Spectroradiometer

RPS 380

Software version: 4.0

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Table of Contents

1.   Introduction

RPS 380 is an easy to use spectroradiometer for various applications. Its miniaturized shape makes it suitable for laboratory as well as industrial use. RPS 380 measures luminance/ radiance as well as illuminance/ irradiance. Furthermore colorimetric data (CCT, chromaticity, color purity, dominant wavelength, CRI) are calculated from the spectral data. Therefore it is suited for the test of light sources as CRT screens as well as for the measurement of illuminance in rooms etc.

The adjustment on the target in case of luminance/ radiance measurements will be proceeded with a pilot laser to be adapted on the measuring head. The correction for irradiance measurements will be done with a cosine corrector head-piece.

Measurement and analysis of data are done by the PC software JETI RPS 380. The connection to the PC is via a serial interface or via a USB interface (depending from the version of the instrument).

PC requirements:

- pentium or higher, min 32 MB RAM
- graphic resolution: 800*600, 16 bit color depth recommended
- Windows 98, 2000, NT (not for USB version), XP; Excel 97 or higher (for data transfer)

The RPS 380 package includes:
- Basic device RPS 380
- Laser head-piece for adjustment purposes (laser class 3a)
- Cosine corrector head-piece
- Protection cap
- Operating instructions
- 3 Replacement batteries for laser head-piece (LR44/ 1.5V)
- Tripod
- Transport box
- CD-ROM and a disk with the calibration file

RS232 version:

- Power supply 230 V / 9 V or 115 V / 9 V
- PC-serial interface cable

USB version:

- USB cable

2. Installation of Software

Execute the following steps on the PC to install the software of the RPS 380:

- Start Windows 98/ 2000/ NT (only RS232 version)/ XP
- Insert the CD in the CD-ROM drive

USB version (do not connect the instrument to the PC before!)

- The following window appears, if the autostart function of Windows is activated. Otherwise click on install.exe in the Install folder of the CD ROM.
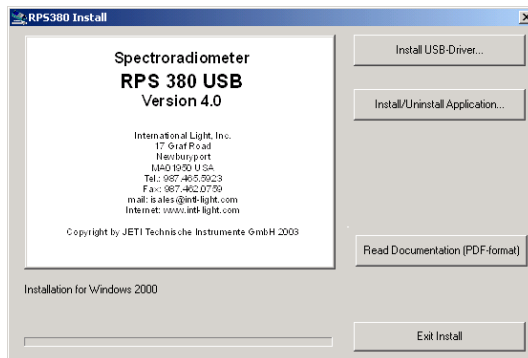
- If the correct driver wasn´t installed before: install it using the Install USB-Driver button
- Click on the Install/Uninstall Application button and follow the instructions for the program installation, connect the instrument during procedure when requested (see 3.)

RS 232 version
- A similar window as above appears, if the autostart function of Windows is activated. Otherwise click on install.exe in the Install folder of the CD ROM.
- Click on the Install/Uninstall Application button and follow the instructions for the program installation.

3.   Installation of Hardware

Unpack the RPS 380 carefully and check the delivered parts.

RS232 version
First, connect the device to a serial interface of the PC using the enclosed serial interface cable and **then** the power supply as shown in the following figure.

USB version
(Proceed when requested during software installation)

Connect the device to an USB interface of the PC using the enclosed USB cable as shown in the following figure.
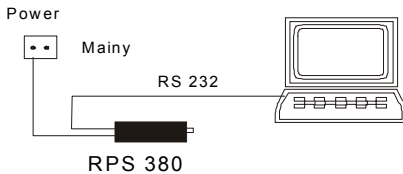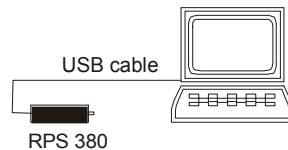

Before use please check that the main line voltage (110 V or 220 V) is in accordance with the input voltage of the delivered power supply. Please secure the correct right secondary polarity of the power supply (printed on the plug).

It may be necessary to install or to update the driver for the USB instrument (see 2.).

The device can be used with the tripod or attached to a suited base with M 4 screws. The following drawing shows the positions of the threads downside the device.
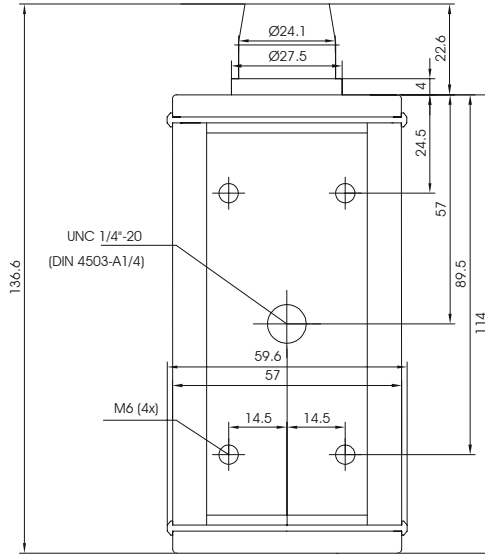
The adjustment of the device for luminance/ radiance measurement will be done with the laser head piece. Put it on the measuring head and find the target by pressing the button. The appearing circle shows the position and diameter of the measurement spot. Then remove the head piece without changing the position of the instrument.

> **Attention: Do not look inside the beam or direct the laser head-piece to another person!**

The cosine corrector head-piece will be attached to the measuring head before illuminance/ irradiance measurements. It will be turned until it is correctly positioned.

4.   Operation of Program

Starting the Program

- Start Windows and then activate the Start menu
- Select RPS 380 or RPS 380 USB under Programs

RS232 version
The software will automatically find the used port (COM 1 ... 4) after starting the program, if the RPS 380 is connected to the PC and the power supply, and will come up with an according message. The data transfer rate is 38,400 Bd.

USB version
The software will automatically find the device after starting the program, if the RPS 380 is connected to the PC with USB cable.
In case of an error, this error will be displayed (see Chap. 5 Error Messages).

Main panel
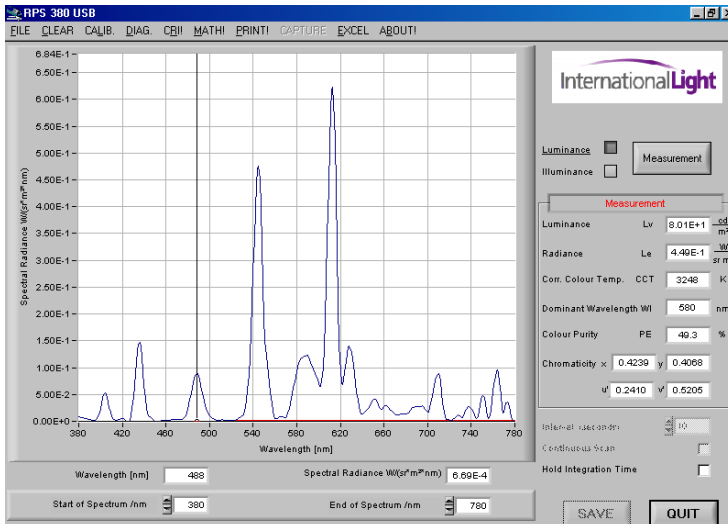
The main panel will be displayed on start-up. It consists of the following parts:

- Menu bar
- Switch for selection of luminance or illuminance measurement
- Diagram (display of spectral radiation or xy/ u´v´ diagram)
- Button for the triggering of measurements
- Display of measuring results (luminance L_v and radiance L_e or illuminance E_v and irradiance E_e, chromaticity x,y and u´,v´, color temperature CCT, dominant wavelength Wl and color purity PE)
- Snap-to-Point cursor with display of values
- Integration time and maximum counts (switch on and off with F12)
- Start and end wavelength and zooming possibility
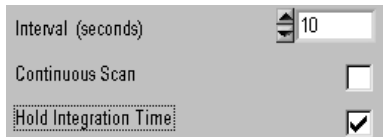- Save (Excel storage) and Quit buttons

Measurement

The first step of measurement is to select between luminance/ radiance and illuminance/ irradiance mode. Click on the desired measuring value, then you will asked to use or to remove the cosine corrector.
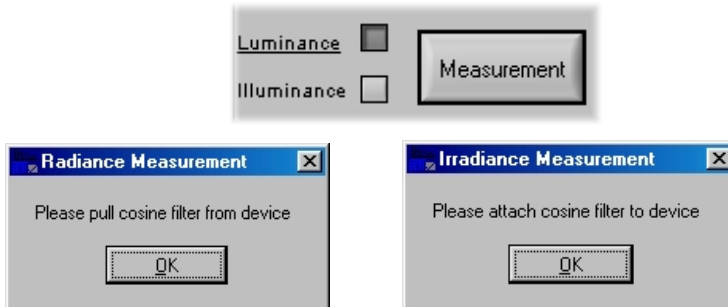
Clicking the button MEASUREMENT will proceed the measurement. The measurement procedure consists of a first spectra acquisition with a fixed integration time, a subsequent calculation of the best integration time for a well-driven spectrum, a second measurement with this time and a final dark signal measurement. In some cases more adaption steps are necessary. You will be informed about the status of the measurement (Adaption to exposure, Performing measurement) and about the remaining time. Finally the measured

values will be displayed below the button. The maximum integration time is 60 s, therefore the maximum measuring time for dark samples is approx. 120 s (max. integration time + max. dark measuring time).

It is possible to hold an once determined integration time for further measurements. This is mainly interesting in case of objects with similar intensity. Simply click the box Hold integration time. It will be warned if over and underexposure occures (Couldn't hold integration time). Then a new adaption will be processed.

Interval (seconds)	⬍ 10
Continuous Scan	☐
Hold Integration Time	☑

Fix integration time
If you want to use a fixed integration time for the measurement instead of the automatic determined one press CTRL T. Afterwards write the time (in ms) into the appearing window. It will be shown after closing the window.

Deactivate the fix integration time function by pressing CTRL T again.

Attention!   There is no warning in case of over or under exposure.

Snap-to-Point Cursor
Single data points of the acquired spectrum can be viewed by using the Snap-to-Point Cursor option, if the spectral radiance or spectral irradiance diagrams are displayed. The respective wavelength and the spectral value of the selected data point will be displayed below the wavelength axis.

Continuous Measurement
If you want to measure continuously you have to select Hold integration time and Continuous Measurement. Afterwards you have to give the desired time interval (time between end of a measurement and start of the next one, maximum 65 535 s = approx. 18 h). Then start the measurement series by clicking the Measurement button. Unselecting Continuous Measurement stops

the series. A bar indicating the time remaining till the next measurement will appear on bottom of the screen.
If you want to store the results start a link to Excel before beginning the series (see: Data transfer to MS Excel). The values will be stored in rows, maximum three tables with 768 rows are possible.

Remark: The Save continuously check box has to be selected for continuous data transfer.

Normally the integration time at start will be hold for all subsequent measurements. It will be adapted without warning in case of over or under exposure. This can influence the difference of time between the successive measurements. If you want to get the same measuring frequency use the Fix integration time option (see above).

Color Rendering Index (CRI)

The calculation of the Color Rendering Index is done according to the CIE report 13.3-1995.

Simply click on the CRI! point in the menu bar after a measurement and a window which can be seen above will be opened.
The General Colour Rendering Index R_a as well as the Special Indices R_1 ... R_{14} are calculated. Furthermore the chromaticity difference DC between the source to be tested and the reference illuminant is shown. This reference illuminant is automatically calculated from the Planckian law, if the color temperature of the sample is below 5000 K and from a daylight approximation, if it is above 5000 K. There is always used the measured CCT for the reference calculation.

Remark: **If the CCT of a light source cannot be calculated, because the chromaticity location is too far from the Planckian curvature, then the Color Rendering Index calculation is also not possible.**

It is also possible to choose the reference illuminant manually by clicking the appropriate box. Then another CCT than the measured one can be used. If the manual option was chosen, successive measurements will use the selected value of CCT. If DC is greater than $5.4 \cdot 10^{-3}$ the resulting Color Rendering Indices may be expected to become less accurate.

Calibration

RPS 380 will be delivered calibrated. The calibration data are stored inside the device. Furthermore the intensity calibration file can be found on the disk. The calibration file contains the spectral sensitivity data of the instrument from 380 … 780 nm in steps of 5 nm, separated for radiance and irradiance mode.
The following figure shows the possibilities for a user calibration under the menu point CALIB.:
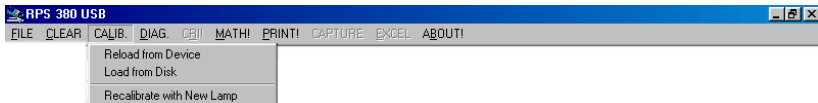
Reload from device:
The reloading can be done in case of any problems with the automatic upload of the calibration data during program start.

Load from disk:
The calibration data can be loaded from disk. The file has the extension .*cal*.

Attention!	The loaded files will not be written into the instrument!

Recalibrate with New Lamp:
It is necessary to have a calibration lamp and to know the spectral radiance of this lamp as well as the spectral irradiance in the plane of the diffuser of the instrument.

Both lamp files have to list the spectral values of the used lamp (step width: 5 nm, range: 380 to 780 nm, unit: **mW/(sr·m²·nm)** for luminance and **mW/(m² nm)** for illuminance) in **decimal or scientific** format:

```
29.54361
34.167968
39.105913
44.745458
50.61276
56.902684
64.150922
71.967095
80.218762
..
```

There have to be 81 values in both files. The file extensions have to be *.lmp*.
After choosing of Recalibrate with New Lamp you have to select between radiance and irradiance calibration. Be sure that the diffusor cap is removed in case of radiance and attached in case of irradiance calibration! Both calibrations can be done independently. Afterwards load the appropriate lamp file.
Then you are asked whether the right lamp is adjusted in a proper way in front of the instrument. If it is done, you have to confirm the calibration, which is password protected. Ask your supplier for details. Afterwards you can repeat the same procedure for the other mode.
The new calibration data will be stored in a file with extension .cal on disk as well as directly inside the instrument. If you start the program again, this new calibration file will be used automatically. If you want to use another file, proceed the step Load from Disk.
If the calibration ends with an error message („data file corrupted") calibrate again.

Set Up

Screen update mode
There are different spectrum display options that can be selected under the CLEAR menu:
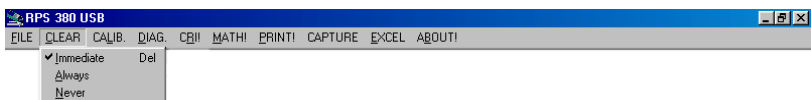
IMMEDIATE	The acquired spectra will be deleted at once (**actuation of the DEL key also deletes the current spectrum display!)**
ALWAYS	The acquired spectra will be deleted before every measurement. Only the most recent acquisition will be displayed.
NEVER	The measured spectra will not be deleted. Further measuring curves are displayed one on top of the other (default setting).

Zooming of wavelength

The start and the end of the displayed spectrum can be adjusted at the screen edge below the diagram with START OF SPECTRUM and END OF SPECTRUM. In addition to using the up/down arrows, the displayed spectral limits can be input using the keyboard number pad. The biggest possible interval is determined by the calibration parameters. The RPS 380 device has been designed to work between 380 nm and 780 nm. For measurements always the full spectral range of the device is used.

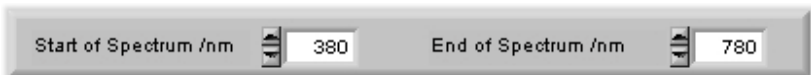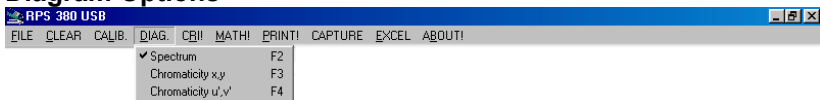**Diagram Options**

Selecting DIAG. in the menu bar opens a window, where the display of the spectral radiance/ irradiance as well as the xy and u´v´ diagram can be choosen.

The color coordinate diagrams contain the Planckian curvature for orientation. The actual measuring values will be indicated in the diagrams.

The following zooming options are possible in both diagrams:

Zoom in:	CTRL + left mouse key (the position of the cursor will be the new center)
Zoom out:	CTRL + right mouse key (the position of the cursor will be the new center)
Shift diagram:	CTRL + Shift + left mouse key – now move the diagram with the mouse
Back:	CTRL + Space (one step back) Home (back to starting diagram)

Print screen
The print of the actual screen on a connected printer is possible by
PRINT!. If no printer is connected the action is ignored without an
error message.

Data transfer to MS EXCEL

- Select the desired measuring mode (luminance or illuminance)
- Select the sub menu item START EXCEL in menu EXCEL
- After a successful start of MS EXCEL the dialogue box
  EXCEL CONNECTION appears. Here the data to be exported
  have to be selected.
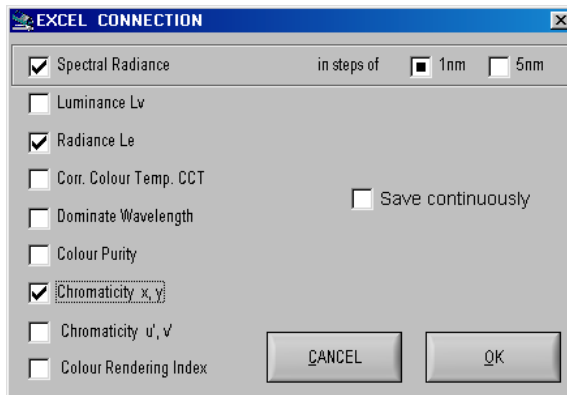
Remark:	The boxes Spectral Radiance/ Spectral Irradiance, Luminance/ Illuminance and Radiance/ Irradiance

appear in dependence from the previously selected mode. Select the desired step width (1 or 5 nm), if these data shall be transfered.

- After activation of the OK button a dialogue box appears, where the name/ a description of the actual measured data set can be filled in (which will be used as column header in the EXCEL-spreadsheet). The Save continuously option offers the possibility to save all further measurements automatically.

- The data transfer will be started by clicking the OK button. The actual measurement will be stored.

To store the same values of further measured spectra, click on the SAVE-Button in the right down corner of the screen after the measurement. It is also possible to store reference spectra data in Excel with the same procedure.

Remark: If you change the measuring mode (luminance/ illuminance) when an Excel sheet is opened, you are asked to close this sheet.

The connection to MS EXCEL will be finished and the data will be stored (*.XLS) by selection of the sub menu item END EXCEL in menu EXCEL.

Important: It is necessary to end the link to MS EXCEL in this manner by END EXCEL and not from MS EXCEL by a closing operation.

Data transfer to a Text file (CAPTURE)

- Select the sub menu item START CAPTURE in the menu CAPTURE

- Type in a file name for the measurement series, the extension is *.dat*.

- After activation of the OK button the calculated values of the actual and all following measurements are written into this file according to the following scheme (on the next page):

| No.	Luminance [cd/sqm]	Radiance [W/(sr*sqm)]	x	y	u'	v'	CCT [Kelvin]	PE %	D. Wavelength [nm]
1	2.895e+04	2.067e+02	0.4780	0.4155	0.2720	0.5319	2505	68	585
2	2.904e+04	2.073e+02	0.4779	0.4155	0.2719	0.5319	2506	68	585
3	2.904e+04	2.073e+02	0.4779	0.4155	0.2719	0.5319	2506	68	585
4	2.905e+04	2.074e+02	0.4778	0.4154	0.2719	0.5319	2507	68	585
5	2.906e+04	2.074e+02	0.4778	0.4154	0.2719	0.5319	2507	68	585
6	6.347e+01	2.590e-01	0.3060	0.3227	0.1955	0.4639	6938	10	486
7	6.907e+01	2.833e-01	0.3079	0.3249	0.1960	0.4654	6803	9	487
8	3.496e+01	1.506e-01	0.3225	0.3436	0.1991	0.4774	5944	3	505

- Capturing will be finished by selecting End Capture.

Reference spectrum management

The point File in the menu bar allows to store measured spectra as a reference for further measurements. There can be used two formates – text file (file extension .txt) or in the Galactic SPC file format (GRAMS compatible, file extension *.spc)*.
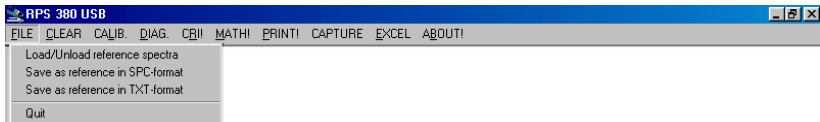

A spectrum can be stored by clicking File/ Save as reference in SPC-format or File/ Save as reference in TXT-format. First type in the name of the file. Afterwards user comments can be written into the following window.

If a reference spectrum stored ealier shall be displayed, click File/ Load/Unload reference spectra (see next side for the appearing window). Up to five reference spectra of both formates can be loaded into the list or unloaded from it. The information data of an actual file are displayed below the file list. Click into the column left of the file name to mark the desired spectra. Then close the window. Now all marked spectra are shown in the diagram. If you click on a spectrum the corresponding measuring values are shown on the right side of the diagram.
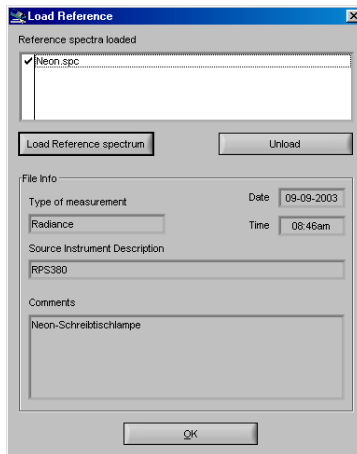
Mathematical Operations

The menu point MATH! allows to proceed the mathematical operations +, -, x and : with the actual measured spectrum as well as with stored references.
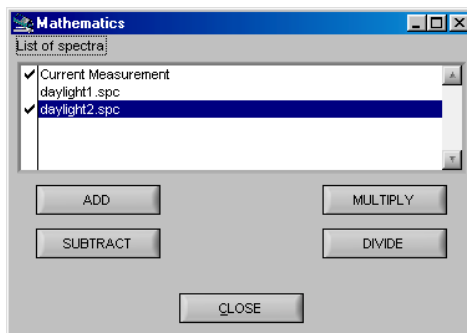
The MATH! window shows a list with the actual spectrum (current measurement) and all selected reference spectra. Click on two desired spectra and on the button for the mathematical operation. In case of subtraction and division the order of operants has to be selected. Afterwards the calculated spectrum is shown in the diagram area.

Closing the MATH! window will remove this spectrum.

Finishing the Program

The program can be exited by selecting the Quit Button or by typing Alt-Q on the keyboard. The finally used measuring mode (luminance or illuminance) will be stored and used for next start of program.

5.   Maintenance and Error Messages

The instrument needs no permanent care, if you use it carefully. It is recommended to recalibrate it every year. Ask your dealer or the producer (see 8.) for details.
The replacement of the laser head-piece should be done with LR 44 only. Open the cap on the backside with a screw driver, replace the 3 batteries (positive pole towards the fixing screw) and close the battery compartment again.

RS 232 version:

Error message	Reason	Removal
Spectrometer not found	instrument was not correctly connected to the PC	Check the installation of hardware see chap. 3 - Installation of Hardware
	Power supply is not connected properly	see chap. 3 - Installation of Hardware
Error Reading From ComPort #	No correct data transfer to PC	Check the installation of the hardware
Lamp too bright	Radiance exceeds the measuring range	Use defined reduction of sample brightness (e.g. with ND filters)
after calibration: data file corrupted	no correct storage of new calibration file	repeat calibration

USB version:

Error message	Reason	Removal
No RPS380 USB found! Switched to offline-mode	Device not connected or USB driver not installed correctly.	Connect the device to the PC or check the installation of the device driver (see install.txt on Setup-CD).
Could not read calibration data from device!	It was not possible to read the data stored inside the instrument.	Temporarily: Use the file from disk. Afterwards contact your supplier.
Could not write calibration data!		Repeat calibration process.
Calibration file empty.	No valid calibration file loaded.	Load the right calibration file with Calib./ Load from disk
Could not read lamp file, process denied!	Lamp file was not readable or did not fit the requirements.	Change lamp file or ensure the correct file access.
OVEREXPO-SURE! Measurement failed.	The measuring object overexposed the instrument due to exceeded measuring range.	Reduce the measuring intensity by calibrated filters.
Could not read parameter.	The software can not read the neccessary parameters from the instrument.	Contact your supplier.
Could not read file!	It was not possible to read a selected reference file.	Check the readability of the file.
Could not write file!	It was not possible to write a measured file as reference.	
Error on USB-Transfer	It was not possible to read or write data via USB	Check the USB-connection and restart the software

6.   **Technical Data**

Application	Measurement of diffuse light sources, screens etc. and of room illuminance etc.
Spectral range	380 ... 780 nm
Spectral resolution (Rayleigh)	9 nm
Wavelength accuracy	$\pm$ 0,5 nm
Digital spectral resolution	4.1 nm
Digital electronic resolution	14 bit A/D
Viewing angle	1,5 °
Measuring distance/ diameter	20 cm - $\varnothing$ 5 mm; 100 cm - $\varnothing$ 26 mm
Measuring values	Spectral radiance/ irradiance Integral luminance/ integral radiance Chromaticity x,y; u´,v´ Correlated Color Temperature Dominant wavelength, color purity Color Rendering Index
Measuring range luminance	2 ... $7 \cdot 10^4$ cd/m^2
Luminance accuracy	$\pm$ 5 %
Luminance reproducibility	$\pm$ 2 %
Color chromaticity accuracy	$\pm$ 0.002 x, y
Color reproducibility	$\pm$ 0.0005 x, y
CCT reproducibility	$\pm$ 20 K (@ 2856 K)
Measuring range illuminance	10 … 100 000 lx
Illuminance accuracy	$\pm$ 5 %
Integration time range	5 ms ... 60 s
Dispersive element	Diffraction grating
Light receiving element	128 pixel photodiode array
Operating cond.	Temperature 10 ... 40 °C
Humidity	< 85 % relative humidity at 35 °C

Power supply	RS 232 version: 230 VAC (115 VAC optional)/ 9 VDC (power supply included) USB version: Hub powered
PC interface	RS 232, 8N1, 38400 Bd or USB1.1 fullspeed (12Mbit/sec)
Dimensions	150 mm x 58 mm x 34 mm
Weight	300 g
Laser head-piece	Laser class 3a P_0 < 5mW λ 650 … 670nm

7.   CE Declaration

The device agrees with the regulations of the instruction 89/336/EEC for electromagnetic compatibility and the low voltage instruction 73/23/EEC for product security.

> EN 55011
>
> EN 60555-2
>
> EN 61010-1

8.   Service

In case of any questions or technical problems please contact:

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