Technical University of Lodz

Department of Semiconductor of Optoelectronics Devices

Laboratory of Optoelectornics

Instruction 2

Measurement of the return losses and insertion losses for the selected fiber optic patchcords.

1. Goal

In this exercise students can analyze an influence of the relationship between the return losses and insertion losses and the different types of optical fiber patch cords. Students will measure the changes of the most important parameter characterizing the optical fiber using the commercial patch cords (from CORNING) and one patch cord made by themselves in Ex.1.

2. Theory

Patchcord is an optical fibre which is ended from both sides with fiber optic connectors

Pigtail is an optical fiber which is ended from one side with fiber optic connector and from the other side it can be welded to the existing fiber network.

Return losses (reflection losses) in telecomunication is defined as loss of power signal resulting from heterogeneity of the transmission line. So in the optoelectronics it will be loss associated with heterogeneity fo refractive index in fiber cladding or in fiber core. They cause the reflection of optical signal back to the source. A large value of optical reflection losses can interfere with the signal source (laser), particularly in the case of WDM systems (Wave Division Multiplexing). Return losses are expressed in dB or dBm (dBm is an abbreviation for the power ratio in dB of the measured power referenced to one mW). They can be calculated using the formula:

$$RL(\mathrm{dB}) = 10\log_{10}\frac{P_\mathrm{i}}{P_\mathrm{r}}$$

where:

P_i – optical power of light source
P_r – optical power of reflected signal

Moreover, in optical fibers we have also the insertion losses which can be define as the optical power dissipated in the transmission line, in our case in the optical fiber. These kind of losses result from radiation absorption or changes in density and refractive index of the core material. Insertion losses is expressed in dB or dBm and is defined by the following formula:

$$10\log_{10}\frac{P_\mathrm{T}}{P_\mathrm{R}}$$

where:

P_T – optical power of light source
P_R – optical power reaching the detector

3. Exercise

The position includes the following elements:

1. AF-ORL-3.1 meter for reflection losses and insertion losses measurements.
2. A set of measuring adapters.
3. A set of reference fibers (FC/APC – FC/APC)

Measurements:

1. Prepare the reference fibers, a set of adapters and tested fiber.
2. Calibrate the meter for measurement of IL by points 3-6.
3. Press the "LASER" button to set the desired wavelength of the laser (1310nm or 1550nm).
4. Connect the fibers with adapters according to Figure 1. Before connecting the fiber with meter check the fibers front using microscope. If you will find any impurities – clean fibers front by using the tissue with alcohol.

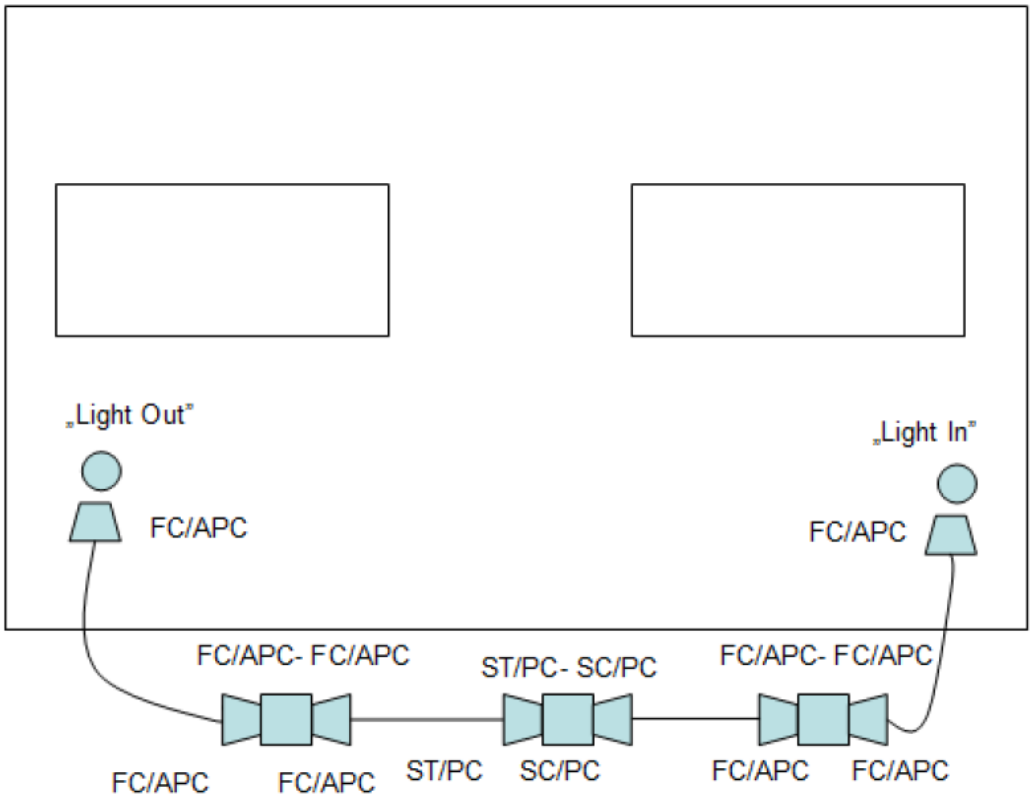

Fig. 1 Calibration of the meter for IL measurement.

5. Calibrate the meter for measurement of IL by pressing the "REF" button.

You'll see the value of the reference system attenuation expressed in the dBm. Message '____' is the value of attenuation in the reference system and calibration error. It has to be lower then 10dBm in another case repeate points 3-5.

6. Connect tested fibers according to Figure 2.
7. Write down the results.
8. Measure the return loss (RL) according to point 9.
9. Repeat points 3-5. Measurement of RL requires re-calibration as for IL.
10. Connect the fibers with adapters according to Figure 3.
11. Calibrate the meter for measurement of RL by pressing the "CAL" button.

    You'll see the value of the reference system attenuation expressed in the dBm. Message '____' is the value of reflection losses in the reference system and calibration error. It has to be lower than 10dBm in another case repeat points 8-10.

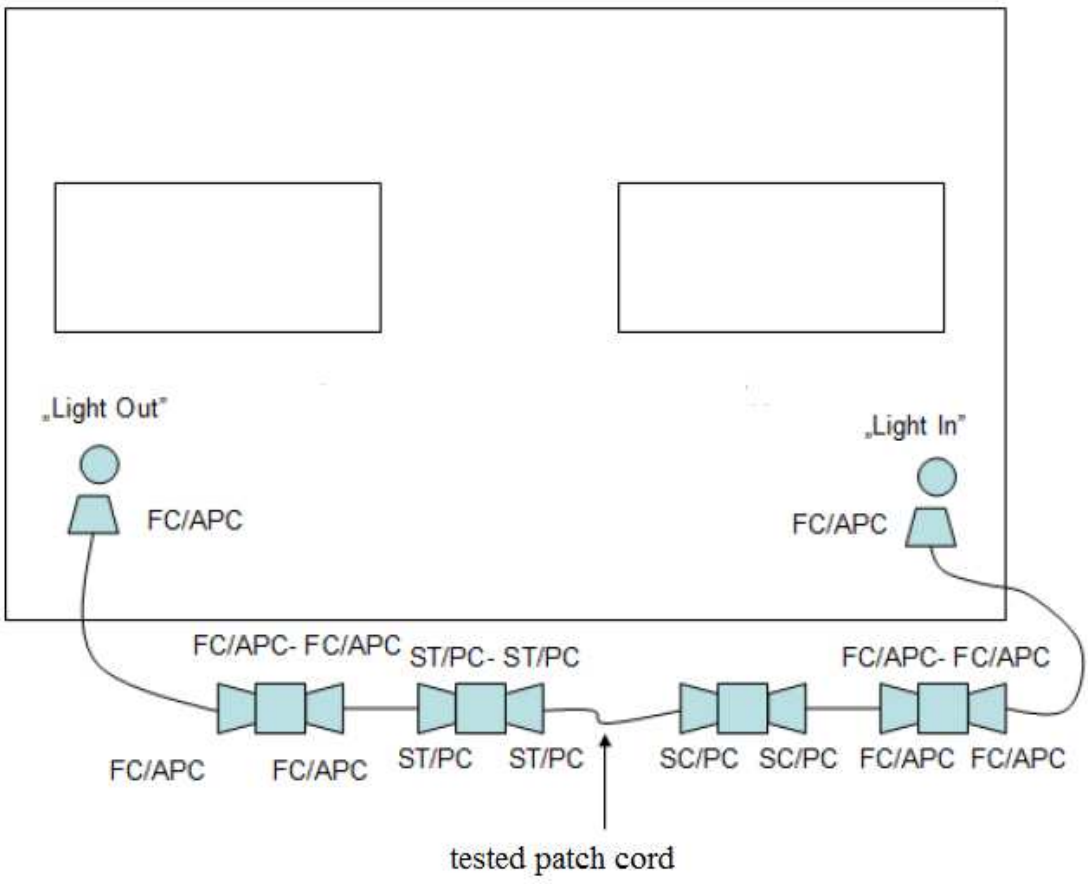

Fig.2 IL measurement.

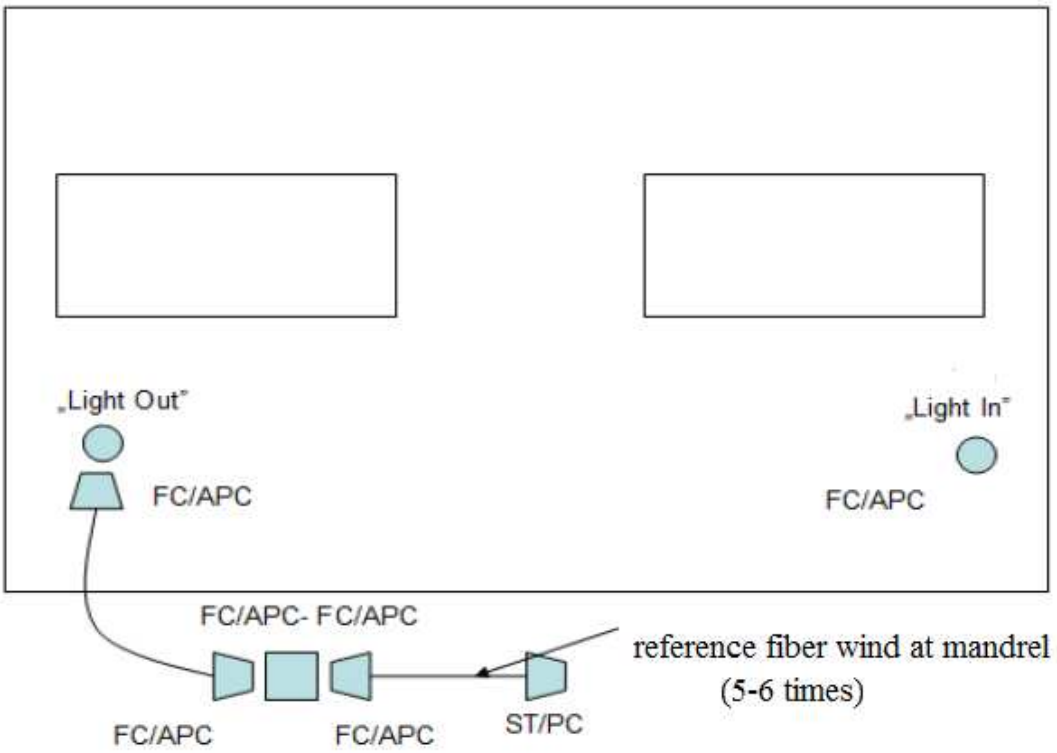

Fig. 3 Calibration of the meter for RL measurement.

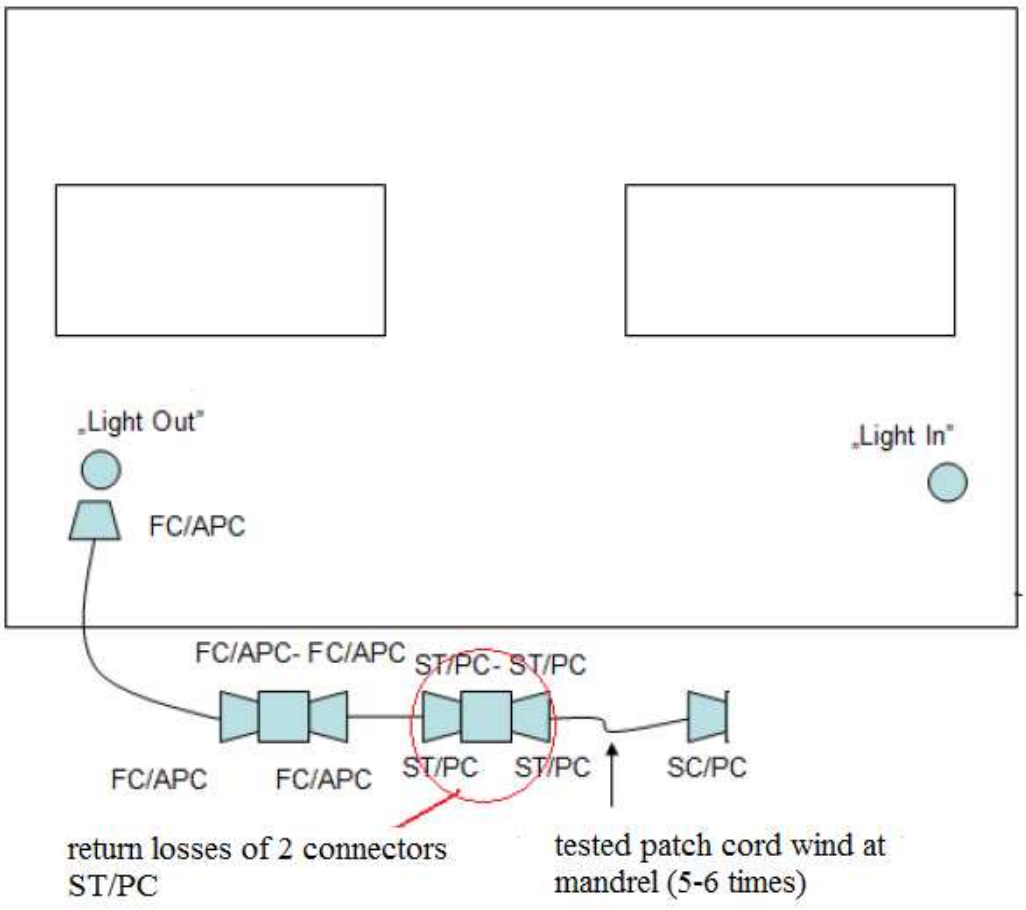

Fig. 4 RL measurement of patch cord ST/PC-ST/PC.

12. Connect tested fibers according to Figure 4.
13. Write down the results.
14. Repeat measurements for patch cords FC/PC-FC/PC; FC/APC-FC/APC; SC/PC-SC/PC; SC/APC-SC/APC. Calibration and measurements do according to points 3-12 using schemes from next Figures.

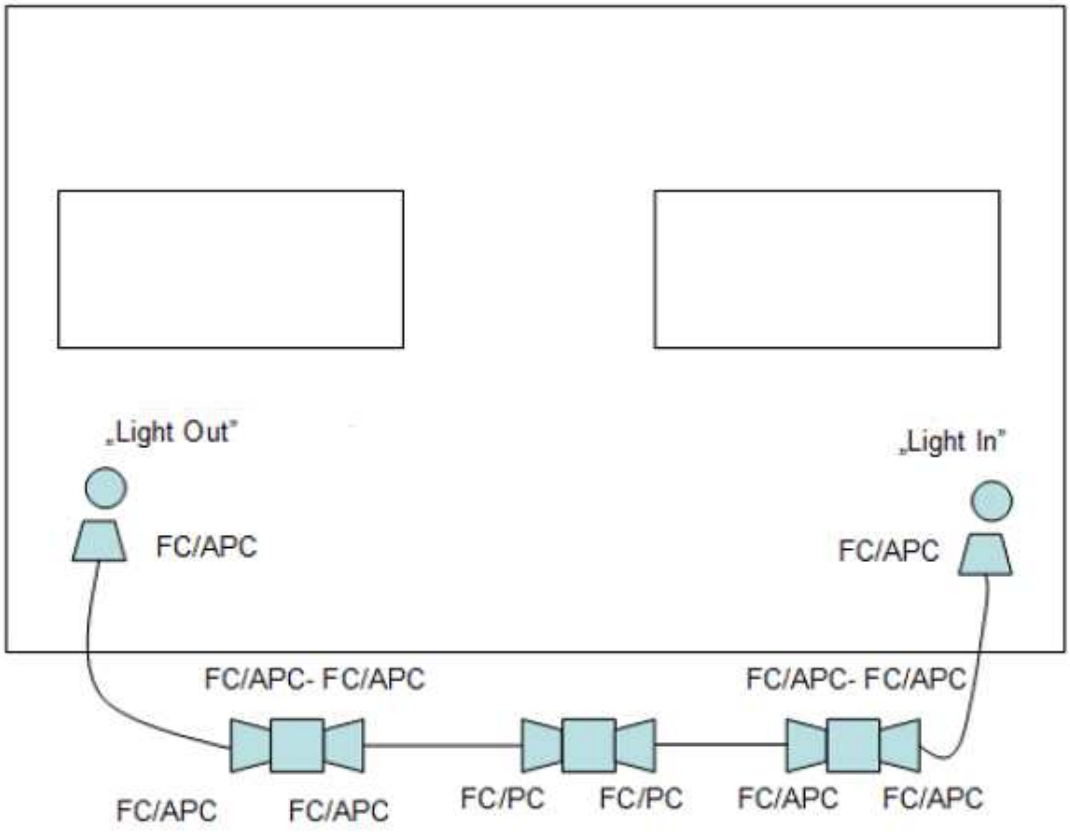

Fig. 5 Calibration of the meter for IL measurement for FC/PC-FC/PC patch cord.

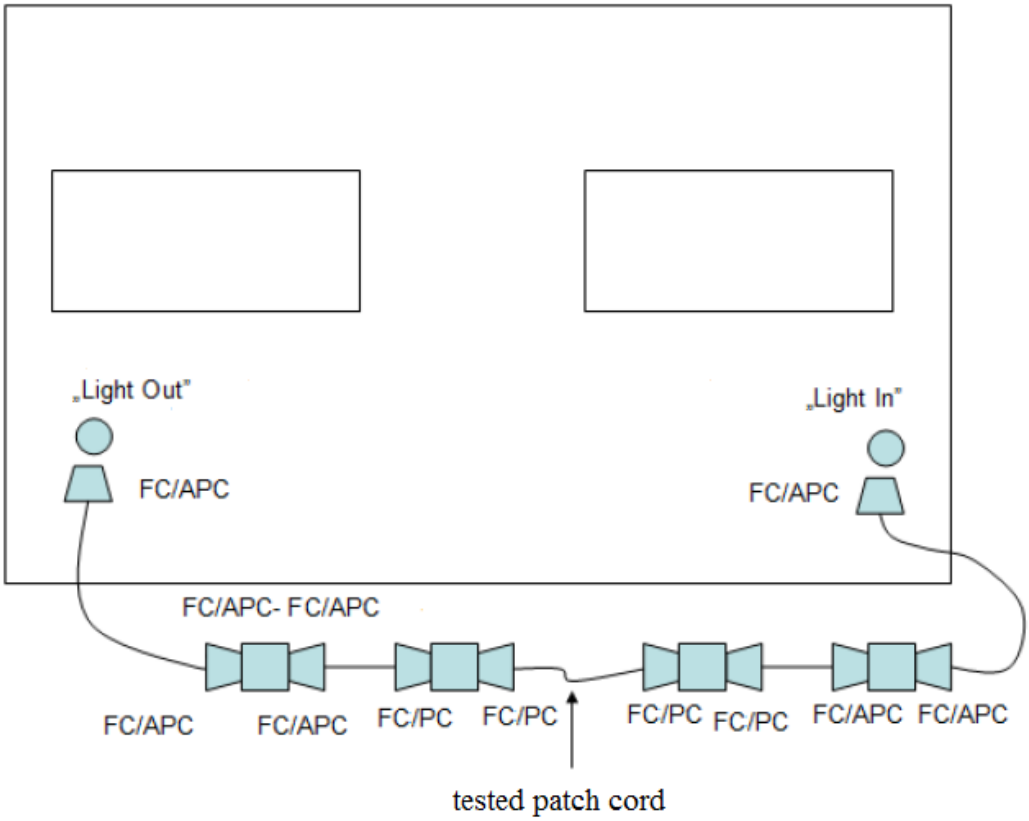

Fig.6 IL measurement.

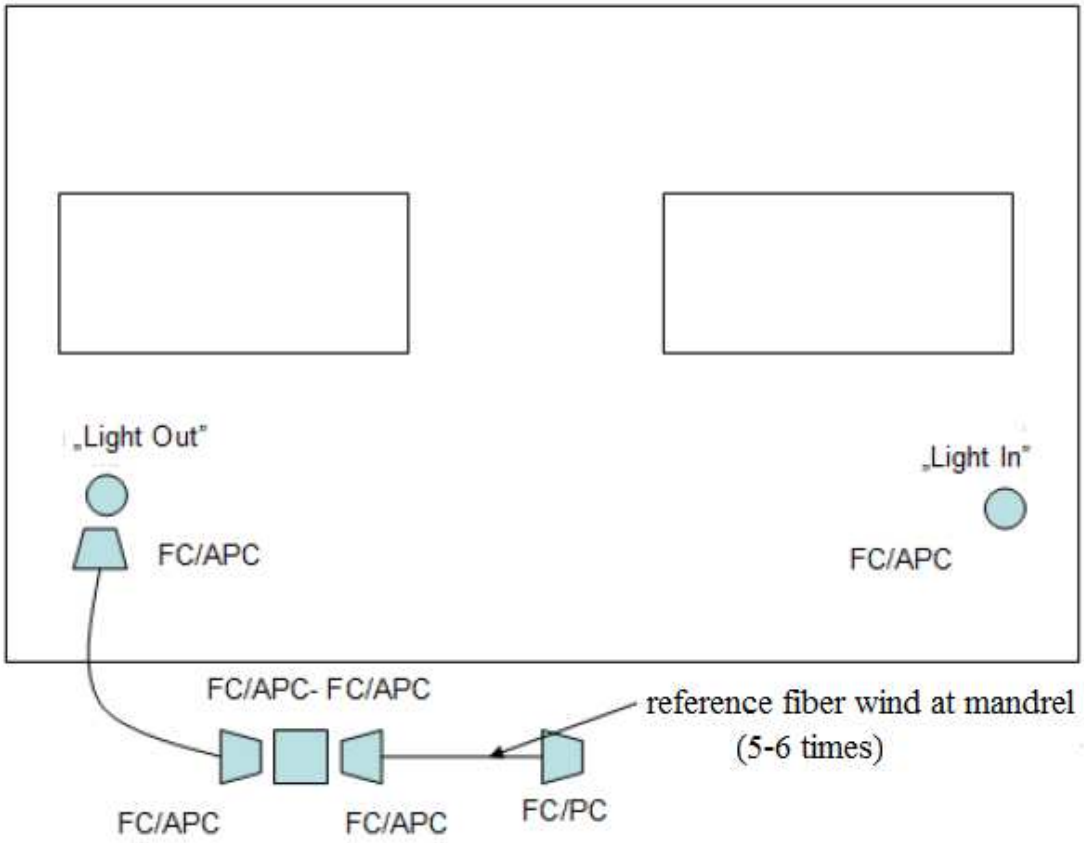

Fig.7 Calibration of the meter for RL measurement.

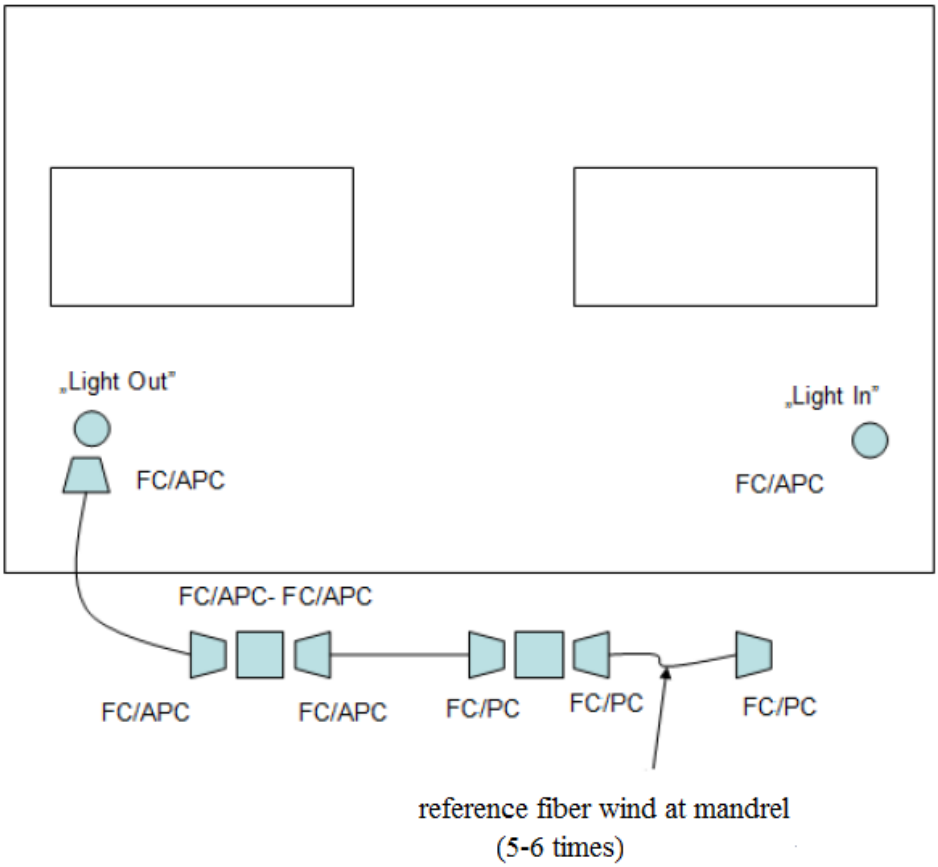

Fig. 8 RL measurement of patch cord FC/PC-FC/PC.

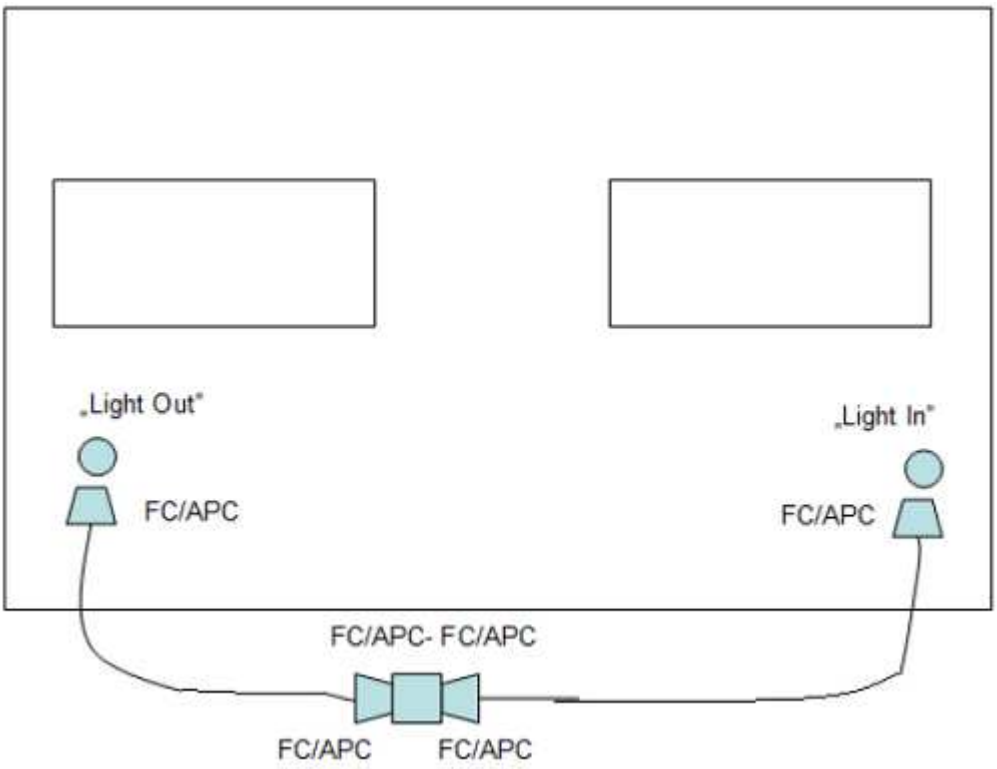

Fig. 9 Calibration of the meter for IL measurement for FC/APC-FC/APC patch cord.

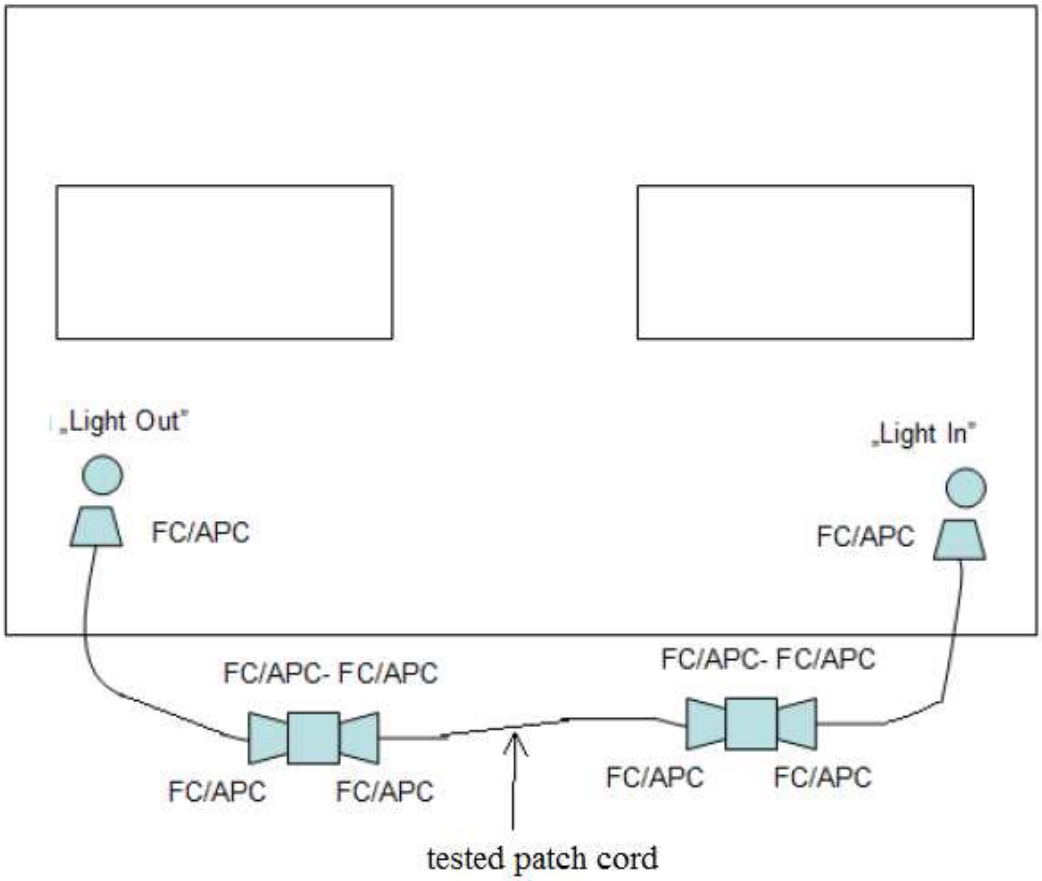

Fig.10 IL measurement.

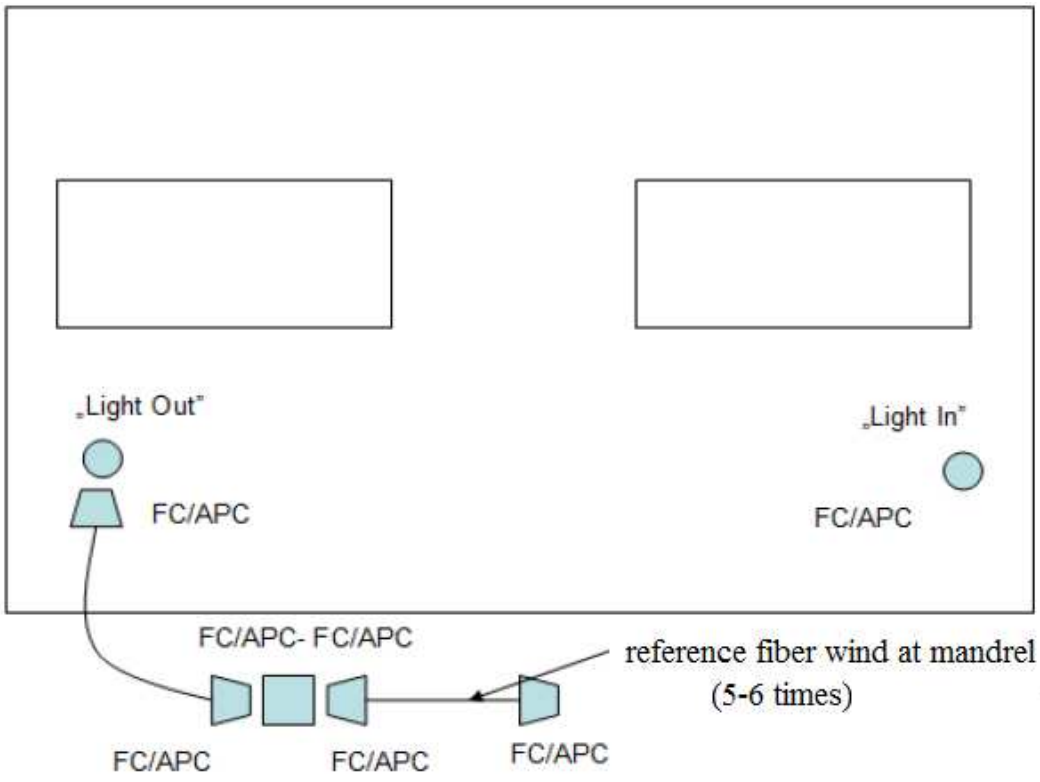

Fig.11 Calibration of the meter for RL measurement.

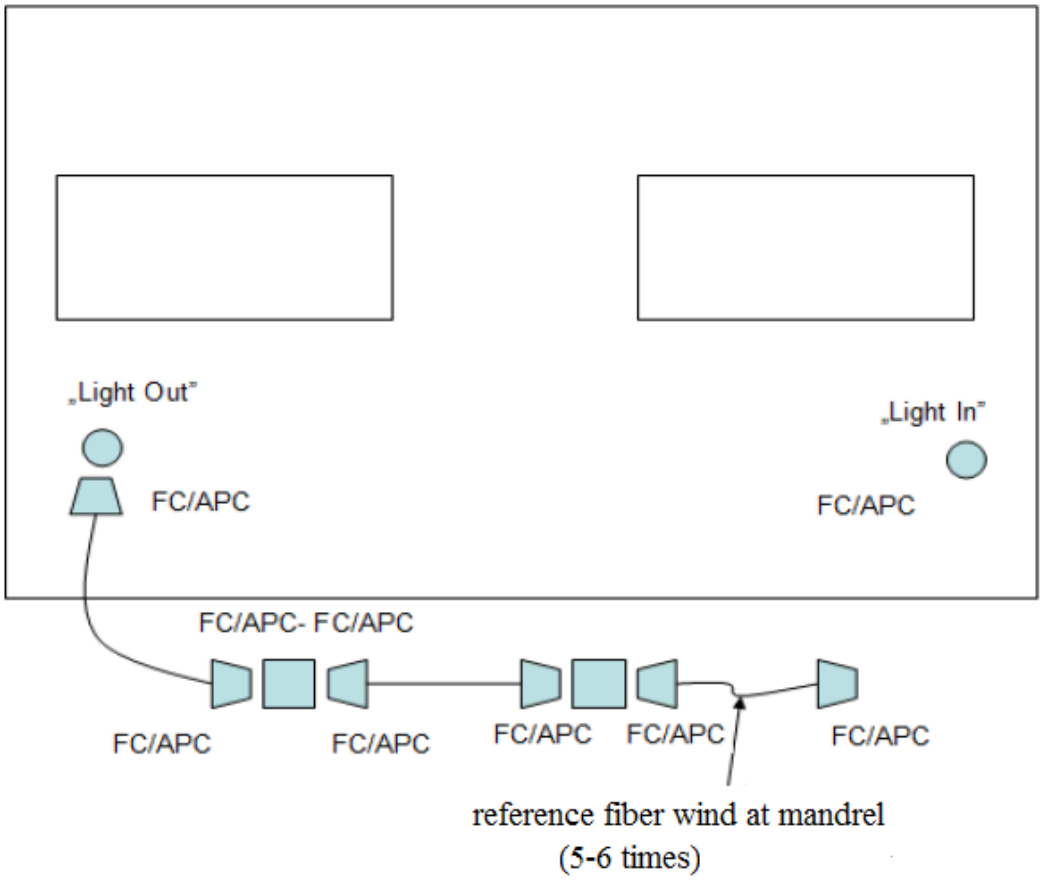

Fig. 12 RL measurement of patch cord FC/APC-FC/APC.

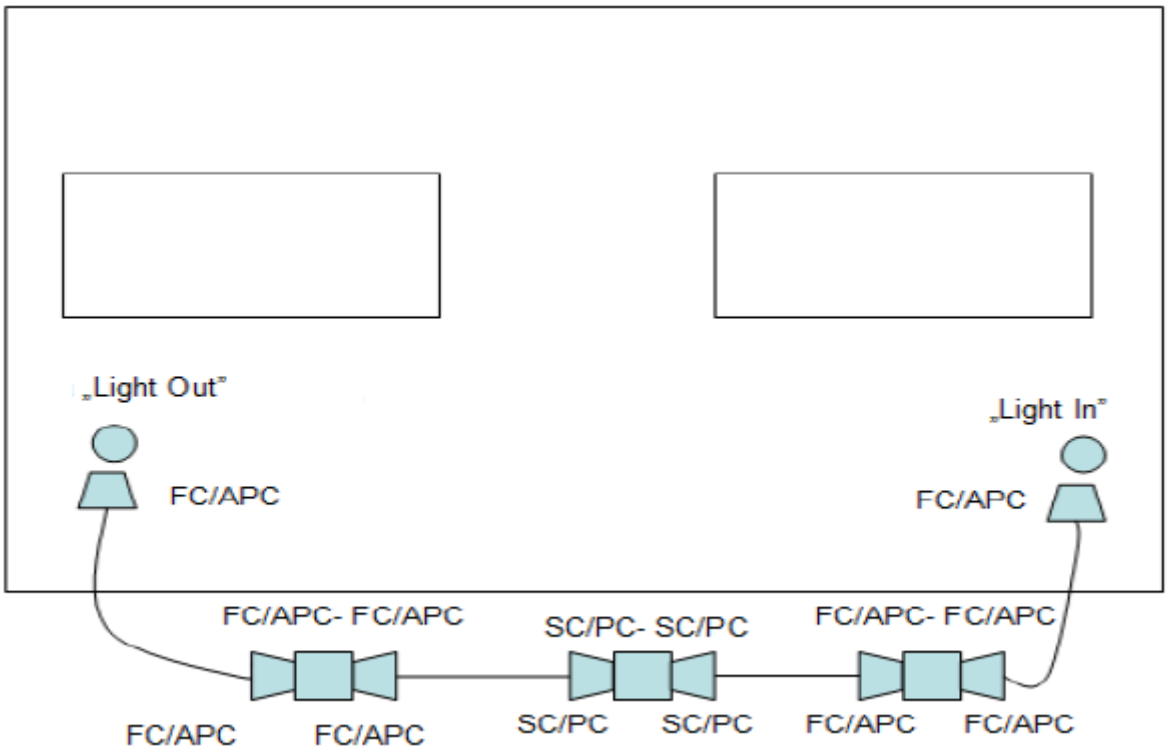

Fig. 13 Calibration of the meter for IL measurement for SC/PC-SC/PC patch cord.

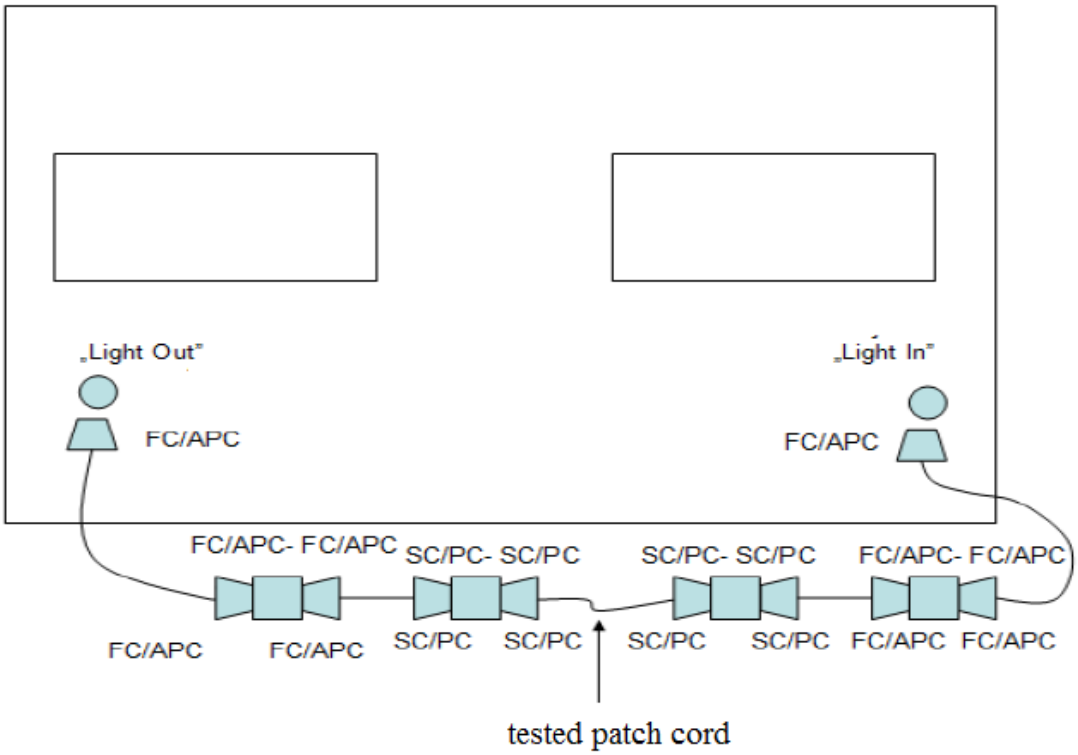

Fig.14 IL measurement.

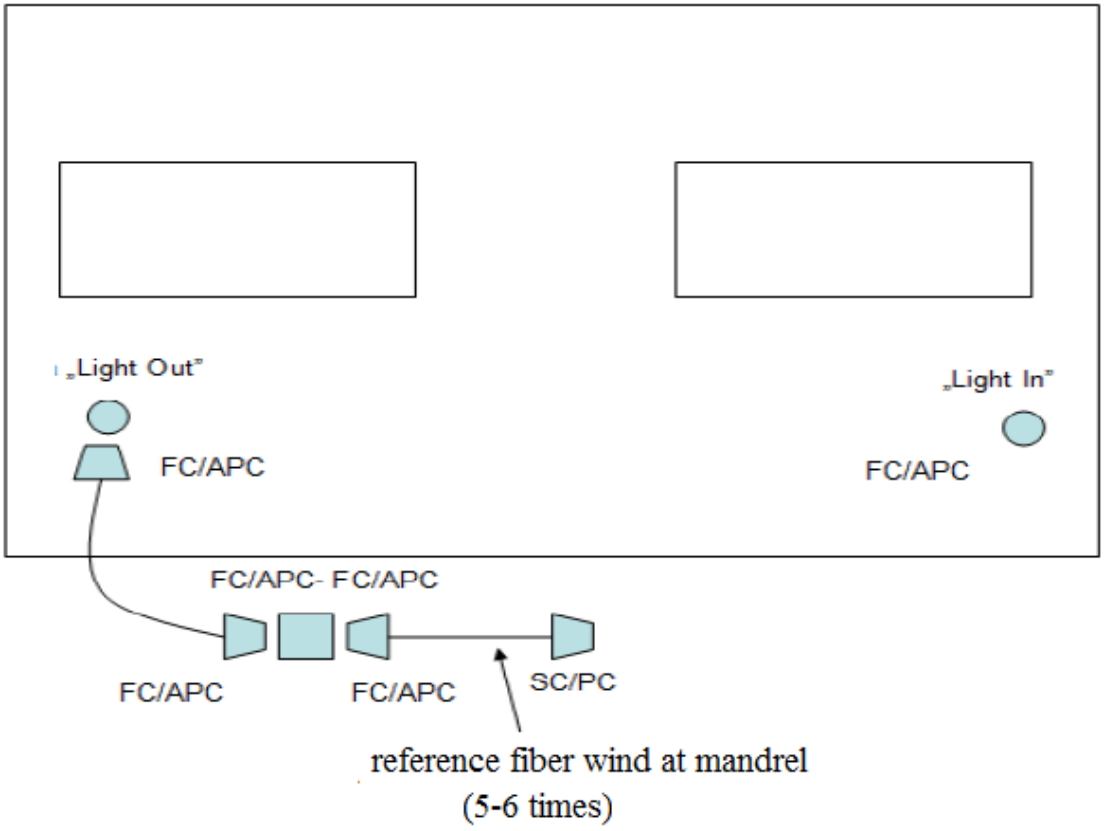

Fig.15 Calibration of the meter for RL measurement.

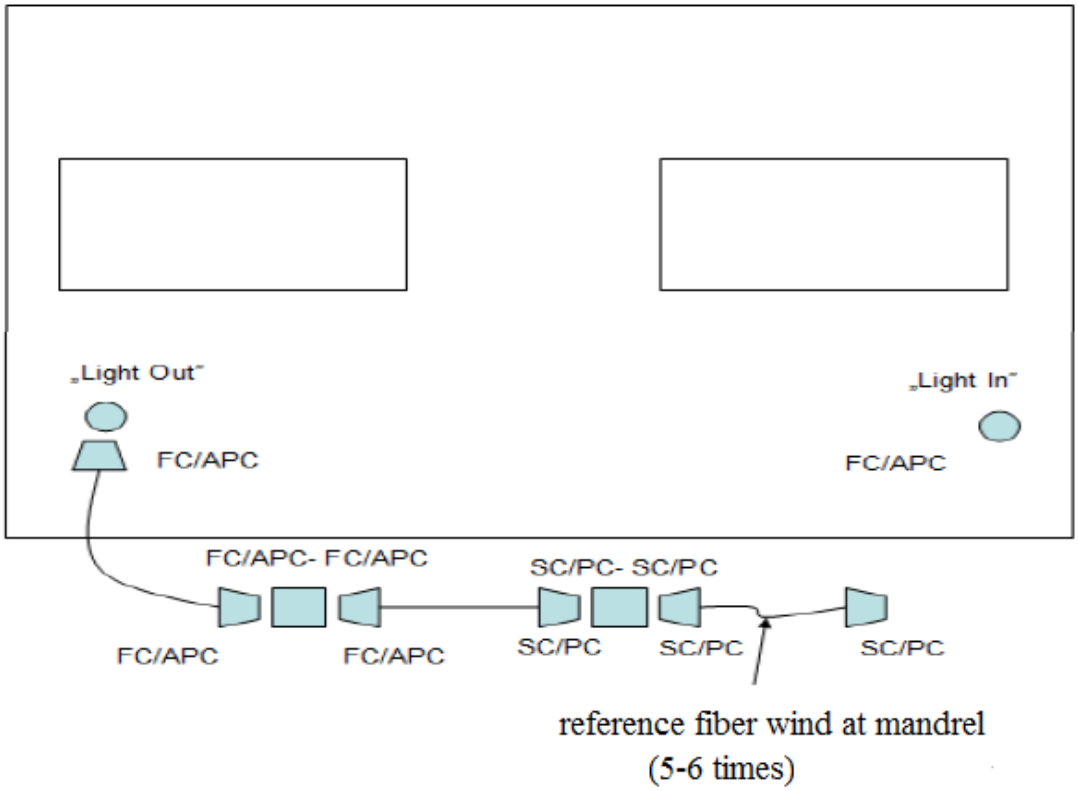

Fig. 16 RL measurement of patch cord SC/PC-SC/PC.

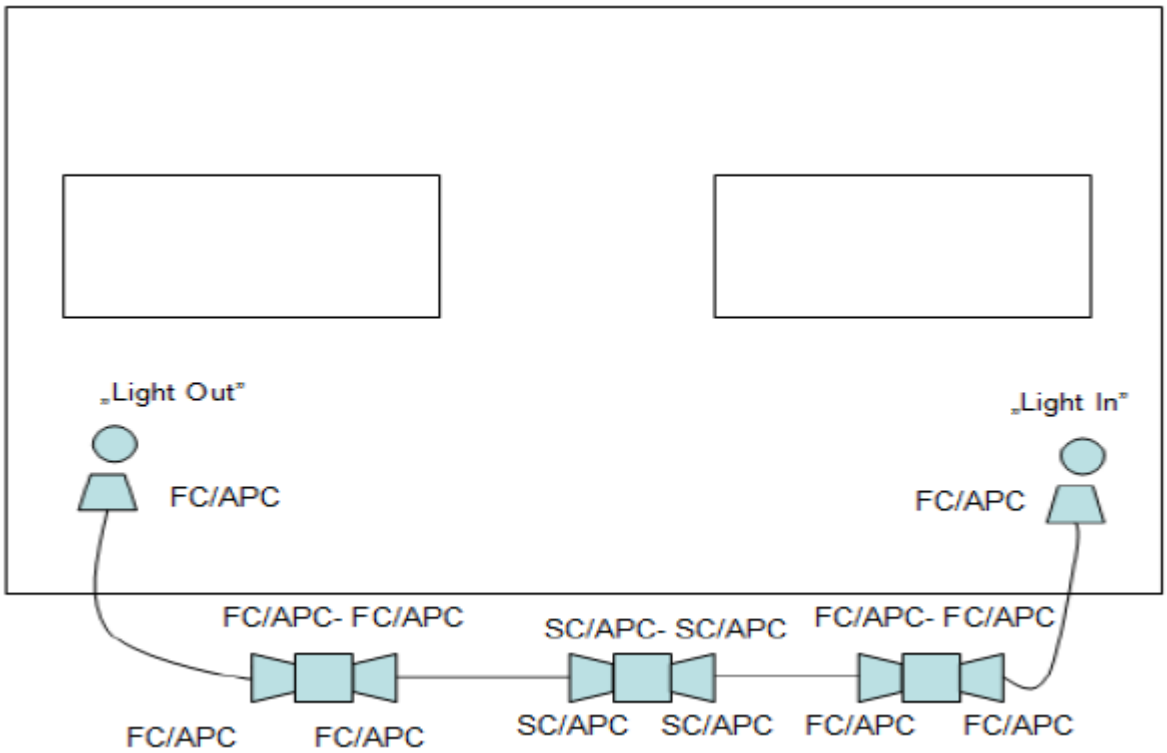

Fig. 17 Calibration of the meter for IL measurement for SC/APC-SC/APC patch cord.

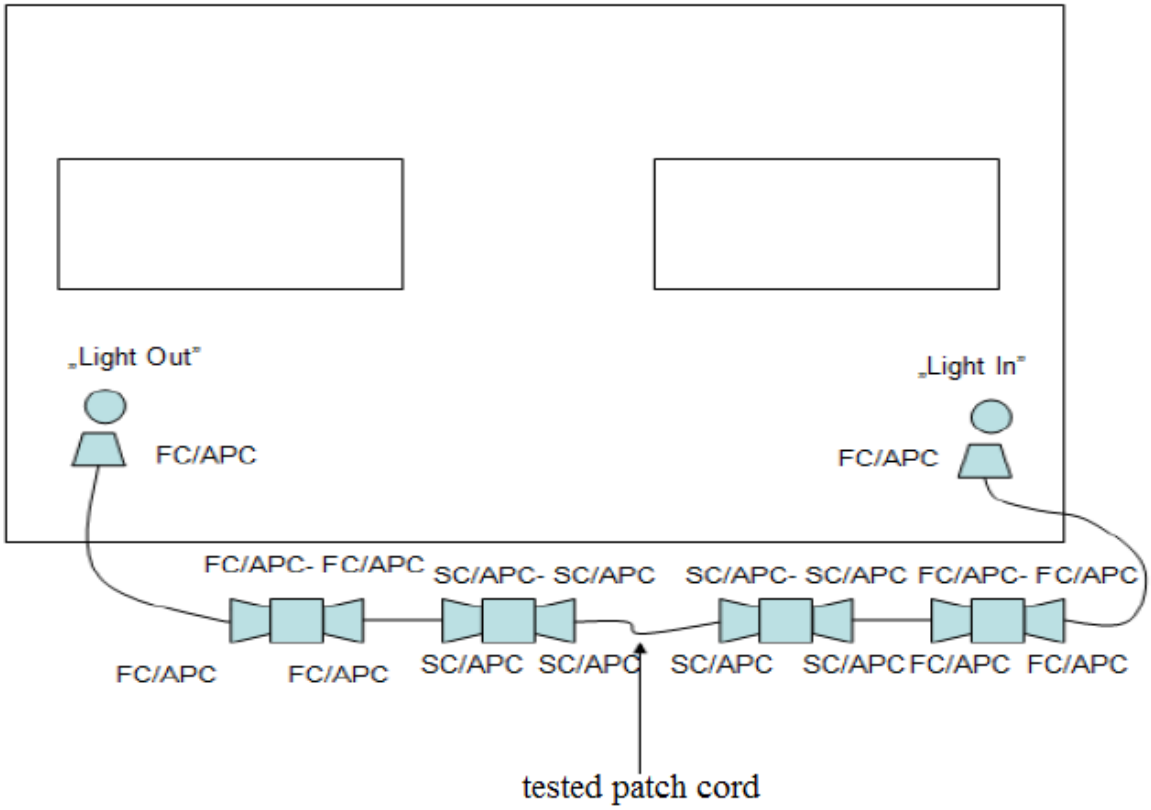

Fig.18 IL measurement.

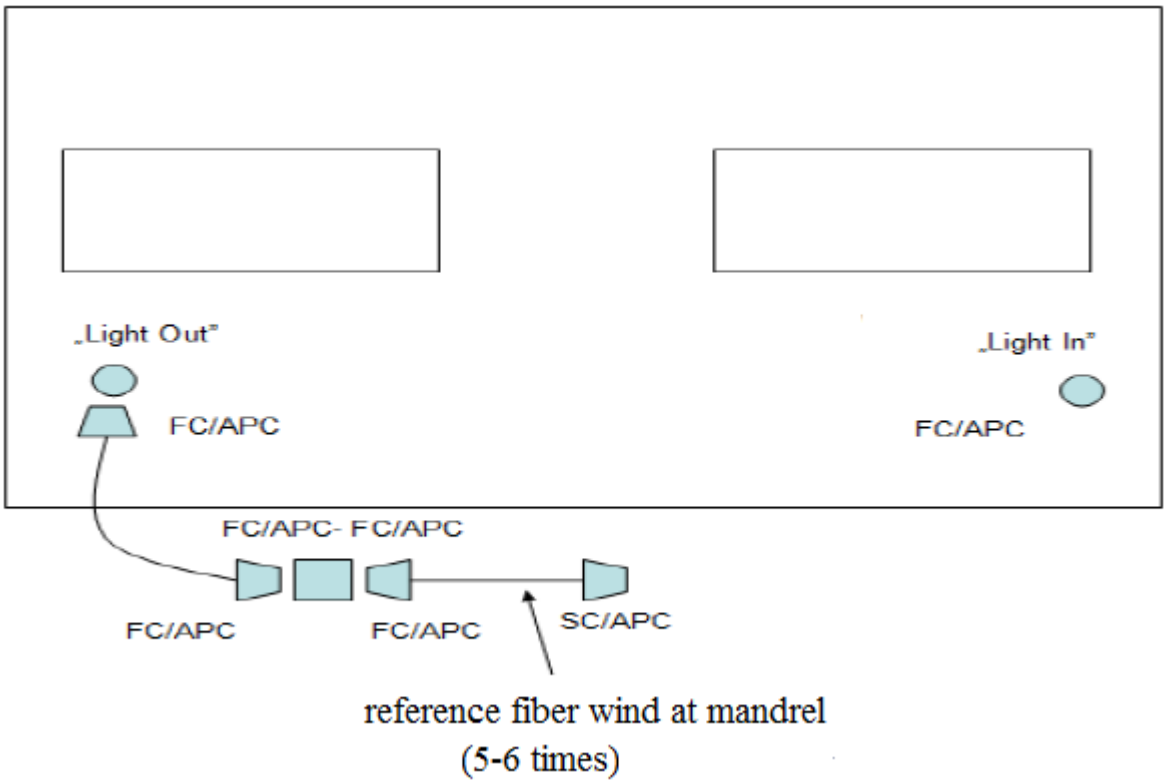

Fig.19 Calibration of the meter for RL measurement.

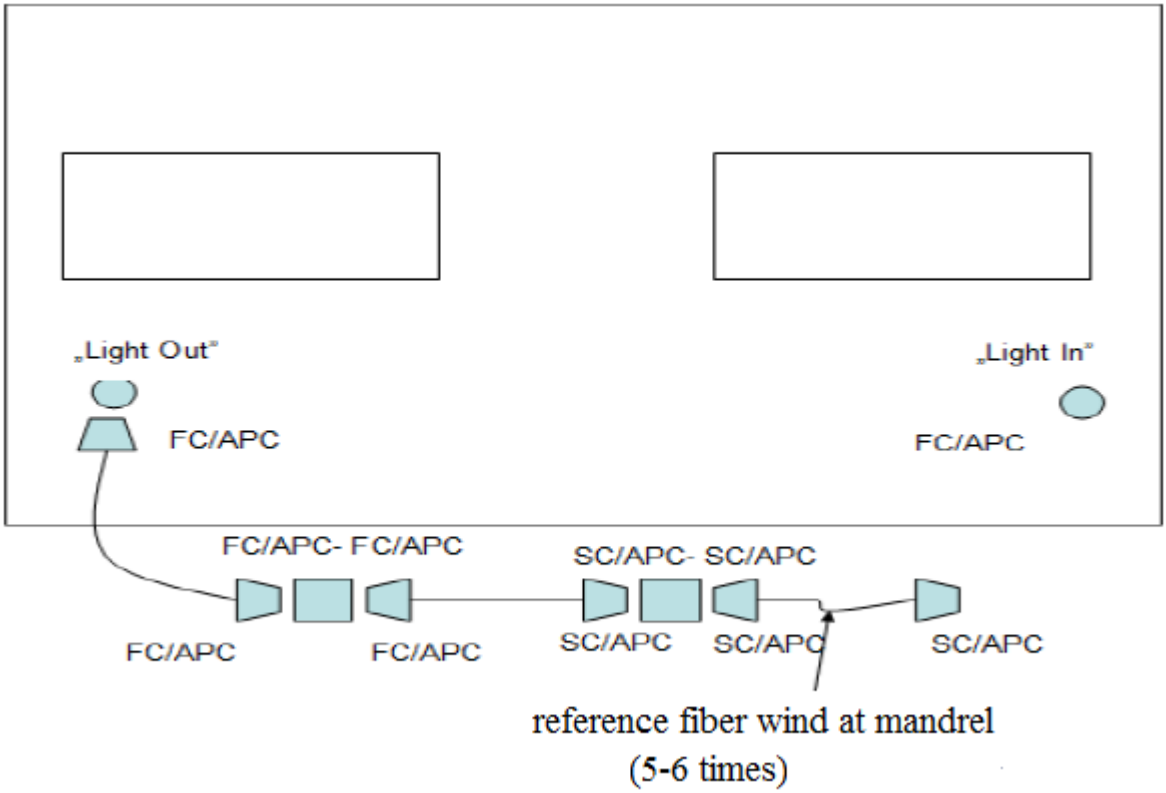

Fig. 20 RL measurement of patch cord SC/APC-SC/APC.

4. Raport

The report should include:

- The results of measurements for patch cord made in Ex. 1
- The results of measurements for commercial patch cords
- Comparison of results for different types of patch cords.