OptiSPICE

EA Modulator Parameter Extractor Manual

Electroabsorption Modulator Parameter Extractor Software for OptiSPICE

Version 5.2

OptiSPICE

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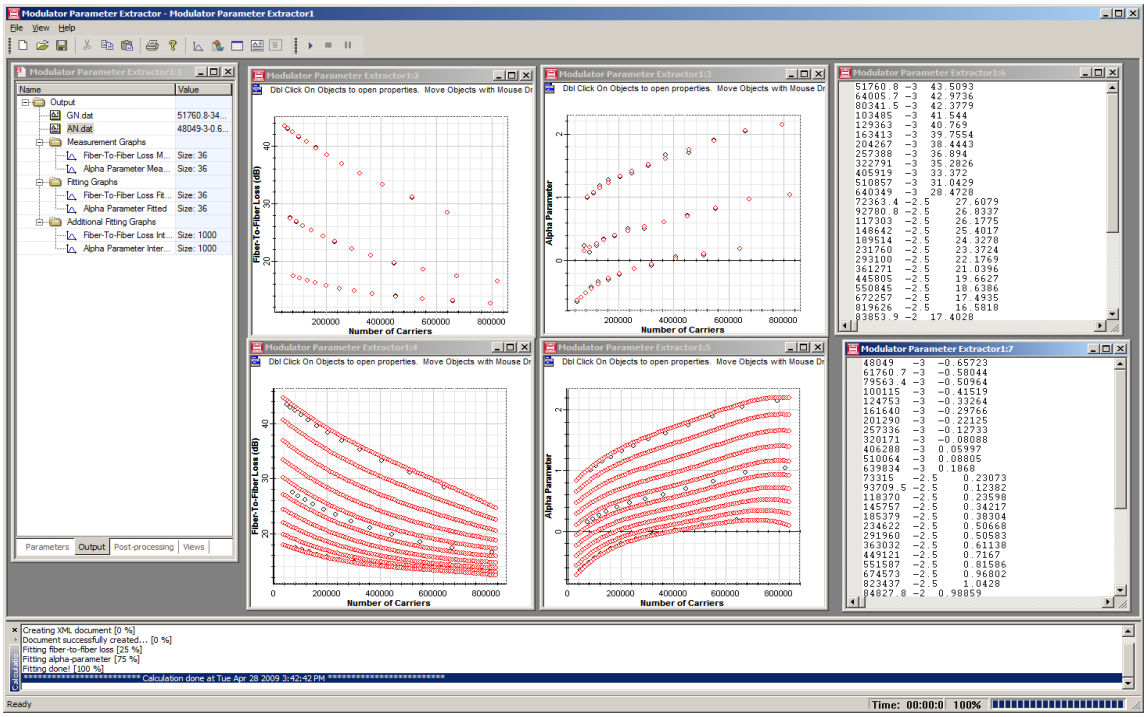
Introduction

The Modulator Parameter Extractor is a software tool that enables parameter fitting of measurements from MQW Electroabsorption Modulators [1] with one or two dimensional functions, using a polynomial form.

Modulator Parameter Extractor generates a polynomial matrix file containing the coefficients of the fitted measurements, calculated from the input measurements such as the dependence of the fiber-to-fiber loss and alpha-parameter on the number of photogenerated carriers and bias voltage.

OptiSPICE uses this file as an input to the Electroabsorption modulator element.

Figure 1 Modulator Parameter Extractor GUI



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Main features

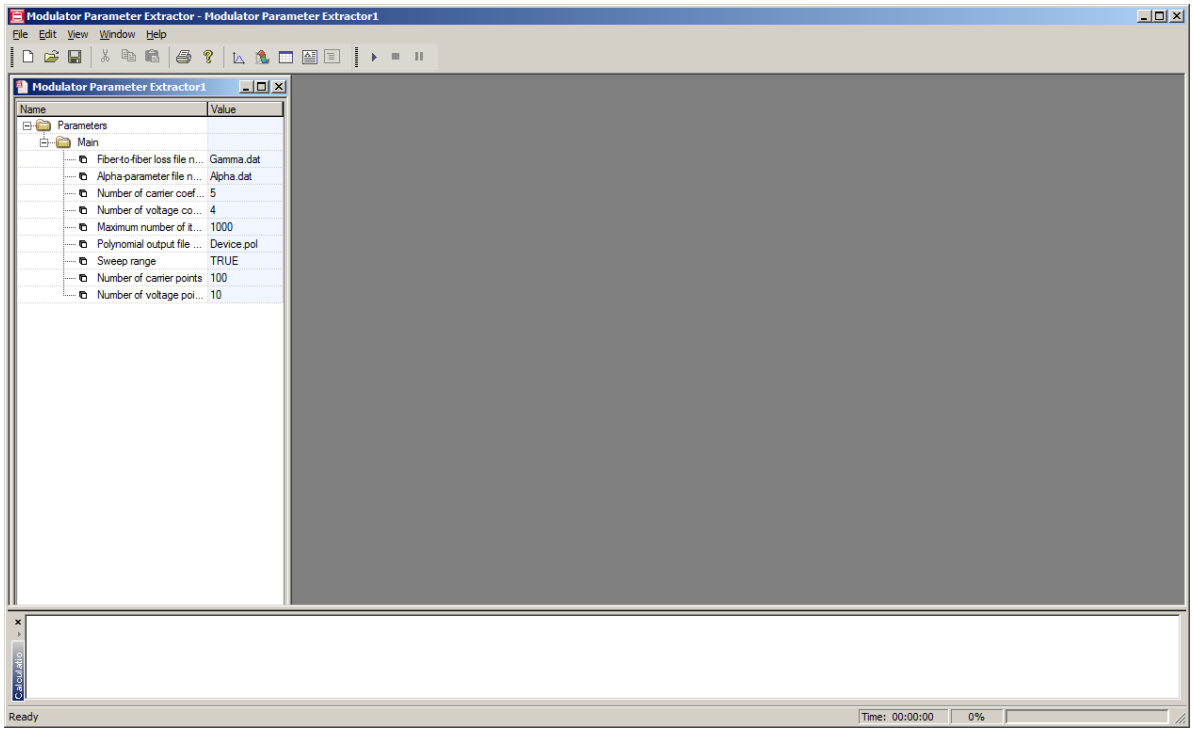
The main features of the Modulator Parameter Extractor include:

Feature	Description
Graphical user interface	A comprehensive Graphical User Interface (GUI) controls the fiber input parameters, output results, presentation graphics and post-processing.
Numerical engine	The numerical engine employs a 2D polynomial fit that allows for the simultaneous fitting of fiber-to-fiber loss and alpha-parameter on the number of photogenerated carriers and bias voltage.
Visualization capabilities	Powerful & intuitive result management allows users to graph almost any set of results available in design. Results are grouped into resizable, moveable views that supports text, tables, 2D and 3D graphs.
Post-Processing	A waveform calculators that uses standard Microsoft VBScript allows for unparalleled capability and flexibility to analyze simulation results.

EA Modulator Parameter Extractor GUI

When you open the Modulator Parameter Extractor, the application looks like Figure 1.

Figure 1 Modulator Parameter Extractor graphical user interface (GUI)



Main parts of the GUI

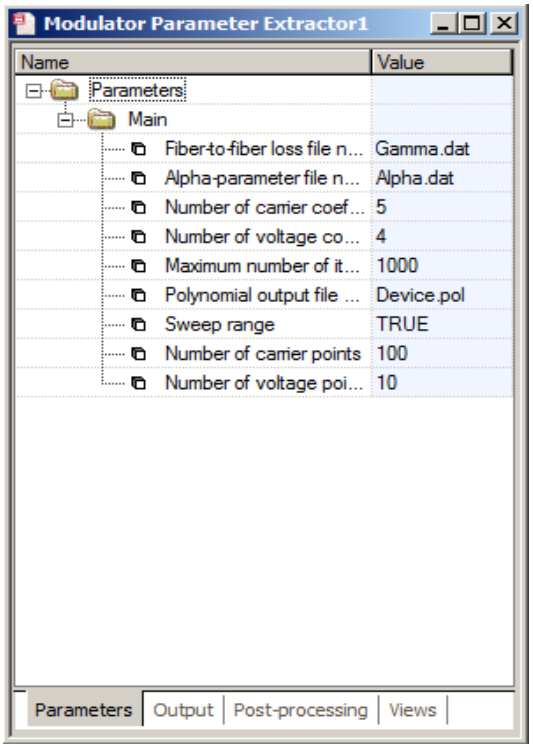
The Modulator Parameter Extractor GUI contains the following main windows:

- Project Browser
  - Parameters tab
  - Output tab
  - Post-processing tab
  - Views tab
- Calculator
- Calculation Output
- Views
- Status bar
- Menu bar

Project Browser

Project browser allows the user to organize the project to achieve results more efficiently, and navigate through the current project. Access parameters, results and views.(see Figure 2).

Figure 2 Project browser (Parameters tab)



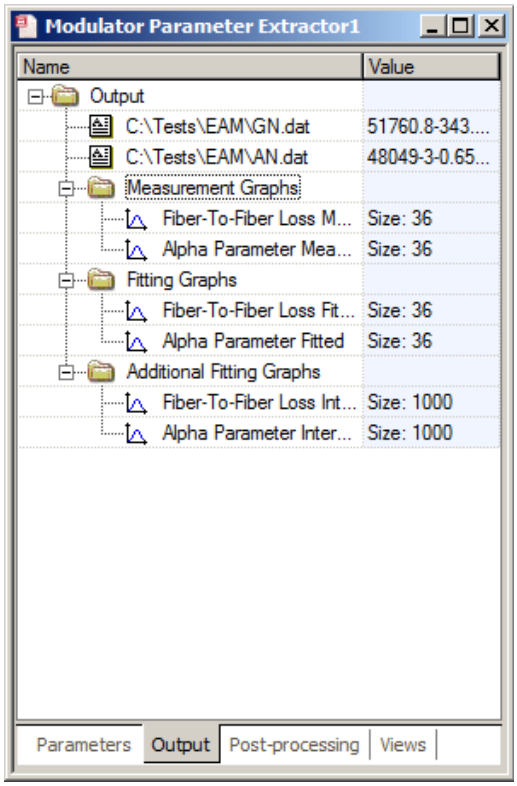
Parameters tab

Lists the properties of the current project. Users can access the parameter editor by double-clicking on any parameter in the list.

Output tab

Displays the results of the calculation (see Figure 3). User can drag-and-drop results into views or simply double-click on any result in order to launch the default view for a given result.

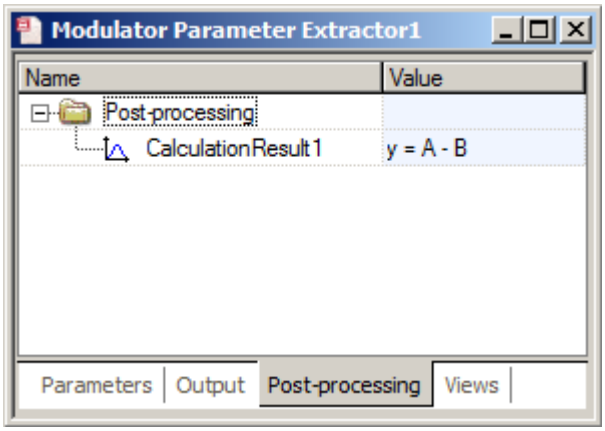
Figure 3 Project browser (Output tab)



Post-processing tab

Displays the post-processed results from the calculator (see Figure 4). User can drag-and-drop post-processed results into views or simply double-click on any post-processed result in order to launch the default view.

Figure 4 Project browser (Post-processing tab)

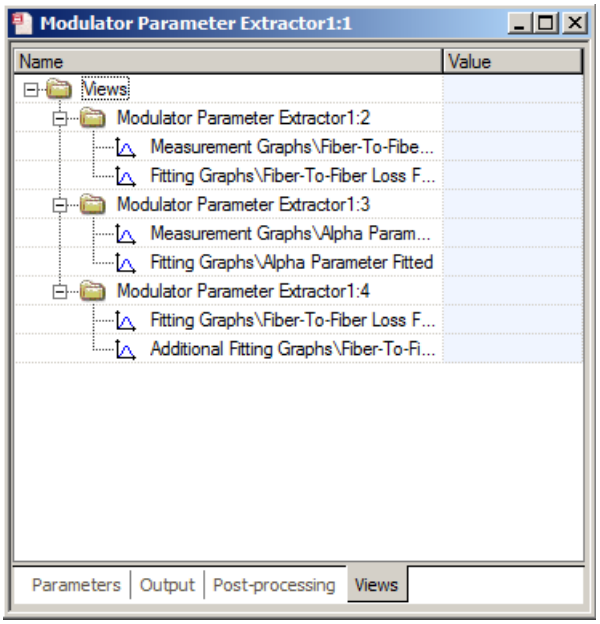


Views tab

Post-processing tab

Displays a list of views that represent active windows containing and displaying results (see Figure 5).

Figure 5 Project browser (Views tab)

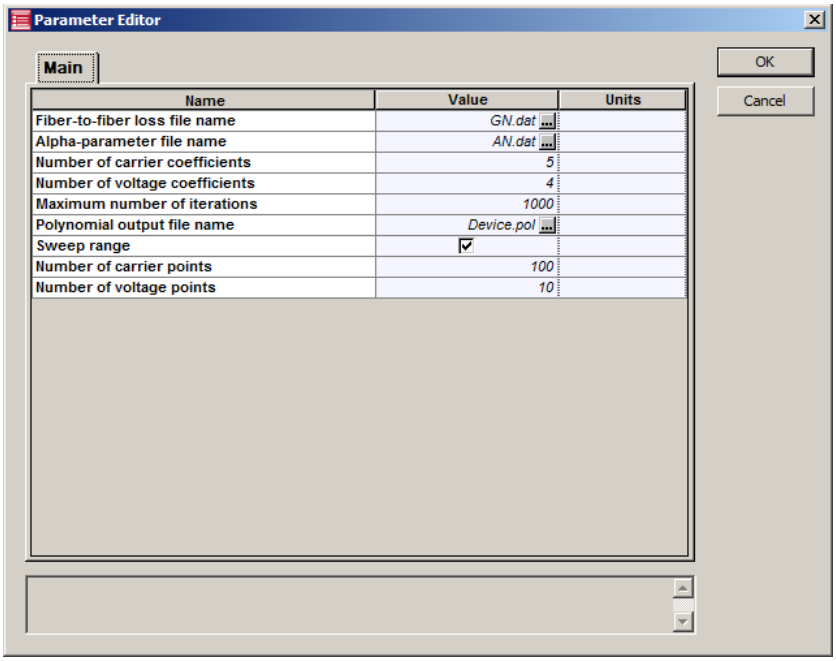


Parameter Editor

Double clicking on any parameter in the Project Browser brings the **Parameter Editor** (see Figure 6). The Parameter Editor allows you to view the list of global parameters of the active project.

> ***Note:*** Please refer to the Technical Background for the description of the parameters listed in the editor.

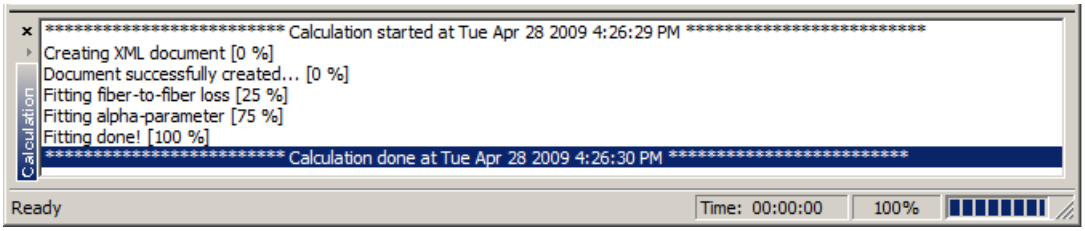
Figure 6 Parameter Editor control



Calculation Output

Information regarding the progress of the calculation is displayed in the Calculation output (see Figure 7).

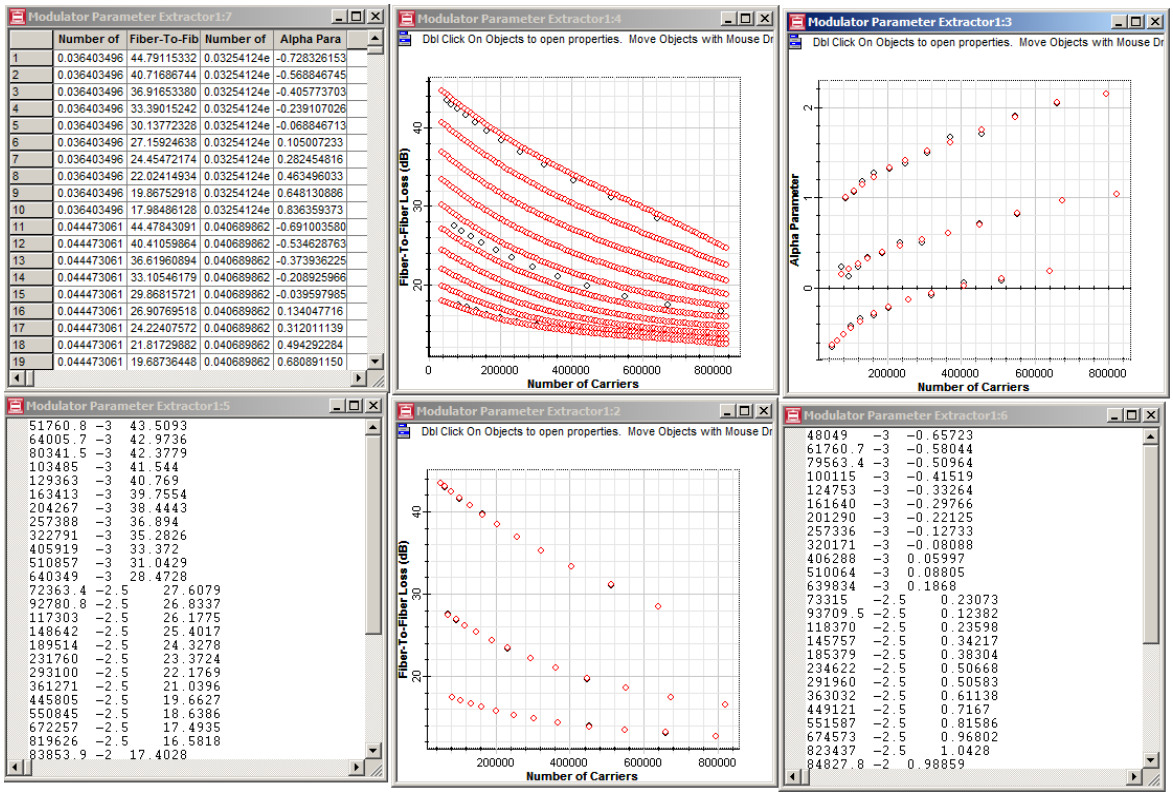
Figure 7 Calculation output



Views

Views are windows that contains results from calculation or post-processing (see Figure 8). They display 2D, tables and text. A user can create an empty view by clicking in one of the toolbar buttons such as *Create 2D Graph View*, *Create Grid View* or *Create Text View*. Alternatively, by double-clicking on a results a view will be automatically created or by selecting a result and clicking on the context menu (right-click) an selecting *View*.

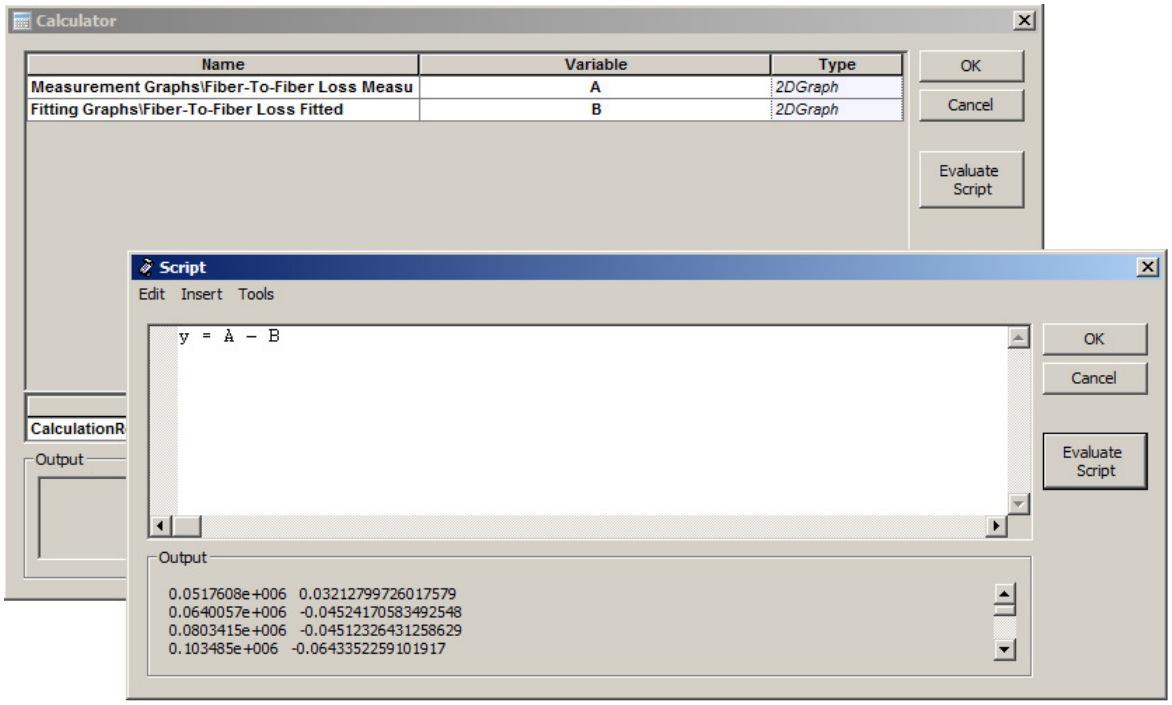
Figure 8 Multiple views



Calculator

The **Calculator** control allows you to operate on the output results to create new results and graphs. By selecting one or more results or 2D graphs the user can select the Calculator on the context menu (right-click). In order to create a new results the user provides a script (Microsoft VBScript Language) that operates on the available variables - the output results MUST be provided to the Y variable.

Figure 9 Calculator



Status bar

Displays useful hints about using the Modulator Parameter Extractor, the time and progress of the calculation (see Figure 10).

Figure 10 Status bar

Menu bar

Contains the menus that are available in the Modulator Parameter Extractor (see Figure 11). Many of these menu items are also available as buttons on the toolbars or from other lists.

Figure 11 Menu bar

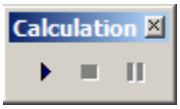
Toolbars

You can select the toolbars that you want to have available in the main layout window. The toolbar options include:

Standard

Contains the buttons to perform all typical windows application actions, in addition to create views options.

Calculation



Calculate, pause or stop the project calculation.

Menus and buttons

This section describes the menus and buttons available in the Modulator Parameter Extractor.

File menu

File menu item	Toolbar button	Description
New (Ctrl+N)		Create a new project.
Open (Ctrl+O)		Open an existing project. Select the project from the **Open** dialog box.
Close		Close the active (current) project. You are prompted to save changes.
Save (Ctrl+S)		Save the active (current) project under the current name in the default location.
Save As		Save the active (current) project with a different name and in a location that you select.
Print (Ctrl+P)		Print the active (current) project.
Print Setup		Set up the printer, page size, orientation, and other printing options.

File menu item	Toolbar button	Description
Print Preview		Preview the active (current) project.
Calculate (Ctrl+F5)		Calculate the active (current) project.
Recent files		List the most recent files that you worked on.
Exit		Exit the application. You are prompted to save changes to the project.

Edit menu

Edit menu item	Toolbar button	Description
Undo (Ctrl+Z)		Undo the last change made in the active (current) layout. You can undo all actions until the last saved operation.
Cut (Ctrl+X)		Remove all selected objects and place them on the clipboard.
Copy (Ctrl+C)		Copy selected objects to the clipboard. The selected objects remain in the active project.
Paste (Ctrl+V)		Copy objects from the clipboard and paste them in a user-defined location—the same layout, a new subsystem, or a new layout.

View menuWindow menu

View menu item	Toolbar button	Description
Toolbars		
Standard		Select to display the **Standard** toolbar.
Calculation		Select to display the **Calculation** toolbar.
Status Bar		Select to display the **Status Bar**.

Window menu item	Toolbar button	Description
Cascade		Arranges all open views in a cascading format.
Tile		Arranges all open views in a tile format.
Arrange icons		Lines up minimized views at the bottom of the application.

Help menu

Help menu item	Description
About Modulator Parameter Extractor	Provides information about Optiwave Corporation—mailing address, telephone and fax numbers, E-mail address, and URL.

Quick Start

This section describes how to run a project, edit parameters, and obtain results.

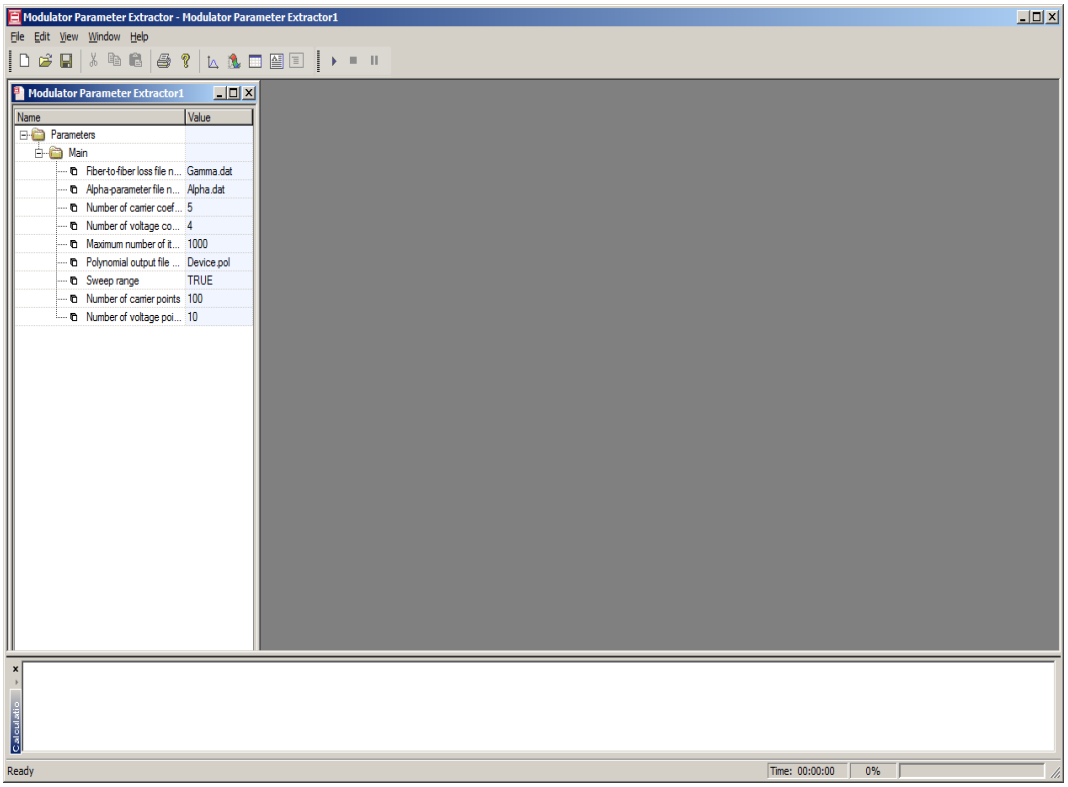
Starting Modulator Parameter Extractor

To start **Modulator Parameter Extractor**, perform the following action.

Action

- From the **Start** menu, select **Programs** > **Optiwave Software**> **OptiSPICE 1> Modulator Parameter Extractor**.
  Modulator Parameter Extractor loads and the graphical user interface appears
  (see Figure 1).

Figure 1 Modulator Parameter Extractor graphical user interface (GUI)



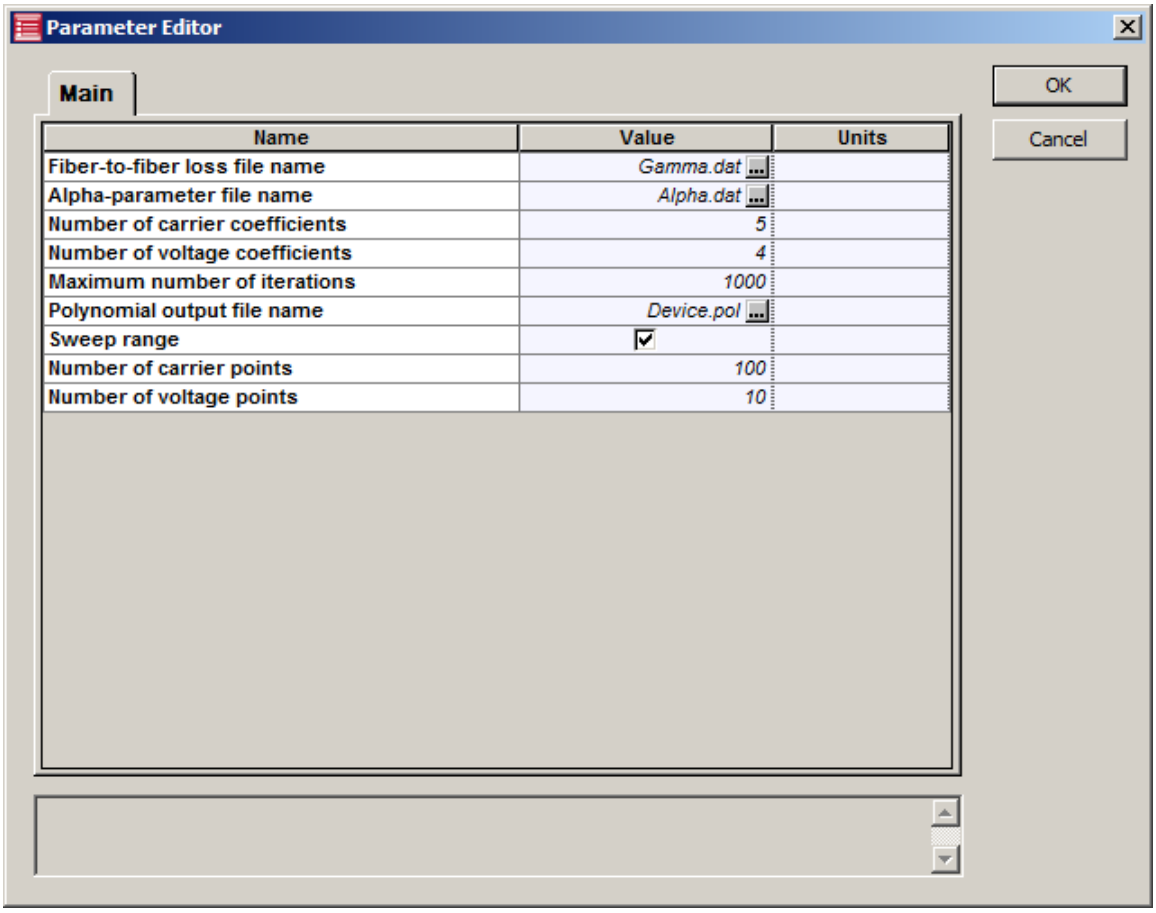
Viewing and editing parameters

To view and edit the project parameters perform the following action.

Action

- In the **Project Browser**, double-click on any parameter in the Parameters tab to view and edit the parameters for the project.
  *The **Parameter Editor** (see Figure 2) dialog box appears.*

Figure 2 Parameter Editor



Parameters are organized by categories. **Filter Parameter Extractor** has one category represented by a tab in the dialog box:

- Main

Each category has a set of parameters. Parameters have the following properties:

- Name
- Value
- Unit

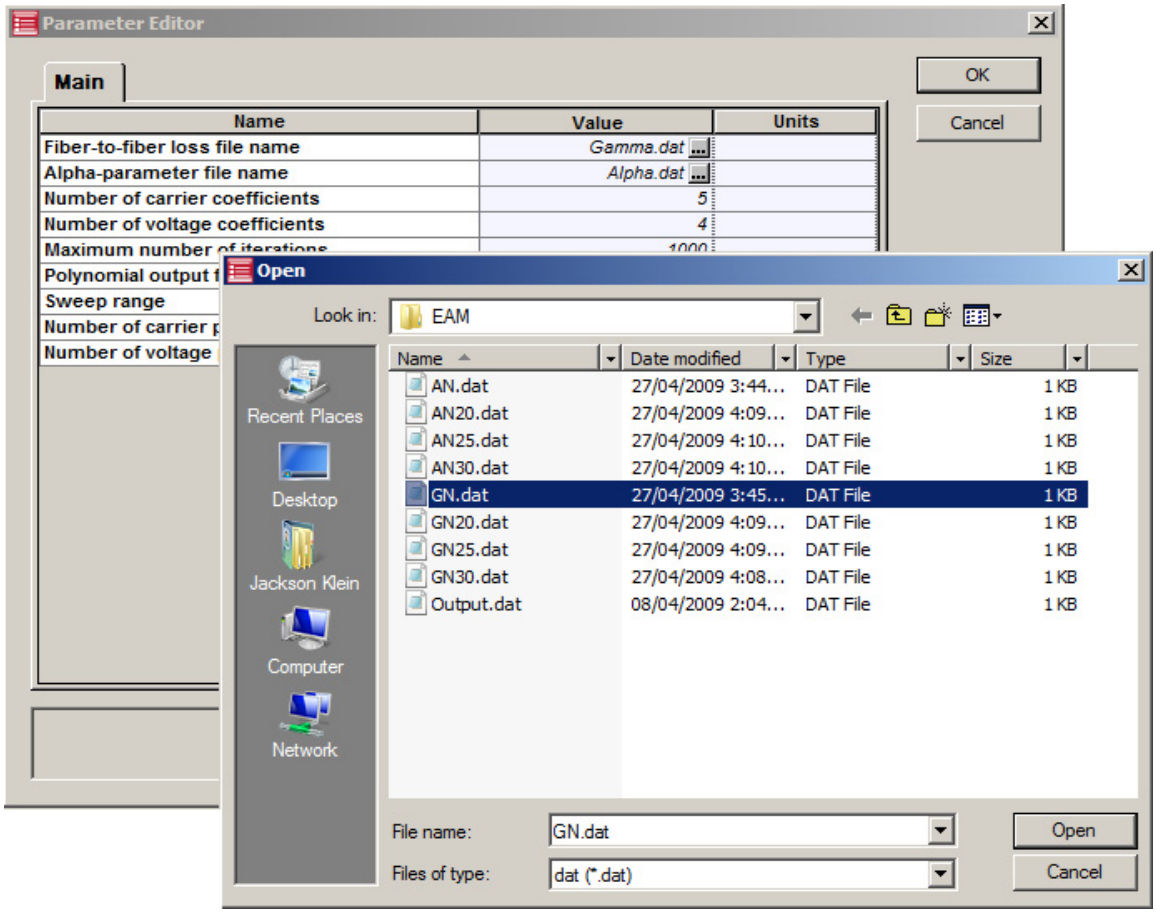
For a detailed description of each parameter please refer to Technical Background.

Parameter settings to create a fiber library for OptiSPICE

To create a fiber library for OptiSPICE perform the following actions.

Step	Action
1	In the **Project Browser**, double-click on any parameter in the Parameters tab to view and edit the parameters for the project. *The **Parameter Editor** (see Figure 2) dialog box appears.*
2	Provide the *Fiber-to-fiber loss and Alpha-parameter file name* parameters - their location is the file destination and the root name for the library (see Figure 3).
3	In the Parameter editor, click on ‘OK’.

Figure 3 Settings to create a fiber library.



Running a simulation

To run a simulation again with the current modulator parameters and create a library file for OptiSPICE, perform the following procedure.

Step	Action
1	In the Calculation toolbar, click on ‘Play’ (see Figure 5). *The **Calculations** starts (see Figure 5).*

Figure 4 Calculation toolbar

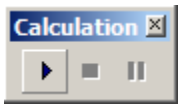
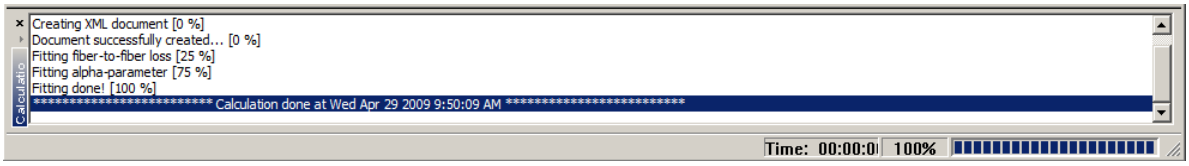


Figure 5 Calculation Output



At the end of the calculation the output tab will contain the results of the simulation.

Visualizing results

To view the results from the calculation, perform the following action.

Action

1 In the **Project Browser**, click on the Output tab to view the results for the project (see Figure 6)

The list of results for the polynomial fitting includes input measurement files (input fiber-to-fiber loss and alpha-parameter) and 2D Graphs (measurement and fitted fiber-to-fiber loss and alpha-parameter)

2 Double-click on Fiber-to-Fiber Loss Fitted result.

The 2D Graph view appears (see Figure 7).

Figure 6 Output results

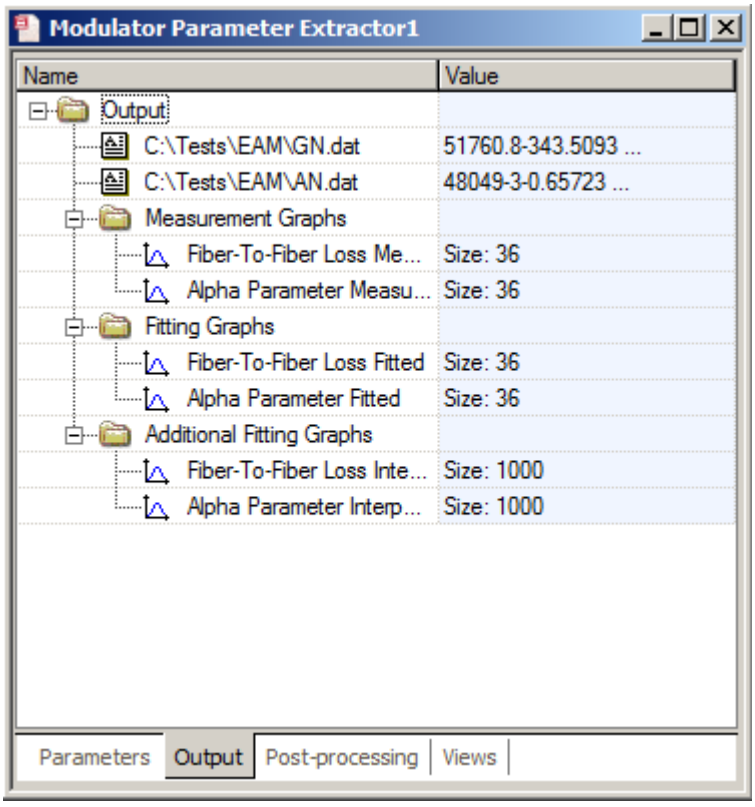
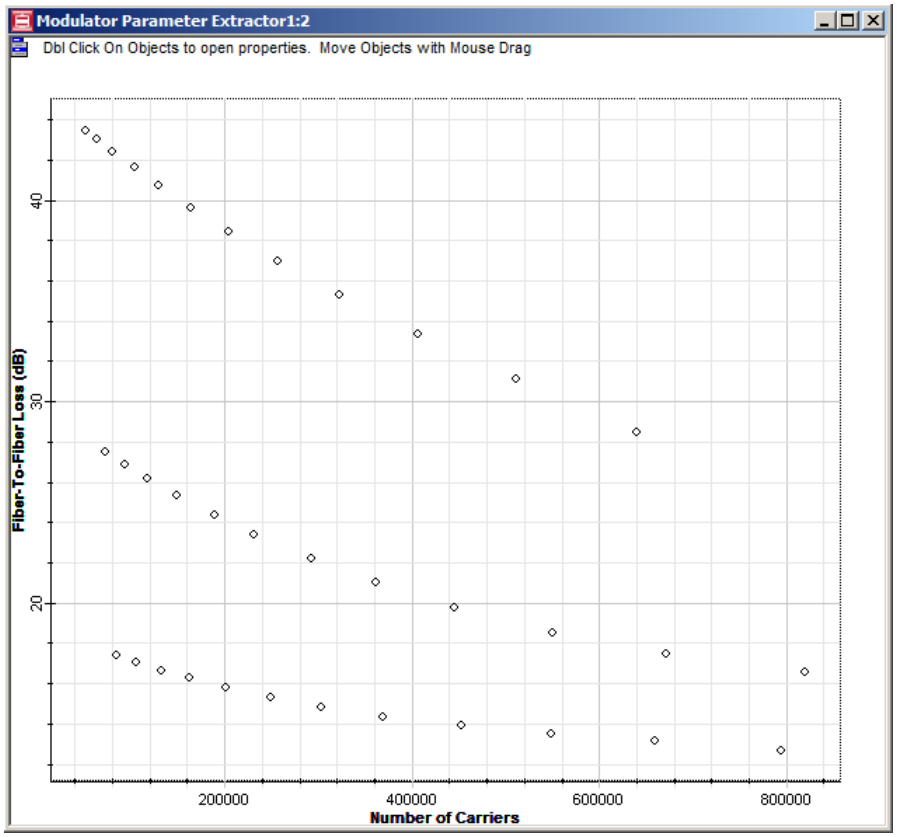
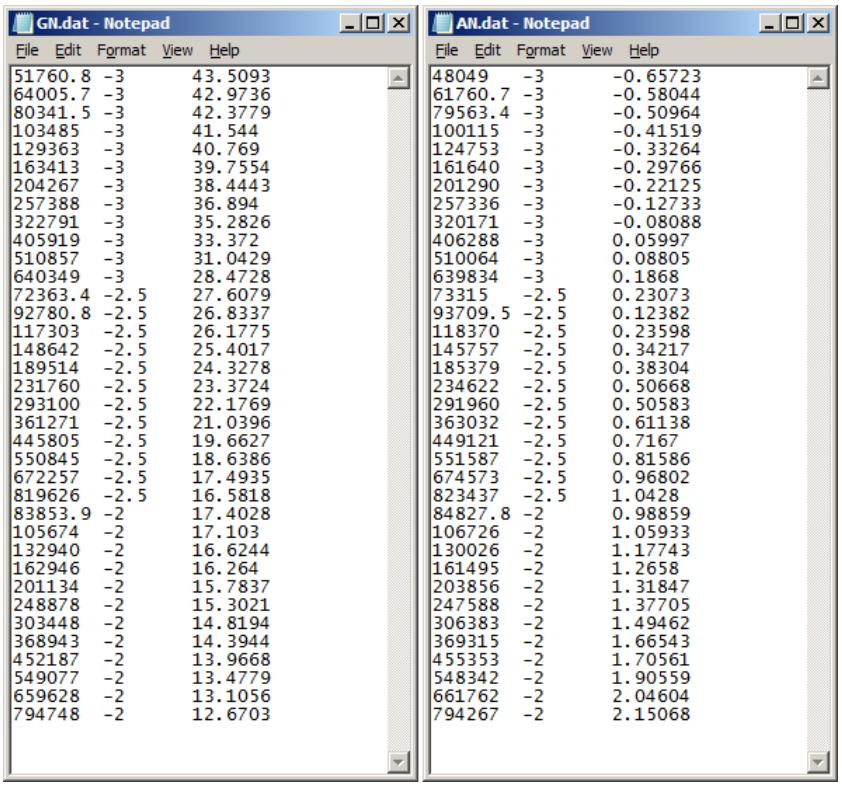


Figure 7 Refractive index profile



The contents of GN.dat (fiber-to-fiber loss) and AN.dat (alpha-parameter) input parameters are depicted in Figure 8. Finally, the polynomial function matrix (Device.pol) is depicted Figure 9.

Figure 8 Measurements of fiber-to-fiber loss and alpha-parameter.



GN.dat - Notepad

File Edit Format View Help

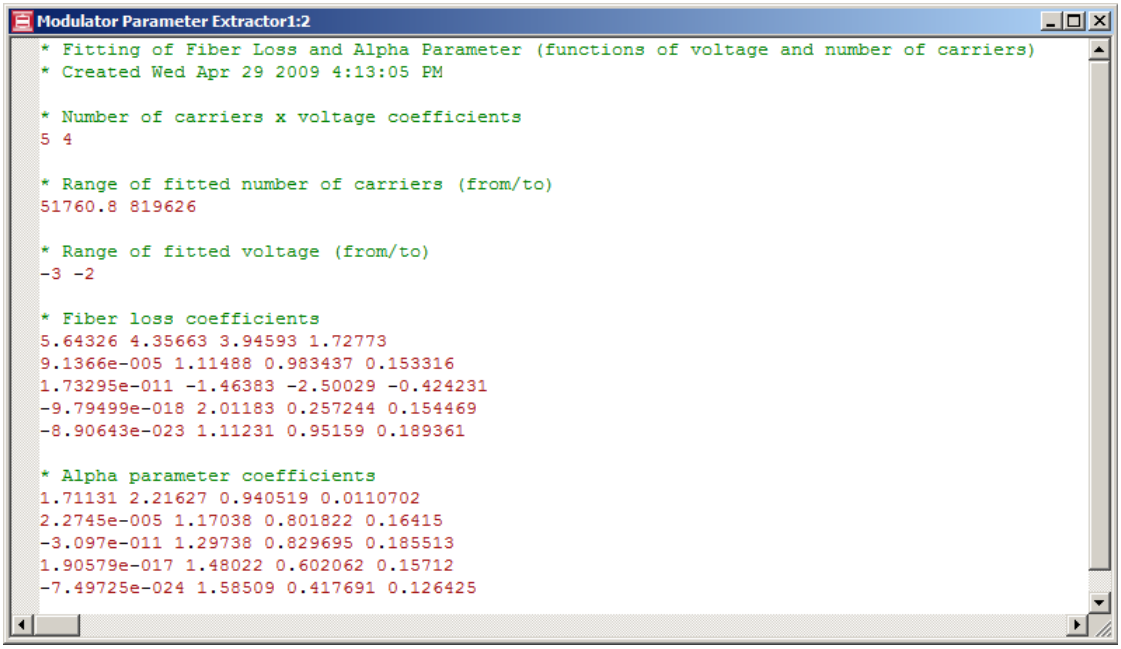
51760.8	-3	43.5093
64005.7	-3	42.9736
80341.5	-3	42.3779
103485	-3	41.544
129363	-3	40.769
163413	-3	39.7554
204267	-3	38.4443
257388	-3	36.894
322791	-3	35.2826
405919	-3	33.372
510857	-3	31.0429
640349	-3	28.4728
72363.4	-2.5	27.6079
92780.8	-2.5	26.8337
117303	-2.5	26.1775
148642	-2.5	25.4017
189514	-2.5	24.3278
231760	-2.5	23.3724
293100	-2.5	22.1769
361271	-2.5	21.0396
445805	-2.5	19.6627
550845	-2.5	18.6386
672257	-2.5	17.4935
819626	-2.5	16.5818
83853.9	-2	17.4028
105674	-2	17.103
132940	-2	16.6244
162946	-2	16.264
201134	-2	15.7837
248878	-2	15.3021
303448	-2	14.8194
368943	-2	14.3944
452187	-2	13.9668
549077	-2	13.4779
659628	-2	13.1056
794748	-2	12.6703

AN.dat - Notepad

File Edit Format View Help

48049	-3	-0.65723
61760.7	-3	-0.58044
79563.4	-3	-0.50964
100115	-3	-0.41519
124753	-3	-0.33264
161640	-3	-0.29766
201290	-3	-0.22125
257336	-3	-0.12733
320171	-3	-0.08088
406288	-3	0.05997
510064	-3	0.08805
639834	-3	0.1868
73315	-2.5	0.23073
93709.5	-2.5	0.12382
118370	-2.5	0.23598
145757	-2.5	0.34217
185379	-2.5	0.38304
234622	-2.5	0.50668
291960	-2.5	0.50583
363032	-2.5	0.61138
449121	-2.5	0.7167
551587	-2.5	0.81586
674573	-2.5	0.96802
823437	-2.5	1.0428
84827.8	-2	0.98859
106726	-2	1.05933
130026	-2	1.17743
161495	-2	1.2658
203856	-2	1.31847
247588	-2	1.37705
306383	-2	1.49462
369315	-2	1.66543
455353	-2	1.70561
548342	-2	1.90559
661762	-2	2.04604
794267	-2	2.15068

Figure 9 Contents of the file generated by the Modulator Parameter Extractor.



Modulator Parameter Extractor1:2

```
* Fitting of Fiber Loss and Alpha Parameter (functions of voltage and number of carriers)
* Created Wed Apr 29 2009 4:13:05 PM

* Number of carriers x voltage coefficients
5 4

* Range of fitted number of carriers (from/to)
51760.8 819626

* Range of fitted voltage (from/to)
-3 -2

* Fiber loss coefficients
5.64326 4.35663 3.94593 1.72773
9.1366e-005 1.11488 0.983437 0.153316
1.73295e-011 -1.46383 -2.50029 -0.424231
-9.79499e-018 2.01183 0.257244 0.154469
-8.90643e-023 1.11231 0.95159 0.189361

* Alpha parameter coefficients
1.71131 2.21627 0.940519 0.0110702
2.2745e-005 1.17038 0.801822 0.16415
-3.097e-011 1.29738 0.829695 0.185513
1.90579e-017 1.48022 0.602062 0.15712
-7.49725e-024 1.58509 0.417691 0.126425
```

Saving the project and closing Modulator Parameter Extractor

To save the project and close the Modulator Parameter Extractor, perform the following procedure.

Step	Action
1	From the **File** menu, select **Save** or **Save As...**
2	From the **File** menu, select **Exit**. *Modulator Parameter Extractor closes.*

Technical Background

Parameters

Main

Name and description	Default value	Default unit	Value range
Fiber-to-fiber loss file name File containing the measurements of the number of carriers, voltage and fiber-to-fiber loss	Gamma.dat		
Alpha-parameter file name File containing the measurements of the number of carriers, voltage and alpha parameter	Alpha.dat		
Number of carrier coefficients The number of carrier coefficients for the numerical fitting	5		[1, 100]
Number of voltage coefficients The number of voltage coefficients for the numerical fitting	4		[1, 100]
Maximum number of iterations The filename with the refractive index profile	1000		[1, 10000]
Polynomial output file name The output file containing the list polynomial coefficients for fiber-to-fiber and alpha parameters for the modulator	Device,pol		
Sweep range Defines whether to evaluate the fitted polynomial function using additional number of carrier and voltage values	YES		[YES,NO]
Number of carrier points Number of additional carrier points for sweep	100		[1, 10000]

Name and description	Default value	Default unit	Value range
Number of voltage points Number of additional voltage points for sweep	10		[1, 10000]

Technical Background

Modulator Parameter Extractor employs a polynomial fitting algorithm. The user provides two files (parameter *Fiber-to-fiber loss filename* and *Alpha-parameter filename*) containing the electroabsorption modulator measurements.

The fiber-to-fiber loss and alpha parameter file format is a list with the number of carriers, the bias voltage and the measurement (loss or alpha parameter) as depicted in Figure 1, or a list with the bias voltage and the measurement (if number of carriers is not available), as depicted in Figure 1.

Figure 1 Measurements of fiber-to-fiber loss and alpha-parameter.

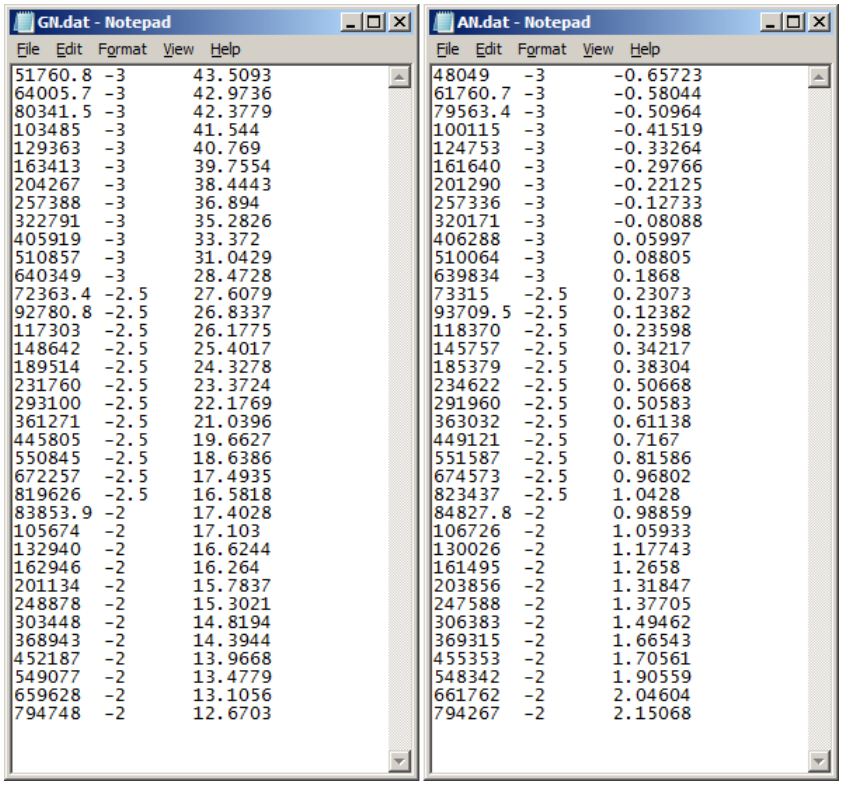
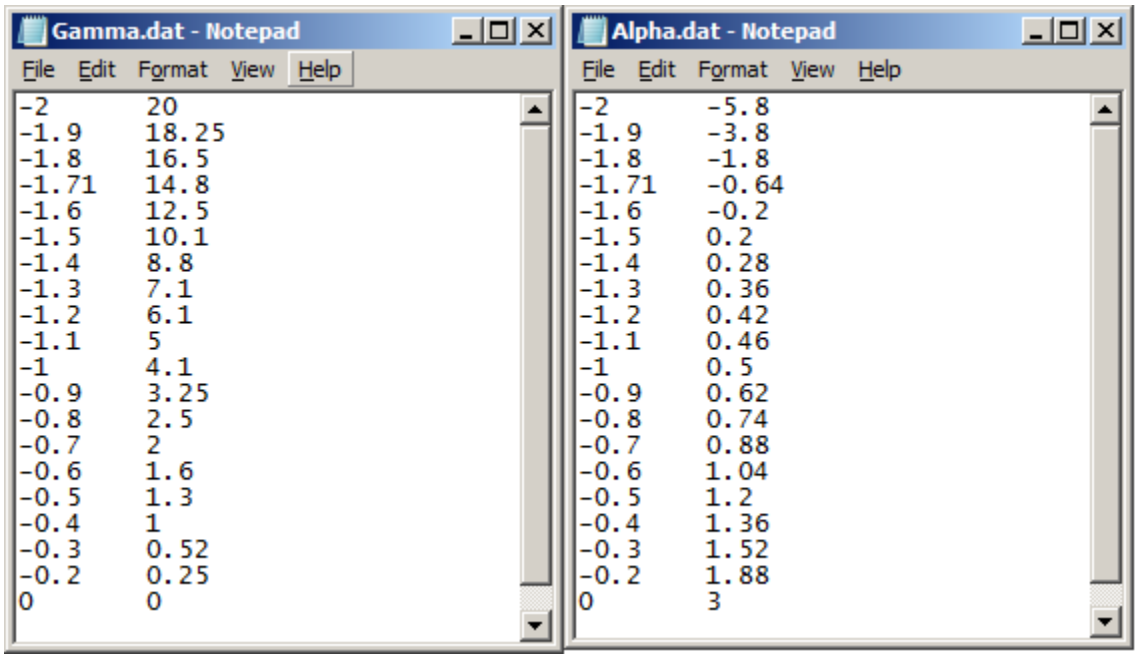


Figure 2 Alternative measurements of fiber-to-fiber loss and alpha-parameter.



Parameters *Number of carrier and voltage coefficients* defines the number of coefficients of the polynomial for the numerical fitting. The user can set parameter *Sweep range* to true in order to create additional fitting graphs. Parameters *Number of carrier* and *voltage points* define the additional number of points used to calculate the additional graphs.

If the number of carriers is not available, the fitting will ignore the parameter *Number of carrier coefficients*.

After the calculation a polynomial function matrix file is generated.

References

[1] N. Cheng, John C. Cartledge, “Measurement-Based Model for MQW Electroabsorption Modulators”, Journal of Lightwave Technology, VOL. 23, NO. 12, December 2005, pp. 4265-4269.

Notes:

Optiwave
7 Capella Court
Ottawa, Ontario, K2E 7X1, Canada

Tel.: 1.613.224.4700
Fax: 1.613.224.4706

E-mail: support@optiwave.com
URL: www.optiwave.com