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# Polarization Mode Dispersion Analyzer

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## FTB-5500

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If the equipment described herein bears the **CE** symbol, the said equipment complies with the applicable European Community Directive and Standards mentioned in the Declaration of Conformity.

Instruction Manual

P/N: MAN-187-I .1AN  
May 2001

**EXFO**

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# Contents

Certification Information.....	v
<b>1 Introducing the FTB-5500 PMD Analyzer .....</b>	<b>1</b>
Basic Polarization Mode Dispersion Theory .....	2
<b>2 Safety Information .....</b>	<b>5</b>
Safety Conventions .....	5
Laser Safety Information .....	6
<b>3 Getting Started with your PMD Analyzer .....</b>	<b>7</b>
Installing Your Application on an FTB-400 or PC .....	7
Inserting and Removing Test Modules.....	9
Loading the Application.....	13
Exiting the Application.....	13
FTB-5500 PMD Analyzer Main Window Description .....	14
<b>4 Setting Parameters .....</b>	<b>21</b>
Preparing for Measurements.....	21
Entering User Information.....	22
Entering DUT Information.....	23
Setting Acquisition Parameters .....	25
Selecting Traces to View.....	29
Customizing Acquisitions.....	32
<b>5 Performing Acquisitions .....</b>	<b>43</b>
Activating/Deactivating the FLS-110P.....	43
Selecting the Source Output Power.....	44
Operating the M-2100BP .....	44
Acquiring Traces.....	46
Selecting Views with the Zoom .....	47
<b>6 Managing Data .....</b>	<b>49</b>
Generating Results Table from the File Menu .....	49
Saving and Retrieving Files.....	49
Opening and Saving Configuration Files .....	50
Opening and Saving Templates .....	51
Printing Data.....	52
Viewing Acquisition Results .....	53
Viewing Statistics.....	53
Viewing Acquisition Information.....	55

# Contents

---

- 7 Maintenance ..... 59**
  - Cleaning the Front Panel ..... 59
  - Cleaning Fixed Connectors ..... 60
  - Cleaning Connectors Equipped with EUI/EUA Adapters ..... 62
  - Cleaning EUI/EUA Adapters ..... 64
  - Cleaning Detector Ports ..... 66
  - Recalibrating the Unit ..... 66
  
- 8 Troubleshooting ..... 67**
  - Using the Online Help ..... 67
  - Finding FAQs on the EXFO Web Site ..... 68
  - Contacting the Technical Support Group ..... 69
  - Transportation ..... 70
  
- 9 Warranty ..... 71**
  - General Information ..... 71
  - Liability ..... 72
  - Exclusions ..... 72
  - Certification ..... 72
  - Service and Repairs ..... 73
  - EXFO Service Centers Worldwide ..... 74
  
- Index ..... 75**

## **Certification Information**

### **F.C.C. Information**

Electronic test equipment is exempt from Part 15 compliance (FCC) in the United States, but EXFO makes reasonable efforts to ensure this compliance.

### **CE Information**

Electronic test equipment is subject to the EMC Directive in the European Union. The EN61326 standard prescribes both emission and immunity requirements for laboratory, measurement, and control equipment. This unit has been tested and found to comply with the limits for a Class A digital device. Please refer to the Declaration of Conformity.

### **Independent Laboratory Testing**

This unit has undergone extensive testing according to the European Community Directive and Standards. All pre-qualification tests were performed internally, at EXFO, while all final tests were performed externally, at an independent, accredited laboratory. This guarantees the unerring objectivity and authoritative compliance of all test results.



# 1 **Introducing the FTB-5500 PMD Analyzer**

Polarization mode dispersion (PMD) is the dispersion of light causing a delay between two principal states of polarization propagating along a fiber or through a device due to the birefringence property of the material.

The FTB-5500 PMD Analyzer takes full advantage of the TIA-approved interferometric method to offer a fast and field-proof unit that can handle almost any situation. This unit, used with the improved M-2100 Broadband Light Source, features the best dynamic range on the market to measure links longer than 200 km.

The FTB-5500 presents improved dynamic range higher than 50 dB for long-haul applications, an autorange function for unknown PMD ranges, multiple-measurement capability for long-term monitoring and an estimated second order PMD for DWDM system fiber certifications.

The FTB-5500 PMD Analyzer is a complete PMD analyzer system. It measures PMD using the internationally recognized interferometric method. The FTB-5500 averages PMD over the complete source wavelength range without any filtering, leaving all the source power for PMD measurement. The full dynamic range remains available to test long fiber spans. The FTB-5500 can withstand small vibrations thanks to its fast measurement time and does not require any special environmental setup to perform reliable measurements.

# Introducing the FTB-5500 PMD Analyzer

## *Basic Polarization Mode Dispersion Theory*



## **Basic Polarization Mode Dispersion Theory**

PMD is an important type of signal dispersion. Dispersion describes here a number of non-intensity dependant physical phenomena resulting directly in pulse spreading, or time jitter, in a digital system and distortion in an analog system. It can reduce system performance as unrepeated link distances are increased and transmission rates pushed upwards.

To better understand the impact of PMD, consider the example of a pulse passing through a wave plate. Upon entering the wave plate, the pulse is decomposed into polarization components aligned with each of the two birefringent axes of the plate (known as the fast and slow axes). The components propagating independently through the wave plate at different group velocities will recombine at the end of the wave plate as a superposition of two pulses split in time.



The delay between those pulses is designated as the differential group delay (DGD) and is written as  $\delta\tau$ . For a Gaussian, unchirped input pulse of rms width  $\sigma_0$ , the rms width at the output is given by

$$\sigma^2 = \sigma_0 + r_0 (1 - r_0) \bullet \delta\tau^2$$

Where  $r_0$  is the fraction of the input-pulse energy launched into one of the birefringence axes. Worst-case spreading occurs when the signal is perfectly split in two ( $r_0 = 1/2$ ), while no spreading occurs if the input state of polarization (SOP) of the launched signal is aligned with one of the birefringence axes.

To generalize this example, we can model a long, weakly birefringent telecommunications fiber as a concatenation of many, randomly orientated birefringent wave plates. Each interface between two wave plates redistributes the optical energy, along both axes of the subsequent wave plate. This transfer of energy is called mode coupling.

In a long fiber, numerous mode-coupling events occur along the fiber length, so that light emerging from the output end is the superposition of a number of pulses with different delays. Nonetheless, it turns out that for any given optical frequency,  $\omega$ , one can always find two orthogonal input principal states of polarization (PSPs) such that a light pulse, having an input SOP matched with the input PSP, undergoes no spreading. For a single wave plate, the PSPs are the two birefringent axes, whereas for a concatenation of wave plates, neither the input nor the output PSPs correspond in general to the alignment of the birefringent axes anywhere.

Contrary to the case of a wave plate, the DGD and PSPs of a long fiber are dependent on wavelength and fluctuate in time as a result of environmental variations such as temperature variations, external mechanical constraints, etc. Their behavior is random, both as a function of wavelength at a given time and as a function of time at a given wavelength. Fortunately, this behavior can be characterized statistically. It can be demonstrated that the probability density function of  $\delta\tau$  is Maxwellian and, by definition, PMD is its rms value, that is:

$$\text{PMD} = \sqrt{\langle \text{DGD}^2 \rangle}$$

## Introducing the FTB-5500 PMD Analyzer

### *Basic Polarization Mode Dispersion Theory*

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**Note:** *PMD is sometimes defined as the mean value of the DGD, which for a Maxwellian distribution yields a value 17% lower than the rms definition.*

If the average is calculated over  $\omega$ , PMD is stable in time, provided that the averaging window is sufficiently large ( $\Delta\omega\delta\tau \gg 1$ ).

It is essential to keep in mind that DGD fluctuates in time and can be either smaller or larger than its rms value or PMD. This results in a statistical probability that a pulse (information bit) is broadened, and leads to the eventual impaired ability of the receiver to efficiently decode the information. This adverse PMD effect makes it a critical phenomenon in limiting transmission of high bit rate information.

In the case of PMD in a long fiber, there is a specific state called input PSP. In this state, when the input SOP of the signal is aligned with one of its axes, it will propagate through the fiber without any spreading or distortion of the signal. This phenomenon is defined as this specific input SOP such that the output SOP is independent of optical frequency. Again, the worst case occurs when the signal is equally split between both input PSPs.

For long telecom fibers with random coupling of energy between modes (i.e.  $L \gg h$  where  $h$  is the coupling length), PMD grows as the square root of the distance, whereas PMD of strong HiBi fiber (negligible mode coupling) is directly proportional to the distance. Therefore the PMD coefficient for negligible mode coupling is expressed as ps/km, while the PMD coefficient for random mode coupling is defined as ps/km<sup>1/2</sup>.

## 2 **Safety Information**

### **Safety Conventions**

You should understand the following conventions before using the product described in this manual:

#### **WARNING**

Refers to a potential *personal* hazard. It requires a procedure which, if not correctly followed, may result in bodily harm or injury. Do not proceed beyond a **WARNING** unless you understand and meet the required conditions.

#### **CAUTION**

Refers to a potential *product* hazard. It requires a procedure which, if not correctly followed, may result in component damage. Do not proceed beyond a **CAUTION** unless you understand and meet the required conditions.

#### **IMPORTANT**

Refers to any information regarding the operation of the product which you should not overlook.

## Safety Information

### *Laser Safety Information*

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## Laser Safety Information

### CAUTION



When the laser safety light is flashing, one (or more) of your modules is emitting an optical signal. Please check all modules, as it might not be the one you are currently using.

### WARNING

Do not install or terminate fibers while a laser source is active. Never look directly into a live fiber, and ensure that your eyes are protected at all times.

### WARNING

Use of controls, adjustments, and procedures for operation and maintenance other than those specified herein may result in hazardous radiation exposure.

### WARNING

Use of optical instruments with this product will increase eye hazard.

# 3 Getting Started with your PMD Analyzer

## Installing Your Application on an FTB-400 or PC

If you have purchased an FTB-400 and a module, the software will have been pre-installed and configured at the factory.

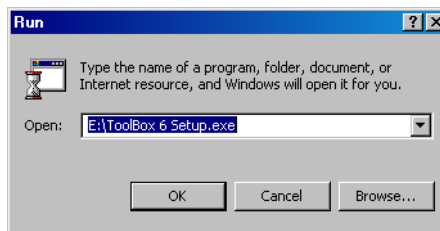
If you are using a PC, or if you ever need to reinstall the software, use the CD that came with your product and follow the instructions below.

**Note:** For help with connecting an external CD-ROM to the FTB-400, refer to the FTB-400 Universal Test System *instruction manual*.

Minimum Requirements	Windows 98 (SE)	Windows 2000
CPU	120 MHz Pentium	133 MHz Pentium
RAM	64 MB	64 MB
Disk space	50 MB	50 MB
Display	Super VGA, 800 x 600	Super VGA, 800 x 600

**Note:** Only administrator-level users can install software under Windows 2000.

1. Insert the installation CD in the CD-ROM drive.
2. Select *Run* from the Windows *Start* menu.

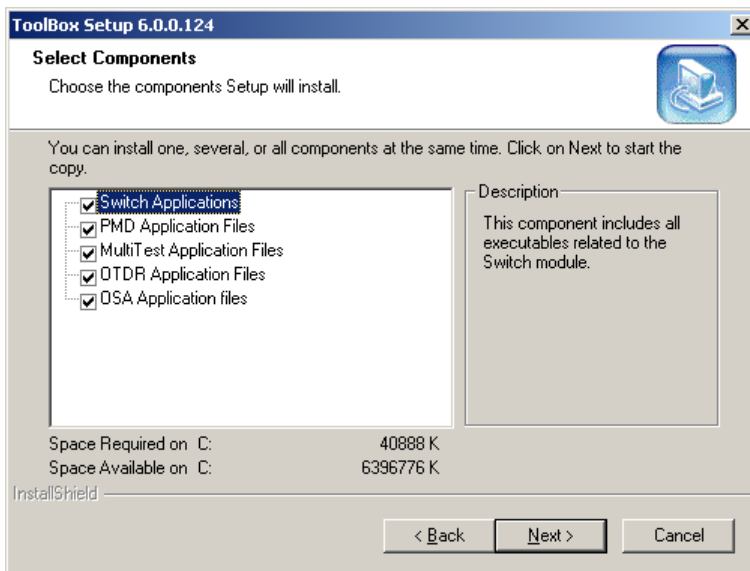


3. Type *E:\ToolBox 6 Setup.exe* in the *Open* text field (the drive letter may vary according to the location of your CD-ROM drive).

## Getting Started with your PMD Analyzer

### Installing Your Application on an FTB-400 or PC

4. Click on *OK* to start the InstallShield Wizard and follow the on-screen instructions.
5. In the *Select Components* window, select the component(s) you want to install and click on *Next* to start the installation.



6. When the installation is complete, the *Installation Completed* message appears. Click on *OK* to reboot your FTB-400 or computer.

## Inserting and Removing Test Modules

To access an application in order to perform tests, you must first insert the desired test module into the FTB-400. Instructions are provided for a two-slot and a seven-slot FTB-400.

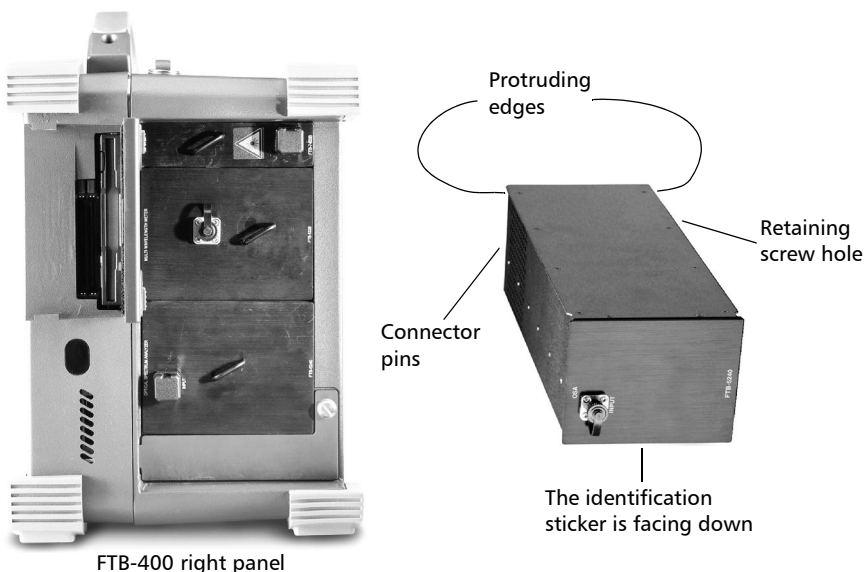
### Inserting a Test Module

## CAUTION

Do not remove or insert a module when the FTB-400 is turned on.

To insert a test module into an FTB-400,

1. Position the FTB-400 so that the right panel is facing you.
2. Take the module and place it so that the identification sticker is facing down. The connector pins should be at the back of the module, on the left side, and the retaining screw hole right beside it.



## Getting Started with your PMD Analyzer

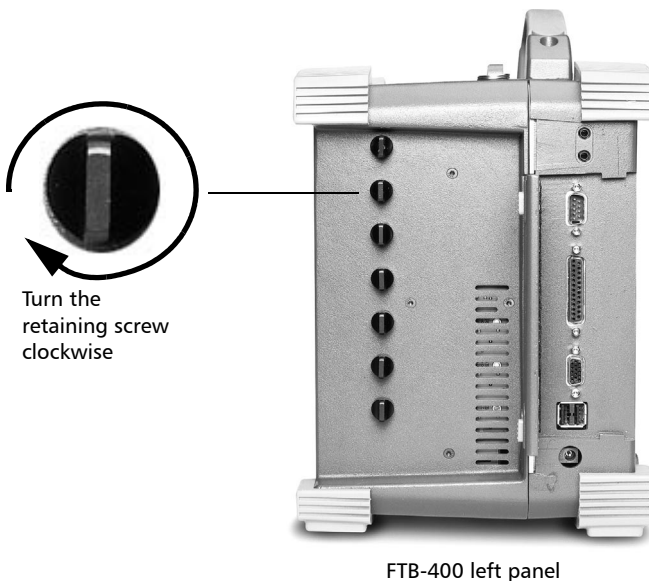
### *Inserting and Removing Test Modules*

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## CAUTION

Inserting a module upside down could result in permanent damage to the module, as the connector pins might be bent.

3. Insert the protruding edges into the grooves of the module slot.
4. Push the module all the way to the back of the slot. The module will stop when it makes contact with the retaining screw.
5. Place the FTB-400 so that the left panel is facing you.
6. While applying slight pressure to the module, turn the retaining screw clockwise until it is tight. This will secure the module into its “seated” position.



When you turn on the FTB-400, the startup sequence will automatically detect the module.



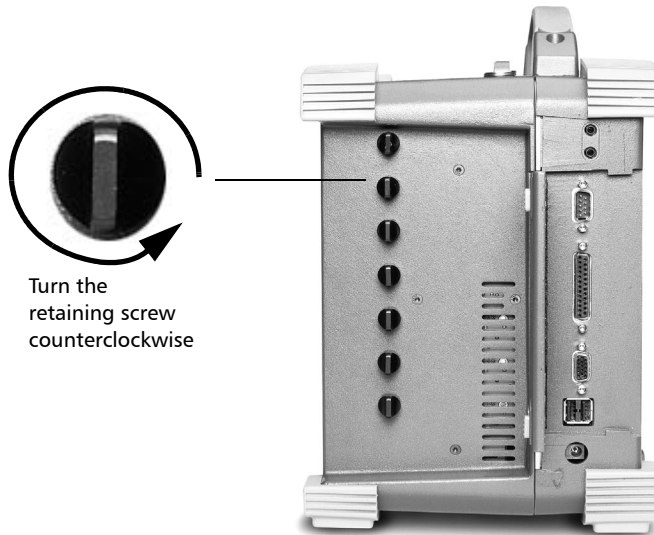
## Removing a Test Module

### CAUTION

Do not remove or insert a module when the FTB-400 is turned on.

To remove a test module,

1. Position the FTB-400 so that the left panel is facing you.
2. Turn the retaining screw counterclockwise until it stops. The module will be slowly released from the slot.



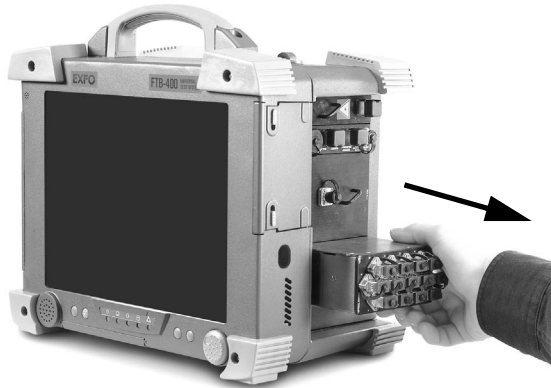
FTB-400 left panel

## Getting Started with your PMD Analyzer

### *Inserting and Removing Test Modules*

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3. Place the FTB-400 so that the right panel is facing you.
4. Hold the module by its side or by the handle (*not by the connector*) and pull it out.



## **CAUTION**

**Pulling out a test module by the connector could seriously damage both the module and connector.**

## Loading the Application

Whether you are using an FTB-400 or a PC, you can only load the application From ToolBox 6. Once you are in the ToolBox environment, you can

- access the single applications in the *Current Modules* view by clicking on the PMD Analyzer module, then on the desired application (FTB-400 only)
- access the integrated applications using the PMD Analyzer module by clicking selecting the *Integrated Applications* tab, and then clicking on the application using your PMD module (FTB-400 only)
- Work on PMD measurement results by selecting the *Work on Results (Offline)* tab, then on the application corresponding to what you wish to analyze (FTB-400 and PC).

Once the PMD Analyzer application is loaded, the corresponding main window opens. This window contains all the necessary commands to control the FTB-5500 module.

## Exiting the Application

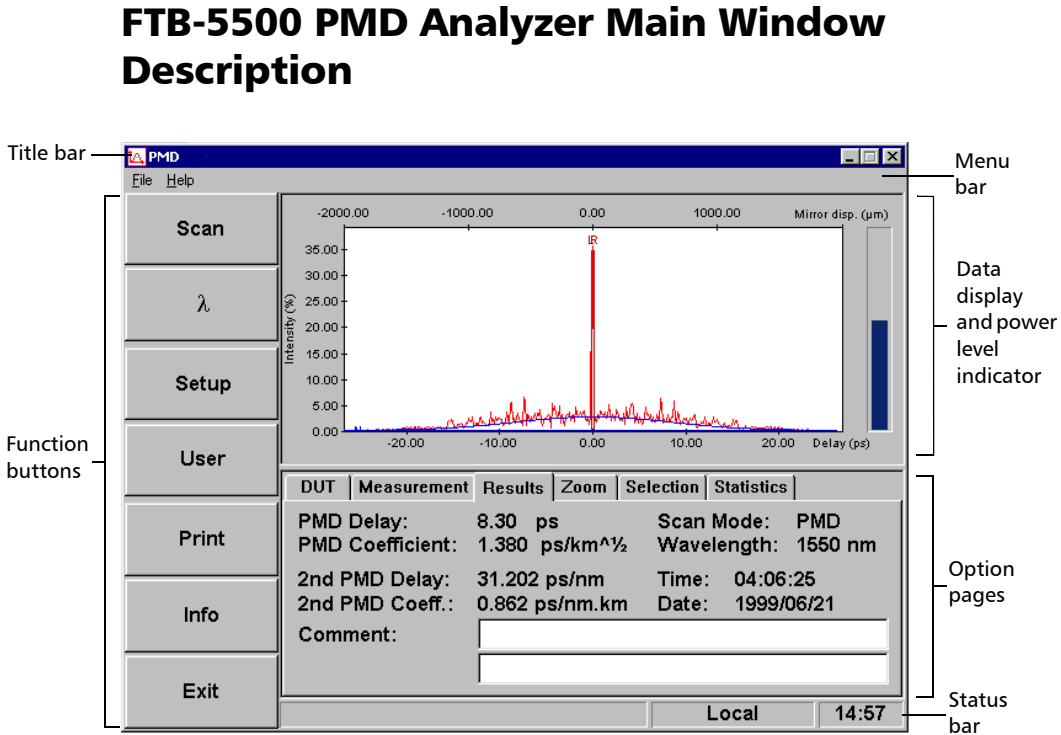
Closing any application that is not in use is a good way to free system memory.

To exit the PMD Analyzer application,

- Click on the Exit button on the bottom right-hand corner of the screen.  
OR
- Click on the X button on the top left-hand corner of the screen  
OR
- Select *File*, then *Exit* in the Menu bar.

# Getting Started with your PMD Analyzer

## FTB-5500 PMD Analyzer Main Window Description



The main window can be divided into five sections:

- Title and menu bars
- Function buttons
- Data display and power level indicator
- Options pages
- Status bar

A split bar divides the data display and the options pages; it can be moved up or down to adjust the size of both sections.

### Title and Menu Bars

The title and menu bars are at the top of the main window. The title bar indicates the name of the application, while the menu bar contains three menus described in the following table.

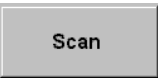






Menu	Option	Function
File	Open Config...	Opens a previous configuration file. See <i>Opening and Saving Configuration Files</i> on page 50. Keyboard shortcut: Ctrl + N
	Save Config...	Saves actual configuration setup to be used in subsequent testing sessions. See <i>Opening and Saving Configuration Files</i> on page 50. Keyboard shortcut: Ctrl + O
	Open Graph...	Opens a trace. See <i>Saving and Retrieving Files</i> on page 49. Keyboard shortcut: Ctrl + G
	Save Graph...	Saves a trace. See <i>Saving and Retrieving Files</i> on page 49. Keyboard shortcut: Ctrl + R
	Build Table...	Generates a data table from selected traces. See <i>Generating Results Table from the File Menu</i> on page 49. Keyboard shortcut: Ctrl + B
	Stop Build	When <i>Build Table</i> is selected, <i>Stop Build</i> replaces <i>Build Table</i> . Selecting <i>Stop Build</i> stops table generation. The application displays the traces loaded before activating the <i>Stop Build</i> command. Keyboard shortcut: Ctrl + Break

## Getting Started with your PMD Analyzer

### FTB-5500 PMD Analyzer Main Window Description

Menu	Option	Function
File	Open Table...	Opens a generated table and all pertaining traces. See <i>Saving and Retrieving Files</i> on page 49. Keyboard shortcut: Ctrl + T
	Stop Load	When <i>Open Table</i> is selected, <i>Stop Load</i> replaces <i>Open Table</i> . Selecting <i>Stop Load</i> stops file retrieval.
	Save Table...	Saves a generated table. See <i>Saving and Retrieving Files</i> on page 49. Keyboard shortcut: Ctrl + A
	Exit	Closes the application.
Help	Hardware...	Displays hardware information. Keyboard shortcut: Ctrl + H
	About...	Opens a window providing the following information: <ul style="list-style-type: none"><li>➤ application name and version</li><li>➤ Customer Support Group phone numbers</li><li>➤ EXFO website and e-mail address</li><li>➤ system information</li></ul>

### Function Buttons

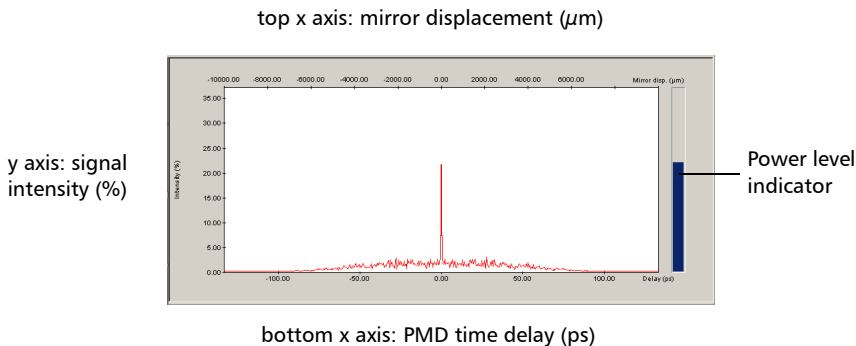
Button	Description
	Starts PMD scanning according to specified setup. This button reads <i>Stop</i> when scanning is in progress. See <i>Acquiring Traces</i> on page 46. Keyboard shortcut: F2
	Changes the wavelength and initiates a scanning session. Keyboard shortcut: F3
	Opens the <i>Setup</i> dialog box where you can specify and set acquisition parameters and data management options. Keyboard shortcut: F4
	Opens the <i>User Information</i> dialog box asking for your name and the company name. This information will appear on printed reports. Keyboard shortcut: F5
	Opens the <i>Print</i> dialog box that allows you to set up and print a PMD report and change printer settings. Keyboard shortcut: F6
	Opens the <i>Measurement Information</i> dialog box that displays complete information about the fiber, the acquisition, and results. See <i>Viewing Acquisition Information</i> on page 55. Keyboard shortcut: F7
	Exits the application.

## Getting Started with your PMD Analyzer

### FTB-5500 PMD Analyzer Main Window Description

## Data Display and Power Level Indicator

The data display section shows a signal intensity trace as a function of time or distance. The bottom x axis represents time delay in picoseconds. The top x axis represents mirror displacement in micrometers. The y axis represents signal intensity in percentage.



The trace will be displayed in this graph form, with a Gaussian fit drawn over the trace. Two vertical cursors, one on each side of the peak, will help determine the peak limits: a horizontal cursor will help determine the noise level, an additional vertical cursor will indicate the peak center. Display of Gaussian fit and cursors is user-selectable. The center cursor is only displayed if the trace in the graph window is the most recent acquisition and if the active page is the *Measurement* page.

The progress bar to the right of the trace display is the power level indicator. This bar is a visual aid to estimate the intensity of the incoming signal. You can toggle the bar display in the *Module* page. For more information, see *Module Page* on page 36.

## Option Pages

The option pages are located at the bottom of the screen. The pages are made active by selecting the corresponding tab. Six pages are available: *DUT*, *Measurement*, *Results*, *Zoom*, *Selection*, and *Statistics*. These pages are detailed in *Setting Parameters* on page 21.



### Status Bar

The status bar displays the current analyzer status.

Information	Description
Scanning in progress...	The progress bar indicates the percentage value of achieved data acquisition process.
Scanning x/total...	The progress bar indicates the percentage of achieved acquisition, while the message indicates how many scans out of a multiple acquisition have been done.
Waiting...	The module is waiting for the next acquisition to start. Depending on your preferences, an acquisition may start manually or automatically after a certain time. For more information, see <i>Configuring Multiple Measurement Acquisitions</i> on page 27.
Scan cancelled...	The <i>Stop</i> button on the main screen, or the <i>Cancel</i> button in the <i>Waiting for Next Acquisition</i> dialog box, was clicked, thus interrupting the process.
Initializing...	The application is setting the initial configuration or preparing the module for an acquisition.
Done	Initialization is over.
Analyzing...	The module is performing calculations on acquisition data to obtain PMD value.

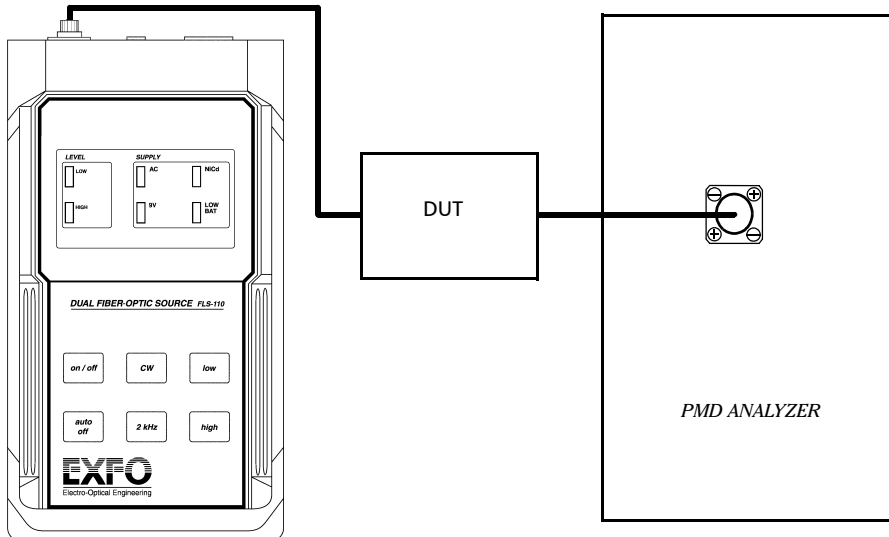


# 4 Setting Parameters

## Preparing for Measurements

Before an acquisition session

1. Clean and verify the quality of the connectors used.
2. Connect the device under test (DUT) according to test requirements (see figure below).



3. Press *CW* to ensure that your source is emitting in CW mode.

This setup lets you measure in the 0.1 to 35.0 ps range, or, if you are using an extended range version, in the 0.1 to 200 ps range. The method used to measure PMD is the interferometric method.

Default values allow plug-and-play PMD acquisition. You do not need to modify these parameters before starting an acquisition.

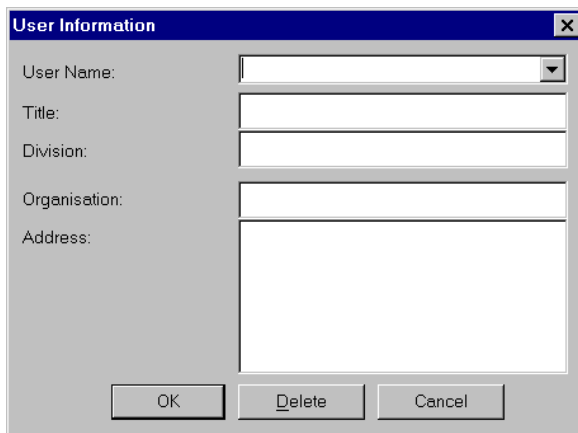
## Setting Parameters

### Entering User Information

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## Entering User Information

The *User* button opens a window where you may enter information about the company and person who will use the PMD Analyzer.



The screenshot shows a dialog box titled "User Information" with a close button (X) in the top right corner. The dialog contains the following fields and controls:

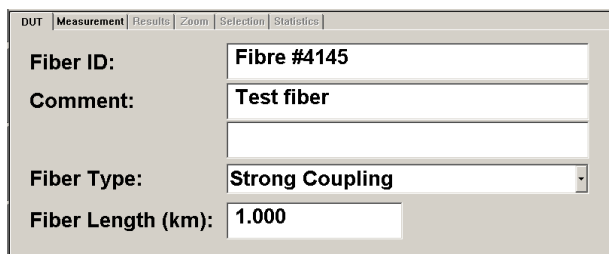
- User Name:** A list box with a downward arrow on the right side.
- Title:** A single-line text input field.
- Division:** A single-line text input field.
- Organisation:** A single-line text input field.
- Address:** A multi-line text input area.
- Buttons:** Three buttons at the bottom: "OK", "Delete", and "Cancel".

Every time a new name is entered in this window, it will be saved and made available in the list box for future use. To delete a name from the *User Name* list, simply select it and delete it. The supplied information will be used for the reports.

## Entering DUT Information

Device under test (DUT) information is entered in the *DUT* page. This information will be available for the reports, information dialogs, etc.

**Note:** *The information in the Fiber ID and Comment text fields is saved with the configuration in the template.*



The screenshot shows a dialog box titled 'DUT' with a tabbed interface. The 'DUT' tab is selected. The dialog contains the following fields:

Fiber ID:	<input type="text" value="Fibre #4145"/>
Comment:	<input type="text" value="Test fiber"/> <input type="text"/>
Fiber Type:	<input type="text" value="Strong Coupling"/>
Fiber Length (km):	<input type="text" value="1.000"/>

## Identifying the Device Under Test

The name (or identification code) of the device is entered in the *ID* line. Enter a name that properly identifies the fiber or DUT.

## Entering Comments About the Acquisition

You can enter general comments about the DUT in the *Comment* lines. These comments will appear in reports and information windows.

## Selecting Device Type

The *Fiber Type* list box has the choice of devices necessary for PMD characterization. If the device type selected is *Strong Coupling* or *Weak Coupling*, the fiber length field will be active to type in the length, in kilometers, of the fiber under test. If *Component* is chosen, this field will not be available. The *Weak Coupling* option allows you to perform PMD measurements on fibers with very low or no polarization mode coupling,

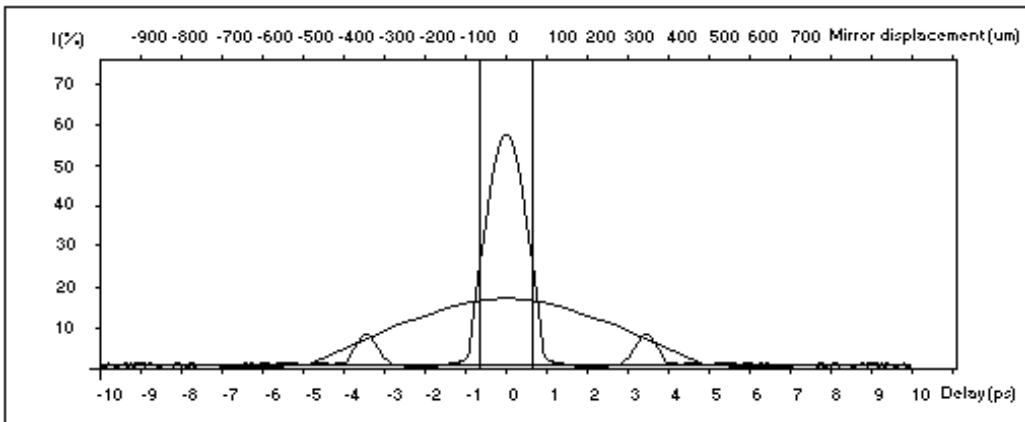
## Setting Parameters

### Entering DUT Information

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also known as weak mode coupling fibers, or HiBi (high birefringence) fibers. The *Component* option adjusts the system to measure low PMD values in passive components.

If you do not know if your fiber has weak polarization mode coupling, you should start by making a single acquisition using *Strong Coupling* measurement parameters. If the resulting trace has a wide main peak with one peak on each side (as in the figure below), it is very likely that you are testing a weak mode coupling fiber. You should then make a new measurement in weak mode coupling to obtain a realistic PMD value.

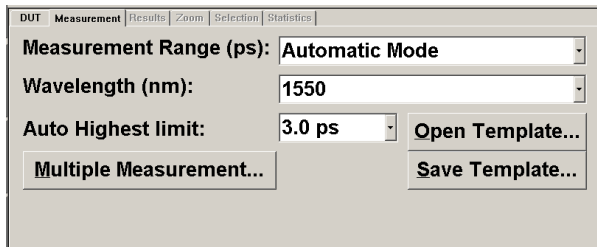


## Specifying Fiber Length

PMD is a function of the distance a signal travels. The fiber length parameter is compulsory since it will be used for PMD coefficient calculations. The entered value must be equal to or greater than 0.001 km (1.0 m).

## Setting Acquisition Parameters

Acquisition parameters are set in the *Measurement* page, where you can find a list of scanning ranges and available wavelengths. This page also allows you to configure multiple acquisitions, save the actual parameter settings as a template or, recall an acquisition parameter file.



### Scanning Range

The scanning range is related to the scan width around the main peak obtained by the analyzer during a measurement and needs to be set according to the PMD being measured. When you first measure a fiber and do not know its PMD, choose an intermediate range, like 0.4–1.2 ps, or 1.0–3.0 ps. Once a measurement is made, it is important to enter a more precise scanning range, one that corresponds to the PMD calculated for the first measurement.

If the PMD value is above the upper limit of the selected range, a message will appear suggesting a higher scanning range be chosen. If the PMD value is below the lower limit of the selected range, a message will appear suggesting you choose a scanning range that contains the obtained PMD value.

The Automatic Mode option allows you to make measurements when the expected PMD value is unknown. This option is only available in Strong Mode Coupling and if all the scanning ranges are available.

## Setting Parameters

### Setting Acquisition Parameters

**Note:** You must be careful when using Automatic Mode. In certain conditions, the proper scanning range may not be identified in this mode. Also, automatic mode may take more time to obtain results, due to selection sequence of the scanning ranges.

Strong Mode Coupling Device		Weak Mode Coupling Device and Component	
ps	μm	ps	μm
0.1 to 0.3	± 100	0.1 to 1.0	± 100
0.2 to 0.6	± 200	1.0 to 2.2	± 200
0.4 to 1.2	± 400	2.0 to 4.8	± 400
1.0 to 3.0	± 1000	4.0 to 12.0	± 1000
2.0 to 6.0	± 2000	10.0 to 24.0	± 2000
4.0 to 12.0	± 4000	20.0 to 48.0	± 4000
10.0 to 35.0	- 4000 to + 10,000	40.0 to 120.0	- 4000 to + 10,000
10.0 to 30.0 (FAST)	± 4000		
10.0 to 50.0 (ERPMD)	- 4000 to + 7000		
10.0 to 115.0 (ERPMD)	- 4000 to + 16,000		
(Automatic Mode)			

**Note:** You will notice that the higher scanning ranges are shifted to the left. This is normal and does not indicate a problem with your module.



The *Scanning Range* list box contains all the scanning ranges available for the module in use. These values change depending on module configuration and on selected device type. ERPMD scanning ranges are available only if you have an IQ-5500ER Extended Range PMD Analyzer.

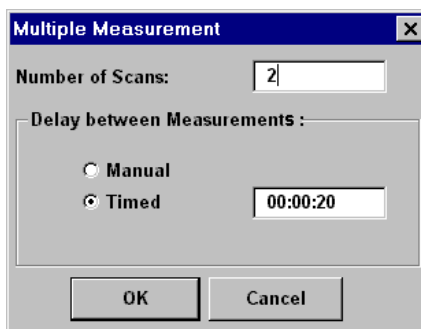
**Note:** *Fast Scan measurement allows quicker results but with lesser accuracy than the regular 10.0 - 35.0 ps range, in the high end of the range.*

## Selecting Wavelength

The *Wavelength* list box allows you to select the acquisition wavelength. These values depend on module configuration. The external polarized source must be set to the same wavelength used by the PMD program.

## Configuring Multiple Measurement Acquisitions

The *Multiple Measurement* button opens a window where multiple acquisition parameters can be set.



You may indicate the number of scans you wish to make and the delay between each measurement. Click on *OK* to accept the choices and close this window. Click on *Cancel* to exit this window without making any changes.

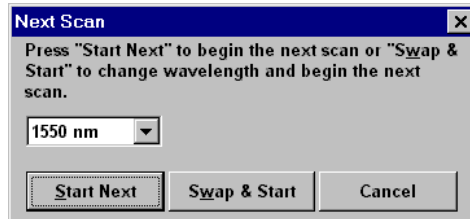
The delay between each measurement is determined in seconds. If you wish to manually determine when an acquisition should start, select the *Manual* radio button. A dialog box will open between each measurement;

## Setting Parameters

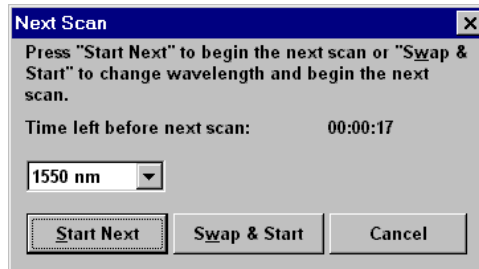
### Setting Acquisition Parameters

---

click on *Start Next* whenever you want the next acquisition to start. You may also change the wavelength for the next acquisition by selecting the wavelength from the list box or cancel all subsequent acquisitions by choosing *Cancel*.



If you select the timed acquisition, you must specify the delay between each acquisition in the edit box to the right of the radio button. After each acquisition, the following dialog box will open:



The dialog box counts down the time left until the next acquisition. To start the acquisition before the time, click on *Start Next*. You may also change the wavelength for the next acquisition by selecting the wavelength from the list box. Click on *Cancel* to stop the acquisition process and the message *Scan cancelled* appears in the status bar.

**Note:** *The multiple measurement mode is used for making multiple acquisitions on the same fiber. Do not change the test fiber between two acquisitions of a multiple measurement mode test since parameters set for a specific fiber may not apply to all fibers.*

When using the multiple measurement mode, results are saved using auto-naming values. A message window lets you choose between overwriting existing files or changing the file names. For information on auto-naming, see *File Name Page* on page 35.

## Opening and Saving Templates

The *Open Template* and *Save Template* buttons allow you to recall a previously saved acquisition parameter file and save the current settings as a template, respectively. Such template files are saved with the *tpl* extension in the folder of your choice.

## Selecting Traces to View

The *Selection* page lists all acquisition results. Each acquisition takes up a line on the table. Use the scroll bars to see all the information.

DUT		Measurement	Results	Zoom	Selection	Statistics		
State	Scan	Fiber ID	Wavelength	Threshold	Delay	Coeff.	2nd Delay	2nd Coeff.
	PMD	FIBER 5	1550 nm	--	24.31 ps	4.040 ps/km/%	267.5 ps/nm	7.307 ps/nm.km
	PMD	FIBER 6	1550 nm	--	0.54 ps	0.089 ps/km/%	0.130 ps/nm	0.0036 ps/nm.km
	PMD	FIBER 8	1550 nm	--	58.02 ps	9.642 ps/km/%	1523.8 ps/nm	42.084 ps/nm.km





Remove Current      Remove All Traces




## Setting Parameters

### *Selecting Traces to View*

---

A multiple acquisition adds a line of information for each acquisition. Each retrieved trace adds a line to the table. The *Build Table* option, in the *File* menu, creates a new table for the selected traces. Four different icons may appear in the first column to indicate information status.

Icon	Description
	No trace available for this acquisition.
	A trace is available for this acquisition. Selecting the information line will display the trace.
	A trace is available for this acquisition, but the values cannot be used for analysis, or the PMD value is valid but exceeds the set threshold.
	A trace is not available for this acquisition, and the values cannot be used for analysis, or the PMD value is valid but exceeds the set threshold.

To find out why  or  appears in the state column of an acquisition, select the acquisition and click on the left mouse button. The status bar displays a message explaining the problem. For example, if the PMD value is meaningful but exceeds the set threshold, a  appears in the state column and the problem is identified in the status bar.

The *Selection* page contains the following information:

<b>Column Title</b>	<b>Description</b>
State	An icon indicates whether a trace is available or not, and the usefulness of the values.
Scan	Scan type used (PMD or ERPMD).
Fiber ID	Fiber identification, as entered in the <i>DUT</i> page.
Wavelength	Wavelength used for the acquisition.
Threshold	Sets user-defined maximum tolerated PMD value.
Delay	PMD delay value.
Coeff.	PMD coefficient.
2nd Delay	2nd order PMD delay value.
2nd Coeff.	2nd order PMD coefficient.
Length	Fiber length, as entered in the <i>DUT</i> page.
Type	DUT type: weak coupling, strong coupling, or component.
Date	Acquisition date.
Time	Acquisition time.
File Name	Name of the acquisition file.
Comment 1 Comment 2	Comments about the acquisition, as entered in the <i>DUT</i> page.

Highlighted information can be deleted from the table by clicking *Remove Current Trace*. If the information has never been saved or has been modified, a warning message will appear to indicate that the trace or

## Setting Parameters

### Customizing Acquisitions

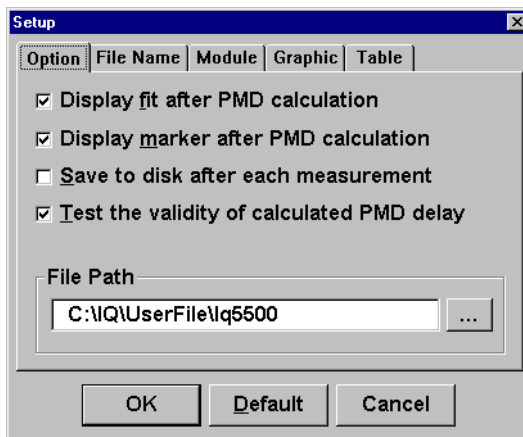
---

changes will be lost if they are not saved. If you save a trace that has never been saved, a *Save* window will open. Selecting *Remove All Traces* erases the contents of the whole table.

## Customizing Acquisitions

Acquisition procedures may be customized to simplify analysis by changing the information in the *Setup* window. Click on *Setup* on the function buttons bar to open the *Setup* window. This window is composed of six pages where you can select different options to customize acquisition procedures, data saving parameters, hardware setup, graph layout, and results table layout. Once all the settings have been selected, click on *OK* at the bottom of the window to accept the changes. Click on *Cancel* to exit without making any changes. Click on *Default* to ignore the changes and set the selections back to EXFO default settings.

### Option Page



#### ***Display fit after PMD calculation***

For strong mode coupling, PMD has a theoretical Gaussian distribution. In normal mode, this option will automatically display the Gaussian curve (or fit) for each trace after acquisition.

#### ***Display marker after PMD calculation***

Delimiting cursor lines will automatically be displayed for each trace after an acquisition.

#### ***Save to disk after each measurement***

When you choose this option, every acquisition is saved automatically. This function is particularly useful when making multiple measurements. By choosing this option, traces will be saved before closing. If you unselect this option, multiple acquisitions will be closed without saving and only the information in the results table will be available.

#### ***Test the validity of calculated PMD delay***

This feature compares the estimated PMD range value and the value given by the calculations. If the acquired PMD value is outside of the selected scanning range, a message will appear suggesting that the range be modified.

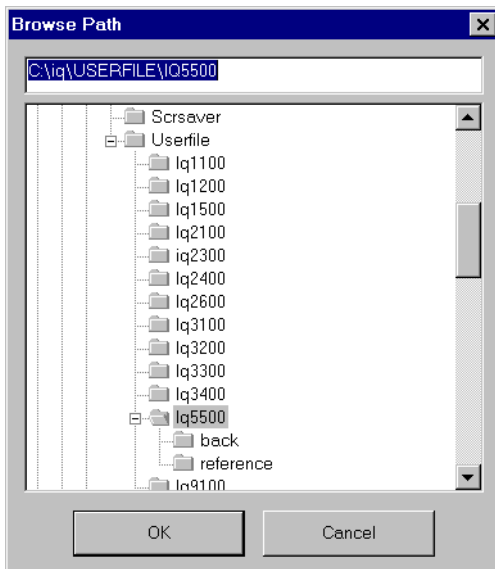
## Setting Parameters

### Customizing Acquisitions

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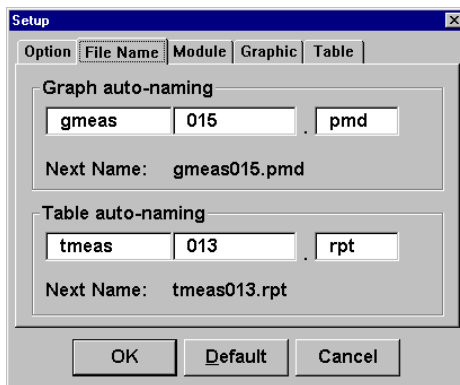
## File Path

From this edit box, you may choose a folder where measurements will be automatically saved when the *Save to disk after each measurement option is selected*. Clicking the button at the end of the line opens a window showing the current folder tree.





## File Name Page



### ***Graph auto-naming***

By setting the default name and number of the first saved trace, all subsequent traces will be saved with the same name and an incremental number structure. The file name can be up to eight characters long. EXFO highly recommends to write names as short as possible, especially when using the incremental number structure.

### ***Table auto-naming***

By setting the default name and number of the first table to be saved, all subsequent tables will be saved with the same name and an incremental number structure. The file name can be up to eight characters long. EXFO highly recommends to write names as short as possible, especially when using the incremental number structure.

## **IMPORTANT**

When using the incremental number structure, ensure that the number of acquisitions does not overflow the character pool. Otherwise, you will not be able to save the acquisition with a name longer than eight characters. If the *Save to disk after each measurement* option is chosen for a multiple acquisition without

## Setting Parameters

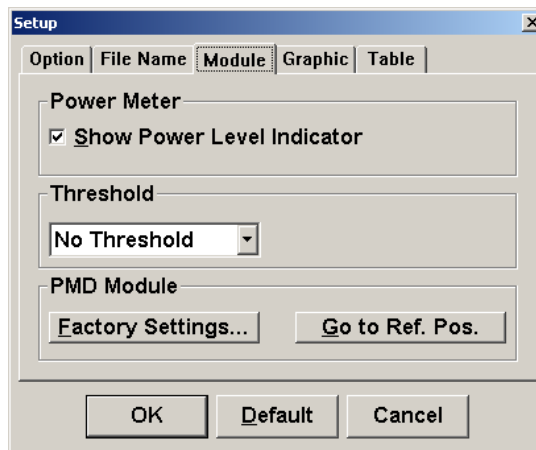
### Customizing Acquisitions

---

changing the name, the program will overwrite the previous acquisitions beginning with the first ones, unless you select “no” in the message box. If you do not choose to save automatically after each acquisition, traces will not be saved and only the acquisition information will be available.

## Module Page

The parameters set in this page affect the hardware-software interface.



The option to show or hide the power level indicator is available in the *Power Meter* box. The power level indicator is displayed as a level bar to the right of the data display. This level bar gives an idea of the incoming signal’s intensity as detected at the input port. To display the power level indicator, select the *Show Power Level Indicator* check box.

To move the mirror to the mechanical reference position, select the *Go to Ref. Pos.* button to eliminate mechanical shifts.

The *Factory Setting* button changes the measurement parameters back to factory default settings. You should only select the *Factory Setting* button as the last resort before repair.

The *Source Module* list box allows you to choose the source employed. For the moment, the only choice available is *External source* (FLS-110P or other).

To set a threshold for the PMD value, select the appropriate range from the *Threshold* list box. If you select OTHER, the *Value* text field will become active and you must enter the maximum PMD value you wish to use as threshold.

The following table displays the maximum accepted PMD value which depends on the bit rate of the system under test. If the PMD value is meaningful but exceeds the user-defined threshold, a ▼ appears in the state column or the *Selection* page. For more information, see *Selecting Traces to View* on page 29.

You will be asked if you want to replace the failed measurement with a new acquisition. If so, the new measurement will overwrite the old one.

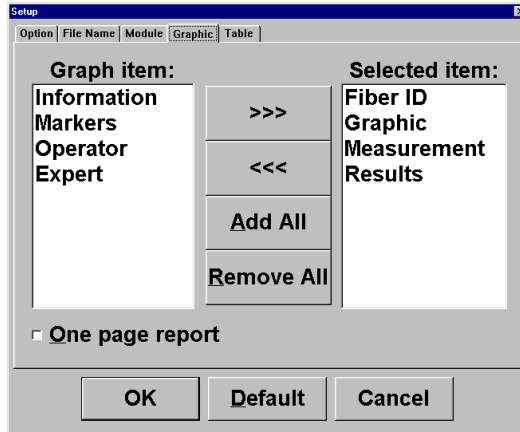
Bit Rate (Gb/s)	Maximum PMD (ps)
2.5 (OC 48 - STM16)	40
10 (OC 192 - STM64)	10
40 (OC 768 - STM256)	2,5
20 (OC 48; Submarine cable)	5

## Graphic Page

To print a graph report, select the information that should appear in the *Graphic* page. The information order may also be determined by selecting the items in the order they should be printed.

## Setting Parameters

### Customizing Acquisitions



To select the information to print,

1. Highlight the desired item in the *Graph item* list.
2. Click on the right arrow to transfer the item to the *Selected item* list.

To print all available information, click on *Add All*.

To remove information,

1. Highlight the item to delete in the *Selected item* list.
2. Click on the left arrow to transfer the item to the *Graph item* list.

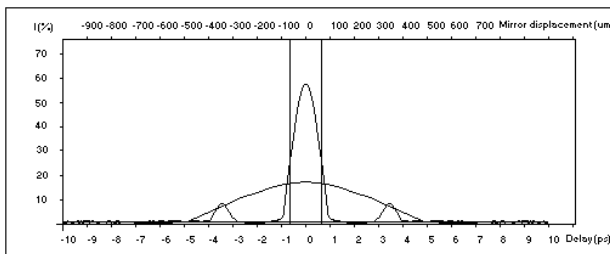
To empty the *Selected item* list, click on *Remove All*.

The following list displays the information provided by each selected item.

### **Fiber ID**

Fiber ID:	
Fiber Type:	Fiber Length:
Comment:	

**Graphic**



**Measurement**

Scanning Range:	Threshold
Scanning Center:	Wavelength:

**Results**

PMD Value:	Date:
PMD Coeff.:	Time:
2nd Order PMD Value:	
2nd Order PMD Coeff.:	

**Information**

Version:	File:
AC Gain:	
DC Gain:	Points:

## Setting Parameters

### Customizing Acquisitions

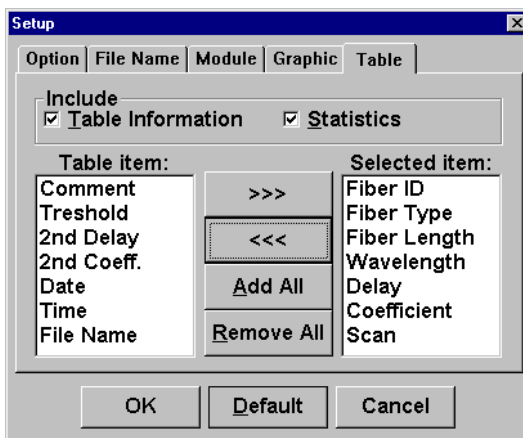
#### Operator

User Name:	Title:
Organization:	Division:

To reduce line spacing and print the whole report on one page, select the *One page report* option.

#### Table Page

To print a table report, you must select the information that should appear in the *Table* page. The information order may also be determined by selecting the items in the order they should print.



You may include table information and statistics. *Table Information* gives the table file path. *Statistics* include calculations made from the files that compose the table.

To select the information to print,

1. Highlight the desired item in the *Table item* list.
2. Click on the right arrow to transfer the item to the *Selected item* list.

To print all available information, click on *Add All*.

To remove information,

1. Highlight the item to delete in the *Selected item* list.
2. Click on the left arrow to transfer the item to the *Table item* list.

To empty the *Selected item* list, click on *Remove All*.

The following list displays the information provided by each selected item.

### Table Information

Path:

### Statistics

	Wavelength	Wavelength	...
Scan Mode			
DUT Type			
Mean PMD Delay	...	...	...
Mean PMD Coefficient	...	...	...
PMD Delay Standard Deviation			
PMD Coefficient Standard Deviation			
Maximum PMD Delay			
Minimum PMD Delay			
Maximum PMD Coefficient			
Minimum PMD Coefficient			
DUT Count	...	...	...

## Setting Parameters

### Customizing Acquisitions

---

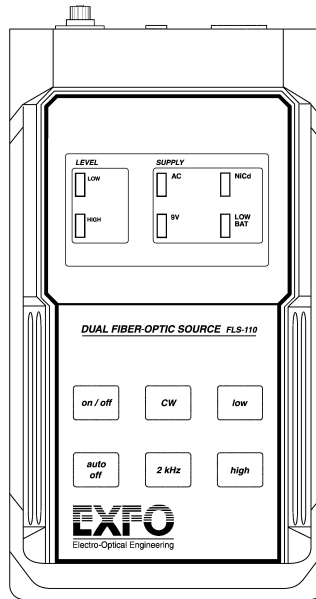
**Table with selected items as column headings**

<b>Selected Item</b>	<b>Description</b>
Number	Trace number as it appears in the trace table.
Fiber ID	Fiber or DUT identification.
Scan	Acquisition type.
Fiber Type	Strong coupling, weak coupling, or component.
Fiber Length	Length of analyzed fiber.
Comment	Comment about the acquisition.
Wavelength	Acquisition wavelength.
Threshold	User-defined maximum tolerated PMD value.
Delay	PMD delay value.
Coefficient	PMD coefficient.
2nd Delay	2nd order PMD delay value.
2nd Coefficient	2nd order PMD coefficient.
Date	Acquisition date.
Time	Acquisition time.
File Name	trace name.



## 5 Performing Acquisitions

To measure PMD with the FTB-5500 PMD Analyzer, EXFO recommends that you use the FLS-110P Light Source (illustrated in the following figure) or the M-2100BP Light Source (illustrated on page 45), which will provide you a larger dynamic range.



### Activating/Deactivating the FLS-110P

The following instruction describes how to power on the light source.

- Press the *on/off* button to activate the light emission. The active power supply (AC, 9V, or NiCd) and power level (LOW or HIGH) LEDs light up on the module front panel, indicating that the source is active.

The following instruction describes how to power off the light source.

- When the source is powered on, press the *on/off* button to stop the light emission. All LEDs then turn off, indicating that the source is off.

## Performing Acquisitions

### Selecting the Source Output Power

---

## Selecting the Source Output Power

- Press *high* to select the highest output power. The *HIGH* LED lights up.
- Press *low* to select the lowest output power. The *LOW* LED lights up.

**Note:** For more information on the *FLS-110P*, please refer to the *FLS-110 Light Source Instruction Manual included with your unit.*

## Operating the M-2100BP

### WARNING

Do not install or terminate fibers while a source is active. Never look directly into a live fiber and ensure that your eyes are protected at all times.

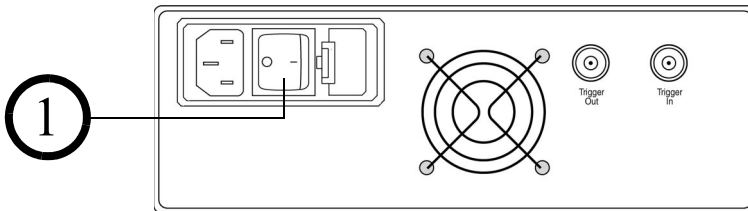
### CAUTION

Use of controls, adjustments, and procedures for operation and maintenance other than those specified herein may result in hazardous radiation exposure.

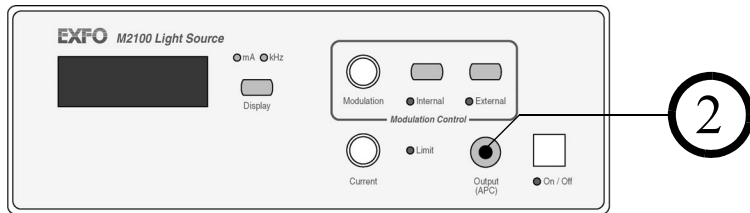
### CAUTION

Use of optical instruments with this product will increase eye hazard.

1. Flick the main power switch located on the back panel. The *On/Off* indicator LED below the *On/Off* button in the lower right corner of the front panel turns on to indicate that the main power is switched on.

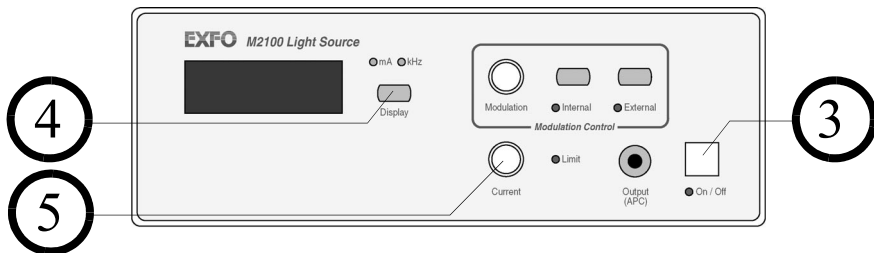


2. Connect the *Output* port of the M-2100BP front panel to a power meter using a singlemode patch cord.



3. Push the *On/Off* button on the bottom right corner of the front panel.
4. Display the drive current by pressing the *Display* push button. The mA active unit indicator LED above it turns on to indicate that the display window is showing the drive current in mA.
5. Slowly increase the drive current (which controls the output power) by turning the *Current* control knob clockwise.

The light source is equipped with “soft-start” circuitry and can be powered on and off without having to set it to zero.



**Note:** Do not activate the Modulation function on the M2100 BP Power Meter This function could lead to incorrect results.

## Performing Acquisitions

### Acquiring Traces

---

## WARNING

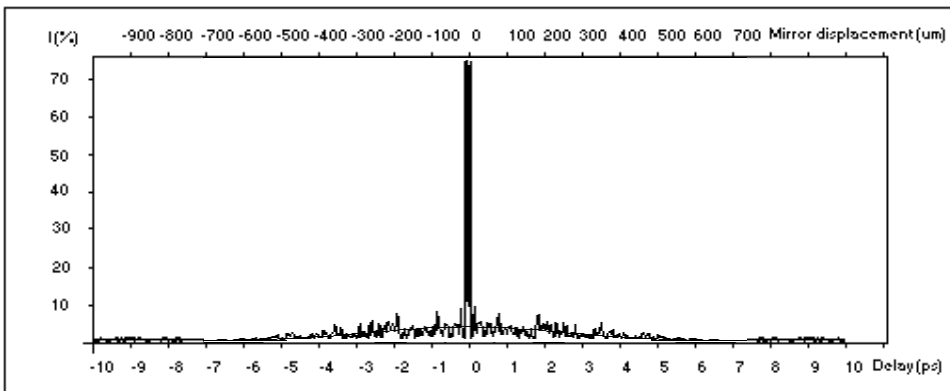
The maximum input power of the FTB-5500 module is - 14 dBm. The maximum power of the M-2100BP light source is - 12 dBm. Never connect the light source directly to the PMD Analyzer. Set the drive current to zero by turning the *Current* control knob counter-clockwise all the way before turning the light source on. This way, you can avoid any possible overloading of the module. Moreover, when increasing the drive current, the power level, indicated on the power level indicator of the PMD Analyzer main window, should not reach 100%.

## Acquiring Traces

To start an acquisition,

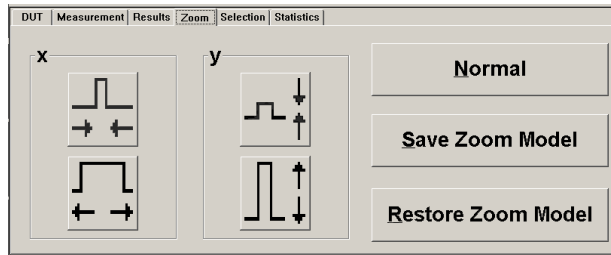
1. Set acquisition parameters as described in *Setting Acquisition Parameters* on page 25.
2. Verify that the DUT is properly connected, that the setup is appropriate and that the source is activated.
3. Click on *Scan* to begin a measurement sequence.

When the measurement is complete, the PMD results graph is displayed.





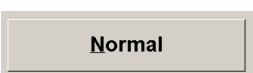


## Selecting Views with the Zoom

The *Zoom* page controls the views by increasing or decreasing the axe scales.



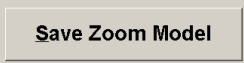

The following table explains how zoom functions affect trace display.

Button	Function
	Enlarges horizontal scale. Reduces trace horizontally.
	Reduces horizontal scale. Enlarges trace horizontally.
	Enlarges vertical scale. Reduces trace vertically.
	Reduces vertical scale. Enlarges trace vertically.
	Sets normal trace view.

## Performing Acquisitions

### *Selecting Views with the Zoom*

---

Button	Function
	Saves current trace view.
	Sets the trace view as it was last saved.

The *Save Zoom Model* and *Restore Zoom Model* buttons enable you to save and recall the trace view preferences. Using this function, you can save time when analyzing the trace, especially when doing multiple acquisitions of the same fiber span over time or analyzing multiple fiber spans simultaneously.

# 6 *Managing Data*

## Generating Results Table from the File Menu

You can display your PMD mean delay and coefficient values in table form for easy analysis. You can choose all your files, or limit table data to one file type in particular. To set up a multiple file table,

1. Select *Build Table...* in the *File* menu.
2. Select the desired traces to be added to the table.
3. Click on *Open*.

**Note:** *If the trace or trace information is not valid, a warning message will appear.*

All selected traces will be open, and an entry will be added for each selected trace in the results table.

## Saving and Retrieving Files

### Saving Files

It is always a good idea to save your files regularly.

To store the onscreen measurement,

1. Open the *File* menu.
2. Choose *Save Graph* or *Save Table*.
3. Choose a name for your file using the *.pmd*, *.rpt* or any other file extension.

By default, the file will bear the default file name entered in the *File Name* page (in the *Setup* dialog) with the default *.pmd* file extension or the last extension used.

4. Select the folder in which you want to save the file. The default folder is `\userfile\FTB5500`. This path can be modified. See *File Path* on page 34.
5. Click on *Save*.

## Managing Data

### *Opening and Saving Configuration Files*

---

**Note:** *If the file name ends with a number, the PMD program will automatically increase the number by one when you take a new measurement.*

### Recalling a Graph or Table

To recall a graph or a table,

1. Open the *File* menu.
2. Select *Open Graph* or *Open Table*.
3. Select the path and file name in the dialog box. The default folder is `\userfile\FTB5500`. This path can be modified. See *File Path* on page 34.
4. Double-click on the name or click *Open*.

## Opening and Saving Configuration Files

A configuration file contains the parameters selected during the last testing session. Upon closing the application, the last parameters will be kept in memory for the next testing session. However, if the operator wishes to save a configuration to be used in a special case, or if there are two or more operators with different working preferences or needs, configurations can be saved and recalled when needed. These parameters include the setup, user information, source type, and DUT configuration.

### Saving Configurations

To save a configuration,

1. Open the *File* menu.
2. Select *Save Config*.
3. Select the file path in the dialog box.
4. Type a file name using the *.cfg* extension (preferably).
5. Click on *Save*.



**Note:** *The default configuration folder is \userfile\FTB5500 and the default name is default.cfg.*

## Recalling Configurations

To recall a configuration,

1. Open the *File* menu.
2. Select *Open Config*.
3. Select the path and file name in the dialog box.
4. Double-click on the name or click *Open*.

## Opening and Saving Templates

The *Measurement* page actual parameter settings can be saved as a template for future acquisitions. See *Setting Acquisition Parameters* on page 25.

The *Open Template* and *Save Template* buttons respectively allow you to recall a previously saved acquisition parameters file and save the current settings as a template. Such template files are saved with the *.tpl* extension in the folder of your choice.

## Saving Templates

To save a template,

1. Select the desired measuring parameters.
2. Click on *Save Template*.
3. Select the desired path.

**Note:** *The default template folder is \userfile\FTB5500 and the default name is default.tpl.*

4. Type a file name using the *.tpl* extension (preferably).

## Managing Data

### *Printing Data*

---

5. Click on *Save*.

## Recalling Templates

To recall a template,

1. Click on *Open Template*.
2. Select the desired template from the folder where it is saved.

**Note:** *The default template folder is \userfile\FTB5500 and the default name is default.tpl.*

3. Double-click on the name, or click *Open*.

Opening a template will replace the information contained in the *Measurement* page.

## Printing Data

Once you have completed and analyzed all acquisitions, you can print traces and generated tables. The current printer is indicated at the top of the *Print* dialog box.

**Note:** *The Print button is only available if a printer is connected and configured.*

The *Printer Setup* option gives you access to Window's *Print Manager* parameters, where a default printer and general printing options such as paper size and page orientation are selected.

**Note:** *When printing a table, always select the Landscape paper orientation.*

## Viewing Acquisition Results

**Note:** When there is no trace, the Results, Zoom, Selection and Statistics pages are not activated.

The *Results* page displays basic information about the recent acquisition. If there is no trace on screen, this page is not available. After a single acquisition, this page becomes active by default to provide a quick overview of the results.

DUT	Measurement	Results	Zoom	Selection	Statistics
<b>PMD Delay:</b>		<b>24.31 ps</b>	<b>Scan Mode:</b>		<b>PMD</b>
<b>PMD Coefficient:</b>		<b>4.040 ps/km<sup>1/2</sup></b>	<b>Wavelength:</b>		<b>1550 nm</b>
<b>2nd PMD Delay:</b>		<b>267.5 ps/nm</b>	<b>Time:</b>		<b>04:54:06</b>
<b>2nd PMD Coeff.:</b>		<b>7.387 ps/nm.km</b>	<b>Date:</b>		<b>1999/06/21</b>
<b>Comment:</b>		<b>Test Fiber</b>			

The information in the *Comment* lines comes from the *DUT* page. This information can be modified from this page and is automatically updated throughout the system.

## Viewing Statistics

The *Statistics* page shows statistical results for the current trace table. These values are automatically updated whenever the table information changes.

DUT	Measurement	Results	Zoom	Selection	Statistics
<b>Wavelength:</b>		<b>1310 nm</b>	<b>1550 nm</b>		
<b>Scan Mode:</b>		<b>PMD</b>	<b>PMD</b>		
<b>DUT Type:</b>		<b>Strong</b>	<b>Strong</b>		
<b>Mean PMD Delay:</b>		<b>0.28 ps</b>	<b>12.42 ps</b>		
<b>Mean PMD Coefficient:</b>		<b>0.278 ps/km<sup>1/2</sup></b>	<b>2.064 ps/km<sup>1/2</sup></b>		
<b>PMD Delay Standard Deviation:</b>		<b>0.00000 ps</b>	<b>16.80944 ps</b>		
<b>PMD Coefficient Standard Deviation:</b>		<b>0.28 ps</b>	<b>2.79351 ps/km<sup>1/2</sup></b>		
<b>Minimum PMD Delay:</b>		<b>0.28 ps</b>	<b>0.54 ps</b>		
<b>Maximum PMD Delay:</b>		<b>0.28 ps</b>	<b>24.31 ps</b>		
<b>Minimum PMD Coefficient:</b>		<b>0.28 ps/km<sup>1/2</sup></b>	<b>0.09 ps/km<sup>1/2</sup></b>		
<b>Maximum PMD Coefficient:</b>		<b>0.28 ps/km<sup>1/2</sup></b>	<b>4.04 ps/km<sup>1/2</sup></b>		
<b>DUT Count:</b>		<b>1</b>	<b>2</b>		

## Managing Data

### Viewing Statistics

---

The following table describes each entry in the statistics table.

Row	Description
Wavelength	Lists all wavelengths found in the trace table.
Scan Mode	Indicates the selected acquisition mode: PMD, FASTSCAN, or ERPMD.
DUT Type	Type of device: strong coupling, weak coupling, or component.
Mean PMD Delay	Mean PMD Delay value for the corresponding wavelength.
Mean PMD Coefficient	Mean PMD Coefficient value for the corresponding wavelength.
PMD Delay Standard Deviation	PMD Delay Standard Deviation for the corresponding wavelength.
PMD Coefficient Standard Deviation	PMD Coefficient Standard Deviation for the corresponding wavelength.
Maximum PMD Delay	Highest PMD value found on the trace table.
Minimum PMD Delay	Lowest PMD value found on the trace table.
Maximum PMD Coefficient	Highest PMD coefficient.
Minimum PMD Coefficient	Lowest PMD coefficient.
DUT Count	Number of acquisitions considered for calculations.

Only meaningful results are used to calculate statistics, that is, those having one of the following symbols in the *State* column of the *Selection* page.



## Viewing Acquisition Information

After you have measured a fiber and a graph has been displayed, you are able to verify and change information about the fiber. To display the *Measurement Information* window, select the *Info* function button. For more information, see *Setting Acquisition Parameters* on page 25.

Click on the appropriate field and type the new information. Acquisition results, as well as system information are displayed on the lower section of the window. These values cannot be modified.

Fiber ID:	FIBER 6		
Comment:	FIBER 6		
Measurement by:			
File Name:	ALBY008.pmd	Fiber Type:	Strong Coupling
Version:	1	Fiber Length:	36.208 km
PMD Delay:	0.54 ps	Date:	1999/06/21
PMD Coefficient:	0.089 ps/km <sup>1/2</sup>	Time:	05:00:30
2nd PMD Delay:	0.130 ps/nm	AC Gain:	2 (Auto)
2nd PMD Coeff.:	0.0036 ps/nm.km	DC Gain:	7.558 M (Auto)
Wavelength:	1550 nm		
Nb of Points:	2243		
Scanning Center:	11680 μm		
Scanning Range:	0.4 to 1.2 ps		
Threshold:	---		

### **File Name**

Name assigned to the trace in the *File* page, on the *Setup* window. For more information, see *File Name Page* on page 35.

### **Version**

Version of the mathematics used to make the acquisition.

### **PMD Delay**

Resulting PMD delay value for the measured fiber length.

## Managing Data

### Viewing Acquisition Information

---

#### **PMD Coefficient**

Calculated PMD coefficient for the analyzed fiber length. This information is not available when the *Fiber Type* field contains *Component*.

#### **2nd Order PMD Delay**

Resulting second order PMD delay value with respect to wavelength for the measured fiber length.

#### **2nd Order PMD Coeff**

Calculated second order PMD coefficient for the analyzed fiber length. This information is not available when the *Fiber Type* field contains *Component*.

#### **Fiber Type**

Indicates the device under test, as selected in the *DUT* page. For more information on this parameter, see *Selecting Device Type* on page 23.

#### **Fiber Length**

As indicated in the *DUT* page. For more information on this parameter, see *Specifying Fiber Length* on page 24. This information is not available when the *Fiber Type* field contains *Component*.

#### **Scanning Center**

Interferometer position relative to its mechanical reference position, measured in  $\mu\text{m}$ .

#### **Scanning Range**

Acquisition scanning range, as selected in the *Measurement Parameters* window and specified in ps and  $\mu\text{m}$ .

#### **Threshold**

Threshold value as selected in the *Module* page of the *Setup* window.

#### **Wavelength**

Acquisition wavelength, as selected in the *Measurement Parameters* window, see *Selecting Wavelength* on page 27.

**Date**

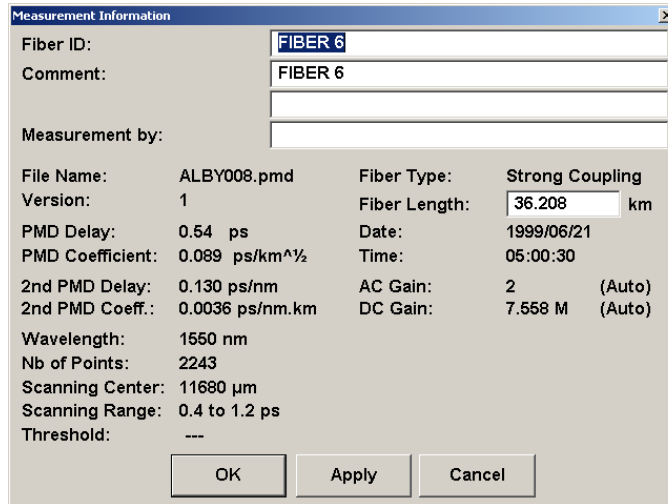
Acquisition date.

**Time**

Acquisition time.

**Nb of Points**

Number of acquisition sample points used to calculate PMD values. The number of points is usually higher than the number of points used to display the trace on screen.



**AC Gain**

Internal AC gain factor determined automatically by the application according to the input signal. More precisely, it represents the amplitude of the detected interference fringes for which the rms value is displayed after each scan.

## Managing Data

### *Viewing Acquisition Information*

---

#### **DC Gain**

Internal DC gain scale value (of the first-stage amplifier) determined automatically by the application. It represents the highest gain setting which does not saturate the detected optical signal, comprised of the AC fringe pattern superimposed on a DC level.



# 7 **Maintenance**

## **CAUTION**

Use of controls or adjustments or performance of procedures other than those specified herein may result in hazardous radiation exposure.

To help ensure long, trouble-free operation,

- Keep the unit free of dust.
- Clean the unit casing with a tissue that has been slightly dampened with water.
- Store unit at room temperature in a clean and dry area.
- Keep the unit out of direct sunlight.
- Avoid high humidity or significant temperature fluctuations.
- If any liquids are spilled on or into the unit, turn off the power immediately and let the unit dry completely.
- Avoid unnecessary shocks and vibrations.

## **Cleaning the Front Panel**

Clean the front panel of the module regularly to avoid build-up of dust, dirt, and other foreign substances. To do so,

1. Gently wipe the front panel with a cloth that has been dampened with soapy water.
2. Rinse the front panel with a cloth that has been dampened with water.
3. Dry with a clean wiping cloth.

## **IMPORTANT**

To help keep the various connectors and adapters clean, EXFO recommends that you install protective caps when the unit is not in use. You should also clean the fiber ends before every connection.

## Cleaning Fixed Connectors

Regular cleaning of connectors will help maintain optimum performance. There is no need to disassemble the module.

To clean fixed connectors,

1. Fold a lint-free wiping cloth in four to form a square.
2. Moisten the center of the lint-free wiping cloth with *only one drop* of isopropyl alcohol.

### **IMPORTANT**

**Alcohol may leave traces if used abundantly. Avoid contact between the tip of the bottle and the wiping cloth, and do not use bottles that distribute too much alcohol at a time.**

3. Gently wipe the connector threads three times with the folded and moistened section of the wiping cloth.

### **IMPORTANT**

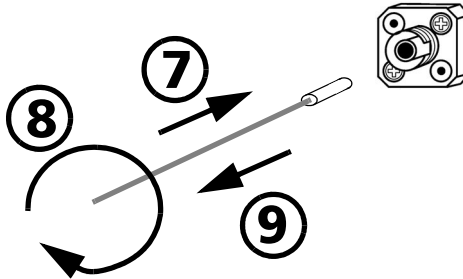
**Isopropyl alcohol takes approximately ten seconds to evaporate. Since isopropyl alcohol is not absolutely pure, evaporation will leave microscopic residue. Make sure you dry the surfaces before evaporation occurs.**

4. With a dry lint-free wiping cloth, gently wipe the same surfaces three times with a rotating movement.
5. Throw out the wiping cloths after one use.
6. Moisten a cleaning tip (2.5 mm tip) provided by EXFO with *only one drop* of isopropyl alcohol.

## IMPORTANT

Alcohol may leave traces if used abundantly. Avoid contact between the tip of the bottle and the cleaning tip, and do not use bottles that distribute too much alcohol at a time.

7. Slowly insert the cleaning tip into the connector until it reaches the ferrule inside (a slow clockwise rotating movement may help).



8. Gently turn the cleaning tip one full turn.
9. Continue to turn as you withdraw the cleaning tip.
10. Perform steps 7 to 9 again, but this time with a dry cleaning tip (2.5 mm tip provided by EXFO).

**Note:** Make sure that you do not touch the soft end of the cleaning tip, and verify the cleanliness of the cotton tip.

11. Throw out the cleaning tips after one use.

## Maintenance

### *Cleaning Connectors Equipped with EUI/EUA Adapters*

# Cleaning Connectors Equipped with EUI/EUA Adapters

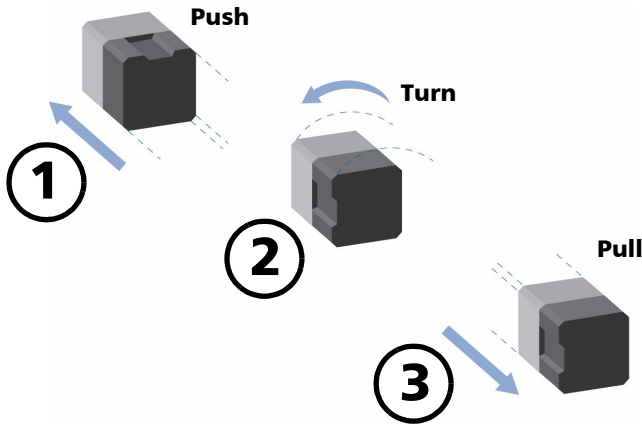
Regular cleaning of connectors equipped with EUI/EUA adapters will help maintain optimum performance. There is no need to disassemble the unit.

## IMPORTANT

If any damage occurs to internal connectors, the module casing will have to be opened and a new calibration will be required.

To clean connectors,

1. Remove the EUI/EUA adapter from the module to expose the optical connector baseplate and ferrule.



2. Use a lint-free wiping cloth and deposit *only one drop* of isopropyl alcohol on it.

## IMPORTANT

Alcohol may leave traces if used abundantly. Avoid contact between the tip of the bottle and the wiping cloth, and do not use bottles that distribute too much alcohol at a time.

3. Gently wipe the connector and ferrule.

## **IMPORTANT**

Isopropyl alcohol takes approximately ten seconds to evaporate. Since isopropyl alcohol is not absolutely pure, evaporation will leave microscopic residues. Make sure you dry the surfaces before evaporation occurs.

4. With a dry lint-free wiping cloth, gently wipe the same surfaces in order to be sure that the connector and ferrule are perfectly dry.
5. Throw out the wiping cloths after one use.

## **WARNING**

**DO NOT** verify the surface of the connector with a fiber-optic microscope **WHILE THE UNIT IS ACTIVE**. Doing so **WILL** result in permanent eye damage.

6. After having cleaned the connectors and having made sure that the unit is not active, verify the surface of the connector with a small, portable fiber-optic microscope.

## Maintenance

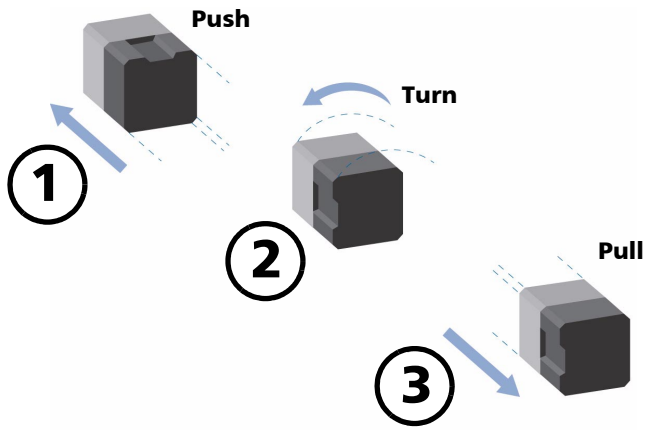
### Cleaning EUI/EUA Adapters

---

## Cleaning EUI/EUA Adapters

To clean EUI/EUA adapters,

1. Remove the EUI/EUA adapter from the module connector.

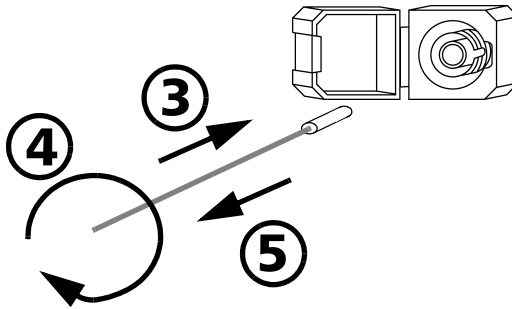


2. Moisten a cleaning tip (2.5 mm tip) provided by EXFO with *only one drop* of isopropyl alcohol.

## IMPORTANT

Alcohol may leave traces if used abundantly. Avoid contact between the tip of the bottle and the cleaning tip, and do not use bottles that distribute too much alcohol at a time.

3. Slowly insert the cleaning tip into the adapter until it comes out on the other side (a slow clockwise rotating movement may help).



4. Gently turn the cleaning tip one full turn.
5. Continue to turn as you withdraw the cleaning tip.
6. Perform steps 3 to 5 again, but this time with a dry cleaning tip (2.5 mm tip provided by EXFO).

**Note:** Make sure that you do not touch the soft end of the cleaning tip, and verify the cleanliness of the cotton tip.

7. Throw out the cleaning tips after one use.

## Cleaning Detector Ports

Regular cleaning of detector ports helps maintain optimum performance.

### **CAUTION**

**Never clean a detector with a cleaning tip. When the detector is not in use, cover it with a detector protective cap.**

To clean detector ports,

- 1.** Remove the detector protective cap.
- 2.** If the detector is dusty, blow dry with compressed air.
- 3.** Gently wipe both the cap and the detector with a lint-free wiping cloth that has been moistened with isopropyl alcohol.
- 4.** Gently wipe the same surfaces with a dry lint-free wiping cloth or blow dry.

## Recalibrating the Unit

To ensure that the unit remains within the published specifications, EXFO recommends that an annual calibration be performed. Please contact EXFO for further information.



# 8 Troubleshooting

Problem	Probable Cause	Recommended Action
Questionable PMD measurements	Optical connectors are dirty.	Clean all optical connections.
	Improper wavelength is selected.	Switch to the correct wavelength on all instruments being used.
	Optical source is unstable.	Wait for source to stabilize.
	The selected mode is not appropriate.	Change the mode weak/strong.
	There are loops in the test jumper.	Remove loops.
	DUT type is incorrect.	Change DUT type.

## Using the Online Help

Context-sensitive and interactive help is available to guide you through the use of your application.

To obtain online help,

1. Click on the *Help* button or press on *F1*. A question mark will appear next to your pointer.
2. Click on any element and a pop-up window will appear to display a description of the selected element.

## Troubleshooting

*Finding FAQs on the EXFO Web Site*

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### Finding FAQs on the EXFO Web Site

The EXFO Web site provides answers to frequently asked questions (FAQs) regarding the use of your product.

To access FAQs,

1. Type the following address in your Internet browser: **www.exfo.com**.
2. Click on the *Support* tab.
3. Click on *FAQs* and follow the on-screen instructions. You will be given a list of questions pertaining to your subject.

## Contacting the Technical Support Group

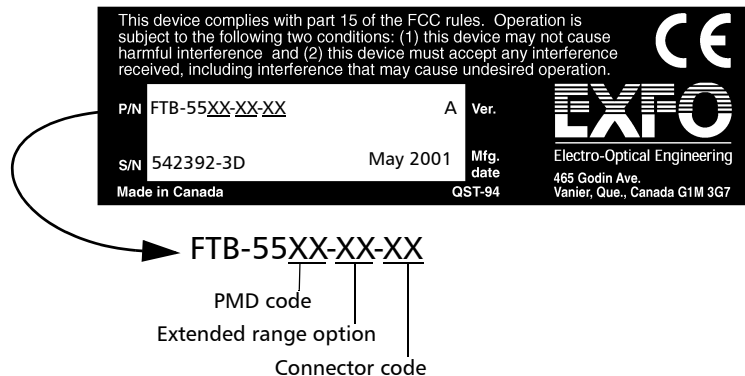
To obtain after-sales service or technical support for this product, contact EXFO at one of the following numbers. The Technical Support Group is available to take your calls from Monday to Friday, 7:30 a.m. to 8:00 p.m. (Eastern Time in North America).

### Technical Support Group

400 Godin Avenue  
Vanier (Quebec) G1M 2K2  
CANADA

1 866 683-0155 (USA and Canada)  
Tel.: (418) 683-5498  
Fax: (418) 683-9224  
support@exfo.com

To accelerate the process, please have information such as the name and the serial number of your product (see the product nameplate shown below) as well as a description of your problem close at hand.



## **Transportation**

Maintain a temperature range within specifications when transporting the unit. Transportation damage can occur from improper handling. The following steps are recommended to minimize the possibility of damage:

- Pack the unit in the original packing material when shipping.
- Avoid high humidity or large temperature fluctuations.
- Keep the unit out of direct sunlight.
- Avoid unnecessary shock and vibration.

# 9 **Warranty**

## **General Information**

EXFO Electro-Optical Engineering Inc. (EXFO) warrants this equipment against defects in material and workmanship for a period of one year from the date of original shipment. EXFO also warrants that this equipment will meet applicable specifications under normal use.

During the warranty period, EXFO will, at its discretion, repair, replace, or issue credit for any defective product, as well as recalibrate the product free of charge should the equipment need to be repaired or if the original calibration is erroneous.

### **IMPORTANT**

The warranty can become null and void if

- the equipment has been tampered with, repaired, or worked upon by unauthorized individuals or non-EXFO personnel.
- the warranty sticker has been removed.
- case screws, other than those specified in this manual, have been removed.
- the case has been opened, other than as explained in this manual.
- the equipment serial number has been altered, erased, or removed.
- the equipment has been misused, neglected, or damaged by accident.

THIS WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES EXPRESSED, IMPLIED, OR STATUTORY, INCLUDING BUT NOT LIMITED TO THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. IN NO EVENT SHALL EXFO BE LIABLE FOR SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES.

## **Warranty**

### *Liability*

---

## **Liability**

EXFO shall not be liable for damages resulting from the use of the purchased product, nor shall be responsible for any failure in the performance of other items to which the purchased product is connected or the operation of any system of which the purchased product may be a part.

EXFO shall not be liable for damages resulting from improper usage or unauthorized modification of the product, its accompanying accessories and software.

## **Exclusions**

EXFO reserves the right to make changes in the design or construction of any of its products at any time without incurring obligation to make any changes whatsoever on units purchased. Accessories, including but not limited to fuses, pilot lamps, and batteries used with EXFO products are not covered by this warranty.

## **Certification**

EXFO certifies that this equipment met its published specifications at the time of shipment from the factory.

## Service and Repairs

EXFO commits to providing product service and repair for five years after the date of purchase.

For service or repair of any equipment, follow the procedure below:

1. Call one of EXFO's authorized service centers (see *EXFO Service Centers Worldwide* on page 74). Support personnel will determine if the equipment requires service, repair, or calibration.
2. If the equipment must be returned to EXFO or an authorized service center, support personnel will issue a Return Merchandise Authorization (RMA) and an address for return.

### **IMPORTANT**

**Never send any unit or accessory back to EXFO without a Return Merchandise Authorization (RMA).**

3. If the unit has an internal storage device, do a backup of your data before sending the unit for repairs.
4. Pack the equipment in its original shipping material. Be sure to include a statement or report fully detailing the defect and the conditions under which it was observed.
5. Return the equipment, prepaid, to the address given by the support personnel. Be sure to write the RMA on the shipping slip. EXFO will refuse and return any package that does not bear an RMA.

**Note:** *A test setup fee will apply to any returned unit that, after test, is found to meet the applicable specifications.*

After repair, the equipment will be returned with a repair report. If the equipment is not under warranty, the customer will be invoiced for the cost appearing on this report. Return-to-customer shipping costs will be paid by EXFO for equipment under warranty. Shipping insurance is at the customer's expense.

## **Warranty**

*EXFO Service Centers Worldwide*

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### **EXFO Service Centers Worldwide**

If you think your product requires servicing, contact your nearest authorized service center.

#### **EXFO Headquarters Service Center**

400 Godin Avenue  
Vanier (Quebec) G1M 2K2  
CANADA

1 866 683-0155 (USA and Canada)  
Tel.: (418) 683-5498  
Fax: (418) 683-9224  
quebec.service@exfo.com

#### **EXFO Europe Service Center**

Le Dynasteur  
10/12, rue Andras Beck  
92366 Meudon la Forêt Cedex  
FRANCE

Tel.: +33.1.40.83.85.85  
Fax: +33.1.40.83.04.42  
europe.service@exfo.com

#### **Beijing OSIC EXFO Service Center**

No. 559 Beijing New Century Hotel  
Office Tower  
No. 6 Southern Capital Gym Road  
Beijing 100044  
P.R.CHINA

Tel.: +86 (10) 6849 2738  
Fax: +86 (10) 6849 2662  
beijing.service@exfo.com

#### **EXFO Asia Pacific Service Center**

151 Chin Swee Road  
#03-29 Manhattan House  
SINGAPORE 169876

Tel.: +65 333 8241  
Fax: +65 333 8242  
asiapacific.service@exfo.com

#### **Burleigh Instruments Service Center**

7647 Main Street Fishers  
Victor, NEW YORK 14564  
USA

Tel.: (716) 924-9355  
Fax: (716) 924-9072  
service@burleigh.com



# Index

<b>A</b>		<b>C</b>	
about window.....	16	caution of product hazard.....	5
AC gain .....	57	center scanning .....	56
acquiring traces.....	46	certification information.....	v
acquisition		certification, warranty .....	72
comments.....	23	cleaning	
date .....	57	connectors with EUI/EUA adapters.....	62
multiple .....	27	detector ports .....	66
number of points.....	57	EUI/EUA adapters .....	64
PMD.....	46	fixed connectors .....	60
results.....	53	the front panel.....	59
setup .....	25	closing application .....	13
time.....	57	coefficient of PMD.....	56
wavelength.....	27, 56	component scan range.....	26
acquisitions, multiple .....	25	configuration	
application		open .....	15, 51
exiting .....	13	recalling .....	51
loading .....	13	save.....	15
automatic mode option .....	25	saving .....	50
auto-naming		connections for tests .....	21
graph.....	35	connector, pulling .....	12
table .....	35	connectors, cleaning.....	60, 62
available wavelengths .....	25	current analyzer status .....	19
<b>B</b>		cursor display .....	33
basic theory on PMD .....	2	customer service.....	73
build		customizing acquisitions .....	32
stop .....	15	<b>D</b>	
table .....	15	data	
button		display .....	14, 18
exit .....	17	management .....	49
info .....	17	printing .....	52
print .....	17	date of acquisition.....	57
scan .....	17	DC gain.....	58
setup .....	17	delay	
user .....	17	between acquisitions .....	28
wavelength.....	17	of PMD.....	55
		description of PMD.....	1

## Index

---

detecting OTDR module .....	10
detector port, cleaning.....	66
device type .....	23
displacement of the mirror.....	36
display	
cursor after PMD calculation.....	33
data .....	18
fit after PMD calculation .....	33
information .....	39
trace .....	18
DUT	
identification .....	23
information .....	23
<b>E</b>	
entering user information .....	22
equipment returns .....	73
estimated PMD range value .....	33
EUI/EUA adapters cleaning .....	64
exit	
application.....	13, 16
button .....	17
<b>F</b>	
factory default settings .....	36
fiber	
HiBi .....	24
ID .....	23, 38
information .....	55
length .....	24, 56
type .....	56
file	
menu .....	15
name .....	55
path.....	34
fit display .....	33
FLS-110P light source .....	43
front panel cleaning .....	59
function buttons .....	14, 17

<b>G</b>	
Gaussian fit .....	18
generating a results table.....	49
graph	
auto-naming .....	35
information.....	39
open .....	15
recalling .....	50
report.....	37
save .....	15

<b>H</b>	
hardware information .....	16
hardware-software interface .....	36
help menu .....	16
HiBi fiber .....	24

<b>I</b>	
identifying DUT .....	23
info button .....	17
information	
about measurements .....	25
about the DUT .....	23
about the user .....	22
display .....	39
fiber .....	55
fiber ID.....	38
graphic .....	39
measurement.....	39
operator.....	40
results .....	39
statistics.....	41
status indicators.....	30
table .....	41
window.....	55
inserting the OTDR module .....	9
intensity of the signal .....	18, 36

<b>L</b>	
length of fiber .....	56
light source	
off .....	43
on .....	43
load, stop .....	16
loading the application .....	13
<b>M</b>	
M-2100BP light source .....	43
M-2100BP operation .....	44
main window .....	14
maintenance	
connectors with EUI/EUA adapters .....	62
detector ports .....	66
EUI/EUA adapters .....	64
fixed connectors .....	60
front panel .....	59
managing data .....	49
mathematics version .....	55
measurement	
information .....	25, 39, 55
parameters .....	25
preparation .....	21
procedure .....	46
measuring PMD .....	43
mechanical shifts .....	36
menu	
bar .....	14
file .....	15
help .....	16
menu bar .....	15
mirror displacement .....	36
module page .....	36
multiple	
acquisitions .....	25
measurement .....	27
<b>N</b>	
name of file .....	55
number of acquisition points .....	57
<b>O</b>	
open	
configuration .....	15, 51
graph .....	15, 50
table .....	16, 50
template .....	29
operating M-2100BP .....	44
operator information .....	40
option	
automatic mode .....	25
option pages .....	14, 18, 32
OTDR module	
detection .....	10
insertion .....	9
pulling connector .....	12
removal .....	11
output power for FLS-110P .....	44
<b>P</b>	
page	
module .....	36
option .....	32
parameters	
comment .....	23
custom .....	32
fiber ID .....	23
fiber length .....	24
scanning range .....	25
wavelength .....	27
path for files .....	34
performing acquisitions .....	43
PMD	
acquisition .....	46
coefficient .....	56
data display .....	18
delay .....	55

## Index

---

delay of second coefficient .....	56
delay of second order .....	56
Gaussian fit .....	18
results graph .....	46
trace display .....	18
polarization mode dispersion	
description .....	1
theory .....	2
power	
light source off .....	43
light source on .....	43
power level indicator .....	14
description .....	18
showing or hiding .....	36
preparing for measurement .....	21
print button .....	17
printing	
data .....	52
graph report .....	37
reports .....	40
protective cap .....	59
pulling OTDR module connector .....	12

## R

range of scan .....	25, 56
recalibration .....	66
recalling	
configuration .....	51
template .....	52
removing the OTDR module .....	11
reports, printing .....	38
restore zoom model .....	48
results	
information .....	39
statistical .....	53
tab .....	53
table .....	30, 49
viewing .....	53
return merchandise authorization .....	73
reverting to factory settings .....	36

## S

safety	
caution .....	5
save	
configuration .....	15
data .....	49
graph .....	15, 49
parameters as template .....	25
table .....	16, 49
template .....	29, 51
to disk after each measurement .....	33
zoom model .....	48
save configuration .....	50
scan button .....	17
scan range	
components .....	26
strong mode coupling device .....	26
weak mode coupling device .....	26
scanning	
center .....	56
range .....	25, 56
second order PMD	
coefficient .....	56
delay .....	56
selecting	
source output power .....	44
traces to view .....	29
type of device .....	23
service and repair .....	73
setting	
delay between acquisitions .....	28
fiber length .....	24
setup	
acquisition .....	25
button .....	17
source .....	44
shipping to EXFO .....	73
showing or hiding power level indicator .....	36
signal intensity .....	18, 36
software, exiting .....	13
source	

activation/deactivation .....	43
setup .....	44
wavelength .....	27
specifying fiber length .....	24
starting a PMD acquisition .....	46
statistical results .....	53
statistics information .....	41
status	
bar .....	14, 19
of the analyzer .....	19
stop	
build .....	15
load .....	16
storage requirements .....	59
storing path .....	34
strong mode coupling device scan range ....	26

## T

table	
auto-naming .....	35
build .....	15
information .....	41
open .....	16
recalling .....	50
report .....	40
results .....	49
save .....	16
taking measurements .....	46
temperature for storage .....	59
template .....	25
open .....	29
recalling .....	52
save .....	29
saving .....	51
saving parameters settings to .....	25
test setup .....	21
theory on polarization mode dispersion .....	2
threshold	
user-defined .....	37
value .....	56
time of acquisition .....	57

title bar .....	14, 15
trace	
acquisition .....	46
display .....	18
view preferences .....	48
traces	
selecting which to view .....	29
transportation requirements .....	59, 70
type	
of device, selecting .....	23
of fiber .....	56

## U

user	
button .....	17
information .....	22
user-defined threshold .....	37

## V

value of threshold .....	56
version of mathematics .....	55
viewing	
acquisition results .....	53
preferences .....	48
selected traces .....	29
table .....	49

## W

warranty	
certification .....	72
exclusions .....	72
general .....	71
liability .....	72
null and void .....	71
wavelength	
acquisition .....	27
available .....	25
button .....	17
for acquisition .....	56
parameters .....	27

## Index

---

weak mode coupling device scan range.....	26
weak polarization mode coupling .....	24
window, measurement information.....	55

### **X**

x-axis zoom .....	47
-------------------	----

### **Y**

y-axis zoom .....	47
-------------------	----

### **Z**

zoom page.....	47
----------------	----