

SR900 & SRpro

Manual



Version 2.0.2

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2 Preface

Dear customer!

Thank you for choosing a product from us!

Please take some time to read this manual carefully. Please pay special attention to the safety instructions.

This is the condition for safe handling and operation of the system and its components.

If you have any questions that are not answered in this manual, please feel free to call us. We will be glad if we can help you. We are also always happy to receive suggestions or ideas.

Our products are subject to constant further development; therefore, there may be minor deviations between your system and the illustrations in this operating manual.

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3 Quick guide spectroradiometric measurement

The short instructions are intended to demonstrate the function of the spectrometer by means of an operating sequence. The detailed instructions can be found starting on page 24. Please observe the safety instructions in these instructions.

The goal of the Quick Start Guide is that you end up with a measured spectrum on your screen.

1. Start the SRpro program.

The program starts with a welcome screen and starts the connection to the spectrometer.



When starting for the first time, set the user to Power User if necessary.
See Start > Options > User
You will find the password as an attachment to these instructions.

2. Check in the main window that the following buttons are active:



Dark measurement (automatic)




Absolute calibration



Automatic integration time

3. Hold the diffuser against a light source Start

the  measurement

A status window is opened. This shows the current integration time is output. The integration time is changed several times to achieve a modulation of approx. 90%. If the correct integration time is found, the window is hidden again and the actual measurement is started.

4. If necessary, continue with the manual dark measurement. Your spectrometer is then ready for operation.

Notes for calibrated measurements:



To perform a calibrated measurement, please select the button "Spectral correction relative" or "Spectral correction absolute". The selection of one of these two buttons releases the drop-down list for the correction file . In this list, select one of the correction files that came with your spectrometer. Please note that the file must match the input optics used (fiber optics, U-ball, diffuser, etc.).

We recommend the use of dark measurements for absolute irradiance measurements, the

Stray light correction and an averaging over 3 to 20 measurements.



Dark measurement (manual)



Stray light correction



Averaging over 3 to 20 measurements

4 Quick guide transmission / reflection measurement

The short instructions are intended to demonstrate the function of the spectrometer by means of an operating sequence. The aim of the short instructions is that you have a measured spectrum on your screen at the end.

1. Start the SRpro program.

The program starts with a welcome screen and starts the connection to the spectrometer.



When starting for the first time, set the user to Power User if necessary.
See Start > Options > User
You will find the password as an attachment to these instructions.

2. Check in the main window that the following buttons are active:



Dark measurement (automatic)



No calibration



Transmission measurement / Reflection measurement



Flash lamp on



Stray light correction on (only for reflection measurements)

3. Connect the light guide for transmission or reflection

4. Set the integration time and the number of measurements. Typical:

- a. for transmission measurements e.g. 200 ms and 10 measurements
- b. for reflection measurements with an integrating sphere e.g. 30000 ms and >3 measurements

5. Start the measurement Start

the  measurement

After the dark measurement, which takes a few seconds, you will be prompted to start the 100% measurement (baseline).

6. Then insert the sample (Note Sample measurement).

7. After that, the measurement appears on the screen.

We recommend using dark measurement, stray light correction and averaging over 10 to 100 measurements.



Dark measurement (manual)



Stray light correction for irradiance and baseline measurements



Averaging

5 Guidelines and standards



The system is a machine according to Annex II A of the Machinery Directive and is therefore supplied with a declaration of conformity and a CE marking (in accordance with the Machinery Directive).

Guidelines	
EU directives	06/42/EC (machinery) (partly applicable) 2014/30/EC (EMC) 2014/35/EC (low voltage)
Harmonized standards	
EN ISO 12100:2010	Safety of machinery - General principles for design - Risk assessment and risk reduction
EN 60204-1:2006 +A1:2009 +AC:2010	Safety of machinery - Electrical equipment of machines - Part 1: General requirements
EN 61000-6-2:2005	Electromagnetic compatibility (EMC) - Part 6-2: Generic standards - Immunity for industrial environments
EN 61000-6-4:2007 + A1:2011	Electromagnetic compatibility (EMC) - Part 6-4: Generic standards - Emission requirements for industrial environments

6 Identification

6.1 manufacturer

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6.2 Change history



We reserve the right to make changes to the content. Opsytec Dr. Gröbel GmbH is not liable for any errors in this documentation. No liability is accepted for indirect damage arising from the supply or use of this documentation, to the extent permitted by law.

Version	Processor	Date	Change
1.43	Paravia	15.08.2014	Creation
1.44	Paravia	10.07.2015	Software update 4.0
2.0.1	Paravia	21.08.2017	Software update 5.0, pixel count
2.0.2	Paravia	19.12.2017	Software update 5.1, EXCEL export

6.3 Copyright



Opsytec Dr. Gröbel GmbH shall retain the copyright for this operating manual. The operating manual is intended for the owner/operator and his personnel.

Copyright in accordance with DIN ISO 16016:

Reproduction and copying of this document, use and disclosure of the contents in this document are strictly prohibited unless expressly authorized.

Non-compliance may lead to a claim for damages. All rights in the case of a patent application, utility model or design are reserved. Violations may be subject to criminal prosecution.

6.4 General identifier

Data for internal use:

Description of the machine:	SR900 with SRpro software
Year of manufacture:
Machine no.
Project no.

6.5 Terms of use

The system is intended for industrial use only. It is forbidden to use the devices in explosive environments or for general illumination

- Installation, commissioning, operation, maintenance and service work may only be carried out by trained and qualified personnel who comply with all safety guidelines and standards.
- Responsibility: Damage resulting from unintentional or unauthorized tampering terminates any right to assert warranty or liability claims against the manufacturer.
- Warranty Disclaimer: The use of any non-original parts will void the warranty.
- Environmental protection: Defective parts containing substances harmful to the environment must be disposed of accordingly.
- Operation is only permitted in a dry environment. The installation is horizontal.
- Only suitable for indoor operation.
- Before opening, the system must be disconnected from the voltage and it must be checked that there is no voltage.
- Wear gloves for servicing, cleaning and replacing the light guides and optical components.
- Do not clean the system when it is in operation.
- The housing must not be opened by the user. The optically active surface must not be touched.
- Gloves must be worn for cleaning the optically active surface.
- The SR900 is a highly sensitive optical measuring instrument. It must not be subjected to shocks.
- When using the system, light and UV radiation may be reflected and scattered by the measuring head. If necessary, suitable protective measures must be used to protect against radiation.
- Any use other than that mentioned above will result in damage to the product. Furthermore, this is related to dangers such as short circuits, fire and electric shock. The entire device must not be changed and/or modified! The safety instructions must be observed at all times.

6.6 Foreseeable misuse

The following is considered a foreseeable misuse:

- Operation of the device without safety devices and safety equipment.
- Activities of untrained personnel on the equipment.
- Failure to follow the owner/operator's operating instructions.
- Ignoring the operating manual.
- Any use outside the specified purpose.

6.7 Legal information

6.7.1 Limitation of Liability

All information in this manual has been compiled taking into account the currently applicable standards and regulations, the technical standard and our many years of knowledge and experience.

The manufacturer is not liable for damages in the event that:

- This manual was ignored,
- the device has been used improperly,
- untrained personnel were used,
- untrained personnel have used the machine incorrectly,
- inadmissible modifications have been made,
- technical changes have been made
- unauthorized spare parts have been used.

We are not liable for common faults of the device caused by a power failure or a failure of the control system.

The actual scope of delivery may differ from the explanations and pictures in this manual in the case of special versions, when additional options are ordered, or due to the latest, technical changes.

The obligations agreed in the delivery contract, as well as the manufacturer's delivery conditions and the legal regulations valid at the time of the conclusion of the contract shall apply.

6.7.2 Conformity of declaration

The declaration of conformity can be found in the appendix or can be requested from the manufacturer.

6.7.3 Warranty terms

The warranty conditions are subject to the Civil Code (BGB) of the Federal Republic of Germany. The warranty period is 1 year, unless otherwise agreed in the purchase documents.

7 General

7.1 Information about this manual

This manual is intended to make the handling of this system and its components safe and efficient. This manual is part of the system and must be kept in its immediate environment, where it is accessible to personnel at all times.

This documentation contains the necessary information for the intended use of the system described. It is intended for technically qualified personnel who have been specially trained for operation, quality assurance, laboratory, maintenance and repair.

The personnel must have read this manual carefully and understood its contents before starting any work. The basic condition for safe working is the observance of all mentioned safety notes and operating instructions in this manual.

Knowledge and technically correct implementation of the instructions, safety requirements and warnings are a condition for safety during operation, maintenance and repair. Only qualified personnel have the necessary expertise to apply the safety instructions, safety requirements and warnings mentioned in this operating manual in a general way in a specific situation.

In addition, the local accident prevention regulations and the general safety regulations for the area of application of the system apply.

Illustrations in this manual are for general understanding; they may differ from the actual version.

Apart from this manual, the instructions for the installed components contained in the appendix apply.

This operating manual cannot cover every possible maintenance case. If you require further information or if special problems occur which are not covered comprehensively enough in this manual, please request the necessary information from the manufacturer.



For ease of description, the above components are collectively referred to as the system.


72 Information about the symbols


7.2.1 Safety instructions


In this manual, safety instructions are represented by symbols. The safety instructions are preceded by signal words indicating the extent of the danger.

To avoid accidents and damage to persons or property, always follow the information and act prudently.

Throughout the text you will find the following pictograms with the following meanings:

	⚠ DANGER
	<p>Imminent danger Possible consequences: Death or most severe injuries.</p> <ul style="list-style-type: none"> • Prevention

	⚠ WARNING
	<p>Dangerous situation Possible consequences: Death or most severe injuries.</p> <ul style="list-style-type: none"> • Prevention

	⚠ CAUTION
	<p>Possible situation Possible consequences: Minor or slight injury. Sometimes also used as a warning of material damage.</p> <ul style="list-style-type: none"> • Prevention



Note

Information about the application or useful, important information

7.2.2 Prohibition signs



General "prohibition sign"

7.2.3 Warning signs



Warning against optical radiation
(such as UV, IR or visible radiation).



Warning against electricity!

7.2.4 Attention



Wear eye protection!



Disconnect the mains plug from the socket!



Disconnect before performing maintenance or repair!



Wear hand protection!



Refer to the instructions!

7.2.5 Optional function

* Optional function,
not available for every system.

7.3 owner/operator information

The system is used on the commercial environment. The owner/operator of the system is therefore subject to the legal obligations regarding occupational safety.

In addition to the safety information in this manual, the generally applicable regulations valid for the area of application of the system with regard to safety, prevention of accidents and protection of the environment must be observed and complied with.

The following applies in particular:

The owner/operator must acquire information about the valid occupational health and safety regulations and determine in a risk assessment additional hazards that have arisen due to the special operating conditions at the place of use of the system. He must implement these in the form of the operating instructions for the operation of the system and specifically for the individual workstations.

The owner/operator is required throughout the life of the system to verify that the operating instructions it has developed are in compliance with the current regulatory status and must update them as necessary.

The owner/operator must clearly assign and define responsibilities for installation/operation, troubleshooting, service and cleaning.

The owner/operator must ensure that all personnel dealing with the system have read and understood this manual. Furthermore, he is obliged to offer personnel training at regular intervals and to provide information about the risks and hazards.

The owner/operator must provide the required personal protection equipment for his personnel. Furthermore, the owner/operator is responsible for ensuring that the system is always in a faultless technical condition. To ensure this, the service intervals specified in this manual and in the technical documents for the individual system must be observed and all safety installations must be regularly checked for function and completeness.

The owner/operator must regularly check all safety devices for function and completeness.

The owner/operator must ensure that the operating personnel have knowledge of first aid measures and the local rescue equipment.

7.4 Personnel requirements

7.4.1 Qualifications

Below, the manual lists the personnel qualifications for the various areas of activity:

7.4.1.1 Qualified electrician

Based on their training, competence, experience and knowledge of the relevant standards and regulations, qualified electricians perform work on the electrical equipment and independently identify and avoid risks.

Qualified electricians are specially trained for the working environment in which they work and they know the relevant standards and regulations. Qualified electricians must meet the requirements of the applicable legal regulations for accident prevention.

7.4.1.2 Qualified specialist

Qualified specialists are or can be trained by Opsytec Dr. Gröbel GmbH in the advanced operation and parameterization of the system, as well as in the performance of preventive service work.

In addition to their technical training, competence and experience, as well as their knowledge of the relevant standards and regulations, they are able to carry out the work assigned to them and independently recognize and avoid possible hazards.

7.4.1.3 Operator

Operators use and operate the system within the scope of its intended use. They are trained by the owner/operator in the work assigned to them and informed about possible hazards.

7.4.2 Training and qualification of personnel

In regular instructions and training, the operating personnel must be informed about the special risks and dangers when working with and handling the system.

The instruction and training should have the following content:

Hazards when working with the system in normal operation.

Hazards associated with service, repair and cleaning activities. Behavior to minimize accident consequences.

Behavior in case of accidents.

Rescue of injured persons.

Working without personal protective equipment can cause damage to health. The company supervisor is instructed to ensure that the personnel wear personal protective equipment.

Special hazards when working on electrical equipment.

The instructions and training must be carried out at regular intervals by the owner/operator. For better tracking, the implementation of the instruction and training should be recorded.

7.4.3 Personal protective equipment

The purpose of personal protective equipment is to protect personnel from hazards that could affect their safety or health at work.

When performing various activities on and with the system, the personnel must wear personal protective equipment. This is repeatedly referred to in the individual chapters of this manual. The personal protective equipment is explained below:

7.4.3.1 Protective gloves

Protective gloves are used to protect hands from visible and/or invisible radiation, friction, abrasions, stings and deep injuries.

7.4.3.2 Safety goggles

Safety glasses are used to protect the eyes from visible and/or invisible.

7.4.3.3 Safety shoes

Safety shoes are worn as protection from heavy parts that could fall and from slipping on slippery surfaces.


8 Safety instructions and residual risk


8.1 General


The system is state of the art and has been built in accordance with recognized safety regulations. Nevertheless, its use may pose risks to the life and extremities of the operating and repair personnel (service personnel) or third parties, or impair the machine. Operate the system only when its safety devices are in perfect condition. Malfunctions that impair their safety must be rectified immediately.


The following safety information must be strictly observed to avoid damage to the machine and personal injury!


82 Safety instructions relating to normal operation

	⚠ CAUTION
	<p>Risk of damage</p> <ul style="list-style-type: none"> • The SR900 is calibrated. Do not subject the device to shock. • CAUTION: Opening the housing will result in loss of calibration.

	⚠ CAUTION
	<p>Risk of damage</p> <ul style="list-style-type: none"> • Skin grease and dirt are absorbent in the UV and visible spectral range. • Avoid fingerprints on the optically active sensor surface. If necessary, clean the components carefully with isopropanol.


	⚠ CAUTION
	<p>Risk of damage</p> <p>Special guidelines must be followed when using an optical fiber. Avoid:</p> <ul style="list-style-type: none"> • Touching the end faces with the fingers • Storage on dusty surfaces • Bumping against hard surfaces • Immersion in e.g. contaminated liquids. • small bending radii (200mm)

	⚠ CAUTION
	<p>Risk of damage</p> <ul style="list-style-type: none"> • Hand-tighten the knurled screws of the SMA-905 light guides.

	⚠ WARNING
	<p>Fire hazard!</p> <p>A high irradiance, which can ignite combustible materials in case of continuous irradiation, is achieved at the output of the <u>light guide of optional flash lamps</u>. Remove all combustible materials and observe the irradiation time and material temperature.</p>

The wearing of personal protective equipment (e.g. safety goggles and hand protection) is mandatory when working on the system.


8.3 Radiation safety


	<p>⚠ WARNING</p>
	<p>Risk of eye injury</p> <p>The SR900 can be optionally equipped with xenon flash lamps. There is then a risk of photochemical or thermal damage to the eye, retinal damage and burns. Visible (blue) light can cause photochemical damage to the eye. If necessary, use suitable protective goggles when operating the unit. The operating personnel must be trained appropriately.</p> <p>Recommended protective equipment:</p> <ul style="list-style-type: none"> - Gloves - Safety glasses, no transmission below 400 nm <p>Do not look into the light source and do not expose skin to the radiation! Avoid reflections of the radiation into the eye!</p> <p>The system should be designed in such a way that a direct view into the light guide receptacles and the light guides is prevented.</p> <p>The devices have been classified in risk group 3 according to DIN EN 62471:2009-03 "Photobiological safety of lamps and lamp systems" classified.</p>


The risk assessment for the workplace is the responsibility of the customer. This requires measurements / assessments according to DIN EN 14255-1:2005-06 "Measurement and assessment of personal exposure to incoherent optical radiation - Part 1: Ultraviolet radiation emitted by artificial sources at the workplace".


DIN 14255-1 itself does not contain any limit values. These are given in Directive "2006/25/EC of the European Parliament and of the Council on the minimum health and safety requirements regarding the exposure of workers to the risks arising from physical agents (artificial optical radiation)".


84 Safety instructions relating to service and repair work

	⚠ WARNING
	<p>Risk of injury when touching live parts</p> <p>Before opening the system, disconnect all components from the supply voltage and check that no voltage is present.</p>

	⚠ CAUTION
	<p>Risk of damage</p> <ul style="list-style-type: none"> • The SR900 is calibrated. Do not subject the device to shock. • CAUTION: Opening the housing will result in loss of calibration.

	⚠ CAUTION
	<p>Risk of damage</p> <ul style="list-style-type: none"> • Skin grease and dirt are absorbent in the UV and visible spectral range. • Avoid fingerprints on the optically active sensor surface. If necessary, clean the components carefully with isopropanol.

	⚠ CAUTION
	<p>Risk of damage</p> <p>Special guidelines must be followed when using an optical fiber. Avoid:</p> <ul style="list-style-type: none"> • Touching the end faces with the fingers • Storage on dusty surfaces • Bumping against hard surfaces • Immersion in e.g. contaminated liquids. • small bending radii (200mm)

	⚠ CAUTION
	<p>Risk of damage</p> <ul style="list-style-type: none"> • Hand-tighten the knurled screws of the SMA-905 light guides.

Service, repair and cleaning work may only be carried out by authorized and specially trained personnel. The system must be de-energized and secured before major work (including cleaning) is performed).

Carry out the prescribed adjustment, service and inspection work in accordance with the instructions. If you require further information in this connection, or if special problems arise which are not dealt with comprehensively enough in this manual, please request the necessary information from the manufacturer.

The housing must not be opened by the user. The optically active surface must not be touched.

Gloves must be worn for cleaning the optically active surface.

The SR900 is a highly sensitive optical measuring instrument. It must not be subjected to shocks.

9 Description of the system and function overview

The compact SR900 spectroradiometer is a high-resolution measuring system for fast and precise measurements in the UV, visible spectral range and IR. The measuring range extends from 200 nm to 1100 nm. The spectroradiometer consists of an array spectrometer without moving parts and a silicon array with 2048 pixels. The spectral resolution is 2.3 nm (pixel pitch 0.4 nm). The SR900 is combined with an SMA-905 quartz optical fiber and our radiometric probes for irradiance and illuminance measurements. With trigger input and output, the SR900 is also suitable for automated measurements.

The SR900 is traceable to the PTB factory calibrated. DAkkS testing in our accredited laboratory is optionally available. The SR900 thus allows accurate spectroradiometric measurements for the evaluation of irradiances and illuminances, biological efficacy and color measurements. Due to the low stray light design, high sensitivity in the UV range is achieved. Control and data evaluation are performed with the spectral software SRpro.

For the SR900, we also carry an extensive range of accessories, which can be combined with customer-specific extensions.

With version 4.0 we already introduced an extended user administration. This makes it possible to switch the user interface permanently between a main user, with all functions, and a restricted user. A password is required for the switchover, which is included in this documentation. It is therefore possible to use the SR900 in a qualified environment.

The user rights differ as follows:

Right	User	Main user
Carrying out measurements	yes	yes
Change settings that affect the Influence measurement result (see below)	no	yes
Manually changing the integration time	yes	yes
Change calibration	no	yes
Saving faulty measurements (as pdf) (see Threshold settings).	no	yes
Automatic save as pdf	yes	no
Evaluation included in the protocol (pdf)	yes	no
Manipulation of measurements / Measurement calculations	no	yes
Change user permanently	no	yes
Change password	no	no

For example, the restricted user is not able to change the following settings:

- Change printer settings and log settings
- Change dynamic measurement
- Change spectral correction off / relative / absolute
- Change correction file
- Change offset correction
- Change dark measurement
- Perform data manipulation
- Accidentally overwrite files

9.1 General product description:

- Spectral range 200-1100 nm
- Low stray light grating with 300 lines/mm
- 1.4 nm bandwidth
- Order filtering
- Spectral software for color measurement, radiometric and effect-related measurements
- Simple validation through user concept
- Extensive range of accessories

9.2 The following components are supplied:

- Spectroradiometer SR900
- Spectrometer software SRpro
- USB cable
- this documentation
- optional: fiber optic cable
- optional: sensor head
- optional: integrating sphere reflection attachment




For ease of description, the above components are collectively referred to as the system.

The following components are required by the customer:

- PC with Windows 7 / 10
- Free USB interface

10 Commissioning

- Unpack all components and remove the packing materials.

	⚠ WARNING
	<p>Risk of damage</p> <p>The light conductors are very sensitive and must not be bent or severely bent.</p> <p>A minimum bending radius of 200 mm must be observed.</p>

10.1 Software installation

- Connect the USB stick or CD to the PC and double-click Setup.exe.
- Follow the installation instructions on the screen and confirm the installation of the drivers.

10.2 Removing SR900

If necessary, you can remove SR900 from your computer. You can do this in the following ways:

- Click on "Start" in the Windows Start menu and select "Programs > SRpro > Remove SRpro".
- Select "Settings > Control Panel" in the Windows "Start" menu. Double-click on "Software" in the control panel. Select SRpro in the dialog box.
- Click on "Software Properties" on the tab page.
- Click on "Install/Uninstall" and click the button "Add/Remove".

10.3 Installing device drivers under Windows 8

In Windows 8, it is no longer possible to install unsigned drivers by default. However, you can allow unsigned drivers.

This tutorial shows how this can be done.

- Key +i
- Press and hold the Shift key and click Restart. Do not release the Shift key until the following screen appears.



- Now click on Troubleshoot



- And then click on Advanced Options



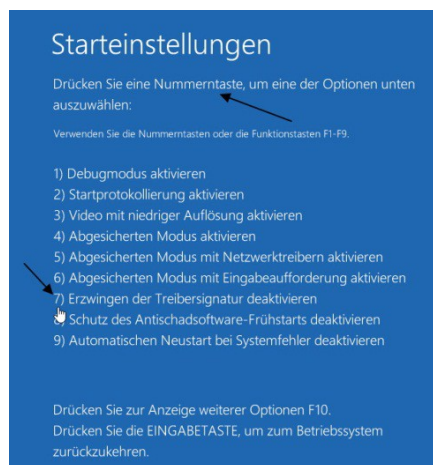
- Then click on Startup Settings



- Click on "Restart" in the subsequent message.



- The computer will then restart.
- When restarting, the startup settings appear



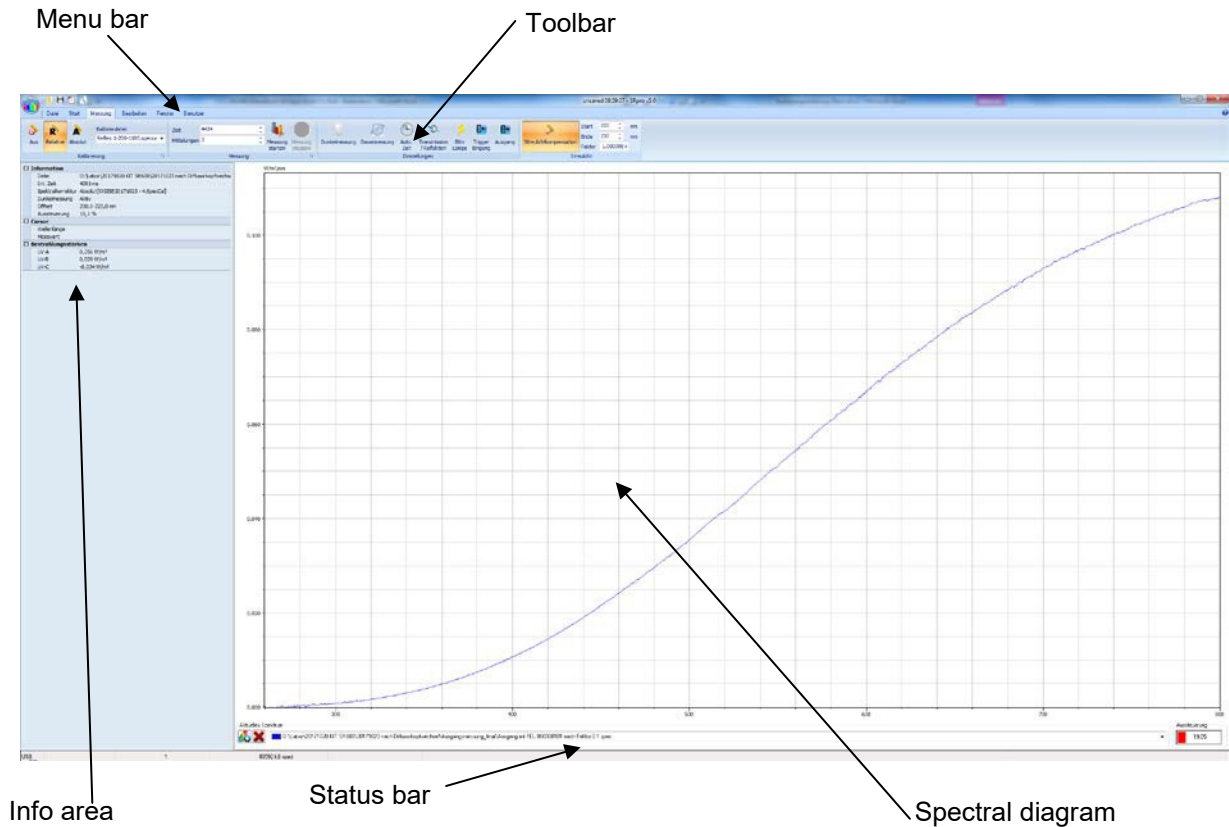
- Now allow the unsigned drivers with the number key 7 or the function key F7. Windows is then started.
- During the installation of the driver, a prompt will now appear. Press "Install this driver software anyway".



11 Software operation

11.1 The controls

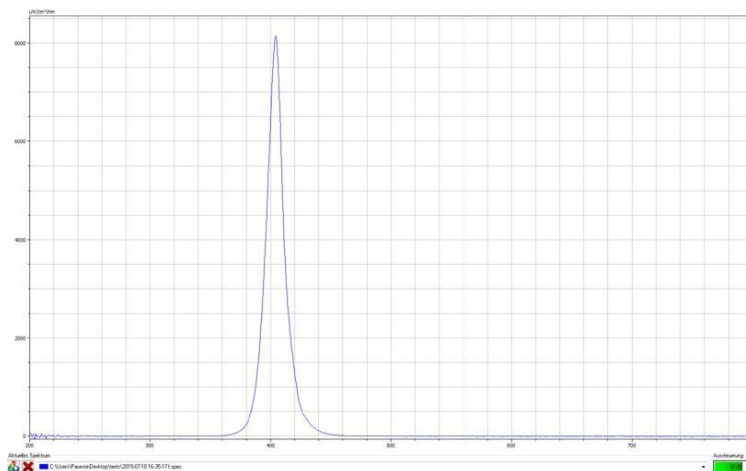
The operating elements are labeled in the following figure. In the following, the individual operating elements are presented in detail and their function is explained.



11.2 The spectral diagram

At the top left of the screen you can see the units, at the bottom right the level. The largest part of the screen is the graphical representation of the spectrum. In horizontal direction the wavelength is displayed, in nm and in vertical direction the spectral irradiance.

The lower part of the screen contains the display of the current cursor position and the controls for managing multiple spectra.



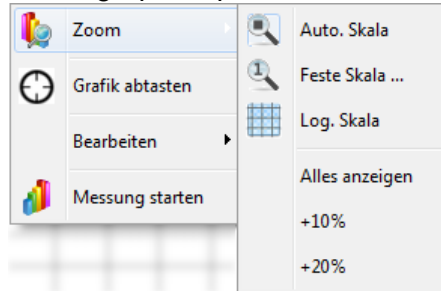
By clicking and holding the left mouse button, a rubber band can be drawn. The section when releasing the left mouse button is zoomed out and displayed enlarged in the spectral window.

Pan function

The Pan function is used to move the graphic. To activate the pan function, the CTRL key must be held. When the mouse pointer is in the graphic, it changes the shape to a cross. Now the graphic can be moved by pressing and holding the left mouse button.

Context menu of the spectral window

Clicking the right mouse button within the graphic opens the context menu.



Under Zoom Auto. Scale can be switched on/off, return to the full range or display the ordinate 10% or 20% larger than the maximum signal.

If the menu item "Scan graph" is selected, a crosshair is displayed as soon as the mouse is in the spectral display. This crosshair follows the mouse movement and is always assigned to the wavelength of the mouse position.

Under the item "Edit" the spectral graph can be copied to the clipboard or saved as a bitmap file. Using these functions, it is possible to transfer the spectral display to a word processing program for documentation purposes.

The bottom item "Start measurement" starts a new measurement.

If the menu item "Scan graph" is selected, a crosshair is displayed as soon as the mouse is in the spectral display. This crosshair follows the mouse movement and is always assigned to the wavelength of the mouse position.


Under the item "Edit" the spectral graph can be copied to the clipboard or saved as a bitmap file. Using these functions, it is possible to transfer the spectral display to a word processing program for documentation purposes. With the function "Copy data to clipboard" the measurement data are comfortably available for a spreadsheet.

11.3 Working with multiple spectra

The SRpro software offers the possibility to display several spectra simultaneously. The current spectrum is always displayed with thicker lines. Bottom right appears



Selection of the active spectrum

Click on the  expand the list of open spectra.

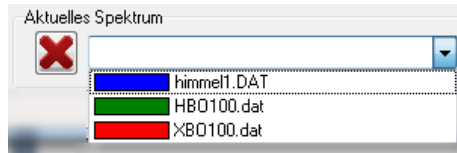


Figure 1: Selection list for active spectrum

Select a spectrum from the list and click on the name. This spectrum is now taken over as the current spectrum. All displays, such as integral values and weights, are now displayed from this spectrum



Delete a spectrum

To delete a spectrum, select the spectrum as the active spectrum. Now press the button to the left of the name. This will delete the active spectrum from the memory.

11.4 Symbol overview

The toolbars provide grouped, context-dependent access to the most important functions. The toolbar is the central control element for performing a measurement. Example:



It is important to know about the functions of each switch and to check the correct setting before performing a measurement.



Open spectrum

Files from previous measurements can be selected and the spectra displayed on the screen.



Save automatically

All measurements can be saved automatically. The file name is given a three-digit number at the end, which is increased by one for each measurement. So names like test001, test002, ... are possible.



Save spectrum

Only one measurement will be saved by entering a name.



Export spectrum

It will save the measurement as an EXCEL file of the CSV file. See options



Print

Here the spectrum is printed. After the spectral diagram, the comment from the info window and the settings during the measurement are printed. The values from the displayed evaluation window (integration, weightings and color measurement) are also printed.



Set printer

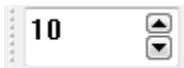
Calls the "Set up protocol" dialog. There you have the possibility to customize the content of the PDF export. You can find an example protocol in the Appendix.



PDF Export

Saves the print output in a pdf. The included evaluations and data can be configured via the printer settings.

A sample protocol can be found in the appendix.



Integration time

In this input window the integration time is set in milliseconds. Depending on the computer speed, the smallest possible value is 30 ms. If the spectrum is displayed incorrectly, the computer speed is too low for the integration time. Then select a longer integration time.

With uncooled array the maximum reasonable integration time is between 30000 and 60000 ms. With cooled array 60000 ms are always possible. Here the value Amax right under the spectrum window should be between 50% and just under 100%, otherwise the integration time should be changed.



Start measurement

Starts a new measurement with the set parameters.



Dark measurement on/off

Here you select whether the dark signal is to be determined before each measurement in a dark measurement with the same integration time and subtracted from the light measurement. Each photodiode array has a temperature-dependent dark current. This means that the photodiodes show a value greater than zero at large integration times, even at complete darkening. This effect can be fully compensated by subtracting a dark measurement from the measurement signal. We recommend, except for test measurements, to always switch on this item.



Continuous measurement on/off

With the parameters set, the measurements are made as fast as possible one after the other (i.e. as fast as the computer speed allows).

allows). In order to make a defined pause between two measurements, a corresponding time can be set in the "Settings->Device options" menu in the "Measurement interval" tab. With **automatic save** on, the number at the end of the file name is incremented. In the upper line a button "Stop" appears on the right, with which one ends the continuous measurement.



Automatic integration time on/off

The button is used to determine whether the integration time should be determined automatically. If the button is pressed, the program will increase the integration time until the largest value of the spectrum between 80 and 90 % lies.

In the case of radiation sources operated with AC voltage, beatings can occur with the measurement time determined in this way, since parts of the period duration are not completely recorded. In this case, an integration time should be selected which is a multiple of the period duration.



Transmission reflection measurement on/off

Both transmission measurements and reflection measurements can be performed. For this purpose, two spectral images are taken in each case: first the measurement of the radiation source, then the measurement with specimen. For the reflection measurement, a reference standard is inserted during the measurement of the radiation source.

Note that the division only produces meaningful values if the lamp also emits radiation in the corresponding spectral range. The noise increases strongly with decreasing intensity.

For transmission and reflectance measurements, a baseline and dark measurement must be performed. These measurements must be repeated when changing the integration time, the number of averages or changing the light guide.

For the same measurements, the 100% measurement (baseline) and the dark measurement can be saved automatically, so that they are not have to be performed again. Consequently, the measurement is faster.

To do this, select in the menu Settings

Baseline correction and USE

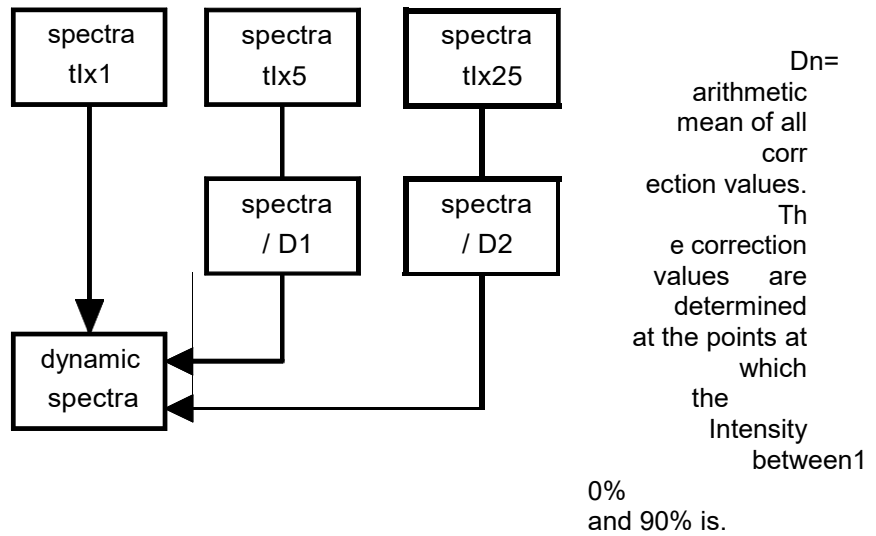
Correct for dark



Dynamic measurement on/off*

The button "Dynamic measurement" determines whether several measurements are performed to improve the dynamics. If the button is pressed, 3 measurements are performed. The first measurement with the normal integration time, the second measurement with the 5-fold integration time and the last measurement with the 25-fold integration time. Subsequently, a spectrum is assembled from the three measurements.

The measurements with multiple integration time are divided by a previously determined correction value. All values of a spectrum with increased integration time, which are smaller than 90% of the saturation value, are divided by the determined correction value and then fed to the further calculation.



t_i = integration time

Figure 2: The calculation of the dynamic spectrum



Averages

In the **Averaging** window, the number of averages performed during a measurement is specified. Averaging over several measurements can improve the signal-to-noise ratio. The value for averaging can be between 1 and 65000. However, values between 10 and 100 are realistic in order not to make the total measurement time too long. If the value 1 is entered as the averaging number, no averaging is performed.



Flash on/off (not available on all spectrometers)*.

By means of the switch Flash you determine whether trigger pulses are to be given to the output Flash during the measurement. The number of flashes depends on the integration time. The flash signals have a frequency of 100 Hz.



External triggering* on/off

After starting the measurement via "Start measurement" the following status window is displayed.

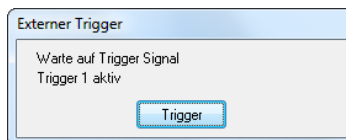


Figure: Waiting for external trigger

The activated trigger input is now monitored. As soon as the trigger signal comes, the measurement is started. If both trigger inputs are activated, the evaluation will show a logical "or" link between the two inputs is performed.



Spectral correction off

The spectrum is referred to the level of the A/D converter. 100% means full modulation of the A/D converter. As soon as the A/D converter has full modulation at a point, the value of the spectrum is set to 100% at this point.



Spectral correction relative

The sensitivity of the spectrometer is not constant over the wavelength. This is due to the diffraction characteristic of the diffraction grating, the spectral sensitivity of silicon and the sensitivity differences of the individual photodiodes. Furthermore, the spectral response of the light guide and the other input optics used enters here. This wavelength dependence is compensated by assigning a correction value to each photodiode. Each measured value is multiplied by a correction factor. Thus, the calculation of color coordinates, color rendering indices and color temperature becomes meaningful.



Spectral correction absolute

The spectrum is given in physical units, e.g. $\mu\text{W}/(\text{cm nm})$ from this further quantities are calculated, e.g. irradiances & illuminances. At saturation, the values jump to the largest value of the spectrum that is not yet in saturation.

Correction file

LWL.KOR

The correction file used is displayed in the window. It must always be the file that belongs to the input optics used.

Start	220	nm
Ende	230	nm
Faktor	1.00000E+	

Stray light correction

From the measured spectrum you can subtract the offset that was determined in a certain wavelength range. To do this, enter the cutoff wavelengths of the range in which you want to determine the stray light component in the window. The stray light correction may be activated only if you know from a radiator that it has no signal in a certain range. During the later measurement, the average value that results in this range is subtracted from the measurement.

After entering the wavelength range for the stray light correction, an offset correction factor can be specified. This factor is used to multiply the stray light offset before it is subtracted from the spectrum. The default value for the offset correction factor is 1.

Stray light arises from diffraction at the entrance slit, from grating defects, from the 0th diffraction order at the grating, as well as all diffraction orders except the 1st order incident on the array, and finally from reflections at the array, window, and filter in front of the array.



Calculator & Data Manipulation

With this function you can manipulate the spectra. The basic arithmetic operations are possible. It is also possible to manipulate with constants. Constants are entered in the left under two input windows in the "Mathematics" window. If the result is to be displayed as a new spectrum, the name is entered in the lower right input window.

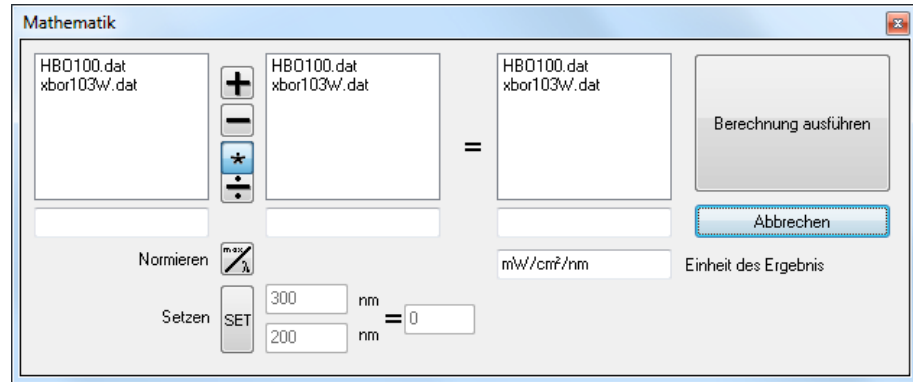


Figure: The math window for data manipulation

Please note that the spectra to be used must be displayed as marked in the figure. If they are only marked with a frame, the program does not recognize this selection. A corresponding message will be displayed.



Information about current spectrum

The instrument settings for the measurement appear in the information window. In addition, text lines for further information can be entered. The contents of this window are always output when printing.



Integral

Irradiance values can be calculated under "Settings -> Evaluations".



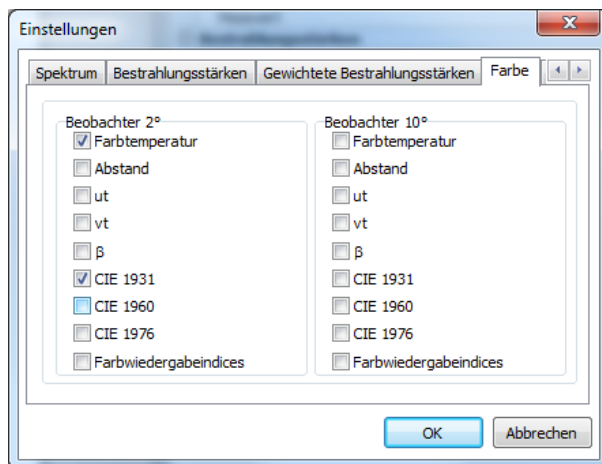
Weightings

irradiance values can be calculated under "Settings -> Evaluations". Weighted



Color coordinates

The values specified in "Settings -> Evaluations" tab Colors are calculated and output.



Window settings color

Cursor	
Wellenlänge	372,8 nm
Messwert	0,0065W/m ² /nm
Bestrahlungsstärken	
UV-A	0,256 W/m ²
UV-B	0,029 W/m ²
UV-C	-0,034 W/m ²
CIE 2°	
Farbtemperatur	3211 K
Meldung	
<input type="checkbox"/> CIE1931	[0,4230,0,3995,0,1775]
x	0,4230
y	0,3995
z	0,1775
<input type="checkbox"/> CIE1960	[0,2436,0,3450]
u	0,2436
v	0,3450



Viewer

The standard observer is set 2° or 10° according to the CIE.



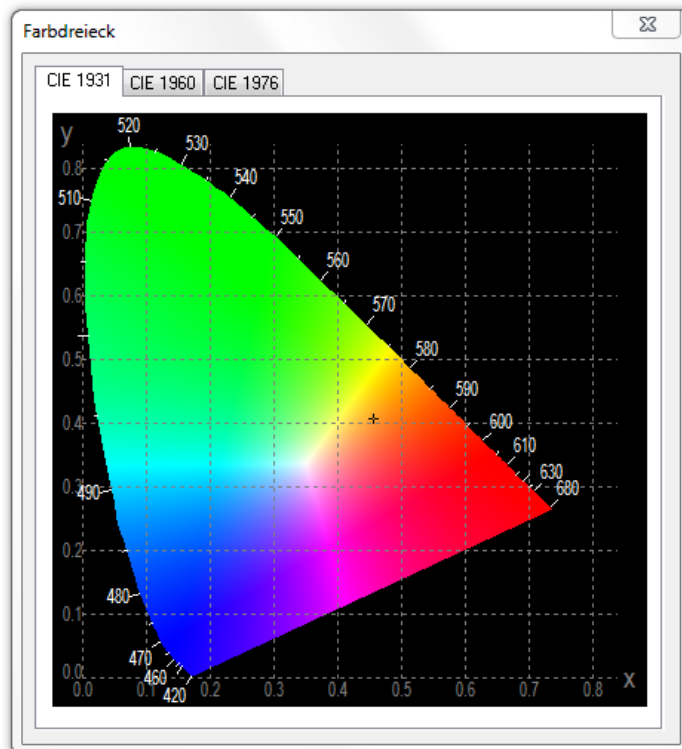
Color rendering indices

If the color measurement is switched on, the color rendering indices can be calculated and output. Only the color values specified in "Settings -> Evaluations" tab colors specified values are output.



Color triangle

If the color measurement is switched on, the position of the color location in the CIE 1931, CIE 1960 or CIE 1976 color triangle can be displayed in the corresponding color triangle.



11.5 File menu

Other settings are available via the menu that have not already been described as an icon. The menu is shown below:



It is possible to save and load an existing settings file. In a settings file (*.ssf), all settings such as integration time, averaging, dark measurement, integration ranges, etc. are saved. The use of settings files is especially useful if you have to perform different measurements again and again.

Switching the program language is possible between German and English. After the language change, all menu items are displayed in the new language and this is permanently saved.

11.6 Window menu

Other settings are available via the menu that have not already been described as an icon. The menu is shown below:



The menu items in detail:



If this function is checked, the graph will be adjusted each time it is redrawn to make maximum use of the spectral graph.



Zooms into the predefinable areas



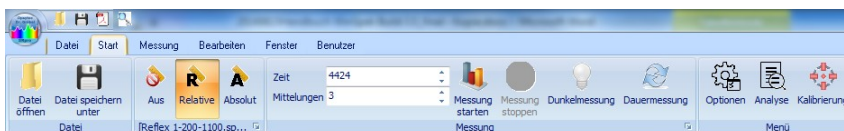
If this function is selected, the ordinate of the graph is scaled logarithmically.




Displays the CIE color triangles

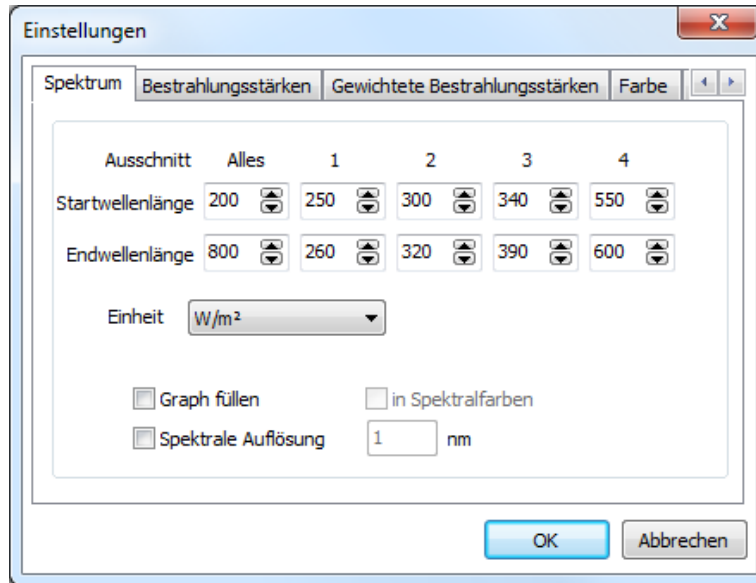
11.7 Analysis menu

Other settings are available via the menu that have not already been described as an icon. The menu is shown below:



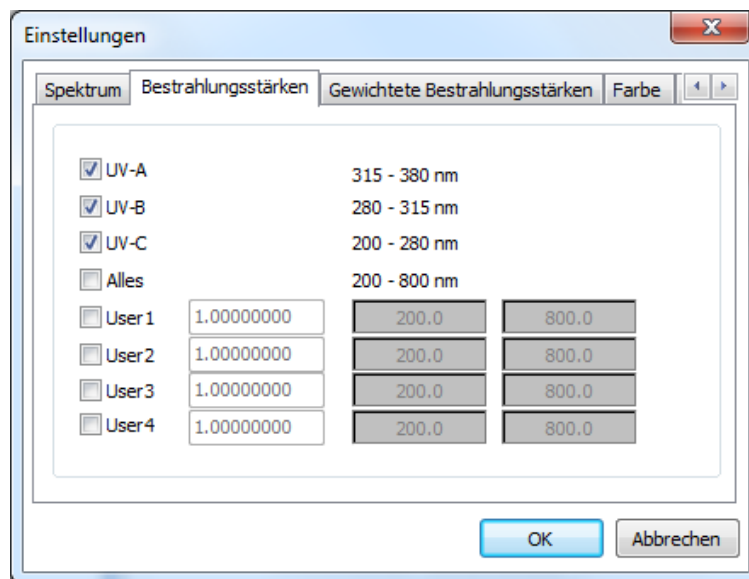
The "Analysis" item opens an options window. In this  the evaluation of the spectra can be made.

The start and end wavelengths of the display are defined under the **"Spectrum" tab**. The unit to be displayed can be selected here and will be converted automatically. "Fill Graph" fills the area under the spectrum in the output.

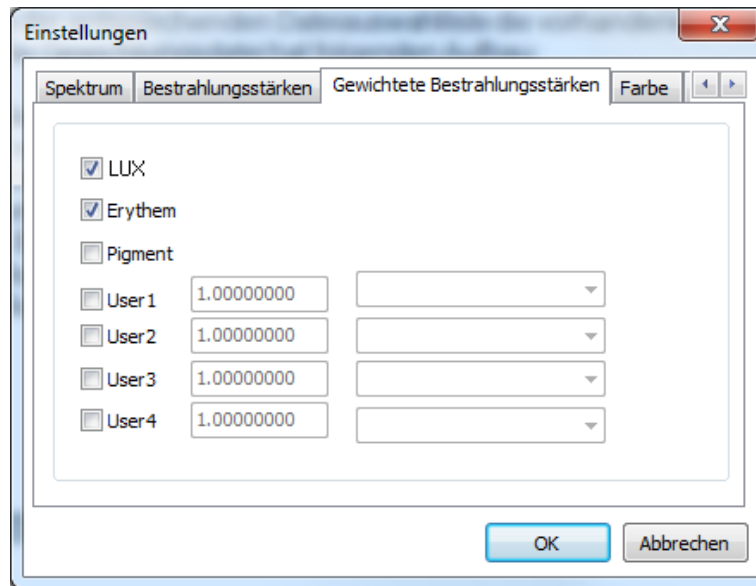


In the **"Irradiances" tab**, you can switch the calculation of the standard integrals on or off. Also a calibration of the integral is possible.

Furthermore, 4 user integrals are available. As soon as you switch on a user integral, the calibration factor and the start and end wavelength of the integral are enabled.



In the **"Weighted irradiances" tab**, the LUX (V(Lambda), erythema weighting and pigment weighting are provided by default.



User weighting files can be selected for User1 to User4. These files must exist in the WEIGHTS directory and have the file extension GEW. If a user weighting is switched on, the existing weightings are displayed in the corresponding file selection list. The weighting file has the following structure:

The weighting files are ASCII files that represent the weights in real format followed by a [CR] character. The weights start at

200nm and end at 800nm. The step size between the individual values is 0.6nm. e.g.

[Real value] [CR] 6.0754321E-002

[Real value] [CR] 5.3765211E-002

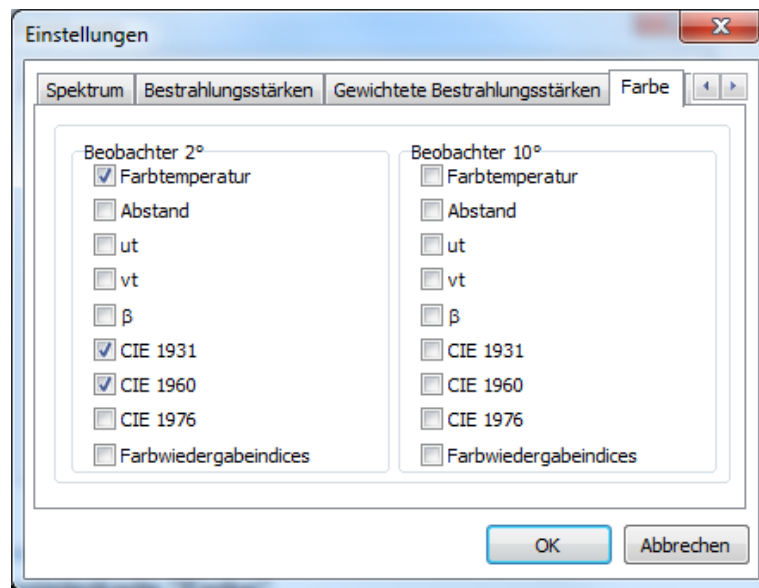
..

..

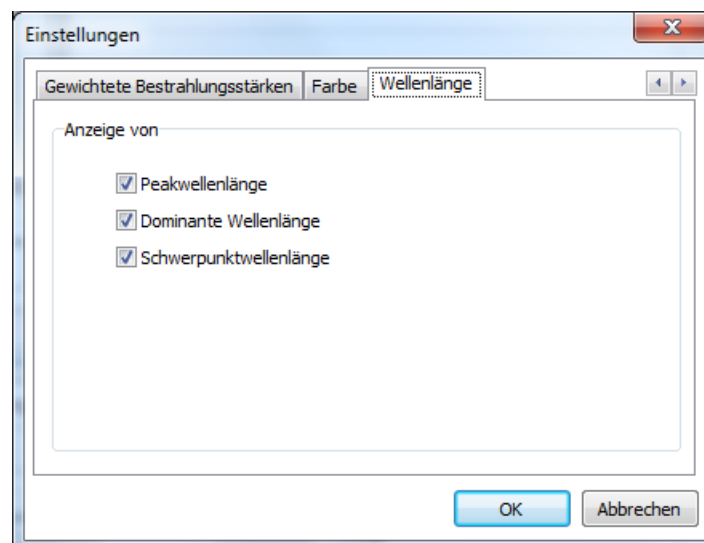
[Real value] [CR] 1.5987988E+001

The file names ERYTHEM.GEW , LUX.GEW and PIGMENT.GEW are standard weightings For the user functions any designations (e.g. USER1.GEW - USER4.GEW) are available.

The **"Color" tab** allows to show/hide color relevant calculation data (color coordinates, color temperature, distance from the Planck train for the 2 degree and the 10 degree observer respectively).

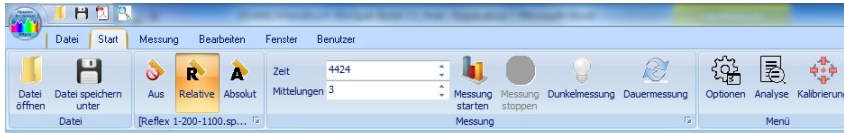


In the **"Wavelength" tab**, you can display the peak wavelength, the dominant wavelength and the centroid wavelength.



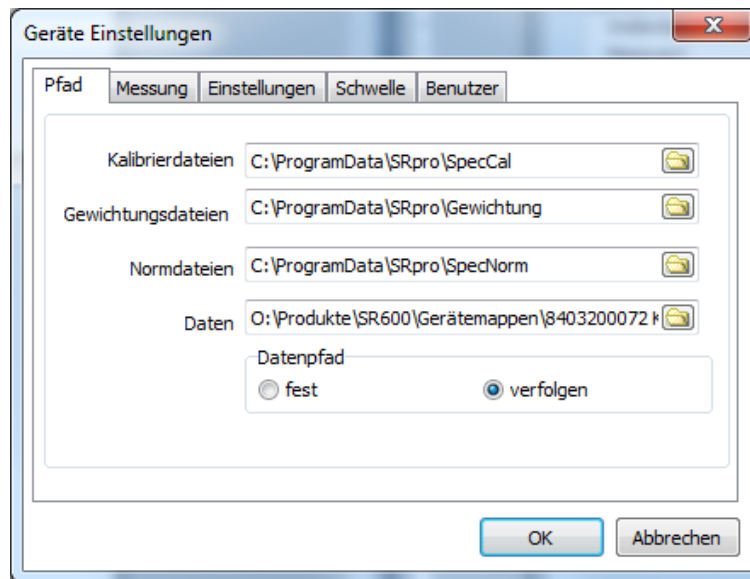
11.8 Options menu

Other settings are available via the menu that have not already been described as an icon. The menu is shown below:

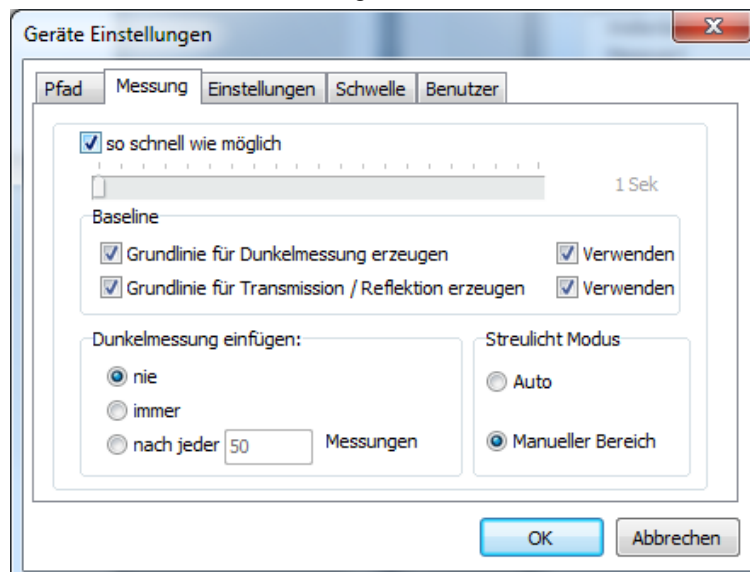


After clicking on "Options" a window is opened which contains further tabs. These tabs can be used to define device settings.

The **"Path" tab** can define the directories to the files used. These directories are created and entered during the installation. However, if you have different directories, the change is possible here.



The **"Measurement" tab** allows to change the pause between two measurements in case of continuous measurement. If the check mark is removed, you can change the pause between two measurements between 1 and 300 seconds using the slider.



In addition, the baseline (for 100%) and the dark measurement can be saved for transmission and reflection measurement so that the same settings do not have to be measured again. To do this, select "Create baseline ..." and "Use" respectively

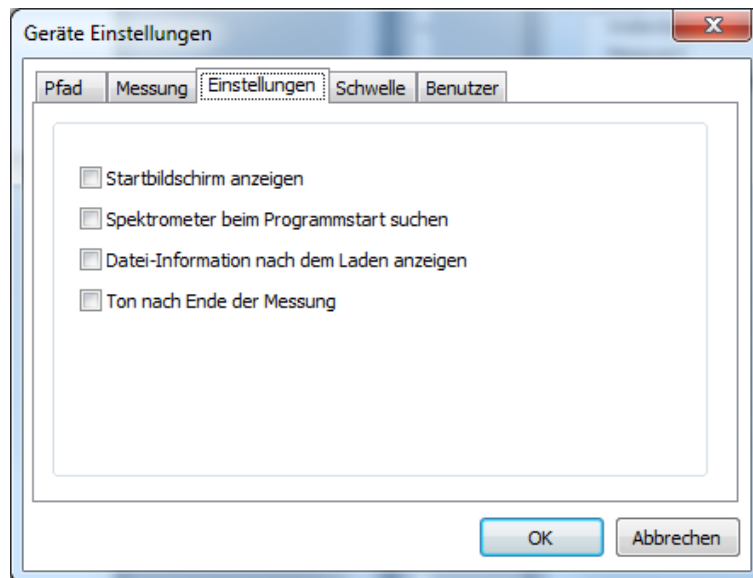
The stray light correction is selected via "Manual Range" or Auto. In the manual range, an offset determined in a certain wavelength range can be subtracted from the measured spectrum. To do this, enter the cutoff wavelengths of the range in which you want to determine the stray light component in the menu. The stray light correction may only be activated if you know from a radiator that it has no signal in a certain range. During the later measurement, the average value that results in this range is subtracted from the measurement.

After entering the wavelength range for the stray light correction, an offset correction factor can be specified. The stray light offset is multiplied by this factor before it is subtracted from the spectrum. The default value for the offset correction factor is 1.

Stray light arises from diffraction at the entrance slit, from grating defects, from the 0th diffraction order at the grating, as well as all diffraction orders except the 1st order incident on the array, and finally from reflections at the array, window, and filter in front of the array.

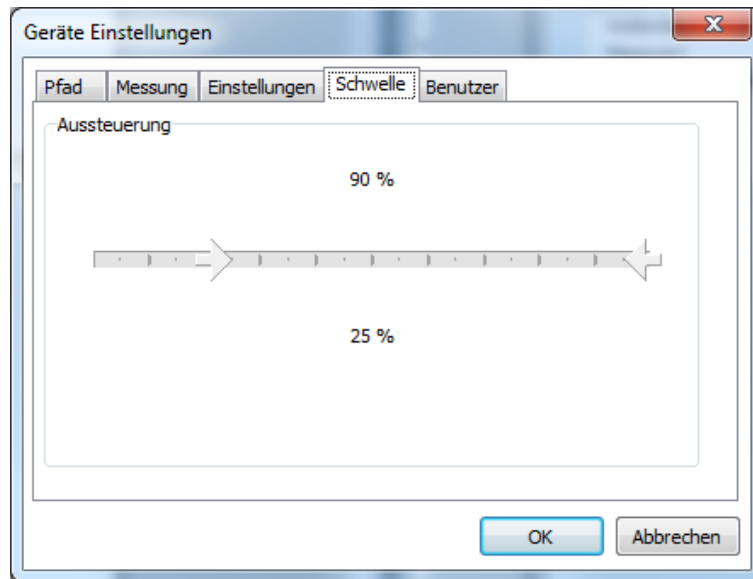
The "Auto" option corrects the stray light by evaluating and subtracting the first pixel.

General settings can be made in the **"Settings" tab**. For example, the start screen can be hidden or the search for the spectrometer at program start can be prevented. Also the possibility to output a sound after the end of a measurement can be switched on here.



In the "Threshold" tab, how to define the range of a valid measurement based on the level. If the level of the measurement is within the thresholds, the measurement is evaluated as OK in the PDF protocol for (standard) users. Note: For power users there is no evaluation.

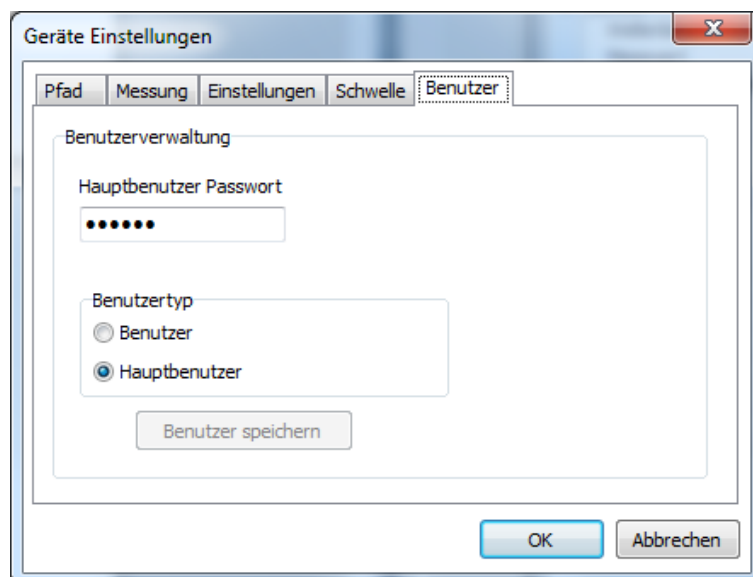
Recommended settings: 30% to 90%



In the **"Users" tab**, it is possible to switch between the restricted (default) user and the main user once or permanently.

Enter the password for the main user and confirm with "Save user" to activate the main user permanently, i.e. at every system start.

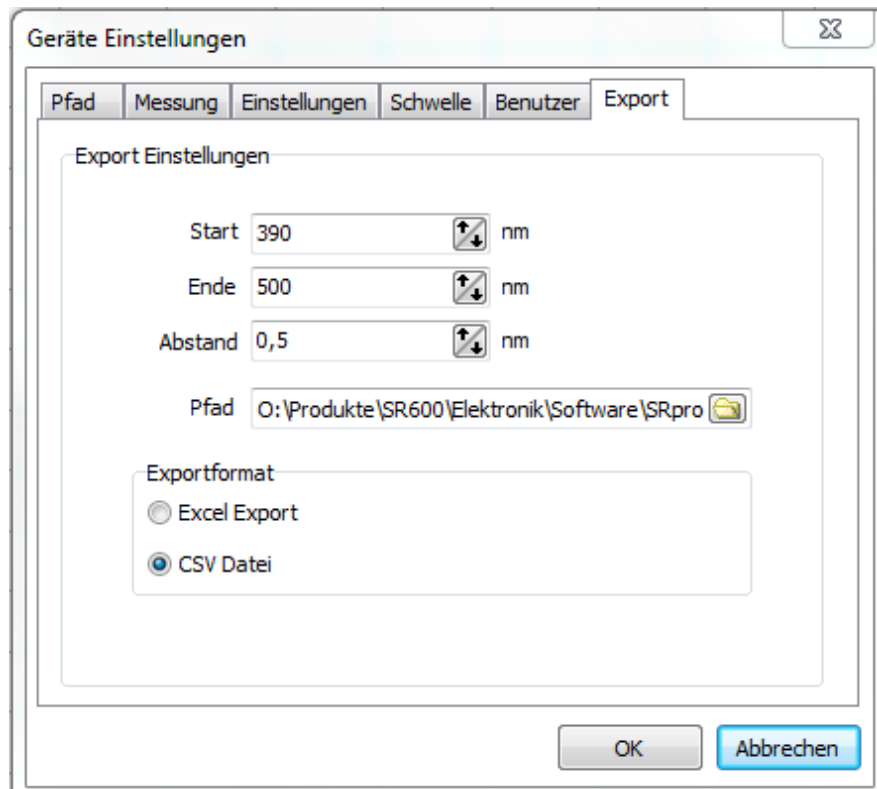
Note: The default setting is restricted user. For one-time setting changes, it is sufficient to enter the password. In this case, do not click on "Save user".



In the **"Export" tab**, the export function can be parameterized. Available are:

- The wavelength range
- The interpolation distance (interpolation points)
- The path
- File format.

Note: Microsoft EXCEL 2010 must be installed for EXCEL export.



11.9 Edit menu

Under the item "Edit" the spectral graph can be copied to the clipboard or saved as a bitmap file. Using these functions, it is possible to transfer the spectral display to a word processing program for documentation purposes. With the function "Copy data to clipboard" the measurement data are comfortably available for a spreadsheet.



11.10 Calibration menu*

With the delivery of the spectrometer you will receive the calibration file as well as a calibration certificate. This calibration data must be transferred to the software in order to obtain an exact measurement.

It is nevertheless possible to calibrate the spectrometer itself to absolute irradiances via the "Calibration" menu item. A relative display of the spectra is still possible despite absolute calibration. The setting of the desired correction type is done via the toolbars. The spectrometer is calibrated at delivery. To increase the accuracy of the measurement result, the program has the possibility to perform its own calibration. For this purpose, a standard lamp or two standard lamps with spectral characteristics guaranteed by the manufacturer are required. The calibration is performed by default in the range of

360-800nm with a halogen lamp and in the range of 200-360 nm with a deuterium lamp. If only one measuring range is required, a partial calibration can also be performed. In this case, the calibration of the other range remains active. The link point at which the two partial calibrations are joined can be shifted from 360 nm to any position in the spectral range. The calibration procedure for a range is described below.



After calling up the menu item "Calibration", a security query is first carried out.

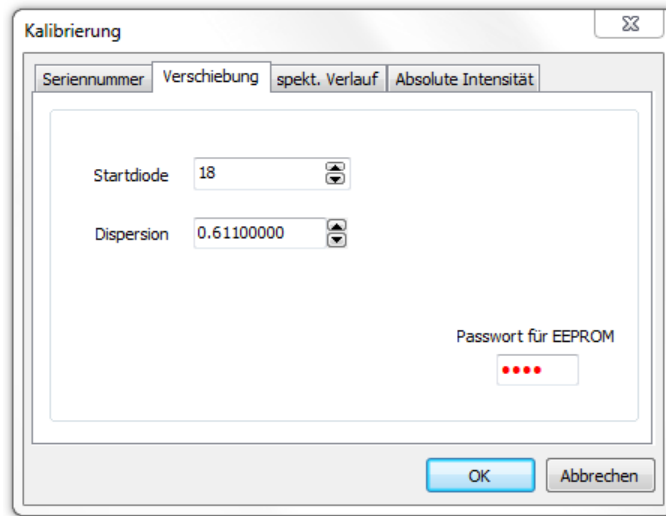
This safety query is performed because an accidental change of the calibration values is not reversible when the subsequent window is closed with "Next". A calibration measurement cannot be reversed under any circumstances.



If an existing calibration file is overwritten by the calibration measurement, this is not reversible.

If you do not have the equipment (measured calibration lamp, deuterium lamp, ...) for the calibration, please cancel the confirmation prompt with the "Cancel" key.

After the security prompt, you are in the "Serial number" tab. Enter the serial number of your device here. You will find the serial number on the back of the device. As soon as you have entered the serial number, a check is made in the parameter files to see whether your device has already been registered. If this is not the case, a corresponding message will be displayed and you can register your device again. If your device is already in the list, the settings for your device are loaded.



Now switch to the "Shift" tab.

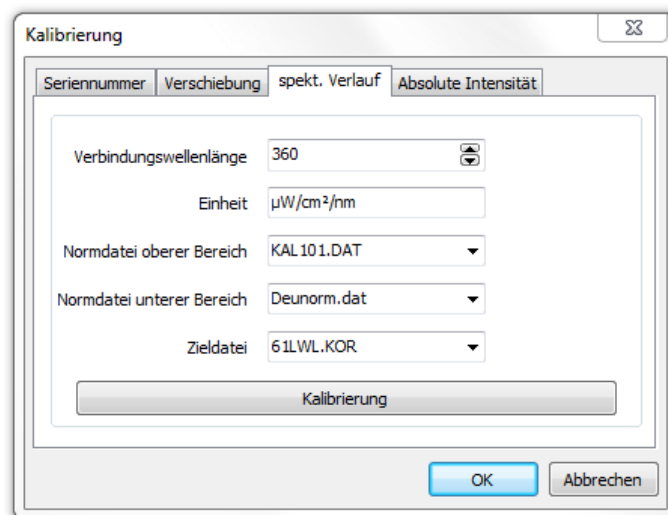
In the "Displacement" tab you have two setting options:

- Start diode:
By changing the start diode number, the position of the spectrum is changed. A fine calibration of the wavelength assignment is possible via this value.
- Dispersion:
Dispersion sets the spread of the spectrum. This value also influences the wavelength assignment.

Only change both values with the greatest care. Make a note of the set values before changing them. After making changes, always take measurements again and evaluate the result. Please note that the window is not displayed modally. I.e. you can use the "Start measurement" icon of the main window at any time without closing the window.

The mercury lines at 253.6 nm, 577.0 nm and 579.0 nm are well suited for setting the start diode number and dispersion. With a successive change of start diode number and dispersion, very good values can be achieved.

When you are satisfied with the wavelength assignment, please switch to the "Spectral Response" tab. Course" tab.



In the register "spec. Course" the spectral sensitivity of the receiver is corrected. The calibration lamps are required for this. The register has the following setting options:

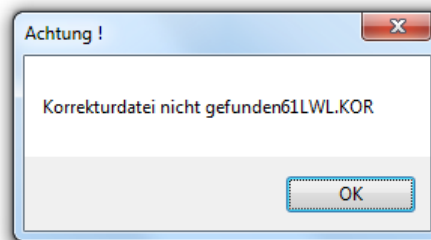
- Connection wavelength:
The linking point of the two partial calibrations can be set here.

- Unit:
Here the unit can be changed. This function allows, for example, to change the calibration to Anglo-Saxon units of measurement.
- Norm file for the upper area:
File name of the standard file for the range from the link wavelength to 800nm. The structure and generation of the standard file is explained in chapter 11.11.
- Norm file for the lower area:
File name of the standard file for the range from 200nm to the link wavelength. The structure and generation of the standard file is described in chapter 11.11 explained.

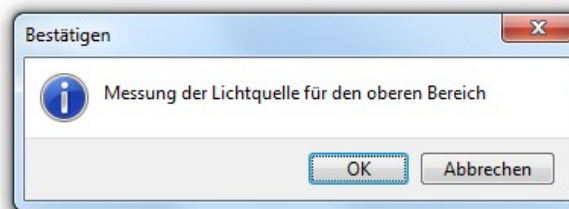
Target file:

The file name for the calibration file to be created can be specified here. Please check if the file already exists. If necessary, use date coding in the file name to avoid accidentally overwriting an existing calibration file.

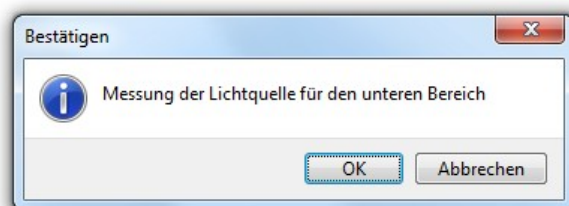
The actual calibration measurement is started with the "Calibration" button. The parameters of the measurement are taken over from the main window. First, it is checked whether the target file already exists. If it is available, it will be loaded. This serves for the fact that with partial calibrations automatically the other partial range is taken over. If the target file is not available, the following message is displayed.



The target file is then recreated and all values are set to zero. The query for the upper spectral range then takes place. If the calibration measurement for the upper spectral range is to be skipped, this can be done by pressing the "Cancel" key.

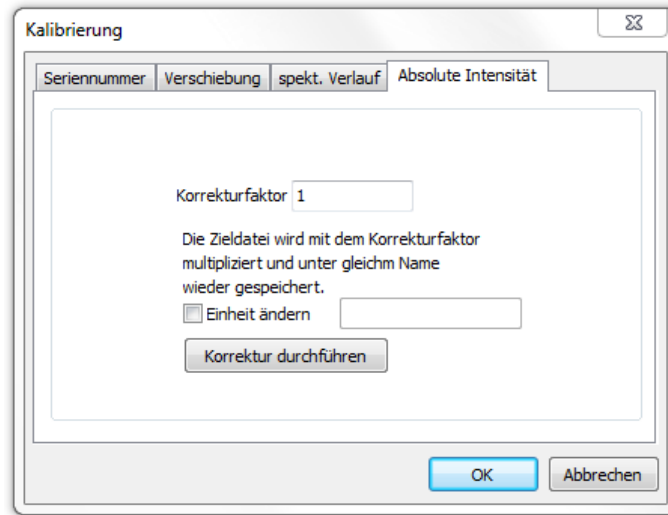


After confirming with "OK", the correction measurement for the upper spectral range is performed. The calibration file is then calculated from the raw data in such a way that the raw data multiplied by the calibration file results in the standard file for the upper spectral range. Values in the calibration file that are below the link wavelength are not changed by this process.



Subsequently, the measurement for the lower spectral range takes place. After the measurement, the values are adjusted so that the correct measured value is present at the connection wavelength.

After calibration has been completed, switch to the "Absolute Intensity" tab.



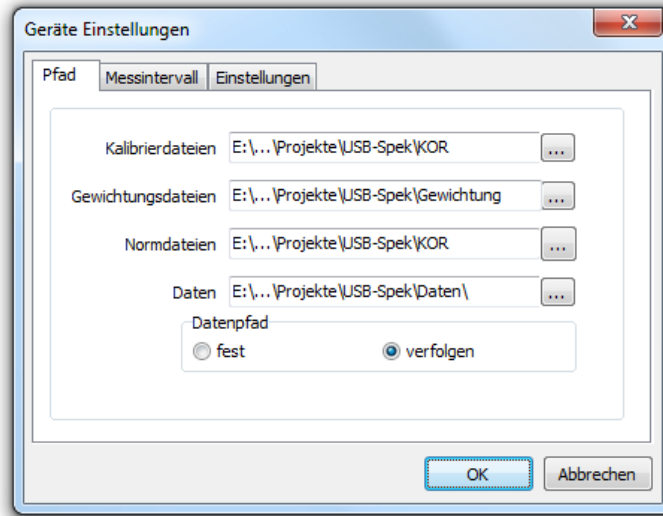
In the "Absolute Intensity" tab, you can correct the absolute intensity. This may be necessary if you have been given the absolute intensities and the irradiance at a certain distance for your calibration lamp but have not carried out the calibration at this distance. Then you can e.g. determine the irradiance ratio between target and actual irradiance at the nominal position and calculate it into the correction file with the button "Perform correction". The target file from the "Spectral course" tab is used as the correction file. Course" tab is used as the correction file.

10.8 Handling and saving the calibration files

To complete the transfer of the calibration files, the calibration files must be transferred.

With the delivery you will also receive the calibration files. These calibration files (*.SpecCal) must be copied into the corresponding directory (default: C:\ProgramData\SR900 \SpecCal). Use the Windows Explorer for this purpose.

If this path does not exist on your computer, you can change it in the menu item "Settings - > Device options" tab sheet "Directories" look up the path for the calibration files.



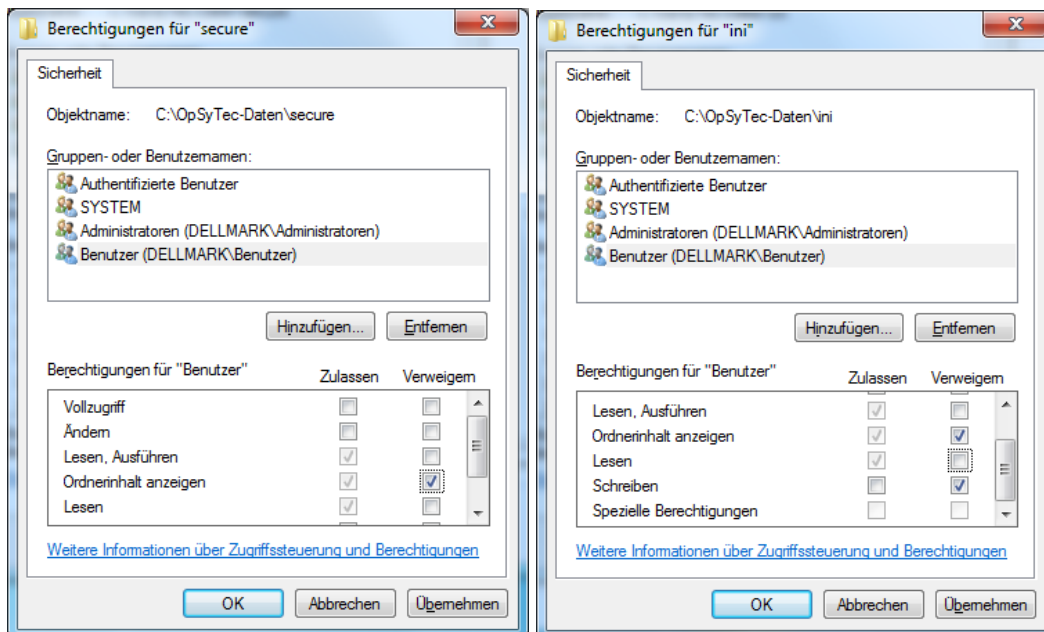
Please copy the calibration files, then into the appropriate directory.



If protection against accidental manipulation or handling of user rights is desired, change the Windows security settings to **"Deny folder contents"**, as shown below as an example:



If protection against accidental manipulation or handling of user rights is desired, change the Windows security settings to **"Deny writing"**, as shown below as an example:



11.11 Standard files

With the optional program NormFile ASCII files are converted by linear interpolation into a standard file for the calibration measurement. The step size as well as the start and end values of the source data are arbitrary. The source ASCII file must have the following format:

```
E.g.
[step size in nm]           [CR]5
[initial wavelength in nm]  [CR]300
[End wavelength in nm]     [CR]900
[Realwert]                  [CR]4.95029144673026E+0001
[Realwert]                  [CR]5.10178270335309E+0001
..
..
[Realwert]                  [CR]5.10178270335309E+0001
```

Press the Open button to load a corresponding source file. The step size, the start wavelength and the end wavelength will be displayed in the left fields.

Now you can change the step size and the wavelength range for the target data in the right input fields. These depend on the type of instrument used. For the standard spectrometer, these are already predefined.

Now press the "Save" button. The program then performs the interpolation and sets target values that could not be interpolated to 0. This is the case if the wavelength range of the source file does not cover the complete wavelength range of the target file. After the interpolation, the file name can be entered in a selection window. Here it is to be paid attention to the fact that the program SPEKTROMETER.EXE can process only files of the type .DAT. Therefore you should always enter the type .DAT at this point. The standard files must be located in the subdirectory KOR.

ATTENTION! An already existing file will be overwritten without confirmation. Therefore, backup copies should be created.

The destination file has the following format.

e.g. Halnorm.dat

```
[Number of spectra(always 1)] [CR]1
[Realwert]                    [CR]4.95029144673026E+0001
[Realwert]                    [CR]5.10178270335309E+0001
..
..
[Realwert]                    [CR]5.10178270335309E+0001
```

1 Technical data

General data	
Ambient temperature	+5 to 40 °C
Storage temperature, approx.	-10 to +50 °C
Humidity	0% to 80% rel. humidity
Cooling	Air cooling

Mounting position, minimum distances	
Body position	horizontal
Minimum distances, top	2 cm
Minimum distances, lateral	2 cm

Spectral ranges	
Classification of spectral ranges	According to CIE
UV-C	200 - 280 nm
UV-B	280 - 315 nm
UV-A	315 - 400 nm
VIS	380 - 780 nm

Control port and optical parameters	
See data sheet spectrometer / on request	

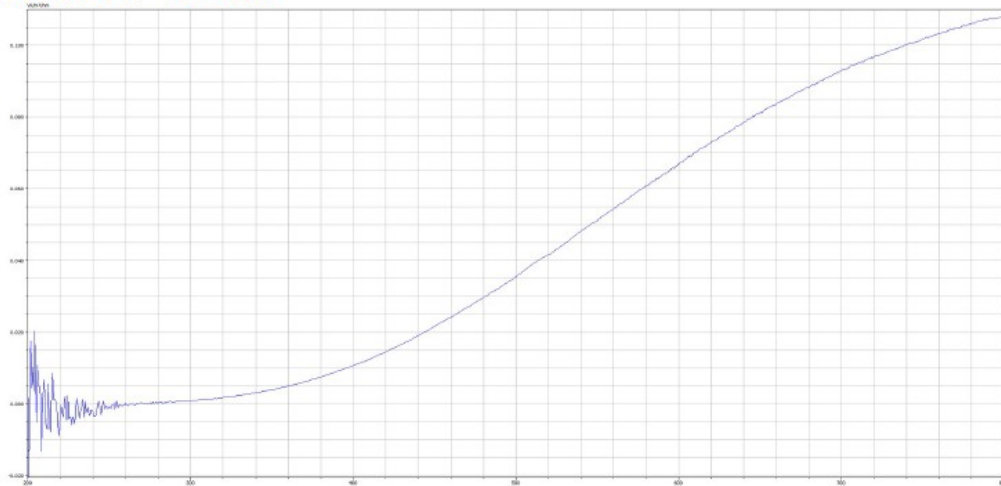
Light guide	
Fiber optic cable connection	SMA-905
Bending radius	> 200 mm

12 Appendix PDF protocol

Opsytec Dr. Gröbel GmbH



Ausgang mit FEL 860300101 nach Faktor 0.1.spec
24.10.2017 16:38:57



Irradiances

UV-A: 0,256 W/m²
 UV-B: 0,029 W/m²
 UV-C: -0,034 W/m²
 All:

Actinic irradiances

Lux: 0,000 Lux
 Erythema:

Wavelength

Peak wavelength: 800,00 nm Dominant wavelength: 581,90 nm
 Spectral centroid: 668,24 nm

Colour coordinates 2°

x: 0,4230 y: 0,3995 z: 0,1775 Color temperature: 3211

Comment:	
<input type="checkbox"/> Ok	<input type="checkbox"/> not OK
Main user	
Editor	Signature
Date / Time	

2 Spare parts, calibration and maintenance



Contact for replacement orders, recalibrations and maintenance needs:

Opsytec Dr. Gröbel GmbH

Am Hardtwald 6-8

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Germany

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Visit us on the Internet: www.opsytec.de

3 Declaration of conformity

We hereby declare,

**Opsytec Dr. Gröbel GmbH
Am Hardtwald 6-8
76275 Ettlingen**

that we have the following
product

**Spectrometer SR900 with software
SRpro**

Type designation:

SR900 and SRpro

have developed, designed and manufactured under their sole responsibility and that the product conforms to the following standard(s) or guideline(s) in this declaration:

2014/35/EU

"Directive of the European Parliament and of the Council on the harmonization of the laws of Member States relating to the making available on the market of electrical equipment designed for use within certain voltage limits (Low Voltage Directive)".

2006/42/EC

"Directive of the European Parliament and of the Council on machinery and amending Directive 95/16/EC (Machinery Directive)".

Ettlingen, 19.05.2017

Dr. Mark Paravia
Management