



FIBER OPTIC TECHNOLOGY
CALIBRATION LABORATORY

PM-800-GL Optical Power Meter

INSTRUCTION MANUAL



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1 Introduction

The **PM-800-GL optical power meter** is designed to measure absolute or relative optical power in optical networks. The AWD (Auto Wavelength Detection) function facilitates the tester settings and eliminates the operator's failure. The memory capacity allows storage and uploading of up to 3000 measurements including memory position or fiber number, wavelength, absolute value or relative value and insertion loss. The SmartProtocol PC evaluation software supports memory download and test report generation.

The rechargeable Li-Pol battery ensures long term working with a minimum service life of 5 years. Batteries can be charged via a USB port or external AC/DC adaptor. The microprocessor controlled charging process ensures optimal battery status and extended operation time.

The PM-800-GL series can measure a wide range of optical power level, -70 to +36 dBm.

2 Features

- Small size, light weight
- InGaAs or Si photodetector
- Four types according to dynamic range
- Detection of modulation 270 Hz, 1 kHz, 2 kHz
- AWD (Auto Wavelength Detection) function
- Two levels high capacity memory: Cable No., Fiber No.
- SmartProtocol PC software - memory download, reporting solution
- Firmware upgrade via USB
- S/N displayed during switch on
- Displayed units: dBm, dB, W
- Reading/writing measured data from/to tag (chip)
- High dynamic range
- Absolute and Relative optical power measurement
- Powered by Li-Pol battery charging via USB port
- 10 min Auto Off, battery status indicator
- Easy to use with menu navigation
- Simple and fast calibration

3 Application

- Absolute or relative optical power measurement
- Optical network measurements
- Measurement output power of optical transmitters
- Measurement input power of optical receivers
- Measurement attenuation in fiber cabling, in conjunction with the LS-800 Optical light source
- Measurement loss in connectors, splices, adaptors, switches and other components
- Easy and rapid identification of failure points in fiber networks
- Suitable for SM and MM applications

4 Accessories

4.1 Standard

- Power meter
- Changeable input adaptors
- USB cable
- Li-Pol battery
- Power charging adapter 5 V DC
- Calibration certificate
- Hard carrying case TE-HC-03
- Smart Protocol PC software
- Data Exporter PC software



USB Power charging adaptor

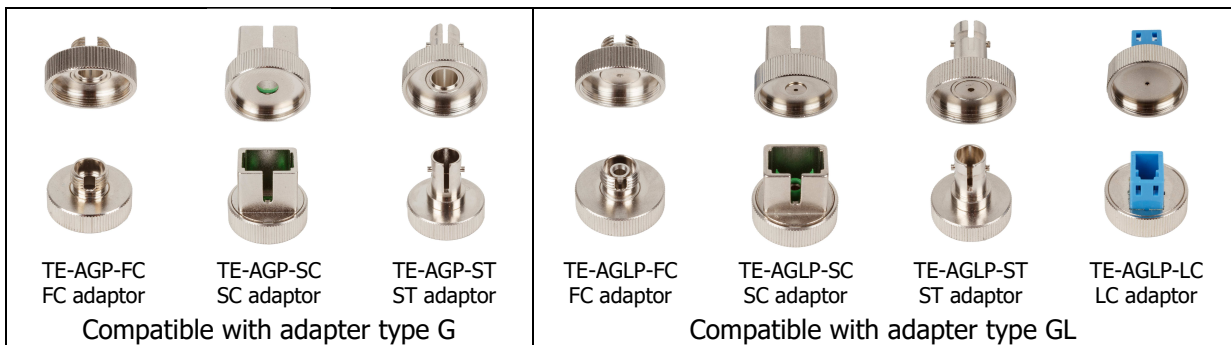
4.2 Optional

- Master patchcords
- Master adaptors



TE-HC-03

4.3 Input adapters:



5 Specifications

General specifications	Value				Unit	Note
Dimensions	165 x 80 x 40				mm	with TE-AGP-250 adapter
Weight	340				g	with battery
Operation temperature	-10 to + 60 / 0 to +45				°C	Discharging / charging battery
Storage temperature	-10 to + 45				°C	
Humidity (non-condensing)	0 to 95				%	
Power Meter	PM-800-06	PM-800-16	PM-800-26	PM-800-36		
Dynamic range	-70 to +6	-60 to +16	-50 to +26	-40 to +36	dBm	
Detector	InGaAs		Si			
Wavelength range	850 to 1700		400 to 1100		nm	
Working wavelengths	850, 1300, 1310, 1490, 1550, 1625		650, 850, 980		nm	can be customized
Accuracy	± 5				%	1310, 1550 nm at -20 dBm
Resolution	0.25				dB	at 25°C
Tone detection	0.270, 1, 2				kHz	
Auto switching (AWD)	Yes				-	
AWD/Modulation Detection	-50 / -45				dBm	1300 – 1625 nm / 850 nm
Data storage	Up to 3000				-	number of measurements
Display units	dBm, dB, W				-	

6 Ordering code:

PM-800	-	XX	-	XX	-	(SI)
		Dynamic range		Adaptor type		Photodetector
		06 -70 to +6 dBm		G 2.5 ⁺ , FC, SC, ST		- InGaAs
		16 -60 to +16 dBm		GL LC, FC, SC, ST		SI Si
		26 -50 to +26 dBm				
		36 -40 to +36 dBm				

Note: 1) G-type without additional adapter is suitable for ferrule 2.5 mm



PM-800 with adapter type G



PM-800 with adapter type GL

7 Safety information

The PM-800 instrument emits no optical power itself and does not create any hazards to the user. To ensure a high level of operator safety during installation, commissioning and operating the equipment, as well as ensuring that the equipment remains undamaged, it is necessary to consider the following general warnings and recommendations.

- For high power optical signal the safety rules for laser systems must be observed, see laser classification.
- Installation, commissioning, operation and service of equipments with high power level are only allowed to be carried out by an authorised person.
- Use only the equivalent connector types to those built into the instrument in order to avoid damage to the instrument components.
- Optical connectors must be clean, in case the connectors are not perfectly clean – please clean them according to the procedure described in the technical specification for the relevant connectors.
- Never use magnifying devices to inspect optical fiber ends unless you are sure that no optical power is being emitted.
- Use only magnifying devices with a built-in infra-red filter to ensure safety.
- During operation, testing or maintenance of a fiber optic system, never look into an active fiber optic cable. Infrared radiation may be present and permanent eye damage can result.
- Avoid direct exposure to the beam.
- Do not activate the laser when there is no fiber attached to the optical output connector.

Under no circumstances should you look into the end of an optical cable attached to the optical output when the device is operational. The laser radiation can seriously damage your eyesight.

7.1 Laser classification

A laser is a light source that can be dangerous to the people exposed to it. Even low power lasers can be hazardous to eyesight. A person exposed to laser radiation (especially invisible radiation) may be unaware that damage is occurring. Some lasers are so powerful that even the diffuse reflection from a surface can be hazardous to the eye. Laser radiation predominantly causes eye injury via thermal effects on the retina. A transient increase of only 10 °C can destroy retinal photoreceptors

Lasers have been classified by wavelength and maximum output power into four classes and a few subclasses since the early 1970s. The classifications categorize lasers according to their ability to produce damage in exposed people, from class 1 (no hazard during normal use) to class 4 (severe hazard for eyes and skin). There are two classification systems, the "old system" used before 2002, and the "revised system" being phased in since 2002. The latter reflects the greater knowledge of lasers that has been accumulated since the original classification system was devised, and permits certain types of lasers to be recognized as having a lower hazard than was implied by their placement in the original

classification system. The revised system is part of the revised IEC 60825 standard. From 2007, the revised system is also incorporated into the US-oriented ANSI Laser Safety Standard (ANSI Z136.1). Since 2007, labeling according to the revised system is accepted by the FDA on laser products imported into the US. The old and revised systems can be distinguished by the 1M, 2M and 3R classes used only in the revised system and the 2A and 3A classes used only in the old system. Class numbers were designated using Roman numerals (I–IV) in the US under the old system and Arabic numerals (1–4) in the EU. The revised system uses Arabic numerals (1–4) in all jurisdictions.

The classification of a laser is based on the concept of accessible emission limits (AEL) that are defined for each laser class. This is usually a maximum power (in W) or energy (in J) that can be emitted in a specified wavelength range and exposure time. For infrared wavelengths above 4 μm , it is specified as a maximum power density (in W/m^2). It is the responsibility of the manufacturer to provide the correct classification of a laser, and to equip the laser with appropriate warning labels and safety measures as prescribed by the regulations. Safety measures used with the more powerful lasers include key-controlled operation, warning lights to indicate laser light emission, a beam stop or attenuator, and an electrical contact that the user can connect to an emergency stop or interlock

Below, the main characteristics and requirements for the classification system from 2002 are listed, along with typical required warning labels. Additionally, classes 2 and higher must have the triangular warning label shown here and other labels are required in specific cases indicating laser emission, laser apertures, skin hazards, and invisible wavelengths

Class 1

A class 1 laser is safe under all conditions of normal use. This means the maximum permissible exposure (MPE) cannot be exceeded. This class includes high-power lasers within an enclosure that prevents exposure to the radiation and that cannot be opened without shutting down the laser. For example, a continuous laser at 600 nm can emit up to 0.39 mW, but for shorter wavelengths, the maximum emission is lower because of the potential of those wavelengths to generate photochemical damage. The maximum emission is also related to the pulse duration in the case of pulsed lasers and the degree of spatial coherence.

Class 1M

A Class 1M laser is safe for all conditions of use except when passed through magnifying optics such as microscopes and telescopes. Class 1M lasers produce large-diameter beams, or beams that are divergent. The MPE for a Class 1M laser cannot normally be exceeded unless focusing or imaging optics are used to narrow the beam. If the beam is refocused, the hazard of Class 1M lasers may be increased and the product class may be changed. A laser can be classified as Class 1M if the total output power is below class 3B but the power that can pass through the pupil of the eye is within Class 1.

Class 2

A Class 2 laser is safe because the blink reflex will limit the exposure to no more than 0.25 seconds. It only applies to visible-light lasers (400–700 nm). Class-2 lasers are limited to 1 mW continuous wave, or more if the emission time is less than 0.25 seconds or if the light is not spatially coherent. Intentional suppression of the blink reflex could lead to eye injury. Many laser pointers are class 2.

Class 2M

A Class 2M laser is safe because of the blink reflex if not viewed through optical instruments. As with class 1M, this applies to laser beams with a large diameter or large divergence, for which the amount of light passing through the pupil cannot exceed the limits for class 2.

Class 3R

A Class 3R laser is considered safe if handled carefully, with restricted beam viewing. With a class 3R laser, the MPE can be exceeded, but with a low risk of injury. Visible continuous lasers in Class 3R are limited to 5 mW. For other wavelengths and for pulsed lasers, other limits apply.

Class 3B

A Class 3B laser is hazardous if the eye is exposed directly, but diffuse reflections such as from paper or other matte surfaces are not harmful. Continuous lasers in the wavelength range from 315 nm to far infrared are limited to 0.5 W. For pulsed lasers between 400 and 700 nm, the limit is 30 mJ. Other limits apply to other wavelengths and to ultrashort pulsed lasers. Protective eyewear is typically required where direct viewing of a class 3B laser beam may occur. Class-3B lasers must be equipped with a key switch and a safety interlock.

Class 4

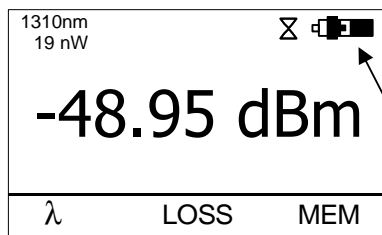
Class 4 lasers include all lasers with beam power greater than class 3B. In addition to posing significant eye hazards, with potentially devastating and permanent eye damage as a result of direct beam viewing, diffuse reflections are also harmful to the eyes within the distance called the Nominal Hazard Zone. Class 4 lasers are also able to cut or burn skin. In addition, these lasers may ignite combustible materials, and thus represent a fire risk, in some cases. Class 4 lasers must be equipped with a key switch and a safety interlock.

8 Maintenance

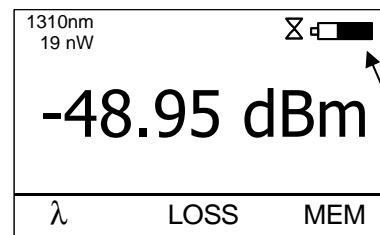
8.1 Battery care

The PM-800 comes equipped with a built-in charger and is powered by Li-Pol battery.

- Charging – via USB port (PC) or by using external USB power charging adaptor (standard accessories)
- Before using the PM-800 for first time, charge fully the battery.
- Use only supplied USB power charging adapter.
- Charge the batteries not to fully charge status before storing PM-800 for a long period.
- If you are not going to use the PM-800 for long period, the batteries will lose its charge during storage. Charge the batteries once every six months.
- The batteries are a consumable. Repeated charging and discharging decreases batteries lifetime.



charging



battery status
indicator

8.2 Instrument care

- During storage and transport keep the instrument in its carry case to protect against crushing, vibration, dust and moisture.
- Where possible keep the instrument away from strong sunlight.
- Clean the instrument housing using alcohol or other cleaning agents. Acetone or other active solvents may damage the case.
- The instrument is resistant to normal dust and moisture, however it is not waterproof. If moisture does get into instrument, dry it out carefully before using it again.

8.3 Recommended cleaning and mating instructions

Cleanliness will affect the performance of an optical fiber system. Perform the following procedures prior the installation. Clean all connectors, adapters, and attenuators before making any connections. The following cleaning materials are recommended and may form part of Your cleaning kit:

- ◆ Lint-free laboratory wipes.
- ◆ Isopropyl alcohol in pressurised dispenser
- ◆ Lint free pipe cleaners.
- ◆ Clean, dry, oil-free compressed air.

CLEANING

Connectors/Terminators:

1. Fold a clean, new wipe into a 2" by 2" square pad.
2. Moisten, but do not saturate, the pad with alcohol making a spot approximately 1/2" in diameter.
3. Open the protective cap (E2000 only).
4. Press the ferrule and face into a wet spot on the wipe. Using force, twist the ferrule so that a hard wiping action takes place. Repeat twice, using a clean alcohol-moistened at each time.
5. Press the ferrule end face into a dry spot on the wipe. Using force, twist the ferrule so that a hard wiping action takes place
6. Close the cap (E2000 only)
7. Discard the used pad.

Attenuators:

1. For an exposed ferrule (in-line type), see connector cleaning procedure, blow the other end dry with clean compressed air.
2. Clean bulkhead attenuators only by blowing with clean compressed air.

Adapters:

1. Moisten one end of a lint-free pipe cleaner with alcohol.
2. Remove excess alcohol from the pipe cleaner with a clean wipe.
3. Insert the moisten pipe cleaner into either end of the adapter and scrub in and out so that the inside surface of the adapter is wiped by the pipe cleaner. Repeat this step for the opposite end.
4. Insert the dry end of the pipe cleaner into either end of the adapter to remove any

residual alcohol. For oversized adapters (biconic), slightly blow the middle of the pipe cleaner fog better surface contact. Repeat this step for the opposite end.

5. Blow the adapter dry with clean compressed air.

MATING

SC, MT-RJ, LC:

1. Align the housing key with the slot in the adapter.
2. Push the connector into the adapter until a click is heard/felt indicating the latching system is engaged. When the SC connector is fully engaged, the white stripes on the side of the housing should be hidden inside the adapter.

FC:

1. Insert the ferrule tip into the adapter.
2. Align the key with the slot in the adapter.
3. Push the connector into the adapter until the coupling nut reaches the adapter housing.
4. Screw the coupling nut clockwise into the adapter.

E 2000:

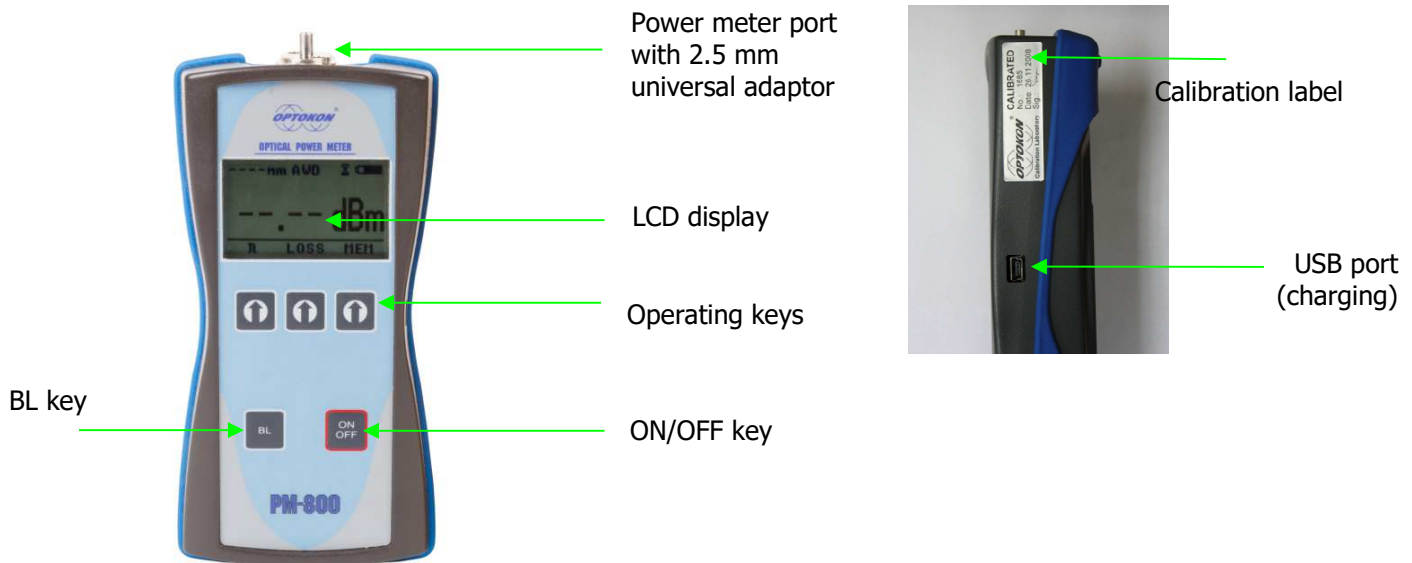
1. Align slots with key on adapter.
2. Push the connector into the adapter until it clicks.

ST:

1. Align the ferrule hub key with the slot in the adapter.
2. Insert the connector into the adapter until the coupling nut reaches the adapter housing.
3. Align the bayonet slots-on the coupling nut with the pins on the outside of the adapter.
4. Push the coupling nut into the adapter while rotating the coupler nut clockwise to lock the bayonet and secure the connection.

Infrared radiation is invisible and can seriously damage the retina of the eye Do not look into the ends of any optical fiber.

9 Instrument and button function description

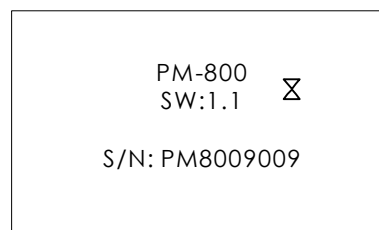
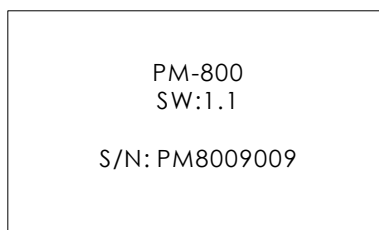


[ON/OFF]

Press to turn the unit on.

Press to turn the unit off.

After switching on, the type of device, serial number and firmware version will be displayed.



The unit will start up with "AUTO OFF" feature – symbol "⏸" will be displayed.

For disable the AUTO OFF feature press and hold the ON/OFF key until symbol "⏸" disappear.

If activated, the unit will turn off after approximately 10 minutes of no activity.

[BL]

Turns the Display Backlight On and Off.



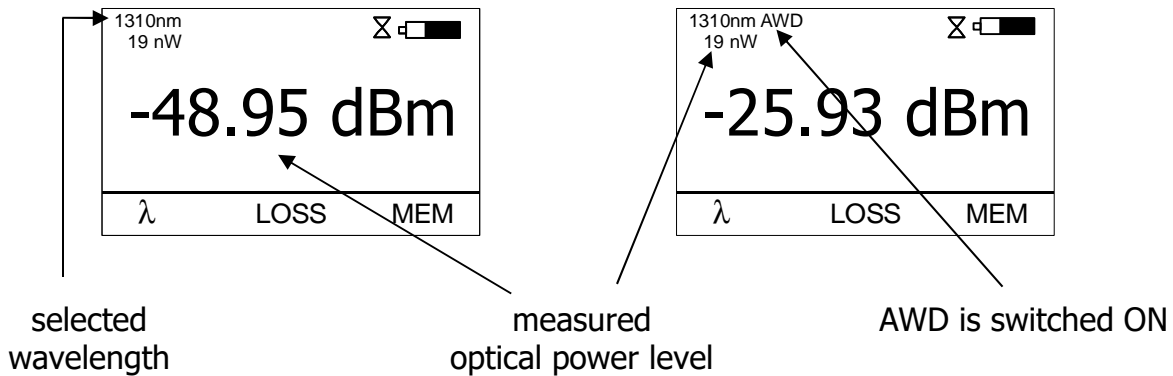
Meaning of these keys depends on current menu.

9.1 Menu #1 – Absolute power measurement mode

In the absolute power measurement mode the absolute value of the optical signal in dBm units is shown on the display.

This screen will appear after the instrument is switched on and information regarding the type of device, serial number and firmware version will appear.

Reading the display:



[λ]

Selects 850, 1300, 1310, 1490, 1550, 1625 nm wavelengths or AWD (Auto Wavelength Detection).

Auto Wavelength Detection is notified by the "AWD" on the display.

Note: LS800 with AWD modulation ON must be connected to PM-800 in order to use this feature.

[LOSS]

Activates the relative power measurement mode (unit dB).

Recalls the last set reference for a selected wavelength.

Goes to menu #2.

[MEM]

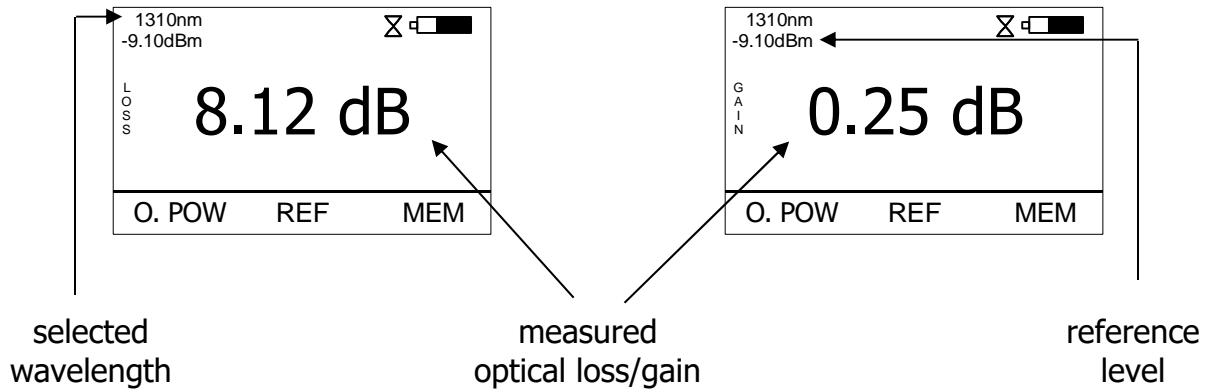
Goes to Memory menu #3.

Starts working with the internal memory.

9.2 Menu #2 – Relative power measurement mode

In the relative power measurement mode is on the value of optical insertion loss in dB units which corresponds to performed reference is shown on the display.

Reading the display:

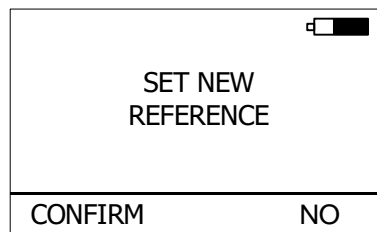


[O.POW]

Returns unit into absolute power measurement mode (unit dBm).
Goes to menu #1.

[REF]

Sets and stores the new reference for the selected wavelength
Note: The new reference must be confirmed by the following screen:



[MEM]


Goes to Memory menu #3.
Starts working with the internal memory.

9.3 Menu #3 – Working with the internal memory

The memory of PM-800 has a structured, two-level organization. The results are stored in memory positions (FIBER) in folders called Cable (CABLE). See table below:

CABLE001	FIBER001 FIBER002 FIBER003 FIBER004 FIBER005 FIBER006 FIBERXXX
CABLE002	FIBER001 FIBER002 FIBER003 FIBER004 FIBER005 FIBER006 FIBERXXX
.....	
CABLEXXX	FIBER001 FIBER002 FIBER003 FIBER004 FIBER005 FIBER006 FIBERXXX

This screen will appear after pressing [MEM] key from Menu#1 or Menu#2

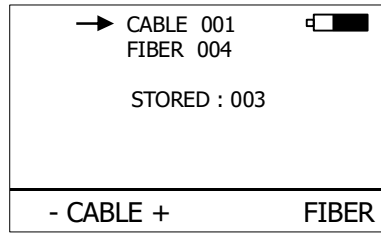
SAVE RESULT 
→ BROWSE RESULTS
UPLOAD MEMORY
ERASE MEMORY
HOME
UP DOWN OK

[UP], [DOWN], [OK]

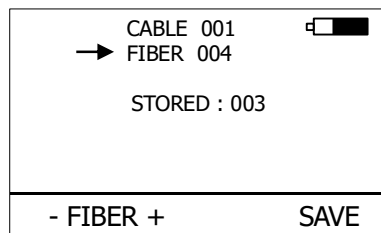
Use these buttons for selection appropriate submenu.

9.3.1 SAVE RESULT

1. By using [UP] [DOWN] select "SAVE RESULT" and press [OK].

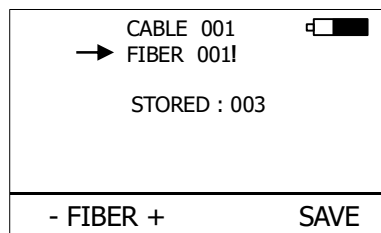


2. Select the cable (folder) using [- CABLE +], the unit will display the number of saved results under the selected cable, then press [FIBER].



3. The unit will suggest the FIBER position under the selected CABLE. Accept the suggested FIBER position and save the result by pressing [SAVE] or change the memory position using [- FIBER +], than press [SAVE] to save the result.

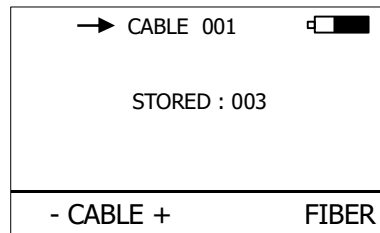
NOTE: If the selected memory position is already occupied, the "!" mark will appear on the display.



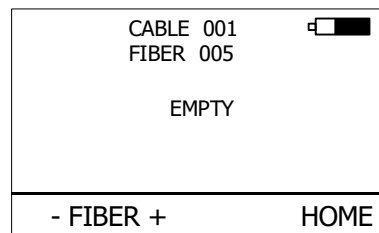
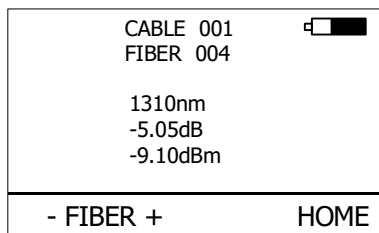
By pressing [SAVE], the new result will OVERWRITE the selected FIBER position and the old result will be discarded.

9.3.2 BROWSE RESULTS

1. By using [UP] [DOWN] select "BROWSE RESULTS" and press [OK]



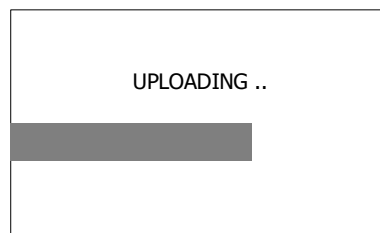
2. Select the cable (folder) using [- CABLE +], the unit will display the number of saved results under the selected cable, then press [FIBER].



3. Use [- FIBER +] to browse through the results.

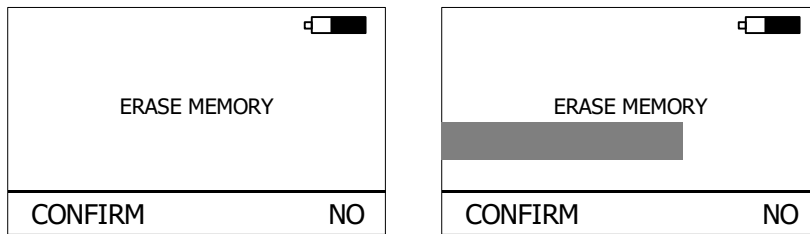
9.3.3 UPLOAD MEMORY

1. By using [UP] [DOWN] select "UPLOAD MEMORY".
2. Press [OK]. All memory content will be sent to the USB port. More information is contained in the chapter "setting up data transfer".



9.3.4 ERASE MEMORY

1. By using [UP] [DOWN] select "ERASE MEMORY" and press [OK].



2. Press [CONFIRM] to erase memory or [NO] for return to main screen.

9.3.5 HOME

1. By using [UP] [DOWN] select "HOME".
2. Press [OK] for return to main screen.

10 Measurement loss

10.1 Basic theory

Loss measures the signal degradation in a fiber optic cable. A light source injects an optical signal of the appropriate wavelength into the fiber and a power meter measures the received signal at the same wavelength.

There are two different measurement methods:

- Method 6
- Method 7

according to IEC 874-1 4.4.7.4.

Power measurement is the basis of optical testing and determines the power budget of the fiber optic link by comparing the power of the transmitter and the sensitivity of the receiver. This difference is the maximum acceptable loss. Power loss is caused by different phenomena such as attenuation of the fiber, dirty connector mating faces, connector misalignment, loss of splices and other issues such as sharp fiber bends. The "end to end" loss test is the most commonly used acceptance test of power loss in fiber optic links. The test is based on measurement the power difference at the input and output of the link.

The PM-800 and LS-800 are used for this test, where the light source (LS-800) acts as a transmitter and the optical power meter (PM-800) as a receiver.

The "end to end" test has two steps:

1. Setting the reference
2. Measurement the loss

Important

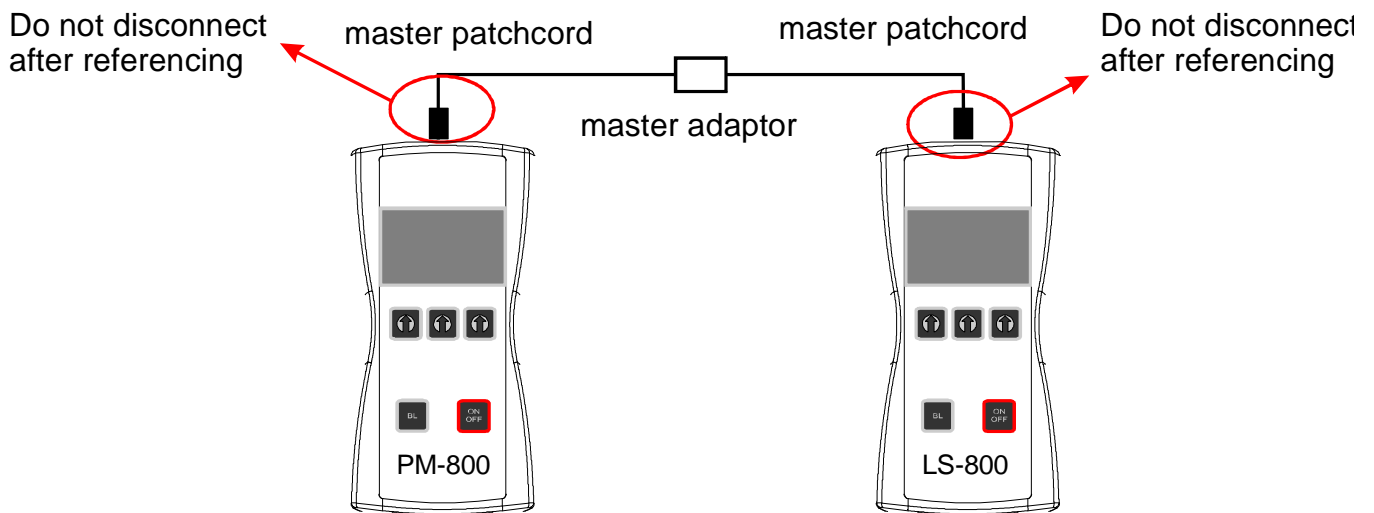
- All connectors and fiber end faces should be cleaned prior to testing (see chapter 7.3).
- The master cord used to set the reference should be the same type as the patchcords (cables) to be tested (MM:50/125, 62.5/125 or SM).
- It is very important that the connections are not disturbed after the reference value is established.

10.2 Method 6

For method 6 two master cords are used to set the reference. Method 6 cancels the effects of the master cords and one adaptor for all subsequent measurements.

10.2.1 Setting the reference

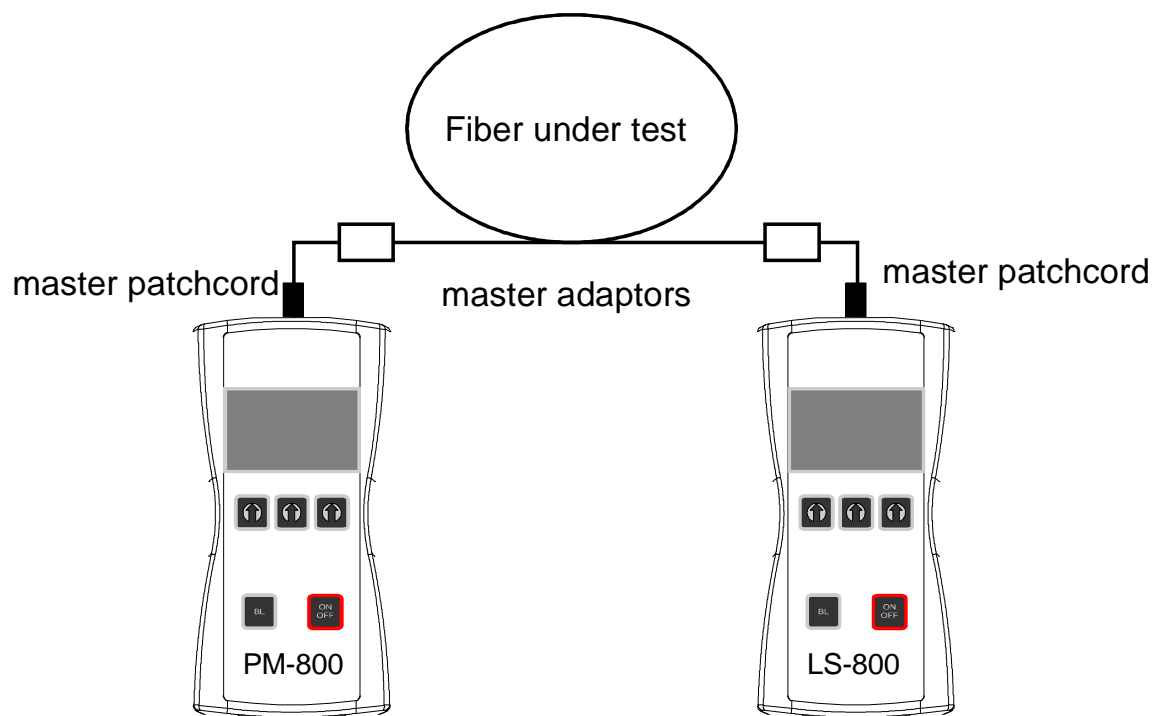
1. Connect the first master cord to the power meter (PM-800).
2. Connect the second master cord to light source (LS-800).
3. Use the master adaptor to connect the two fiber ends (pic.1).
4. Power on the light source and by pushing [λ] select the appropriate wavelength.
5. Power on the power meter and by pushing [λ] select the appropriate wavelength range.
6. On the power meter activate the relative power measurement mode - by pushing [LOSS].
7. Set and store the new reference for the selected wavelength - by pushing [REF] and than [CONFIRM].



(pic.1)

10.2.2 Measurement Loss

1. Do not disconnect the master cords from the light source and power meter.
2. Disconnect second master cord from the adaptor.
3. Connect the trace to be measured between the master cords. An extra master adaptor is required (pic.2).
4. The power meter display will simultaneously report the value with the message "LOSS" or "GAIN" in dB.
5. This value represents a difference between the reference and the performed measurement.
6. If the value will be displayed with the "LOSS" message, the trace to be measured has just this loss.
7. If the value will be displayed with the "GAIN" message, this means that the trace to be measured has been compared with the reference for this gain.
8. Value of loss (or gain) can be stored in the internal memory (see "SAVE RESULT" chapter).



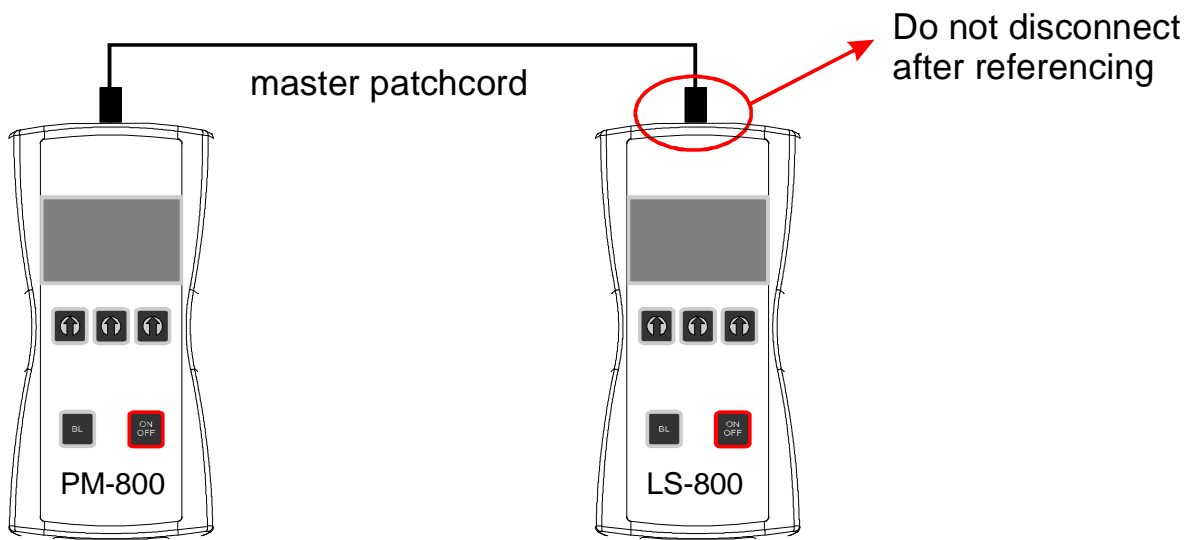
(pic.2)

10.3 Method 7

For method 7, one master cord is used to set the reference. The master cord will be cancelled for all subsequent measurements.

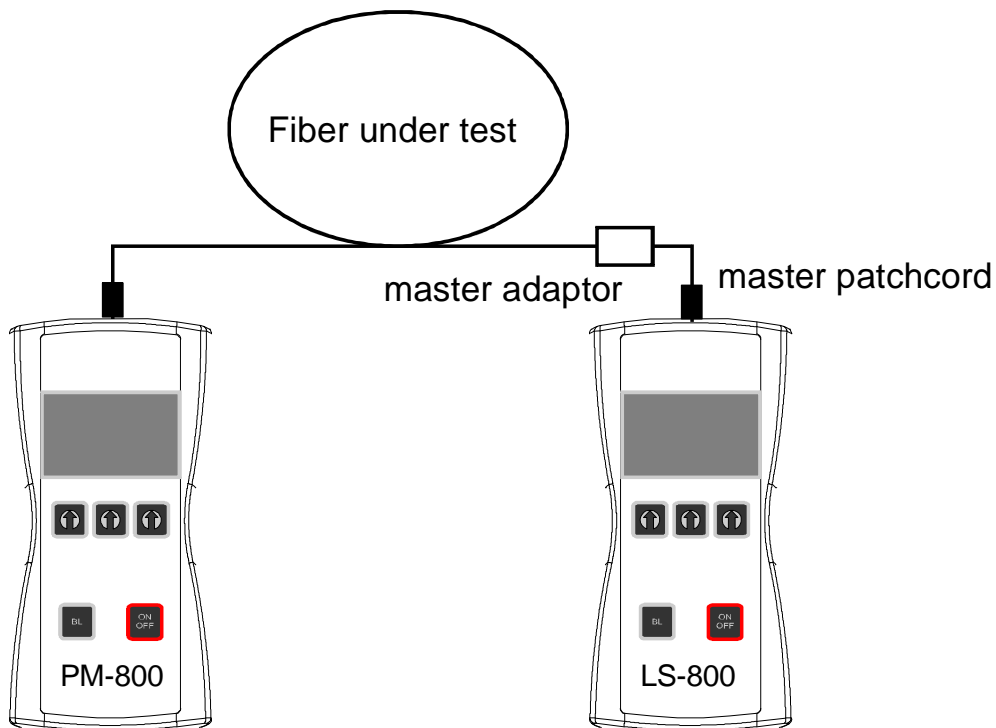
10.3.1 Setting the reference

1. Connect the master cord to the power meter (PM-800).
2. Connect the second end of the master cord to the light source (LS-800, pic.3).
3. Power on the light source and select the appropriate wavelength - by pushing $[\lambda]$.
4. Power on the power meter and select the appropriate wavelength range - by pushing $[\lambda]$.
5. On the power meter activate the relative power measurement mode - by pushing [LOSS].
6. Set and store the new reference for the selected wavelength - by pushing [REF] and than [CONFIRM].



10.3.2 Measurement Loss

1. Do not disconnect the master cord from the light source.
2. Disconnect the master cord from the power meter port.
3. Connect the trace to be measured between the power meter port and the master cord that is attached to the light source. An extra master adaptor is required (pic.4)
4. The power meter display will report the value simultaneously with the message "LOSS" or "GAIN" in dB.
5. This value represents the difference between the reference and the performed measurement.
6. If the value will be displayed with the message "LOSS", the trace to be measured has just this loss.
7. If the value will be displayed with the message "GAIN", this means that the trace to be measured has been compared with the reference for this gain.
8. The value of the loss can be stored in the internal memory (see "SAVE RESULT" chapter).



(pic.4)

10.4 High power measurement

There are 4 levels of dynamic range, up to +36 dBm depending on photodetector type. Use the right type of PM-800 in accordance of expecting max power level in your network.

PM-800-06: -70 to +6 dBm
PM-800-16: -60 to +16 dBm
PM-800-26: -50 to +26 dBm
PM-800-36: -40 to +36 dBm

Warning !!!

For high power optical signal the safety rules for laser systems described in Chapter 7 must be observed.

11 Setting up data transfer

1. Connect the PM-800 to a PC using the USB cable provided and turn the PM-800 on. The PC will prompt you to install the drivers for new hardware. Use the drivers provided by OPTOKON. These drivers will create a virtual serial com port.
2. Start the Hyper Terminal
 Start >> Programs >> Accessories >> Communication >> Hyper Terminal



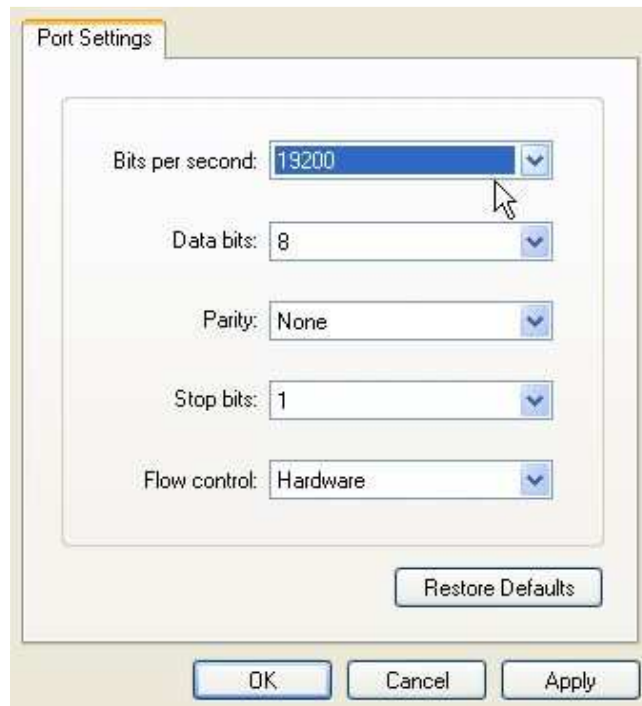
3. Enter the name of a connection, then click on OK.



4. Choose the virtual serial port the PM-800 is connected to, then click on OK

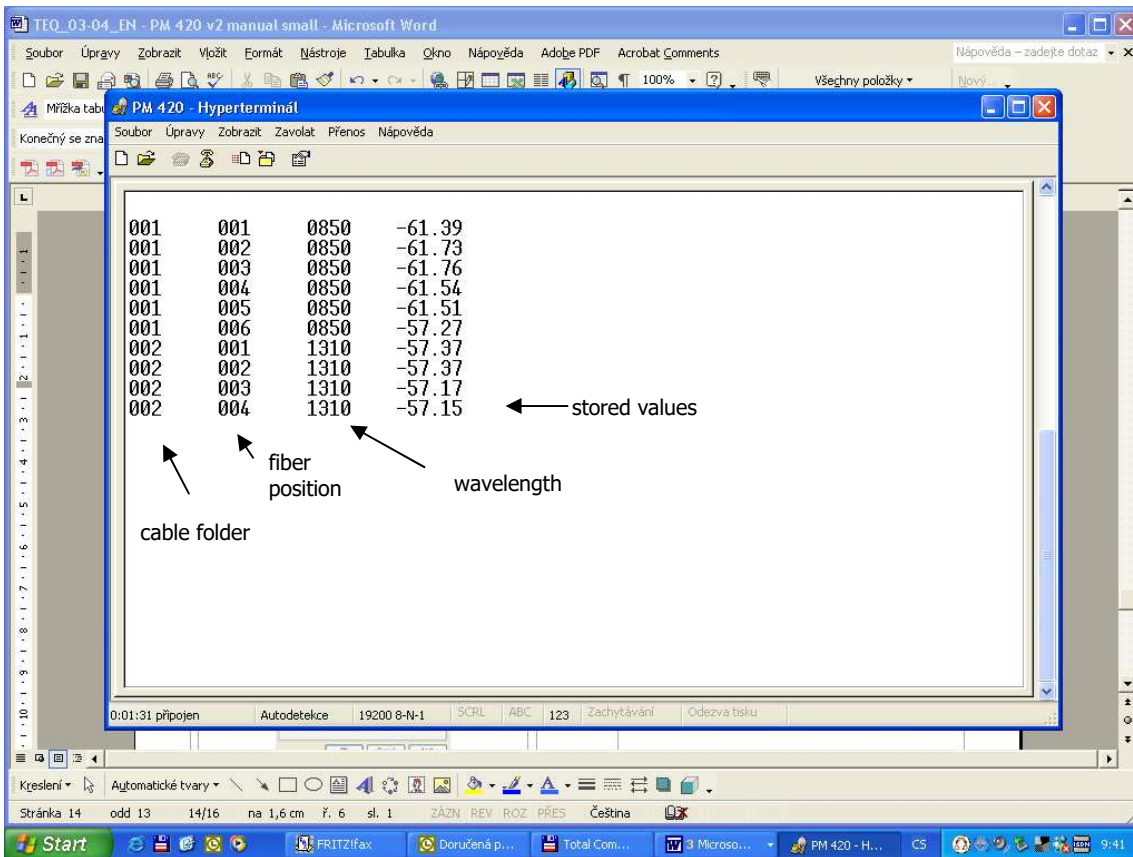


5. Set "Bits per second" to 19200, then click on OK



6. Go to the menu in PM-800 and push [MEM], select [UPLOAD MEMORY], [OK].

The stored data will be transferred to the PC in this format:



The data from this window can be easily copied to any other application.

12 Power loss and decibels

Loss (dB)	% Loss	dBm	Power (mW)
0	0.0	-50	0.00001
0.1	2.3	-40	0.0001
0.2	4.5	-30	0.001
0.3	6.7	-20	0.01
0.4	8.8	-10	0.10
0.5	10.9	-9	0.13
0.6	12.9	-8	0.16
0.7	14.9	-7	0.20
0.8	16.8	-6	0.25
0.9	18.7	-5	0.32
1	20.6	-4	0.40
2	36.9	-3	0.50
3	49.9	-2	0.63
4	60.2	-1	0.79
5	68.4	0	1.00
6	74.9	1	1.26
7	80.0	3	2.00
8	84.2	5	3.16
9	87.7	7	5.01
10	90.0	10	10.00
12	93.7	12	15.84
15	96.8	15	31.62
20	99.0	17	50.12
30	99.9	20	100.00

14 Calibration, service center

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