



LED  
MINISPECTROMETER  
LMS-R  
TECHNICAL DESCRIPTION



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## GENERAL INFORMATION

### Device and applications overview

LMS-R LED Minispectrometer – is a new portable device for express spectral analysis in the near infrared (IR) range from 1.3 to 2.4  $\mu\text{m}$  based on multi-element LED matrix and wideband photodiode.

Using IR LEDs and photodiodes enables numerous benefits: minimising device dimensions, reducing its power consumption and measurement time while essentially decreasing its price comparing to functional analogues. These advantages open new possibilities for application of spectral analysis. Minispectrometer can be used for qualitative and quantitative composition analysis of samples within various application areas:

- express analysis of food (for example, defining deviations from the normal parameters judged by the absorption properties of the analysed sample);
- analysis of biomaterials for medical purposes (for example, concentration of sugar in blood, urine etc.);
- moisture control (for example, moisture control of paper, wood, coffee, wool, constructional materials etc);
- analysis of oil and oil products;
- analysis of plastics;
- and in many other areas.

### Main features

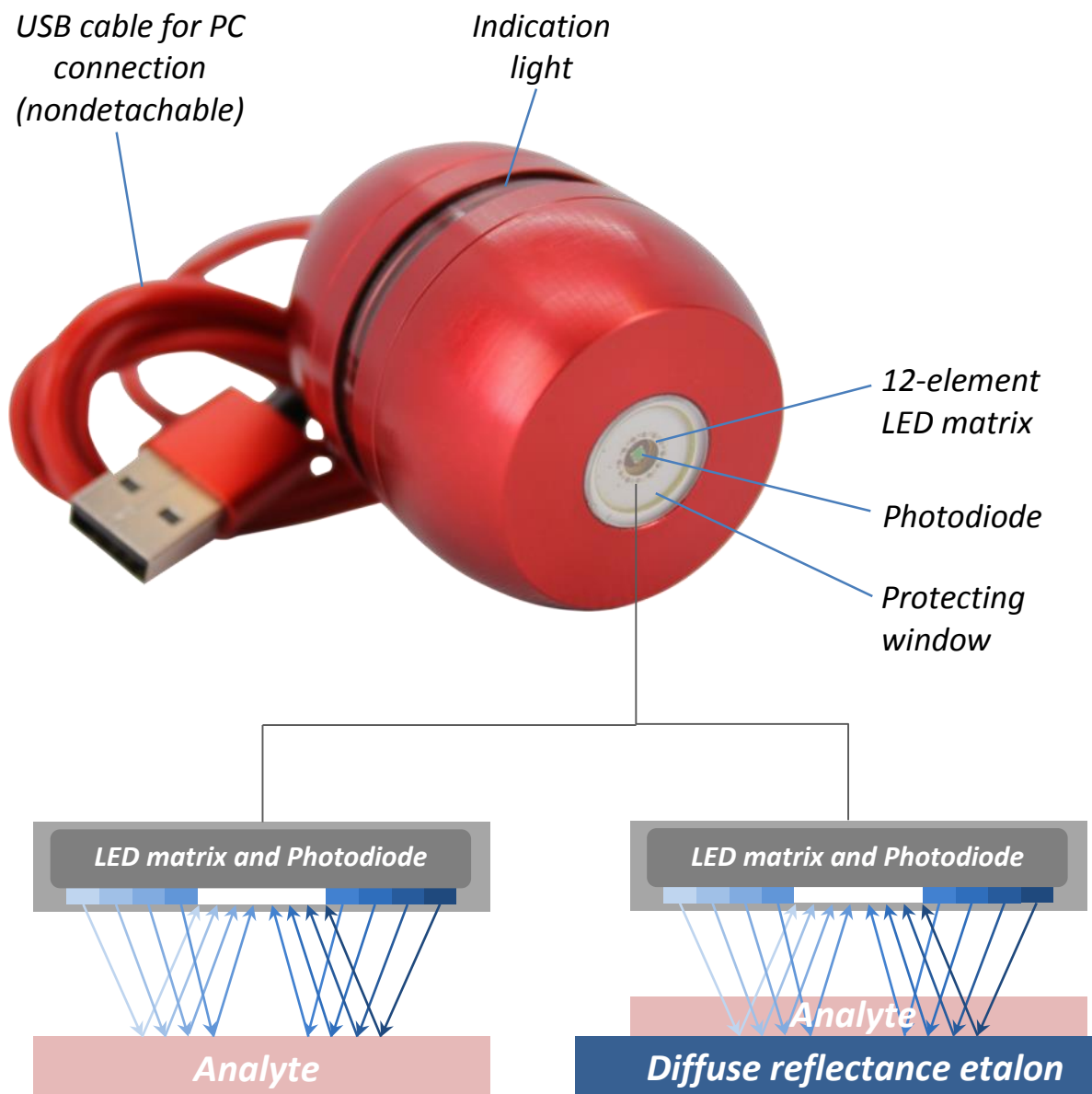
- ❖ measurement of reflectance/scattering spectra of solid and liquid samples in the range from 1.3 to 2.4  $\mu\text{m}$ ;
- ❖ high measurement speed: 1 s;
- ❖ compact sizes: 60x42x42 mm;
- ❖ lightweight: 130 g;
- ❖ low power consumption: max 2.5 W;
- ❖ power supply and operation from PC via USB interface;
- ❖ provided with a software for Windows PCs.

## GENERAL INFORMATION

### Device main view and operation principle

LMS-R minispectrometer is formed in a single body that includes optical and electronic blocks. Main part of the optical block is a 12-element LED matrix and a wideband photodiode operating in the spectral range from 1.3 to 2.4  $\mu\text{m}$ . Spectral characteristics of LED matrix and photodiode are presented in the **Appendix**.

#### *LMS-R minispectrometer main view*



## GENERAL INFORMATION

LEDs are turned on one by one and irradiate the analysed sample. Emission reflected back from the sample is captured by the photodiode, converted into electrical signals that are further processed by the electronic block and software.

Measurement result put out by the minispectrometer is dependence of reflectance (scattering factor) vs. wavelength, this dependence can be displayed as a spectral curve or as a histogram.

▲ *This minispectrometer version doesn't include any calibration dependences for the analysis of specific materials.*

### Package contents



1. Minispectrometer.
2. Reflection etalon (standardly fluorine plastic etalon is provided).
3. USB flash drive with a software and etalon calibration data file.
4. Package-case.

### Requirement to PC

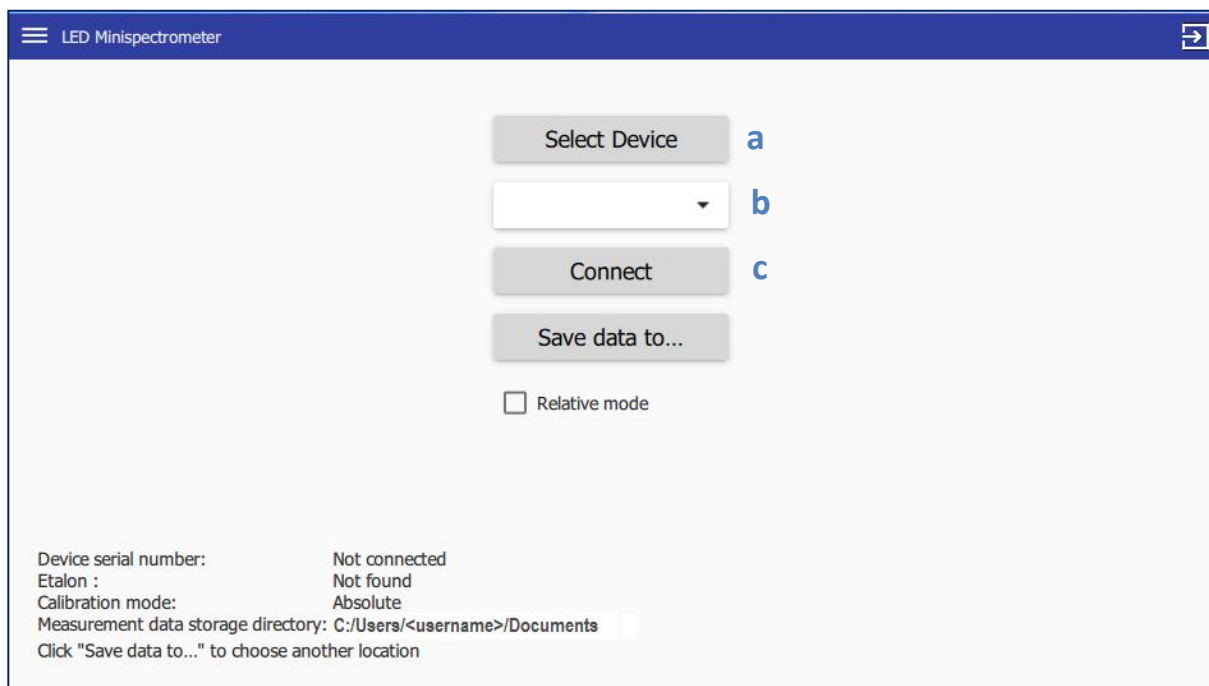
- Operation system Windows 7, 8, 10.
- USB 2.0 or USB 3.0.

## OPERATING INSTRUCTION

1. Install the minispectrometer software running “LEDMinispectrometerInstaller.exe” file (provided with the device on the USB flash drive) and following the installer instruction.
  2. Connect minispectrometer to PC via USB interface. Indication light will turn on upon device connection informing that the device is ready for operation.
- ✓ *Minispectrometer has 2 types of indication: back lighting and circle lightning. Back lighting indicates connection to power supply, circle lightning – start and end of measurement.*

When device is connected to the PC driver of the visual com-port is installed (in case the driver is not found by the PC automatically, please use the driver from “Driver-1.0.0.0” folder saved on the USB flash drive provided with the device).

3. Run “LEDMinispectrometer” software. Your PC will display the window with initial program settings, corresponds to the Menu option “Settings” (fig.1)<sup>1</sup>.



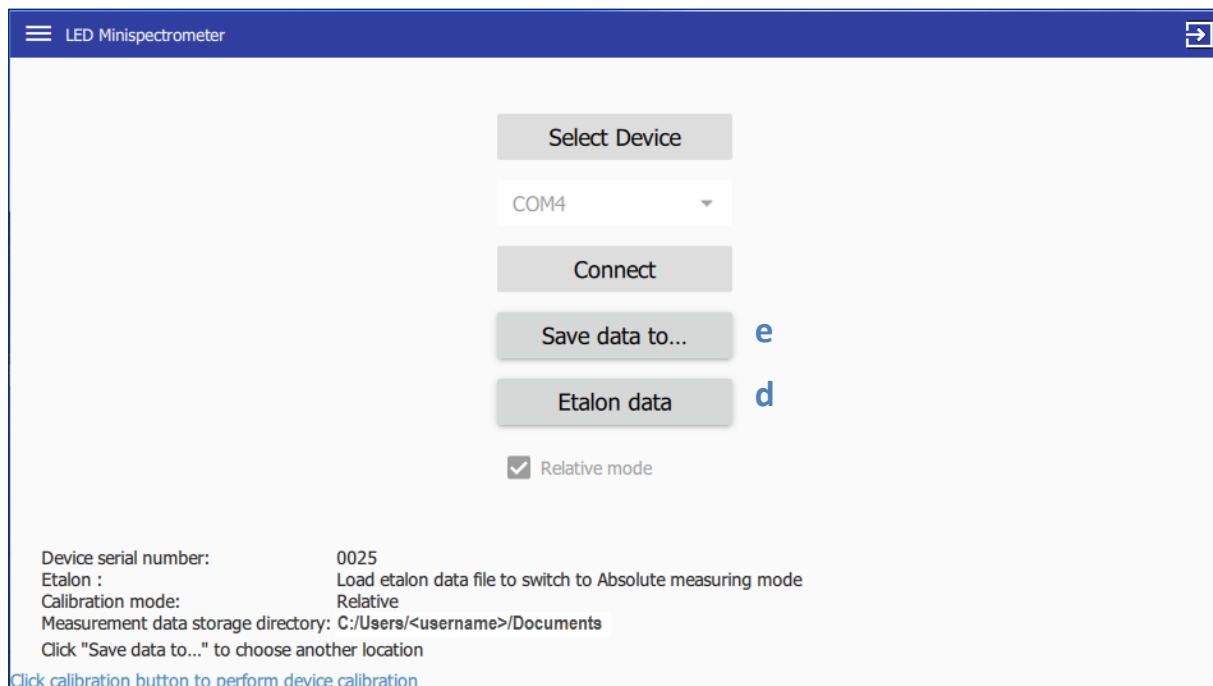
*Fig.1. Program settings – connecting the device.*

### 3.1 Click “Select Device” button (fig.1, a).

<sup>1</sup> You can expand the window with a double-click on the window title bar.

## OPERATING INSTRUCTION

- 3.2 Choose the available device from the drop-down list (fig.1, b) (the number of the visual com-port will be displayed).
- 3.3 Click “Connect” button (fig.1, c).
- 3.4 When the program is run for the first time – “Etalon data” button will be displayed (fig.2, d). By clicking “Etalon data” button download the etalon calibration data file – “calibrator” file (provided with the device on the USB flash drive). This file is to be downloaded just once, on the next program run the “Etalon data” button won’t be displayed.



*Fig.2. Program settings – downloading the etalon calibration file, choosing directory for data storage.*

- 3.5 For choosing directory of measurement data storage click “Save data to...” button (fig.2, e). Directory can be changed while working with the device.

**▲** *The program enables absolute and relative modes of reflectance/scattering spectra measurements.*

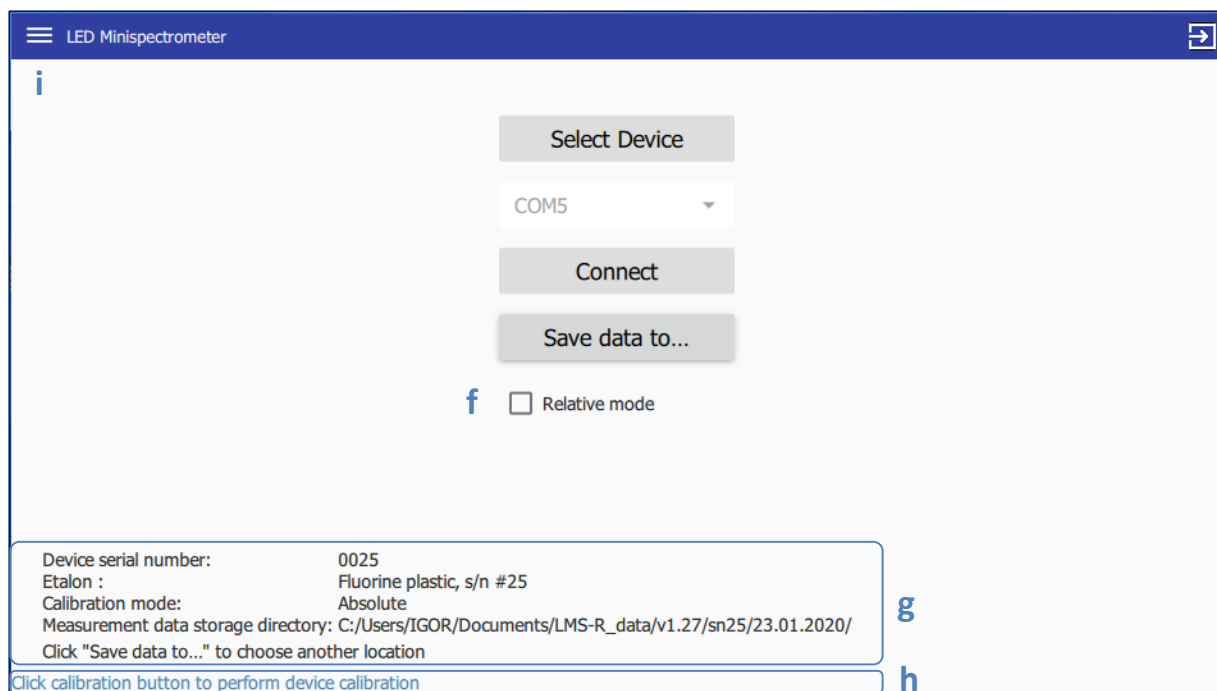
- ✓ *Absolute measurement mode – a mode when the minispectrometer is calibrated using the etalon (provided with the device) with a known reflectance spectrum. When this mode is chosen minispectrometer puts out absolute reflectance values of the analyzed samples.*

## OPERATING INSTRUCTION

- ✓ *Relative measurement mode – a mode, when reflectance spectrum of one of the samples (reference sample) is taken for 100% of reflectance and all of the following measurements are done comparatively to this reference sample.*

3.6 Absolute measurement mode is set by default. If needed, relative measurement mode can be chosen by checking the checkbox “Relative mode” (fig.3, f).

▲ *It is not possible to switch between the measurement modes after measurement starting.*



*Fig.3. Choosing of the measurement mode (absolute or relative).*

Main settings are done, information about them will be displayed in “Settings” menu (fig.3, g):

- Device serial number – serial number of the minispectrometer connected to the PC;
- Etalon – name of the etalon;
- Calibration mode – Absolute or Relative mode;
- Measurement data storage directory.

In the message bar at the bottom of the window (fig.3, h) you will see information about the program actions or user prompts.

Now everything is ready for measurements.

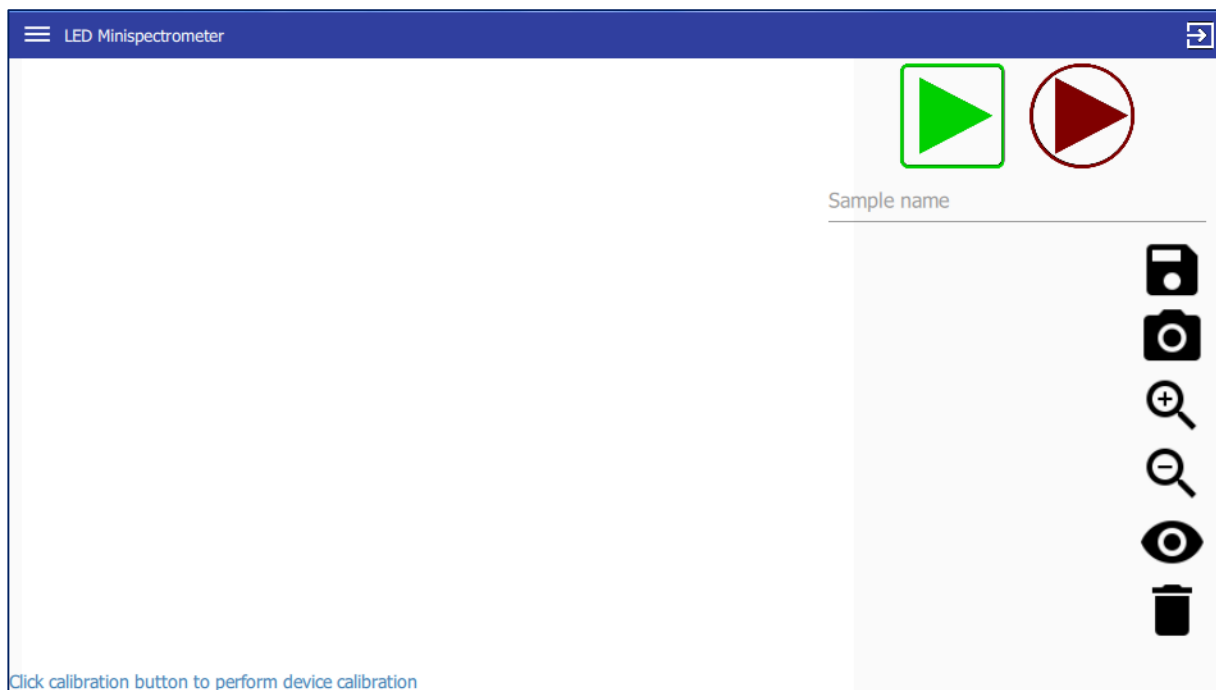


## OPERATING INSTRUCTION

- Click Menu button on the left top corner of the program window (fig.3, i), you will see the following menu options:



<b>GraphView</b>	Measurement results displaying as spectral curves
<b>HistogramView</b>	Measurement results displaying as histograms
<b>Settings</b>	Settings for minispectrometer connection with a PC and operation starting
<b>About</b>	Software version
<b>Quit</b>	Exiting the program

- Choose the mode of the results display: “GraphView” – displays spectral curves or “HistogramView” – displays histograms (it is possible to switch between displaying modes during measurements). Main program window will open (fig.4).



*Fig.4. Main program window.*

Operation of the device is performed using buttons of the main program window:

-  – run calibration measurement
-  – run measurement

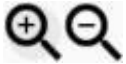
## OPERATING INSTRUCTION



– save data to .csv-file



– save data displayed on the main window (spectral curves or histograms) as a picture (in .png-file)



– scaling displayed results



– displaying results checked with checkboxes




– deleting data checked with checkboxes

6. Run the calibration measurement using etalon or reference sample in comparison to which further measurements are to be performed:

6.1. Put etalon or reference sample on a horizontal surface.

6.2. Put the minispectrometer on the etalon or sample, ***minispectrometer window must be located in contact with the etalon/reference sample, when using etalon – in the center of the it (fig.5). Moving of the minispectrometer during the measurement (indicated with the circle lightning) must be avoided.***

6.3. Click the Calibration button  of the main program window to run the calibration measurement. Circle lightning will indicate the start and the end of the calibration process.

Calibration time - 1 sec.



Fig. 5. Minispectrometer orientation relative to the etalon at calibration measurement: a – correct, b - incorrect.


## OPERATING INSTRUCTION

▲ *Calibration measurement should be performed prior to every set of measurements.*

7. Now it is possible to start samples measurement:

7.1. Put the sample on a horizontal surface.

7.2. Put the minispectrometer on the sample, ***minispectrometer window must be located in contact with the analyzed sample. Moving of the minispectrometer during the measurement (indicated with the circle lightning) must be avoided.***

7.3. Click the Measurement button  of the main program window to run the sample measurement. Circle lightning will indicate the start and the end of the measurement process.

Measurement time - 1 sec.

Measurement results will be plotted on the main program window as spectral curves (fig. 6) or as histograms (fig. 7) depending on the chosen data display mode.

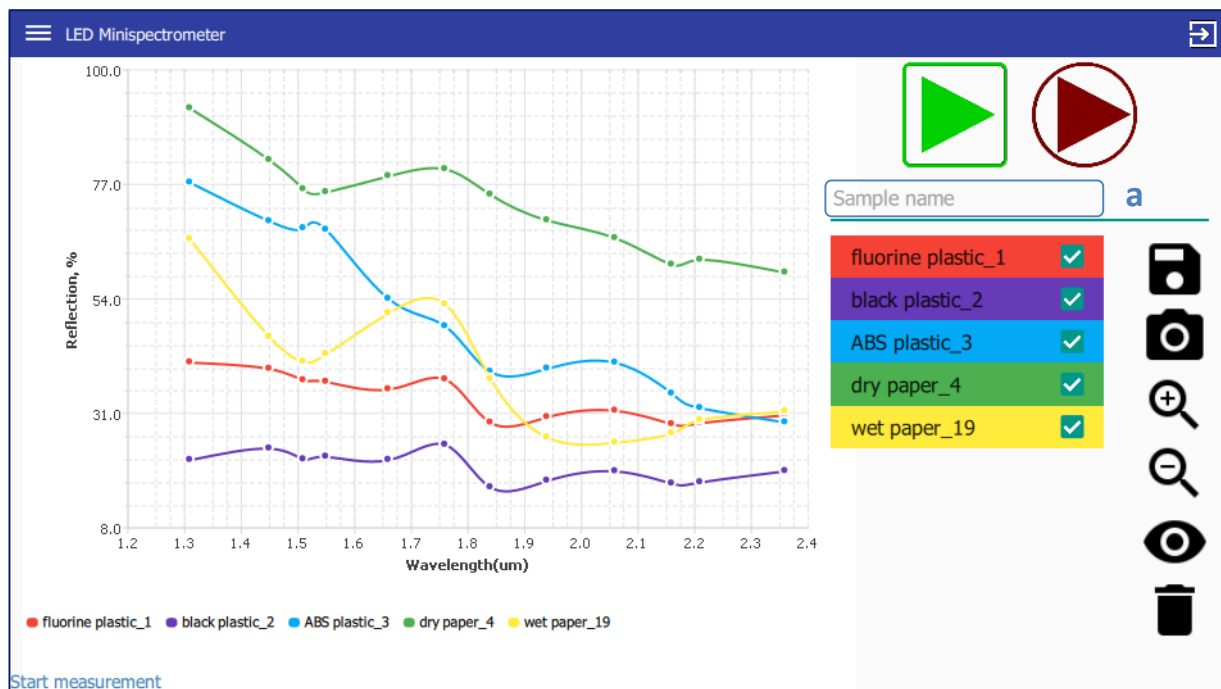


Fig.6. Results displaying as spectral curves.



# OPERATING INSTRUCTION



Fig.7. Results displaying as histogram.

- ✓ If needed, you may put in the sample name before running the measurement in the text field “Sample name” (fig.6,7, a).
- ✓ Double click on the name of the measured spectrum in the list enables one to rename it. Note that each name must be unique.

8. Obtained data can be saved in two ways:

- as csv-file (can be opened with “Excel”) – to do that click  button. Example of the saved data layout is presented on fig.8.
- as png-picture – to do that click  button.

The name of the saved data has the following format:

“YYYYMMDD\_HHMMSS\_<name assigned by the user>”.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1	um	1,31	1,45	1,51	1,55	1,66	1,76	1,84	1,94	2,06	2,16	2,21	2,36	
2	fluorine plastic_1	41,1922	39,9073	37,6117	37,3036	35,7923	37,7928	29,1111	30,2179	31,5	28,8	29,0107	30,5965	
3	black plastic_2	21,5912	23,8955	21,7254	22,2588	21,6054	24,6408	16,1028	17,4231	19,3252	16,8611	17,1081	19,3589	
4	ABS plastic_3	77,331	69,5622	68,1681	67,8505	53,9827	48,4737	39,3194	39,9569	41,1446	34,9316	32,036	29,1427	
5	dry paper_4	92,261	81,8549	76,0096	75,4092	78,6377	80,0311	74,9033	69,7495	66,1691	60,8474	61,8243	59,2439	
6	wet paper_19	65,9442	46,3164	41,3506	42,8701	51,1368	52,8686	37,8643	26,1257	25,0823	26,9559	29,6214	31,3711	
7														
8														
9														

Fig. 8. Example of the data layout in the file.

## TECHNICAL CHARACTERISTICS

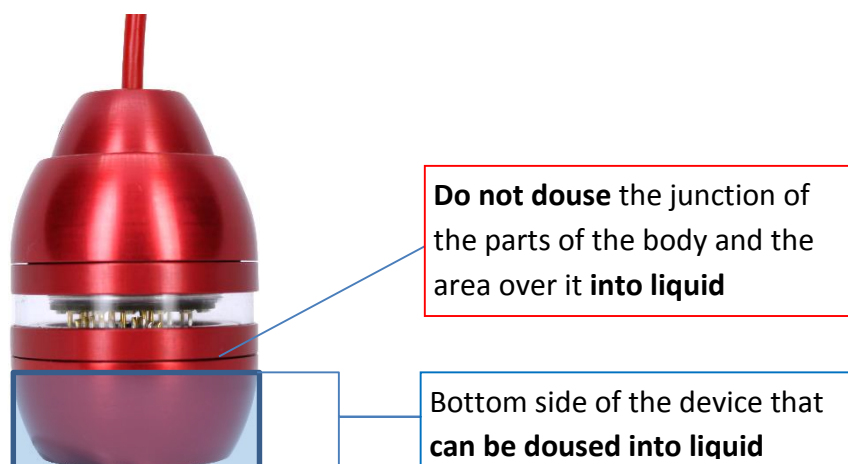
Wavelength range, $\mu\text{m}$	1.3-2.4
Sizes, mm	60 x 42 x 42
USB cable length, m	$\sim 0.8 \dots 1.0$
Weight, g	130
Body material	Aluminum
Input voltage, V	max 5.25
Input power, W	max 2.5
Power supply	from PC via USB
Measurement speed, s	1

### PRECAUTIONS

⚠ Device disassembling is not allowed, violation of the device integrity can cause it's damaging or malfunctioning.

⚠ Device performance at ambient conditions different from the normal room environment was not tested and can't be guaranteed.

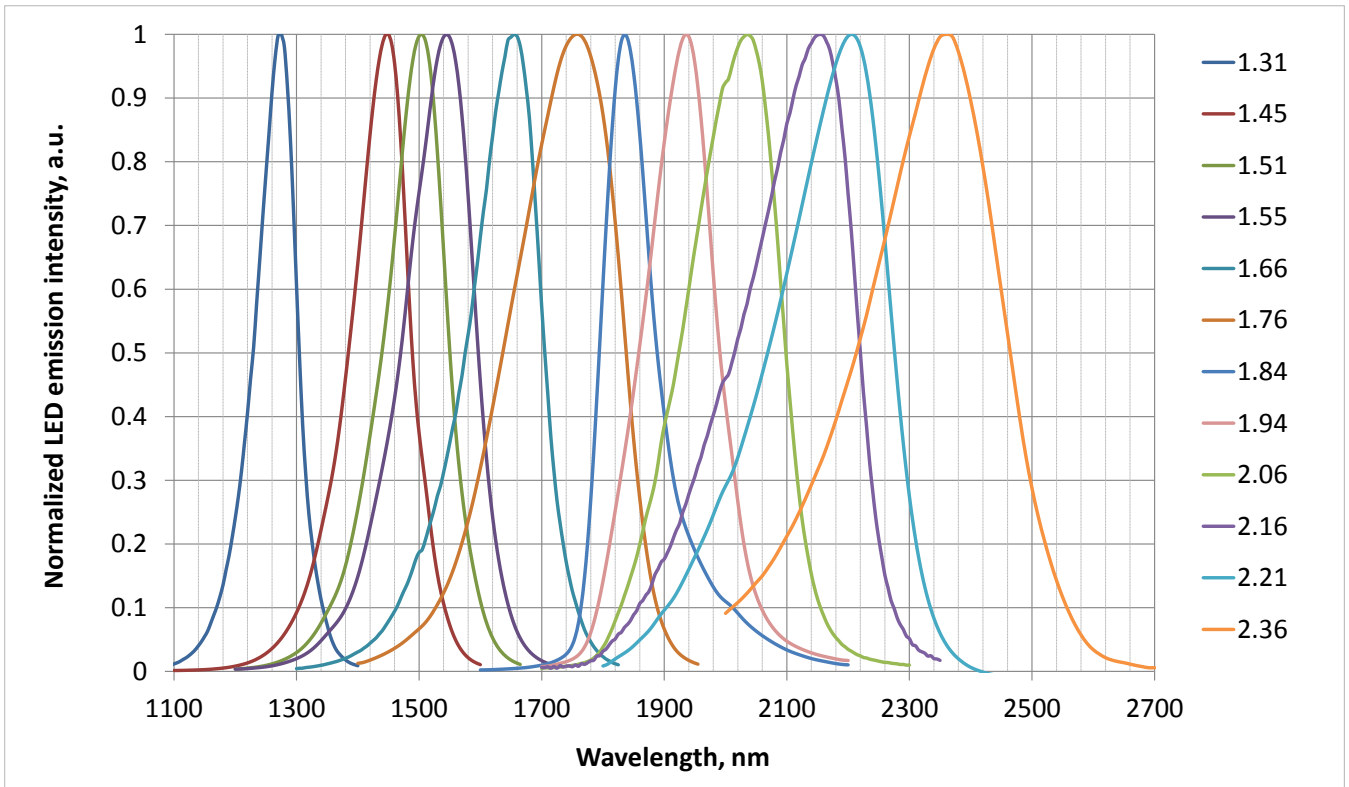
⚠ For the analysis of liquid samples it is safe to douse the bottom side of the device directly into liquid BUT the liquid should not reach the junction of the bottom part of the body with the ring part and the area over it, as pointed in the figure 9 below:



*Fig. 9. Device dousing into liquid.*

**Note!** Please refer to your provider if you have any questions.

### LED emission spectra



### Spectral distribution of Photodiode specific detectivity

