W-Edit 14 User Guide—Contents

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1   Introduction

W-Edit: A Waveform Viewer

Visualizing the complex numerical data resulting from VLSI circuit simulation is critical to testing, understanding, and improving those circuits. W-Edit is a waveform viewer that provides ease of use, power, and speed in a flexible environment designed for graphical data presentation. The advantages of W-Edit include:

- Tight integration with T-Spice, Tanner EDA's circuit-level simulator. W-Edit can chart data generated by T-Spice directly, without modification of the output data files. W-Edit charts data dynamically as it is produced during the simulation.

- Charts are automatically configured for the type of data being presented.

- A data set is treated by W-Edit as a unit called a *trace*. Multiple traces from different output files can be viewed simultaneously, in single or multiple windows. You can copy and move traces between charts and windows. You can perform trace arithmetic or spectral analysis on existing traces to create new ones.

- You can pan back and forth and zoom in and out of chart views, including specifying the exact *x-y* coordinate range W-Edit displays. You can measure positions and distances between points easily and precisely with the mouse.

- You can customize properties of axes, traces, grids, charts, text, and colors.

Numerical data is input to W-Edit in the form of plain or binary text files. Header and comment information supplied by T-Spice is used for automatic chart configuration. Runtime update of results is made possible by linking W-Edit to a running simulation in T-Spice.

W-Edit saves information on chart, trace, axis, and environment settings in files with the **.wdb** (W-Edit Database) extension. You can load a **.wdb** file in conjunction with a data file to automatically apply saved formats and environment settings. The **.wdb** file does not contain any trace data.

Documentation Conventions

This section contains information about the typographical and stylistic conventions used in this user guide.

Special Fonts

The following inline references are represented by a bold font:

- Menu and simulation commands (For example: **.print tran v(out)**.)

- Literal user input (For example: Enter **14.5**.)

- Program output (For example: S-Edit generates names for the ports on the symbol based on the **PAD** string.)

- All dialog elements—fields, checkboxes, drop-down menus, titles, etc. (For example: Click **Add**.)

Freestanding quotations of input examples, file listings, and output messages are represented by a constant-width font—for example:

```
.ac DEC 5 1MEG 100MEG
```

Variables for which context-specific substitutions should be made are represented by bold italics—for example, *myfile*.**tdb**.

Sequential steps in a tutorial are set off with a checkbox (☑) in the margin.

References to mouse buttons are given in all capitals—for example, MOVE/EDIT. When a key is to be pressed and held while a mouse button is used, the key and button are adjoined by a plus sign (+). For example, **Shift**+SELECT means that the **Shift** key is pressed and held while the SELECT mouse button is used.

The terms "left-click," "right-click," and "middle-click" all assume default mappings for mouse buttons.

Text omitted for clarity or brevity is indicated by an ellipsis (**…**).

Menu Commands and Dialog Titles

Elements in hierarchical menu paths are separated by a **>** sign. For example, **File > Open** means the **Open** command in the **File** menu.

Tabs in dialog boxes are set off from the command name or dialog box title by a dash. For example, **Setup > Layers—General** and **Setup Layers—General** both refer to the **General** tab of the **Setup Layers** dialog.

Special Keys

Special keys are represented by the following abbreviations:

Key	*Abbreviation*
Shift	**Shift**
Enter	**Enter**
Control	**Ctrl**
Alternate	**Alt**
Backspace	**Back**
Delete	**Del**
Escape	**Esc**
Insert	**Ins**
Tab	**Tab**
Home	**Home**

Key	*Abbreviation*
End	**End**
Page Up	**PgUp**
Page Down	**PgDn**
Function Keys	**F1 F2 F3** …
Arrow Keys	$\downarrow, \leftarrow, \rightarrow, \uparrow$

When certain keys are to be pressed simultaneously, their abbreviations are adjoined by a plus sign (+). For example, **Ctrl**+**R** means that the **Ctrl** and **R** keys are pressed at the same time.

When certain keys are to be pressed in sequence, their abbreviations are separated by a space ( ). For example, **Alt**+**E R** means that the **Alt** and **E** keys are pressed at the same time and then released, immediately after which the **R** key is pressed.

Abbreviations for alternative key-presses are separated by a slash (/). For example, **Shift**+$\uparrow$ / $\downarrow$ means that the **Shift** key can be pressed together with either the up ($\uparrow$) arrow key or the down ($\downarrow$) arrow key.

2   Working with Traces and Charts

Traces

Each column of data in a data file corresponds to a dependent variable that is plotted as one or more traces in W-Edit. A trace represents a single simulation run for a given dependent variable. You can manage which traces are displayed in a chart with **Chart > Traces** (page 62).
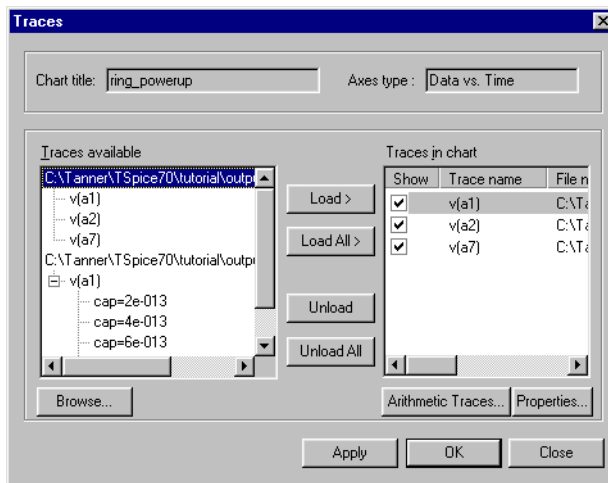
The top portion of the **Traces** dialog is read-only when the chart contains traces; it displays the **Chart title** and **Axes type** for the chart. There are three possible values for the **Axes type** field:

- **Data vs. Time**
- **Data vs. Frequency**
- **Data vs. Voltage**

You cannot add traces to a chart that do not match the chart's **Axes type**.

The bottom portion of the dialog lists the **Traces available** in all open files and, under **Traces in chart**, which traces are loaded in the chart. Not all traces that are loaded in a chart need to be displayed at one time.

The **Traces in chart** column is divided into three subcolumns. The **Show** column indicates which traces are displayed in the chart; you can display or hide a trace by checking or unchecking the box next to it. The **Trace name** is a compilation of heading information in the data file; W-Edit uses this to uniquely identify each trace. **File name** is the name of the data file in which the trace is saved.

Note: The order in which traces are loaded in a chart determines the order in which trace labels appear in the legend. This is also the order in which traces will be displayed if the chart is expanded (see Expanding and Collapsing Charts on page 13).

The **Traces** dialog contains two buttons:

- **Arithmetic Traces** (see Arithmetic Traces, below)—Adds an arithmetic trace to the chart.

- **Properties** (see Properties on page 12)—Modifies the properties of the trace selected in the **Traces in chart** column.

Arithmetic Traces

You can create traces in new or existing charts as a function of other traces or of the *x*-axis variable. You can also create traces with a constant *y*-value.

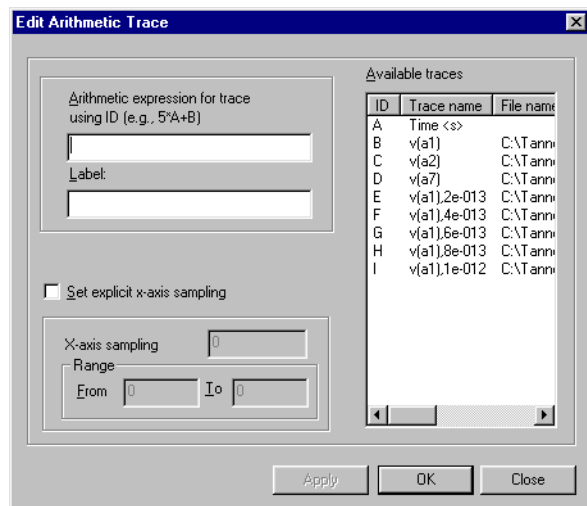Each trace in the **Available traces** list is identified with a unique letter, **A**-**Z**. A maximum of 26 traces are available at one time, and the *x*-axis is always listed as trace **A**.

In the **Arithmetic expression for trace using ID** field, enter a mathematical expression consisting of numbers, trace IDs, and operators. (Operators are listed in Arithmetic Operations, below.) For example, in the dialog above, **A*2** results in a new trace with a *y*-value twice as large as trace **v(a1)**. A **2** in the **Arithmetic expression for trace using ID** field results in a trace with constant value *y*=2.

Trace operations are done on a point-by-point basis. For instance, if trace **x** consists of points **(x1, x2,…)**, then the arithmetic trace **x^2** will consist of points **(x12**, **x22**,**…)**. The default range of an arithmetic trace is the intersection of the ranges of the input traces.

The **Set explicit x-axis sampling** check box allows you to select a sampling interval and *x*-axis range for the arithmetic trace. When you set *x*-axis sampling, W-Edit only calculates points in the arithmetic trace at evenly spaced intervals. **X-axis sampling** is the distance between data points for the new trace. The new data points do not need to correspond to points in the input traces; W-Edit uses linear interpolation to calculate input values at each sample point. **Range** is the maximum and minimum *x*-axis values for the new trace.

Warning: Arithmetic trace data is only valid within a range equal to the intersection of the ranges of the input traces. When setting *x*-axis sampling, you should always use a **Range** that is contained within the ranges of all input traces.

You must enter values for **X-axis sampling** and **Range** when adding an arithmetic trace to a blank chart.

If *x*-axis sampling is not set explicitly, W-Edit evaluates the arithmetic expression at every sample point that is represented by one or more of the input traces and contained within the default range. When input traces have different *x*-axis data points, W-Edit uses linear interpolation to supply missing values.

A simple example of trace addition (without explicit *x*-axis sampling) is illustrated below.

The range of the arithmetic trace is the intersection of the ranges of the input traces.
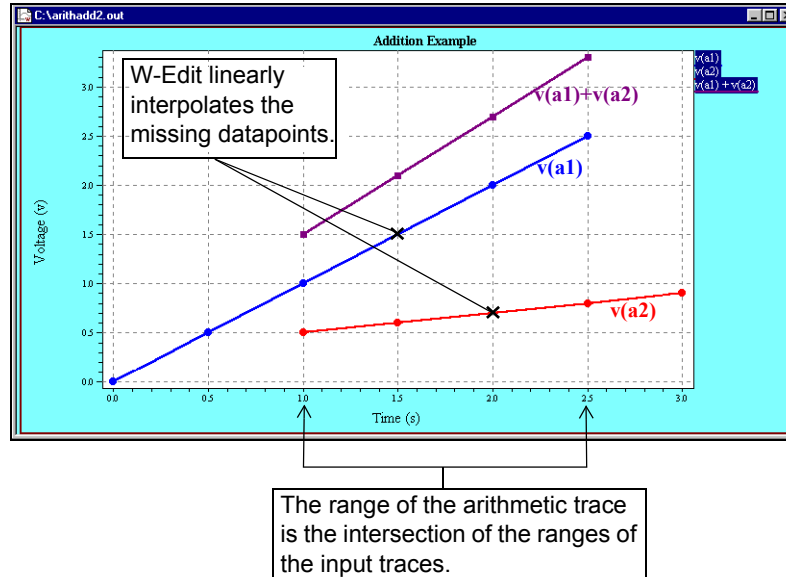
Arithmetic Operations

W-Edit evaluates expressions according to a standard mathematical operator precedence, shown below. Level 1 has the highest operator precedence; Level 5 has the lowest.

Priority	Operation	Description
Level 1	**(x)**	Parentheses
Level 2	**x^y**	Exponentiation
Level 3	**−x**	Unary negation
Level 4	**x×y** **x/y**	Multiplication Division
Level 5	**x+y** **x−y**	Addition Subtraction

The operations available in W-Edit are summarized in the following table. The variables **x** and **y** can represent either numbers or trace IDs. All angles are in radians.

Operation	Description
x + y	Addition
x − y	Subtraction
x * y	Multiplication

Operation	Description
x / y	Division
x ^ y x**y	Exponentiation (x^y)
−x	Unary negation
(x)	Parentheses — to override operator precedence
abs(x)	Absolute value of x (same as **fabs**)
fabs(x)	Absolute value of x (same as **abs**)
sqrt(x)	Square root of x (domain error if $x < 0$)
pow(x,y)	Exponentiation (x^y)
pwr(**x,y**)	(sign of x)·$|x|^y$
sin(x)	Sine of x
asin(x)	Inverse sine of x (domain error if $|x| > 1$)
sinh(x)	Hyperbolic sine of x
cos(x)	Cosine of x
acos(x)	inverse cosine of x (error if $|x| > 1$)
cosh(x)	Hyperbolic cosine of x
tan(x)	Tangent of x
atan(x)	Inverse tangent of x (range: $[-\pi/2, \pi/2]$)
atan2(x,y)	Inverse tangent of y/x (range: $[-\pi, \pi]$)
tanh(x)	Hyperbolic tangent of x
log(x)	Natural logarithm of x (error if $x \le 0$)
log2(x)	Logarithm (base 2) of x (error if $x \le 0$)
log10(x)	Logarithm (base 10) of x (error if $x \le 0$)
db(**x**)	x in decibels: (sign of x)·$20 \cdot \log_{10}(|x|)$
exp(x)	e^x
ceil(x)	Smallest integer not less than x
floor(x)	Largest integer not greater than x
int(**x**)	Largest integer not greater than x (same as **floor**)
sgn(x)	Sign of x: -1 if $x < 0$ 0 if $x = 0$ 1 if $x > 0$
sign(**x,y**)	(sign of y)·$|x|$
ldexp(x,y)	$x \times 2y$ for integer y
fmod(x,y)	Remainder of x/y (error if $y = 0$)

Operation	*Description*
min(expression1, expression2)	Evaluates to the minimum of the two arguments.
max(expression1, expression2)	Evaluates to the maximum of the two arguments.

Properties

Each trace has a set of properties associated with it, including a label, line style, marker type, width, and color. You can change the properties of a selected trace in the **Trace Properties** dialog. There are three ways to access **Trace Properties**:

▪ In **Chart > Traces**, select a trace from the **Traces Available** list and then click **Properties**.

▪ Double-click on the trace within a chart.

▪ Double-click on the trace label in the chart legend. If the label corresponds to a group of simulation runs, this method will open the **Trace Properties** dialog for the entire trace family.
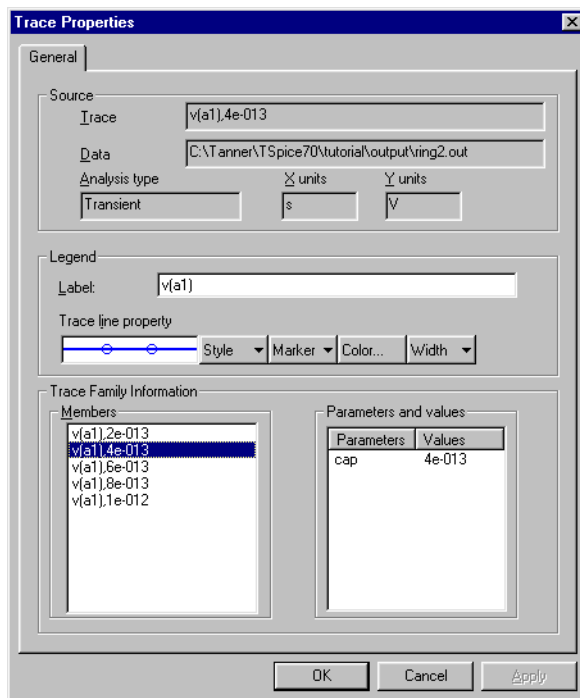
The **Source** area of the dialog displays read-only information obtained from the data file. **Trace** is the heading used to label trace data in the **Data** file. Also included are the **Analysis type** performed and the **X units** and **Y units** for the trace.

Trace properties are editable in the **Legend** area of the dialog:

Label	Legend text corresponding to the selected trace or trace family. All members of a trace family share a single **Label**.
Style	Line style (solid, dotted, dashed, etc.). The default is a solid line. For broken line styles, the **Width** is automatically set to 1.

Marker	Selects markers to display when the trace is selected. Markers correspond to individual data points. Markers are not included in the chart legend.
Color	Trace color. W-Edit uses a 256-color palette.
Width	Line width in pixels. The default value is 1. The **Width** field is only enabled when **Style** is solid (default).

The **Trace Family Information** area provides information about multiple simulation runs for a single dependent variable. (Multiple runs are invoked in the T-Spice netlist by the **sweep** keyword and by **.step** or **.alter** commands.)

The **Members** column lists each trace that is available for editing. When you open the **Trace Properties** dialog for a trace family, all of the member traces are listed. Select a trace in the **Members** column to edit its properties in the **Legend** area. Only trace line properties (**Style**, **Marker**, **Color**, and **Width**) can differ for traces within a family. Changes to the **Label** field apply to the entire trace family.

Simulation runs in a trace family are identified by the numeric value of the swept parameters. (In this case, **alter** is treated as a parameter.) W-Edit names individual traces by appending the trace label with parameter values, separated by commas. For instance, the trace:

```
v(out),3,1e-013
```

is the member of trace family **v(out)** obtained when the first and second swept parameters had values of **3** and **10-13**, respectively. Parameter values are listed in the order in which they were applied in the simulation.

The **Parameters and values** column is a legend that identifies swept parameter values corresponding to the trace selected in the **Members** column.
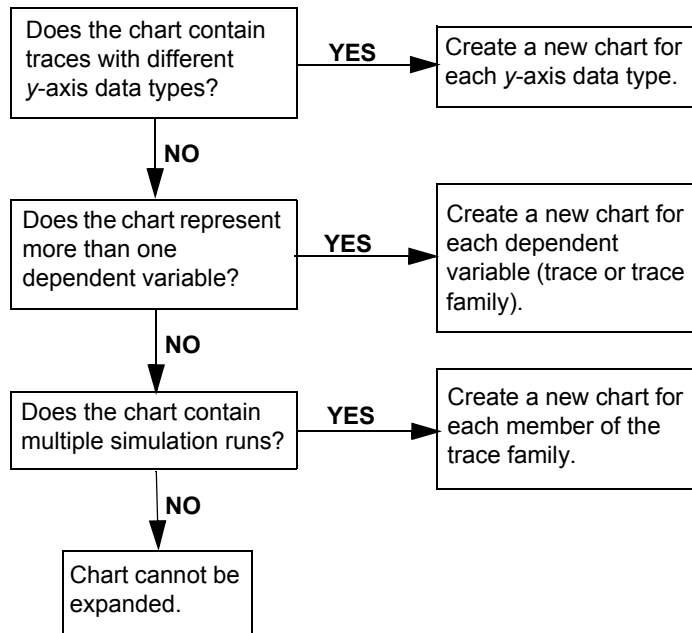
Expanding and Collapsing Charts

You can view traces from a data file in a single chart or in multiple charts. When you first load a data file, W-Edit displays the traces that use the same *x*- and *y*-axis system in a single chart. If traces have different axis systems, W-Edit creates multiple charts.

The **Chart > Expand Chart** command separates traces on the selected chart into multiple new charts, which replace the original. The new charts have increasingly specific groupings of traces, displayed at four distinct levels:

- *x*-axis system. Traces with the same *x*-axis units and *x*-axis scale (log or linear) are grouped together. This is the broadest possible grouping of traces; different *x*-axis systems can never be plotted on the same chart.

- *y*-axis data type. Each chart contains a single, unique *y*-axis data type. A data type is a measured quantity and associated units, such as **Voltage (V)**, **Current (A)**, **Noise (V)**, etc. Each chart is restricted to a single axis scale (log or linear.)

- Dependent variable. Traces corresponding to multiple simulation runs for the same dependent variable are shown on the same chart. Each chart contains either a trace family or an independent trace.

- Individual trace. Each chart contains exactly one trace.

When you use the **Chart > Expand Chart** menu command, W-Edit applies the following algorithm to the selected chart:

Does the chart contain traces with different *y*-axis data types?	**YES** →	Create a new chart for each *y*-axis data type.
↓ **NO**		
Does the chart represent more than one dependent variable?	**YES** →	Create a new chart for each dependent variable (trace or trace family).
↓ **NO**		
Does the chart contain multiple simulation runs?	**YES** →	Create a new chart for each member of the trace family.
↓ **NO**		
Chart cannot be expanded.		

When you use **Chart > Expand Chart** to view traces separately, the new charts will be displayed in the same order that traces were loaded in **Chart > Traces** (page 62).
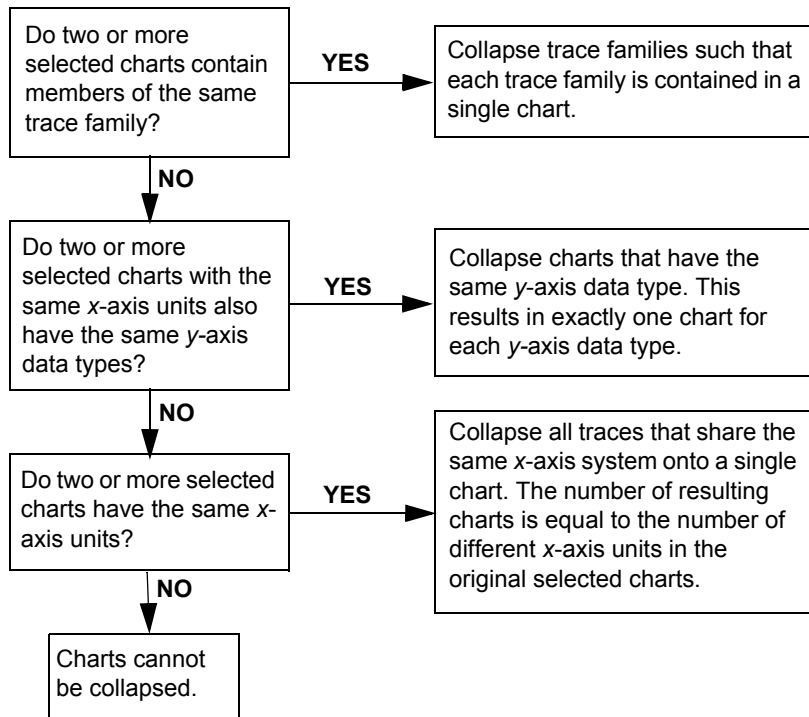
Note: The maximum number of charts you can display on one screen is limited by your computer. If there is not enough space to fully expanded a chart, W-Edit will distribute traces among as many new charts as your monitor can display.

You can combine multiple charts that use the same axis system into a single chart. To combine charts, select the desired charts and use **Chart > Collapse Charts**. (To select a chart without deselecting others, hold the **Shift** or **Ctrl** key while clicking on the desired chart.)

Chart > Collapse Charts applies the same levels of trace separation as **Chart > Expand Chart**. When you collapse charts, W-Edit combines the traces in the selected charts, so that traces are grouped by trace family, *y*-axis data type, or *x*-axis units. Charts are collapsed in the reverse order in which they are expanded: W-Edit first collapses trace families, then *y*-axis data types, and finally all traces with the same *x*-axis units.

When different *y*-axis data types are collapsed onto a single chart, the new *y*-axis label combines all data types, separated by commas. For instance, if *y*-axis data types **Voltage (V)** and **Phase (deg)** are collapsed, the new chart will have *y*-axis label **Voltage (V), Phase (deg)**.

W-Edit collapses selected charts as follows:

| Do two or more selected charts contain members of the same trace family? | **YES** → | Collapse trace families such that each trace family is contained in a single chart. |

NO ↓

| Do two or more selected charts with the same *x*-axis units also have the same *y*-axis data types? | **YES** → | Collapse charts that have the same *y*-axis data type. This results in exactly one chart for each *y*-axis data type. |

NO ↓

| Do two or more selected charts have the same *x*-axis units? | **YES** → | Collapse all traces that share the same *x*-axis system onto a single chart. The number of resulting charts is equal to the number of different *x*-axis units in the original selected charts. |

NO ↓

Charts cannot be collapsed.

Lock-View Sets

When you expand a chart, the resulting charts have the same setting for **Chart > Lock X-Axis** (page 69) as the original. **Lock X Axis** toggles inclusion of the chart in a *lock-view set*. A lock-view set is a collection of charts with the same *x*-axis units and scale (log or linear) that scroll and zoom in unison. Any action that affects the view of the *x*-axis in one member of a lock-view set affects the view of all other charts in the set. There cannot be more than one lock-view set for any given combination of *x*-axis units and scale.

You can add or subtract charts from a lock-view set with **Chart > Lock X-Axis** or by placing (or removing) a check in the **Lock X-Axis (Synchronize View)** check box in the **Chart Options—General** dialog. (See **Chart > Options—General** (page 70).) The **Chart > Lock X-Axis** command toggles the state of the selected chart; W-Edit displays a check mark next to the menu command if the selected chart is currently locked.

When you zoom or scroll the *x*-axis of a locked chart, the entire lock-view set is affected. Other charts in the lock-view set do not need to be selected for the *x*-axis operation to apply. However, all selected charts will zoom or scroll together, even if they are not locked.

Measurement Bars and Markers

You can measure the distance between data points using a pair of vertical or horizontal bars. You can also place markers at exact data points on a trace.

Vertical Bars

Use **Chart > Cursors > Vertical Bars** (page 67) to measure the exact *x*- and *y*-coordinates of traces. This command places a pair of vertical bars in the selected charts. Vertical bars are synchronized in selected charts; when you move a vertical bar, the vertical bars in all selected charts become aligned and move together. W-Edit displays the *x*-axis value for both bars and the distance between them in the upper left corner of each chart. For each label associated with a single trace, the *y*-axis value at the position of the selected bar is displayed below the trace label in the chart legend. (The *y*-axis value is not displayed under labels that represent trace families.)

Horizontal Bars

Use **Chart > Cursors > Horizontal Bars** (page 67) to place a pair of horizontal bars in the selected charts. You can move the bars in only one chart at a time. W-Edit displays the *y*-axis value for both bars and the distance between them in the upper left corner of the chart.

Markers

Use **Chart > Cursors > Markers** (page 68) to place two markers in each selected chart. The second marker initially appears directly on top of the first. You can move markers in only one selected chart at a time. Markers always snap to data points on a trace. W-Edit displays the markers' exact coordinates and the vertical and horizontal distances between them in the upper right corner of the chart.

When you expand a chart that contains markers, the new charts will display markers at the same trace data points as in the original chart. If the two markers in the original chart are split between two new charts, then W-Edit will add a second marker to each. This is because all charts have either zero or two markers.

When you collapse charts that contain markers, W-Edit preserves two of the trace markers at their original trace data points. The rest of the markers are deleted.

Annotations

Use **Chart > Insert Annotation** to add an annotation to a chart.
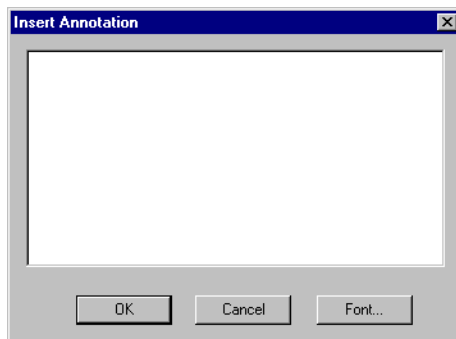
Annotations are text objects manually placed in charts, as opposed to chart titles, axis labels, tick mark numbers, and legends, which are internally generated. You can place any number of annotations within the axis system of a chart.

To create an annotation, select **Chart > Insert Annotation** to open the **Insert Annotation** dialog. Type the desired text in the editing field, and then use the **Font** button to change the font, color, size, and style of the text. Click **OK** to close the dialog. Move the cursor to the desired position and click the left mouse button to place the annotation.
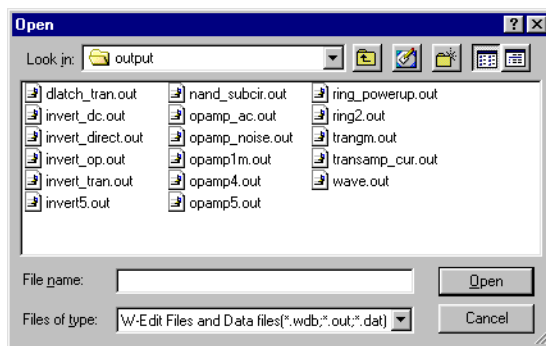
*Note:*   Annotations cannot be cut, copied, or pasted into charts.

Tutorial

This tutorial introduces some of the functions and commands available in W-Edit. The files used in the tutorial are **invert_tran.out** and **ring_powerup.out**, located in the **\tutorial\output** subdirectory of the main T-Spice Pro directory.

Loading the Data File

☑   Launch W-Edit.

☑   Use **File > Open** (page 51) to open **ring_powerup.out**.


When you first load a data file W-Edit displays the traces in a single chart, which is selected.
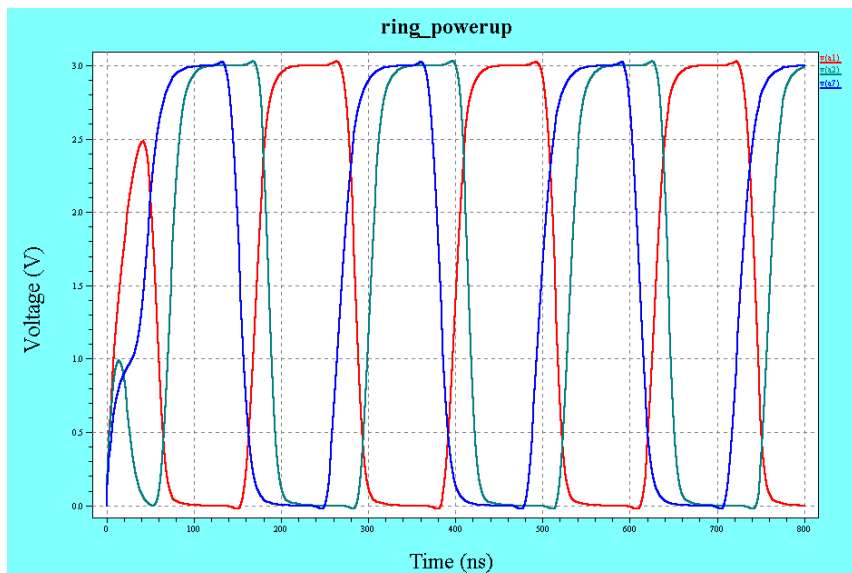
Note: Chart characteristics such as foreground and background color, trace colors, and marker styles will display according to your default settings. You may have different option settings than the chart shown above.

Expanding and Collapsing Charts

☑   Use **Chart > Expand Chart** (page 68) or click ▤ to separate each trace into an individual chart. Three charts are created and selected.
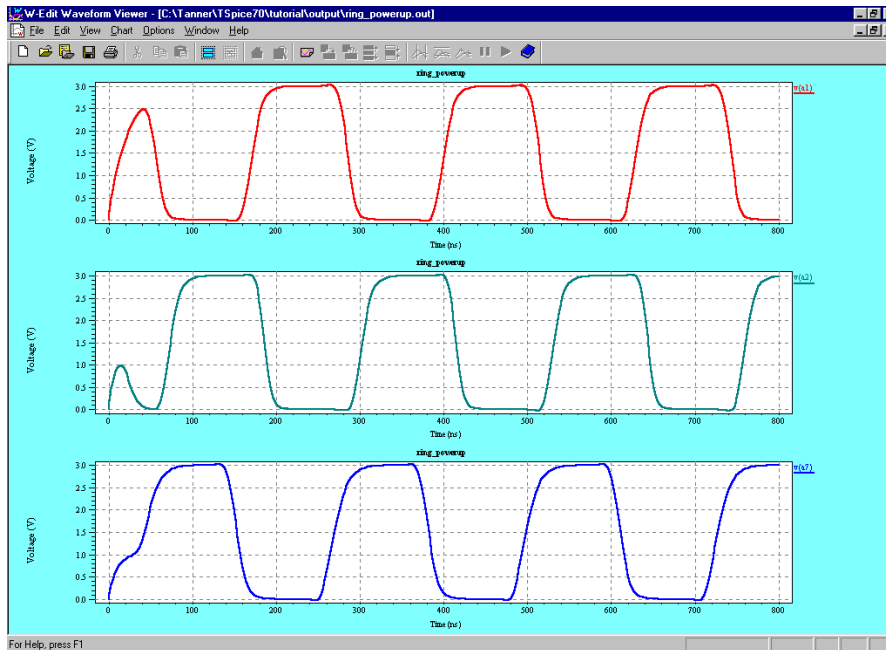
☑   Position the pointer anywhere in the middle chart and click the left mouse button. This will select the middle chart and deselect the others.

☑   Add the bottom chart to the group of selected charts by holding the **Shift** key while clicking anywhere in the bottom chart. The top chart should still be deselected.

☑   Use **Chart > Collapse Charts** (page 69) or click ▤ to combine the two selected charts into a single chart. The new chart replaces the original charts at the bottom of the display and is selected.
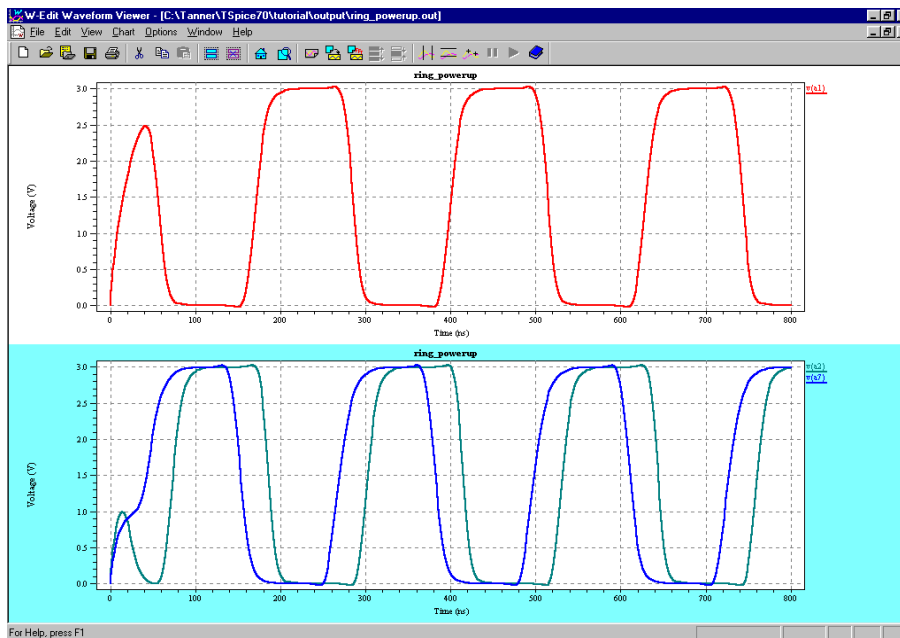
Copying and Pasting Traces

☑   In the selected (bottom) chart, click the label **v(a2)** in the legend to select the trace. Notice that the individual data points become highlighted.

☑   Use **Edit > Cut** (page 57) to remove the trace from the chart.

☑   Select the top chart. Use **Edit > Paste** (page 57) to place trace **v(a2)** in the chart.

☑   Use **Edit > Select > Traces** (page 58) to select both traces in the top chart.

☑   Use **Edit > Copy** (page 57) to copy the traces to the W-Edit clipboard without removing them from the chart.

☑   Select the bottom chart. (This action deselects the top chart and its traces.) Use **Edit > Paste** (page 57) to place the traces into the chart. All three traces should now be in the bottom chart.

☑   Select the top chart. Use **Edit > Clear** (page 58) and click **Yes** in the resulting message box to delete the selected chart.
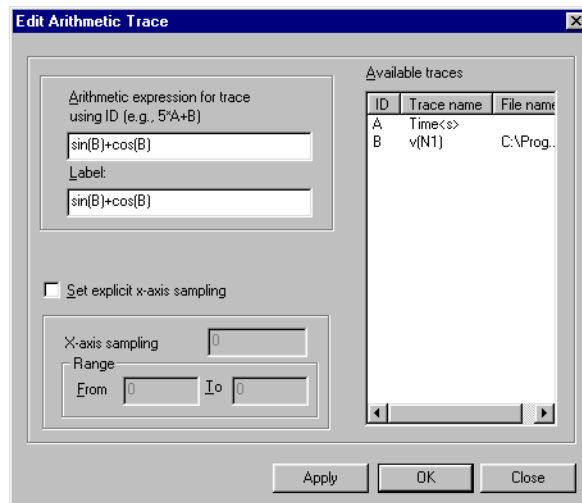
Managing Traces

☑   Select the remaining chart. Use **Chart > Traces** (page 62) to open the **Traces** dialog. Double-click on
         the file (**ring_powerup.out**) in the **Traces available** column to display the available traces.
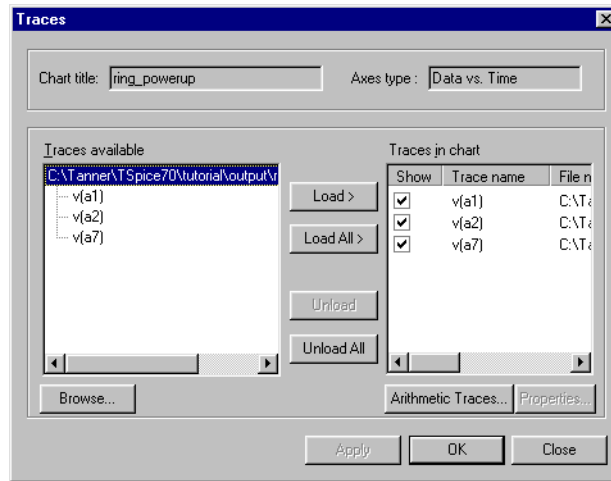
☑   The **Traces in chart** column shows a list of traces selected for the chart. Click **Unload All** to remove all
         of the traces from the chart.

☑   In the **Traces available** column, select **v(a1)**. Click **Load** to add the single trace back into the chart.

☑   Click **Apply** to apply the changes without closing the **Traces** dialog.

Adding Arithmetic Traces

☑   Click **Arithmetic Traces** (page 63) to open the **Edit Arithmetic Trace** dialog.

☑   In the **Arithmetic expression for trace using ID** field, type **sin(B) + cos(B)** (see illustration above).

☑   Click **OK**. The new trace appears in the chart and is selected. Click **Close** in the **Traces** dialog to view the chart.
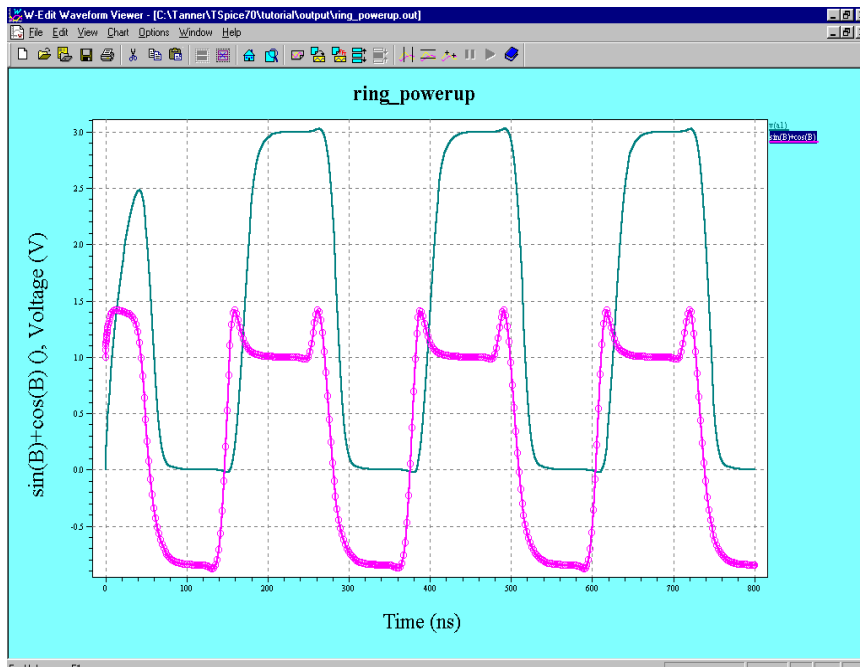
Changing Trace Properties

☑   Double-click **v(a1)** in the legend to open the **Properties** (page 65) dialog for the trace.
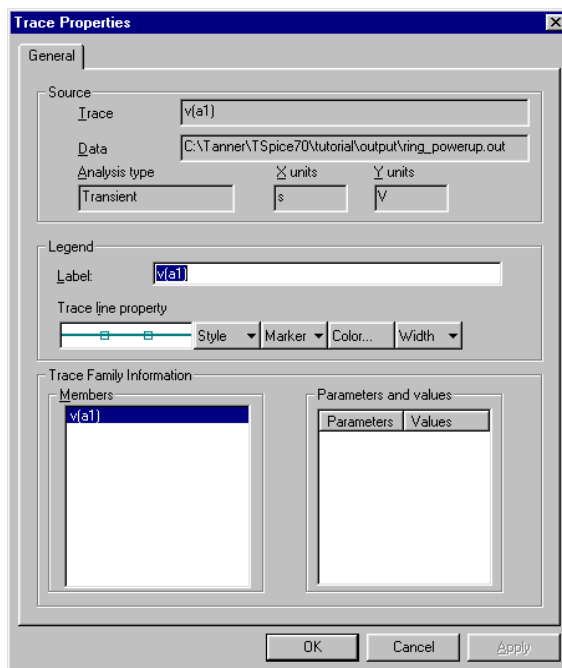

☑   In the **Label** field, change the label of the trace to **v(output)**.

☑   Click **Color**. In the color palette, change the color of the trace to blue (or the color of your choice).

☑ Explore the other trace appearance controls: **Style**, **Marker**, and **Width**. Use these to select the line style, marker type, and line width of your choice.

☑ Click **OK** to apply the changes and close the **Trace Properties** dialog.

Zooming and Panning

☑ Use **View > Zoom In X** (page 59) to define an area along the *x*-axis. Place the crosshair marker at 200 ns and drag the vertical bar to 500 ns.
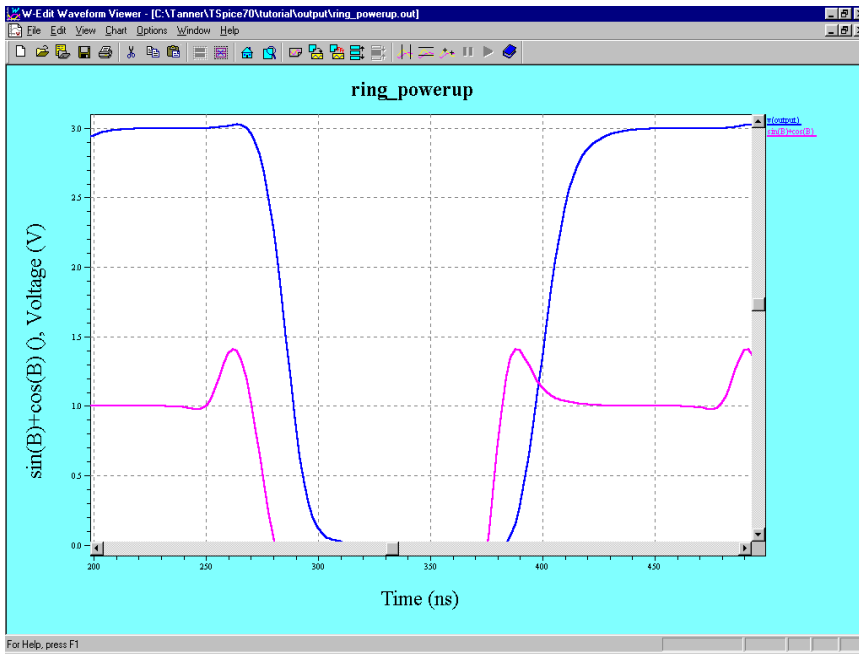
☑ Use the arrow keys or scroll bar to pan around the chart.

☑ Use **View > Zoom Range** (page 60) to zoom into a specific *x*- and *y*-range.
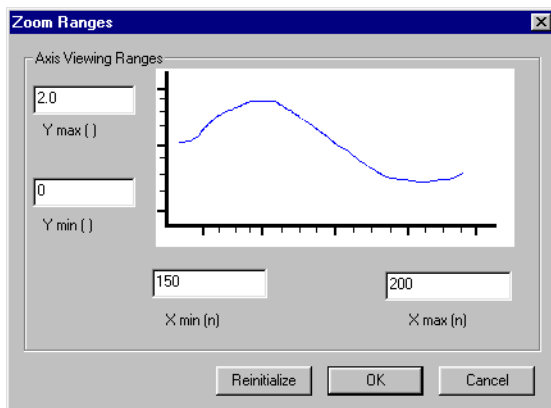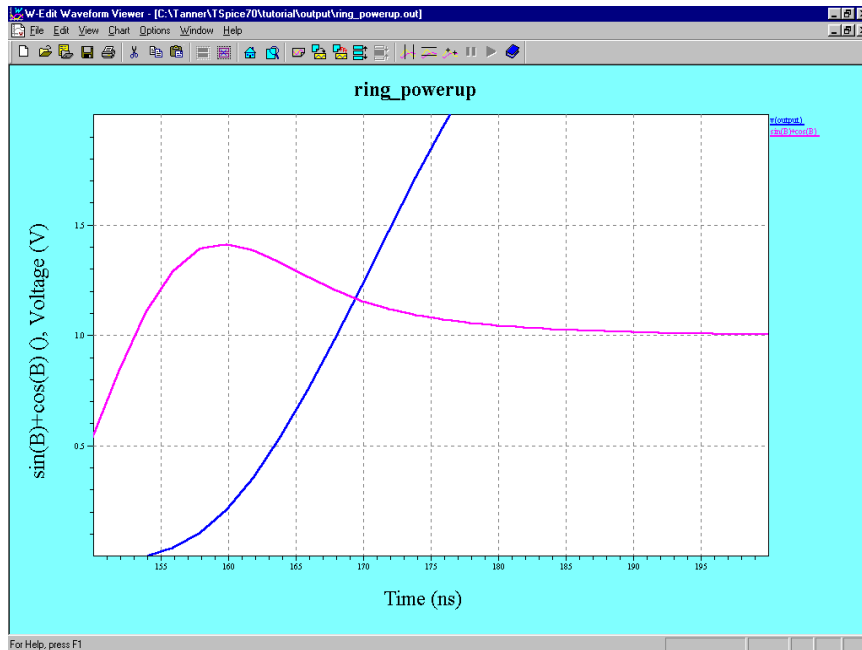

☑ Type the following values in each of the fields:

Y max   2.0

Y min	0
X min	150
X max	200

Click **OK**. W-Edit displays only the specified range.

☑   Use **View > Home View** (page 60) to return to the view that includes both traces in their entirety.

3   Getting Started

Launching W-Edit

You can launch W-Edit from the Windows Start menu or by using one of the W-Edit shortcuts included in T-Spice Pro applications. To launch W-Edit from the Start menu, click the **Start** button on the Windows taskbar and navigate to **Programs > Tanner EDA > T-Spice Pro v*xx.y* > W-Edit**, where ***xx.y*** is the version number of T-Spice Pro.

- A W-Edit shortcut button is included in the Tanner S-Edit and T-Spice applications. The W-Edit button looks like this:

Restoring Default Settings

You can restore default settings by launching W-Edit from a command-line interface (CLI) with the **-f1** command-line parameter.

☑   Click the **Start** button on the Windows taskbar and select **Run**.

☑   Click the **Browse** button and navigate to the directory that contains **wedit.exe**, then add a space and **-f1** to the end of the path.

☑   The default installation path, where ***xx.y*** represents the product version, is as follows. The final result would look like this:
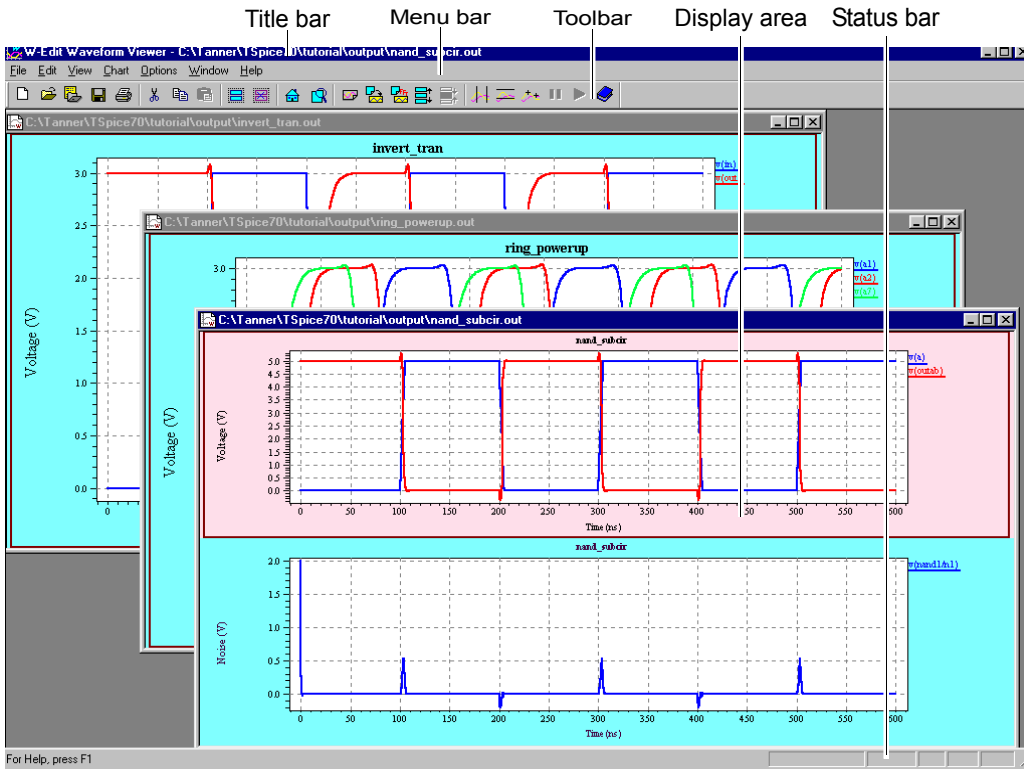
```
C:\Program Files\Tanner EDA\Tanner Tools vxx.y\wedit.exe -f1
```

☑   Click **OK** to launch W-Edit.

User Interface

The W-Edit user interface has five major components:

- Title bar
- Menu bar
- Toolbar
- Status bar
- Display area

Title bar   Menu bar   Toolbar   Display area   Status bar

Title Bar

Refer to your Windows documentation to find out how to use the title bar to minimize, zoom, resize, move, or close the application window.

Menu Bar

The menu bar contains the names of the W-Edit command menus.

Open, save, link, and print files

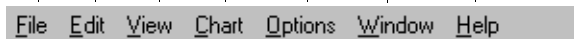Edit and select charts, traces, and annotations

Display and magnify charts

Manipulate charts and set up chart parameters

Set default display settings and file browser directory

Select, tile, and cascade windows

Access the online documentation and product information

File   Edit   View   Chart   Options   Window   Help

When there is no chart open, only the **File**, **View**, **Options**, and **Help** menus are available.

Toolbar

The toolbar contains buttons to launch the most commonly used menu commands. The toolbar is *dockable*; to make it *floating*, double-click the edge of the toolbar or select the edge and click and drag the toolbar to a new location. You can also resize the floating toolbar. The toolbar returns to its default location when you close and reopen W-Edit.
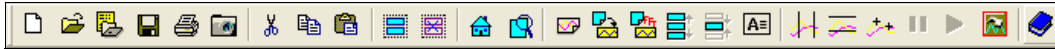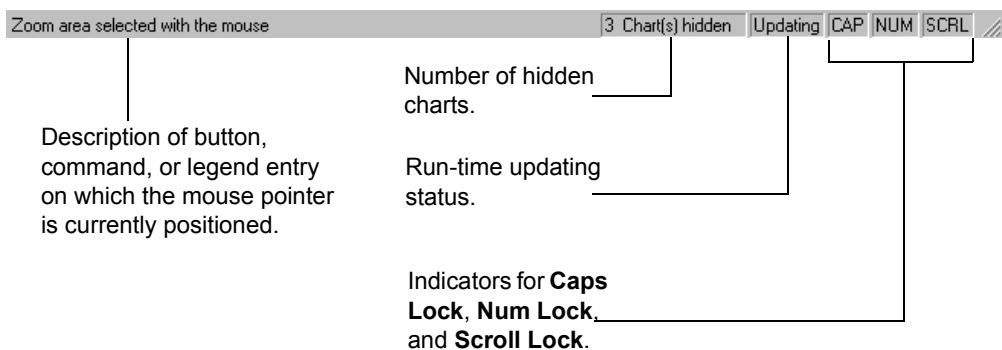

If you move the mouse over a toolbar button, a ToolTip will appear next to the pointer to identify the corresponding command:

Status Bar

The status bar has six *panes*, shown below:

When the pointer is positioned over a toolbar button or highlighted menu command, the first pane displays a short description of the function of the button or command. When the pointer is positioned over a legend item in a chart, the first pane displays the trace name and the name of its originating file.

The second pane displays chart-specific information (for example, the number of hidden charts when only selected charts are displayed).

The third pane displays window-related information. For example, when a chart linked to a data file is updating, the message **Updating** appears in the third pane. When you pause a runtime update, the message **Paused** appears.

Display Area

The *display area* consists of the entire W-Edit interface not occupied by the title bar, menu bar, toolbar, or status bar. W-Edit has a *multiple document interface* (MDI): you can open, view, edit, resize, minimize, or rearrange multiple windows in the display area. The actual area available to contain windows is much larger than the area viewable at any one time; vertical and horizontal scrollbars appear along the sides of the display area if any windows extend beyond the current viewable area.

Windows

The largest discrete unit in the display area is the *window*. You can have multiple windows open but only one window can be active at any given time. The title bar of the active window is highlighted. To make a window active, either click in the desired window or select it from the list of open files in the **Window** menu. You can scroll in windows, and they can be minimized, zoomed (maximized), resized, moved, tiled, and layered (cascaded).

You can create a new window with any one of the following commands:

- **File > New** (page 51)
- **File > Open** (page 51)
- **File > Load Data** (page 53)
- **File > New Simulation Update** (page 53)

Each window in W-Edit corresponds to a **.wdb** file. If you close a window that W-Edit created when it loaded a data file, W-Edit prompts for the name of the **.wdb** file to save. (For information on **.wdb** files, see Viewing and Saving Data on page 30.)

Charts and Traces

Each window in W-Edit consists of one or more *charts*. A chart contains a rectangular *x*- and *y*- axis system, with two-dimensional data in the form of individual continuous curves called *traces*. Auxiliary items—grid lines, tick marks, and explanatory labels—are also included in charts.
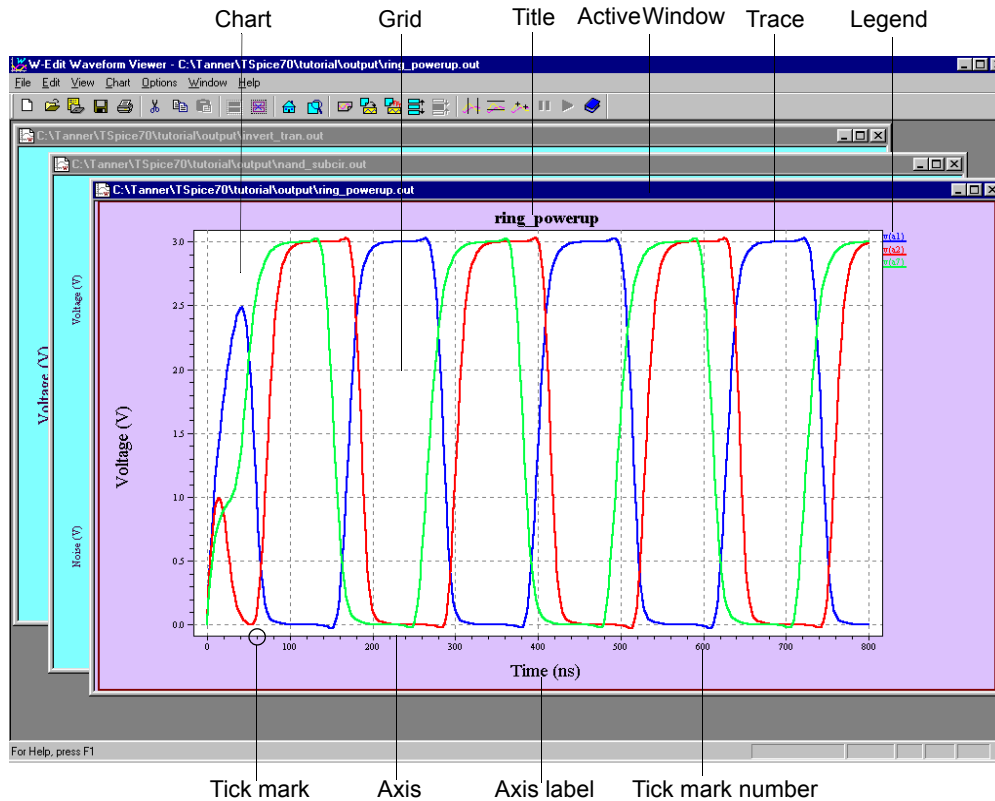
Each chart must have an axis system. W-Edit supports a rectangular axis system, with one *x*- and one *y*-axis.

W-Edit uses built-in ratios to determine the size of the axis system and the positions of the title, labels, and legends in a chart. When you change the chart size, W-Edit adjusts the size and position of chart elements accordingly.

Traces are formed from columns of numbers in the data file. Generally, there is one *x*-column and one corresponding *y*-column to make up the (*x*,*y*) pair of coordinates that form a trace. For information about data columns, see Data File Format on page 84.

Traces that represent individual sweeps from a **.step** or **.alter** command are grouped into *trace families*. Each trace family contains all parameter sweeps or **.alter** simulations for a dependent variable. Traces in a family can be edited individually, but all trace family members share the same label and a single entry in the chart legend.

Each trace has a name, label, and display properties (color, width, style, and marker type). The name of a trace is determined from the data file; you cannot edit trace names in W-Edit. The label appears in the legend to identify a trace or trace family. You can customize the label and display properties in the **Trace Properties** dialog (see Properties on page 65). Members of trace families always have the same label. The name, alias, and file information are displayed in the status bar when the pointer is placed over the trace legend.

When W-Edit initially reads a data file, it displays trace properties according to settings in the **Trace color table** in the **Options > Chart Default Options—Format** dialog (see **Options > Chart Default Options—Format** (page 78)).

Axis Systems

Each chart has exactly one axis system. An axis system consists of an axes rectangle, grid lines, tick marks (on the left and bottom sides), numbers associated with the tick marks, and labels and units for the *x* and *y*-axes. Tick marks and grid lines are automatically adjusted every time you change the view with a zoom or pan operation. You can edit axis labels and units, configure the visibility and spacing of the major and minor tick marks, and set both the *x*- and *y*-axis to show linear or logarithmic scales with **Chart > Options—Axes** (page 72).

W-Edit supports three types of *x*-axis coordinate systems: *Data, Time*, and *Frequency*. W-Edit automatically assigns the *x*-axis system for a chart using header information in the data file. Once an axis system is assigned, incompatible traces (traces with units that do not match the *x*-axis system) cannot be added to the chart.

W-Edit automatically generates both *x*- and *y*-axis labels from information in the data file. Labels have the general format **Type (unit)**; where the **unit** field includes a metric prefix if applicable. **Type** is the name of the axis variable (e.g. Time, Voltage, etc.). For information about how label information is included in data files, see Label Line on page 85.

You can change the text for all labels and units with **Chart > Options—Axes** (page 72)**.** Each axis label combines three editable fields in the **Chart > Options—Axes** dialog: **Label**, **Unit**, and **Engineering prefix**. A sample axis label is shown below:
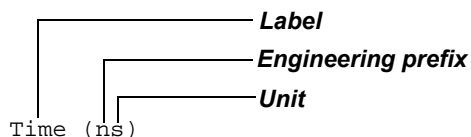
W-Edit always includes parentheses in the label text, even if the units are not specified.

Sometimes different traces in a single chart have different *y*-axis units; in this case W-Edit displays all the units, delimited by commas:
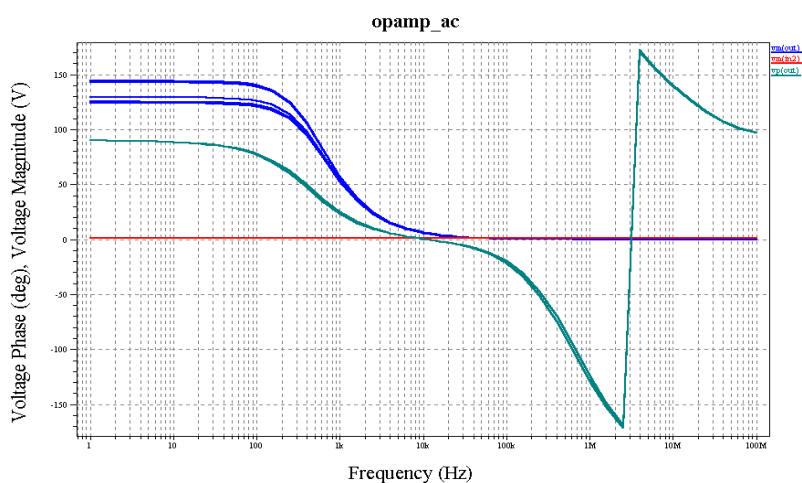
Viewing and Saving Data

A W-Edit input *data file* is the file that contains numerical simulation data. The data file also contains supplementary information about units, labels, analysis types, and parameter values that W-Edit uses to construct a visible representation of the data. Data files are generated by T-Spice, or you can use a text editor or another simulation tool to create them.

W-Edit reads two types of data files: **.out** files, which contain the numeric information as text; and **.dat** files, which contain the numeric information in binary format. In general, **.out** files are created from T-Spice simulations. (For more information on the general format of data files, see Data File Format on page 84.)

You can view data files statically by opening the files (see Opening Files, below), or dynamically through a runtime update operation (see Runtime Update on page 30).

Opening Files

Use **File > Open** (page 51) to open **.wdb**, **.out**, and **.dat** files. You can also open **.out** and **.dat** files with **File > Load Data** (page 53). A **.wdb file** contains chart display settings for a particular data file and a pointer to the data file. When you open a **.wdb file**, W-Edit automatically loads the associated data file along with the saved chart information. When you open a **.out** or **.dat** file, W-Edit displays the data using default chart settings. The default chart title is the filename.

Note: **.wdb** files do not save simulation data; they contain option settings and a pointer to the data file (***.out** or ***.dat**). Please see Saving Files on page 31 for more information on this topic.

Warning: If a **.dat** or **.out** file is deleted, renamed, or moved to a different directory, or if the column headings have changed, W-Edit will be unable to open any **.wdb** file that points to that data file.

Runtime Update

W-Edit can dynamically plot T-Spice simulation data as traces during a *runtime update*. You can initiate a runtime update in two ways:

- Start a T-Spice simulation. Under **Waveform options** select **Show during**. (For more information see Running the Simulation on page 22 of the *T-Spice User Guide and Reference*.)

- Use **File > New Simulation Update** (page 53) to instruct W-Edit to intercept a T-Spice simulation output file that is in progress. W-Edit plots the existing data and dynamically updates the chart as the data is available in the output file.

During a runtime update, W-Edit plots the full *x*-axis range and dynamically updates traces inside the axis system. The *y*-axis range is updated when the traces extend beyond the current range.

You can pause and resume a runtime update at any time during the T-Spice simulation with **File > Pause Auto Update** (page 54) and **File > Resume Auto Update** (page 54), respectively. W-Edit automatically terminates the runtime update when the simulation in T-Spice is halted or completed.

If a data file is displayed in W-Edit and the data in the file is updated through a subsequent simulation, you can statically update all charts linked to the data file by using **File > Update** (page 54). This command is only available when the save date and time of the data file have changed since the file was

loaded into W-Edit. **File > Update** only updates the traces in the chart; chart configurations are unchanged.

Runtime communication between T-Spice and W-Edit is mediated through the output file generated by T-Spice. Therefore, performance may fluctuate across a network due to network traffic.

Saving Files

W-Edit does not save simulation data to a new file. **File > Save** (page 52) and **File > Save As** (page 52) produce W-Edit Database (**.wdb**) files that contain information related to how the data is displayed—chart, trace, and axis settings—along with a pointer to the name and path of the data file. **.wdb** files are in binary format.

Warning: If a **.dat** or **.out** file is deleted, renamed, or moved to a different directory, or if the column headings have changed, W-Edit will be unable to open any **.wdb** file that points to that data file.

Selecting and Deselecting Objects

Most operations and commands work only on selected objects within the active window. W-Edit has three types of objects: charts, traces, and annotations.

To select an object, position the pointer over the object and click the left mouse button. Selecting an object automatically deselects all other objects (except for the active chart, which remains selected). For example, clicking on a trace deselects all annotations and other traces in the chart. To add or subtract an object from the selected group without affecting other selections, press and hold either the **Shift** or **Ctrl** key as you left-click on the object.

Traces and annotations cannot be explicitly selected in deselected charts. Selecting a trace or annotation in a deselected chart will automatically select the chart in addition to the desired object.

You can use the **Edit > Select** and **Edit > Deselect** commands to select all objects of a specific type. The following table describes each command:

Edit > Select > Charts	Selects all charts in the active window.
Edit > Select > Traces	Selects all traces in the selected charts.
Edit > Select > Annotations	Selects all annotations in the selected charts.
Edit > Deselect > Charts	Deselects all charts in the active window.
Edit > Deselect > Traces	Deselects all traces in the selected charts.
Edit > Deselect > Annotations	Deselects all annotations in the selected chart.
Edit > Select All	Selects all charts, traces, and annotations in the active window.
Edit > Deselect All	Deselects all charts, traces, and annotations in the active window.

Selecting Traces

You can select an individual trace by clicking on the trace label in the legend or by clicking on or near the trace. The **Selection range** field in the **Chart Options—General** dialog determines the width of the boundary, in pixels, within which a click will select a trace. (See **Chart > Options—General** (page 70).) Double-clicking a trace opens the **Trace Properties** dialog for the selected trace. (See Properties on page 65.)

Note: Double-clicking anywhere in a chart opens the **Chart Options** dialog. For information on this dialog, see **Chart > Options** (page 69).

4   Data Presentation

Customizing the Display

Chart > Options allows you to customize chart settings for individual charts. You can also save the settings as the default for all new and subsequently opened charts by clicking **Save As Default**.

The following tutorial demonstrates how to customize the display.

☑   Launch W-Edit.

☑   Open **ring.out**. This file is in the **\tutorial\output** subdirectory of the main T-Spice Pro directory.

☑   Select trace **v(a2)**. Use **Edit > Clear** to delete the trace from the chart.

Chart Options—General

☑   Use **Chart > Options** (page 69) or double-click in the chart to open the **Chart Options—General** dialog. For specific information on each field, see **Chart > Options—General** (page 70).
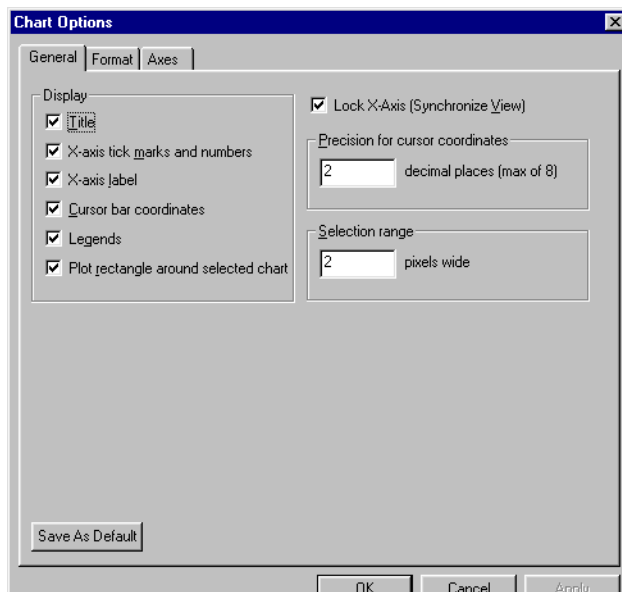
☑   Change the **Chart title** to **W-Edit Exercise**.

☑   Notice the options under **Display**. Place a check in each of the check boxes. (For information on each option, see **Chart > Options—General** (page 70).)

☑   Change the **Precision for cursor coordinates** to **3**.

☑   Change the **Selection range** to **5**.

☑   Click **Apply** to apply the changes without closing the dialog.

Chart Options—Format

☑   Click the **Format** tab. For specific information on each field, see **Chart > Options—Format** (page 71).
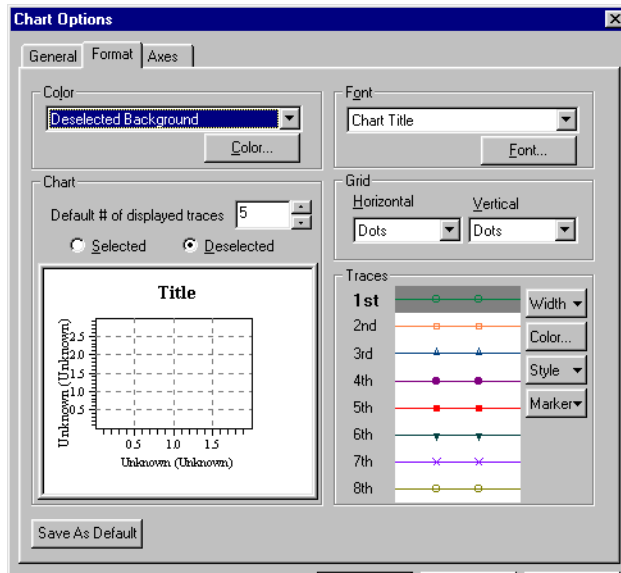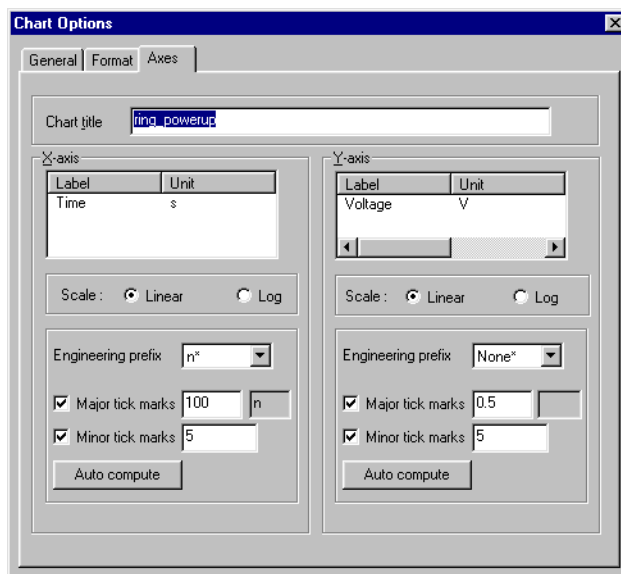

The **Chart Options—Format** dialog contains color settings for selected and deselected charts. You determine which state the dialog is in at a given time by selecting the **Selected** or **Deselected** option under **Chart**. The illustration reflects the settings for the particular state.

☑   Choose the **Deselected** option under **Chart**. In the **Color** drop-down list, change the color of the **Deselected Background**, **Deselected Foreground**, and **Grid Color**.

☑   Choose the **Selected** option under **Chart**. In the **Color** drop-down list, change the color of the **Selected Background** and **Selected Foreground**.

☑   Click **Apply** to apply the changes.

☑   In the **Font** drop-down list, select **Chart Title**. Click the **Font** button. Change the **Font style** to **Italic** and the **Size** to **24**. Click **OK**.

☑   Change the font size for the other items in the **Font** drop-down list: **Labels and Units**, **Cursor Coordinates**, **Major Tick Number**, and **Legend**.

☑   Under **Grid**, change the **Horizontal** and **Vertical** lines from **Dots** to **Dashed** in the drop-down lists.

☑   Click **Apply** to apply the changes.

Chart Options—Axes

☑   Click the **Axes** tab.

The **Chart Options—Axes** dialog contains label, scale, and tick mark settings for the *x*- and *y*-axes. For specific information on each field, see **Chart > Options—Axes** (page 72).

☑   Under **X-axis**, change **Major tick marks** to **125**. Change **Minor tick marks** to **4**.

☑   Under **Y-axis**, change the text in the **Label** field to **Voltage at nodes a1 & a7**. Change the text in the **Units** field to **Volts**.

☑   Under **Y-axis**, change **Major tick marks** to **0.3**. Change **Minor tick marks** to **3**.

☑   Click **OK** to apply the changes and close the dialog.

☑   Use **File > Save** (page 52) to save the file as **ring.wdb**.

The final display should look similar to the illustration below.
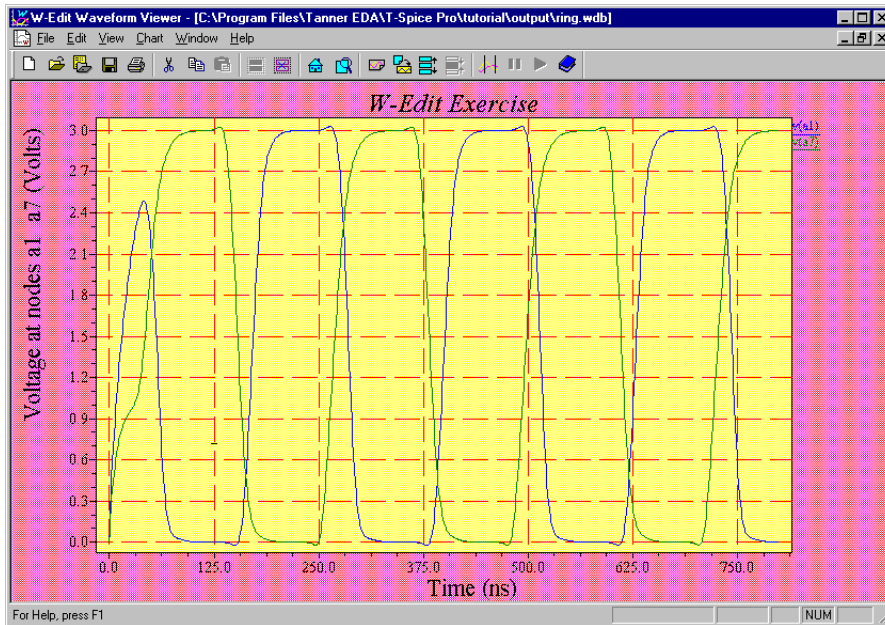
5   Fast Fourier Transform

Introduction

Spectral analysis is used to represent a time-domain signal in terms of its frequency components. The most common form of spectral analysis, the discrete Fourier transform (DFT), employs the Fourier transform on discrete-time signals to calculate Fourier coefficients at samples along the frequency spectrum. W-Edit implements an efficient and accurate approximation to the DFT, the Fast Fourier Transform (FFT).

The FFT can be run on transient analysis data in W-Edit using **Chart > FFT** (page 67) or the FFT toolbar button .

Sampling

The FFT algorithm requires that transient analysis data have the following characteristics:

- The total number of data points must be equal to a power of 2.
- The samples must be equally spaced in time.

Because the T-Spice dynamic time-stepping algorithm results in unequal time steps, T-Spice transient analysis simulation results will normally not meet the sampling criteria stated above (unless **.options prtdel** is used). To meet FFT requirements, W-Edit uses polynomial interpolation to re-sample the transient data at an appropriate number of equal time intervals. You can choose both the number of samples and the order of polynomial interpolation in the **Chart > Options—FFT** (page 74) dialog.

The sampling rate of time-domain data, F_s, is the highest frequency that can be distinguished from a discrete-time Fourier transform. Frequency data resulting from the FFT is periodic with period $2F_s$; frequencies greater than the sampling rate are "folded" back into the lower frequencies, rendering them indistinguishable. This artifact of the FFT is called aliasing. W-Edit provides an option to prevent aliasing using the "best fit" number of points.

The best fit number is based on the Nyquist theorem, which states that the FFT sample rate must be at least twice the highest frequency present in the time-domain. If W-Edit resamples transient data at a rate below the Nyquist requirement, aliasing may result. When you select the best fit option, W-Edit calculates a number equal to four times the total time range of the signal, divided by the smallest peak-to-peak wavelength. W-Edit rounds this number up to the nearest power of two to determine the "best fit".

Consider, for example, the following sample data:
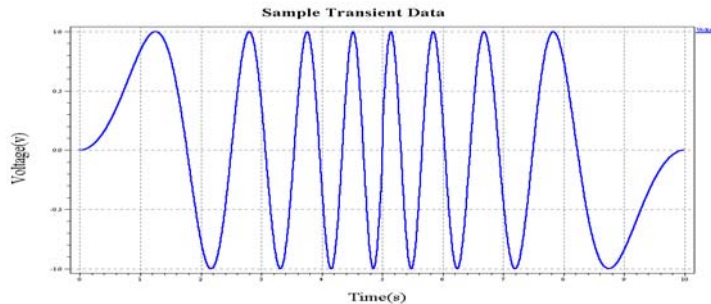
Because the regions at the beginning and end of the transient analysis have relatively low frequency, they may be originally sampled at a lower rate than the high frequency middle section. When W-Edit applies uniform sampling, a sampling frequency is required that preserves the highest frequencies in the signal.

In this example, the smallest peak-to-peak wavelength is 0.6 seconds, with the data spanning a total time range of 10 seconds. W-Edit will calculate the best fit number as:

$$bf = 4\left(\frac{10s}{0.6s}\right) = 66.7,$$

which is rounded to the next highest power of 2 to give:
$$bf = 128.$$

W-Edit will resample the transient data with 128 equally spaced time intervals, thus ensuring that all frequencies present in the original signal are preserved.

T-Spice can also control both the sampling interval and interpolation of transient analysis output during simulation. The T-Spice command **.options prtdel** causes T-Spice to produce transient analysis data at fixed time intervals. The T-Spice option **.options prtinterp=[0|1]** determines how T-Spice achieves fixed time steps. If **prtinterp** is 1 (true), then solutions are first calculated at the T-Spice engine's internal time steps. The transient output at fixed time intervals is linearly interpolated from the internal time step data. If **prtinterp** is 0 (false), then T-Spice is forced to directly calculate solutions at fixed time steps. T-Spice continues to take additional internal time steps to ensure accuracy. For more information on sampling controls in T-Spice, see **Timestep and Integration Options** (page 236) in the *T-Spice User Guide*.

Window Functions

The transient analysis data you view in W-Edit will necessarily be finite. The FFT calculation uses a periodic extension of the signal; thus, if the transient data is either aperiodic or contains a non-integer number of periods, discontinuities will result. These regions of sharp transition may cause artifacts in spectral analysis. One way to minimize the effects of a finite signal is to apply a window function during the FFT. Windows are designed to preserve full signal strength at the center and taper gradually to zero at the edges. As a result, the beginning and end points of the signal data are smoothly matched to eliminate large discontinuities.

W-Edit offers the following standard window functions:

- Rectangular (default)

- Bartlett

- Welch

- Hanning

- Hamming

- Blackman

- Blackman-Harris

- Gaussian

- Kaiser-Bessel

You can select a window function in the **FFT Windows** section of the **Chart > Options—FFT** (page 74) dialog. Two of the window functions, Gaussian and Kaiser-Bessel**,** are calculated based on a parameter called alpha. If either of these windows is selected, a field becomes available in which you can define alpha.

The dialog for selecting a window function is shown below.
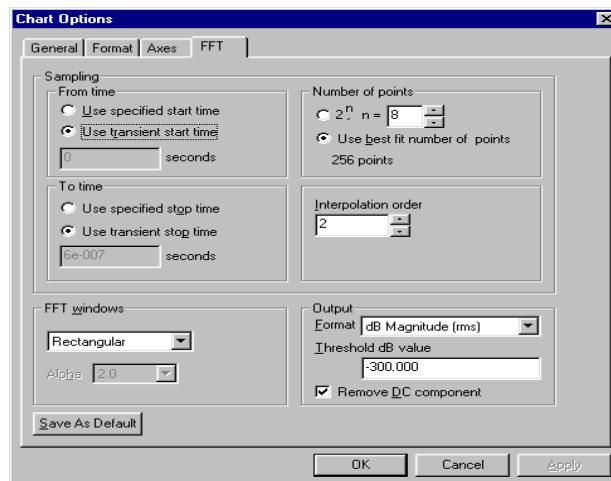
Window functions present a compromise between *spectral spreading* and *spectral leakage*. The frequency response of most windows is an oscillating function that decays with frequency. Spectral spreading, which causes a loss of spectral resolution, is proportional to the width of the mainlobe. Spectral leakage is the introduction of high frequencies from sidelobes. Mainlobe width and sidelobe amplitude have an inverse relationship. The choice of an appropriate window function depends on the characteristics of your data and on your goals in performing spectral analysis. As a general rule, the more complex window functions have better performance characteristics.

A description of each available window function is given on the following pages. All of the graphs and frequency responses correspond to 64-point windows. In the window equations, *n* is the index of window data points, N is the total number of points in the window, and W(*n*) is the value of the window function at point *n*.

Rectangular Window

The rectangular window is equivalent to not applying any window at all. Its magnitude is one for the entire duration of the window; the data signal remains unaltered during FFT.

The rectangular window is the default in W-Edit, and it is the simplest approach to performing an FFT. Of all the windows of a given size, the rectangular window has the best spectral resolution and the worst spectral leakage. Spectral leakage is high because the edges are not tapered, thus permitting high-frequency discontinuities to persist in the FFT.

The rectangular window is shown below. The time-domain window is graphed on the left, and the frequency response (in dB) is graphed on the right.
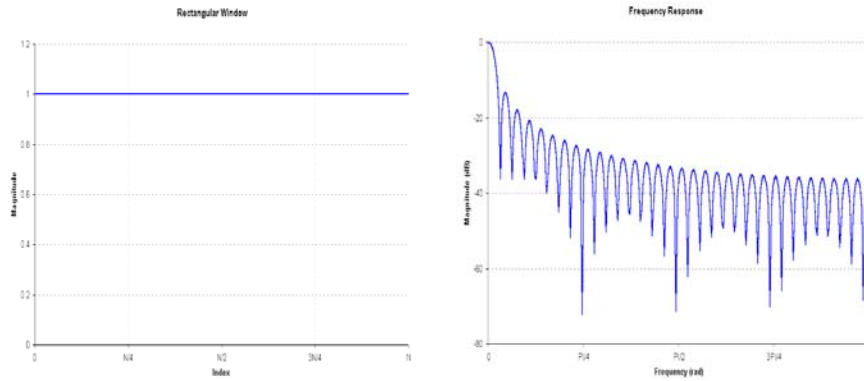
Bartlett Window

The Bartlett window is simply a triangle with unit amplitude at the center of the window and zero amplitude at the edges. The equations for a Bartlett window are given by:

$$W(n) = \frac{2n}{N}, 0 \leq n \leq \frac{N}{2}$$

$$W(n) = \frac{2(N \angle n)}{N}, \frac{N}{2} \leq n \leq N \angle 1$$

The Bartlett window is shown below, along with its frequency response.
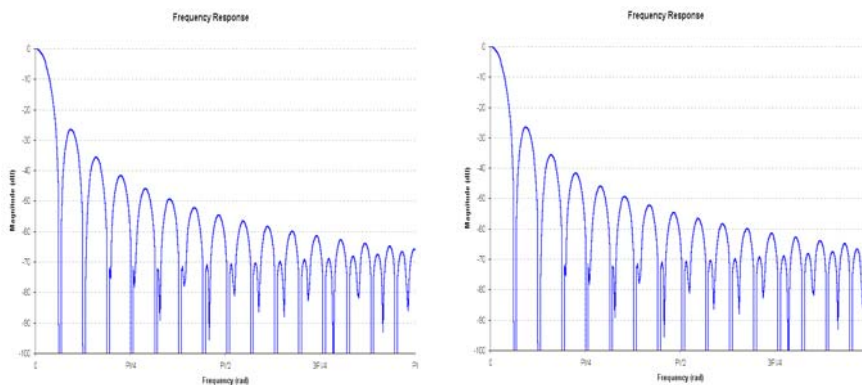
Welch Window

The Welch window is described by the equation:

$$W(n) = 1 \angle \left[\frac{n \angle \frac{N}{2}}{\frac{N}{2}} \right]^2$$

The Welch window and corresponding frequency response are shown below.
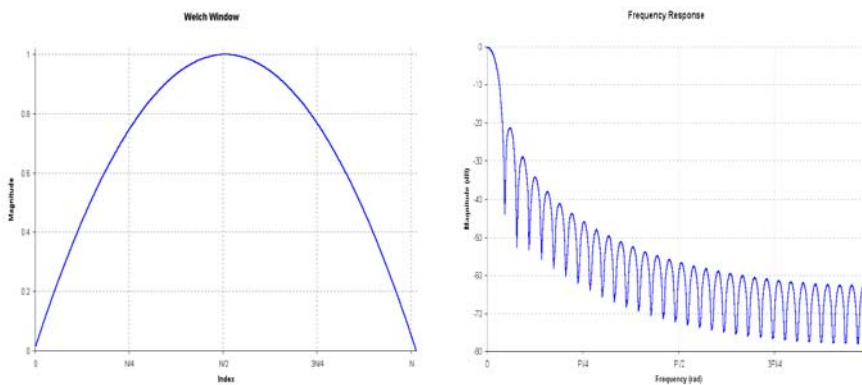
Hanning Window

The Hanning, Hamming, Blackman, and Blackman-Harris windows are described by increasingly complex cosine functions. The simplest of these is the Hanning window, which is described by the equation:

$$W(n) = 0.5 \angle 0.5 \cos\left(\frac{2\pi n}{N}\right)$$

The Hanning window and corresponding frequency response are shown below.
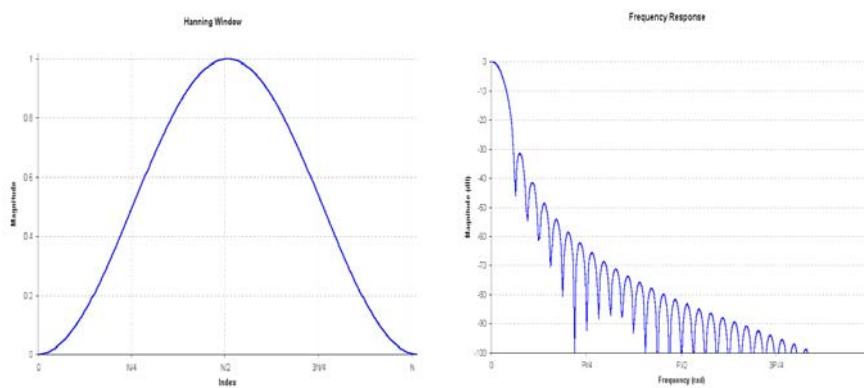
Hamming Window

The Hamming window is described by the equation:

$$W(n) \;=\; 0.54 \angle 0.46 \cos\left(\frac{2\pi n}{N}\right)$$

The Hamming window and corresponding frequency response are shown below.
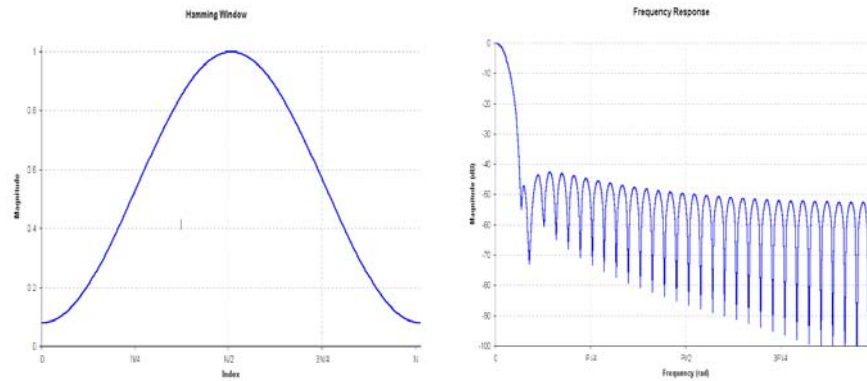
Blackman Window

The Blackman window is calculated by the equation:

$$W(n) \;=\; 0.42659 \angle 0.49656 \cos\left(\frac{2\pi n}{N}\right) + 0.07685 \cos\left(\frac{4\pi n}{N}\right)$$

The Blackman window and its corresponding frequency response are shown below.
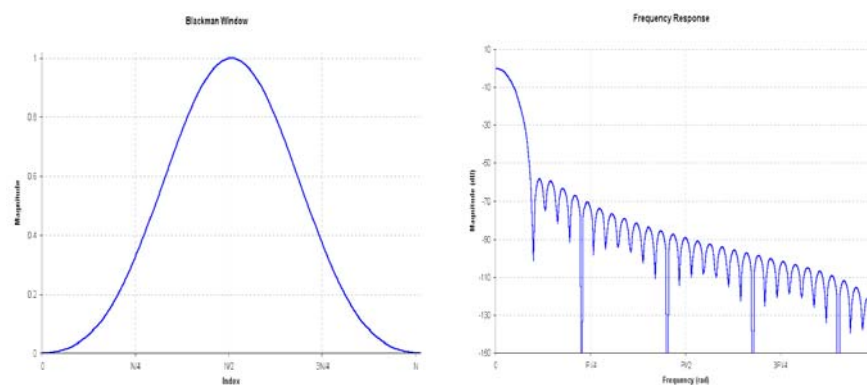
Blackman-Harris Window

The Blackman-Harris window is described by the equation:

$$W(n) = 0.35875 \angle 0.48829 \cos\left(\frac{2\pi n}{N}\right) + 0.14128 \cos \quad \left(\frac{4\pi n}{N}\right)$$

$$\left(\angle 0.01168 \cos\left(\frac{6\pi n}{N}\right) \right)$$

The Blackman-Harris window and corresponding frequency response are shown below.
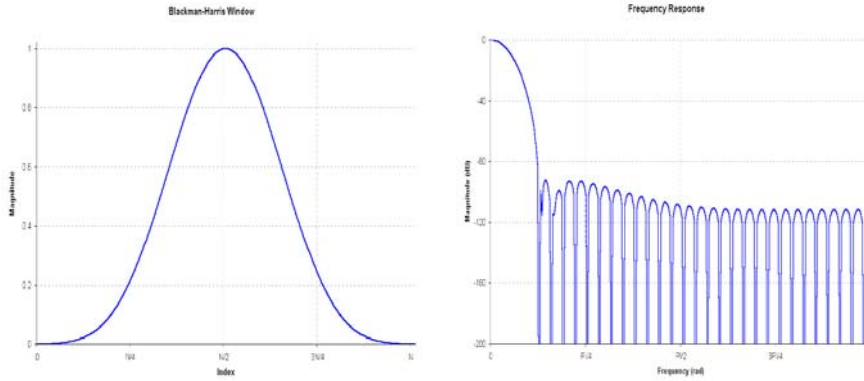
Gaussian Window

The Gaussian window function is a Gaussian probability distribution with mean N/2. The Gaussian window has a user-specified parameter, alpha, that is inversely related to the width of the curve.

$$W(n) = \exp\left(\frac{\angle \alpha^2 \left(n \angle \frac{N}{2}\right)^2}{2N^2} \right)$$

The Gaussian window and corresponding frequency response are shown below for varying alpha.
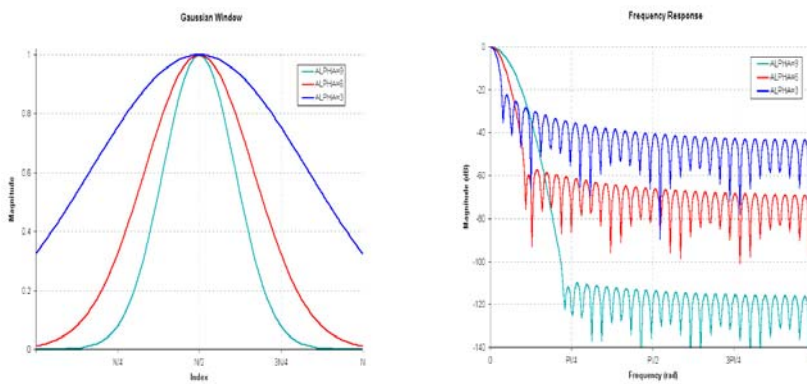
Kaiser

The Kaiser window is also a function of the parameter alpha. Varying alpha will alter characteristics of the Kaiser window such as 3-dB bandwidth, sidelobe levels, and process loss. The Kaiser window function is:

$$W(n) = \frac{I_0\left(\alpha\sqrt{1 \angle \left(\frac{2(n \angle (N/2))}{N}\right)^2}\right)}{I_0(\alpha)}$$

where I_0 is the zero-order modified Bessel function. The Kaiser window and corresponding frequency response are shown below for varying alpha.
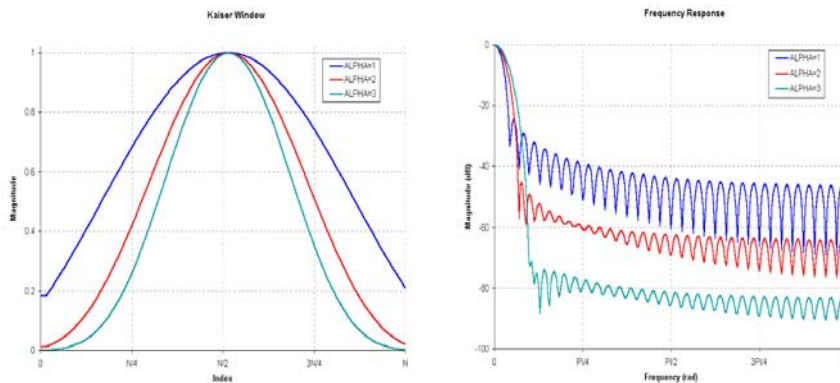
FFT Output

In general, an FFT data point z can be represented as a complex number:

$z = x + y$i, where i $= (-1)^{1/2}$.

W-Edit uses one of the following output formats to calculate a real number representation of z. Other output fields are described in **Chart > Options—FFT** (page 74)

Format	Definition	Y-Axis Label
Magnitude	$(x^2 + y^2)^{1/2}$	**Label (*Unit* rms)**
dB Magnitude	Magnitude in dB: $20 \cdot \log_{10}[(x^2 + y^2)^{1/2}]$	**Label (dB *Unit* rms)**
dB Relative Magnitude	dB Magnitude shifted so that peak value is 0: $dBMag$ - max($dBMag$)	**Relative *Label* (dB *Unit* rms)**
Phase	$\arctan(x/y)$	**Label Phase (degrees)**
Unrolled Phase	Running sum of the phase difference between frequency bins: $UP(n) = UP(n\text{-}1) + \Delta P$	**Label Phase Sum (degrees)**

Format	*Definition*	*Y-Axis Label*
Real Part	x	**Real** *Label* (***Unit***)
Imaginary Part	y	**Imaginary** *Label* (***Unit***)

FFT Charts in W-Edit

W-Edit automatically creates a new chart every time you use the FFT command. As you manipulate FFT charts and their options settings, the following principles will apply.

- **Chart > FFT** causes W-Edit to perform a separate FFT for each trace in the selected chart. W-Edit then creates a new chart to display all of the FFT calculations.

- W-Edit identifies an FFT trace by the transient analysis data it represents. Traces with different options that were calculated from the same data are considered duplicates. If you collapse such traces onto a single chart, W-Edit will keep the only first trace and its corresponding options. You cannot display multiple versions of the same FFT data on one chart.

- When you collapse traces with different properties, W-Edit keeps the properties for each trace. If you edit the **Chart > Options** dialogs, however, W-Edit will redisplay all traces with the current settings.

6   Command Reference

File Menu

Command	Shortcut	Toolbar Button
File > New (page 51)	**Ctrl+N**	
File > Open (page 51)	**Ctrl+O**	
File > Close (page 52)		
File > Save (page 52)	**Ctrl+S**	
File > Save As (page 52)		
File > Load Data (page 53)		
File > New Simulation Update (page 53)		
File > Pause Auto Update (page 54)		
File > Resume Auto Update (page 54)		
File > Update (page 54)		
File > Print Setup (page 55)		
File > Print Preview (page 55)		
File > Print (page 56)	**Ctrl+P**	
File > (most recently opened) (page 56)		
File > Exit (page 56)		

Edit Menu

Command	*Shortcut*	*Toolbar Button*
Edit > Cut (page 57)	**Ctrl+X**	✂
Edit > Copy (page 57)	**Ctrl+C**	📄
Edit > Paste (page 57)	**Ctrl+V**	📋
Edit > Paste Special (page 57)	**Ctrl+Shift+V**	
Edit > Clear (page 58)	**Del**	
Edit > Select > Charts (page 58)		
Edit > Select > Traces (page 58)		
Edit > Select > Annotations (page 58)		
Edit > Deselect > Charts (page 58)		
Edit > Deselect > Traces (page 58)		
Edit > Deselect > Annotations (page 58)		
Edit > Select All (page 58)	**Ctrl+A**	
Edit > Deselect All (page 58)	**Ctrl+D**	

View Menu

Command	Shortcut	Toolbar Button
View > Toolbar (page 59)		
View > Status Bar (page 59)		
View > Mouse Zoom (page 59)	Z	
View > Zoom In X (page 59)		
View > Zoom In Y (page 59)		
View > Zoom In (page 59)	+	
View > Zoom Out (page 59)	-	
View > Home View (page 60)	Home	
View > Zoom Range (page 60)		
View > Pan > Left (page 60)	left arrow	
View > Pan > Right (page 61)	right arrow	
View > Pan > Up (page 61)	up arrow	
View > Pan > Down (page 61)	down arrow	
View > Show Only Selected Charts (page 61)		
View > Show All Charts (page 61)		

Chart Menu

Command	Shortcut	Toolbar Button
Chart > New Chart (page 62)		
Chart > Traces (page 62)		
Chart > Export Data (page 66)		
Chart > FFT (page 67)		
Chart > Export Data (page 66)		
Chart > Cursors > Vertical Bars (page 67)		
Chart > Cursors > Horizontal Bars (page 67)		
Chart > Cursors > Markers (page 68)		
Chart > Cursors > Clear All (page 68)		
Chart > Expand Chart (page 68)		
Chart > Collapse Charts (page 69)		
Chart > Lock X-Axis (page 69)		
Chart > Options (page 69)		

Option Menu

Command	Shortcut	Toolbar Button
Options > Chart Default Options (page 77)		
Options > Global Options (page 81)		

Window Menu

Command	Shortcut	Toolbar Button
Window > Cascade (page 82)		
Window > Tile Horizontally (page 82)		
Window > Tile Vertically (page 82)		
Window > Arrange Icons (page 82)		
Window > Close All (page 82)		
Window > (most recently opened) (page 82)		

Help Menu

Command	Shortcut	Toolbar Button
Help > W-Edit User Guide (page 83)		
Help > T-Spice User Guide (page 83)		
Help > T-SpiceT-Spice Pro Tutorials (page 83)		
Help > T-SpiceAbout W-Edit (page 83)		

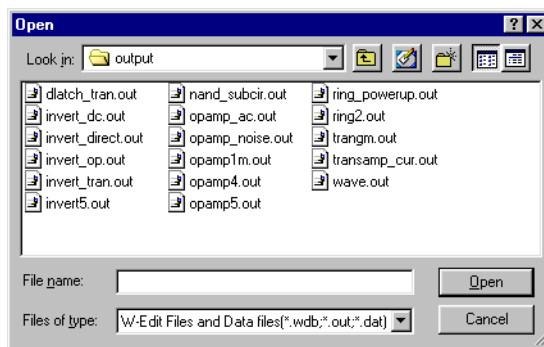# File Commands

File > New

Creates a new document with an empty chart.

Use this command to create a new chart with traces from different data files; paste traces or charts from the Clipboard; or arithmetically create new traces based on the *x*-axis unit.

File > Open

Prompts for the name and path of an existing W-Edit or data file to open as the active window.

Look in	The source directory. The drop-down list shows the parent directory and subdirectories, any of which may be chosen as the new source directory.
File name	The name of the file to be opened. The wildcard character ***** can be used to limit the list of available files. (For example, to list only **.wdb** files whose names begin with the letter **a**, type **a*.wdb** and press **Enter**.) All files of the specified type in the source directory are listed.
Files of type	The type of file listed. There are three predefined types:

- W-Edit files (**.wdb**)
- T-Spice ASCII output files (**.out**)
- T-Spice binary output files (**.dat**)

Select (***.***) to list all files in the source directory.

Warning: **.wdb** files store pointers to data files and trace names, not the data itself. Deleting, renaming, or moving a data file to a different directory or changing the trace names will cause the link in the **.wdb** file to fail.

When W-Edit cannot find the links in a **.wdb** file, the **File > Open** operation fails and W-Edit displays the following notice:

File > Close

Closes the active window. Prompts to save the file in **.wdb** format if the file has not been saved since the last change.
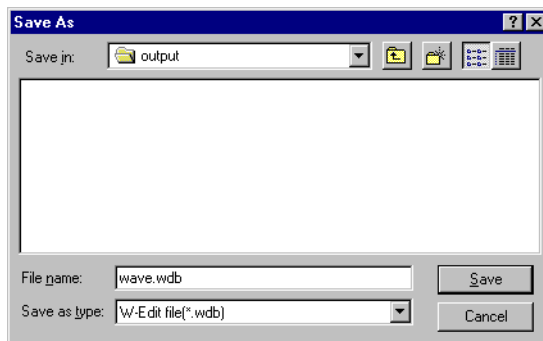
File > Save

Saves the active window in **.wdb** format, using the same name and path as when last saved. If the active window has not previously been saved, the **Save As** dialog (**File > Save As** on page 52) opens.

Note: Chart settings and links to data files are saved in the **.wdb** file. Trace data is not saved directly in **.wdb** files.

File > Save As

Saves the active window as a new **.wdb** file, prompting for the filename and path. A warning appears if the name chosen belongs to an existing file.

|	
Save in	The target directory into which the file is to be saved, with a list of its parent directory and its subdirectories, any of which may be chosen as the new target directory.
File name	The name of the new file. The saved file must have a specific name. All files of the specified type in the target directory are listed. The wildcard character ***** can be used to search for an existing filename (see **File > Open** on page 51).
Save as type	The type of file listed. W-Edit files must be saved in **.wdb** (W-Edit database) format.

File > Load Data

Prompts to load a data file, then creates a new document with chart and axis types configured according to the information read from the file.
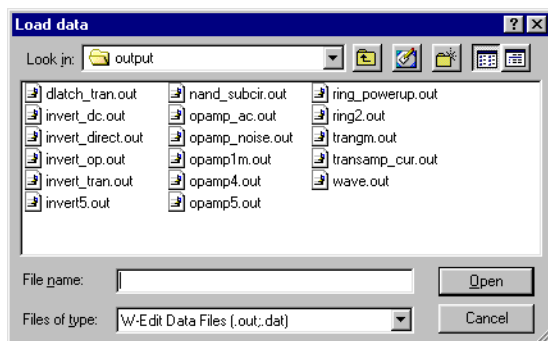
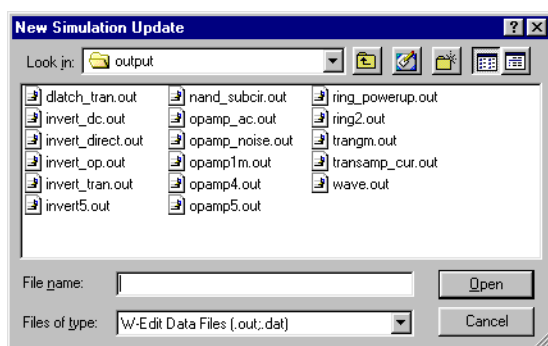| Look in	The source directory. The drop-down list shows the parent directory and subdirectories, any of which may be chosen as the new source directory.
File name	The name of the file to be opened. The wildcard character ***** can be used to limit the list of available files (see **File > Open** on page 51). All files of the specified type in the source directory are listed. Only one file can be opened at a time.
Files of type	The type of file listed. There are two predefined types:

- T-Spice ASCII output files (**.out**)
- T-Spice binary output files (**.dat**)

All files in the source directory are listed with (***.***).

Note: **.wdb** files cannot be opened with **File > Load Data**. To open a **.wdb** file, use **File > Open** on page 51.

File > New Simulation Update

Prompts for the name and path of a runtime data file in T-Spice to dynamically link to W-Edit. W-Edit creates a new chart window and plots the data as it is simulated in T-Spice. The plot continues until W-Edit reaches an end-of-simulation marker or the simulation is halted in T-Spice.

Look in	The source directory. The drop-down list shows the parent directory and subdirectories, any of which may be chosen as the new source directory.
File name	The name of the file to be linked. The wildcard character ***** can be used to limit the list of available files (see **File > Open** on page 51). All files of the specified type in the source directory are listed. Only one file can be linked at a time.
Files of type	The type of file listed. There are two predefined types:

- T-Spice ASCII output files (**.out**)

- T-Spice binary output files (**.dat**)

All files in the source directory are listed with (***.***).

File > Pause Auto Update

Halts automatic plotting of T-Spice runtime data files. The link to the data file remains. You can resume plotting with **File > Resume Auto Update** on page 54.

Note: This command is available for files automatically linked to W-Edit from T-Spice using the **Show during** option in T-Spice. (For information on this option see Running the Simulation on page 22 of the *T-Spice User Guide and Reference*.) It is not available for data files linked with **File > New Simulation Update** on page 53.
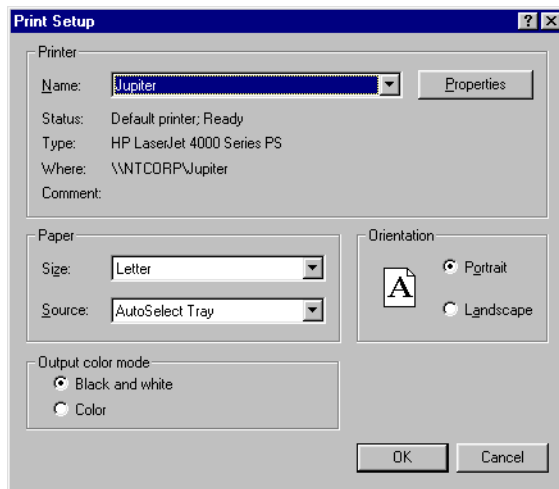
File > Resume Auto Update

Resumes plotting of runtime data files paused with **File > Pause Auto Update** on page 54.

File > Update

Statically updates all charts in the active window linked to a data file. This command is only available when the date and time of the data file have changed since the file was loaded into W-Edit. Chart configurations remain unchanged.

File > Print Setup
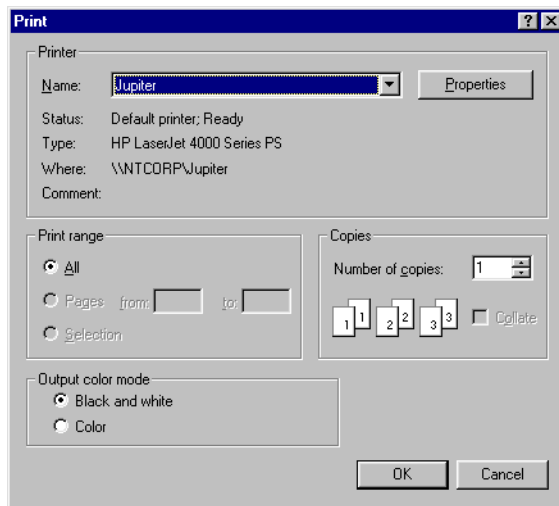
Changes the printer and printing options.

Printer	The default device to which the data in the active window will be printed.
Properties	Opens the **Properties** dialog. For information on these options, see your Windows documentation.
Paper	The size and source of the paper.
Orientation	Whether the long side of the page(s) printed will be vertical (**Portrait**) or horizontal (**Landscape**) relative to the text.
Output color mode	Determines what color information W-Edit sends to the printer:

- **Black and white**—Foreground objects are set to black and background objects are white.
- **Color**—W-Edit sends color instructions to the printer that match the color settings on your screen. If you are not using a color printer, then the printer will translate color instructions to grayscale.

File > Print Preview

Displays the active window as it will be printed in full-page mode. Charts cannot be edited in this mode.

File > Print

Prompts for instructions, then prints the active window.

Printer	The device to which the active window will be printed.
Properties	Opens the **Properties** dialog. For information on these options, see your Windows documentation.
Print range	Option not supported.
Copies	Number and order of copies to be printed.
Output color mode	Determines what color information W-Edit sends to the printer:

- **Black and white**—Foreground objects are set to black and background objects are white.

- **Color**—W-Edit sends color instructions to the printer that match the color settings on your screen. If you are not using a color printer, then the printer will translate color instructions to grayscale.

File > *(most recently opened)*

Opens recently opened files directly, bypassing **File > Open** on page 51 and **File > Load Data** on page 53. The most recently opened files are listed first.

File > Exit

Exits W-Edit. A warning appears for each open document that has not been saved in a **.wdb** file.

Edit commands

Edit > Cut

Copies selected traces, annotations, or charts to the Clipboard and removes them from the display area. Selected traces include both numerical data and display properties (label, line style, color, width, and markers).

Traces and charts are copied to the internal Clipboard and can be used in W-Edit documents. Charts are also copied to the external Clipboard and can be pasted or embedded in other applications.

Note: Annotations cannot be pasted into a chart. If you select an annotation and choose **Edit > Cut**, the annotation will be removed from the chart. However, if you attempt to paste the annotation into another chart, W-Edit will instead copy the entire original chart and annotation into the active window.

Edit > Copy

Copies selected traces or charts to the Clipboard without removing them from the display area. Selected traces include both numerical data and display properties (label, line style, color, width, and markers).Traces and charts are copied to the internal Clipboard and can be used in W-Edit documents. Charts are also copied to the external Clipboard and can be pasted or embedded in other applications.

Note: You cannot copy and paste annotations separately from charts.

Edit > Paste

Pastes the contents of the internal Clipboard into the display area. If the contents are traces, they are pasted into the selected chart(s). Trace properties (line style, width, color, and marker types) are included in the standard paste operation. (To paste only the trace data, use **Edit > Paste Special** on page 57.) If the contents are charts, they are pasted into the bottom of the active window.

Edit > Paste Special

Selects the amount of trace information to paste from the Clipboard. **Paste Special** is only enabled after cutting or copying a trace. When W-Edit is first installed, the default setting is **Data only**. W-Edit maintains the most recent selection as the current default.
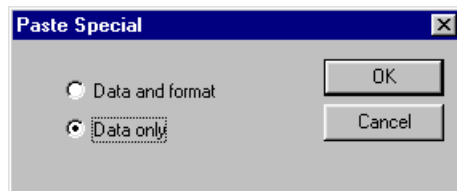
Data and format	Pastes both trace data and trace properties (line style, color, width, and marker type) into the selected chart. This is equivalent to **Edit > Paste**.
Data only	Pastes only trace data into the selected chart. Trace properties will be assigned according to the chart settings.

Edit > Clear

Deletes the selected traces, annotations, or charts without saving them to the clipboard.

Edit > Select > Charts

Selects all charts in the active window.

Edit > Select > Traces

Selects all traces in selected charts in the active window. Selected charts in nonactive windows are not affected.

Edit > Select > Annotations

Selects all annotations in selected charts in the active window. Selected charts in nonactive windows are not affected.

Edit > Deselect > Charts

Deselects all charts in the active window. Selected charts in nonactive windows are not affected.

Edit > Deselect > Traces

Deselects all traces in selected charts in the active window. Selected charts in nonactive windows are not affected.

Edit > Deselect > Annotations

Deselects all annotations in selected charts in the active window. Selected charts in nonactive windows are not affected.

Edit > Select All

Selects all objects (charts, traces, and annotations) in the active window.

Edit > Deselect All

Deselects all objects (charts, traces, and annotations) in the active window.

View Commands

Unless you are using a command where it is set explicitly, the default zoom-in or -out value is 10%.

Note that zooming in or out of a chart that is part of a locked view set causes all charts in the set to be zoomed. See **Chart > Lock X-Axis** on page 69.

View > Toolbar

Displays or hides the toolbar.

View > Status Bar

Displays or hides the status bar.

View > Mouse Zoom

Zooms to a rectangular area (box) in a selected chart, specified with the mouse.

To draw the mouse zoom box, click in the area within the axes with the left mouse button and drag the mouse until the desired area is within the box. When you release the button, the corners of the box in the old view become the limits of the axes in the new view. The entire box must be within the area contained by the axes. If you release the button outside the axes, the limits of the box are clipped to the bounds of the old axes.

View > Zoom In X

Zooms into the x-axis keeping the y-axis range unchanged.

View > Zoom Out X

Zooms out of the x-axis keeping the y-axis range unchanged.

View > Zoom In Y

Zooms into the y-axis keeping the x-axis range unchanged.

View > Zoom Out Y

Zooms out of the y-axis keeping the x-axis range unchanged.

View > Zoom In

Magnifies the selected charts by 10 percent in both axes. Scroll bars appear automatically if any trace is not completely displayed.

View > Zoom Out

Expands the view of the selected charts by 10% in both axes.

View > Home View

Sets the axis ranges on the selected charts to include the extreme (smallest and largest) data values in each chart.

Axis scale (log or linear) and major and minor tick marks are preserved according to the current **Chart > Options—Axes** settings. W-Edit reverts metric prefixes of axis numbers to their default settings.

W-Edit removes scroll bars from charts in home view.

Note: For logarithmic data, the smallest and largest data values that determine home view do not include values less than 10^{-15}. Values below 10^{-15} are clipped; W-Edit does not include them in the display.

View > Zoom Range

Zooms into a specific region in a selected chart. You can specify *x*- and *y*-axis ranges for only a single chart at a time. Selecting multiple charts disables the command.
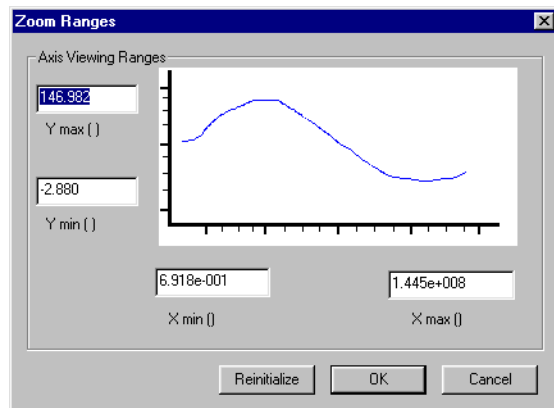
Axis Viewing Ranges	Designates the maximum and minimum *x*- and *y*-axis values to display.
Reinitialize	Resets the **Axis Viewing Range** values to the selected chart's **Home View** ranges.

Zoom range values are automatically reinitialized when you expand a chart. W-Edit removes scroll bars from the selected chart when a zoom range is applied.

Note: The **View > Zoom Range** command only applies to the selected chart. Charts in the same lock-view set are not affected by this command.

View > Pan > Left

Moves the selected charts' views to the left by 10% of each chart's visible *x*-axis range. Selected charts pan together, and charts in a lock-view set pan together. This command is equivalent to pressing the left arrow key.

View > Pan > Right

Moves the selected charts' views to the right by 10% of each chart's visible x-axis range. Selected charts pan together, and charts in a lock-view set pan together. This command is equivalent to pressing the right arrow key.

View > Pan > Up

Moves the selected charts' views up by 10% of each chart's visible y-axis range. Selected charts pan together. This command is equivalent to pressing the up arrow key.

View > Pan > Down

Moves the selected charts' views down by 10% of each chart's visible y-axis range. Selected charts pan together. This command is equivalent to pressing the down arrow key.

View > Show Only Selected Charts

Hides unselected charts and shows only selected charts in the active window. A message indicating how many charts are hidden appears on the right side of the status bar. Charts in nonactive windows are not affected.

Note: You cannot use the **Edit > Select All** command in this mode.

View > Show All Charts

Shows all selected and deselected charts in the active window. Charts in nonactive windows are not affected.

Chart Commands

Chart > New Chart

Adds a new, untitled chart at the bottom of the active window. The new chart is selected and all other charts in the active window are deselected.

Chart > Traces

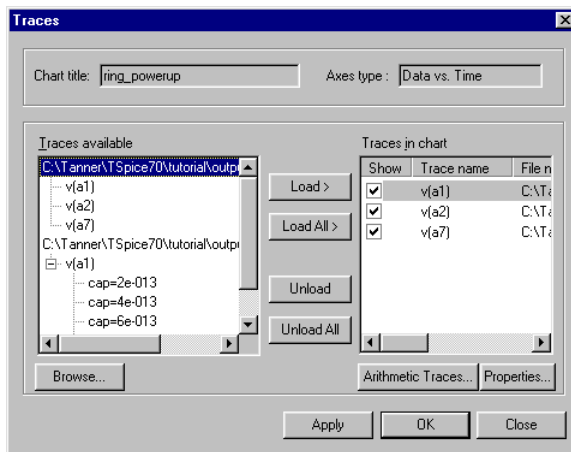Prompts to load and display traces from open files in the selected chart. Only one chart can be selected at a time.

Chart title	Read-only field that displays the name of the selected chart. You can change the chart title in **Chart > Options—Axes**.
Axes type	The axes type for the selected chart. Every trace has an associated axes type that is automatically determined from the data file, and only *one* axes type can be represented on a single chart. The axes types are:

- **Data vs. Time**—transient analysis data

- **Data vs. Freq.**—AC and noise analysis data

- **Data vs. Data**—Transfer analysis data

- **Unknown**

W-Edit assigns the **Unknown** type to an empty chart. When **Unknown** is displayed, you can select an axes type from a pull-down menu. Once an axes type is assigned, only traces that match that type can be loaded onto the chart.

When you load a trace on a chart with **Unknown** axes type, the chart's axes type is automatically reset to that of the loaded trace.

You cannot edit the axes type for a trace or for a chart that contains traces. You cannot add traces with different axes types to the same chart.

Traces available	Lists all open files and traces available in memory that match the selected chart's **Axes type**. (If a file does not contain compatible traces, the list will contain the entry **no traces match axes type**.) The list is hierarchical; to view a lower level, double-click a file or trace.
	To add traces to the **Traces loaded** list, select files or traces and click **Load**. Click **Load All** to add all available traces to the **Traces loaded** list.
Browse	Opens the **Load Data File** dialog to load additional files and traces into memory.
Traces in chart	Lists all traces loaded in memory for the selected chart, in the order in which traces appear in the legend (and in expanded charts). The **Show** check box specifies whether or not a trace is displayed.
	To remove traces from the selected chart, select one or more traces and click **Unload**. Click **Unload All** to remove all traces from the selected chart.
Arithmetic Traces	Opens the **Edit Arithmetic Trace** dialog. (See Arithmetic Traces, below.)
Properties	Opens the **Trace Properties** dialog. (See Properties, below.)
Apply	Applies all changes to the selected chart without closing the dialog.
OK	Closes the dialog and applies the changes to the selected chart.
Cancel	Closes the dialog without applying changes to the selected chart. Changes already applied with the **Apply** button are not affected.

Arithmetic Traces

Creates an arithmetic trace in the selected chart as a function of loaded traces or of the x-axis variable.

- In a new chart, original traces are formed as a function of the x-axis variable. You must specify both the x-axis range and the spacing between points.

- If traces are already loaded in a chart, configuring the x-axis for the new trace is optional. If you do not set the x-axis configuration explicitly, W-Edit will use the maximum valid range for all input traces and calculate arithmetic trace values corresponding to each input data point.

A maximum of 26 traces, including the x-axis unit, can be used in an arithmetic expression at one time.
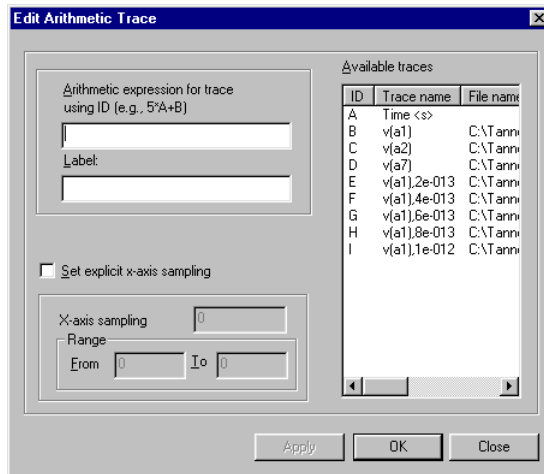
| **Available traces**	Lists all traces in the selected chart. Each trace is identified by a unique letter, **A** - **Z**. Trace **A** always represents the independent variable (x-axis). Trace **A** is equivalent to the trace $y=x$.
Arithmetic expression for trace using ID	The arithmetic expression for the new trace. For a list of operators you can use to combine traces listed in the **Available traces** column, see Expressions on page 56 of the *T-Spice User Guide and Reference*.
Label	The label for the new trace. This label appears in the chart legend. The arithmetic equation is used as the label if an alternate label is not supplied.
Set explicit x-axis sampling	When checked, you can set explicit sampling for the new trace. The check box is automatically checked if the selected chart is empty.
	When unchecked, W-Edit calculates arithmetic trace values at all data points contained in one or more input traces within the valid data range. The valid data range is the intersection of the ranges of the input traces.
	In both cases, W-Edit linearly interpolates input values at missing data points in the input trace.
X-axis sampling	The distance between data points for the new trace. If this distance is different than the sampling in the input traces, W-Edit uses linear interpolation to obtain input values.
Range	Specifies the x-axis range for the new trace. The x-axis range is only valid within the intersection of x-axis ranges of all input traces. If you exceed this range, some arithmetic trace data will not have valid inputs and should be ignored.
Apply	Adds the arithmetic trace to the **Available traces** column without closing the dialog.

Warning: Arithmetic traces and the trace data they are derived from are not saved in **.wdb** files. Original source traces are loaded from the linked data file(s). W-Edit does not save arithmetic trace formulas or calculations to either **.wdb** or data files.

Properties

Prompts for trace properties including label, line type, and color. For traces that include swept variables, you can set the properties for each member of the trace.
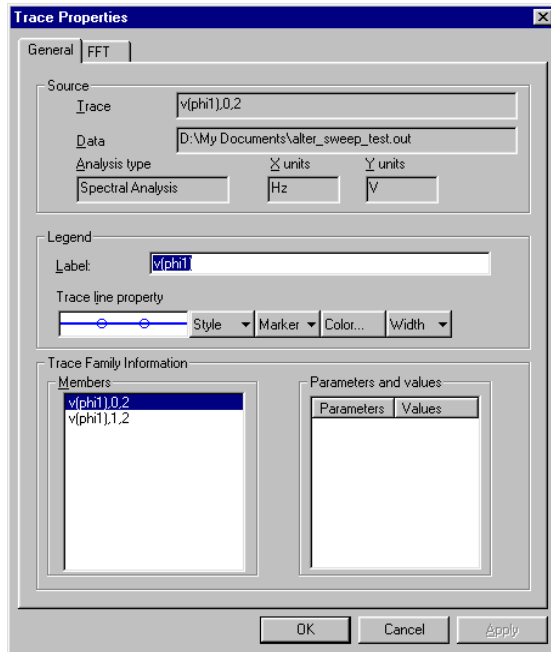
General

Trace	The name of the trace selected in the **Members** column.
Data	The path for the linked data file. This field is read-only.
Analysis type	The type of analysis that produced the trace. This field is read-only.
X units	The *x*-axis units for the trace. This field is read-only.
Y units	The *y*-axis units for the trace. This field is read-only.
Label	The name of the trace in the legend. Click **Font** to modify the text style, color, and size.
Line type	The line style associated with the selected trace member.
Color	The color of the line associated with the selected trace member.
Members	Lists individual trace members of a family of traces.
Parameters and values	Lists each parameter and its value associated with the trace member selected in the **Members** column.
Apply	Applies all changes without closing the dialog.
OK	Closes the dialog and applies the changes to the selected trace.
Cancel	Closes the dialog without applying changes to the selected chart. Changes already applied with the **Apply** button are not affected.

FFT

The **FFT** tab is available for traces that represent Fourier transform calculations. The options on this tab are identical to those in **Chart > Options—FFT** , but they apply only to the selected trace. Members of a trace family can have different FFT options.

Chart > Export Data

Insert Annotation

Inserts an annotation in the selected chart. To place the annotation, use the mouse to move the cursor to the desired position and click the left mouse button. You can move an annotation by selecting it and dragging it to a new position.
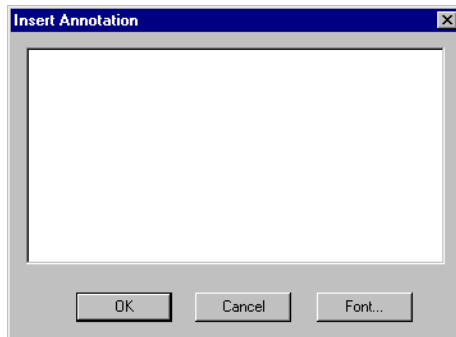
(Text area)	Type the desired text in this space.
Font	Open the **Font** dialog (not shown).

When you cut or copy a chart, any associated annotations move with the chart. Annotations themselves cannot be cut, copied, or pasted into charts.

When you use **Chart > Expand Chart** on page 68, any annotations in the original chart are placed in the resulting top chart. When you use **Chart > Collapse Charts** on page 69, annotations in the top chart are placed in the resulting chart. Annotations in other charts are lost.

Chart > FFT

Performs an FFT on transient analysis data. This option is only available when a chart containing transient analysis data is selected. If the chart contains more than one trace, W-Edit performs a separate FFT for trace.

The FFT outputs are plotted on a new chart at the bottom of the screen. The FFT chart is automatically selected and all other charts are deselected

You can customize FFT options with **Chart > Options—FFT** on page 74.

Chart > Cursors > Vertical Bars

Toggles the display of a pair of vertical cursor bars in the selected charts. To move a bar, use the left mouse button to select and drag it to a new position. Bars in multiple selected charts move together.

In each chart, the x-coordinates (horizontal positions) of both bars and the x-difference (horizontal separation) between them are displayed at the top left of the chart as **X1**, **X2**, and **X2-X1**. For legend labels that are associated with a single trace, W-Edit displays the y-coordinate of each trace corresponding to the x-coordinate of the vertical bar being moved in the chart legend. W-Edit does not display the y-coordinates for traces resulting from a parametric sweep.

Chart > Cursors > Horizontal Bars

Toggles the display of a pair of horizontal cursor bars in all selected charts. To move a bar, select and drag it with the left mouse button. Bars in multiple selected charts do *not* move together.

In each chart, the *y*-coordinates (vertical positions) of both bars and the *y*-difference (vertical separation) between them are displayed at the top left of the chart as **Y1**, **Y2**, and **Y2-Y1**.

Chart > Cursors > Markers

Toggles the display of two markers in each selected chart. The markers initially appear with the second marker on top of the first, so that you will have to move one marker for the other to become visible. Markers snap to data points in traces. You can move a marker by dragging it to a new position with the left mouse button.

W-Edit displays the coordinates of each marker in the top right corner the chart. In the same region, W-Edit also shows the horizontal and vertical and distances between the two markers as **dx=*value*** and **dy=*value***.

Chart > Cursors > Clear All

Removes vertical bars, horizontal bars, and markers from the selected charts.

Chart > Expand Chart

Expands the selected chart into multiple charts containing different subsets of traces. There are four levels of chart separation; expansion of a chart always separates traces by the broadest applicable categories. The four possible levels of separation are:

- *x*-axis units—All traces with the same *x*-axis units are contained on one chart. This is always the starting point for the **Chart > Expand Chart** operation.

- *y*-axis data—Traces are separated by *y*-axis data type. Each new chart contains traces with the same measured quantity and associated units.

- Trace families—Each chart contains a single dependent variable, which may be a single trace or a collection of parameter sweeps.

- Individual traces—Each new chart displays a single trace.

Note: If a level of separation does not apply to traces on the selected chart, then W-Edit automatically skips to the next category. For instance, if you select **Chart > Expand Chart** for a chart in which all traces have identical *y*-axis data types, W-Edit will create multiple charts separated by trace families.

The new charts appear in **Home** view. (See **View > Home View** on page 60.) Only a single chart can be expanded at a time. After the operation the charts are all selected and all have the same axis range as the original.

Charts are displayed in the same order that traces were loaded. You can unload and reload traces for a single chart with **Chart > Traces** on page 62.

Sometimes there is not enough room in the application window to create the required number of new charts. When this occurs, the following warning appears:
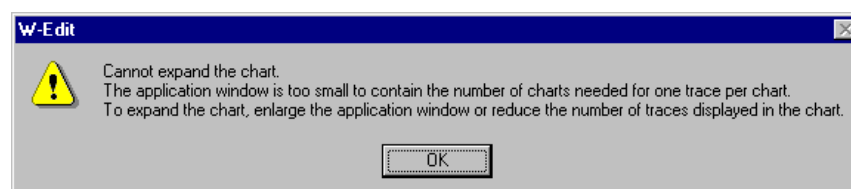
For information on the behavior of annotations when you expand a chart, see **Chart > Export Data** on page 66.

Chart > Collapse Charts

Deletes selected charts and collapses (combines) traces into new charts with increasingly broad categories of shared traits. Traces can be combined at four levels:

- Individual traces—Each chart displays a single trace. **Chart > Collapse Charts** never results in this level of separation.

- Trace families—Each chart contains a single dependent variable, which may be an individual trace or a collection of parameter sweeps. If some of the selected charts contain individual members of trace families, then **Chart > Collapse Charts** will only collapse traces enough to group families together.

- y-axis data—Traces are separated by y-axis data type. Each new chart contains traces with the same measured quantity and associated units.

- x-axis units—All traces with the same x-axis units are contained on one chart. This is the maximum possible combination of traces; you can not collapse charts with different x-axis units.

Note: If a combination of traces is already fully implemented on the selected charts, then W-Edit automatically skips to the next category. For instance, if you select **Chart > Collapse Chart** for charts that each contain a complete trace family, W-Edit will combine the traces into new charts separated by y-axis data type.

W-Edit uses the axis system of the top chart selected as the standard. Any selected charts with axis systems different from the top one are ignored. The new chart appears in **Home** view. (See **View > Home View** on page 60.)

For information on the behavior of annotations when you collapse charts, see **Chart > Export Data** on page 66.

Chart > Lock X-Axis

Toggles membership of selected charts in a lock-view set. (When a chart is locked, a checkmark appears next to the **Lock X-Axis** menu item.) Charts in a lock-view set are locked in their view along the x-axis; any change to the x-axis view (zoom or pan) of one chart in the set affects the view of the others, regardless of whether or not they are selected. Unlocked charts zoom or pan independently.

Only charts with the same x-axis data type and scale (log or linear) can share a lock-view set. Logarithmic and linear x-axes cannot share a lock-view set, even if their units are the same.

The x-axis is locked by default in new charts. You can change this default setting in **Options > Chart Default Options—General** on page 77 by unchecking the **Lock X-Axis** box. When you expand a chart, the resulting new charts always share the same **Lock X-Axis** setting as the parent chart.

Note: Zooming or panning affects all selected charts with the same x-axis data type, regardless of whether they belong to the lock-view set of the chart you are editing. Charts in the same lock-view set are affected regardless of whether or not they are selected.
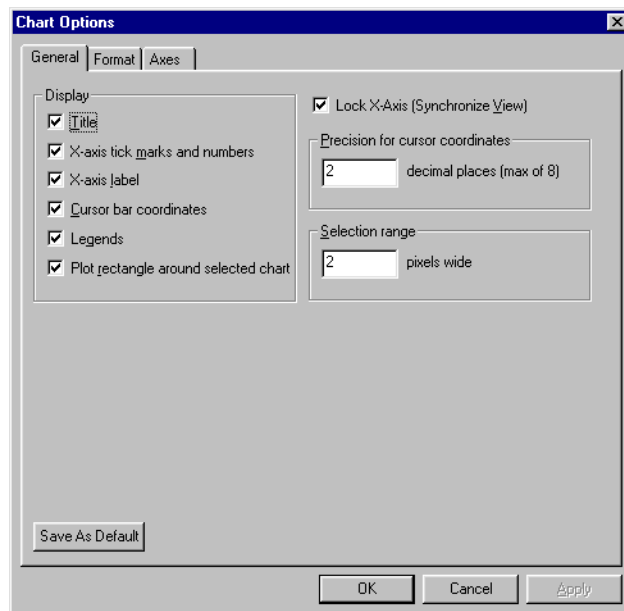
Chart > Options

Opens the **Chart Options** dialog and prompts for chart-specific settings to the selected chart. Only one chart can be selected at a time.

The **Chart Options** dialog contains three or four tabs:

- **General**
- **Format**
- **Axes**
- **FFT** *(visible only for FFT charts)*

Chart > Options—General

Prompts for general chart settings.

Display	Check boxes specify the display of the chart **Title**, **X-axis tick marks and numbers**, **X-axis label**, **Cursor bar coordinates**, and **Legends**. **Plot rectangle around selected chart** specifies whether or not a rectangle is drawn around the chart when it is selected.
Lock X-Axis (Synchronize View)	Specifies whether or not a chart belongs to a lock-view set. (See **Chart > Lock X-Axis** on page 69 for a description of a lock-view set.)
Precision for cursor coordinates	The number of decimal places W-Edit displays for coordinates associated with vertical and horizontal cursor bars and markers.
Selection range	The size, in pixels, of an invisible rectangular boundary surrounding each data point in a trace. If you click the mouse inside the boundary, the trace is selected. If you click the mouse outside the boundary, the trace is deselected. The default range is 2 pixels.
Save as Default	Saves the current general chart settings as the default shown in **Options** > **Chart Default Options—General**. Chart default options are preserved and loaded every time you launch W-Edit.

Chart **>** Options—Format

Prompts for color, font, and grid settings.

Color	Applies a color choice to the selected chart element. Select the item you want to edit from the drop-down list. The drop-down list contains elements of the selected or deselected chart according to the **Chart** setting (see below). Click **Color** to change the color in the color palette (not shown). The changes are reflected in the **Chart** illustration.
Font	Select the desired item in the drop-down list. Click **Font** to change text size, color, and style.
Chart	Previews settings for the selected chart. Choose to preview settings for the **Selected** or **Deselected** mode. **Color** settings (above) are only editable in the current preview mode. The **Default # of displayed traces** does not affect the current chart. The value set here is saved in the **Options > Chart Default Options** dialog when you click **Save as Default**.
Grid	Use the drop-down lists to choose **Dashed**, **Dots**, or **None** for **Horizontal** and **Vertical** grid lines.

| **Trace color table** | Defines the order of assigning properties to the traces as each data column (trace) is read into W-Edit. Select one of the 8 traces displayed to access property settings for that trace: |

- **Width**—pixel width of the trace. The default value is 1. This field is only editable when **Style** is a solid line.

- **Color**—displays a color palette from which you can select trace color.

- **Style**—line style for the trace (solid, dashed, etc.). If the line style is not solid, the W-Edit automatically sets the trace width to 1.

- **Marker**—marker shape. Markers represent data points and are only displayed when the trace is selected.

The first trace read takes the **1st** displayed properties, the second trace the **2nd** properties, etc. If there are more than eight traces in a chart the order of trace properties cycles back to the beginning.

| Save as Default | Saves the current chart format settings as the default shown in **Options > Chart Default Options—Format**. Chart default options are preserved and loaded every time you launch W-Edit. |

Chart **>** Options—Axes

Prompts for *x*- and *y*-axis settings and chart title.
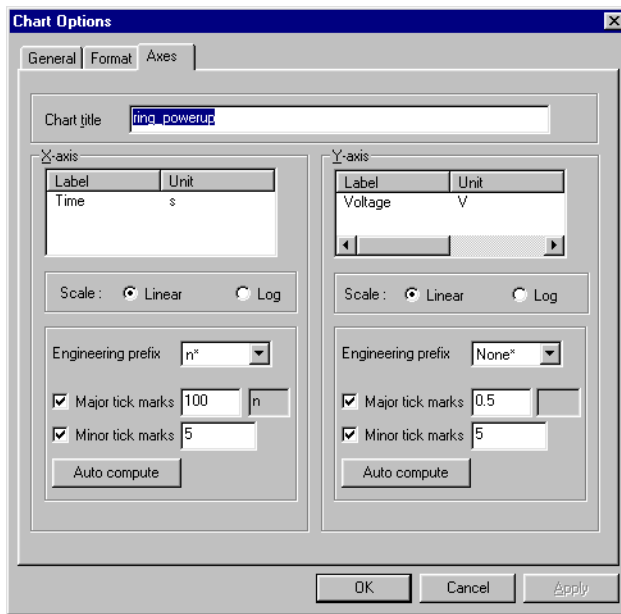
| **Chart title** | The title of the selected chart. |

The following settings are available for both the **X-axis** and the **Y-axis**.

| **Label** | The text that appears along the *x*- and *y*-axis. |

Units	Text displayed along the *x*- or *y*-axis after the selected metric prefix. The metric prefix and **Units** text appear in parentheses next to the **Label**.
Scale	Select **Linear** or **Log** to determine which scale is used for each axis in the chart.
	W-Edit clips data before calculating **Log** scale by substituting 10^{-15} for every value lower than 10^{-15}. This is done before the logarithm calculation. Clipped values are not shown in **Home View**, but you can scroll the view to see them.
Engineering prefix	. Pull-down menu of metric prefix abbreviations. W-Edit automatically calculates a best fit scaling factor, shown with an asterisk in the pull-down menu.

n	*Scaling*
	10^{12}
	10^{9}
	10^{6}
	10^{3}
	10^{-3}
	10^{-6}
	10^{-9}
	10^{-12}
	10^{-15}

Major tick marks	The distance, in units, between numbered tick marks. W-Edit automatically computes a best fit number of major tick marks when you change the **Engineering prefix**.
Minor tick marks	The number of (unnumbered) tick marks in between numbered tick marks. W-Edit automatically computes a best fit number of minor tick marks when you change the **Engineering prefix**.
Auto compute	Restores W-Edit's automatic calculations for major and minor tick marks after they have been manually edited.

Chart > Options—FFT

Prompts for FFT specifications relating to sampling, FFT windowing, and output formats for all FFT *traces on a chart. To change options for an individual trace, double click on the trace and edit the* **Trace Properties** *dialog.*

Sampling

From time	Specifies the starting time of the data set for which W-Edit will calculate the FFT.

- **Use transient start time** (default)— selects the smallest time from all of the input traces.
- **Use specified start time**—allows you to type a start time in the display.

To time	Specifies the ending time of the data set for which W-Edit will calculate the FFT.

- **Use transient stop time** (default)—selects the largest time from all of the input traces.
- **Use specified start time**—allows you to type a stop time in the display.

Number of points	Number of equally-spaced input points used to calculate the FFT. This number must be equal to a power of 2.

- **Use best fit number of points** (default)— twice the Nyquist requirement, rounded up to the nearest power of 2.
- **n**—selects an integer power of 2 such that the number of points is equal to 2^n.

Interpolation order	Selects the order of the polynomial data interpolation used to obtain equally spaced points in the input signal. (Default: 2.)
Use T-Spice fixed time intervals	Checkbox requesting that no trace interpolation be performed. This option is only displayed when all of the input transient data traces have the same fixed time steps. You can set fixed time steps in T-Spice using **.options prtdel** (see **.options** on page 107 in the *T-Spice User Guide and Reference*).

FFT Window

To select a window for the FFT function, simply choose one of the windows listed in the drop-down menu. The **Rectangula**r window (default) is equivalent to not using any window.

If a **Gaussian** or **Kaiser-Bessel** window is selected, then the field determining **alpha** becomes available. Alpha is a parameter of the Gaussian and Kaiser window functions that affects 3 dB bandwidth and other key characteristics.

For detailed descriptions of all the available window functions, see Window Functions on page 38.

Output

Format	Selects the method used to calculate output values from complex FFT data:

- **dB Magnitude (rms)**—magnitude expressed in dB.

- **dB Relative to Peak**—dB magnitude shifted so that the peak value is 0.

- **Magnitude**—root mean square of FFT data points.

- **Phase**—expressed in degrees.

- **Unrolled Phase**—running sum of phase changes between FFT data points

- **Real Part**

- **Imaginary Part**

Threshold dB value	The minimum value, in dB, that W-Edit will display when the format is **dB Magnitude** or **dB Relative Magnitude**.
Remove DC component	Checkbox to omit the first frequency bin of FFT results from W-Edit display.
Save as Default	
Save as Default	Saves the current chart FFT settings as the default shown in **Options > Chart Default Options—FFT**. Chart default options are preserved and loaded every time you launch W-Edit.

Options Commands

Options > Chart Default Options

Sets defaults for chart display and FFT analysis.

The **Options > Chart Default Options** contains three tabs:

- **General**
- **Format**
- **FFT**

Options > Chart Default Options—General

Sets titles, tick marks and labels. Sets selection range and cursor precision.
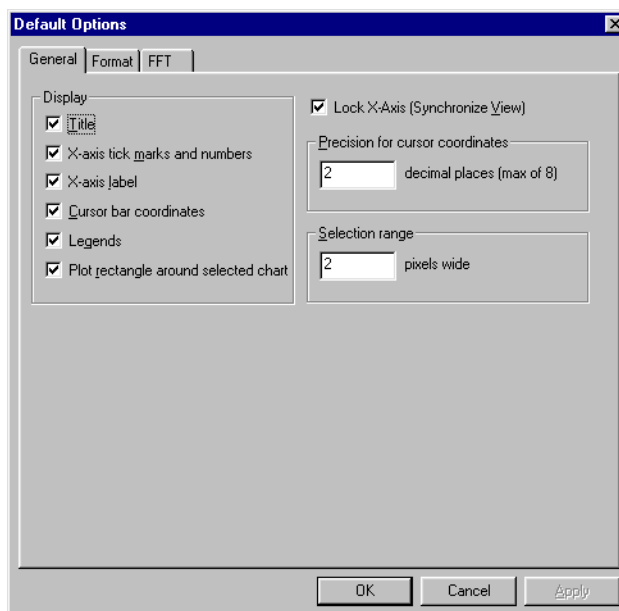
Chart title	The title of the selected chart.
Display	Check boxes specify the display of the chart **Title**, **X-axis tick marks and numbers**, **X-axis label**, **Cursor bar coordinates**, and **Legends**. **Plot rectangle around selected chart** specifies whether or not a rectangle is drawn around the chart when it is selected.
Lock X-Axis (Synchronize View)	Specifies whether or not a chart belongs to a lock-view set. (See **Chart > Lock X-Axis** on page 69 for a description of a lock-view set.)
Precision for cursor coordinates	The number of decimal places W-Edit displays for coordinates associated with vertical and horizontal cursor bars and markers.

Selection range	The size, in pixels, of an invisible rectangular boundary surrounding each data point in a trace. If you click the mouse inside the boundary, the trace is selected. If you click the mouse outside the boundary, the trace is deselected. The default range is 2 pixels.

Options > Chart Default Options—Format

Sets default color, font, trace number, grid, and trace properties.

Color	Applies a color choice to the selected chart element. Select the item you want to edit from the drop-down list. The drop-down list contains elements of the selected or deselected chart according to the **Chart** setting (see below). Click **Color** to change the color in the color palette (not shown). The changes are reflected in the **Chart** illustration.
Font	Select the desired item in the drop-down list. Click **Font** to change text size, color, and style.
Chart	Previews settings for the selected chart. Choose to preview settings for the **Selected** or **Deselected** mode. **Color** settings (above) are only editable in the current preview mode. The **Default # of displayed traces** determines the maximum number of traces W-Edit automatically displays on a new chart. The default number of traces when W-Edit is first installed is 5; after that, the last entered value is preserved.
Grid	Use the drop-down lists to choose **Dashed**, **Dots**, or **None** for **Horizontal** and **Vertical** grid lines.

Trace color table	Defines the order of assigning properties to the traces as each data column (trace) is read into W-Edit. Select one of the 8 traces displayed to access property settings for that trace:

- **Width**—pixel width of the trace. The default value is 1. This field is only editable when **Style** is a solid line.

- **Color**—displays a color palette from which you can select trace color.

- **Style**—line style for the trace (solid, dashed, etc.). If the line style is not solid, the W-Edit automatically sets the trace width to 1.

- **Marker**—marker shape. Markers represent data points and are only displayed when the trace is selected.

The first trace read takes the **1st** displayed properties, the second trace the **2nd** properties, etc. If there are more than eight traces in a chart the order of trace properties cycles back to the beginning.

Options > Chart Default Options—FFT

Sets default sampling and windowing options for FFT analysis.

Sampling

From time	Specifies the starting time of the data set for which W-Edit will calculate the FFT.

- **Use transient start time** (default)— selects the smallest time from all of the input traces.
- **Use specified start time**—allows you to type a start time in the display.

To time	Specifies the ending time of the data set for which W-Edit will calculate the FFT.

- **Use transient stop time** (default)—selects the largest time from all of the input traces.
- **Use specified start time**—allows you to type a stop time in the display.

Number of points	Number of equally-spaced input points used to calculate the FFT. This number must be equal to a power of 2.

- **Use best fit number of points** (default)— twice the Nyquist requirement, rounded up to the nearest power of 2.
- **n**—selects an integer power of 2 such that the number of points is equal to 2^n.

Interpolation order	Selects the order of the polynomial data interpolation used to obtain equally spaced points in the input signal. (Default: 2.)
Use T-Spice fixed time intervals	Checkbox requesting that no trace interpolation be performed. This option is only displayed when all of the input transient data traces have the same fixed time steps. You can set fixed time steps in T-Spice using **.options prtdel** (see **.options** on page 107 in the *T-Spice User Guide and Reference*).

FFT Window

To select a window for the FFT function, simply choose one of the windows listed in the drop-down menu. The **Rectangula**r window (default) is equivalent to not using any window.

If a **Gaussian** or **Kaiser-Bessel** window is selected, then the field determining **alpha** becomes available. Alpha is a parameter of the Gaussian and Kaiser window functions that affects 3 dB bandwidth and other key characteristics.

For detailed descriptions of all the available window functions, see Window Functions on page 38.

Output

Format	Selects the method used to calculate output values from complex FFT data:

- **dB Magnitude** (default) —magnitude expressed in dB.
- **dB Relative to Peak**—dB magnitude shifted so that the peak value is 0.
- **Magnitude**—root mean square of FFT data points.
- **Phase**—expressed in degrees.
- **Unrolled Phase**—running sum of phase changes between FFT data points
- **Real Part**
- **Imaginary Part**

Threshold dB value	The minimum value, in dB, that W-Edit will display when the format is **dB Magnitude** or **dB Relative Magnitude**.
Remove DC component	Checkbox to omit the first frequency bin of FFT results from W-Edit display. (The default setting is to remove DC.)

Options > Global Options

Sets the the initial path location of all file browsers so that file open and save operations can be optionally synchronized with the S-Edit active project directory..

Last referenced directory	Sets the initial path location of all file browsers to the last directory in which a file was opened or saved. (This is the default option.)
Schematic Editor active project	Sets the initial path location of all file browsers to the directory of the project active in S-Edit.
(unlabeled)	Sets a fixed initial path which you can type in or browse to.

Window Commands

Window > Cascade

Arranges windows in an overlapping fashion, starting from the top left corner of the display area, so that the title bars are visible. The window active when the command is executed remains active in front.

Window > Tile Horizontally

Arranges windows horizontally in a non-overlapping fashion, resizing them to fill the display area.

Window > Tile Vertically

Arranges windows vertically in a non-overlapping fashion, resizing them to fill the display area.

Window > Arrange Icons

Arranges window icons, if any are present, in rows starting at the bottom left of the display area.

Window > Close All

Closes all windows. A warning appears if there are any unsaved files open.

Window > *(most recently opened)*

All open windows in the display area are listed. A check marks the name of the active window. Choosing a name in the list makes that window active.

Help Commands

Help > W-Edit User Guide

Opens the *W-Edit User Guide*.

Help > T-Spice User Guide

Opens the *T-Spice User Guide and Reference*.

Help > T-SpiceT-Spice Pro Tutorials

Opens the *T-Spice Pro User Guide*.

Help > T-SpiceAbout W-Edit

Displays version, copyright, support, and sales information.

7   Data File Format

Introduction

This chapter describes the format of *data files* readable by W-Edit. If you have data from sources other than T-Spice simulations, you can apply a simple format that allows W-Edit to display the data alongside T-Spice simulation results.

W-Edit data files can be either entirely text format (**.out**), or a combination of text and binary data (**.dat**). Text files are generated in T-Spice with the command **.print** (page 120), which prints simulation output in text format to a **.out** file. The T-Spice command **.probe** (page 134) prints simulation output in binary format, resulting in creation of a **.dat** file.

A data file generated as a T-Spice output file may consist of more than one section. By default, W-Edit creates one chart per section. Each section of a readable T-Spice output file is preceded by a header indicating the analysis type, the number of columns, and the column types, so that W-Edit can determine appropriate chart and axis types. All columns in a section of the output file are read into the same chart. A *trace* is a set of two columns representing *x* and *y* values plotted in two dimensions, or a sequence of points resulting from calculations on multiple columns (complex data).

Non-Graphical Content

Comments

```
*text
```

Comment lines always begin with an asterisk and are ignored by W-Edit, with the exception of lines beginning with ***WEDIT:** (see Section Definition on page 85) .

Non-Graphical Data Blocks

A non-graphical data block is a section of descriptive text following a data block. Use non-graphical data blocks for large sections of comments. Non-graphical data blocks are delimited as follows:

```
* BEGIN NON-GRAPHICAL DATA
Comment text describing data in previous
graphical data block.
* END NON-GRAPHICAL DATA
```

The first and last lines of a non-graphical data block must be entered exactly as shown. The W-Edit parser ignores all text contained within a non-graphical data block.

Graphical Data Blocks

Graphical data blocks contain the data to be plotted, along with key information required by W-Edit to translate data into appropriate charts. A graphical data block consists of the following elements, in this exact order:

1.	*Section definition*	Defines the type of analysis results to be plotted.
2.	*Label line*	Defines names of data columns.
3.	*Data lines*	Data values to be plotted.
4.	*End of section*	Ends the graphical data block.

Section Definition

The section definition consists of a combination of two types of lines. First, lines beginning with ***WEDIT:** describe commands used to generate the data, formatted in T-Spice syntax. Second, an analysis line states the type of analysis used: transfer, transient, or AC analysis.

There are three possible formats for the section definition, one corresponding to each of the three analysis types.

*WEDIT: XFER cycles *sweepParameter number* [*sweepParameter number*]
*WEDIT: {**.step** |**.dc**} *sweep* [*sweep*] [*sweep*]
[***WEDIT: binary**]
TRANSFER ANALYSIS – [**alter=**number] [parameter=number]...

*WEDIT: .ac *sweep* [*sweep*] [*sweep*]
[***WEDIT: binary**]
AC ANALYSIS - [**alter=**number] [parameter=number]...

*WEDIT: .tran *start_time stop_time*
[***WEDIT: binary**]
TRANSIENT ANALYSIS - [**alter=**number] [parameter=number]...

W-Edit uses the section definition to distinguish between sweeps in the data columns, and to group traces from different sweeps together into trace families.

The line:

*WEDIT:binary

indicates that numerical data is in binary format. When this line is absent, W-Edit assumes that numerical data will be in text format.

Label Line

The label line identifies the number, names, and unit types of data columns in the section. Each column of data must have a single corresponding label in the label line; labels are separated by white space (tabs or blanks). Labels must be specified in one of the following formats:

*LabelName[**<unit>**]*

or

```
'Label Name'[<unit>]
```

where *LabelName* is the name of the corresponding data column, and *unit* is an optional string which specifies the unit of the values in the data column. If a label name contains a space, it must be enclosed by single quotation marks.

When units are specified, W-Edit uses these to automatically generate appropriate axis labels such as **Voltage (V)**, **Current (A)**, or **Time (s)**.

Data Lines

Data lines contain T-Spice simulation results or other numerical data that will be plotted by W-Edit. Unlike the section definition and label lines, which must be in text format, the data lines can contain either text or binary data. Graphical data blocks in **.dat** files may contain data lines in either text or binary format; binary sections are flagged in the section definition. Data lines in **.out** files are always in text format.

Text format

Text format is the only data representation used in **.out** files, and it allows easy editing or creation of data values in a text editor. The data lines in **.out** files are organized into columns of text. The first column of data always represents the *x*-axis for all following columns. (A graphical data block can contain only one set of *x*-axis values.) Each line of data contains exactly as many numerical values as there are data columns listed in the label line. Numbers within a data line are separated by spaces or tabs.

Each entry in a data line should be in floating-point format:

$[-]d.dddddddddd\mathbf{e}[+|-]ddd$

with up to 10 digits of precision and an exponent no greater than ±37.

In text format, the graphical data block is ended with a blank line.

Binary Data Formats

W-Edit interprets the **.dat** file extension as an indication that the data file contains some binary data, as well as the required text fields. The only part of a **.dat** file that is in binary format is numerical simulation outputs in graphical data blocks. Because W-Edit also supports text-formatted data lines, a binary graphical data block must include the following in the section definition:

*WEDIT: binary

This indicates that W-Edit will read binary simulation output. See Section Definition on page 85 for more information about defining graphical data blocks.

Data values in binary format are double-precision floating point numbers; each entry is 8 bytes (64 bits).

W-Edit supports three different compression formats for binary data. All of the data in a graphical data block are coded with the same compression algorithm. The three possible formats are:

- *No compression*. Each simulation output value is represented in the data file by a double-precision floating point number (8 bytes).

- Constant waveform compression. Only values that differ from the previous entries for each column are included in the data file. When W-Edit reads the graphical data block, a key sequence indicates which data values follow and which values are omitted. W-Edit automatically inserts the column's previous value for each omission.

- Linear extrapolation compression. Values are omitted from the data file when they are linearly related to the previous two entries in the same column. As with constant waveform compression, a key sequence indicates which data values are given and which are omitted. For the omitted values, W-Edit linearly extrapolates from the previous two column entries to determine the correct value.

A block of binary data begins with a single *binary read byte* that indicates the compression of the following data. The value of the binary read byte is set as follows:

Value of binary read	*Compression algorithm*
0	No compression
2	Constant waveform compression
3	Linear waveform compression

After W-Edit reads the binary read byte, the next byte in the data file is a *control byte*. A control byte appears before every row of data and at the end of the graphical section; W-Edit uses the value of this byte to determine the end of the graphical data block. If the control byte is equal to 0x01, this signals that W-Edit has reached the end of the graphical data block. If the control byte has any other value, W-Edit proceeds to read the next row of data. When the control byte is set to 0x01, W-Edit proceeds to the next graphical or non-graphical data block, as applicable.

W-Edit reads each row of binary simulation data according to the compression algorithm specified by the binary read byte.

No Compression

If no compression was used in creating the data file, then W-Edit reads n double-precision floating point numbers in each row, where n is the number of columns listed in the label line (see Label Line on page 85).

Constant Waveform Compression

The constant waveform compression algorithm uses a *key sequence* at the beginning of each row. The length of the key sequence is the minimum number of bytes needed to represent each column of data with a single bit.

Each bit in the key sequence represents a comparison between the current and previous values for a particular column. If the current value is equal to the previous value in a column, then the bit corresponding to that column is set to 0. Otherwise, the bit for that column is set to 1.

For example, consider the following columns of sample data:

```
Time<s>         Out1<v>         Out2<v>         Out3<v>
0               2.3             4.5             1.6
1               2.5             4.7             1.3
2               2.6             4.7             1.4
```

The key sequence for the third row of data is **[1 1 0 1]**. The zero in the third column bit indicates that the third column's value does not change from the previous row.

After the key sequence for a row, W-Edit reads *m* double-precision floating point numbers, where *m* is the number of bits set to 1 in the key sequence. For each 0 column bit, W-Edit inserts the value for that column in the previous row.

For instance, in the example above, the key sequence **[1 1 0 1]** is followed by three numbers: **2**, **2.6**, and **1.4**. When W-Edit reads the data, it automatically inserts the number **4.7** in the third column position.

Linear Waveform Compression

As in constant waveform compression, linear waveform compression uses a key sequence at the beginning of each row. In this case, each bit in the sequence represents a comparison between the current value for a particular column and the previous two values for that column. If the current value is linearly related to the previous two values, then the bit is 0. Otherwise, the bit is set to 1.

For example, consider the following columns of sample data:

```
Time<s>         Out1<V>         Out2<V>         Out3<V>
0               2.3             4.5             1.6
1               2.4             4.7             1.3
2               2.5             4.7             1.4
```

The key sequence for the third row of data is **[0 0 1 1]**. The first two zeros indicate that the first two columns have constant slope across the current and previous two rows.

After the key sequence for a row, W-Edit reads *m* double-precision floating point numbers, where *m* is the number of bits set to one in the key sequence. For each 0 column bit, W-Edit linearly extrapolates the correct value from the previous two rows.

For instance, in the example above, the key sequence **[0 0 1 1]** is followed by two numbers: **4.7** and **1.4**. When W-Edit reads the data, it linearly extrapolates the first and second columns' previous two values and automatically inserts the numbers **2** and **2.5**.

Swept Parameters

When a graphical data block contains swept data, there are two acceptable formats for data lines, illustrated in the following two examples. Both examples contain DC transfer analysis data for a CMOS inverter.

In the first example, results from sweeps are entered sequentially within the columns of a single graphical data block.

```
*WEDIT: XFER cycles V1  7 VDD  3
*WEDIT: .dc V1 0 3 0.5 VDD 2 4 1
TRANSFER ANALYSIS
       V1<V>        v(IN)<V>       v(OUT)<V>
 0.0000e+000   0.0000e+000   1.9999e+000
 5.0000e-001   5.0000e-001   1.9965e+000
 1.0000e+000   1.0000e+000   1.1864e-001
 1.5000e+000   1.5000e+000   9.4228e-006
```

```
 2.0000e+000   2.0000e+000  -1.5709e-006
 2.5000e+000   2.5000e+000   6.6202e-008
 3.0000e+000   3.0000e+000   1.7033e-006
 0.0000e+000   0.0000e+000   2.9999e+000
 5.0000e-001   5.0000e-001   2.9984e+000
 1.0000e+000   1.0000e+000   2.9309e+000
 1.5000e+000   1.5000e+000   2.7900e-001
 2.0000e+000   2.0000e+000   2.6574e-002
 2.5000e+000   2.5000e+000   4.4976e-006
 3.0000e+000   3.0000e+000   4.6019e-008
 0.0000e+000   0.0000e+000   4.0000e+000
 5.0000e-001   5.0000e-001   3.9989e+000
 1.0000e+000   1.0000e+000   3.9598e+000
 1.5000e+000   1.5000e+000   3.7145e+000
 2.0000e+000   2.0000e+000   4.5169e-001
 2.5000e+000   2.5000e+000   1.0939e-001
 3.0000e+000   3.0000e+000   1.5777e-002
```

In this case, the section definition line

*WEDIT: XFER cycles V1 7 VDD 3

declares that the data was obtained from a nested sweep, with 7 different values for swept parameter **V1** and 3 different values for swept parameter **VDD**. W-Edit uses this information to separate the columns of data into three sections corresponding to the different values of **VDD**. The values of **V1** (*x*-axis values) are the same in each section.

Alternatively, sweeps can be separated into different graphical data blocks. The next example shows the same data set in such a format:

```
*WEDIT: XFER cycles V1   7
*WEDIT: .dc V1 0 3 0.5 VDD 2 4 1
TRANSFER ANALYSIS - VDD=2
      V1<V>        v(IN)<V>      v(OUT)<V>
 0.0000e+000   0.0000e+000   1.9999e+000
 5.0000e-001   5.0000e-001   1.9965e+000
 1.0000e+000   1.0000e+000   1.1864e-001
 1.5000e+000   1.5000e+000   9.4228e-006
 2.0000e+000   2.0000e+000  -1.5709e-006
 2.5000e+000   2.5000e+000   6.6202e-008
 3.0000e+000   3.0000e+000   1.7033e-006


*WEDIT: XFER cycles V1   7
*WEDIT: .dc V1 0 3 0.5 VDD 2 4 1
TRANSFER ANALYSIS - VDD=3
      V1<V>        v(IN)<V>      v(OUT)<V>
 0.0000e+000   0.0000e+000   2.9999e+000
 5.0000e-001   5.0000e-001   2.9984e+000
 1.0000e+000   1.0000e+000   2.9309e+000
 1.5000e+000   1.5000e+000   2.7900e-001
 2.0000e+000   2.0000e+000   2.6574e-002
 2.5000e+000   2.5000e+000   4.4976e-006
 3.0000e+000   3.0000e+000   4.6019e-008


*WEDIT: XFER cycles V1   7
*WEDIT: .dc V1 0 3 0.5 VDD 2 4 1
TRANSFER ANALYSIS - VDD=4
      V1<V>        v(IN)<V>      v(OUT)<V>
 0.0000e+000   0.0000e+000   4.0000e+000
 5.0000e-001   5.0000e-001   3.9989e+000
```

```
1.0000e+000   1.0000e+000   3.9598e+000
1.5000e+000   1.5000e+000   3.7145e+000
2.0000e+000   2.0000e+000   4.5169e-001
2.5000e+000   2.5000e+000   1.0939e-001
3.0000e+000   3.0000e+000   1.5777e-002
```

In this example, the section definition line:

*WEDIT: XFER cycles V1 7

does not include the parameter **VDD**, because only one value of **VDD** is used in each graphical data block. However, the analysis line:

TRANSFER ANALYSIS - VDD=2

indicates which value of **VDD** corresponds to the current graphical data block definition. This allows W-Edit to label trace properties with the appropriate parameter values. W-Edit will group different graphical data blocks corresponding to the same parameter into trace families. The resulting W-Edit plot is identical for both examples.

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