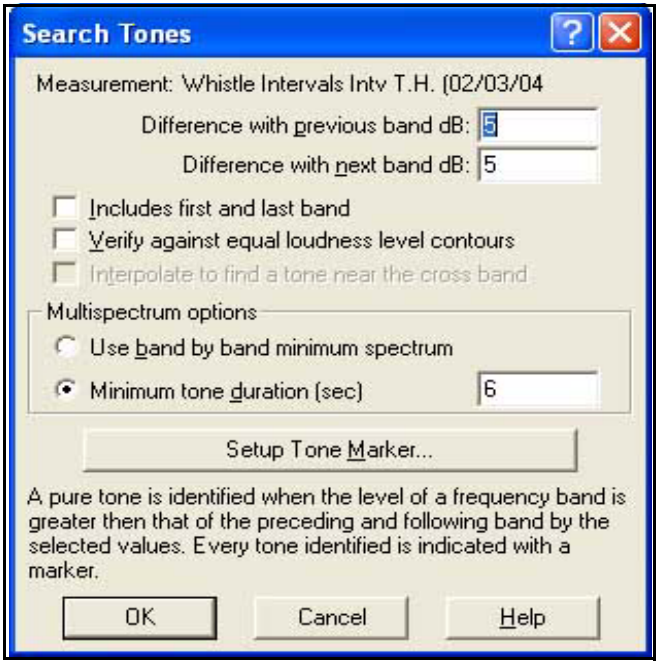


FIGURE 7-36 Search Tones Menu, Multiple Spectra

There are now two new options:

- Use band by band minimum spectra
- Minimum tone duration

Minimum Tone Duration

Adding a minimum time duration to a pure tone search adds a lot of flexibility when searching for persistent tones. Perform a pure tone search with the minimum tone duration checked and a time of 0.2 seconds entered. The result will be as shown in FIGURE 7-37 .

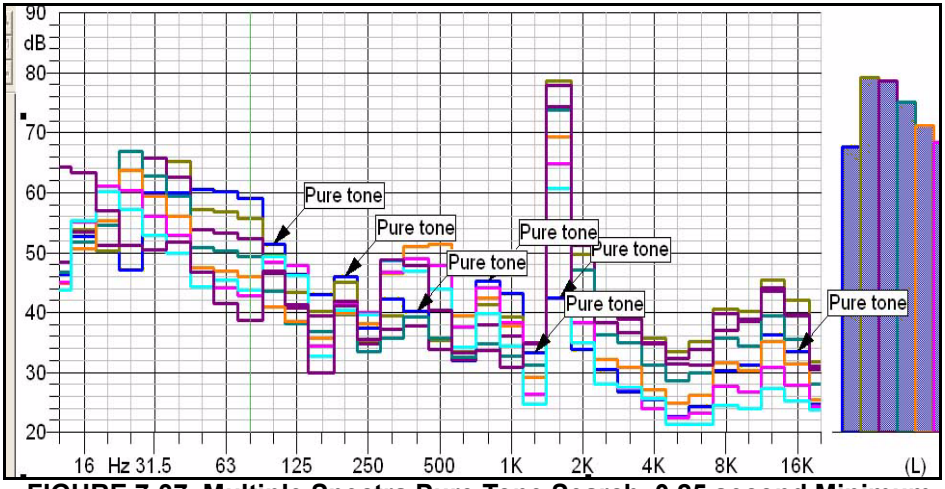


FIGURE 7-37 Multiple Spectra Pure Tone Search, 0.25 second Minimum

Seven tones have been found meeting this criterion. Now repeat the search using a minimum time of 2 seconds to obtain the graph shown in FIGURE 7-38 .

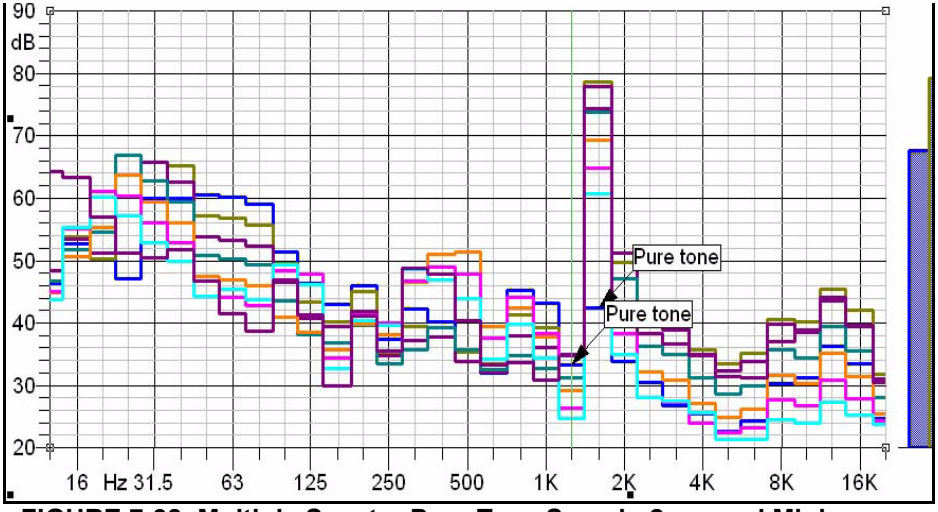


FIGURE 7-38 Multiple Spectra Pure Tone Search, 2 second Minimum

We can see that increasing the minimum time to 2 seconds has reduced the number of detected pure tones to 2.

Use band by band minimum spectra

This is a rather specialized routine which is useful when looking for persistent low level tones which are masked by noise which is variable in time and frequency.

In this operation, the lowest level in each frequency band is taken and they are used to build a new spectrum; The band-by-band minimum spectrum. The search for pure tones is then performed using this spectrum.

When we select this option and perform the search, the result is as shown in FIGURE 7-39 .

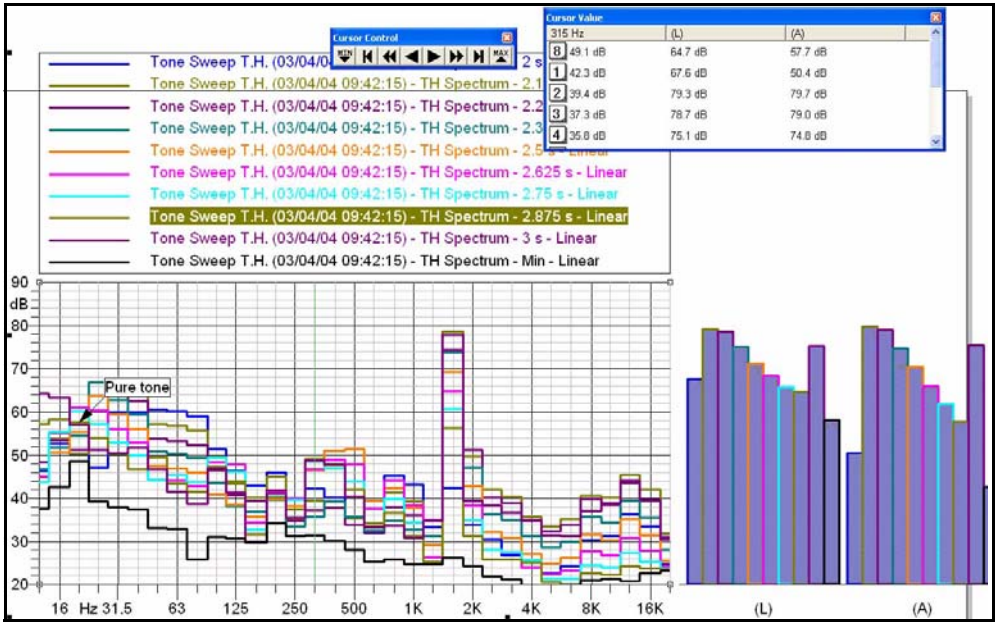


FIGURE 7-39 Pure Tone Search, Band-by-Band Minimum Spectrum

The single pure tone at 20 Hz seems very surprising when viewed along with the spectra corresponding to 2 - 3 seconds. However, by adding a curve for the Band-by-Band Minimum, as shown by the thick black curve, it becomes clear that the result is correct.

We could have accomplished the same thing by simply graphing the Band-by-Band Minimum Spectrum by itself and performing the search, but this technique lets us work directly with the full multiple spectrum display

CHAPTER

8 Templates

In this Chapter we will show how to build some templates using some of the basic graph types. Although there are many different templates provided, and usually it is easiest to modify one of these, there may be instances where it is more direct just to build your own from a basic graph type.

Building a Simple Spectrum Graph

Open the document **Third Octave Spectrum** from the Demo Folder. Left click **Insert/XY Graph** to obtain the graph shown in FIGURE 8-23 .

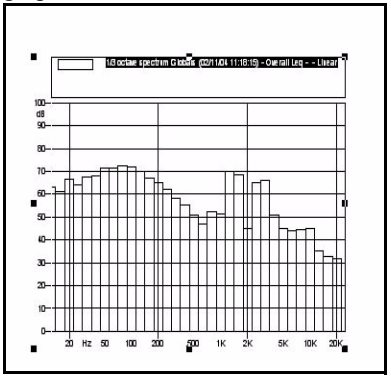


FIGURE 8-1 Basic XY Graph

The curve represents a 1/3 octave spectrum since that is the data which was contained in the document **Third Octave Spectrum.**

Place the cursor above the vertical scale until the two headed arrow appears, right click, then left click **Properties** and select the General tab to obtain the menu shown in FIGURE 8-2 .

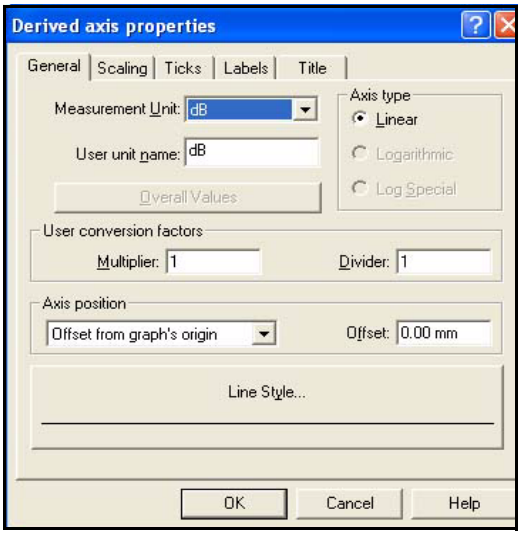


FIGURE 8-2 Vertical Properties/General Menu

We will continue to use dB as the measurement units, but this can be changed by left clicking the down arrow to the right of the “Measurement Unit” field and selecting from a drop down list. Note the other parameters which can be set from this menu.

Left click the Scaling tab to obtain the display shown in FIGURE 8-3 .

FIGURE 8-3 Vertical Properties/Scaling

Change the Axis Size to be:

- **Start:** 20
- **Stop:** 80

and check the check box for “Lock with axis size”

Left click the Title tab to obtain the display shown in FIGURE 8-4

.

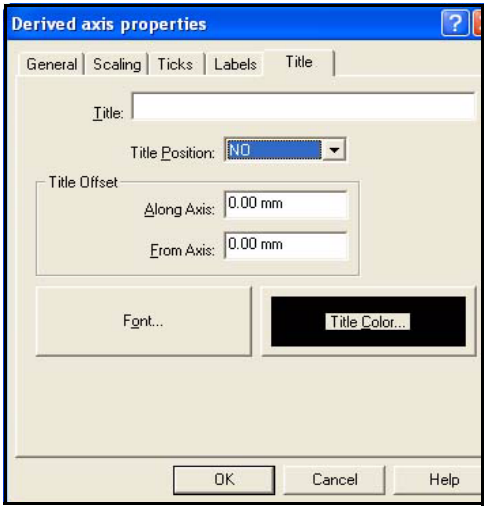


FIGURE 8-4 Vertical Properties/Title

Type “Sound Pressure Level, dB” into the “Title” field. Left click the down arrow to the right of the “Title Position” field and select “Before” from the drop down menu.

Left click **Font** and select

- **Font Size:** 16
- **Font Style:** Bold

Left click **OK**.

Left click **Title Color** and select the blue square from the color palette (5th column, 4th row) and left click **OK**.

Left click **OK** to obtain the graph shown in FIGURE 8-5 .

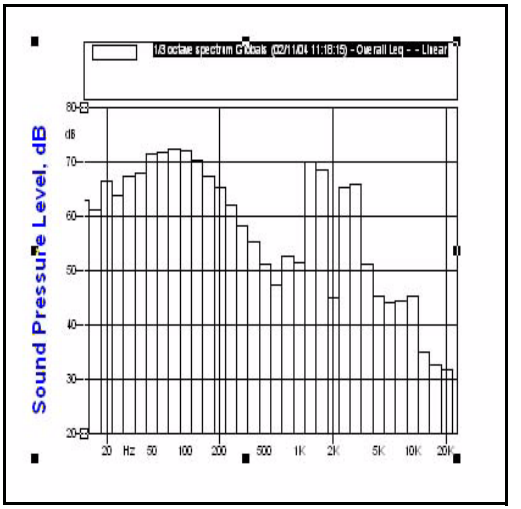


FIGURE 8-5 Graph with Vertical Axis Modified

Modify Horizontal Scale

Place the cursor above the horizontal scale until the two headed arrow appears, right click, then left click **Properties** and select the General tab to obtain the menu shown in.

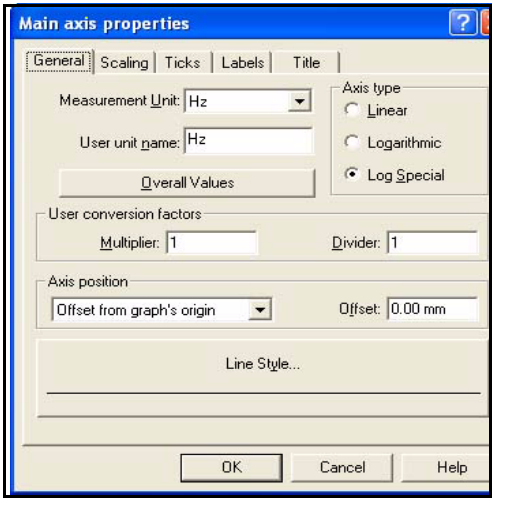


FIGURE 8-6 Horizontal Axis Properties/ General

We will leave this as-is, but note the many ways this menu can be used to modify the graph parameters.

Left click the Scaling tab to obtain the display shown in FIGURE 8-7 .

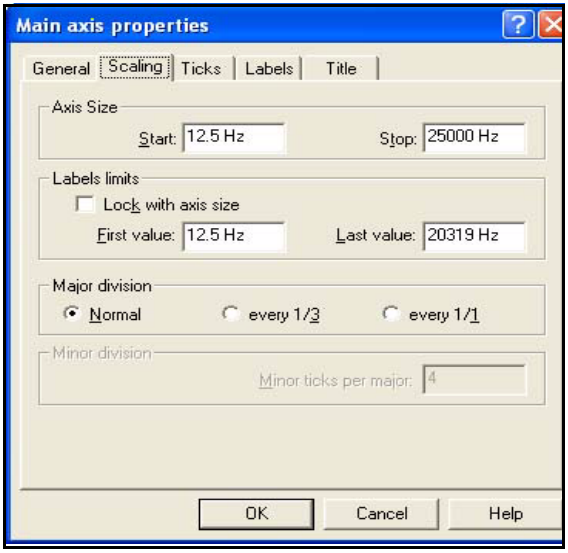


FIGURE 8-7 Horizontal Axis Properties/ Scaling

Modify the Axis Size to be:

- **Start:** 63
- **Stop:** 20000

and check the check box for “Lock with axis size”.

*Try setting the Major division to be **every 1/3** and you will see there is not enough room to fit all the numbers while keeping them large enough to read.*

Select Major division to be **every 1/1**.

Left click the Title tab. Set the Title to be “Frequency, Hz”, and set the font size and color to be the same as the for the vertical axis. Left click **OK** until the graph appears. It should look as shown in FIGURE 8-8 .

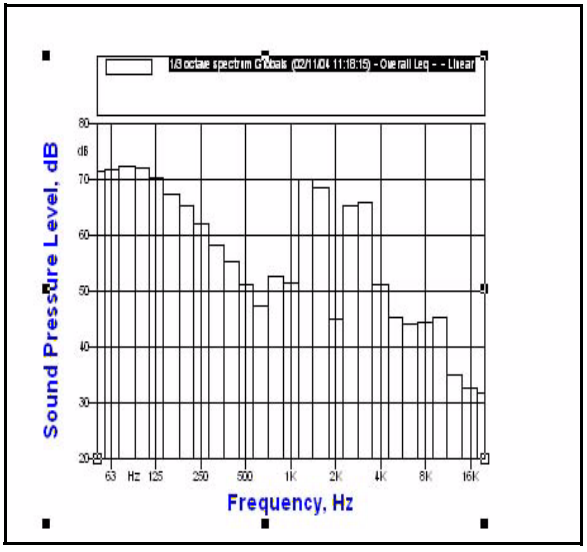


FIGURE 8-8 Graph with Horizontal Axis Modified

Place the cursor over the graph area, right click, then left click **Properties**. Left click the Axis Data tab, highlight the data field (only one in this instance) under "Displayed data", left click **Edit** and left click the Curve tab to obtain the display shown in FIGURE 8-9 .

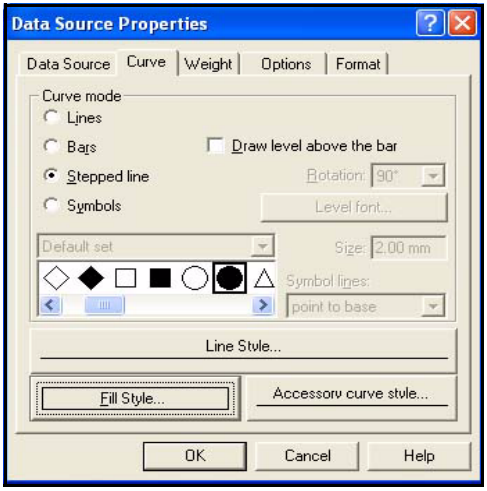


FIGURE 8-9 Properties/Curve Menu

Select “Curve Mode” to be “Bars”, left click **Line Style** to obtain the menu shown in FIGURE 8-10 .

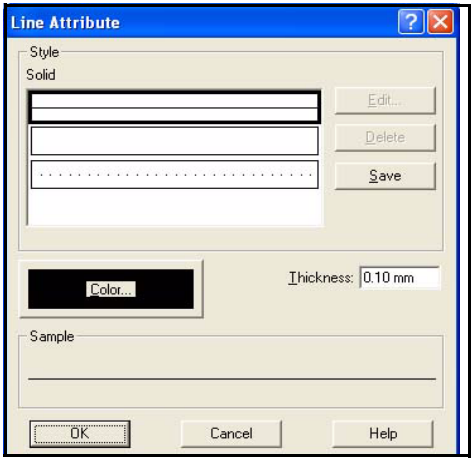


FIGURE 8-10 Properties/Line Style Menu

Select the solid line at the top, set the Thickness to be 0.1, and left click Color to obtain the display shown in FIGURE 8-11 .

FIGURE 8-11 Color Palette

Left click the black square, last row in the first column and left click **OK** twice to return to the menu shown in FIGURE 8-9 .

Left click **Fill Style** to obtain the display shown in FIGURE 8-11 .

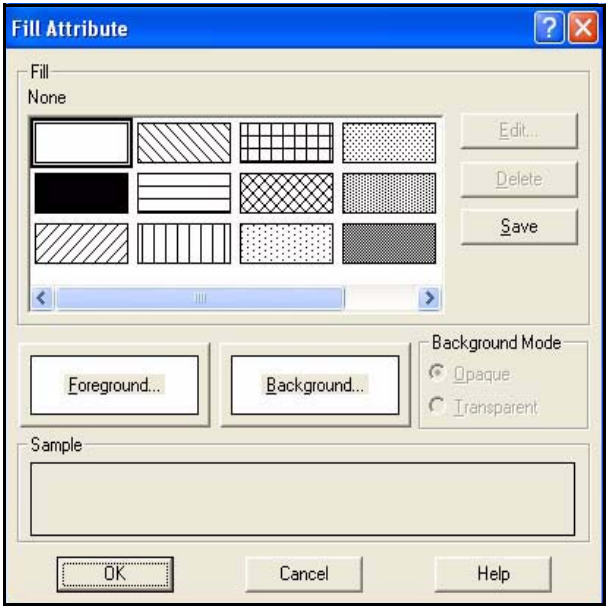


FIGURE 8-12 Fill Style Menu

Left click the pattern shown in the 2nd column, 1st row, then left click **Foreground** to open the same color pallet shown in FIGURE 8-11 .

Select the same blue color used for the horizontal and vertical axes and left click **OK** twice to return to the display shown in FIGURE 8-9 .

Set Cursor Format

Left click the Format tab to obtain the display shown in FIGURE 8-13 .

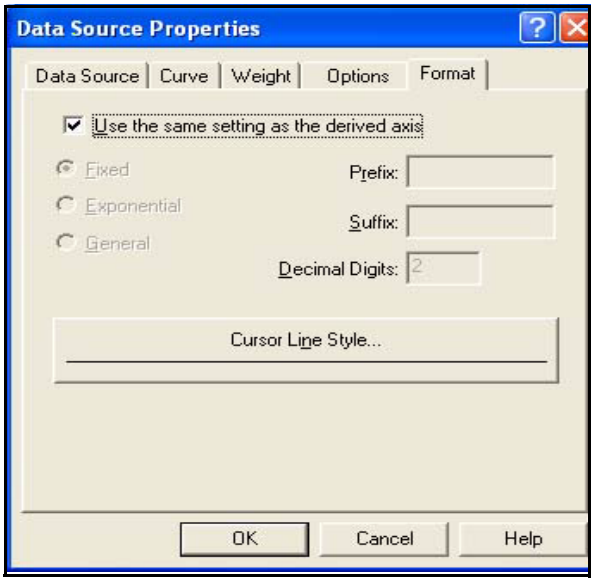


FIGURE 8-13 Properties/Format Menu

Left click Cursor Line Style to obtain the same menu shown in FIGURE 8-10 . The thickness of the cursor can be selected from that menu, and by left clicking Color the cursor color can be selected. For this example, select:

- **Line Thickness:** 0.1
- **Line Color:** Red

Left click **OK** four times to obtain the graph shown in FIGURE 8-14 .

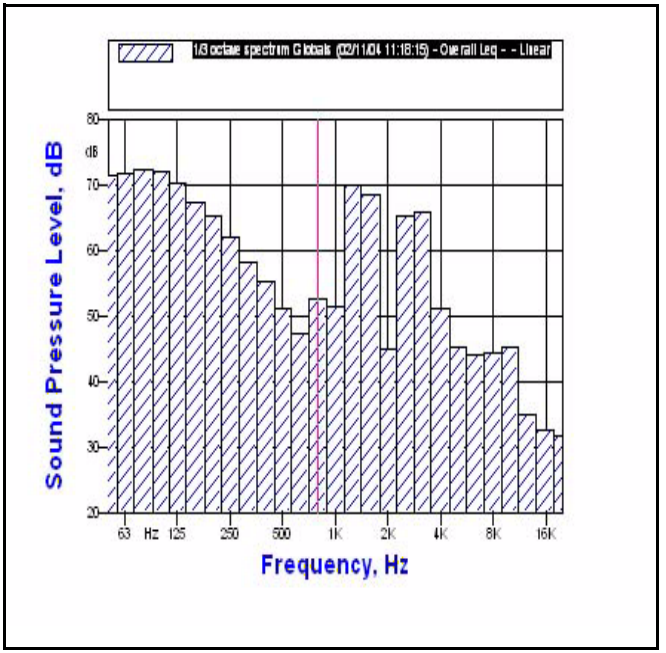


FIGURE 8-14 Complete Custom Spectrum

To save this as a graph template, refer to the section ‘Save as a Template” on page 8-20.

Building a Complex Template

Start with a Sonogram

Open the document **Build Complex Template** from the Demo Folder. Left click **Insert/Sonogram** to obtain the display shown in FIGURE 8-15

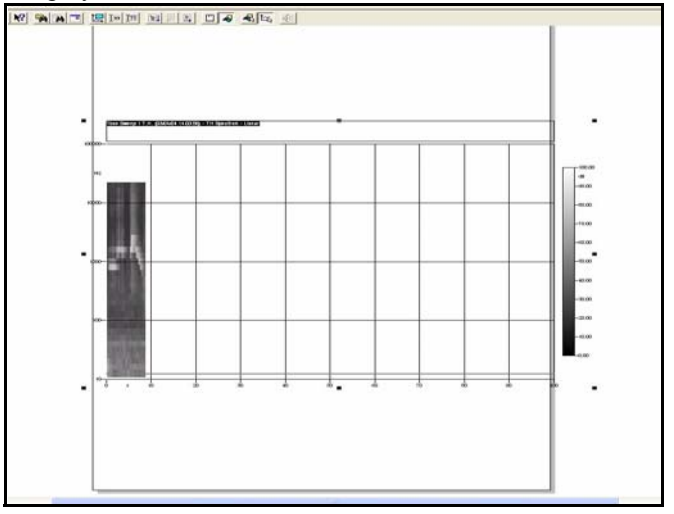


FIGURE 8-15 Basic Sonogram

Size Sonogram to Document

Left click the Selection Priority:Object icon on the upper toolbar, move the cursor over the lower left corner of the graph shown in FIGURE 8-15 until the diagonal double headed arrow appears. Hold down the left mouse button and slide up and left until the size of the graph is small enough to fit in the document page. Release the left mouse button, move the cursor over the graph area, hold down the left mouse button and slide the entire graph until the graph in centered on the document.

Left click the Selection Priority:Graph icon.

Set the Sonogram Parameters

Open the Properties Menu (cursor over graph, right click, left click Properties) and left click **Axes-Data**.

Set Color resolution to “Fine (8x)

Left click **Horizontal Axis (unit = s),** Scaling tab, Set “Stop” to 10 s, check the “Lock with axis size” check box and left click **OK**.

Left click **Vertical Axis (unit = Hz),** Scaling tab, Set “Stop” to 20,000 Hz, check the “Lock with axis size” check box and left click **OK**.

Left click **Z Axis (color scale),** Color scale tab, **Load scale,** browse to find the file “rainbow.csc” in the Demo Documents folder, left click **Open** and double left click **OK**.

Move and reduce size using the techniques described in ‘Size Sonogram to Document” on page 8-13 to fit onto the document page as shown in FIGURE 8-16 .

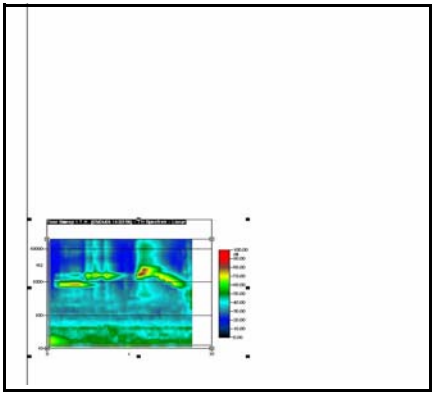


FIGURE 8-16 Sonogram on Document

Left click **Insert/Graph Template** to open Select Graph Template Menu. Under "Select Measurement", check **ALL** check box, highlight **Tone Sweep 1 TH,** Highlight **1/3 Octave profile** from General folder, left click **Next**, check "Put on current page", check "Move in center of page", check "Automatic Zoom, No" and left click **Finish** to obtain the display shown in FIGURE 8-17 .

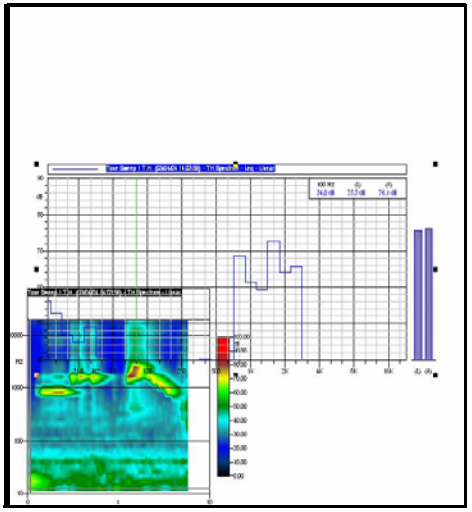


FIGURE 8-17 Sonogram and Spectral Plot on Graph

Left click **Selection Priority: Object** icon from upper Toolbar, left click inside the Spectral Graph object and slide it up above the sonogram so it can be worked on.

Use the Properties Menu to make the following modification:

1. **Axis-Data/ Edit:** change **Value** to **Spectrum** (not Spectrum (Calc Leq as it was previously). Double left click **OK.**

Synchronize with Spectrum Graph

Position the cursor over the sonogram, right click, then left click **Synchronize graphs**, and left click **Spectrum/Bin Mode** to obtain the window shown in FIGURE 8-18 .

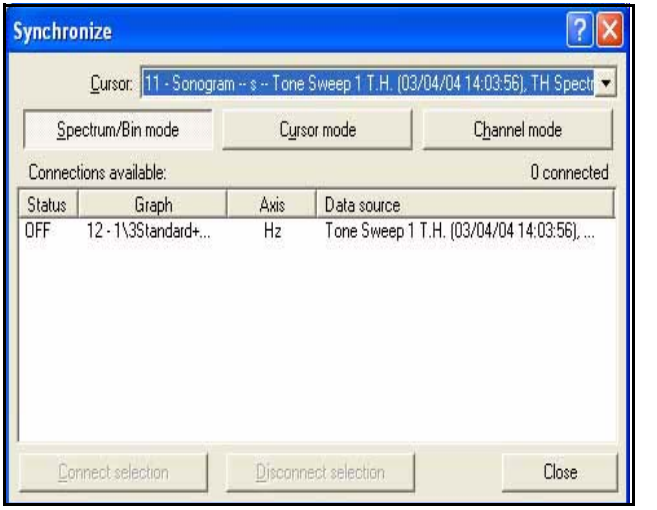


FIGURE 8-18 Synchronize Graphs Menu

Note that, at this time, there is only a single item in the Cursor Data window at the top, for the 1/3 octave spectrum we just added. In the cursor window, we can see the units are "s" indicating that we are linking the time cursors.

Highlight the only item under "Connections available", left click **Connect selection** to change the Status to "ON"**,** and left click **Close**.

Left click **Selection Priority: Graph** icon from upper Toolbar and left click inside the sonogram. Left click at various locations and note that the cursor in the Spectral Graph follows the sonogram cursor.

Use the Properties Menu to make the following modification to the Spectral Graph:

1. **Legend:** change **Display mode** to **Do not display**
2. **Axis-Data:** change Main Axis from Horizontal to Vertical and left click **OK**.

Left click **Selection Priority: Object** icon from upper Toolbar, left click Spectral Graph object and resize it so it will fit on the page to the right of the sonogram, then slide it into position as shown in FIGURE 8-19 .

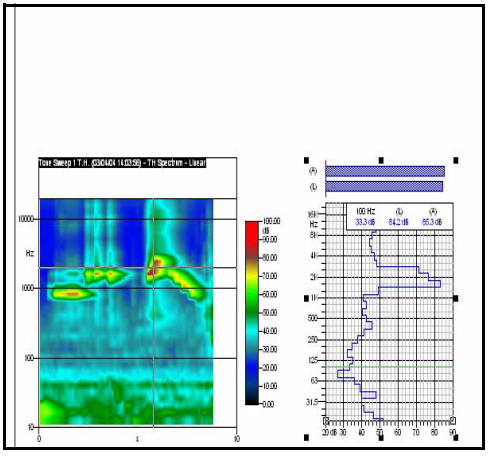


FIGURE 8-19 Spectral Graph Resized and Repositioned

Add a Frequency Band Time History Graph

Left click **Insert/Graph Template** to open Select Graph Template Menu. Under “Select Measurement”, check **ALL** check box, highlight **Tone Sweep 1 TH,** Highlight **Time History** from the General folder, left click **Next**, check “Put on current page”, check “Move in center of page”, check “Automatic Zoom, No” and left click **Finish** to obtain the display shown in FIGURE 8-17 . FIGURE 8-20 .

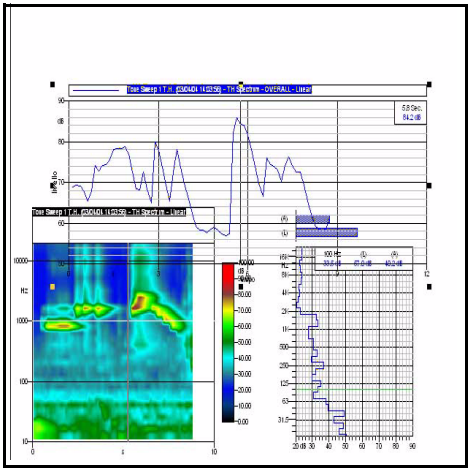


FIGURE 8-20 Sonogram, Spectral Graph and Time History in Document.

Left click **Selection Priority: Object** icon from upper Toolbar, left click the Time History object, slide it up above the sonogram, resize it, remove the legend display and

autoscale the time axis to obtain the display shown in FIGURE 8-21 .

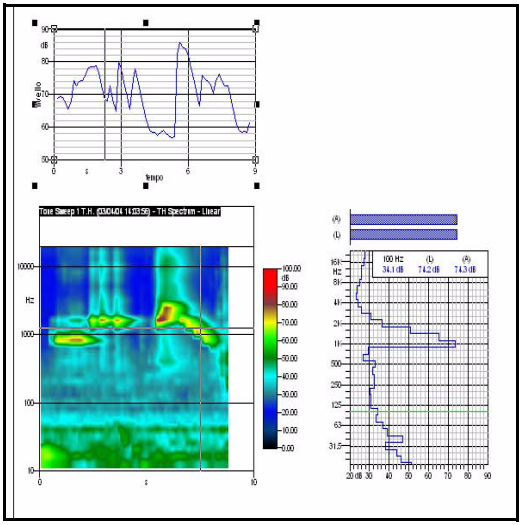


FIGURE 8-21 Time History Graph Resized and Repositioned

Synchronize with Time History Graph

Once again, position the cursor over the sonogram, right click, then left click **Synchronize graphs**, and left click Spectrum/Bin Mode. This will open the window shown in FIGURE 8-18 . Left click the down arrow to the right of the Cursor data field to open the window shown in FIGURE 8-22 .

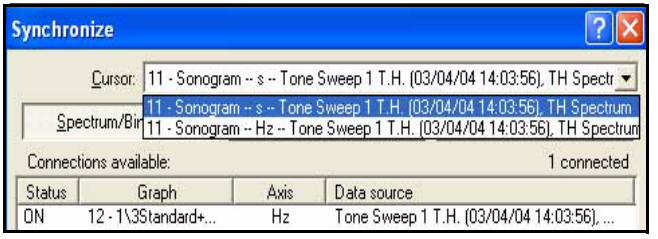


FIGURE 8-22 Cursor Data Field Window

Now there are two items; the first with units of “s” and the second with units of “Hz”. We have already linked the time cursor to the spectrum graph, now we want to link the spectrum cursor to the Time History graph, so highlight the second item and left click **Connect selection** to change the

Status to “ON”**,** and left click **Close**. Now, the cursors in both graphs are linked to the sonogram.

Save as a Template

Here we will save this new template into the General template folder. Left click **File/Template/Save Graph Template** to open the display shown in FIGURE 8-23 .

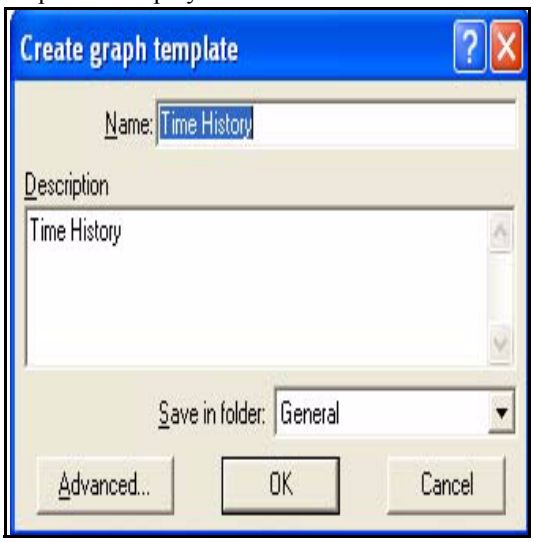


FIGURE 8-23 Save Graph Template

If you wish to create a new graph template folder, left click ***File/ Template/Template Organizer*** *and work with that menu.*

Type a name for this graph template into the “Name” field. Type appropriate text into the “Description” field. The folder into which the template is to be saved is selected from the drop down menu which appears when left clicking the down arrow to the right of the “Save in folder”. Left clicking Advanced will open a menu permitting the setting of additional parameters such as the Priority and the selection of which instrument to associate with this template.

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