

**PMD440**

**INTERFEROMETRIC PMD  
MEASUREMENT SYSTEM**  
250ps Offset Scan Range

**INSTRUCTION MANUAL**

**Manual version 2.1 September 2000**

**PerkinElmer Optoelectronics**

(FORMERLY EG&G INSTRUMENTS)  
SORBUS HOUSE, MULBERRY BUSINESS PARK,  
WOKINGHAM, BERKSHIRE, RG41 2GY,  
UNITED KINGDOM.  
TELEPHONE NATIONAL 0118 977 3003.  
TELEPHONE INTERNATIONAL +44(0) 118 977 3003.  
FAX +44 (0) 118 977 3493.

E Mail: sales\_fiberoptics@perkinelmer.com

Email Service service\_fiberoptics@perkinelmer.com

## WARRANTY

PerkinElmer Optoelectronics warrants each system to be free from defects in material and workmanship. Obligations under this warranty shall be limited to replacing or repairing, at our option, any instrument returned, freight prepaid, to our factory, within ONE year of shipment to the original purchaser, provided authorisation for such return has been given by our authorised representative.

This warranty shall not apply to any system which our inspection shall disclose to our satisfaction, has become defective or unworkable due to abuse, mishandling, misuse, accident, alteration, negligence, improper installation or other causes beyond our control. Instruments manufactured by others, and included in or supplied with our equipment, are not covered by this warranty but carry the original manufacturer's warranty, which is extended to our customers and may be more restrictive. Certain subassemblies, accessories or components may be specifically excluded from this warranty.

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## SHOULD YOUR EQUIPMENT REQUIRE SERVICE

A. Contact the factory on +44 118 977 3003 in the United Kingdom, or your local distributor for details of local customer support. In many cases it will be possible to expedite servicing by localising the problem to a particular plug-in circuit card. If not, a field service visit may be necessary, this will be decided at the time of the call.

B. If it is necessary to return any equipment to the factory, we require the following information.

- (1) Model number and serial number.
- (2) Your name (system user).
- (3) Your address.
- (4) Address to which system should be returned.
- (5) Your telephone number and extension.
- (6) Symptoms (in detail, including control settings).
- (7) Your purchase order number for repair charges, or your service contract number (does not apply to repairs in warranty).
- (8) Shipping instructions (if you wish to authorise shipment by any method other than normal surface transportation).
- (9) To avoid delays in customs clearance, authorisation and special requirement related to specific models must be obtained from PERKINELMER OPTOELECTRONICS BEFORE SHIPMENT OF THE GOODS.

Ship the equipment being returned to:

PERKINELMER OPTOELECTRONICS,  
Sorbus House, Mulberry Business Park,  
Wokingham, Berkshire. RG41 2GY.  
United Kingdom

C. Address correspondence in UK to:

PERKINELMER OPTOELECTRONICS,  
Sorbus House, Mulberry Business Park,  
Wokingham, Berkshire. RG41 2GY.  
United Kingdom

Phone: +44 118 977 3003  
Fax : +44 118 977 3493

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# Chapter 1

## HARDWARE CONFIGURATION.

### 1.1 Introduction To The PMD440.

The PMD440 is designed to measure the polarisation mode dispersion in optical fibers and cables. It consists of a separate polarised LED light source and a interferometric receive unit controlled by a lap top computer. As there is no requirement for communication between the two units measurements can easily be made on installed cables as well as in the factory. The units have been designed for portable use but must not be directly exposed to rain or water.

Please see chapter 2 for operation of the equipment

The apparatus to which this instruction manual applies has been supplied in a safe condition. The manual contains some information and warnings that must be followed by the user to ensure safe operation and to retain the apparatus in a safe condition

**The maximum input power to the unit is 0dBm, damage to the receiver detector may occur above this level.**

### 1.2 Inspection.

Newly received apparatus should be inspected for shipping damage. If any is noted, immediately notify PerkinElmer Optoelectronics and file a claim with the carrier. The shipping container should be saved for possible inspection by the carrier.

The complete PMD440 system consists of the following:

- a. PMD440-1 Receive interferometer
- b. PMD440-2, PMD440-3 or PMD440-4 polarised LED light sources
- c. Lap top controller
- d. 3 power leads plus parallel interface cable to connect the computer to the PMD440-1
- e. Assorted documentation from EG&G and National Instruments
- f. Shipping/transportation packing

### **WARNING !**

THE PROTECTIVE GROUNDING MAY BE RENDERED INEFFECTIVE IN DAMAGED APPARATUS. DAMAGED APPARATUS SHOULD NOT BE OPERATED UNTIL ITS SAFETY HAS BEEN VERIFIED BY QUALIFIED PERSONNEL. DAMAGED APPARATUS SHOULD BE TAGGED TO INDICATE TO A POTENTIAL USER THAT IT MAY BE UNSAFE AND THAT IT SHOULD NOT BE OPERATED.

### 1.3 Safety Mechanism.

As defined in IEC Publication 348, Safety Requirements for Electronic Measuring Apparatus, the PMD440 is a Class 1 apparatus, that is apparatus that depends on connection to a protective conductor to earth ground for equipment and operator safety. Before any other connection is made to the apparatus, the protective earth terminal shall be connected to a protective conductor. The protective connection is made via the earth ground prong of the power cord plug. This plug shall only be inserted into a socket outlet provided with the required earth ground contact. The protective action must not be negated by the use of an extension cord without a protective conductor, by use of an "adapter" that does not maintain earth ground continuity, or by any other means.

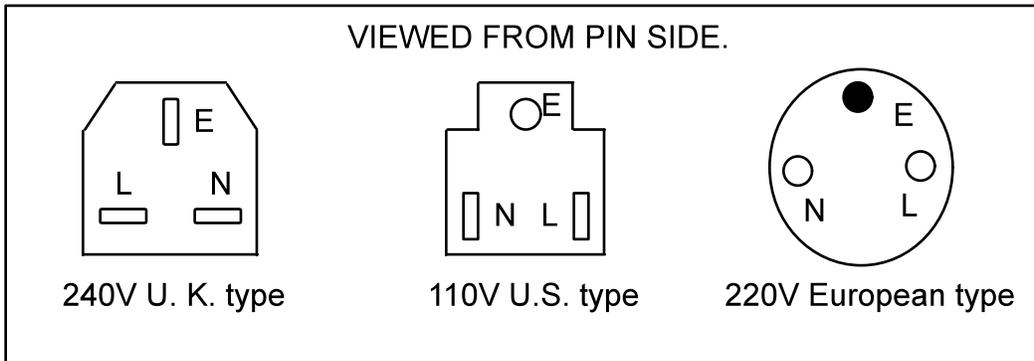
When the system is first supplied by PerkinElmer Optoelectronics or their agents a suitable power cord plug will be provided. The power cord plug provided for the U.K., European and the U.S. will be of the type illustrated in Figure 1.1. Should it be necessary to change the power cord plug an approved type should be used. In every case the wiring colour code is as follows :-

Brown	- Live (L)
Blue	- Neutral (N)
Green/yellow	- Earth (E)

### WARNING !

IF IT IS NECESSARY TO REPLACE THE POWER CORD OR THE POWER PLUG, THE REPLACEMENT CORD OR PLUG MUST HAVE THE SAME POLARITY AS THE ORIGINAL. OTHERWISE A SAFETY HAZARD FROM ELECTRICAL SHOCK, WHICH COULD RESULT IN PERSONNEL INJURY OR DEATH, MIGHT RESULT.

Figure 0-1 Power Cord Plugs With Polarity Indication.



## 1.4 Power Voltage Selection And Line Fuses.

### CAUTION !

THE APPARATUS DESCRIBED IN THIS MANUAL MAY BE OPERATED WITH MAINS POWER SOURCES FROM 85-264 VOLTS, 50/60Hz WITHOUT ADJUSTMENT

*CHANGING THE LINE FUSE SHOULD ONLY BE DONE BY A QUALIFIED SERVICE TECHNICIAN, AND THEN ONLY WITH THE INSTRUMENT DISCONNECTED FROM ALL SOURCES OF POWER.*

Check the fuse rating. Both the receive unit and the light sources require 20mm T1.0A anti-surge fuses. Ensure that the correct fuses are used for safe operation.

## 1.5 Equipment Servicing.

### WARNING !

POTENTIALLY LETHAL VOLTAGES ARE PRESENT INSIDE THIS APPARATUS. SERVICE SHOULD BE PERFORMED BY QUALIFIED PERSONNEL ONLY. TO AVOID ELECTRIC SHOCK, DO NOT PERFORM ANY SERVICING UNLESS YOU ARE QUALIFIED TO DO SO.

## 1.6 Ventilation.

The PMD440 receive unit and light source are both cooled by convection. Ensure that a free airflow is possible around the units and that they are not covered up in use.

The overall operating requirements are that the ambient temperature be restricted to the range of 0 deg C to 35 deg C.

## 1.7 Defects And Abnormal Stresses.

Whenever it is likely that the protection provided by the connection to earth ground has been impaired, the apparatus shall be made inoperative and secured against any unintended operation. The protection is likely to be impaired if, for example, the apparatus :

- (1) Shows visible damage,
- (2) Fails to perform the intended measurement,
- (3) Has been subjected to prolonged storage or operation under unfavourable conditions,
- (4) Has been subjected to severe transport stresses.
- (5) Such apparatus should not be used until its safety has been verified by qualified service personnel.

## 1.8 Hardware Installation.

PLEASE NOTE. INSTALLATION SHOULD ONLY BE CARRIED OUT BY AFTER READING THIS MANUAL AND BY A SUITABLY TRAINED PERSON.

### Computer Installation.

The PMD440 is controlled from an IBM or compatible personal computer. Control is via the parallel port.

## 1.9 General Specification For PMD440.

Operating wavelength range : 1250 - 1350 nm and/or 1500 - 1600 nm, for the LED light source options.  
The 1300nm light source case is coded grey and the 1550nm black.

PMD scan range: 250ps

Time resolution: 7fs

Measurement time: Typically 15-30 seconds for full 250ps scan

Maximum input power: 0dBm (Abs), Damage to the detector may occur above this level. -  
18dBm, Maximum measurement input power.

Operating Temperature Range: 0 to 35 degrees Celsius.

Storage Temperature Range: -20 to +65 degrees Celsius

Weight: Receiver unit : 4kg., 8 lbs. max.  
Light Source : 0.7kg., 1.5 lbs.

Dimensions: Receiver unit: 36 x 32 x 11 cm.  
Light source: 24 x 15 x 6 cm.

Power Consumption: Receiver unit: 30 Watts max. (100/240 V 50/60Hz).  
Light source: 10 Watts max. (100/240 V 50/60Hz).

# Chapter 2

## SYSTEM SOFTWARE OPERATION.

*Please see section 2.8 for details on making a typical PMD measurement.*

### 2.1 Introduction.

The PMD400 series instrument is entirely software controlled using a laptop or desk top computer. The program is controlled by the use of SOFTKEYS and a MENU from either a keyboard or a mouse. The MENU is the line of labels along the top of the screen. The SOFTKEYS are the keys along the top of the keyboard labelled F1 to F10. The corresponding SOFTKEY functions are displayed along the bottom of the screen. These functions may be selected by the user to perform measurements, store data, print results etc.

The system has two levels of operation:

1. TEST
  2. SERVICE MODE
1. The TEST level is for the normal measurements of fibers. It allows the operator to select and edit test files to store fiber details and test parameters, and take measurements of PMD. Results may displayed on screen or printed and imported as ASCII text files by external programs. A Power bar allows the instantaneous power level in the fibers to be monitored on the screen. Access to test level functions is restricted through use of user defined passwords.
  2. The SERVICE MODE requires a service password to be entered correctly and is designed for use by PerkinElmer service engineers. It allows reference power levels to be established and calibration information to be recorded. Password access may be set up under the service menu item.

## 2.2 Software Installation and parallel port configuration.

The PMD400 series program usually is supplied factory installed, with the computer parallel port configured for standard bi-directional operation, and no further actions are required.

### Supplied Files

#### 1. PMD400 series installation program for Windows

The following files comprise the PMD program:

PMD440.EXE

PMD440.HLP

PMD440INF.INI (created when the program is first executed)

#### 2. National Instruments NIDAQ software CDROM.

A number of programs and files are installed by the NIQAQ software including NIDAQ32.DLL and configuration utilities.

### Installation details

**Note: Software is normally installed on the supplied computer. Only carry out the operations below if installing on a new computer.**

To install the PMD400 series program completely, both the Windows95 PMD program, and the National Instruments NIDAQ software must be installed. Once installed, the NIDAQ software must be set for operation with a National Instruments DAQPAD 1200 data acquisition card and a parallel port must be allocated to it. This parallel port must be set for standard bi-directional operation.

Note that the DAQPAD1200 data acquisition card is supplied built into the PMD400 series instrument.

The PMD400 series installation disk should be used to install the Windows95 PMD program. When initially installed, the PMD400 series program acquisition menus and buttons will be disabled. These menus and buttons will become enabled when the National Instruments NIDAQ software is installed and configured. The program will then allow acquisition to proceed.

If measurements do not need to be taken, a "Stand Alone" only installation may be performed by installing the Windows95 PMD400 series disk alone. By default, this mode of operation allows use of all functions with the exception of those concerned with data acquisition. Menu functions and keys associated with the data acquisition will be greyed and inactive. A demonstration and training mode option may be used to simulate the presence of PMD hardware in which case all functions and keys may be used.

### Installation to allow "Stand Alone" operation

Place the installation disk in drive A and using Control Panel Add/Remove programs, install the PMD program.

A PMD.exe shortcut will be installed on the desktop.

### Installation to allow Data Acquisition

The DaqPad1200 is designed to operate with a standard bi-directional parallel port or EPP parallel port. The PMD400 series version has been tested with the standard parallel port however and it is necessary that the computer CMOS settings should be set to configure the parallel port mode to this standard bi-

directional mode of operation. The DaqPad1200 will not operate with a parallel port ECP mode of operation, which is frequently set as the CMOS default.

To modify the CMOS settings refer to your computer manual and use the software utilities provided by computer manufacturer to edit the parallel port configuration.

**To install the NIDAQ drivers and test the DAQPAD 1200 proceed as follows:**

Install the PMD400 series program as detailed for stand alone operation.

Install the National Instruments software. Insert the NIDAQ CDROM, and using the Control Panel Add/Remove programs install the NIDAQ drivers. The installation program proves a number of selection check boxes but only install the NIDAQ drivers to minimise disk requirements.(Note that the drivers option installs drivers and the configuration utilities required to setup the DAQPAD 1200 card. Details about the installation are given in the DaqPad1200 documentation).

Inform the PC of the new DaqPad1200 hardware as follows. Click on the Control panel Add New Hardware and begin the installation by clicking on the next button. Windows will not automatically find the DaqPad1200, so prevent it from searching for new hardware by clicking on the NO check box. Clicking next will present a list of hardware types. Click on Data Acquisition devices and select the DAQ pad 1200. Click on next and proceed with the installation.

Plug the DaqPad1200 into the parallel port and switch it on.

A NIDAQ configuration utility program may be used to allocate a parallel port to the DaqPad1200 and check its operation This utility is automatically installed when the drivers are installed and may be accessed from the Start/ Programs NIDAQ-for windows menu selection. Run the program and select a device number for the Daqpad1200. Select Configure and allocate a parallel port to the device.(e.g. lpt1:)

Run the Test Panels to check operation of the board.

Run the PMD400 series program and ensure that acquisition can proceed by performing a measurement.

## **2.3 Start Up.**

Connect the PMD400 series instrument to the computer and switch on the instrument power. Switch on the computer, it will automatically load the "Microsoft Windows" software.

To execute the PMD400 series control software, click on the PMD icon on the desktop to load and run the PMD.exe program.

**Summary:**

1. Switch on the instrument.
2. Switch on computer.

## 2.4 The Windows Environment.

The PMD400 series program runs in the Microsoft Windows environment. As such the control of the program is similar to any other Windows program. The Windows manual supplies a detailed explanation of the operating system as well as the utilities that are supplied with the Windows package.

The system can be controlled with a mouse or just from the keyboard. In this document a click with the mouse refers to moving the cursor over the item and pressing the left mouse button once. Double click with the mouse refers to moving the cursor over the item and pressing the left mouse button twice in rapid succession.

In the PMD400 series software, the main functions on the pull down menus are duplicated on function keys F1 to F10 shown at the bottom of the screen.

### Function keys.

The function can be selected by either pressing the corresponding function key on the keyboard or clicking it with the mouse.

### Pull down menus.

From the menu bar at the top of the screen, to select a pull down menu either click it with the mouse or press the Alt key together with the underlined letter in the menu name. To select the **New** menu press Alt and N. If an item in a menu is shown in grey it cannot be selected. This is the case for functions which can only be selected after the password has been correctly entered or for functions which are only valid after a measurement has finished, such as **Save**.

### Tool bars.

Clicking on the tool bar buttons may access certain frequently used menu items. Position the mouse cursor over the buttons to show context help that indicates their function.

The PMD400 series program contains the following toolbar buttons:

[File-New] [FileOpen] [File Save] [Print] [Help]

### Dialog boxes.

Certain selections bring up a dialog box that contain one or more controls. These allow various items to be chosen using either the keyboard or a mouse. The item selected in the dialog is shown highlighted by a dotted lined box. Such an item is termed as having the input focus and further key strokes will be aimed at that object. To move the input focus to another object use the TAB key or TAB + SHIFT to retrace the movement.

To exit the dialog, click on **Ok** or **Cancel**. **Cancel** will ignore any new selections and revert to the old settings. **Ok** will use any new settings selected. In most cases the keyboard **Return** will choose **Ok** and **Escape** will choose **Cancel**.

### Tab Dialog boxes.

Tab dialogs are used to group entries that may be related onto several pages or "tabs". Click on the labelled tab at the top of the dialog to allow entries on that page to be displayed and modified.

### Buttons.

Most dialog boxes contain a **Cancel** and **Ok** button and sometimes further buttons. The **Ok** button can be selected by clicking it with the mouse, pressing Alt and O or often by just pressing RETURN. The **Ok** button signifies that you will use the selected item(s), or set ups, and it closes the dialog.

The **Cancel** button can be selected by either clicking it with the mouse, pressing Alt and C or by pressing the Escape button. The **Cancel** button will close the dialog box without using the selected item(s), leaving them in their original state.

The **Apply** button present on tab dialog boxes can be used to accept the selected item(s) or set ups as if the OK button had been pressed. The **Apply** button does not close the dialog box however and allows further modifications to be made. In instances where this facility is inappropriate or not required the button will remain greyed and inaccessible.

### List box.

A list box is where there is a list of items from which one or more can be selected. For example in the file select dialog box the test files available are listed. One file can be selected either by clicking over the file name with the mouse or moving the up/down cursor and pressing return. The selected file will be highlighted.

### Option buttons.

Option or radio buttons signify a series of options only one of which can be selected. Selecting one automatically deselects the others. They can be selected by either being clicked with the mouse, or pressing the **Tab** key to move forward to the group of buttons (or **Shift Tab** to move backwards), then using the cursor keys (< , >) to select the button.

### Check boxes.

These are square boxes which may have a tick in the centre. The box is used to signify the item or function shown along side, being selected or not. A tick signifies selection; an empty box signifies no selection. Selection is achieved by either clicking with the mouse or moving to the item with the **Tab / Shift + Tab** key and then pressing the **Space** bar to toggle the selection.

### Edit boxes.

These are boxes, which allows the user to enter a number or characters from the keyboard. Select a box by using the **Tab/ Shift +Tab** key or clicking with the mouse. When the item is initially selected and displayed in inverse video entering a new character will remove all the existing data. To prevent this press a cursor key first, then edit the existing entry. For example in the Fiber dialog box, the Fiber length, ID and message are entered via edit boxes. **Backspace** and **delete** are also allowed.

### Drop-down list boxes.

A drop-down list box appears initially as a small rectangular box with the current choice (default) highlighted in the box. The arrow in a square box at the right of the rectangular box opens into a list of available choices when you select it. If there are more choices than can fit in the drop-down list box, scroll bars are provided at the right hand side of the box.

To open a drop-down list box and select an item:

#### Using the Mouse

1. Click the arrow in the square at the right of the box to open the drop-down list box.
2. Click the Up or Down scroll arrow or drag the scroll bar to move to the item you want.
3. Click the item.

#### Using the Keyboard.

1. Press **ALT+Down Arrow** to open the drop-down list box.
2. Use the **Up or Down Arrow** key to reach the item you want, and press **ALT+Up Arrow** or **ALT+Down Arrow** to select the item.

## 2.5 Menus.

### Overview.

The main menu provides access to all of the functions needed to control data acquisition, display and storage. It contains the following functions:

Menu	Sub Menu	Function Overview
<b>File</b>		
	New Ctrl+N	Creates a new data file ready for a new measurement.
	Open Ctrl+O	Opens a previously stored data file.
	Save Ctrl+S F8	Saves the current data file with the current filename.
	Save As	Saves the current data file with a new file name.
	Save Report as Text	Saves the results in text format.
	Export Raw Data As Text	Exports the plot data.
	Print Ctrl+P	Prints the graph or results of selected fibers.
	Print Preview	Previews the results of select fibers .
	Page Setup	Sets up the printed page format.
	Exit	Exits the PMD program.
<b>Edit</b>		
	Setup PMD	Sets up parameters for the current measurement.
	Test File	Sets up parameters that control the data acquisition and display.
	Results F5	Allows entry of plot scales
<b>Measure</b>		
	PMD F2	Starts a measurement or sequence of runs and repeats.
	Power Bars F7	Displays the power bars.
	Gain F3	Displays a sevice mode gain selection dialog.
	Stop F10	Aborts a run or sequence of runs.(Available as F10 key only)
<b>System</b>		
	Password	Allows entry of a password.
	Configure Function Keys	Sets function key labels
	Configure Menus and Passwords	Sets passwords and access levels
	Configure Remote control	Sets up remote control connection
<b>View</b>		
	Toolbar	Shows or hides the tool bar.
	Status Bar	Shows or hides the status bar.

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Button Bar	Shows or hides the button bar.
Results Summary	Shows the results summary.

**Service**

Instrument I.D.	Enters an Instrument identifier.
Remote Control Diagnostics	Displays remote control diagnostics dialog
Get Reference Powers	Monitors and stores reference powers.
Acquisition Mode	Sets the data acquisition device and mode.
Range Calibration	Sets the psec calibration.
Gain Calibration	Sets the gain calibration.
Warning Limits	Sets the system warning limits.

**Help**

Contents	Shows the online help.
About	Shows the software version number.

## 2.5.1 File Menu Functions

**File - New Ctrl+N**

Clicking on the New menu item or toolbar button will clear the current data from memory, clear, any display and report to set the PMD software ready for a new measurement. The current test file will be used to establish the data acquisition and display parameters.

**File - Open Ctrl+O**

Clicking on the Open menu item or tool bar button will present a **Open File** dialog that may be used to select a .PMD data file. Click on the dialog **Ok** button to load and display the file and display a report.

**File - Save Ctrl+S F8**

Clicking on the Save menu item or tool bar button will save the current data. The current filename displayed on the main window banner will be used for storage. A file with “.pmd” extension will be created to containing the graphic data, and a file with “.txt” extension will be created to contain the summary results.

**File - Save As**

Clicking on the Save As menu item will present a Save File dialog that may be used to enter the filename of a file to be used for the storage of the current data. Click on the dialog **Ok** button to save the file. A file with “.pmd” extension will be created to contain the graphic data, and a file with “.txt” extension will be created to contain the summary results.

### File - Save Report As Text

Clicking on the Save Report As Text will present a Save File Dialog that may be used to enter the name of a file to be used to save the current results summary.report. Comma and Quote formatting information will be removed from the report prior to storage.

### File - Export Raw Data As Text

Clicking on the Export Raw Data as text will present an Export File Dialog that may be used to enter the name of a file to be used to save the current plot data in a fixed format, comma and quote delimited text file. The file consists of a fixed number of header strings (quote delimited) followed by a list comprising index number, pico second, and percent intensity, for each data point in the file. Each data field is separated by a comma.

The export file dialog contains the usual file Save As entry fields and an additional entry allowing the number of points in the exported file to be restricted:

**No Points to Skip:** Enter the number of points to be ignored e.g. 0 will export all data, 1 will export ever other point, 4 will export every fifth point.

### File - Print

The print menu item will display a dialog box allowing selection of a Graph report or summary report. The functions is designed to print data on the currently active Windows printer. The Print Preview menu item may be used to display the expected output on the screen before taking a hard copy.

### File - Print Preview

The Print Preview menu item performs the same function as the print menu item, allowing graphs and reports to be displayed. Output is produced on the screen rather than a printer however. Once the preview screen is displayed, a print button allows a hard copy to be made.

### File - Page Setup

The Page Setup menu item will present a Page Setup dialog to allow the printer page Top, Left, Bottom, and Right margins to be setup and saved. Enter the required values into the edit boxes and click on **Ok** to accept the entries. Click on **Cancel** to exit the dialog without making any changes.

### File - Exit

Click on the Exit menu item to terminate any data acquisition and exit the PMD program.

## 2.5.2 Edit Menu Functions

### Edit - Setup PMD

Setup PMD displays a dialog that allows run sequencing, data storage and printout information to be entered.

**Fiber Data Entry** Allows entry of a company name to be displayed in reports and toggles the display a Fiber Data dialog at the start of each run.

**Logo** Enters the logo to be displayed as the first line in the report.

<b>On/Off</b>	Selects to display the Fiber data dialog at the start of each run.
<b>Data Acquisition</b>	Enters the run sequencing information
<b>Runs To Average Per Repeat</b>	Enters the number of measurements to be made. A running average PMD will be reported for these measurements.
<b>Number Of Repeats</b>	Enters the number of times to repeat the running average sequence. The total number of measurements will be Runs To Average Per Repeat x Number Of Repeats. The average value reported will be reset at the start of each repeat.
<b>Delay between runs</b>	Enters the time delay (minutes) between runs.
<b>Delay between repeats</b>	Enters the time delay (minutes) between repeats.
<b>Storage</b>	Enters storage parameters
<b>Autosave</b>	Check the box to automatically save measurement data.
<b>Base Filenames</b>	<p>The base filename button presents a filename selection dialog. The filename selected will be used to create filenames by appending the autosave number and a file extension. For example, a base filename of Untitled_1.pmd and autosave number of 1 will cause filenames of Untitled_1.pmd and Untitled_1.txt to be saved. The .pmd file will contain the plot data and the .txt file will contain the summary report comprising PMD results and averages.</p> <p>Existing files will be overwritten when storage occurs.</p>
<b>Autosave Number:</b>	Enters the autosave number to be used for the next measurements autosave filename.
<b>Save as ID:</b>	Forces the autosave filename to be based upon the fiber I.D. The autosave number will be appended to the fiber I.D. to create the filename.
<b>Print Results</b>	Selects on line printout options
<b>Graph Results</b>	Check to cause the Plot report to be printed after each measurement.
<b>Final Summary Report</b>	Check to cause the final summary report to be printed at the end of a run-repeat sequence.

### Edit - Test File F6

The Test File menu item allows test files that contain all of the parameters governing data acquisition and initial display to be created and maintained. Test files are stored in groups of ten in a disk file with a ".ptf" file extension. Clicking on the Test file menu item will present a Select Test Files dialog. The dialog allows an existing group of test files to be selected from a drop down list box, or it allows a new group to be created by the user clicking on a New Group button. Default test files are generated whenever a new group file is created. The dialog displays a list of the test files numbered 1 through 10 together with their individual names. A group file description may be entered into the description field.

To edit a test file, first select the test number-description from the list box and click on the edit test files button. A Test File Options Tab dialog will be presented containing a number of tab selections with controls to set up the operating parameters:

**Test Type tab**            The test type tab allows a description of the test file to be entered:

**Test File** Enters the test file name. The name will appear in reports and in the test number description list of the Select Test Files dialog.

**Description** Enters a free form description of the test file.

**PMD Process Options tab**

The PMD Process Options tab allows the parameters governing processing and display to be entered.

**Source** Selects the type of source and its coherence time.

Default coherence times are as follows:

1310nm: 0.056psec

1550nm: 0.064psec

White light 0.020 psec

A.S.E 0.400 psec

**Process** Enters the type of processing to be performed.

**Deterministic recorded** Causes a report of every PMD value greater than an intensity threshold to be recorded

**Report %** Enters a percentage intensity threshold above which PMD values will be recorded. The entry is only available when deterministic reports are selected.

**Random** Causes a report of the average PMD determined from the second moment of the measured data.

**Warning limit psec** Enters a PMD threshold value above which a warning message will be recorded for random reports.

**Standards** Allows a PMD warning limit to be selected from a list of values.

**Warning limit psec/km<sup>-1/2</sup>** Enters a PMD/km<sup>-1/2</sup> threshold value above which a warning message will be recorded for random reports.

Warning messages are annotated with an "(R)" in the Acquisition field of the summary report.

**Display range** Selects the initial display window for the PMD plot as 4, 10, 30,140 or 250 psec.

**Edit - Results**

The Results menu item displays a plot scale dialog which allows the x and y axes upper and lower limits to be entered and selected for use with all files. It also allows the fiber length, I.D., and message to be modified. When the dialog is displayed, the last selected zoom values are presented. The values may be modified by entering new values into edit boxes, or by selecting the current plot axis limits:

- Minimum psec** Enters the minimum psec plot axis value
- Maximum psec** Enters the maximum psec plot axis value
- Minimum intensity** Enters the minimum intensity plot axis value
- Maximum intensity** Enters the maximum intensity plot axis value
- Current expansion** Press to select the current plots axes values

<b>Apply to All</b>	Check to apply the zoom values to all files
<b>Fiber data</b>	Click to present the Fiber data dialog box to allow the fiber length, I.D. and message to be entered. When new values are entered and accepted by clicking on the OK buttons, the PMD results will be recalculated using the new values.

### 2.5.3 Measure Menu Items

#### Measure - PMD F2

The PMD F2 menu item starts a measurement.

A fiber data entry dialog will be displayed if the Edit-Setup PMD fiber data entry was selected followed by a Power Bar. The fiber data entry allows a fiber ID and description to be entered.

#### Fiber Data Entry Dialog

<b>Fiber length (km)</b>	Enter Fiber length (km)
<b>Fiber ID</b>	Enter fiber identifier description
<b>Message</b>	Enter free form message

Click on **Ok** on the dialog to continue with a PMD measurement and display the power bar, or **Cancel** to abort the option.

Click on **Ok** on the Power bar to continue with the measurement or **Cancel** to abort the option.

A PMD measurement scan will take about 20 seconds. During acquisition, a progress indicator on the status bar will indicate that acquisition is in progress. At the end of acquisition and processing, the PMD plot will be displayed and PMD results will be displayed. The PMD plot data and summary files will be stored and printed according to the Edit Setup PMD options.

A temporary report file PMDREPORT.TXT will be updated at the end of a run with the latest summary results. This file is overwritten each time a new run repeat sequence is started.

#### Measure - Power Bar F7

The Power Bar F7 menu item displays a power bar dialog and starts monitoring the power at a rate of 1 sample per second.

A power readout relative to reference power values set by the Service Get Reference Powers menu item is calculated and displayed in the power bars. The reference level is shown by a red line on the power bar and represents the maximum power level (no loss).

***The maximum input power before possible damage to the instrument is 0 dBm (1mW). Do not exceed this level under any circumstances. The power of the optical sources provided is approximately -21dBm.***

<b>Power Bar</b>	Displays 100+ optical power dBm.
<b>Power (db)</b>	Displays 100+ optical power dBm
<b>Loss (db)</b>	Displays (Reference optical power – Instantaneous optical power)

When the Service password is used, the amplifier range and gain may be set manually and additional readouts are available on the power bar.

<b>Voltage/(Range x Gain)</b>	Displays the voltage divided by the range x gain
<b>ADC</b>	Displays the instantaneous ADC counts
<b>Autorange</b>	Check to automatically setup the amplifier range and gain. Uncheck to use the existing range and gain settings that were set using the Measure Gain F3 menu item. When autorange is checked, clicking on <b>Ok</b> on the power bar will cause the new range and gain settings to be recorded and subsequently used. Note that this function is only operational in service mode and is present for diagnostic purposes only. In other operational modes the amplifier range and gain is always set up automatically and cannot be set manually.

### Measure Gain F3

The Gain F3 menu item allows the amplifier range and gain to be set manually when the Service password is in use. The option is not available in other operational modes.

**Range** Selects range 1,10  
**Gain** Selects gain of 1, 10, 100, 1000

Click on **Ok** to accept the setting or **Cancel** to exit the dialog.

### Measure - Stop F10

The Stop F10 key stops data acquisition, terminating the current run and any sequence of runs and repeats.

## 2.5.4 System Menu items

### System - Enter Password

The Password menu displays a password entry dialog. Only those functions designated for use with the password (System Menu Configure Menus and Passwords) will be enabled.

### System - Configure Function Keys

The Configure function keys menu item allows the text descriptions of the function keys to be customized. The menu item presents a dialog which will allow text for function keys F1 through F10 to be entered. The text strings will be displayed on the function keys together with a label "F number" (e.g. F1) when the OK button is used to accept the entries.

The following controls may be used to setup the text labels:

**Function key text edit boxes** Enters up to 20 characters of text.  
**Defaults button** Restores the function label keys to the program supplied defaults.

### System - Configure Menus and Passwords

The Configure menus and passwords menu item allows password access to the PMD400 functions to be setup.

Three passwords are permitted which may have full access to the PMD functions. Two of the passwords may be set with restricted access by checking options in a list of available functions

<b>Password 1</b>	Enters a password with restricted access
<b>Password 2</b>	Enters a password with restricted access
<b>All Functions Password</b>	Enters a password with full access

Double click on the check boxes, or use the spacebar on a highlighted entry, to indicate functions that may be accessed. Note that Up and Down arrow keys may be used to scroll through a list.

Click on **Ok** to accept the selections or **Cancel** to exit the dialog.

### System Configure Remote Control

The Configure remote control menu item may be used to set up the RS232 communications protocol to allow remote control by a host computer.

To make a connection, it is important that the same protocol is use on the PMD400 series computer and host computer. A number of options may be selected for use. These will be accepted when the **Ok** button is pressed to exit from the dialog:

<b>Enable remote control by RS232</b>	Check to connect to the host computer when the <b>Ok</b> button is used to exit from the dialog. Uncheck to disconnect the host computer.
<b>Baud Rate</b>	Set the bit rate
<b>Data bits</b>	Set the number of data bits
<b>Stop bits</b>	Sets the number of stop bits
<b>Parity</b>	Sets the parity test protocol
<b>I/P Terminator</b>	Sets the input terminators. (Characters used to identify a command received from the host computer)
<b>O/P terminator</b>	Sets the output terminators (Characters appended to data transmitted to the host computer)
<b>Flow Control</b>	Sets the flow control protocol
<b>Start End Characters</b>	Check to start a transmission with ASCII 0x2 (STX) and terminate with ASCII 0x3 (ETX) characters
<b>Defaults</b>	Sets up a default protocol.

## 2.5.5 View Menu Functions

### View - Tool bar

Check the menu to display the tool bar. Click again to hide the bar. When visible, the tool bar may be relocated by clicking on it and dragging to its new location before releasing the left mouse button

### View - Status bar

Check the menu to display a status bar at the bottom of the CPM500 display. Click again to hide the bar. The status bar indicates the progress of data acquisition and contains a red- green monitor indicator that blinks during data transfer. Context sensitive help information is displayed on the status bar when acquisition has stopped.

#### **View - System Button bar**

The button bar contains buttons that emulate the function keys. Check the menu to display the tool bar. Click again to hide the bar. When visible, the tool bar may be relocated by clicking on it and dragging to its new location before releasing the left mouse button.

#### **View - Results Summary**

The Results summary menu item displays a dialog that shows the summary report data.

The Summary dialog shows the contains a number of buttons:

<b>Next</b>	displays the next page
<b>Prev</b>	displays the previous page
<b>Open File</b>	Opens a highlighted file. Double clicking on the results of interest in the summary dialog list box, or clicking on the Open File button will display a file open dialog containing the filename of the data file. Clicking on <b>Ok</b> will open the open the .PMD file and display the plot and results.

Note: To print the summary data, close the report dialog and use the File Print or File Print Preview menu items.

## **2.5.6 Service Menu Functions**

### **Service - Instrument I.D.**

The Instrument I.D. menu item presents a dialog allows an instrument identifier string to be entered. This information will be stored in each data file and displayed in the report header.

The dialog contains an edit entry field:

<b>Instrument I.D.</b>	Enter the identified string.
------------------------	------------------------------

### **Service - Remote Control Diagnostics**

The Remote Control Diagnostics menu item displays a dialog showing a history of the RS232 Read and Write transactions. The dialog may be used as a diagnostic tool when setting up remote control programs. The dialog will display 5000 characters in any one transaction up to a total of 64000 characters maximum. The screen will be cleared automatically if more than 64000 characters are present before being updated with new data. If raw data or reports containing more than 5000 characters are transmitted then the display will be truncated. Under these circumstances, ... will be appended to the partial raw data or report display to indicate that further information was transferred.

### **Service - Get Reference Powers**

The Get Reference Powers Menu items are designed for use by Service Engineers and set up calibration values. These calibration values are factory set, and under normal operating conditions, should not be adjusted.

The Get Reference Powers menu item presents four sub menu items that allow the reference power level to be setup according to the wavelength of the source in use. The reference power is used in the power bar display where it is show as a red line. The Loss displayed on the power bar dialog is calculated relative to the reference power levels.

Menu items	
<b>1310nm</b>	Measures 1310 nm source reference
<b>1550nm</b>	Measures 1550 nm source reference
<b>White Light</b>	Measures White light source reference
<b>A.S.E</b>	Measures A.S.E source reference

Get Reference Powers Dialog

<b>AD Value</b>	Displays the ADC count
<b>Voltage/(range x gain)</b>	Displays the voltage/(range * gain)
<b>Power (dB)</b>	Displays 100+ reference power

**Get Reference Power** Measures the power using the current range and gain settings.

Click on the **Get Reference Power** button to monitor the power, click on **Ok** to accept and record the value.

### Service - Acquisition mode

The Acquisition Mode Menu item is designed for use by Service Engineers to set up diagnostic and calibration values. These values are normally factory set, and should not be adjusted.

The Acquisition mode menu item sets up system data acquisition parameters. Default values should be applied as follows:

<b>Software Start</b>	Uncheck to select hardware triggered start (default = unchecked)
<b>Demo</b>	Check to simulate the presence of PMD400 series hardware. Measurement start and stop functions become enabled and data from the Demo.Dat file is used for demonstrations (default=unchecked).
<b>Ignore leading points</b>	Enter the number of leading points to ignore (default = 0)
<b>Ignore trailing points</b>	Enter the number of trailing points to ignore (default=0)
<b>Filter order</b>	Enter a binomial filter order to be applied (default=0)
<b>Noise threshold</b>	Enter the noise threshold (default 4)
<b>Hardware</b>	Select Parallel for use with the PMD400 series instrument rather than PCMCIA or PC ATMIO16XE110 cards (default=parallel)
<b>Switch Source</b>	Check to cause the white light source switch to be switched if present (PMD400 only) when the test file indicates white light. IO line CONFIG_0 will be set high for white light or low otherwise (default = unchecked).
<b>Range</b>	Switches between original scan range of +/- 140ps and the current range of -50 to +250ps. The second mode is selected when the box is ticked. The two following boxes, Centre psec minimum and maximum are used to locate the central autocorrelation peak as part of the factory calibration process.

Click on **Ok** to accept the new parameters or **Cancel** to exit the dialog.

### Service - Range Calibration

The Range Calibration Menu item is designed for use by Service Engineers to set up range calibration values. These values are normally factory set, and should not be adjusted.

<b>Voltage</b>	Enter the voltage for the range calibration
<b>Distance (mm)</b>	Enter the distance for the calibration voltage

Click on **Ok** to accept the new calibration or **Cancel** to exit the dialog.

### Service - Gain Calibration

The Gain Calibration Menu item is designed for use by Service Engineers to set up gain calibration values. These values are normally factory set using a laser source, and should not be adjusted.

The gain calibration compensates the detector response for mirror position and fits a quadratic response curve. The Gain calibration menu item presents a dialog that allows the response curve to be set up automatically using a laser calibration, or allows the quadratic coefficients to be entered manually. Setting all coefficients to zero will prevent the gain calibration from being applied.

<b>X<sup>2</sup> Coefficient</b>	Enters the coefficient
<b>X Coefficient</b>	Enters the coefficient
<b>Intercept</b>	Enters the coefficient
<b>Max signal</b>	Indicates the maximum signal level
<b>Std Err Estimate</b>	Indicates the curve fit

**Laser Calibration** Starts an automatic calibration using an external 1550nm DFB –20dBm laser source. Pressing the **Laser Calibration** button will present the power bar. Clicking **Ok** on the Power bar will cause a measurement to be performed and a calibration curve will be plotted.

### Service - Warning Limits

The Warning Limits Menu item is designed for use by Service Engineers to set up warning calibration values. These values refer to the maximum operating range of the PMD400 series instrument under normal operating conditions and should not be adjusted.

<b>Upper Limit (psec)</b>	Enters the maximum PMD above which a warning will be reported
<b>Lower Limit (psec)</b>	Enters the minimum PMD below which a warning will be reported
<b>Upper limit (volts)</b>	Enters the maximum voltage above which a warning will be reported
<b>Lower Limit (volts)</b>	Enters the minimum voltage below which warning will be reported

**Show Warning limits** Check to cause a warning dialog to be displayed if any PMD data falls outside of the warning limits after each run. (NB. The dialog will only be displayed when one run and one repeat is specified in the Edit Setup PMD dialog)

Warnings are always annotated in the PMD summary report as an “(E)” displayed in the Acquisition time field. Note that additional warnings specified in the Test File result in “(R)” annotations in the acquisition field of a random report.

## 2.5.7 Help Menu Items

### Help Contents

The Help Contents menu item displays this help file.

### Help About

The Help About menu item displays PMD400 series version information

## 2.6 Main Display

The Main Display Page displays a plot of PMD data and a summary report of the PMD. A number of controls are available to manipulate the plot display and display additional information.

### Changing the plot display window.

The default plot display window is set in the test file. The Mouse may be used to expand or contract the display window by creating an expansion rectangle over the plot as follows:

#### To expand the plot:

1. Position the mouse over the plot at the imaginary corner of an expansion rectangle.
2. Hold down the left mouse button, and drag the mouse to the opposite corner of the expansion rectangle
3. Release the mouse button. The plot within the expansion rectangle will be redrawn full size.

#### To contract the plot

Click the mouse right button. The plot will be redisplayed at its previous expansion or over the full psec range of -50psec to +250 psec.

### Plot Colors

An expanded plot shows a number of indicators:

Grey Fill	Area designated as an autocorrelation peak, not contributing to PMD
Blue Fill	Area contributing to PMD
Red plot	A Gaussian plot of the same value as the displayed total PMD value. This should only be used as a guide to judge the randomness of the measured PMD distribution.

### Displaying a position cursor

A moveable psec position cursor may be displayed over the screen:

Click over the Cursor F4 soft key. A cursor will be displayed on the left-hand side of the plot with the psec delay indicated in a display rectangle. To move the cursor, position the mouse over the display rectangle below the psec axis, and hold down the mouse left button. Drag the cursor to the desired position and release the left button.

Click over the Cursor F4 soft key again to remove the cursor from the display.

### Report Display List box

The report display indicates the PMD from the last measurement with summary information about the acquisition. Horizontal and vertical scroll bars may be used to view information off screen.

Information displayed includes a goodness of fit parameter when random PMD is being measured. These values range from zero through to one. A value of one indicates an optimum gaussian pmd distribution while a value of zero indicates a poor fit.

**Acquisition status indicators**

<b>Total PMD</b>	Displays the average of all of the PMDs within the current repeat sequence.
<b>Pass/Fail</b>	Displays “Pass” if the total PMD falls within the test file warning limits, otherwise displays “Failed”.
<b>Run Number</b>	Displays the current run number.
<b>Repeat Number</b>	Displays the current repeat number.
<b>Time To next Run</b>	Counts down to the next run in a run – repeat sequence.

**2.7 Remote control commands**

All of the following remote control commands return BUSY if the system is currently performing an operation and is unable to execute them.

See:

*2.7.1 Explanation of Remote commands*

Command	Response
<b>Dialogs</b>	
GET DATA message	Entered data or CANCEL
GET FIBER DATA	OK or CANCEL
PROMPT nn	OK or CANCEL
<b>Test Information</b>	
READ ID	Fiber ID.
READ LENGTH	Fiber Length
READ MESSAGE	Fiber Message
SET ID nn	OK or ERROR
SET LENGTH nn	OK or ERROR
SET MESSAGE nn	OK or ERROR
<b>Test groups and files</b>	
READ FILE	Test File number
READ GROUP	Group File name
SET FILE nn	OK or ERROR
SET GROUP nn	OK or ERROR
READ DESCRIPTION	Test file description
READ SOURCE	Test file source wavelength
READ COHERENCE	Test file source coherence time
READ PROCESS	Deterministic or random process type
READ PSEC WARNING	Random process psec limit or ERROR
READ PSECKM WARNING	Random process psec/km <sup>-1/2</sup> limit or ERROR
READ RANGE	Display range
READ THRESHOLD	Deterministic process report threshold
<b>Setup information</b>	
READ RUNS	number or runs
READ REPEATS	number of repeats

READ DELAY RUNS	delay between runs
READ DELAY REPEATS	delay between repeats
READ BASE FILENAME	base filename
READ AUTOSAVENO	autosave number
READ LOGO	company logo
READ FINAL SUMMARY	summary printout flag
READ GRAPH REPORT	graph printout flag
READ AUTOSAVE	autosave flag
READ MEASUREPOWER	measure powerbar flag
SET RUNS nn	OK or ERROR
SET REPEATS nn	OK or ERROR
SET DELAY RUNS nn	OK or ERROR
SET DELAY REPEATS nn	OK or ERROR
SET BASE FILENAME nn	OK or ERROR
SET AUTOSAVENO nn	OK or ERROR
SET LOGO nn	OK or ERROR
SET FINAL SUMMARY nn	OK or ERROR
SET GRAPH REPORT nn	OK or ERROR
SET AUTOSAVE	OK or ERROR
SET MEASUREPOWER	OK or ERROR
Measurements	
STATUS	status word
MEASURE	OK, FINISHED or ABORTED
MEASURE POWER	Power measured in dB
MEASURE LOSS	Loss measured in dB
ABORT	OK
Results	
READ RESULTS nn	Summary results file or ERROR
READ PMD	PMD or ERROR
READ PMDCOEFFICIENT	PMD coefficient or ERROR
READ PMD2ORDER	2nd Order PMD
READ PMDFIT	Regression coefficient
READ PASSFAIL	PASS or FAIL
READ TOTALPMD	Current Total PMD
READ PMDERRNO	PMD calculation error code
READ PLOTDATA	Psec vs intensity data or ERROR
READ CALCDATA	Noise corrected psec vs intensity data or ERROR
READ GAUSDATA	Gaussian fit as psec vs intensity data or ERROR
Other Commands	
RUN nnn	OK or ERROR

## 2.7.1 Explanation of the remote commands

### Dialogs

GET DATA message

Returns: Entered data or CANCEL

The function allows the user to be prompted by a dialog box. The message is displayed at the top of the box. The dialog box has an **Ok** and **Cancel** button. If the **Ok** button is selected the entered character string is returned. If the **Cancel** button is selected CANCEL is returned. The message can be any string up to 70 characters.

#### GET FIBER DATA

Returns OK or CANCEL

The function allows the user to be prompted by a dialog box normally used at the start of a measurement. The fiber length, ID and a message can be entered. When the **Ok** button is selected OK is returned. When the **Cancel** button is selected CANCEL is returned. To read back the entered data use the READ ID, READ LENGTH, and READ MESSAGE commands.

#### PROMPT nn

Return OK or CANCEL

The function allows the user to be prompted by a dialog box. nn should contain a character string that will be shown when the dialog box is displayed. When the **Ok** button is selected OK is returned. When the **Cancel** button is selected CANCEL is returned.

### Test Information

#### READ ID

Returns Fiber ID

#### READ LENGTH

Returns Fiber length in kilometers

#### READ MESSAGE

Returns Fiber Message

#### SET ID nn

Returns OK or ERROR

Sets the fiber identification message. The ID string length should be less than 256 characters.

#### SET LENGTH nn

Returns OK or ERROR

Sets the fiber length used during a measurement. nn is the length ( 0.00001 to 250 km).

#### SET MESSAGE nn

Returns OK or ERROR

Sets the fiber message associated with a measurement. nn is the message string. Length of nn must be less than 256 characters.

### Test Groups and files

#### READ FILE

Returns the Test File number used for the measurement (1-10).

#### READ GROUP

Returns the Group File name used for the measurement (1-10).

#### SET FILE nn

Returns OK or ERROR

Sets the test file number used for the measurement. nn is the file number ( 1-10 ).

SET GROUP nn

Returns OK or ERROR

Sets the Group file used for the measurement. nn is the group name. Length of the group name should be less than 256 characters.

READ DESCRIPTION

Returns the Test file description used for the measurement

READ SOURCE

Returns the source wavelength used for the measurement:

1310 nm, 1550 nm, White Light, A.S.E.

READ COHERENCE

Returns the coherence of the source used for the measurement e.g. 0.06

READ PROCESS

Returns the process type use for the results calculations:

Deterministic, Random.

READ PSEC WARNING

Returns the random process psec limit. If the test file is set to deterministic process type

ERROR is returned.

READ PSECKM WARNING

Returns the random process psec/km<sup>-1/2</sup> limit. If the test file is set to deterministic process type

ERROR is returned.

READ RANGE

Returns the initial display range used for the measurement

READ THRESHOLD

Returns the deterministic process report threshold. If the test file is set to random process type ERROR is returned.

**Setup information**

READ RUNS

Returns the number of runs in a run repeat sequence (1-999).

READ REPEATS

Returns the number of repeats within a run repeat sequence (1-99).

READ DELAY RUNS

Returns the delay between runs in minutes (0-59).

READ DELAY REPEATS

Returns the delay between repeats in minutes (0-59).

READ BASE FILENAME

Returns the base filename (255 characters maximum).

READ AUTOSAVENO

Returns the autosave flag (0=No, 1=yes).

**READ LOGO**

Returns the company logo used in the first line of a report (255 characters maximum).

**READ FINAL SUMMARY**

Returns the printout final summary flag (0=No, 1=Yes).

**READ GRAPH REPORT**

Returns the printout graph summary flag (0=No, 1=Yes).

**READ AUTOSAVE**

Returns the autosave reports flag (0=No, 1=Yes).

**READ MEASUREPOWER**

Returns the flag which dictates whether the power bar should be displayed during a measurement (0=No, 1=Yes).

**SET RUNS nn**

Returns OK or ERROR

Sets the number of runs use for a run - repeat averaging sequence. nn is the number of runs (1-999).

**SET REPEATS nn**

Returns OK or ERROR

Sets the number of repeats used for a run - repeat averaging sequence. nn is the number of repeats (1-99).

**SET DELAY RUNS nn**

Returns OK or ERROR

Sets the delay between runs in minutes. nn is the delay (0-59).

**SET DELAY REPEATS nn**

Returns OK or ERROR

Sets the delay between repeats in minutes. nn is the delay (0-59).

**SET BASE FILENAME nn**

Returns OK or ERROR

Sets the base filename for results storage. Nn is the base filename (255 characters maximum).

**SET AUTOSAVENO nn**

Returns OK or ERROR

Sets the a postfix number which will be appended to the base filename to construct the filename for data storage. nn is the number (1=50000).

**SET LOGO nn**

Returns OK or ERROR

Sets the logo that will be displayed as the first line of a report. nn is the logo (255 characters maximum).

SET FINAL SUMMARY nn

Returns OK or ERROR

Sets a flag to indicate whether to print a final summary report at the end of a run repeat sequence. nn is the flag (0 = No, 1=Yes).

SET GRAPH REPORT nn

Returns OK or ERROR

Sets a flag to indicate whether to print a graph report after each run. nn is the flag (0=No, 1=Yes).

SET AUTOSAVE nn

Returns OK or ERROR

Sets a flag to indicate whether to automatically save report after each run. nn is the flag (0=No, 1=Yes).

SET MEASUREPOWER nn

Returns OK or ERROR

Sets a flag to indicate whether to display the power bar before taking a measurement (0-NO, 1=Yes).

### Measurements

STATUS

Returns status word

The STATUS command returns a word indicating the type of run information currently present:

0 = Instrument is ready but no results not available e.g. File New menu was used

1 = Measurement started

2 = Measurement finished without error

3 = Results loaded from disk e.g. File Open menu was used.

4 = Run Aborted or some error occurred.

MEASURE

Returns OK, FINISHED or ABORTED

The Measure command initiates a sequence of runs and repeats according to the current test file and setup conditions. OK is returned when the command is accepted. FINISHED is returned when the sequence of runs and repeats has finished. ABORTED is returned if the sequence of runs and repeats is terminate early by the user pressing the F10 button, or if an error occurs during PMD calculations.

MEASURE POWER

Returns Power measured in dB

The Power returned is calculated at the wavelength set in the current test file.

MEASURE LOSS

Returns Loss measured in dB

The Loss returned is calculated at the wavelength set in the current test file.

ABORT

Returns OK

The Abort function stops a run repeat measurement sequence. Results of measurements taken before the abort command is used will be preserved.

Note: If modal dialogs or error messages are shown during a measurement, the ABORT Command will return BUSY

## Results

### READ RESULTS nn

Returns Summary results file nn or Error

The Read Summary command returns the summary results file. nn should specify the results pathname e.g. c:\program files\leg&g\pmd\untitled\_1.txt. The temporary file pmdreport.txt may be specified to download the last run. Note that this file is deleted when the program exits.

### READ PMD

Returns PMD or ERROR

This function returns the pmd calculated for the last measurement. ERROR is returned if the process type is deterministic. A null string will be returned if data is not present.

### READ PMDCOEFFICIENT

Returns PMD coefficient for the last measurement. ERROR is returned if the process type is deterministic. A null string will be returned if data is not present.

### READ PMD2ORDER

Returns the second order PMD for the last measurement. ERROR is returned if the process type is deterministic. A null string will be returned if data is not present.

### READ PMDFIT

Returns the regression coefficient for the last measurement. ERROR is returned if the process type is deterministic. A null string will be returned if data is not present.

### READ PASSFAIL

Returns PASS if the total PMD falls within warning limits or FAIL if the condition does not apply. ERROR is returned if the process type is deterministic. A null string will be returned if data is not present.

### READ TOTALPMD

Returns the Total PMD. ERROR is returned if the process type is deterministic.

### READ PMDERRNO

PMD calculation error code:

0=no error

1-10=pmd calculation error

11=pmd system out of range warning

12=pmd test file range warning

13=pmd per km test file range warning

14=pmd upper and lower range warning

15=no run

### READ PLOTDATA

Returns psec vs intensity data or ERROR.

The command creates a temporary file "RS232DATA.TXT" in the PMD installation directory which contains the data as a large number of comma delimited strings with carriage return line feed terminators e.g. -140.00000, 0.000000 crlf .Up to 40000 of these strings will be present which will take several minutes to transfer via RS232. The transfer may be stopped with the ABORT command.

**READ CALCDATA**

Returns noise corrected psec vs intensity data or ERROR

The command creates a temporary file "RS232DATA.TXT" in the PMD installation director which contains the data as a large number of comma delimited strings with carriage return line feed terminators e.g. – 140.00000, 0.000000 crlf. All intensity values falling below the noise level are set to zero. Up to 40000 of these strings will be present which will take several minutes to transfer via RS232. The transfer may be stopped with the ABORT command.

**READ GAUSDATA**

Returns the random process Gaussian fit psec vs. intensity data or ERROR.

The command creates a temporary file "RS232DATA.TXT" in the PMD installation director which contains the data as a large number of comma delimited strings with carriage return line feed terminators e.g. – 140.00000, 0.000000 crlf. Up to 40000 of these strings will be present which will take several minutes to transfer via RS232. The transfer may be stopped with the ABORT command.

**Other Commands**

RUN nn

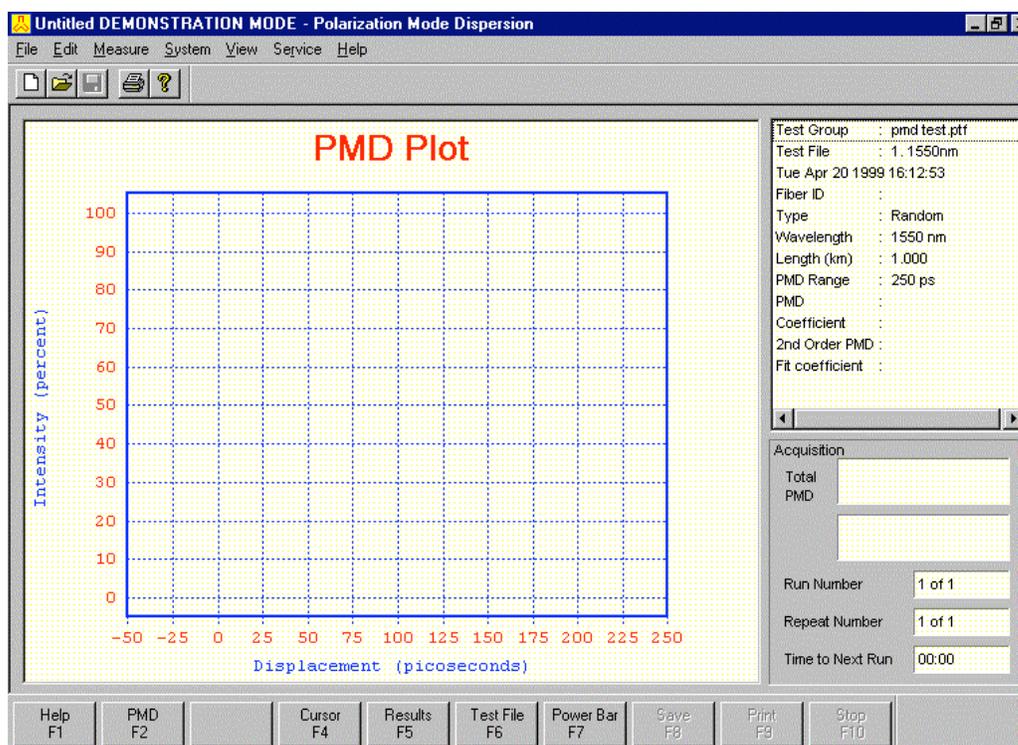
Return OK or ERROR

This command runs an external program called nn

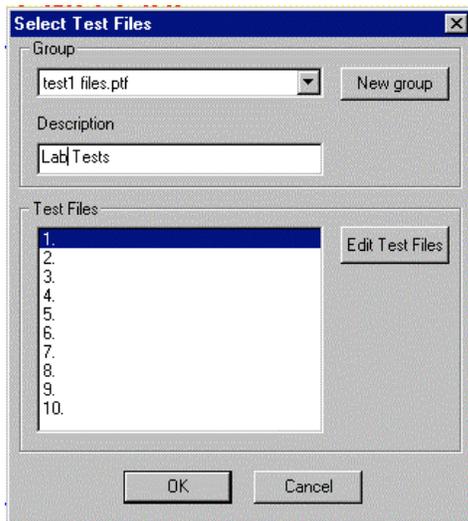
e.g. RUN Notepad c:\program files\eg&g\pmd\untitled.txt

## 2.8 Typical Measurement Sequence

1. Switch on the system as described in section 2.3. The following will be displayed on the computer screen.

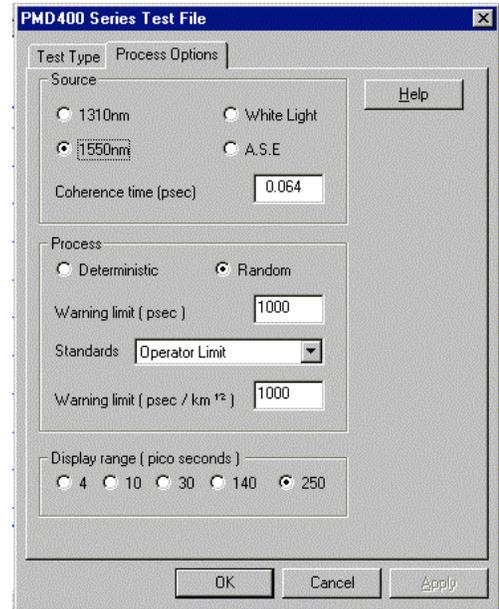


2. Click on “EDIT” and “TEST FILES”. The following box will appear.

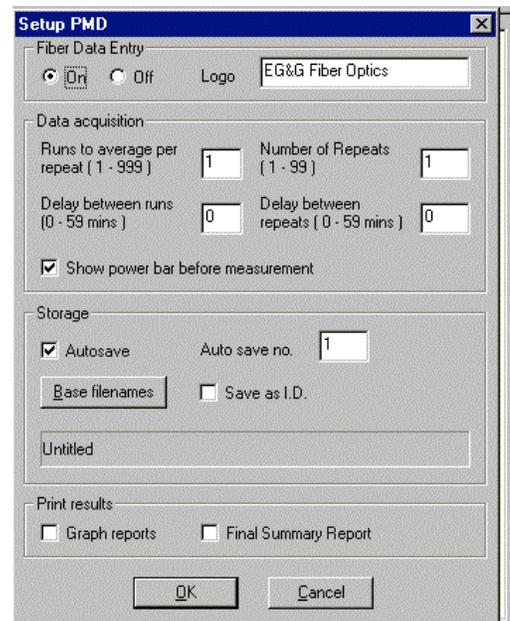


3. Either select a prepared test file or click on “EDIT TEST FILE” to define new test parameters as shown below.

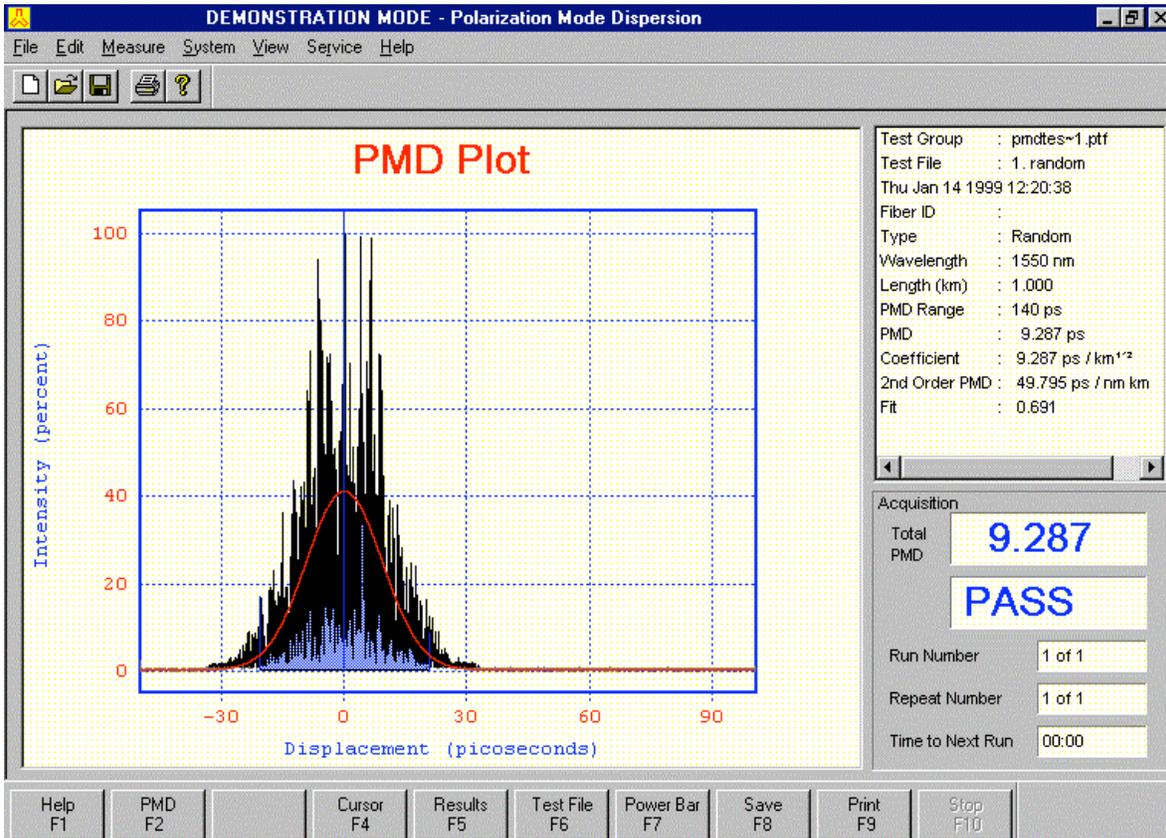
- To change the measurement parameters click on the "PMD method". Select the correct light source to be used with the PMD system, this will automatically select the correct source coherence time.. The "Random" button should be enabled for fiber measurements or the "Deterministic" option for hibi fibers or for some calibration artefacts. Choose the PMD range to be displayed. The PMD range only affects the screen display, the measurement is always made over the full range to prevent erroneous results. Selecting a smaller display range is particularly useful when measuring low PMDs. The warning limits are to enable the software to flash up a PASS/FAIL message if the measurement exceeds these limits, e.g. 40ps for an OC48 system. Set to 1000 to disable the function. Finally click "OK" when finished.



- The final part of the setup is by clicking "EDIT, Setup PMD". The box shown on the right will appear. Fiber Data entry allows you to manually enter fiber details before each entry. The Logo is printed on test sheets etc. The section below allows multiple measurements to be made, up to 99 repeats of 999 measurement runs. Set both to 1 for a single measurement. Clicking "Autosave" ensures that the computer will always save the measured data, the base filename can be set by the associated button on the right as well as the start number. This will be incremented by one for each measurement. The "Print results" button allows for automatic printing after a measurement but must only be enabled if a printer is connected.



- If an SLED light source is to be used with the system, check that the available power does not saturate the PMD440 receiver unit. (The power input to the unit must be less than -18dBm) If this is not the case then the PMD451 optical attenuator must be placed in series with the light source.
- Measuring. Select the PMD key. A fiber details box will appear, if selected as indicated above. The next box shows a power bar to check that the fiber has been correctly connected. Click "OK" when the fiber has been correctly connected and a measurement will be made and the result displayed as shown below. The measurement progress is indicated by a moving bar graph display at the bottom of the screen. Please note that as part of the autoranging function more than one measurement scan can be made. The measurement shows a fiber with a total PMD of 9.287ps. Also shown is the value per root km. The red curve superimposed over the measurement data is a Gaussian curve with the same PMD value as the measured data. It can be used *subjectively* to see how "random" the measured data is. The "fit" value can be used similarly, the closer to a unity value the more random the data.



7. If “Runs” and “Repeats” have been set up the multiple measurements will be made but only the last measurement will be displayed. Use the “View” menu at the top of the screen to display a summary of all the measurements.

## 2.9 Typical PMD File Format for the PMD400 Series

Results are normally stored in a delimited test file for easy importing into an Excel or other spreadsheet. It is possible on the "File" menu to select storage as a normal text file if the data is to be imported into a word processor.

A typical file is as follows:

```
" EG&G Fiber Optics"
" Polarization Mode Dispersion"
" TestTime   : Thu Jul 09 1998 10:04:13"
" Test File  : 2. 1300nm 50 ps"
" Test Group : 1.ptf"
" System ID  : EG&G Fiber Optics PMD400 #1"
" Fiber Length : 2.700 (km)"
" Fiber ID   : a5"
" Message    : 1300nm"
" Report File : A:\a5.txt
" Process     : Random
" Wavelength : 1310 nm"
" PMD Range  : 4 ps
" Auto Save  : Off - Data not saved"
" Run ", " Repeat ", " PMD ", " PMD per ", " PMD 2nd ", " Fit ", " Average ", " Avg PMD ", " Avg. 2nd ",
Acquisition
" No ", " No ", " ", " root km ", " Order ", " ", " PMD ", " /root km ", " Order PMD ",
"
    1, 1, 1.148, 0.698, 0.282, 0.820, 1.148, 0.698, 0.282, " Thu Jul 09 1998 10:04:13
"
```

Imported into a spreadsheet as comma delimited data with a " qualifier the result will be:

EG&G Fiber Optics								
Polarization Mode Dispersion								
TestTime : Thu Jul 09 1998 10:04:13								
Test File : 2. 1300nm 50 ps								
Test Group : 1.ptf								
System ID : EG&G Fiber Optics PMD400 #1								
Fiber Length : 2.700 (km)								
Fiber ID : a5								
Message : 1300nm								
Report File : A:\a5.txt								
Process : Random								
Wavelength : 1310 nm								
PMD Range : 4 ps								
Auto Save : Off - Data not saved								
Run	Repeat	PMD	PMD per	PMD 2nd	Fit	Average	Avg PMD	Avg. 2nd
No	No		root km	Order		PMD	/root km	Order PMD
1	1	1.148	0.698	0.282	0.82	1.148	0.698	0.282

Acquisition
Thu Jul 09 1998 10:04:13

If repeated measurements have been selected there will be multiple rows of results.

# Chapter 3

## POLARISATION MODE DISPERSION BACKGROUND.

This Section describes the background of the measurement of polarisation mode dispersion (PMD) using the PerkinElmer Optoelectronics PMD Measurement System. In particular, the origins and treatment of PMD in optical fibers is discussed, together with a description of the interferometric technique used.

### 3.1 What is Polarisation Mode Dispersion (PMD)?

In a standard telecommunications single mode fiber, there are in fact two orthogonally polarised modes supported by the waveguide structure. The two polarised modes travel with different *phase* velocities (giving rise to birefringence) and also different *group* velocities (giving rise to mode dispersion, known more usually as polarisation mode dispersion or PMD). The intrinsic birefringence is often as a result of core ovality or ellipticity, or from asymmetric thermal stresses frozen-in to the fiber. In standard single-mode telecommunications fiber, the intrinsic birefringence is generally quite low. The result of this is that the two modes are so closely matched in their respective phase and group velocities that external effects, acting on the refractive indices of the glass which makes up the waveguide structure will strongly couple the modes together. It is the random mode coupling connected with the intrinsic birefringence that gives PMD in fibers its unique properties.

Conversely, in high-birefringence or Polarisation-Maintaining fibers (PMF) this birefringence is deliberately made high in order that the external effects are swamped, so that a polarisation-maintenance function is achieved. In this case, the intrinsic birefringence leads to two distinct output pulses of light – one corresponding to the “slow” mode and the other to the “fast” mode. This kind of fiber can be used to produce calibration artefacts to check the repeatability of PMD measurement systems. The total birefringence is proportional to the length of fiber measured and has a single value. If measured on the PMD400 the deterministic option should be selected in the “PMD Method” screen.

In a normal fiber, where birefringence is low, intrinsic effects are of a similar magnitude to the external effects (extrinsic effects), which act as a random set of disturbances to the fiber, each of which is capable of causing significant mode-coupling between the orthogonal modes of the fiber. The mode coupling will depend on the strength and spatial position/orientation of the external effect(s) relative to the intrinsic birefringence of the fiber. These effects are temperature, bending, twist, side pressure etc, which occur naturally in most installed fiber cables, in an uncontrolled and generally random manner.

Since mode coupling is an almost random phenomenon, the apparent group velocity differences between the modes are 'smeared' resulting in a random distribution of light pulse arrival times. Alternatively the light can be considered as packets that have travelled in random proportions of total travel time in each of the two modes (coupling across from one to the other at a random set of disturbances). Packets will spend time more time, or less time, in each mode, but with some variation in proportions. Individual packets will arrive sooner or later than the mean arrival time of all the packets. PMD is a measure of this mean value but it will vary instantaneously in value.

The strength of the mode coupling has a significant effect on the width of any pulses sent down the fiber and hence the bandwidth of the transmission medium. Weak coupling would act only slightly upon the intrinsic birefringence of the fiber, so the output pulse width could be quite wide- almost equal to the intrinsic PMD. Conversely, strong mode coupling can act strongly upon the intrinsic birefringence, mix the fast and slow modes and so reduce the pulse width. That is, strong mode coupling gives low PMD. In this case there is almost the same propagation delay for all input polarisation's, and no “memory” of what that

input polarisation state was in the output light. Mode coupling is an extremely important component in the development and understanding of PMD in fibers.

The random mode coupling in a fiber has the effect of creating new orthogonal states (referred to as Principal States of Polarisation (PSP's) or Eigenmodes), which no longer bear any relation to the original (intrinsic) modes of the fiber waveguide. The differential group delay (DGD) between these two states is the instantaneous PMD. Polarisation dispersion is defined as the RMS DGD between orthogonally polarised light paths in the fiber over a given averaging regime.

Since the modes are continually randomly coupled together, the PMD builds up along the fiber with a square-root length dependence. Thus PMD is measured in units of ps/ $\sqrt{\text{km}}$ . Generally, the effect of PMD is small compared to chromatic dispersion, except when operating near the dispersion zero. The network systems which operate near this dispersion zero include high bit-rate submarine or long haul systems, especially those using optical amplifiers. It is in these systems and also analogue (CATV) transmission that PMD plays a significant role. PMD can be related from fiber to cable, but only in cases where production and design are stable, well-controlled and where a large sample of measurements has been taken to build up a "mapping function" from fiber to cable. Even then, statistical uncertainty limits must be given.

To summarise:

- PMD stands for Polarisation Mode Dispersion
- PMD limits fiber bandwidth
- PMD can be affected strongly by external "mode coupling" influences such as bending or twisting.
- PMD is a randomly varying quantity in fibers
- PMD is quantified on a statistical basis; this means that the actual PMD at a given moment in time can vary above or below the nominal PMD value determined from a measurement.

### 3.2 Second Order PMD.

First order PMD of course represents a primary bandwidth limitation in fiber transmission. This is now part and parcel of link power/bandwidth budgeting. However, the variation of the DGD between PSP's as wavelength varies can also cause bandwidth limitation, in the form of "second order PMD", called PMD2 for short. Here's how:

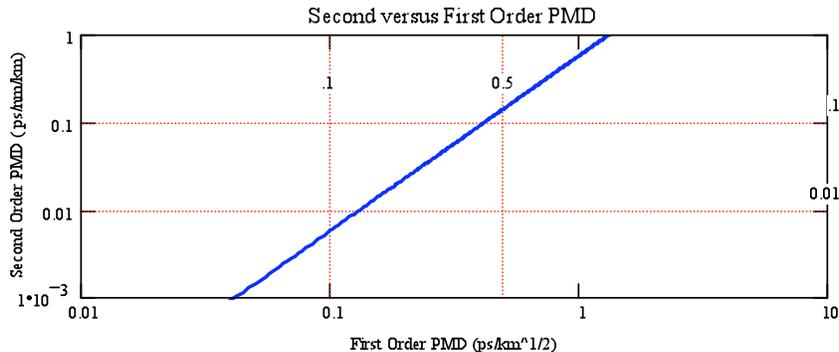
As the DGD varies rapidly with wavelength, obviously, if a laser is used which has variable frequencies (or is modulated and/or has chirp), then DGD will similarly be modulated. This appears to all intents and purposes like a form of chromatic dispersion (CD). Hence, the variation of DGD with wavelength is also important as well as the DGD level itself. It is possible to show that the PMD2 builds up linearly with length in a long strongly coupled fiber. Thus PMD2 has units of ps/nm/km, just like CD. PMD2 has a mean value of zero, but remember again that this is a statistical parameter, with again no memory of the input state of polarisation. The instantaneous value of PMD2 may be positive or negative. Therefore for system CD budgeting, the maximum *numerical* total CD plus PMD2 must be taken as the design parameter.

It is possible to relate PMD2 directly to first order PMD. FOR A LONG-LENGTH FIBER WITH STRONG MODE COUPLING a very simple relationship pertains between the RMS PMD2 and RMS PMD:

$$\text{Second Order PMD ( in ps/nm/km)} = \frac{\{\text{First Order PMD ( in ps/\sqrt{km})}\}^2}{\sqrt{3}}$$

Figure 3-1 shows this relationship in a log-log format.

**Figure 3-1 Second Order PMD in relation to first order PMD.**



Note the current fiber specification level 0.5 ps/ $\sqrt{\text{km}}$  is marked and such a fiber has ~0.1 ps/nm/km additional chromatic dispersion. While for state-of-the-art fibers of 0.1 ps / $\sqrt{\text{km}}$ , the additional chromatic dispersion is less than 0.01 ps/nm/km.

Thus for a fiber with 1 ps/ $\sqrt{\text{km}}$  PMD (RMS), will have 0.7 ps/nm/km PMD2 (RMS). Note that this PMD2 adds directly to the normal chromatic dispersion of the fiber.

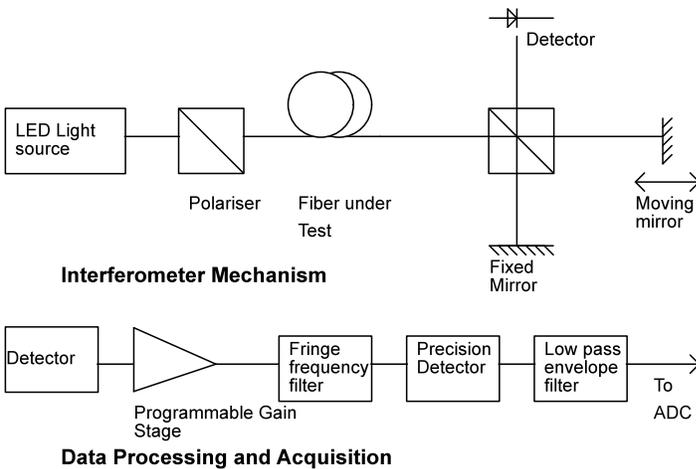
Second Order PMD (PMD2) is a natural consequence of PMD in a fiber. The value of PMD2 is statistically variant, like PMD, and is governed by a distribution. There is a simple relationship between PMD and PMD2, which may be used for strongly mode-coupled fibers. The working "safety factor" for PMD2 is typically five. PMD2 is only likely to be a problem in high-PMD fibers.

### 3.3 The Interferometric Technique and the PMD400 Series

The interferometric technique has been accepted for PMD measurement by the TIA and ITU. This method is described in TIA FOTP 124.

The interferometric technique uses a polarised light source and an interferometer as the receiver.

The test fiber is excited by a linearly polarised light source typically comprising a 1310nm or 1550nm LED plus a polariser effective over the operating wavelength region. The polariser has a typical extinction ratio of over 30dB to meet the TIA recommendations of >20dB. In addition the source spectral shapes are approximately Gaussian to ensure a smooth autocorrelation function that can be subtracted from the measured fiber result. The spectral width of these sources directly affects the minimum PMD measurable. Typically values of 0.065ps are achievable at 1550nm and slightly less at 1310nm. This will result in a minimum accurate PMD measurement of 0.1 to 0.15ps. The maximum PMD range is defined by the FOTP as one third of the maximum delay measured. For the 250ps range of the PMD440 this would give a maximum PMD of 83ps. In practice measurements up to 100ps can be made with only small errors.



**Fig. 3-2 Interferometer Block Diagram**

The receiver consists of a Michelson interferometer. This is implemented mainly in fiber but the variable optical path is accomplished in air by moving a mirror over a range of approximately 55mm. As the mirror is moved fringes of varying amplitude will be seen by the detector diode. The envelope of these detected fringes is utilised to provide PMD information. When the two arms of the interferometer are of equal length the amplitude of the interference fringes will reach a maximum. This central autocorrelation peak is used to determine the zero time delay position for the interferometer.

Where PMD exists in the fiber connecting the light source to the interferometer this additional delay will cause the interferogram to be broadened in proportion. In the case of a highly mode coupled fiber excited by a single state of polarisation a quasi-Gaussian distribution of time delays will be produced and the PMD will be equal to the second moment of this distribution.

The pulse broadening may also be normalised for fiber length that is entered manually at the start of the measurement by the user. In fact, because of the strong mode coupling that normally dominates the intrinsic effects, the length dependence is not linear but generally increases in proportion to the square root of fiber length. Thus PMD is quoted in  $\text{ps}/\text{km}^{1/2}$ .

For a simple birefringent artefact such as hi-bi fiber two responses will be produced, one on either side of the central autocorrelation peak. The time delay between the central peak and either of these responses will give the delay of the artefact. The PMD for such devices is proportional to length, not the square root of length as for a highly mode coupled fiber.

# POLARIZATION MODE DISPERSION

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## **WHAT IS POLARIZATION MODE DISPERSION?**

**Polarization Mode Dispersion (PMD)** is an effect caused by a single mode optical fiber supporting two forms of light, each having a separate polarization state. Silica, the major constituent of optical fibers, exhibits a property called *birefringence*. Birefringence causes these two polarization states described above to travel at slightly different velocities.

Imagine a pulse of light travelling in the fiber. This will be split into two pulses, each of a different polarization state. As they move down the fiber they will travel at slightly different velocities, as determined by the fiber birefringence. At the far end of the fiber this velocity difference will cause the two pulses to arrive at slightly different times. A sharp pulse at one end of the fiber will therefore be gradually spread out by the time it reaches the far end. This pulse broadening is known as *dispersion*.

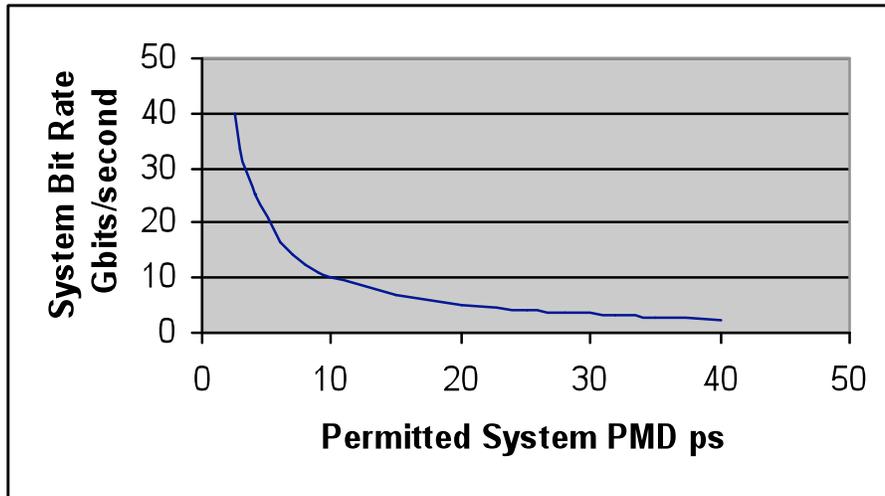
A digital signal consists of a rapid stream of pulses, if excessive dispersion causes one pulse to run into the next (intersymbol interference) it will be difficult for the system electronics to separate them out and errors will be caused. This increase in bit error rate is the major effect of PMD.

One thing separates out PMD from other fiber characteristics. The fiber birefringence is affected by stresses on the fiber caused by the cabling process, the installation environment and temperature fluctuations. *PMD therefore changes with time, cable design and location*. Measurements are only repeatable to within 10-15% and are given as average values in picoseconds per square root of the length (normally in KM).

## **PMD LIMITS FOR DIGITAL SYSTEMS**

The usual guide for PMD is for the dispersion to be less than one tenth (10%) of the time between adjacent pulses in the digital system (the bit period). Theoretically, PMD in excess of 10% of the bit period may cause the transmission system to exceed its designed error rate. One thing to remember is that this is only a guide. Some systems will work with PMD levels considerably higher than this limit. The overall system error rate will depend on the system noise, chromatic dispersion and the actual performance of electronics rather than the target specification for PMD.

The chart below shows the PMD limit for various systems.



System Type	Bit Rate (Gbits/s)	PMD Limit (ps)
OC-48 SDH16	2.5	<b>40</b>
OC-192 SDH64	10	<b>10</b>
OC-768 SDH256	40	<b>2.5</b>

Practically if you are installing OC-48 systems you need to be aware of PMD and you *may* have problems. For OC-192, PMD will limit the fibers that can be used. And at the moment, it is fortunate that OC-768 systems are still at the laboratory stage as few fibers in the current network will support it!

## **WHO NEEDS TO MEASURE PMD?**

Anyone who is installing or using digital systems of 2.5Gbits/second (OC-48) or above should measure PMD. At the moment this tends to be for links between towns and cities but increasingly metropolitan routes will be operated at these rates as the demand for bandwidth increases.

There is now a great awareness of PMD with fiber and cable makers and recently manufactured cables have PMD levels of 0.5ps per root KM or less. 0.2ps is becoming an accepted limit. At the lower limit of 0.2ps an amplified cable can be 2500KM long before the 10ps OC-192 limit is reached ( $0.2 \times \sqrt{2500} = 0.2 \times 50 = 10\text{ps}$  total). As long as one is sure that new cables meet these limits PMD should not be a problem. With older, installed cables the situation can be much worse. Until recently PMD was not recognized as a potential problem and not measured. Any carrier will want to use the installed network to its maximum capability and many of these cables will contain fibers with very high PMD.

Fibers have been found in all parts of the world with PMD values in the range of 6 to 40ps over 100KM or less of cable. Many of these fibers will not support OC-48 or OC-192 systems or will give high error rates under certain circumstances. Within most carriers' networks there will exist numbers of these suspect fibers. These can either be found by measurement using the PMD440, or by the system failing on installation or during operation.

Another group of people interested in PMD measurements are the system providers. They have to specify a PMD operating limit for their systems and it is also in their interest to be able to make field measurements in case of disputes with customers. If a system is not performing correctly the source of the problem has to be located.

## **WHAT CAN YOU DO ABOUT PMD?**

First you need to check out your network to characterize the cable loss, reflections, chromatic dispersion and PMD. This will enable the you to estimate the maximum bit rates that can be used over the fiber. If this will enable your traffic growth plans to be met then there is not a problem. If this is not the case then there are three options:

1. Use regenerators in the system. These will re-time the signal and eliminate problems due to PMD and Chromatic Dispersion. This option is expensive and will only work at one bit rate.
2. Use wavelength division multiplexing. Instead of one OC-192 system, operate four channels at OC-48 to get 10Gbits/sec. Again, this is costly but your system can be upgraded to more channels in the future.
3. Install a new cable. This will ensure you have the right transmission medium for your system. This may be the most costly option of all.

Economics will decide, but Option 2 currently appears to be the most popular.

\* \* \*

# **PMD440 REMOTE CONTROL USING SYMANTEC PCANYWHERE**

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## What is Symantec pcANYWHERE

pcANYWHERE is a communications software package designed to allow remote control of one PC from another, and includes the ability to transfer disk files to and from the PCs. When used with the PMD400 or PMD440, the PC running the PMD400 or PMD440 software runs the pcANYWHERE program and is configured as a host computer. Once configured, it may be accessed by a remote PC also running pcANYWHERE. The PMD400 series software runs on the host PC but all screen views, mouse and keyboard operations are reflected onto the remote PC, allowing the remote operator to control the PMD 400 series instrument using the remote keyboard and mouse.

## Connecting a host and remote PC together

The host and remote PCs may be physically connected by a number of cable connection options. These include short direct parallel port and serial port connections, and longer distance modem - phone lines and networks. When controlling the PMD440 over distances greater than a few metres it is recommended that either a network or modem-phone line connection is used.

A network connection requires that both the PMD400 series host and the remote PC are connected to a network. This installation will require a network card and appropriate network support software to be installed in both PCs. TCP/IP, Netware IPX/SPX, NetBios, Banyan Vines, ISDN, and Netware Connect (NASI) connections are supported.

A modem connection requires a modem to be configured on each PC. A recommended option is to utilise an external modem on the PMD 400 series host PC, connecting it to the serial port. This provides a robust physical connection for reliable operation.

The pcANYWHERE software recognizes the hardware options available on the PC and provides "connection wizards" to allow the connection options to be setup and configured.

## Main Functions in pcANYWHERE

When the pcANYWHERE program is run a main window is displayed showing eight buttons, six of which correspond to the primary functions of pcANYWHERE.

Quick Start: Displays a wizard for each of the primary functions. The wizard is an executable file that automatically prompts you for information necessary to accomplish the related task. The button configures "Be a Host PC", "Remote Control", "File Transfer", "Be A Gateway", and "Call On line service" options.

Be a host PC: Creates a list of one or more host connection items, establishing the computer as a host to be accessed by a remote PC. Each connection item configures a communications protocol, to be used for the connection between the host and remote PC. This includes modem selection and phone numbers selection etc.

Remote Control: Creates and manages a list of one or more remote sessions allowing a host to be selected and controlled from the PC. Once selected, the host PC screen appears as a window or full size on the remote, and the remote keyboard and mouse may be used to control the host PC. Files may be transferred between the PCs in this mode of operation.

File Transfer: Establishes a connection with a host and displays a file manager showing directories on the host and remote PC. Files may be selected and transferred between PCs.

Be a Gateway: Establishes a PC as a gateway on the network, allowing its communication device to be shared by the PCs on the network. It allows remote users to access a pcANYWHERE host on the network via the gateway modem.

Remote networking: Establishes the PC as a remote node on a network with access to network files and directories, as if it was connected to the network directly. Performance is restricted by the relatively slow speed of telephone lines compared with direct local area network connections however.

Call On-line service: Connects to bulletin board services and external information services such as CompuServe.

### Configurable options

In addition to the six main functions, pcANYWHERE provides a number of utilities that simplify or automate the remote control and file transfer processes. These include:

1. The PMD 400 series PC may be configured to power up into the host mode.
2. The host PC screen may be blanked to improve security.
3. The host keyboard and mouse may be locked to improve security.
4. Password protection may be used to prevent unauthorized users from canceling a waiting host.
5. Remote users may be established with access privileges including ability to blanking the host screen, canceling the host, uploading files, downloading files, and specifying hard drive access.
6. The host PC may be restarted under command from the remote.
7. Messages may be passed between the host and remote in a "chat mode".
8. Files may be automatically transferred to and from the host, or synchronized on both the host and remote. A user defined AutoXfer procedure controls this process. This may be executed automatically when the host and remote initially connect at the start of a session, or at any time on command from the remote.

### System requirements

#### Hardware:

A PC of the following minimum specification is recommended to operate the pcANYWHERE software:

486 or higher processor, 8MB ram or higher, SVGA or higher resolution display adapter, hard disk drive, CD ROM drive, 20MB free hard disk space.

To optimize screen displays, it is recommended that windows is configured for a 256 color palette in the control panel display configuration item using 800 x 600 screen resolution.

#### Software:

Windows, and Symantec pcANYWHERE 32 version 8.0

The software license permits pcANYWHERE to be installed on two PCs, one to be used as a host, the other to be used as a remote.