LED
Microsensor NT

LED
MINISPECTROMETER
LMS-R

TECHNICAL DESCRIPTION

rev. 240519

CONTENTS

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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 µm 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);
- water concentration measurement in cut-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 µm;
- 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.

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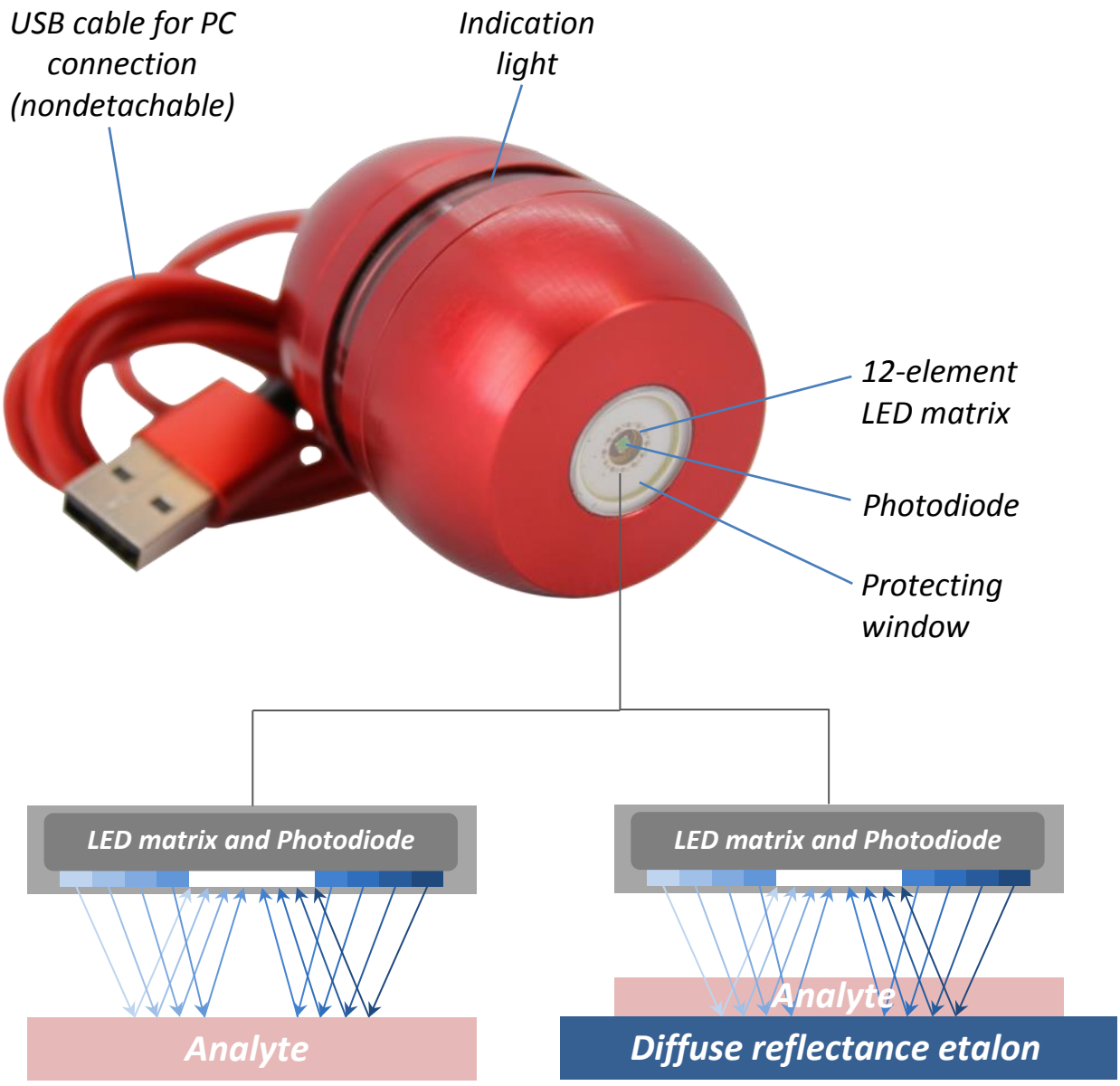
Device main view and operation principle

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 µm. Spectral characteristics of LED matrix and photodiode are presented in the **Appendix**.

LMS-R minispectrometer main view



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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. Diffuse reflectance etalon.
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.

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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).

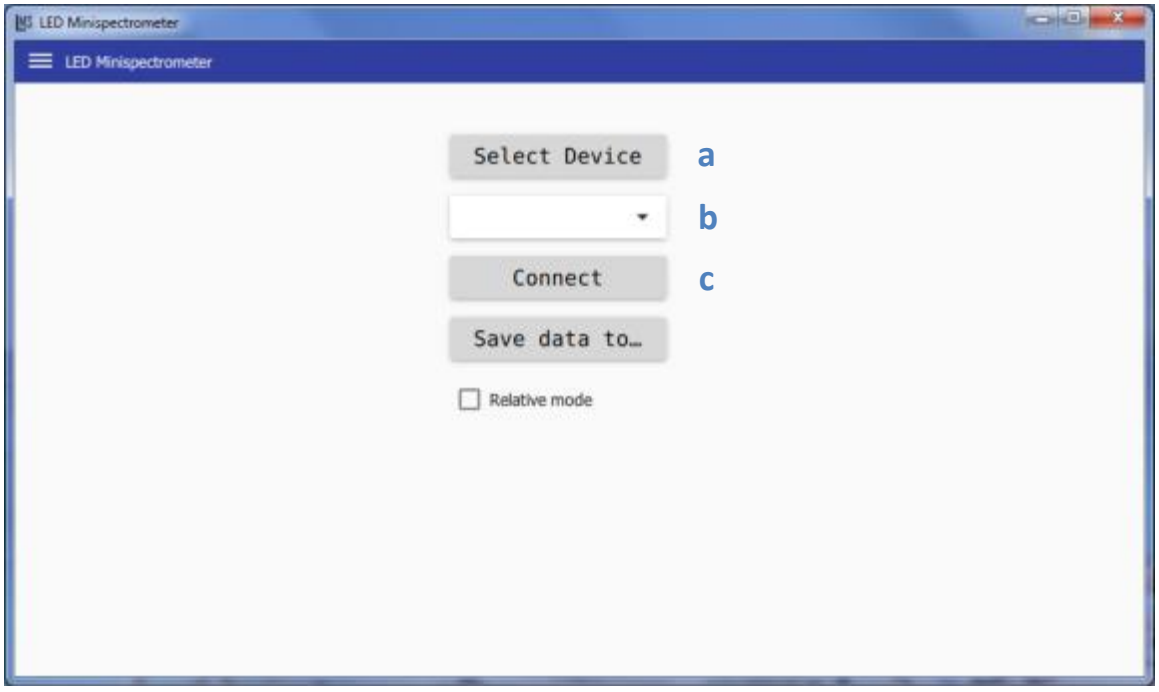

Fig.1. Window with program settings.

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

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).

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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, at next program running “Etalon data” button won’t be displayed.

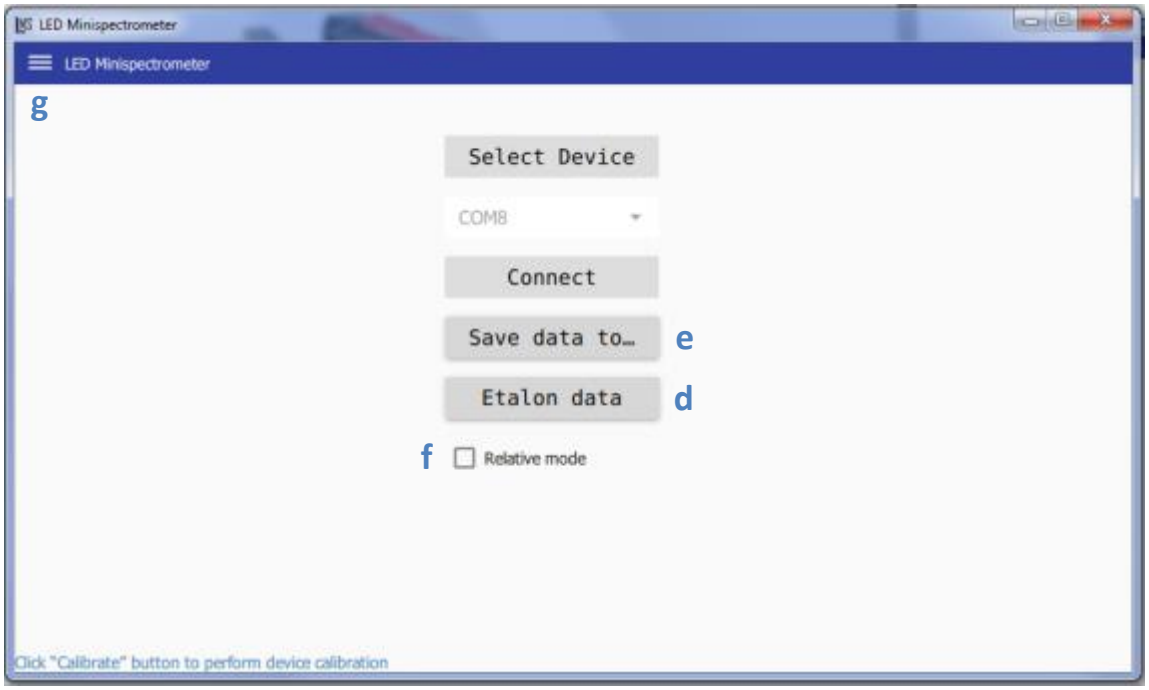

Fig.2. Window with program settings – download of etalon calibration data file*.*

3.5 For choosing directory of measurement data storage click “Save data to…” button (fig.2, e).

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

- ✓ *Absolute measurement mode – a mode when device 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 analyzed samples.*
- ✓ *Relative measurement mode – a mode, when reflectance spectrum of one of the samples (reference sample) is taken for 100% of reflectance and all 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.2, f).

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

Main settings are done and measurements can be started.

4. Click Menu button on the left top corner of the program window (fig.2, g), you will see the following menu options:

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

5. 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.3).

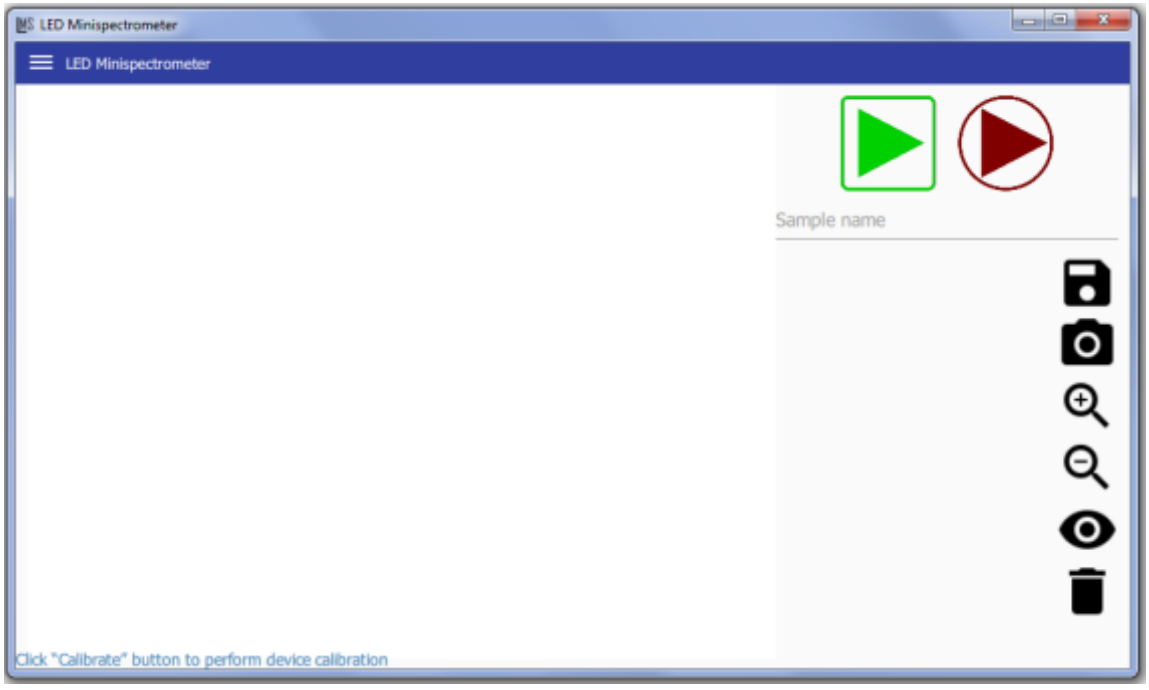

Fig.3. Main program window.

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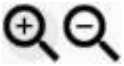
Operation with the device is performed using buttons of the main program window:

 – run calibration measurement

 – run measurement

 – 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.4). 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.

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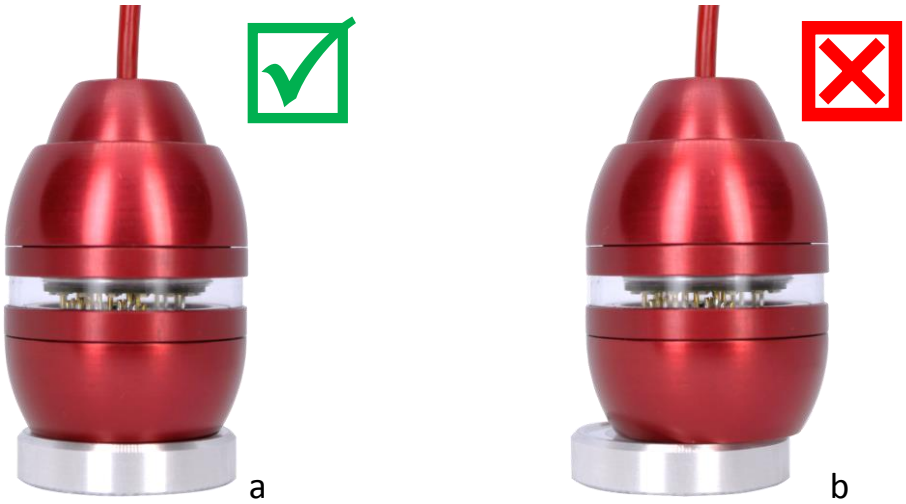

Fig. 4. Minispectrometer orientation relative to the etalon at calibration measurement: a – correct, b - incorrect.

⚠ *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. 5) or as histograms (fig. 6) depending on the chosen data display mode.

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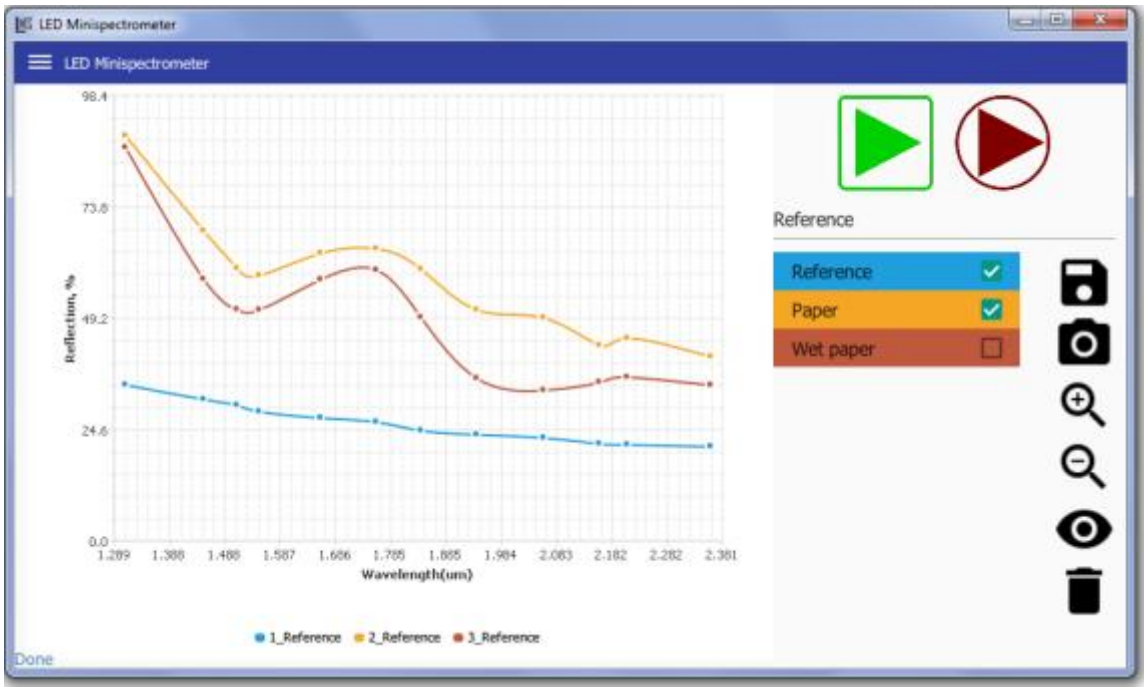

Fig.5. Results displaying as spectral curves.

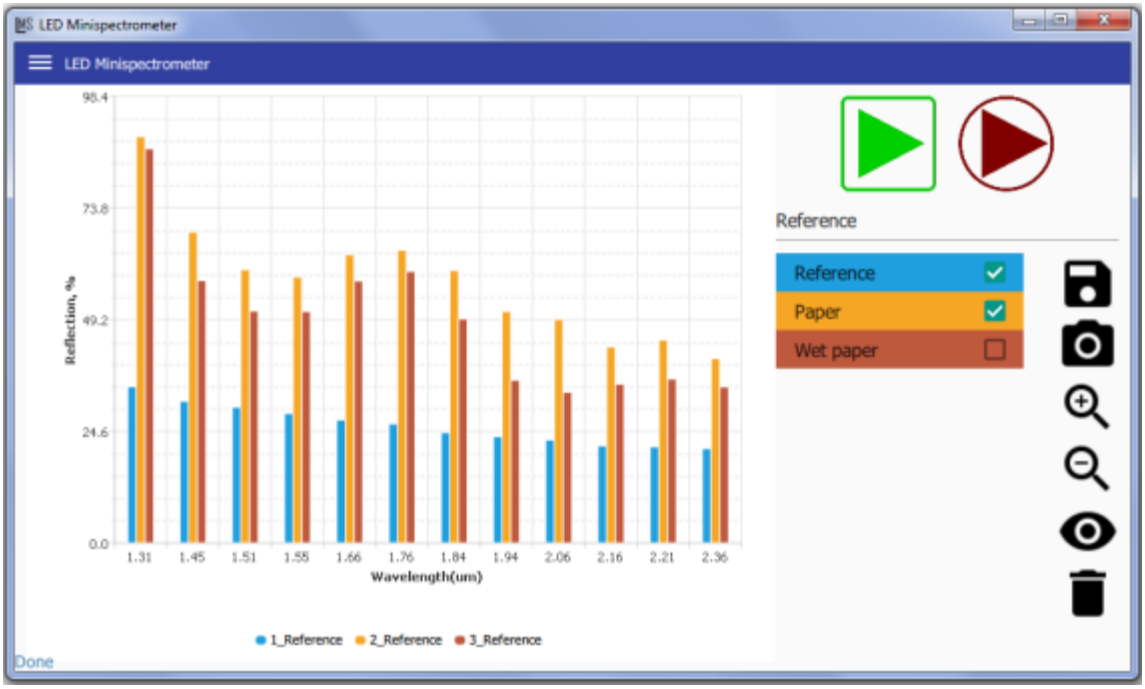

Fig.6. Results displaying as histogram.

- ✓ If needed, you may put in the sample name before running the measurement in the text field “Sample name”.
- ✓ Double click on sample names enables renaming of the obtained data.

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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.7.
   - as png-picture – to do that click  button.

X36

	A	B	C	D	E	F	G	H
1	um	Reference	Teflon	Paper				
2	2.36	95.080	21.733	55.223				
3	2.21	94.980	23.870	56.256				
4	2.16	95.025	26.006	57.256				
5	2.06	94.992	28.143	58.224				
6	1.94	94.979	30.279	59.856				
7	1.84	95.049	32.416	85.456				
8	1.76	95.004	34.552	86.546				
9	1.66	95.039	36.689	85.956				
10	1.55	95.017	38.826	60.497				
11	1.51	95.044	40.962	65.545				
12	1.45	94.996	43.099	87.546				
13	1.31	95.049	45.235	110.114				
14								

Fig. 7. Example of the data layout in the file.

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Wavelength range, µm	1.3-2.4
Sizes, mm	60 x 42 x 42
USB cable length, m	~0.8 ... 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

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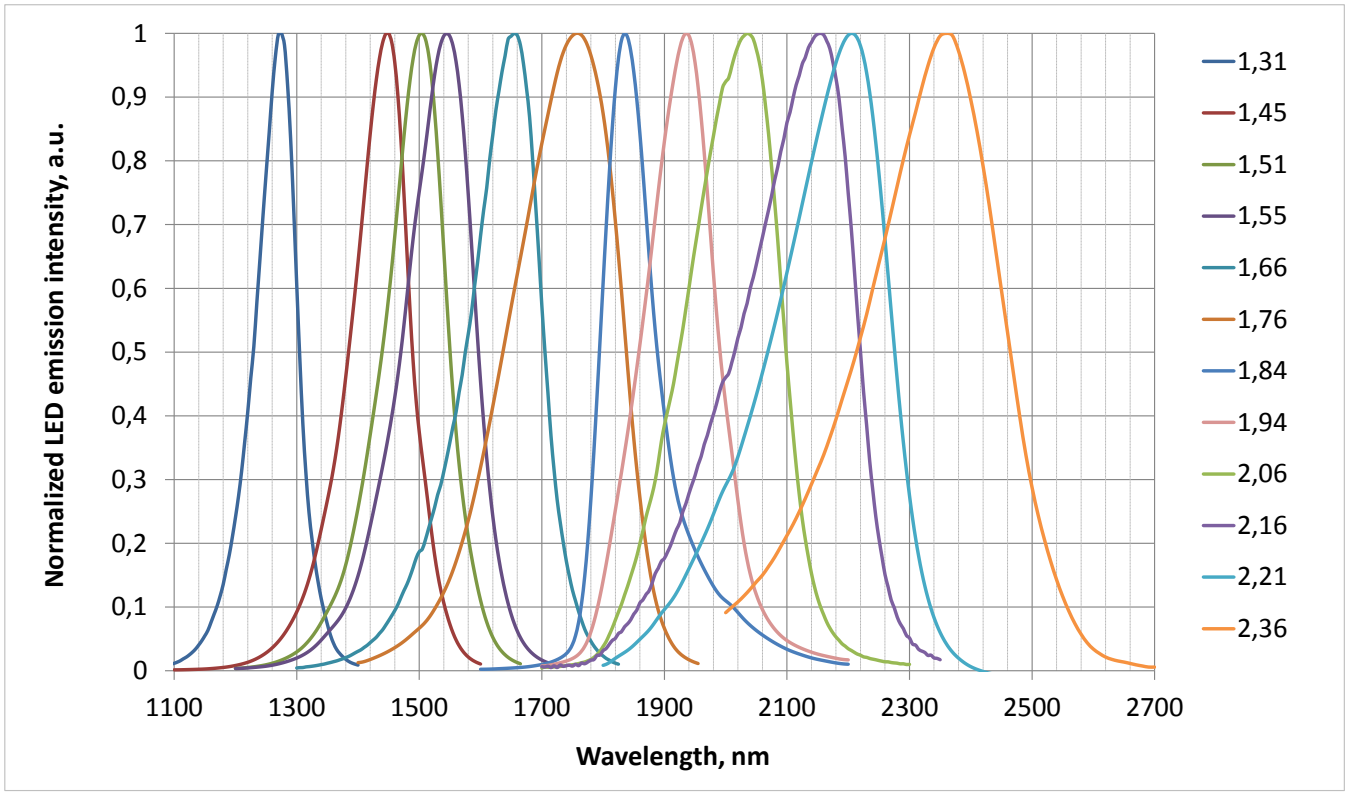
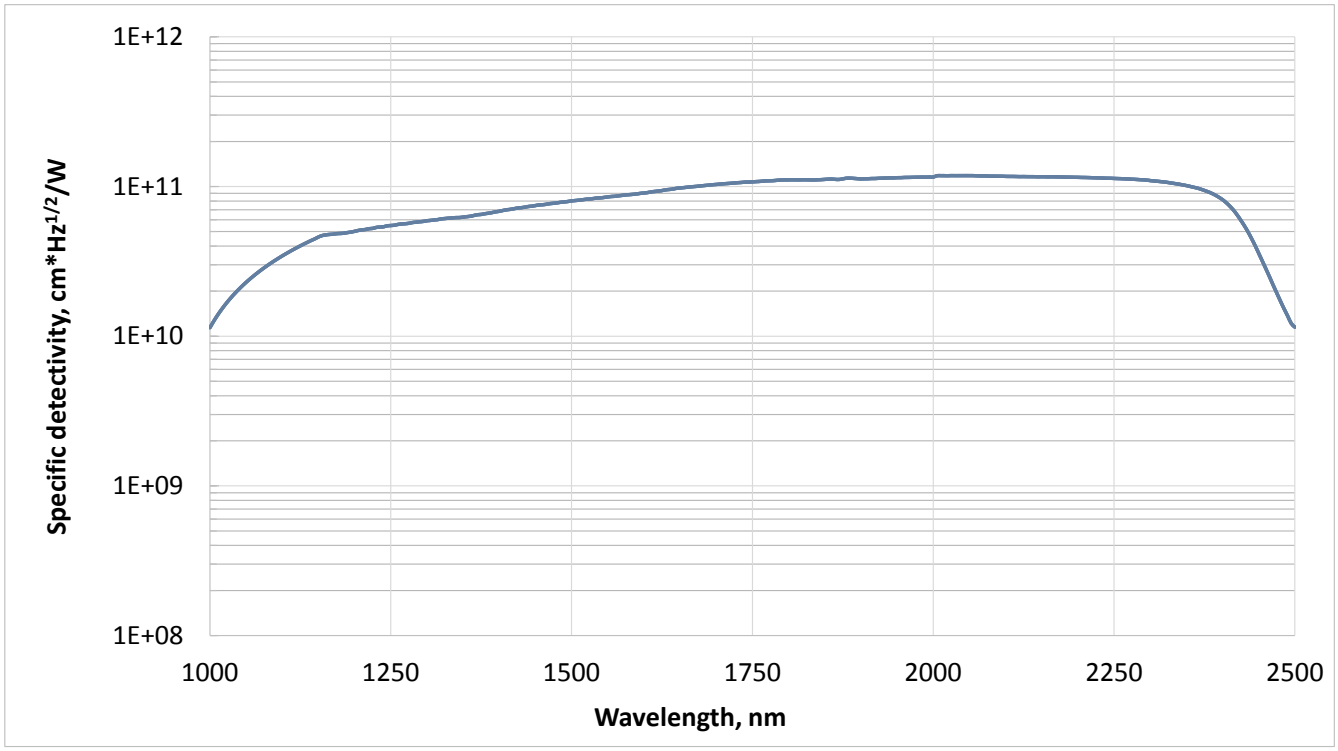
LED emission spectra



Spectral distribution of Photodiode specific detectivity



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