



FIBER OPTIC TECHNOLOGY
CALIBRATION LABORATORY

OFT-820 Loss Test Set

INSTRUCTION MANUAL



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1 Introduction

The OFT-820 series optical Loss Test Set combines two optical test equipments – Light Source and Power Meter in the same box. The optical Light Source fulfills all the necessary technical requirements for field equipment. Available in various working wavelengths combinations: 850, 1300, 1310, 1490, 1550 and 1625 nm. The optical Power Meter is designed to measure absolute or relative optical power in optical networks.

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 generating. The rechargeable battery ensures long term working with a minimum life time of 5 years.

2 Features

- Small size, light weight
- S/N displayed during switch on
- AWD (Auto Wavelength Detection) function
- Powered by 3 AA type batteries, battery charging via USB port, μ P controlled
- USB port - battery charging, data download, FW upgrade
- Easy to use with menu navigation
- Simple and fast calibration
- 10 min Auto Off, battery status indicator

- InGaAs or Si photodetector
- Detection of modulation 270 Hz, 1 kHz, 2 kHz
- Two levels high capacity memory: Cable No., Fiber No.
- SmartProtocol PC software - memory download, reporting solution
- Displayed units: dBm, dB, W
- Absolute and Relative optical power measurement

- Changeable output connectors – light source ports

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 fibre cabling.
- 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

- Loss Test set
- SmartProtocol PC software
- Universal 2.5 mm adaptor at power meter port (TE-ADP-250)
- FC/PC interface at light source port
- External USB Power charging adaptor
- USB connection cable
- Rechargeable NiMH batteries – 3 pcs
- Traceable calibration certificate
- Hard carrying case (TE-HC-03)



TE-HC-03

4.2 Optional

- Master patchcords
- Master adaptors
- Universal SFF 1.25 mm adaptor (TE-ADP-125) or SC FC, ST, ...testing adaptors at power meter port
- Changeable adaptors at light source port

Power metr adaptors



TE-ADP-250



TE-ADP-125



TE-ADP-SC



TE-ADP-FC

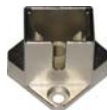


TE-ADP-LC

Light source adaptors



TE-ALS-FC



TE-ALS-SC



TE-ALS-ST

Other types available on request:

- TE-ADP-SC SC adaptor
- TE-ADP-FC FC adaptor
- TE-ADP-ST ST adaptor
- TE-ADP-SMA SMA adaptor
- TE-ADP-LC LC adaptor
- TE-ADP-MU MU adaptor
- TE-ADP-DIN DIN adaptor



USB Power charging adaptor

5 Specifications

Light Source

Output power

LD 850 nm, LED 850 nm, 1300 nm -20 dBm
 LD 1310, 1490, 1550, 1625 nm -9 dBm Standard, 0 dBm Premium

Stability (1 hour, delta/2):

LD 850 nm, LED 850, 1300 nm ± 0.03 dB
 LD 1310, 1490, 1550, 1625 nm ± 0.05 dB

Power meter

Photodetector	1 mm InGaAs	
Working wavelengths	850, 1300, 1310, 1490, 1550, 1625 nm	can be customized
Dynamic range: Standard	-65 dBm to +10 dBm -57 dBm to +17 dBm	1300, 1310, 1490, 1550, 1625 nm 850 nm
Uncertainty	$\pm 5\%$	1310, 1550 nm @ -20 dBm
Resolution	0.01	
AWD/Modulation Detection	-50 dBm -45 dBm	1300 – 1625 nm 850 nm

General

Dimensions	165 x 80 x 50 mm	with 2.5 mm universal adapter
Weight	400 g	with battery
Temperature	operating -10 to +50 °C storage -40 to +70 °C	
Humidity (non condensing)	0 to 95%	
Operating temperature	-10 to +50 °C	
Battery working time	> 50 hrs	between battery charging
Battery life time	> 5 years	2700 mA/h NiMH
Compliant with RoHS-requirements (2002/95/EG, 27.01.2003)		

Note:

typ. value

tested after 20 min warm up
 temperature $23 \pm 1^\circ$

can be customized

1300, 1310, 1490, 1550, 1625 nm
 850 nm

1310, 1550 nm @ -20 dBm

1300 – 1625 nm

850 nm

with 2.5 mm universal adapter

with battery

between battery charging

2700 mA/h NiMH

6 Safety information

OFT-800 Light source complies with the following safety classifications:

IEC825-1 and 21CFR1040: Class1

This applies to laser and LED options up to 1 mW, above 700 nm. Devices in this category are classified as safe for use by technicians under normal viewing, provided that magnifying devices are not used.

It is the responsibility of the user to acquire adequate training and familiarity with relevant safety issues and work practices before using this equipment.

WARNING!

The OFT-800 Power meter 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.

- Never use magnifying devices to inspect optical fiber ends unless you are certain that no optical power is being emitted.
- Only use 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 this can result in permanent eye damage.
- Avoid direct exposure to the beam.
- Do not activate the laser when there is no fiber attached to the optical output connector.
- 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.
- Use only the equivalent connector types to those built into the instrument in order to avoid damage to the instrument components.
- 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.
- For high power measurement above +10 dBm is necessary to use PM-800H.
- Installation, commissioning, operation and service of equipments with high power level are only allowed to be carried out by an authorised person.

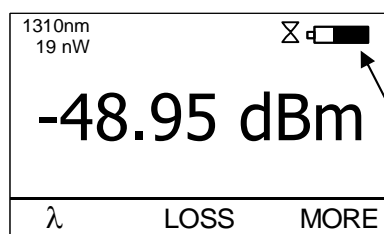
7 Maintenance

7.1 Battery care

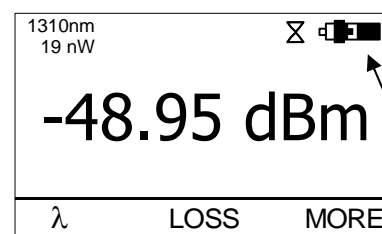
The OFT-800 comes equipped with a built-in charger and is powered by three NiMH AA type batteries (standard accessories).

Never use alkaline batteries !!!

- Charging – via USB port (PC) or by using external USB power charging adaptor (standard accessories)
- Before using the OFT-800 for first time, charge fully the batteries.
- Use only supplied USB power charging adapter.
- Charging is not recommended until battery status indicator is 30% or less. Recommended charging time of batteries is 12 to 14 hrs.
- Charge the batteries fully before storing PM-800 for a long period. The batteries will lose its charge during storage.
- If you are not going to use the OFT-800 for long period, charge the batteries once every six months.
- The batteries are a consumable. Repeated charging and discharging decreases batteries lifetime.
- To extend batteries lifetime it is recommended that batteries be completely drained before re-charging – battery refresh. Otherwise the batteries lose its ability to fully recharge.



charging



battery status
indicator

7.2 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.

7.3 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:

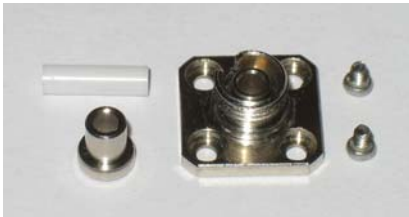
1. Align the ferrule hub key with the slot in the adapter.
2. Insert the connector into the adapter until the coupling nut reaches the adapter housing.
3. Align the bayonet slots-on the coupling nut with the pins on the outside of the adapter.
4. Push the coupling nut into the adapter while rotating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

7.4 Light source Adaptor set exchange

The OFT-800 comes equipped with an adaptor set (FC, SC or ST adaptor). The adaptor set includes:

- adaptor body with flange
- two screws
- adaptor sleeve
- adaptor nut.



For exchanging the adaptor or cleaning the ferrule end face please use the following instructions:

1. Loosen the two adaptor flange screws



2. Carefully remove the adaptor body, be careful of the sleeve



3. Using the optical connector ferule, carefully remove the adapter sleeve



4. Remove the adaptor nut. Now the adaptor set is fully removed.

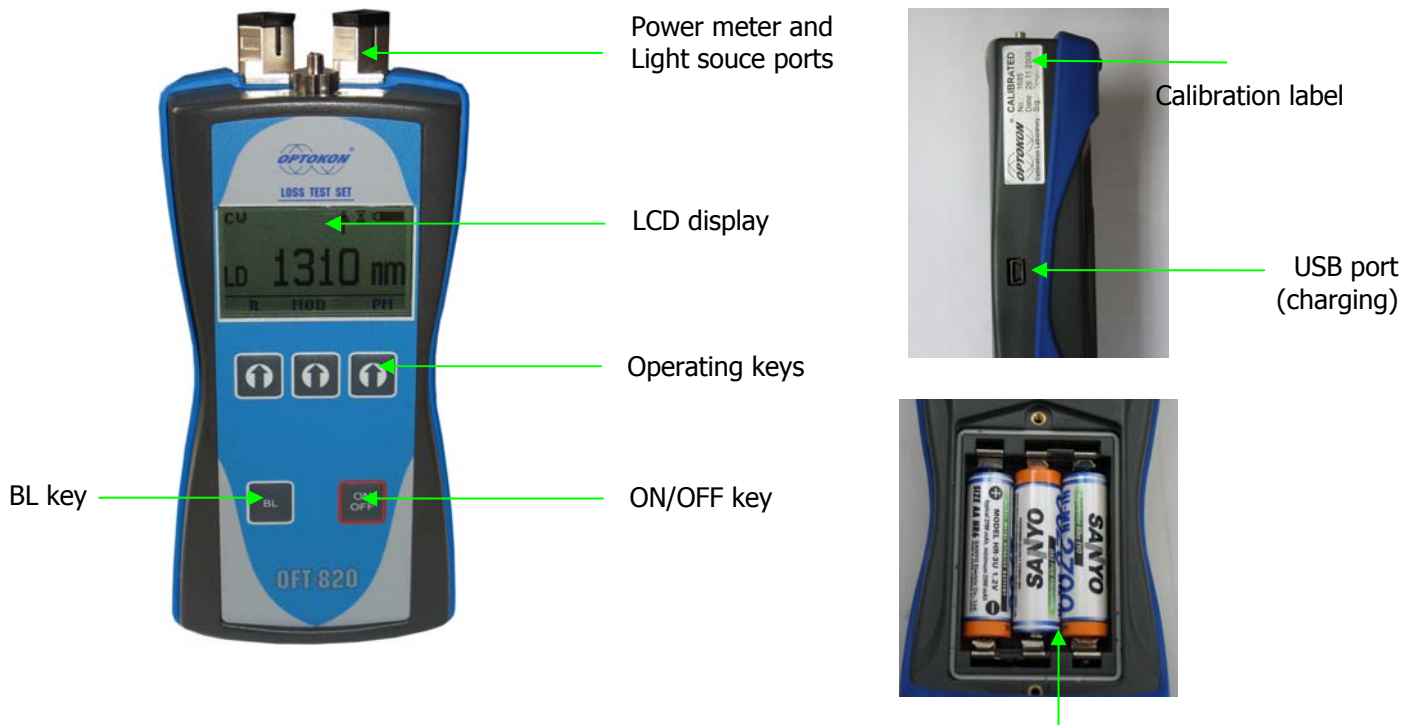


If necessary, carefully clean the ferrule end face using alcohol and lint-free laboratory wipes.

5. Insert the adaptor nut and the sleeve back.
6. Attach the appropriate adaptor body and tighten the screws again

8 Instrument and button function description

8.1 General description

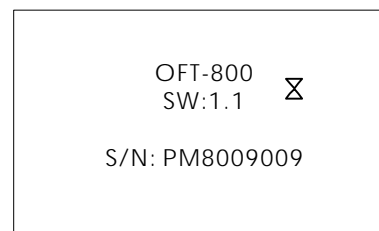


[ON/OFF]

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.

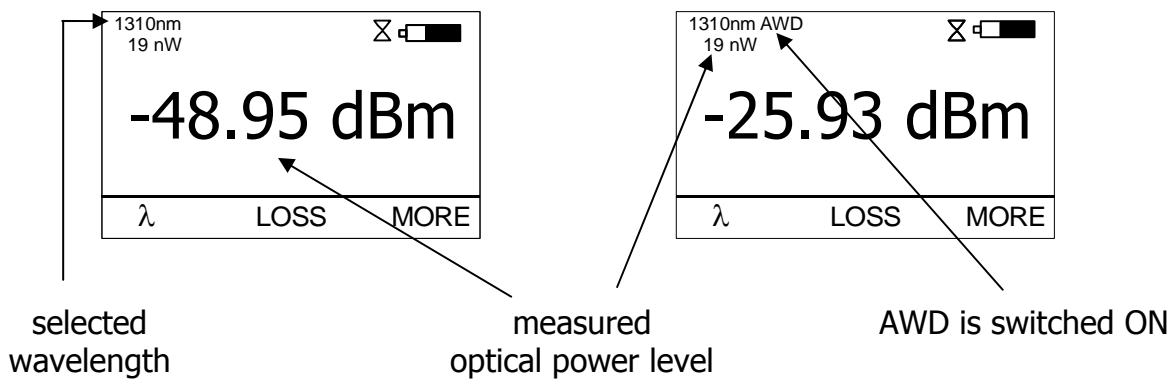
8.2 Power meter

8.2.1 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.

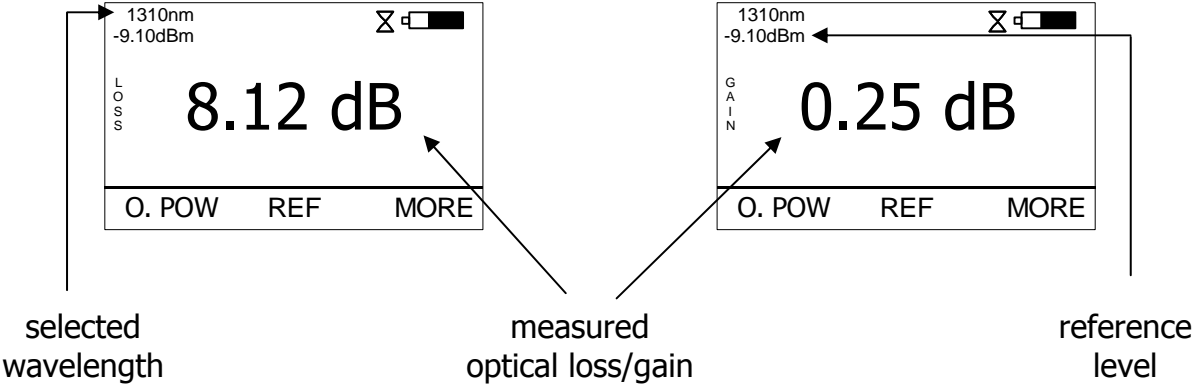
[MORE]

Goes to navigation menu #3.

8.2.2 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:

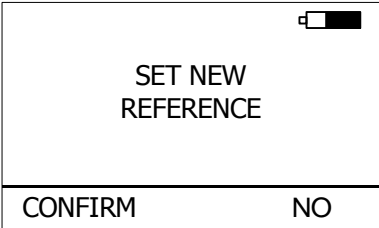


[O.POW]

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

[REF]

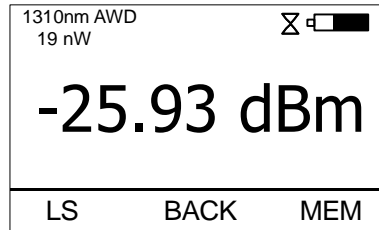
Sets and stores the new reference for the selected wavelength
Note: The new reference must be confirmed by the following screen:



[MORE]

Goes to navigation menu #3.

8.3 Menu #3 – Navigation

**[LS]**

Goes to Light source menu#4.

[BACK]

Returns unit into absolute or relative power measurement mode (unit dBm or dB).
Goes to menu #1 or #2.

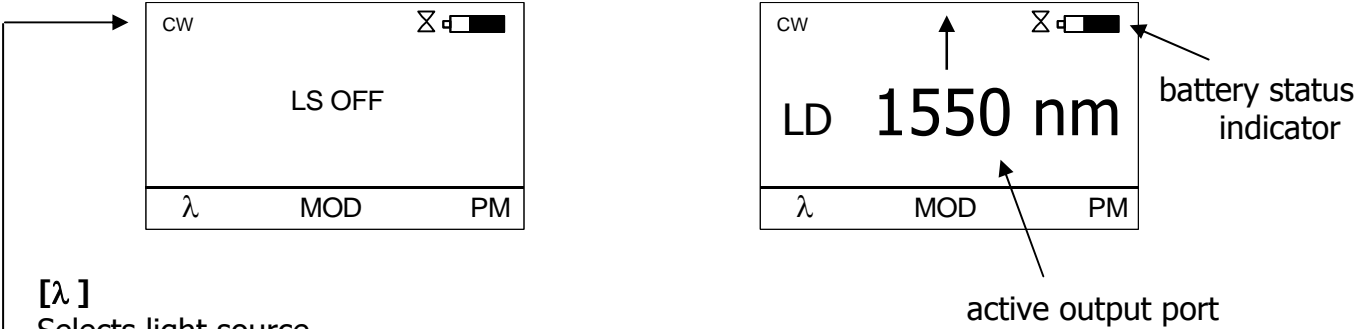
[MEM]

Goes to Memory menu #5.
Starts working with the internal memory.

8.4 Light source

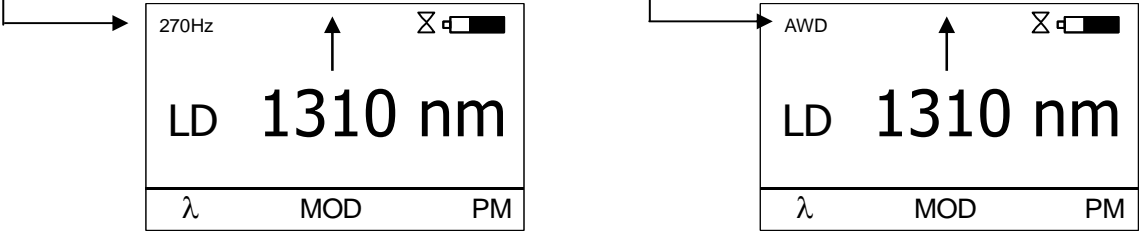
8.4.1 Menu #4 – Light source menu

Reading the display:



[λ]
 Selects light source
 For available source configurations, see relevant datasheet.

[MOD]
 Selects the modulation:
 CW – Continuous wave
 270Hz – 270kHz Modulation
 1KHz – 1kHz Modulation
 2KHz – 2kHz Modulation
 AWD – Auto Wavelength Detection – Modulation




[PM]
 Returns unit into absolute or relative power measurement mode (unit dBm or dB).
 Goes to menu #1 or #2.

8.5 Menu #5 – Working with the internal memory

The memory of OFT-820 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

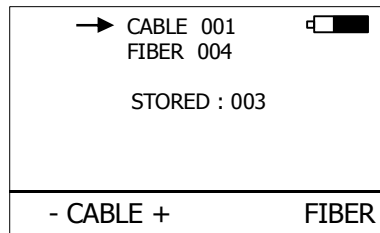
This screen will appear after pressing [MORE] key from Menu#1 or Menu#2 then [MEM].

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

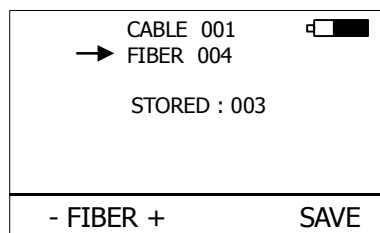
[UP], [DOWN], [OK]
Use these buttons for selection appropriate submenu.

8.5.1 SAVE RESULT

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

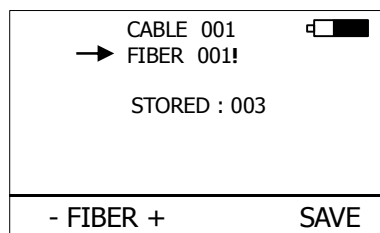


2. Select the cable (folder) using [- CABLE +], the unit will display the number of saved results under the selected cable, then press [FIBER].



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 +], then press [SAVE] to save the result.

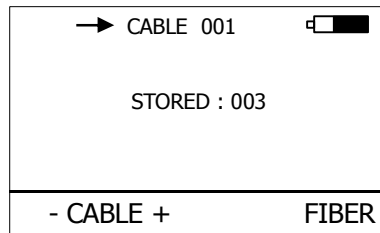
NOTE: If the selected memory position is already occupied, the "!" mark will appear on the display.



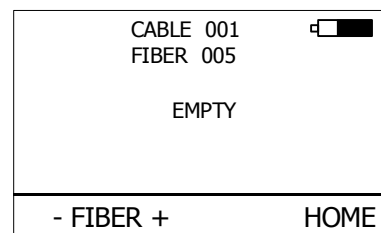
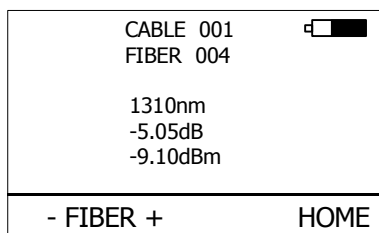
By pressing [SAVE], the new result will OVERWRITE the selected FIBER position and the old result will be discarded.

8.5.2 BROWSE RESULTS

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



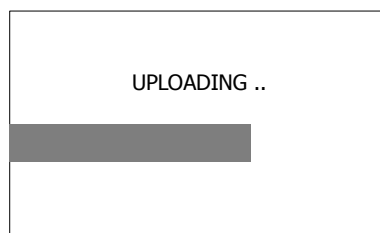
2. Select the cable (folder) using [- CABLE +], the unit will display the number of saved results under the selected cable, then press [FIBER].



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

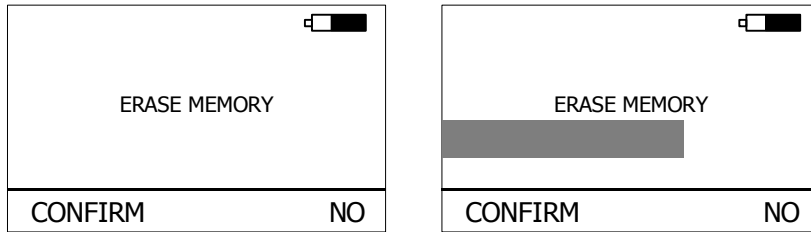
8.5.3 UPLOAD MEMORY

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".



8.5.4 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.

8.5.5 HOME

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

9 Measurement loss

9.1 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.

One or two units OFT-820 are used for this test, where Light source port is acting as transmitter and Optical power meter port as 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.

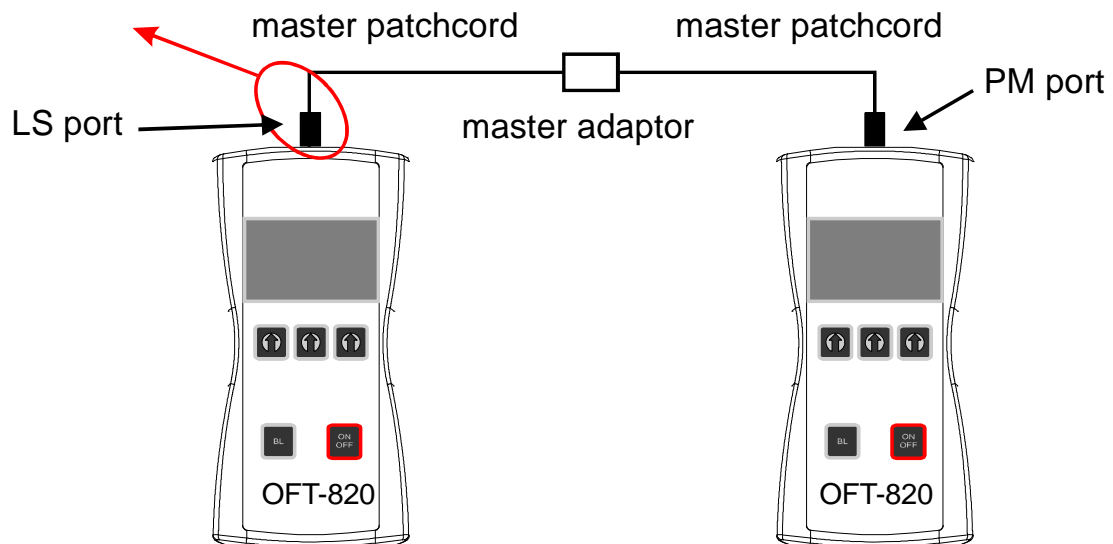
9.2 Method 6 - two instruments

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

9.2.1 Setting the reference pic.1

1. Connect first Master cord to Light source port of first OFT-820 instrument.
2. Connect second Master cord to Power meter port of second OFT-820 instrument.
3. Use Master adaptor to connect the two fiber ends.
4. Power on first OFT-820 instrument (light source).
5. Push **[MORE]**, **[LS]**.
6. By pushing **[λ]** activate appropriate wave-length.
7. Power on second OFT-820 instrument (power meter).
8. By pushing **[λ]** select appropriate wave-length range.
9. Activate relative power measurement mode - by pushing **[LOSS]**.
10. Set and store the new reference for selected wave-length - by pushing **[REF]**, **[CONFIRM]**.

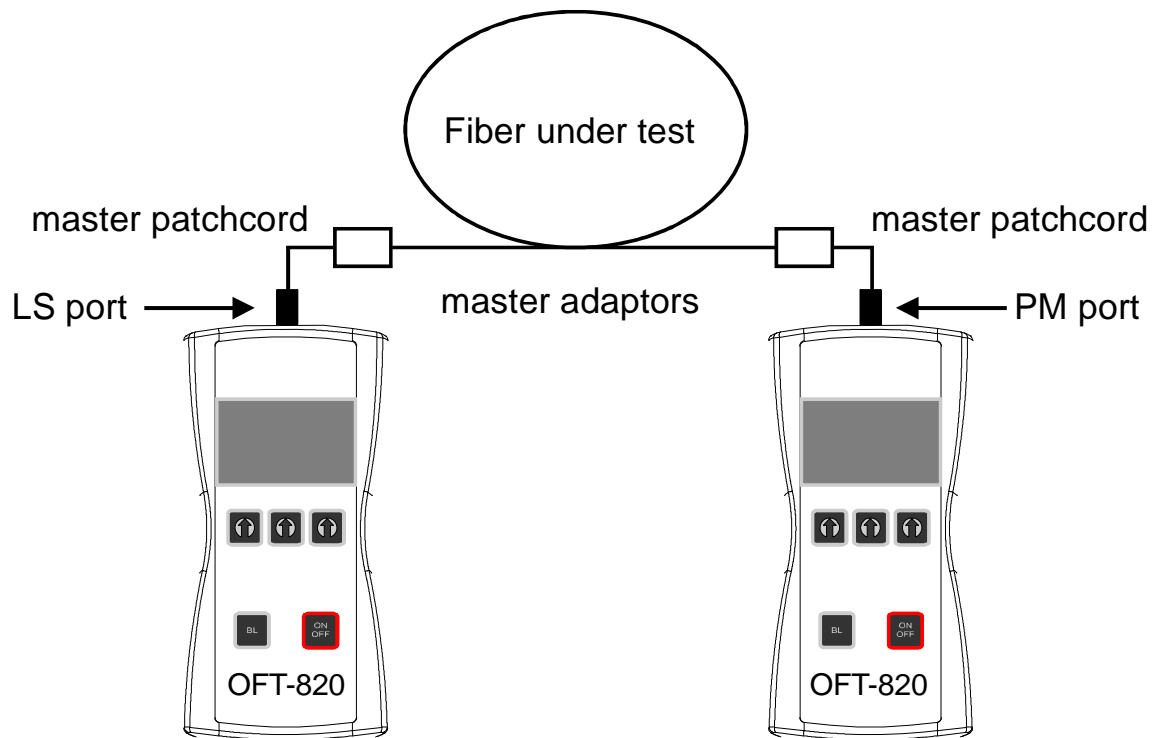
Do not disconnect
after referencing



(pic.1)

9.2.2 Measuring Loss pic.2

1. Do not disconnect the Master cords from instruments.
2. Disconnect one Master cord from adaptor.
3. Connect the trace to be measured between the Master cords. An extra Master adaptor is needed.
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).



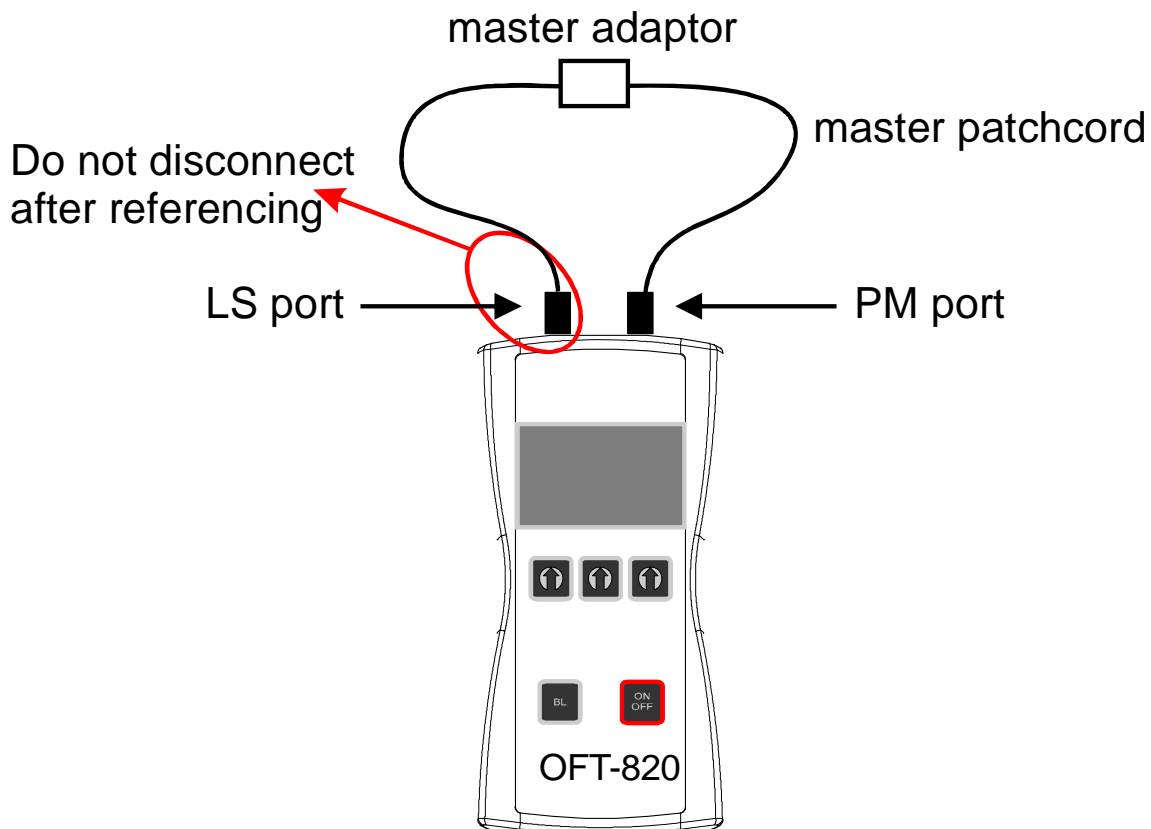
(pic.2)

9.3 Method 6 - one instrument

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

9.3.1 Setting the reference pic.3

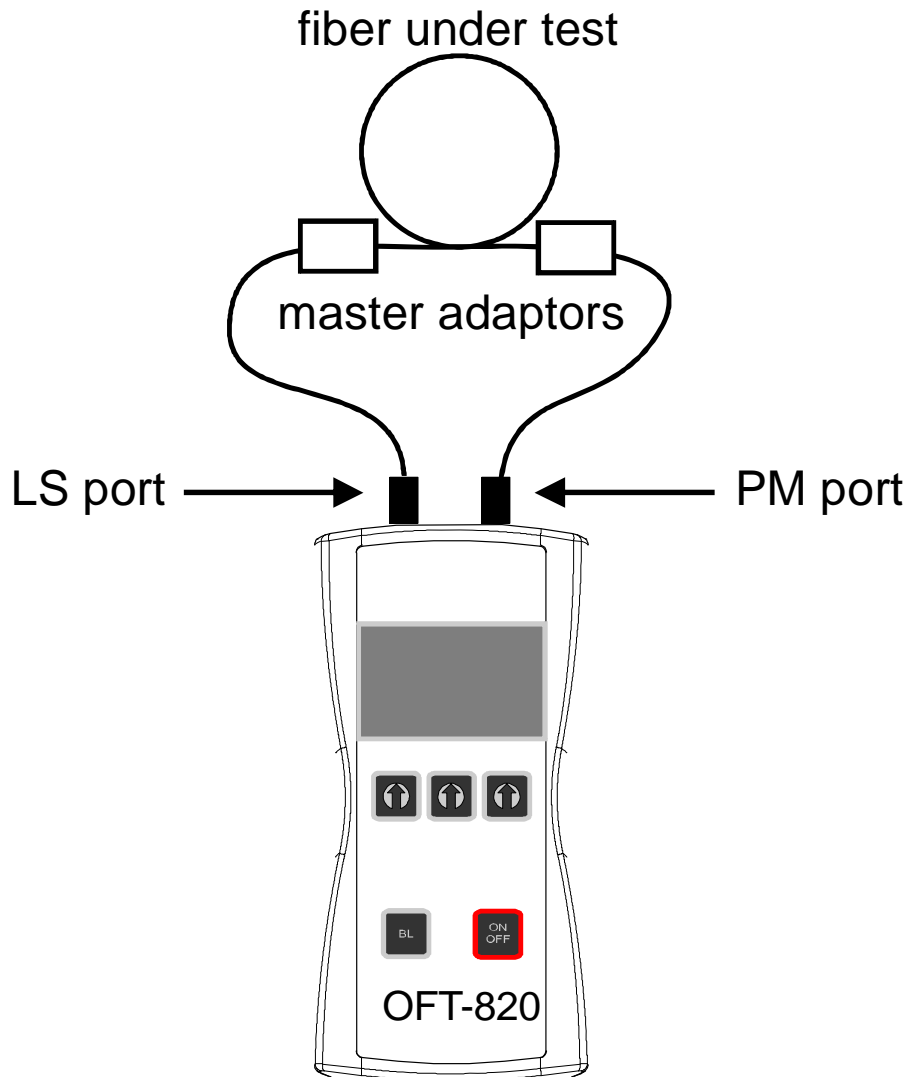
1. Connect first Master cord to Light source port.
2. Connect second Master cord to Power meter port.
3. Use Master adaptor to connect the two fiber ends.
4. Power on OFT-820 instrument.
5. Push **[MORE]**, **[LS]**.
6. By pushing **[λ]** activate appropriate wave-length (light source).
7. Push **[PM]** and select appropriate wave-length range - by pushing **[λ]** (power meter).
8. Activate relative power measurement mode - by pushing **[LOSS]**.
9. Set and store the new reference for selected wave-length - by pushing **[REF]**, **[CONFIRM]**.



(pic.3)

9.3.2 Measuring Loss pic.4

1. Do not disconnect the Master cords from instrument.
2. Disconnect one Master cord from adaptor.
3. Connect the trace to be measured between the Master cords. An extra Master adaptor is needed.
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.4)

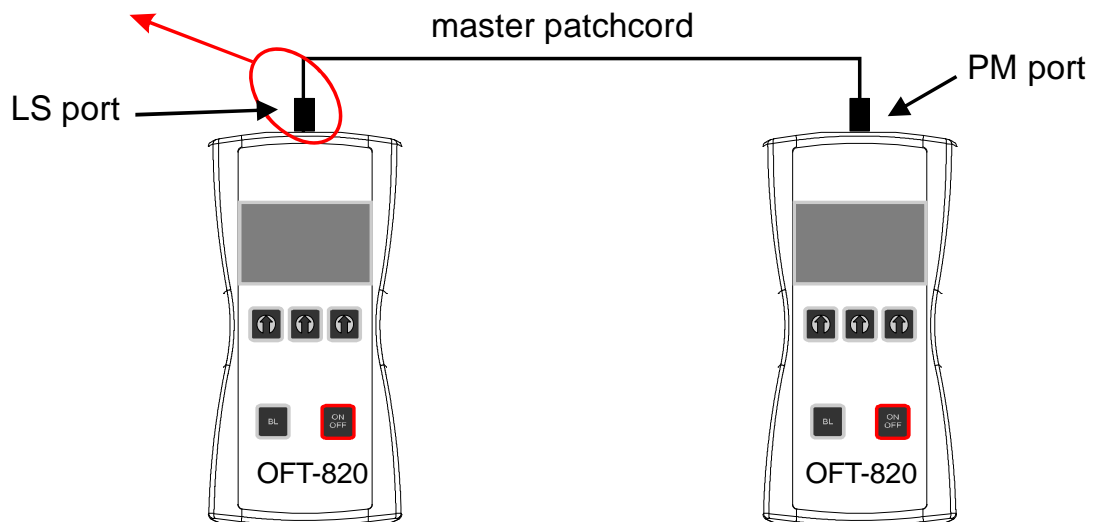
9.4 Method 7 - two instrument

For method 7 one Master cord are used to set reference. Master cord will be canceled out for all subsequent measurements.

9.4.1 Setting the reference pic.5

1. Connect Master cord to Light source port of first OFT-820 instrument.
2. Connect second end of Master cord to Power meter port of second OFT-820 instrument.
3. Power on first OFT-820 instrument (light source).
4. Push **[MORE]**, **[LS]**.
5. By pushing **[λ]** activate appropriate wave-length.
6. Power on second OFT-820 instrument (power meter).
7. By pushing **[λ]** select appropriate wave-length range.
8. Activate relative power measurement mode - by pushing **[LOSS]**.
9. Set and store the new reference for selected wave-length - by pushing **[REF]**, **[CONFIRM]**.

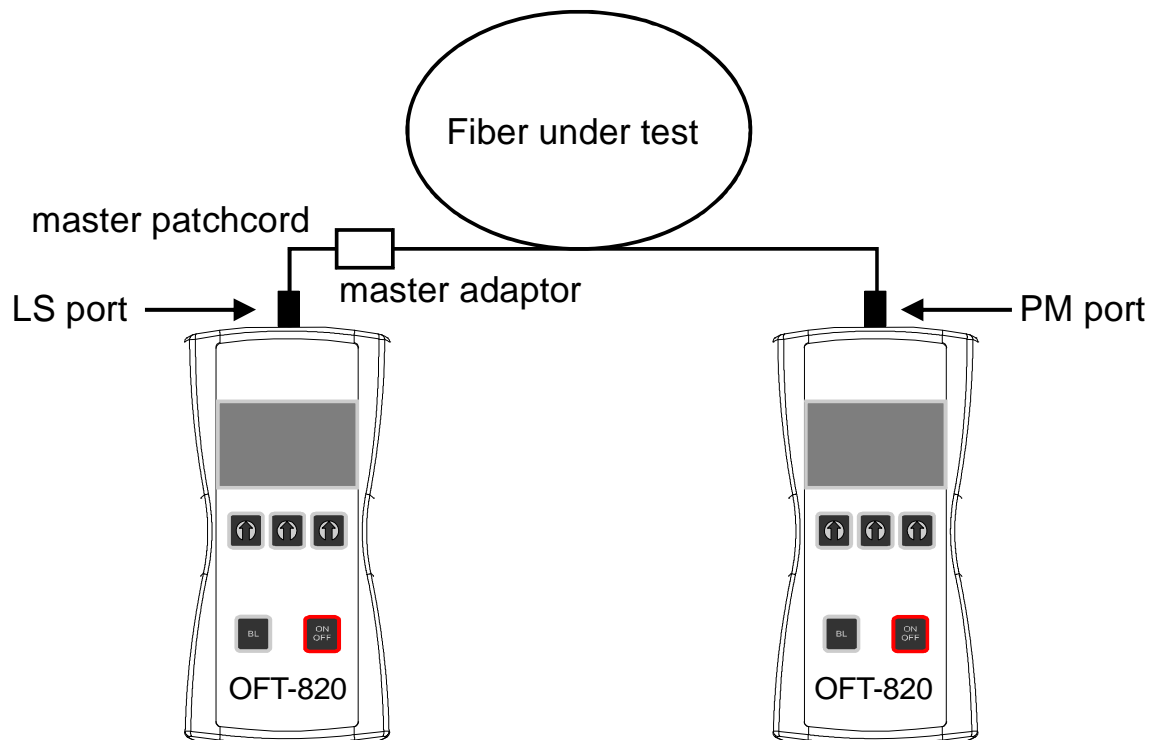
Do not disconnect
after referencing



(pic.5)

9.4.2 Measuring Loss pic.6

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



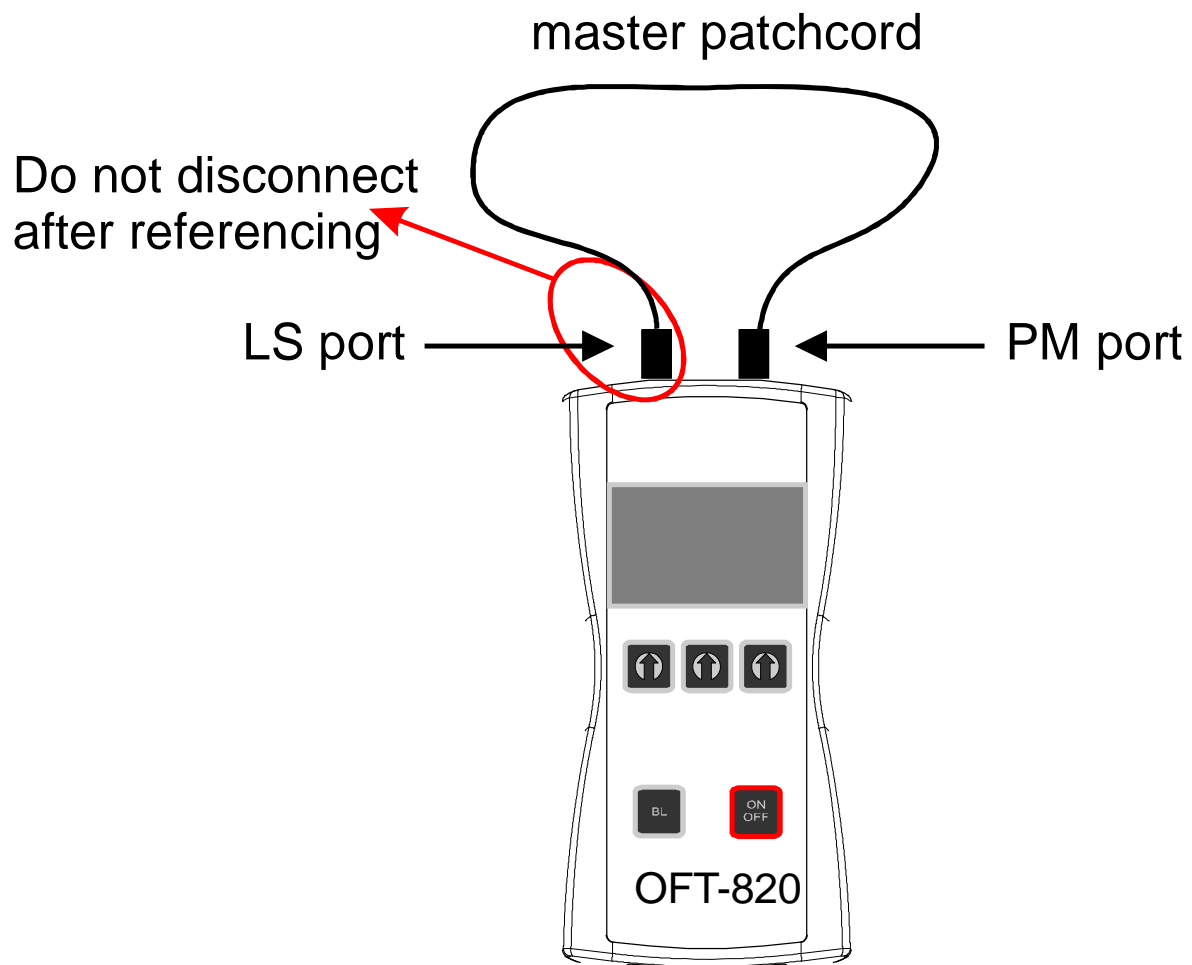
pic. 6

9.5 Method 7 - one instrument

For method 7 one Master cord are used to set reference. Master cord will be canceled out for all subsequent measurements.

9.5.1 Setting the reference pic.7

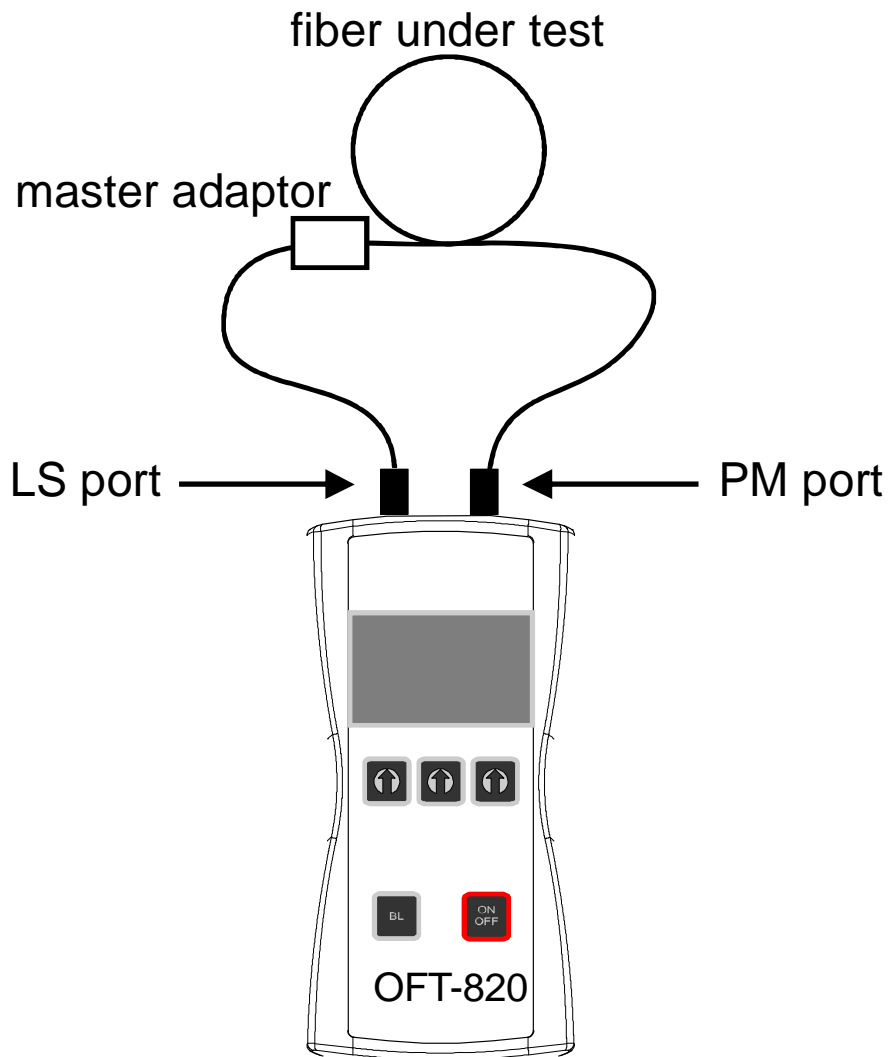
1. Connect Master cord to Light source port.
2. Connect second end of Master cord to Power meter port.
3. Power on OFT-820 instrument.
4. Push **[MORE]**, **[LS]**.
5. By pushing **[λ]** activate appropriate wave-length (light source).
6. Push **[PM]** and select appropriate wave-length range - by pushing **[λ]** (power meter).
7. Activate relative power measurement mode - by pushing **[LOSS]**.
8. Set and store the new reference for selected wave-length - by pushing **[REF]**, **[CONFIRM]**.



(pic.7)

9.5.2 Measuring Loss pic.8

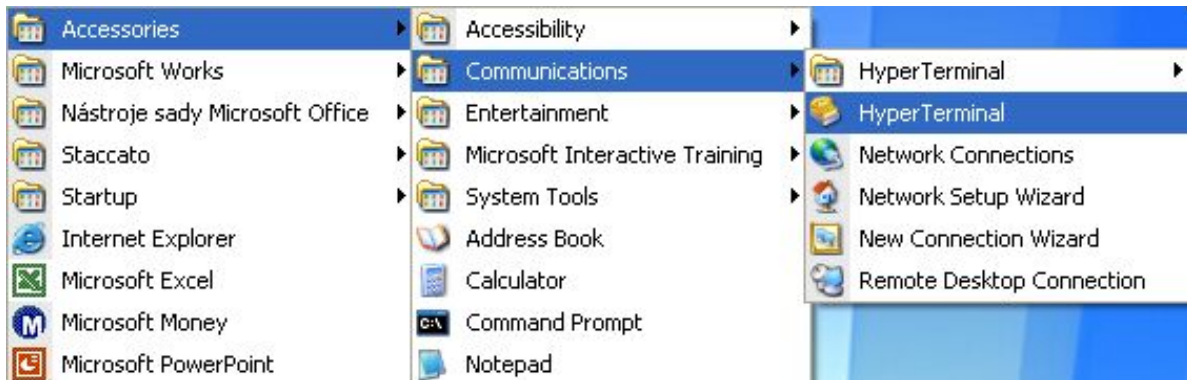
1. Do not disconnect the Master cord from Light source port.
2. Connect the trace to be measured between the Power meter port and the Master cord that is attached to Light source. An extra Master adaptor is needed.
3. The power meter display will simultaneously report the value with the message "LOSS"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



pic. 8

10 Setting up data transfer

1. Connect the OFT-820 to a PC using the USB cable provided and turn the OFT-820 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



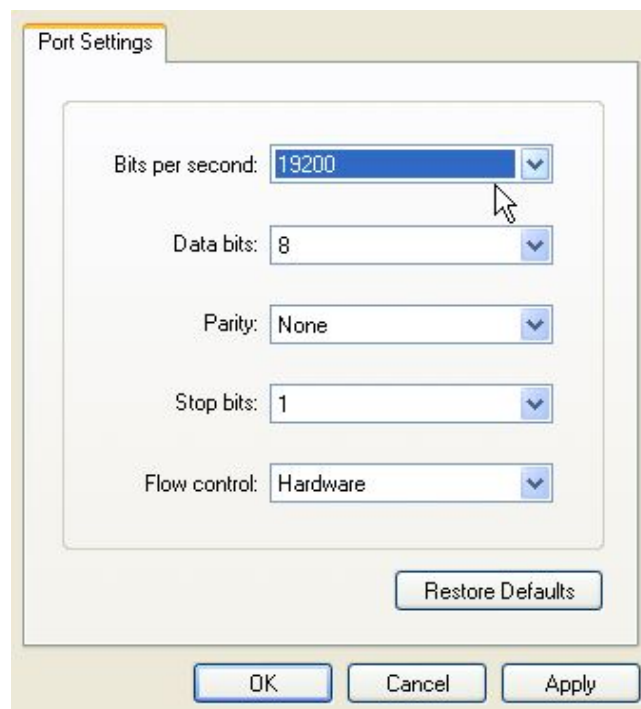
3. Enter the name of a connection, then click on OK.



4. Choose the virtual serial port the OFT-820 is connected to, then click on OK

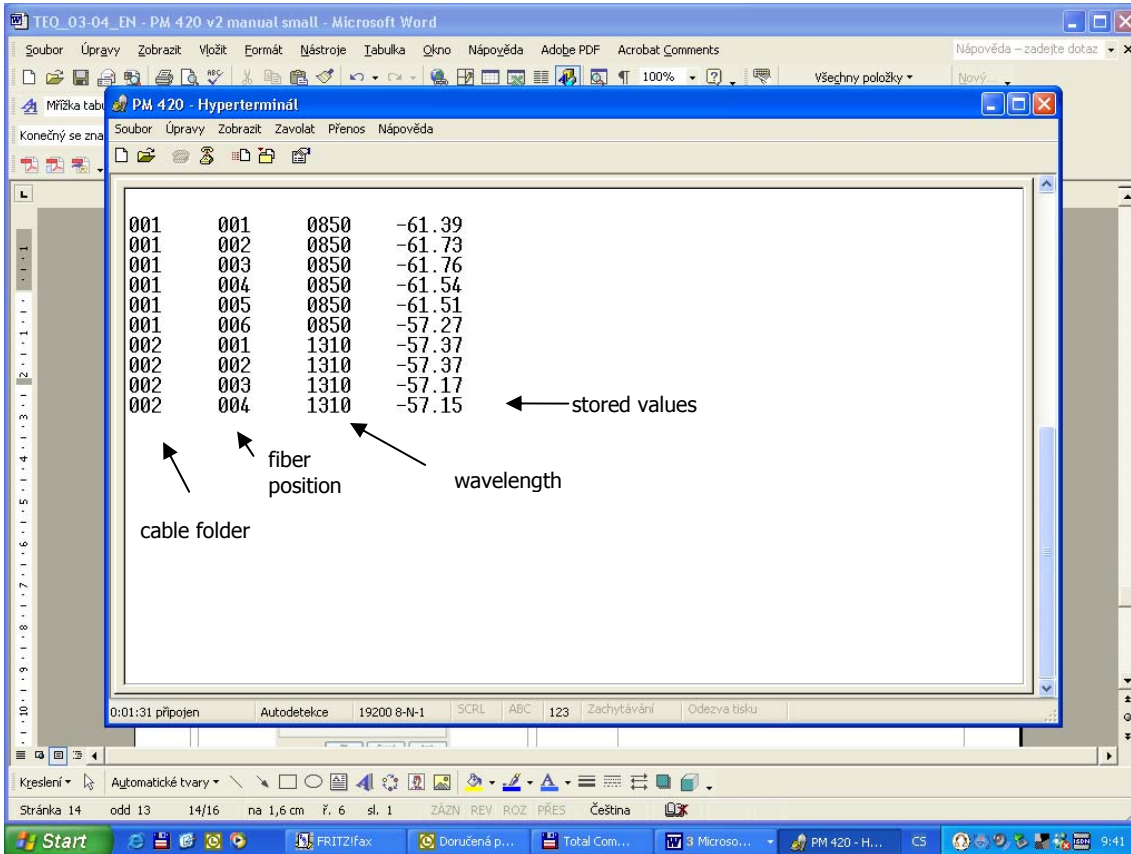


5. Set "Bits per second" to 19200, then click on OK



- Go to the menu in OFT-820 and push [MORE], [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.

11 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

13 Calibration, service center

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