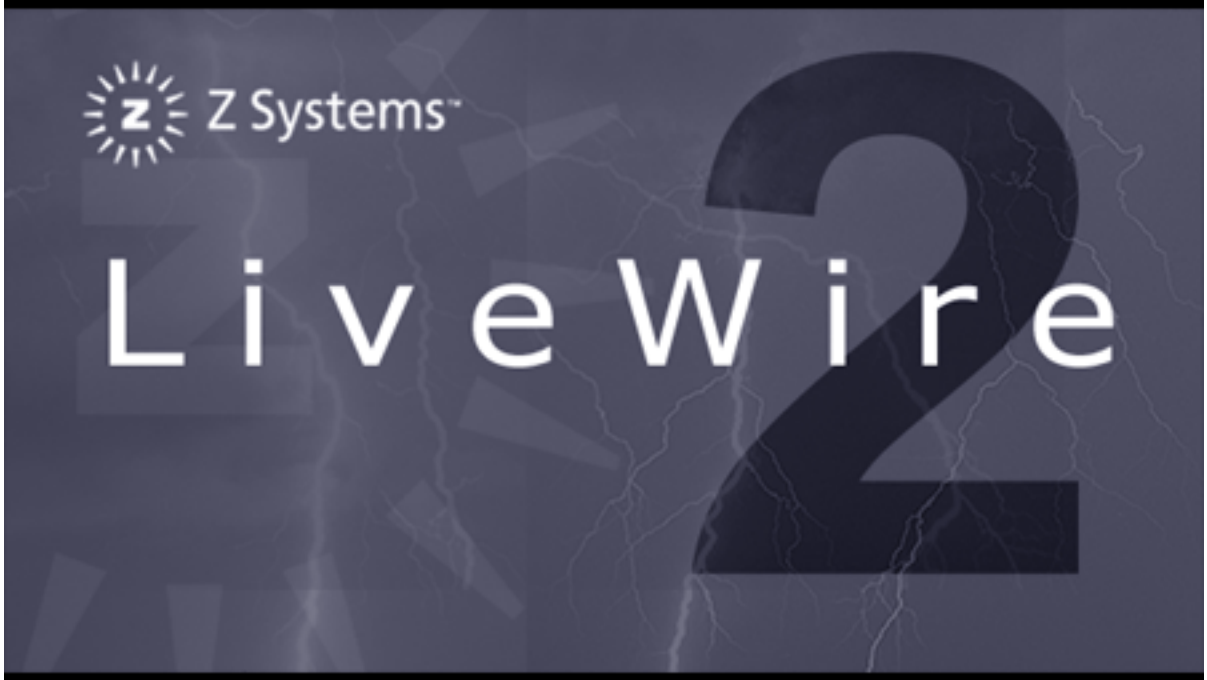
LiveWire 2
User's Manual



The Professional's Data Analysis and Visualization Tool.

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1 Introduction

Z Systems, Inc. specializes in developing data analysis, acquisition and visualization software and software technologies that provide a complete solution for scientists, engineers, and OEM software developers. LiveWire, which was developed using Z Systems' software technologies, is the best data visualization and analysis software packages available today.

1.1 What is LiveWire?

LiveWire is a simple, yet powerful software tool designed to visualize and present time-based data. This application uses a single window split pane user interface. It supports the importation and exportation of industry standard data file formats, such as COMTRADE[1] and EMTDC[2]. It also provides users with the ability to import and export general data formats such as comma separated variable files (*.csv) and text files (*.txt). LiveWire even provides the means to generate data from user-defined equations and import/export data from other applications using the clipboard.

LiveWire has a very wide range of advanced features not available in similar software packages. Features like smart axis and dynamic aperture controls in both the graphs and plots allow the user to easily navigate through their data. Other features like enhanced tool tips present the user with thumbnail views of data sets. The ability to save and restore LiveWire workspaces (*.lww) provide the user with a sense of comfort and security that their worksheets and imported data files will not have to be regenerated, like many other data analysis packages. The capability to generate Bitmap images on a frame-by-frame basis, allow the user to add results and visual depiction to their reports quickly and effortlessly, without using additional software.

Z Systems LiveWire provides the user with a very intuitive, very robust software environment. Along with the wide array of features and Z Systems' imbedded technology, it is obvious why LiveWire is the only choice for data analysis software.

[1] Common Transient Data Exchange **(COMTRADE) IEEE-C37.111** is fully supported for years **1991, 1996(draft), 1997(draft) and 1999** in both ASCII and BINARY and Multi-File spanning.

[2] Electromagnetic Transients for DC **(EMTDC)**. This format uses information files and multi-file spanning to support up to 200 channels.

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2.0 Installation and Setup

LiveWire is currently supported on PC's running Microsoft Windows 9x, ME, NT, XP, and 2000 operating systems.

2.1 System Requirements

The following are the minimum recommended specifications.

Processor	100 MHz Pentium processor (higher speed recommended).
Operating System	Microsoft Windows 95 or later, Windows NT 4.0 or later.
Memory (RAM)	32 MB (64 MB or more recommended).
Hard disk space	50 MB minimum. Additional space may be required to save workspaces as you use LiveWire.
Monitor	SVGA minimum, XGA recommended. 17" size or higher for desktop and 11" or higher for laptop, 800x600 resolution (1024x768 or higher recommended).
Other peripherals and hardware	A CD-ROM drive and 32 bit CD-ROM drivers, a mouse or compatible pointing device.

2.2 Installation Procedures

Automatic installation

1. Insert the LiveWire CD into your CD Rom drive.
2. LiveWire will automatically begin its self-install program.
3. Follow the on screen instructions to continue with the installation.

Note 1 If installation does not automatically start, follow the manual installation
Note 2 You can hit cancel at any time to stop the installation procedure.

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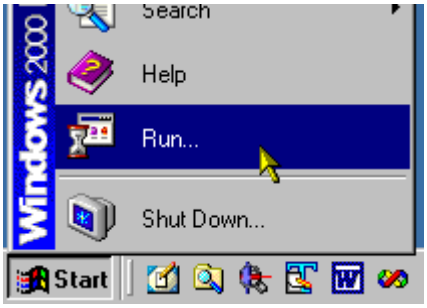
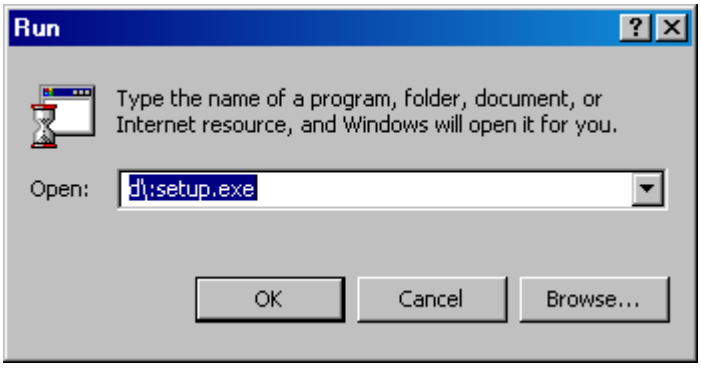
Manual installation

1. Have the LiveWire CD in your CD Rom drive.
2. From the **Windows** taskbar, click **Start** ▸ **Run**.



3. Type **{your CD drive letter}:\setup.exe** in the Open text box.



4. Click **Ok**, then follow the on-screen instruction to install the program.

Note 1 You have to determine the drive letter of your CD drive where the LiveWire CD is located and substitute {your CD drive letter}:\setup.exe

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2.3 Starting LiveWire

From the **Windows** taskbar, click **Start ▸ Programs ▸ LiveWire ▸ LiveWire.**

Note: The first time you execute LiveWire you will be prompted for a registration key. This key will be located upon the Z System LiveWire CD. If you do not enter a registration key, LiveWire will go into evaluation mode and allow you to demo the application for 30 days before disabling itself. If you do not have the registration key, contact Z Systems, Inc, and they will provide you with one.

2.4 Uninstalling LiveWire

If uninstalling from Microsoft Windows, use the standard uninstall procedure. From the **Windows** taskbar, click **Start ▸ Settings ▸ Control Panel ▸ Add/Remove Programs**. If you are not familiar with this procedure, ask for assistance from your system administrator to avoid unintentional deletion of some other program or module, or use the Microsoft Windows help.

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3.0 Application Overview

3.1 LiveWire Environment

As you look at the main window of LiveWire you will notice an environment very similar to that many commonly used applications. The general interface consists of a single window split pane with tree navigation. The purpose of the left pane is to manage workspaces, including worksheets and data. The right pane is used to visualize and interact with the active worksheets. At the top of the window: **File, Edit,** etc. are called the main menu items.

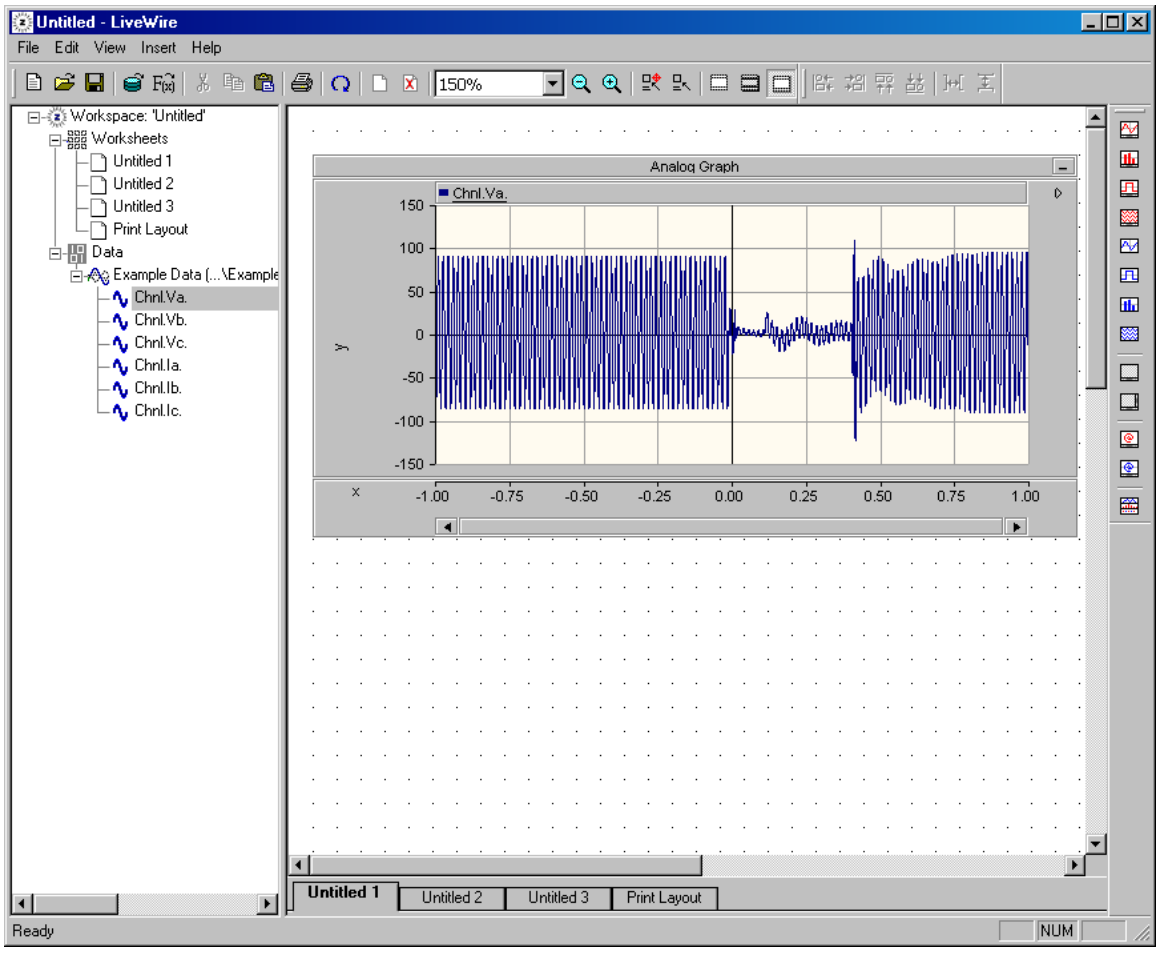

Figure 3.0: The LiveWire Environment.

3.1.1 Title Bar, Menu Bar, and Tool Bars

Title Bar

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At the top most part of the window that displays "*active workspace name* – LiveWire" is called the **LiveWire title bar**. The active workspace name changes depending on the current workspace you have open. When you start LiveWire, by default an empty untitled workspace will be active.

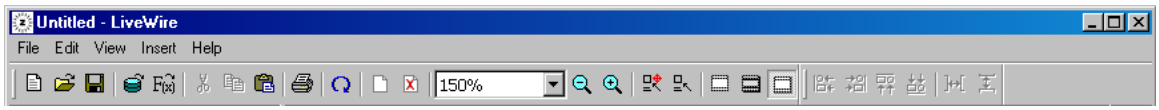

Figure 3.1: Example of the LiveWire Title Bar, Menu Bar, and Tool bar.

Menu Bar

The area under the title bar consisting of **menu items** is called the **menu bar**. All main menu items are drop down menus, which means that when you point the cursor to one of these menu items and click the left mouse button, a list will appear below it. To select an item, move the cursor over that particular item (the item is highlighted) and click the left mouse button. The following figure illustrates opening an existing LiveWire workspace.

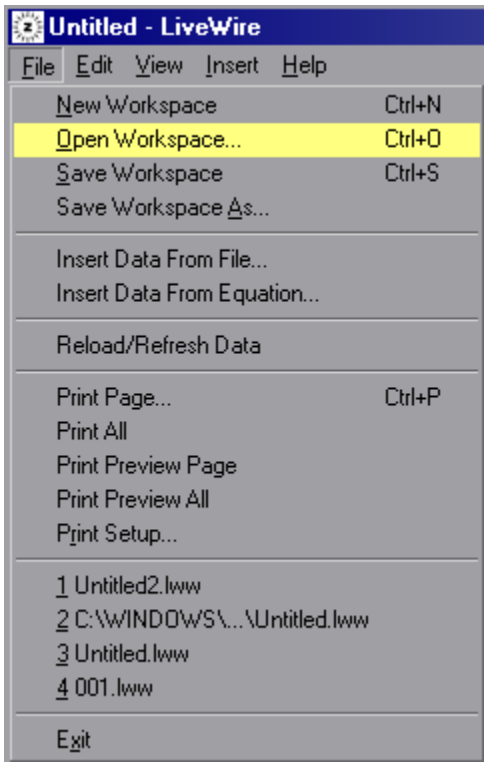

Figure 3.2: Opening an existing workspace using the menu bar.

Tool Bars

The group of pictures just below the menu bar are called the **tool bar**. Each picture is a **tool bar button**. While the menu items are two stage processes, the tool bar buttons are single

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stage processes. They initiate actions as soon as you click on them and hence are easier to use. For this reason, frequently used operations have button representations.

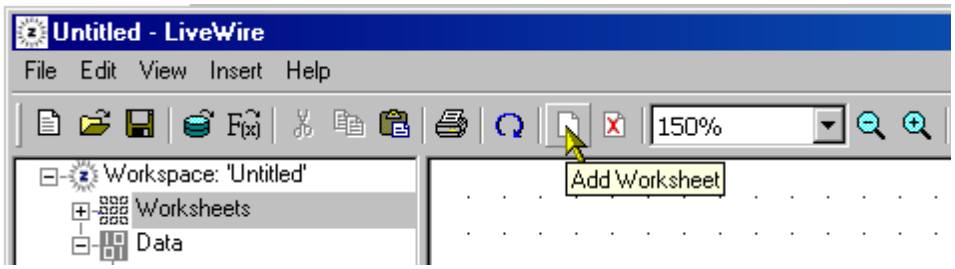
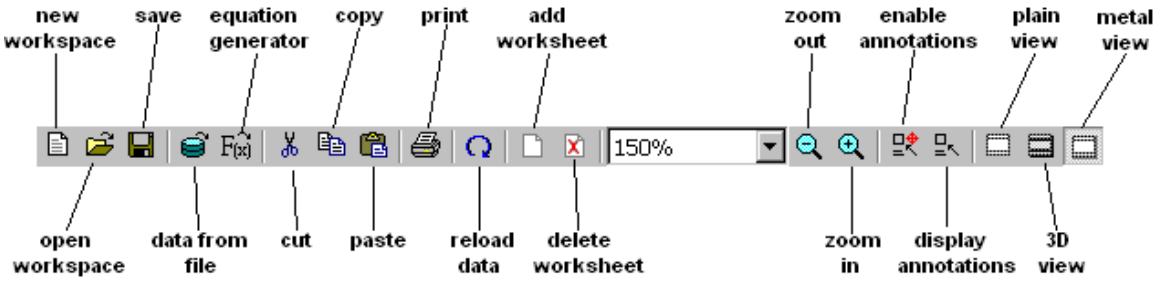
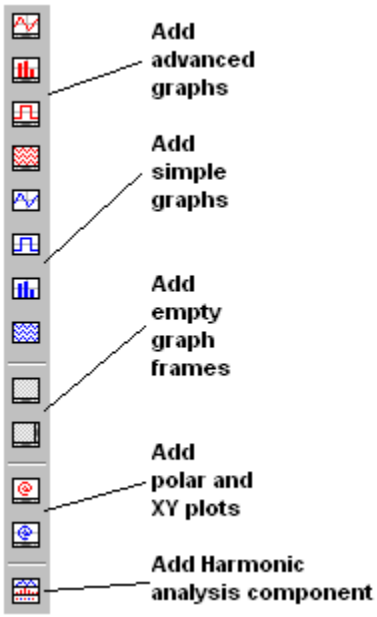
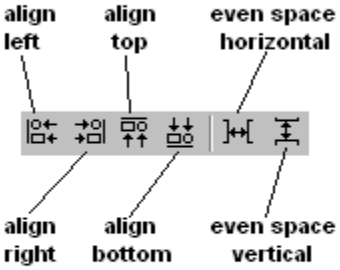


Figure 3.3: Example of the opening an existing workspace using the tool bar.

Toolbar descriptions







3.1.2 Workspace

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The workspace can be thought of as a project. Like a project, the workspace can contain multiple elements. Each workspace contains multiple worksheets, similar to documents, and data files. The figure below illustrates a sample workspace.

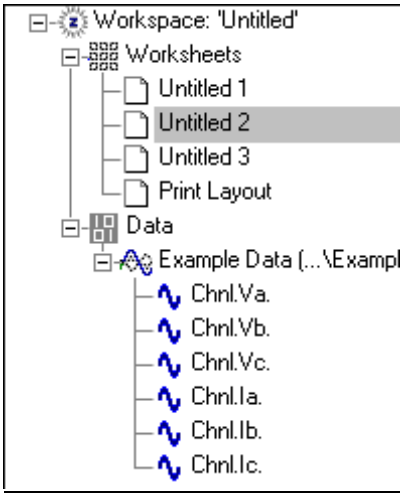

Figure 3.4: A LiveWire workspace.

From Figure 3.4, we can see a workspace entitled "Untitled". This workspace contains two components, one worksheet component entitled "Worksheets", and one data component, which itself contains five data sets.

In LiveWire, workspaces are broken down visually in tree views; similar to way Microsoft Explorer visually depicts hard disks, and their contained directories.

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The Navigation Tree

The Workspace item
- Represents the workspace

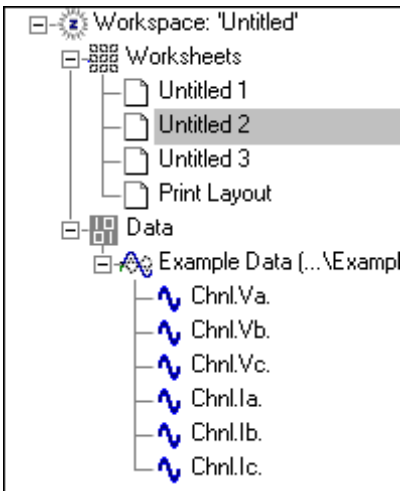
The Worksheets item
- Represents all worksheets

The Worksheet item
- Represents a single worksheet

The Data item
- Represents all the data currently loaded in LiveWire

The Record item
- Represents a record of data

The Trace item
- Represents a single trace or "Channel" of data



Note 1: Data loaded from a file are Blue
Data pasted into LiveWire are Purple
Data generated by LiveWire are Green

How to Access Features/Properties

The features/properties of the different tree components can be accessed via the menus. Right click on any tree items to bring up the menu associated with that component.

Creating a New Workspace

To create a new workspace in LiveWire:

- From the LiveWire menu, click **File** ▸ **New Workspace**, or click the button from the toolbar.

Opening an Existing Workspace

To open an existing workspace in LiveWire:

- From the LiveWire menu, click **File** ▸ **Open Workspace**, or click the button from the toolbar.

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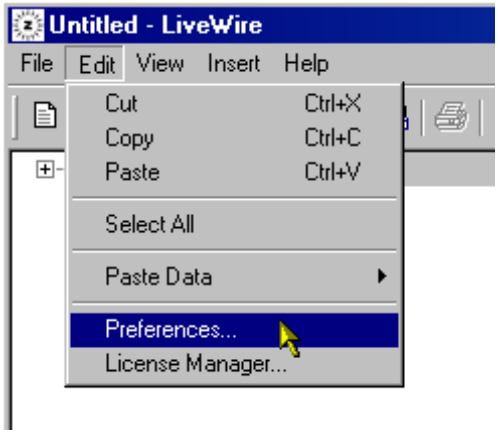
Saving a Workspace

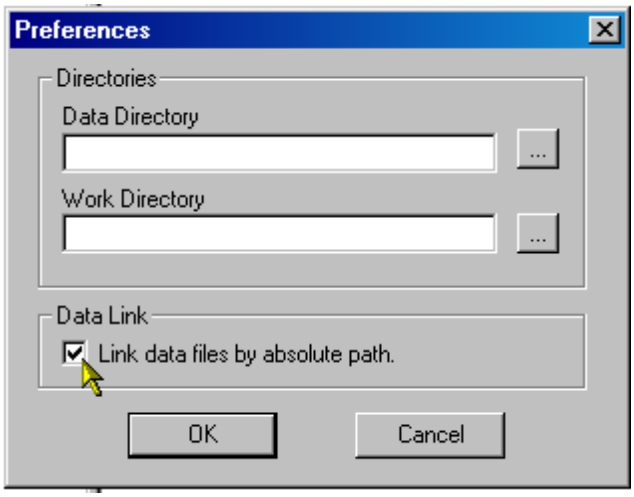
To save an existing workspace in LiveWire:

- From the LiveWire menu, click **File** ▸ **Save Workspace**, or click the  button from the toolbar.
-

Absolute/Relative Path Data

Data loaded in LiveWire can be associated with the workspace in a relative or absolute manor.





Absolute path - results in data being independently associated with the workspace. If the workspace is moved, it will still find the data.

Relative path - results in the workspace being dependant on the relative location of the data. If the workspace is moved, the data must also be moved relative to the new location of the workspace.

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3.1.3 Worksheet

The LiveWire worksheet is similar to a document; it represents a sheet of paper. This is the area where you will create components, such as graphs and plots, and analyze your data. The figures below illustrate sample workspaces. Each worksheet can be oriented as a portrait or as a landscape.

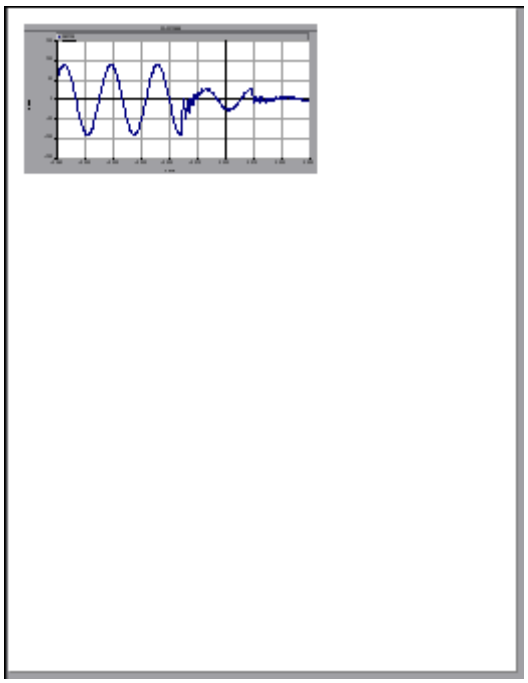

Figure 3.5: Example of a LiveWire worksheet (Portrait).

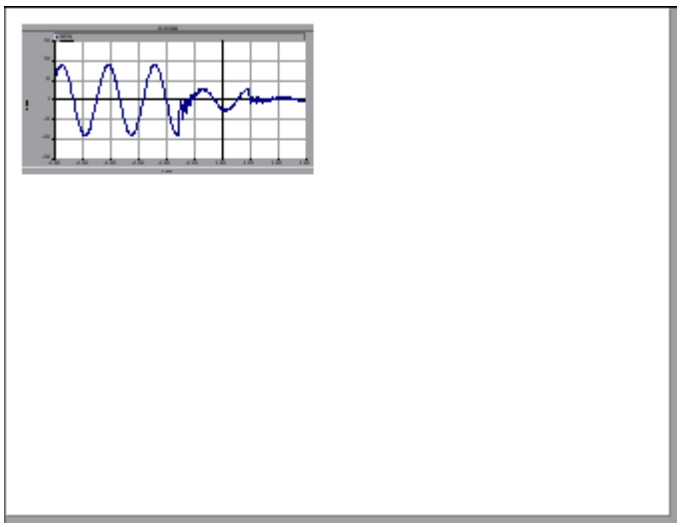

Figure 3.6: Example of a LiveWire worksheet (Landscape).

Adding Additional Worksheets

Additional worksheets can be added to the LiveWire workspace. The user can then switch between these multiple worksheets.

- Right click on the **Worksheets** tree item to pull up the **Add Worksheet** menu option.

- Or click the icon on the toolbar.

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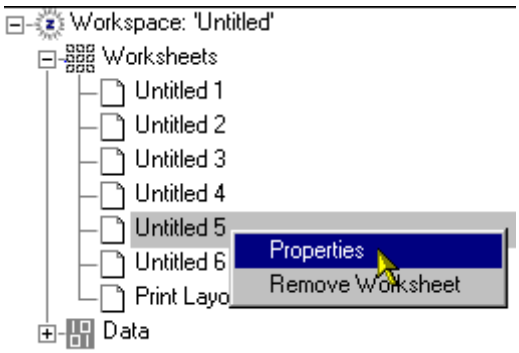
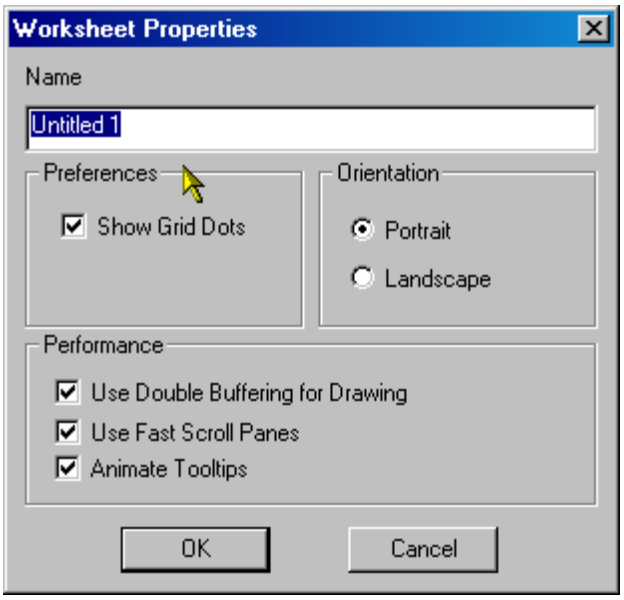
Reorder/Rename Worksheets

You can rename worksheets by invoking the worksheet properties. Left mouse click on the appropriate tree node and select Properties.





You can also change the order of the worksheets on the tree by left clicking on the appropriate tree item and dragging the node. Upon the release, the worksheet will anchor in the new position.

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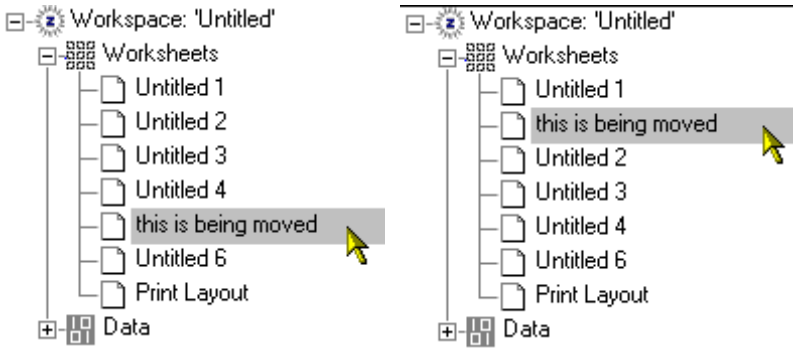
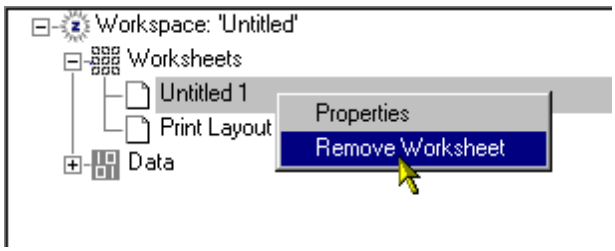


Deleting Worksheets

Worksheets can be deleted from the LiveWire workspace. All graphs will be unloaded and deleted.

- Right click on the **Worksheets** tree item to pull up the **Remove Worksheet** menu option.



- Or click the  icon on the toolbar.

Focus is the Key

All menus and settable properties in LiveWire are in reference to the component currently in focus. Components can be brought into focus by clicking on them once. This also applies to putting the worksheet or the tree in focus.

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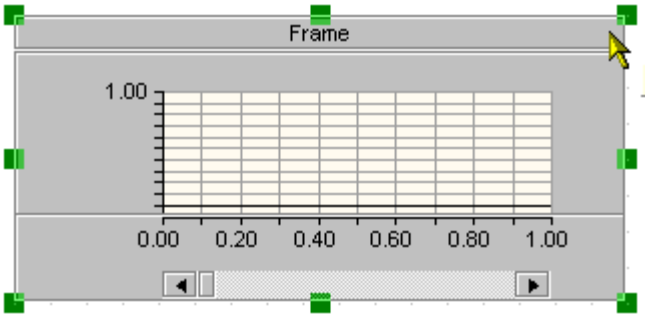


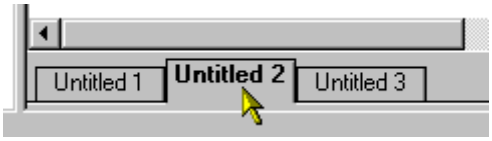
Moving Components Around the Worksheet

All components on the worksheet can be dragged anywhere on the worksheet by clicking on them with the mouse and dragging them with the mouse button held down. For most components dragging the frame of the component does this.

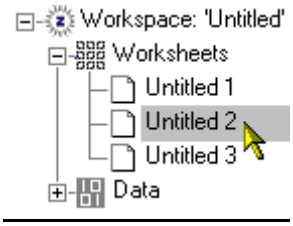
How to Access Features/Properties

All features/properties of the worksheet can be accessed via the menu.

- Right click anywhere on the worksheet
- Or by a double left click on the worksheet tab at the bottom



- Or by right clicking on the tree item associated with this worksheet.



How to Change Worksheet Views

LiveWire provides the user with three different types of worksheet views. The following figures illustrate each of these views.

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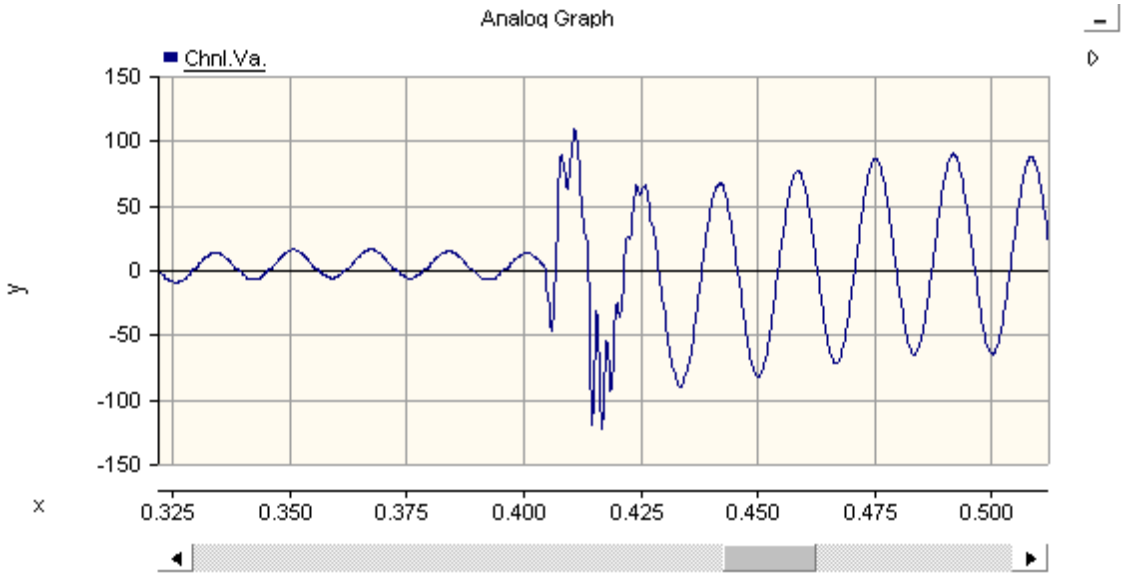

Figure 3.7: Example of the "Plain" View.

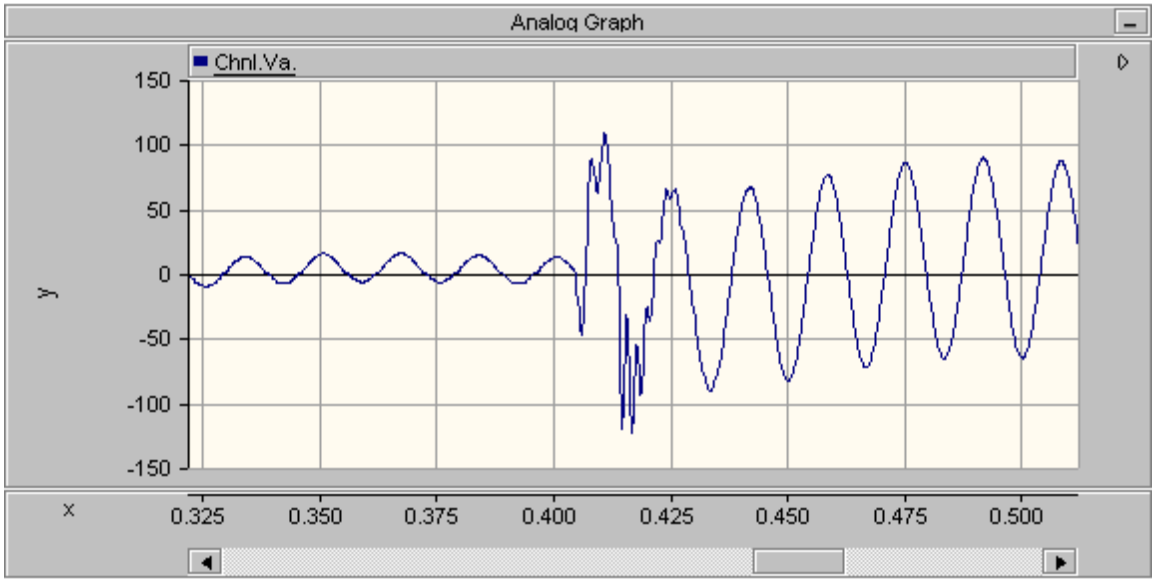

Figure 3.8: Example of the "Metal" View.

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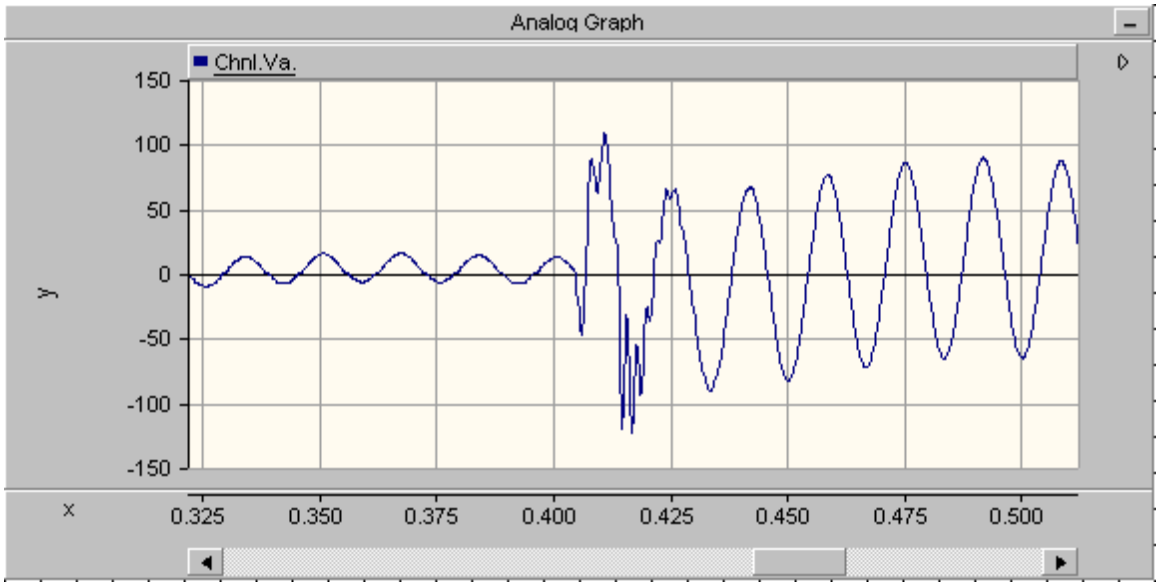

Figure 3.9: Example of the "3D" View.

To change or toggle between the three different views:

- From the LiveWire menu, click **View** ▸ **Look and Feel** ▸ **Plain**, or click the  button from the toolbar for the "Plain" view.

or

- From the LiveWire menu, click **View** ▸ **Look and Feel** ▸ **Metal**, or click the  button from the toolbar for the "Metal" view.

or

- From the LiveWire menu, click **View** ▸ **Look and Feel** ▸ **3D**, or click the  button from the toolbar for the "3D" view.

Zooming a Worksheet

LiveWire provides the user with the ability to zoom in and out or zoom to predefined amounts on the worksheet.

To simply zoom in and out:

- From the LiveWire menu, click **View** ▸ **Zoom In**, or click the  button from the toolbar for zooming in on the worksheet.

or

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- From the LiveWire menu, click **View ▸ Zoom Out**, or click the  button from the toolbar for zooming out on the worksheet.

To zoom to a predefined amount:

- From the LiveWire menu, click **View ▸ Zoom To ▸ *zoom percentage***, or select a *zoom percentage* from the combo box that is located on the toolbar.

Printing a Worksheet

When printing workspaces, only the active workspace can be printed or viewed in the print preview. LiveWire uses special features that check printer configurations and adjust displays so that the presentation is never sacrificed.

To print a work space:

- From the LiveWire menu, click **File ▸ Print**, or click the  button from the toolbar.

3.1.4 Tab Window

The bottom of the worksheet contains a "tabbed window". Each tab represents a different worksheet in LiveWire. The "highlighted" tab is associated with the current worksheet in focus. The user can navigate between all the worksheets either by using the tabs or by clicking on the worksheet component on the tree.

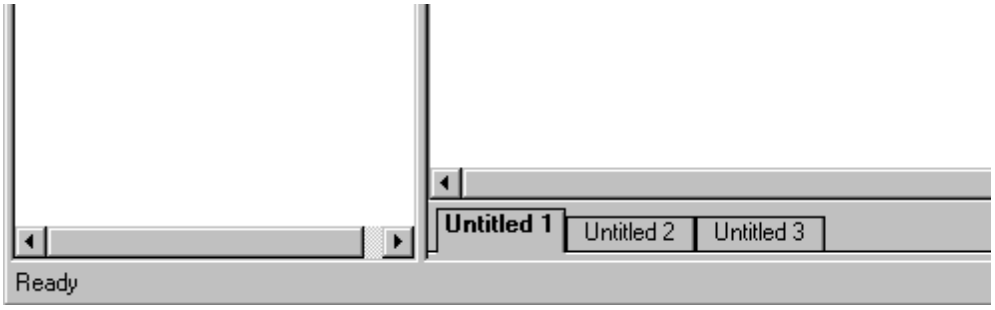

Figure 3.10: Example of the Tab Window.

3.1.5 Annotations

LiveWire has built in annotation support. Annotation objects are placed on a secondary layer that is transparent and sits right over top of the entire canvas.

Activating the Annotation Layer

This layer can be toggled on and off via buttons on the application toolbar.

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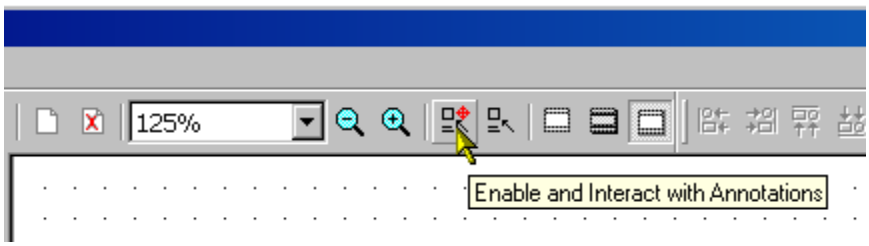
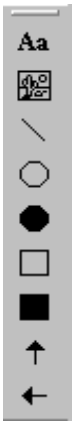


Adding Annotation Objects

Annotation objects that can be added include:

- Text areas or "sticky notes"
- Imported images
- Lines
- Circles (filled/non filled)
- Squares (filled/non filled)
- Arrows (vertical/horizontal)

These annotation objects can be created from either the annotation toolbar (visible when annotation layer is active),



or by **right clicking** on the "active" annotation layer and selecting **Add Annotation** from the popup menu.

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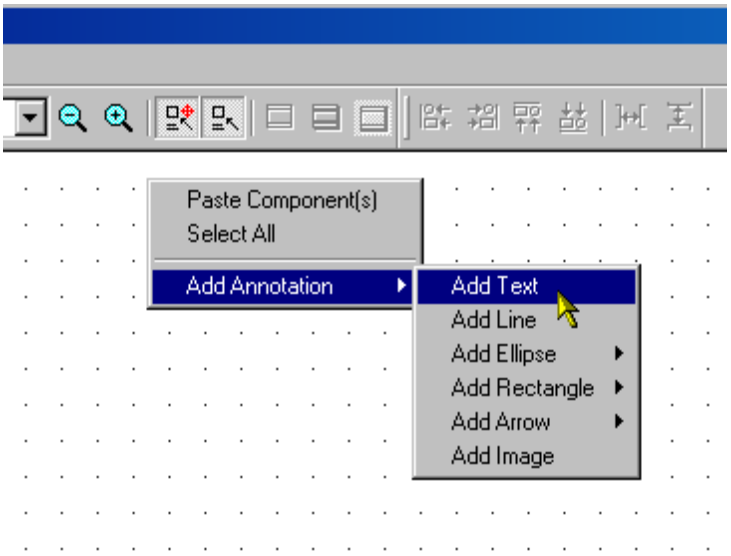
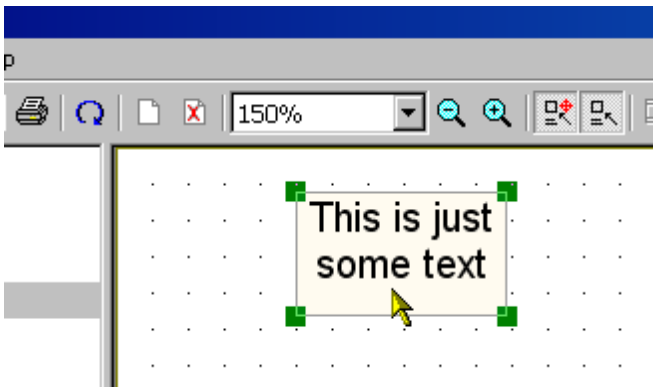


Resizing Annotation Objects

Any object on the annotation layer can be resized by simply **left clicking** on the object to bring up the green resize pads.



By **clicking** and **dragging** any of the green resize pads the object will stretch.

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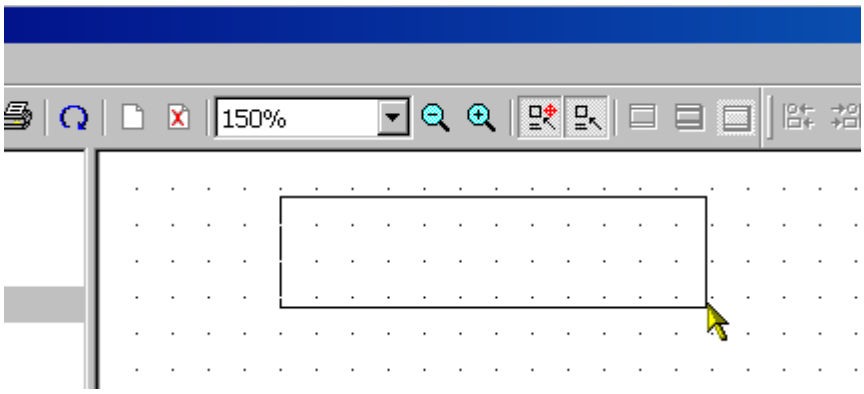
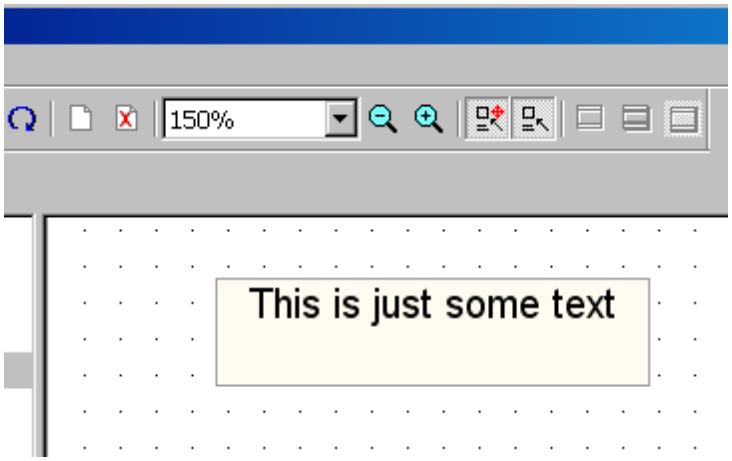


Upon **releasing** the **mouse**, the object will be resized.



Moving Annotation Objects

Objects can also be moved around anywhere on the annotation layer by simply using the **mouse** and perform a **click**, **drag**, and **release** operation on the object.

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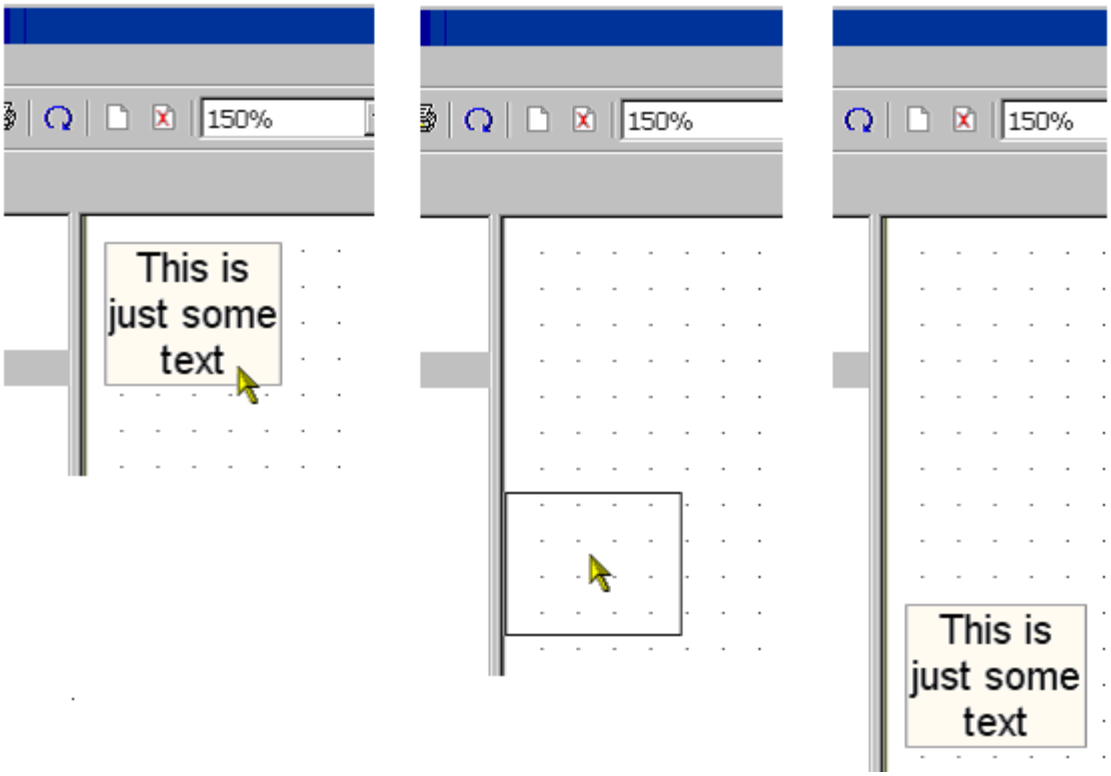
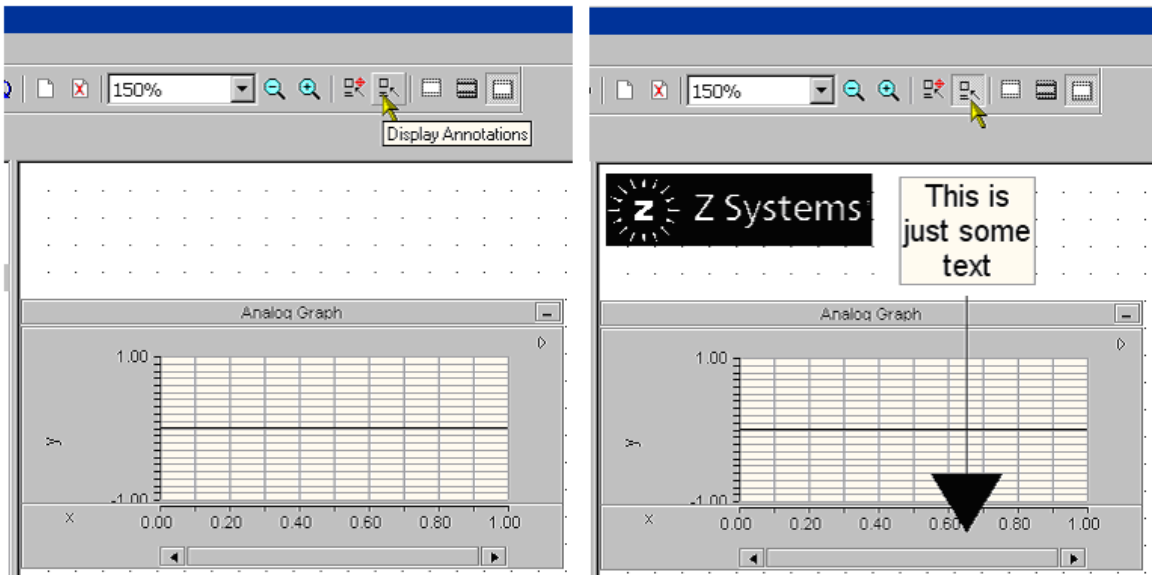


Displaying Annotations

Annotations may be toggled on and off at any time by **toggling** the show annotations **button**.



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3.1.6 Printing

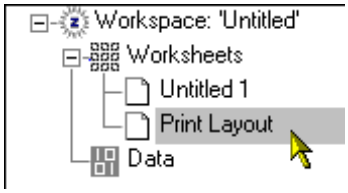
Introduction

LiveWire allows the user to customize a printing template that is used to print all pages during a print job. Elements such as margins, page numbers, and images can be added in just a few minutes.

LiveWire makes custom printing easy by breaking down the process into 3 easy steps.

- Set your margins
- Add custom printing elements
- Print!

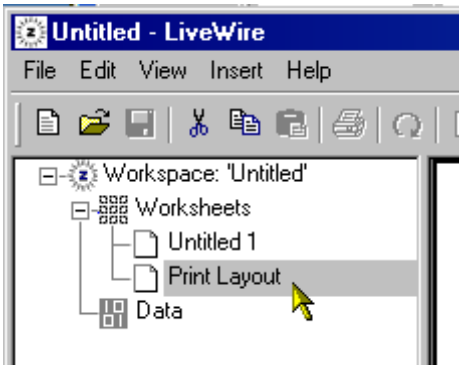
The customizable printing template is used for all printed pages and is saved along with the workspace and all worksheets. It can be accessed via the tree and the **Print Layout node**.



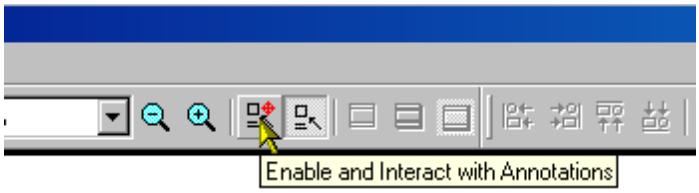
Adjustable Margins

Margins can be set graphically by **clicking / dragging** the margins.

1) Go to the Print Layout



2) Activate annotation layer



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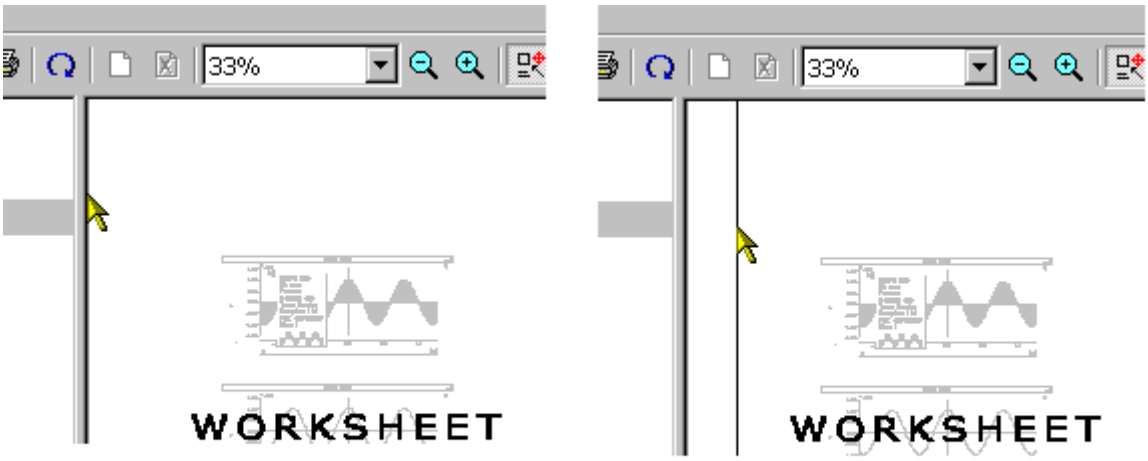
3) Drag margins by **click** and **drag** with the **mouse**



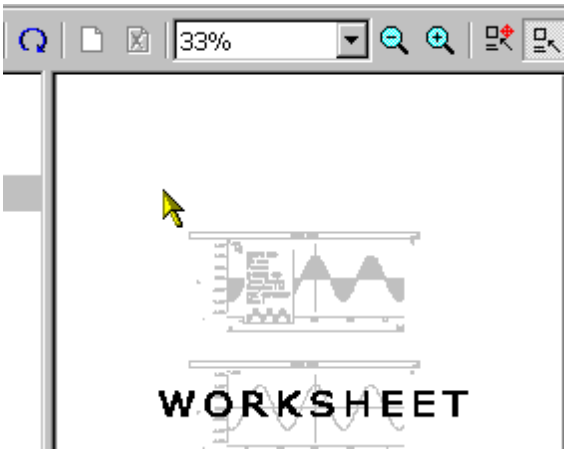
left mouse click on any of the 4 borders

hold left button down and drag ther margin over

OR

The margins can be adjusted via the properties box.

1) **Right click** on the Print Layout



2) Select **Properties** from the menu

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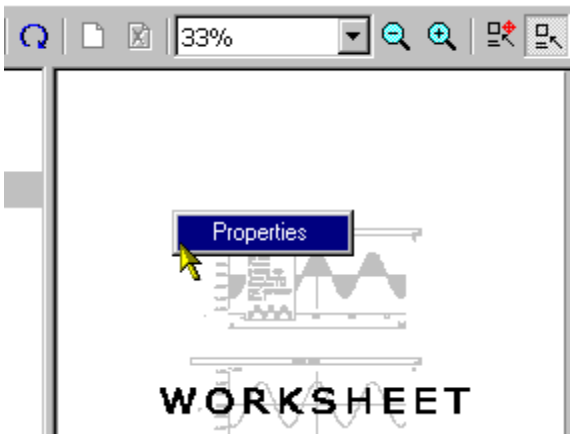
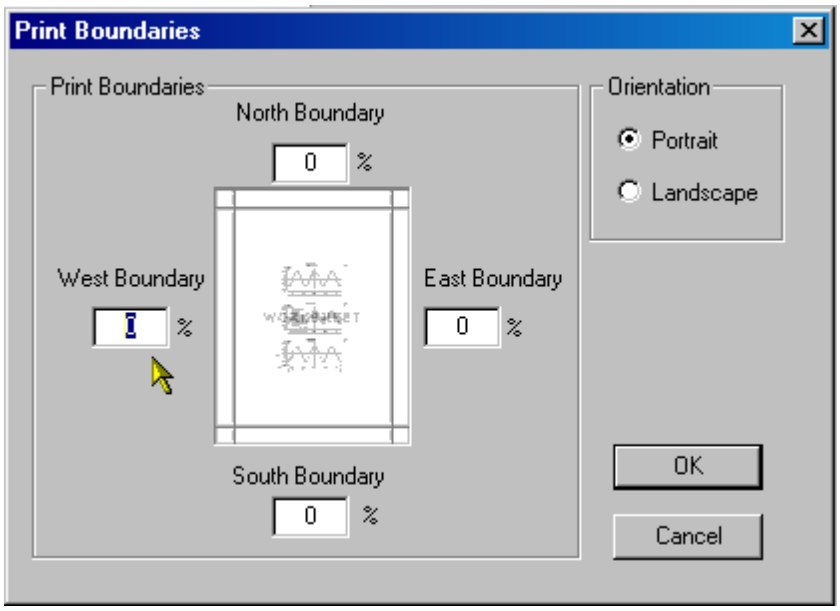


3) Manually enter a **percentage** for the margin



Adding Print Objects

If you adjust all four margins, the print layout will now consist of 8 separate cells that surround a center "worksheet" cell.

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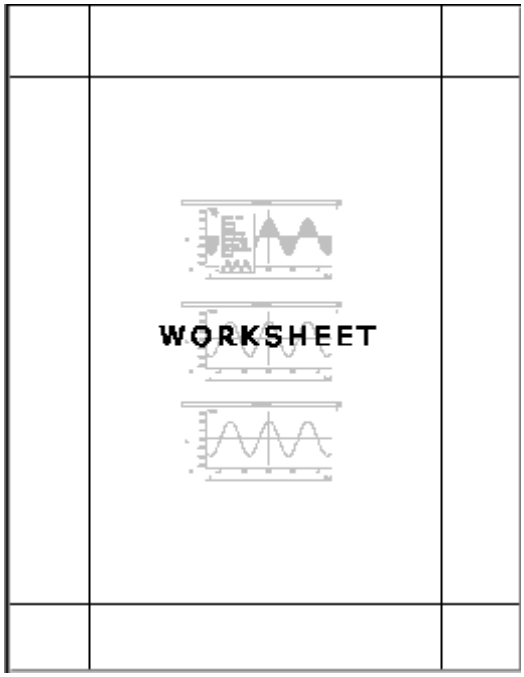
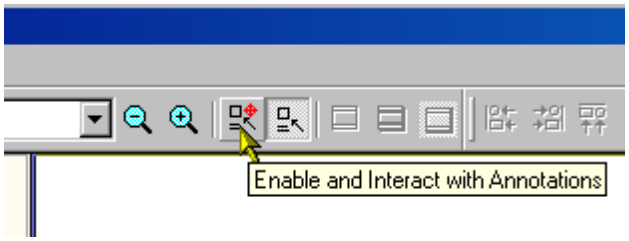


Within the 8 bordering cells, print objects can be added that will be visible on every printed worksheet.

Print objects can be added by using the built in menu system.

1) Make sure the annotation layer is turned off.



2) **Right click** the **mouse** over one of the bordering eight cells.

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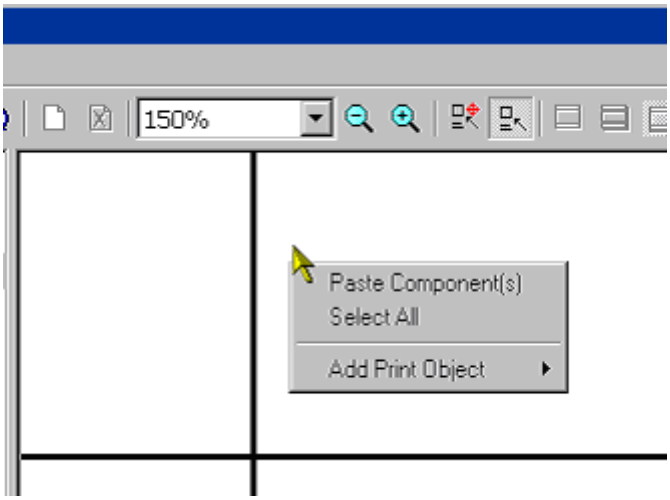
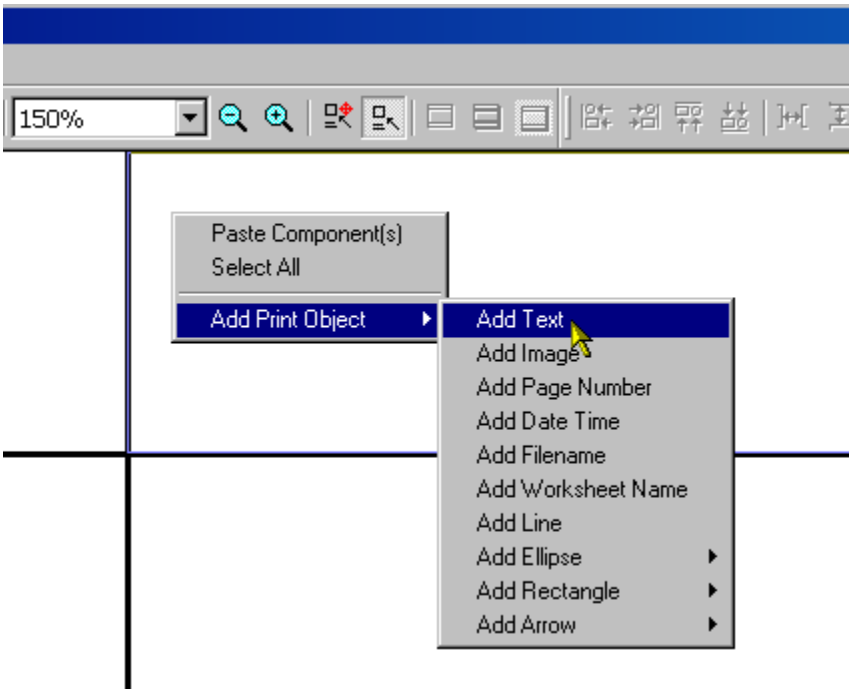


3) **Select** from the list of print objects



4) **Place** object by **drag** and **drop**

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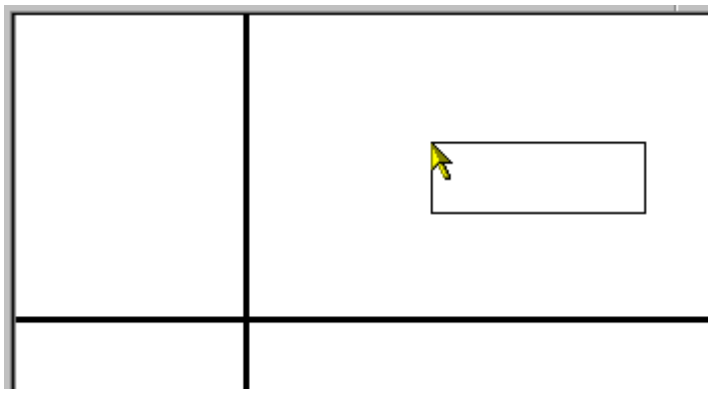
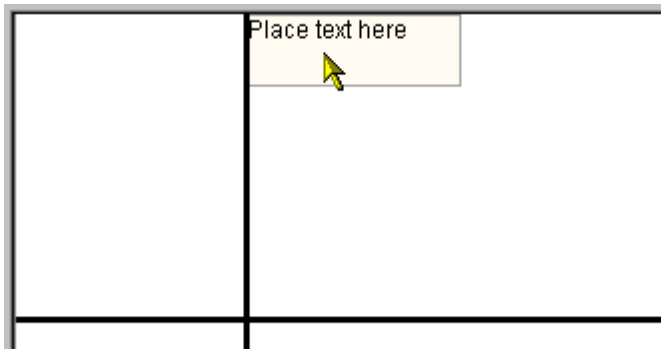


Before



After

Final Print

When you have assembled your printing template, all printed documents will adopt this template during a print job.

The following is an example of a fully constructed printing template.

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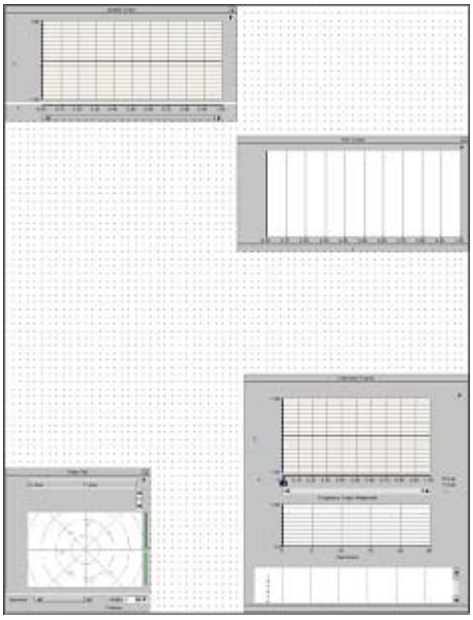
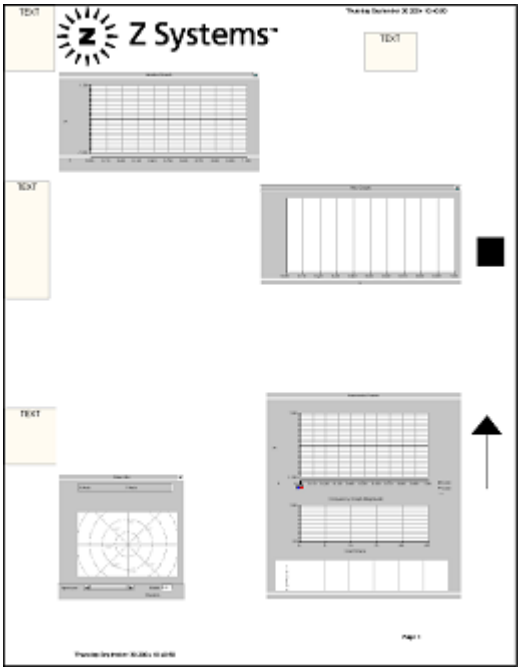
The next set of images depicts a worksheet during draft time and then what it looks like at print time when it adopts the global print template.





The last set of images depicts a different worksheet during draft time and thane what it looks like at print time when it adopts the global print template.

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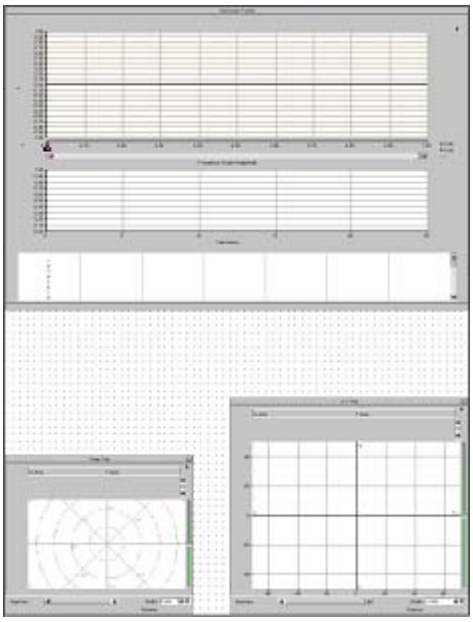

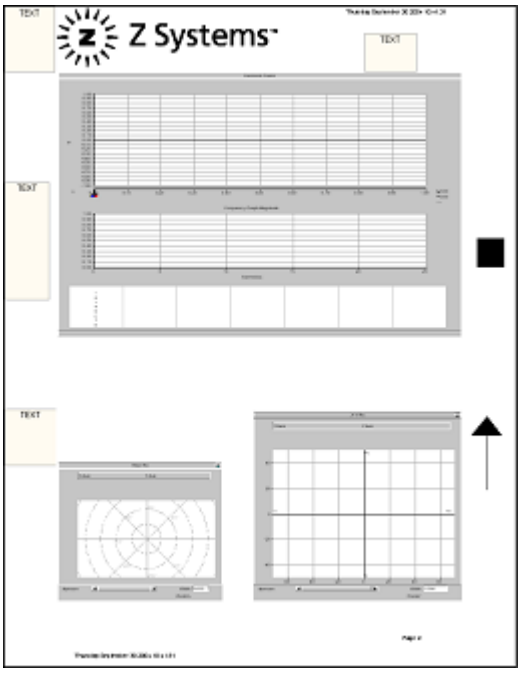

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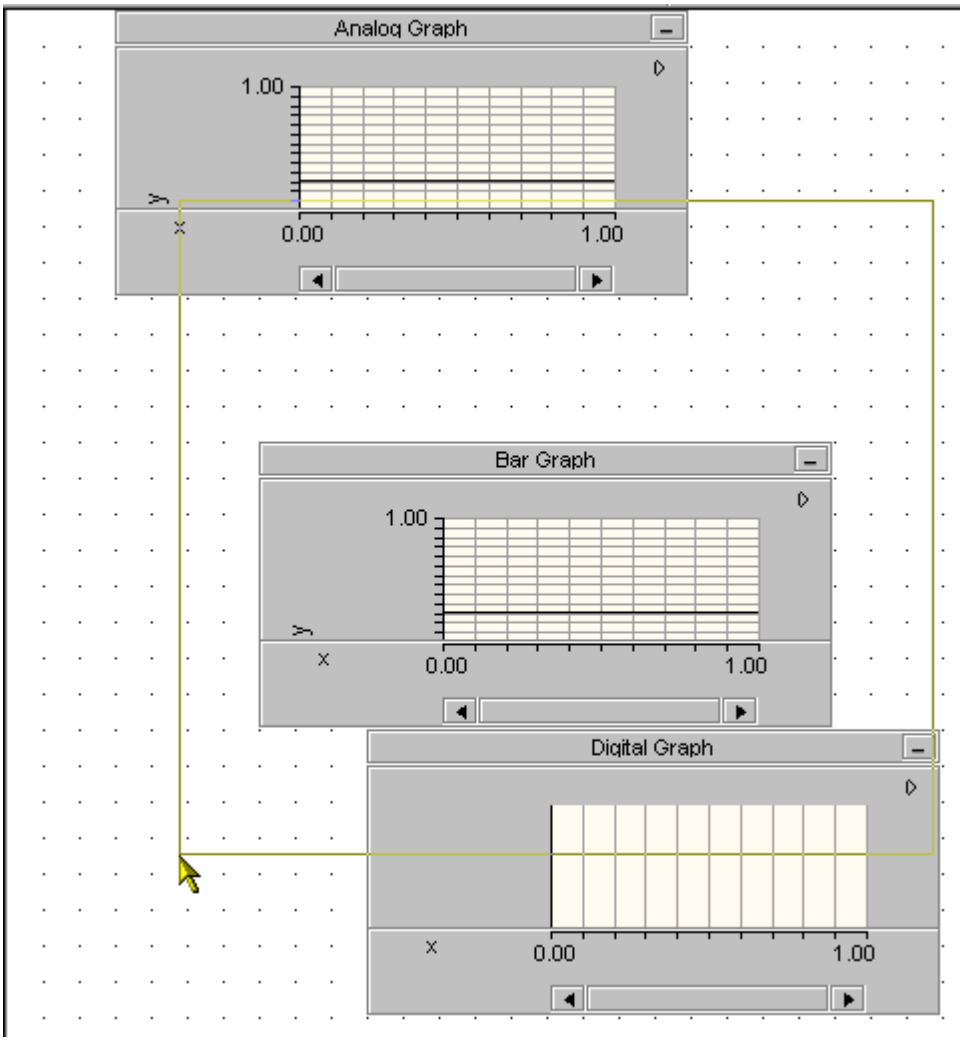
3.1.7 Multiple Selection of Graphs and Formatting

To multiply select components, use the mouse and perform a "**left button click and drag**" to box a region encompassing the desired components.



Aligning Graphs

To align the components, use the **mouse** and **right click** over any of the multiply selected components. Select the "**Align**" option from the menu.

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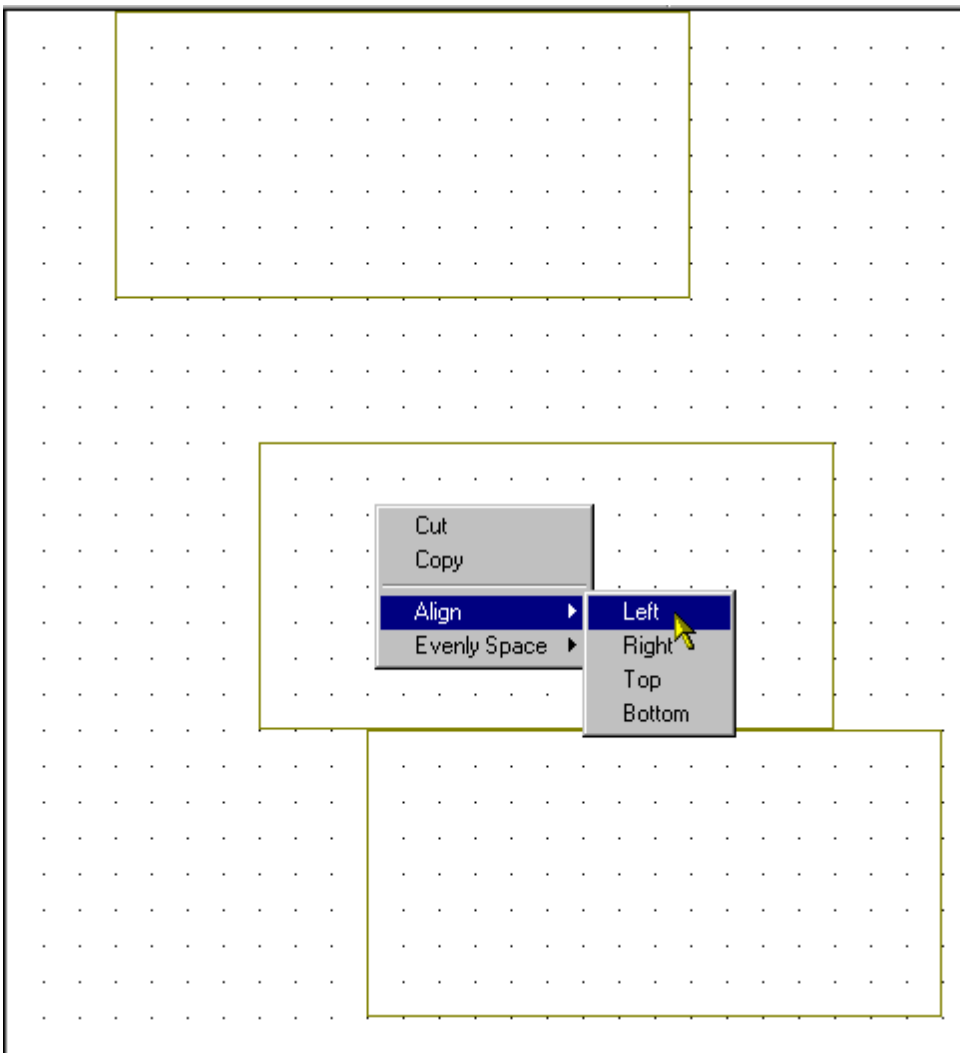

Format the Spacing Between Graphs

To format the spacing, use the **mouse** and **right click** over any of the multiply selected components. Select the "**Evenly space**" option from the menu.

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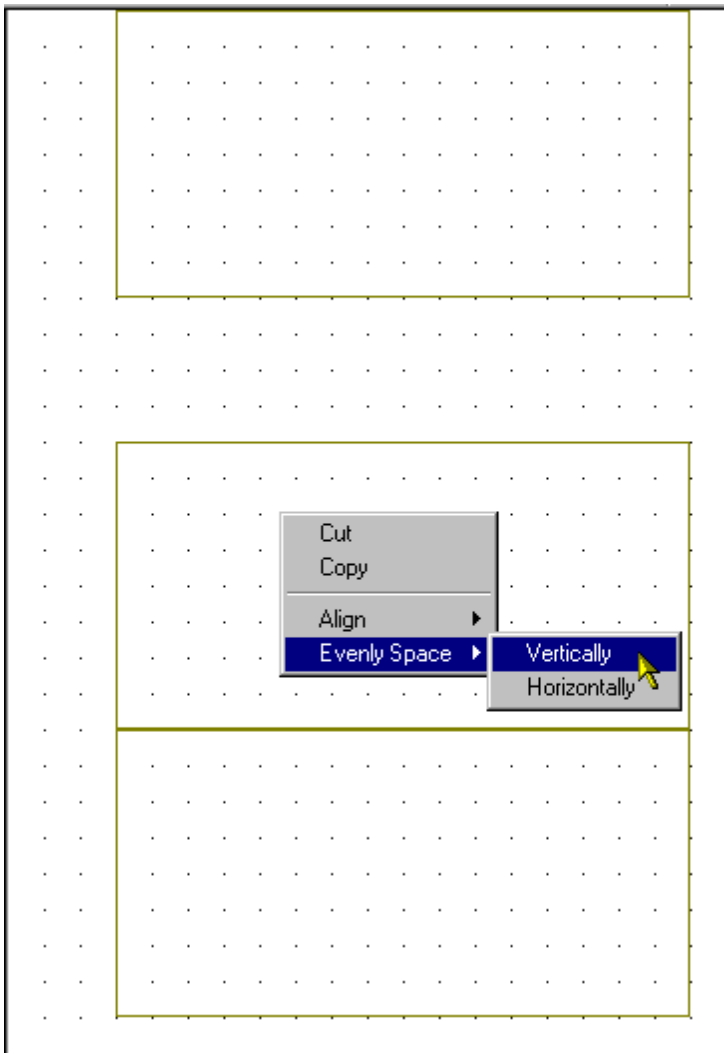

Moving Multiply Selected Graphs

Using the mouse, perform a "**left click and drag**" on any of the multiply selected components. The group will move as a whole.

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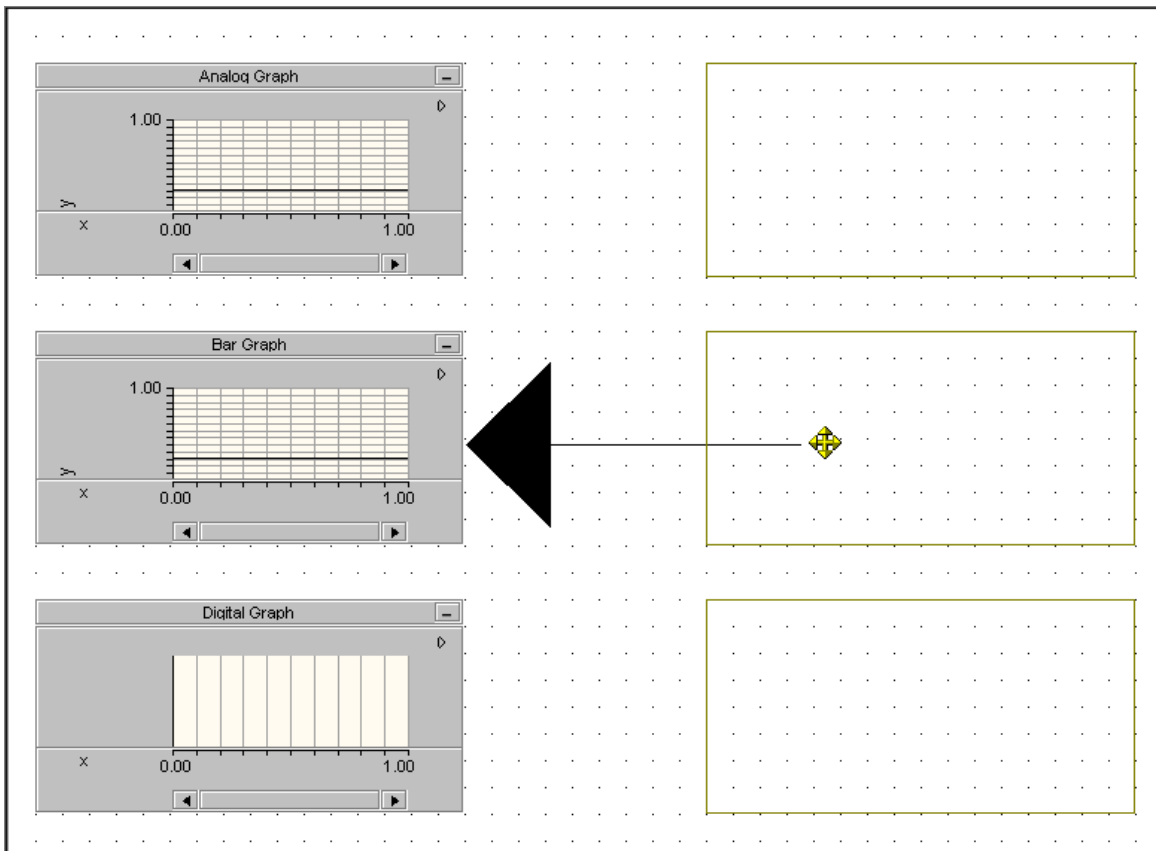

3.2 Data Manipulation

LiveWire supports the importation and exportation of industry standard data file formats, such as COMTRADE[3] and EMTDC[4]. It provides users with the ability to import and export general data formats as well, such as comma separated variable files (*.csv) and text files (*.txt). LiveWire even provides the means to generate data from user-defined equations and import/export data from other applications using the clipboard. Records are stored as a single domain data set with one or more measured trace data sets.

3.2.1 Importing Data Files

---

[3] Common Transient Data Exchange **(COMTRADE) IEEE-C37.111** is fully supported for years **1991, 1996(draft), 1997(draft) and 1999** in both ASCII and BINARY and Multi-File spanning.

[4] Electromagnetic Transients for DC **(EMTDC)**. This format uses information files and multi-file spanning to support up to 200 channels.

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Livewire provides the user with the capability to import five different file formats:

- COMTRADE files (*.cfg)
- EMTDC files (*.inf)
- Comma Separated Variable files (*.csv)
- Tab Delimited files (*.txt)
- Text files (*.txt).
- PSS/E (PTI) files (*.asc; *.raw)
- All Files (*.*)

The text file format allows the user to import data files that may not have typical delimiters, or delimiters the user is unaware of.

Formatted and Unformatted File Types

Comma Separated Variable files, Tab Delimited, and Text files all have additional importation options. They can be brought in as Formatted or Unformatted.

Formatted data – the first column of data is interpreted as the domain of the data set.

Unformatted data – all data is interpreted as range data and the domain is calculated by the sample size.

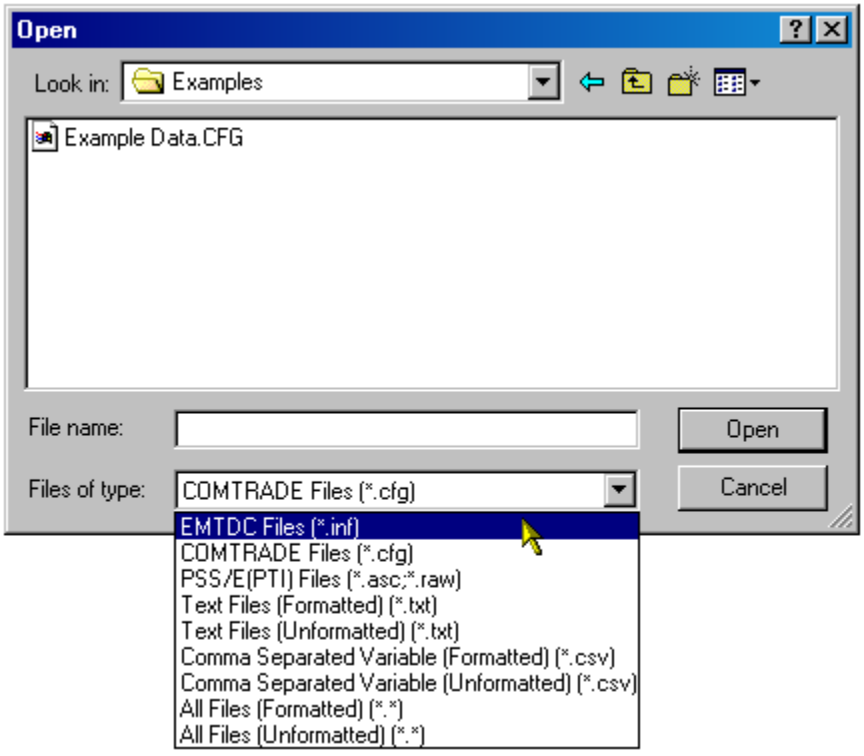

Figure 3.11: Example of the Importation Dialog.

To import/load a data file in LiveWire:

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- From the LiveWire menu, click **File ▸ Import Data File**

or

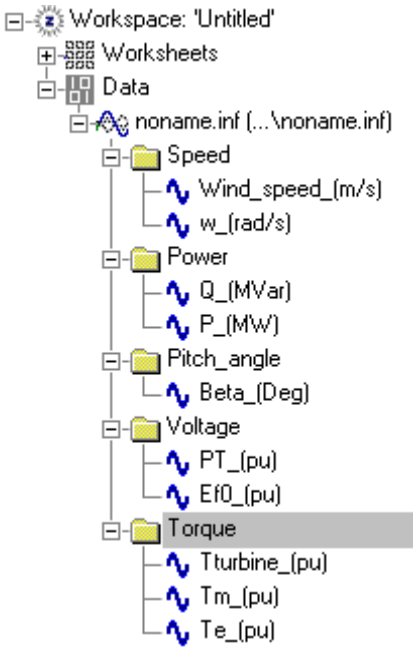
- From the Workspace item in the tree view, right-click to generate a pop-up menu. From the pop-up menu click **Insert Data Source**

Note 1:

There is built in support to directly read in PSCAD version 2 data.

Note 2:

EMTDC data from PSCAD will adopt the grouping structure that is defined in a PSCAD project.



3.2.2 Exporting Data Files

Livewire allows the user to export data in two different file formats:

- COMTRADE files (*.cfg)
- Comma Separated Variable files (*.csv).

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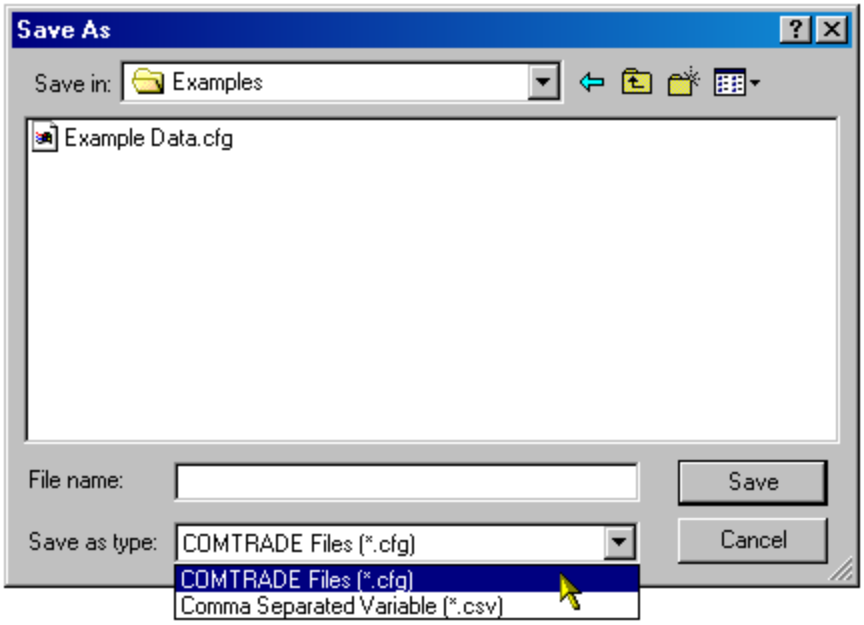

Figure 3.12: Example of the Exportation Dialog.

Exporting COMTRADE Data Files

The COMTRADE export module provides the user with the capabilities to write IEEE Standard Common Format for Transient Data Exchange IEEE C37.111 data files. This module implements support for the 1991, 1996, 1997, and 1999 versions. Both ASCII and Binary formats are supported for all the revisions. For the convenience of the user, this module also provides header support and multiple channel selection, allowing subsets of data to be written. Below is a visual example of the COMTRADE Exportation dialog.

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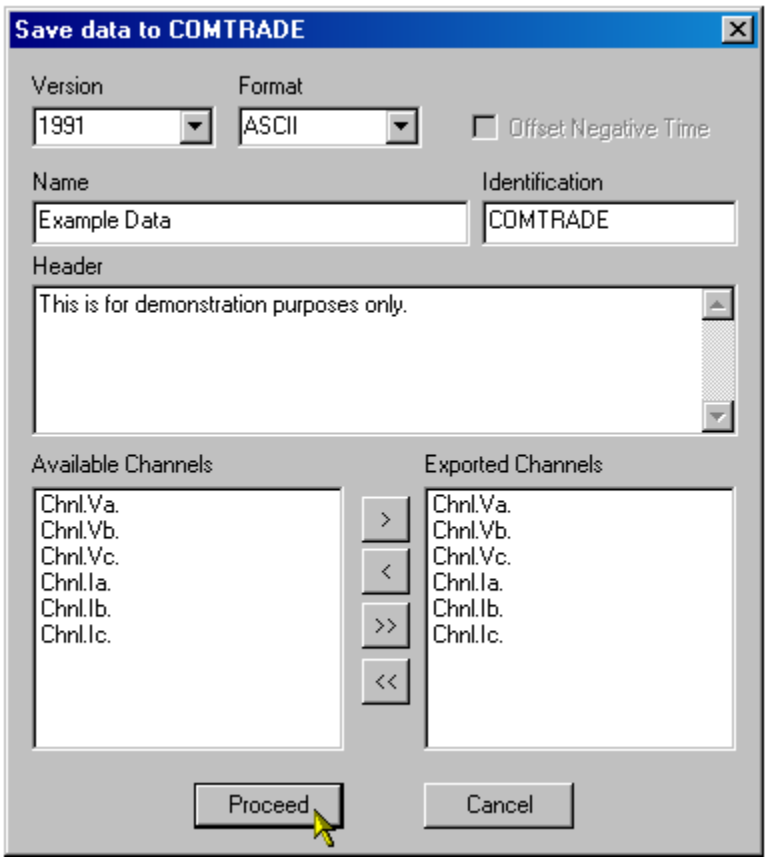

Figure 3.13: Example of the COMTRADE Exportation Dialog.

To export/save a data file in LiveWire:

- From the Data item in the tree view, right-click to generate a pop-up menu. From the pop-up menu click **Export to Data File**

Note: When saving a workspace that contains data, which was not imported but rather pasted into Livewire, be sure to export that data before to ensure that the entire workspace will save properly. The workspace must have a location in memory to store that data.

3.2.3 Copy/Paste Data

LiveWire has the resources to allow users to copy data from other applications like Microsoft Excel, and paste it directly into a workspace. The user can also copy data from LiveWire and paste it into various other applications.

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How to Copy and Paste Data to LiveWire

To paste data into LiveWire from another application:

- Copy a region of data from another application.

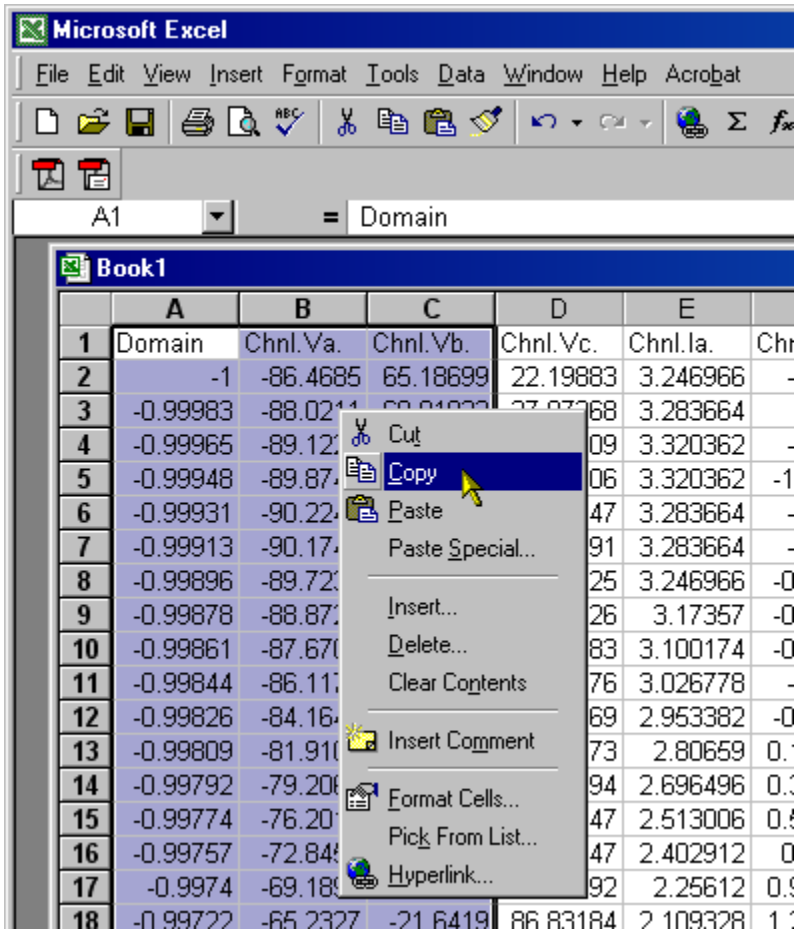

Figure 3.14: Copying data from another application.

- From the LiveWire menu, click **Edit ▸ Paste Data From Clipboard**

or

- From the worksheet, right-click to generate a pop-up menu. From the pop-up menu click **Paste Data From Clipboard**

or

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- From the Data item in the tree view, right-click to generate a pop-up menu. From the pop-up menu click **Paste Data From Clipboard**

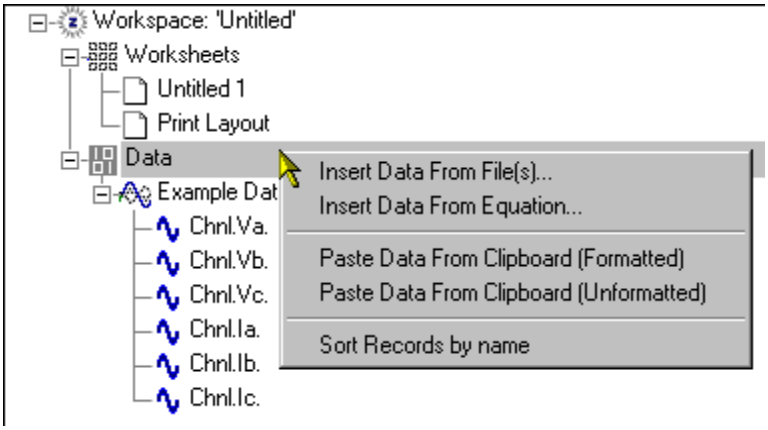

Figure 3.15: Example of pasting data into LiveWire.

Note 1: paste data from clipboard has 2 options, formatted and unformatted.

- **Formatted text** is textual data having its first column being the **domain.**
- **Unformatted text** is textual data with no domain values (all range data). The domain will be calculated from the sample size.

How to Copy and Paste Data from LiveWire

There are numerous ways to copy data from LiveWire. If a component on the worksheet contains data, that data can be copied and then pasted into another software program.

To paste data from LiveWire to another application:

- From any particular graph or curve, right-click to generate a pop-up menu. From the pop-up menu click **Copy Visible Data to Clipboard**, which will copy only the portion of data visible in the graph, click **Copy Marker Bounded Data to Clipboard**, which will copy only the portion of data contained between the markers, or click **Copy All Data to Clipboard**, which will copy all the data in the graph.

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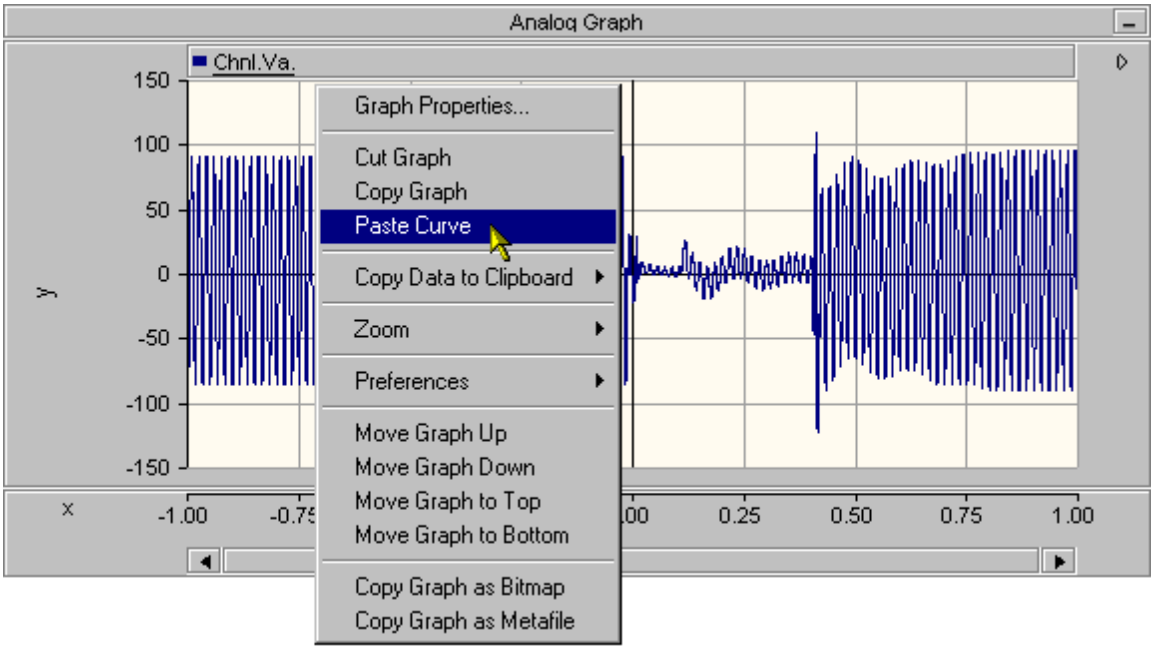

Figure 3.16: Example of copying data from LiveWire.

- Paste the data into the other application.

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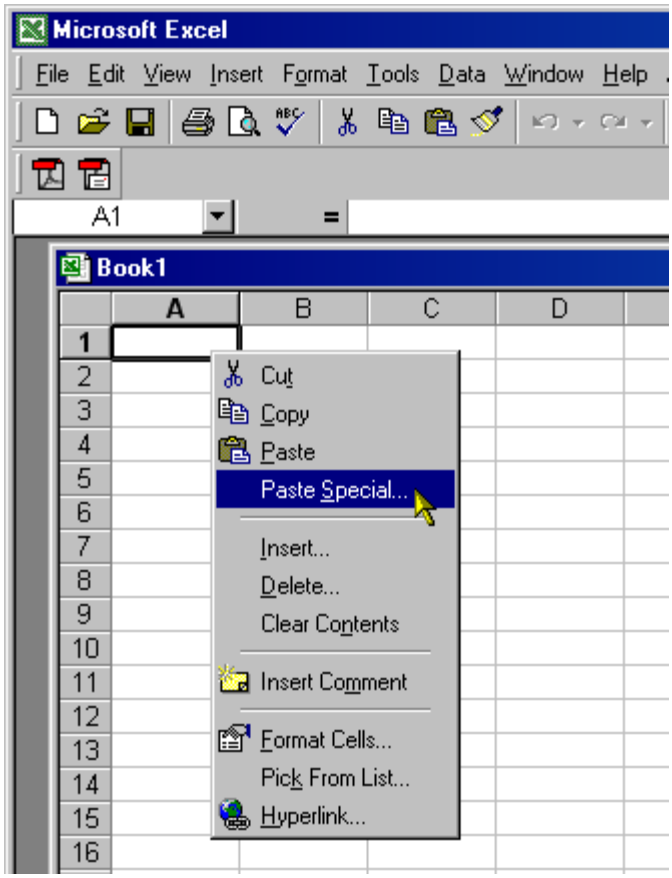

Figure 3.17: Example of pasting LiveWire data into another application.

3.2.4 Data Generation

The Data Generator Dialog

Livewire provides the user with the capability to generate theoretical data from mathematical equations. The equations and their properties can be defined in the equation generator dialog. The editable equation properties are as follows:

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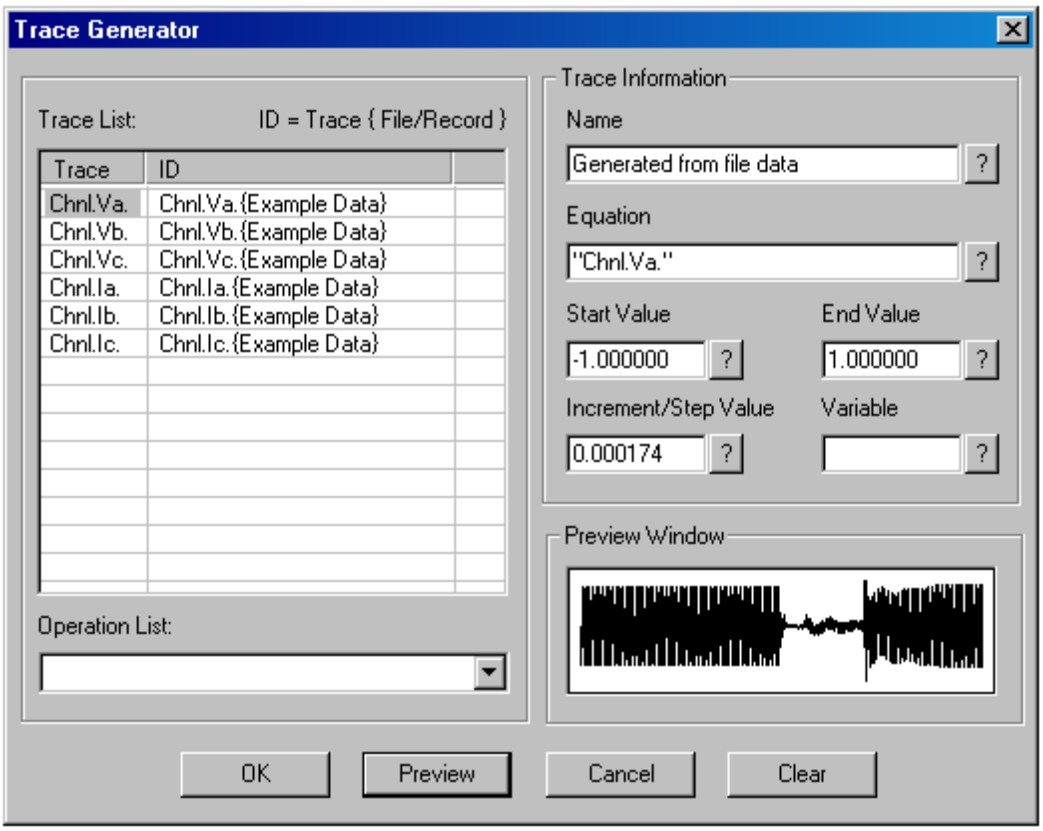

Figure 3.18: The Trace Generator dialog.

Editable fields

- **Name** – A unique name using only alphanumeric characters {a..Z, 0..9}. Names must begin with a letter.
- **Equation** – A user defined equation made up of variables, trace ids, and operators. These items can be either typed in manually or by selecting from the trace/operator lists.
- **Start Value** – A start value for the data extents, must be less than end value.
- **End value** – An end value for data extents, must be greater than the start value.
- **Increment** – A data increment or step where a point will be generated, must be greater than zero.
- **Variable** – A unique variable using only alphanumeric characters {a..Z, 0..9}. Variables must begin with a letter.

Display fields

- **Trace list** – A listing of all the traces currently loaded into the workspace. These traces can be selected into the equation by typing them out or by selecting with the mouse.

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- **Operator list** – This is a list of all the currently available math operators supported by LiveWire.

- **Preview Window** – A preview of the generated data.

Buttons

- **OK** – Commits all dialog parameters to the generation mechanism, which generates data. The newly generated data is automatically sent to the workspace after processing is finished.

- **Cancel** – This will quit dialog without generating any new data. All parameters set by the user will be discarded.

- **Preview** – This will create a curve in the preview widow that represents the data generated with the parameters set forth by the user in the dialog. This action does not commit the new curve to LiveWire until you click OK. This feature allows the user to preview the generated data and make changes without affecting the application.

- **Clear** – This will clear all editable fields in the dialog.

Independent Data Generation

You can invoke the Independent data generation by simply choosing "Insert data from equation" option available in the application menu or by right clicking on the "Data" item on the tree. A dialog will come up with user definable properties for generated data.

1) Enter a name for the trace
2) Enter an equation using a variable of your choice. All trace variables in the equation must be delimited by quotes (" ").
3) Enter start, end, and increment values
4) Enter the variable used by your equation
5) Press OK to commit the data or preview to preview trace

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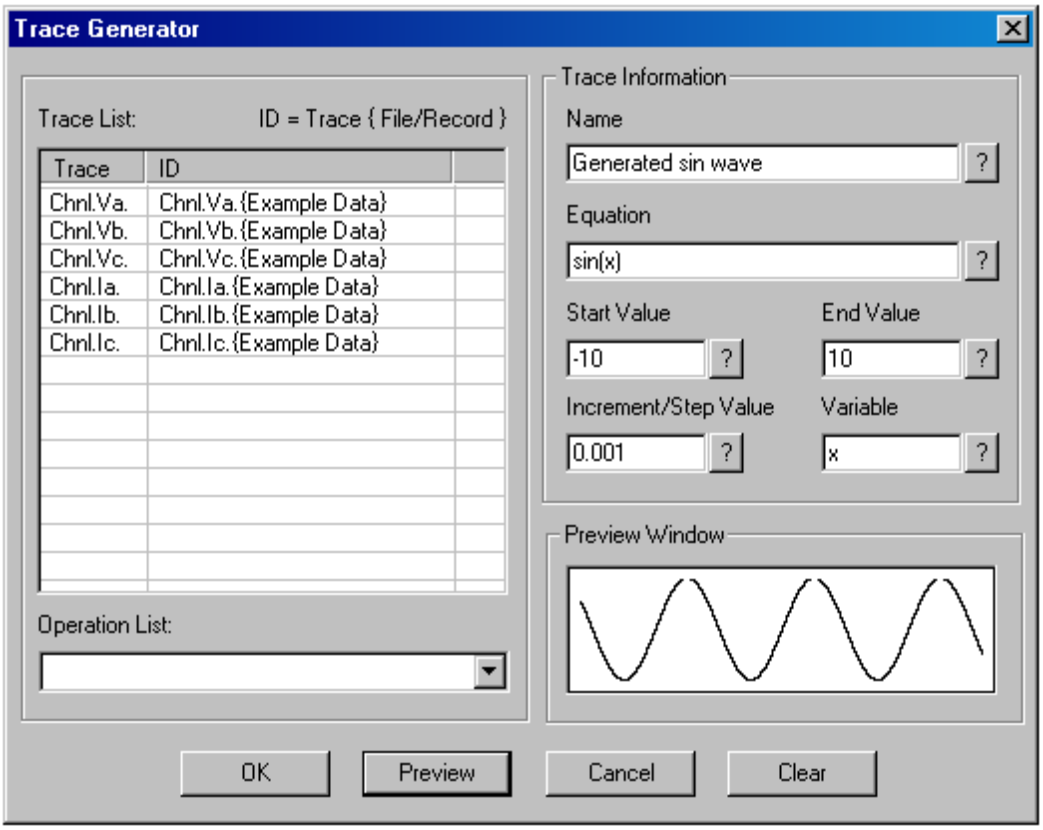

Figure 3.19: Example of the Trace Generator dialog.

If you decide to use the preview button, a curve will be generated that is temporary and none of it's data will be created in LiveWire.

If you press OK, data will be generated and inserted into LiveWire where it will be accessible immediately on the navigation tree.

Dependent Data Generation

You can invoke Dependent data generation by simply choosing "Insert data from equation" option available in the application menu or by right clicking on the "Data" node on the tree. A dialog will come up with user definable properties for generated data.

1) Enter a name for the trace
2) Enter an equation using a variable and/or a trace(s) of your choice from the trace list. All variables in the equation must be delimited by quotes (" ").
3) Enter start, end, and increment values
4) Enter the variable used by your equation
5) Press OK to commit the data or preview to preview trace

Left mouse clicking on the desired trace from the trace window may also select traces.

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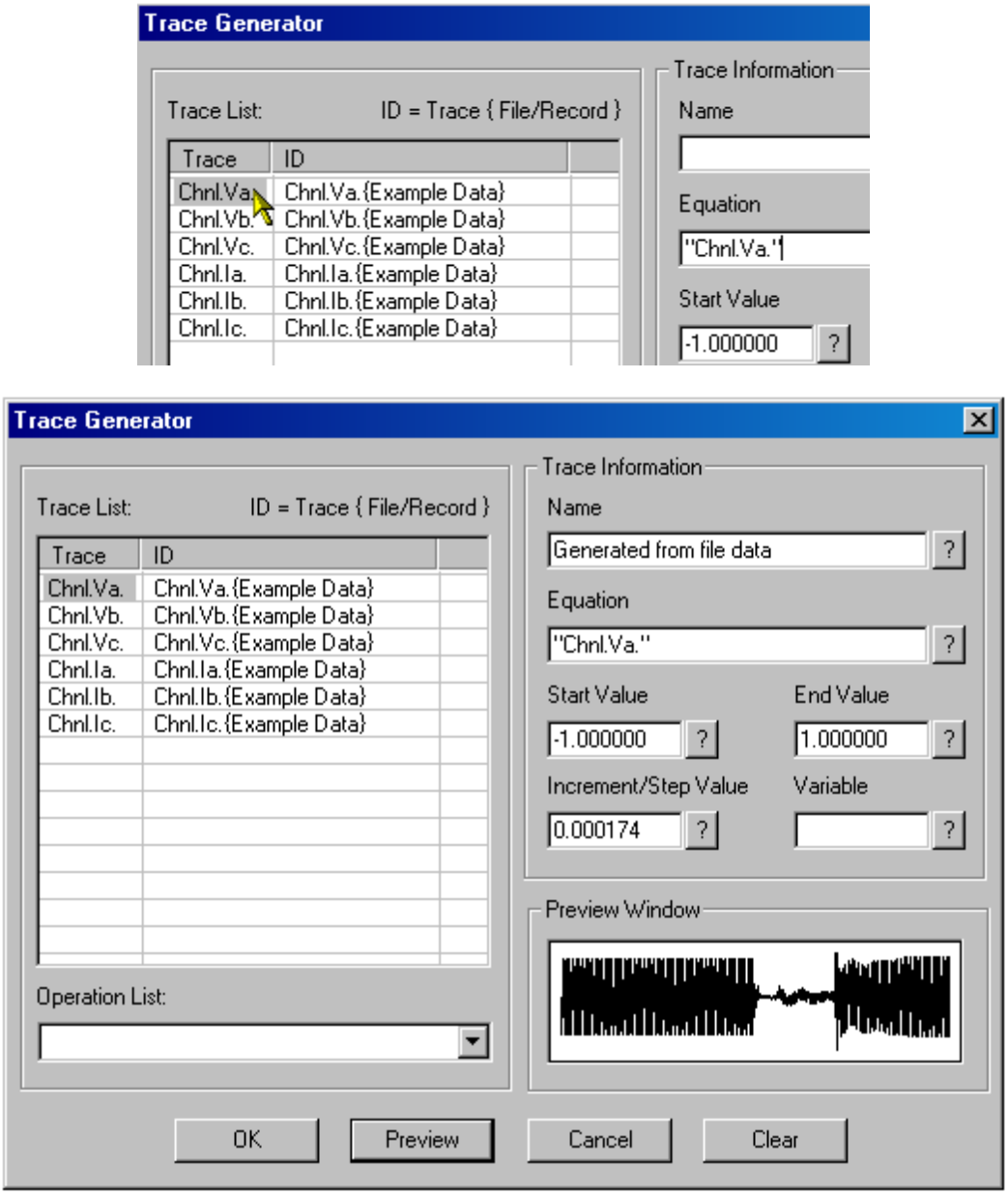

Figure 3.20: Example of the Trace Generator dialog with fields filled in.

If you decide to use the preview button, a curve will be generated that is temporary and none of it's data will be created in LiveWire.

If you press OK, data will be generated and inserted into LiveWire where it will be accessible immediately on the navigation tree.

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Dependent Data Generation *Special Note* (mismatched data)

LiveWire allows the user to perform mathematical operations on two sets of data whose bounds and increments are mismatched. To see how it is handled, the following two examples illustrate but problems separately.

Case 1 "Mismatched bounds"

Two sets of data are added
- Data set 1 starts at time 0 and ends at time 10
- Data set 2 starts at time 5 and ends at time 10
- Bounds for the new generated curve are set by the user from –10 to 10

Result

The new data will be created as follows:
- No data will exist from –10 to 0 but a domain will exist
- Data from 0 to 5 will be created that is an exact copy of Data set 1 from 0 to 5
- Data from 5 to 10 will be the addition of Data set 1 and Data set 2

Case 2 "Mismatched data increment"

Two sets of data are added
- Data set 1 increment does not match Data set 2 increment
- User sets the increment of the generated data to neither that of set 1 or 2

Result

The new data will be created as follows:
- The increment of the generated curve will be the user defined increment
- Data from both dependant curves are INTERPOLATED if no data exists at a given time step.

3.2.5 Synchronization of Data

This is a special feature that updates the data in LiveWire when data has been changed. A popup box giving the option to reload the file will prompt the user. If the user chooses yes, the data will automatically reload with the changes reflected in the graphs and **all dependant data** (data generated with an external data as one of the variables).

If the user chooses no, the unaltered data will remain in LiveWire. To force a manual reload, there is reload button  at the top of the application. It can be pressed at anytime to refresh all data.

External Model

LiveWire automatically detects changes in **File data** when the file has been altered by an external mechanism such as a Data Logger or Simulator.

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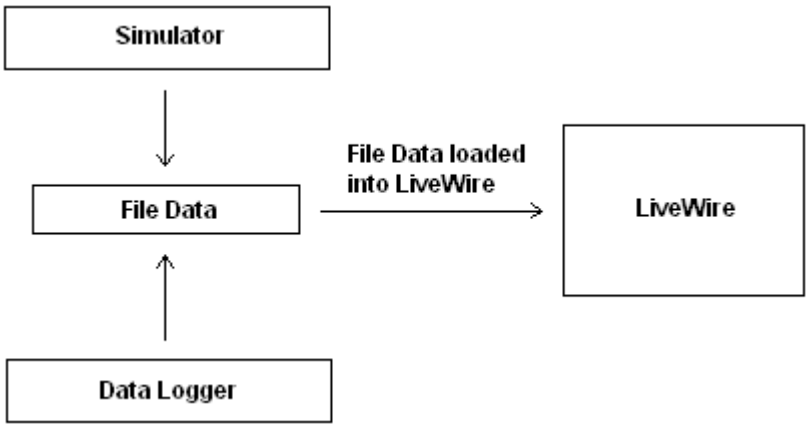
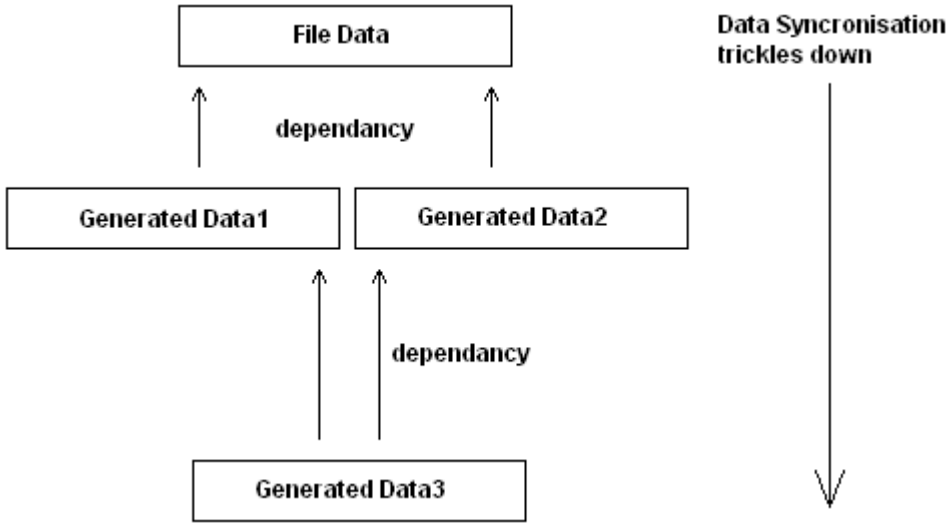


The synchronization of data has no bounds. You can have an unlimited number of dependencies and an unlimited number of dependant levels (curve A dependant on curve B dependant on curve C ...). As soon as a reload occurs, a "trickle effect" will update all data starting from the parent (altered file) all the way down to all dependant children (generated data with dependencies).

Internal Model



Changes in the loaded File Data triggers a "regeneration" of all **Dependent** data.

Scenario 1

Loaded Data from Files

When you load data from a file, LiveWire will continuously monitor that file. If another application alters the data, the refresh popup dialog will appear.

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Pressing "Yes" will result in LiveWire reloading the data. Any graphs containing the altered data will also automatically reload.

Scenario 2

Generated data with Dependencies on File Data

Using the "trace generator", you can generate data dependent on any external file data. By doing so, the generated trace will have a dependency on a specific file data. If another application alters the data in that file, the refresh popup dialog will appear.

Pressing "Yes" will result in LiveWire reloading the file data. Any graphs containing the altered data will also automatically reload. Furthermore all generated data/graphs with dependencies on the reloaded file will also regenerate.

NOTE:

The synchronization of data has no bounds. You can have an unlimited number of dependencies and an unlimited number of dependant levels (curve A dependant on curve B dependant on curve C …). As soon as a reload occurs, a "trickle effect" will update all data starting from the parent (altered file) all the way down to all dependant children (generated data with dependencies).

3.2.6 Attaching Data to Graphs and Plots

For the graphs and/or plots to be useful, you must be able to get the data connected to them. LiveWire provides many different ways to do this. On the worksheet, LiveWire represents every data set as a curve. To display or visualize a data set in a graph it must be attached as a curve.

How to Add a Curve to a Graph

To add a curve to a graph in LiveWire:

- From a data set object in the tree view, right-click to generate a pop-up menu. From the pop-up menu click **Copy as Curve**.

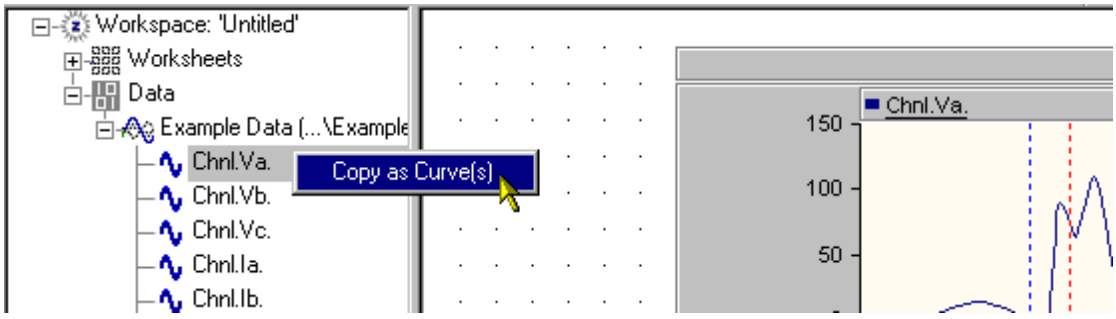

Figure 3.21: Example of creating a curve from the data object in the tree view.

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- From the surface of one of the graphs, right-click to generate a pop-up menu. From the pop-up menu click **Paste Curve**.

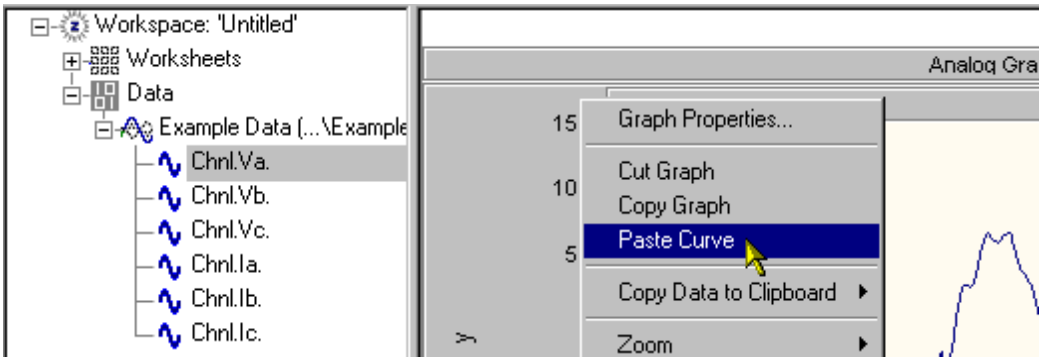

Figure 3.22: Example of pasting a curve into a graph.

LiveWire also allows the user to drag curves from the tree view and drop them on a graph. This would be similar to creating a curve and then pasting it upon any of the graphs. To perform this task, simply select a curve from the data set object in the tree view, drag it over into the workspace, and drop it on the desired graph.

- Using your mouse, select a curve from the data set object in the tree view, click and drag it over into the worksheet, and drop it on the desired graph

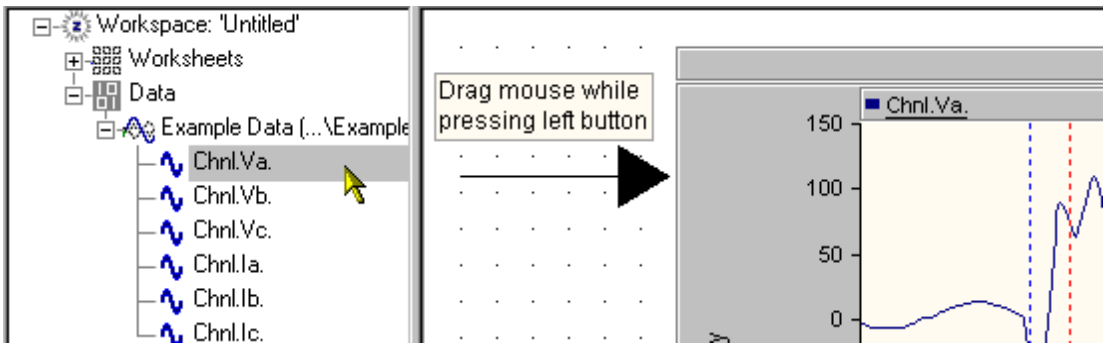

Figure 3.23: Example of dragging a curve into a graph.

3.2.7 Moving Groups of Data into a Graph

Hold either the **Ctrl** or **Shift** key down on the keyboard while selecting the desired traces from the tree. They will highlight as you select each one and be handled as a group. Now you can perform a drag and drop just as you did for single channels.

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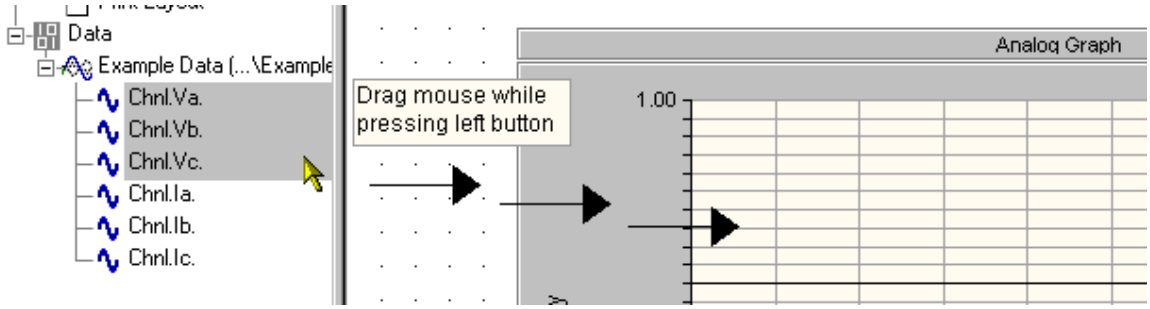
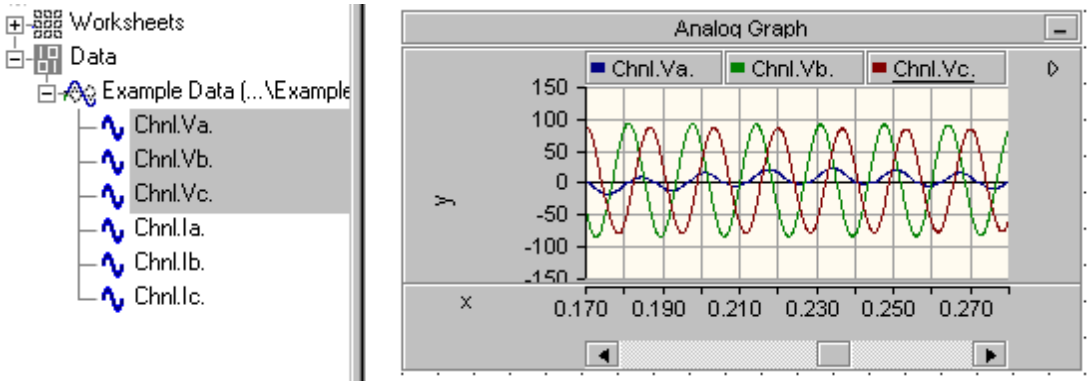


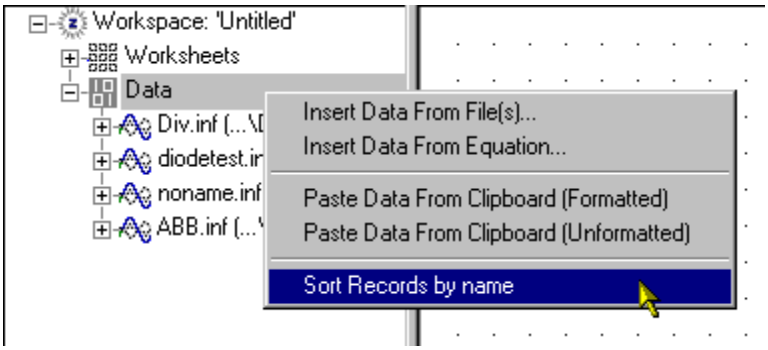
The group of data will transfer into the graph as a whole.



3.2.8 Sorting Data Alphabetically

Record Sorting

Right click on the **Data** node on the workspace tree and select the **Sort records by name** option.



Group Sorting

Right click on a record node on the workspace tree and select the **Sort Groups by name** option.

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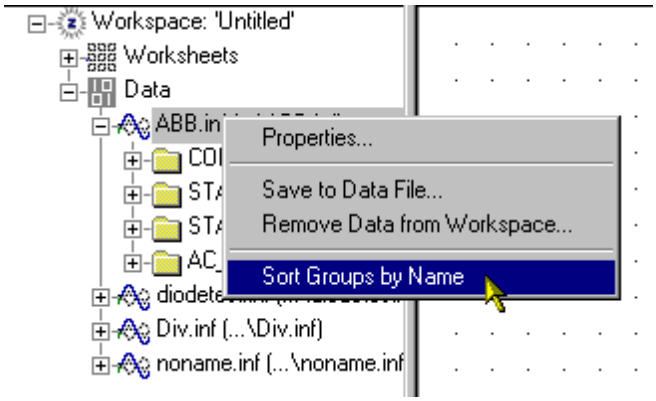
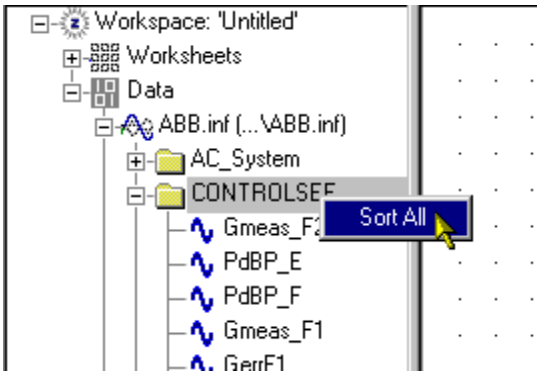


Channel Sorting

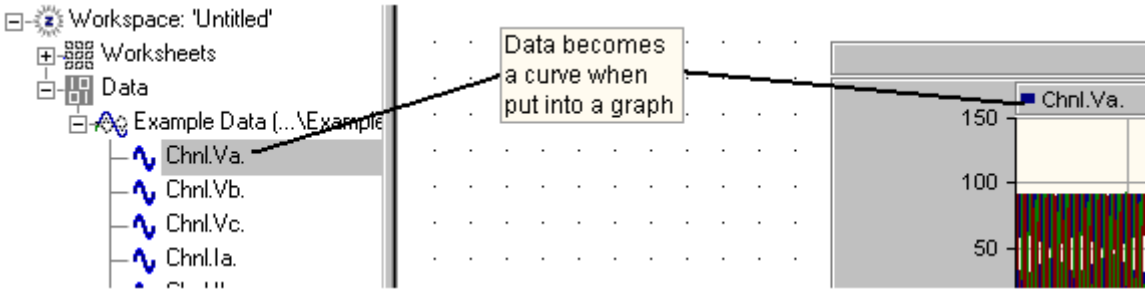
Right click on a **group** node on the workspace tree and select the **Sort All** option.



3.2.9 Data Properties

Introduction

When data is brought into a graph, a "curve" is created. A curve is what LiveWire uses to display data. The curve has properties, which determine how the data is to be displayed. The user can change these properties and thus change the way the data is represented.



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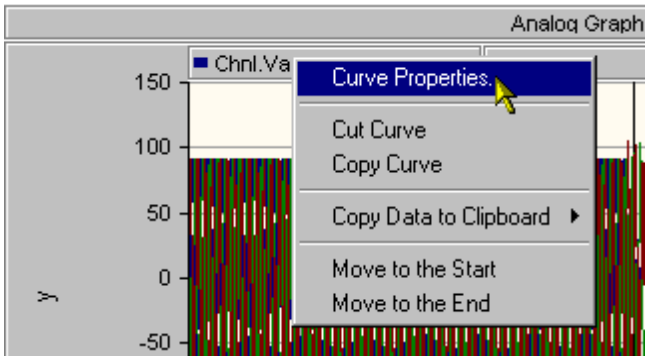
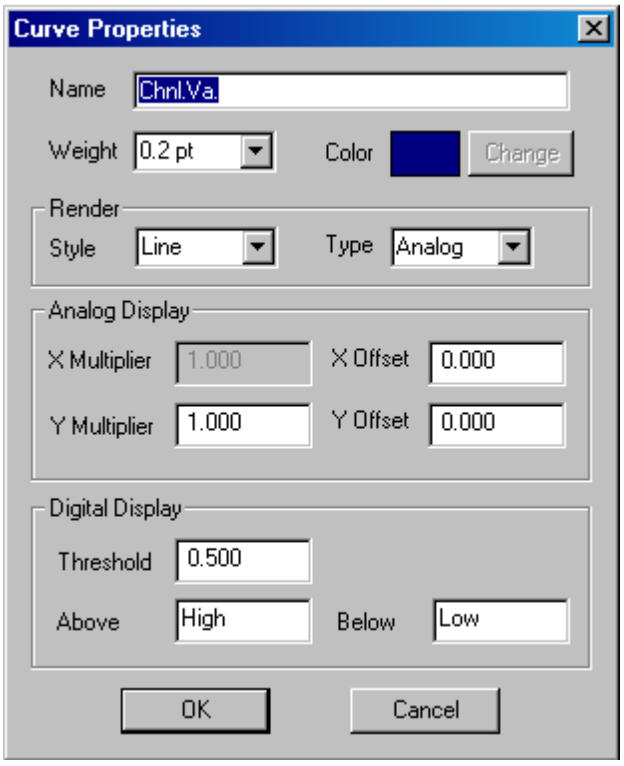
Curve Properties

Curves have properties that can be viewed and set by right clicking on any curve and selecting the Curve Properties option. From the dialog that opens up you can see that you can change such properties as the name and rendering options. This can be done for any curve in any graph in Livewire.





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4.0 LiveWire Graphs and Plots

LiveWire provides the user with a wide array of graphs and plots. From simple graphs to advanced graph frames, the user has many options to use when analysing their data.

4.1 Creating Simple Graphs

The simple graph is a graph that provides the user with a clean, lightweight visual depiction of data. Users may choose from three different types of graphs:

- Analog graphs
- Digital graphs
- Bar graphs

4.1.1 Creating an Analog Graph

To create/add a new simple analog graph to the active worksheet:

- From the LiveWire menu, click **Graph** ▸ **Simple Graph** ▸ **Add Analog Graph**, or click the  button from the toolbar.

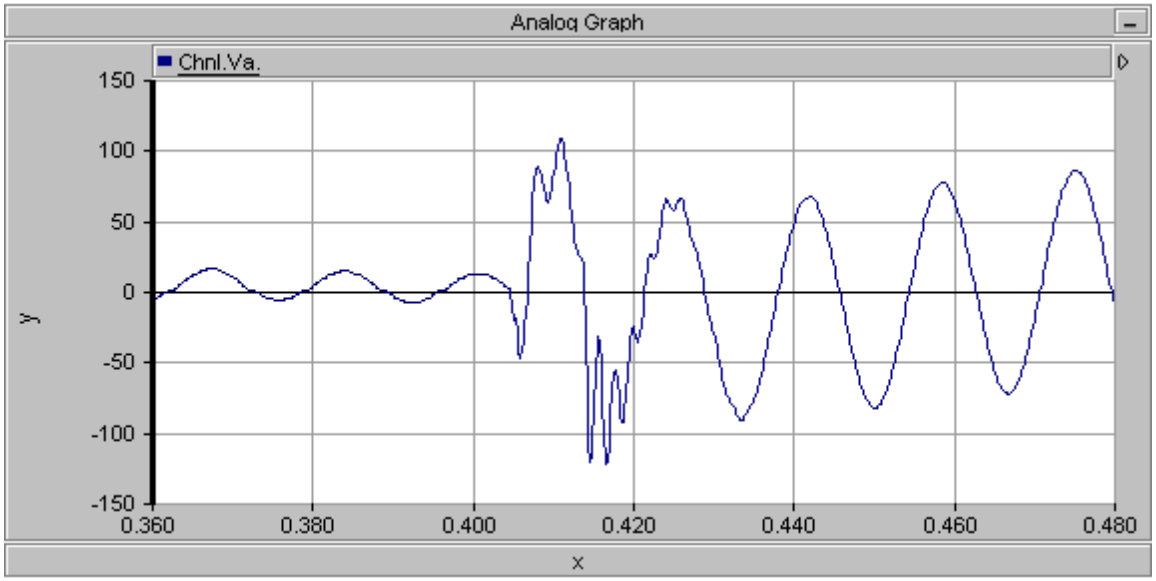

Figure 4.0: Example of a Simple Analog Graph.

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4.1.2 Creating a Digital Graph

To create/add a new simple digital graph to the active worksheet:

- From the LiveWire menu, click **Graph** ▸ **Simple Graph** ▸ **Add Digital Graph**, or click the  button from the toolbar.

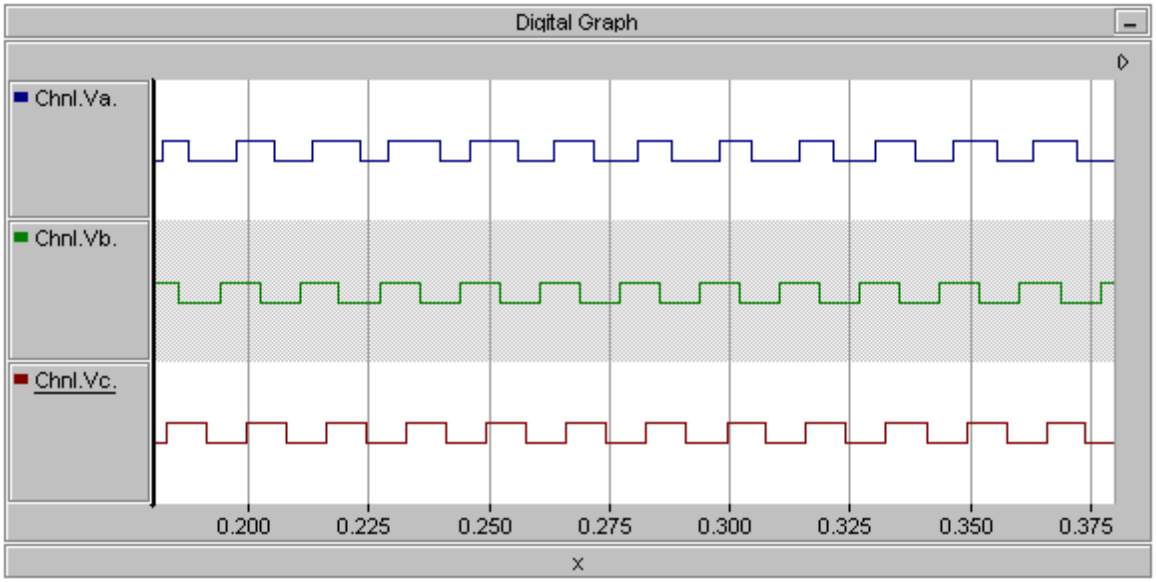

Figure 4.1: Example of a Simple Digital Graph.

4.1.3 Creating a Bar Graph

To create/add a new simple digital graph to the active worksheet:

- From the LiveWire menu, click **Graph** ▸ **Simple Graph** ▸ **Add Bar Graph**, or click the  button from the toolbar.

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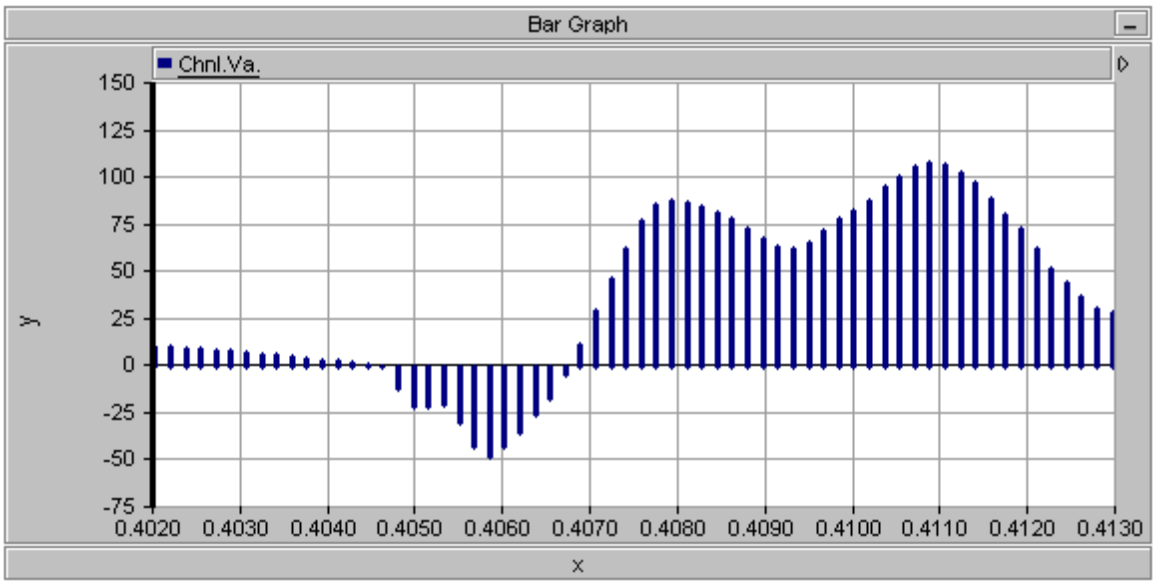

Figure 4.2: Example of a Simple Bar Graph.

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4.2 Creating Advanced Graphs

The advanced graph is a graph that provides the user with more functionality than the simple graph did. Additional features like the ability to pan data, or the ability to attach analyses are present in the advanced graph that were not in the simple graph. Like the simple graph through, users may choose from three different types of graphs:

- Analog graphs
- Digital graphs
- Bar graphs

4.2.1 Creating an Analog Graph

To create/add a new advanced analog graph to the active worksheet:

- From the LiveWire menu, click **Graph** ▸ **Advanced Graph** ▸ **Add Analog Graph**, or click the  button from the toolbar.

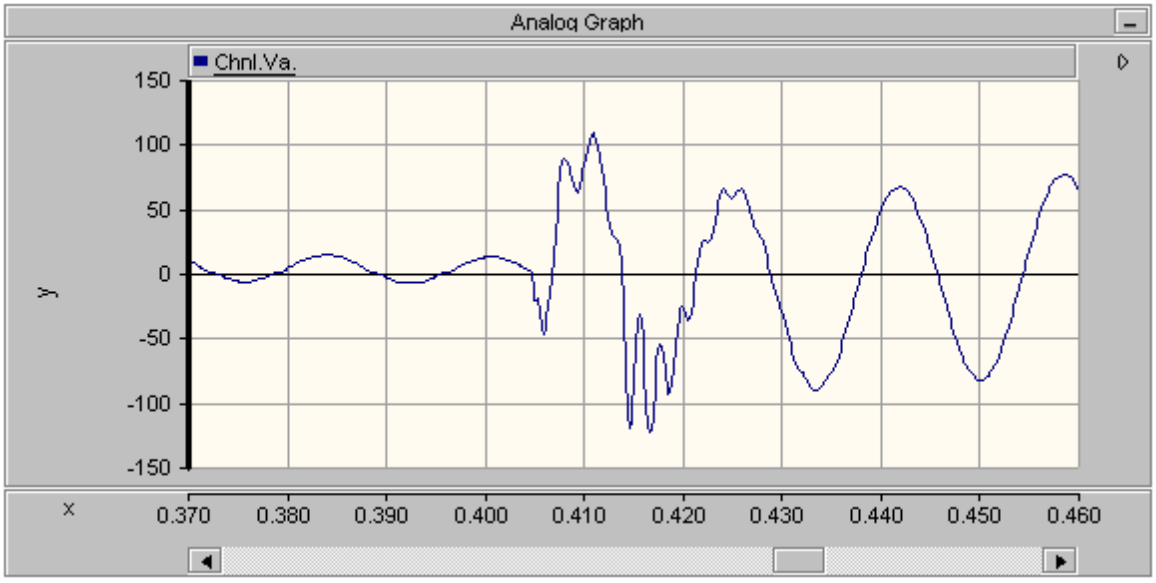

Figure 4.3: Example of an Advanced Analog Graph.

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4.2.2 Creating a Digital Graph

To create/add a new advanced digital graph to the active worksheet:

- From the LiveWire menu, click **Graph** ▸ **Advanced Graph** ▸ **Add Digital Graph**, or click the  button from the toolbar.

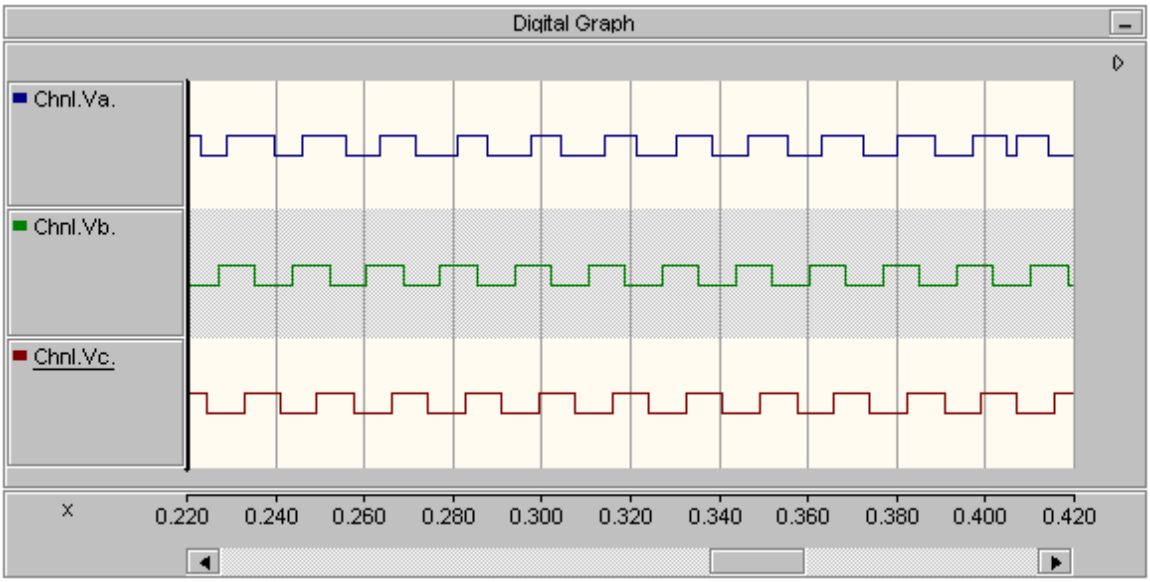

Figure 4.4: Example of an Advanced Digital Graph.

4.2.3 Creating a Bar Graph

To create/add a new advanced digital graph to the active worksheet:

- From the LiveWire menu, click **Graph** ▸ **Advanced Graph** ▸ **Add Bar Graph**, or click the  button from the toolbar.

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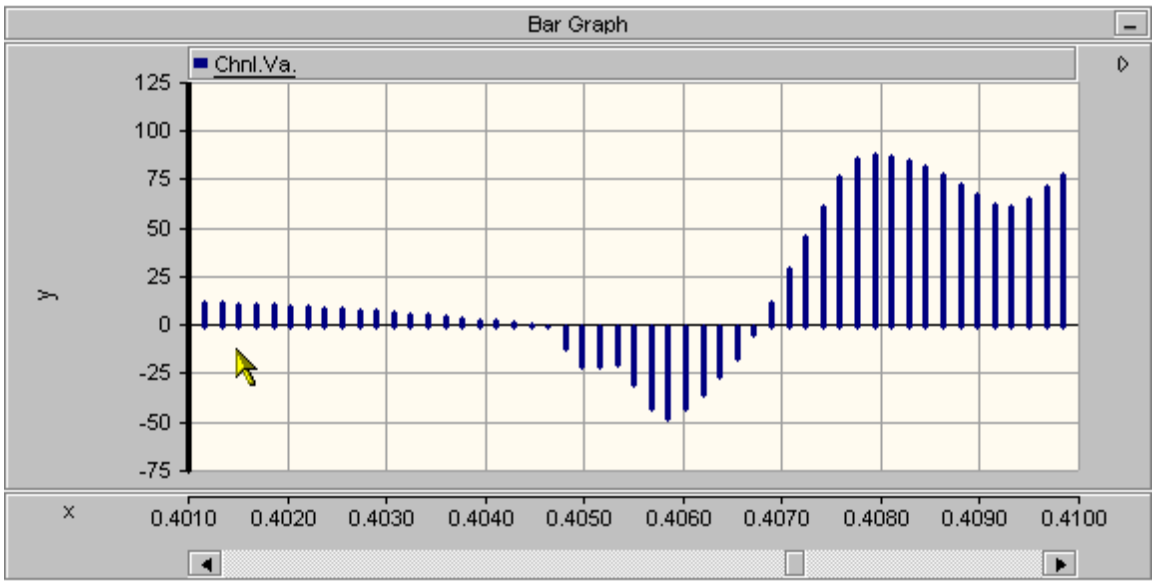

Figure 4.5: Example of an Advanced Digital Graph.

4.3 Creating Plots

The plots are quite different from the graphs in LiveWire. They use different dimensions; instead of having one domain axis and one range axis like typical graphs, they have two-domain axis. The other significant difference between the plots and the graphs are their behaviour to data. The graphs operate with any number of curves or data sets; the plots however, work with curve pairs. As a result, before the plot can render data it must have two curves at an equivalent sampling rate, one that represents the X-axis and one that represents the Y-axis. In LiveWire there are two types of plots to choose from:

- X-Y plots
- Polar plots

4.3.1 Creating an X-Y Plot

The X-Y plot is a type of plot that renders its data with Cartesian coordinates.

To create/add a new X-Y plot to the active worksheet:

- From the LiveWire menu, click **Graph** ▸ **Plot** ▸ **Add X-Y Plot**, or click the  button from the toolbar.

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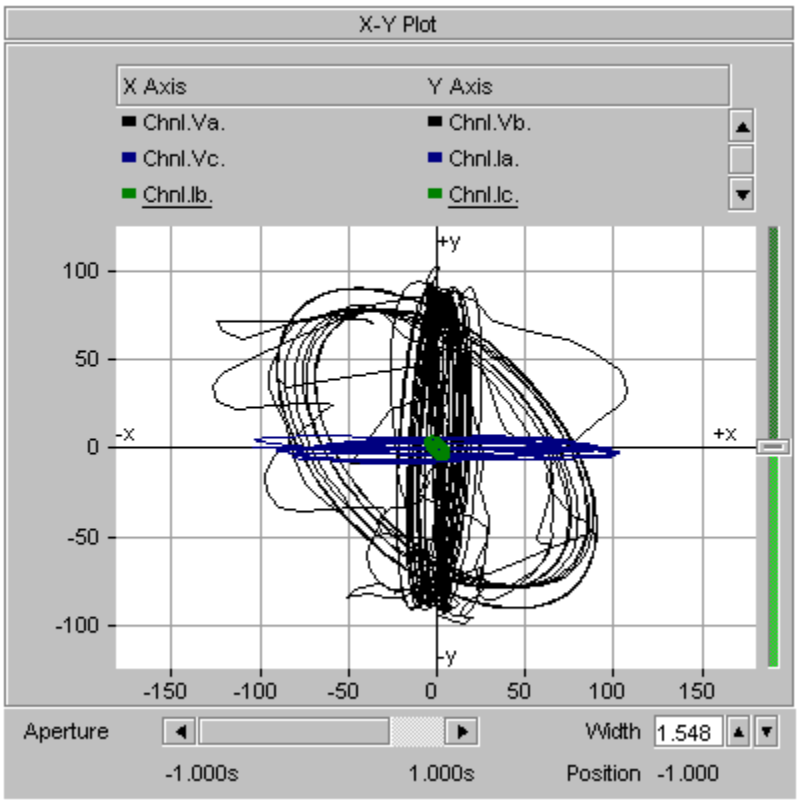

Figure 4.6: Example of a X-Y Plot.

4.3.2 Creating a Polar Plot

The polar plot is a type of plot that renders its data with polar coordinates.

To create/add a new polar plot to the active worksheet:

- From the LiveWire menu, click **Graph** ▸ **Plot** ▸ **Add Polar Plot**, or click the  button from the toolbar.

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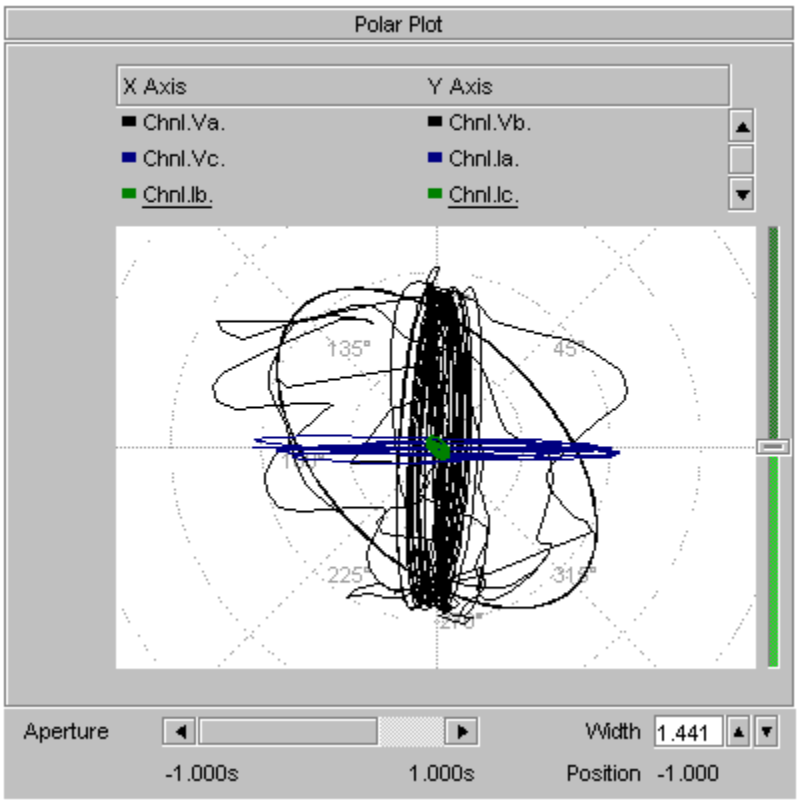

Figure 4.7: Example of a Polar Plot.

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4.4 Creating Graph Frames

The graph frames are simply the frameworks around the advanced graphs. What makes these components so special is their unlimited flexibility for advanced users. Multiple graphs of different types can be added and removed from the frame. This component allows the user to have complete control of their analysis and the visualization of it. LiveWire provides two types of graph frames:

- Graph Frames without vertical scrolling
- Graph Frames with vertical scrolling

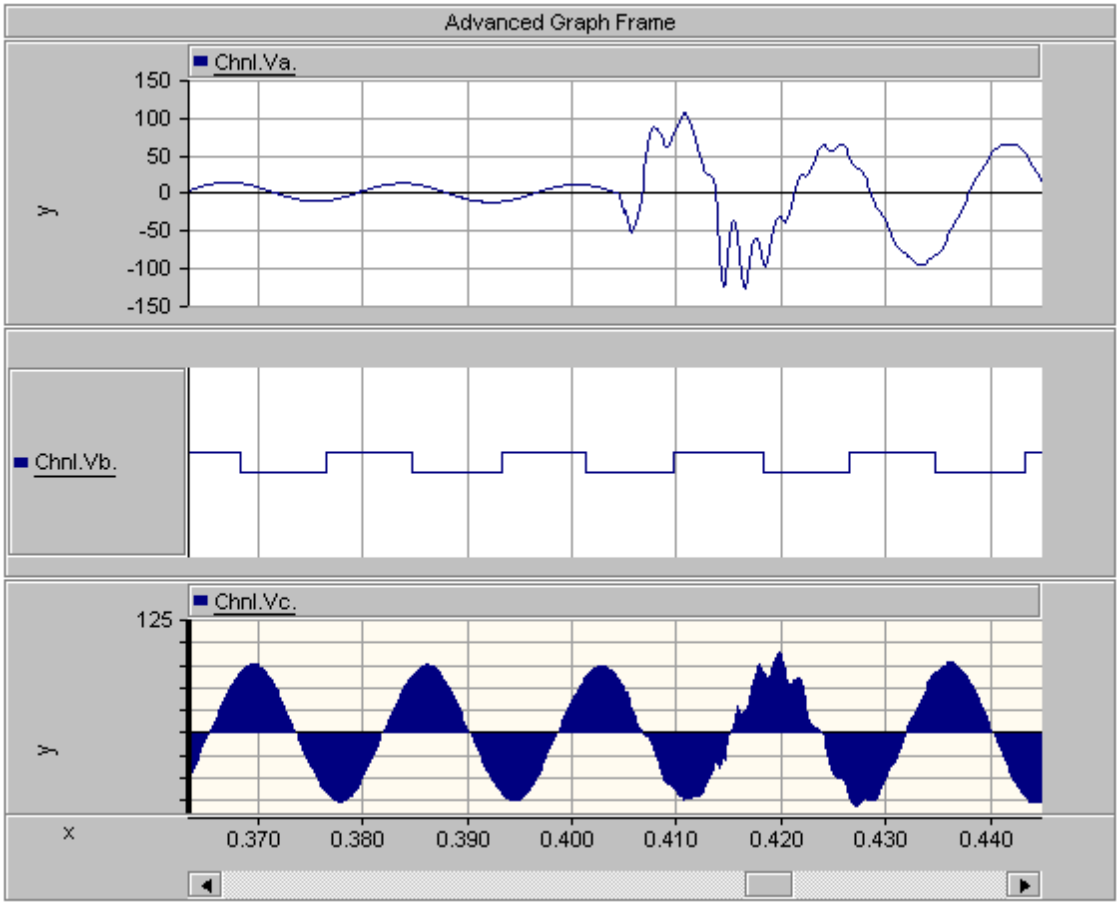

Figure 4.8: Example of a Graph Frame with multiple graphs.

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4.4.1 How to Create a Graph Frame without Vertical Scrolling

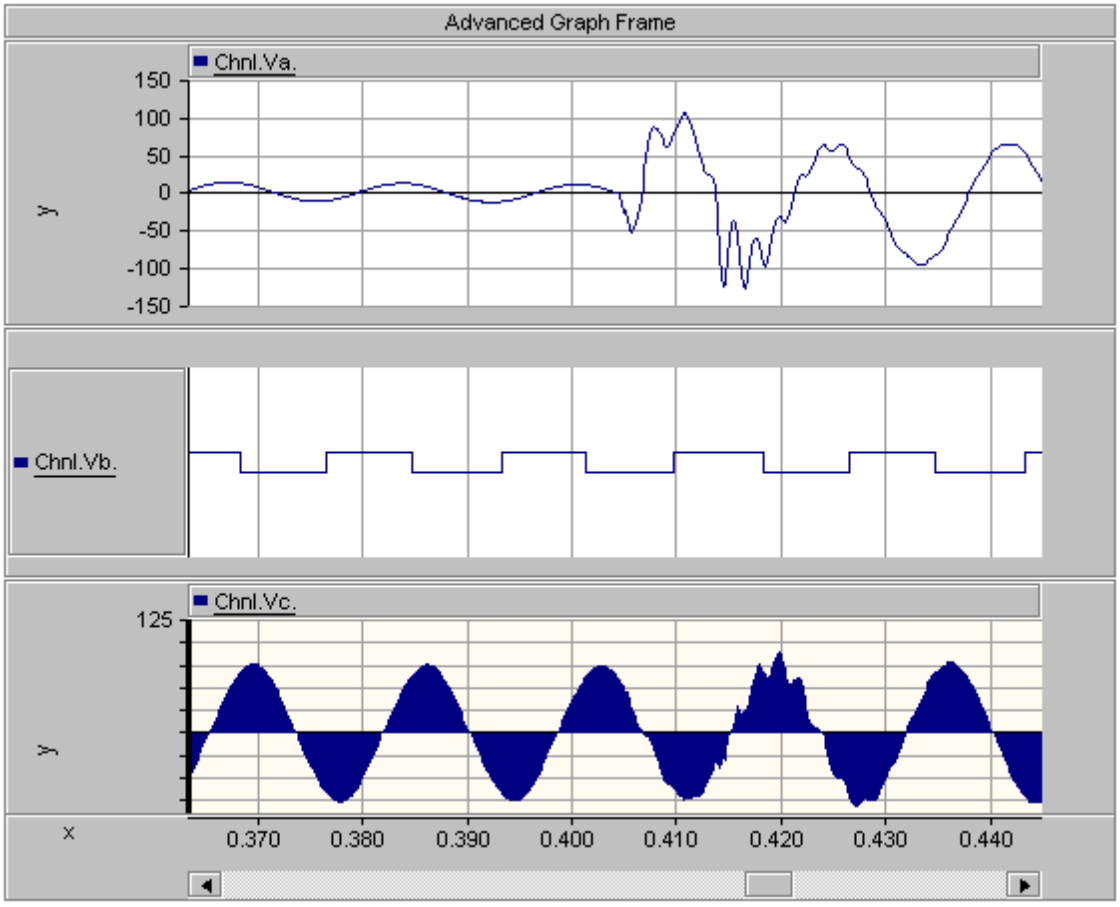

Figure 4.9: Example of a Graph Frame without vertical scrolling.

To create/add a new graph frame without vertical scrolling to the active worksheet in LiveWire:

- From the LiveWire menu, click **Graph** ▸ **Graph Frame** ▸ **Add Graph Frame**, or click the  button from the toolbar.

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4.4.2 How to Create a Graph Frame with Vertical Scrolling

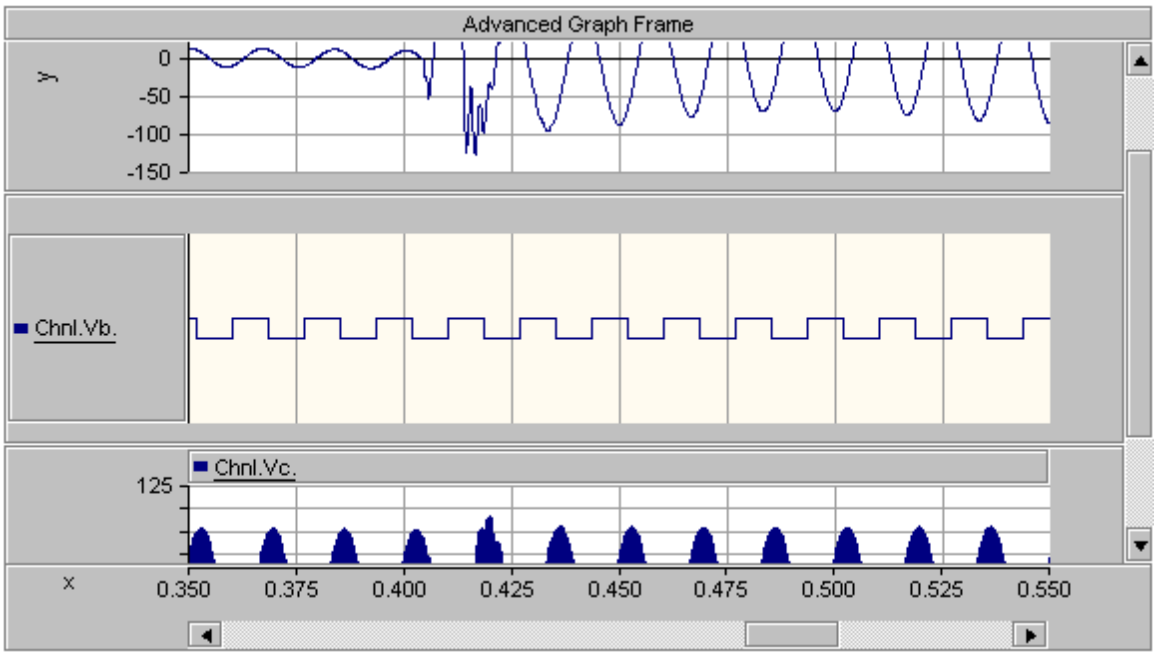

Figure 4.10: Example of a Graph Frame with vertical scrolling.

To create/add a new graph frame with vertical scrolling to the active worksheet in LiveWire:

- From the LiveWire menu, click **Graph** ▸ **Graph Frame** ▸ **Add Graph Frame with Vertical Scroll**, or click the  button from the toolbar.

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4.5 Graph Features

The graphs have many features available to the user; the following outlines only a few of the more important features. All of the features within the graphs can be accessed by the property dialogs or from the pop-up menus.

4.5.1 How to Zoom Data

There are many different ways to zoom in and out of data within the graphs. The following demonstrates many of the most common ways.

General Zoom In

- Select a desired graph by clicking on its plot area. From the surface of the graph, right-click to generate a pop-up menu. From the pop-up menu click **Zoom ▸ Zoom In**, or press the "**+**" key.

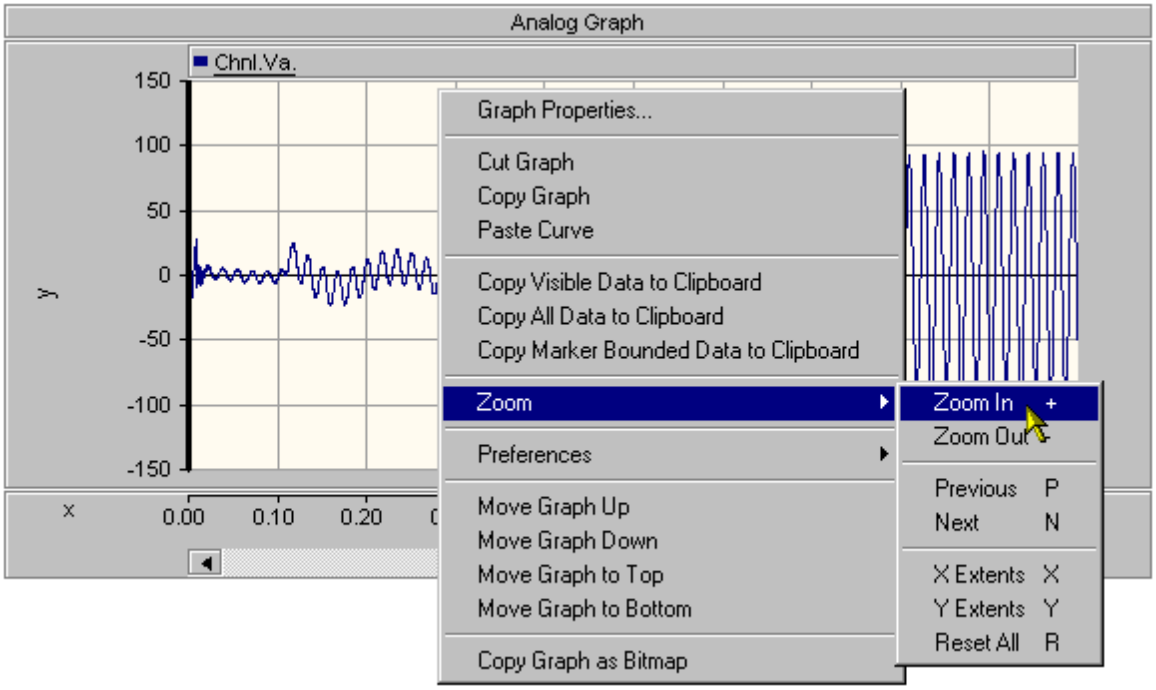

Figure 4.11: Example of zooming in on a graph.

General Zoom Out

- Select a desired graph by clicking on its plot area. From the surface of the graph, right-click to generate a pop-up menu. From the pop-up menu click **Zoom ▸ Zoom Out**, or press the "**-**" key.

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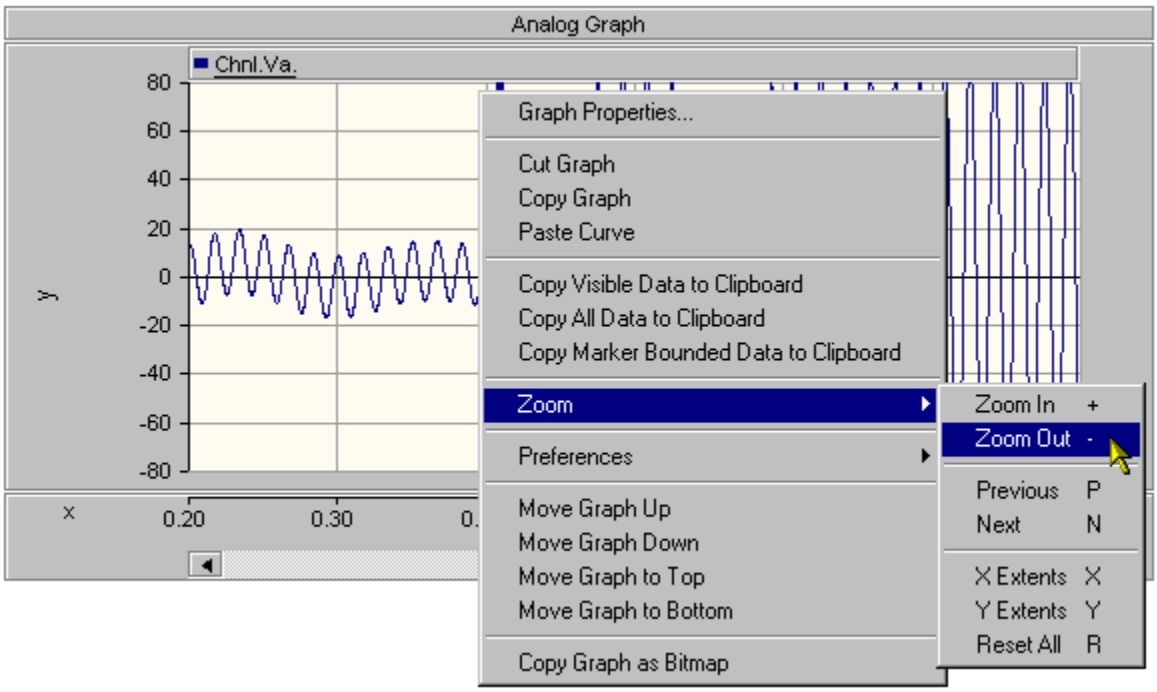

Figure 4.12: Example of zooming out on a graph.

Box Zoom

- Select a desired graph by clicking on its plot area. From the surface of the graph, drag a box region over the desired area you would like to zoom.

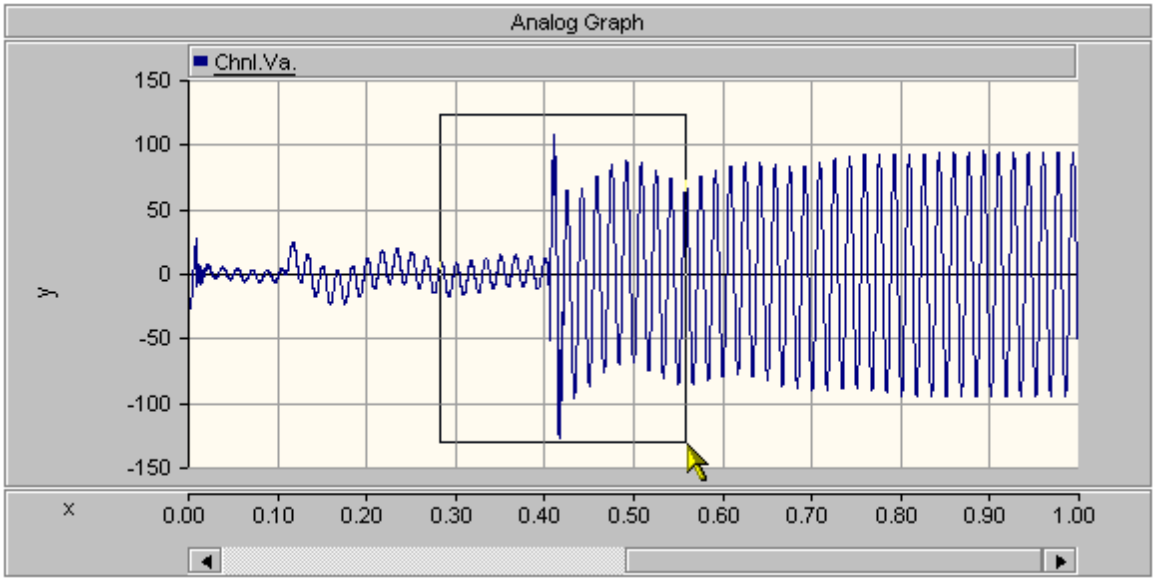

Figure 4.13: Example of box zooming on a graph.

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Vertical Zoom

- Select a desired graph by clicking on its plot area. From the surface of the graph, with the **Shift** key pressed, drag a region over the desired area you would like to zoom.

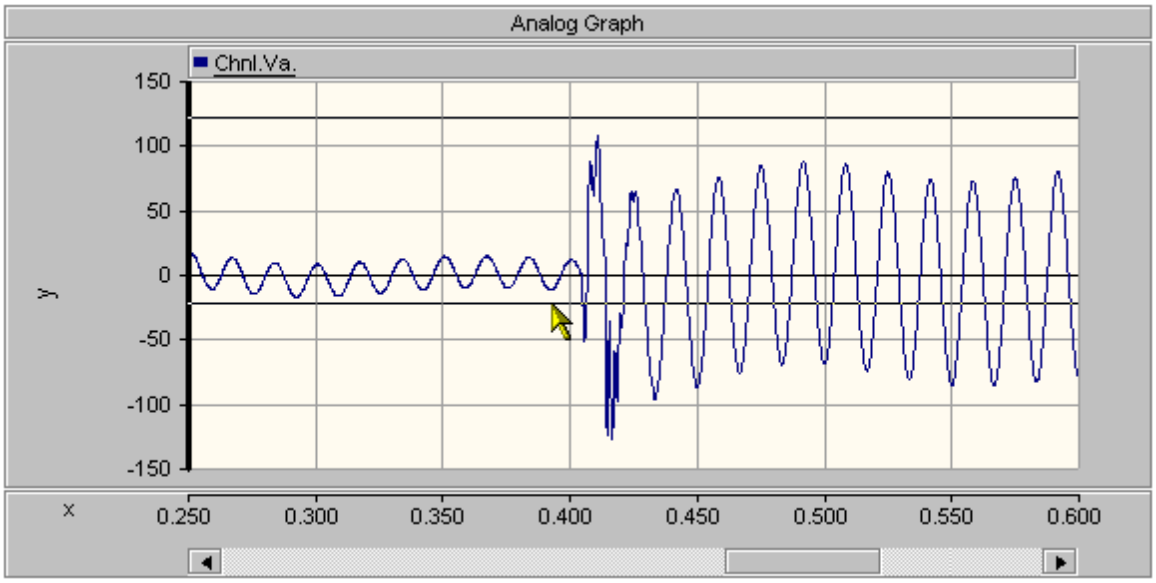

Figure 4.14: Example of vertical zooming on a graph.

Horizontal Zoom

- Select a desired graph by clicking on its plot area. From the surface of the graph, with the **Ctrl** key pressed, drag a region over the desired area you would like to zoom.

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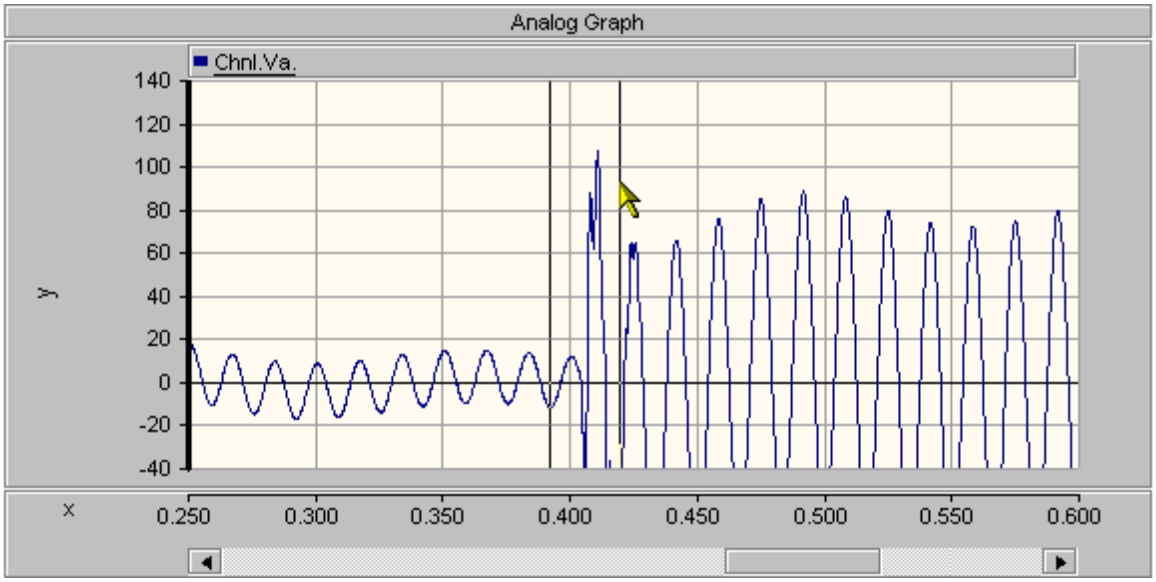

Figure 4.15: Example of horizontal zooming on a graph.

Undo Zoom

- Select a desired graph by clicking on its plot area. From the surface of the graph, right-click to generate a pop-up menu. From the pop-up menu click **Zoom** ▸ **Previous**, or press the "**P**" key.

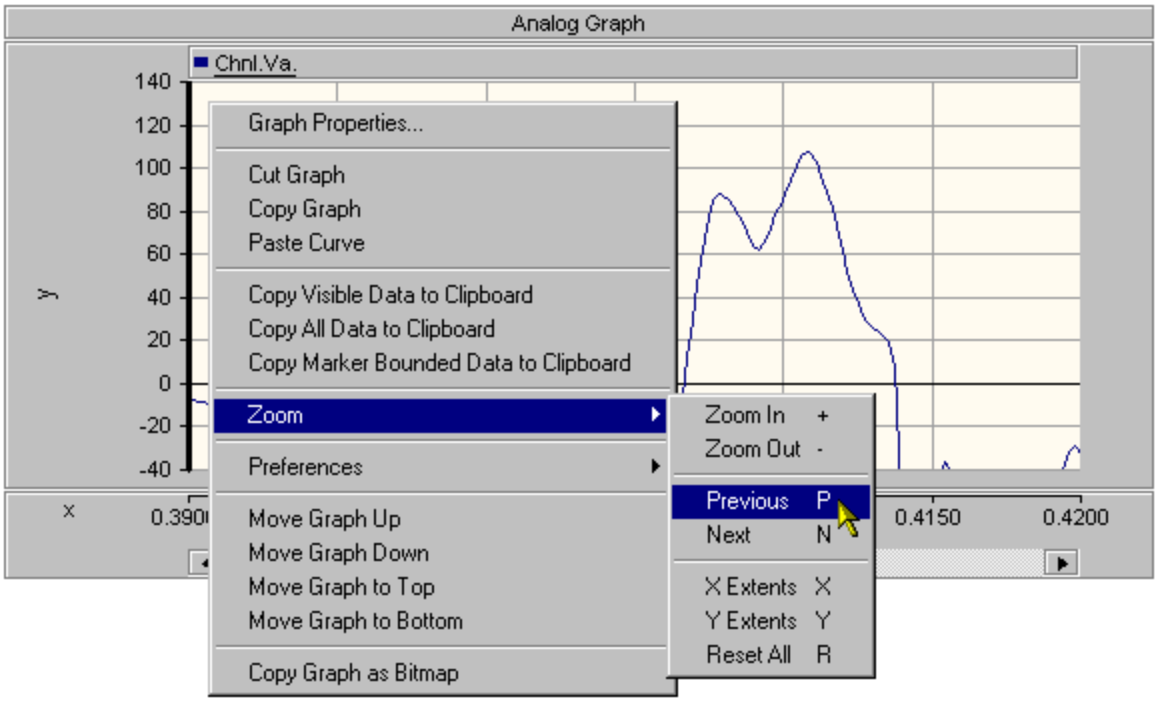

Figure 4.16 Example of undoing zoom on a graph.

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Redo Zoom

- Select a desired graph by clicking on its plot area. From the surface of the graph, right-click to generate a pop-up menu. From the pop-up menu click **Zoom** ▸ **Next**, or press the "**N**" key.

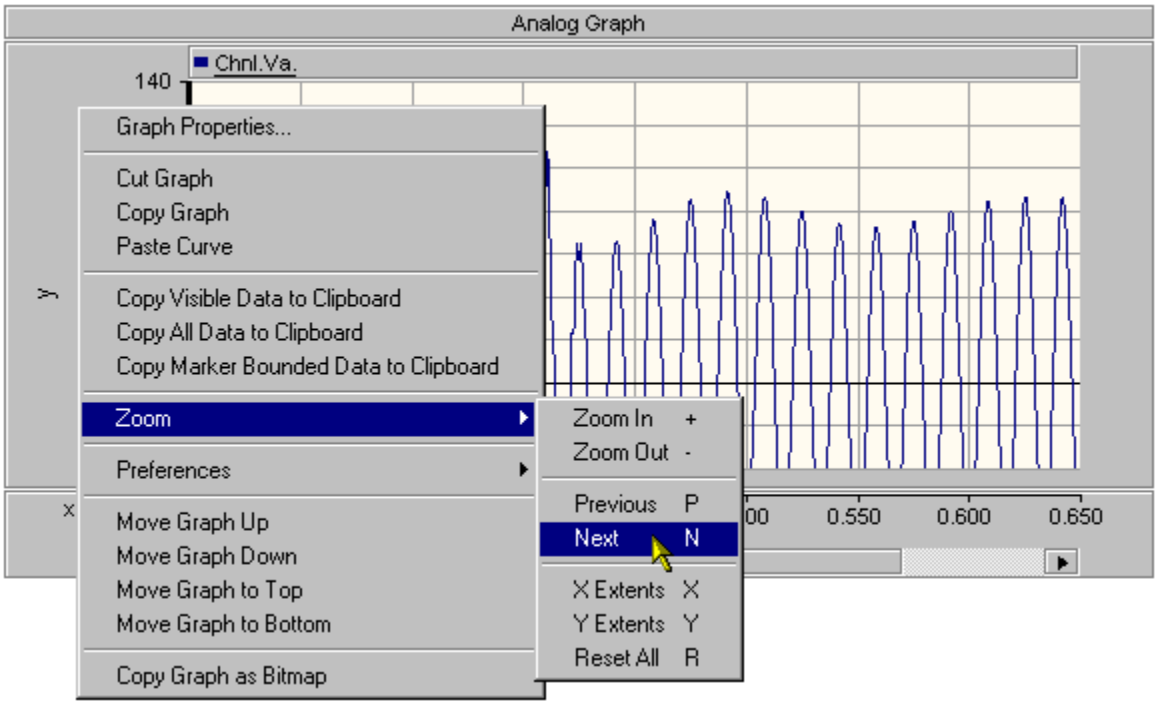

Figure 4.17: Example of redoing zoom on a graph.

Reset Extents

- Select a desired graph by clicking on its plot area. From the surface of the graph, right-click to generate a pop-up menu. From the pop-up menu click **Zoom** ▸ **Reset All**, or press the "**R**" key.

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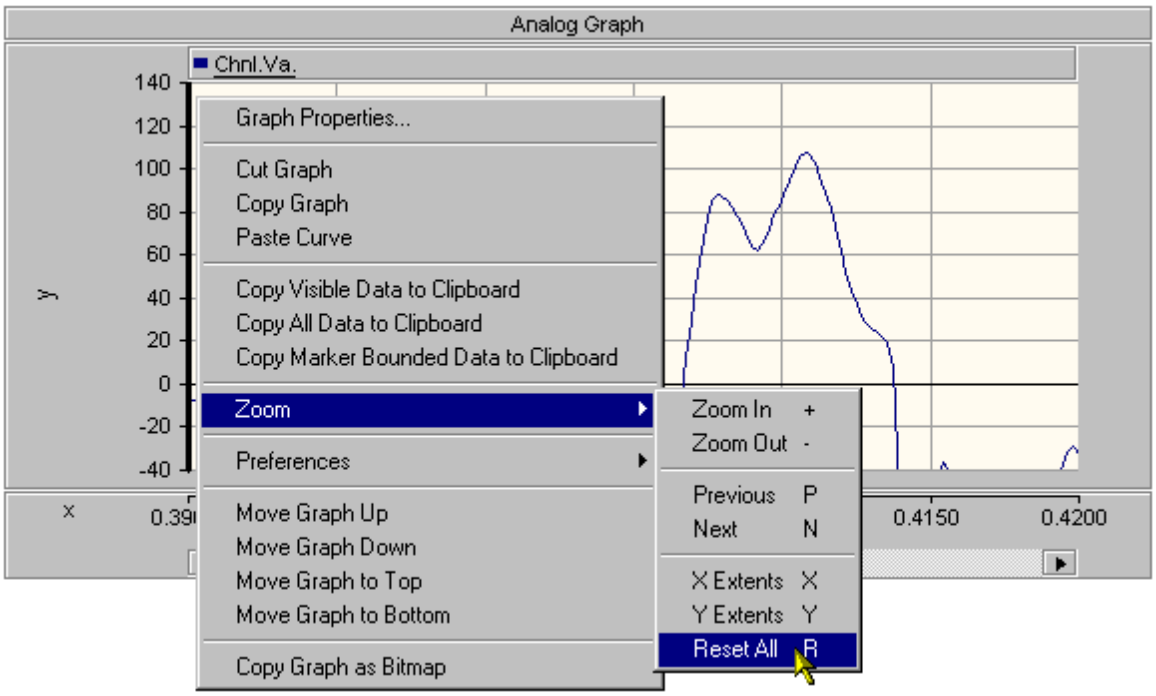

Figure 4.18: Example of resetting the overall extents of a graph.

Reset Vertical Extents

- Select a desired graph by clicking on its plot area. From the surface of the graph, right-click to generate a pop-up menu. From the pop-up menu click **Zoom ▸ Y Extents**, or press the "**Y**" key.

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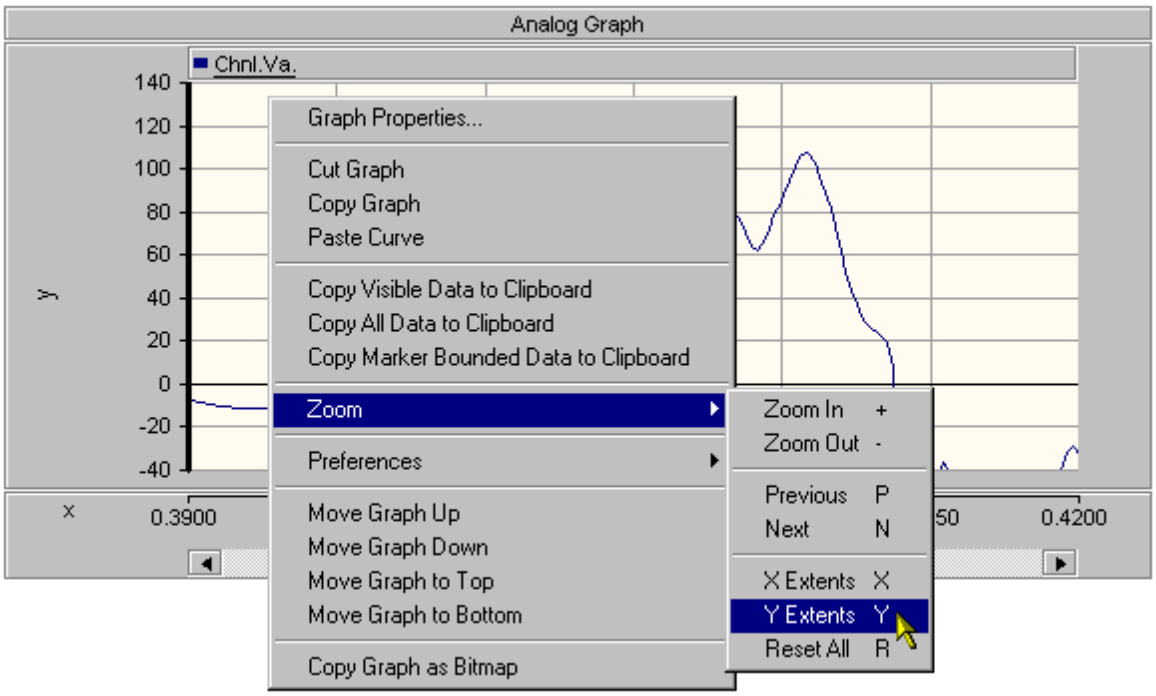

Figure 4.19: Example of resetting the vertical extents of a graph.

Reset Horizontal Extents

- Select a desired graph by clicking on its plot area. From the surface of the graph, right-click to generate a pop-up menu. From the pop-up menu click **Zoom ▸ X Extents**, or press the "**X**" key.

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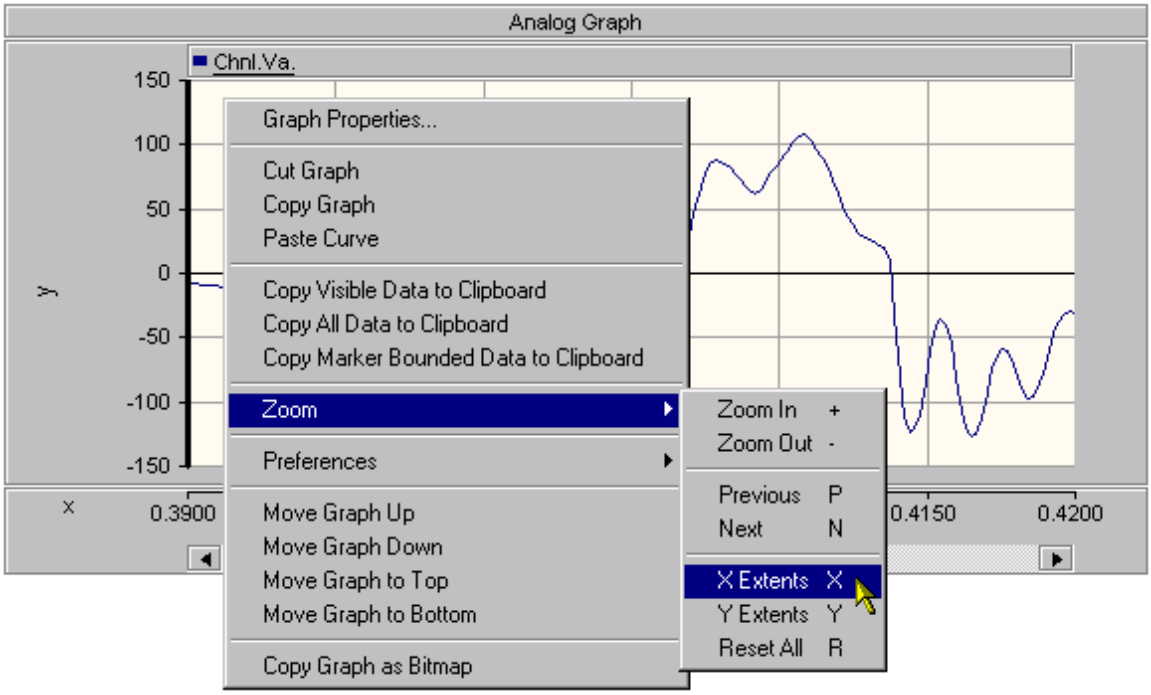

Figure 4.20: Example of resetting the horizontal extents of a graph.

4.5.2 How to Use Markers

The markers that are included in the advanced graphs provide users with extra information about the data and assist them in simple analyses.

Enabling/Disabling Markers

There are a couple of ways to enable and/or disable the markers; the two most common ways are as follows:

- From the surface of the graph, right-click to generate a pop-up menu. From the pop-up menu click **Preferences ▸ Show Markers**, or press the "**M**" key.

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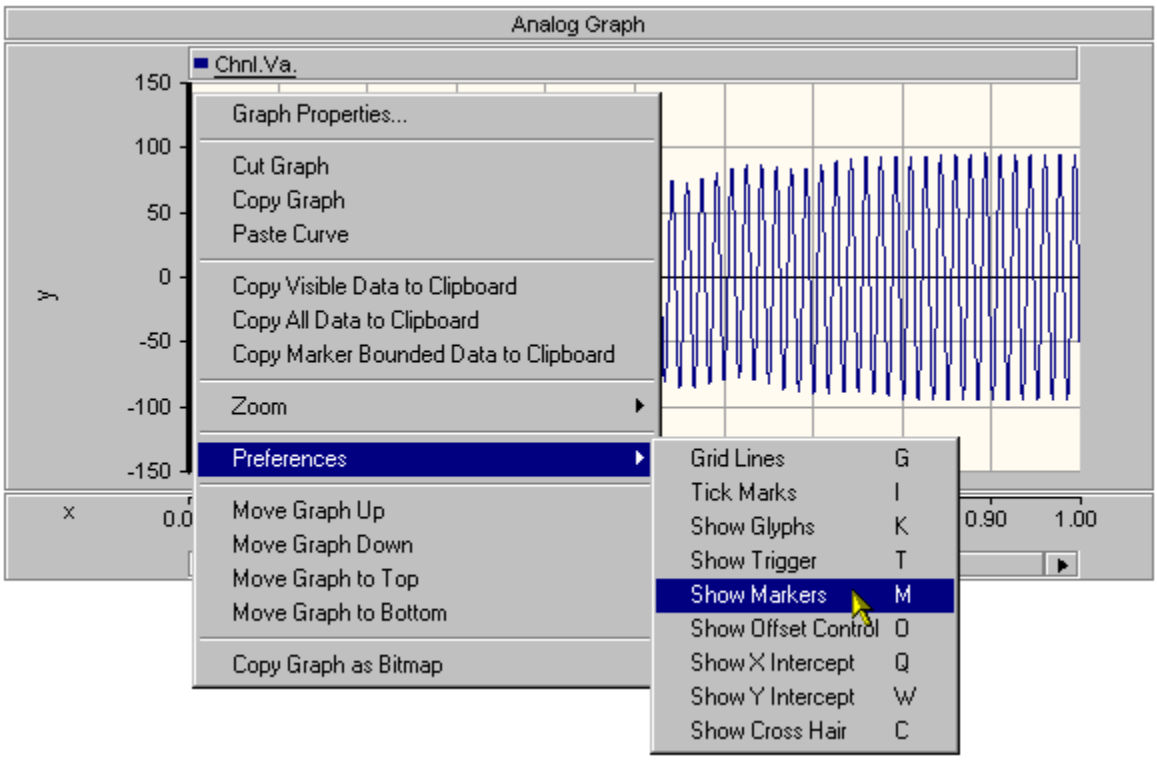

Figure 4.21: Example of enabling the markers on a graph.

Or

- From the surface of the horizontal axis control region, right-click to generate a pop-up menu. From the pop-up menu click **Axis Properties**. From the axis properties dialog box, check the **Show Markers** box.

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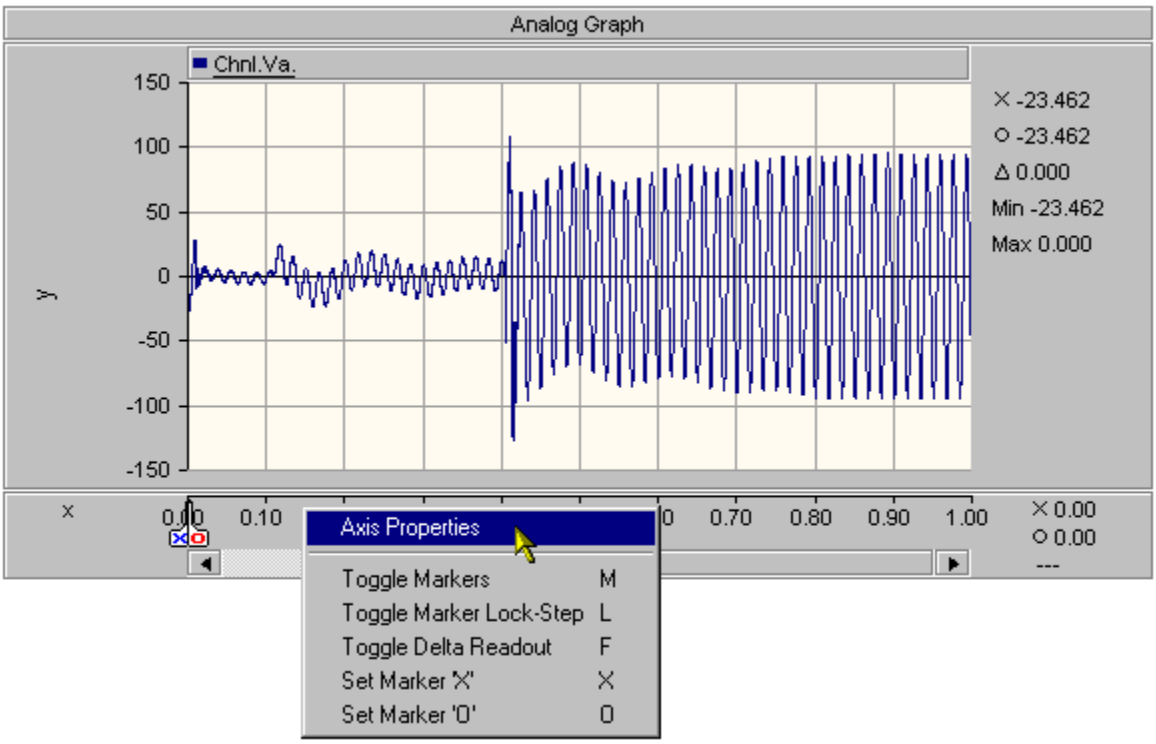

Figure 4.22: Example of enabling the axis properties dialog box.

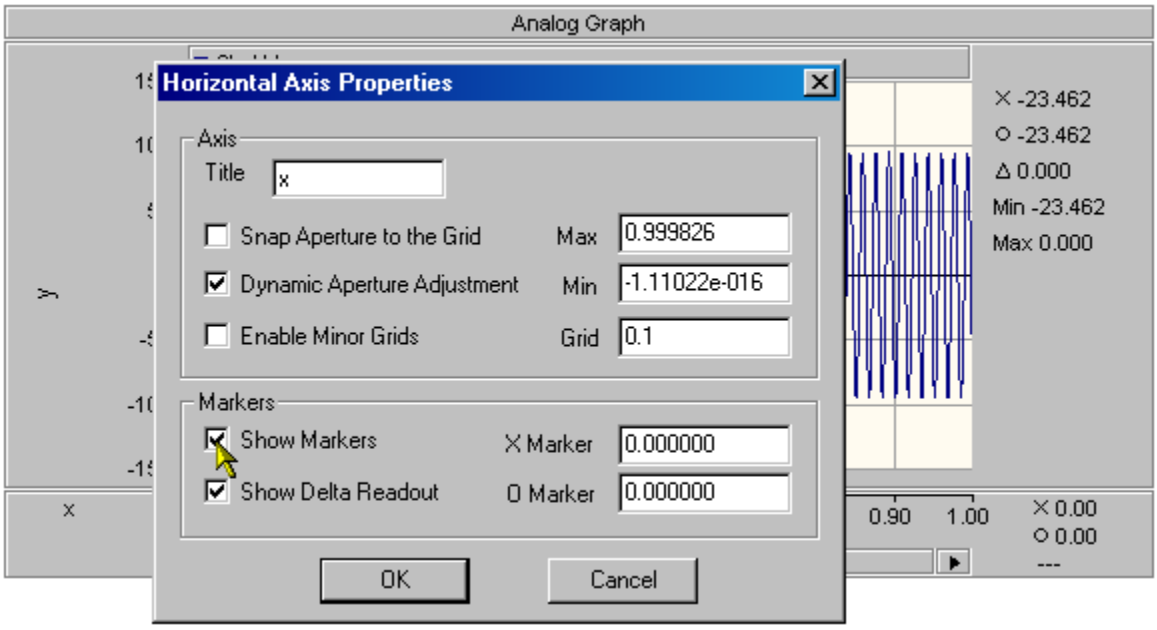

Figure 4.23: Example of enabling the markers on a graph.

Adjusting Markers

There are a couple of ways to adjust the markers; the two most common ways are as follows:

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- Select either one of the markers and drag it to the desired location.

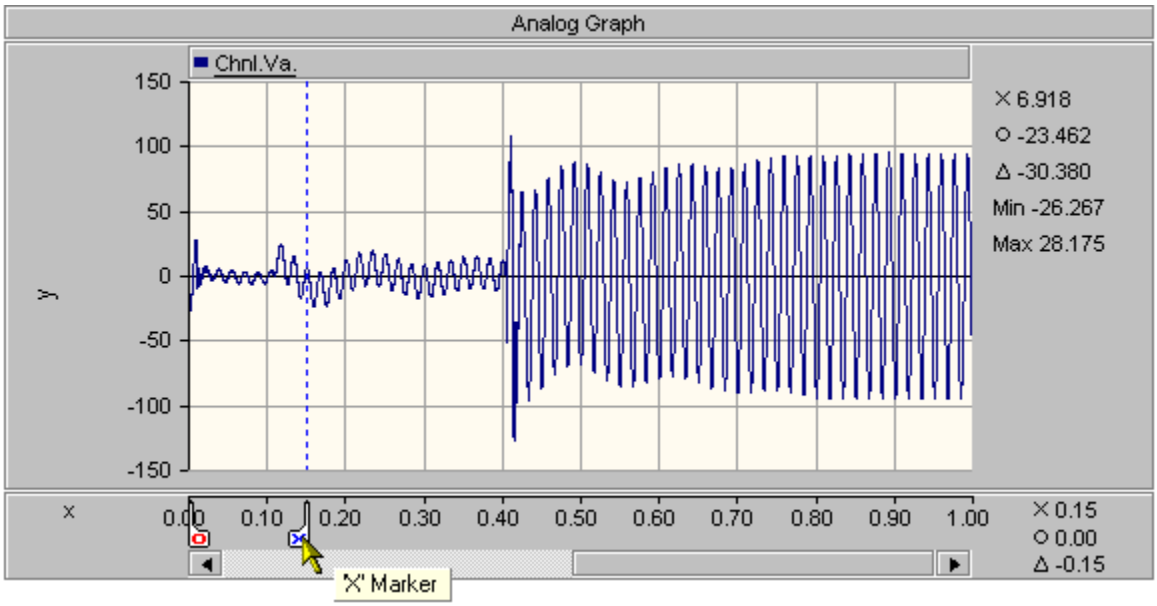

Figure 4.24: Example of dragging the "X" marker on a graph.

Or

- From the surface of the horizontal axis control region, right-click to generate a pop-up menu. From the pop-up menu click **Axis Properties**. From the axis properties dialog box, type the location for each of the associated markers.

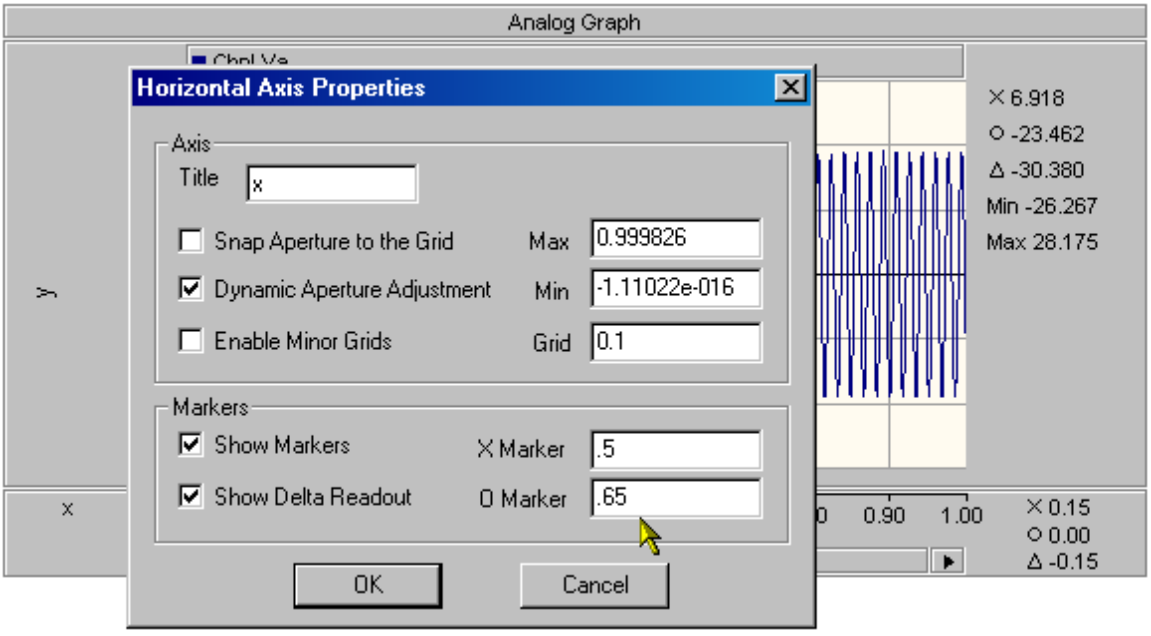

Figure 4.25: Example of setting the location of the markers from the axis properties dialog box.

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Locking/Unlocking Markers

- The horizontal axis control region, right-click to generate a pop-up menu. From the pop-up menu click **Toggle Marker Lock-Step**, or press the "**L**" key.

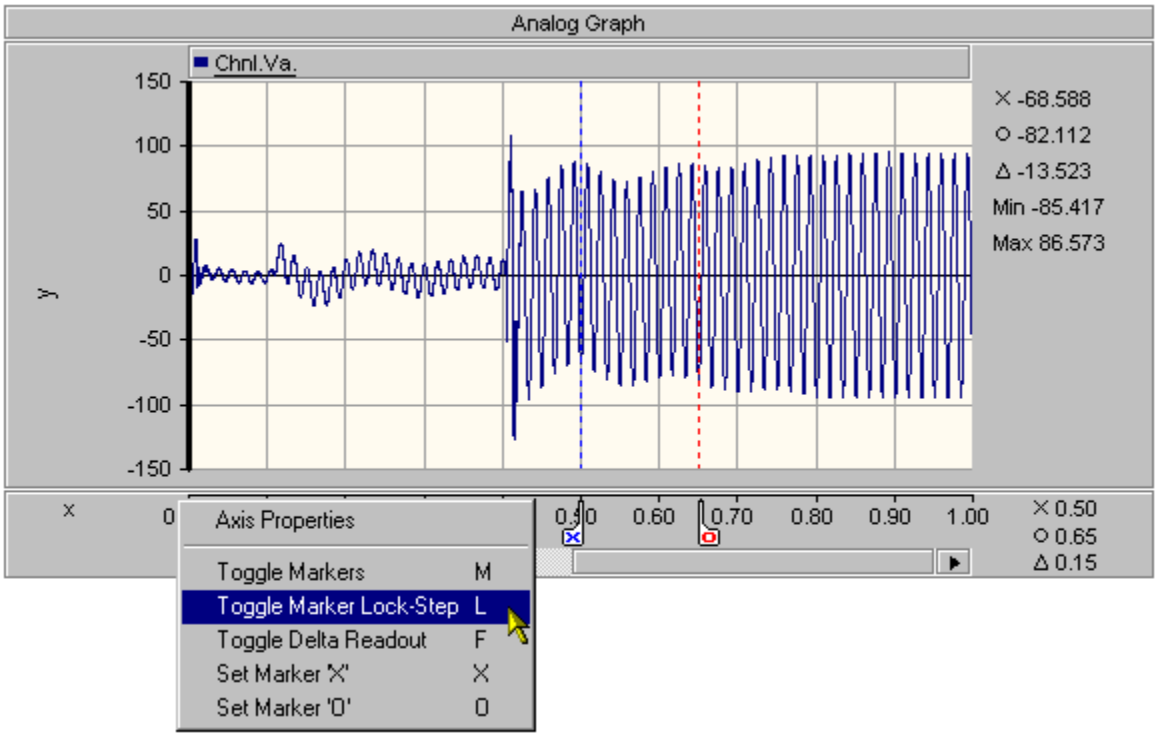

Figure 4.26: Example of locking the markers on a graph.

4.5.3 How to Adjust Axis

Both the vertical and the horizontal axis may be adjusted if the user needs. The methods of doing this are very similar for both the simple and advanced graph. For this example, we will only demonstrate using the more common advanced graph.

Adjust Vertical Axis

- From the graph properties dialog box, type the desired values into the associated Y-Axis fields.

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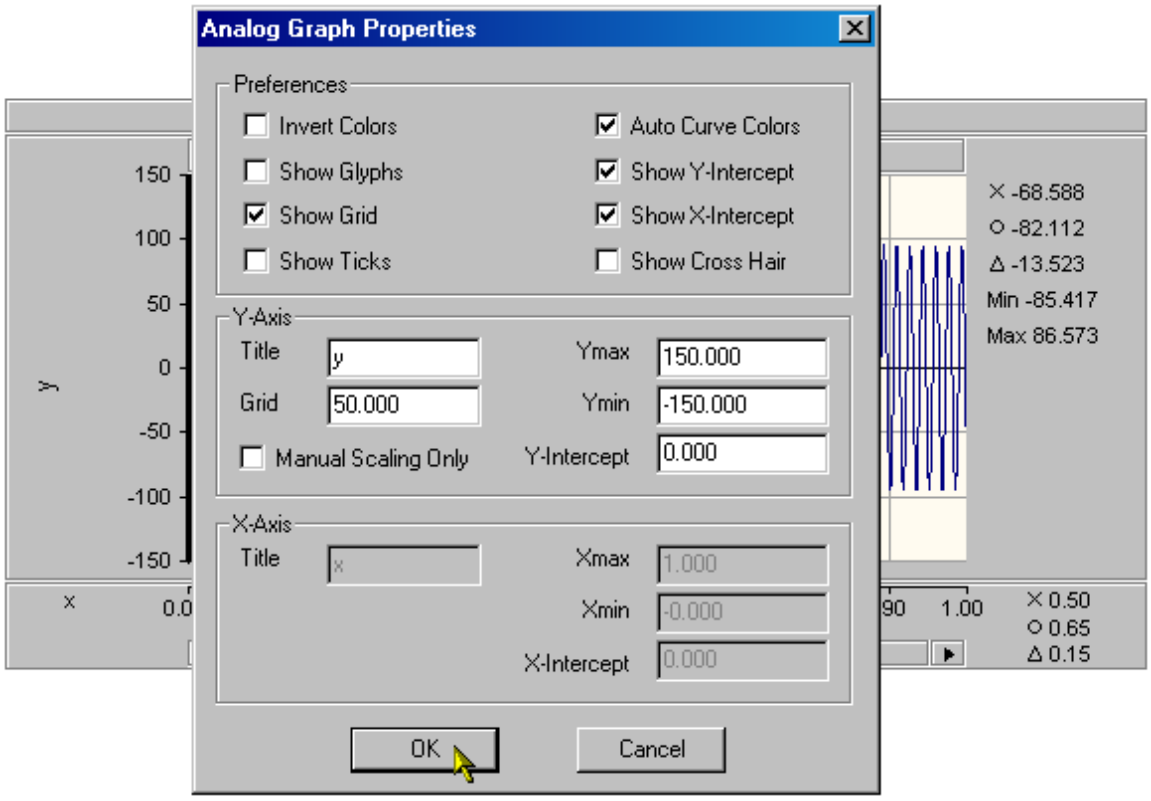

Figure 4.27: Example of the graph properties dialog box.

Adjust Horizontal Axis

- From the axis properties dialog box, type the desired values into the associated Axis fields.

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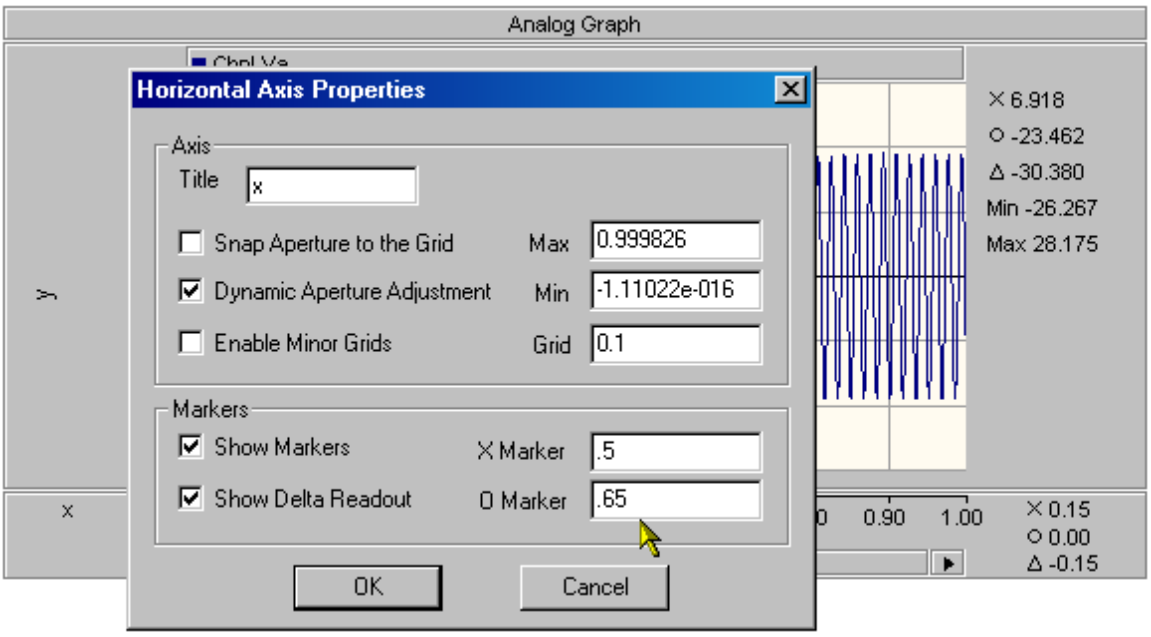

Figure 4.28: Example of the axis properties dialog box.

4.5.4 How to Pan Data

The advanced graphs have a special feature that is very useful to many users, and that is its ability to pan data. This feature allows a user to view data over a precise region and move through the rest with the same conditions.

General Panning

- From the horizontal axis control region, using the slider, move through the data.

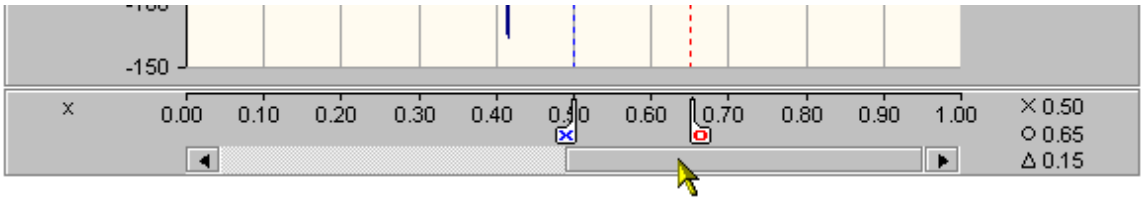

Figure 4.29: Example of panning the data within a graph.

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Adjustable Aperture

The aperture can be adjusted "on the fly" using the mouse and panning slider control. For those of you who don't understand the purpose of this aperture control, you can think of it as an adjustable window that allows the user to view data over a specified time quantity.

- From the horizontal axis control region, move the mouse pointer near the edge of the slider control. The mouse pointer will change when the adjustable aperture is active. Left click and drag the mouse to change aperture size.

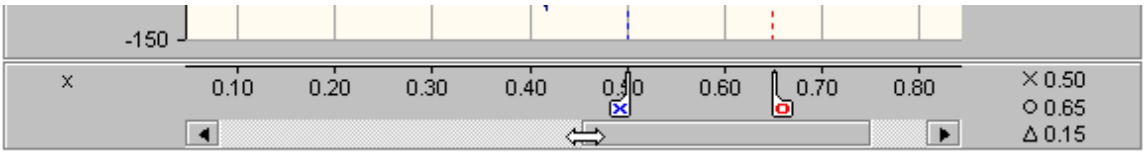

Figure 4.30: Example of the adjustable aperture.

Focus Region Around Markers

There may be times when any one of the markers has moved outside the visible region. To bring that marker back into focus:

- Click on the indicator (arrows below the axis), which advises the user that a particular marker is outside the visible region.

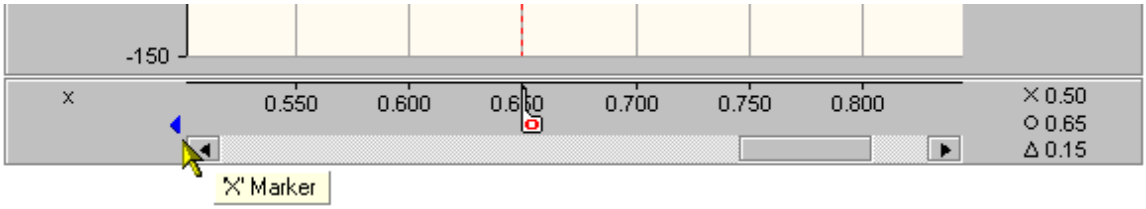

Figure 4.31: Example of the indicator used to advise the user that a particular marker is outside the visible region.

4.5.5 How to Offset Active Curves

Once a desired curve is active (selected), it may be offset dynamically with the use of the offset control.

Enable/Disable Offset Control

- From the surface of the graph, right-click to generate a pop-up menu. From the pop-up menu click **Preferences ▸ Show Offset Control**, or press the "**O**" key.

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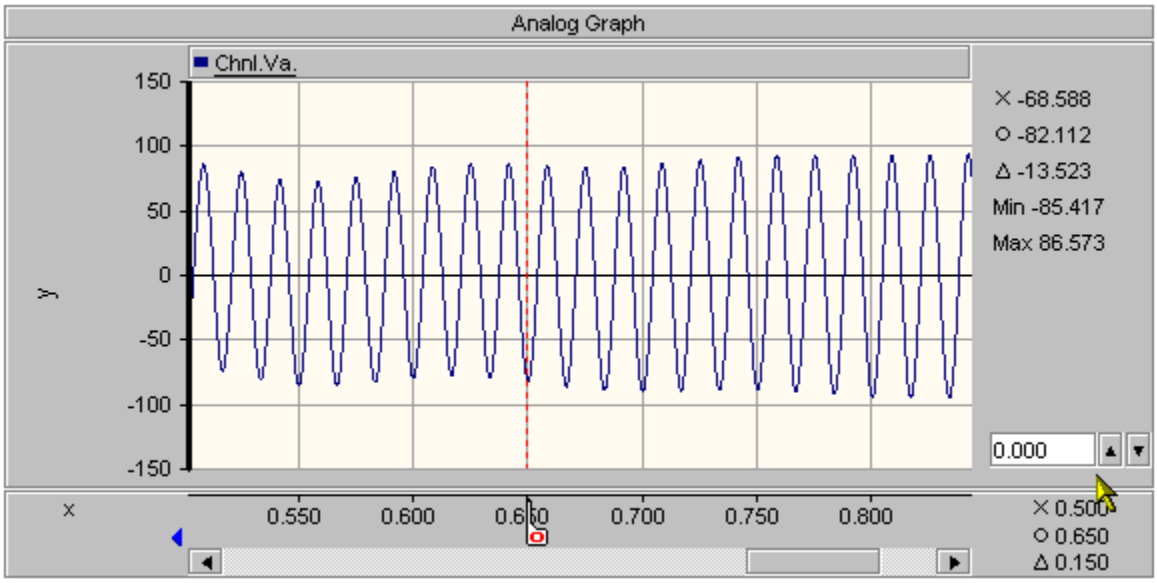
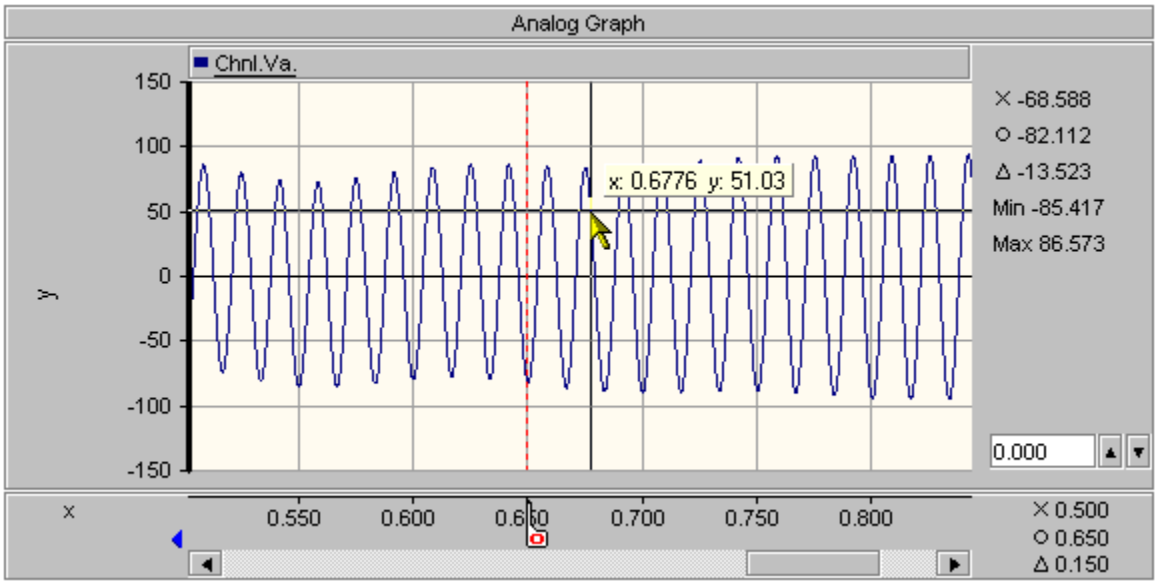


Figure 4.32: Example of the offset control within a graph.

4.5.6 How to use the Cross Hairs

The crosshairs that are included in all of the graphs and plots provide the user with information about the data on a point-by-point basis.



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Enabling/Disabling the Cross Hairs

There are a couple of ways to enable and/or disable the crosshairs; the two most common ways are as follows:

- From the surface of the graph, right-click to generate a pop-up menu. From the pop-up menu click **Preferences ▸ Show Cross Hair**, or press the "**C**" key.

Or

- From the surface of the graph, right-click to generate a pop-up menu. From the pop-up menu click **Graph Properties**. From the graph properties dialog box, check the **Show Cross Hair** box.

Toggle Cross Hair Mode

The cross hair feature in the graphs has two modes of operation. The default mode snaps the cross hair to the data points and provides the user with point-by-point information. The other mode doesn't snap the cross hair to the data, but rather provides the user with general coordinate information relating to the graph.

4.5.7 How to Set General Display Preferences

Like many of the components within LiveWire, the user can adjust their displays to suit their needs.

Set Display Preferences

- From the surface of the graph, right-click to generate a pop-up menu. From the pop-up menu click **Properties**. From the properties dialog box, select the preferences desired.

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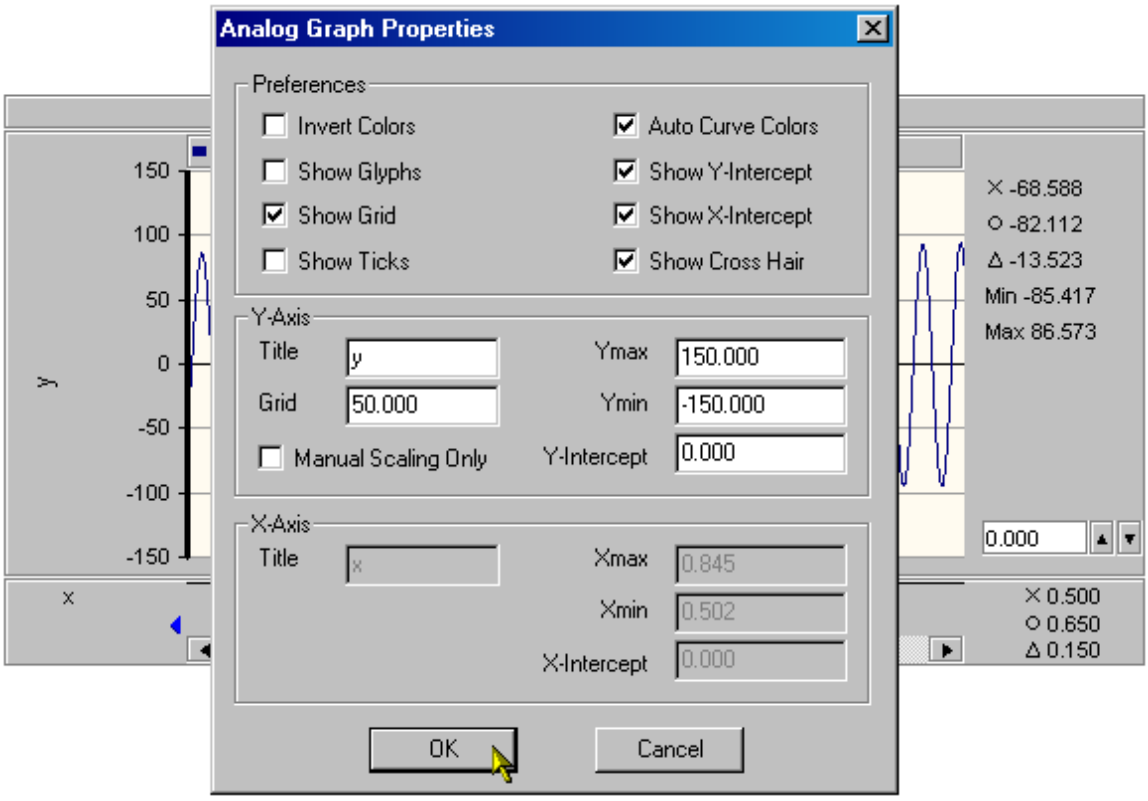


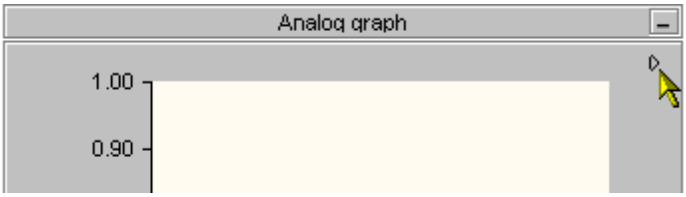
Figure 4.33: Another example of the graph properties dialog box.

Note: Many of these preferences can also be set using the pop-up menus and/or the keyboard shortcuts.

4.5.8 Graph Toolbar

Tool bar

The tool bar itself is like a menu but is activated via a button placed on the graph.



When activated, the toolbar will slide outward and away from the graph.

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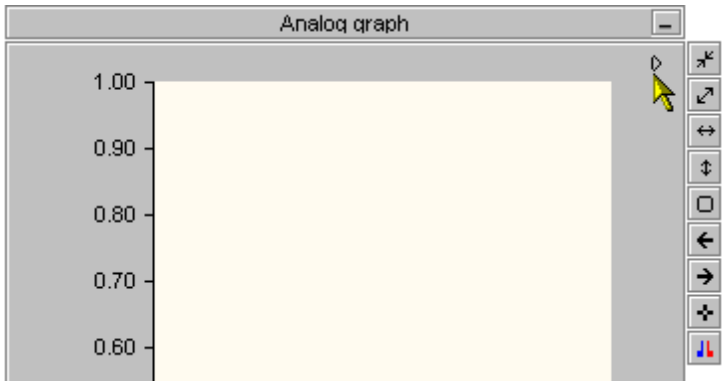
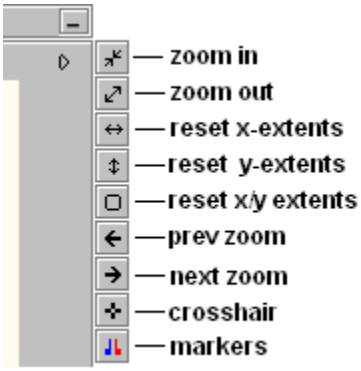


As you can see from the above illustration, the toolbar is comprised of a row of buttons each corresponding to a different commonly used graphs property.



By pressing a desired button on the toolbar, the associated property in the graph is invoked. Upon releasing the button, the toolbar will close, mimicking the behaviour of a menu.

4.5.9 Manual Graph Sizing

Introduction

Graphs in LiveWire automatically adjust to "best fit" its frame. This feature can be turned off to allow the user to manually define the size.

Shut Off Auto Sizing

Auto sizing can be turned off through the properties of the graph frame. **Right click** on the graph frame and select **Frame Properties** from the menu. In the dialog that opens, toggle the auto sizing option.

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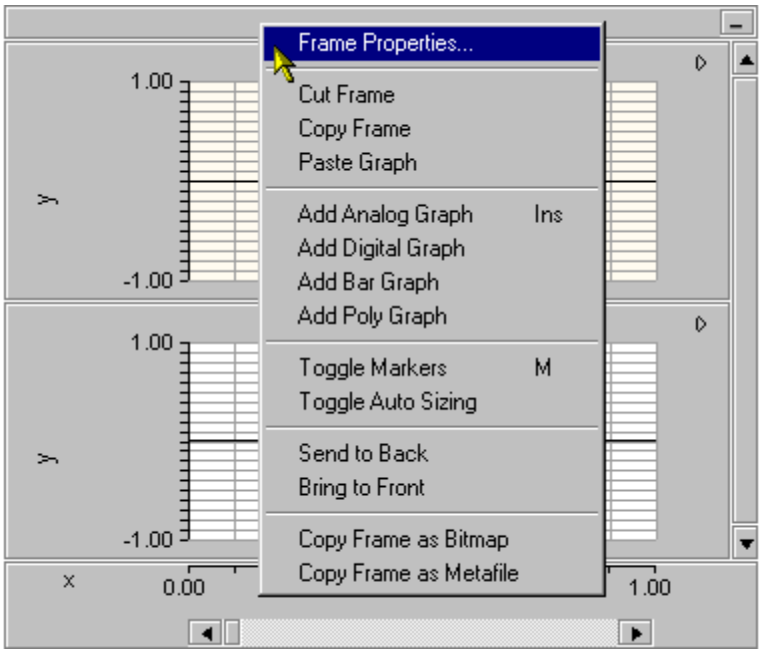

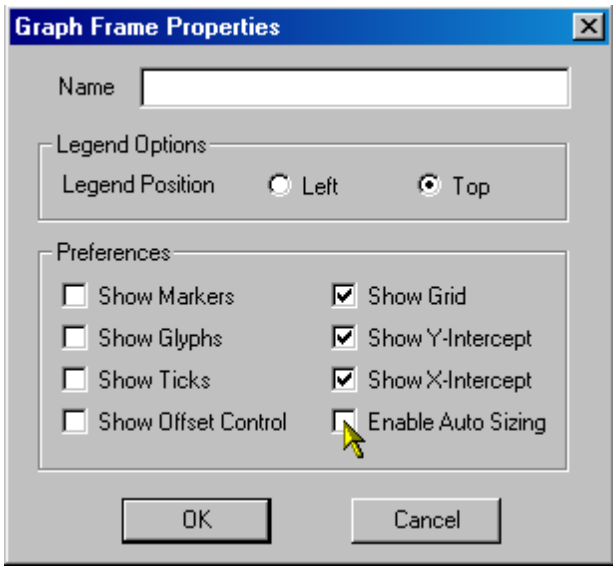

Using the Keyboard to Adjust the Graph

Using the mouse, click one of the graphs in the frame to bring it into focus. For course adjustments, hold down the **CTRL** key and press the **Arrow up/down** keys to change the size. For fine adjustments, hold down the **ALT** key and press the **Arrow up/down** keys to change the size.

Using the Properties Dialog to Explicitly Set a Size

Right click on the graph and select **Graph Properties** from the menu. Within the dialog that opens, there is an editable field where a specific size for the graph can be entered.

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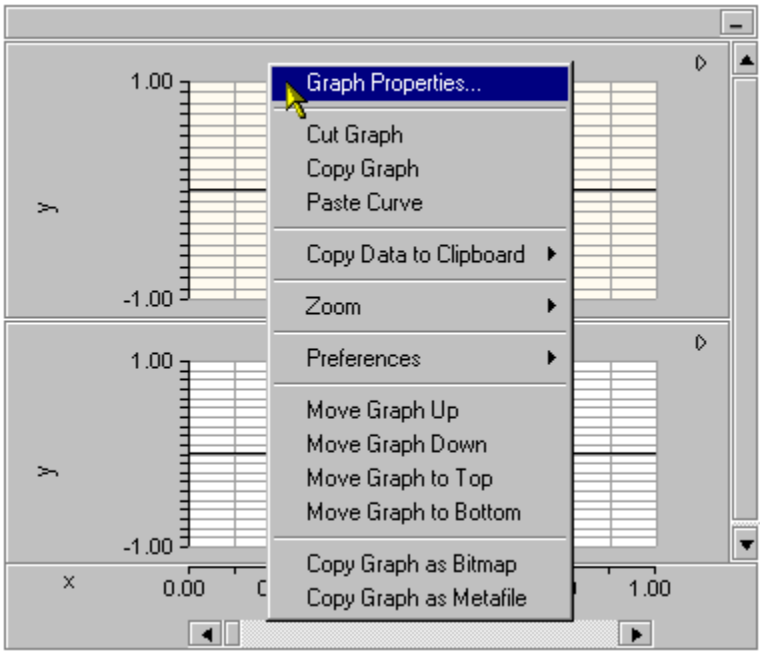

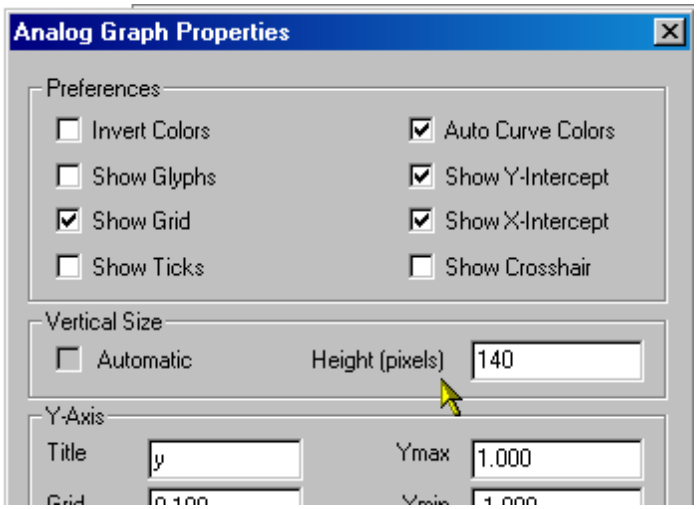

4.6 Plot Features

Like the graphs, the plots also have many features available to the user. In general though, most of the features outlined in the previous section hold true for this component as well. And like the graphs, all of the features within the plots can be accessed by the property dialogs or from the pop-up menus. The following will only demonstrate additional and/or unique features contained within this component.

4.6.1 How to Zoom Data

The plot can zoom in and out of data exactly the same way as the graphs, the only difference is the additional control included in the plots, which may assist users.

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To use the zoom control:

- Select the slider on the right side of the plot region. Adjust it to the desired zoom level.

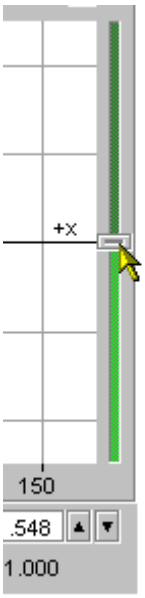

Figure 4.34: Example of the zoom control.

Enabling/Disabling the Aspect Ratio

By default the plots maintain an aspect ratio of 1:1. The following may disable this feature:

- From the surface of the plot, right-click to generate a pop-up menu. From the pop-up menu click **Plot Properties**. From the plot properties dialog box, uncheck the **Maintain Aspect Ratio** box.

4.6.2 How to Use Markers

The markers that are included in the plots are slightly different then the ones included in the advanced graphs with regard to their use, but still provide users with extra information about the data and assist them in simple analyses.

Adjusting Markers

There are a couple of ways to adjust the markers; the two most common ways are as follows:

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- Select either one of the markers and drag it to the desired location.

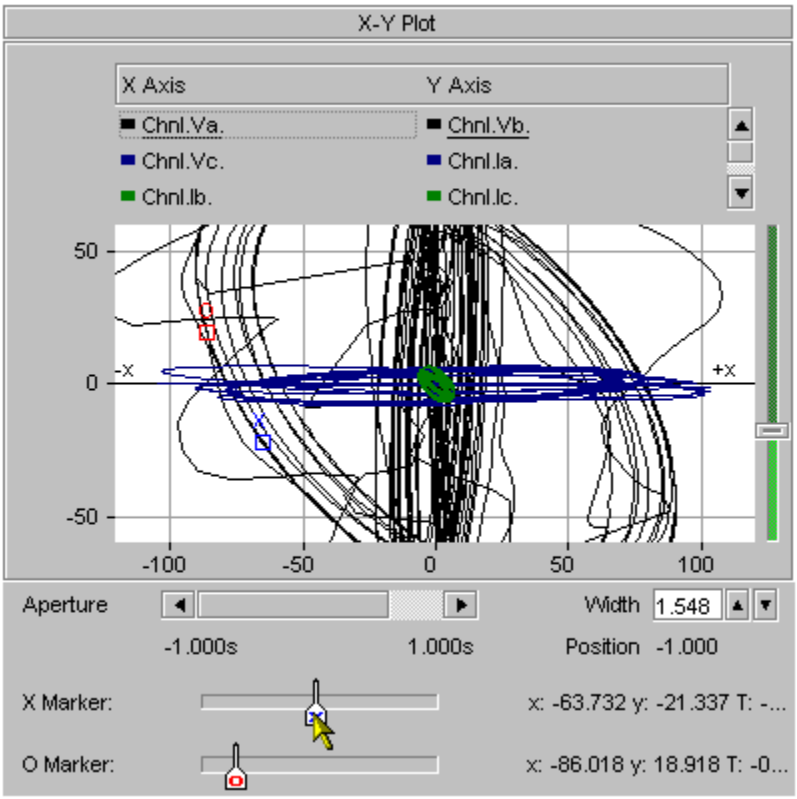

Figure 4.35: Example of dragging the markers on a graph.

Or

- From the surface of the plot region, right-click to generate a pop-up menu. From the pop-up menu click **Plot Properties**. From the plot properties dialog box, type the location for each of the associated markers.

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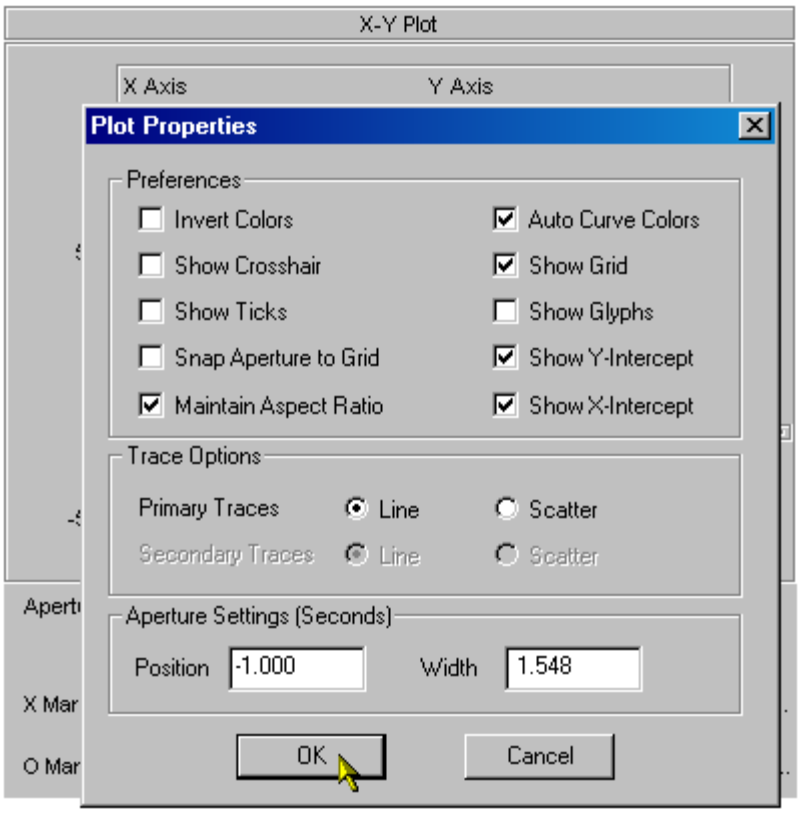

Figure 4.36: Example of setting the location of the markers from the plot properties dialog box.

4.6.3 How to Adjust Trace Options

Within the plots, the user has the option to adjust whether specific traces are displayed as lines and/or scatter points.

To adjust this feature:

- From the plot properties dialog box, select the desired style from the **Trace Options** section.

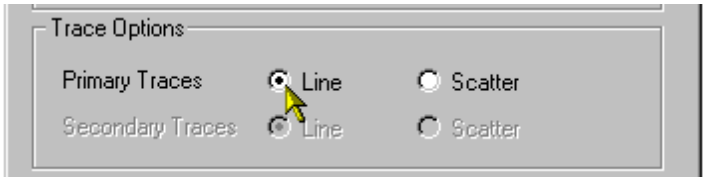

Figure 4.37: Select the desired style for the primary (first) trace and general (all other) traces, from the plot properties dialog.

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4.6.4 How to Pan Data

The plots, similar to the graphs, provide the user with the capability to pan data. Unlike the graphs though, the aperture of the panning control can be manually adjusted. For those of you who don't understand the purpose of this aperture control, you can think of it as an adjustable window that allows the user to view data over a specified time quantity.

General Panning

- From the time domain control region, using the slider, move through the data.

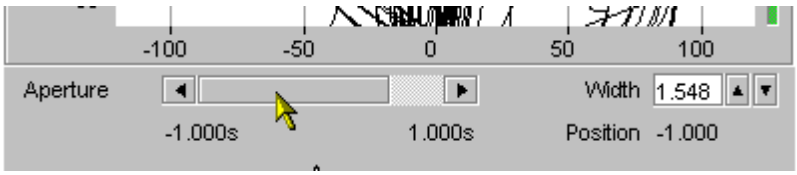

Figure 4.38: Example of panning the data within a plot.

Adjusting Aperture

- From the plot properties dialog box, type desired values into the appropriate fields from the **Aperture Settings** section.

Figure 4.39: Set the desired values for the aperture control from the plot properties dialog.

4.7 Graph Frame Features

In general, the graph frame has a limited number of features. Primarily the frame is only used to contain graphs. However, the following will demonstrate some of the feature, which are available.

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4.7.1 How to Add Graphs

The graph frame provides the user with the capability to directly add new graphs. Meaning, instead of cutting/copying a graph and pasting it into a graph fame, the frame itself can add new graphs.

To add new graphs:

- From the top (header) of the graph frame, right-click to generate a pop-up menu. From the pop-up menu click **Add Analog Graph** to add an analog graph, or any one of the other graphs (digital or bar).

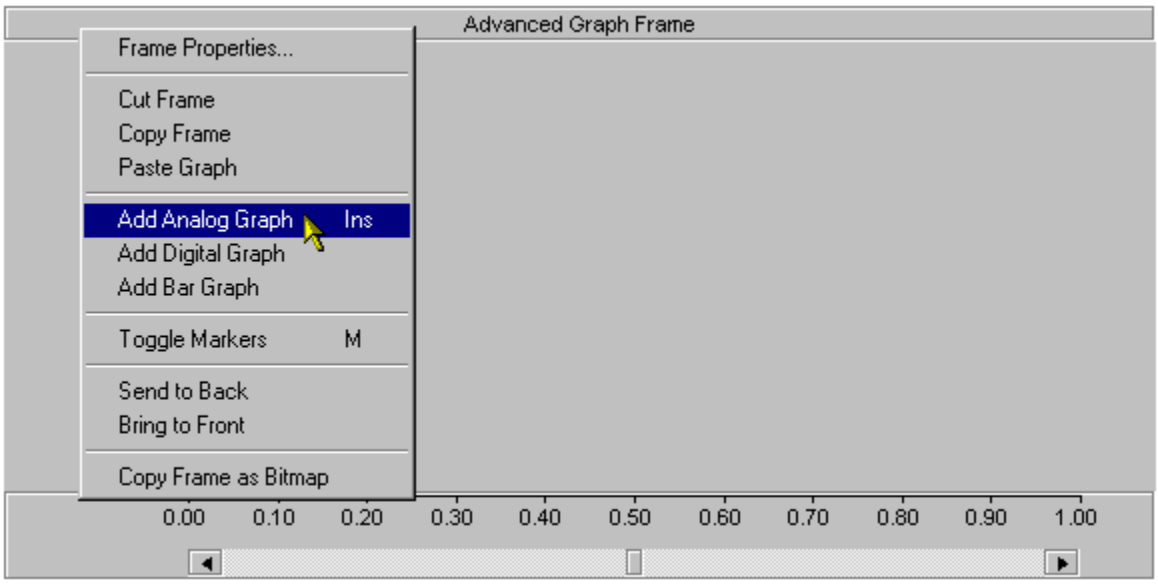

Figure 4.40: Example of adding a new analog graph to a graph frame.

4.7.2 How to Move Graphs within a Graph Frame

There may be a need at some time to move a graph within the graph frame.

To move a graph:

- Select the desired graph from the frame. From the surface of the graph, right-click to generate a pop-up menu. From the pop-up menu click one of the **Move Graph** items.

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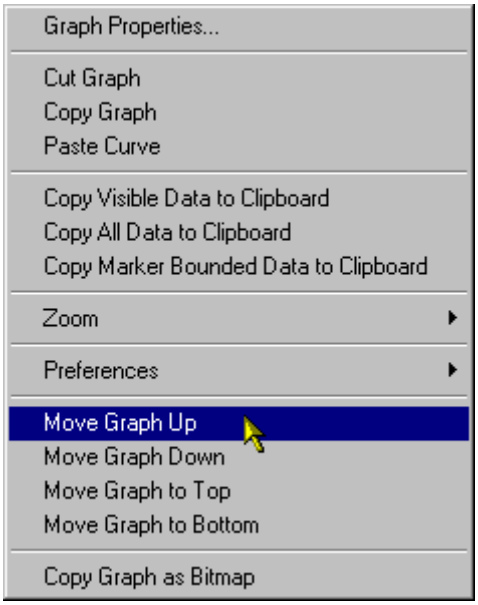
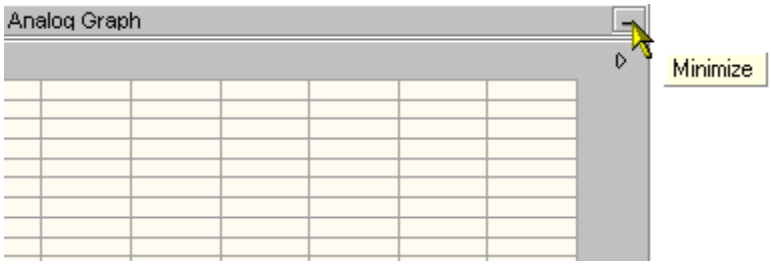


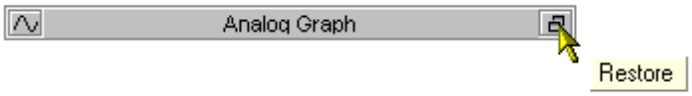
Figure 4.41: Example of moving a graph up one place within a graph frame.

4.7.3 Minimize and Maximize graphs

All graphs in Livewire have the ability to minimize to an icon on the worksheet. This is invoked by pressing on the minimize button on the frame of any graph.



To restore, press the maximize button on the graph icon



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5.0 Harmonic Analysis Component

5.1 Creating Harmonic Components

5.1.1 How to Create a Harmonic Component

The harmonic component is a specialized component, which provides the user with the ability to perform harmonic analysis on various data.

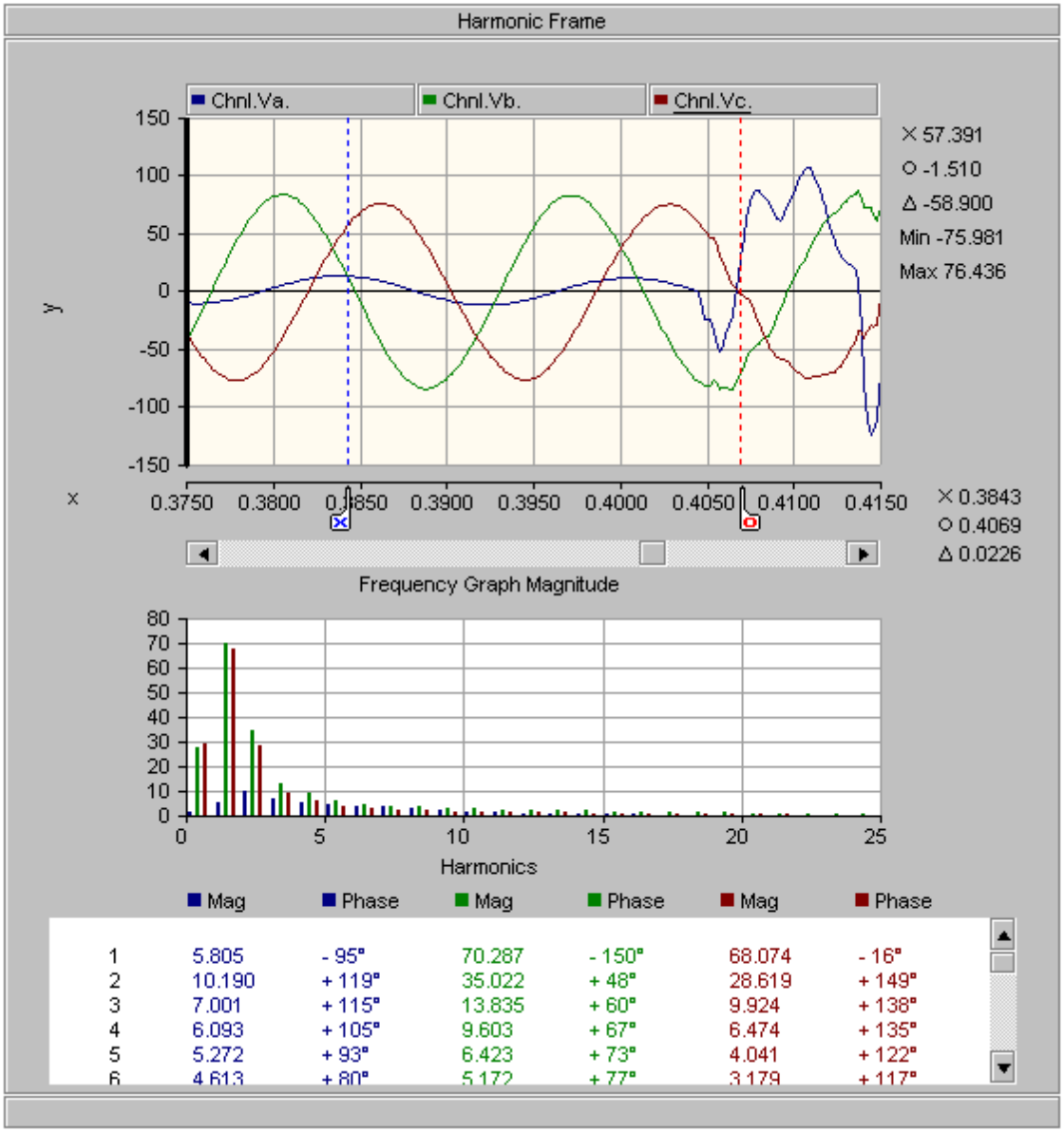

Figure 5.0: Example of a Harmonic Component.

To create/add a new harmonic component to the active worksheet in LiveWire:

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- From the LiveWire menu, click **Graph ▸ Specialized ▸ Add Harmonic Graph Component**, or click the  button from the toolbar.

5.2 Attaching Data to Harmonic Components

For the harmonic component to be useful, you must be able to get the data connected to them. LiveWire provides many different ways to do this. To display or visualize and perform a harmonic analysis on a data set in a graph it must be attached as a curve.

5.2.1 How to Add a Curve to a Graph

To add a curve to a harmonic component in LiveWire:

- From a data set object in the tree view, right-click to generate a pop-up menu. From the pop-up menu click **Copy**.

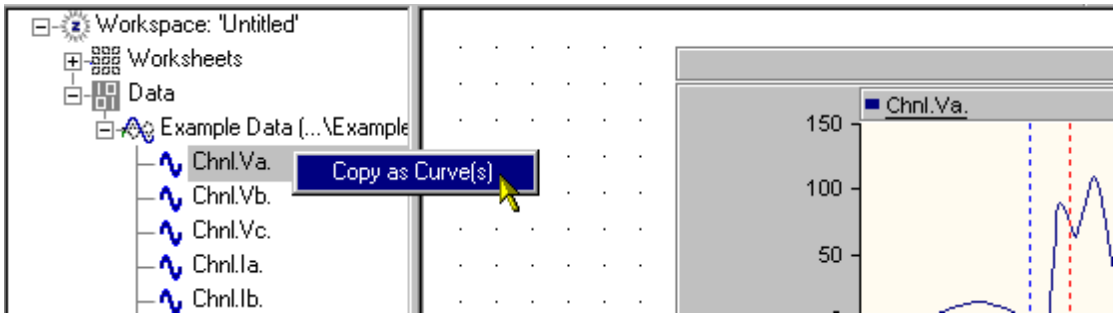

Figure 5.1: Example of creating a curve from the data object in the tree view.

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- From the surface of the graph within a harmonic component, right-click to generate a pop-up menu. From the pop-up menu click **Paste Curve**.

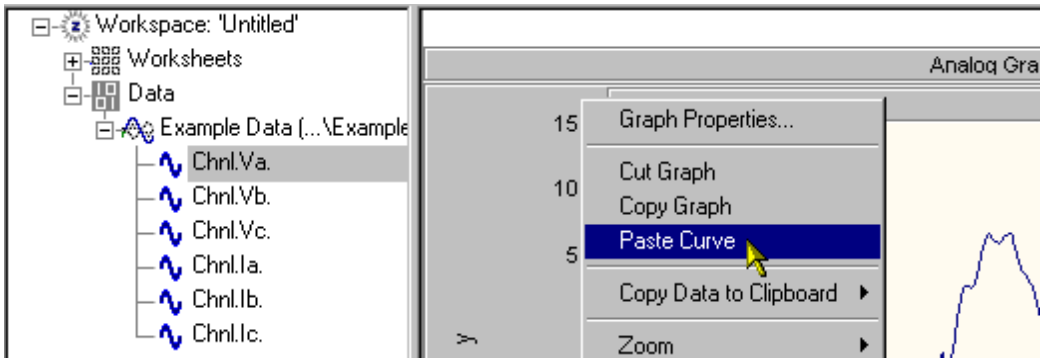

Figure 5.2: Example of pasting a curve into a graph within a harmonic component.

Very similar to the other components in LiveWire, user can drag curves from the tree view and drop them on the graph contained in a harmonic component. This would be similar to creating a curve and then pasting it upon the graph. To perform this task, simply select a curve from the data set object in the tree view, drag it over into the workspace, and drop it on the contained graph.

5.3 Harmonic Component Features

The harmonic component contains a few features, which are not common to the other analysis components within LiveWire. The following covers a couple of the more important ones. Similar to the other analysis components, all of the features can be accessed by the property dialogs or from the pop-up menus.

Note: Features that would usually be contained with the individual components are still that way.

5.3.1 How to Perform Analysis

Initially when a harmonic component is created, no analysis is present. To perform an analysis, there must be at least one curve present and the markers within the graph component must enable. The markers control the analysis, and a DFT (Discrete Fourier Transform) transform is applied to the data contained between the two markers.

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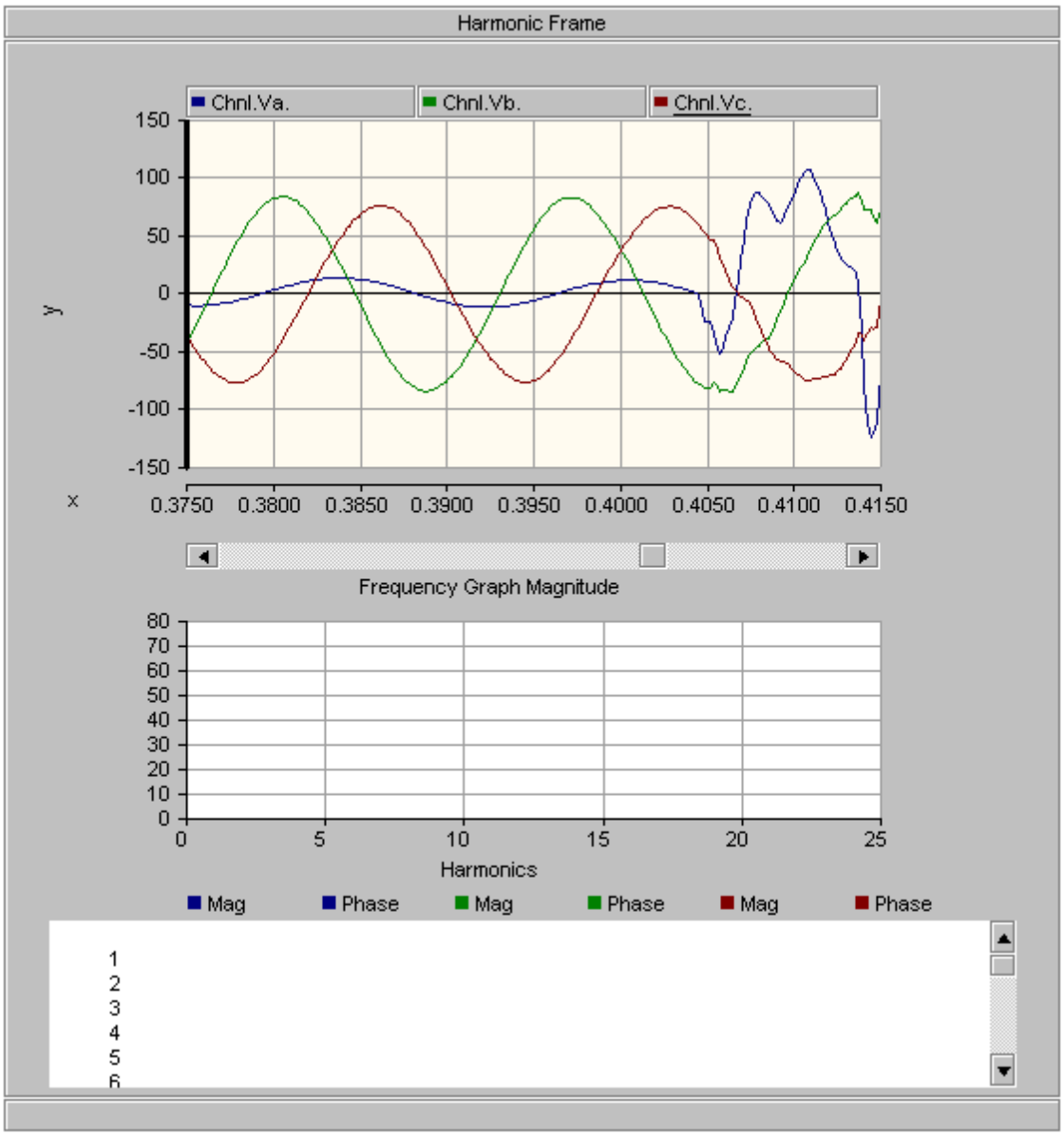

Figure 5.3: Example of a harmonic component prior to enabling the markers and the analysis component.

5.3.2 Enabling/Disabling the Positive-Negative-Zero Sequence Transform

The Positive-Negative-Zero (PNZ) Sequence transform comes from the study of symmetrical components and their use as a tool for analyzing unbalanced three-phase power systems at steady state.

Normally, a power system operates under balanced conditions. However, under fault (abnormal) conditions, the system may become unbalanced. To perform steady-state analysis of an unbalanced system, the method of symmetrical components is required. Symmetrical

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components allow you to break down the problem of solving unbalanced fault conditions in the power system.

Symmetrical components consist of three sets of phasors; the positive sequence, the negative sequence, and the zero sequence.

Before the Positive-Negative-Zero Sequence transform can be applied, there must be exactly three curves present in the harmonic component.

There are a couple of ways to enable and/or disable the PNZ Sequence transform; the two most common ways are as follows:

- From the frame of the harmonic frame, right-click to generate a pop-up menu. From the pop-up menu click **Toggle PNZS Transform**, or press the "**Z**" key.

Or

- From the frame of the harmonic component, right-click to generate a pop-up menu. From the pop-up menu click **Properties**. From the harmonic component properties dialog box, check the **Enable Positive-Negative-Zero Sequence Transform** box.

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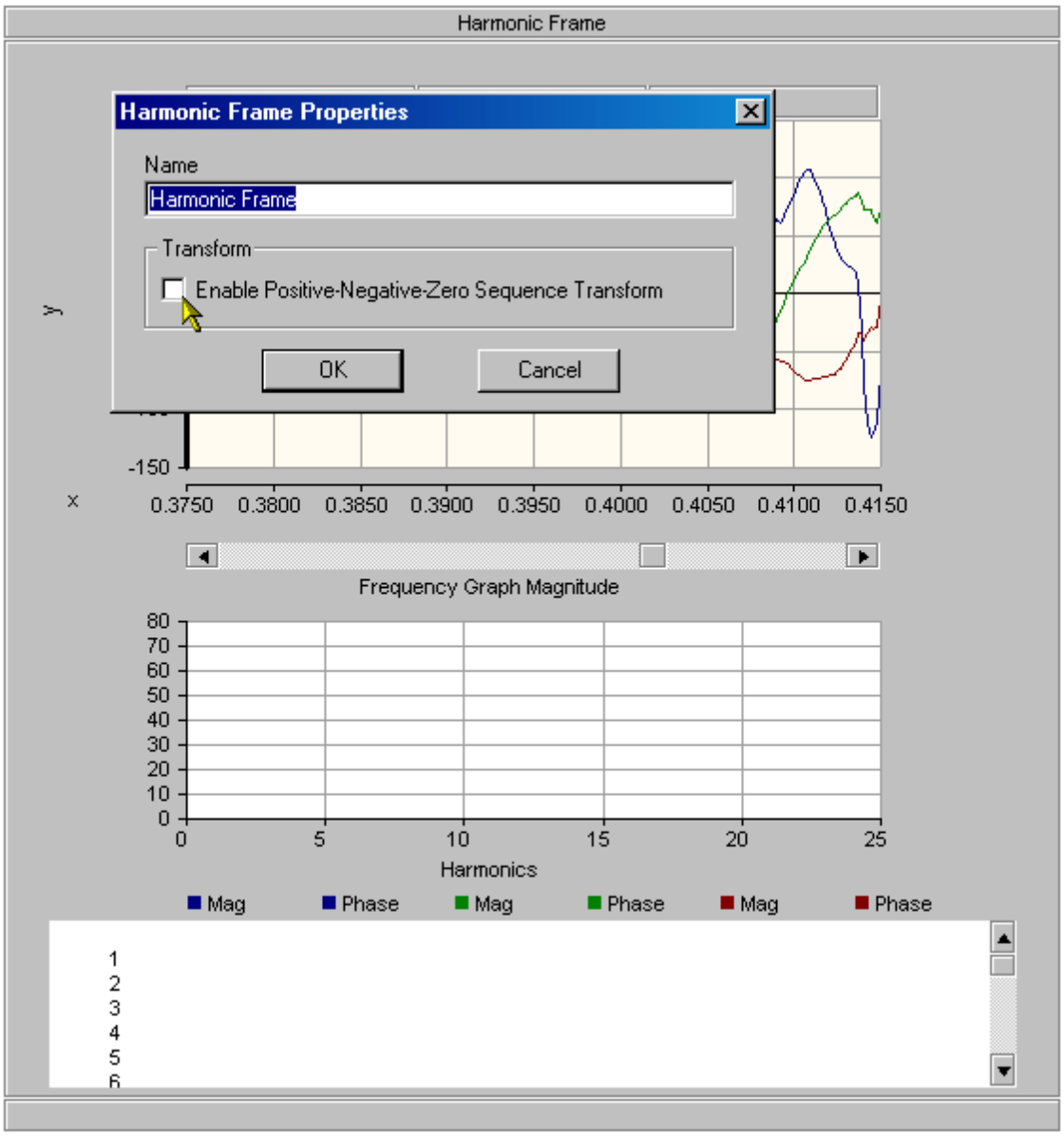

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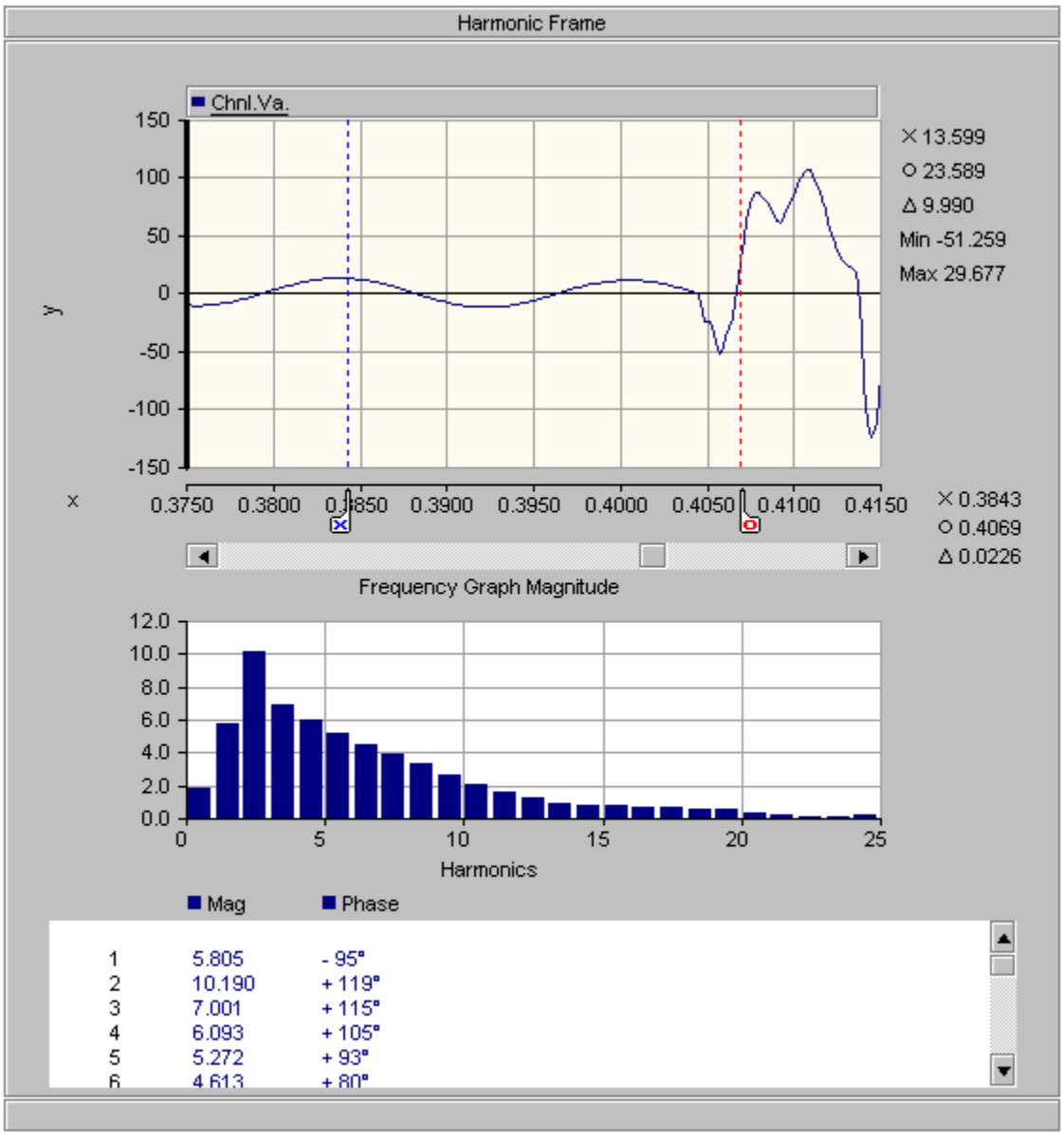

Figure 5.5: Example of a harmonic component with one curve.

5.3.3 How to Toggle Between Magnitude and Phase Plots

By default, the harmonic component displays its frequency component as a magnitude plot. However, the user can toggle between this plot and a phase plot.

To toggle the plot type, there are two common methods:

- From the surface of the frequency plot component, right-click to generate a pop-up menu. From the pop-up menu click either **Display Phase Plot** or **Display Magnitude Plot**. The user can also press the "**1**" or "**2**" key respectively.

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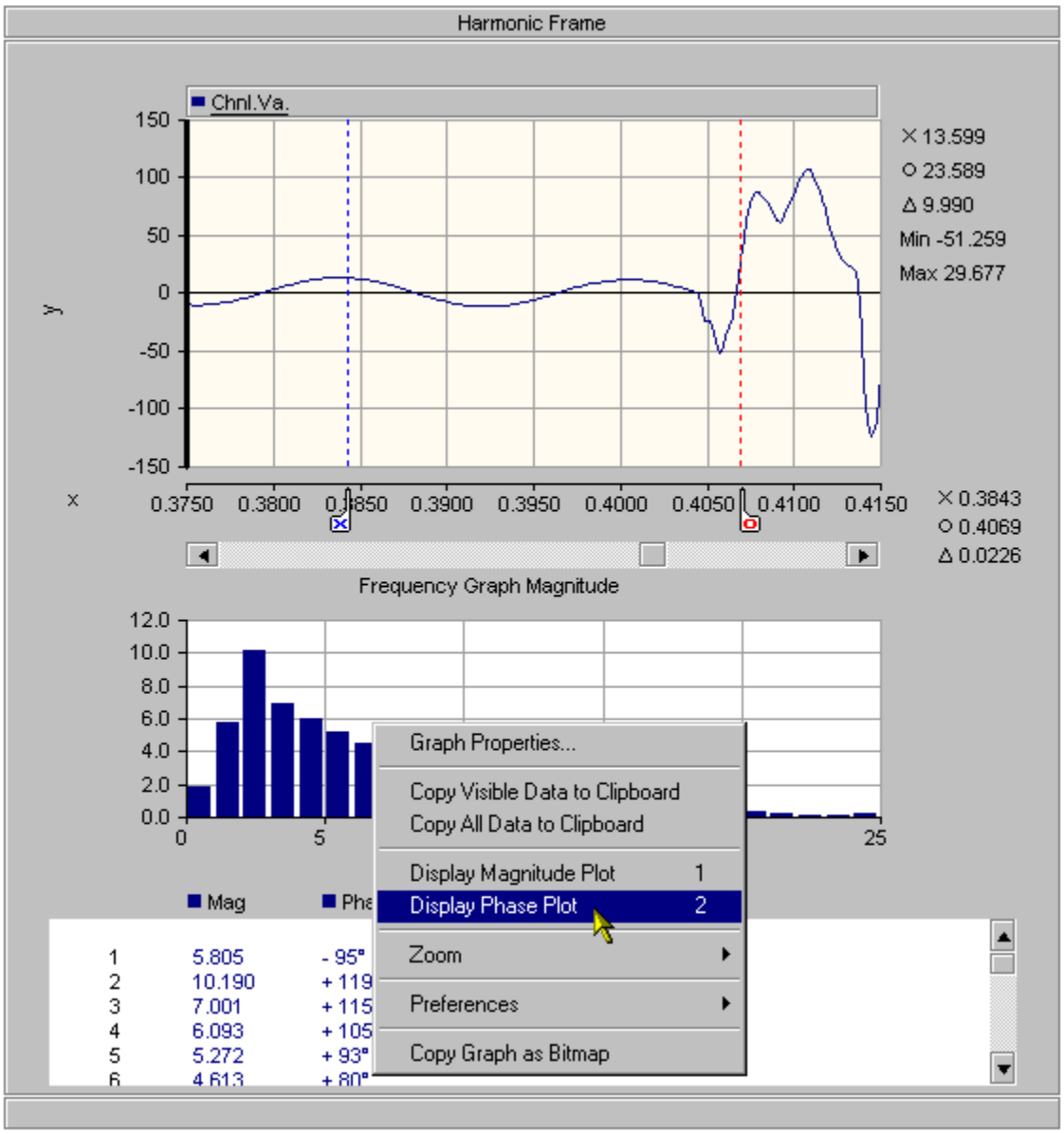

Figure 5.6: Example of selecting a phase plot for the frequency graph component of the harmonic component.

Or

- From the frequency graph properties dialog box, select the desired plot from **Plot Options** section.

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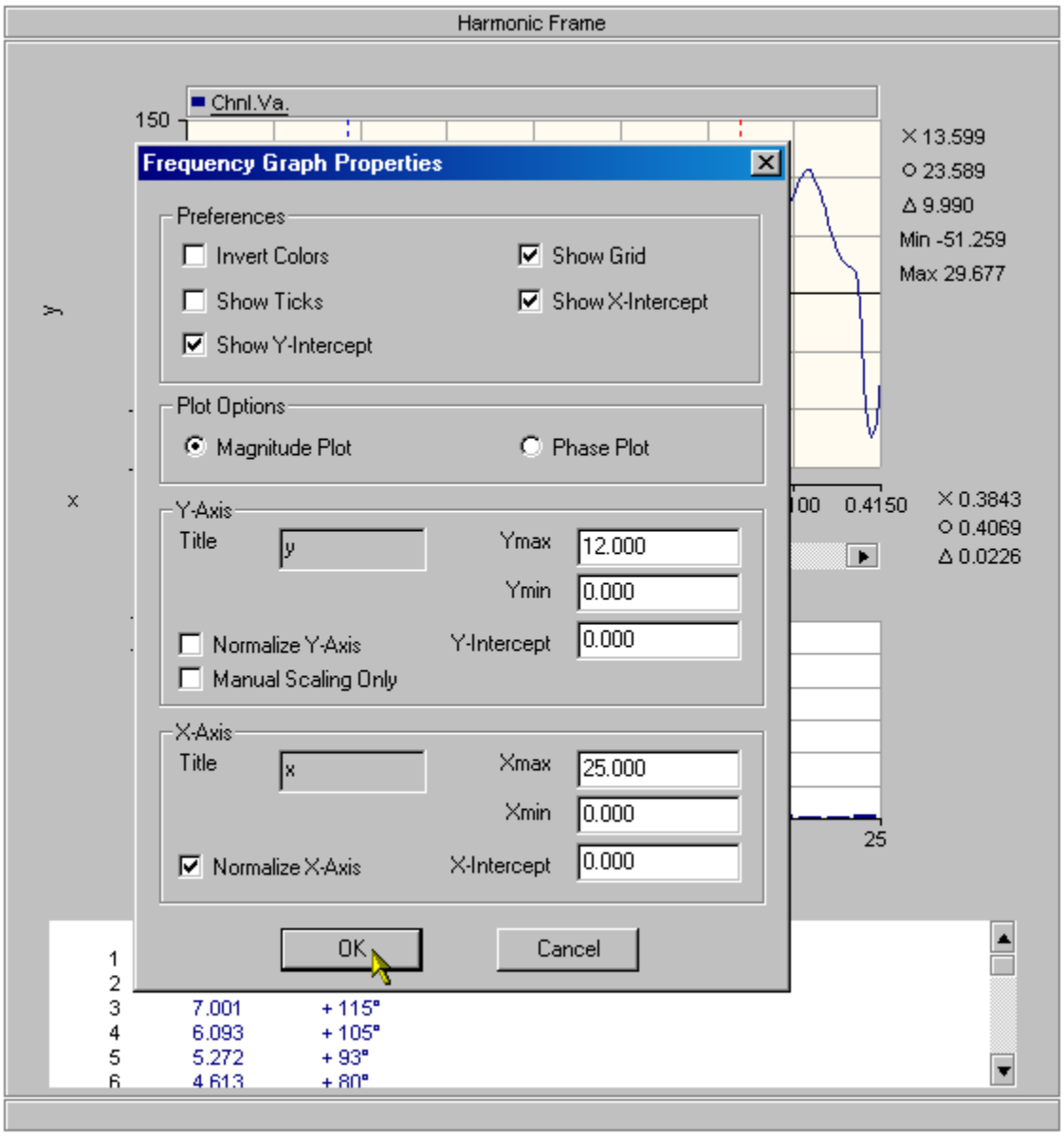

Figure 5.7: Example of the frequency graph properties dialog box.

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6.0 Keyboard Shortcuts

6.1 General Components

Key Press	Action
Ctrl + N	Create new workspace
Ctrl + O	Open existing workspace
Ctrl + S	Save workspace
Ctrl + P	Print workspace
Ctrl + V	Paste component from clipboard
Ctrl + C	Copy component to the clipboard
Ctrl + V	Paste component from clipboard

6.2 Graph Components

Key Press	Action
+	Zoom in
-	Zoom out
P	Undo zoom
N	Redo zoom
X	Reset horizontal axis
Y	Reset vertical axis
R	Rest both axis
G	Enable/disable grid
I	Enable/disable tick marks
K	Enable/disable glyphs/hatch
O	Enable/disable offset component
M	Enable/disable markers
Q	Enable/disable x intercept
W	Enable/disable y intercept
C	Enable/disable crosshair
H	Toggle the crosshair mode
Tab	Set next curve active
Space	Set next curve active

6.3 Axis Components

Key Press	Action
↑	Move "O" marker to the left
↓	Move "O" marker to the right
←	Move "X" marker to the left

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→	Move "X" marker to the right
X	Snap the "X" marker to the mouse
O	Snap the "O" marker to the mouse
L	Lock the markers
F	Toggle the delta marker readout mode

6.4 Frequency Plots

Key Press	Action
1	Display the magnitude plot
2	Display the phase plot

6.5 Harmonic Analysis Component

Key Press	Action
Z	Enable/Disable the Positive-Negative-Zero Sequence Transform

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8.0 Example Workspaces

LiveWire installation comes with an Examples directory that contains workspaces to illustrate various features of LiveWire. The **Examples** directory is located under the LiveWire installation directory in LiveWire\Examples.

The example workspaces described in this section are mainly meant to illustrate the use of LiveWire. Each example introduces a new feature. If you are a first time user, go through all the examples in the order they are listed.

8.1 Simple Analog Graph • SimpleAnGraph.lww	This example simply illustrates how to create a basic analog graph with one curve.
8.2 Simple Graphs • SimpleGraphs.lww	This example shows you how to create the basic graphs with one curve in each.
8.3 Advanced Analog Graph • AdvanceAnGraph.lww	This example illustrates how to create an advanced analog graph with multiple curves and some of the features available in the advanced graphs.
8.4 Advanced Graphs • AdvanceGraphs.lww	This example demonstrates how to create multiple advanced graphs with multiple curves.
8.5 X-Y Plot • XYPlot.lww	This example simply illustrates how you would create an XY plot.
8.6 Graph Frame • GraphFrame.lww	This example illustrates the power of the graph frame, and demonstrates how multiple graphs, with multiple curves can be contained with one.
8.7 Graph Frame with Vertical Scrolling • GraphFrameWVS.lww	This example demonstrates how to create a graph frame with vertical scrolling, and the robustness this frame can provide.
8.8 Harmonic Component* • HarmonicComponent.lww	This example demonstrates how to create a harmonic component. This example is only available in LiveWire PS

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9.0 LiveWire Licence Agreement

LIVEWIRE V2 LICENCE AGREEMENT

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