# OptiSPICE

## Waveform Viewer Manual

Waveform Viewer Feature for OptiSPICE

Version 5.2

# OptiSPICE

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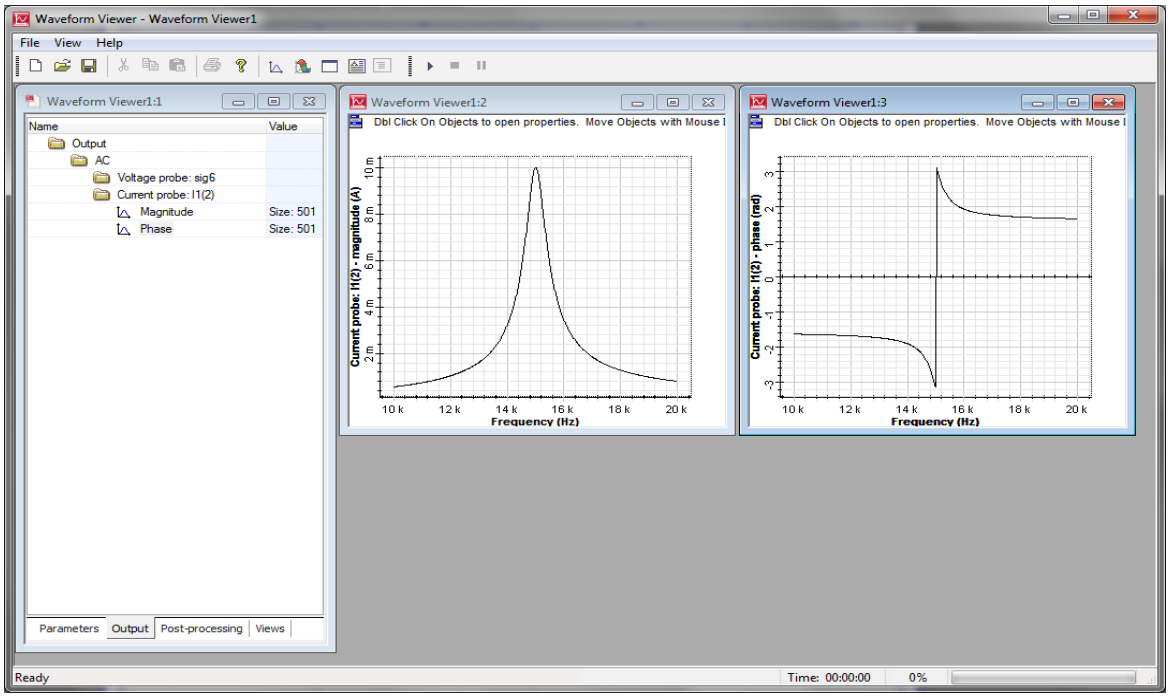
# Introduction

The Waveform Viewer is post processing analysis tool that allows users to view the data captured from all probes placed in an OptiSPICE circuit design (or when *JobControl AllMon* is set to 1 or 2)

It can be used to review the data captured following Transient, AC, DC and Operating point analysis of electrical, optical and opto-electronic circuits. Access to the Waveform Viewer is automatically displayed following completion of an **Analysis > Run**. An example output from Waveform Viewer is shown in Figure 1.

**Figure 1 Waveform Viewer GUI**

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## Main features

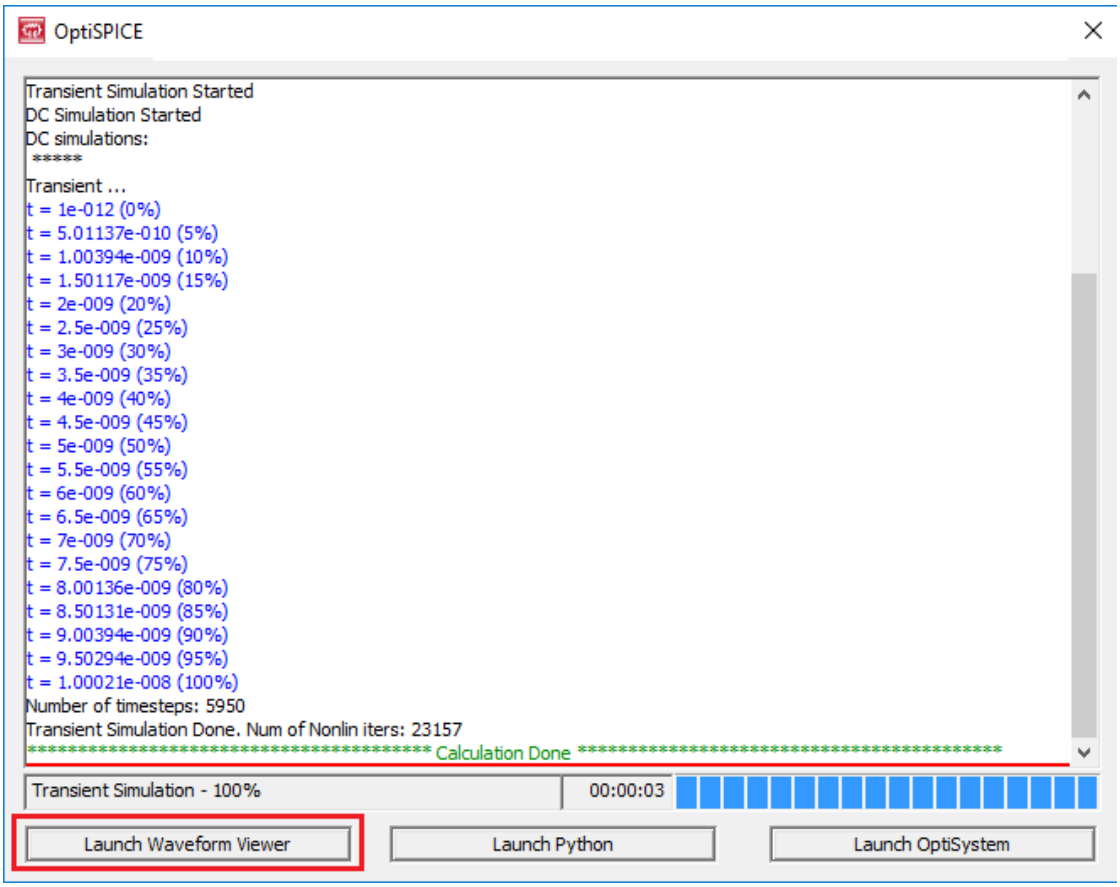
The main features of the Waveform Viewer include:

| Feature | Description |
|---|---|
| **Post-processing data visualization** | Following an **Analysis > Run** all probe locations can be quickly accessed (via a menu tree architecture) and viewed in either a data grid, text or 2D graph format. Multiple views can be opened at once. |
| **Bi-directional optical signal analysis** | For optical signals, both the input (ingress) and output (egress) signals can be viewed for any optical probe. |
| **Data export** | The data captured from any probe can be exported for visualization or manipulation by 3rd party tools such as calculation spreadsheets. |
| **Presentation and analysis tools** | All 2D Graphs can be modified (multiple curve overlay, curve types, markers, axes labels, legend, etc.) to assist with report preparation. Graphs can be saved to clipboard or exported in BMP or EMF formats. |

# Waveform Viewer GUI and features

Following a simulation the Waveform Viewer can be directly accessed by selecting the “Launch Waveform Viewer” button at the bottom left of the OptiSPICE simulation results window (see Figure 1).

**Figure 1 Launch Waveform Viewer**



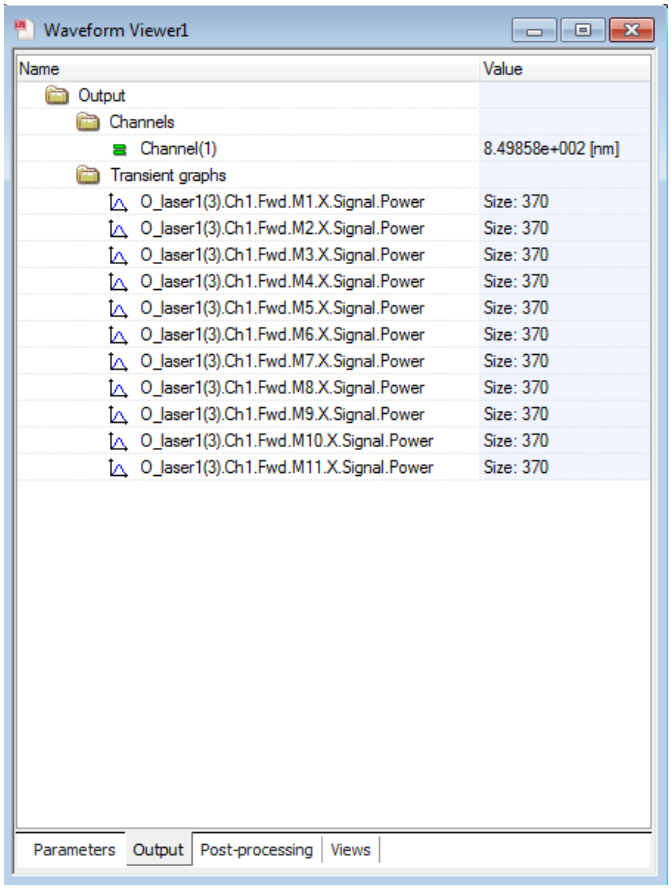
# Waveform Viewer GUI overview

The Waveform Viewer GUI consists of a “Parameters”, “Output”, “Post-processing” and “Views” tabs. The features of each tab (and the menu structure) are discussed in this section.

## Output tab

The “Output” tab is opened by default and is the location where all simulation data can be accessed. An example output for the “MM_Laser_11LongModes.osch” OptiSPICE example is shown in Figure 2. The data associated with probes can be viewed under the “Transient graphs” folder. (In this case the simulation is a Transient analysis. If DC, AC or Operating point analysis is performed then the folder title name will be updated accordingly.)

**Figure 2 Output tab of Waveform Viewer**



The naming convention for the 2D graphs is interpreted as follows:

- “O” represents an optical signal (V and I (not shown in this example) represent, respectively, electrical voltage and current)
- “laser1(3)” represents the device and associated port being monitored
- “Ch1” represents the wavelength channel being monitored (the wavelength of which is defined under the “Channels” folder)

  ***Note:*** Multiple channels may be present at an optical port. Separate 2D graphs will be displayed for each channel
- “Fwd” represents the direction of the signal (it will either be exiting (normally Fwd) or entering the port (normally Rev))
- “Mx” represents the mode of the signal (this can either represent a transverse spatial node or a longitudinal mode in the case of the LASER model)

  ***Note:*** Multiple modes can be associated with a channel. In this example 11 longitudinal modes are associated with Ch1
- “X” represents the polarization of the channel and mode (when a channel has a dual polarization, both X and Y 2D graphs will be displayed)
- “Signal.Power” represents the format of the optical field data (it may also be displayed as Signal.Re, Signal.Im, Signal.Phase and Signal.Chirp, representing Real magnitude, Imaginary magnitude, phase and chirp, respectively.

  ***Note:*** Signal data linked to All Monitors will only display data in the Signal.Re and Signal.Im format.

### Filtering of results

It is possible to filter the output data list by directly entering search criteria in the Search box as shown in Figure 3.

- To display only electrical probe data type “electrical”
- To display only optical probe data type “optical”
- To display only current data, type “current”
- To display only voltage data, type “voltage”
- To display information for a specific probe location simply type in the exact name of the probe. For example to display probe data entering or leaving the device with name “mmfiber1”, type the same name in the Search box (all probes associated with the device “mmfiber1” will be displayed). If you wish to then only see the data for the forward direction and only real data, enter a space followed by “fwd”, another space, and then “real” (see Figure 4).

**Figure 3 Search box for Output tab**

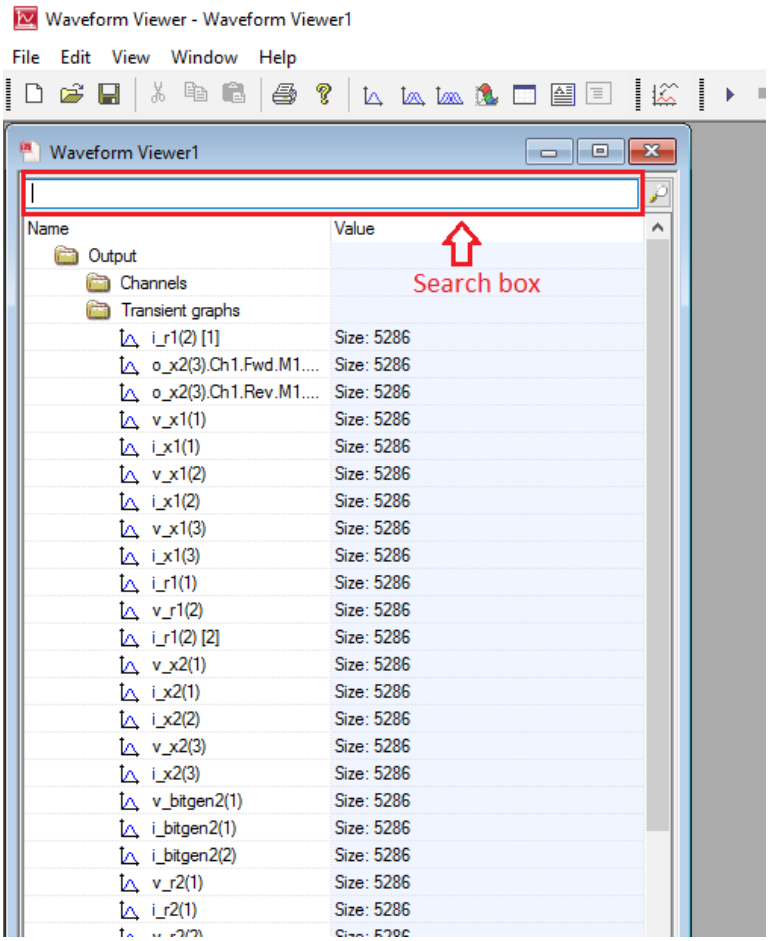
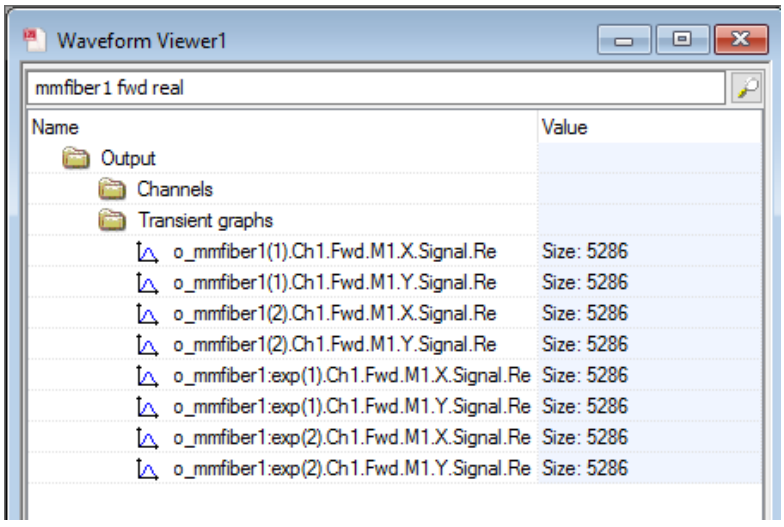


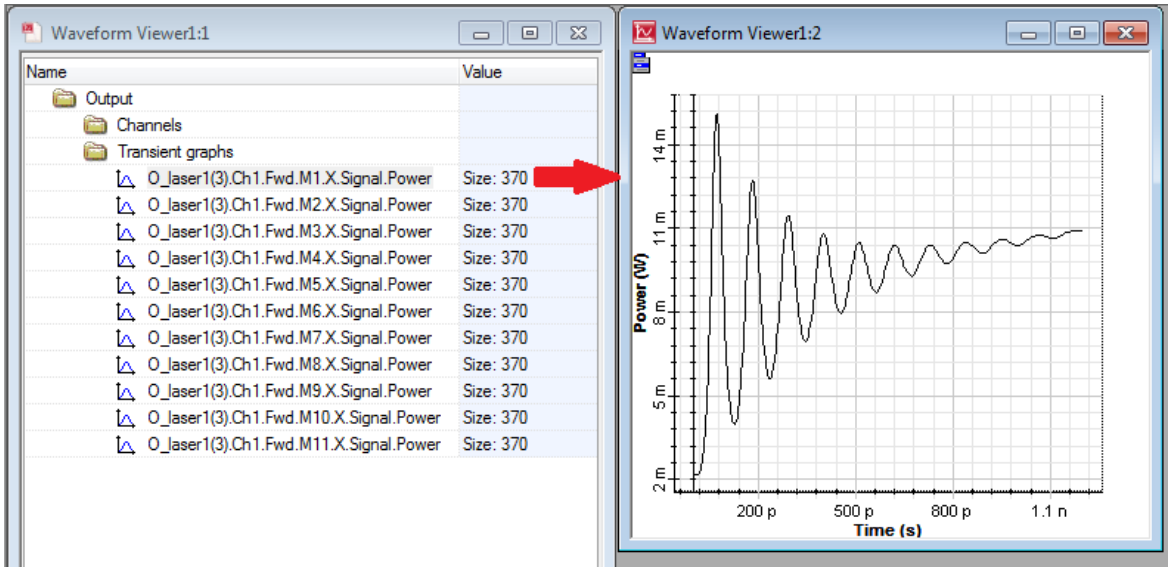

**Figure 4 Search box example results**



### 2D Graph View

To quickly view the 2D graph associated with a probe/monitor, left-click mouse twice on the associated graph data (see Figure 5).

**Figure 5 2D graph view for optical field**




You can also simultaneously load multiple 2D graphs within the same view. Two methods can be used:

- Select the 2D icon on the top menu bar of the Waveform Viewer window to create a blank 2D view. Drag (Left-click hold mouse) and drop (Left-click release mouse) one or more of the 2D graphs from the Graphs folder of the Output tab (see Figure 6)
- Holding the CTRL key, left-click mouse on the graphs you wish to simultaneously view and right-click mouse and select “View” from the pull down menu (see Figure 7)

**Figure 6 2D graph view of multiple 2D graphs**

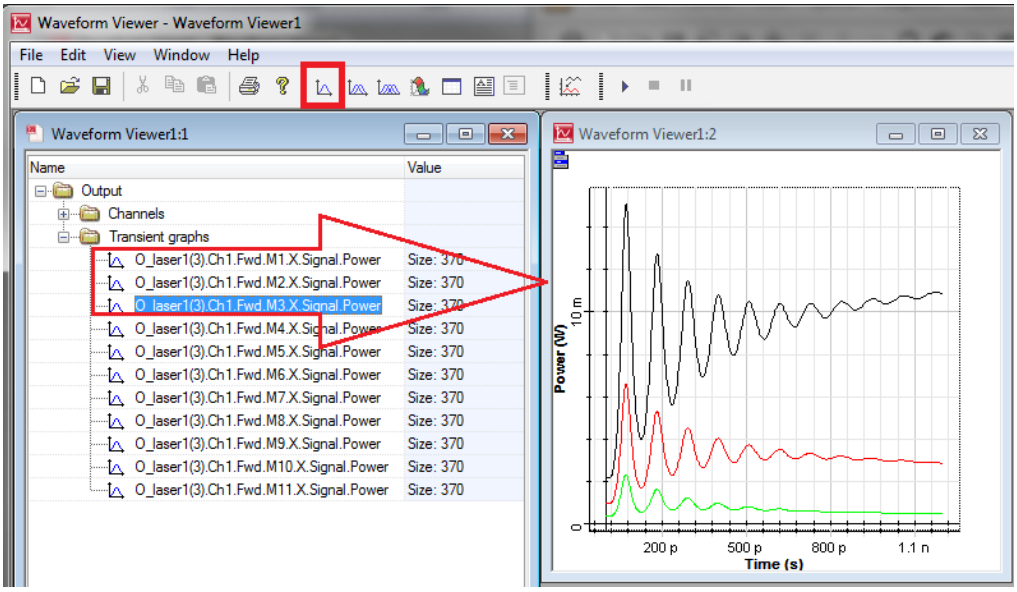
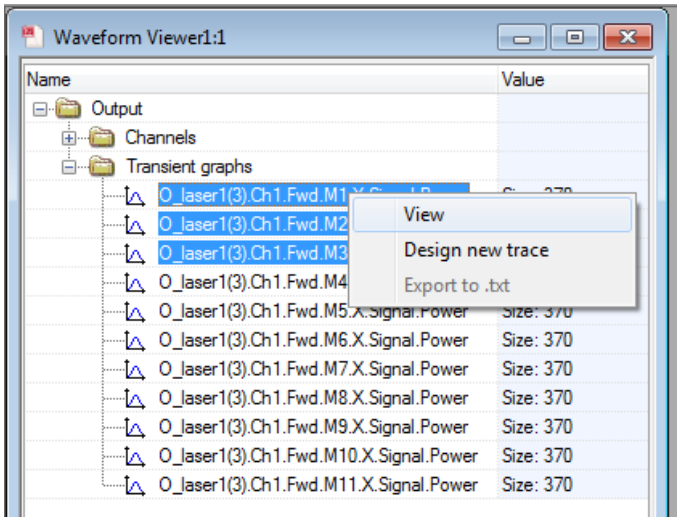


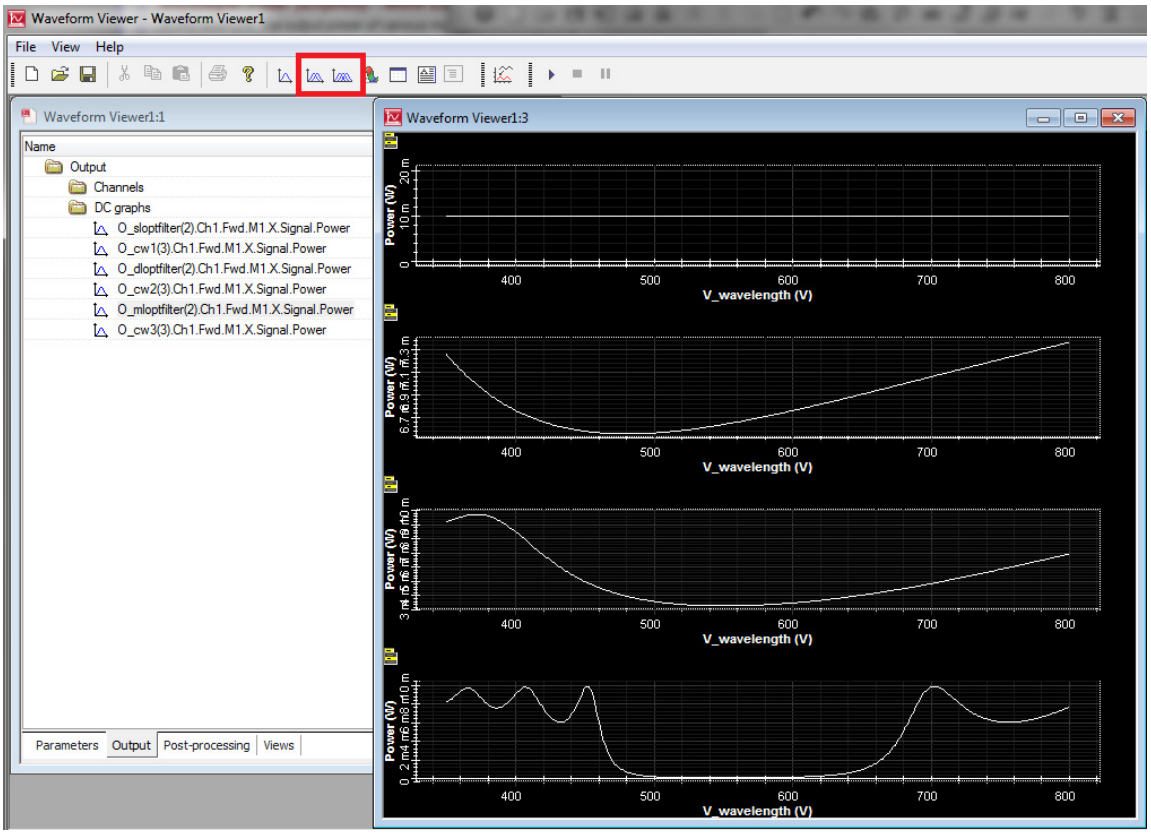

**Figure 7 Accessing simultaneous graphs using the “View” feature**




### Double 2D and Multi 2D Graphs Views

In addition to the 2D Graph View, graphs can be loaded into multiple 2D Graph Views to allow for the side-by-side comparison of transient-time results. To activate the “Double 2D Graph” or “Multiple 2D Graph” views select the respective icon from the Waveform Viewer menu bar and drag and drop the desired 2D graph onto any of the graphing panels in the 2D Graph View (see Figure 8 for example of Multi 2D Graph View)

**Figure 8 Multi 2D Graph View**

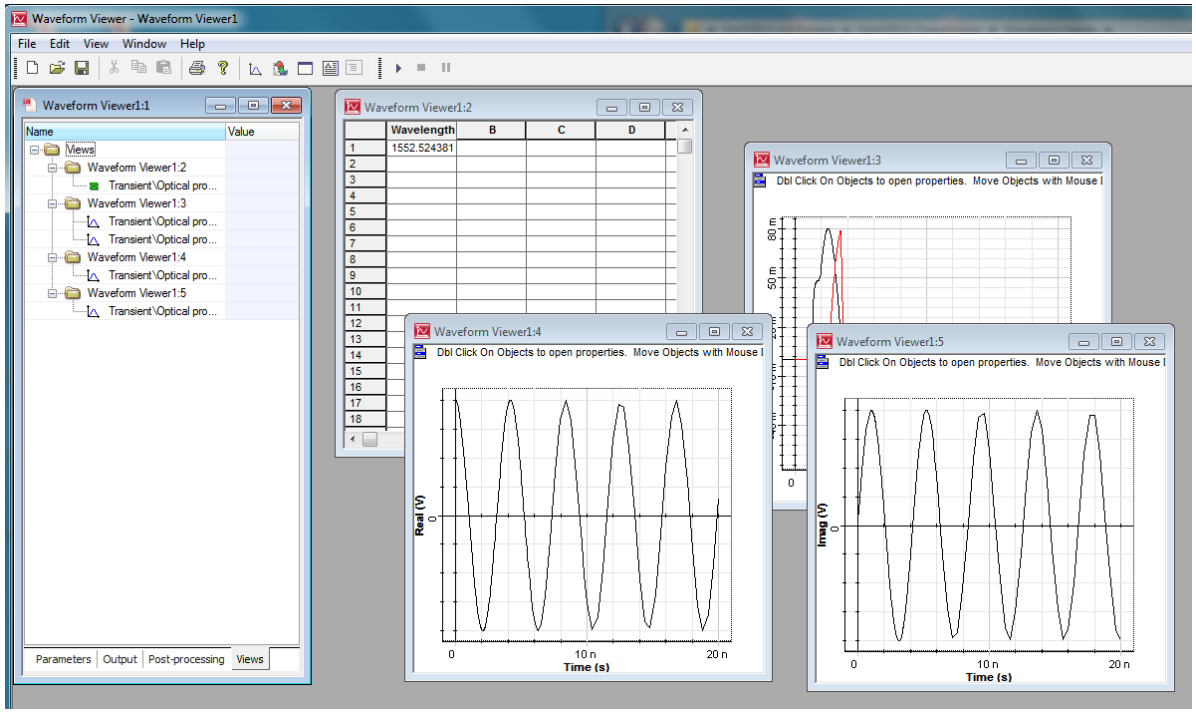



## Views tab

The Views tab registers all instances of 2D and 3D graphs, tables and text views that have been created within the Output tab. After double-clicking on a result, or by selecting a result and clicking on the context menu (right-click) and selecting *View*, a view will be automatically created. Within the Views tab these “views” can be accessed and managed (Figure 9). For example if you wish to delete a view; select the 2D, 3D, table or text folder, right-click and select “Remove”. Also to delete all Views, select the “Views” folder, right-click mouse and select “Remove all”.

***Note:*** When saving a waveform file, all active views in the Views tab will be saved and will automatically re-appear when re-opening the file.

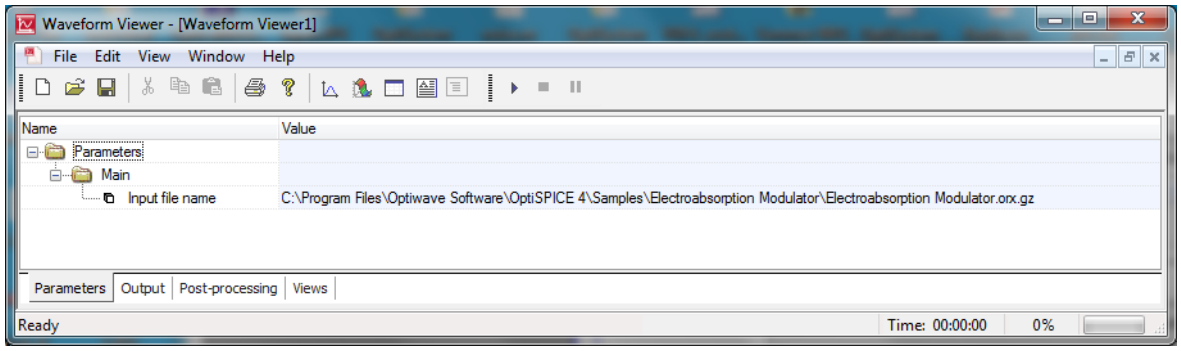
**Figure 9 Waveform Viewer (Views tab)**




## Parameters tab

The Parameters tab allows for the viewing of parameters associated with the Waveform Viewer project. The primary parameter is the “Input file name”(Figure 10).

**Figure 10 Waveform Viewer (Parameters)**




## Post-processing tab

The post-processing tab contains all instances of customized graphs built using the “Design new trace” feature. Please see the section *Designing new trace feature* for further information.

## Design new trace feature

It is possible to create customized graphs from one or more of the 2D graph results contained in the Output tab.

To start building a customized trace you can either:

- select the “Add traces to plot” icon on the top menu bar of the Waveform Viewer window (Figure 11); or,
- holding the CTRL key, left-click mouse on the graphs you wish to use a a source for building a customized trace and right-click mouse and select “Design new trace” from the pull down menu (Figure 12)

**Figure 11 Add traces to plot dialog box**

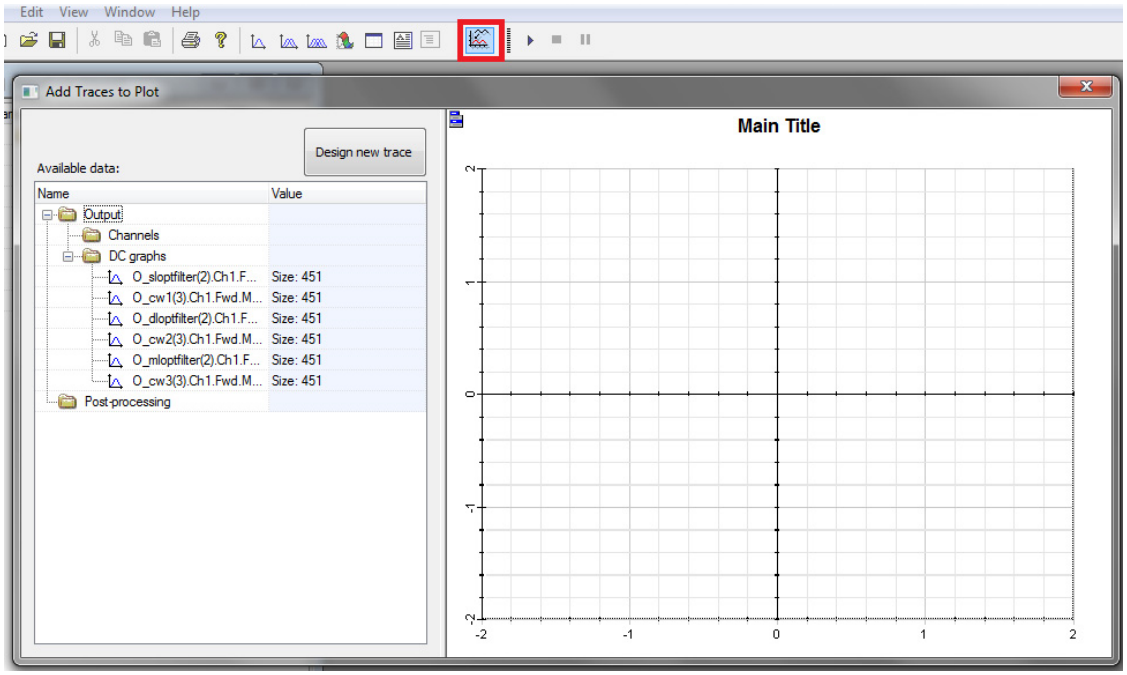
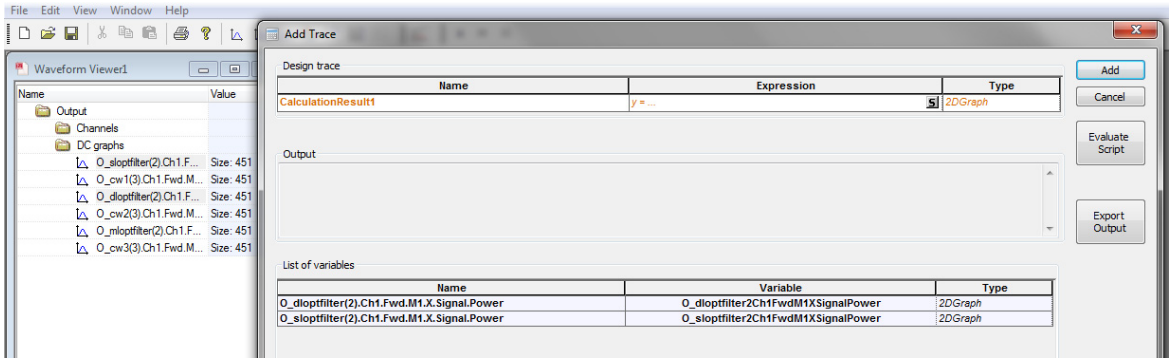
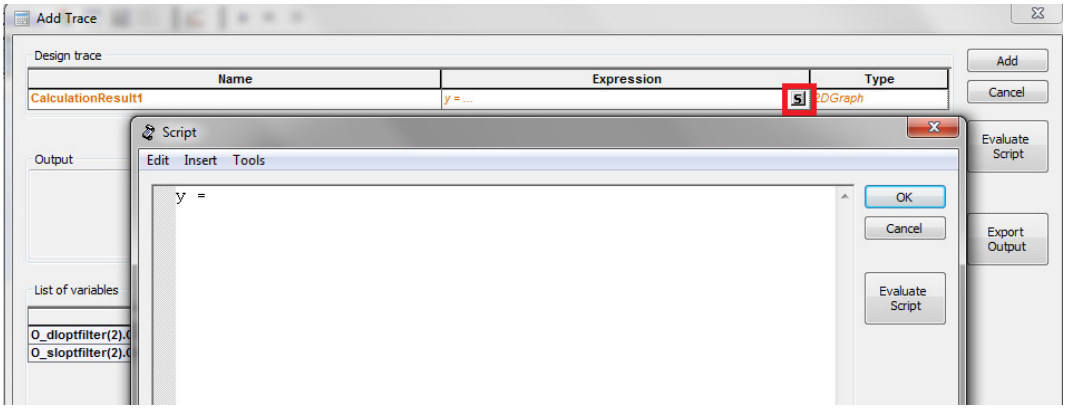



**Figure 12 Add trace dialog box**



To create a new trace select the Script icon (small grey box) under the Expression column in the Design trace window. This will open a new dialog box (Figure 13)

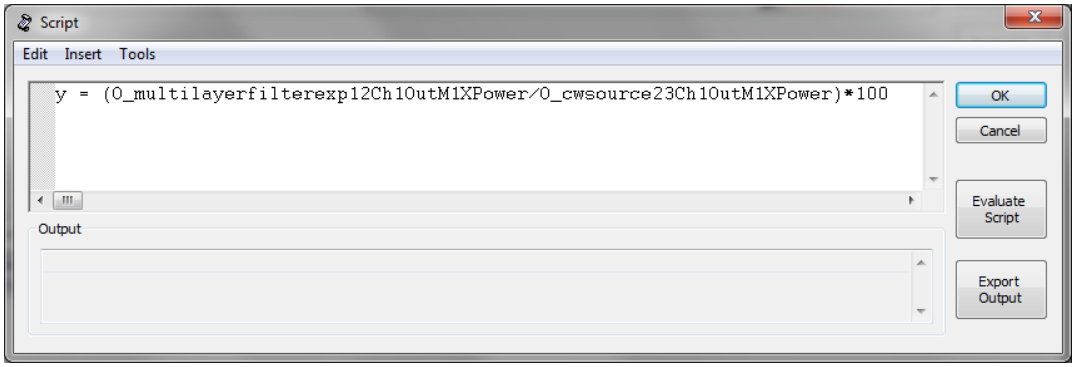
**Figure 13 Script dialog box for building a customized trace**




***Note:*** To access the Script dialog box from the “Add traces to plot” dialog box, first select the “Design new trace” button, followed by the Script icon (small grey box) under the Expression column in the Design trace window

To create a new trace; add functions, variables and constants after the “=” sign in the equation editor (see Figure 14). In this example two graph results are divided and multiplied by 100 to create a transmittance graph in “%”.)

**Figure 14 Example script expression**

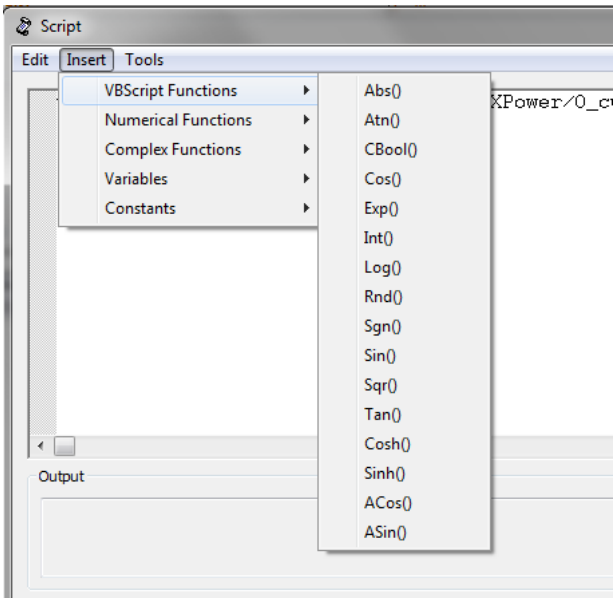



Script expressions can be entered directly into the equation editor or inserted from a pull down menu under the “Insert” tab of the Script dialog box (see Figure 15). The following functions are available:

- **VBScript functions** including trigonometric operations, absolute value, integer portion of a number, etc.
- **Numerical functions** including SUM, INTEGRAL and DERIVATIVE or a data set.
- **Complex functions** including initialization of complex number objects, complex addition/subtraction/multiplication/division, absolute value, normalize, etc.
- **Variables** which provides the name of each 2D graph data set from the Output tab

- **Constants** which provide a handy list of basic scientific constants including pi, elementary charge, Boltzmann constant, Planck's constant, etc.

**Figure 15 Insert functions menu**




Once you have completed an equation the results can be inspected by selecting "Evaluate script". The results of the calculation will be displayed within the Output dialog box of the Script window.

To save a customized plot, select the "Add" button in the upper right corner of the "Add trace" dialog box. The post-processing calculation script will be saved under the Post-Processing and Views tabs.

## Saving and loading Waveform Viewer files

A Waveform Viewer (WV) file can be saved by clicking the "Save" button on the top menu bar of the WV window (WV files are saved in the "*.owav"* format, for example *Waveform Viewer1.owav*). The WV files can then be retrieved by double-clicking on the "*.owav*" file or by opening the Waveform Viewer application in the Windows Explorer panel and opening the required ".owav" file.

The WV file is associated with an ".orx.gz" file (defined in the Parameters tab) allowing all probe data and views to be accessed without having to re-open the original OptiSPICE schematic/netlist. It is also possible to open other ".orx.gz" files by double-clicking the "Input file name" parameter (from the Parameters tab) and updating the "Value" field with a new file directory and ".orx.gz" name.

# Optical signal data viewing options

It is possible to change the format of the optical probe data (optical fields, power, phase or chirp) presented in the Output tab of the WV viewer. This can be done on a per probe basis as follows:

1 Within OptiSPICE Schematics, double-click on the optical probe that you wish to modify

2 Click on the **Value** field within the **Type** parameter field (**Main** tab) - see Figure 16

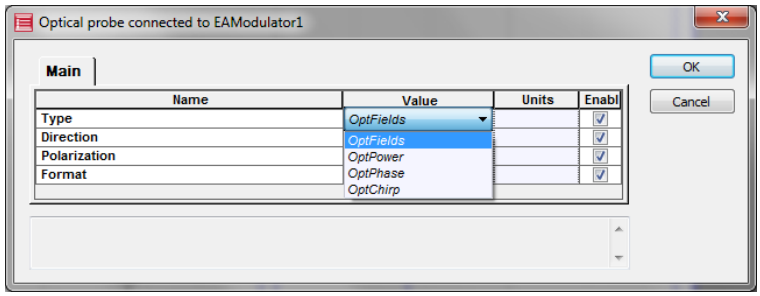
   a. To view optical data in complex or magnitude-phase notation, select *OptFields*

   b. To view optical data in power notation, select *OptPower*

   c. To view optical data in phase notation, select *OptPhase*

   d. To view optical data in chirp (derivative of phase) notation, select *OptChirp*

**Figure 16 Optical probe type settings**



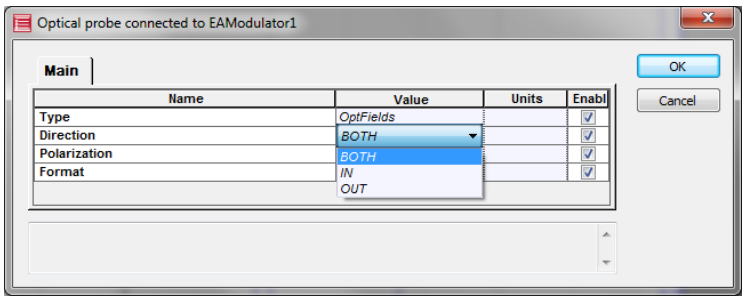

3 Click on the **Value** field within the **Direction** parameter field (**Main** tab) - see Figure 17

   a. To view optical data for both ingress and egress directions, select *BOTH*

   b. To view optical data for the ingress direction, select *IN*

   c. To view optical data for the egress direction, select *OUT*

**Figure 17 Optical probe Direction settings**



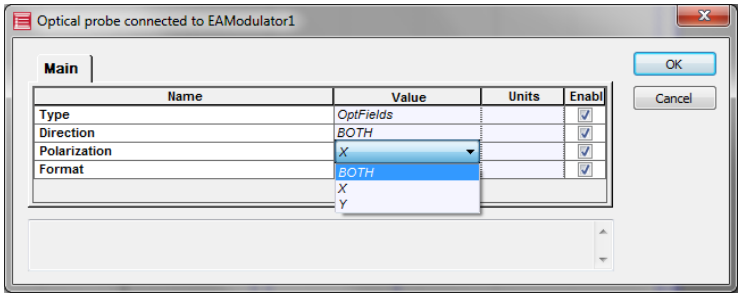
4 Click on the **Value** field within the **Polarization** parameter field (**Main** tab)- see Figure 18

a. To view optical data for both polarizations, select *BOTH*

b. To view optical data for the X polarization, select *X*

c. To view optical data for the Y polarization, select *Y*

**Figure 18 Optical probe Polarization settings**




5 Click on the **Value** field within the **Format** parameter field (**Main** tab) - see Figure 19

a. To view optical data in complex notation, select *CMPLX*

***Note:*** The **Type** parameter must be set to *OptFields* to view complex data

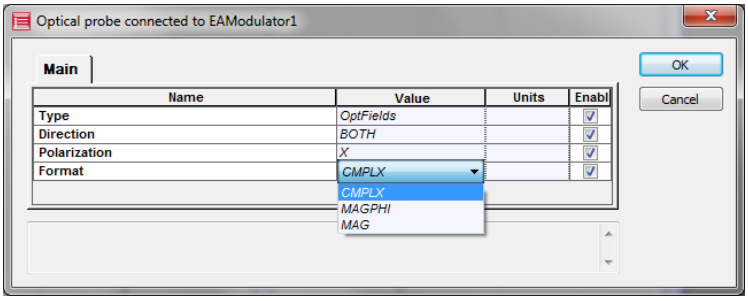
b. To view optical data in magnitude-phase notation, select *MAGPHI*

***Note:*** The **Type** parameter must be set to *OptFields* to view magnitude-phase data

c. To view optical data in magnitude or power notation, select *MAG*

***Note:*** Use this setting when using *OptPower*, *OptPhase* and *OptChirp*

**Figure 19 Optical probe Polarization settings**




***Note:*** No settings are required for voltage and current probes. Data will be shown in magnitude or complex format based on the type of analysis performed.

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