PM-1100

Optical Power Meter

Instruction Manual

Second Edition

P/N: MAN-099-I .2ACE

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

If the equipment described herein bears an **FCC** *statement, the said equipment complies with the relevant Federal Communications Commission standards.*

December 1999

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Certification Information

F.C.C. Information to User

This unit has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 (Subpart B) of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This unit generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this unit does cause harmful interference to radio or television reception, which can be determined by turning the unit off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the unit and receiver.
- Connect the unit into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

WARNING

Changes or modifications not expressly approved by EXFO Electro-Optical Engineering, Inc. could void the user's authority to operate the unit.

- This unit is equipped with a shielded 3-wire power cord and plug. Use this power cord in conjunction with a properly grounded electrical outlet to avoid electrical shock and to reduce radio frequency interference which may emanate from the power cord.

- Shielded remote I/O cables, with properly grounded shields and metal connectors, are recommended to be used in order to reduce radio frequency interference which may emanate from these cables.
- This unit is equipped with a shielded GPIB cable for GPIB remote operation.

POWER METER PERFORMANCE VARIATION

In a 3 V/m radiated field (26–1000 MHz, 80% AM modulation with a 1 kHz sine wave) or with a conducted RF field of 3 V (0.15–100 MHz, 80% AM modulation with a 1 kHz sine wave), readings may vary by ±0.1 µW.

INDEPENDENT LABORATORY TESTING

This unit has undergone extensive CE certification testing both internally, at EXFO, and externally, at an independent, qualified laboratory. All pre-qualification tests were performed at EXFO while all final tests were performed at UltraTech Engineering Labs, Inc., a renowned test laboratory from Mississauga, Canada. This guarantees the unerring objectivity and authoritative compliance of all test results.

CE INFORMATION TO USER

This unit has been tested and found to comply with the limits for a Class B digital device. Please see the Declaration of Conformity.

CSA INFORMATION TO USER

This unit received CSA certification under the model name “GO”. The CSA Certificate Number is LR 107723. The “C-US” indicator adjacent to the CSA Mark signifies that the product has been evaluated to the applicable ANSI/UL and CSA Standards, for use in the U.S. and Canada.

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1 Introduction

The PM-1100 Optical Power Meter provides accurate power measurements over a wide dynamic range with high resolution and excellent linearity. It is particularly suitable for automated measurements.

The built-in memory lets you store up to 20 preselected wavelengths of the sources under test. The wavelength value is used both to correct power readings and tag stored results.

As many as 10 different user setups may be programmed, each allowing up to 20 wavelengths. You can manually store 512 readings (power level, wavelength, and offset), or 1024 readings using a programmed sequence.

Three models are available. The PM-1101 uses a Si detector for the 450 nm to 1100 nm range, and the PM-1103 uses an InGaAs detector to cover 800 nm to 1700 nm. Both offer a dynamic range of +9 dBm to -100 dBm. The high-power PM-1102X uses a selected germanium detector to cover 750 nm to 1700 nm from +25 dBm to -75 dBm.

The PM-1100's large display can be easily read from a distance or in poor ambient lighting conditions.

Standard GPIB and RS-232 interfaces permit the PM-1100 to be controlled remotely from any compatible PC or test station. Optional rack mount is available.

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2 General Description

Front Panel

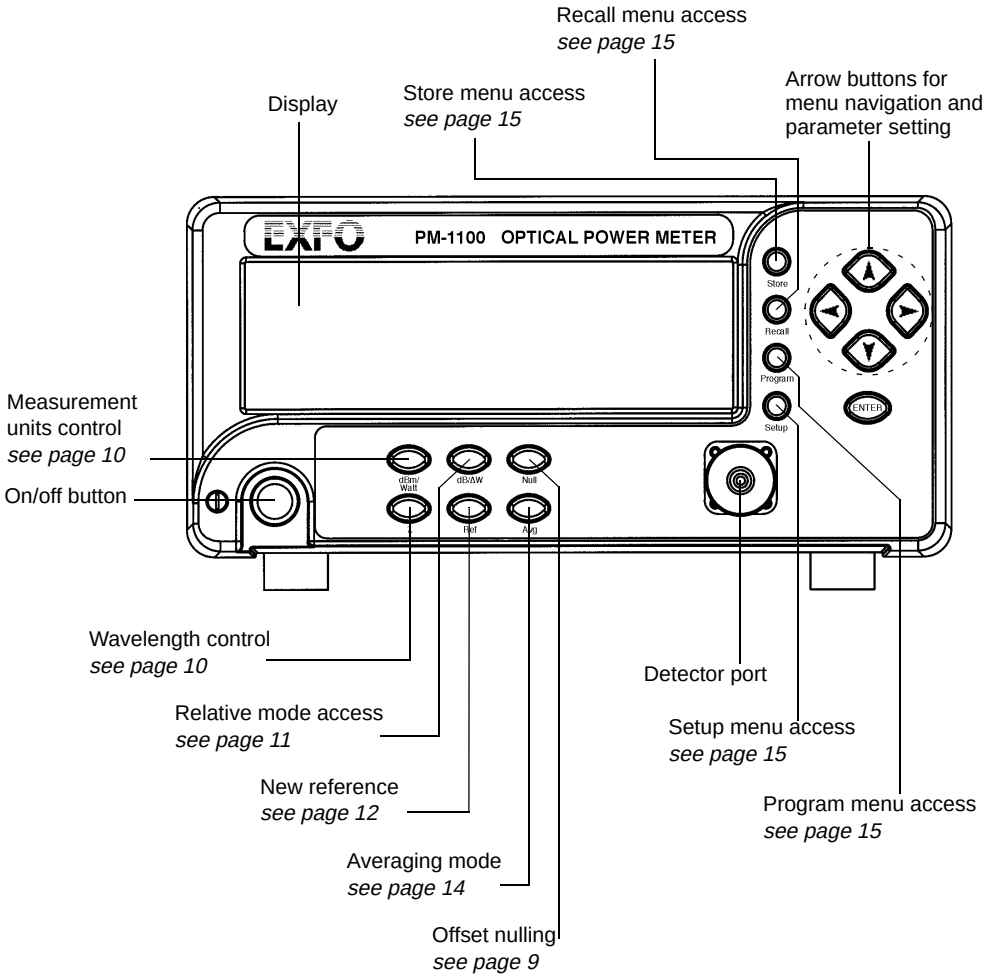

Figure 2-1. *Front Panel*

Note: *Your PM-1100 may slightly differ from the illustration.*

Back Panel

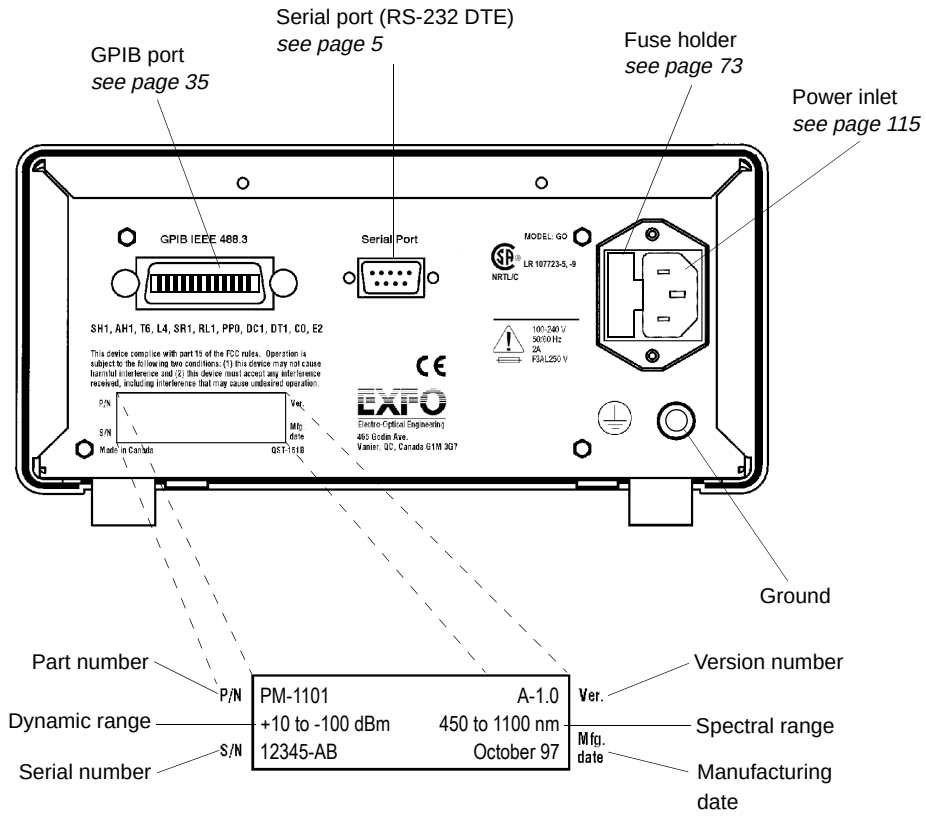

Figure 2-2. *Back Panel*

Note: *Your PM-1100 may slightly differ from the illustration.*

RS-232 Connector Pinout

The RS-232 connector (serial port) at the back of the PM-1100 uses a DTE pinout configuration.

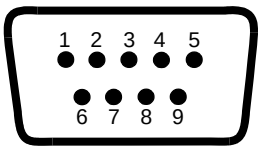

Figure 2-3. *RS-232 Connector Pinout*

Pin	Description	Direction
2	Receive (Rx)	Input
3	Transmit (Tx)	Output
5	Signal ground (Gnd)	—

Table 2-1. *RS-232 Pinout Configuration*

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3 General Safety Information

Safety Conventions

The following conventions should be understood before operating the unit:

WARNING

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

CAUTION

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

IMPORTANT

Refers to any information regarding the operation of the product which should not be overlooked.

Safety Instructions

Operation

WARNING

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

CAUTION

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

CAUTION

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

Power Cable

WARNING

To avoid electrical shock, do not operate the unit if there are signs of damage to any part of the outer surface (covers, panels, etc.).

To avoid serious injury, the following precautions must be observed before powering on the unit.

Maintenance

IMPORTANT

When the module is not being used, the protective cap should be fitted over the detector port.

Fuse Replacement

This symbol, found at the back of the PM-1100, indicates that the user should refer to the instruction manual for fuse replacement.

4 Basic Operation

Turning On and Off the PM-1100

Before turning the PM-1100 on, please read *General Safety Information,* on page 7. To turn the unit on and off, use the red button in the lower left corner of the front panel.

At power-up, the unit beeps twice and performs a self-test. Before taking any measurements, it is recommended that you null the detector offsets (see *Offset Nulling*). When the unit is turned off, the following items remain in non-volatile memory:

- manually stored data
- acquisition data
- reference values
- remote control settings
- shortlisted wavelengths
- customized settings
- saved configurations (up to 10)

Note: *The power cord is the most effective disconnect device. To ensure the power is completely turned off, disconnect the power cord.*

Offset Nulling

It is recommended that you null the detector offsets before every test session and after any environmental change (temperature and humidity variations affect the performance of optical detectors).

IMPORTANT

Light must not reach the detector when nulling offsets.

1. Place protective cap over detector port.
2. Push *Null*. The offset nulling process takes approximately 90 seconds. Once done, the unit returns to the previously active operation state.

If you are trying to perform an offset nulling with the protective cap improperly tightened on the detector port, the message *PUT CAP* will flash on the display. When *PUT CAP* is displayed, ensure the protective cap is properly tightened and press *Null* to resume the offset nulling process or press *ENTER* to cancel the offset nulling.

Note: *Offset nulling constants are retained until a new offset nulling is performed.*

Measuring Absolute Power

Press dBm/Watt to display the absolute power of the signal received at the detector port. dBm/Watt is also used to toggle between dBm and watts measurement units. When using watts measurement units, the PM-1100 will automatically use pW, nW, μW, or mW, according to the power of the signal. Press λ to toggle between the wavelengths in the shortlist (to edit the shortlist of wavelengths, see *Customizing the Shortlist of Wavelengths,* on page 26).

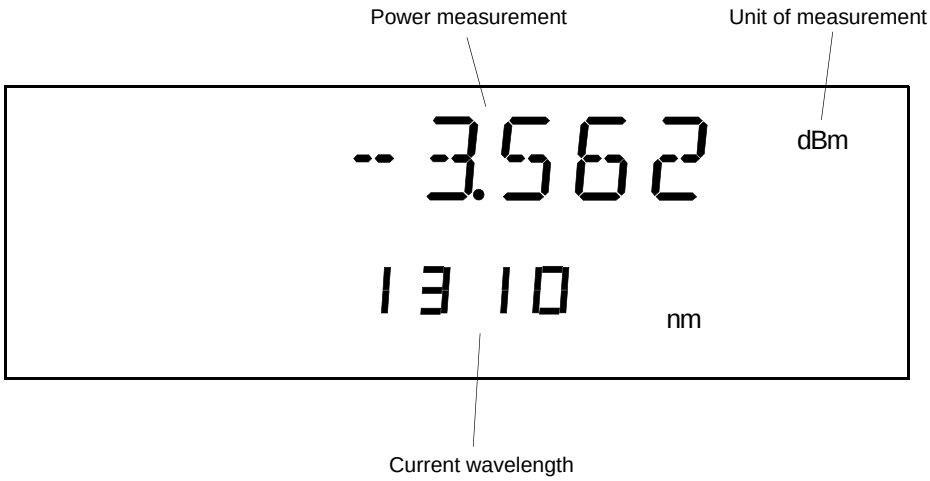


Figure 4-1. *Display in Absolute Mode*

Note: *"--------" indicates a reading below range. "++++++++" indicates a reading above range.*

Relative Power

In relative mode, the PM-1100 compares the power of the signal received at the detector port to a preset reference value in dBm or watts. The relative power is equal to the absolute power minus the reference value, therefore

- a negative measurement indicates that the received power is below the reference value, and
- a positive measurement indicates that the received power is above the reference value.

To activate relative mode, press *dB/ΔW*. Once in relative mode, pressing *dB/ΔW* switches between dBm and watt measurements units for the relative power and reference value. If necessary, press λ to toggle between the wavelengths in the shortlist (to edit the shortlist of wavelengths see *Customizing the Shortlist of Wavelengths,* on page 26).

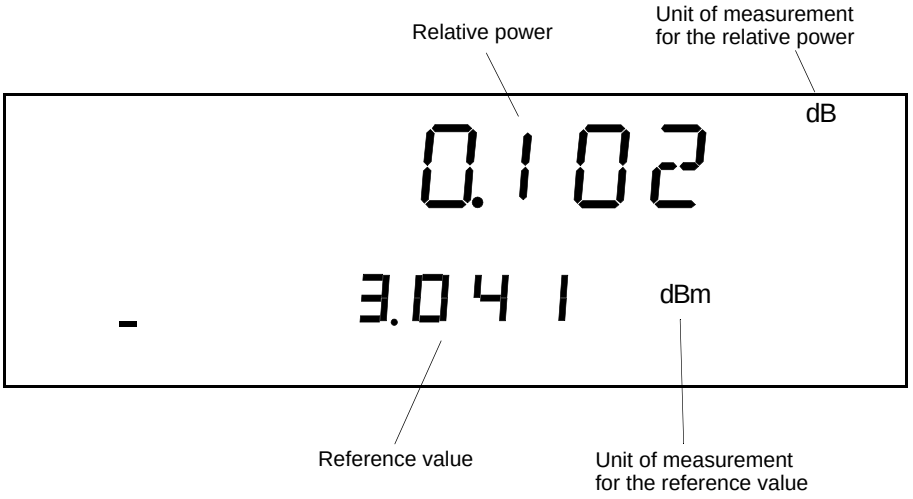


Figure 4-2. *Display in Relative Mode (in dB)*

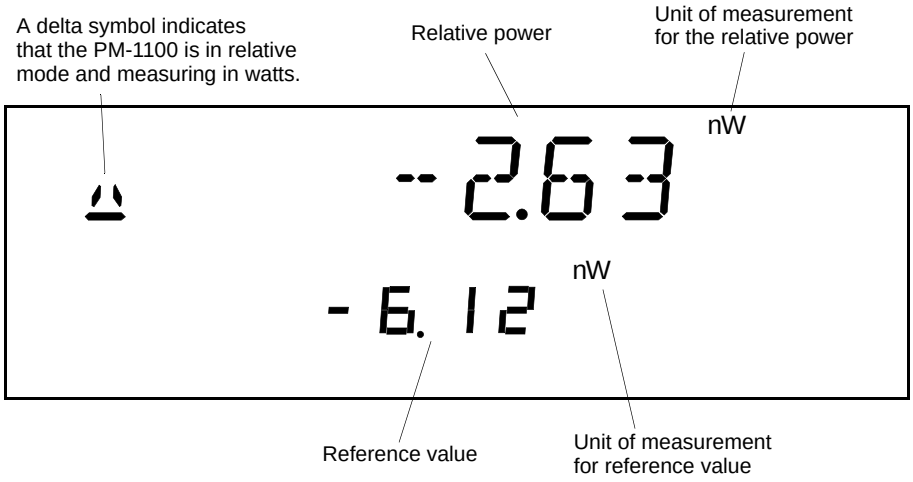


Figure 4-3. *Display in Relative Mode (in watts)*

When you access relative mode, the PM-1100 displays the last reference value entered at the current wavelength. One reference value can be stored for each wavelength in the shortlist and will remain in memory until a new reference value is stored at the same wavelength. However, if you use *dB/ΔW*, the reference value will be converted from dBm to watts (and vice versa) when the measurement unit of the relative power toggles between dB and watts.

Note: *If you set a reference while an offset is active, the reference measurement will take into account the offset (only when using dB measurement units).*

Entering the Current Power as the Reference Value

The power of the signal currently received at the detector can be stored as the reference value.

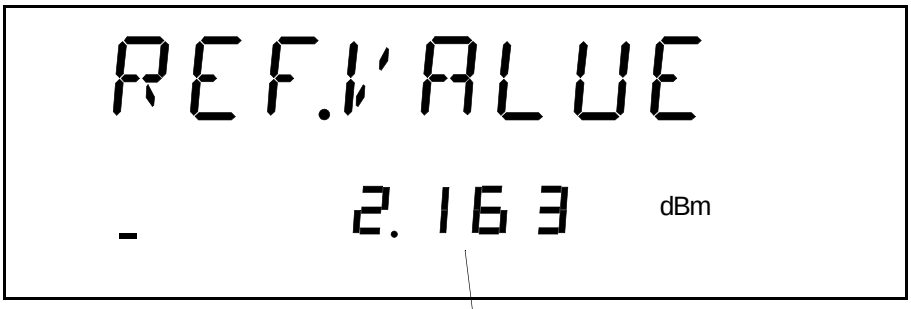
1. Use λ to select the wavelength.

2. Use *dBm/Watt* to select the measurement units.

3. Press *Ref*.

Entering a Specific Reference Value

1. Use λ to select the wavelength.
2. Select the measurement unit using *dBm/Watt.*
3. Press *Setup*.
4. Scroll (left/right arrows) to *REF.VALUE.*



Current reference value for the selected wavelength and in the selected measurement unit

5. Press *ENTER*. The first segment of the current reference value will start flashing.
6. Enter a new reference value. Use the up/down arrows to change the flashing segment and left/right arrows to activate the next segment.
7. Press *ENTER*.

Note: *Any value outside the PM-1100 measurement range will be rejected. The unit will beep and you will be prompted to enter a new value.*

8. To exit the *Setup* menu, press *Setup*.

Average Mode

Choose *Avg* in order for the displayed power measurement to be averaged or not. When the average mode is enabled, the eight most recent measurement samples are used to compute an unweighted average. This average is displayed as the measured value. *Avg* is also displayed in the upper right corner, indicating that the average mode is enabled.

5 Advanced Functions

The blue buttons to the right of the display give access to single level menus: *Store*, *Recall*, *Program*, and *Setup*. The following diagram shows the menus and their items.

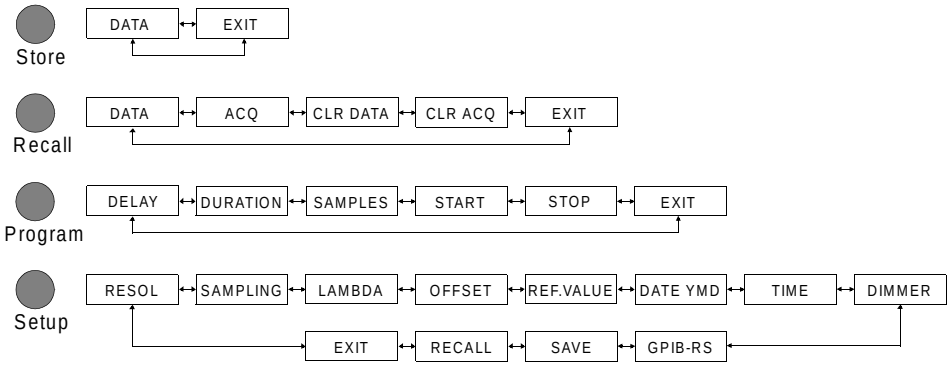


Figure 5-1. *Menu Diagram*

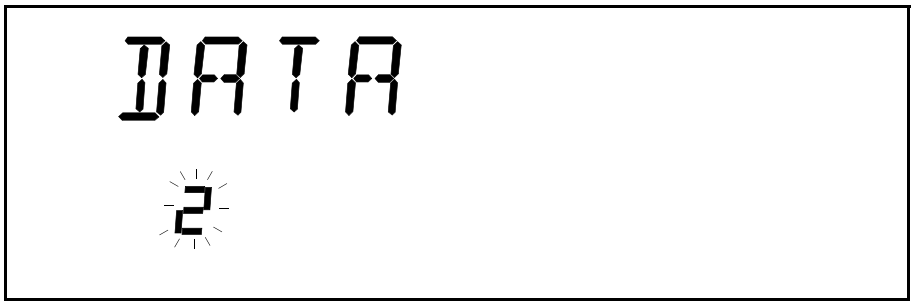
To move (in loop) between the menu items, use the left/right arrows. To exit a menu,

- ➤ press the button that gave access to the menu, or
- ➤ scroll (left/right arrows) until *EXIT* is displayed, then press *ENTER*.

Storing Data Manually

The PM-1100 has 512 memory registers to manually store absolute or referenced measurements. To store a measurement,

1. With the desired measurement on the screen, press *Store*. A register number will be suggested (flashing).



Note: *The suggested register number automatically increments each time you store a measurement.*

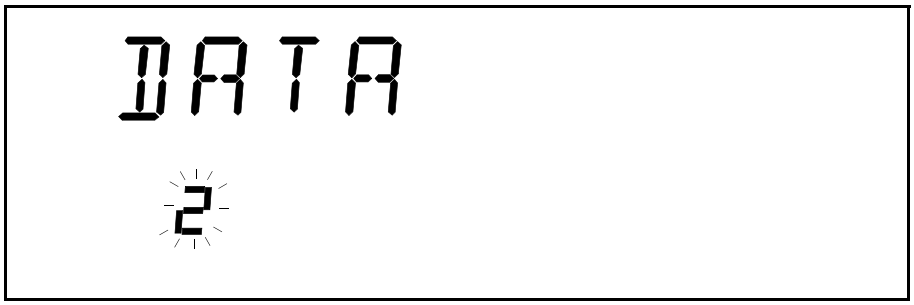
Note: *You can select another register number using the up/down arrows.*

2. Press *ENTER* to store the measurement in the flashing register. The unit automatically returns to measurement mode.

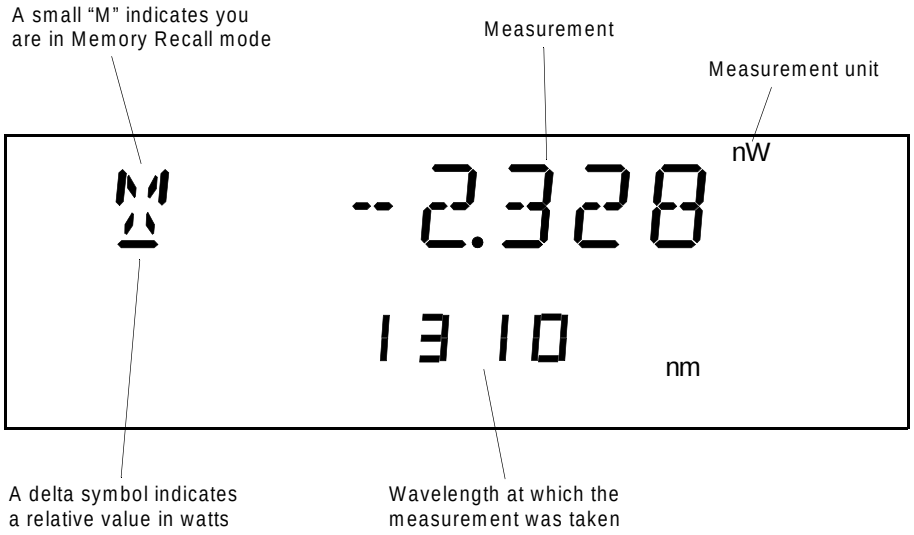
Recalling Manually Stored Data

The data you stored manually (see *Storing Data Manually,* on page 15) can be recalled one register at a time.

1. Press *Recall*. You will see the following display with a register number flashing.



2. Using the up/down arrows, scroll to the register number you want to view.
3. Press *ENTER*. The selected register will be displayed.



Note: *A dashed line with no unit of measurement indicates an empty register. A dashed line with the wavelength and the units of measurement indicates a reading below range. "++++++++" indicates a reading above range.*

➤ To view another register, press *ENTER*. The next register will be suggested (flashing). If necessary, scroll (up/down arrows) to the desired register number. Press *ENTER* again to display the contents of the register.

Tip: *You can press* ENTER *repeatedly to quickly scan the measurements in adjacent registers.*

➤ To exit the *Recall* menu, press *Recall*.

Erasing Manually Stored Data

The manually stored data (up to 512) can only be erased as a group.

1. Press *Recall*.

2. Scroll (left/right arrows) to *CLR DATA*.

IMPORTANT

After you press *ENTER*, all the manually stored data in the 512 registers will be deleted without any other warning.

3. Press *ENTER*.

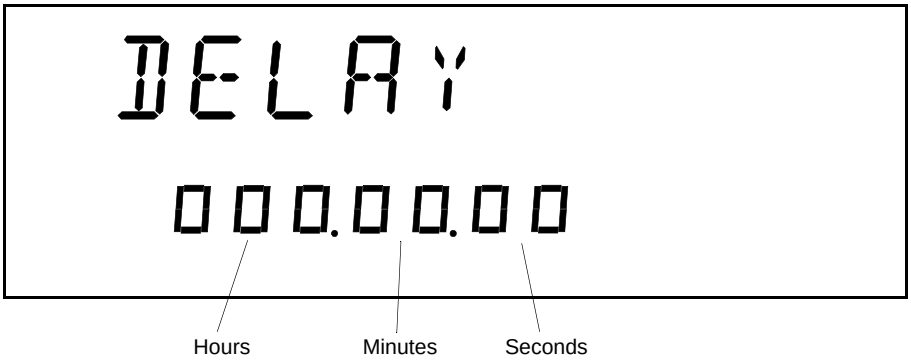
4. To exit the *Recall* menu, press *Recall*.

Programming an Acquisition

You can program the PM-1100 to automatically acquire absolute or referenced measurements. The following program parameters may be set:

- delay: the beginning of the program may be delayed by up to 999 hours, 59 minutes, and 59 seconds;
- duration: the program can last up to 999 hours, 59 minutes, and 59 seconds;
- number of samples: up to 1024 samples can be taken (depending on the selected duration).

1. Press *Program*. You will see the following display:

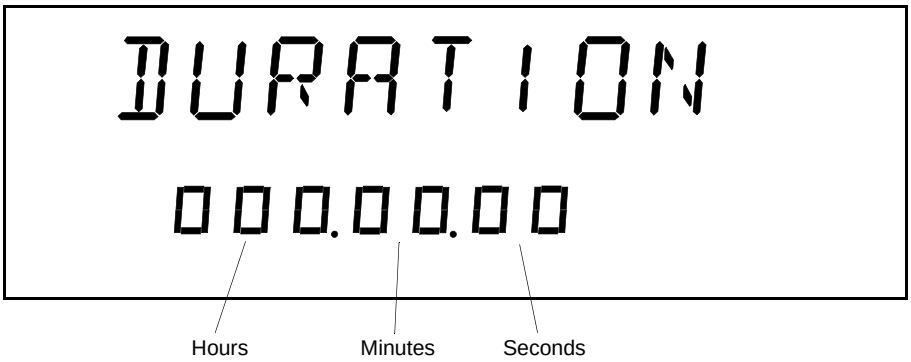


2. Set a delay (if you do not want the acquisition to be delayed, leave the delay value at *000.00.00*).

2a. Press *ENTER*. The first digit will start flashing. Use the up/down arrows to change the flashing digit and the left/right arrows to activate the next digit.

2b. Once the delay is set, press *ENTER*.

3. Press the right arrow. You will get the following display.

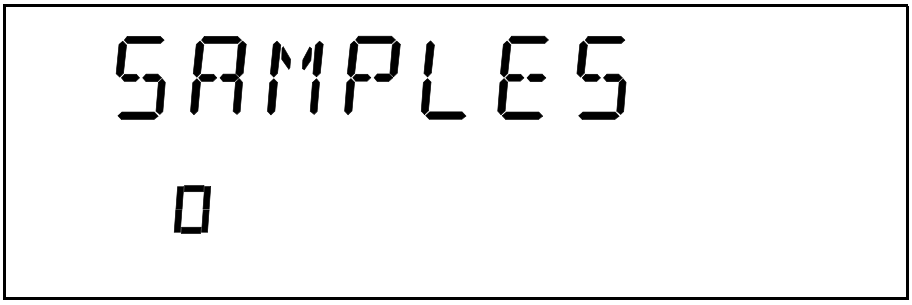


4. Set the duration of the acquisition.

4a. Press *ENTER*. The first digit will start flashing. Use the up/down arrows to change the flashing digit and the left/right arrows to activate the next digit.

4b. Once the duration is set, press *ENTER*.

5. Press the right arrow. You will see the following display.



6. Set the number of samples to be taken during the acquisition.

6a. Press *ENTER*. The digit will start flashing. Use the up/down arrows to toggle between the possible number of acquisitions (the number of acquisitions the PM-1100 can store depends on the duration you set at step 4).

6b. Once the number of samples is set, press *ENTER*.

7. To exit the *Program* menu, press *Program*.

Starting the Acquisition

When you start an acquisition, data is acquired in the current measurement mode; that is, at the current wavelength, with the current measurement unit, and with or without an offset and a reference. Therefore, before starting an acquisition, you should set these parameters as required. You can choose one of the following procedures.

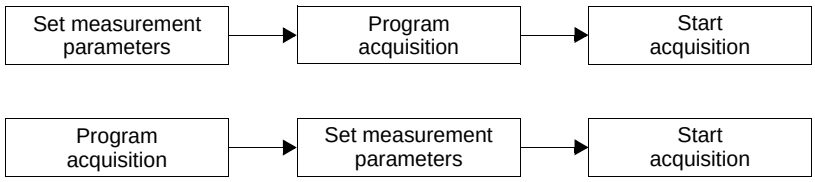


Figure 5-2. *Starting an Acquisition*

IMPORTANT

Starting an acquisition erases all acquisition data in memory.

Whenever you are ready to start the acquisition, press *Program*, scroll (left/right arrows) to *START*, then press *ENTER*.

- If no delay was set, the acquisition will start immediately.
- If a delay was set, choosing *START* will initiate the countdown. The acquisition will automatically start once the countdown has expired.

Program is displayed on the left side of the display while the acquisition is in process. All functions are deactivated during the countdown and the acquisition.

Tip: *Once you have started the acquisition, the display returns to measurement mode. If you want to know how much time is left in the delay (before the acquisition starts), press* Program*, and then scroll (left/right arrows) to* DELAY*. If you want to know how much time is left in the acquisition, press* Program*, then scroll (left/right arrows) to* DURATION*.*

Stopping the Acquisition

Once the acquisition starts, it continues until the set duration has expired. When the acquisition is over, the unit beeps, *PRG STOP* is displayed, and the data is stored automatically. You can also terminate the acquisition before the set duration has elapsed.

IMPORTANT

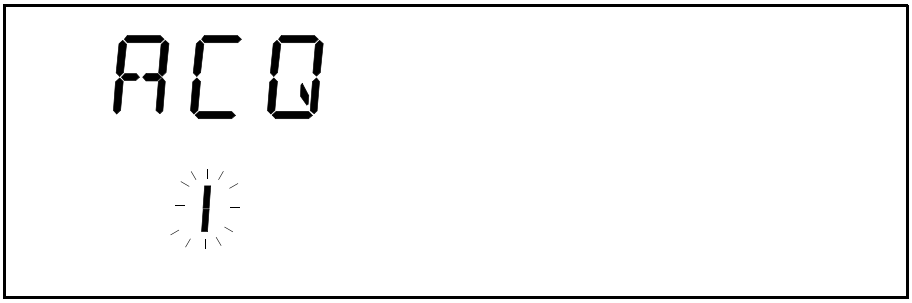
If you stop the acquisition before it ends, only the samples that were taken before you stopped the acquisition will be saved.

1. While the acquisition is in process, press *Program*.
2. Scroll (left/right arrows) to *STOP.*
3. Press *ENTER*.

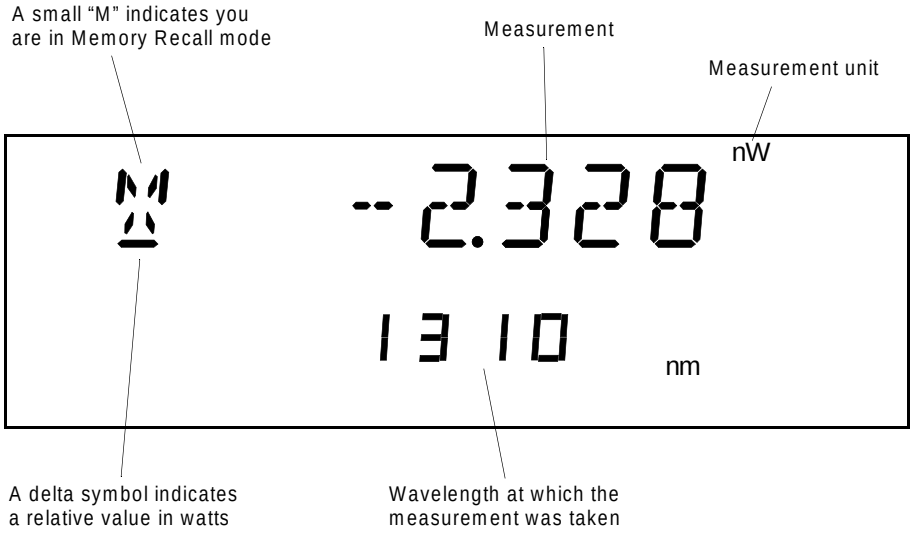
Recalling Acquisition Data

The data stored during a programmed acquisition (see *Programming an Acquisition,* on page 18) can be recalled one sample at a time. Each sample is stored in a memory register.

1. Press *Recall*.
2. Scroll (let/right arrows) to *ACQ*. A register number will flash.



3. Using the up/down arrows, scroll to the register number you want to view.
4. Press *ENTER*. The selected register will be displayed.



Note: *A dashed line with no wavelength indicates an empty register. A dashed line along with a wavelength indicates a reading below range. "++++++++" indicates a reading above range.*

➤ To view another register, press *ENTER*. The next register will be suggested (flashing). If necessary, scroll (up/down arrows) to the desired register number. Press *ENTER* again to display the register.

Tip: *You can press* ENTER *repeatedly to quickly scan the measurements in adjacent registers.*

➤ To exit the *Recall* menu, press *Recall*.

Erasing Acquisition Data

The data stored through a programmed acquisition (up to 1024) can only be erased as a group.

1. Press *Recall*.

2. Scroll (left/right arrows) to *CLR ACQ*.

IMPORTANT

After you press *ENTER*, all the acquisition data in the 1024 registers will be deleted without any other warning.

3. Press *ENTER*.

4. To exit the *Recall* menu, press *Recall*.

Customizing Your PM-1100

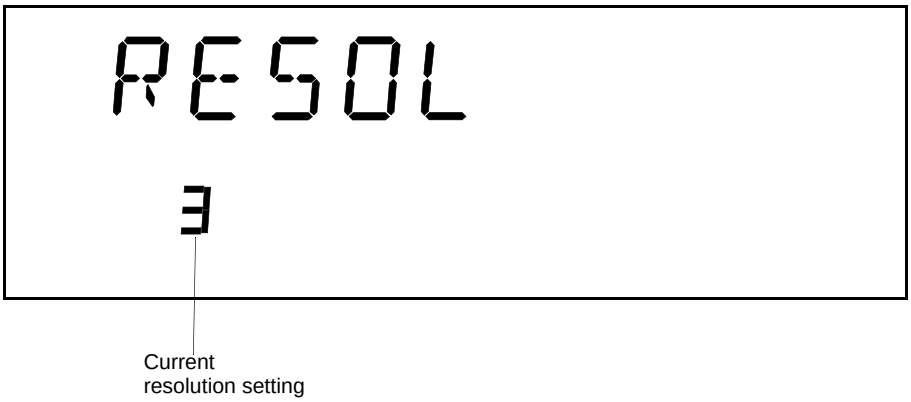
Customized settings are kept in non-volatile memory and are, therefore, saved when the PM-1100 is turned off. Settings for a specific use or user may also be saved (up to 10 configurations can be saved). See *Saving a Configuration,* on page 32.

Changing the Resolution

You can set the PM-1100 to display 0, 1, 2, or 3 digits after the decimal point. An automatic resolution is also available, where the number of digits after the decimal point is determined by the actual power level being measured.

Note: *Higher power levels can be more accurately measured and, therefore, displayed with a greater resolution.*

1. Press *Setup*. You will see the following screen:



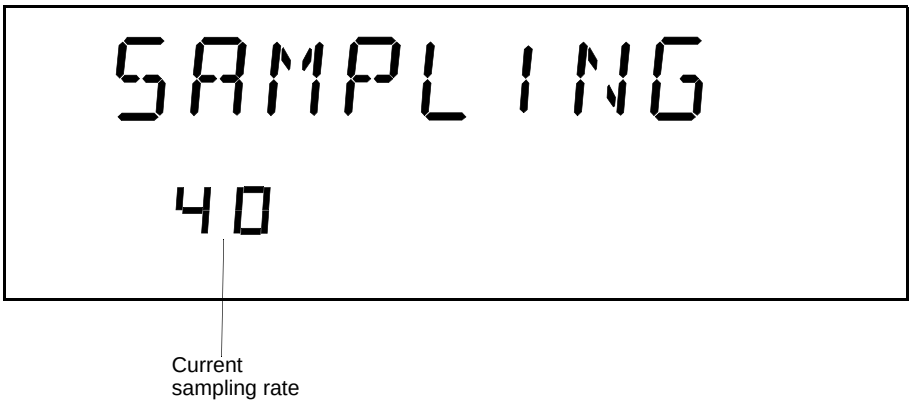
2. Press *ENTER*. The current resolution setting starts flashing.
3. Scroll (up/down arrows) to select a new resolution setting (0, 1, 2, 3, or Auto).
4. Press *ENTER*.
5. To exit the *Setup* menu, press *Setup*.

Changing the Sampling Rate

You can set the number of samples taken by the PM-1100 every second: 0.1 (1 every 10 seconds), 0.5 (1 every 2 seconds), 1, 5, 10, 20, or 40.

Note: *The maximum display refresh rate of the PM-1100 is 5 values every second, no matter what sampling rate is selected.*

1. Press *Setup*.
2. Scroll (left/right arrows) to *SAMPLING*.



3. Press *ENTER*. The current sampling rate starts flashing.

4. Scroll (up/down arrows) to select a new sampling rate (0.1, 0.5, 1, 5, 10, 20, or 40 per second).

5. Press *ENTER*.

6. To exit the *Setup* menu, press *Setup*.

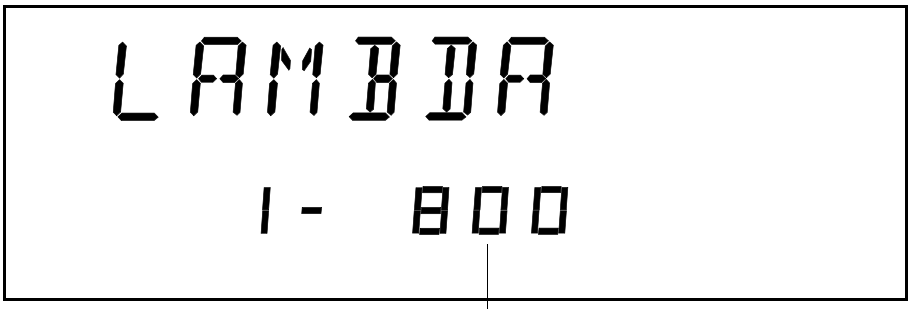
Customizing the Shortlist of Wavelengths

The PM-1100 detector port can measure optical power at many wavelengths. The accepted wavelengths (spectral range, see *Optical Specifications,* on page 67) depend on the type of detector with which the PM-1100 is equipped. Store the wavelengths you use the most often in a shortlist so you can quickly access them by pressing λ during a test session. The shortlist includes up to 20 wavelengths.

To add a wavelength to the shortlist,

1. Press *Setup*.

2. Scroll (left/right arrows) to *LAMBDA*.



You can scroll up or down to see all the wavelengths in the shortlist.

3. Scroll (up/down arrows) to *Add*.

4. Press *ENTER*. A wavelength will be suggested, first digit flashing.

5. Use the up/down arrows to change the flashing digit and the left/right arrows to activate the next digit.

6. Once the digits are set, press *ENTER*.

7. To exit the *Setup* menu, press *Setup*.

To erase one wavelength from the shortlist,

1. Press *Setup*.

2. Scroll (left/right arrows) to *LAMBDA*.

3. Scroll (up/down arrows) until the wavelength you want to delete appears in the lower portion of the display.

4. Press *ENTER*. The wavelength will start flashing.

5. Set all the wavelength digits to zero (use the up/down arrows to change the flashing digit and left/right arrows to activate the next digit).

Note: *The wavelength that is currently active in absolute mode cannot be erased.*

6. Press *ENTER*.
7. To exit the *Setup* menu, press *Setup*.

To erase all wavelengths from the shortlist,

1. Press *Setup*.
2. Scroll (left/right arrows) to *LAMBDA*.
3. Scroll (up/down arrows) until *DEL ALL* appears in the lower portion of the display.
4. Press *ENTER*.
5. To exit the *Setup* menu, press *Setup*.

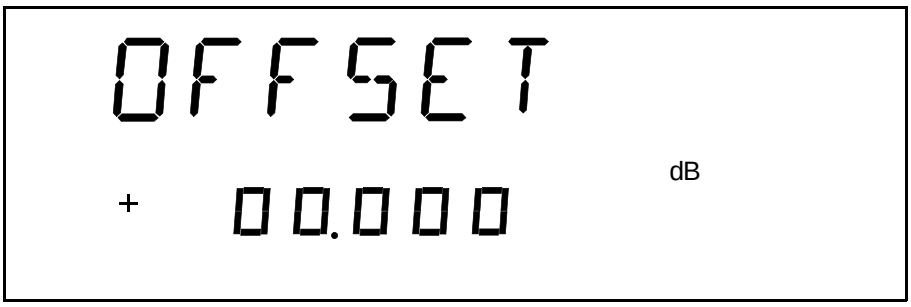
Note: *The wavelength that is currently active in absolute mode cannot be erased.*

Setting an Offset

An offset can be applied to any measurement that is displayed in either dB or dBm. The offset value, which can be positive or negative, is always expressed in dB and is added to the measured power. *Offset On* appears to the left of the display when an offset is being used. Offsetting the measured power is useful when compensating for known power losses or applying a calibration offset.

Note: *The offset is only applied when dB or dBm units are selected.*

1. Press *Setup*.
2. Scroll (left/right arrows) to *OFFSET*.



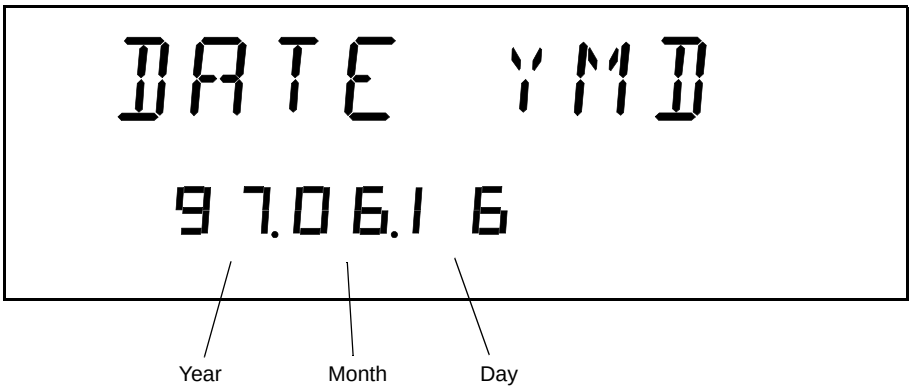
3. Press *ENTER*. The offset symbol (- or +) will start flashing.
4. Set a new offset (use the up/down arrows to change the flashing segment and the left/right arrows to activate the next segment).
5. Press *ENTER*.
6. To exit the *Setup* menu, press *Setup*.

Note: *To deactivate the offset, you must set it to 0.* Offset On will *no longer appear in the lower left portion of the display.*

Setting the Date

The date must be entered according to the year-month-day format.

1. Press *Setup*.
2. Scroll (left/right arrows) to *DATE YMD*.



3. Press *ENTER*. The first digit will start flashing.

4. Set a new date (use the up/down arrows to change the flashing digit and the left/right arrows to activate the next digit).

5. Press *ENTER*.

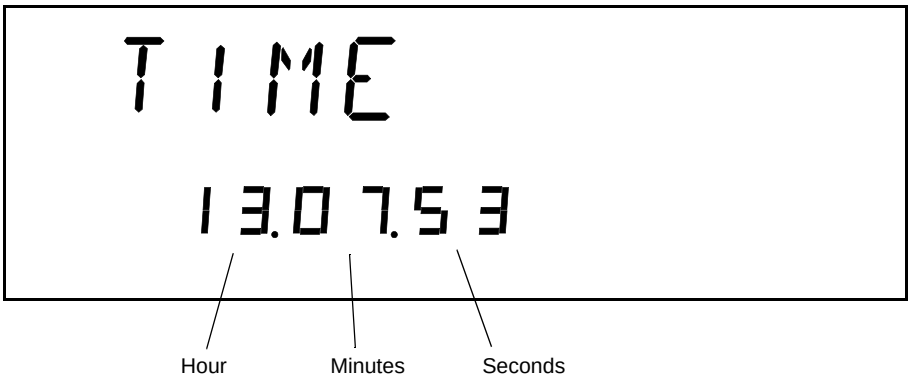
6. To exit the *Setup* menu, press *Setup*.

Setting the Clock

The time must be entered according to the 24-hour format.

1. Press *Setup*.

2. Scroll (left/right arrows) to *TIME*.



3. Press *ENTER*. The first digit will start flashing.

4. Set a new time (use the up/down arrows to change the flashing digit and the left/right arrows to activate the next digit).

5. Press *ENTER*.

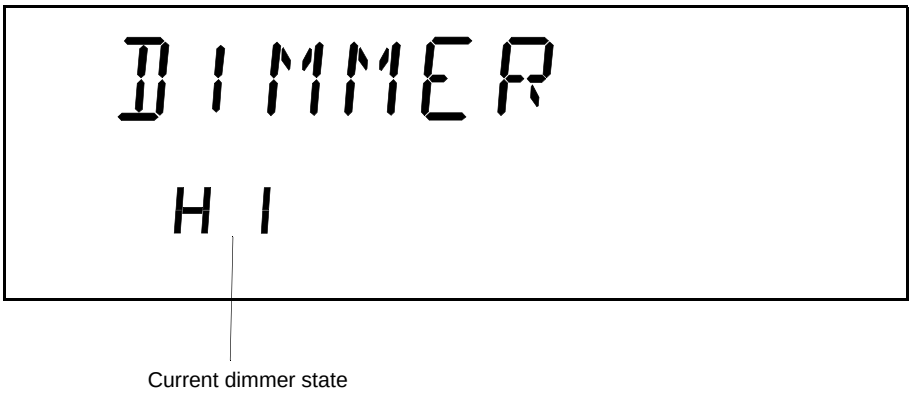
6. To exit the *Setup* menu, press *Setup*.

Setting the Display Intensity

Display intensity may be set to high or low. You can also turn off the display without turning off the unit.

1. Press *Setup*.

2. Scroll (left/right arrows) to *DIMMER*.



3. Press *ENTER*. The current dimmer state will start flashing.

4. Use the up/down arrows to modify the dimmer: *LO*, *HI*, or *OFF*.

5. Press *ENTER*.

Note: *Setting the dimmer to* OFF *turns off the display. Press any key to turn the display back on*.

6. To exit the *Setup* menu, press *Setup*.

Saving a Configuration

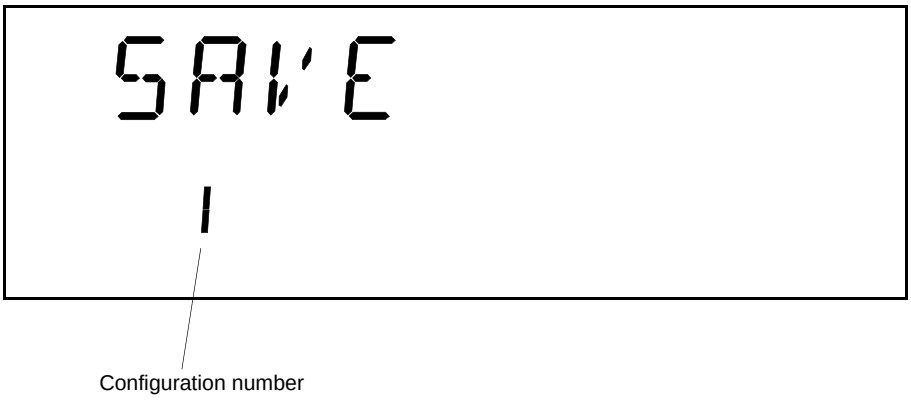
Once the PM-1100 is customized for a specific application or user, it is possible to save the configuration. Saved parameters are:

- resolution
- sampling rate
- current wavelength and corresponding reference
- offset

Up to ten configurations can be saved and recalled as needed.

1. Customize the PM-1100 as required.

2. Press *Setup*.
3. Scroll (left/right arrows) to *SAVE*.

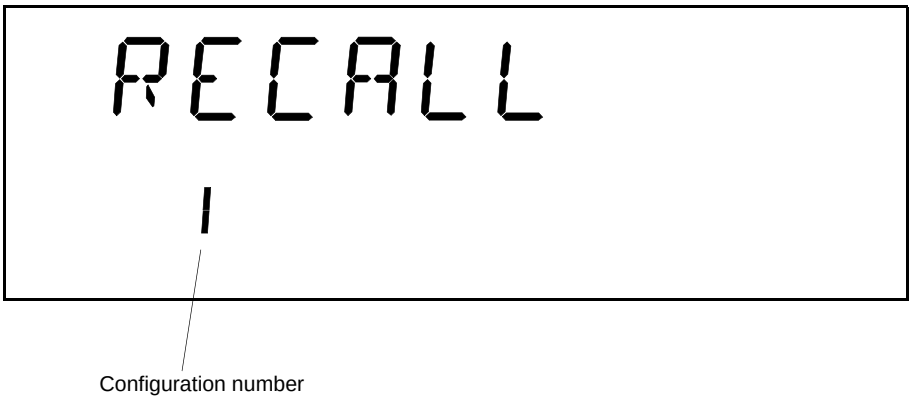


4. Press *ENTER*. The current configuration number will start flashing.
5. Use the up/down arrows to modify the configuration number.
6. Press *ENTER*.
7. To exit the *Setup* menu, press *Setup*.

Recalling a Configuration

Once you have saved a configuration (*Saving a Configuration,* on page 32), you can recall it any time.

1. Press *Setup*.
2. Scroll (left/right arrows) to *RECALL*.



3. Press *ENTER*. The configuration number (bottom of the screen) will start flashing.
4. Use the up/down arrows to select the number of the configuration you want to recall.
5. Press *ENTER*.
6. To exit the *Setup* menu, press *Setup*.

6 Remote Control

The PM-1100 can be remotely controlled either by

- a GPIB interface (through a GPIB cable connected to the GPIB port); or
- an RS-232 interface (through a serial cable connected to the serial port).

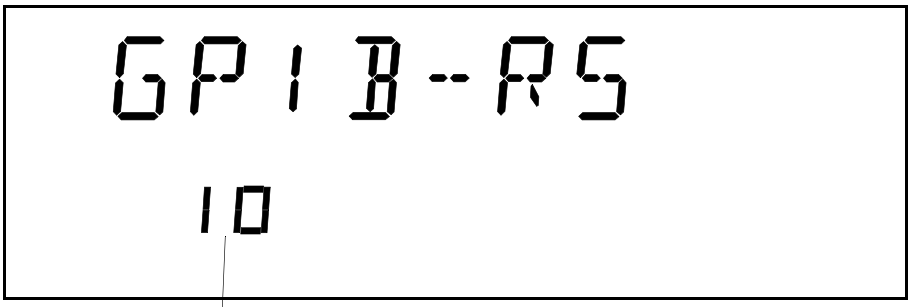
The commands used in both protocols are the same and are described in the following pages. When the PM-1100 is being remotely controlled, *Remote* appears in the lower left corner of the display.

Note: *If you have already designed a GPIB program to control a power meter from EXFO's IQ Series (IQ-1100, IQ-1200, or IQ-1500), you can reuse sections for the PM-1100.*

Setting the PM-1100 for Remote Control

To remotely control the PM-1100, you need to set a GPIB address or activate the RS-232 port.

1. Press *Setup*.
2. Scroll (left/right arrows) to *GPIB-RS*.



3. Press *ENTER*. The current setting will start flashing.
4. Using the up/down arrows, enter a new setting.

- a numbered setting represents a GPIB address (between 1 and 30)

➤ for RS-232 control, scroll (up/down arrows) to RS-232 (before setting 1 or after setting 30).

5. Press *ENTER*.

6. To exit the *Setup* menu, press *Setup*.

Communication Parameters

For GPIB Communication	
Terminate Read on EOS	Yes
Set EOI with EOS on Writes	Yes
Type of compare on EOS	8-bits
EOS byte	0Ah
Sens EOI at end of Writes	Yes
GPIB Primary address	see page 35
GPIB Secondary address	None

Table 6-1. *GPIB Communication Parameters*

For RS-232 Communication	
EOS bytes	0Ah
Baud rate	9600 bps
Parity	None
Data bits	8 bits
Stop bits	1 bits
Flow Control	None
Activation	see page 35

Table 6-2. *RS-232 Communication Parameters*

Note: *EOS means "End of String". EOI means "End or Identify".*

Standard Status Data Structure

Figure 6-1 on the following page illustrates the four common status and enable registers as defined by lEEE 488.2. This diagram is a useful aid in understanding the general commands and how a service request (SRQ) is generated. The four registers are

- Standard Event Status Register (ESR)
- Standard Event Status Enable Register (ESE)
- Status Byte Register (STB)
- Service Request Enable Register (SRE)

Bit	ESR	ESE	STB	SRE
0	Operation Complete	Operation Complete	N/A	N/A
1	Request Control	Request Control	N/A	N/A
2	Query Error	Query Error	Error Bit	Error Summary Bit
3	Device Dependent Error	Device Dependent Error	Questionable Status	Questionable Status
4	Execution Error	Execution Error	Message Available	Event Status Summary Bit
5	Command Error	Command Error	Event Status Summary Bit	Message Available
6	User Request	User Request	Master Summary Status	Request Service / Master Summary Status
7	Power On	Power On	Operation Status	Operation Status

Table 6-3. *Standard Registers*

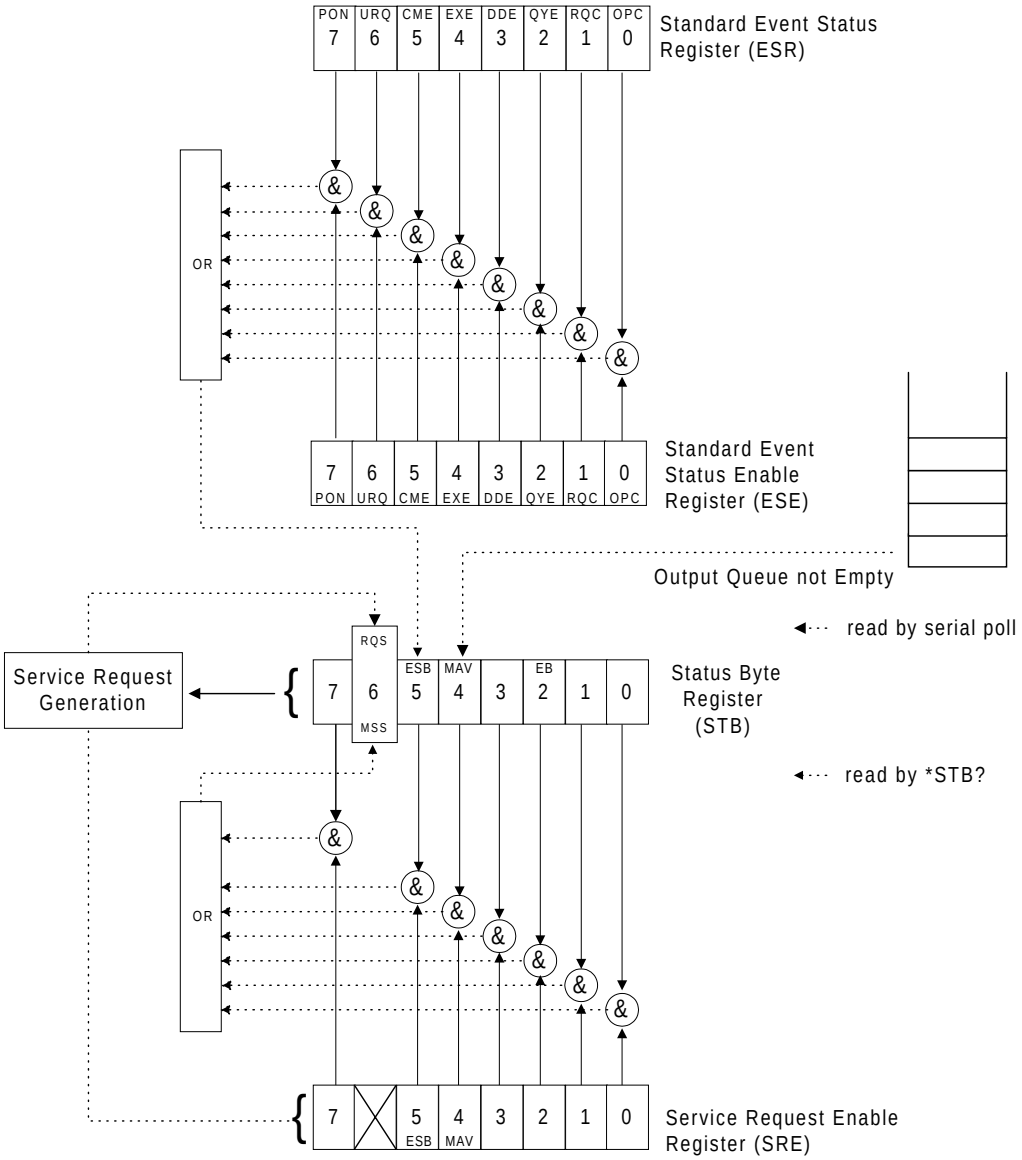


Figure 6-1. *Standard Status Data Structures (IEEE 488.2)*

An SRQ is forced when a bit is set in the STB and at the same time the corresponding SRE bit is set. When the SRQ is generated, the RQS bit is set to 1 and remains set until read by a serial poll. Once the RQS is read, it returns to 0.

Command Structure

The GPIB and RS-232 commands follow the guidelines determined by the Standard Commands for Programmable Interface (SCPI) consortium. For example, the command syntax

FORM:READ[:DATA]<space><digits>

is used to change the measurement display resolution (number of digits after the decimal point) of a PM-1100.

In this particular example,

- FORM identifies that the command is a part of the SCPI FORMat subset of commands;
- READ and DATA are keywords that define the function of the command;
- [ ] indicates that a keyword or a parameter is optional;
- <space> indicates that a space is required; and
- <digits> is the command parameter.

For example, the typical FORM:READ:DATA 1 command instructs the PM-1100 to display a power measurement with 1 digit after the decimal point.

Note: *It is recommended to retrieve the response immediately after each query.*

General Commands

The PM-1100 recognizes the main commands identified in IEEE-488.2. These commands, as well as some optional general commands, the programming state commands, and some status queries, are summarized in Table 6-4.

Command	Function
*CLS	Clear status command
*ESE	Standard event status enable command
*ESE?	Standard event status enable query
*ESR?	Standard event status register query
*IDN?	Identification query
*LOK	Set Remote Lockout programming state
*OPC	Operation complete command
*OPC?	Operation complete query
*REM	Set Remote programming state
*RST	Reset command
*SRE	Service request enable command
*SRE?	Service request enable query
*STB?	Read status byte query
SYST:ERR?	Error status query
SYST:VERS?	Identification status query
*TRG	(Not supported)
*TST?	Self test query
*WAI	(Not supported)

Table 6-4. *General Commands Summary*

The commands are fully explained on the following pages.

*CLS

Description This command sets the contents of the Standard Event Register (ESR), the Status Byte Register (STB), and the Error Queue (ERR) to zero. This command is commonly used to clear the status registers before enabling SRQ. Note that the output queue, Standard Event Status Enable Register (ESE), and Service Request Enable Register (SRE) are not affected.

Syntax *CLS

*ESE

Description This command is used to set bits in the Standard Event Status Enable Register (ESE) to a new value (initial value is 255). The contents of the ESE register are logically ANDed with the ESR register. A non zero result will set the Event Summary Bit (ESB) of the Status Byte Register (STB). This command is useful for selecting which events may generate an SRQ.

Syntax *ESE<space><value>

Parameter The <value> parameter must be between 0 and 255.

*ESE?

Description This query reads the contents of the Standard Event Status Enable Register (ESE).

Syntax *ESE?

Response A binary integer between 0 and 255.

*ESR?

Description This query reads the contents of the Standard Event Status Register (ESR).

Syntax *ESR?

Response A binary integer between 0 and 255.

*IDN?

Description This query reads the IQ system identification string.

Syntax *IDN?

Response “EXFO E.-O. Eng PM-1100 Vxx.xx”, where xx.xx is the current product version.

*LOK

Description This command is used to set the Remote Lockout programming state.

Syntax *LOK

*OPC

Description This command will cause the PM-1100 to generate the “Operation complete” message in the Standard Event Status Register (ESR) when all pending selected PM-1100 operations have been completed.

Syntax *OPC

Example *OPC;*IDN?

*OPC?

Description This query puts an ASCII 1 in the output queue when the content of the input queue has been processed. This query is useful to prevent another command from being processed until the current command is complete.

Syntax *OPC?

Response “1”

*REM

Description This command is used to set the Remote programming state.

Syntax *REM

*RST

Description This command empties the step response list. It is only seen when it is part of another multiple command. In the example below, by adding this command after *IDN?, you will not be able to access the answer. The *RST, in this instance, erases the identification string. In addition, this command performs the following operations:

1. Return to initial state before command was sent, and not necessarily to previous settings.
2. Force the device to enter into an Operation Complete Command Idle State (OCIS).
3. Force the device to enter into an Operation Complete Query Active State (OQAS).
4. Initialize previous responses unless there has been a program message terminator preceded by an *RST.

Syntax *RST

Example *IDN?;*RST<NL>

*SRE

Description This command sets bits in the Service Request Enable Register (SRE; initial value is 255), and enables the matching bit in the Status Byte Register (STB). The command can be used to select which events can initiate a service request.

Syntax *SRE<space><value>

Parameter The <value> parameter must be between 0 and 255.

*SRE?

Description This query returns the contents of the Service Request Enable Register (SRE).

Syntax *SRE?

Response A binary integer between 0 and 255.

*STB?

Description This query returns the contents of the Status Byte Register (STB).

Syntax *STB?

Response A binary integer between 0 and 255.

SYSTem:ERRor?

Description This command returns the next error in the list. When an error is generated, an error number is sent to the error list. The error list is accessed with the SYST:ERR? query. If the list contains 20 errors and a new error occurs, the error will replace the first error in the list.

Syntax SYST:ERR?

Response See error list and descriptions in *Error Messages,* on page 65.

SYSTem:VERSion?

Description This query returns the current system software version.

Syntax SYST:VERS?

Response “EXFO E.O. Engineering PM-1100 Vxx.xx”, where xx.xx is the current product version.

Note The *IDN? and SYST:VERS? queries are equivalent. They give the same result.

*TRG

Description Not supported

Syntax *TRG

*TST?

Description This query initiates an internal self-test and returns a binary value indicating the results of the test.

Syntax *TST?

Response A binary value:
“0” if the test is complete with no errors
“1” if the test is complete with errors

*WAI

Description Not supported

Syntax *WAI

Specific Commands

ABORt

Description This command stops any measurement in progress.

Syntax ABOR(0..26)

Example ABOR3

DISPlay:DIMMer

Description This command is used to adjust the intensity of the PM-1100 display (high or low) or to turn off the display without turning off the unit.

Syntax DISP:DIMM<space><data>

Parameters The <data> parameter can be “HI”, “LO”, or “OFF”.

Example DISP:DIMM OFF

Note When the display is turned off by this command, any key pressed on the PM-1100 keypad will return the display to high intensity. To prevent this, lock the PM-1100 keypad with the *LOK command.

See also DISP:DIMM?, *LOK, and *LOK?

DISPlay:DIMMer?

Description This query returns the intensity of the PM-1100 display (high, low, or off)

Syntax DISP:DIMM?

Response “HI” if the intensity is high
“LO” if the intensity is low
“OFF” if the display is off

Example DISP:DIMM?

FETCh[:SCALar]:POWer:DC?

Description This query returns the last stored value.

Syntax FETC(0..26)[:SCAL]:POW:DC?

Response A power measurement in the "±999.999E±99" exponential format in the selected units. The number of digits after the decimal point depends on the selected resolution.

Example FETC3:SCAL:POW:DC?

See also INIT:CONT, INIT:CONT?, INIT:IMM, and READ:SCAL:POW:DC?

FORMat:READings[:DATA]

Description This command changes the resolution of the displayed power value, when dB or dBm is selected.

Syntax FORM(0..26):READ[:DATA]<space><digits>

Parameters The <digits> parameter can be:
"0" -zero digit after the decimal point
"1" -one digit after the decimal point
"2" -two digits after the decimal point
"3" -three digits after the decimal point
"4" -auto-resolution, determined by the measured power level

Example FORM3:READ:DATA 3

FORMat:READings[:DATA]?

Description This query returns the current resolution of the displayed power value when dB or dBm units are selected.

Syntax FORM:READ:DATA?

Response "0" if there is zero digit after the decimal point
"1" if there is one digit after the decimal point
"2" if there are two digits after the decimal point
"3" if there are three digits after the decimal point
"4" if automatic resolution is set (determined by the measured power level)

Example FORM:READ:DATA?

INITiate:CONTinuous

Description This command starts or stops continuous mode. When continuous mode is activated, the latest value is continuously stored in the initialized memory location so it can be fetched at any time with the FETC[:SCAL]:POW:DC? query. Values can be power or loss measurements, depending on the current measurement mode of the PM-1100.

Syntax INIT:CONT<space><boolean>

Parameters The <boolean> value can be
"0" to stop continuous mode
"1" to start continuous mode

Example INIT:CONT 1

Note Use the INIT:STOR command to initialize a memory location.

See also FETC:SCAL:POW:DC?, INIT:CONT?, INIT:IMM, INIT:STOR, and READ:SCAL:POW:DC?

INITiate:CONTinuous?

Description This query returns a value indicating whether continuous mode is activated.

Syntax INIT:CONT?

Response "0" if continuous mode is stopped
"1" if continuous mode is started

Example INIT:CONT?

See also FETC:SCAL:POW:DC?, INIT:CONT, INIT:IMM, and READ:SCAL:POW:DC?

INITiate[:IMMediate]

Description This command stores a value in the initialized memory location so it can be fetched at any time with the FETC[:SCAL]:POW:DC? query. Values can be power or loss measurements, depending on the current measurement mode of the PM-1100.

Syntax INIT[:IMM]

Parameters N/A

Example INIT:IMM

Note Use the command INIT:STOR to initialize a memory location.

See also FETC:SCAL:POW:DC?, INIT:CONT, READ:SCAL:POW:DC?

INITiate:STORage

Description This command allows you to initialize a memory location (out of the 512 available) before storing or recalling an absolute or referenced measurement.

Syntax INIT:STOR<space><data>

Parameters The <data> parameter is a memory location. This value can be any value between 1 and 512, inclusive.

Example INIT:STOR 99

Note Use the INIT:CONT or INIT:IMM commands to store a value in the initialized memory location.
Use the FETC[:SCAL]:POW:DC command to fetch the value currently in the initialized memory location.

See also INIT:IMM, INIT:CONT, and FETC[:SCAL]:POW:DC

MMEMory:ACQuisition

Description This command initiates a data acquisition with the currently set parameters (delay, duration, number of samples). The acquisition will continue until the duration elapses or until an acquisition stop (MMEM:ACQ 0) command is sent.

Syntax MMEM:ACQ<space><boolean>

Parameters The <boolean> parameter can be
“1” start the data acquisition
“0” stop the data acquisition

Example MMEM:ACQ 1

MMEMory:ACQuisition?

Description This query returns a value indicating whether data acquisition is in progress.

Syntax MMEM:ACQ?

Response The response is in the format
"1" data acquisition is in progress
"0" data acquisition is not in progress

Example MMEM:ACQ?

MMEMory:ACQuisition:DATA?

Description This command returns the number of data saved by the last acquisition.

Syntax MMEM:ACQ:DATA?

Response Number of acquired data saved in memory locations in the "600" format.

Example MMEM:ACQ:DATA?

MMEMory:ACQuisition:DATA:RECAll:UNIT?

Description This query returns the measurement units corresponding to the last value fetched with the MMEM:ACQ:DATA:RECA:VALUE? query.

Syntax MMEM:ACQ:DATA:RECA:UNIT?

Response The measurement units in the format
"0" for dBm
"1" for watt
"2" for dB
"3" for delta watt

Example MMEM:ACQ:DATA:RECA:UNIT?

MMEMory:ACQuisition:DATA:RECAll:VALUE?

Description This command returns the measurement saved in the <data> memory location.

Syntax MMEM:ACQ:DATA:RECA:VALUE?<space><data>

Parameters The <data> parameter represents the memory location from which to recall the measurement data (out of the 1024 available).

Response Measurement data saved in the specified memory location in the "±999.999E±99" format.

Note Use the MMEM:ACQ:DATA:RECA:UNIT? query to get the corresponding measurement units.
Use the MMEM:ACQ:DATA:RECA:WAV? query to get the wavelength at which the measurement was taken.

Example MMEM:ACQ:DATA:RECA:VALUE? 1021

MMEMory:ACQuisition:DATA:RECAll:WAVelength?

Description This query returns the wavelength corresponding to the last value fetched with the MMEM:ACQ:DATA:RECA:VALUE? query.

Syntax MMEM:ACQ:DATA:RECA:WAV?

Response A wavelength in the “9999 nm” format.

Example MMEM:ACQ:DATA:RECA:WAV?

MMEMory:ACQuisition:DELete

Description This command clears the 1024 memory locations reserved for the acquisition data.

Syntax MMEM:ACQ:DEL

MMEMory:ACQuisition:DELAy

Description This command changes the delay parameter for the acquisition setup.

Syntax MMEM:ACQ:DELA<space><delay>

Parameters The <delay> parameter is the delay before the acquisition starts in the “HHH,MM,SS” format (the maximum delay is 999 hours, 59 minutes, 59 seconds).

Example MMEM:ACQ:DELA 000,01,50

MMEMory:ACQuisition:DURAtion

Description This command changes the duration parameter for the acquisition setup.

Syntax MMEM:ACQ:DURA<space><duration>

Parameters The <duration> parameter is the duration of the acquisition setup in the "HHH,MM,SS" format (the maximum duration is 999 hours, 59 minutes, 59 seconds).

Example MMEM:ACQ:DURA 000,01,50

MMEMory:ACQuisition:SAMPles

Description This command changes the samples parameter for the acquisition setup.

Syntax MMEM:ACQ:SAMP<space><samples>

Parameters The <samples> parameter is the number of samples to be set for the acquisition setup. If an invalid parameter is entered, the closest valid parameter will be entered instead.

Note The duration of the acquisition has a direct effect on the values that can be set for the number of samples.

D x R = S

where

D = duration parameter set with the MMEM:ACQ:DURA command (in seconds)

R = any of the possible sampling rates in sec^{-1} (get the complete list with the SENS:FREQ:CAT? query)

S = valid number of samples (MUST be a whole number)

Example MMEM:ACQ:SAMP 200

MMEMory:ACQuisition:SAMPles?

Description This command returns the current number of samples for the acquisition setup.

Syntax MMEM:ACQ:SAMP?

Response Current number of samples in the "1" format

Example MMEM:ACQ:SAMP?

READ[:SCALar]:POWer:DC?

Description This query returns the measurement currently read by the PM-1100 (whether the unit is in absolute power or relative mode).

Syntax READ[:SCAL]:POW:DC?

Response A measurement in the "±999.999E±99" format. To know the current measurement units, use the SENS:POW:UNIT? query.

Example READ:SCAL:POW:DC?

See also FETC:SCAL:POW:DC?, INIT:CONT, INIT:CONT?, and INIT:IMM

SENSitivity:AVERage[:STATe]

Description This command activates or deactivates data averaging.

Syntax SENS:AVER[:STAT]<space><boolean>

Parameters The < boolean > parameter can be
"0" averaging is disabled
"1" averaging is enabled

Example SENS:AVER:STAT 1

SENSitivity:AVERage:STATe?

Description This query returns a value indicating whether data averaging is enabled or disabled.

Syntax SENS:AVER:STAT?

Response "0" averaging is disabled
"1" averaging is enabled

Example SENS:AVER:STAT?

SENSitivity:CORRection:COLLect:ZERO

Description This command performs an offset nulling measurement.

Syntax SENS:CORR:COLL:ZERO

Example SENS:CORR:COLL:ZERO

SENSitivity:CORRection:OFFSet[:MAGNitude]

Description This command sets an offset value that is applied when dB or dBm units are selected.

Syntax SENS:CORR:OFFS[:MAGN]<space><numeric_value>
[<space>DB]

Parameters The <numeric_value> is an offset with dB units in the ±99.999 format.

Example SENS:CORR:OFFS:MAGN 22.105

SENSitivity:FREQuency

Description This command selects a data sampling rate.

Syntax SENS:FREQ<space><numeric_value>

Parameters The <numeric_value> is the sampling rate with sec^{-1} units. 0.1, 0.5, 1, 5, 10, 20, 40 samples per second.

Example SENS:FREQ 20

SENSitivity:FREQuency?

Description This query returns the current sampling rate.

Syntax SENS:FREQ?

Response Returns the current sampling rate in samples/second units.

Example SENS:FREQ?

SENSitivity:FREQuency:CATalog?

Description This query returns a list of available sampling rates.

Syntax SENS:FREQ:CAT?

Response List of available sampling rates in the "40.0;20.0;10.0;5.0;1.0;0.5;0.1" format

Example SENS:FREQ:CAT?

SENSitivity:POWer:REFerence?

Description This query returns the reference power for the current wavelength.

Syntax SENS:POW:REF?

Response The current reference value in dBm, which can be any value within the power range of the power meter in the “99.999 dBm” format.

Example SENS:POW:REF?

SENSitivity:POWer:REFerence:DISPlay

Description This command performs a new reference measurement for the current wavelength and changes the display to read relative power (dB units).

Syntax SENS:POW:REF:DISP

Example SENS:POW:REF:DISP

SENSitivity:POWer:REFerence:STATe

Description This command selects whether absolute (dBm) or relative power measurements are performed.

Syntax SENS:POW:REF:STAT<space><boolean>

Parameters The <boolean> value represents either dB or dBm
“0” to set absolute mode
“1” to set relative mode

Example SENS:POW:REF:STAT

SENSitivity:POWer:REFerence:STATe?

Description This query returns a value indicating wheter the power meter is displaying absolute (dBm) or relative power values.

Syntax SENS:POW:REF:STAT?

Response “0” absolute mode is active (dBm or watt)
“1” relative mode is active (dB or delta watt)

Example SENS:POW:REF:STAT?

SENSitivity:POWer:UNIT

Description This command changes the measurement units.

Syntax SENS:POW:UNIT<space><value>

Parameters The <value> can be
“0” or “DBM”
“1” or “W”
“2” or “DB”
“3” or “DW”

Example SENS:POW:UNIT DBM

SENSitivity:POWer:UNIT?

Description This query returns the current measurement units.

Syntax SENS:POW:UNIT?

Response The response will be
“0” if units are dBm
“1” if units are watt
“2” if units are dB
“3” if units are delta watt

Example SENS:POW:UNIT?

SENSitivity:POWer:WAVelength

Description This command selects a new operating wavelength.

Syntax SENS:POW:WAV<space><numeric_value> [<space>NM]

Parameters The <numeric_value> is an operating wavelength expressed in nanometers (nm). Any wavelength within the spectral range of the optical detector (at 1 nm resolution) may be selected. See *Optical Specifications,* on page 67 for the exact spectral range of each detector type.

Example SENS:POW:WAV 1310

SENSitivity:POWer:WAVelength?

Description This query returns the currently selected calibrated wavelength.

Syntax SENS:POW:WAV?

Response The current wavelength in nanometers (nm) in the “9999 nm” format

Example SENS:POW:WAV?

UNIT:POWer

Description This command changes the measurement display units.

Syntax UNIT:POW<space><units>

Parameters The <units> parameter can be

WATT	measured value displayed in watts (pw, nw, μw, or mw);
DB	measured value displayed in dB relative to the current reference;
DBM	measured value displayed in dBm; or
DWATT	measured value displayed in watts relative to the current reference.

Example UNIT:POW DBM

Quick Reference Command Tree

Command					Parameter/ Response	Description
ABOR					—	Stop continuous measurements
DISP	DIMM				<LO|HI|OFF>	Set display intensity
	DIMM?				(LO|HI|OFF)	Get display intensity
FETC	[SCAL]	POW	DC?		(±999.999E±99)	Get stored value
FORM	READ	[DATA]		*	<0|1|2|3|4>	Set display resolution
		[DATA]?		*	(0|1|2|3|4)	Get display resolution
INIT	CONT				<0|1>	Start/stop continuous measurements
	CONT?				(0|1)	Continuous measure-ments in progress?
	[IMM]				—	Store single measurement
	STOR				<0 to 513>	Initialize memory location
MMEM	ACQ				<0|1>	Start/stop acquisition

Table 6-5. *PM-1100 Quick Reference Command Tree (Part 1 of 3)*

Command					Parameter/ Response	Description
MMEM	ACQ?				(0|1)	Acquisition in progress?
	ACQ	DATA?			(0 to 1025)	Get number of acquired measure-ment
		DATA	RECA	UNIT?	(0|1|2|3)	Get measurement units
				VALU?	(0 to 1025)	Get acquired measurement
				WAV?	(9999 nm)	Get wavelength
		DEL			—	Clear memory locations
		DELA			<HHH,MM,SS>	Set delay
		DURA			<HHH,MM,SS>	Set duration
		SAMP			<0 to 1025>	Set number of samples
		SAMP?			(0 to 1025)	Get number of samples
READ	[SCAL]	POW	DC?		(±999.999E±99)	Store and get value
SENS	AVER	[STAT]		*	<0|1>	Set data averaging
		STAT?			(0|1)	Data averaging active?

Table 6-5. *PM-1100 Quick Reference Command Tree (Part 2 of 3)*

Command					Parameter/ Response	Description
SENS	CORR	COLL	ZERO	*		Perform null measurement
		OFFS	[MAGN]		<99.999> [DB]	Set offset value
	FREQ			*	<value> [HZ]	Set sampling rate
	FREQ?				(99.9)	Get sampling rate
	FREQ	CAT?			(99.9;99.9;...)	List sampling rates
	POW	REF?			(+99.999 dBm)	Get reference value
		REF	DISP	*	—	Set reference
			STAT	*	<0|1>	Set absolute or relative
			STAT?		(0|1)	Get absolute or relative
		UNIT		*	<0|1|2|3>	Set power unit
		UNIT?			(0|1|2|3)	Get power unit
		WAV		*	<9999> [NM]	Set wavelength
		WAV?			(9999 nm)	Get wavelength
UNIT	POW			*	<WATT|DB|DBM|WATT>	Set display unit

Table 6-5. *PM-1100 Quick Reference Command Tree (Part 3 of 3)*

* These commands are not executed if a data acquisition is in progress. The "Program running" message will be returned.

Error Messages

System and device specific errors are managed by the PM-1100. The generic format for error messages is illustrated in Figure 6-2.

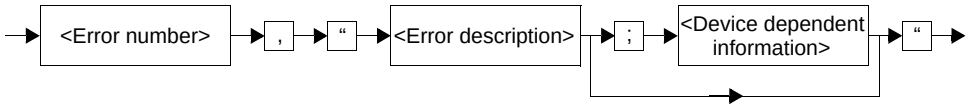


Figure 6-2. *Generic Error Message Format*

As shown in the above figure, the message contains three parts: the error number, error description, and device dependent information. All error messages are stacked in a FIFO buffer. When there is at least one message in the buffer, bit 2 of the Status Byte Register is set to 1. Use the SYST:ERR? query to read the most recent message. The error message buffer is initialized when starting the PM-1100, when executing the *CLS command, or by reading the last message stored in the buffer.

Error Number	Description	Probable Cause
-100	“Command error.”	An error occurred while validating a command.
-101	“Undefined header.”	Unknown command.
-102	“Missing parameter.”	A command parameter is missing.
-103	“Parameter not allowed.”	An extra parameter is present.
-104	“Data type error.”	Invalid parameter format.
-200	“Execution error.”	An error occurred while executing a command.
-300	“Device dependent error.”	A command has taken longer than expected to complete execution.
-300	“Light on detector.”	Light reached the detector during the offset nulling.

Table 6-6. *Error Messages (Part 1 of 2)*

Error Number	Description	Probable Cause
-300	“Invalid wavelength.”	The entered wavelength is out of range.
-300	“Parameter out of range.”	The command parameter is out of range.
-300	“No stored data.”	No data is stored in the specified location.
-300	“Program running.”	An acquisition is already in progress.
-300	“Program duration not initialized.”	No duration parameter is currently defined for the program.
-300	“No samples available.”	No sample parameter is currently defined for the program.
-300	“No data.”	No data to recall.
-300	“Invalid unit.”	The requested measurement units are invalid.
-300	“Invalid resolution.”	The requested resolution is invalid.
-300	“Invalid state.”	The state of the PM-1100 is not compatible with the command sent.
-300	“Invalid sampling rate.”	The requested sampling rate is invalid.
-300	“Invalid storage location.”	The specified storage location is invalid.
-300	“Invalid delay value.”	The entered delay value is invalid.
-300	“Invalid duration value.”	The entered duration value is invalid.
-400	“Query error.”	An error occurred while accessing the output queue.
-500	“System error.”	System is out of memory.

Table 6-6. *Error Messages (Part 2 of 2)*

7 Technical Specifications

Optical Specifications

Model	PM-1101	PM-1102X	PM-1103
Detector type	Si	GeX	InGaAs
Detector size (mm)	1	2	1
Dynamic range (dBm)[1]	+10 to -100	+20 to -75	+9 to -100
Spectral range (nm)	450 to 1100	750 to 1700	800 to 1700
Accuracy (dB)[2]	±0.2 (5%)		
Resolution (dB)[3]	0.001		
Linearity (dB)[4]	±0.015		
Spectral resolution (nm)	0.1		

1. From 32° to 86°F/0° to +30°C.
2. From 1000 nm to 1650 nm for PM-1102X/1103.
   From 600 nm to 1100 nm for PM-1101.
3. From +10 dBm to -60 dBm for PM-1101 and PM-1103.
   From +25 dBm to -35 dBm for PM-1102X.
4. From 0 dBm to -60 dBm for PM-1101 and PM-1103.
   From +10 dBm to -35 dBm for PM-1102X.

General Specifications

Note: *The PM-1100 is intended for indoor use only.*

Dimensions	Width:	8.75 in./21.8 cm
	Height:	4.575 in./11.1 cm
	Length:	11.25 in./28.5 cm
Operating temperature	32° to 104°F/0° to 40°C	
Storage temperature	-40° to 158°F/-40° to 70°C	
Relative humidity[1]	0 to 80% non-condensing	
Maximum operation altitude	6150 ft./2000 m	
Pollution degree	2	
Installation category	II	
Power supply rating	100 to 240 V (50/60 Hz)	
	maximum 2 A	

1. Measured in 32° to 104°F/0° to +40°C temperature range.

Specifications are subject to change without notice.

8 Maintenance

Contacting the Customer Service Group

If you encounter any difficulty while operating this product, please call EXFO at one of the offices listed below. Our Customer Service Group is available in North America from 7:30 a.m. to 8:00 p.m. (Eastern Standard Time), Monday to Friday.

EXFO Electro-Optical Engineering (Corporate Headquarters)
465 Godin Avenue
Vanier QC G1M 3G7
Canada

1 800 663-3936 (USA and Canada)
Tel.: (418) 683-0211
Fax: (418) 683-2170
support@exfo.com
www.exfo.com

EXFO Europe
Centre d'Affaires Les Metz
100, rue Albert Calmette
78353 Jouy-en-Josas, France

Tel.: 33-1 34 63 00 20
Fax: 33-1 34 65 90 93

Transportation and Storage

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

- Pack the unit in the original packing material when shipping.
- Store unit at room temperature in a clean and dry area.
- Avoid high humidity or large temperature fluctuations.
- Keep the unit out of direct sunlight.
- Avoid unnecessary shock and vibration.

WARNING

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

CAUTION

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

CAUTION

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

Safety Precautions

While manipulating optical fibers, laser radiation may be encountered at source output ports and at fiber ends. Avoid long-term exposure to laser radiation.

The following safety precautions must be observed during the operation and servicing of the units. Failure to comply with these precautions or with specific indications elsewhere in this manual violates safety standards of intended use of the unit. EXFO assumes no liability for the user's failure to comply with these requirements.

- This unit is intended for indoor use only.
- Unit covers cannot be removed during operation.
- Before powering on the unit, all grounding terminals, extension cords, and devices connected to it should be connected to a protective ground via a ground socket. Any interruption of the protective grounding is a potential shock hazard and may cause personal injury.
- Whenever the ground protection is impaired, the unit is not to be used and must be secured against any accidental or unintended operation.
- Only fuses with the required rated current and specified type (IEC, 250 V, 2 A, fast blow, 0.197” x 0.787”/5 mm x 20 mm) may be used for replacement. Do not use repaired fuses or short-circuited fuse holders.

- Any adjustments, maintenance, and repair of opened units under voltage should be avoided and carried out only by skilled personnel aware of the hazards involved. Do not attempt internal service or adjustment unless another person qualified in first aid is present. Do not replace any components while power cable is connected.
- Operation of any electrical instrument around flammable gases or fumes constitutes a major safety hazard.
- Installation of replacement parts or modification of the unit should be carried out by authorized personnel only.
- Capacitors inside the unit may be charged even if the unit has been disconnected from its electrical supply.

AC Requirements

The PM-1100 can operate from any single-phase AC power source between 100 V and 240 V (50/60 Hz). The maximum input current is 2 A.

Power Cable

This unit uses an international safety standard three-wire power cable. This cable serves as a ground when connected to an appropriate AC power receptacle. The type of power cable supplied with each unit is determined according to the country of destination.

Only qualified electricians should connect a new plug if needed. The color coding used in the electric cable depends on the cable. New plugs should meet the local safety requirements and include the following features:

- adequate load-carrying capacity
- ground connection
- cable clamp

WARNING

To avoid electrical shock, do not operate the unit if there are signs of damage to any part of the outer surface (covers, panels, etc.).

To avoid serious injury, the following precautions must be observed before powering on the unit.

- ***If the unit is to be powered via an auto-transformer for voltage reduction, the common terminal must be connected to the grounded power source pole.***
- ***Insert the plug into a power outlet with a protective ground contact. Do not use an extension cord without a protective conductor.***
- ***Before powering on the unit, the protective ground terminal of the unit must be connected to a protective conductor using the unit power cord.***
- ***Do not tamper with the protective ground terminal.***

General Maintenance

There are no user-serviceable components in the PM-1100 Optical Power Meter, notwithstanding the procedure described in this section. The PM-1100 has been designed to require minimum maintenance and to provide reliable operation for many years to come.

IMPORTANT

When the module is not being used, the protective cap should be fitted over the detector port.

To help ensure long, trouble-free operation,

- Keep the PM-1100 free of dust
- Do not to spill liquids on or into the unit. If the unit does get wet, turn off the power immediately and let the unit dry completely

➤ Clean the PM-1100 casing with a slightly damp (with water) cloth.

Cleaning the Fiber Ends

The test jumper fiber ends must be kept clean at all times to ensure minimum loss and to reduce reflection.

1. Gently wipe the fiber ends with a lint-free swab dipped in isopropyl alcohol (98% pure or more).
2. Dry using clean compressed air.

Cleaning the Detector Port

The optical port should also be cleaned regularly to ensure optimum performance.

1. Remove the protective cap.
2. Gently wipe the window of the detector with a lint-free swab dipped in isopropyl alcohol.
3. Dry using clean compressed air or with a dry lint-free swab.

Fuse Replacement

The PM-1100 contains two fuses of type IEC, 250 V, 2 A, fast blow 0.197" x 0.787"/5 mm x 20 mm. The fuse holder is located at the back of the PM-1100, just beside the power inlet.

This symbol, found at the back of the PM-1100, indicates that the user should refer to the instruction manual for fuse replacement.

To replace the fuses,

1. Unplug the power cord from the PM-1100.
2. Pull the fuse holder out of the PM-1100.

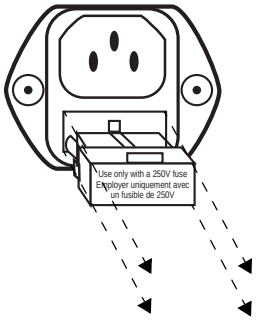


Figure 8-1. *Pulling out the Fuse Holder*

3. Verify and replace the fuses if necessary.

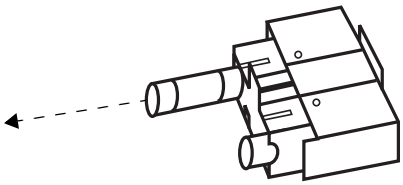


Figure 8-2. *Replacing the Fuses*

4. Make sure the fuses are firmly in the holder prior to reinsertion.

5. Firmly push the holder into place.

Recalibration

To ensure that the power meters remain within the published specifications and to maintain NIST traceability, EXFO recommends that an annual calibration be performed. Please contact EXFO for further information regarding calibration of the PM-1100 Optical Power Meter.

Software Upgrade

To upgrade the PM-1100 embedded software using a diskette, you must connect your PM-1100 to a computer through a null modem cable.

Note: *The software upgrade may be performed in DOS, Windows 3.1, or Windows 95. If problems occur, please contact EXFO.*

IMPORTANT

When using a notebook computer to upgrade the PM-1100 software, you should perform the upgrade in a DOS environment.

Proceed with the software upgrade only if the version indicated on the diskette is greater than the software version currently installed on your unit. To check the software version currently installed on your unit, see the information displayed at start-up.

To perform a software upgrade,

1. Turn off the PM-1100.
2. Connect one end of a null modem cable to the PM-1100 RS-232 serial port and the other end to an unused communication port on your computer (ex. COM2).
3. Insert the upgrade diskette into the computer diskette drive.
4. Create a new directory on the computer hard drive, then copy the contents of the diskette into the new directory.
5. Execute the “lo0006.exe” file to start the software upgrade.

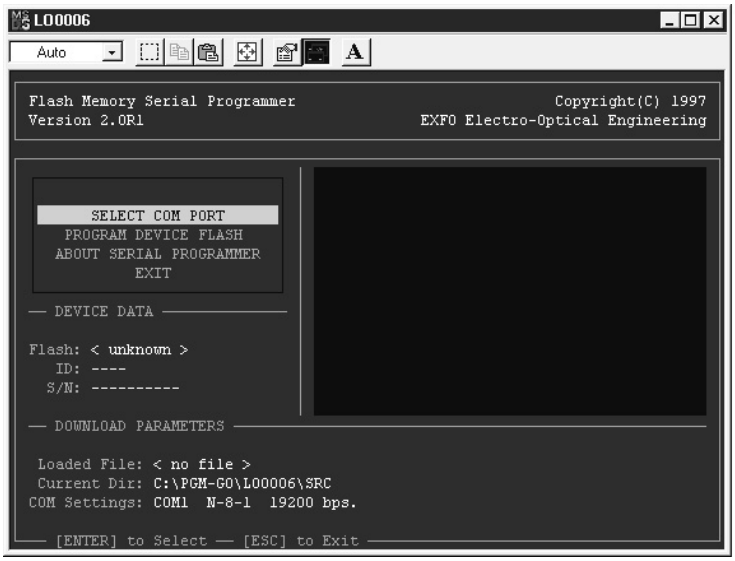


Figure 8-3. *Software Upgrade Utility*

6. Highlight the “SELECT COM PORT” command, then press *Enter*.

7. Select the COM port to which the null modem cable is connected on your computer, then press *Enter*.

8. Highlight the “PROGRAM DEVICE FLASH” command, then press *Enter*.

9. Once you see the “Waiting for device handshake” message, turn on the PM-1100. The PM-1100 screen will remain off; the unit will beep once and programming will start automatically. A progress bar on the computer screen will indicate the status of the software upgrade.

10. Once the software upgrade is complete, the “Reboot device for self-test” message will appear.

11. Turn off the PM-1100 and then on again to use the upgraded software. During self-test execution, the PM-1100 should display the new software version number.

9 Warranty

General Information

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

During the warranty period, EXFO will, at its discretion, repair, replace, or issue credit for any defective product. This warranty also covers recalibration during two years if the equipment is repaired or if the original calibration is erroneous.

IMPORTANT

The warranty can become null and void if

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

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

Liability

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

Exclusions

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

Certification

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

Service and Repairs

EXFO commits to providing product service and repair for five years after the date of purchase. To obtain service or repair for any equipment, follow the procedure below.

1. Call EXFO Customer Service Group. Support personnel will determine if the equipment requires service, repair, or calibration.
2. If the equipment must be returned to EXFO or an authorized service center, support personnel will issue a Return Merchandise Authorization (RMA) and an address for return.
3. If the unit has an internal storage device, do a backup of your data before sending the unit for repairs.

4. Pack the equipment in its original shipping material. Be sure to include a statement or report fully detailing the defect and the conditions under which it was observed.

IMPORTANT

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

5. Return the equipment, prepaid, to the address given by the support personnel. Be sure to write the RMA on the shipping slip. EXFO will refuse and return any package which does not bear an RMA.

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

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

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Glossary

a	Abbreviation for atto, which indicates 10^{-18} units.
adapter	A device for coupling two connectors.
amplitude	The distance between high and low points of a waveform or signal.
ASCII	American Standard Code for Information Interchange. A system used to represent letters, numbers, symbols, and punctuation as bytes of binary signals.
attenuation	The diminution of average optical power. Attenuation results from absorption, scattering, and other radiation losses. Attenuation is generally expressed in dB without a negative sign.
attenuation coefficient	A factor expressing attenuation per unit length, expressed in dB/km.
attenuator	An optical device, either fixed or adjustable, that reduces the intensity of light propagating through it.
backscattering	That portion of scattered light that returns in a direction generally opposite to the direction of propagation.
baud rate	Measurement of data transmission speed, expressed in bits per second or bps.
Bellcore	Bell communications research, an organization that contains much of the former Bell labs. It specializes in telephone network technology, standards and interfaces.
BER	Bit error rate. On a transmission link, the number of digital “highs” that are interpreted as “lows”, and vice versa, divided by the total number of bits received. In modern networks, BERs much better than 10^{-18} are expected.
c	Velocity of light in a vacuum = 2.997925 x 10^{8} m/s
°C	Degree Celsius. To convert to Fahrenheit: $F = \frac{9}{5}C + 32$.
CFR	Code of Federal Regulations

connector	A junction that allows an optical fiber or cable to be repeatedly connected or disconnected to a device such as a source or detector.
coupler	A device whose purpose is to distribute optical power among two or more ports or to combine optical power from two or more fibers into a single port.
CW	Abbreviation for continuous wave. Refers to non-modulated, constant-intensity light.
dB	Decibel
dBm	Decibel referenced to a milliwatt.
DDE	Dynamic Data Exchange
decibel (dB)	The standard unit used to express gain or loss of optical power. A standard logarithmic unit for the ratio of two powers.
directivity	In a 3-port optical circulator, the ratio of power launched into port 1 that exits via port 2 vs. the fraction that exits via port 3.
DLL	Dynamic Link Library
DMA	Direct Memory Addressing
DUT	Device under test
E	Abbreviation for exa, which indicates 10^{18} units.
EDFFA	Erbium doped fluoride fiber amplifier
EDFSA	Erbium doped silica fiber amplifier
EIA	Electronics Industries Association
electromagnetic interference	Any electrical or electromagnetic interference that causes degradation, failure in electronic equipment, or undesirable response. Optical fibers neither emit nor are affected by EMI.
EMI	Electromagnetic interference.
EOI	End of Image Marker

EOS	Effective Opening Size
ESB	Event Summary Bit
ESE	Standard Event Status Enable Register
ESR	Standard Event Status Register
f	Abbreviation for femto, which indicates 10^{-15} units.
f	Frequency, often also designated by ν.
FCC	Federal Communications Commission. A U.S. government body overseeing and regulating national electrical and radio communications. The FCC, formed in 1934, also deals with licences, tariffs, and limitations. The members of the commission are appointed by the U.S. president.
FIFO	First In First Out
frequency	The number of cycles per second, denoted by hertz (Hz).
G	Abbreviation for giga, which indicates 10^{9} units.
Ge	Germanium
GeX	High power germanium
GPIB	General Purpose Interface Bus
hr	Hour
Hz	Hertz. Denotes number of cycles per second.
IEC	International Electrotechnical Commission. A standardization body at the same level as ISO.
IEE	Institute of Electronic Engineering. It is a professional body covering all aspects of electronics and electrical engineering, including software, network, and computer engineering.
IEEE	Institute of Electrical and Electronics Engineering. It is a professional body very active, among other things, in many fiber-optic and opto-electronic related fields.

index matching material	A material, often a liquid or a cement, whose refractive index is nearly equal to the core index, used to reduce Fresnel reflections from a fiber's endface.
index of refraction	The ratio of the group velocity of light in a vacuum to the group velocity of light in a given medium.
InGaAs	Indium gallium arsenide.
ISA	Industry Standard Architecture
ISO	International Organization for Standardization. Commonly believed to stand for International Standards Organization. In fact, ISO is not an abbreviation—it is intended to signify uniformity (derived from the Greek *iso* meaning "equal"). ISO is responsible for many standards including those for data communications and computing.
ITU	International Telecommunications Union. The ruling body for telecommunications and the source of many network standards.
jumper	Fiber-optic cable that has connectors terminated on both ends. Used to connect two pieces of equipment, modules, or components.
k	Abbreviation for kilo, which indicates 10^3 units.
LD	Laser diode
LED	Light emitting diode
loopback	Type of diagnostic test in which the transmitted signal is returned to the sending device after passing through a communications link or network.
M	Abbreviation for mega, 10^6 units.
m	Abbreviation for milli, 10^{-3} units.
min	Minute
n	Abbreviation for nano, 10^{-9} units.
n	Refractive index. For the silica glass used in optical fibers, $n \approx 1.465$.

NIST	National Institute of Standards and Technology. U.S. governmental body that provides the assistance in developing standards. It was formerly the National Bureau of Standards.
noise figure	A measure of the quality of an amplifier, defined as the ratio of output to input SNRs.
P	Abbreviation for peta, which indicates 10^{15} units.
p	Abbreviation for pico, which indicates 10^{-12} units
P	Power
PCS	Plastic-clad silica (fiber)
RMA	Return merchandise authorization
s	Second
SCPI	Standard Commands for Programmable Instruments
sensitivity	For an optical instrument, the smallest signal that can be detected in the absence of any other signal.
Si	Silicon
SNR	Signal-to-noise ratio. The ratio of the received optical power, divided by the noise floor for the optical system.
SRE	Service Request Enable Register
SRQ	Service Request
STB	Status Byte Register
t	Time
T	Abbreviation for tera, wich indicates 10^{-12} units.
V	volt
VA	volt-ampere
W	watt
wavelength	For monochromatic light, the distance between two successive peaks (or troughs) of the sinusoidally-varying

	electric-field amplitude. Note that, unlike frequency, the wavelength of light is inversely proportional to the refractive index of the medium through which it propagates. It is for this reason that accurate wavelength measurements are generally specified as being determined in “air” or in “vacuum”.
λ	lambda. Greek letter used to denote wavelength.
μ	Abbreviation for micro, which indicates 10^{-6} units.
ν	nu. Greek letter used to denote frequency. Traditionally, the physics community uses “ν” to denote frequency whereas the engineering community uses “*f*”.

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U

W

ERRATUM

This information applies only to the PM-1100 Optical Power Meter instruction manual.

GPIB Commands and Queries

- The FORM:READ:DATA? query does not exist and should be removed from page 48 of the manual.
- On page 52 of the manual, the MMEM:ACQ:DATA:RECA:VALUE? query should be defined as follows:

MMEMory:ACQuisition:DATA:RECAll:VALUE?

Description	This query returns the measurement saved in the <data> memory location.
Syntax	MMEM:ACQ:DATA:RECA:VALUE?<space><data>
Parameters	The <data> parameter represents the memory location where measurement data is stored (out of the 1024 available).
Response	Measurement data saved in the specified memory location in the "±999.999E±99" format.
Notes	➤ Use the MMEM:ACQ:DATA:RECA:UNIT? query to get the corresponding measurement units. ➤ Use the MMEM:ACQ:DATA:RECA:WAVE? query to get the wavelength at which the measurement was taken.
Example	MMEM:ACQ:DATA:RECA:VALUE? 1021

- On page 53 of the manual, the MMEM:ACQ:DATA:RECA:WAV? query should be named and defined as follows:

MMEMory:ACQuisition:DATA:RECAll:WAVElength?

Description	This query returns the wavelength corresponding to the last value fetched with the MMEM:ACQ:DATA:RECA:VALUE? query.
Syntax	MMEM:ACQ:DATA:RECA:WAVE?
Response	A wavelength in the "9999 nm" format.
Notes	➤ Use the MMEM:ACQ:DATA:RECA:UNIT? query to get the corresponding measurement units. ➤ Use the MMEM:ACQ:DATA:RECA:WAVE? query to get the wavelength at which the measurement was taken.
Example	MMEM:ACQ:DATA:RECA:WAVE?

➤ On page 54 of the manual, the MMEM:ACQ:SAMP command should be defined as follows:

MMEMory:ACQuisition:SAMPles

Description This command changes the samples parameter for the acquisition setup.

Syntax MMEM:ACQ:SAMP<space><samples>

Parameters The <samples> parameter is the number of samples to be set for the acquisition setup. If an invalid parameter is entered, the closest valid parameter will be entered instead.

Note The duration of the acquisition directly affects the values that can be set for the number of samples

D x R = S

where

- ➤ D = duration parameter set with the MMEM:ACQ:DURA command (in seconds)
- ➤ R = any of the possible sampling rates in $seconds^{-1}$ (get the complete list with the SENS:FREQ:CATA? query)
- ➤ S = valid number of samples (MUST be a whole number)

Example MMEM:ACQ:SAMP 200

➤ On page 57 of the manual, the SENS:FREQ:CAT? query should be named and defined as follows:

SENSitivity:FREQuency:CATAlog?

Description This query returns a list of available sampling rates.

Syntax SENS:FREQ:CATA?

Response List of available sampling rates in the "40.0;20.0;10.0;5.0;1.0;0.5;0.1" format.

Example SENS:FREQ:CATA?

➤ On page 60 of the manual, the SENS:POW:WAV command should be named and defined as follows:

SENSitivity:POWer:WAVElength

Description This command selects a new operating wavelength.

Syntax SENS:POW:WAVE<space><numeric_value> [<space>NM]

Parameters The <numeric_value> is an operating wavelength expressed in nanometers (nm). Any wavelength within the spectral range of the optical detector (at 1 nm resolution) may be selected. See *Optical Specifications* on page 67 for the exact spectral range of each detector type.

Example SENS:POW:WAVE 1310

➤ On page 60 of the manual, the SENS:POW:WAV? query should be named and defined as follows:

SENSitivity:POWer:WAVElength?

Description This query returns the currently selected calibrated wavelength.

Syntax SENS:POW:WAVE?

Response The current wavelength in nanometers (nm) in the "9999 nm" format.

Example SENS:POW:WAVE?

➤ On page 61 of the manual, the UNIT:POW command should be named and defined as follows:

UNIT:POWer

Description This command changes the measurement display units.

Syntax UNIT:POW<space><units>

Parameters The <units> parameter can be

- ➤ W: measured value displayed in watts (pw, nw, μw, or mw)
- ➤ DBM: measured value displayed in dBm
- ➤ DB: measured value displayed in dB relative to the current reference
- ➤ DW: measured value displayed in watts relative to the current reference

Example UNIT:POW DBM

➤ On pages 62-64 of the manual, the Quick Reference Command Tree should be modified as follows to reflect changes in GPIB commands:

Command					Parameter/ Response	Description
MMEM	ACQ	DATA	RECA	VALUE?	(0 to 1025)	Get acquired measurement
				WAVE?	(9999 nm)	Get wavelength
SENS	FREQ	CATA?			(99.9;99.9;...)	List sampling rates
	POW	WAVE			<9999> [NM]	Set wavelength
		WAVE?			(9999 nm)	Get wavelength
UNIT	POW				<W|DB|DBM|DW>	Set display unit