

# **SymProbe**

## **User Guide**

Product version 2.xx

# **SymProbe User Guide**

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# Table of Contents

<b>Part I Introduction</b>	1
<b>Part II Results postprocessing</b>	1
<b>Launching SymProbe</b>	1
<b>Input formats</b>	2
<b>Part III Work environment</b>	2
<b>Main window</b>	2
<b>Menu</b>	3
<b>Hot keys</b>	4
<b>Toolbar</b>	5
<b>Status bar</b>	6
<b>Part IV File menu</b>	6
<b>Open</b>	7
<b>Save As</b>	8
<b>Print Preview</b>	8
<b>Print</b>	10
<b>Print Setup</b>	10
<b>Print to EMF-file</b>	11
<b>Copy to Clipboard</b>	11
<b>Close</b>	11
<b>Part V View menu</b>	11
<b>Zooming</b>	12
<b>Display Control</b>	12
<b>Part VI Plot menu</b>	13
<b>Optional Y axis</b>	14
<b>Adding and deleting plots</b>	15
<b>Moving plots</b>	16
<b>Unsynchronizing X axis</b>	17
<b>Combining and scattering traces</b>	18
<b>Changing height and width of the plot</b>	19

<b>SymProbe User Guide</b>	<b>Contents</b>
<b>Part VII Trace menu</b>	22
Marking traces	22
Adding traces	22
Editing traces	24
Evaluate goal function	24
Calculator	28
Separate branch	38
Eye Diagram	39
Histogram	40
Fourier	42
Managing traces	43
<b>Part VIII Tools menu</b>	45
Axis settings	45
Options	45
Cursor	47
Additional Parameters	47
<b>Part IX Help menu</b>	48
<b>Index</b>	

## Introduction

SymProbe is a specialized full functional waveform postprocessor for viewing and processing simulation results of SPICE programs.

## Results postprocessing

This section contains information about postprocessing of simulation results with *SymProbe*.

***SymProbe* is a program for visualization of simulation results, including:**

- working with files( [<File> menu](#));
- changing view settings of simulation results and implementing display control ( [<View> menu](#));
- processing of plots ([<Plot> menu](#)) and traces ([<Trace> menu](#)), including implementing of algebraic or specific operations ([Evaluation goal function](#)), performing [Eye Diagram](#)-, [Histogram](#)-, [Fourier](#)- transforms;
- displaying simulation results in process;
- carrying traces from one SymProbe window to another (cross-probing).

## Launching SymProbe

Operating Systems: Windows and Linux.

There are the following ways for launching SymProbe:

- 1) as an individual utility from Windows GUI or command line;
- 2) as a part of SymCAD Design Environment when simulation running (running automatically);
- 3) as a runtime result visualizing utility with running SymSpice (see SymSpice documentation).

## Command line syntax

*symprobe* [*options*] [*<file>* ]

## Options

<code>--version, -v</code>	Displays the version number, build date and copyrights of SymProbe.
<code>--help, -h</code>	Outputs message of usage SymProbe.
<code>-c</code>	Indicates that <i>SymProbe</i> will apply certain session settings stored in file “view.ppw”, placed in the same directory where <i>&lt;file&gt;</i> is.

## SymProbe User Guide

	After closing SymProbe renews session settings to “view.ppw”.
<file>	file with simulation results.
-noInitDir	use <current working directory> as an initial directory for Open dialog box.
-d <InitDir>	use <InitDir> as an initial directory for Open dialog box.

### Input formats

Supported input formats: APB, CSV, CSDF, RAW, NUTMEG.

Format	Analysis Type			
	AC	DC	TRAN	Sweep
APB	+	+	+	+
CSDF	+	+	+	one sweep only
CSV	+	+	+	one sweep only
RAW	+	+	+	one sweep only
NUTMEG BIN	+	+	+	one sweep only
NUTMEG ASCII	+	+	+	one sweep only

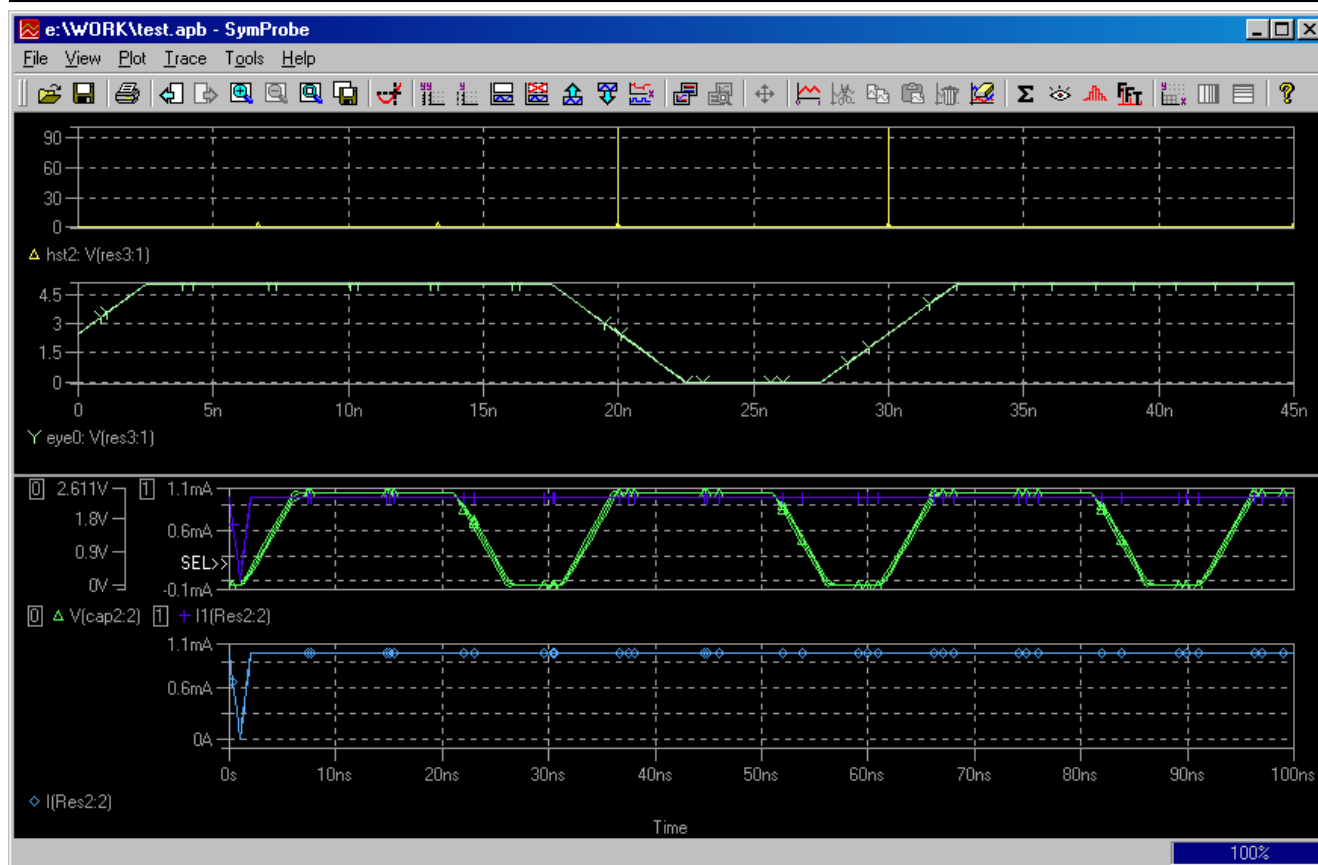
'+' denotes that SymProbe supports input file of this format for type analysis indicated

### Work environment

This section contains information about SymProbe interface: [main window](#), [menu](#), [hot keys](#), [toolbar](#), [status bar](#).

#### Main window

SymProbe looks in the following way:



In the upper portion of the main window there is a [menu](#), lower – the [toolbar](#), which provides fast access to menu commands. The toolbar can be hidden if you remove the tick opposite <Toolbar> command from the [<View> menu](#). In the lower portion of the main window there is the [status bar](#), which provides information about every menu command. The status bar also can be hidden if you remove the tick opposite <Status Bar> command from the [<View> menu](#). The main window can contain several plots; into each plot can be placed several traces. The active plot is marked by sign "SEL>>". To every plot you can add from 1 to 3 Y Axis with different scales. To make trace (and corresponding plot active) selected - click on it. You can select trace by clicking on its name also. The name of the selected trace is highlighted.

## Menu

*SymProbe* menu contains commands necessary for operation with plots and traces:

- printing traces ([<File> menu](#));
- defining work environment and zooming ([<View> menu](#));
- operation with plots (adding, combining, moving, etc.) ([<Plot> menu](#));
- operation with traces (adding, copying, deleting, etc.) ([<Trace> menu](#));
- setting axis, defining *SymProbe* options, operation with cursor ([<Tools> menu](#));
- displaying help topics about the program ([<Help> menu](#)).

You can choose menu item with the mouse or you can use shortcut keys. For example, press *Alt + T* to display Trace menu (press *Alt*, then underlined menu character). Next, press *A* to add a new trace to the active plot.

### Hot keys

#### File

<i>Open...</i>	<i>Ctrl + O</i>
<i>Save</i>	<i>Ctrl + S</i>
<i>Print...</i>	<i>Ctrl + P</i>
<i>Close</i>	<i>Alt + X</i>

#### View

<u><i>Zoom</i></u>	
<i>Back</i>	<i>Alt + Left Arrow</i>
<i>Forward</i>	<i>Alt + Right Arrow</i>
<i>In</i>	<i>I</i>
<i>Out</i>	<i>O</i>
<i>All</i>	<i>*</i>
<i>All X</i>	<i>Shift + X</i>
<i>All Y</i>	<i>Shift + Y</i>
<i>Display Control</i>	<i>F12</i>

#### Plot

<i>Add Y Axis</i>	<i>Ctrl + Y</i>
<i>Delete Y Axis</i>	<i>Ctrl + Shift + Y</i>
<i>Add Plot</i>	<i>Ctrl + L</i>
<i>Delete Plot</i>	<i>Ctrl + Shift + L</i>
<i>Move Up</i>	<i>Ctrl + Up Arrow</i>
<i>Move Down</i>	<i>Ctrl + Down Arrow</i>
<i>Unsynchronize X Axis</i>	<i>Ctrl + Break</i>
<i>Combine</i>	<i>Ctrl + Add</i>
<i>Scatter Traces</i>	<i>Ctrl + Sub</i>
<i>Scatter Traces and Zoom</i>	<i>Ctrl + Mult</i>

#### Trace

<i>Add...</i>	<i>Ins</i>
<i>Add All</i>	<i>Ctrl + Shift + Ins</i>
<i>Cut</i>	<i>Ctrl + X / Shift + Del</i>
<i>Copy</i>	<i>Ctrl + C / Ctrl + Ins</i>
<i>Paste</i>	<i>Ctrl + V / Shift + Ins</i>
<i>Delete</i>	<i>Del</i>
<i>Delete All</i>	<i>Ctrl + Shift + Del</i>
<i>Undelete</i>	<i>Ctrl + U</i>
<i>Eval Goal Function...</i>	<i>Shift + E</i>



Tools



<u>Cursor</u>	
<i>Display</i>	<i>C</i>
<i>Freeze</i>	<i>F</i>
<i>Move to X / Y</i>	<i>G</i>
<i>Swap Cursors</i>	<i>W</i>
<i>Prev. Branch A1</i>	<i>Ctrl + 4</i>
<i>Next Branch A1</i>	<i>Ctrl + 6</i>
<i>Prev. Branch A2</i>	<i>Ctrl + Shift + 4</i>
<i>Next Branch A2</i>	<i>Ctrl + Shift + 6</i>











Help

User's Manual	F1
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















<u>Cursor Action \ Cursor</u>	<u>First (A1)</u>	<u>Second (A2)</u>
<i>Move cursor to the left</i>	<i>Left Arrow</i>	<i>Shift + Left Arrow</i>
<i>Move cursor to the right</i>	<i>Right Arrow</i>	<i>Shift + Right Arrow</i>
<i>Move cursor to the beginning</i>	<i>Home</i>	<i>Shift + Home</i>
<i>Move cursor to the end</i>	<i>End</i>	<i>Shift + End</i>
<i>Move cursor to the next branch</i>	<i>Ctrl + 6</i>	<i>Ctrl + Shift + 6</i>
<i>Move cursor to the previous branch</i>	<i>Ctrl + 4</i>	<i>Ctrl + Shift + 4</i>
<i>Move cursor to the next trace</i>	<i>Ctrl + Right Arrow</i>	<i>Ctrl + Shift + Right Arrow</i>
<i>Move cursor to the previous trace</i>	<i>Ctrl + Left Arrow</i>	<i>Ctrl + Shift + Left Arrow</i>

## Toolbar

The toolbar is designed for quick access to menu items. The tools on the toolbar can be available  and unavailable . The tasks that the tools perform are described throughout this manual.

Button	Name	Description
	<b>Open</b>	Open a data file
	<b>Save</b>	Save the file
	<b>Print</b>	Print the view
	<b>Zoom back</b>	Zoom to the previous zoomed area view
	<b>Zoom forward</b>	Zoom to the forward zoomed area view
	<b>Zoom in</b>	Zoom in the plot-view twice, the center of view is chosen by pointer
	<b>Zoom out</b>	Zoom out the plot-view twice, the center of view is chosen by pointer
	<b>Zoom all</b>	Scale up or scale down the plot-view to show all traces
	<b>Save view to disk</b>	Save current view to disk
	<b>Cursor On/Off</b>	Toggle on or toggle off the cursor

## SymProbe User Guide

	<a href="#">Add Y Axis</a>	Add Y Axis to the active plot
	<a href="#">Delete Y Axis</a>	Delete Y Axis from the active plot
	<a href="#">Add plot</a>	Add new plot
	<a href="#">Delete plot</a>	Delete the selected plot
	<a href="#">Move plot up</a>	Move the active plot up
	<a href="#">Move plot down</a>	Move the active plot down
	<a href="#">Unsync X Axis</a>	Set individual X axis for selected plot
	<a href="#">Combine plots</a>	Place traces from several plots to one plot
	<a href="#">Scatter traces and zoom</a>	Place each trace on separate plot and scale the plot-view
	<a href="#">Resize plot</a>	Change the height(width) of a plot
	<a href="#">Add</a>	Add trace(s) to active plot
	<a href="#">Cut</a>	Remove the selected trace(s) and place it(them) on the Clipboard
	<a href="#">Copy</a>	Copy the selected trace(s) on the Clipboard
	<a href="#">Paste</a>	Place the trace(s) from the Clipboard to the active plot
	<a href="#">Delete</a>	Delete the selected trace(s)
	<a href="#">Delete all</a>	Delete all traces from the selected plot
	<a href="#">Eval Goal Function</a>	Evaluate a goal function
	<a href="#">Eye Diagram</a>	Eye-diagram transform
	<a href="#">Histogram</a>	Histogram transform
	<a href="#">Fourier</a>	Fourier transform
	<a href="#">Axis settings</a>	Set the range of X and Y axis, type of range (linear or logarithmic)
	<a href="#">Log/linear X Axis</a>	Switch X axis between linear and logarithmic scaling
	<a href="#">Log/Linear Y Axis</a>	Switch Y axis between linear and logarithmic scaling
	<a href="#">About <i>SymProbe</i></a>	Show the program information, version, copyright

## Status bar

Status bar is situated at the bottom of the SymProbe main window. Status bar displays auxiliary information, which is used during program operation. Status bar is divided into several regions:



In the region 1 prompts about application of different control elements are displayed. These prompts appear while pointing the mouse cursor on the proper menu item or toolbar button.

In the region 2 the percent of simulation fulfillment is displayed.

To display/hide status bar, choose <Status Bar> command from the [<View> menu](#).

## File menu

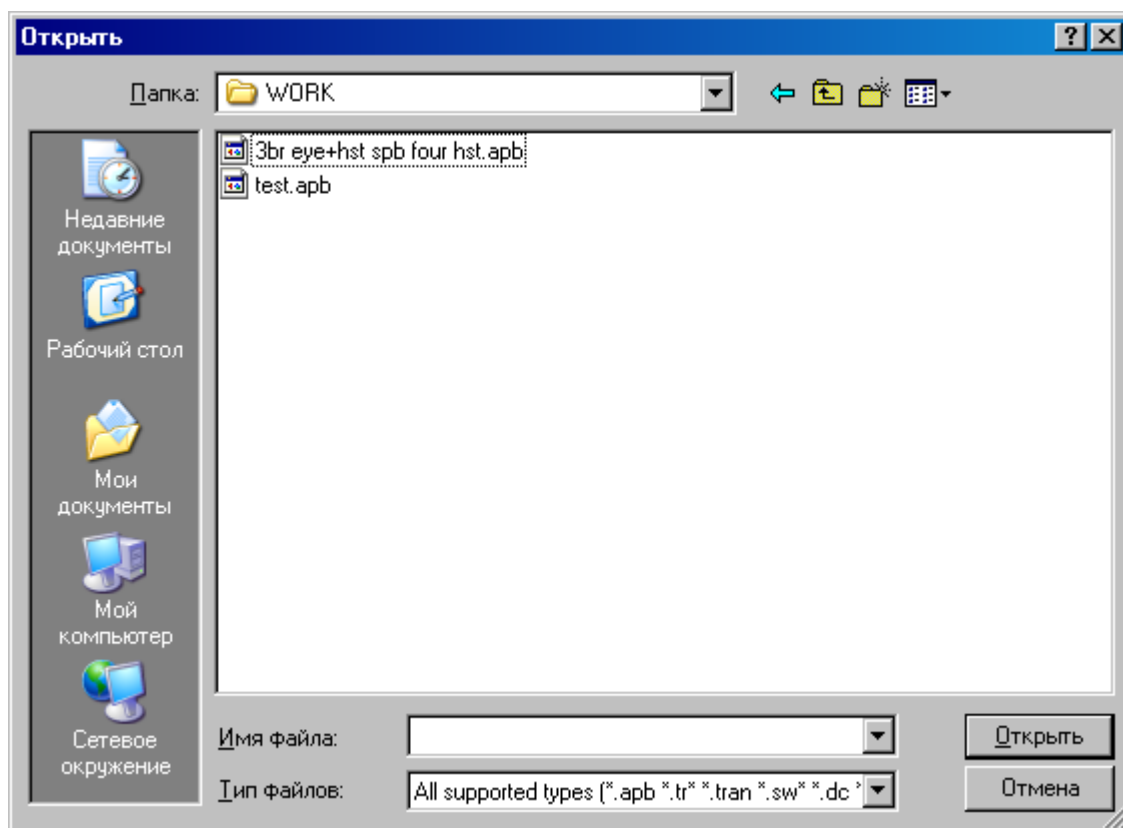
File menu contains commands for saving files and traces printing.

<a href="#">Open</a>	open a file with another instance of <i>SymProbe</i>
Save	save the file with graphics settings made
<a href="#">Save As...</a>	save the file in APB format
<a href="#">Print Preview...</a>	preview the waveform postprocessor window before printing
<a href="#">Print...</a>	print the view
<a href="#">Print Setup...</a>	specify printer settings, select page size and orientation during printing
<a href="#">Print to EMF-file...</a>	print the view to EMF-file (Windows only)
<a href="#">Copy to Clipboard...</a>	print the view to the clipboard as image
Close no Save	exit from <i>SymProbe</i> with no question save changes
<a href="#">Close</a>	exit from <i>SymProbe</i>

## Open

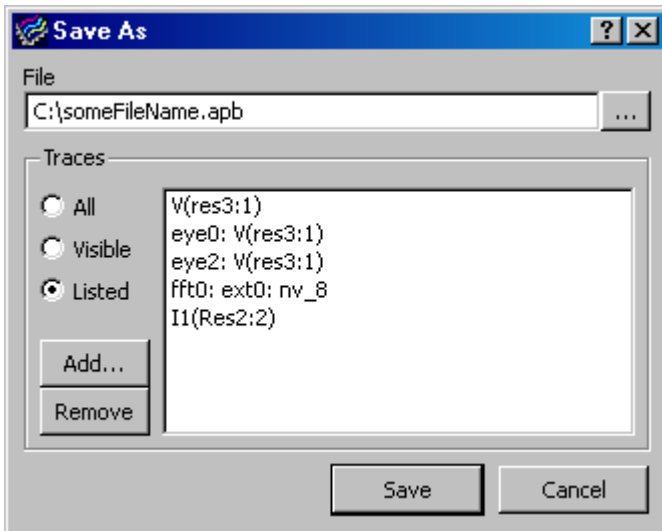
Open window is meant for selecting file you want to be viewed.

**Note:** This file will be opened with another instance of *SymProbe*














### Save As


Save As window allows to choose a file you want to view be saved. Also you can direct which traces will be saved.

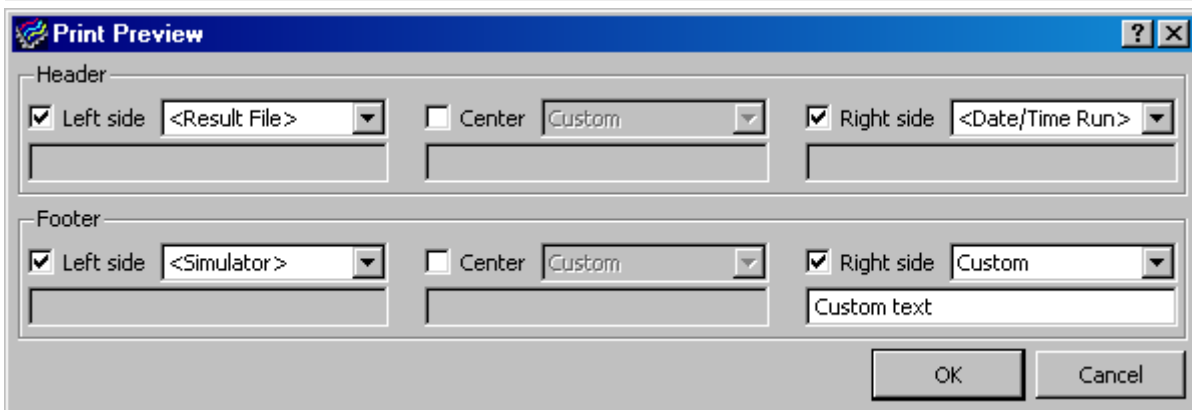



### Print Preview

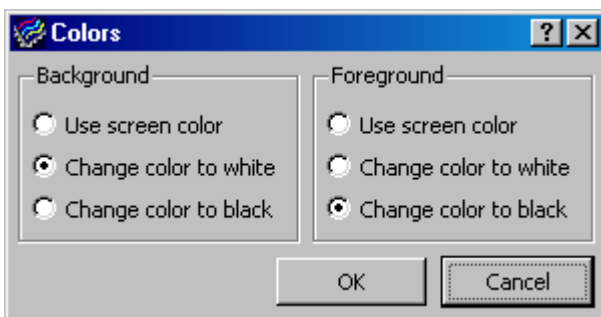
Print preview window is meant for printing process control. To display this window, from the [<File> menu](#) choose [<Print Preview>](#). The Preview window contains menu and the toolbar:


Button	Name	Description
	<a href="#">Print</a>	Print the view
	<a href="#">Print Setup</a>	Specify printer settings
	Grid	Display / hide grid
	Trace Mark	Display / hide traces mark symbols
	Cursor	Display / hide the cursor
	Header/Footer	Modify header/footer
	Colors...	Change background/foreground colors
	Break on Pages	Break layout on pages
	One Page	Layout fit one page
	Pages	View selected layout-pages
	All Pages	View all layout-pages

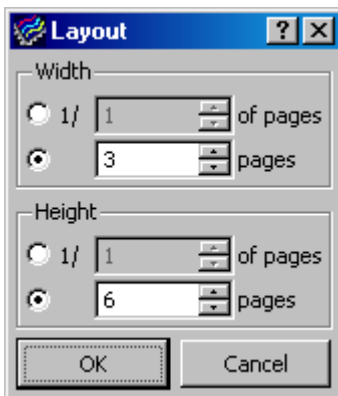
Choose  button to place information about simulation in header/footer. Select proper check box to specify position for information placement (left, right or center). From the drop-down list choose type of information.




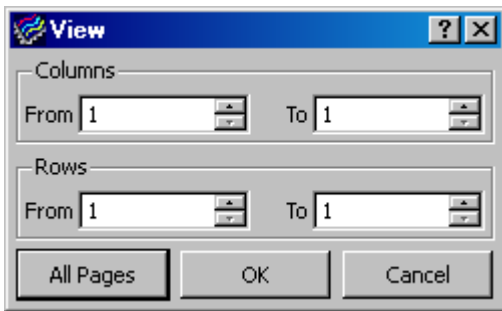
Choose  button to set background/foreground colors.



Choose  button to break layout. You can shrink or expand the printing area to print it on the part of the page or on several pages varying Width and Height values.




Choose  button to view selected pages. In appeared dialog box choose pages to display.

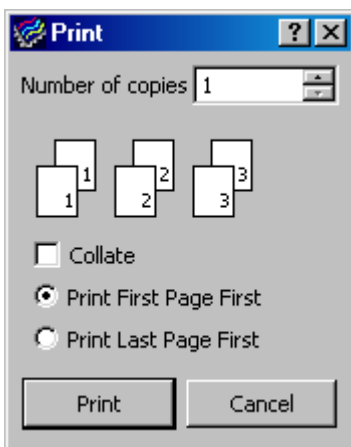


If you are done previewing the contents of the SymProbe view, from the [<File> menu](#) choose <Close> or press Esc to close the preview window.

### Print

To print the SymProbe view, from the [<File> menu](#) choose <Print>, or choose  button on the toolbar.

- In "Number of Copies" field enter required number of copies you want to get.
- To print all pages of the first copy select the check box "Collate" or clear this check box to print all copies of the first page and then all copies of the following pages.
- Radio buttons "Print First Page First" and "Print Last Page First" allow you to choose page order.



### Print Setup

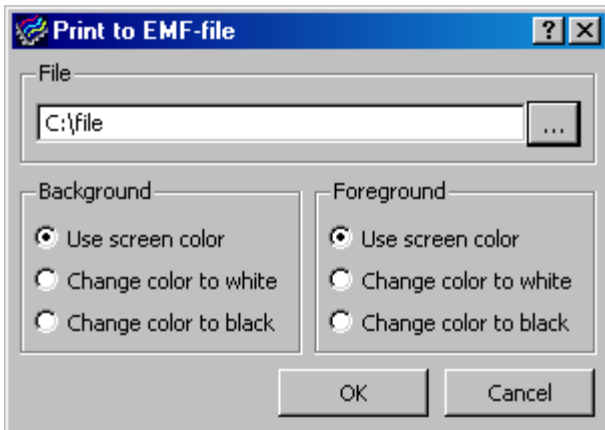
To specify printer settings, from the [<File> menu](#) choose <Print Setup>. Dialog box displays where you can change settings of printer (name and properties), paper (size and source), page orientation (portrait or landscape).

When you select printer name, its properties display automatically: status, type, port and comments. After clicking Properties button, dialog box for specifying printer properties displays (according to printer type).

## Print to EMF-file

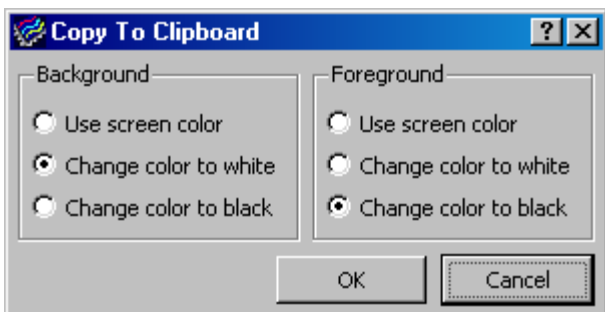
Create EMF-file and print the view to it with specified background/foreground colors.

**Note:** Available on Windows only.



## Copy to Clipboard

For more convenient SymProbe window copying on the Clipboard use <Copy to Clipboard> command from [File menu](#). Next dialog box will appear:



In this dialog box specify colors of background and plots with traces.

## Close

Close *SymProbe* program at all.

## View menu


View menu contains commands:


<a href="#">Zoom</a>	
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## SymProbe User Guide



<b>Back</b>	return to the previous view
<b>Forward</b>	return to the following view
<b>In</b>	zoom in the active plot-view twice
<b>Out</b>	zoom out the active plot-view twice
<b>All</b>	view all traces on plot
<b>All X</b>	scale up or scale down the plot-view for optimal placement of the trace along X axis
<b>All Y</b>	scale up or scale down the plot-view for optimal placement of the trace along Y axis
<b>Save view to disk</b>	save the current session view to “view.ppw” file, placed in the same directory where <data file> is
<b><a href="#">Display Control</a></b>	save the current session view for subsequent plotting
<b>Toolbar</b>	display / hide the toolbar
<b>Status Bar</b>	display / hide the status bar

### Zooming

To scale up the separate part of the trace, select by pointer rectangular area that specifies the plot with new ranges of X and Y axis. To zoom in the plot-view twice, choose  button, or from the [<View> menu](#) choose <Zoom/In>.

To zoom out the plot-view twice, choose  button, or from the [<View> menu](#) choose <Zoom/Out>.

To view all traces on the plot, choose  button, or from the [<View> menu](#) choose <Zoom/All>.

To return to the previous view, from the [<View> menu](#) choose <Zoom/Back> or press  button. To return to the next view, from the [<View> menu](#) choose <Zoom/Forward> or press  button.

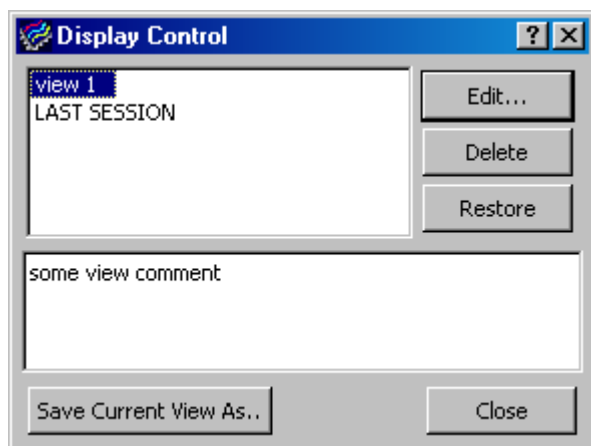
To scale up or scale down the image for optimal placement of the trace along X axis (or Y Axis), from the [<View> menu](#) choose <Zoom/All X (Y)>.

### Display Control

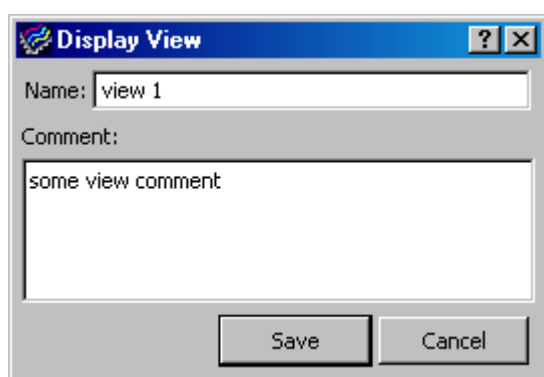
You can create displays to save the contents of the *SymProbe* window. You can use a saved display to display traces as long as the current file has variables with the same names as the variables in the saved display. To save current display for subsequent plotting,



from the [View menu](#) choose <Display Control>. The next dialog box appears:



To edit existing display view, choose *Edit* button. To delete display view, choose *Delete* button. To restore selected display view in *SymProbe* window, choose *Restore* button. To save display view, choose *Save Current View As...* button.



In appeared dialog box type the name of the current view and comment on it.

## Plot menu


Plot menu contains commands for working with plots:

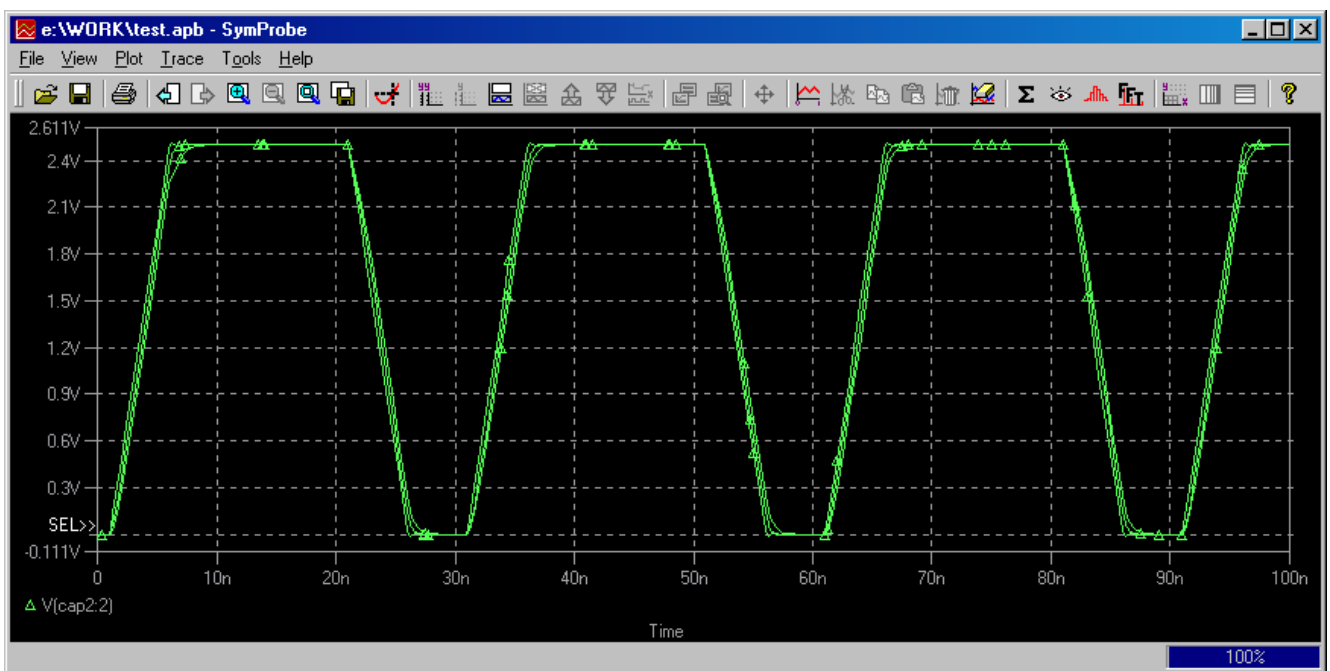
<a href="#">Add Y axis</a>	add Y axis to the active plot
<a href="#">Delete Y axis</a>	delete the selected Y axis
<b>Auto scale Y Axis</b>	automatic scale along Y axis
<a href="#">Add Plot</a>	add a plot in upper portion of <i>SymProbe</i> main window
<a href="#">Delete Plot</a>	delete the selected plot (marked by sign "SEL>>")
<a href="#">Move Up</a>	move the active plot up
<a href="#">Move Down</a>	move the active plot down

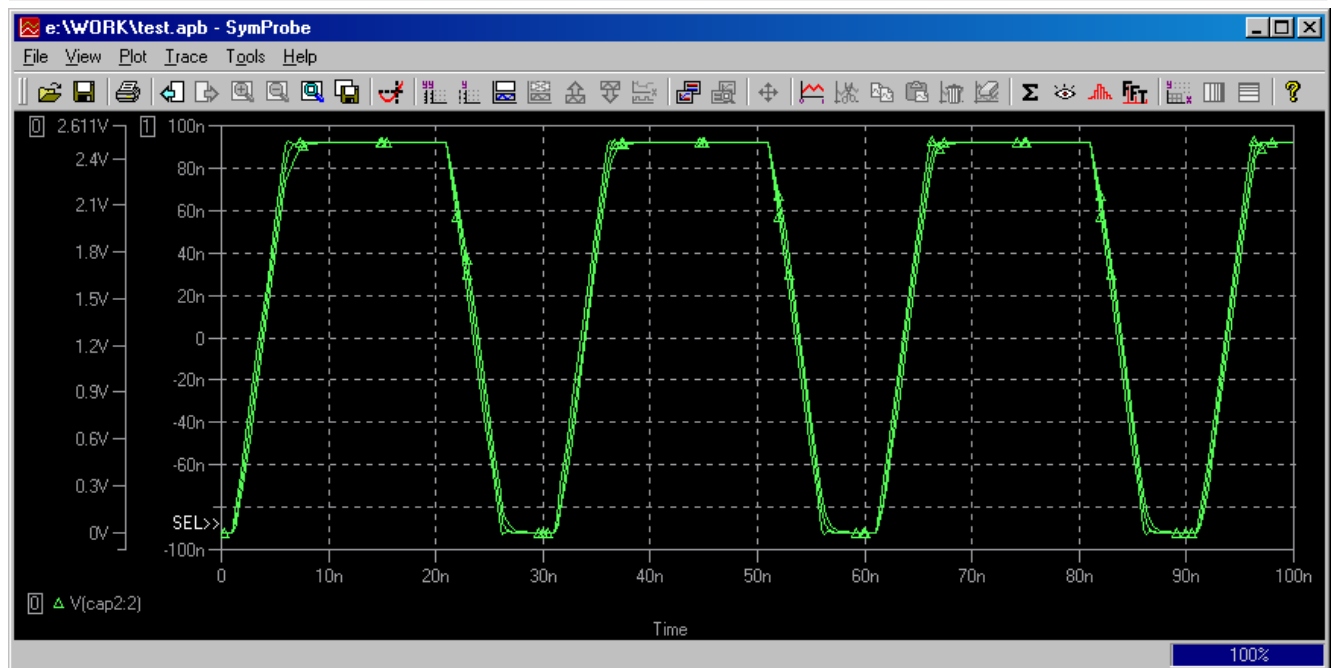
## SymProbe User Guide


<a href="#">Unsynchronize X Axis</a>	set the own X axis for selected plot
<a href="#">Combine</a>	place traces from several plots to one plot
<a href="#">Scatter traces</a>	place each trace on a separate plot
<a href="#">Scatter traces and Zoom</a>	place each trace on a separate plot and scale the image
<a href="#">Resize</a>	change size of a plot
<i>Adjust Size</i>	
<a href="#">Width</a>	adjust width of all plots
<a href="#">Height</a>	adjust height of all plots
<a href="#">Auto</a>	adjust width and height of all plots

### Optional Y axis

For each plot you can specify 3 optional Y Axis and associate to each of them several traces. For every optional Y Axis you can regulate range and units. To add Y Axis, choose  button, or from the [Plot menu](#) choose <Add Y Axis>.



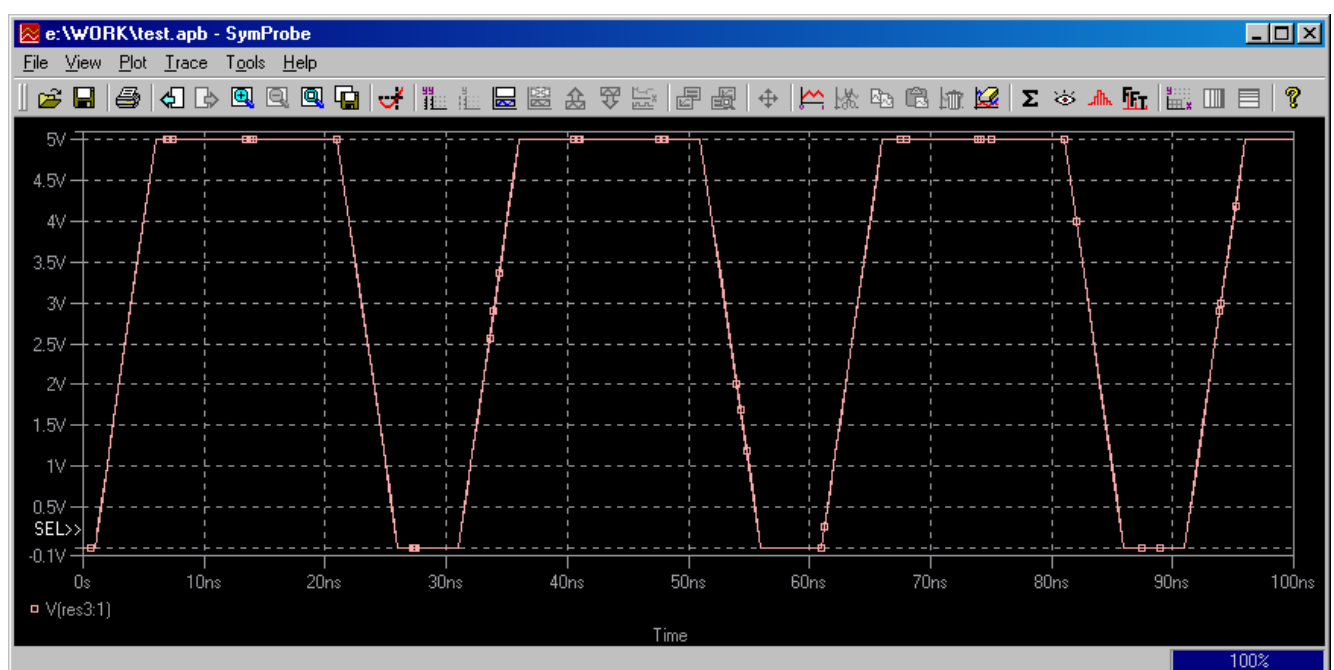


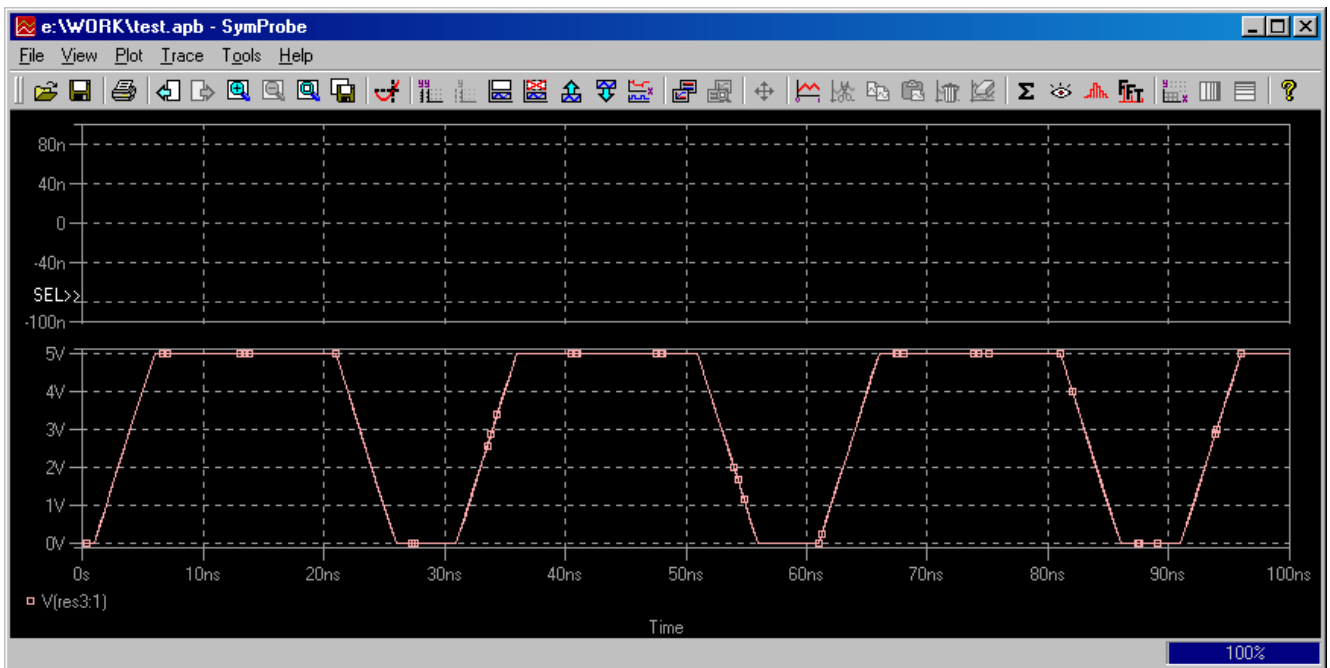
To delete optional Y Axis, select it and choose  button, or from the [Plot menu](#) choose <Delete Y Axis>.

## Adding and deleting plots


You can open a multiple number of plots, but only one of them is active at the moment. It is identified by symbol "SEL>>" at the left of Y axis. To make the plot active, click the left mouse button on it.

To add a new plot, choose  button, or from the [Plot menu](#) choose <Add Plot>.




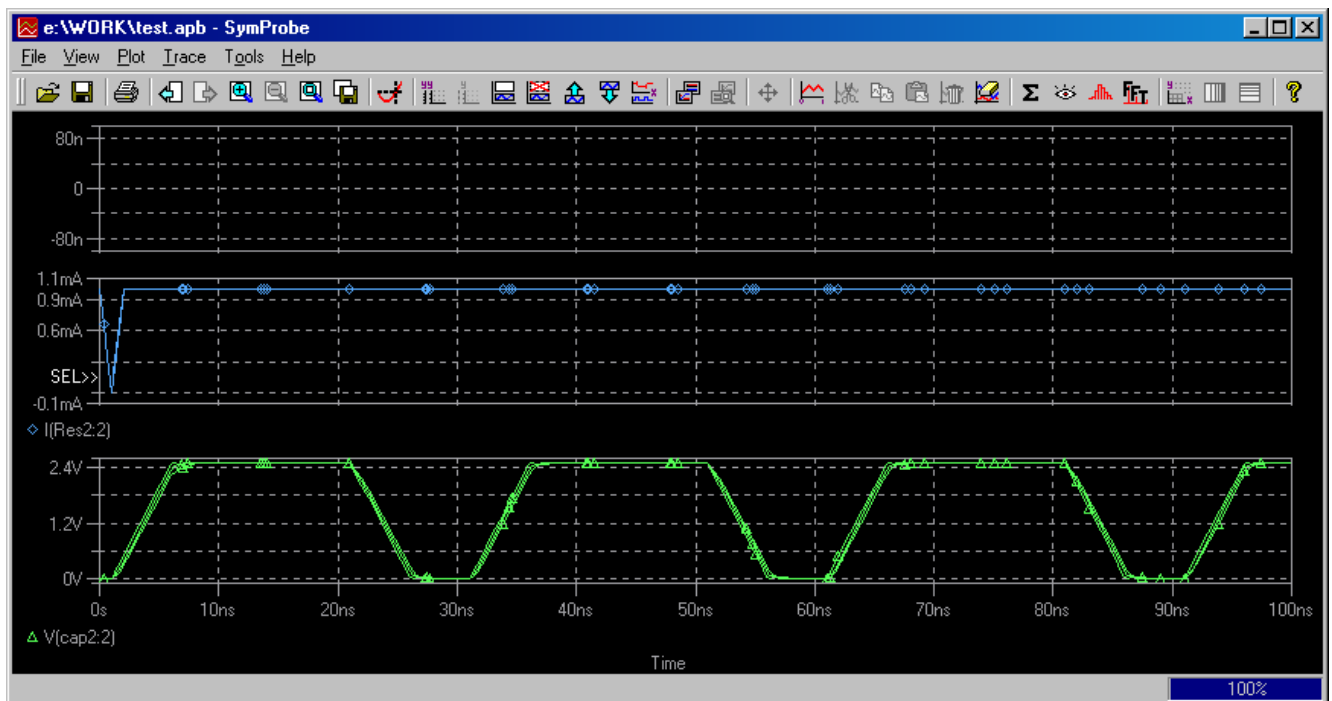
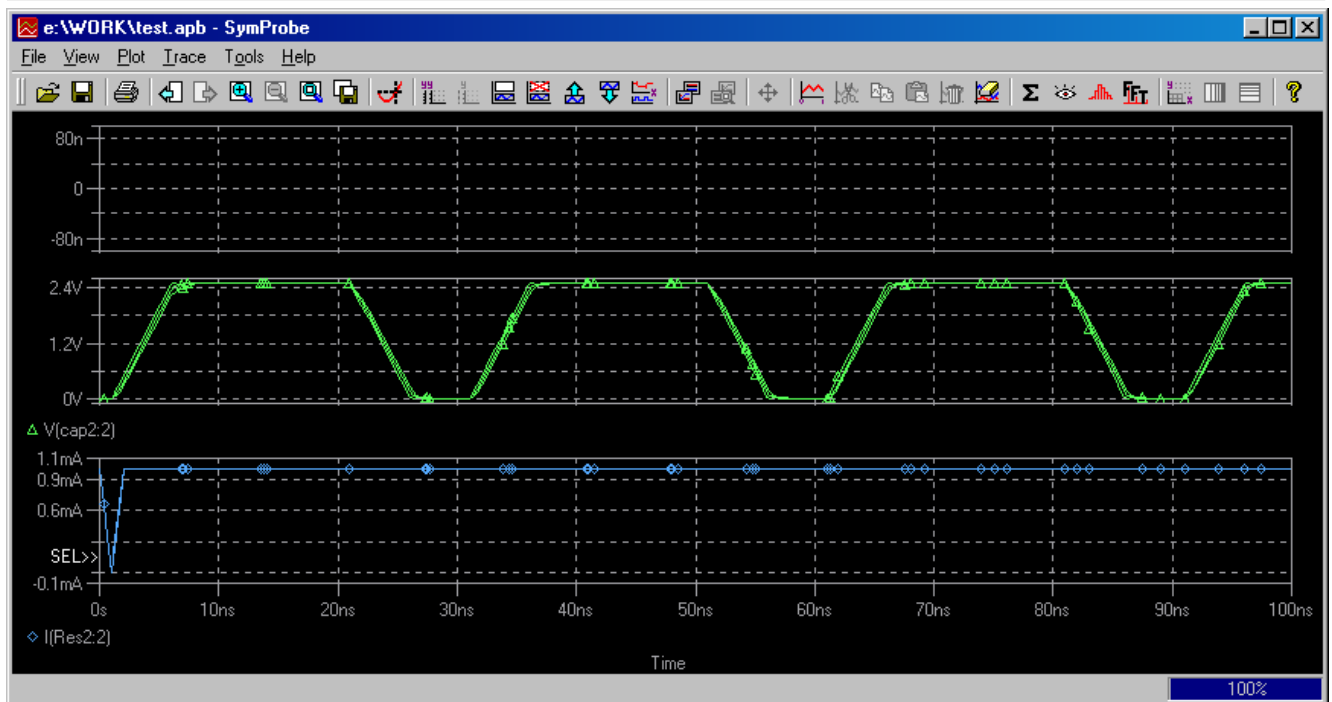



Just added plot will appear in the upper portion of SymProbe main window.

To delete the plot, select it and choose  button, or from the [Plot menu](#) choose <Delete Plot>.


### Moving plots

If there are several plots in SymProbe main window, you can change their positions. To move the plot up, select it by pointer and click  button, or from the [Plot menu](#) choose <Move Up>.

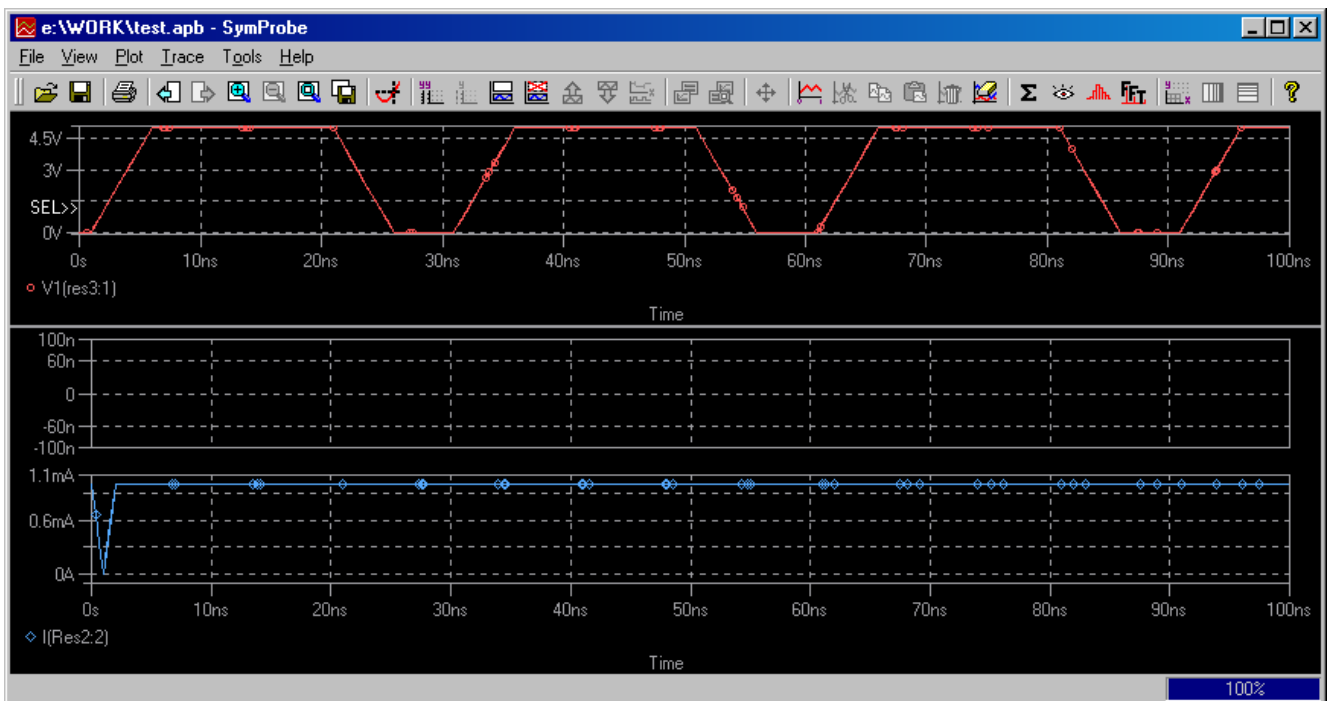
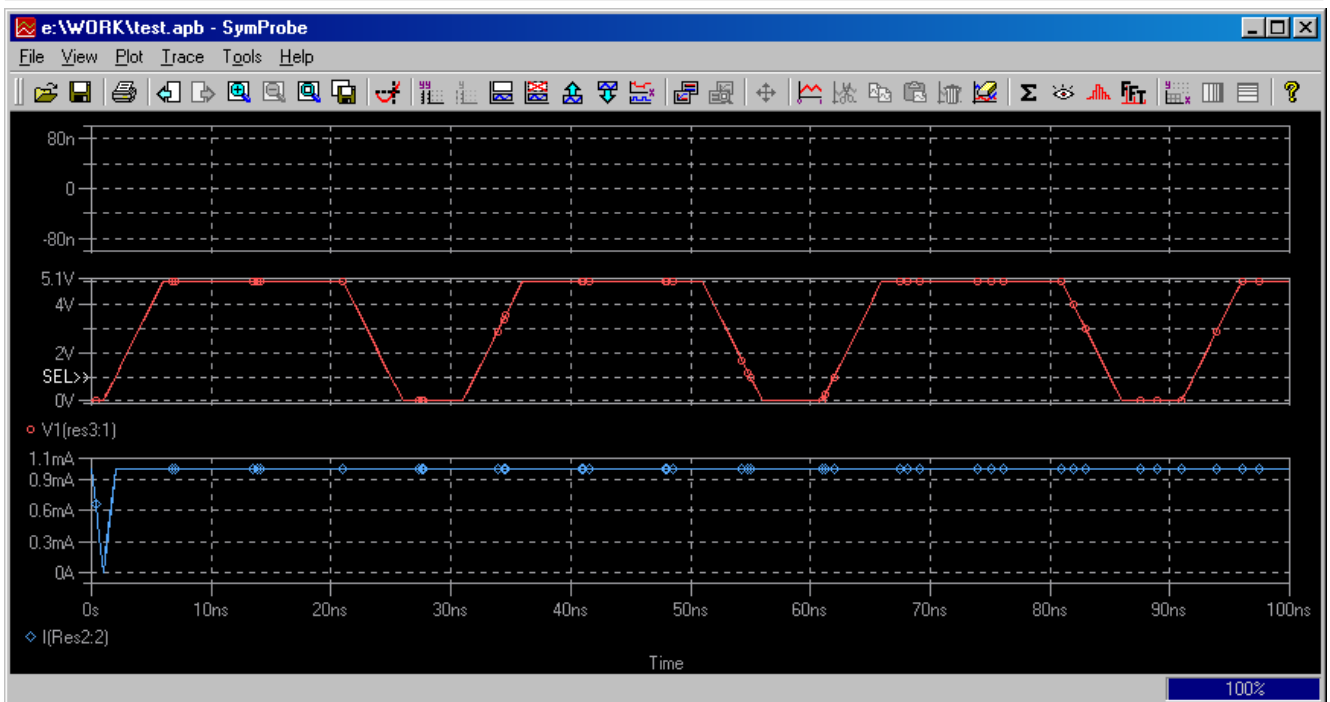


To move the plot down, select it by pointer and click  button, or from the [Plot menu](#) choose <Move Down>.

## Unsynchronizing X axis


By default for several plots in SymProbe there is one X Axis with the range set in [Axis settings](#) dialog box. If it is necessary to separate X Axis of one plot, choose  button, or from the [Plot menu](#) choose <Unsynchronize X Axis>.

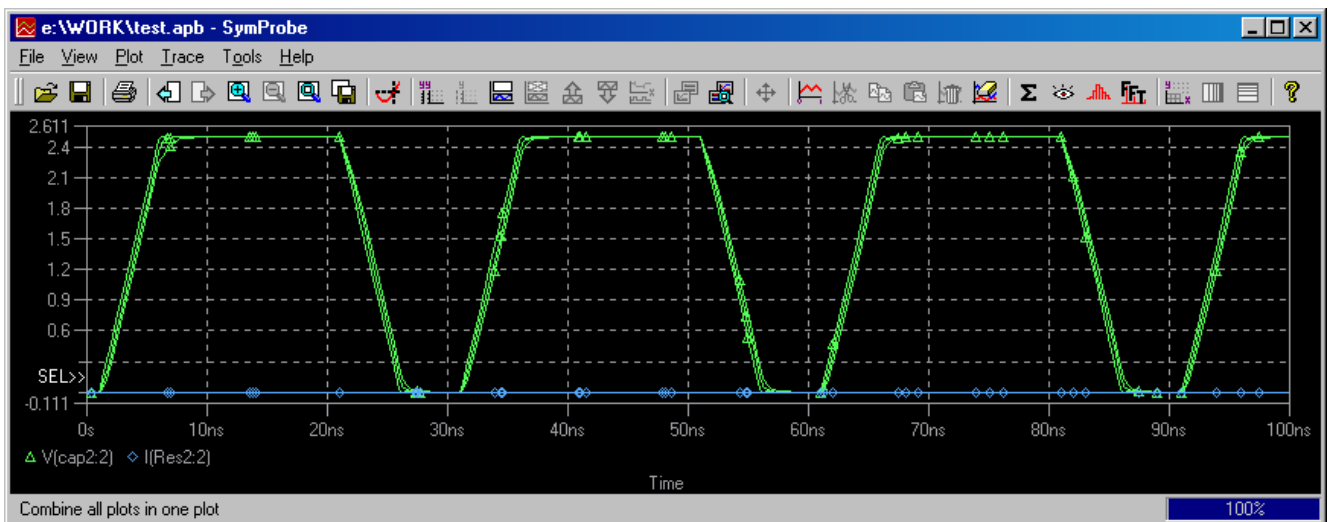
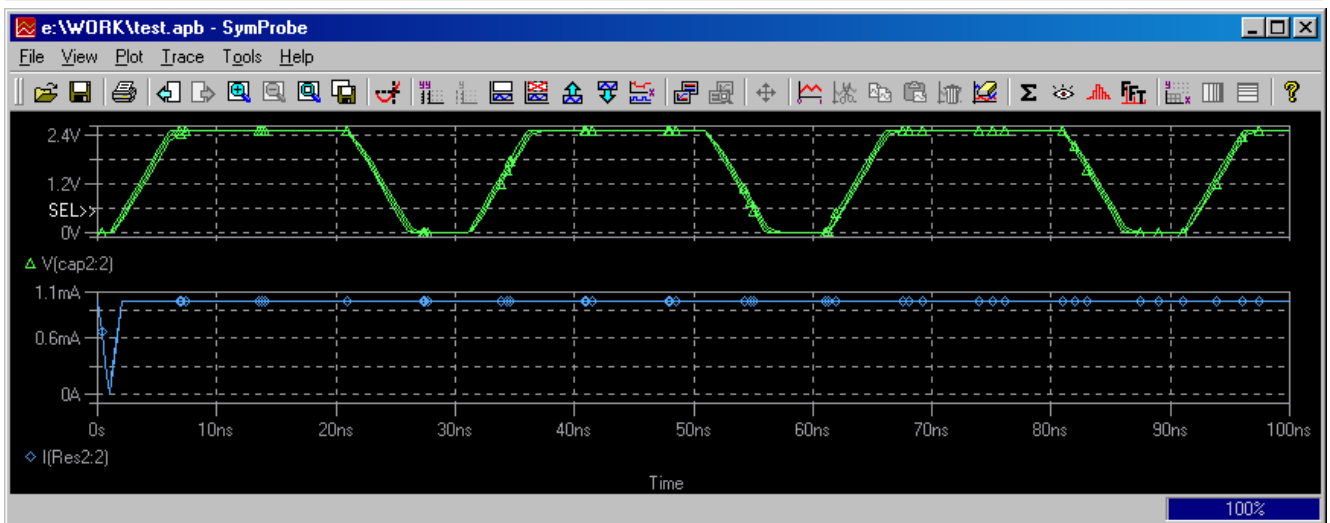
## SymProbe User Guide




After that the active plot will be separated from others by full line and it will have individual X Axis.

### Combining and scattering traces

If it is necessary to reposition traces from different plots to one, choose  button, or from the [Plot menu](#) choose <Combine>.




To distribute each trace on the separate plot, choose <Scatter traces> from the [Plot menu](#). To do such operation with zooming, choose  button, or from the [Plot menu](#) choose <Scatter traces and Zoom>.

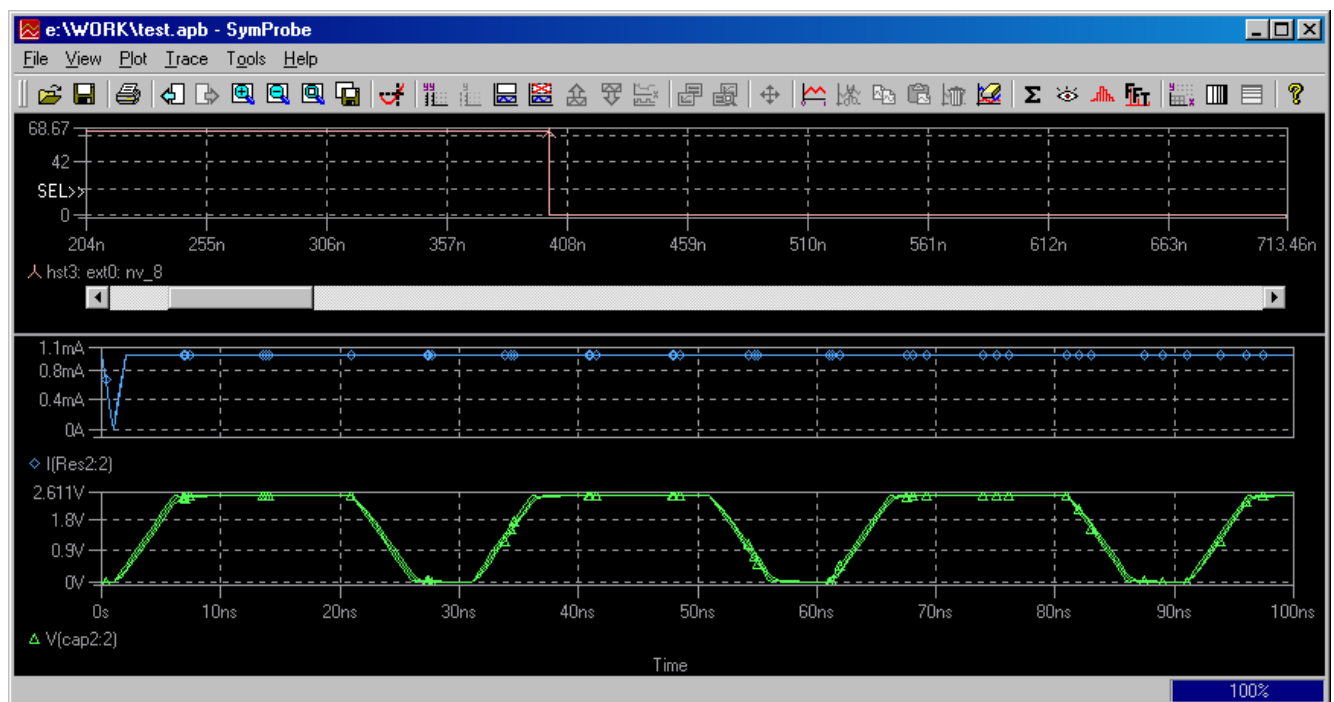
## Changing height and width of the plot

To be able to modify the height of the plot, clear the check box opposite Auto resize plot field in the [Options](#) dialog box.

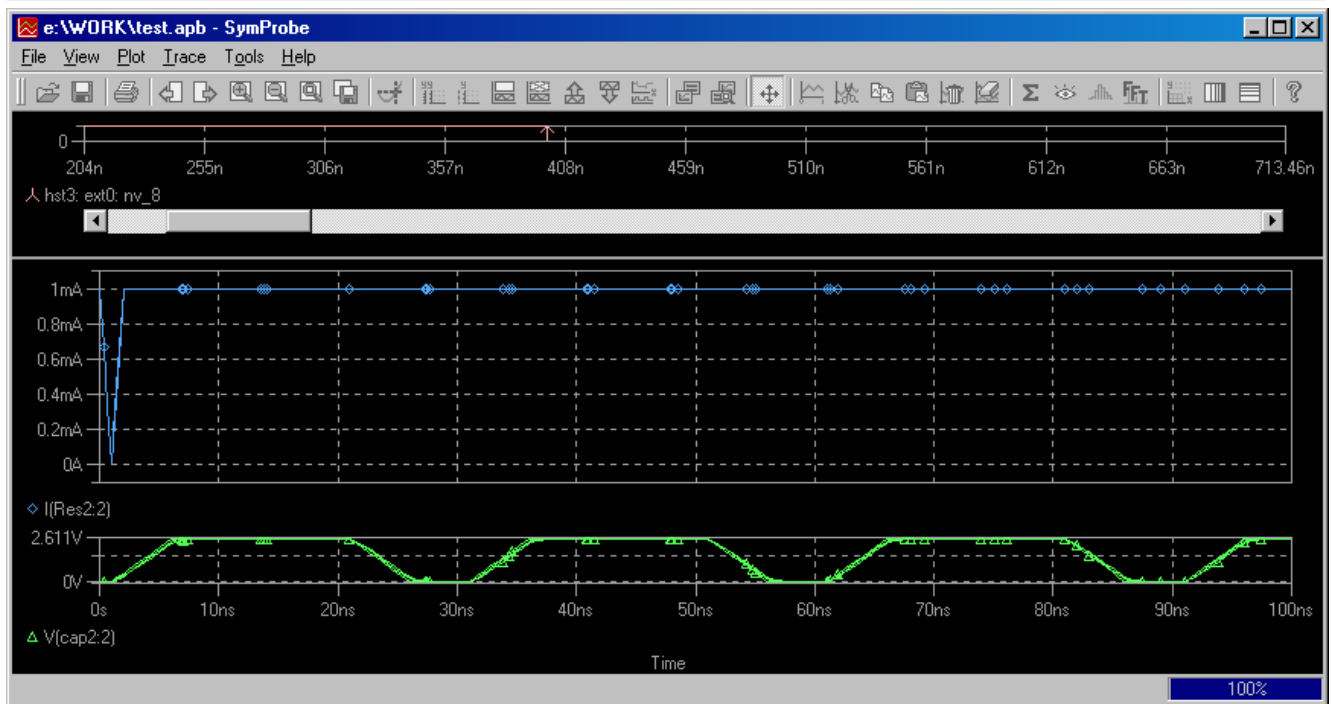
## SymProbe User Guide




To change size of a plot, choose  button, or from the [Plot menu](#) choose <Resize>. Position the cursor on the boundary, that have to be moved, press and hold the left mouse button while dragging the mouse.

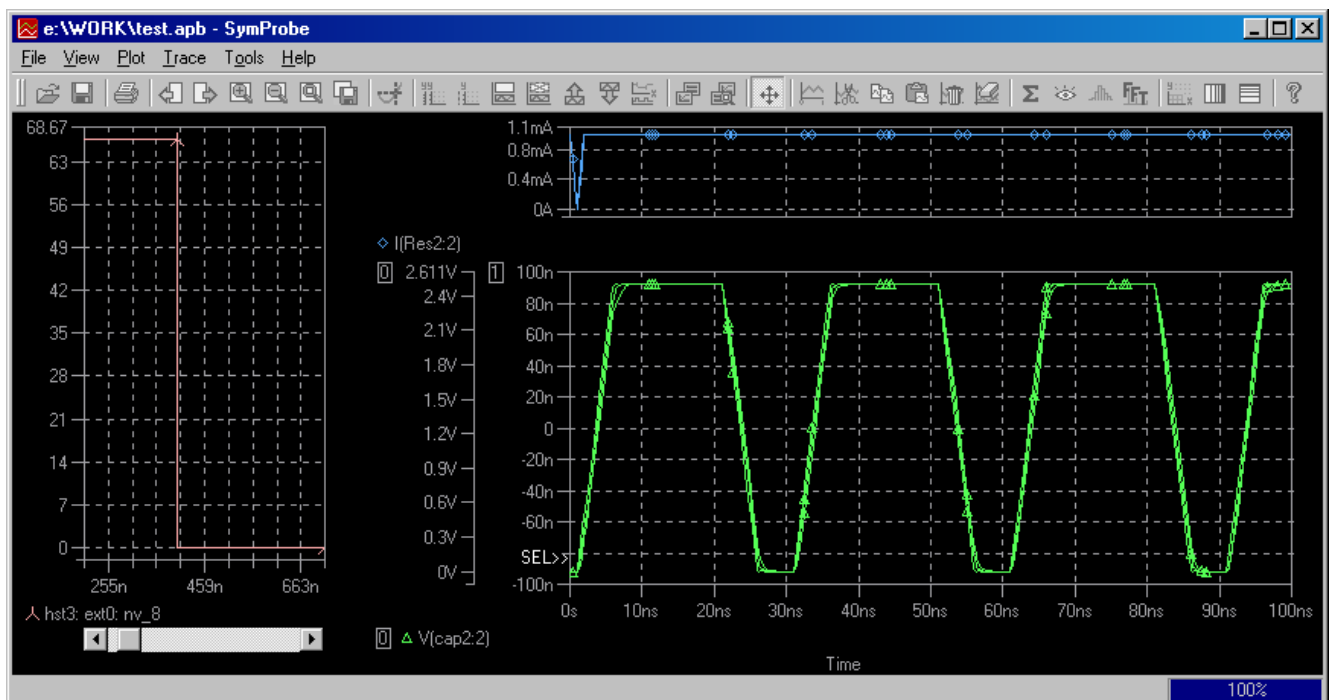






To make all heights of plots equal, from the [Plot menu](#) choose <Adjust Size/Height>. To make all widths of plots equal, from the [Plot menu](#) choose <Adjust Size/Width>.

To be able to modify size of the plot, clear the check box opposite Auto resize plot field and Horiz. Unsynchronize X-Axis in the [Options](#) dialog box, choose  button or from the [Plot menu](#) choose <Unsynchronize X Axis>. Width changing process is the same as for height.



To make all widths and heights of plots equal, from the [Plot menu](#) choose <Adjust Size/Auto>.

### Trace menu

Trace menu contains commands for working with traces:

<a href="#">Mark</a>	mark traces
<a href="#">Add</a>	add trace(s) to the active plot
<a href="#">Add All</a>	add all traces to the active plot
<a href="#">Properties...</a>	selected trace properties
<a href="#">Cut</a>	delete the selected trace(s) and place it(them) to the Clipboard
<a href="#">Copy</a>	copy the selected trace(s) to the Clipboard
<a href="#">Paste</a>	copy the trace(s) from the Clipboard
<a href="#">Delete</a>	delete the selected trace(s)
<a href="#">Delete All</a>	delete all traces from the active plot
<a href="#">Undelete</a>	undelete last deleted trace(s)
<a href="#">Eval goal function...</a>	mathematical expressions for the selected variable
<a href="#">Separate Branch...</a>	separate branch of trace
<a href="#">Eye Diagram...</a>	eye-diagram transform
<a href="#">Histogram...</a>	histogram transform
<a href="#">Fourier...</a>	fourier transform
<a href="#">Aliases...</a>	manage the trace alias
<a href="#">Manage...</a>	manage the traces


### Marking traces

Traces in SymProbe window are marked with different symbols (circles, squares, triangles). This allows to distinguish one trace from another. To mark traces, from the [Trace menu](#) choose <Mark>. Remove the tick if you don't need to mark traces.

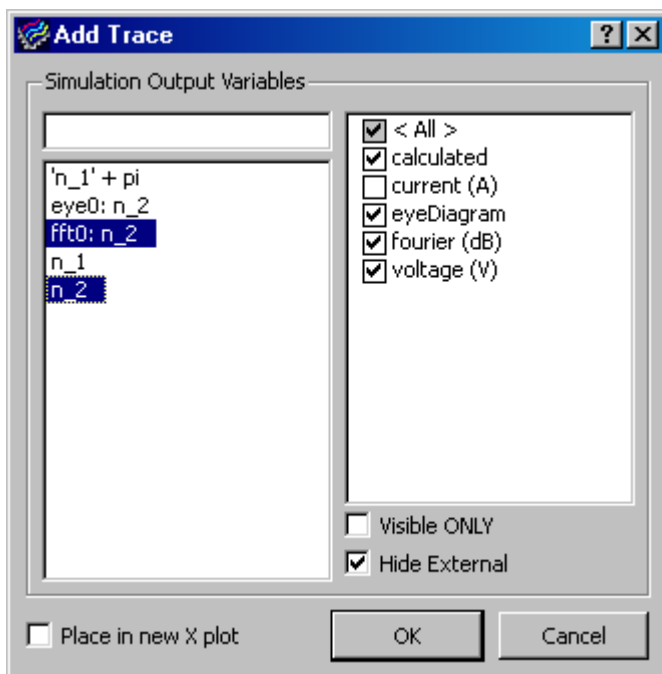
### Adding traces

Every plot can contain a multiple number of traces, but only one of them is active at the moment. To make the trace active, click the left mouse button on the name of its output variable, it will be displayed in the selection color.

To place all trace in the selected plot, choose <Add All> from the [Trace menu](#).

To place trace(s) in the selected plot, choose  button or from the [Trace menu](#) choose <Add>.

In the appeared "Add Trace" dialog box select check boxes near names of output variables which traces you want to add. The list of corresponding markers, specified in input files, displays in the dialog box. To select marker, click the left mouse button on its name. To select multiple markers, press and hold Ctrl key while selecting necessary markers one by one. To select a group of markers, press and hold Shift key then choose two markers. All markers, placed in the list between two chosen markers, will be selected automatically. To exclude the marker from the selection set, press and hold Ctrl key, then click the left mouse button on marker name. After the set of markers is formed click OK button.



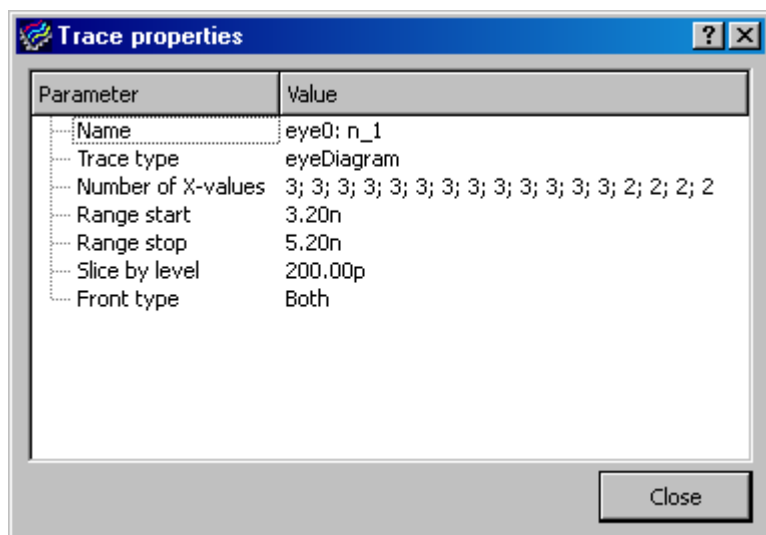
If the filter (a field for text input) is not empty (leading and trailing whitespaces are trimmed, a field containing whitespaces only is empty), in the Traces list only those names will be available which contain text from the filter field.


You can transfer trace from one plot to another to compare results of simulation. Press and hold the left mouse button on the name of the trace while moving cursor. Release the left mouse button when cursor is over necessary plot. One copy of the trace will be transferred to a new plot, other will remain in the previous plot.


Also you can transfer trace from one plot in the one SymProbe window to the plot of another instance of SymProbe in the same way. Prefix "ext" will be set for this transferred trace name.


### Editing traces

To view the selected trace properties choose <Properties...> from [<Trace> menu](#) or double-click the trace name (the name you clicked is highlighted).




To delete the selected traces and place them to the Clipboard, choose  button, or from the [<Trace> menu](#) choose <Cut>.

To copy the selected traces to the Clipboard, choose  button, or from the [<Trace> menu](#) choose <Copy>.

To paste the traces from the Clipboard, choose  button, or from the [<Trace> menu](#) choose <Paste>.

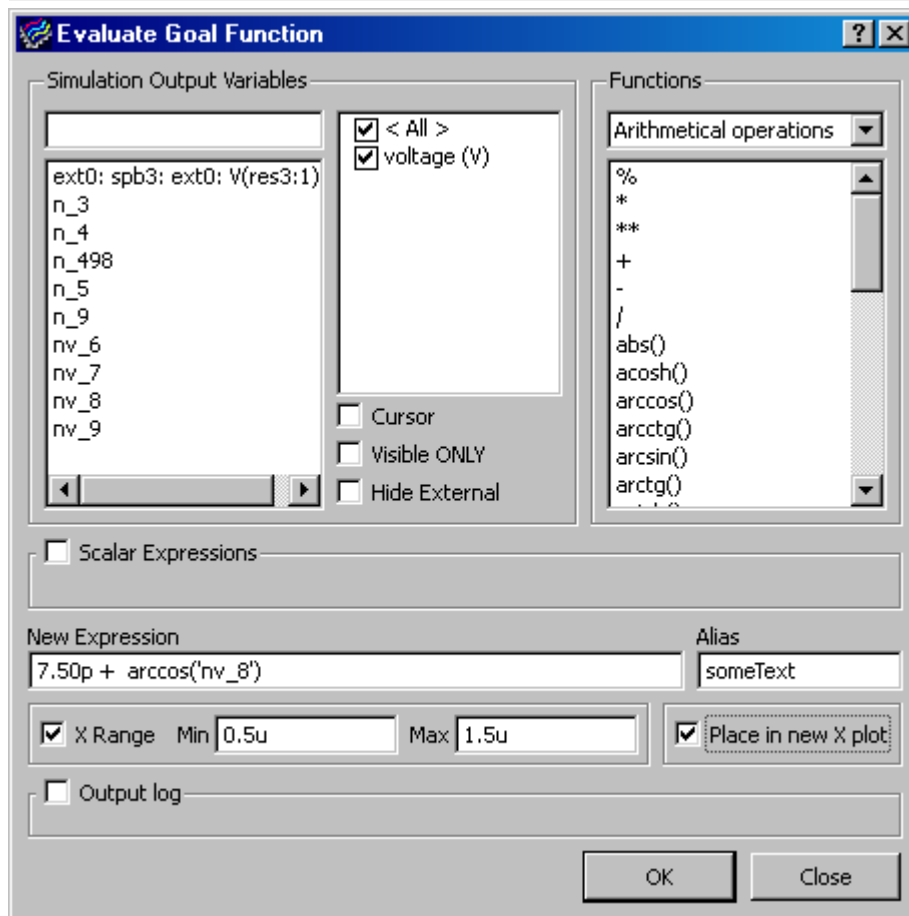
To delete the selected traces, choose  button, or from the [<Trace> menu](#) choose <Delete>.

To delete all traces from the active plot, choose  button, or from the [<Trace> menu](#) choose <Delete All>.

To undo last delete command, from the [<Trace> menu](#) choose <Undelete>.

### Evaluate goal function

To implement arithmetical or algebraic operations on the traces, from the [<Trace> menu](#) choose <Eval Goal Function>. The next dialog box appears:



Choose the check box near name of output variable to display markers corresponding to this output variable. To select the marker, double click the left mouse button on its name.

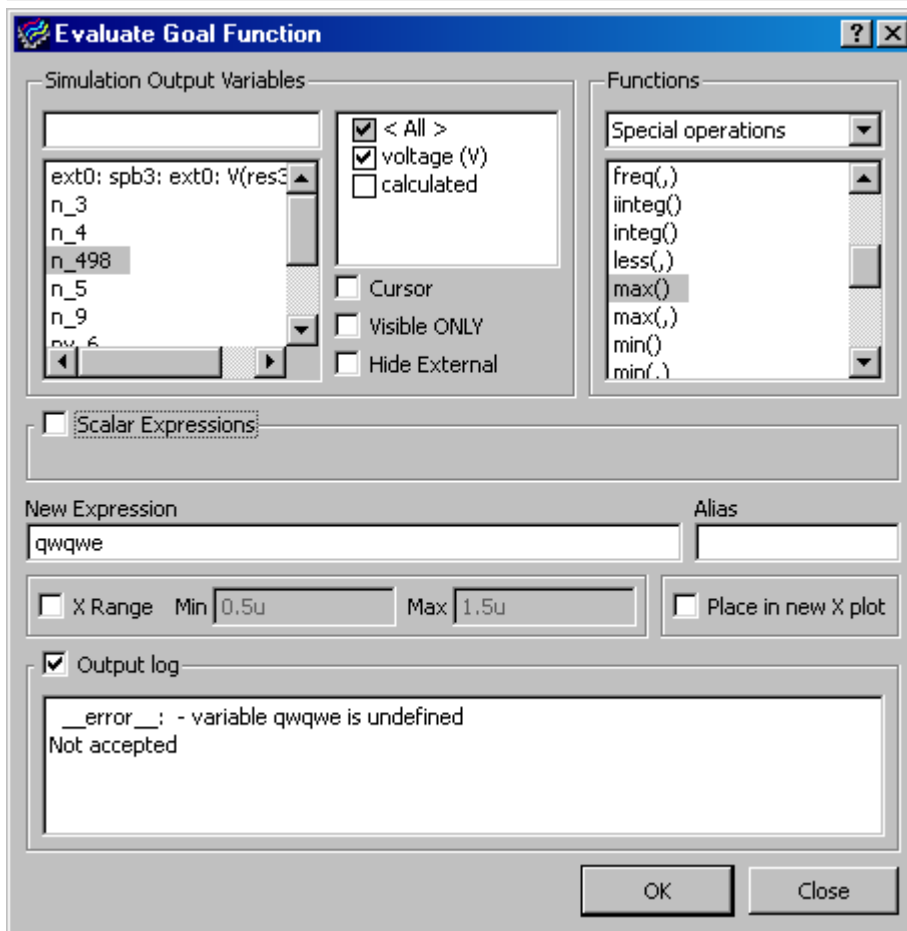
From the Functions drop down list choose the type of operations (arithmetical or special). For more information about operations see [Calculator](#).

In the text field New Expression specified variables and operations on them display. New expression may be calculated in specified range and new trace may be placed in new plot with own X axis.

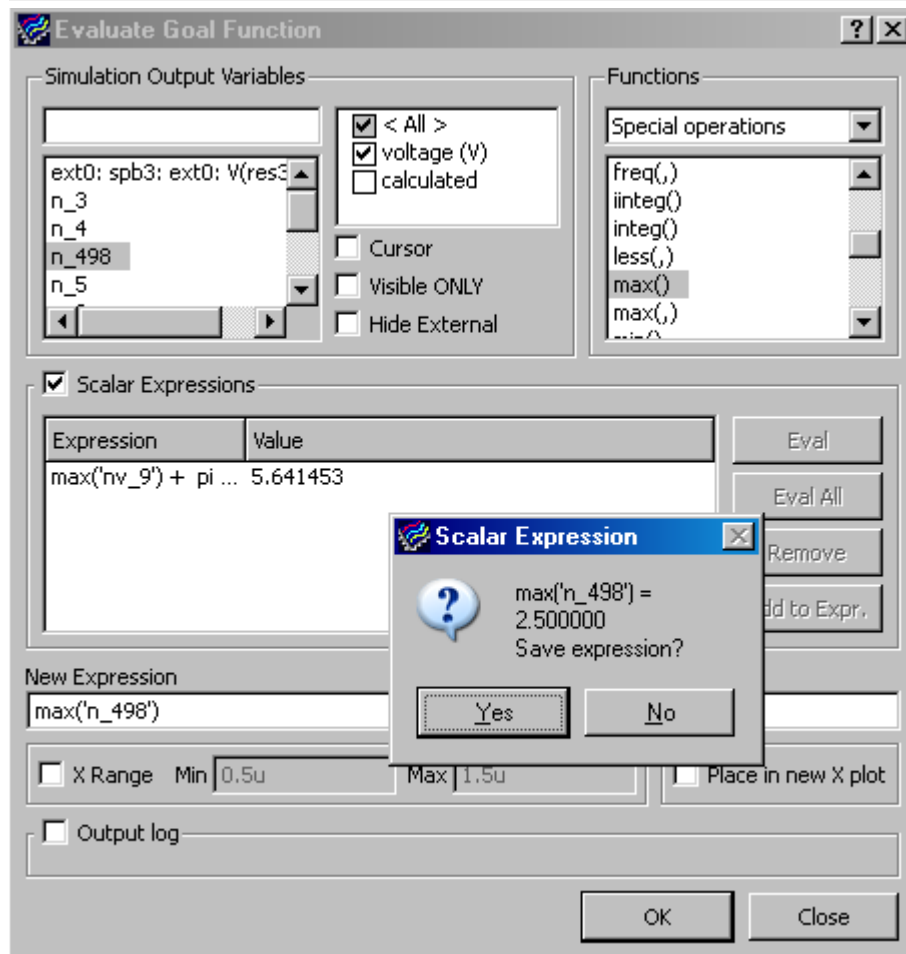
After specifying the expression click OK button.

If in this expression errors were detected, corresponding message appears in the Output log field.

## SymProbe User Guide

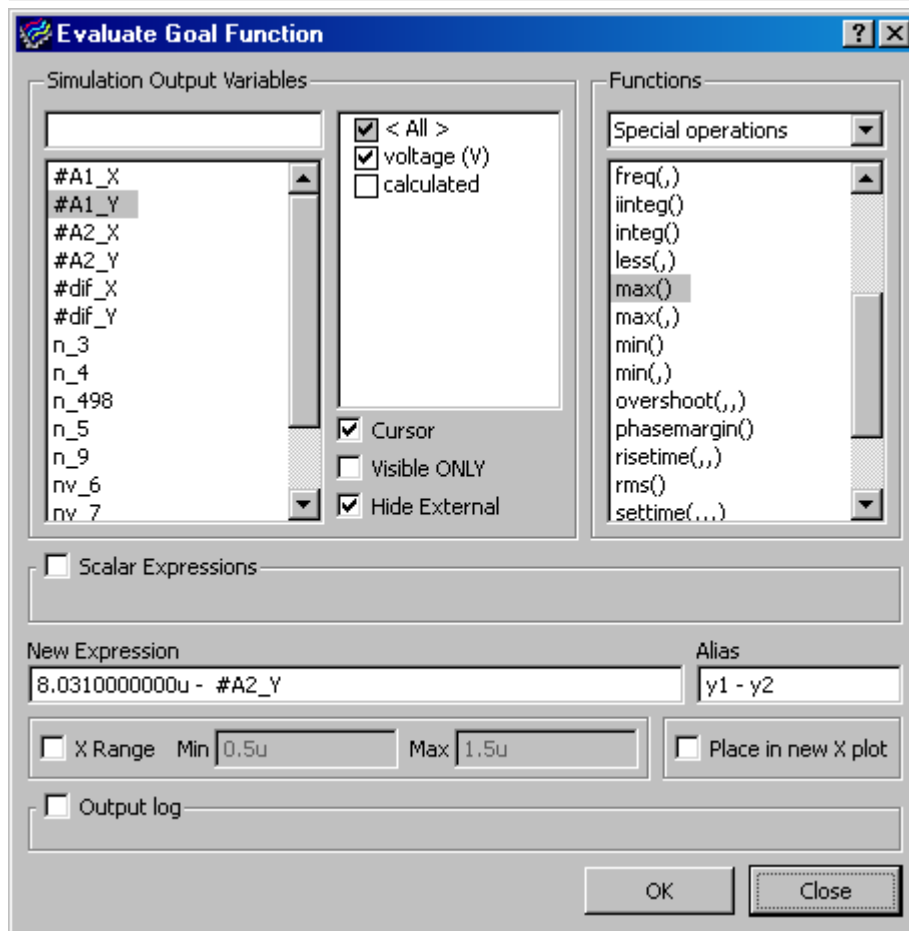


If new expression is a scalar value you will be informed about its value.



## Using cursor values

To apply cursor values in expressions choose variables: #A1\_X, #A1\_Y, #A2\_X, #A2\_Y, #dif\_X, #dif\_Y from "Simulation Output Variables" box or enter these names manually.



## Calculator

### Introduction

Calculator is a calculator working with arrays of values, which allows evaluate expressions with voltage level, current into pin using algebraic operations, mathematical and special functions.

### Calculator expressions

Calculator expressions can contain arithmetical operations, mathematical and special functions. Function names are case insensitive.

### Arithmetic operations

+	addition
-	subtraction
*	multiplication
/	division
%	residue of division
**	exponentiation



Mathematical functions	
Trigonometric functions	
sin(x)	sine
cos(x)	cosine
tg(x)	tangent
ctg(x)	cotangent
asin(x)	arc sine
acos(x)	arc cosine
atg(x)	arc tangent
actg(x)	arc cotangent
sh(x)	hyperbolic sine
ch(x)	hyperbolic cosine
th(x)	hyperbolic tangent
cth(x)	hyperbolic cotangent

## Algebraic functions

exp(x)	exponential function
log(x)	logarithm base 10
ln(x)	natural logarithm
abs(x)	absolute value
int(x)	integer part
sqr(x)	squaring
sqrt(x)	square root

Special functions	
deriv(x)	derivative
integ(x)	integral (vector)
iinteg(x)	integral (number)
min(x)	minimum
max(x)	maximum
xmin(x)	minimum coordinate
xmax(x)	maximum coordinate
avg(x)	vector average
avgw(x,w)	window width average
cross(x, y)	crossing
delay(x, y, z)	delay
overshoot(x, y, z)	overshoot

## SymProbe User Guide

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settime(x, y, z, w)	setup time
risetime(x, y, z)	signal rise time
falltime(x, y, z)	signal fall time
rms(x)	root-mean-square deviation
phaseMargin(x)	phase margin
bandLow(x, y)	band low
bandHigh(x, y)	band high
bandPass(x, y)	band pass

Functions can perform operations on numbers and vectors (operands). The result of function calculation can also be an operand. As a function result numbers or vectors can be used. Marker names, numerical constants, constant p appear to be the calculator operands.

### Function description

#### Operations and mathematical functions

Arithmetical operations and mathematical functions can be performed on numbers and vectors. The result of operation on two numbers is a number. The result of operation on number and vector is a vector, contained elements equal to the result of operation on corresponding values of initial vector and number. The result of operation on two vectors is a vector. Its values contain results of operation on the value pairs of initial vectors. For successful accomplishment of operation, vectors should have equal length.

#### Examples

a = 1.67, b = 3.25

a + b = 4.92

a = 1.67, b = {1, 2, 3}

a + b = {2.67, 3.67, 4.67}

a = {1, 2, 3}, b = {4, 2, 1}

a / b = {0.25, 1, 3}

a\*\*b=ab

The result type of mathematical function call corresponds to the argument types.

#### Special functions

##### avg(x)

Function avg(x) calculates vector x average at every point. Average is defined as integral of expression f(x) over the x range, divided by x range.

$$avg(f(x)) = \frac{\int_0^x f(t) dt}{x}$$

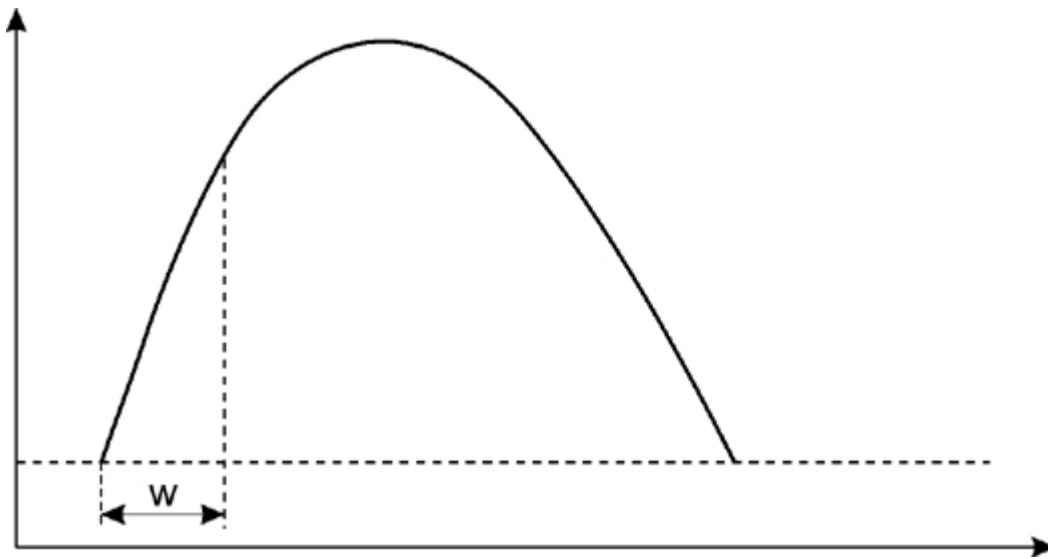
where  $x \in (0, x)$ . The function returns vector.

$\text{avgw}(x, w)$

Function  $\text{avgw}(x, w)$  calculates window width average, using the expression:

$$\text{avgw}(x, w) = \frac{\int_{x-w}^x f(x) dx}{w}$$

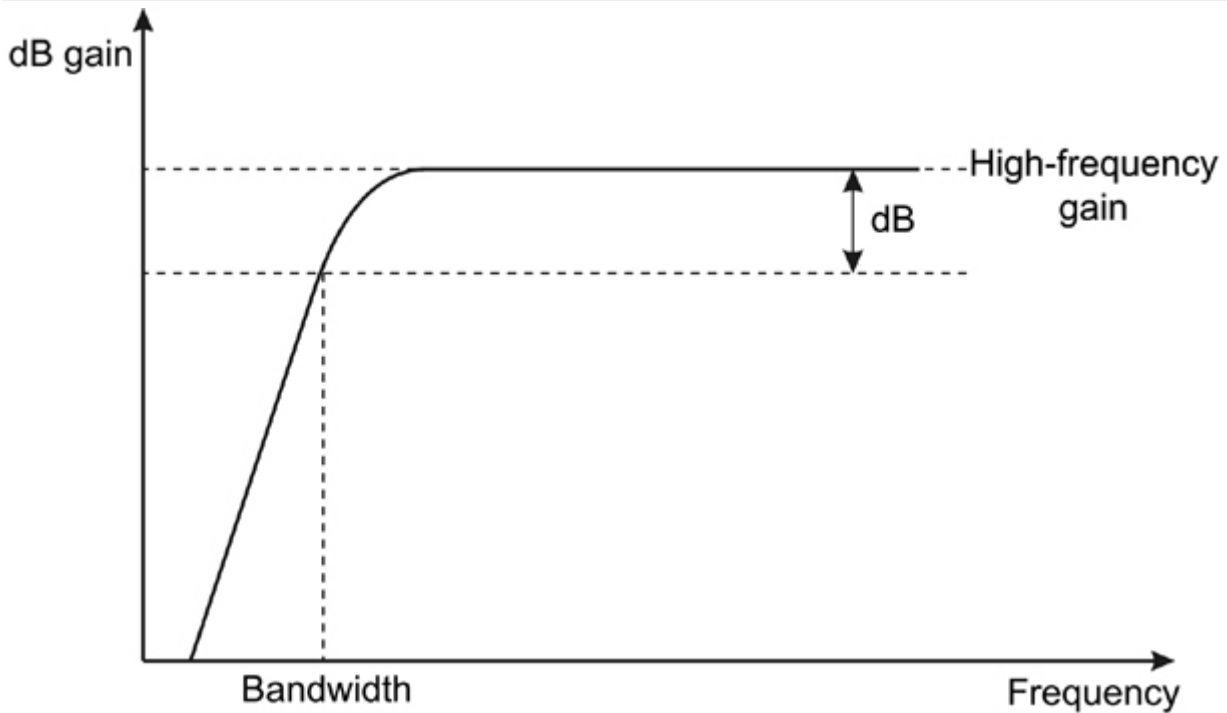
where  $w$  – window width.



The result of  $\text{avgw}(x, w)$  function has an offset  $w/2$  relatively initial trace.

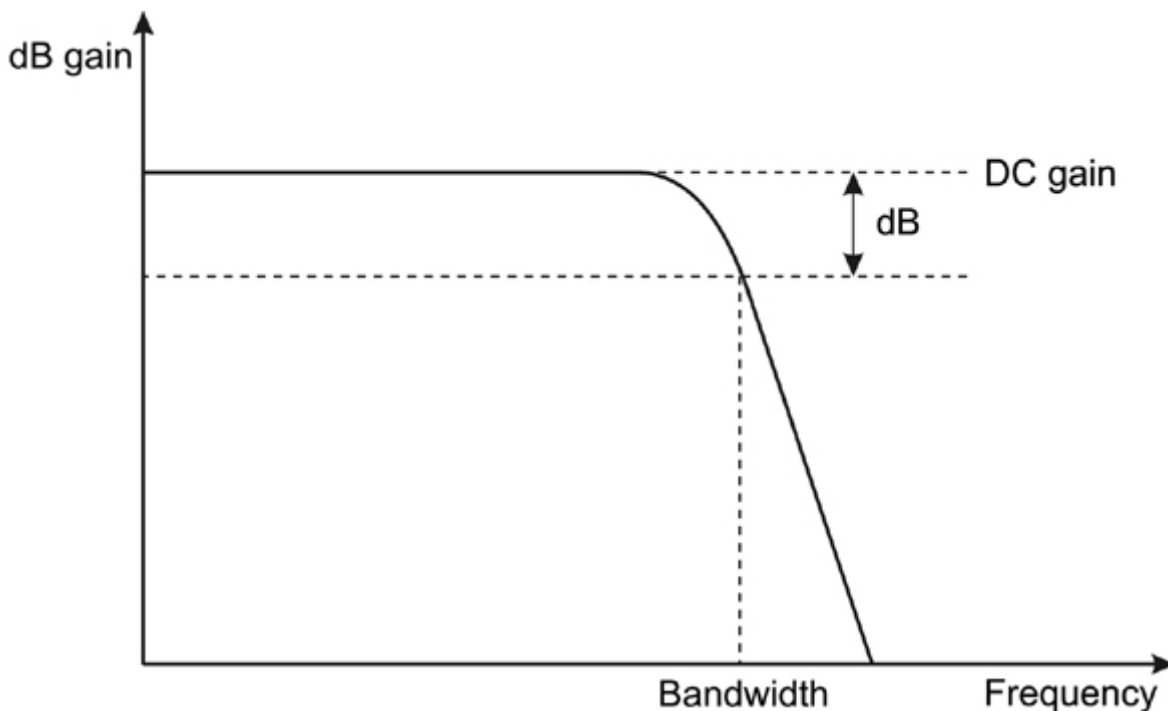
$\text{bandhigh}(x, n)$

$\text{Bandhigh}(x, n)$  function calculates high frequency filter pass band width. Parameters:  $x$  – voltage at the filter output,  $n$  – dB value. The calculator evaluates high frequency filter pass band width by determining the highest frequency at which voltage absolute value  $n$  decibel less than voltage value at point with maximal frequency. This function is applicable only to data obtained by AC analysis. The function can be called in the next form:  $\text{bandhigh}(x)$ , in this case dB value takes the default value – 3db. The function returns number.



`bandlow(x, n)`

`Bandlow(x, n)` function calculates low frequency filter pass band width. Parameters:  $x$  – voltage at the filter output,  $n$  – dB value. The calculator evaluates low frequency filter pass band width by determining the lowest frequency at which voltage absolute value  $n$  decibel less than voltage value for DC analysis. This function is applicable only to data obtained by AC analysis. The function can be called in the form `bandlow(x)`, in this case dB value takes the default value – 3db. The function returns number.



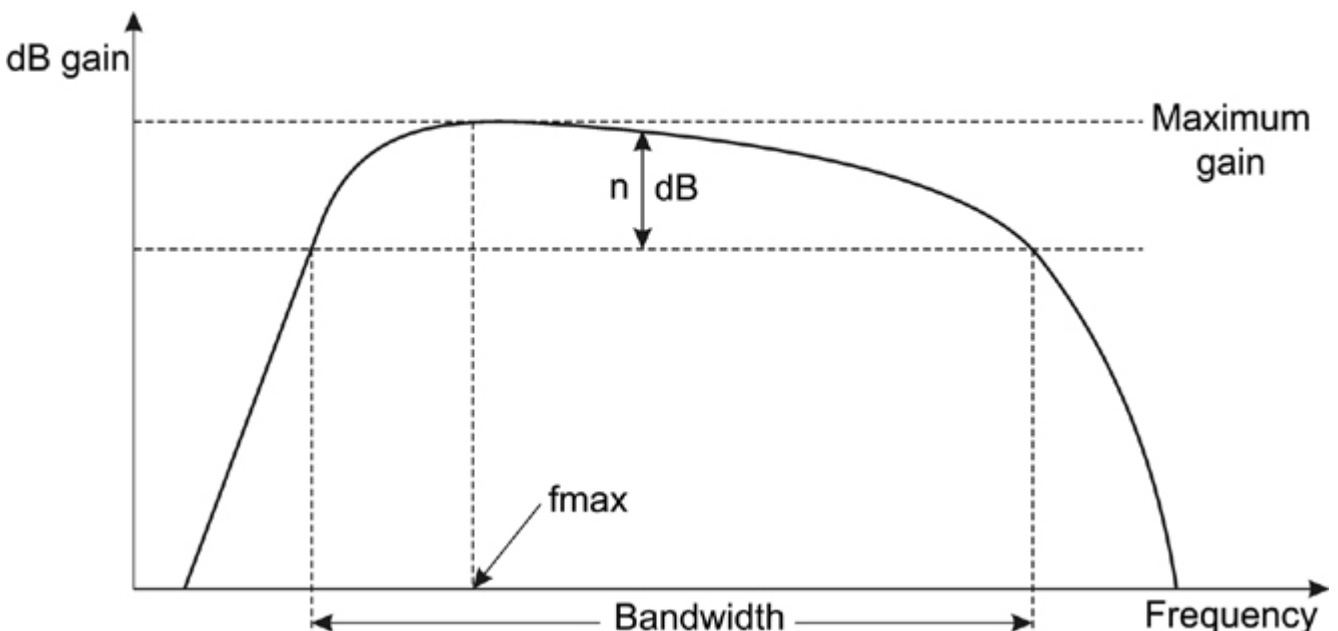
bandpass(x, n)

Bandpass(x, n) function calculates band-pass filter pass band width. Parameters: x – voltage at the filter output, n – dB value. The function can be called in the next form: bandpass(x), in this case dB value takes the default value – 3db.

The calculator evaluates filter pass band width by determining:

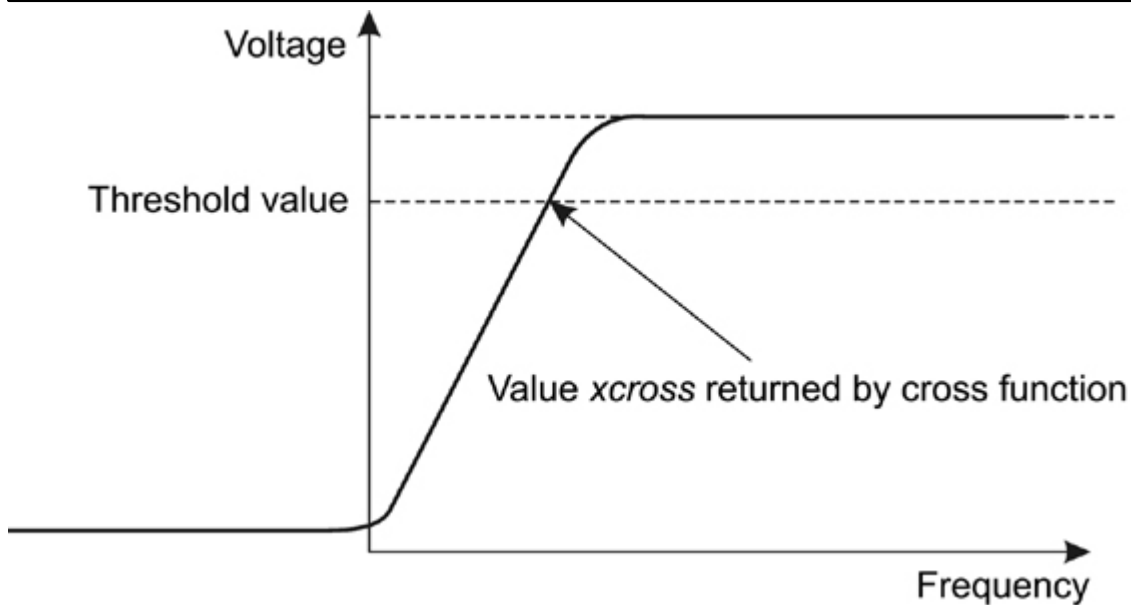
1. Lowest frequency (fmax) at which voltage absolute value has maximal value.
2. Highest frequency less than fmax at which voltage absolute value n decibel less than voltage maximal value.
3. Lowest frequency larger than fmax at which voltage absolute value n decibel less than voltage maximal value.
4. Difference of results at step 2 and step 3.

This function is applicable only to data obtained by AC analysis. The function returns number.



cross(x, y)

Cross(x, y) function calculates the first point of X axis, where x function crosses y level. Function also can be called in the form cross(x, y, n). In this case the n-th cross point is calculated. The function returns number.



`delay(x, y, z)`

`Delay(x, y, z)` function calculates delay between first cross of `x` vector with `z` value and the subsequent cross of `y` vector with the same value. The function returns number.

`deriv(x)`

`Deriv(x)` function calculates derivative of `x` vector with respect to `X` axis variable by cubic spline method. The function returns vector.

`iinteg(x)`

`iinteg(x)` function calculates indefinite integral of `x` with respect to `X` axis variable by Simpson algorithm (that is precise for quadratic expressions). The function returns number.

`integ(x)`

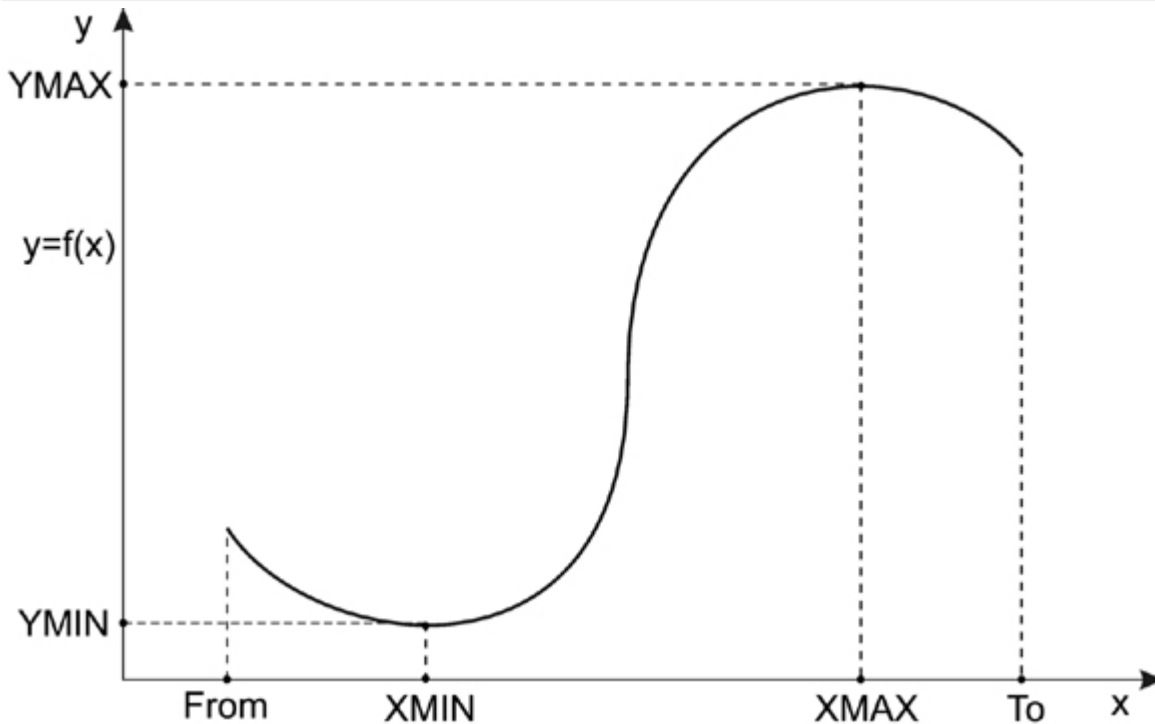
`integ(x)` function calculates definite integral of `x` vector at every point. Integration accomplishes with respect to `X` axis variable by Simpson algorithm (that is precise for quadratic expressions). The function returns vector.

`max(x)`

`Max(x)` function calculates the maximal value of `x` vector. It is possible to represent the function in the form `max(x, n)`. In this case `n`-th maximum is calculated. The function returns number.

`min(x)`

`Min(x)` function calculates the minimal value of `x` vector. It is possible to represent the function in the form `min(x, n)`. In this case `n`-th minimum is calculated. The function returns number.



$x_{\max}(x)$

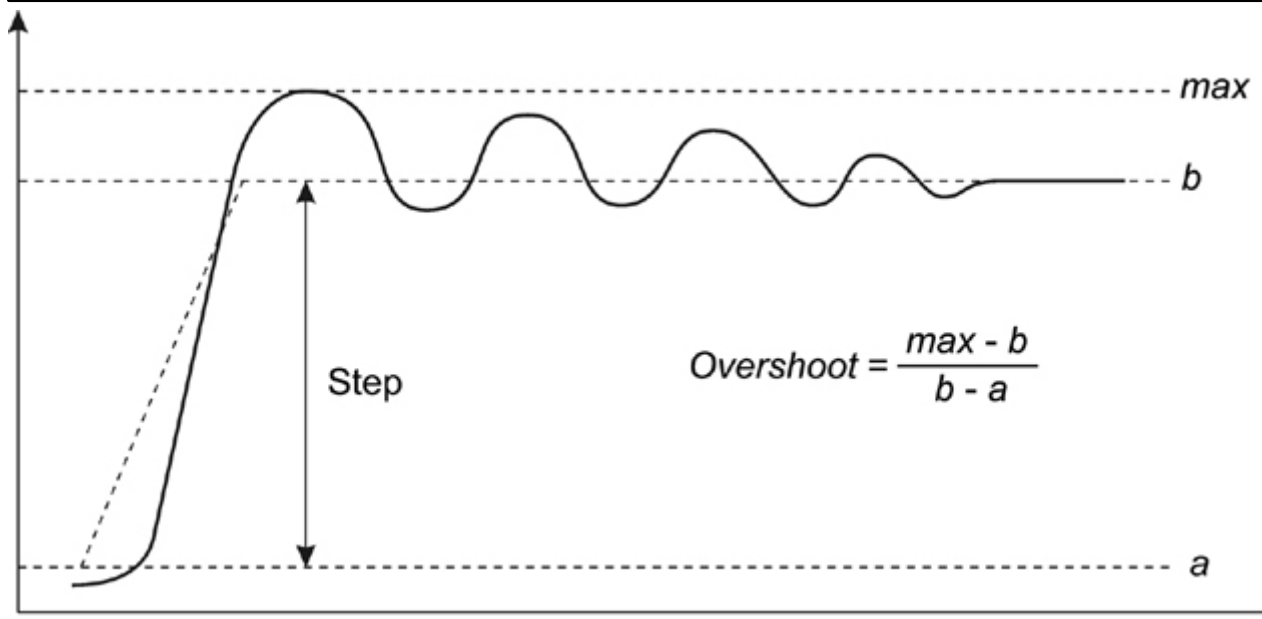
$x_{\max}(x)$  function calculates the coordinate of  $x$  vector maximal value over  $X$  axis. It is possible to represent the function in the form  $x_{\max}(x, n)$ . In this case  $n$ -th maximum coordinate is calculated. The function returns number.

$x_{\min}(x)$

$x_{\min}(x)$  function calculates the coordinate of  $x$  vector minimal value over  $X$  axis. It is possible to represent the function in the form  $x_{\min}(x, n)$ . In this case  $n$ -th minimum coordinate is calculated. The function returns number.

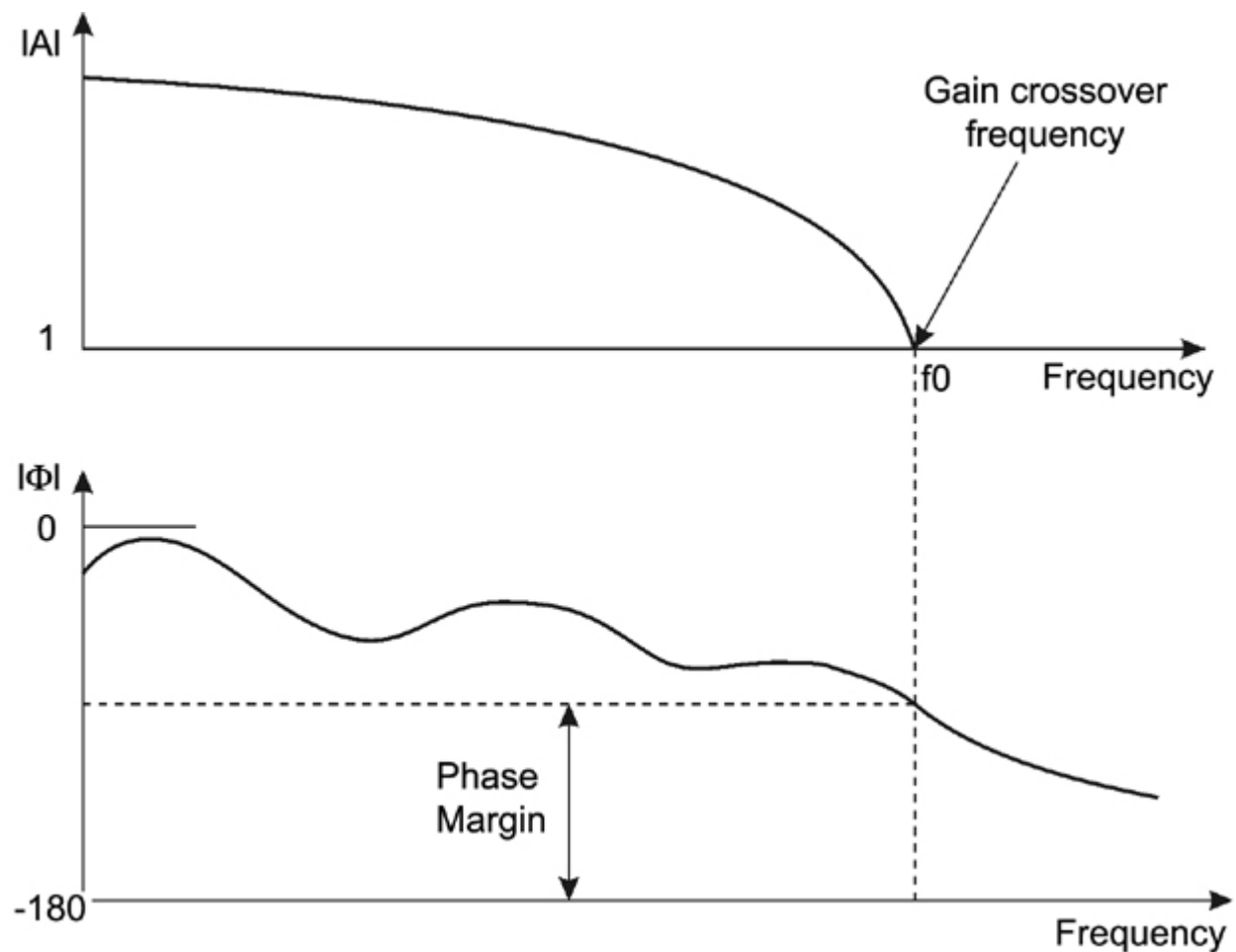
$\text{overshoot}(x, a, b)$

$\text{Overshoot}(x, a, b)$  function calculates overshoot relative value of  $x$  vector. For  $x$  the initial level ( $a$ ) and the final level ( $b$ ) of transient process are specified. Function returns number. This function is applicable only to damped oscillation and to data obtained by TRAN analysis.



### phaseMargin(x)

PhaseMargin(x) function calculates phase margin of x vector. Function argument is a marker name.





$\text{phaseMargin}(\text{gain}) = 180 + \text{phase}(\text{value}(\text{gain } f_0))$

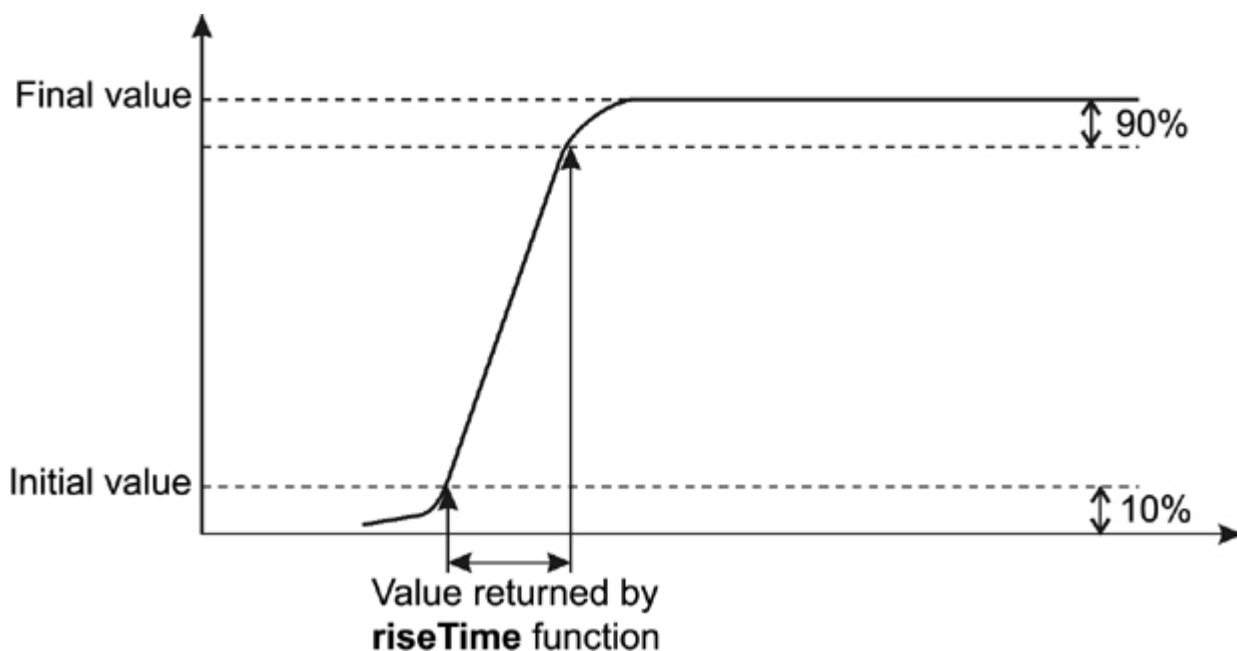
Phase margin is calculated as the difference between phase in degrees at a frequency  $f_0$  and  $-180$  degrees. Frequency  $f_0$  is a frequency where the gain equals to 1. Phase margin have to be positive for stability. The function returns number. This function is applicable only to data obtained by AC analysis.

$\text{fallTime}(x, a, b)$

FallTime(x, a, b) function calculates fall time of x vector. For x the initial level (a) and the final level (b) of transient process are specified. Fall time is the time necessary for signal alteration from level 90% of overfall to level 10%. This function is applicable only to data obtained by TRAN analysis. The function returns number.

$\text{riseTime}(x, a, b)$

RiseTime(x, a, b) function calculates rise time of x vector. For x the initial level (a) and the final level (b) of transient process are specified. Rise time is the time necessary for signal alteration from level 10% to level 90% of the difference between a and b. This function is applicable only to data obtained by TRAN analysis. The function returns number.



$\text{rms}(x)$

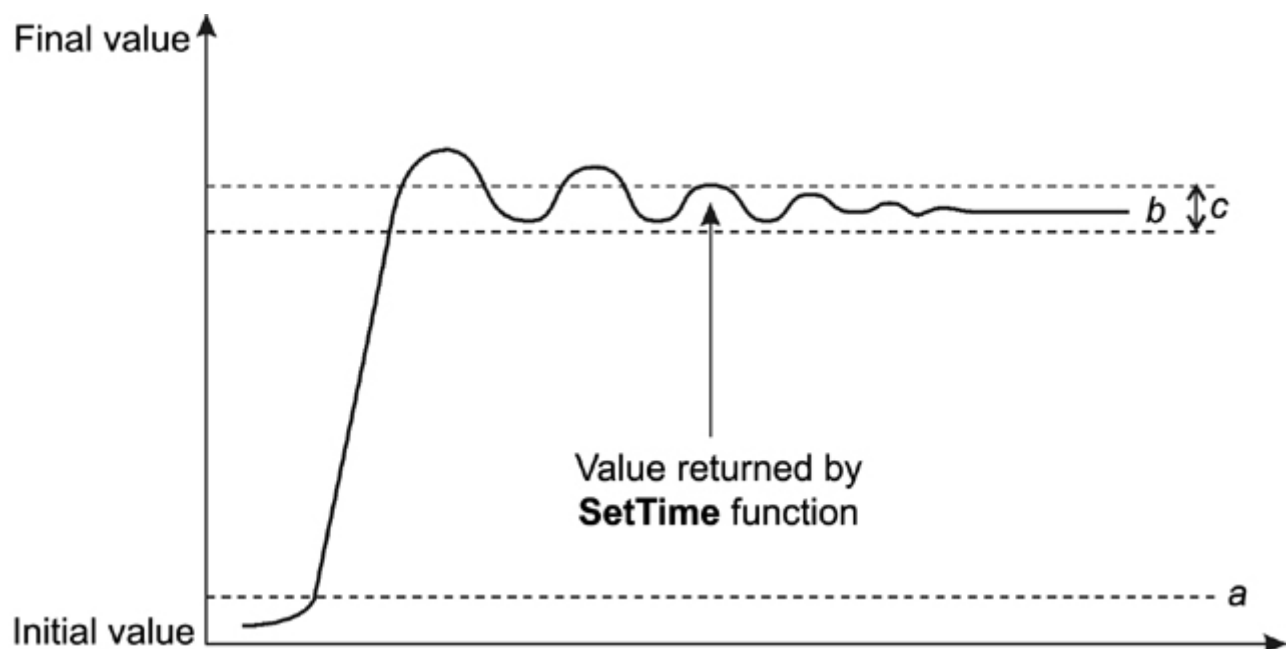
Rms(x) function calculates mean-square deviation of x vector. Mean-square deviation is equal to square root of integral of the x squared over the range, divided by x range. For example, if  $y = f(x)$ , then

$$rms(y) = \sqrt{\frac{\int_0^x f(t)^2 dt}{x}}$$

The function returns number.

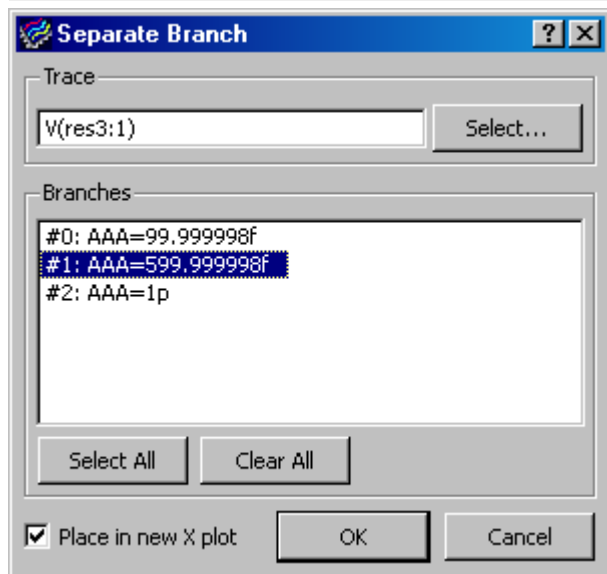
setTime(x, a, b, c)

SetTime(x, a, b, c) function calculates time necessary to set x vector value in the range c/100 percents of difference between initial level (a) and the final level (b) of transient process.



### Separate branch

If some trace has more the one branch there is possibility to separate any branches creating new trace. From the [<Trace> menu](#) choose <Separate Branch...>. The next dialog box appears:



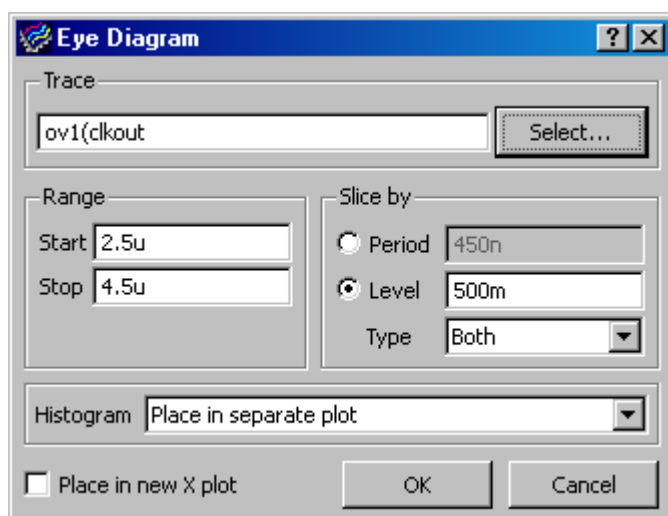
In the Branches list choose those of them you want to separate. New Trace with selected branches will be created. Prefix "spb" will be set for this new trace name . Original Trace will stay without any changes.

## Eye Diagram

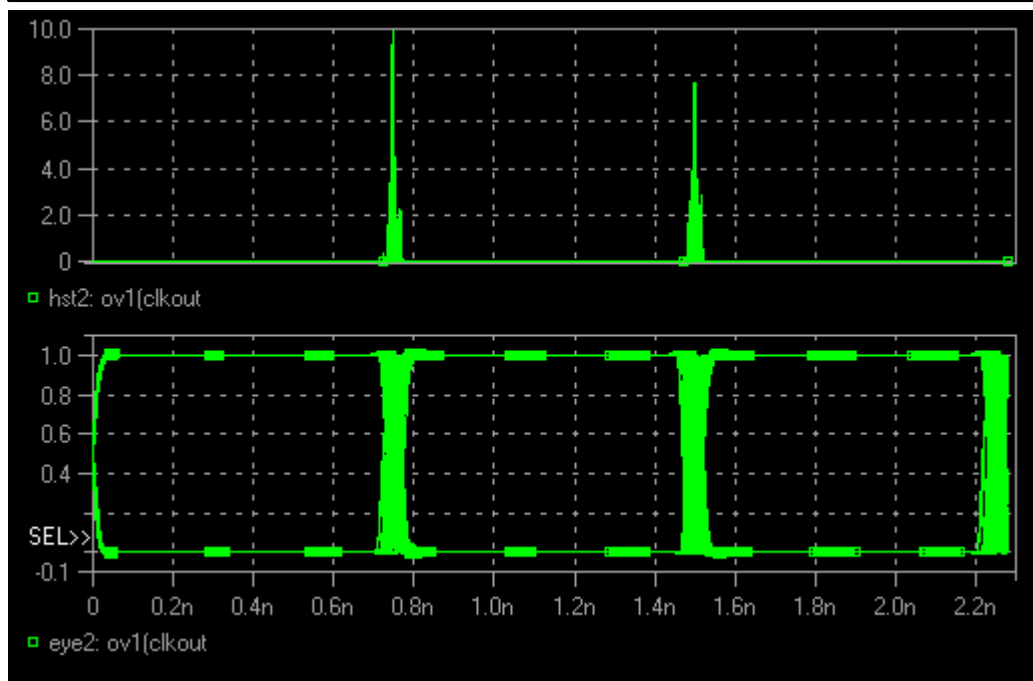
Eye-Diagram is used for measure:

- Additive noise in the signal
- Peak distortion due to interruptions in the signal path
- Timing synchronization & jitter effects.

To perform Eye-Diagram transform choose  button or from the [Trace menu](#) choose <Eye Diagram...>. The next dialog box appears:



Start, Stop set range of waveform X-values using for Eye-Diagram forming.



There two ways for slicing data into segments forming Eye-Diagram:

- with the time period, for which Period value must by set. This way is not accurate way because of error accumulation.
- with the signal edge, for which Level value must by set, and edge Type must be chosen: Rise, Fall, Both.

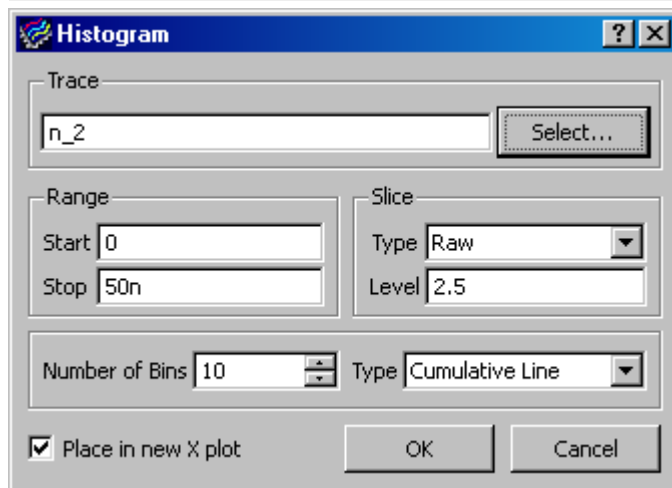
Together with eye-diagram your are able to draw Jitter distribution histogram, which can be placed it in the same or separate plot.

Prefix "eye" will be used for the new trace names. Original Trace will stay unchanged.

## Histogram

Histogram is often used for periodic signal Jitter estimation. It also can be used for making arbitrary signal histogram.

To perform Histogram transform click  button or choose <Histogram...> from [<Trace>](#) menu. The next dialog box appears:



Range Start, Range Stop set range of waveform X-values using for Histogram forming.

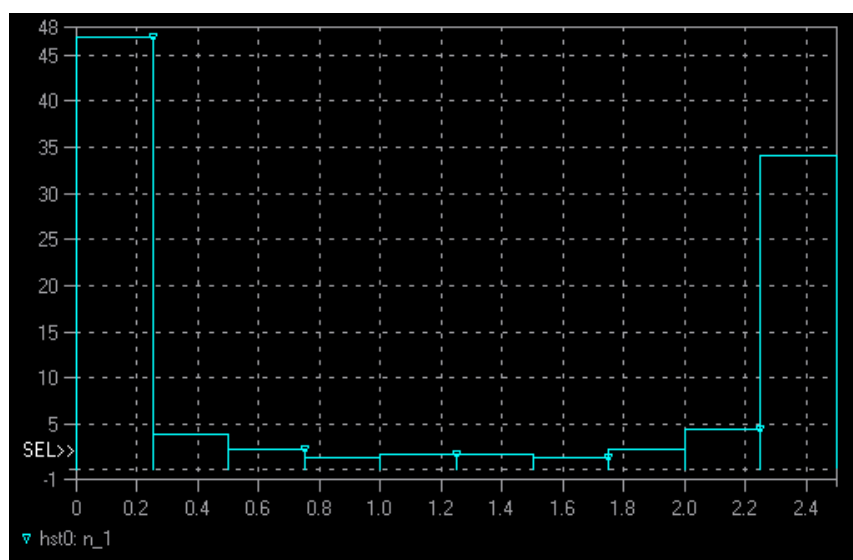
There are several ways for slicing the signal into segments. To slice the signal with it's edges set up Level value and choose Type: Rise-rise, Fall-fall, Rise-fall, Fall-rise.

Histogram for arbitrary signal represents distribution of Y-values, for example it can be applied for results of Monte-Carlo analysis. For arbitrary signal choose Type: Raw.

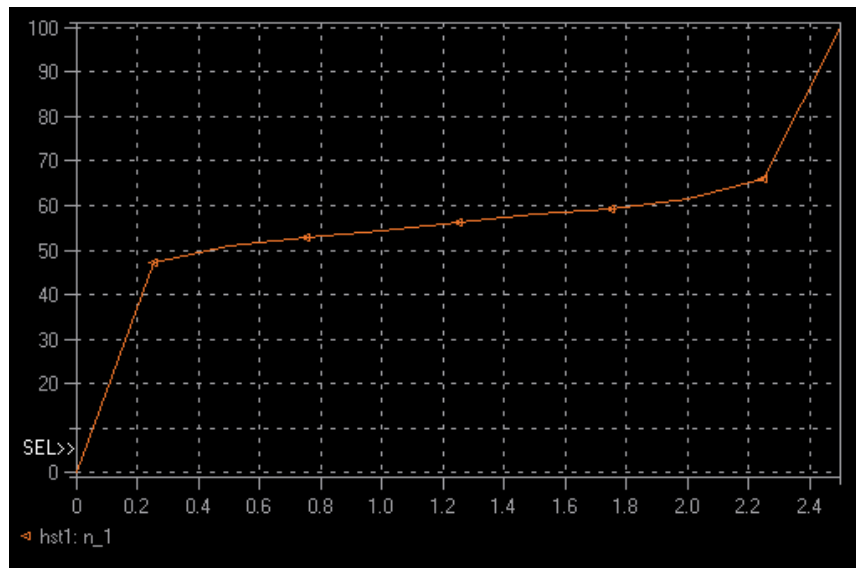
Number of Bins defines how many subranges the whole range will be divided in.

Histogram Type can take one of the following values:

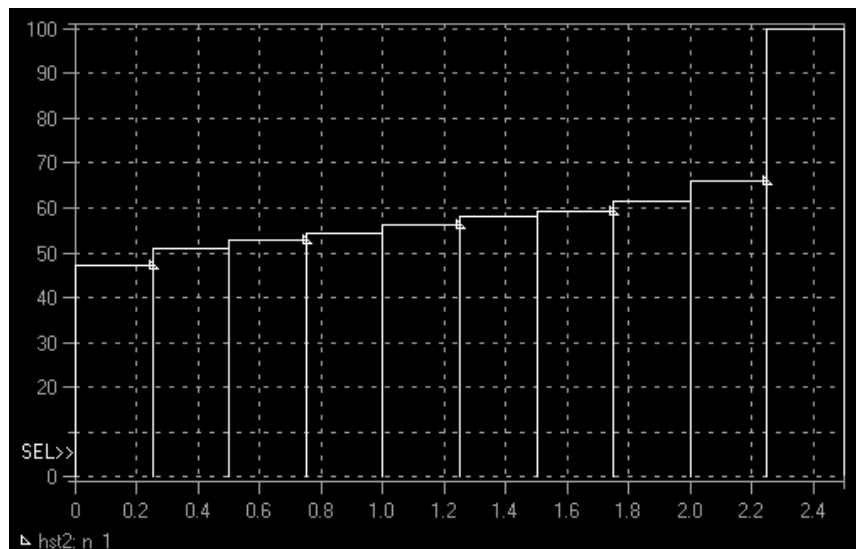
Standard - for each bin the number of values fell in correspondend subrange will be displayed.



Cumulative Line - the value of each subrange is a cumulative sum of subrange values represented as curve.




Cumulative Box - the value of each subrange is a cumulative sum of subrange values represented as histogram.

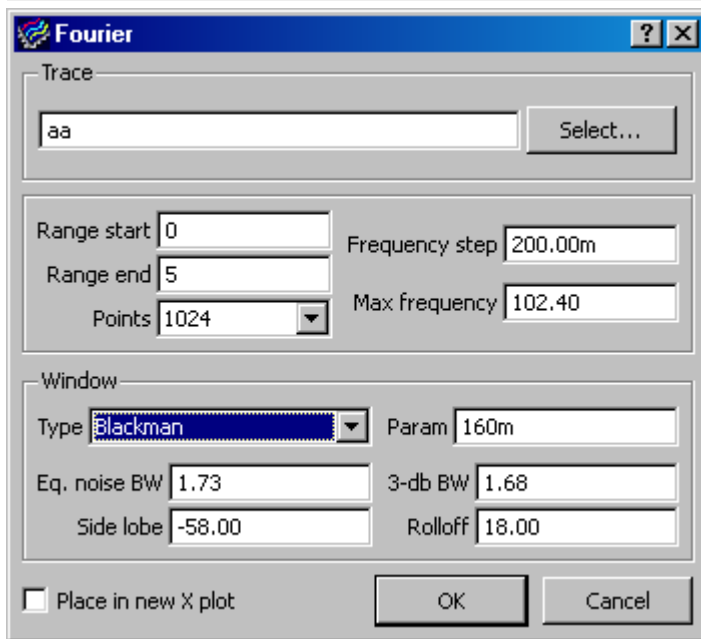


Prefix "hst" will be used for the new trace names. Original Trace will stay unchanged.

## Fourier

Fourier transform is used for periodic signal spectrum estimation.

To perform Fourier transform click  button or choose <Fourier...> from the [<Trace>](#) menu. The next dialog box appears:



Range Start, Range Stop set range of waveform X-values using for Fourier transform. A number of samples are set with Points. Frequency step, Max frequency are calculated for reference use.

To mitigate the effects of spectral leakage as the Finit-time Fourier transform window function is used.

There are following Window Types: Rectangular, Triangular, Humming, Blackman, Blackman-Harris, Cosine, Hann, Cosine3, Cosine4, Cosine6, Kaiser, Kaiser-Parzen, Nutall, Adaptive, Adaptive2.

For some Window Types the Param value might be set for window adjustment.

#### Note

While choosing Window Type take into account of following dependence: the more frequency precision (measured by the main lobe width - 3-dB BW) the less noise suppression, i.e. Side lobe increases.

Eq. noise BW, Rolloff are given for reference use. They are showed for particular Window Types.

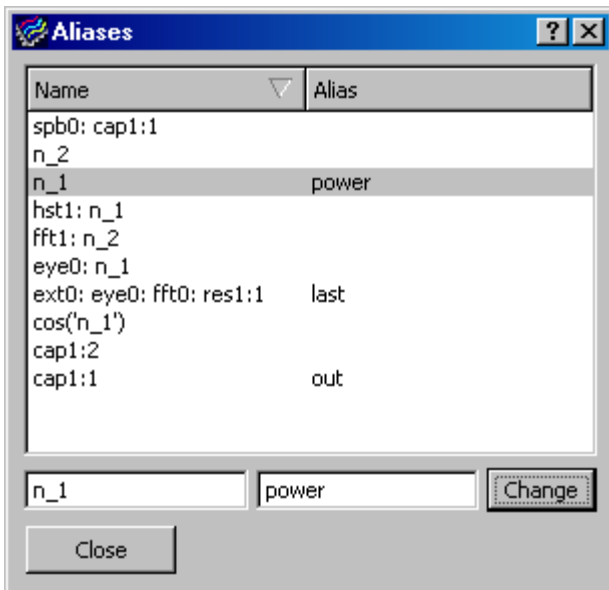
There are empirical methods Adaptive, Adaptive2. These methods combain the Fourier transform results obtained with use of different window functions.

Prefix "fft" will be used for the new trace names. Original Trace will stay unchanged.

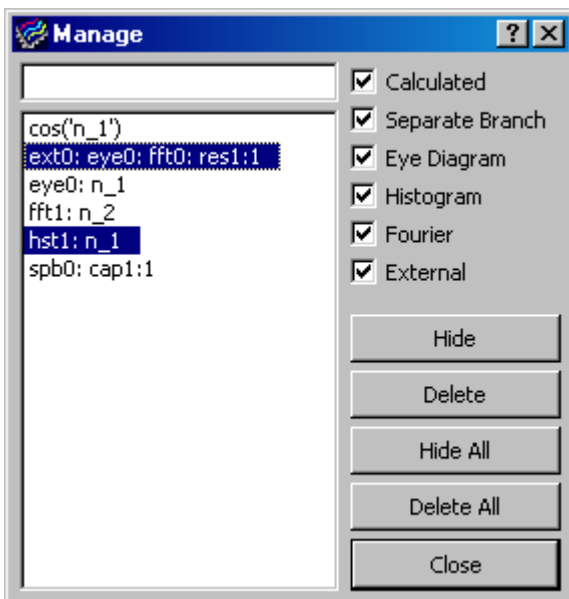
## Managing traces

You can set alternative name (alias) for Trace. To do this, from the [<Trace> menu](#) choose <Aliases>. In appeared dialog box choose trace for which you want to set alias

and enter it applying changes with *Change* button:



To operate on special Traces, from the [Trace menu](#) choose <Manage>. In appeared dialog box the list of special traces will be displayed:



Check boxes and text-filter help you to filter traces on which you want to manage. Select traces in the list and then press button *Hide* or *Delete* to hide or delete the selected traces. Press *Hide All* or *Delete All* button to hide or delete all traces. *Hide* means that traces will be removed from SymProbe view but they will be available to add to view again with command <Add> from [Trace menu](#). *Delete* means that traces will be deleted without cancellation. Press *Close* button to close the dialog box.




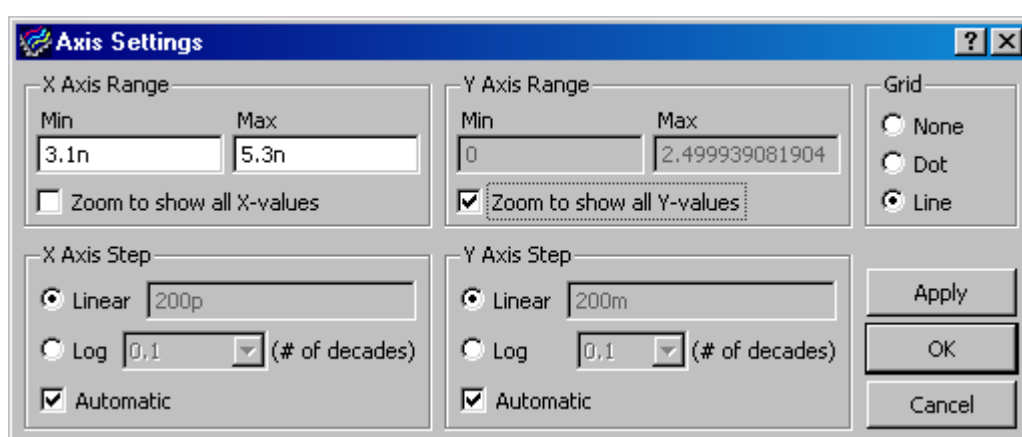
## Tools menu

Tools menu contains commands:

<a href="#">Axis Settings...</a>	set the range of X and Y axis, choose the type of range (linear or logarithmic) and grid style
<a href="#">Options...</a>	change properties of the active plot
<b>Cursor</b>	
<b>Display</b>	toggle on or toggle off the cursor
<b>Freeze</b>	fix/release position of the cursors
<b>Move to X/Y</b>	move the cursors to specified point
<b>Swap Cursors</b>	swap the cursors by positions
<b>Prev. Branch A1</b>	move the cursor A1 to the next branch of trace
<b>Next Branch A1</b>	move the cursor A1 to the previous branch of trace
<b>Prev. Branch A2</b>	move the cursor A2 to the next branch of trace
<b>Next Branch A2</b>	move the cursor A2 to the previous branch of trace
<a href="#">Additional Parameters...</a>	<data file> information

## Axis settings

To specify grid style and axis ranges, choose  button, or from the [Tools menu](#) choose <Axis Settings>, or double click the left mouse button on X or Y axis. The next dialog box appears:



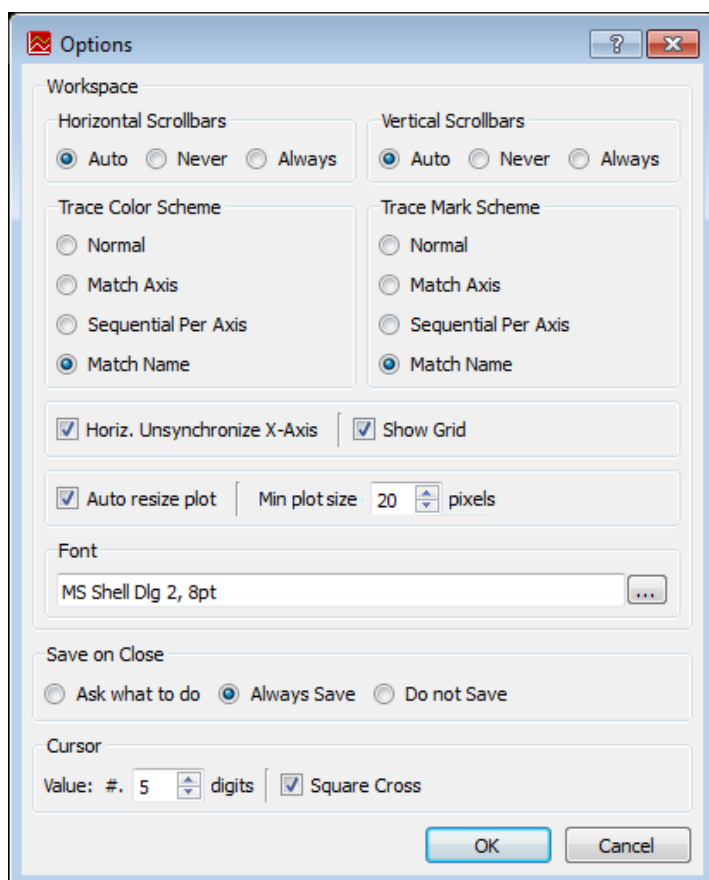
You can change X and Y axis ranges and type (linear or logarithmic), select grid style.

## Options


To change plot properties, from the [Tools menu](#) choose <Options>.

## SymProbe User Guide

Option	Description
Horizontal and Vertical Scrollbars	Controls scrollbar visibility.
Trace Color Scheme	Defines the method of assigning unique color of a trace.
Trace Mark Scheme	Defines the method of assigning unique mark of a trace.
Horiz. Unsynchronize X-Axis	Matches unsynchronized plots either horizontally or vertically.
Auto resize plot	Enables 'Resize plots' mode to modify plot size individually.
Min plot size	Setup minimum plot size for scaling.
Show Grid	Controls grid visibility.
Font	Defines font to plot legend and notices
Save on Close	Defines if Save dialog box appears on close.
Cursor Value	Setup a number of digits after decimal point on the cursor panel.
Square Cross	Turns on/off the square marker pointing the cross-place of vertical and horizontal cursor lines.



## Cursor

When one or more traces are displayed, you can use cursors to display the exact coordinates of two points. In addition, differences are shown between the corresponding coordinate values for the two cursors. For sweep analysis value of sweep variable is also displayed for each trace. To display cursor, choose  button, or from the [Tools menu](#) choose <Cursor/Display>. The Cursors window appears, showing the current position of the cursor on the X Axis and Y Axis. As you move the cursors, the values in the cursor box change. Both cursors are initially placed on the trace listed first in the trace legend. You can move the cursor box anywhere over the SymProbe window by dragging the box to another location. The cursor A1 moves along the curve by means of <←, →> keys. The cursor A2 moves the same way with the Shift key pressed. Mouse also can drive cursors: the left mouse button move the cursor A1, the right mouse button move the cursor A2. <Cursor> menu has commands: <Freeze>, <Move to X/Y>, <Swap Cursors>. These commands change the location of cursor that was repositioned last. If cursors haven't been moved yet, commands change the location of the first cursor.

Freeze – fix position of cursors to enable area zooming by mouse pointer;

Move to X/Y – move cursors to specified point;

Swap Cursors – swap cursors by positions.

If Trace has some branch with values You can move cursor A1 to the next/previous branch with <Cursor/Next Branch A1>, <Cursor/Prev. Branch A1> from [Tools menu](#). You can move cursor A2 the same way as cursor A1.

If both cursors are on same histogram trace the cursor window has additional fields displaying cumulative sum.

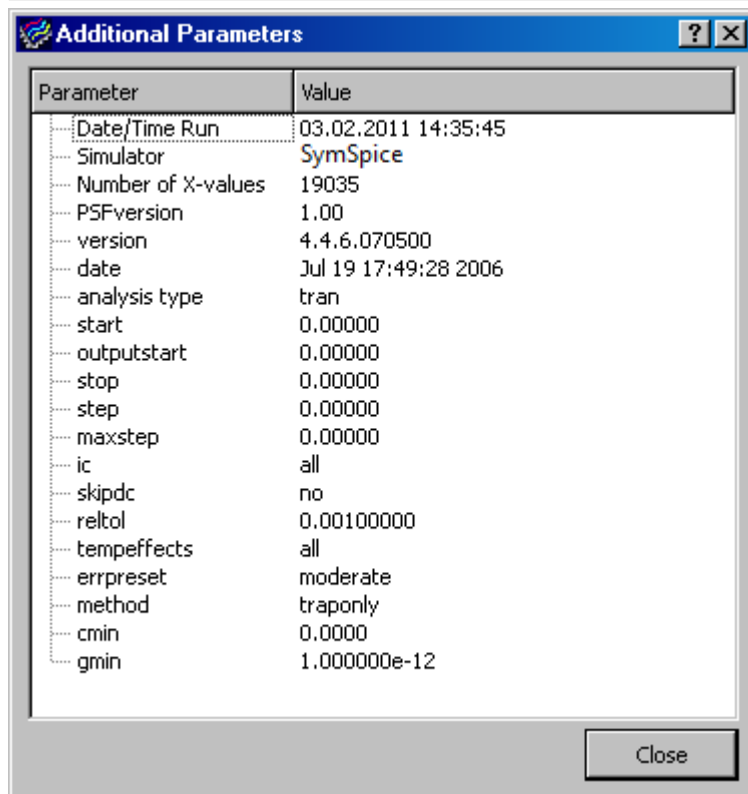
There are two histograms on eye-diagram generated histogram trace, so max cumulative sum value is 200%.

## Additional Parameters

<Additional Parameters...> dialog box allows you to see some information fetched from <data file>.

## SymProbe User Guide

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## Help menu

Help menu contains information about SymProbe program and how to use it:

User's Manual	Open SymProbe User's Manual
About SymProbe...	Open window with information about version of program

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# Index

## - A -

Add 14, 15, 22

## - C -

Combine 18

Cursor 47

## - D -

Delete 14, 15, 24

## - G -

Goal functions 24, 38, 39, 40, 42, 43

Grid 45

## - L -

Linear step 45

Logarithmic step 45

## - M -

Mathematical functions 28

Menu 3, 6, 11, 13, 22, 45

## - P -

Print 8, 10

## - R -

Resize 19, 45, 47

## - S -

Scale 12

Scatter 18

Scrollbars 45, 47

Special functions 28

## - U -

Unsynchronize 17

## - W -

Work with plots 15, 16, 18, 19

Work with traces 22, 24