# Operating Instructions

# *JETI LiVal*

## Software Version: 7.x

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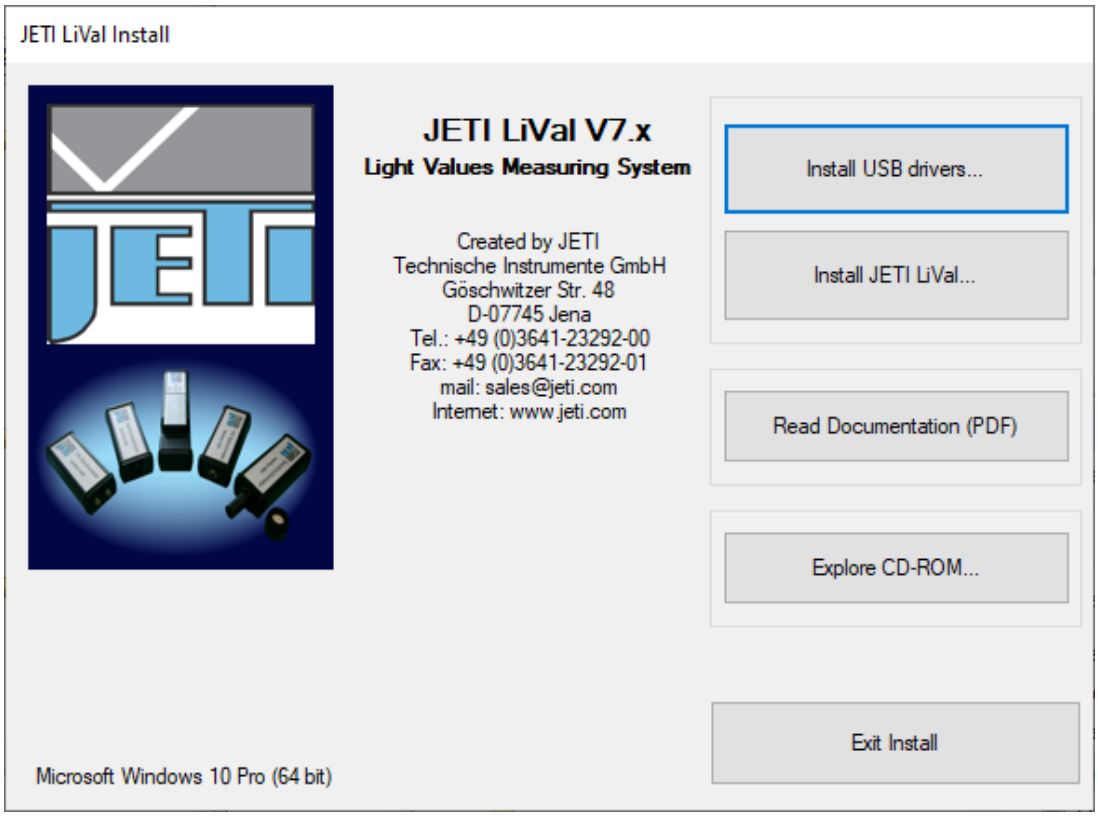
# 1 PC-Software – Installation under Windows

| **Note:** | You must have administrator privileges to install the device driver! |
|---|---|

Execute the following steps on the PC to install the software *JETI LiVal*:

- Start Windows 8.1/ 10.
- Insert the USB flash drive in an open USB slot on your computer.
- Run ‘install.exe’ from the ‘Install’ folder of the USB flash drive. The following window appears:




- Click on Install *JETI LiVal*... and follow the instructions to install the program.

# 2 Start the Software

- Start Windows and then activate the Start menu.
- Connect the *JETI* device via USB or Bluetooth to the computer.
- Select *JETI LiVal* under All Programs.

The software will automatically search for all *JETI* devices connected to the PC. If more than one unit is found, a selection list will appear.

By default, the next time the software is started, it will try to establish a connection with the last used device to save time for searching through all ports and interfaces.

There are some command line arguments that can be used to change this default behavior. This will cause a use of fixed ports and interfaces:

**COM number** (e.g. 'COM 64') – connection through a given COM-port

**FTDI address** (e.g. 'FTDI A6015FTH') – USB-connection via FTDI driver

**BT address** (e.g. 'BT 0x0013430FCFEB') – connection via Bluetooth

**TCPIP address** (e.g. 'TCPIP 192.163.115.163') – connection via TCP/IP (for LAN-devices)

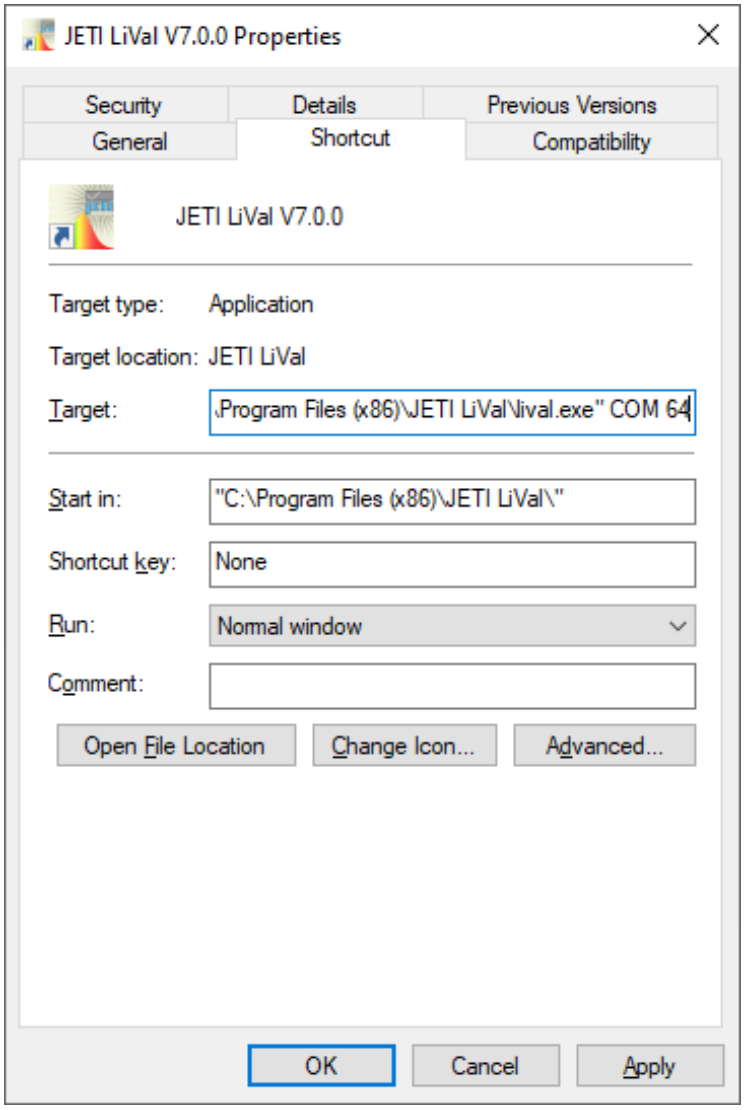
Other arguments:

**SEARCH** – force searching of devices. May be useful if more than one device is connected. In this case, *JETI LiVal*'s attempt to open the last connected device is omitted.

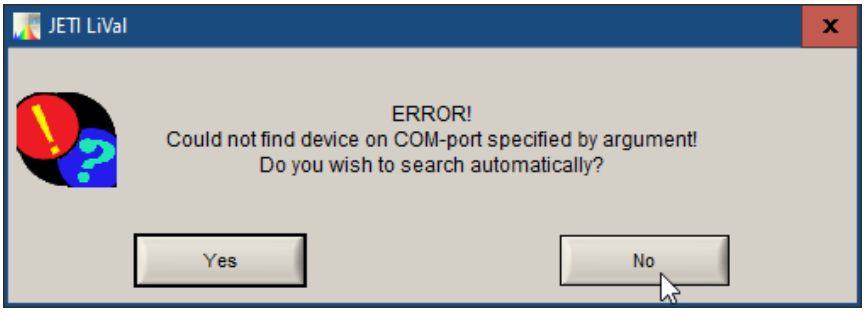
**OFFLINE** – start *JETI LiVal* in offline mode.

To insert command line arguments, edit the program's shortcut as follows: right-click the '*JETI LiVal*' icon on the desktop and select Properties. The following dialog appears:



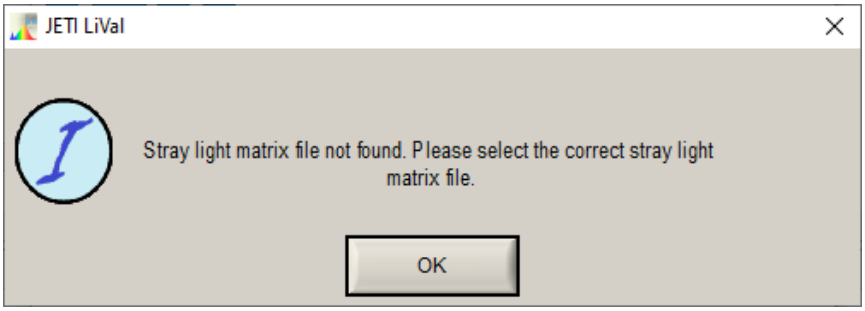

Type in the arguments *after* the last quotation mark in the 'Target' box ('COM 64' in this example). Use a space sign between the quotation mark and the arguments.
If no device can be found on the specified port, the software will ask to perform an automatic scan as shown below:



## 2.1 Stray light correction

If a connection is being opened to a device that has been calibrated with stray light correction, an attempt is made to automatically load the appropriate stray light matrix. When using such a device with *JETI LiVal* for the first time, an Internet connection is required. If no Internet connection is available or no suitable stray light matrix was found, the following message appears:

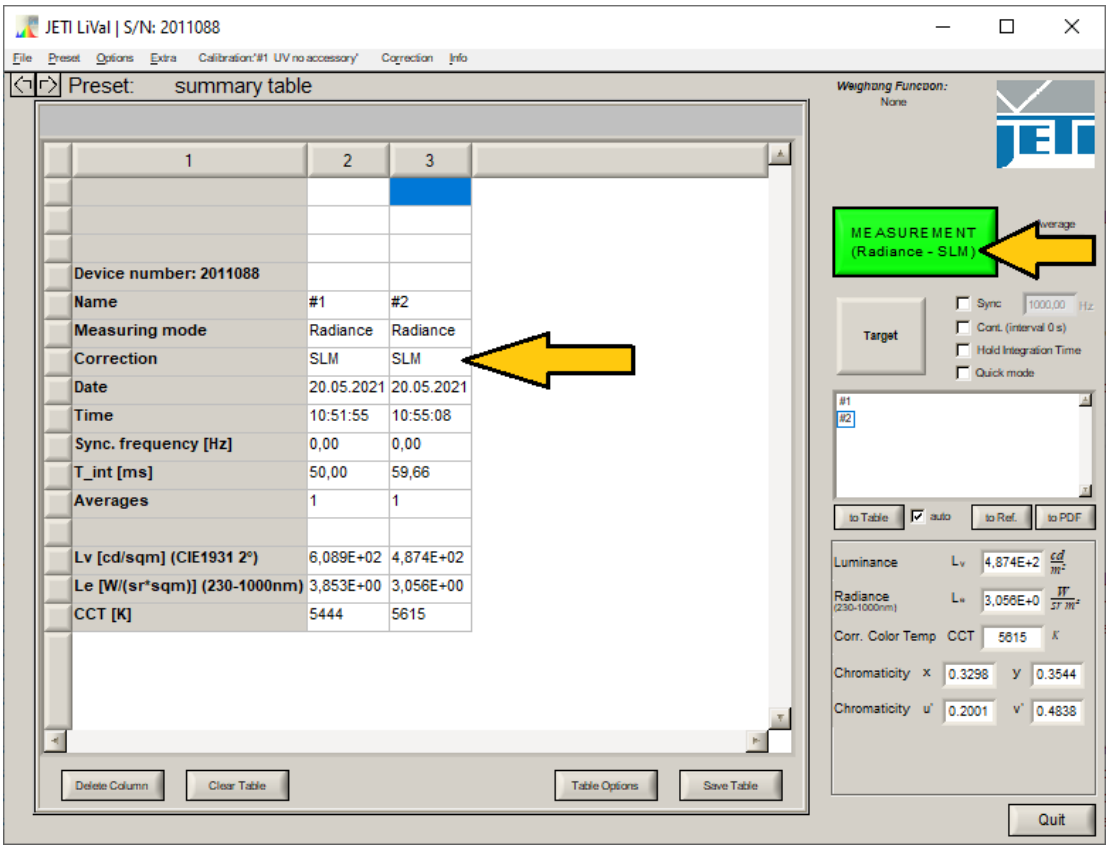



After that, a file selection dialog appears where a correct stray light file can be selected manually. If no file is selected, LiVal will start in offline mode without connecting to the device. If the selected file was not a stray light matrix or the wrong one, the upper message will appear again followed by file selection dialog.

A stray light matrix file can also be included manually. To do this, create the subdirectory `C:` ▸ `ProgramData` ▸ `JETI` ▸ `SLM` if it does not already exist and copy the file [serial-number].slm into this directory. The next time *JETI LiVal* is restarted, the matrix is then loaded automatically.

If you do not have a suitable stray light matrix available, please contact your supplier.

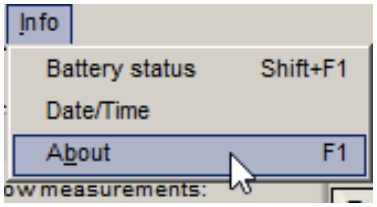
The extension ‘SLM’ on the Measurement button and in the table view under ‘Correction’ indicates that the stray light correction is used.



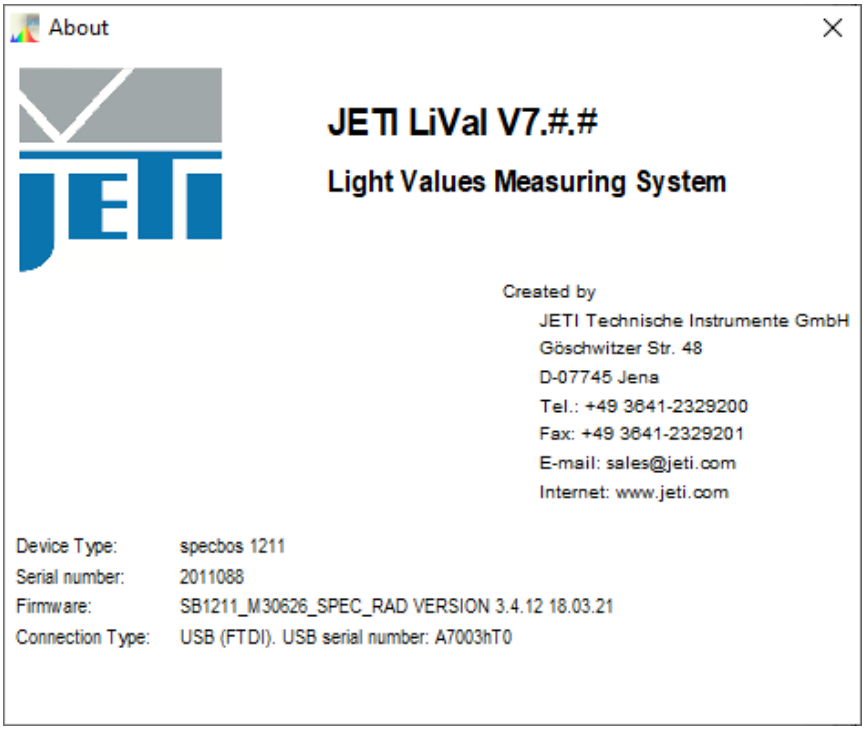

| | 1 | 2 | 3 |
|---|---|---|---|
| | Device number: 2011088 | | |
| | Name | #1 | #2 |
| | Measuring mode | Radiance | Radiance |
| | Correction | SLM | SLM |
| | Date | 20.05.2021 | 20.05.2021 |
| | Time | 10:51:55 | 10:55:08 |
| | Sync. frequency [Hz] | 0,00 | 0,00 |
| | T_int [ms] | 50,00 | 59,66 |
| | Averages | 1 | 1 |
| | Lv [cd/sqm] (CIE1931 2°) | 6,089E+02 | 4,874E+02 |
| | Le [W/(sr*sqm)] (230-1000nm) | 3,853E+00 | 3,056E+00 |
| | CCT [K] | 5444 | 5615 |

## 2.2 About

Info/About will open an information window, which shows the software version, serial number, connection type, baudrate and the firmware version.



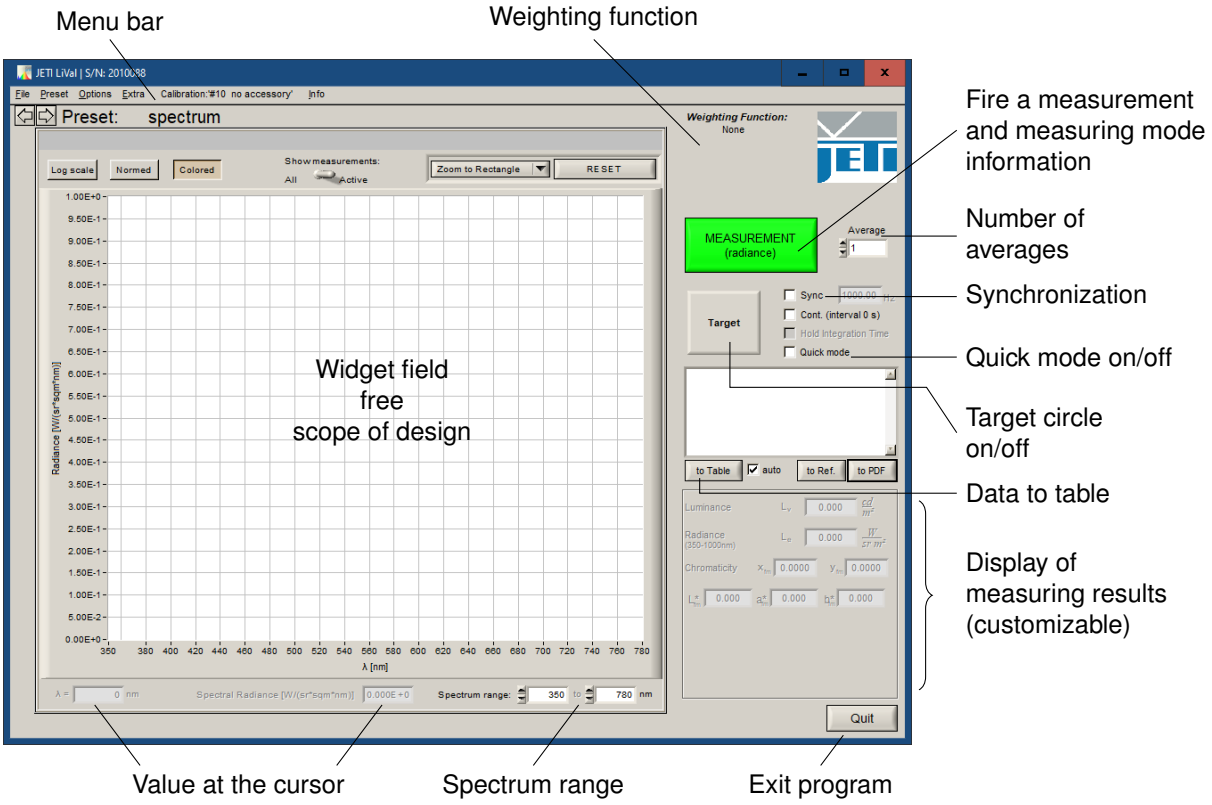

 




Press x to close the window.

# 3 Quick Start

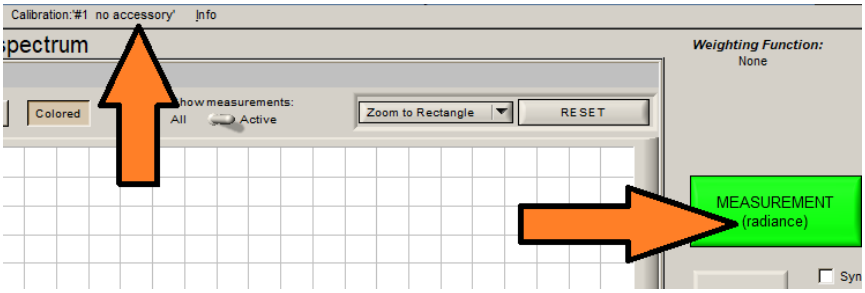
- Connect the *JETI* spectroradiometer to a PC or Laptop.
- Start *JETI LiVal* under Programs in the Start menu (software and driver installation is described in the operation manual).




## 3.1 Measuring Mode Luminance/ Radiance

| | |
|---|---|
| **Attention:** | Do not look into the laser beam or aim the laser at another person! Do not look into the beam with optical devices like telescopes or collimator lenses! |

- If *JETI LiVal* was started with no accessory attached to the device, the software will be in Radiance mode.

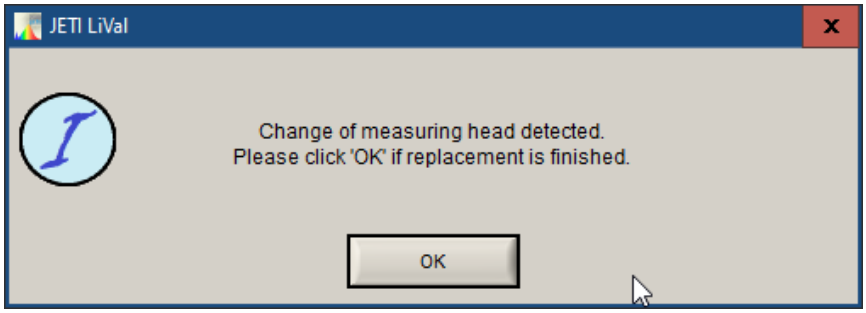


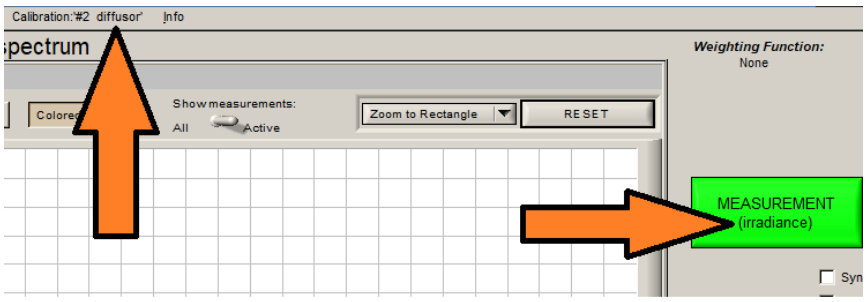

- Click the Target button and adjust the instrument viewing to the desired position.
- Click one Measurement button to start the measurement.
- Maximum measuring time = 120 s.
- Press Esc to interrupt a running measurement in case of problems.
- Spectrum and measuring values will be shown.
- If you need other measuring values, use the option Customize from the pop-up menu (right mouse key) in the measuring results field and/ or Preset > Custom1-3 (F10).
- Proceed further measurements by clicking on the Measurement button again.
- Scroll between different measurements in the legend by clicking on their names.
- Measuring data transferred into the table view can be stored in '.csv' or '.xls' file formats.
- Use the Save Table button in the table view, select the file name, format and storage location of the file and press OK.

## 3.2 Change Measuring Mode to Illuminance/ Irradiance

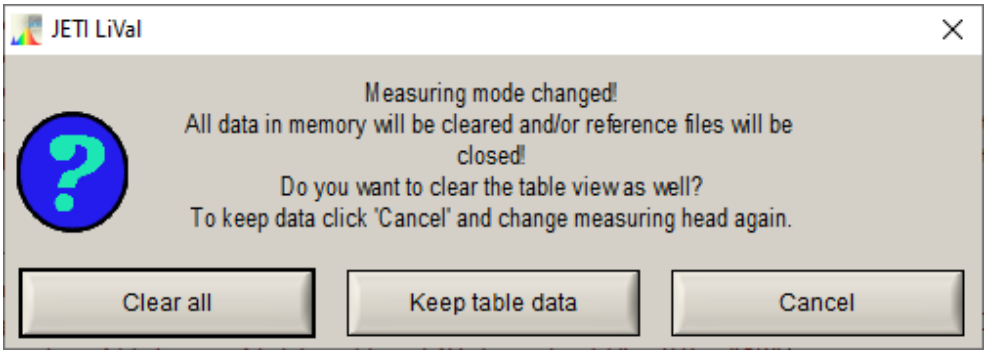
- Attach the diffuser cap to the device.

- The measuring mode will be switched to Irradiance automatically and the units of photometric and radiometric data will be changed accordingly.



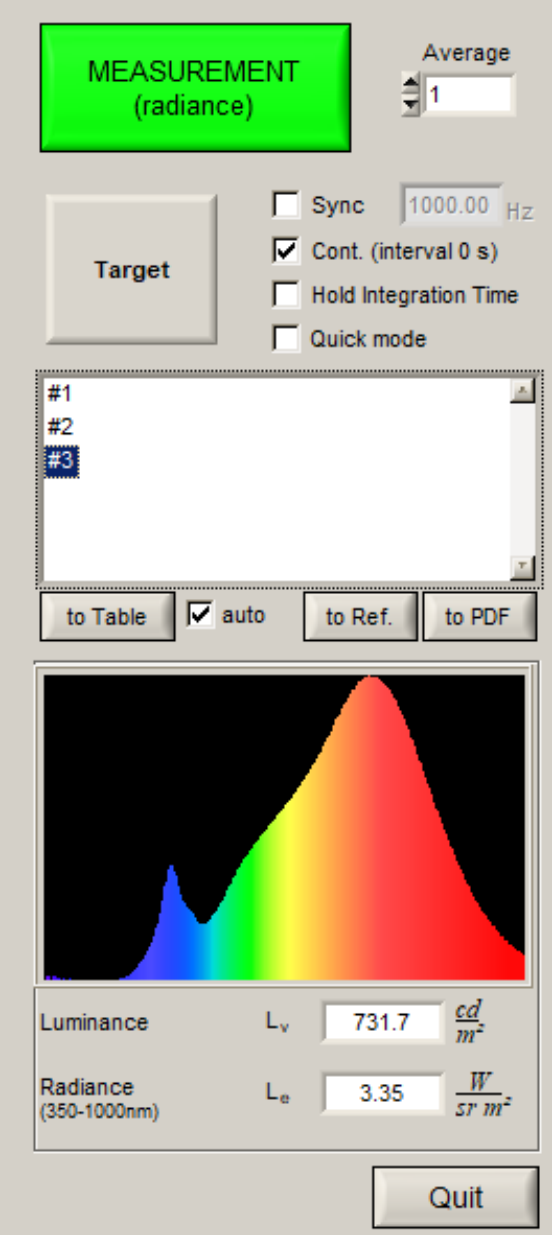

- If there are remaining measurements in Radiance mode, the following message will appear:




- Store the measurements if needed and switch to Illuminance mode again.
- Use the program like before (except for the target marker).

# 4 Measurement

## 4.1 Measuring Procedure




The measurement procedure consists of a first spectra acquisition using 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 spectrum measurement. In some cases, more adaptation steps are necessary. You will be informed about the status of the measurement on the edge of the screen below the diagram: ‘Adaption to exposure’ or ‘Performing measurement’.

The maximum integration time is 60 s, therefore, the maximum measuring time for low intensity sources is approximately 130 s (adaption time + max. integration time + max. dark measuring time).

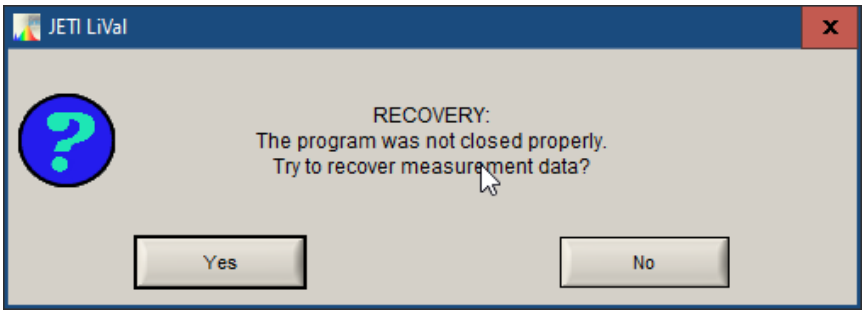
The measured spectrum as well as the radiometric, photometric and colorimetric data, calculated from the spectrum, are displayed. Furthermore, the number of the measurement is shown in the legend.

The following measurements are shown together with their derived values. Clicking on the spectrum line displays the data of former measurements. A thick line always indicates the actual spectrum.

The measuring button will be colored red during the measurement and can be used to abort the procedure.


Pressing the Esc key interrupts a running measurement too. The measured data will be stored in temporary files during the measuring session. If an error occurs and *JETI LiVal*

cannot be closed properly, it will try to recover data from temporary files after the next program start. To recover, the user must click Yes, when the following dialog appears:



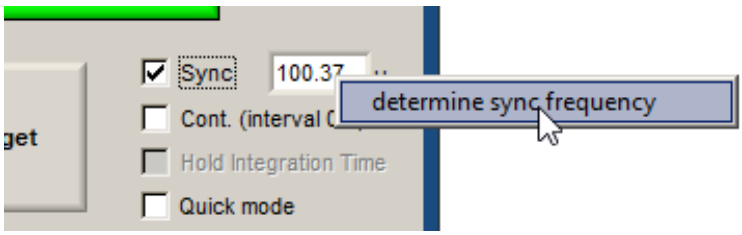

## 4.2 Synchronization (specbos 1211, spectraval)

If you want to measure modulated light sources (typical examples are TV monitors and PWM modulated LED's), it is necessary to synchronize your device to the repetition rate, because **specbos 1211** and **spectraval** devices are very sensitive. Otherwise the results, especially of bright sources, will fluctuate significantly. If the repetition rate of the display lies in the order of magnitude of the measuring time of the instrument, the repeatability of the measurement will be poor.

To do this, select the ☑ Sync checkbox. The frequency setting can be adjusted manually between 0.1 (for older devices 16) and approximately 2000 Hz.

The frequency can be appraised automatically with a single right mouse click in the numeric field with the frequency setting.

If your light source is a PC monitor or a TV-set, a distance from it to the instrument should be approximately two to three times the height of the screen. Set it to 90 % white and exclude the influence of artificial light in the room (it would be a good idea to just turn it off). To proceed the measurement, click on the field determine sync frequency. The following measurements use the set or measured frequency, as long as the ☑ Sync is not unchecked again.




If the sync measurement fails (error message: Could not determine sync frequency!), it can have the following reasons:

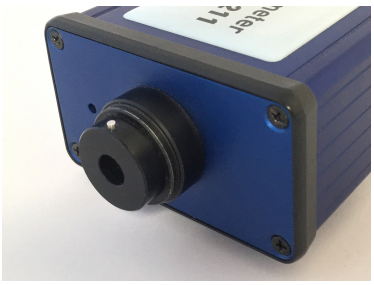
- The instrument is positioned too far from the light source.

- The influence of the surrounding light or other light sources is too significant.
- The source is not modulated (note that some monitors do not fluctuate in intensity if their brightness control is set to maximum).

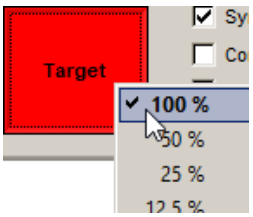
## 4.3 Measuring Modes

### 4.3.1 Luminance Mode



- Connect the device to the PC.
- Start the software.
- Click on Target (or press the button switch of **specbos 1211** or **spectraval** shortly, or use the shortcut Ctrl + L).

**Target – Indication of the Measuring Area.** In Luminance mode a Target button appears. It turns red when the laser is switched on.




**specbos 1211**, **spectraval**: Alternatively, the switch on the rear side of the device can be used. Press it shortly to switch the target marker on or off.

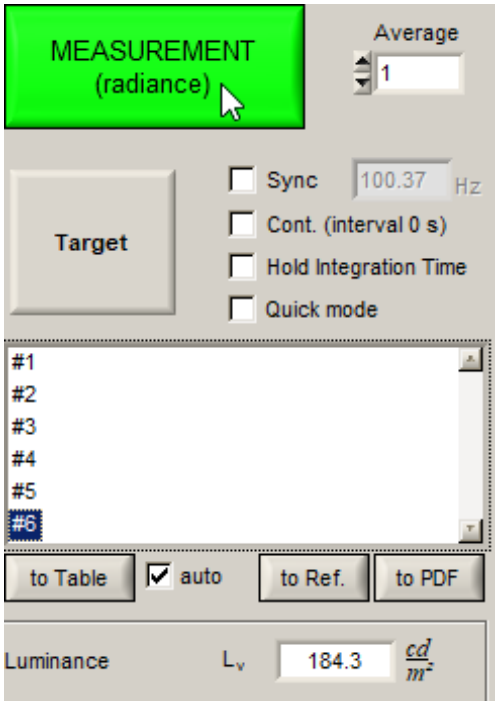
The diameter of the measuring spot can be adjusted by changing the distance to the measuring object. The inside of the red circle marks the measuring area.

Adjust the device so that the laser circle is placed on the desired measuring location. After switching the laser on, it blinks shortly in order to catch the attention of the user.

Afterwards, it shines continuously. A right mouse click on Target allows the reduction of the laser's intensity.

| **Attention:** | Do not look into the laser beam or aim the laser at another person! Do not look into the beam with optical devices like telescopes or collimator lenses! |
|---|---|

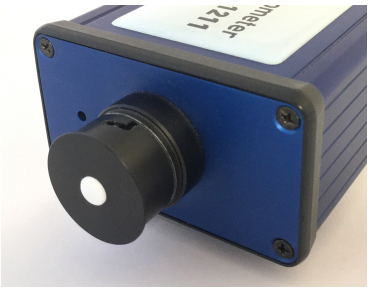
- Click on Measurement or, alternatively, use the trigger connector to activate a measurement. The measured data will be shown in the measurement display.




- The Esc key can interrupt a running measurement.
- For information only:
  F12 shows the used integration time and the measured counts (maximal value of the spectrum).
- If needed: Rename the measurement (see chapter 6.2.1 'Change Measurement Name and Graph Options', page 100), export the measurement(s) (see chapter 7.1.2 'Exporting the Data', page 122) or save the measurement(s) as reference (see chapter 7.2 'JETI LiVal Own Files', page 123).
- Quit exits the program.

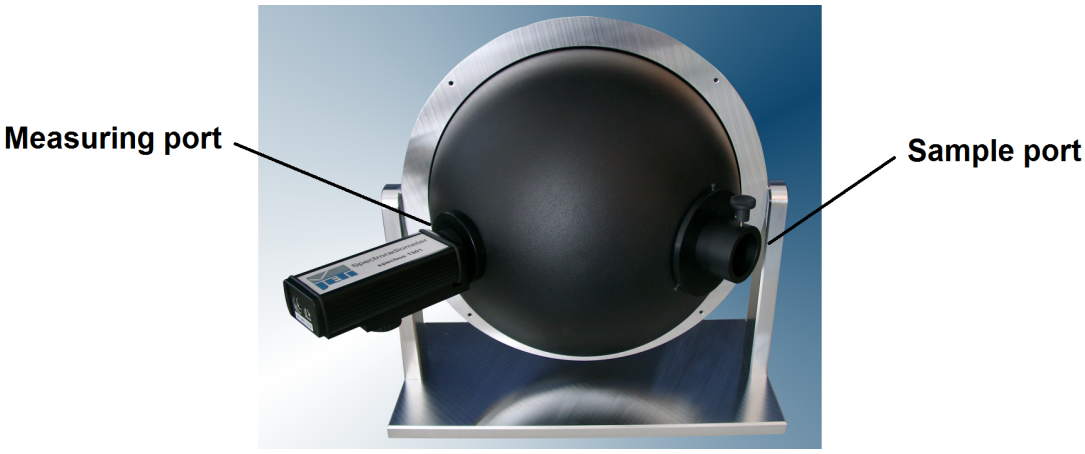
### 4.3.2 Illuminance Mode



- Connect the device to the PC.
- Attach the diffuser and position the device at the desired measuring position.
- Start the software, it will switch to Illuminance mode automatically.
- Click on Measurement or alternatively use the trigger connector to initiate a measurement. The measured data will be shown below the measurement button.
- Esc can interrupt a running measurement.
- For information only:
  F12 shows the integration time and the number of measured counts (maximal value of the spectrum).
  Target button is invisible because the laser normally is senseless being used with a diffuser. The shortcut Ctrl + L keeps working though, because the *are* some cases (for example, a device calibrated together with a separate external diffuser plate) in which the laser can be needed.
- If needed:
  Rename the measurement (see chapter 6.2.1 ‘Change Measurement Name and Graph Options’, page 100), export the measurement(s) (see chapter 7.1.2 ‘Exporting the Data’, page 122) or save the measurement(s) as reference (see chapter 7.2 ‘JETI LiVal Own Files’, page 123).
- Quit exits the program.

### 4.3.3 Luminous Flux Mode – specbos 1301 and 1311

- Attach your device to the integrating sphere.



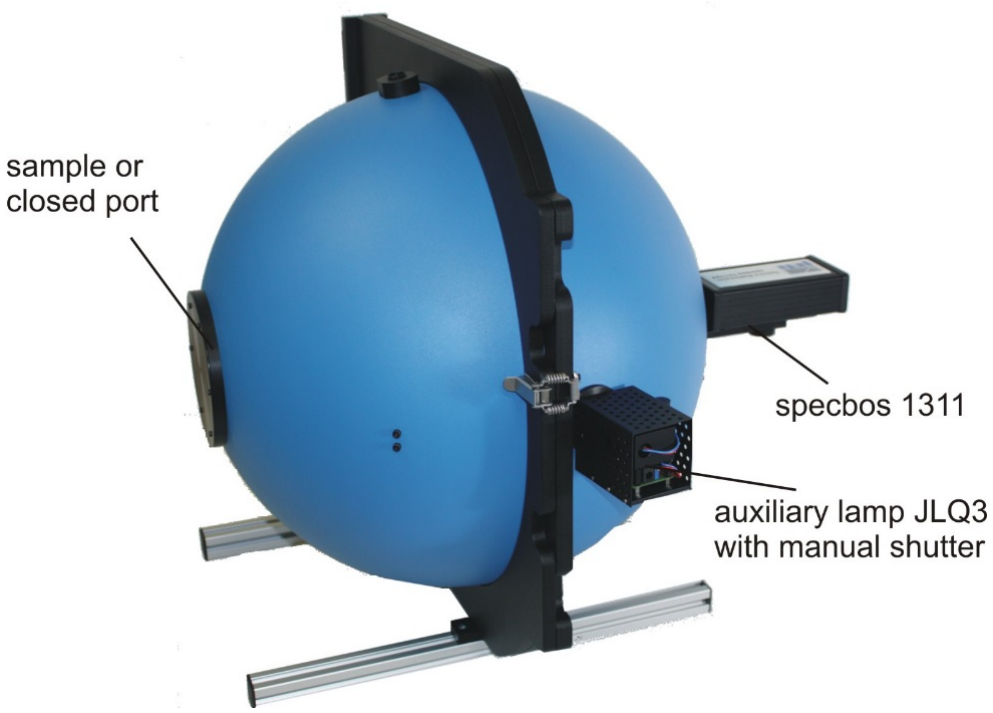

- Connect the device to the PC.
- Start the software, it will switch to Luminous flux mode.
- Insert the probe into the sample port of the integrating sphere and turn it on. It may take some time to warm up.
- Click on Measurement or, alternatively, use the trigger connector to initiate a measurement. The measured data will be shown below the measurement button.
- Esc can interrupt a running measurement.
- For information only:
  F12 shows the integration time and the counts.
- If needed: Rename the measurement (see chapter 6.2.1 ‘Change Measurement Name and Graph Options’, page 100), export the measurement(s) (see chapter 7.1.2 ‘Exporting the Data’, page 122) or save the measurement(s) as reference (see chapter 7.2 ‘JETI LiVal Own Files’, page 123).
- Quit exits the program.

### 4.3.4 Luminous Flux Measurement Mode with Self-Absorption Correction

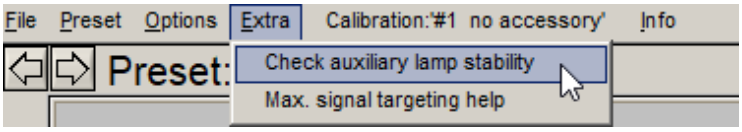
(only **specbos 1311** with hinged sphere and auxiliary lamp)

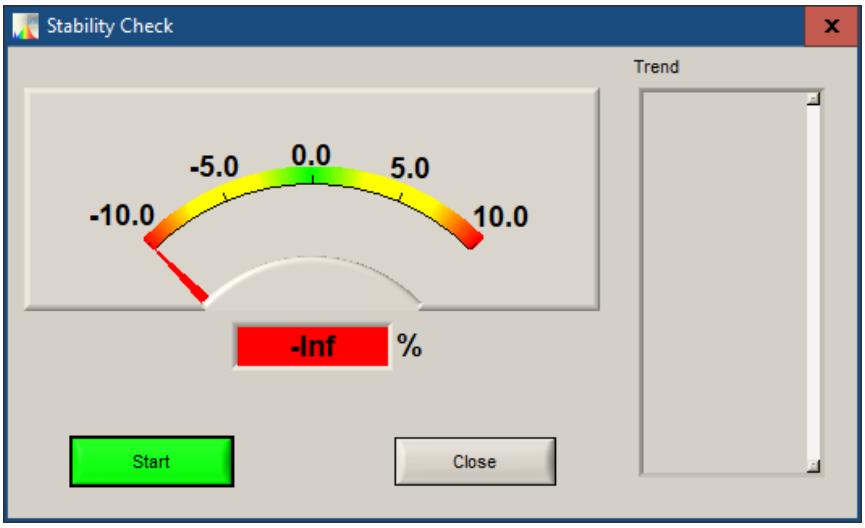
If the integrating sphere is equipped with an auxiliary lamp, the lamp can be used to compensate the self-absorption of the sample. This function is mainly applied if the $4\pi$

measuring geometry is used.
The auxiliary lamp **JLQ3** is described in a separate instruction.




- Switch on the auxiliary lamp (connect the power supply) and open the manual shutter.
- Use the menu point Extra > Check auxiliary lamp stability... to monitor the stability of the lamp.



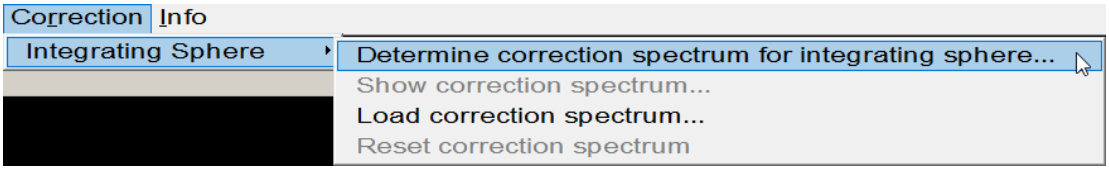



- The stability check mode proceeds a measurement every 30 seconds and the difference between two successive measurements is shown in percent.
  'Trend' displays a table with all the different values.

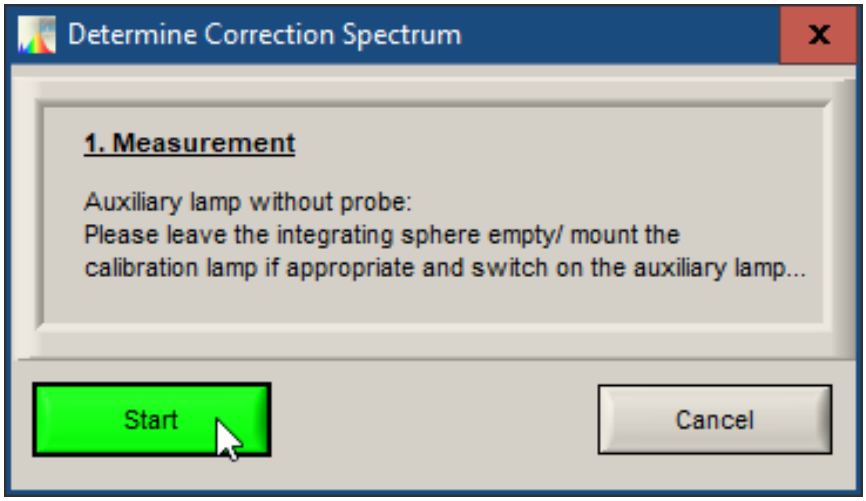
| **Remark:** | This check can also be used to monitor the temporal behavior of other lamps. |
|---|---|

  Stop the stability check by clicking on Close if the desired stability, e.g. 0.5 %, is reached.

- For the following step, the sphere has to be without a sample and closed.

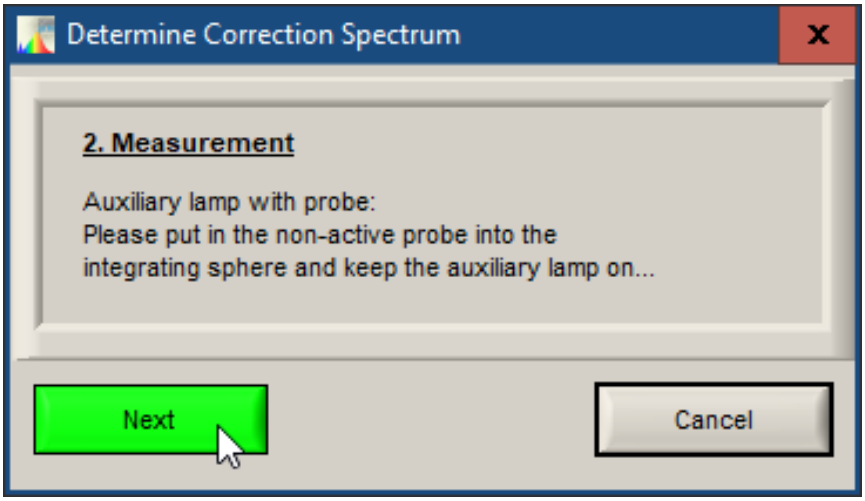



- Select the menu point
  Correction > Integrating Sphere > Determine correction spectrum for integrating sphere... (this is only possible if the device is connected to the sphere properly) and start the first measurement of the auxiliary lamp.

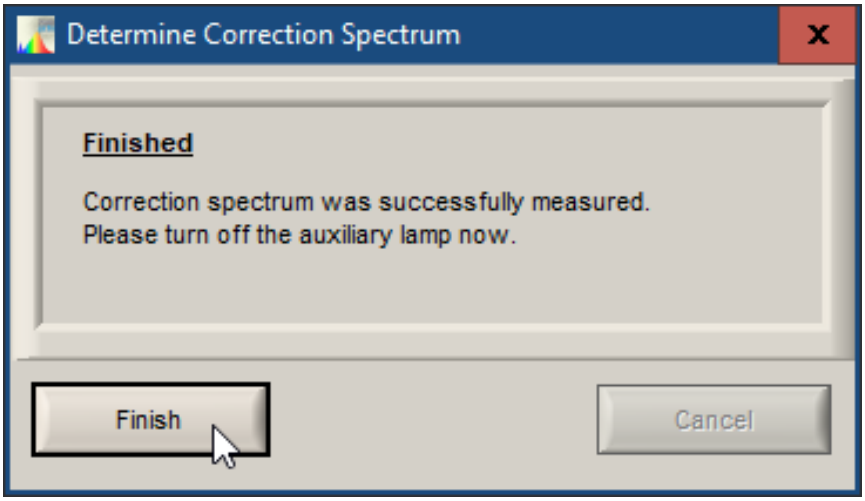


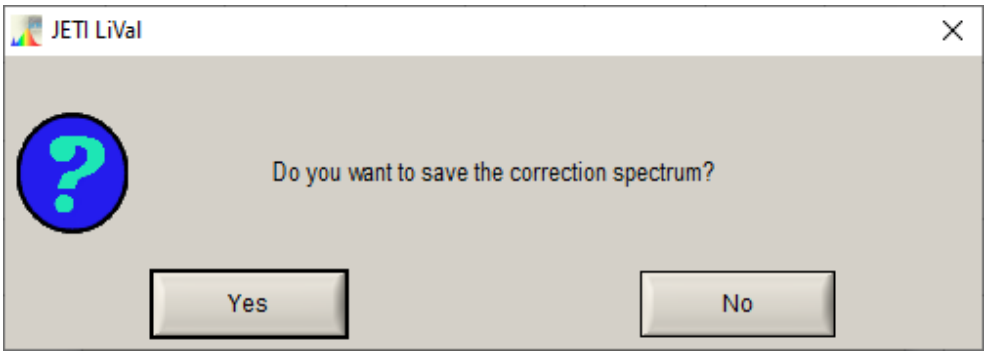
- Open the sphere, install the measuring sample (leave it switched off) and close the sphere, afterwards, start the second measurement.




- When the measurement is completed, close the auxiliary lamp shutter and finish the correction measurement.

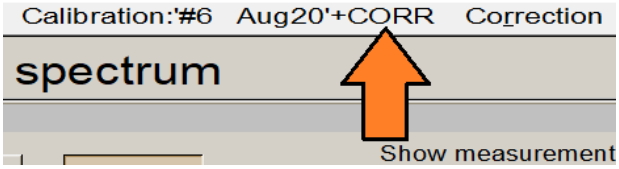


- To store the correction spectrum as a file (file extension '.aux'), click Yes, when the following dialog appears:




The stored correction spectrum can be read in again via the Correction > Integrating sphere > Load correction spectrum menu item.

- Regardless of whether the save query was answered with yes, the correction spectrum will be calculated, stored and applied to all following measurements in Flux mode.
This will be indicated by a '+CORR' label after the calibration name in the menu. Additionally, every measurement where the correction was used will be marked yellow in the legend.

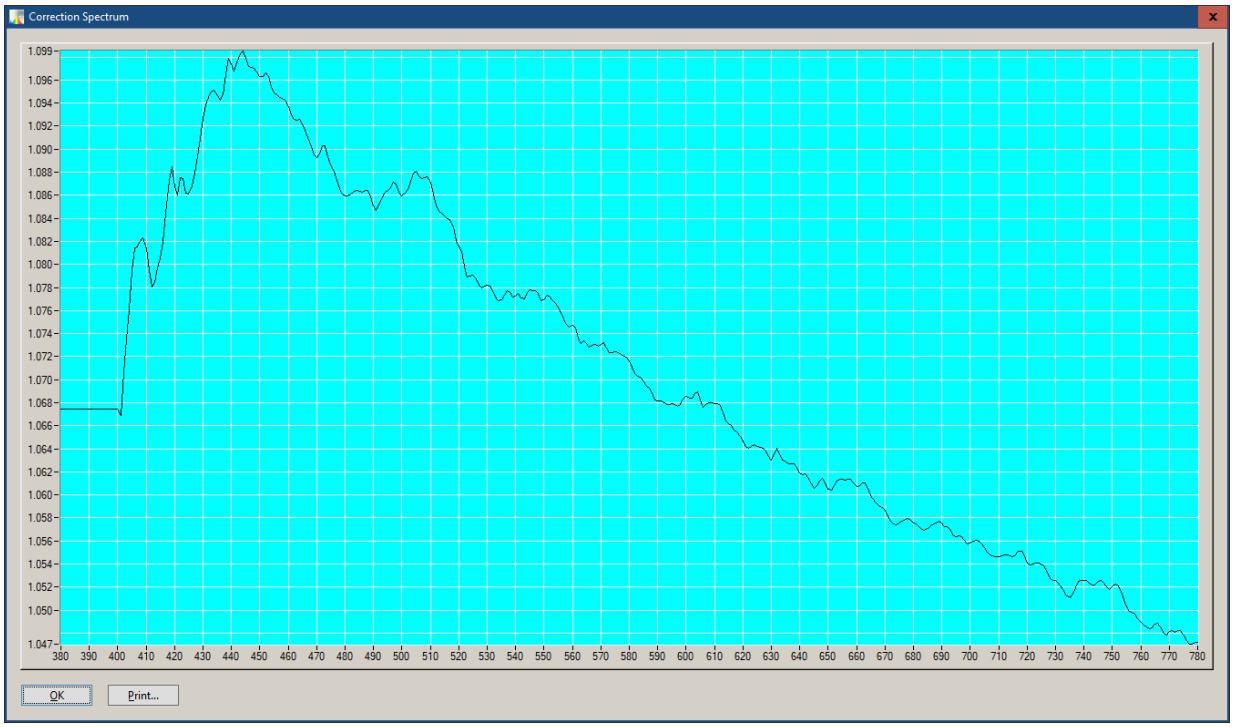



| **Remark:** | The correction data can be used for all following measurements as long as the sample type is not changed. Otherwise, the auxiliary lamp measurement has to be repeated for the new sample type or loaded via Correction > Integrating sphere > Load correction spectrum if a suitable correction spectrum has already been saved. |
|---|---|

- The correction data can be removed using the menu item Calibration > Reset correction factor. The data will not be stored if the measuring mode was changed or *JETI LiVal* was closed.

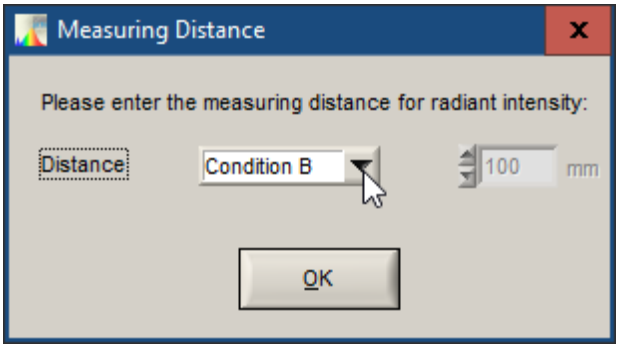
- Use the menu point Calibration > Show correction spectrum... to visualize the correction spectrum.




- Turn on the power supply of the sample and proceed the measurement as described in chapter 4.3.3 ‘Luminous Flux Mode – specbos 1301 and 1311’, page 23.
- After every measurement of the correction spectrum it is stored in a temporary file and can be used e.g. after program restart without having to repeat measurements (a confirmation popup-window will appear automatically).

### 4.3.5 Luminous Intensity Mode – specbos 1401

- Connect the device to the PC and to the measuring set up.
- Start the software, it will switch to Luminous intensity mode.
- Type in the measuring distance.



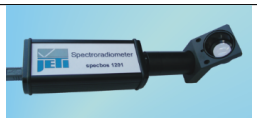

  It will be requested automatically if the program is started with the attached measuring head. Use Ctrl + D to update the distance if it is changed during the measurement.

- Default values are 316 mm (condition A of CIE 127-2007) and 100 mm (condition B of CIE 127 2007). Other values are also possible if you don't use the tubes.
- Insert the probe into the holder and switch it on.
- Insert the holder into the port.
- Click on Measurement or, alternatively, use the trigger connector to activate a measurement. The measured data will be shown below the measurement button.
- Esc can interrupt a running measurement.
- For information only:
  F12 to display the integration time and the measured counts (maximum throughout spectrum).
- If needed:
  Rename the measurement (see chapter 6.2.1 'Change Measurement Name and Graph Options', page 100, export the measurement(s) (see chapter 7.1.2 'Exporting the Data', page 122) or save the measurement(s) as reference (see chapter 7.2 'JETI LiVal Own Files', page 123).
- Quit exits the program.

## 4.4 Special Measurements

### 4.4.1 Small Luminance Sources
**(only specbos 1201 focus / 1211 focus)**

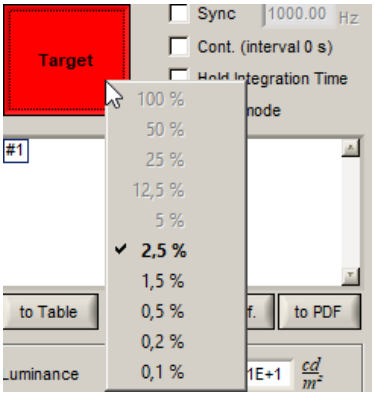
**specbos 1201/1211** can be used for measurement spot sizes of 4 mm and more, depending on the measurement distance. **specbos 12x1 focus** with special attachments (focusing optics) can be used to measure small sized lighting areas, e.g. alphanumeric displays or signs. Different extensions for spots of 3 mm, 1 mm and 0.5 mm diameter are available.

| Name | Measuring diameter | Measuring distance | Field of view | Length |
|---|---|---|---|---|
|  Focusing optics 3 | 3 mm | 70 mm | 2.1° | 77 mm |
|  Focusing optics 1 | 1 mm | 26 mm | 1.9° | 26 mm |
|  Focusing optics 0.5 | 0.5 mm | 46 mm | 0.6° | 77 mm |

The attachments have to be screwed on the flange of **specbos 12x1 focus**. The device detects the measuring head automatically and calls up the corresponding calibration file.

- Connect the device to the PC.
- Start the software.
- Click on Target
  A right mouse click on Target allows the reduction of the laser intensity. Use 0.2 %,

0.5 % or 1.5 % for best viewing conditions with the focusing optics.
The target is automatically reduced to 2.5 %, for your safety.




The device has to be positioned in the right measuring distance (focus) for the measurement. For the right measuring distance, use the table above. The measurement process itself is the same as without additional optics.

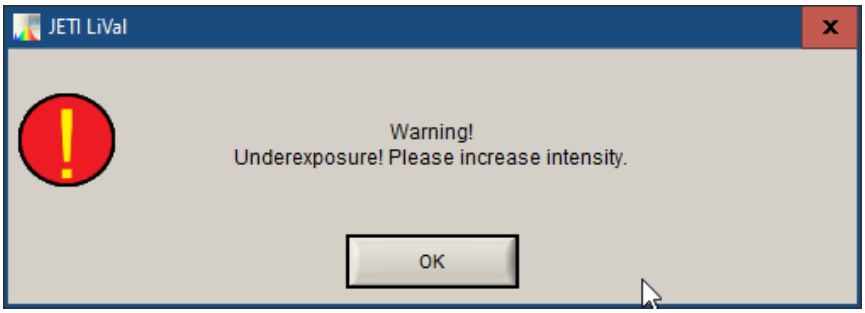
- Adjust the device so that the laser circle is placed on the desired measuring location; attach the loupe when using the focusing optics of 0.5 mm.
- Click on Measurement or, alternatively, use the trigger connector to initiate a measurement. The measured data will be displayed below the measurement button.
- Esc can interrupt a started measurement.
- For information only:
  Press F12 to display the integration time and the measured counts (maximum throughout spectrum).
- If needed: Rename the measurement (see chapter 6.2.1 ‘Change Measurement Name and Graph Options’, page 100), export the measurement(s) (see chapter 7.1.2 ‘Exporting the Data’, page 122) or save the measurement(s) as reference (see chapter 7.2 ‘JETI LiVal Own Files’, page 123).
- Quit exits the program.

### 4.4.2 Pulsed Sources

It is possible to measure single pulse sources of flash lamps with **specbos 1201** and **specbos 1211**. This is only possible in Illuminance mode. Furthermore, it is necessary to trigger the flash of the *JETI* device unit. See chapter ‘Trigger Functions’ (Operating Instructions ‘*JETI* spectroradiometer specbos’ on the UBS flash drive) for the pinout of the rear side connector and connect it with the trigger input of the flash lamp (using the connector included in the device delivery).

- Connect the device to the PC and attach the diffuser.
- Start the software, it will switch to Illuminance mode.
- Switch the unit to Options > Type of light source > single flash.
- Press the Measurement button to start a measurement. The integration time is fixed to 200 ms. The photometric and radiometric values will be given as exposure; the units are lx s and J m$^{-2}$. In case of over- or underexposure, a warning message will appear:




- Adjust the intensity by decreasing or increasing the measuring distance. Regardless of underexposure the measurement is valid. In case of overexposure the results are not valid and will not be shown.

The effective intensity $I_{eff}$ [cd] of a single flash (with neglectable pulse length (µs range)) can be calculated from the measured luminous exposure $H_v$ [lx s] by the following equation (d – measuring distance [m]):

$$I_{eff} = \frac{H_v}{0.2} \cdot d^2$$

### 4.4.3 Measurements with Accessories

The measuring range of **specbos 1201** and **specbos 1211** in Luminance/ Illuminance mode can be shifted to higher intensities using external attenuating filters and diffusers with filters, mounted in a cap to be attached to the instrument. If a filter is used, the instrument will automatically use the respective calibration data.

- Connect the device to the PC and start the software.
- Click on Target (or press the illuminated switch of **specbos 1211** shortly).
- Adjust the device and click on Target again, the laser will be switched off.
- Attach the filter.

- Click on Measurement or alternatively use the trigger connector to initiate a measurement. The measured data will be shown below the measurement button.
- Esc can interrupt a running measurement.
- For information only:
  Press F12 to display the integration time and the counts (maximal raw value throughout the spectrum).
- If needed:
  Rename the measurement (see chapter 6.2.1 ‘Change Measurement Name and Graph Options’, page 100), export the measurement(s) (see chapter 7.1.2 ‘Exporting the Data’, page 122) or save the measurement(s) as reference (see chapter 7.2 ‘JETI LiVal Own Files’, page 123).
- Quit exits the program.

Sometimes it is necessary to use the device with additional accessories, which cannot be detected automatically by the device’s sensors. In this case, you need to select the calibration file manually. To do this, select Calibration > Sensor mode > Sensor disabled in the menu.


The calibration file itself can then be selected in the drop-down menu next to the Measurement button.

| **Remark:** | If the sensor is disabled, always make sure that the right calibration file is selected to obtain correct measuring results. |
|---|---|

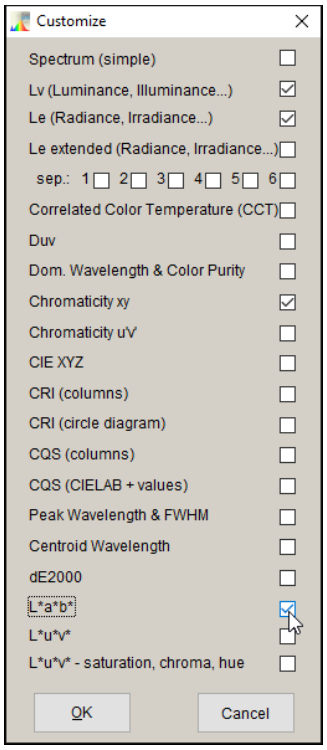
# 5 Displaying of Results

## 5.1 General

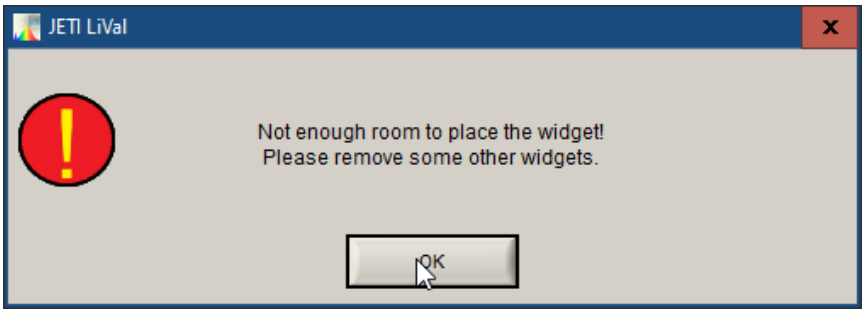
There are two areas in the main screen, where measuring results can be displayed.
The small field on the right side is suitable for numerical values mostly (though diagramms for CRI and CQS can also be displayed in it). It is called the ‘Measuring results field’.
The large area on the left side is suitable for more ambitious measurements like tables and complex diagrams (though simple numerical values can also be displayed in it). It is called the ‘Widget field’.
Both areas are customizable.
The values to be displayed in the ‘Measuring results field’ can be chosen freely from a list. To do this, right click somewhere in the ‘Measuring results field’ and then click on Customize in the appearing pop-up menu.
The widgets to be displayed in the ‘Widget field’ can be set freely and designed if ‘Custom’ preset is chosen.

## 5.2 Measuring Results Field

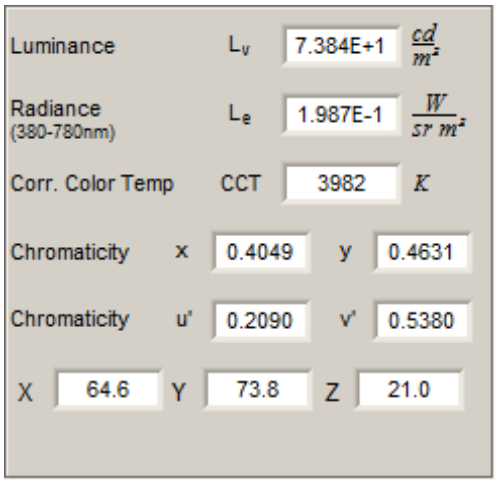
The measuring results field only has very limited amount of space, and only a limited number of values can be displayed in it simultaneously.
If you right click in the‘Measuring results field’ and then click on Customize, you will see the following window:

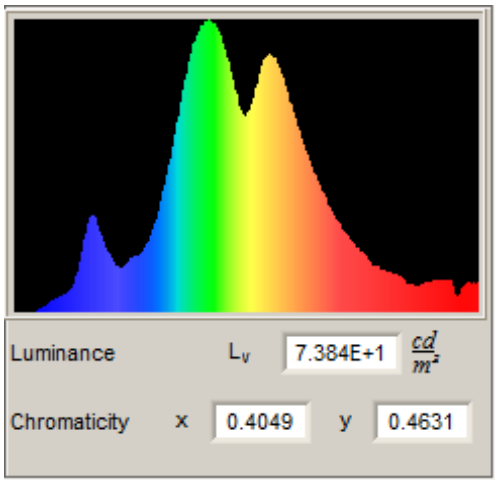


You can select/deselect the values you like/dislike to be displayed. If too many values are selected so that there is not enough room, the following warning will be shown:




The room that every value requires can be different, so there is no universal formula for the number of values that can be displayed. But as a rule of thumb 6 lines or 2 lines and one diagram can be displayed as follows:




All values and charts from the ‘Measuring results field’ can be also found in the list of widgets for the ‘Widget field’. The only exception is the simple version of spectrum chart which is specially designed for a tight look of the ‘Measuring results field’.

## 5.3 Widget Field

Every calculation, diagram or value can be displayed at least in one ‘widget’ – a separate window with a certain graphical or numerical representation. The user in custom mode can arrange the widgets freely.

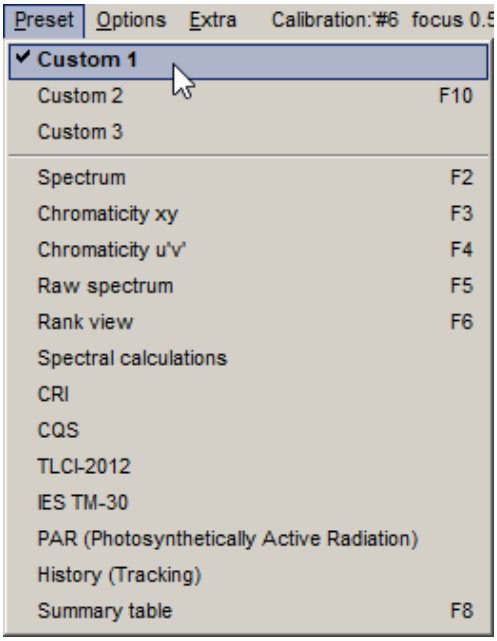
This concept is introduced since *JETI LiVal* version 6, and different ‘View’ - modes that have existed in earlier versions had to become a part of it. So ‘presets’ were introduced. Each preset is a certain fixed combination of widgets.

‘Spectrum’, ‘Chromaticity xy’, ‘Chromaticity u’v’’, ‘Raw spectrum’, ‘Rank view’, ‘PAR (Photosynthetically Active Radiation)’ and ‘Summary table’ presets contain only one full-screen widget. This makes them look similar as corresponding ‘View’-modes in earlier *JETI LiVal* versions.

‘Spectral calculations’ and ‘TLCI-2012’ presets contain also only one widget. ‘CQS’ and ‘History’ contain 3, ‘CRI’ and ‘IES TM-30-15’ presets contain 4 and 7 widgets respectively.

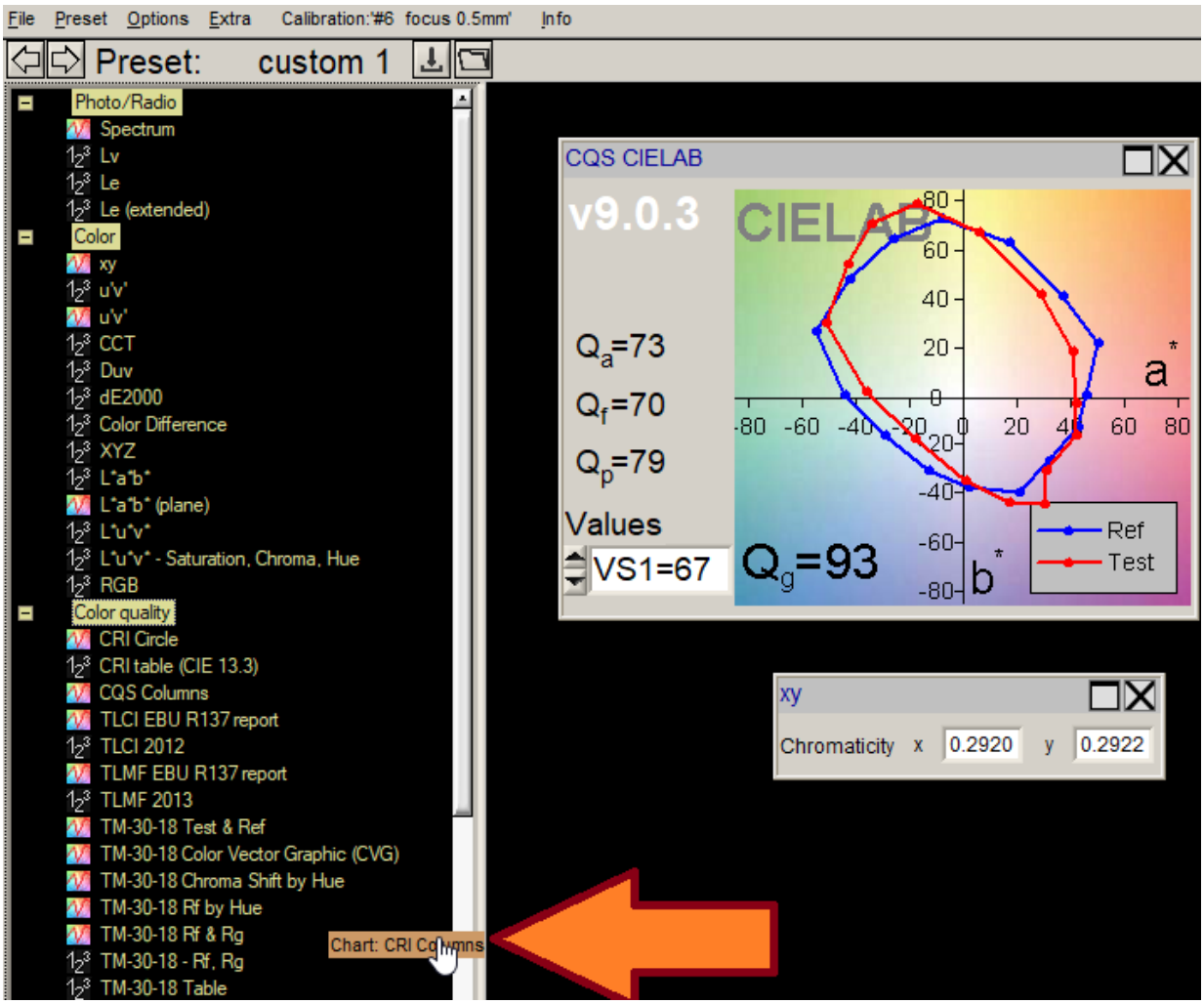
Each of three ‘Custom’ presets contains all of the widgets that are available in *JETI LiVal*.

See chapter 12 ‘Shortcut Keys’, page 141, for shortcut keys to switch between different display modes.



In ‘Custom’ presets, any number of the widgets can be moved from the list on the left side into the widget field with the drag-and-drop technique. The user can arrange them freely.




Using  and  buttons the current configuration of the ‘Custom’ preset can be stored as a ‘.dat’ file.

| | |
|---|---|
| **Remark:** | For compatibility purposes *JETI LiVal* ignores all data it cannot interpret. This means for example that it is possible to load a ‘Custom’ preset configuration file with an older *JETI LiVal* version than it was created with, but the settings for new widgets that did not exist in the older version will be ignored. |

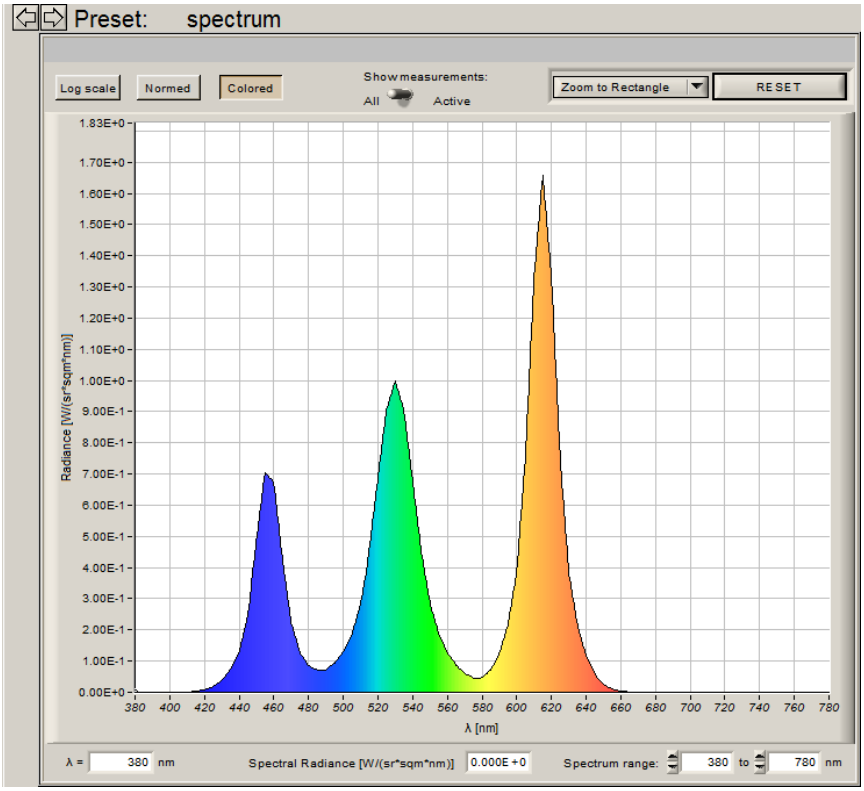
All settings and all data combined in the custom preset will be stored when the program is closed. A description of every single widget follows.

## 5.4 Photo/Radio

### 5.4.1 Chart: Spectrum

Available in: ‘Spectrum’, ‘CRI’, ‘CQS’, ‘Custom’ presets.




This widget shows the measured radiometric spectrum.

**Widget Options:**

**Log scale**

Switch Y-axis to logarithmic scale.

**Normed**

Shows all spectra normed to maximum of one for better comparability.

**Colored**

Display a colored spectrum. Visible light is displayed in colors that correspond to their wavelengths. Ultraviolet and infrared radiation is displayed grey.

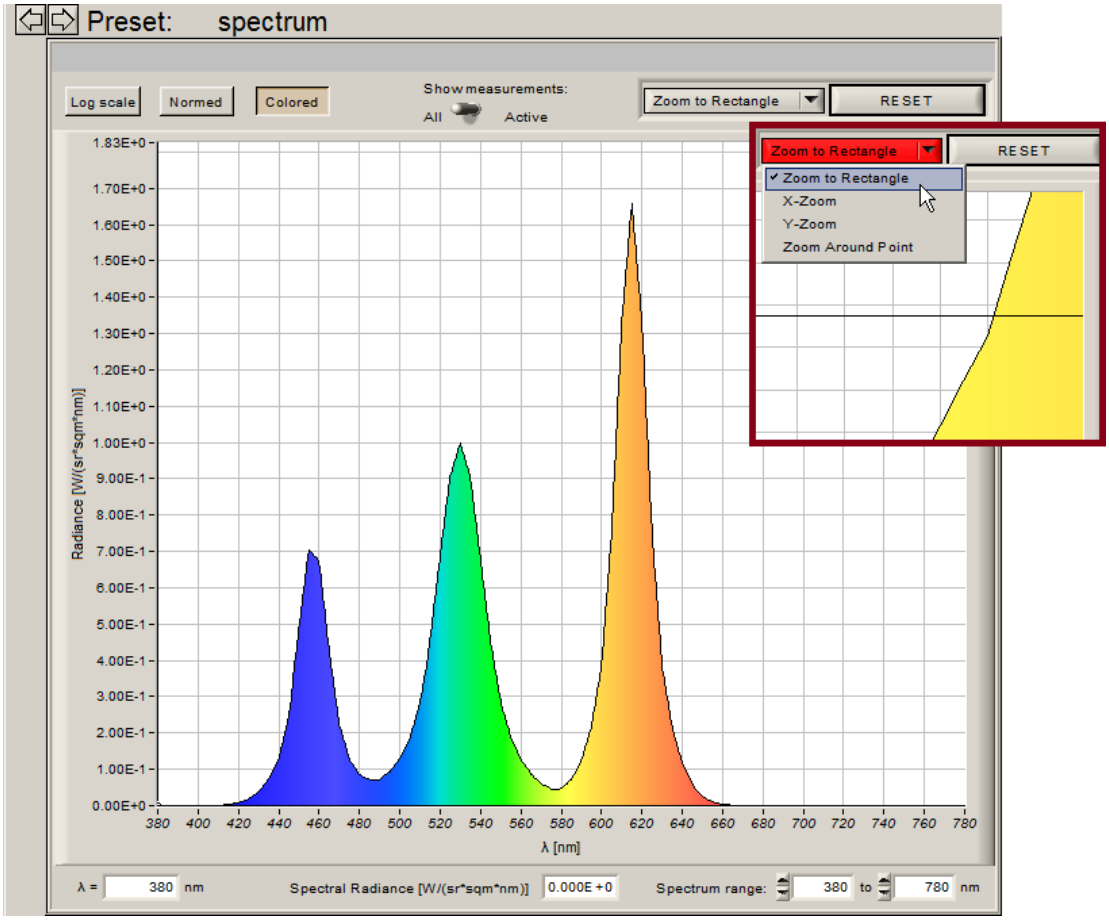
### Show measurements

Switch between All and Active

All**:** All measured spectra are displayed in the diagram.

Active**:** Only the active measured spectrum is displayed in the diagram.

### Zoom




To zoom into a diagram, hold Ctrl-key down, then click the left mouse button and drag a rectangle that contains just the region you want to zoom into. The level of zoom can be selected in the drop down menu above the diagram. X-Zoom and Y-Zoom are only valid for the spectrum diagram. A checkmark shows the selected zoom and the print is shown red.
Zoom out by clicking RESET next to the Zoom drop down menu.

### Spectrum range

The start and the end of the displayed spectrum can be adjusted at the screen edge below the diagram spectrum range, alternatively. In addition to using the ↑ or ↓ keys, the displayed spectral limits can be typed in using the keyboard number pad. The maximum interval for **specos 1x01** or the **spectraval** device is between 380 nm and 780 nm. The full spectral range of the device is always used for a measurement.

## 5.4.2 Num: Lv

Available in: 'Custom' preset.

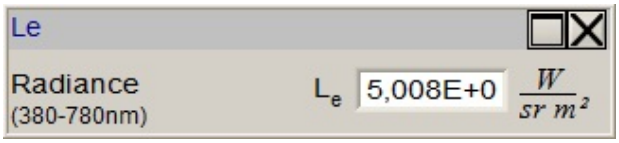

Shows the photometric value of the active spectrum in the widget field (depending on the used accessory it will be Luminance, Illuminance, Luminous Flux or Luminous Intensity).

### Relevant settings:

Luminous Efficiency Function: Options > Luminous Efficiency Function
Photometric Units: Options > Photometric Units
Number Format: Options > Number format

## 5.4.3 Num: Le

Available in: 'Custom' preset.



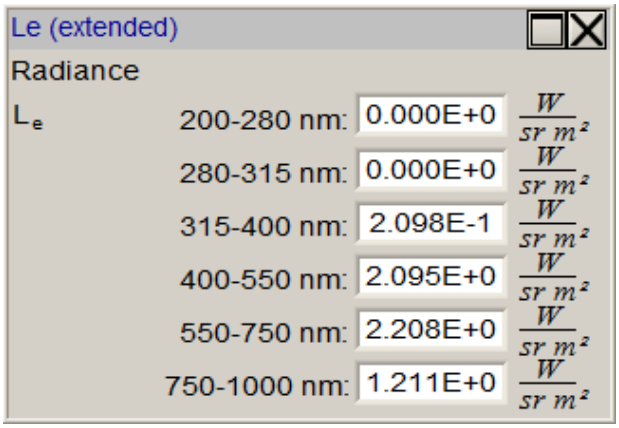

Shows the radiometric value of the active spectrum. Depending on the used accessory the value has a meaning of Radiance, Irradiance, Radiant Flux or Radiant Intensity.

### Relevant settings:

Number Format: Options > Number format
Calculation Range: Options > Calculation range

### 5.4.4 Num: Le (extended)

Available in: ‘Custom’ preset.




Shows 6 radiometric values calculated in specified wavelength ranges. Depending on the used accessory the values have a meaning of Radiance, Irradiance, Radiant Flux or Radiant Intensity.

**Relevant settings:**

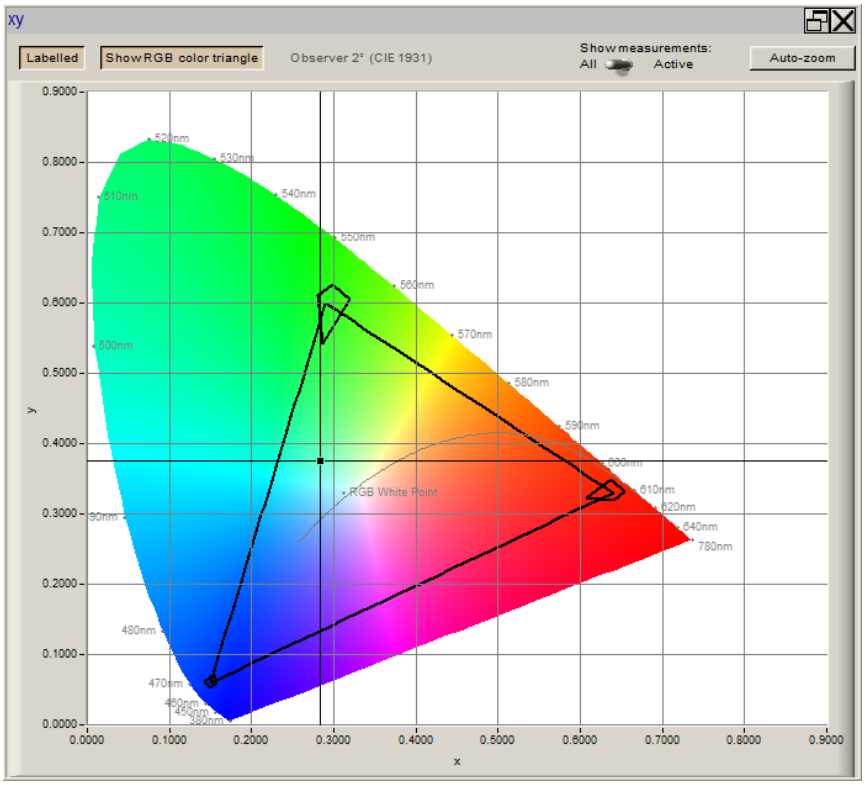
Number Format: Options » Number format
Calculation Range: Options » Calculation range

## 5.5 Color

### 5.5.1 Chart: xy

Available in: ‘Chromaticity xy’, ‘Custom’ presets.




The color coordinate diagram contains the Planckian curvature for orientation. The actual measuring values are indicated in the diagram.
Use mouse wheel to zoom in, Ctrl+selecting an area holding the left mouse key to zoom to a rectangle and the right mouse key to reset.

**Widget Options:**

**Labelled**

Display wavelengths along the spectral color line.

**Show RGB color triangle**

Display RGB space (triangle and tolerances for primaries).

**Auto-zoom**

Zoom to the current measuring point so that size of the visible chart area is $0.1400 \times 0.1400$.

### Show measurements

Switch between All and Active

All: Chromaticities of all measurements are displayed in the diagram.

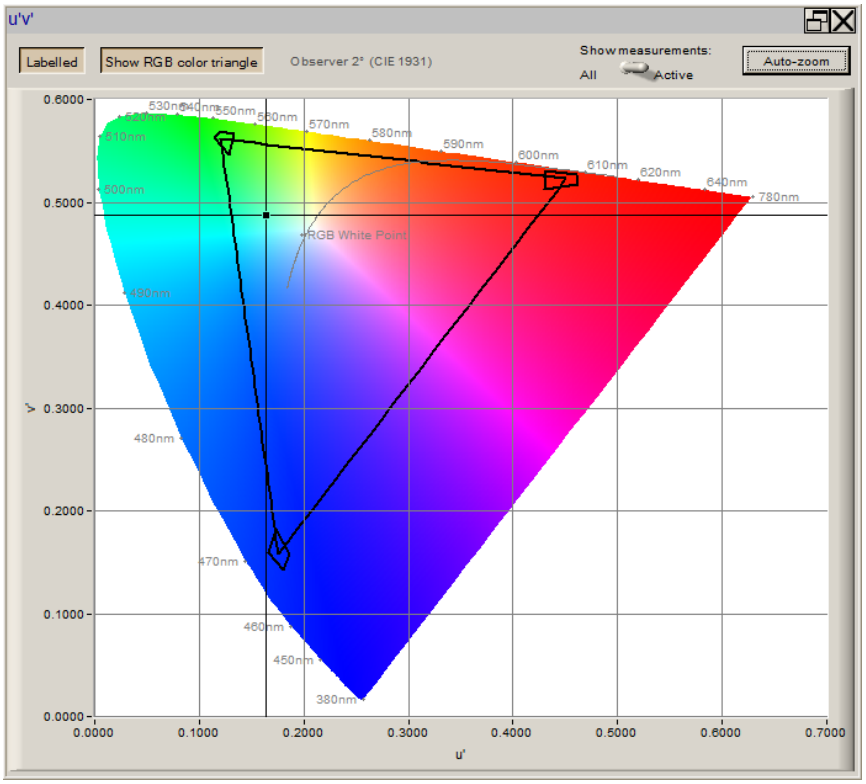
Active: Chromaticity only of the active measurement is displayed in the diagram.

### Relevant settings:

Observer: Options > Observer
RGB color space: Options > RGB

## 5.5.2 Chart: u'v'

Available in: 'Chromaticity xy', 'Custom' presets.




The color coordinate diagram contains the Planckian curvature for orientation. The actual measuring values are indicated in the diagram.
Use mouse wheel to zoom in, Ctrl+selecting an area holding the left mouse key to zoom to a rectangle and the right mouse key to reset.

**Widget Options:**

**Labelled**

Display wavelengths along the spectral color line.

**Show RGB color triangle**

Display RGB space (triangle and tolerances for primaries).

**Auto-zoom**

Zoom to the current measuring point so that size of the visible chart area is $0.1400 \times 0.1400$.

**Show measurements**

Switch between All and Active

All**:** Chromaticities of all measurements are displayed in the diagram.

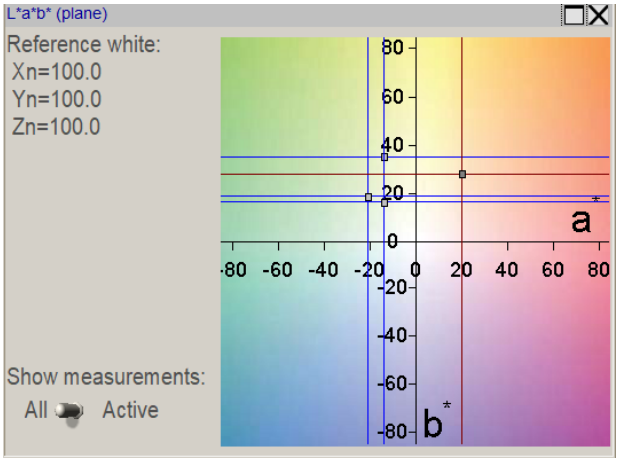
Active**:** Chromaticity only of the active measurement is displayed in the diagram.

**Relevant settings:**

Observer: Options > Observer
RGB color space: Options > RGB

### 5.5.3 Chart: L*a*b* (plane)

Available in: ‘Custom’ preset.



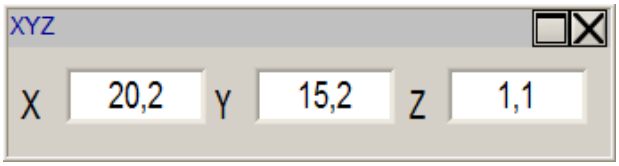
Visualizes a*b* coordinates from CIE L*a*b* calculation for the current spectrum or for all spectra as a point on a plane.

**Relevant settings:**

Observer: Options > Observer
L*a*b* white point reference: Options > L*a*b*

### 5.5.4 Num: XYZ

Available in: ‘Custom’ preset.



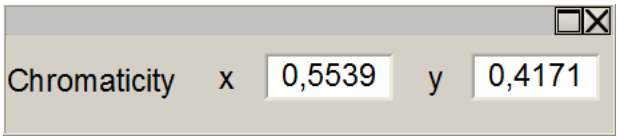

Displays the XYZ values of the measured spectrum.

**Relevant settings:**

Observer: Options > Observer

### 5.5.5 Num: xy

Available in: ‘Custom’ preset.



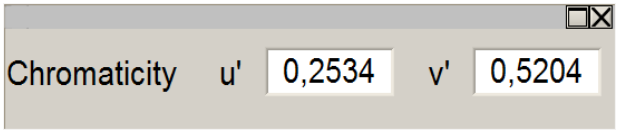

Displays xy chromaticity as two numbers with a precision of 4 decimal places.

**Relevant settings:**

Observer: Options > Observer

### 5.5.6 Num: u'v'

Available in: 'Custom' preset.



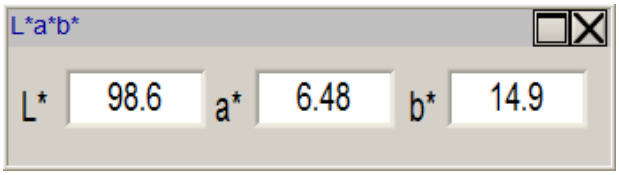

Displays u'v' chromaticity as two numbers with a precision of 4 decimal places.

**Relevant settings:**

Observer: Options > Observer

### 5.5.7 Num: L*a*b*

Available in: 'Custom' preset.




Displays CIE L*a*b* color coordinates.

The values are calculated as follows:

$$L^* = 116 f(Y/Y_n) - 16$$
$$a^* = 500[f(X/X_n) - f(Y/Y_n)]$$
$$b^* = 200[f(Y/Y_n) - f(Z/Z_n)],$$

where

$$f(\xi) = \begin{cases} \xi^3 & \text{for } \xi > (24/116)^3, \\ (841/108)\xi + 16/116 & \text{for } \xi \leq (24/116)^3, \end{cases}$$

X, Y, Z are the tristimulus values of the test object color stimulus considered and $X_n$, $Y_n$, $Z_n$ are the tristimulus values of the specified white object color stimulus.

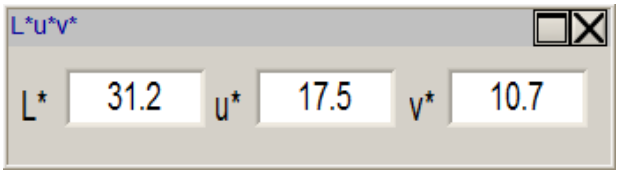
**Relevant settings:**

Observer: Options > Observer
L*a*b* white point reference: Options > L*a*b*

### 5.5.8 Num: L*u*v*

Available in: ‘Custom’ preset.




Displays CIE 1976 (L*u*v*) color coordinates.

L* is the same as in the L*a*b* widget.

u* and v* are calculated as

$$u^* = 13L^*(u' - u'_n)$$
$$v^* = 13L^*(v' - v'_n),$$

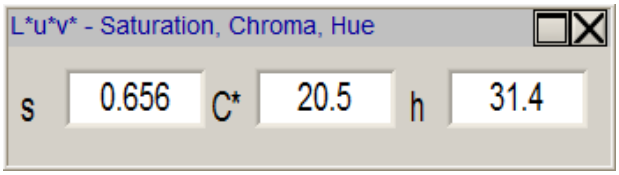
where $u'_n$ and $v'_n$ describe the specified white object color stimulus (the values are derived from XYZ-values specified under the L*a*b* white point reference settings).

**Relevant settings:**

Observer Options > Observer
L*a*b* white point reference Options > L*a*b*

### 5.5.9 Num: L*u*v* - Saturation, Chroma, Hue

Available in: ‘Custom’ preset.




Displays CIE 1976 (L*u*v*) additional values: saturation, chroma, hue-angle. They are calculated as follows:

$$s_{uv} = 13\sqrt{(u' - u'_n)^2 + (v' - v'_n)^2},$$
$$C^*_{uv} = \sqrt{u^{*2} + v^{*2}} = L^* s_{uv},$$
$$h_{uv} = arctan\frac{v' - v'_n}{u' - u'_n} = arctan\frac{v^*}{u^*}.$$

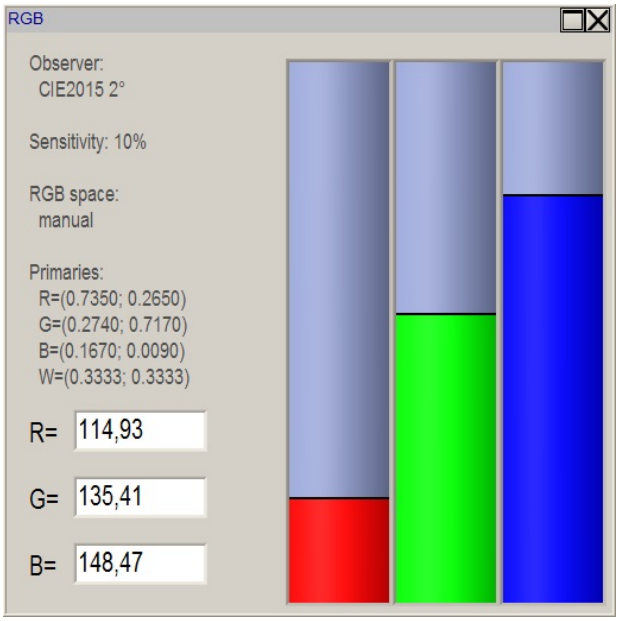
**Relevant settings:**

Observer: Options > Observer
L*a*b* white point reference: Options > L*a*b*

### 5.5.10 Num: RGB

Available in: ‘Custom’ preset.




Displays the RGB values of the measured spectrum in a selected gamut, with respect to a certain white point.

**Relevant settings:**

Observer: Options » Observer
L*a*b* white point reference: Options » L*a*b*

### 5.5.11 Num: CCT

Available in: ‘Custom’ preset.


Displays the Correlated Color Temperature. If the point given by color coordinates lies too far from the Planckian curvature ($|D_{uv}| > 0.05$) or CCT value is beyond the range from 600 K to 20 000 K, CCT gets the value of 0, and its field is dimmed. Connected calculations like CRI, CQS, TLCI, TM-30-15 or CFI that require a plausible CCT value also cannot be done in this case.

Note that CCT is calculated always on the basis of CIE 1931 chromaticity coordinates and does not depend on observer settings.

**Relevant settings:**

None.

### 5.5.12 Num: Duv

Available in: ‘Custom’ preset.

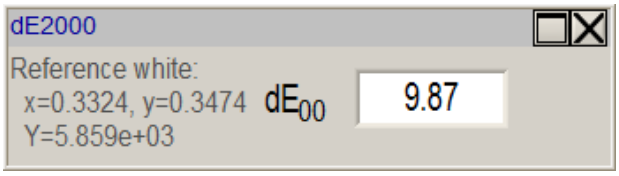

Displays the chromaticity difference value $D_{uv}$. This is the distance to the Planckian curvature. $D_{uv}$ is only meaningful for white samples. If the point given by color coordinates lies too far from the Planckian curvature ($|D_{uv}| > 0.05$) or CCT value is beyond the range from 600 K to 20 000 K, $D_{uv}$ gets the value of 0, and its field is dimmed.

**Relevant settings:**

None.

### 5.5.13 Num: dE2000

Available in: ‘Custom’ preset.




Displays the color difference value dE2000. The reference point is a white point with the same luminance as the measured test light source.

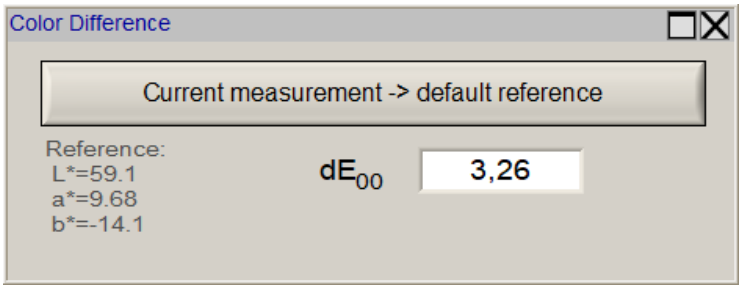
**Relevant settings:**

Observer: Options › Observer
Reference white point: Options › RGB

### 5.5.14 Num: Color Difference

Available in: ‘Custom’ preset.




Displays results of color difference calculations performed by a chosen standard (CIE76 or CIEDE2000; the resulting value is designated $dE_{ab}$ and $dE_{00}$ respectively). The formula for these calculations are based on CIE L*a*b* color coordinates.

Do a measurement. Click on Current measurement -> default reference to make it a reference for subsequent measurements. It is also applied as a reference to itself, that is why dE value gets 0 after this operation.

Do other measurement and L*a*b* values of the reference measurement will be used for calculations.

The reference L*a*b* color coordinates are stored for all observers, and the resulting dE value is calculated also for all observers, so that the observer settings for the reference measurement and for the current measurement always match.

**Relevant settings:**

Observer: Options > Observer
Calculation standard: Options > Color Difference
L*a*b* white point reference: Options > L*a*b*

## 5.6 Color Quality

### 5.6.1 CRI

The calculation of the Color Rendering Index is done according to the CIE report 13.3-1995.
The special indices $R_1$ to $R_{14}$ and the JIS $R_{15}$ are calculated. The general Color Rendering Index $R_a$ as well as its extended version $R_e$ are shown.

| | |
|---|---|
| **Note:** | The meaning of $R_e$ index changes depending on CRI-settings (Options > CRI). It can be the mean value of either 14 or 15 special indices. |

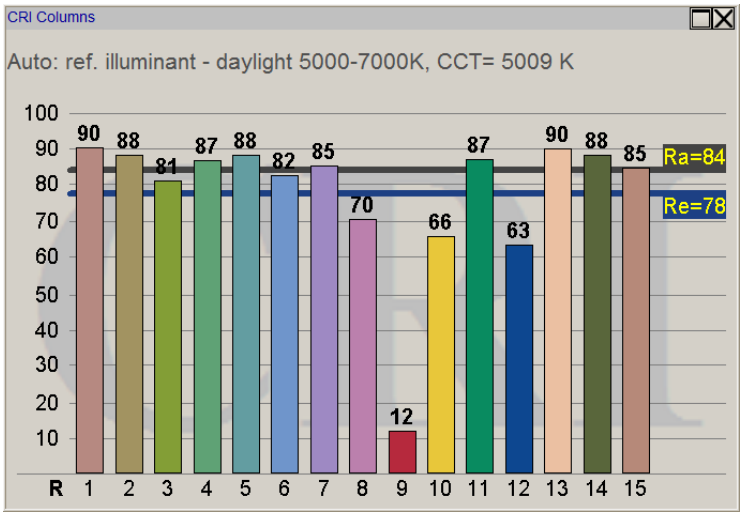
 

This reference illuminant is calculated automatically from the Planckian law if the color temperature of the sample is below 5000 K and from a daylight approximation if it is above 5000 K. The measured CCT will be used for the reference illuminant calculation.

| **Remark:** | If the CCT calculation was not possible (see CCT description), then the Color Rendering Index calculation is also not possible. |
|---|---|

#### 5.6.1.1 Chart: CRI Columns

Available in: ‘CRI’, ‘Custom’ presets.



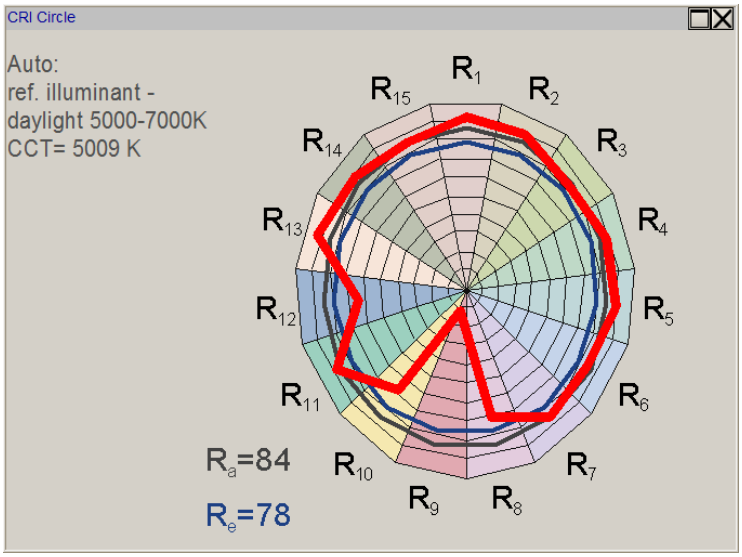

The widget displays the CRI data in columns. $R_a$ and $R_e$ indices are shown as two lines in the background.

**Relevant settings:**

CRI reference illuminant: Options > CRI

#### 5.6.1.2 Chart: CRI Circle

Available in: ‘CRI’, ‘Custom’ presets.




The widget displays the CRI data as a circle diagram. $R_a$ and $R_e$ indices are shown as two thin circle lines in the background.

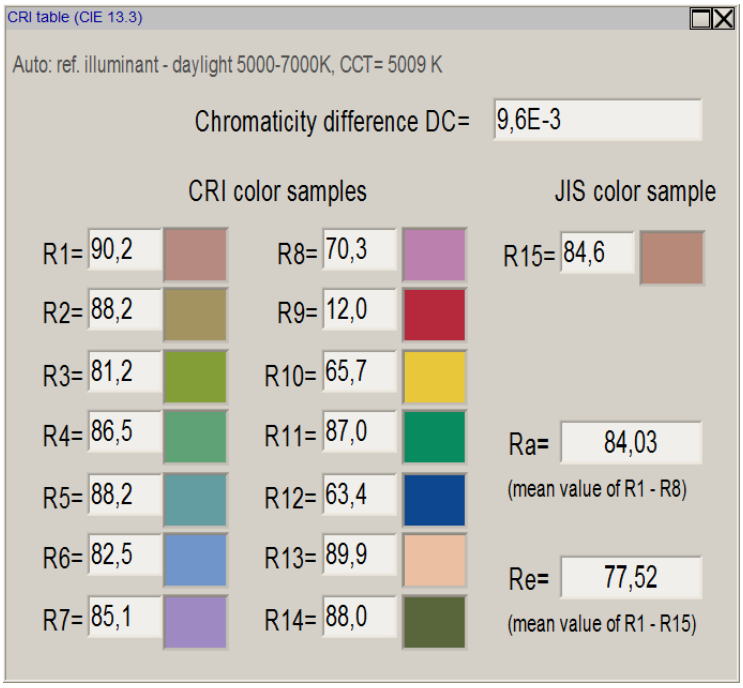
**Relevant settings:**

CRI reference illuminant: Options > CRI

#### 5.6.1.3 Chart: CRI Table

Available in: ‘CRI’, ‘Custom’ presets.




The widget displays all CRI-relevant numeric results with color samples for better orientation. Additionally, the chromaticity difference DC between the test object and the reference illuminant is shown.

**Relevant settings:**

CRI reference illuminant: Options > CRI

### 5.6.2 CQS

The calculation of the Color Quality Scale (CQS) is also possible.

*‘A Color Quality Scale (CQS) is being developed at NIST, which evaluates several aspects of the quality of the color of objects illuminated by a light source. This metric involves several facets of color quality, including color rendering, chromatic discrimination, and observer preferences.’* http://colorqualityscale.com/

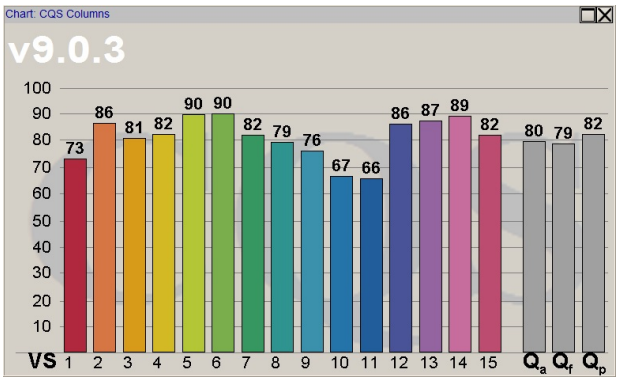
The calculation of the Color Quality Scale values is done according to the sheet (version 9.0.3) of NIST. In addition, the general score $Q_a$, fidelity index $Q_f$, color preference scale $Q_p$ and relative gamut area $Q_g$ are calculated.

| **Remark:** | If the CCT calculation was not possible (see CCT description), then the Color Quality Scale calculation is also not possible. |
|---|---|

#### 5.6.2.1 Chart: CQS Columns

Available in: ‘CQS’, ‘Custom’ presets.



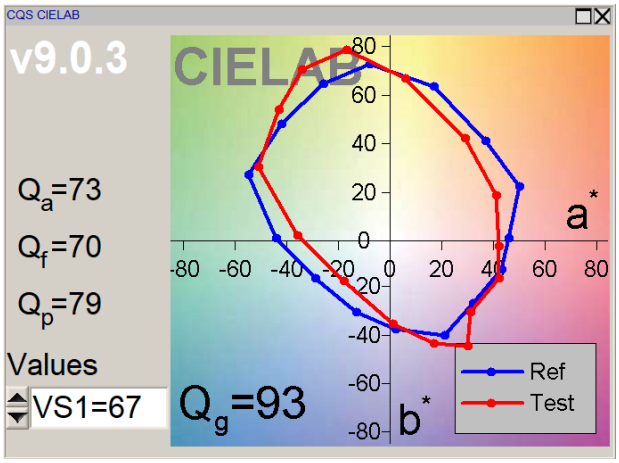

This widget displays CQS relevant values as a column chart except $Q_g$, which is not scaled to the range of 0 to 100 and, therefore, cannot be displayed in the same diagram.

**Relevant settings:**

None.

#### 5.6.2.2 Chart: CQS CIELAB

Available in: ‘CQS’, ‘Custom’ presets.




The widget displays colors of reference and test light sources for each CQS color sample in the CIELAB coordinate system. The general score $Q_a$, fidelity index $Q_f$, color preference scale $Q_p$ and relative gamut area $Q_g$ are also displayed. Individual $VS_x$ values can be read up from the ‘Values’ control.

**Relevant settings:**

None.

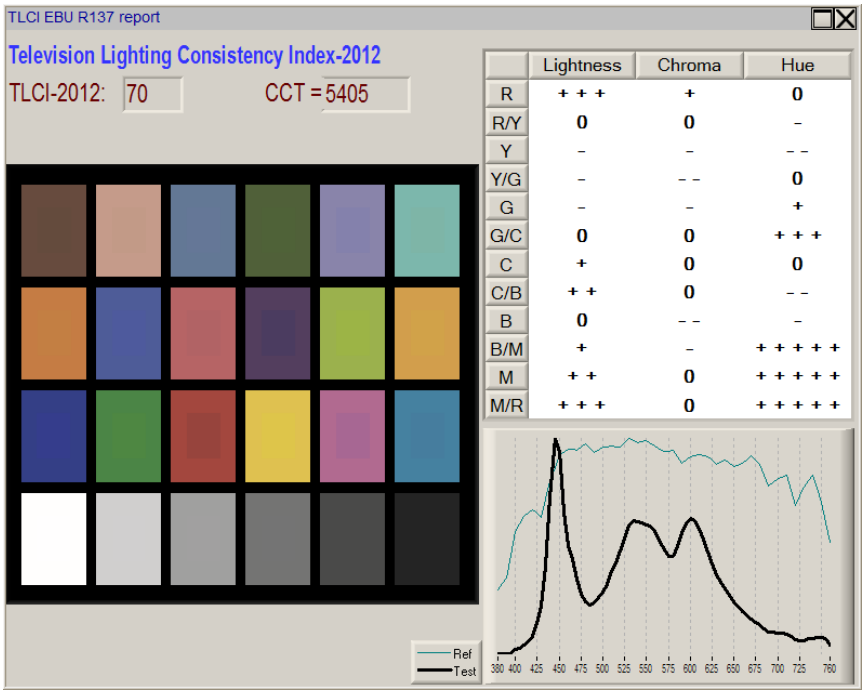
### 5.6.3 TLCI & TLMF EBU R137

Television Lighting Consistency Index 2012 and Television Luminaire Matching Factor 2013 calculations are done according to the software and documentation of EBU Tech 3353—3355 (see https://tech.ebu.ch/tv-lighting--consistency-index-2).

| **Remark:** | If the CCT calculation was not possible (see CCT description), then TLCI and TLMF calculations are also not possible. |
|---|---|

#### 5.6.3.1 Chart: TLCI EBU R137 Report

Available in: ‘TLCI-2012’, ‘Custom’ presets.




The widget displays ‘Colorists advice table’, final $Q_a$ value, color samples for test and reference light sources and schematic graphs with spectra like the native EBU software does.

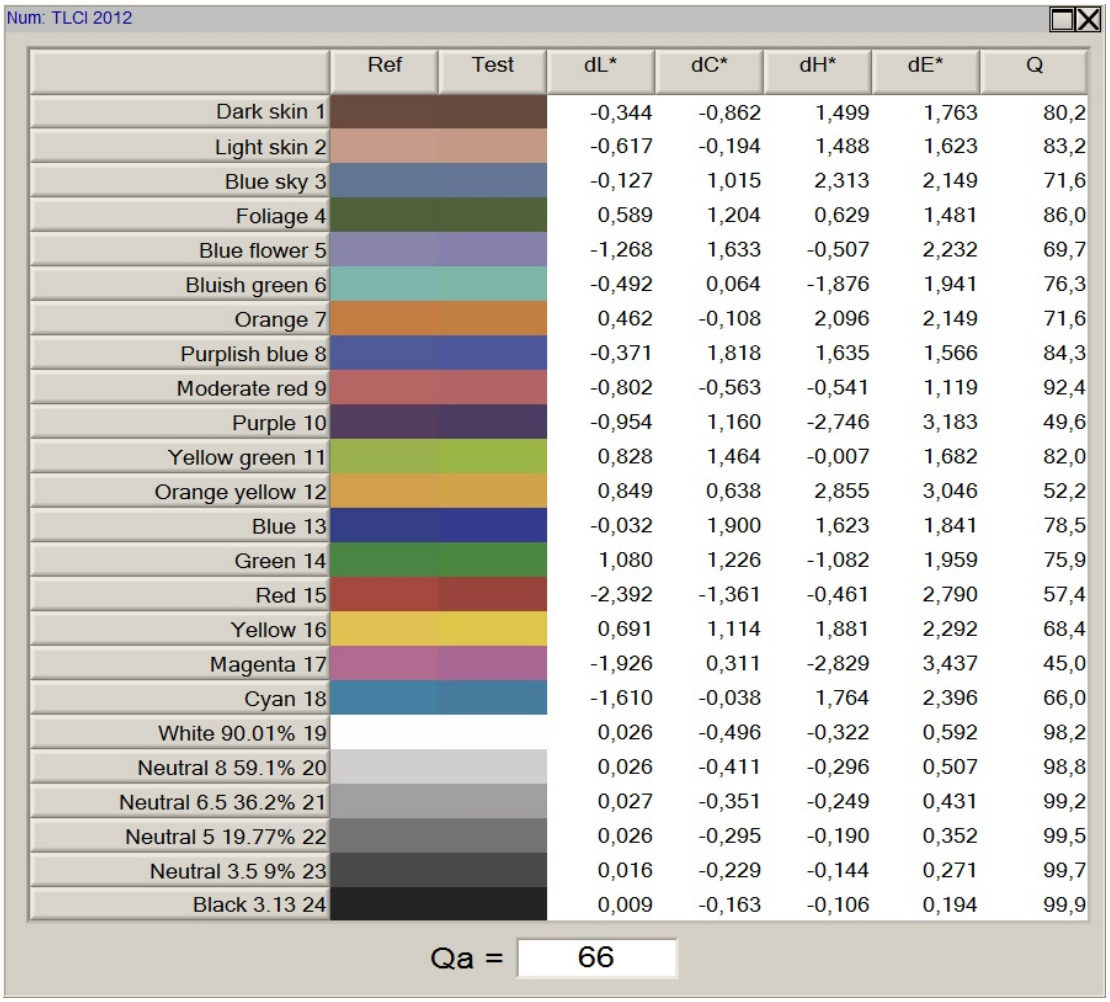
**Relevant settings:**

None.

### 5.6.3.2 Num: TLCI 2012

Available in: ‘Custom’ preset.




| | Ref | Test | dL* | dC* | dH* | dE* | Q |
|---|---|---|---|---|---|---|---|
| Dark skin 1 | | | -0,344 | -0,862 | 1,499 | 1,763 | 80,2 |
| Light skin 2 | | | -0,617 | -0,194 | 1,488 | 1,623 | 83,2 |
| Blue sky 3 | | | -0,127 | 1,015 | 2,313 | 2,149 | 71,6 |
| Foliage 4 | | | 0,589 | 1,204 | 0,629 | 1,481 | 86,0 |
| Blue flower 5 | | | -1,268 | 1,633 | -0,507 | 2,232 | 69,7 |
| Bluish green 6 | | | -0,492 | 0,064 | -1,876 | 1,941 | 76,3 |
| Orange 7 | | | 0,462 | -0,108 | 2,096 | 2,149 | 71,6 |
| Purplish blue 8 | | | -0,371 | 1,818 | 1,635 | 1,566 | 84,3 |
| Moderate red 9 | | | -0,802 | -0,563 | -0,541 | 1,119 | 92,4 |
| Purple 10 | | | -0,954 | 1,160 | -2,746 | 3,183 | 49,6 |
| Yellow green 11 | | | 0,828 | 1,464 | -0,007 | 1,682 | 82,0 |
| Orange yellow 12 | | | 0,849 | 0,638 | 2,855 | 3,046 | 52,2 |
| Blue 13 | | | -0,032 | 1,900 | 1,623 | 1,841 | 78,5 |
| Green 14 | | | 1,080 | 1,226 | -1,082 | 1,959 | 75,9 |
| Red 15 | | | -2,392 | -1,361 | -0,461 | 2,790 | 57,4 |
| Yellow 16 | | | 0,691 | 1,114 | 1,881 | 2,292 | 68,4 |
| Magenta 17 | | | -1,926 | 0,311 | -2,829 | 3,437 | 45,0 |
| Cyan 18 | | | -1,610 | -0,038 | 1,764 | 2,396 | 66,0 |
| White 90.01% 19 | | | 0,026 | -0,496 | -0,322 | 0,592 | 98,2 |
| Neutral 8 59.1% 20 | | | 0,026 | -0,411 | -0,296 | 0,507 | 98,8 |
| Neutral 6.5 36.2% 21 | | | 0,027 | -0,351 | -0,249 | 0,431 | 99,2 |
| Neutral 5 19.77% 22 | | | 0,026 | -0,295 | -0,190 | 0,352 | 99,5 |
| Neutral 3.5 9% 23 | | | 0,016 | -0,229 | -0,144 | 0,271 | 99,7 |
| Black 3.13 24 | | | 0,009 | -0,163 | -0,106 | 0,194 | 99,9 |

Qa = 66

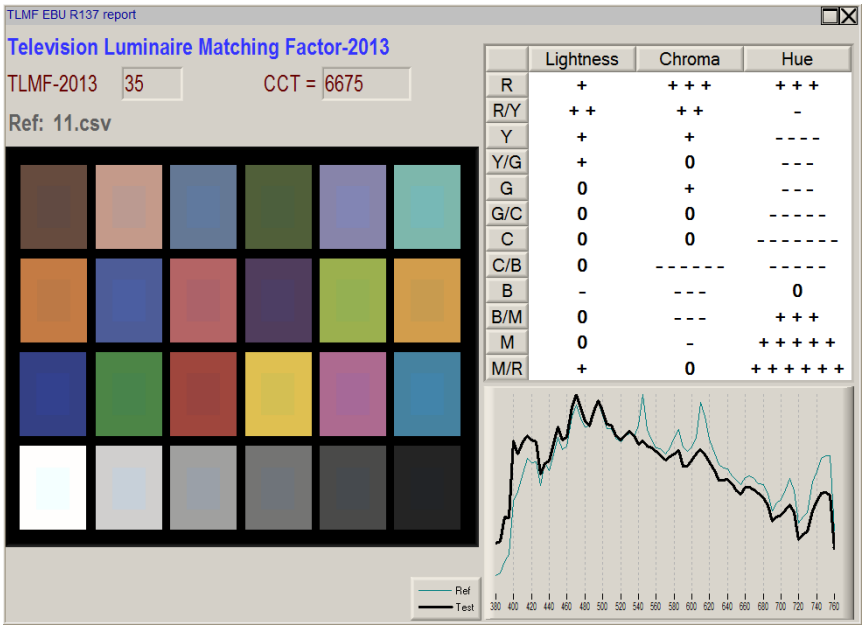
The widget displays individual color differences for reference and test light samples.

**Relevant settings:**

None.

### 5.6.3.3 Chart: TLMF EBU R137 Report

Available in: ‘Custom’ preset.



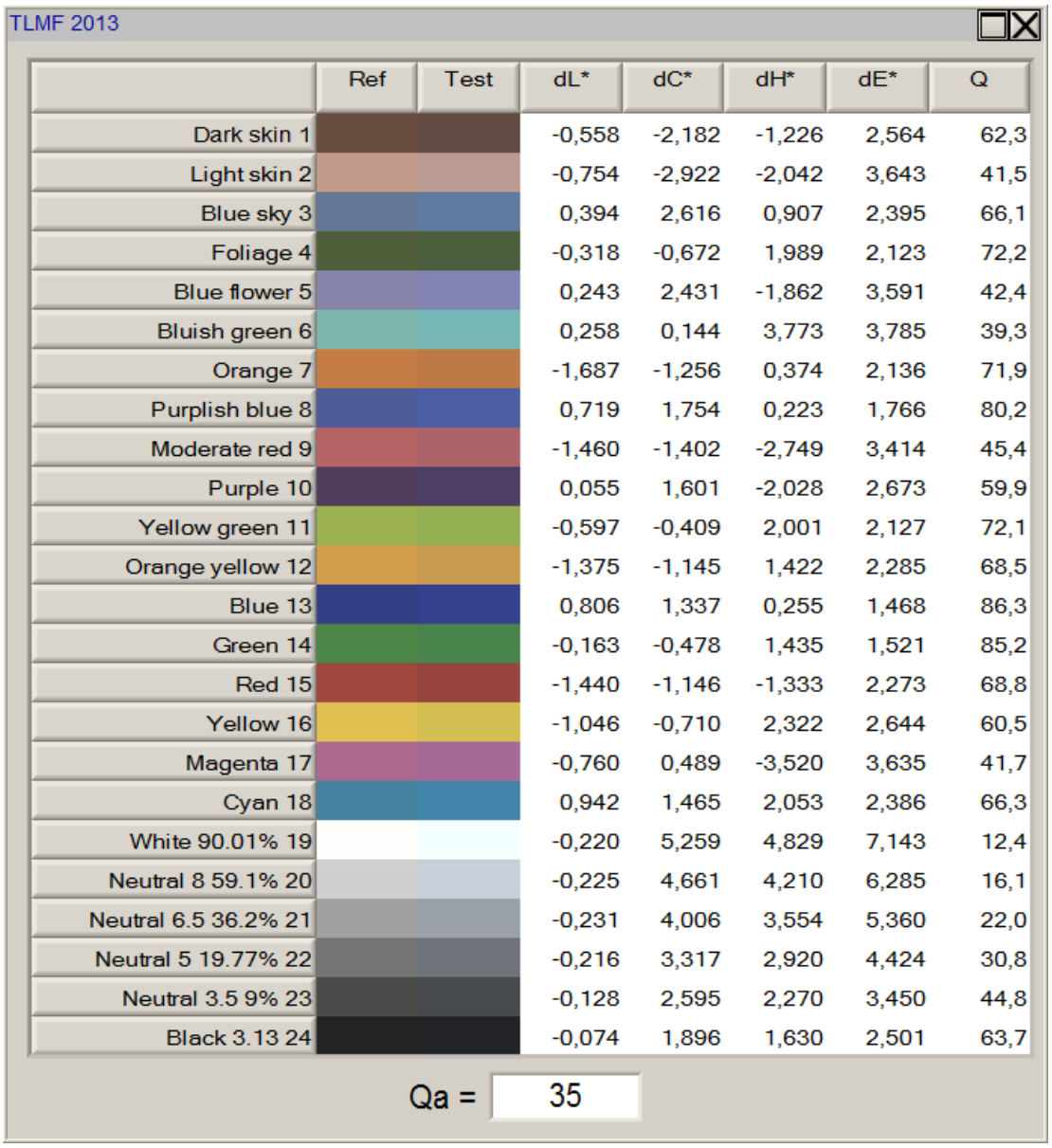

The widget displays ‘Colorists advice table’, final $Q_a$ value, color samples for test and reference light sources and schematic graphs with spectra like the native EBU software does. The only differences from the TLCI widget are labeling and that the file name of the reference spectrum is also specified.

**Relevant settings:**

Reference spectrum as file: Options > TLMF

#### 5.6.3.4 Num: TLMF 2013

Available in: ‘Custom’ preset.




| | Ref | Test | dL* | dC* | dH* | dE* | Q |
|---|---|---|---|---|---|---|---|
| Dark skin 1 | | | -0,558 | -2,182 | -1,226 | 2,564 | 62,3 |
| Light skin 2 | | | -0,754 | -2,922 | -2,042 | 3,643 | 41,5 |
| Blue sky 3 | | | 0,394 | 2,616 | 0,907 | 2,395 | 66,1 |
| Foliage 4 | | | -0,318 | -0,672 | 1,989 | 2,123 | 72,2 |
| Blue flower 5 | | | 0,243 | 2,431 | -1,862 | 3,591 | 42,4 |
| Bluish green 6 | | | 0,258 | 0,144 | 3,773 | 3,785 | 39,3 |
| Orange 7 | | | -1,687 | -1,256 | 0,374 | 2,136 | 71,9 |
| Purplish blue 8 | | | 0,719 | 1,754 | 0,223 | 1,766 | 80,2 |
| Moderate red 9 | | | -1,460 | -1,402 | -2,749 | 3,414 | 45,4 |
| Purple 10 | | | 0,055 | 1,601 | -2,028 | 2,673 | 59,9 |
| Yellow green 11 | | | -0,597 | -0,409 | 2,001 | 2,127 | 72,1 |
| Orange yellow 12 | | | -1,375 | -1,145 | 1,422 | 2,285 | 68,5 |
| Blue 13 | | | 0,806 | 1,337 | 0,255 | 1,468 | 86,3 |
| Green 14 | | | -0,163 | -0,478 | 1,435 | 1,521 | 85,2 |
| Red 15 | | | -1,440 | -1,146 | -1,333 | 2,273 | 68,8 |
| Yellow 16 | | | -1,046 | -0,710 | 2,322 | 2,644 | 60,5 |
| Magenta 17 | | | -0,760 | 0,489 | -3,520 | 3,635 | 41,7 |
| Cyan 18 | | | 0,942 | 1,465 | 2,053 | 2,386 | 66,3 |
| White 90.01% 19 | | | -0,220 | 5,259 | 4,829 | 7,143 | 12,4 |
| Neutral 8 59.1% 20 | | | -0,225 | 4,661 | 4,210 | 6,285 | 16,1 |
| Neutral 6.5 36.2% 21 | | | -0,231 | 4,006 | 3,554 | 5,360 | 22,0 |
| Neutral 5 19.77% 22 | | | -0,216 | 3,317 | 2,920 | 4,424 | 30,8 |
| Neutral 3.5 9% 23 | | | -0,128 | 2,595 | 2,270 | 3,450 | 44,8 |
| Black 3.13 24 | | | -0,074 | 1,896 | 1,630 | 2,501 | 63,7 |

Qa = 35

The widget displays individual color differences for reference and test light samples.

**Relevant settings:**

Reference spectrum as file: Options > TLMF

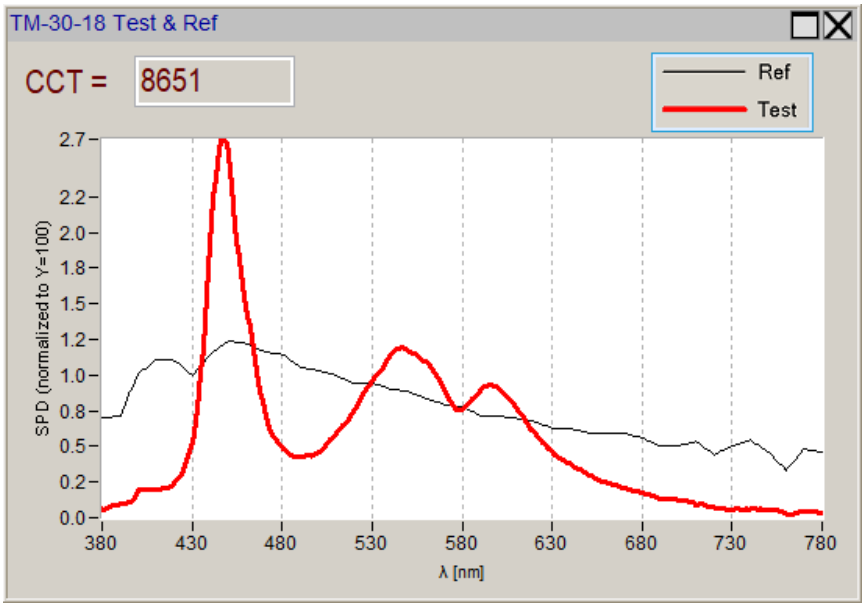
### 5.6.4 IES TM-30-18

IES TM-30-18 is a method of quantifying of the color rendition characteristics of a light source. 99 CES (color evaluation samples) with known spectral reflectance functions are analyzed for the light source with the measured spectrum and an ideal reference light source. Results are grouped by their hue values into 16 groups 'hue bins'. From a comparison of results for the both light sources two values are derived: $R_f$ (fidelity, 'closeness to reference') and $R_g$ (gamut, 'increase or decrease in chroma').

| | |
|---|---|
| **Remark:** | If the CCT calculation was not possible (see CCT description), then the TM-30-18 calculation is also not possible. |

#### 5.6.4.1 Chart: TM-30-18 Test&Ref

Available in: 'IES TM-30', 'Custom' presets.




The widget displays Correlated Color Temperature, the measured spectrum and generated on the basis of CCT reference spectrum, which is either daylight or Planckian standard illuminant, or a mixture of both (as native IES TM-30-18 calculation tool does).

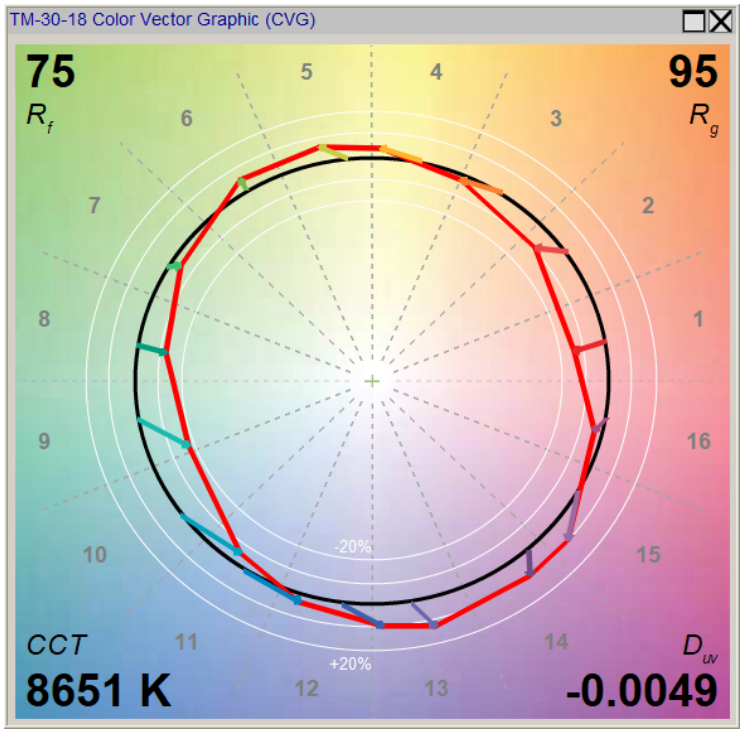
**Relevant settings:**

None.

### 5.6.4.2 Chart: TM-30-18 Color Vector Graphic (CVG)

Available in: ‘IES TM-30’, ‘Custom’ presets.



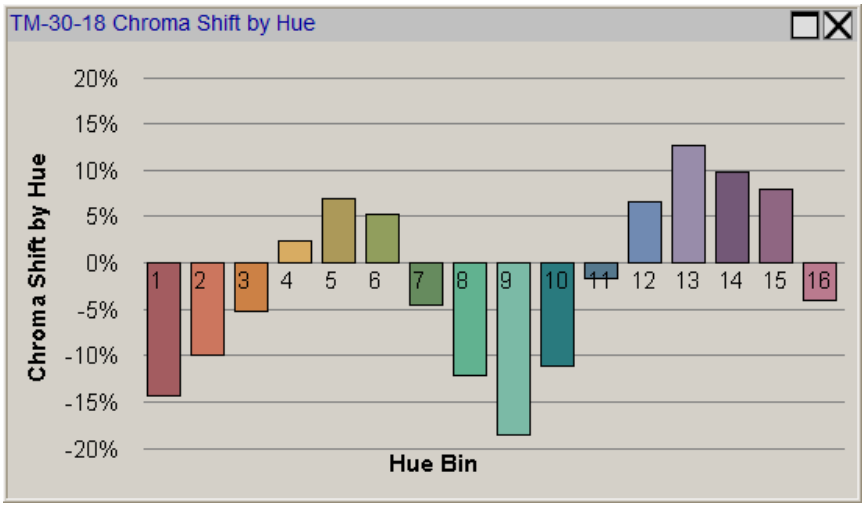

The widget displays a color vector graphic in Lab-color space.

**Relevant settings:**

Color Vector Graphic (CVG) chart options: Options » TM-30

#### 5.6.4.3 Chart: TM-30-18 Chroma Shift by Hue

Available in: ‘IES TM-30’, ‘Custom’ presets.



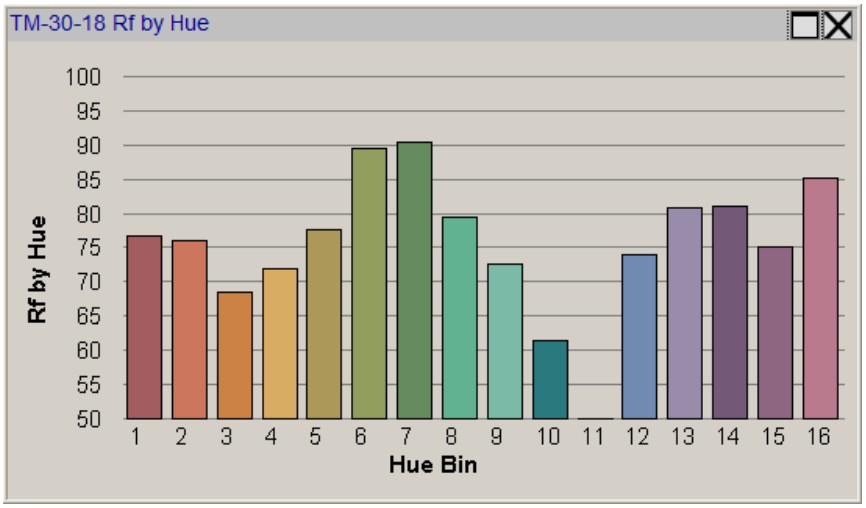

The widget displays chroma shifts for every hue bin.

**Relevant settings:**

None.

#### 5.6.4.4 Chart: TM-30-18 $\mathrm{R_f}$ by Hue

Available in: ‘IES TM-30’, ‘Custom’ presets.



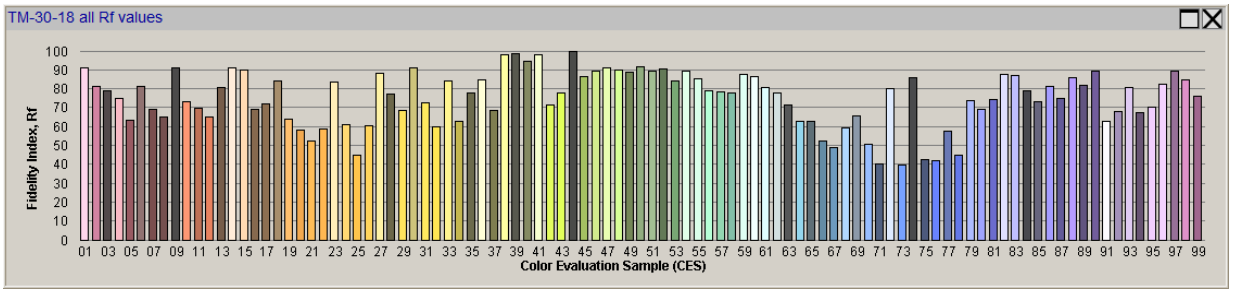

The widget displays individual values of fidelity index $R_f$ for every hue bin.

**Relevant settings:**

None.

### 5.6.4.5 Chart: TM-30-18 All $\mathrm{R_f}$ Values

Available in: 'IES TM-30', 'Custom' presets.



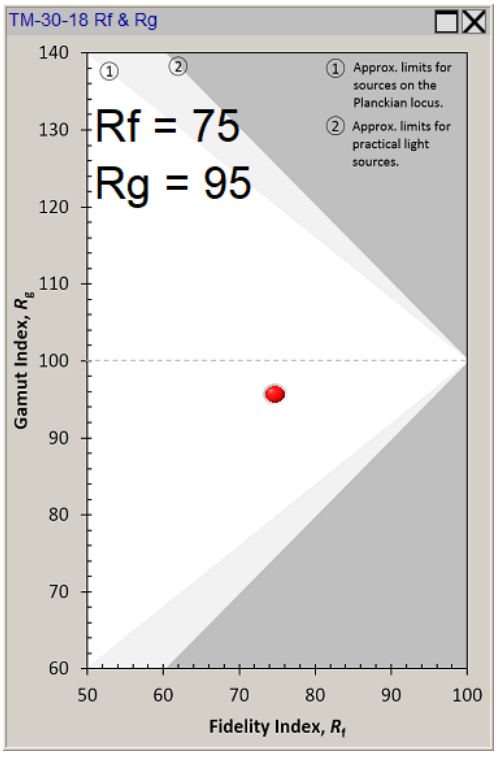

The widget displays individual values of fidelity index $R_f$ for every color evaluation sample (CES).

**Relevant settings:**

None.

### 5.6.4.6 Chart: TM-30-18 $\mathrm{R_f}$&$\mathrm{R_g}$

Available in: 'IES TM-30', 'Custom' presets.



The widget displays gamut and fidelity indices as a point with coordinates ($R_f$, $R_g$). The light source has the best color rendition properties if the point is in the corner of the white area.

**Relevant settings:**

Show/hide $R_f$ and $R_g$ values, their precision and font size: Options > TM-30

#### 5.6.4.7 Num: TM-30-18 Table

Available in: 'IES TM-30', 'Custom' presets.

TM-30-18 Table

| | | Graphic shifts (%) | |
|---|---|---|---|
| Hue Bin | Rf | Chroma | Hue |
| 1 | 77 | -14% | -2% |
| 2 | 76 | -10% | 9% |
| 3 | 68 | -5% | 18% |
| 4 | 72 | 2% | 18% |
| 5 | 78 | 7% | 10% |
| 6 | 90 | 5% | -1% |
| 7 | 90 | -5% | -4% |
| 8 | 79 | -12% | 1% |
| 9 | 73 | -19% | 15% |
| 10 | 61 | -11% | 28% |
| 11 | 45 | -2% | 28% |
| 12 | 74 | 7% | 18% |
| 13 | 81 | 13% | 8% |
| 14 | 81 | 10% | -6% |
| 15 | 75 | 8% | -20% |
| 16 | 85 | -4% | -7% |

The widget displays individual $R_f$ values, chroma and hue graphic shifts for every hue bin.

**Relevant settings:**

None.

#### 5.6.4.8 Num: TM-30-18 — $\mathbf{R_f}$, $\mathbf{R_g}$

Available in: ‘IES TM-30’, ‘Custom’ presets.


The widget displays gamut and fidelity indices $R_f$ and $R_g$ as numbers.

**Relevant settings:**

Precision of $R_f$ & $R_g$: Options » TM-30

### 5.6.5 CIE2017 Color Fidelity Index (CFI)

Color Fidelity Index (CFI) can be seen as a further improvement of IES TM-30 method. It also uses 99 samples called Test Color Samples (TCS) which are rather similar but not exactly the same as Color Evaluation Samples used in TM-30.

| | |
|---|---|
| **Remark:** | If the CCT calculation was not possible (see CCT description), then the CFI calculation is also not possible. |

#### 5.6.5.1 Num: CIE2017 Color Fidelity Index

Available in: ‘Custom’ preset.

CIE2017 Color Fidelity Index

| Rf | Rf1 | Rf2 | Rf3 | Rf4 | Rf5 | Rf6 | Rf7 | Rf8 | Rf9 |
|---|---|---|---|---|---|---|---|---|---|
| 78.9 | 91.6 | 83.1 | 82.6 | 84.1 | 67.5 | 84.0 | 73.9 | 68.7 | 94.8 |
| **Rf10** | **Rf11** | **Rf12** | **Rf13** | **Rf14** | **Rf15** | **Rf16** | **Rf17** | **Rf18** | **Rf19** |
| 81.3 | 79.9 | 76.3 | 82.9 | 92.6 | 90.3 | 71.1 | 76.6 | 84.8 | 73.8 |
| **Rf20** | **Rf21** | **Rf22** | **Rf23** | **Rf24** | **Rf25** | **Rf26** | **Rf27** | **Rf28** | **Rf29** |
| 58.3 | 64.1 | 66.7 | 85.7 | 69.1 | 57.8 | 66.3 | 88.8 | 80.2 | 68.3 |
| **Rf30** | **Rf31** | **Rf32** | **Rf33** | **Rf34** | **Rf35** | **Rf36** | **Rf37** | **Rf38** | **Rf39** |
| 84.7 | 71.7 | 62.2 | 79.7 | 67.7 | 81.3 | 91.3 | 73.4 | 92.5 | 96.3 |
| **Rf40** | **Rf41** | **Rf42** | **Rf43** | **Rf44** | **Rf45** | **Rf46** | **Rf47** | **Rf48** | **Rf49** |
| 91.0 | 94.0 | 72.7 | 75.5 | 99.0 | 83.9 | 86.1 | 88.0 | 85.8 | 84.5 |
| **Rf50** | **Rf51** | **Rf52** | **Rf53** | **Rf54** | **Rf55** | **Rf56** | **Rf57** | **Rf58** | **Rf59** |
| 91.5 | 91.5 | 90.9 | 83.3 | 91.6 | 89.5 | 81.5 | 80.7 | 81.4 | 91.1 |
| **Rf60** | **Rf61** | **Rf62** | **Rf63** | **Rf64** | **Rf65** | **Rf66** | **Rf67** | **Rf68** | **Rf69** |
| 91.5 | 87.7 | 86.1 | 73.4 | 74.1 | 69.9 | 65.4 | 62.9 | 70.7 | 76.0 |
| **Rf70** | **Rf71** | **Rf72** | **Rf73** | **Rf74** | **Rf75** | **Rf76** | **Rf77** | **Rf78** | **Rf79** |
| 62.2 | 53.8 | 85.1 | 52.8 | 91.7 | 54.3 | 52.4 | 69.3 | 54.6 | 80.3 |
| **Rf80** | **Rf81** | **Rf82** | **Rf83** | **Rf84** | **Rf85** | **Rf86** | **Rf87** | **Rf88** | **Rf89** |
| 75.6 | 79.9 | 89.7 | 87.8 | 85.8 | 80.3 | 81.0 | 79.9 | 86.7 | 80.4 |
| **Rf90** | **Rf91** | **Rf92** | **Rf93** | **Rf94** | **Rf95** | **Rf96** | **Rf97** | **Rf98** | **Rf99** |
| 88.2 | 75.9 | 70.9 | 82.7 | 66.9 | 74.9 | 83.6 | 85.3 | 84.3 | 78.7 |

Displays all special color fidelity indices $R_{f,i}$ and the general color fidelity index $R_f$ as a table.

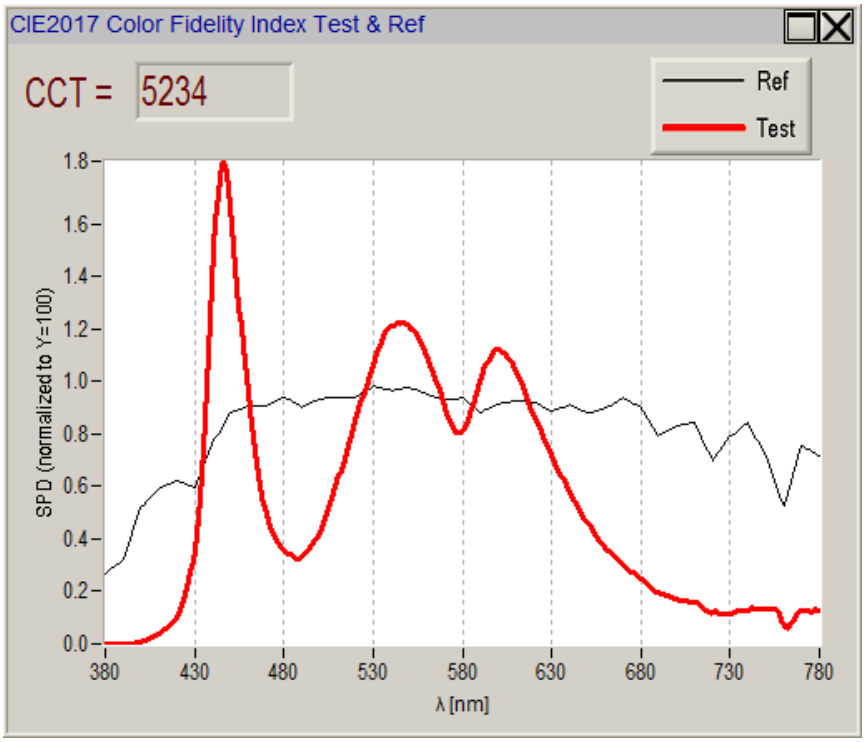
**Relevant settings:**

None.

#### 5.6.5.2 Num: CIE2017 Color Fidelity Index Test & Ref

Available in: ‘Custom’ preset.



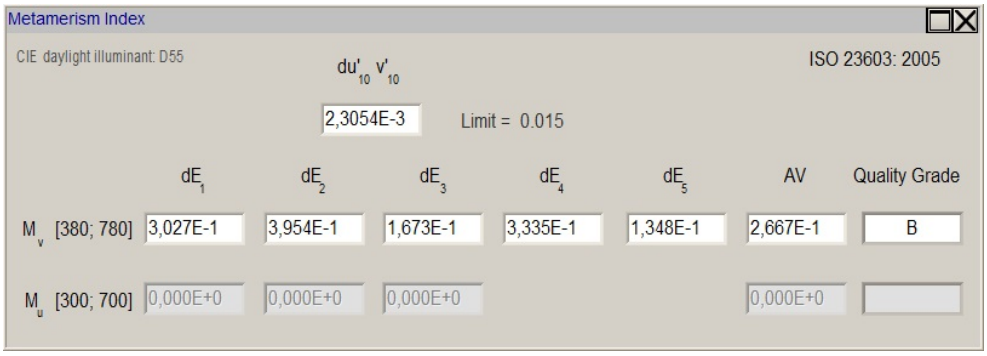

The widget displays Correlated Color Temperature, the measured spectrum and generated on the basis of CCT reference spectrum, which is either daylight or Planckian standard illuminant, or a mixture of both.

**Relevant settings:**

None.

#### 5.6.6 Num: Metamerism Index

Available in: ‘Custom’ preset.



Calculates metamerism values $M_v$ and $M_u$ according to ISO 23603:2005.
$M_u$ will be calculated only if a **specbos 1211 UV** is used.

Color difference $du'_{10}v'_{10}$ of the actual spectrum and the selected reference illuminant is calculated. The field is marked with red if the limit of 0.015 is exceeded.
The individual $dE$ of the metameric samples are shown in addition to the average values $M_v$ and $M_u$.
Furthermore, the related quality grade is displayed.

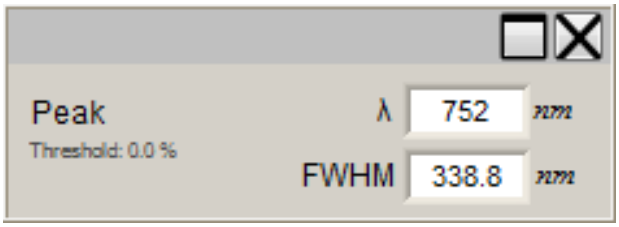
**Relevant settings:**

Reference illuminant: Options > Metamerism

## 5.7 LED Values

### 5.7.1 Num: Peak WL & FWHM

Available in: 'Custom' preset.




This widget displays the peak wavelength of a spectrum and the belonging width (FWHM–Full Width at Half of Maximum). This is especially of interest for LED and similar spectra.

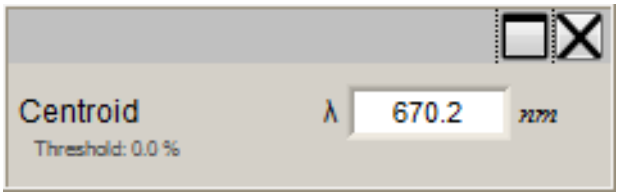
**Relevant settings:**

Threshold for calculations of peak wavelength and FWHM: Options > LED

### 5.7.2 Num: Centroid WL

Available in: ‘Custom’ preset.



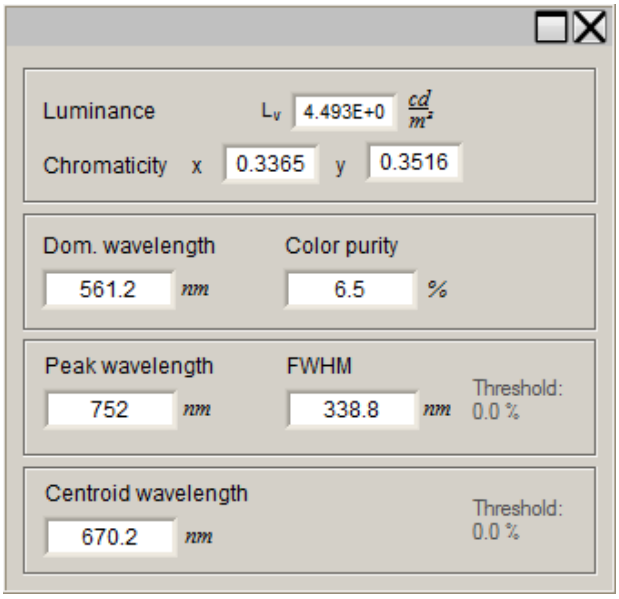

This widget displays the centroid wavelength of a spectrum. This is especially of interest for LED and similar spectra.

**Relevant settings:**

Threshold for centroid calculation: Options > LED

### 5.7.3 Num: LED Summary

Available in: ‘Custom’ preset.



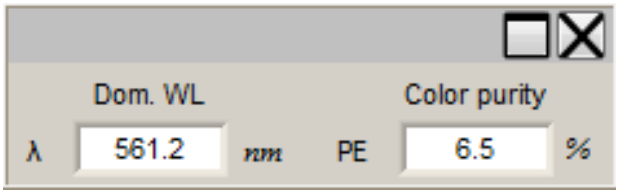

The widget displays a summary of the main optical values of LEDs.

**Relevant settings:**

Observer: Options > Observer
Luminous Efficiency Function: Options > Luminous Efficiency Function
Photometric units: Options > Photometric Units
Thresholds for calculation of peak wavelength, FWHM and centroid: Options > LED

### 5.7.4 Num: Dom. WL & Color Purity

Available in: ‘Custom’ preset.




This widget displays the dominant wavelength and the color purity, calculated from the actual spectrum.

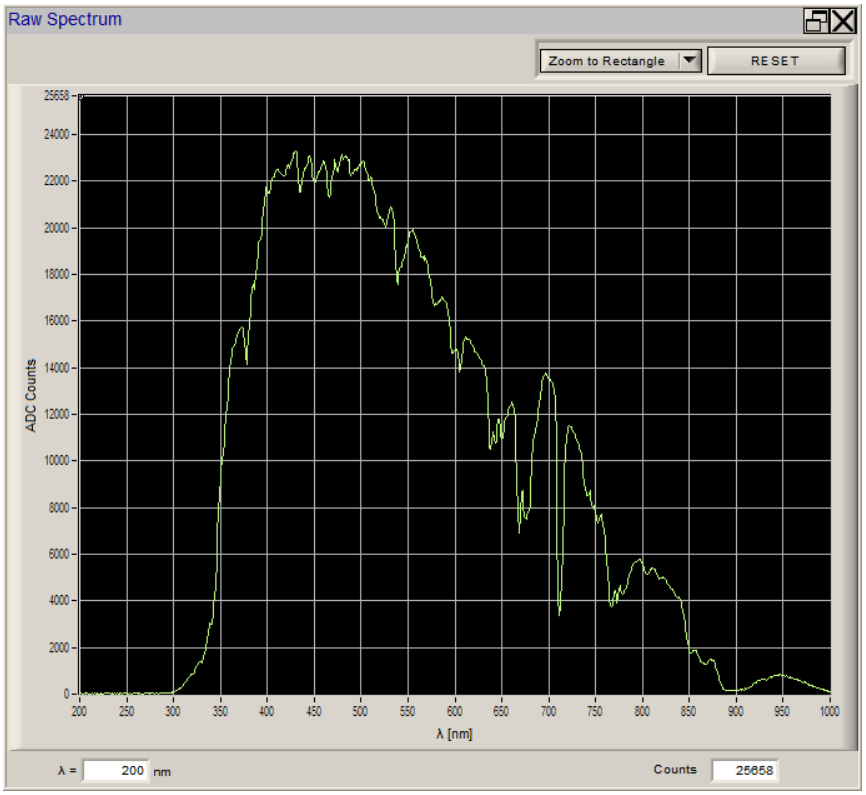
**Relevant settings:**

Observer: Options/ Observer

## 5.8 Other

### 5.8.1 Chart: Raw Spectrum

Available in: ‘Raw spectrum’, ‘Custom’ presets.



This displays the raw data of a measurement. This can be useful sometimes, e.g. if the general characteristics of the measured spectrum outside the calibrated range are of interest. The raw spectrum is the basis for all radiometric calculations.

**Widget Options:**

**Zoom**

Similar as in chapter 5.4.1 ‘Chart: Spectrum’, page 38.

**Spectrum range**

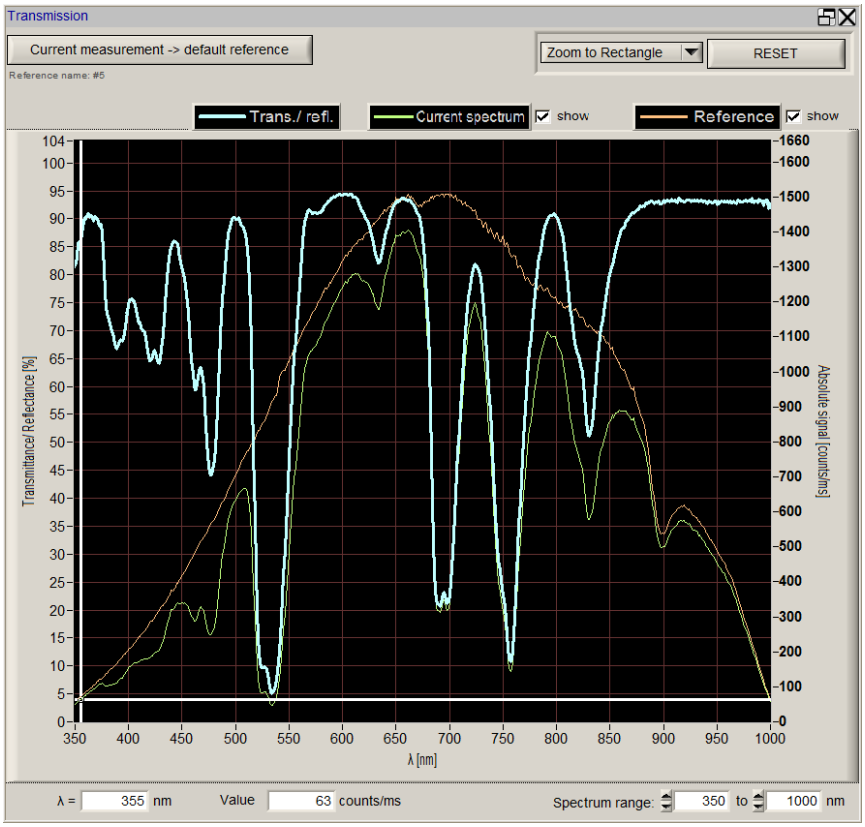
Similar as in chapter 5.4.1 ‘Chart: Spectrum’, page 38.

**Relevant settings:**

None.

### 5.8.2 Chart: Transmission

Available in: ‘Custom’ preset.



This widget displays results of transmission calculations performed on the basis of raw data. Note that reference and current spectrum graphs displayed in the widget have not counts as units but $\mathrm{counts\,ms^{-1}}$; reference spectrum and current spectrum can be taken with different integration time and normalization to it is necessary to make the spectra comparable.

| | |
|---|---|
| **Note:** | Transmission measurements are based on raw spectra to make it possible to use even uncalibrated devices. It allows to use data taken beyond the calibrated range. The drawback is that the user is responsible for choosing a reasonable wavelength range by himself.<br>Rule of thumb: use transmission data only in the range for which your device *could* be calibrated (this information you can find in technical data). |

To do a transmission measurement:

- Do a measurement of a light source you want to use as reference.
- Click on Current measurement -> default reference button. The normalized raw spectrum is copied to an internal buffer and will be used as reference for all subsequent measurements. It is also applied as reference to the current measurement, that is why you see a $100\,\%$ transmission line after this operation.
- Place an object whose transmission you want to measure somewhere on the way from the light source to device.
- Do another measurement. Light blue line is the desired transmission.

To perform a reflectance measurement:

- Go to Options > Spectral Weighting Function and load reflectance data of your reference reflector. (Distribution of *JETI LiVal* contains an example reflectance file of a grey diffuse reflector `Example_ReflectanceTarget_20percent.csv` which you can find in `Functions` subfolder of where your *JETI LiVal* is installed).
- Click on Current measurement -> default reference button. The normalized raw spectrum is *divided* by the loaded reflectance data (so you get data for the pure light source without a reference reflector) and is copied to an internal buffer and will be used as reference for all subsequent measurements. It is also applied as reference to the current measurement, that is why you see a transmission line that is equal to the loaded reflectance data after this operation.
- Change the reference reflector to an object whose reflectance you want to measure.
- Do another measurement. Light blue line is the desired reflectance.

**Widget Options:**

**Show**

Checkboxes in the legend let to display/hide the current and the reference spectra. Transmission spectrum is always displayed.

**Zoom**

Similar as in chapter 5.4.1 ‘Chart: Spectrum’, page 38.

**Spectrum range**

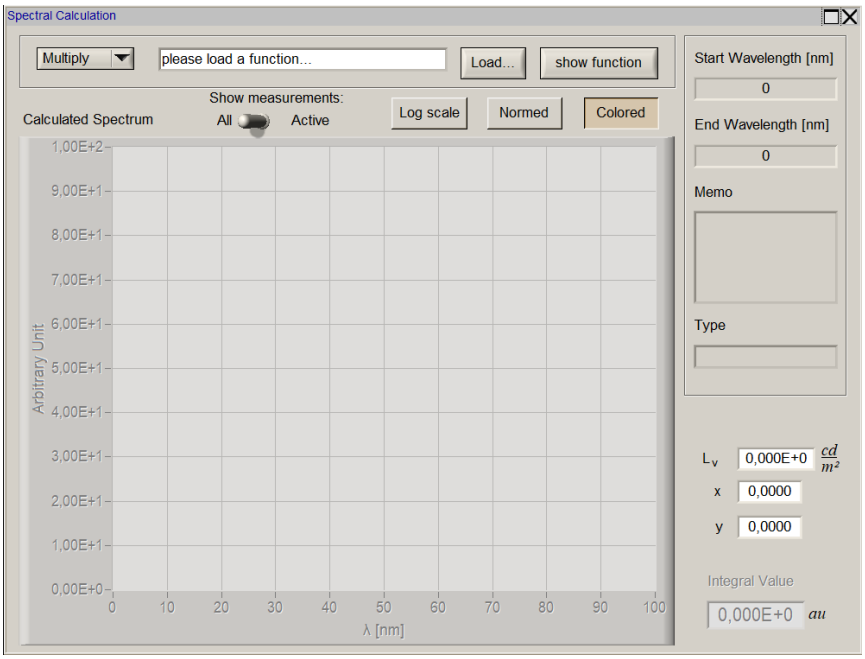
Similar as in chapter 5.4.1 ‘Chart: Spectrum’, page 38.

**Relevant settings:**

Spectral weighting function: Options » Spectral Weighting Function

### 5.8.3 Chart: Spectral Calculation

Available in: ‘Spectral calculation’, ‘Custom’ presets.




Enables the user to make spectral calculations with two spectra or a measured spectrum and a weighting function. The basic operations of $+$, $-$, $\times$ and $\div$ are possible. Select the operation from a drop down menu in the upper left corner of the window.

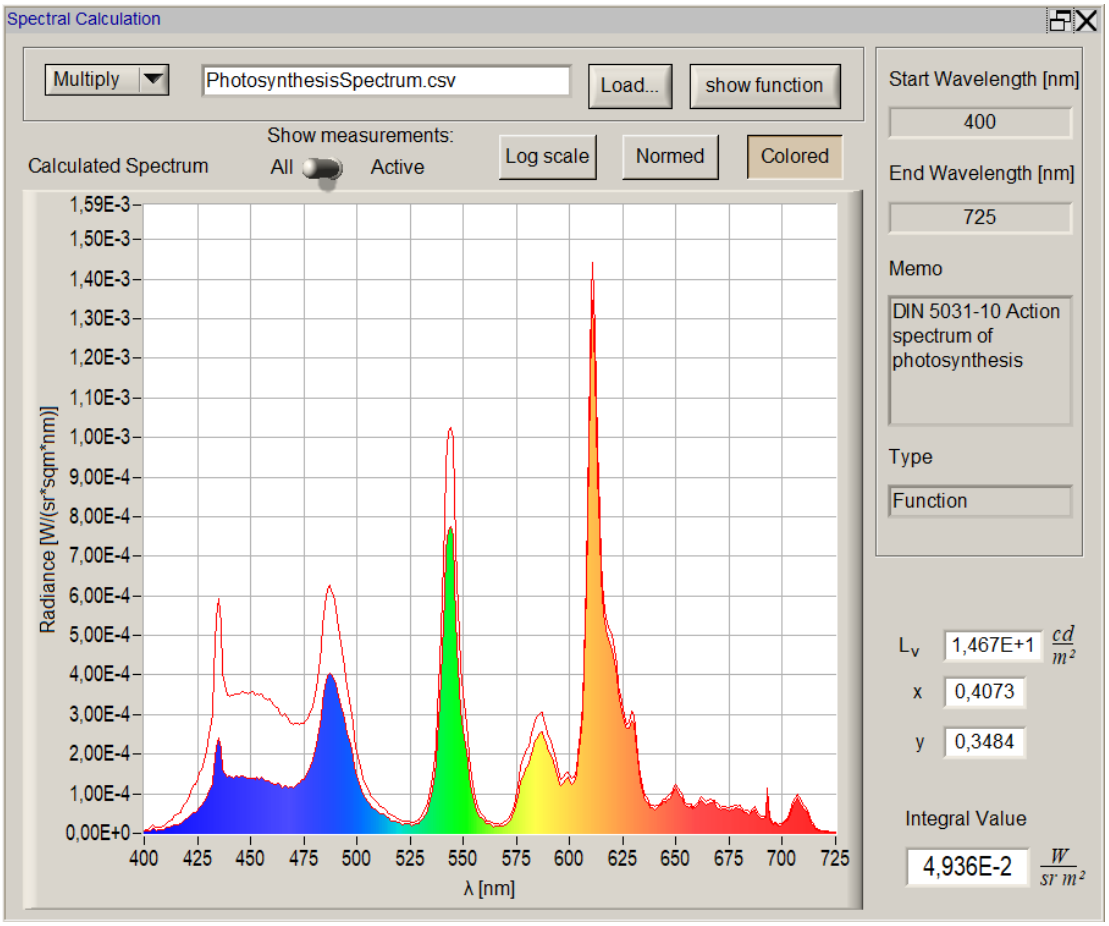
 

The first operand is the active spectrum and the second one (function) can be a reference spectrum (see chapter 7.2 ‘JETI LiVal Own Files’, page 123) or another spectrum in ‘.csv’ format according to the following structure:

*TYPE,FUNCTION*
*Start Wavelength [nm],350*
*End Wavelength [nm],500*
*Number of points,151*
*Memo,EX spectrum G-300M(PS-2)*
*Unit, none*
*Wavelength,Relative Intensity*
*350,0.987719*
*351,0.988889*
*352,0.990643*
*353,0.992982*
*354,0.995906*
*355,1.000000*
*356,0.999415*
*357,1.000000*
*358,0.998830*
*359,0.998830*
*360,0.996491*
*...*

The wavelength step width can be 1 nm or 5 nm.




If the second spectrum is an action spectrum and the operation is selected to Multiply, the result will be a weighted spectrum. If the unit is specified with 'none', the unit of the weighted spectrum will be displayed, otherwise the unit a.u. (arbitrary units) will be used.
The second spectrum / weighting function has to be loaded with the Load button and can be viewed using the show function button.
The spectrum resulting from the calculation is shown in the diagram. Furthermore, an integral value is calculated through integration.
The settings of the spectra calculation will be stored.

The other widget options Log scale, Normed, Colored and the switch Show measurements All / Active function similiar as in chapter 5.4.1 'Chart: Spectrum', page 38.

Examples for the application of weighting functions are the measurement of

- effective radiation for plants in greenhouses;
- damaging radiation for artwork;

- hazardous optical radiation for humans according to directive 2006/25/EC (the weighting functions are contained on the software USB flash drive);
- charging effectivity of phosphorescence displays.

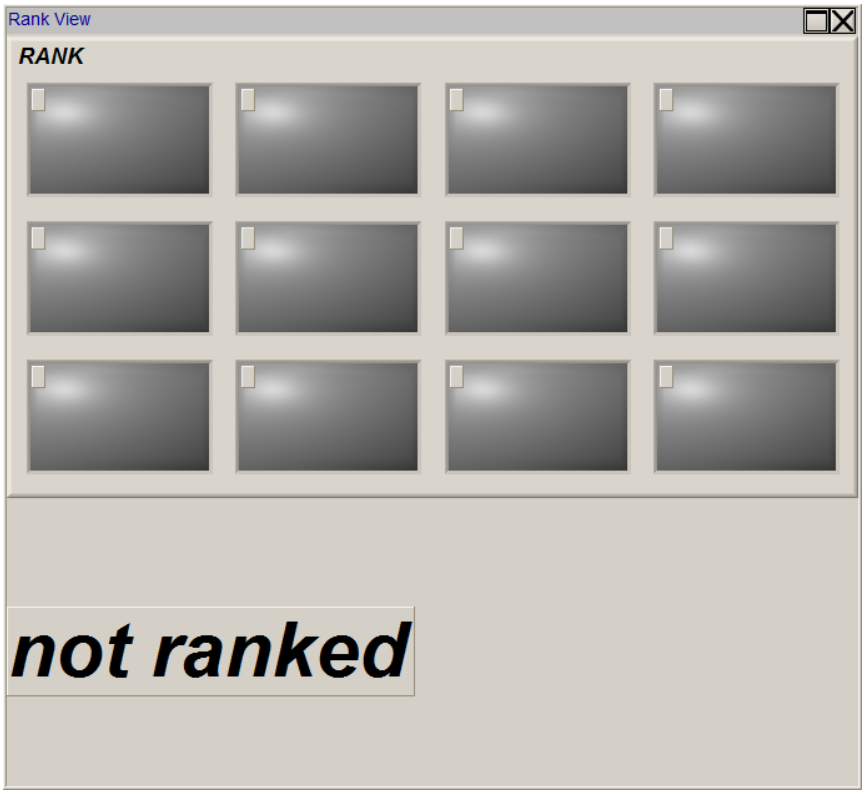
Adequate care has to be exercised during measurements with weighting functions with extreme slopes to obtain accurate results.

**Relevant settings:**

Number Format: Options > Number format

### 5.8.4 Chart: Rank View

Available in: ‘Rank view’, ‘Custom’ presets.

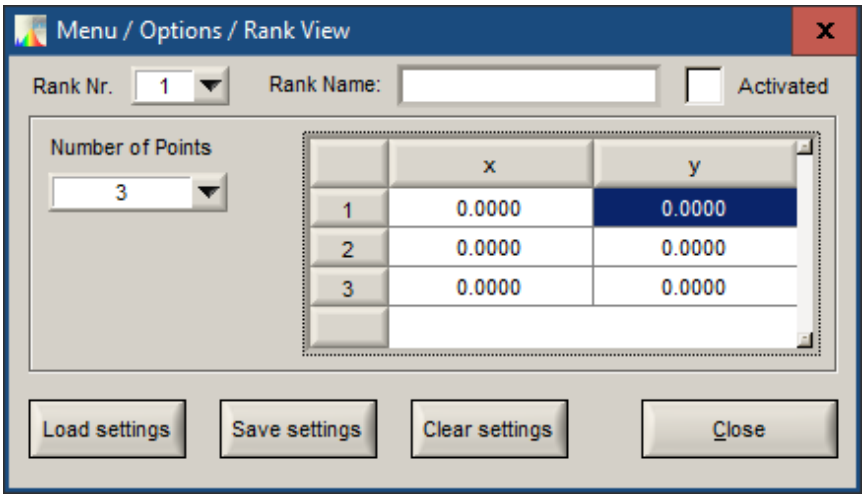



*JETI LiVal* offers the possibility to classify DUTs manually according to their xy chromaticity using the rank view widget.
At the beginning, the borders of the ranks in xy coordinates have to be defined.

**Preparation of Ranks**

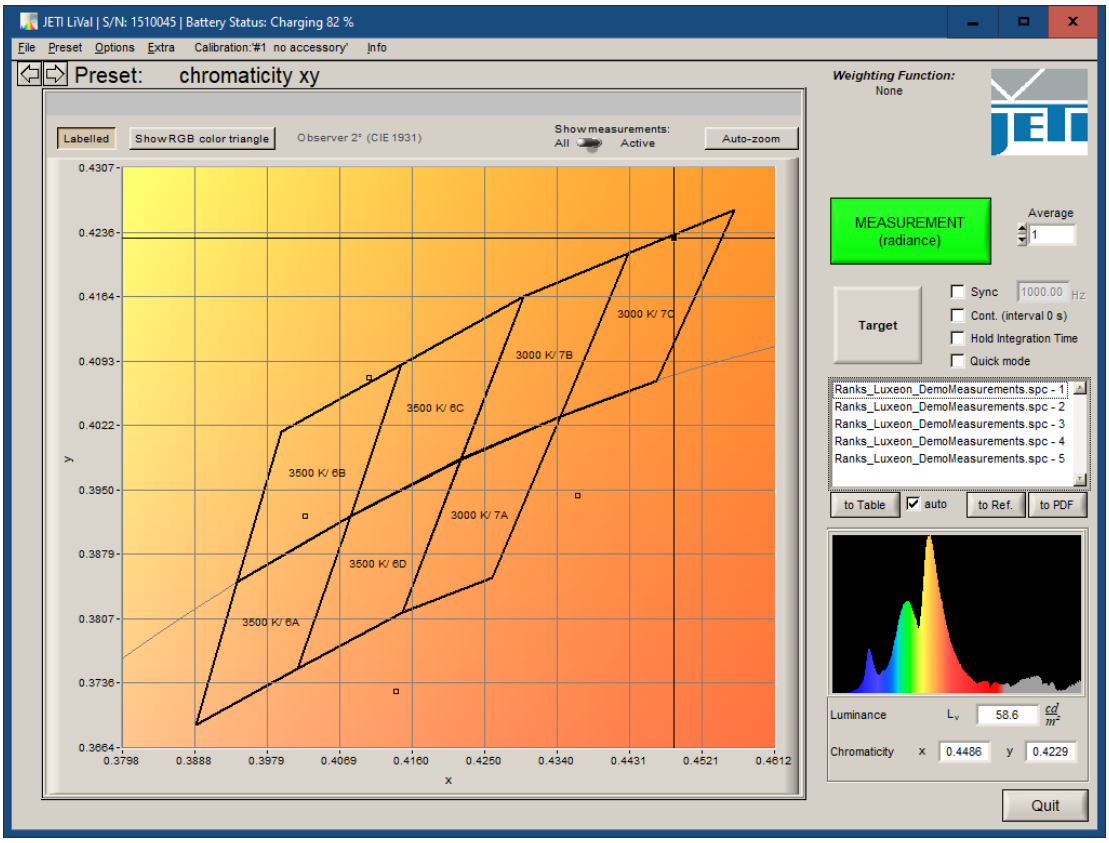
Up to 12 different ranks can be arranged, which are summarized in one rank file. Each

rank has to be defined by a polygon in the xy diagram, which can have up to 8 corners. The menu point Options > Rank View opens the following window:



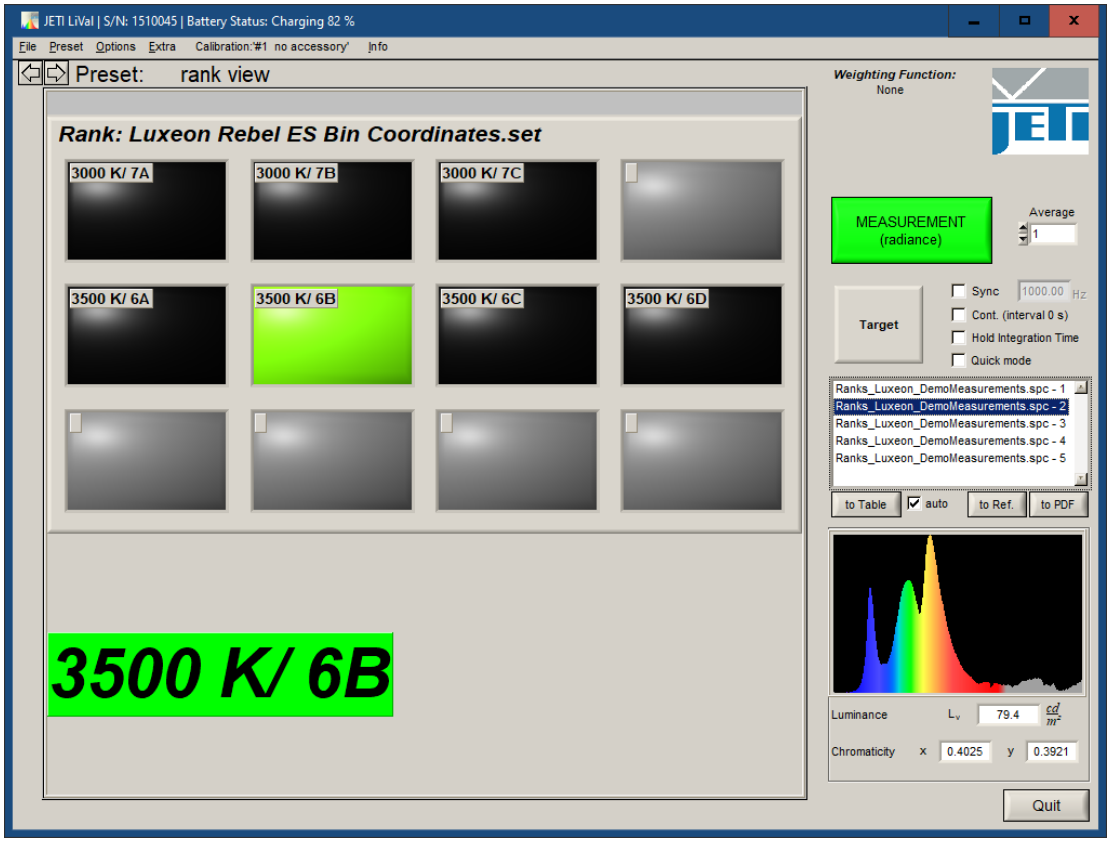

Here it is possible to select the rank number, the number of corners (points), the xy coordinates of the corners and the rank name. If the data of all ranks are specified, the ranks can be stored together within a file via Save settings. Several groups with up to 12 ranks can be stored in different files. Use a distinguishable name for each file. Click Load settings and select the appropriate file if you want to use the ranks for classification. If not all ranks of a file are needed, deactivate the unnecessary ones with the Activated

check box. The deactivated ranks will remain in the file for further use.
The activated ranks will be shown in the xy diagram.

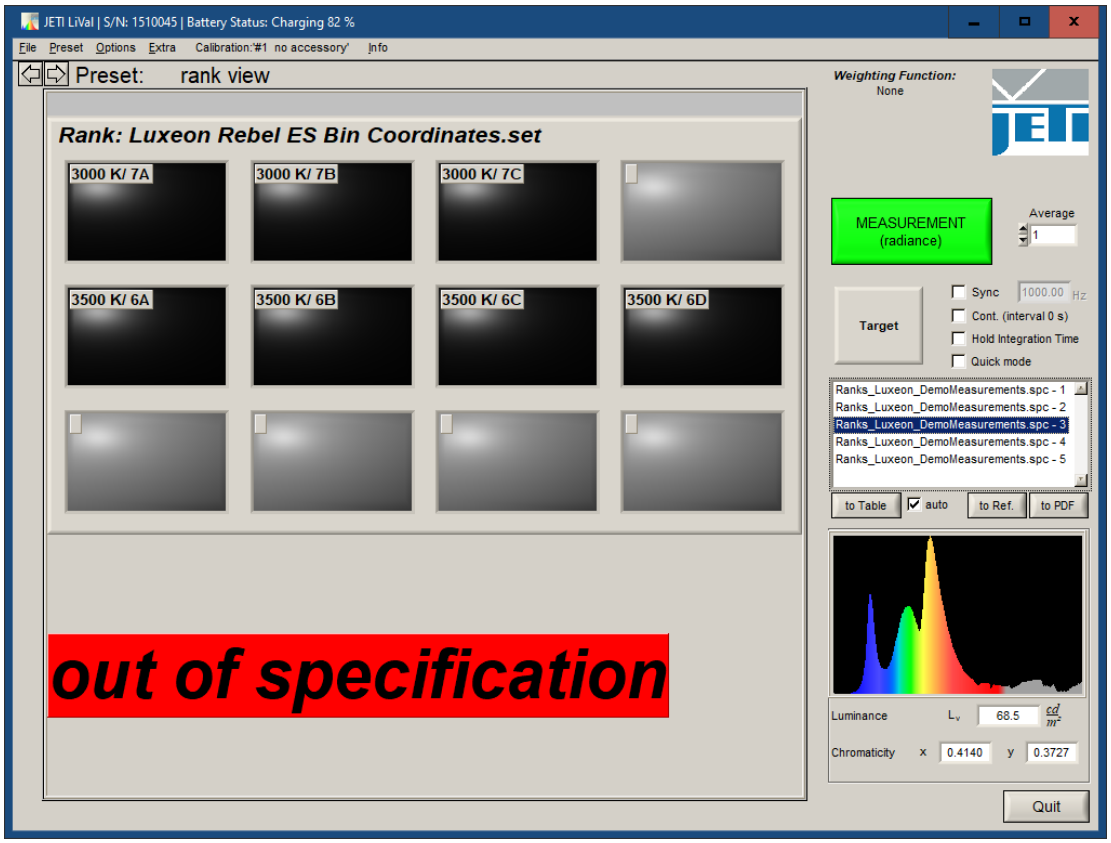



## Usage of Ranks

Open the menu point Preset > Rank view or press F6. A window, showing different boxes for the ranks in addition to the measuring values, will be opened. Once the measured xy coordinates fall into a rank, it is displayed in light green color, and its name is displayed large in the lower part of the window.



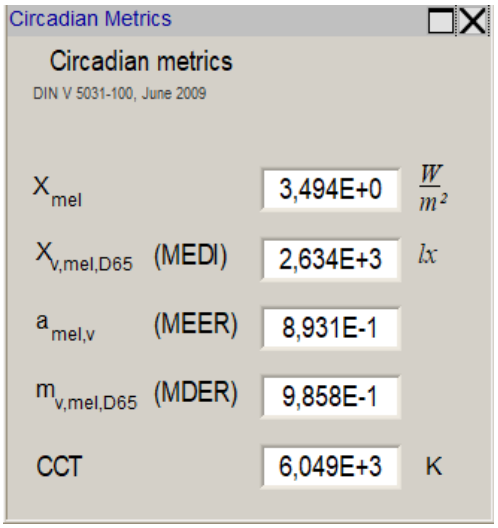

Furthermore, this rank is shown below the boxes. If the measuring result does not fall into any specified rank, the message ‘out of specification’ will be shown.



| **Remark:** | If the xy coordinates lie on a border line, belonging to two different ranks, the first rank in the sequence will be selected. |
|---|---|

### 5.8.5 Num: Circadian Metrics

Available in: 'Custom' preset.




The action spectrum for circadian effects due to suppression of melatonin is implemented in the software. Therefore, it is possible to calculate the circadian radiant value ($X_{mel}$), the melanopic daylight equivalent photometric quantity ($X_{v,mel,D65}$), the melanopic action factor ($a_{mel,v}$) and the melanopic daylight efficacy ratio ($m_{v,mel,D65}$) of a light source. This is only possible in Irradiance measurement mode.
CCT values are also indicated due to their correlation to $a_{mel,v}$.

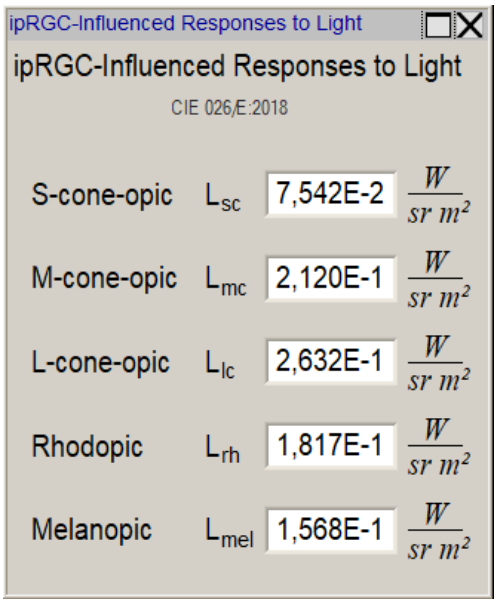
**Relevant settings:**

Action spectrum: Options/ Circadian
Luminous Efficiency Function: Options > Luminous Efficiency Function

### 5.8.6 Num: ipRGC-Influenced Responses to Light

Available in: ‘Custom’ preset.



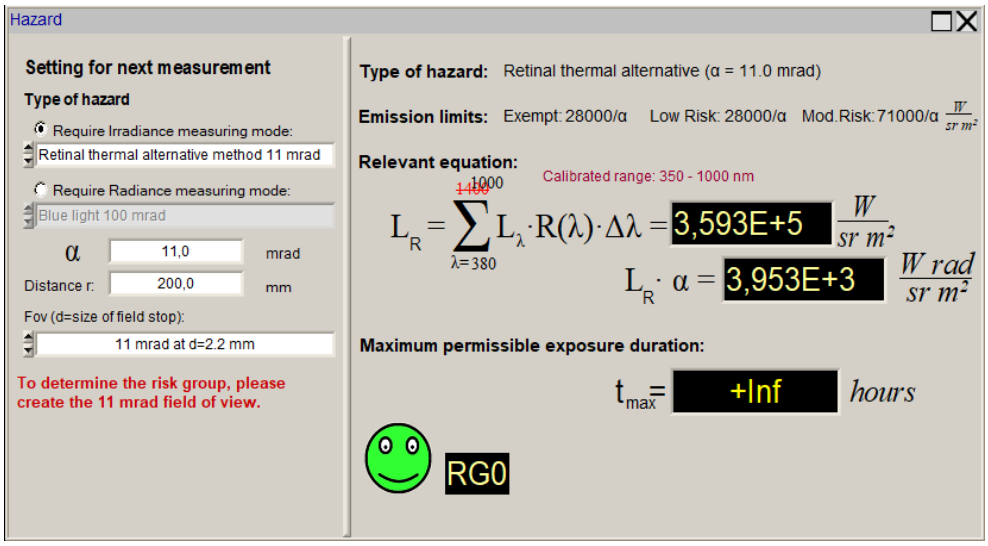

This widget can be seen as a more modern and extended version of the ‘Circatian Metrics’ widget. Calculations are based on CIE DIS 026/E:2018 Draft International Standard.

**Relevant settings:**

None.

### 5.8.7 Num: Hazard

Available in: ‘Custom’ preset.



Displays results of hazard calculations performed as described in CEI/IEC 62471:2006. Calculations for eight hazard types are available:

**Radiance measuring mode:**

- Retinal blue light hazard (FOV 100 mrad, 11 mrad or 1.7 mrad)
- Retinal thermal hazard (FOV 11 mrad )
- Retinal thermal hazard (weak visual stimulus) (FOV 11 mrad)

**Irradiance measuring mode:**

- Actinic UV hazard for the skin and eye
- Near-UV hazard for the eye
- Retinal blue light hazard – small source
- Infrared radiation hazard for the eye
- Thermal hazard for the skin
- Blue light alternative method (FOV 100 mrad, 11 mrad or 1.7 mrad)
- Retinal thermal alternative method 11 mrad
- Retinal thermal (weak visual stimulus) alternative method 11 mrad

Retinal blue light hazard and retinal thermal hazard measurements require that the device is used in luminance/radiance mode; other hazard types require illuminance/irradiance mode.

Although the option buttons on the left side of the widget are activated/deactivated depending on the selected hazard type, the user is responsible for selecting the correct accessories (focusing optics, diffusors, apertures) himself. It is only checked whether the selected hazard type is possible in the current measurement mode. Only in Radiance mode, an additional check is made whether the calibration file matches the selected Field of view (FOV).

On the right side of the widget the measurement results are displayed with the following values: Type of hazard (including FOV or angle $\alpha$, if relevant), emission limits and relevant equation (for information only; they are different for different hazard types), result of the relevant equation, maximum permissible exposure duration and risk group.

If the calculation range prescribed by the standard exceeds the calibration range of the device, this is marked in the equation by highlighting of the corresponding sum limits.

**Widget options:**

**Type of hazard**

Type of hazard calculation to be made.

**Radiance measuring mode:**

Blue light:

- According to IEC 62471: The the risk group is determined according to IEC 62471, i.e. the FOV (Field of view) is automatically selected in the correct order.
- Manually: FOV can be selected regardless of the previously measured risk group.

| **Note:** | A measurement with FOV = 11 mrad is always >= RG1, a measurement with 1.7 mrad is always >= RG2. |
|---|---|

Retinal thermal / Retina thermal weak:

- $\alpha$

  Angle $\alpha$ for retinal thermal hazard calculation. This option appears only if 'Type of hazard' is set to 'Thermal'.

**Irradiance measuring mode:**

Actinic UV skin & eye / Eye UV-A / Blue-light small source / Eye IR / Skin thermal:

- no further settings necessary

Alternative methods Blue light / Retinal thermal / Retina thermal weak:

- Distance r: Distance of the field stop to the aperture stop
- Fov: Field of view calculated as the size of the field stop d / distance r
- For further settings for blue light (According to IEC 62471 / Manually) and for retinal thermal and retinal thermal (weak visual stimulus) (angle $\alpha$) see Radiance measurement mode.

| **Note:** | Widget options affect only subsequent measurements. So, it is a normal behavior if nothing happens immediately after switching them. |
|---|---|

**Relevant settings:**

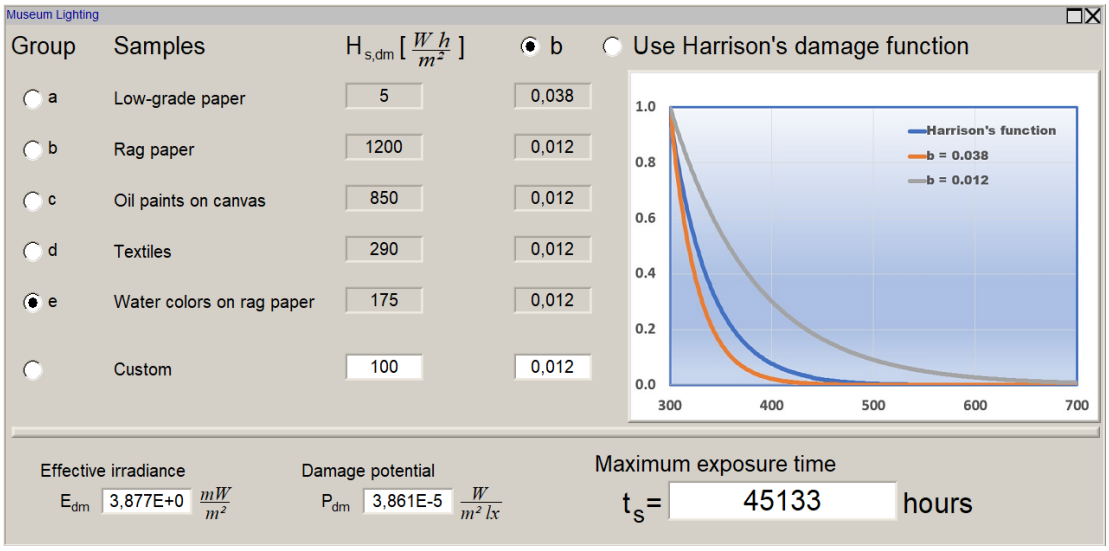
Spectral Weighting Function: Options > Spectral Weighting Function

| **Note:** | To avoid confusion with double-applied weighting function, hazard calculation is not performed if any user-defined weighting function is loaded. |
|---|---|

### 5.8.8 Num: Museum Lighting

Available in: ‘Custom’ preset.




Displays results of calculations of potential damage to museum objects according to CIE 157:2004 ‘Control of Damage to Museum Objects by Optical Radiation’.

Calculations are performed in following steps:

- The Effective Irradiance that causes damage is calculated as

$$E_{dm} = \int_{\lambda} E_{e,\lambda} \cdot s(\lambda)_{dm,rel} \cdot d\lambda \qquad [\mathrm{mW/m^2}]$$

- Damage Potential is calculated as

$$P_{dm} = \frac{E_{dm}}{E_v} \qquad [\mathrm{W/(m^2 \cdot lx)}]$$

- The Critical Duration of Exposure is calculated as

$$t_s = \frac{H_{s,dm}}{E_{dm}} \qquad [\mathrm{hours}]$$

  where $H_{s,dm}$ is the threshold effective radiant exposure set by user in dependence on the group of sample materials.

$s(\lambda)_{dm,rel}$ used in the first equation is relative spectral object responsivity given either by an exponential function of the form

$$s(\lambda)_{dm,rel} = e^{-b(\lambda-300)}$$

or by the 'Harrison's damage function'.

Though the Harrison's damage function ('An Investigation of The Damage Hazard in Spectral Energy', Laurence S. Harrison, 1954) considered to be obsolete, it is still widely used. To make it comparable with the exponential function, it has been normalized so that it gives 1 at 300 nm, and also it has been extra- and interpolated because originally it was tabbed from 300 nm to 780 nm in 20 nm steps.

**Widget options:**

**Group of samples**

The threshold effective radiant exposure $H_{s,dm}$ and the coefficient $b$ (the latter only if the exponential function is used) depend on this setting.

**Use Harrison's damage function**

If chosen, the coefficient $b$ is ignored and Harrison's damage function is use instead of the exponential function.

| | |
|---|---|
| **Note:** | Widget options affect only subsequent measurements. So, it is a normal behavior if nothing happens immediately after switching them. |

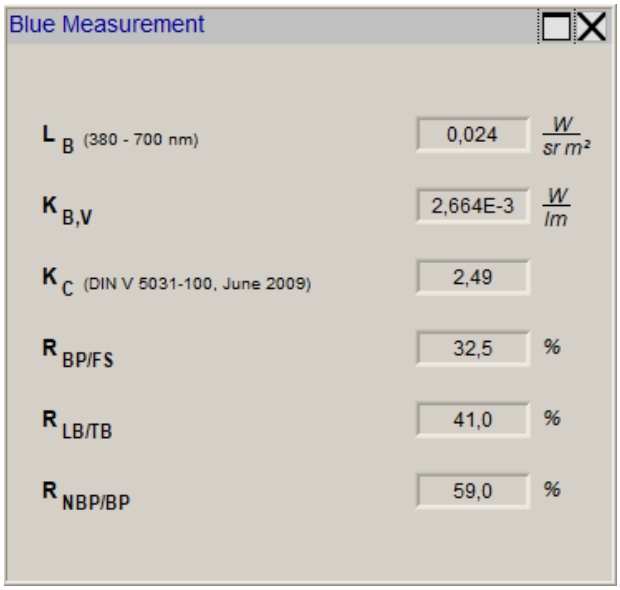
**Relevant settings:**

None.

### 5.8.9 Num: Blue Measurements

Available in: ‘Custom’ preset.




Shows the results of calculations to assess the long-time effects of blue light radiation from displays on human eyes and the blue light ratios required to test the so called "low blue mode" of displays.

Calculations are performed in following steps:

- The blue light hazard weighted radiance is calculated as

$$L_B = \int_{300}^{700} L_{e,\lambda} \cdot B(\lambda) \cdot d\lambda \qquad [\mathrm{mW/m^2}]$$

  where $B(\lambda)$ is the blue light hazard spectral weighting function.

- The blue light hazard efficacy is calculated as

$$K_{B,V} = \frac{\int_{300}^{700} L_{e,\lambda}(\lambda) \cdot B(\lambda) \cdot d\lambda}{K_m \cdot \int_{380}^{780} L_{e,\lambda}(\lambda) \cdot V(\lambda) \cdot d\lambda} \qquad [\mathrm{W/lm}]$$

  where

  $K_m$ is the maximum value of the spectral luminous efficacy (683 lm/W);
  $V(\lambda)$ is the CIE spectral luminious efficiency function for phototopic vision.

- The circadian efficacy is calculated as

$$K_C = \frac{\int_{380}^{780} L_{e,\lambda}(\lambda) \cdot C(\lambda) \cdot d\lambda}{\int_{380}^{780} L_{e,\lambda}(\lambda) \cdot V(\lambda) \cdot d\lambda}$$

- The ratio of a band with a bandwidth of +-20nm next to the blue peak to the entire power spectrum is calculated as

$$R_{BP/FS} = 100\% \cdot \frac{\int_{BluePeak-20}^{BluePeak+20} L_{e,\lambda}(\lambda) \cdot d\lambda}{\int_{380}^{780} L_{e,\lambda}(\lambda) \cdot d\lambda} \quad [\%]$$

- The ratio of light in the range from 415nm - 455nm compared to 400nm – 500nm is calculated as

$$R_{LT/TB} = 100\% \cdot \frac{\int_{415}^{455} L_{e,\lambda}(\lambda) \cdot d\lambda}{\int_{400}^{500} L_{e,\lambda}(\lambda) \cdot d\lambda} \quad [\%]$$

- The blue peak in "low blue mode" should not be more than double as high as the highest peak in other parts of the spectrum. The ratio of the highest peak outside the blue to the blue peak is calculated as

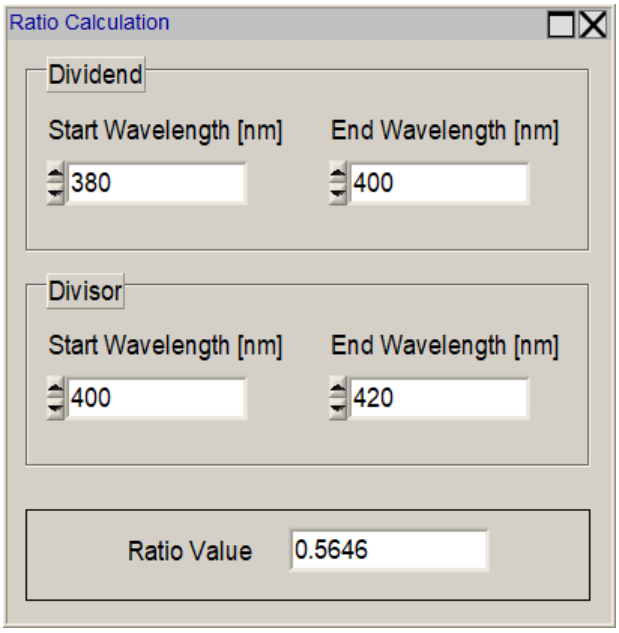
$$R_{NBP/BP} = 100\% \cdot \frac{L_{NotBluePeak}}{L_{BluePeak}} \quad [\%]$$

**Relevant settings:**

Action spectrum for $K_C$: Options » Circadian

### 5.8.10 Num: Ratio Calculation

Available in: 'Custom' preset.




Ratio Calculation allows to calculate the ratio of the integral values of two wavelength ranges of a spectrum. The specified wavelength ranges will be stored for each measurement separately.

**Relevant settings:**

None.

### 5.8.11 PAR (Photosynthetically Active Radiation)

The general PAR value $E_{phot}$ is the number of photons emitted by a light source in one second regardless of their individual frequency and of their impact on the biological system. It is calculated according to the following formula:

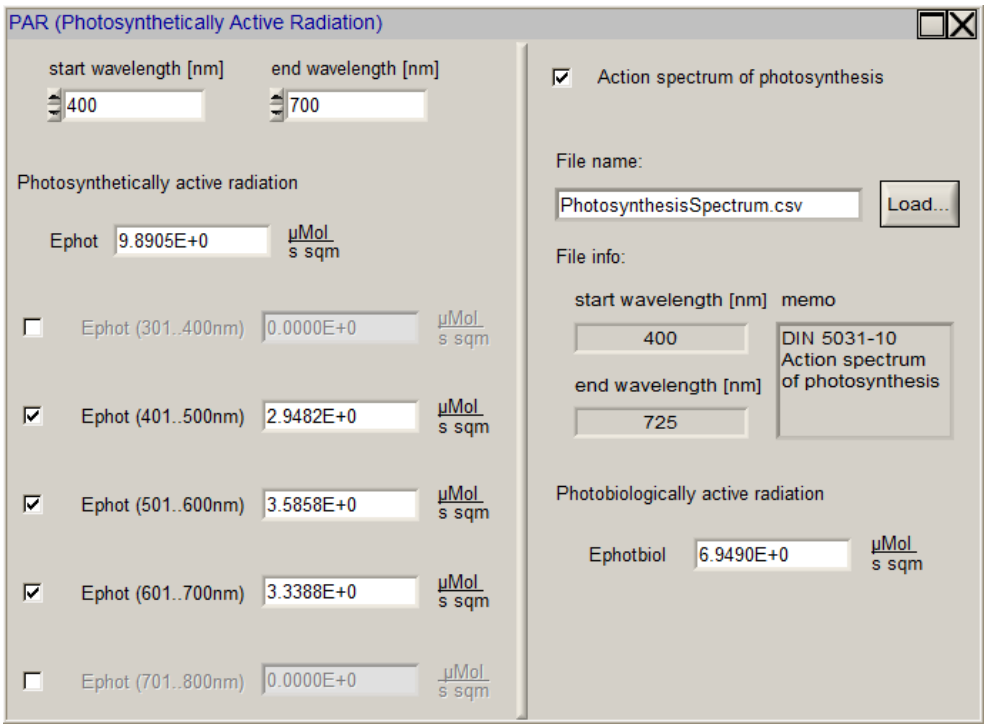
$$E_{phot} = \frac{1}{h \cdot c} \int_{\lambda_1}^{\lambda_2} E(\lambda) \cdot \lambda \cdot d\lambda,$$

where $E(\lambda)$ – measured spectral distribution, $\lambda_{1,2}$ – wavelength range, $h$ – Planck constant, $c$ – speed of light.

#### 5.8.11.1 Num: PAR

Available in: ‘Custom’ preset.




The standard wavelength range for PAR is 400 nm to 700 nm, but the borders can be changed. Furthermore, it is possible to calculate the PAR value in selected wavelength ranges of 100 nm.

Additionally, it is possible to calculate an effective PAR number $E_{photbiol}$ if Action spectrum of photosynthesis is checked. It uses a standardized action spectrum of photosynthesis and weighs the effect of the photons depending on their wavelength. The following formula is used ($s(\lambda)$–action spectrum):

$$E_{photbiol} = \frac{1}{h \cdot c} \int_{\lambda_1}^{\lambda_2} E(\lambda) \cdot s(\lambda) \cdot \lambda \cdot d\lambda.$$

The action spectrum according to DIN 5031-10 is supplied and must be loaded only once. The file is located in the *JETI LiVal* functions folder. In the future, it is also used by default after a program restart.
Alternatively, it is possible to use own action spectra. They have to meet the following structure:

*TYPE,FUNCTION*
*Start Wavelength [nm],350*
*End Wavelength [nm],500*
*Number of points,151*
*Memo,DIN5031-10*
*Unit, none*

*Wavelength, Relative Intensity*
*350,0.987719*
*351,0.988889*
*352,0.990643*
*353,0.992982*
*354,0.995906*
*355,1.000000*
*356,0.999415*
*357,1.000000*
*...*

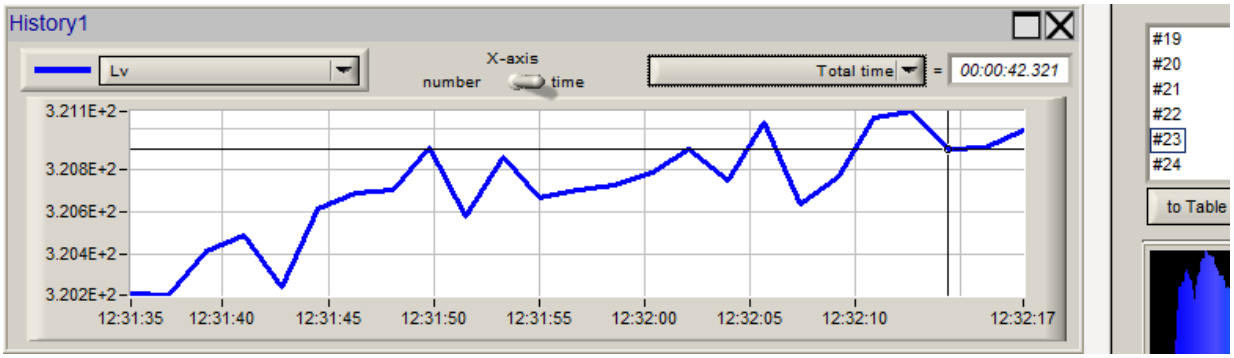
| **Remark:** | The PAR value is measured physically correct if the device is used in Illuminance mode. |
|---|---|

**Relevant settings:**

None.

### 5.8.12 History1–5

Available in: ‘History’, ‘Custom’ presets.




These five widgets allow to track changing of a certain measuring value over the time. They are especially useful in combination with ‘continuous scan’ mode.
X-axis marks are measurement names. Y-axis marks are corresponding values.

**Widget options:**

**Value to track (left drop-down list)**

Measuring value to be tracked: $L_v$, $L_e$, CCT, $x$, $y$, $u'$, $v'$, Dominant Wavelength, Color Purity, Centroid Wavelength, Peak Wavelength, FWHM, $L_e$ (extended; for any of 6 custom set ranges), battery voltage and battery percent.

**Number/time switch**

If set to 'number', the data points are places equidistant along the x-axis corresponding to the number of measurement. If set to 'time', the x-axis displays time.

**Calculated value to show (right drop-down list)**

There are some values that can be calculated from the history data: minimal and maximal values, difference between maximum and minimum, mean value, 'Michelson contrast' and the total time between the first and the last measurement.

In Irradiance measurement mode, the Luminous Exposure Hv can be additionally calculated for the tracking value Ev and the Radiant Exposure He for the tracking value Ee. Hv and He are calculated in the History widget over the total period of all existing measurements.

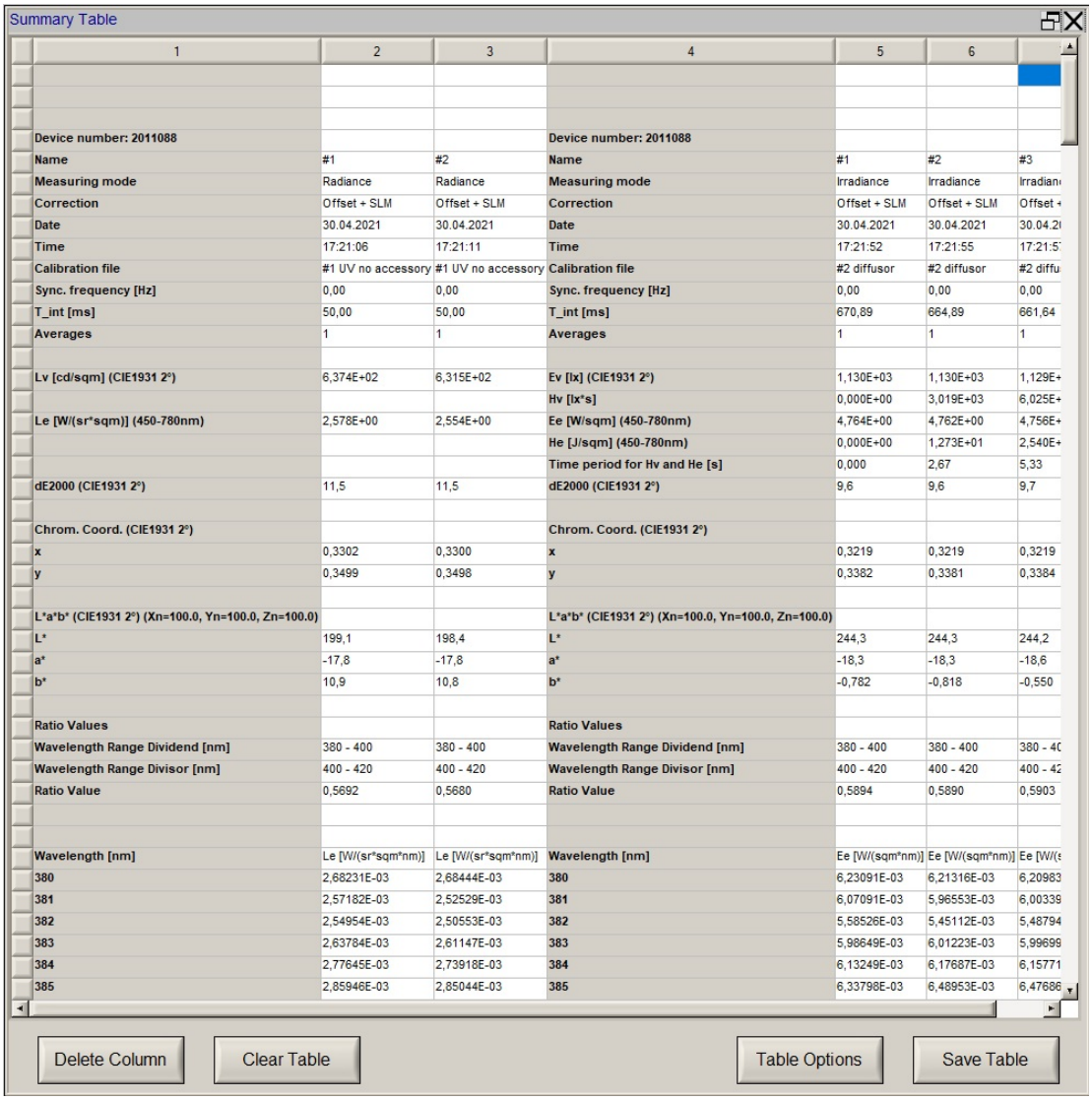
**Relevant settings:**

See relevant settings of every individual value.

### 5.8.13 Summary Table

Available in: ‘Summary table’, ‘Custom’ presets.




| 1 | 2 | 3 | 4 | 5 | 6 | |
|---|---|---|---|---|---|---|
| Device number: 2011088 | | | Device number: 2011088 | | | |
| Name | #1 | #2 | Name | #1 | #2 | #3 |
| Measuring mode | Radiance | Radiance | Measuring mode | Irradiance | Irradiance | Irradian |
| Correction | Offset + SLM | Offset + SLM | Correction | Offset + SLM | Offset + SLM | Offset + |
| Date | 30.04.2021 | 30.04.2021 | Date | 30.04.2021 | 30.04.2021 | 30.04.2( |
| Time | 17:21:06 | 17:21:11 | Time | 17:21:52 | 17:21:55 | 17:21:5 |
| Calibration file | #1 UV no accessory | #1 UV no accessory | Calibration file | #2 diffusor | #2 diffusor | #2 diffu |
| Sync. frequency [Hz] | 0,00 | 0,00 | Sync. frequency [Hz] | 0,00 | 0,00 | 0,00 |
| T_int [ms] | 50,00 | 50,00 | T_int [ms] | 670,89 | 664,89 | 661,64 |
| Averages | 1 | 1 | Averages | 1 | 1 | 1 |
| Lv [cd/sqm] (CIE1931 2°) | 6,374E+02 | 6,315E+02 | Ev [lx] (CIE1931 2°) | 1,130E+03 | 1,130E+03 | 1,129E+ |
| | | | Hv [lx*s] | 0,000E+00 | 3,019E+03 | 6,025E+ |
| Le [W/(sr*sqm)] (450-780nm) | 2,578E+00 | 2,554E+00 | Ee [W/sqm] (450-780nm) | 4,764E+00 | 4,762E+00 | 4,756E+ |
| | | | He [J/sqm] (450-780nm) | 0,000E+00 | 1,273E+01 | 2,540E+ |
| | | | Time period for Hv and He [s] | 0,000 | 2,67 | 5,33 |
| dE2000 (CIE1931 2°) | 11,5 | 11,5 | dE2000 (CIE1931 2°) | 9,6 | 9,6 | 9,7 |
| Chrom. Coord. (CIE1931 2°) | | | Chrom. Coord. (CIE1931 2°) | | | |
| x | 0,3302 | 0,3300 | x | 0,3219 | 0,3219 | 0,3219 |
| y | 0,3499 | 0,3498 | y | 0,3382 | 0,3381 | 0,3384 |
| L*a*b* (CIE1931 2°) (Xn=100.0, Yn=100.0, Zn=100.0) | | | L*a*b* (CIE1931 2°) (Xn=100.0, Yn=100.0, Zn=100.0) | | | |
| L* | 199,1 | 198,4 | L* | 244,3 | 244,3 | 244,2 |
| a* | -17,8 | -17,8 | a* | -18,3 | -18,3 | -18,6 |
| b* | 10,9 | 10,8 | b* | -0,782 | -0,818 | -0,550 |
| Ratio Values | | | Ratio Values | | | |
| Wavelength Range Dividend [nm] | 380 - 400 | 380 - 400 | Wavelength Range Dividend [nm] | 380 - 400 | 380 - 400 | 380 - 40 |
| Wavelength Range Divisor [nm] | 400 - 420 | 400 - 420 | Wavelength Range Divisor [nm] | 400 - 420 | 400 - 420 | 400 - 42 |
| Ratio Value | 0,5692 | 0,5680 | Ratio Value | 0,5894 | 0,5890 | 0,5903 |
| Wavelength [nm] | Le [W/(sr*sqm*nm)] | Le [W/(sr*sqm*nm)] | Wavelength [nm] | Ee [W/(sqm*nm)] | Ee [W/(sqm*nm)] | Ee [W/( |
| 380 | 2,68231E-03 | 2,68444E-03 | 380 | 6,23091E-03 | 6,21316E-03 | 6,20983 |
| 381 | 2,57182E-03 | 2,52529E-03 | 381 | 6,07091E-03 | 5,96553E-03 | 6,00339 |
| 382 | 2,54954E-03 | 2,50553E-03 | 382 | 5,58526E-03 | 5,45112E-03 | 5,48794 |
| 383 | 2,63784E-03 | 2,61147E-03 | 383 | 5,98649E-03 | 6,01223E-03 | 5,99699 |
| 384 | 2,77645E-03 | 2,73918E-03 | 384 | 6,13249E-03 | 6,17687E-03 | 6,15771 |
| 385 | 2,85946E-03 | 2,85044E-03 | 385 | 6,33798E-03 | 6,48953E-03 | 6,47686 |

The summary table is probably the most important widget because all measured data can be stored there and then be exported into ‘.xls’ or ‘.csv’ file formats.

| | |
|---|---|
| **Remark:** | The labels ‘Spectral Radiance’/ ‘Irradiance’; ‘Luminance’/ ‘Illuminance’ and ‘Radiance’/ ‘Irradiance’ are changing automatically in dependence of the attached measuring head. |

The transfer of data into the table is described in chapter 7.1.1 ‘Data Transfer into the Table Widget’, page 122.

**Relevant settings:**

Values to be shown in the table: Options > Table

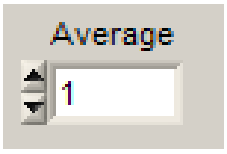
 

# 6 Settings

## 6.1 Measurement Settings

### 6.1.1 Averaging

The Average setting between the *JETI* logo and the Measure button can be used to obtain the spectrum as an average value from up to 10000 successive measurements.




### 6.1.2 Integration Time

The default behavior (as described in chapter 4.1 ‘Measuring Procedure’, page 18) of *JETI* spectroradiometers is automatic adaption of the integration time according to the light level of the source before every measurement with maximal possible integration time of 60 s.

But the integration time adaption is a rather time-consuming procedure, and 60 s are a rather long period of time. Thus, several possibilities to reduce the measuring time were implemented.

These are:

- Reducing the maximal integration time calculated by adaption algorithm. Useful if measuring dark light sources or black color samples. Adaption is still performed before every measurement, but the integration time will never be longer as the specified value. (See chapter 6.1.2.1 ‘Setting of Maximal or Fixed Integration Time’, page 93.)
- Using of fixed integration time. In this case, adaption is never performed, and cases of over- or underexposure are ignored (though overexposured measurements are marked red in the legend). This option is intended for experienced users who can take responsibility for correct settings of integration time for a well-driven spectrum. (See chapter 6.1.2.1 ‘Setting of Maximal or Fixed Integration Time’, page 93.)
- Using of ☑ Hold Integration Time option. All subsequent measurements are performed with the previously used integration time. Adaption is performed only if over- or underexposure occurs. (See chapter 6.1.2.2 ‘Hold Integration Time’, page 94.)

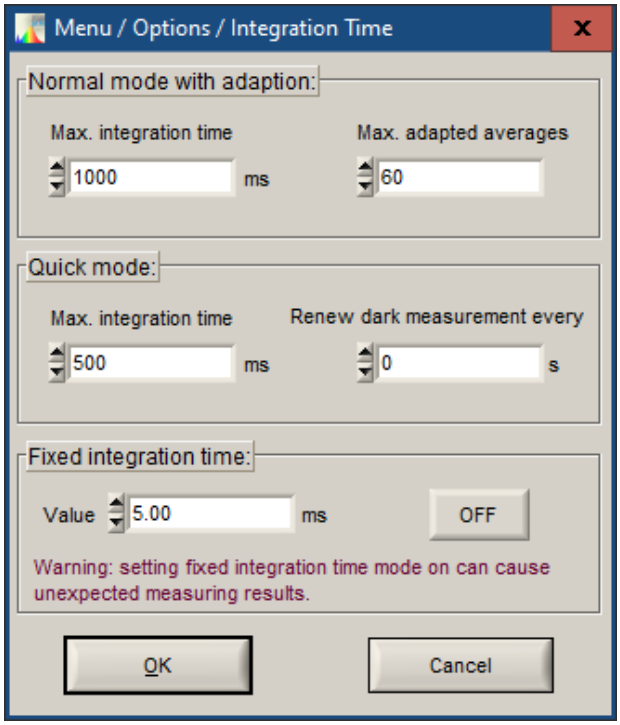
 

- Using of ☑ Quick Mode option (useful only in continuous mode with ☑ Cont. switched on). Adaption is never performed. For **specbos** devices, dark measurement is made only once at the beginning. Integration time is limited to 0.5 s. Cases of over- or underexposure themselves are ignored (their results are still stored with red marking in the legend), but these cases cause integration time changes for the subsequent measurements. Precision of results is very low. Useful for quick device adjustment. (See chapter 6.1.2.3 'Quick Mode', page 95.)
- Using of Extra > Max. Signal Targeting Help. Principally, the same as the Quick Mode, but no calculations are performed and measuring results are not stored. Useful for device adjustments, if it is to be directed to the brightest point of an extended light source (what can be a problem, for example, for hazard measurements). (See chapter 6.1.2.4 'Max. Signal Targeting Help', page 95.)

Next sections describe all mentioned options separately.

#### 6.1.2.1 Setting of Maximal or Fixed Integration Time

This option provides control over integration time settings. You can use Ctrl + T -shortcut to open this window.



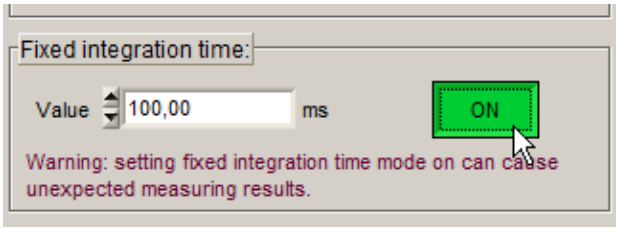

'Max. integration time' and 'Max. adapted averages' (**spectraval** only, for other devices this control is not visible) are internal device parameters which have influence on the behavior of the integration time adaption algorithm. The setting is saved to the internal

memory of the device and stays the same until device is reconnected.
It can be useful to make many measurements of some dark light source within a relative short time, if precision of measuring results is not very important.
If using fixed integration time, the setting is ignored.

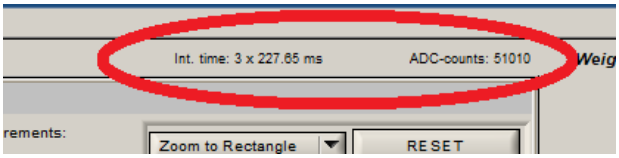
Max. integration time and Renew dark measurement every ... s are settings which are relevant if using 'quick mode' (for explanations, see chapter 6.1.2.3 'Quick Mode', page 95).

In some cases, it is desirable to set the integration time to a fixed value. This can be done through setting of the Value of 'Fixed integration time' (in ms) and switching the fixed integration time mode ON.




The following measurements will use this integration time without performing of adaption.

A suitable value for the integration time can be found after a first measurement with activated adaption by pressing the F12 button (Tint). The information of adapted integration time and the related counts will appear on the top of the window left from Target button.




| **Remark:** | When a fixed integration time is used, there will be no warning in case of underexposure, and in the case of overexposure the measurements will be marked red in the legend. |
|---|---|

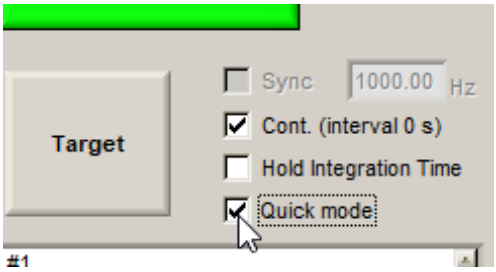
### 6.1.2.2 Hold Integration Time

It is possible to save previously determined integration time for further measurements. This can be of interest if many objects with similar intensity are measured: in this case the time that the device spends for adaption of integration time can be saved. Simply click the box ☑ Hold Integration Time. If over- and underexposure occurs, a warning will be shown (Couldn't hold integration time). Then a new adaptation will be processed and the new time will be saved for further measurements.
Another technique that allows to set integration time to a fixed value manually is intended only for experienced users. Refer to chapter 6.1.2.1 'Setting of Maximal or Fixed Integration Time', page 93 to learn how to do this.

### 6.1.2.3 Quick Mode

Switch ☑ Cont. with the interval of 0 s and ☑ Quick Mode on and start measurements.




For **specbos** devices, a so-called 'dark compensation' measurement will be performed. After that, the device will be able to estimate the level of a dark signal for all integration times and to save time on doing dark measurements again and again before every measurement.
Though, for long measurement series 'dark compensation' measurements should be repeated from time to time. This time period is settable under Options › Integration Time (field ⇕ Renew dark measurement every ). 0 means that the 'dark compensation' measurement is never repeated.

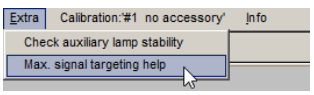
☑ Auto transfer option stays disabled during the whole series of 'quick measurements'. But measuring results can be transferred to the table afterwards.

Integration time will change automatically during the series of 'quick measurements' seeking to keep the signal level at approximately a half of its maximum, but it never exceeds the limit set under Options › Integration Time (field 'Max. integration time' for 'Quick mode'). Default setting is 0.5 s.

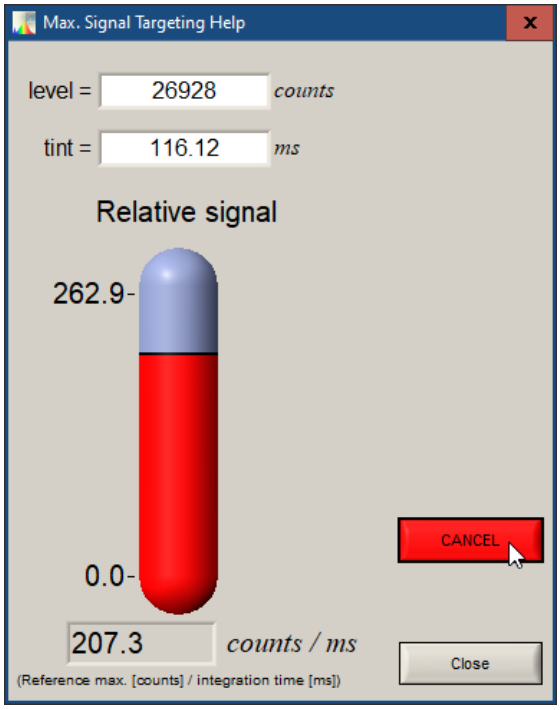
If overexposure occurs, no warning is shown, and results of this measurement are still stored. But the integration time will be automatically reduced for subsequent measurements.

### 6.1.2.4 Max. Signal Targeting Help

Menu point Extra › Max. Signal Targeting Help provides a simple tool for quick device adjustments to the maximum of signal.

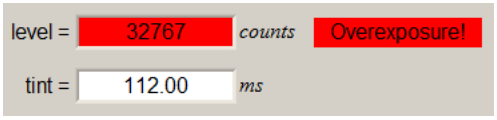





After clicking on Start, quick measurements start to be performed in the same manner as in ☑ Quick Mode. This procedure is even more quick than Quick Mode, because no calculations are done and no results are stored.

If an overexposure occurs, a red warning appears shortly.



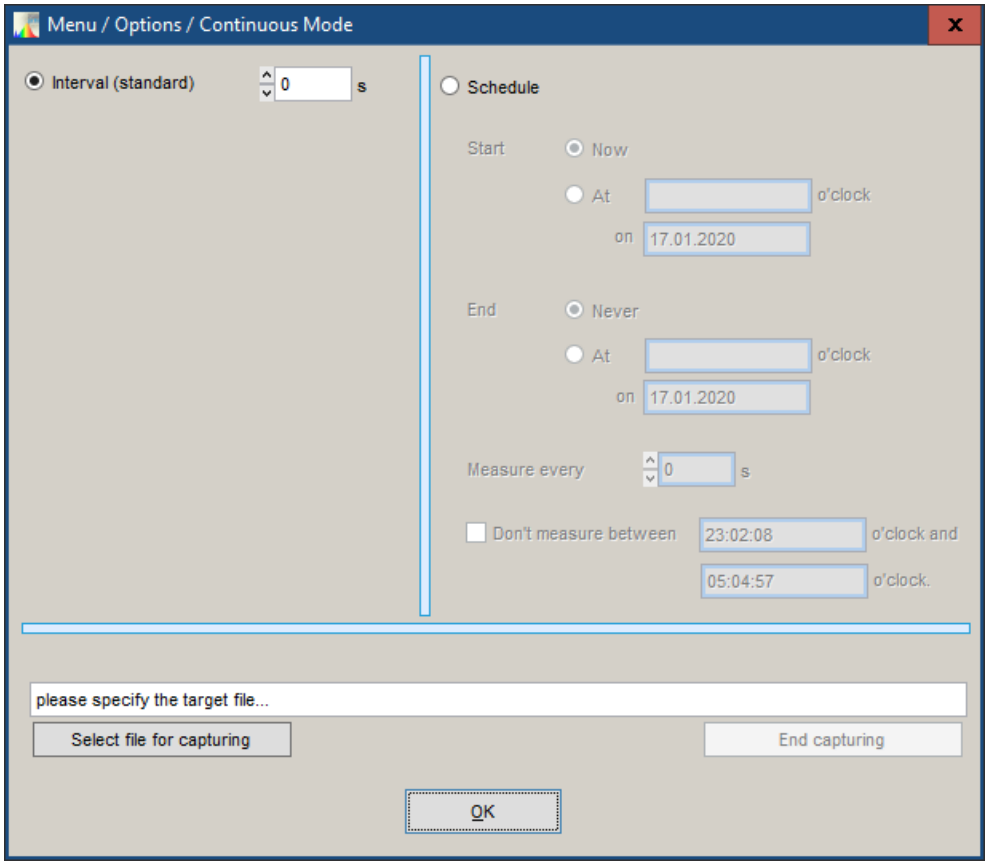

The maximum of the indicator shows the maximal signal measured during the current series of measurements.

So the idea of usage is like following: set your device on a tripod, click on Start and scan slowly through an extended light source to get the maximal value. Then scan through the light source for the second time to reach this maximum again.

### 6.1.3 Continuous Measurement

If you want to measure continuously, you have several options.

Right-click on the checkbox ☑ Cont. in the main panel or call the menu point Options › Continuous Mode.




The main choice is between the ‘Interval (standard)’ mode and the ‘Schedule’ mode.

The first one is just the classical continuous mode that was the only option up to *JETI LiVal* version 6.10.x. The settable value is the time period between the end of one measurement and the beginning of the next measurement in seconds.

If you select this mode, this will be shown also in the main window as follows:

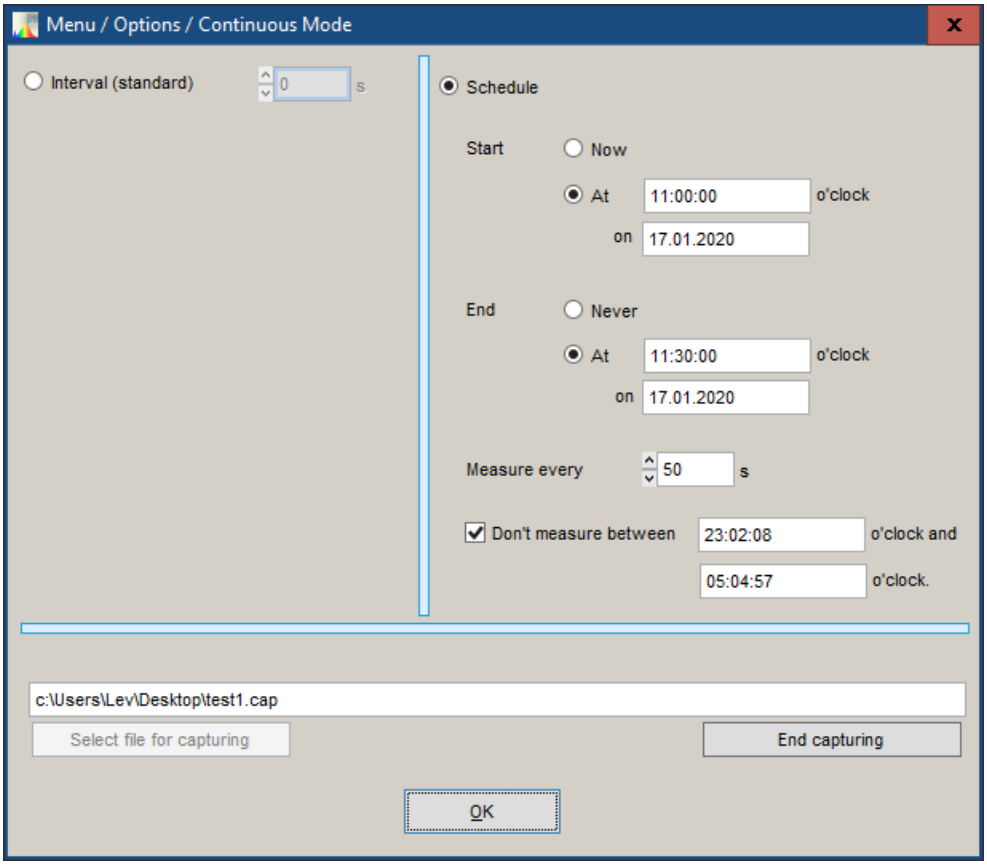

The advantage of this mode is that it is possible to set the interval to 0 and to fire the measurements just one after another, what provides the quickest measurement series the device is capable to.

But the mode has a drawback: it has no relation to the absolute time.

Sometimes the task is, for example, to make a measurement to the beginning of every hour (or minute).

To make it possible, the 2nd ‘Schedule’ mode has been developed.




It is possible to set the start and the end time of the series of measurements: input it as text from the keyboard in the ss:mm:hh or dd.mm.yyyy formats correspondingly.

If start time is set to ⊙ Now , the measurement series will start as soon as you set the check-box ☑ Cont. in the main window of *JETI LiVal*. Or if the check-box is already set, as soon as you close the settings-window.

The measuring period set under ⬍ Measure every must be reasonably long; if the time for the next measurement comes while the previous measurement is still running, the next measurement will be omitted.

Additional option ☑ Don’t measure between gives a possibility to set a scheduled break in the series of measurement. It was thought as a sort of ‘bedtime’-setting for applications where it is senseless to measure in the night.


Select file for capturing button allows to open a file for capturing. That means that results of every measurement made in continuous mode will be stored in a file. The file is written line-by-line to make operation of writing to file secure. The general purpose is to avoid

data loss in the case of unexpected events (soft- or hardware crash) during long series of measurements. (See also chapter 7.3 ‘Capturing’, page 127).

Continuous mode works also in combination with ☑ Hold Integration Time and ☑ Fixed integration time options (see explanations above).

If you use a combination of both ☑ Hold Integration Time and ☑ Cont., the measurements will be done without adaption. Integration time at start will be used for all subsequent measurements until over- or underexposure happens.
If it happens, the adaption of integration time will be done again, and the series of measurements will continue.

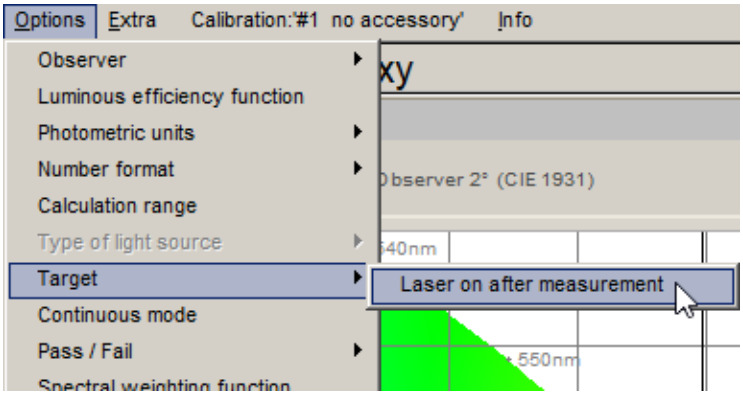
If you use ☑ fixed integration time option, no adaption will be done.

### 6.1.4 Type of Light Source

See chapter 4.4.2 ‘Pulsed Sources’, page 31

### 6.1.5 Target

The target laser will be switched off automatically if it is switched on while a measurement is started. Afterwards, it will not be switched on again by default.



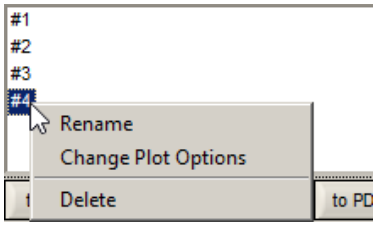

The Options > Target > Laser on after measurement causes the target laser to be switched on again automatically after a measurement. This feature can be used for a new adjustment of the measuring area.
The feature is active after each single or continuous measurement.

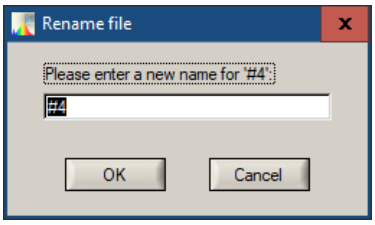
## 6.2 Settings of Measured Data

### 6.2.1 Change Measurement Name and Graph Options

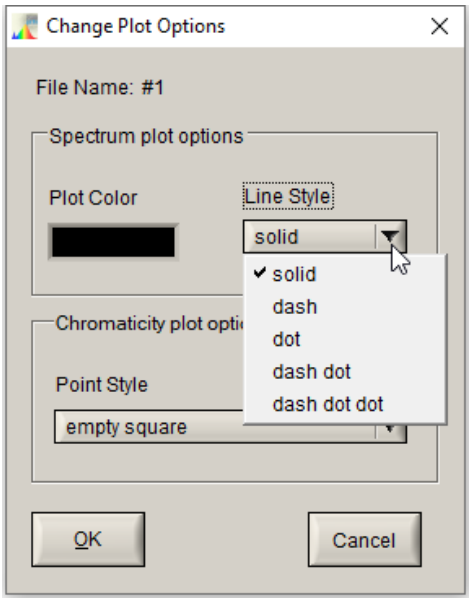
The proceeded measurements are named with consecutive numbers. Corresponding plots have some default appearance.
Do rename measurements or to change their graphical appearance, make a right mouse click on the desired measurement name in the legend to open a pop-up menu.




- Rename item allows to rename a measurement:



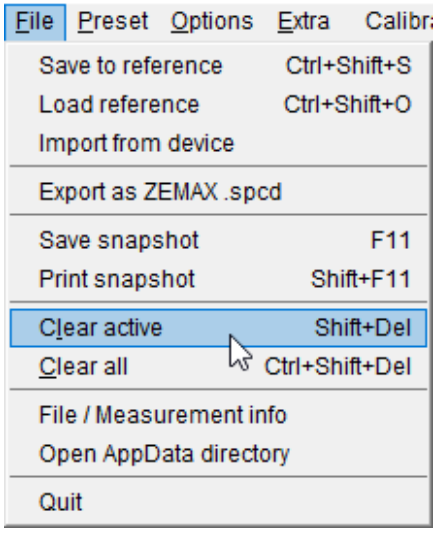

- Change Plot Options allows to change the plot color and line/point style:



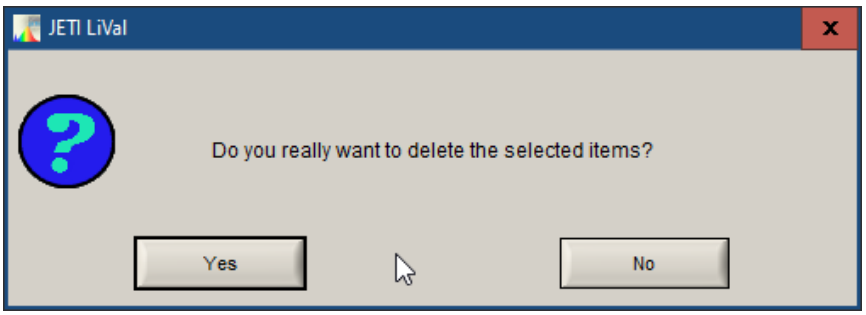

- Delete deletes the actual measurement.
  A confirmation dialog will always appear before data are deleted.

### 6.2.2 Delete Measurements

Additionally, the active measurement or all measured data can be deleted under the menu point File.




A single measurement can also be deleted with the Shift + Del shortcut after selecting it in the legend with a left mouse click. It is also possible to delete a number of measurements using the Ctrl or Shift keys in the usual manner; simply mark the entries, which are to be deleted. Use Ctrl + A to mark all measurements. All measurements can also be deleted at once with Ctrl + Shift + Del.
A confirmation window will appear before data is deleted.

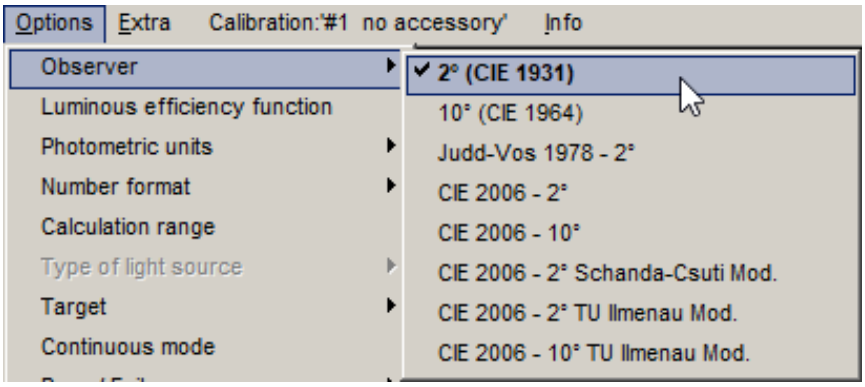


## 6.3 Calculations and Format Settings

### 6.3.1 Observer

Through the menu point Options > Observer it is possible to switch between different color matching functions (CMF).




CIE 1931 $2°$, CIE 1964 $10°$, Judd-Vos 1978 $2°$, CIE 2006 $2°$ and $10°$, CIE 2006 $2°$ Schanda-Csuti modified, CIE 2006 $2°$ and $10°$ TU Ilmenau modified functions are available.

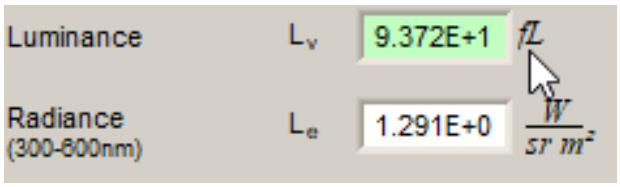
- In case of CIE 1931 $2°$, all relevant data get no index.
- In case of CIE 1964 $10°$, all relevant data get the index $10$.
- In case of Judd-Vos 1978 $2°$, all relevant data get the index $JV$.
- In case of CIE 2006 $2°$, all relevant data get the index $F$.
- In case of CIE 2006 $10°$, all relevant data get the index $F10$.
- In case of CIE 2006 $2°$ Schanda-Csuti mod., all relevant data get the index $fm$.
- In case of CIE 2006 $2°$ TU Ilmenau mod., all relevant data get the index $IL$.
- In case of CIE 2006 $10°$ TU Ilmenau mod., all relevant data get the index $IL10$.

| **Remark:** | Please keep in mind that *JETI* spectroradiometer in Luminance mode has a field of view of $1.8°$! |
|---|---|

It is recommended to use the $2°$ observer for fields of view up to $4°$.

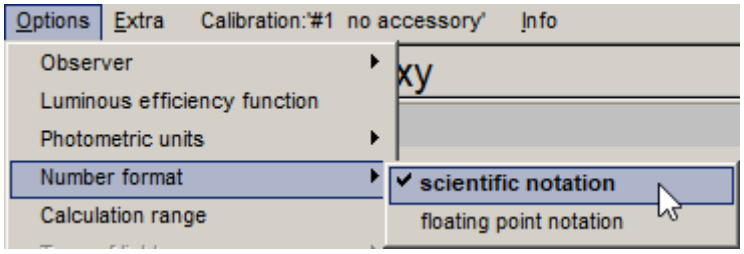
### 6.3.2 Photometric Units – SI Units/ Imperial Units

It is possible to switch between SI and imperial units using the Options > Photometric units menu point. In case of imperial units, Luminance units are footlamberts (*fL*) and Illuminance units are footcandle (*fc*).




### 6.3.3 Number Format

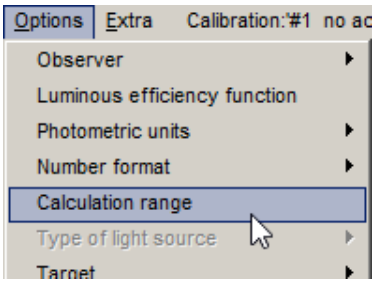
The Options > Number Format allows the user to switch between scientific and floating point notation.

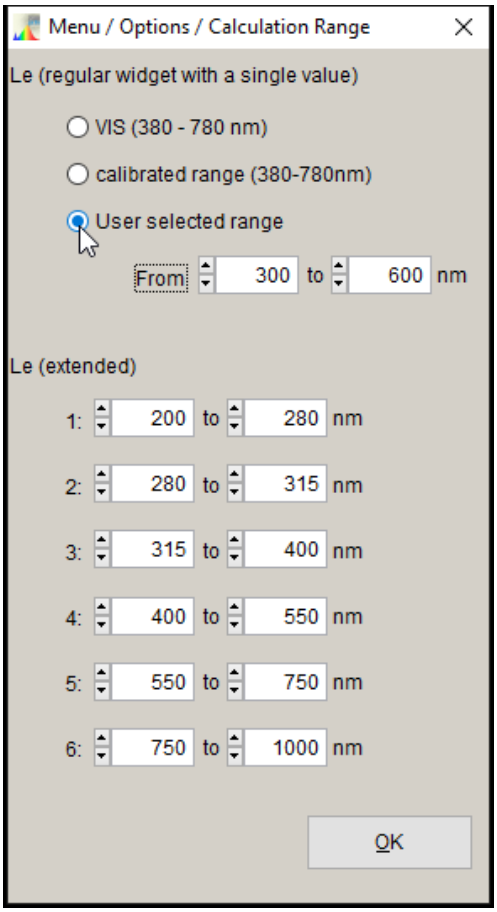



### 6.3.4 Calculation Range

The menu point Options > Calculation Range allows to specify wavelength ranges that are used for radiometric calculations, relevant for $L_e$.

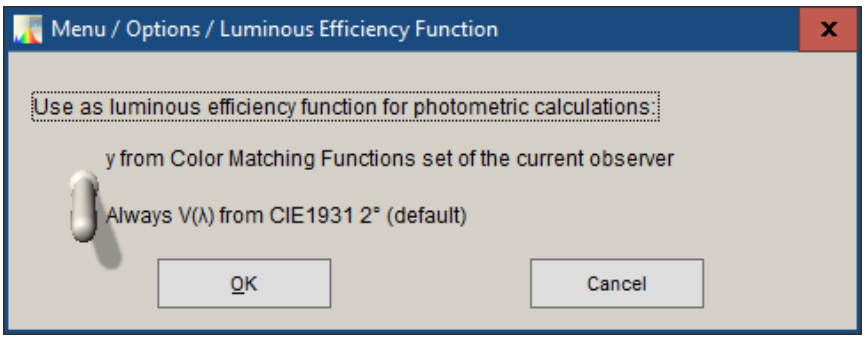



For the regular 1-value Le widget, there is a choice between the wavelength range that corresponds to the visible light (380 nm to 780 nm), the entire calibrated wavelength range (**specbos 1201**, **spectraval 1501** and **spectraval 1511**: 380 nm to 780 nm; **specbos 1211**: 350 nm to 1000 nm; **specbos 1211 UV**: 230 nm to 1000 nm) and user selected range.

For the extended 6-values Le widget, 6 ranges can be specified by user.

### 6.3.5 Luminous Efficiency Function

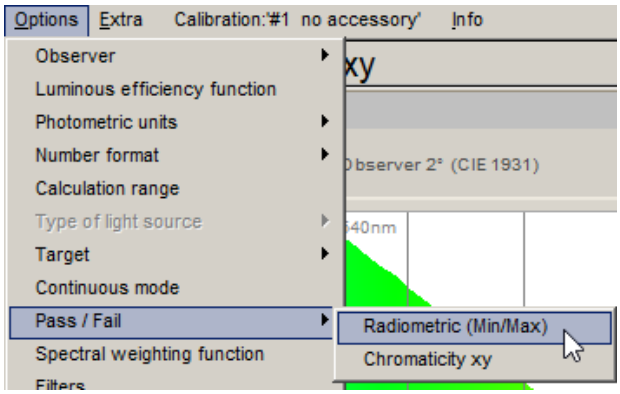


By default, the central color matching function $\overline{y}(\lambda)$ of the CIE 1931 color space is used as luminosity function $V(\lambda)$ for photometric calculations.

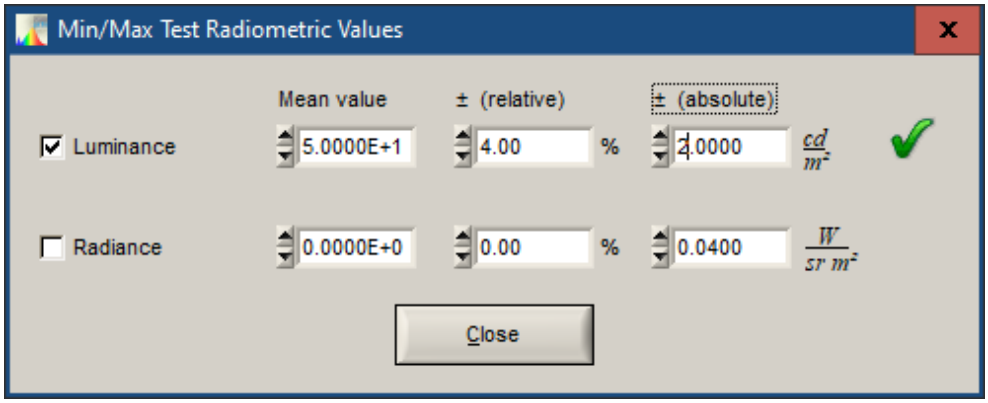
The menu point Options › Luminous Efficiency Function allows to change this behavior and to use the central color matching function of the *current* observer (chosen under Options › Observer) as the luminosity function.

### 6.3.6 Pass / Fail

The Pass / Fail option can be activated in the menu point Extra › Pass / Fail. It is possible to select one or both radiometric quantities and/ or the chromaticity xy.




The radiometric quantities are characterized by a value and a tolerance (relative or absolute alternatively). The tolerance of xy can be characterized by a polygon with 3 to 15 vertices or by the McAdam ellipse.



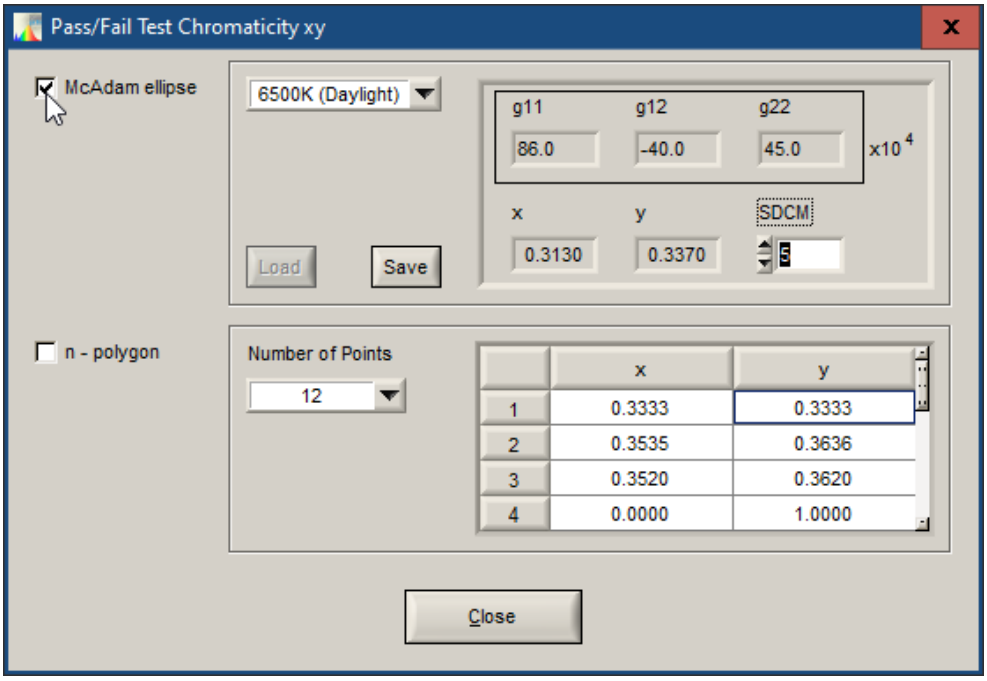

The ellipse is defined by:

- the central xy value;
- the McAdam coefficients $g_{11}$, $g_{21}$ and $g_{22}$;

- the color step (SDCM, maximum 10).

The standard values for the McAdam ellipses of different CCTs (EN 60081:1998 and ANSI C78.376-2001) are included. Furthermore, it is possible to define user specific ellipses and store the data in a SET file for further use.
The Pass / Fail option can be activated by clicking on the check box left to the category. All specified values are saved and available after a restart of the program.



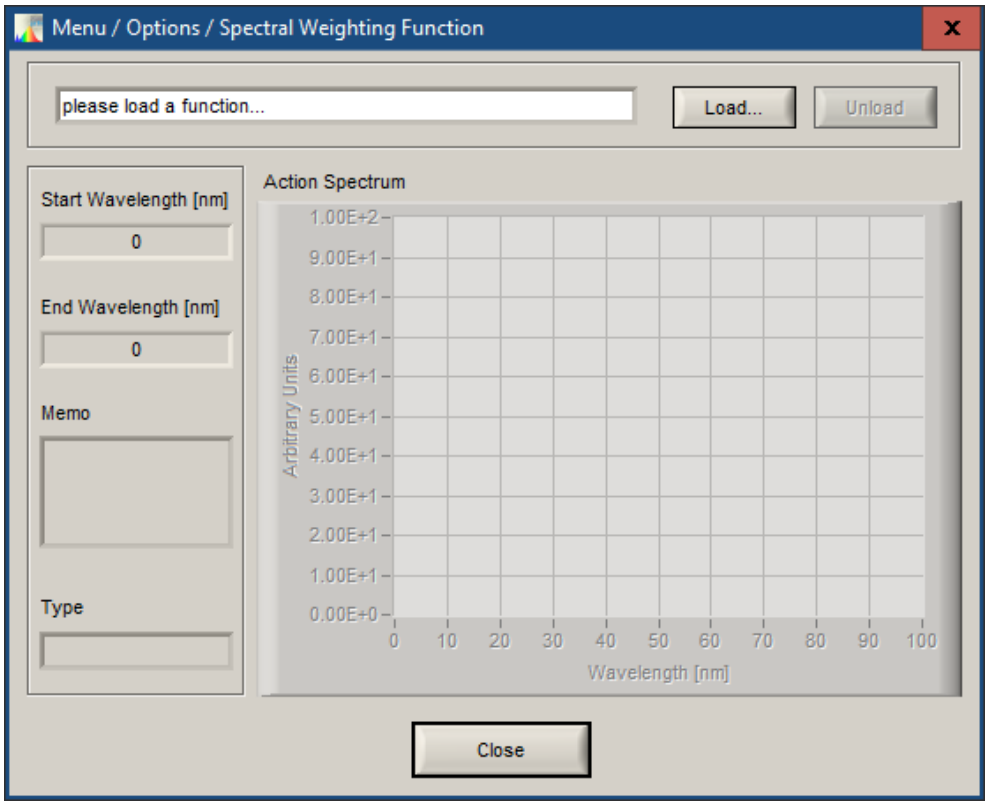

The results of a Pass / Fail check are shown after every measurement through coloring of the background. Appropriate values in boxed green or red, respectively, and also as a green checkmark/ red cross in the 'Pass/ Fail' window.
It is not possible to store the Pass / Fail results.

### 6.3.7 Spectral Weighting Function

This spectral weighting function works on the same principle as the 'Widget Field'–tool spectral calculation (chapter 5.8.3 'Chart: Spectral Calculation', page 72) in 'Multiply'–mode.
The main difference is that while 'Spectral Calculation' is just an additional tool, which does not affect the measurement results themselves, 'Spectral Weighting Function' is applied directly to the measured spectrum, and all derivative values are computed for the resulting spectrum.
To turn it on, choose Options > Spectral Weighting Function or use a shortcut in the main

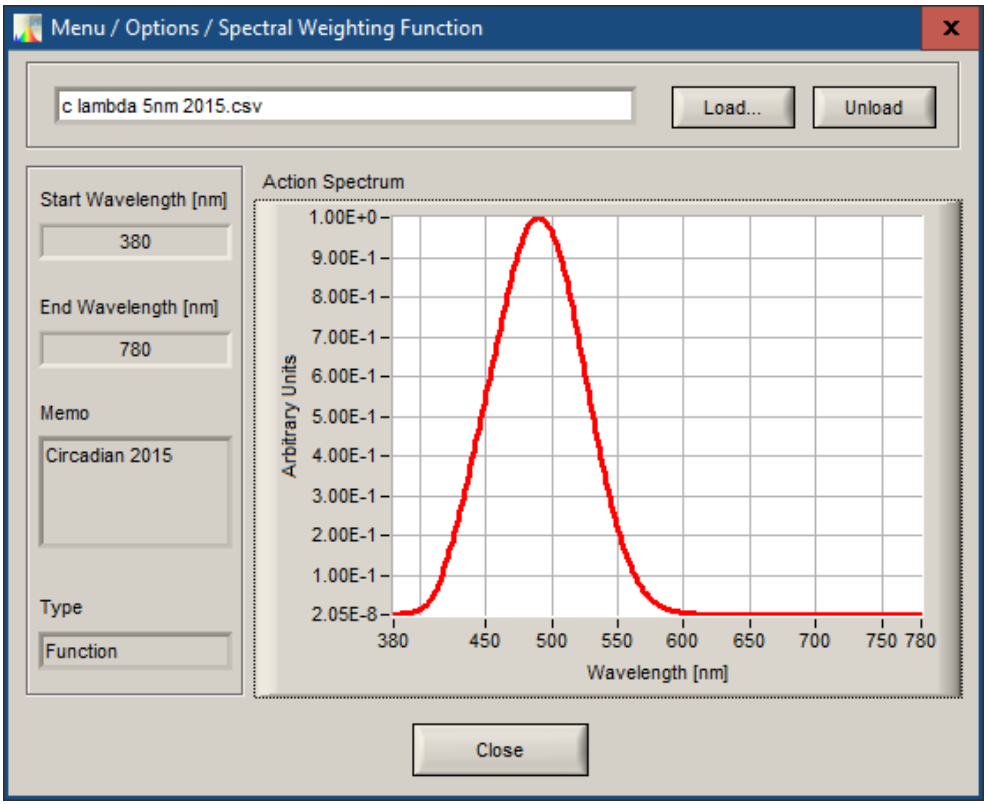
 

window (whatever stays below ‘Weighting Function’ — the word ‘none’ or a previously loaded function — works as a shortcut and leads to the settings).



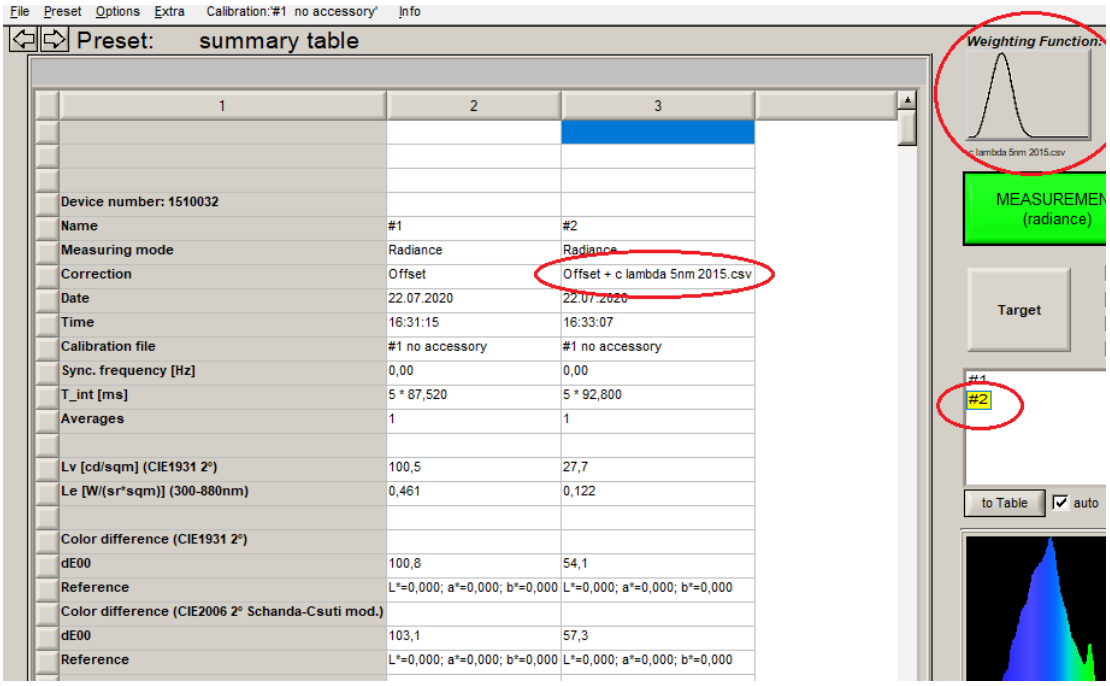

 

Click Load and choose a weighting function that is assumed to be stored on disk as a '.csv'-file.
After the correction spectrum is loaded, you can close this window.




Now all subsequent measurements will be weighted with the chosen function. The function itself will be shown schematically in the main window.

Every measurement affected by a weighting function is marked with yellow in the legend. In addition, the name of the weighting function is displayed in the table that is shown in 'table view'-mode and can be saved.




To turn the 'Spectral Weighting Function'-mode off, go to the menu point Option > Spectral Weighting Function again and click Unload.

### 6.3.8 Filters

Savitzky-Golay-smoothing (or DISPO–Digital Smoothing Polynomial Filter) is a low-pass filter, which can be seen as an improvement and generalization of standard moving window averaging. The idea of both is to replace each data value $f_i$ by a linear combination $g_i$ of $f_i$ itself and some of its nearby neighbors:

$$g_i = \sum_{n=-n_L}^{n_R} c_n f_{i+n}$$

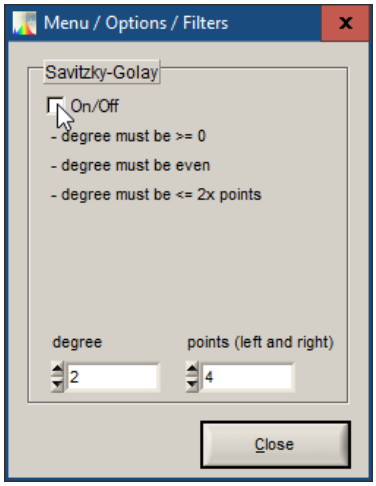
Here $n_L$ is the number of points used 'to the left' of a data point $i$, i.e., earlier than it, while $n_R$ is the number used to the right, i.e., later. A so-called causal filter would have $n_R = 0$.
By moving window averaging all coefficients $c_n$ are equal $c_n = 1/(n_L + n_R + 1)$.
The idea of Savitzky-Golay filtering is to approximate the underlying function within the moving window not by a constant (whose estimate is the average), but by a polynomial

of higher order, typically quadratic or quartic. For each point $f_i$, a polynomial is least-squares fit to all $n_L + n_R + 1$ points in the moving window and then $g_i$ is set to be the value of that polynomial at position $i$.
This allows it to preserve higher moments of the underlying function and, therefore, to reduce any undesirable bias, or to put it simpler: the Savitzky-Golay-smoothing treats narrow spectral lines much more gently than moving window averaging.

| **Remark:** | Note that it can be applied only before measurements, and it will only affect the subsequent measurements. |
|---|---|

The Savitzky-Golay-smoothing can be switched on/off under menu Options.

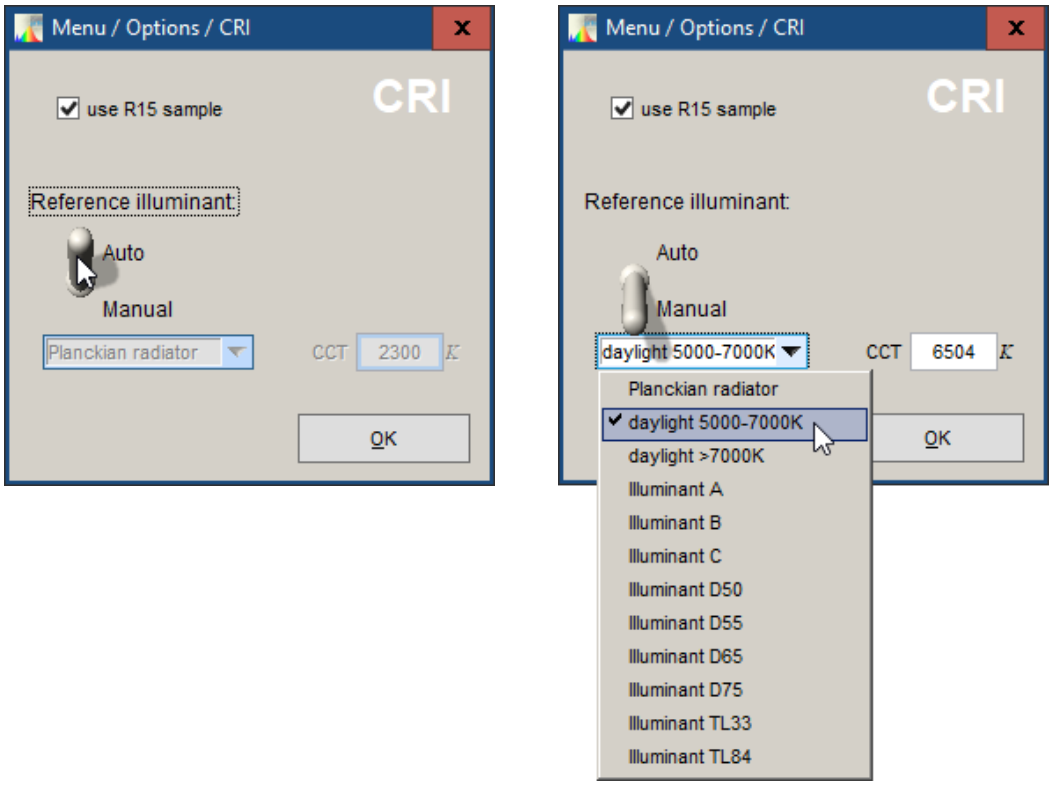



The degree of a polynomial and the number of points to the left and to the right from a current data point ($points = n_L = n_R$) have to be chosen. $Degree = 0$ corresponds to the moving window averaging sub-case.

### 6.3.9 CRI

With the menu point Options > CRI it is possible to choose whether the $R_{15}$ index is considered for calculation or select the reference illuminant for CRI calculation manually.



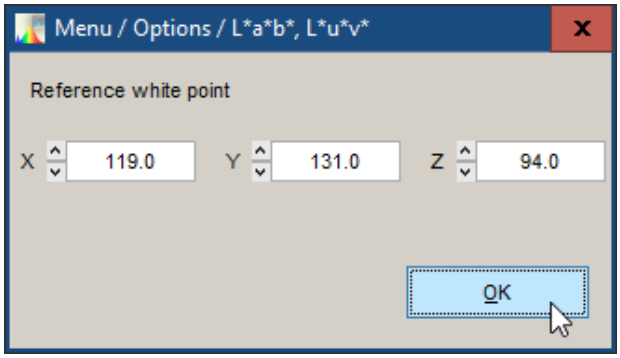

If ‘use R15 sample’ option is checked, in the CRI circle diagram appears the 15th sector, in the CRI column chart appears the 15th column, and $R_e$ index gets the meaning of the mean value of all indices from $R_1$ to $R_{15}$.

If ‘Reference illuminant’ switch is set to ‘Manual’ then another illuminant as default one and another CCT than the measured one can be used. In this case, successive measurements will use the selected value of CCT. If the chromaticity difference DC is greater than $5.4 \cdot 10^{-3}$, the resulting Color Rendering Indices may be expected to become less accurate.
There are following standard illuminants you can choose from: (illuminant A, B, C, D series, TL33, TL84).

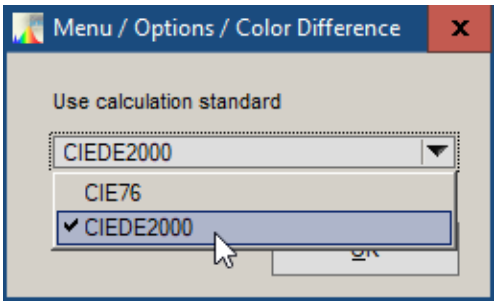
### 6.3.10 L*a*b*, L*u*v

The Options > L*a*b*, L*u*v* allows to set the white point reference for CIE L*a*b* calculations.



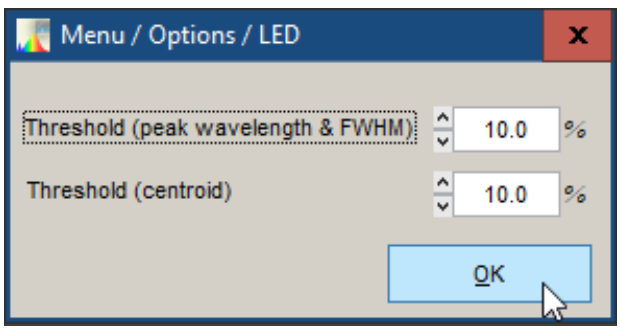

### 6.3.11 Color Difference

The Options > Color Difference allows to set the calculation standard for the color difference widget.




### 6.3.12 LED

The Options > LED allows the user to set the Threshold level to be used for the FWHM calculation and, separately, the level for the centroid calculation.

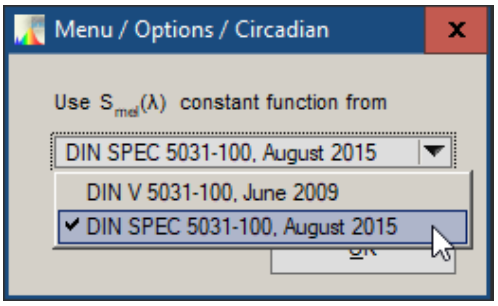


### 6.3.13 Rank View

The Options > Rank View box is described in chapter 5.8.4 ‘Chart: Rank View’, page 75.

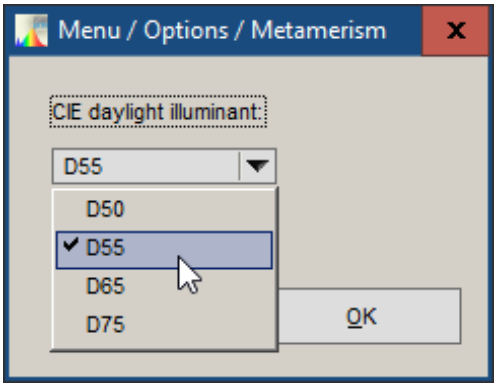
### 6.3.14 Circadian Metrics

With Options > Circadian it is possible to select the Action spectrum. The original Brainard data (DIN V 5031-100, June 2009) or those of DIN SPEC 5031-100, August 2015, can be used.




### 6.3.15 Metamerism

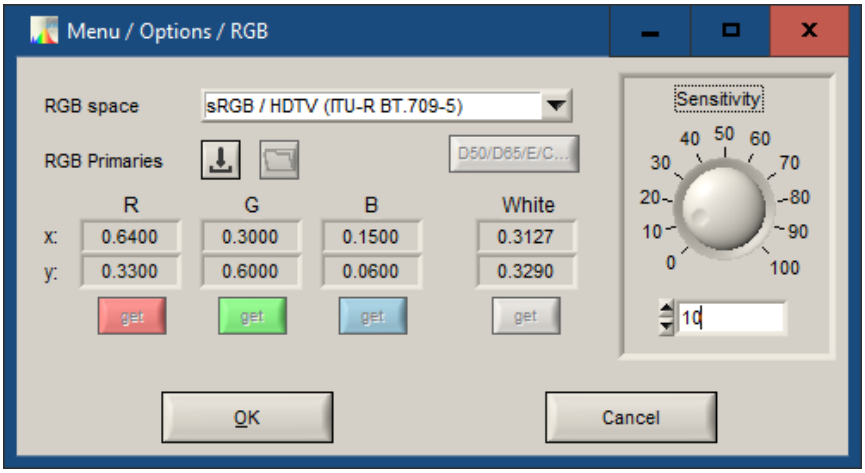
With Options > Metamerism it is possible to select the reference illuminant for metamerism calculation.



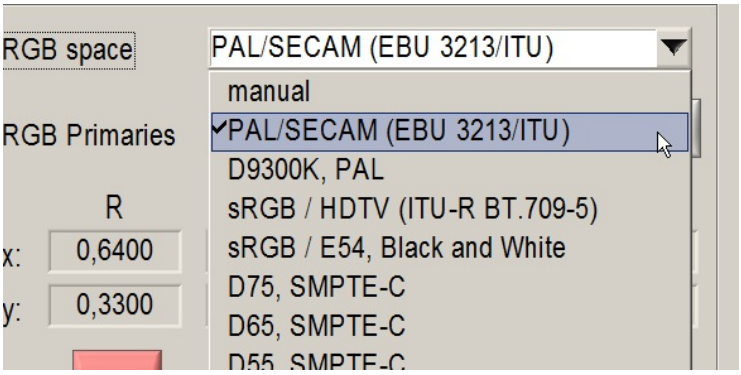
### 6.3.16 RGB

The Options > RGB box lets to set a color space for RGB-calculation and display sensitivity.




You can

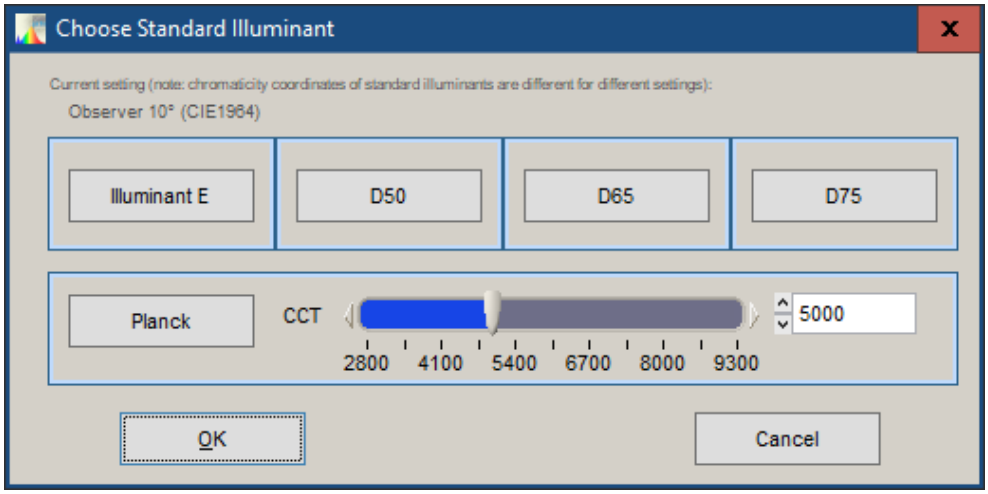
- use one of the predefined data sets:
  - PAL/SECAM (EBU 3213/ITU)
  - D9300K, PAL
  - sRGB / HDTV (ITU-R BT.709-5)
  - sRGB / E54, Black and White
  - D75, SMPTE-C
  - D65, SMPTE-C
  - D55, SMPTE-C
  - D3200K, SMPTE-C
  - DCI-P3
  - D-Cinema v1.2
  - Adobe (1998)
  - Trinitron
  - CIE RGB
  - ColorMatch P22-EBU
  - NTSC (1953)
  - Wide Gamut 700/525/450 nm
  - ITU-R Rec.2020 / Rec.2100
  - Best
  - Beta
  - Bruce
  - Don 4
  - ECI v2
  - Ekta Space PS5
  - ProPhoto




- (with RGB-space set to ‘manual’): type in user specific x and y values for the primaries and the white point manually,
- (with RGB-space set to ‘manual’): get x and y values from the actual measurement using the get buttons.
- (with RGB-space set to ‘manual’): load an existing ‘.rgb’-file from disk using button.

Both standard and manual settings can be saved to ‘.rgb’-file using button (the file format ‘.rgb’ is a legacy of *JETI MoDiCal* software and is compatible with it).

D50/D65/E/C...–button provides a small utility for generating of white point coordinates for different standard illuminants.

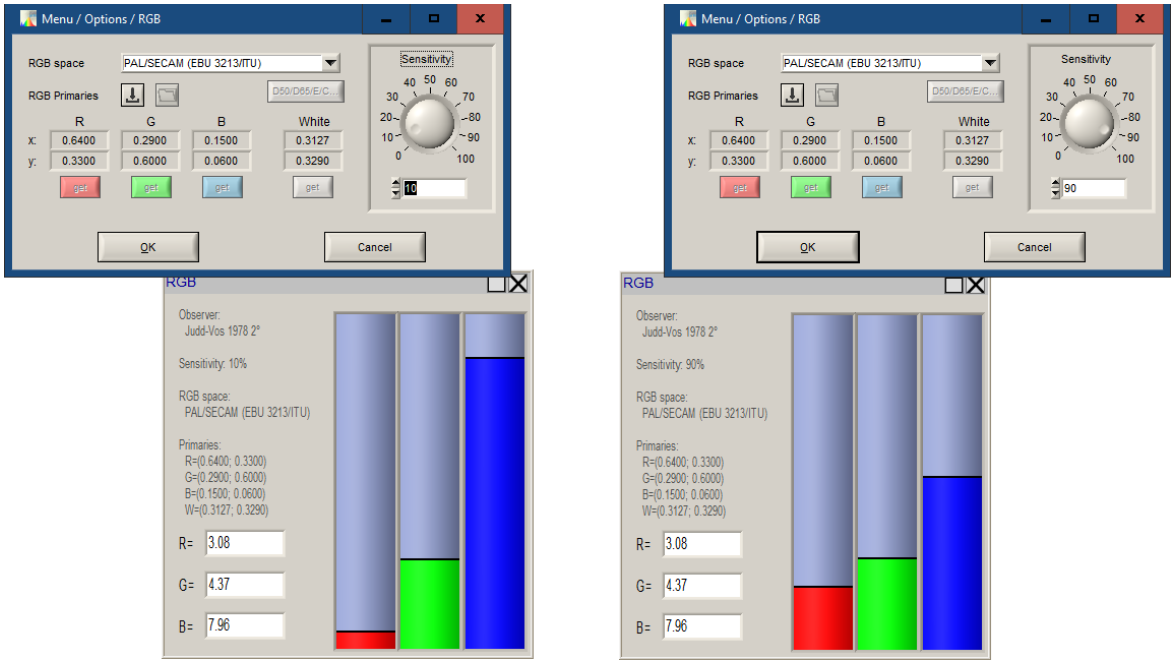



It is possible to choose between standard illuminants E, D50, D65, D75 and Planck (for specified value of Correlated Color Temperature).

| **Remark:** | White point coordinates are calculated for the current Observer setting (which matters because white point coordinates are different for different sets of Color Matching Functions). But all the 'Standard Illuminant'-utility do is one-time change of 'White'-setting in the RGB-widget, which does not remember the user's choice in the utility. So, you should use the utility again every time after you change your Observer setting to update the white point. |
|---|---|

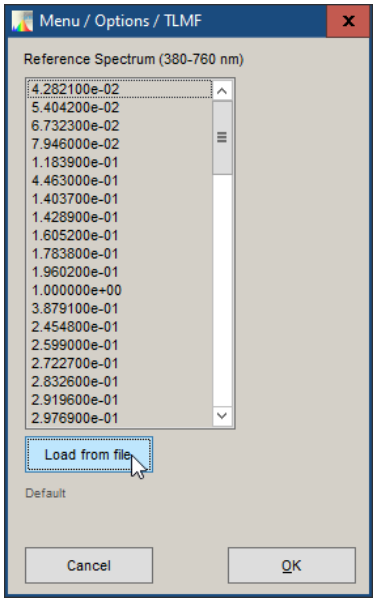
Sensitivity-knob is a pure display setting and it has no influence on any measuring results. Here is a comparison of 10 % (left) and 90 % (right) sensitivity settings for the RGB-widget displaying the same values:




The default setting value is 100 %.

### 6.3.17 TLMF

With Options > TLMF it is possible to select a '.csv' file with a reference spectrum for TLMF calculation.




The file must contain a single spectrum and have LiVal-compatible '.csv' format.

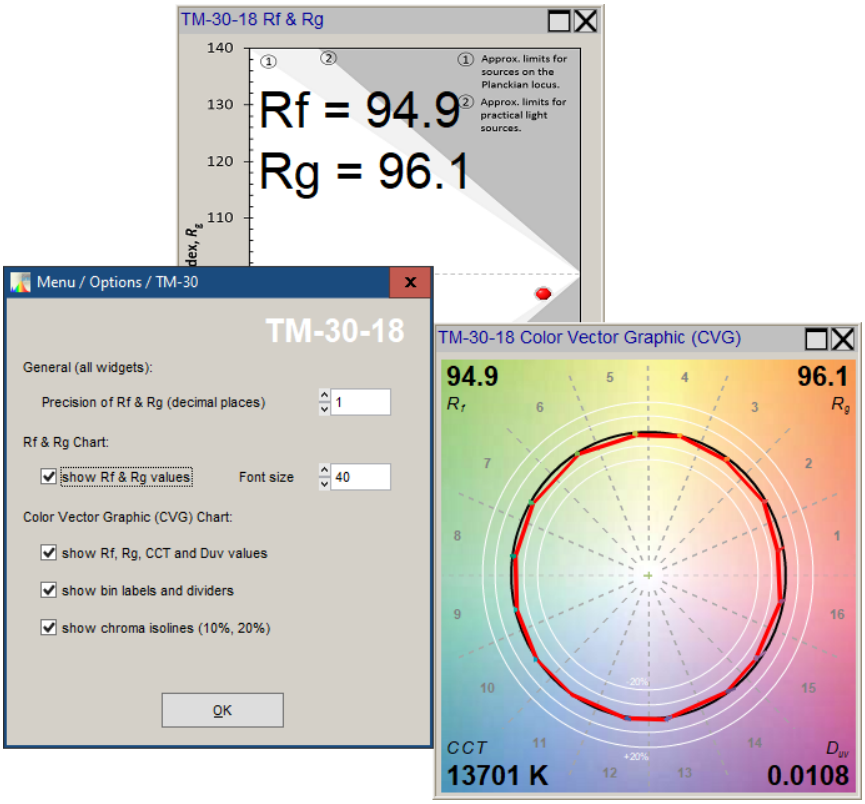
### 6.3.18 TM-30

With Options > TM-30 it is possible to select precision of $R_f$ and $R_g$ values displayed inside some of the TM-30-18 widgets.

For TM-30-18 $R_f$&$R_g$ widget, it is also possible to adjust their font size and to make them invisible.

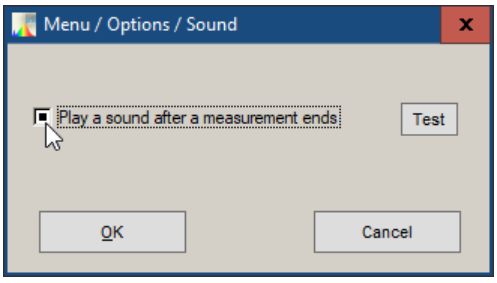
 

For Color Vector Graphic Chart it is possible to show or hide some more items, like labels, chroma isolines and additional values.



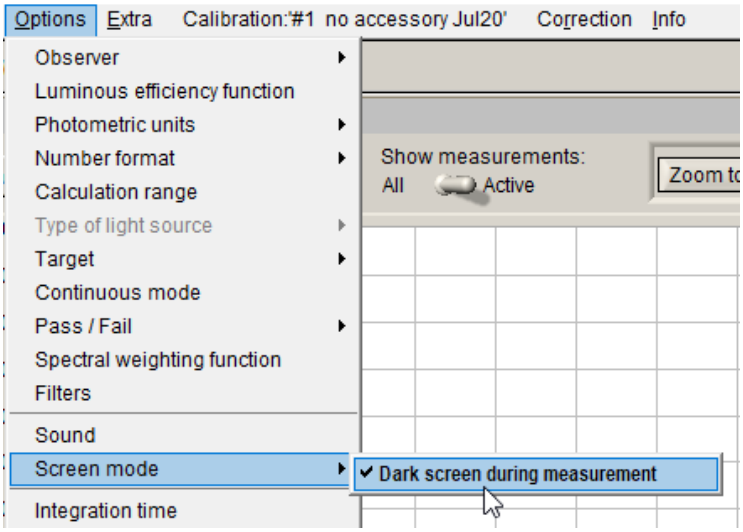

## 6.4 Sound

With this option, *JETI LiVal* gives a sound signal after every measurement. The computer needs to be equipped with a speaker or headphones.



## 6.5 Screen mode

The Options > Screen mode > Dark screen during measurement causes the screen to be darkened automatically during each measurement.

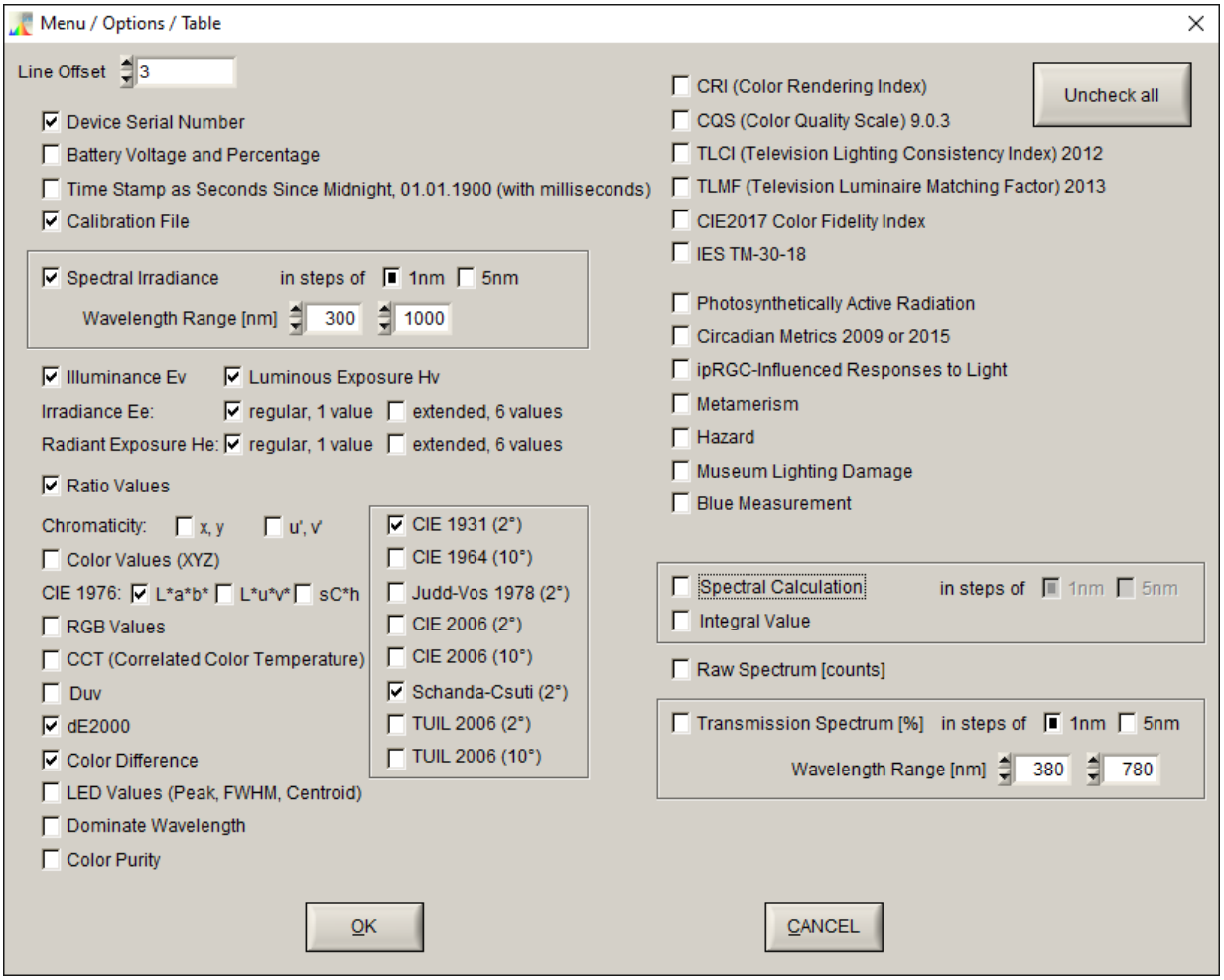



By pressing any key the darkening can be removed temporarily until the next measurement.

## 6.6 Table

Through Options > Table or through the Table Options button in the table view, the desired data to be listed in the summary table can be selected.




Measurement name, date and time stamp are always exported and this behavior is not settable.

Line Offset setting lets to leave the specified number of the table lines empty. The cells in these lines can be edited afterwards (used for comments etc.).

For spectral radiometric and spectral transmission data, wavelength range and step are settable (the step can be either 1 nm or 5 nm).

If ☑ Hazard is checked, ☑ Calibration File also gets checked and dimmed, because in most cases hazard measurement methods presume switching between different calibrations and information about it is essential.

The Luminous Exposure Hv and Radiant Exposure He options are only displayed in the Irradiance measuring mode. In contrast to the history widget in the table view, these

values are only calculated for continuous measurements and refer to the period from the start of the continuous measurement to the time of of the respective measurement. When changing the calculation range, only current measurements are recalculated. For loaded measured values, ‘not calculated’ appears after changing the calculation range.

# 7 Data Storage

## 7.1 Data Table Export

It is always necessary to transfer the measured data into the data table before they can be exported.

### 7.1.1 Data Transfer into the Table Widget

- Open the data table ( Preset > Summary Table or use the short key F8 ).
- Initially, the table is empty.
- Select some measurements in the legend (use Ctrl and Shift in a usual way to select several single measurements or a block of subsequent measurements).
- Click to Table below the legend to export the data to the table.

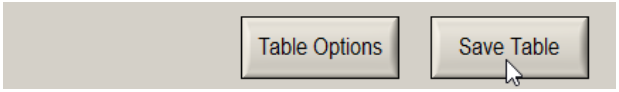

The selected measurement will be transferred.
The measurement names from the legend will be used as column headers in the table.
It is also possible to save loaded reference spectra in the same manner.
If the checkbox ☑ auto is activated, all following measurements will be transferred to table automatically.

### 7.1.2 Exporting the Data

Measuring data transferred into the table can be stored in 'csv', '.xls' or '.xlsx' file formats (Excel 97 or higher).

| **Remark:** | Excel[1] installation is not required. |
|---|---|

Use the Save Table button in the table view, enter the file's name, select a format and location for the file and press OK to save it.




| **Remark:** | Only the values that were selected under Save Table are exported. |
|---|---|

It is not possible to load the exported data into *JETI LiVal* again.

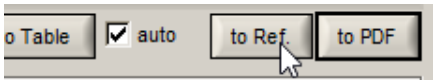
See next chapter on how to load data into the software again.

[1] registered trademark of Microsoft

## 7.2 JETI LiVal Own Files

### 7.2.1 Save...

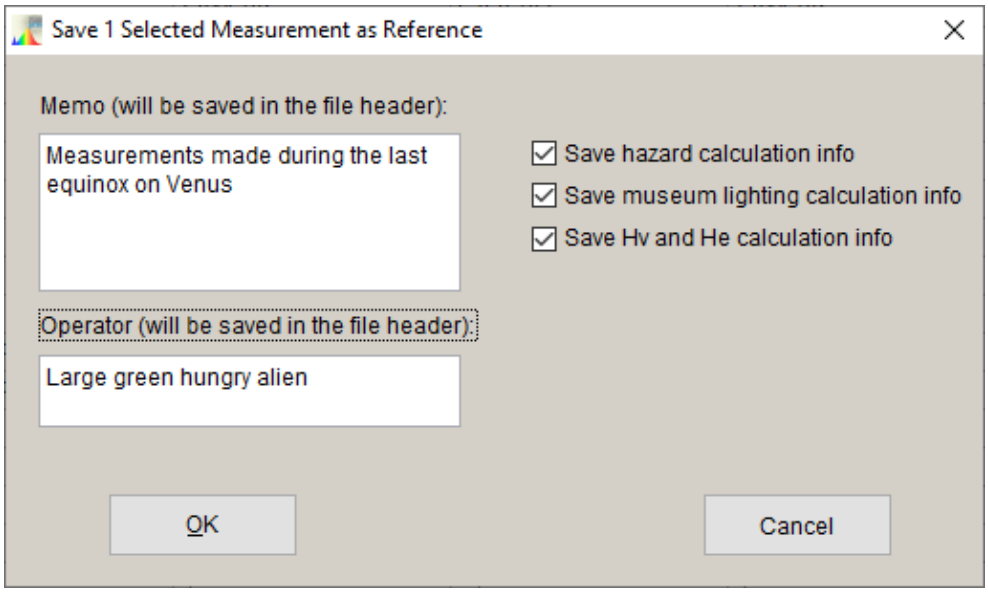
to Ref. button in the main window below the legend or File > Save to reference (in earlier versions of *JETI LiVal* File > Save had this functionality) allows the user to save selected spectra so that they can be loaded again in *JETI LiVal* for example as a reference for future measurements.




Following formats are available:

- Character Separated Values (CSV, file extension '.csv') or
- Galactic SPC file format (GRAMS compatible, file extension '.spc').

First, select some measurements in the legend by clicking on them and using Ctrl or Shift keys to select multiple items. After clicking on to Ref. button, a window with some options appears.




It is possible to add a user comment (memo) and the operator's name (both are optional and can be left empty), or to save information about hazard, museum lighting or Luminous Exposure Hv and Radiant Exposure He measurement modes (without this information, these calculations cannot not be performed correctly after the spectra are loaded again).

| **Remark:** | Saved spectra can be used directly for Spectra Calculations (see chapter 5.8.3 'Chart: Spectral Calculation', page 72. |
|---|---|

### 7.2.2 Load...

Once saved spectra files can be loaded using the menu point File > Load reference.

CSV and SPC file formats are accepted. Batch loading of multiple files as well as loading of files that contain multiple spectra is also possible (to mark multiple files in the 'Load'-window use Ctrl and Shift key combinations in the usual manner of Windows-Explorer).

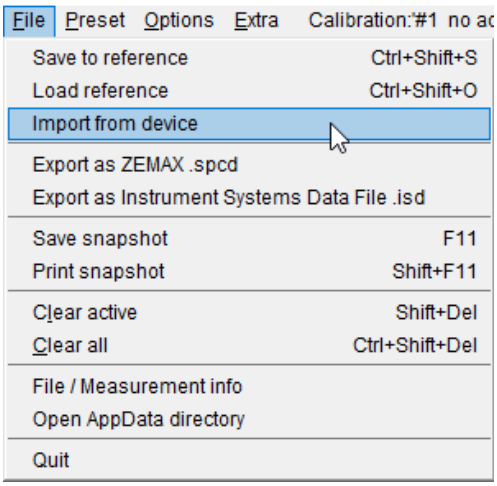
### 7.2.3 Import from SD card (spectraval 1511 only)

If some measurements were made with a spectraval 1511 device in standalone mode and saved to its microSD card, it could be required to transfer them to PC.

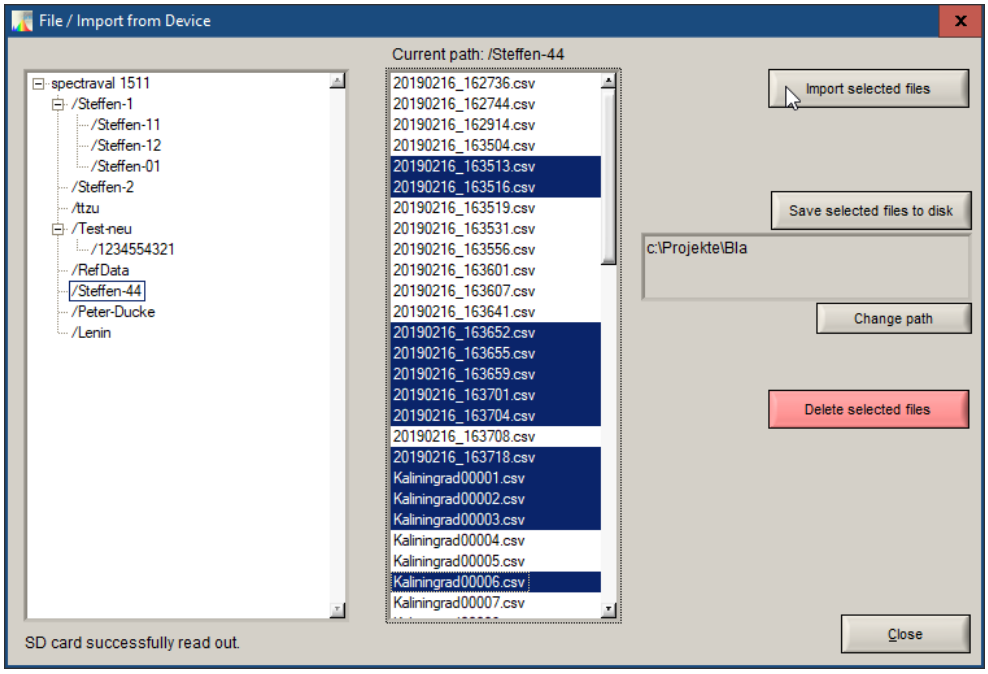
Actually, the better and the more convenient way to do this is to get the microSD card from the device, to plug it into an SD card slot on the PC using a special adapter and to manage the files in a usual way using Windows Explorer.

If this way is not desired or not possible, *JETI LiVal* has a special tool to do the task. A notable drawback of this tool is a poor transferring speed though.

Use the menu point File > Import from Device






The tree on the left side shows the directory structure on the spectraval 1511's microSD card. After clicking on a directory name all files contained in this directory are listed on the right side. Use common selection shortcuts to choose the files: left click, Ctrl + left click, Ctrl + Shift + left click, double click (selects all files).

There are two options: it is possible to import files directly into *JETI LiVal* using the button Import selected files. The spectra will appear in the legend like normal measurements. The second option is to save files to a chosen directory on some data storage device (PC hard disk, USB flash, another SD card, etc.). Choose the target directory with Change path, and click on Save selected files to disk.

### 7.2.4 CSV file format

Structure of CSV-files that *JETI LiVal* produces looks like following:

*MODEL;SPECBOS*
*TYPE;Radiance*
*Number of datasets;2*
*Operator;Jack Daniels*
*Memo;It's some memo text*
*Start Wavelength [nm];350*
*End Wavelength [nm];1000*
*Number of points;651*
*Name;NameOfSpectrumNo1;NameOfSpectrumNo2*

*Correction;Offset;Offset*
*Calibration file;#1 no accessory;#1 no accessory*
*Integration Time [ms];8.10;5.92*
*Date;05/18/2018;05/18/2018*
*Time;09:00:16am;09:23:58am*
*Wavelength [nm];Spectral Radiance [W/(sr*sqm*nm)]*

*350;6.708691E-03;9.557178E-03*
*351;7.967482E-03;1.131609E-02*
*352;9.664601E-03;1.397381E-02*
*353;1.165634E-02;1.720344E-02*
*354;1.318849E-02;1.914403E-02*
*355;1.366467E-02;1.961429E-02*
*356;1.287415E-02;1.844924E-02*
*...*
*1000;1.654410E-02;2.350264E-02*

Sometimes the task is to create a CSV file with some exterior spectral data to use it later in *JETI LiVal*. The easiest way to do this is to do any measurement with any device and to save it with *JETI LiVal*. Then open the file in the Notepad or any other text editor and exchange the data with yours.

Or just use the sample above keeping in mind the following:

The format of the header is not so strict; it is only important that certain tags are specified. These are:

MODEL – possible values are 'SB1201', 'SPECBOS' or 'SV15x1',
TYPE – possible values are 'Radiance', 'Irradiance', 'Radiant Flux', 'Radiant Intensity', 'Radiant Exposure' and 'Arbitrary'; not case-sensitive.

Number of datasets – if not specified, the value is assumed to be equal to 1.

Operator – must be specified, but the value does not matter (maximum 63 characters),
Memo – as well (maximum 129 characters),

Correction – as well,
Date – as well (in format MM/DD/YYYY),
Time – as well (in format hh:mm:ss).

Start Wavelength – must have a reasonable value,
End Wavelength – as well,
Number of points – as well (is always equal to End Wavelength - Start Wavelength + 1),
Calibration file – as well (in format #nr name),
Integration Time – as well.

Wavelength step must always be equal to 1.

Wavelength – must be specified as well as spectral data.

Empty lines are ignored.

Format and number of digits in the spectral data can be any (internally, the conversion to numbers is made with C-function strtod).

Separator character can be comma **or** semicolon (but not mixed!). Decimal separator must be a period character.

## 7.3 Capturing

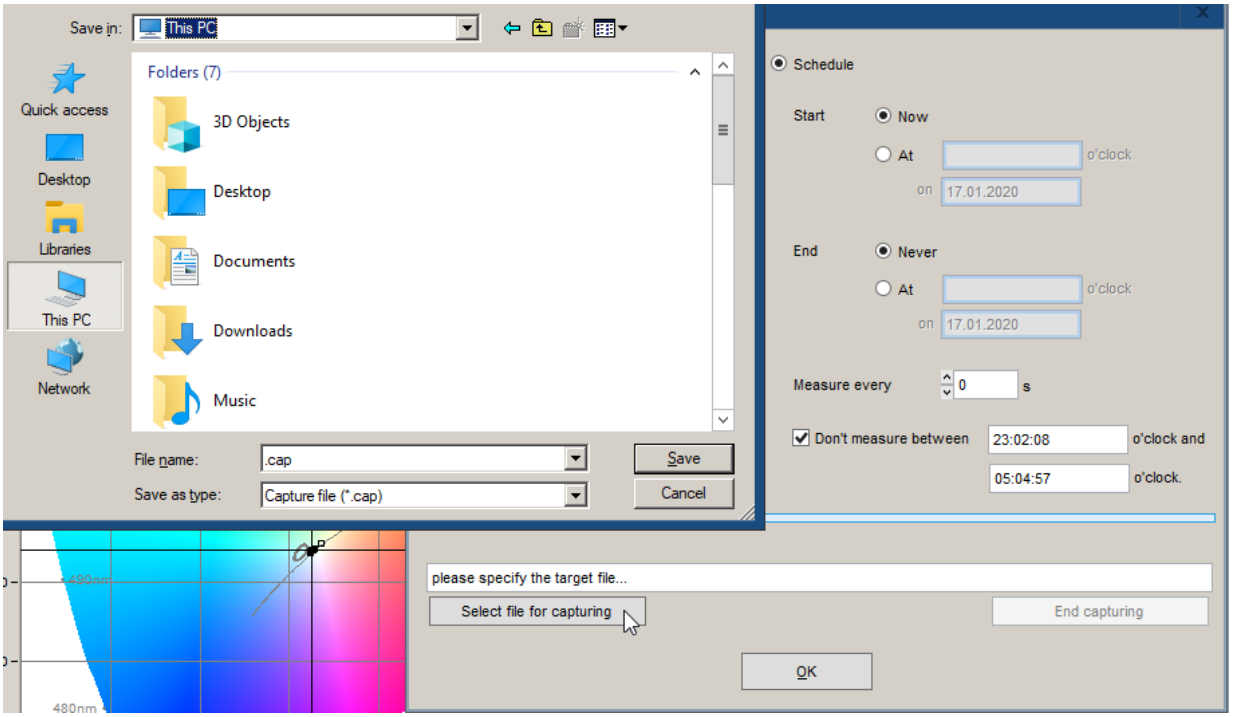
In some applications it is necessary to make very long series of measurements, leaving the device and the software unattended for long periods of time. In this case the problem of secure data storage arises, because every soft- or hardware crash can kill the results of hours or days of work.

For such a case a Capturing mode has been developed.

It works together with the Continuous mode (see chapter 6.1.3 ‘Continuous Measurement’, page 96).

Go to Options > Continuous mode and click on Select file for capturing. Then choose a location and a file name in a usual way.

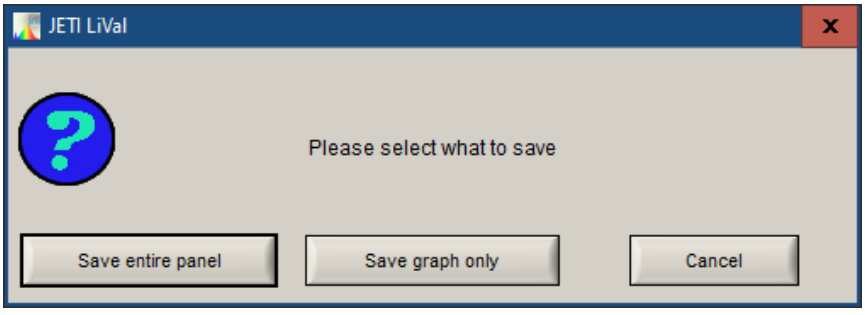



After doing this, all the measurements that will be made in continuous mode will be written line by line into this file. Time stamp, photometric value and spectral radiometric data are stored.

| **Note:** | In difference to other file formats, the spectral values are added line by line and not column by column. If the data would be added column by column, it would be necessary to rewrite the entire file after every measurement, what is not quite secure. |
|---|---|

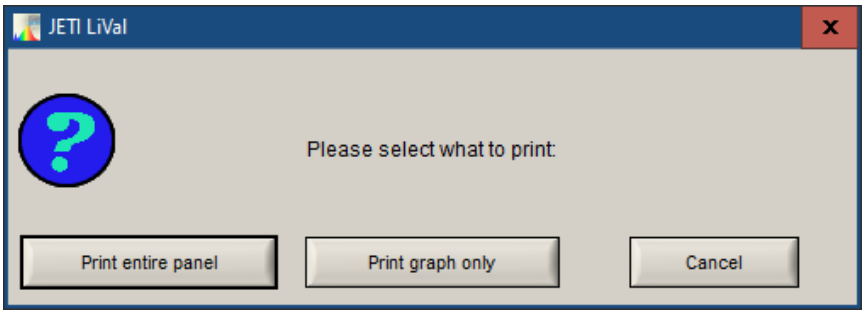
## 7.4 Snapshot

Use File > Save Snapshot menu commands to store the actual screen in a file (shortcut F11) or to print it out (shortcut Shift + F11).



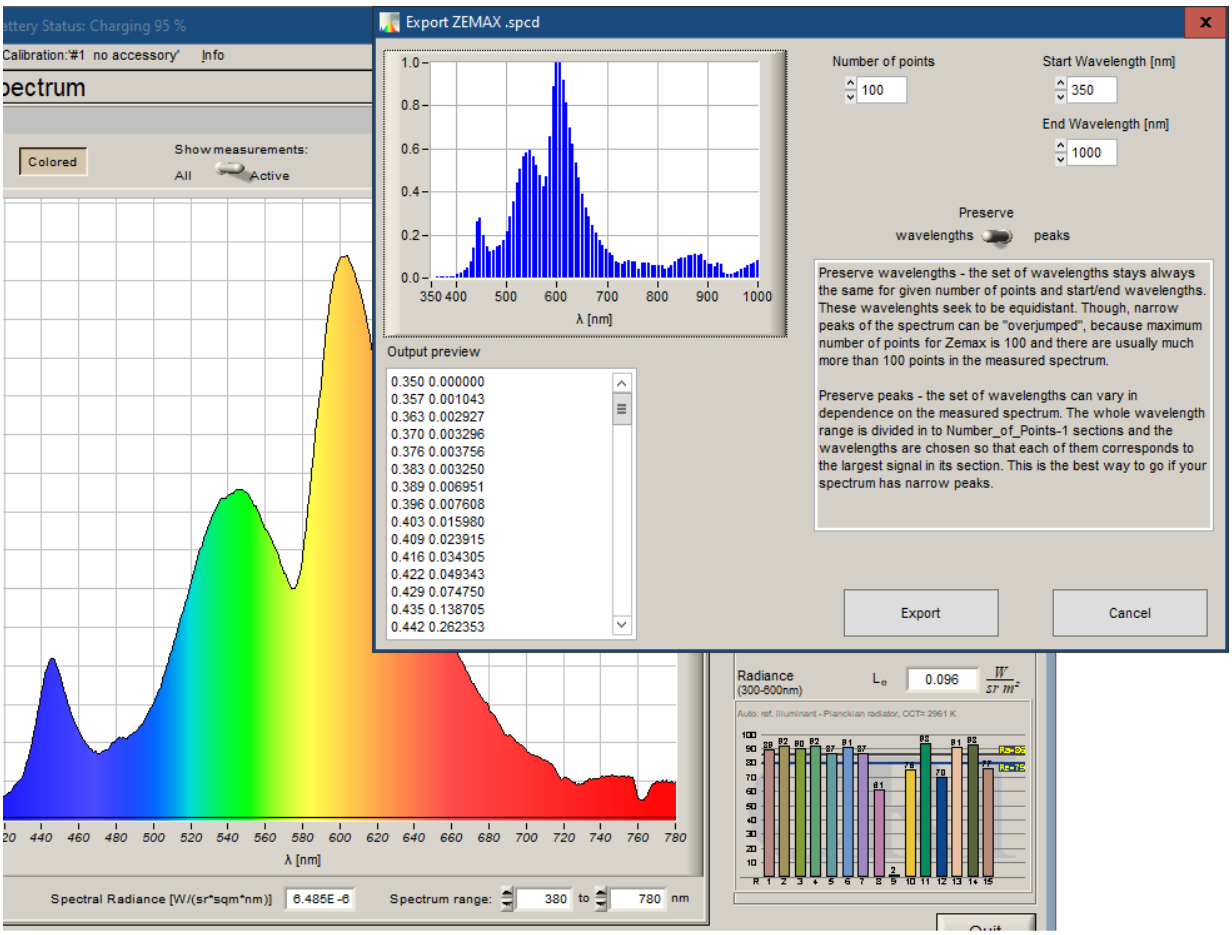

 

The entire screen or just the widget's window can be saved.
'.jpg', '.bmp' and '.png' file formats are available. If you want to print the snapshot, you will be asked to check your printer settings.




## 7.5 Zemax .spcd

Use File > Export as Zemax .spcd menu command to store the selected measurement as a *Zemax*-compatible spectrum file.



The output spectrum is stored in relative units (maximum spectral value = 1), wavelength units are µm, maximum number of wavelengths – 100 (because of internal limits of *Zemax*).
Switch Preserve wavelengths/ peaks lets to choose between two modes: 'preserve wavelength' makes the set of wavelengths equidistant as good as possible. This is the preferred mode for usual smooth spectra like halogen lamps or LEDs. In 'preserve peaks'-mode the wavelengths are chosen so that every of them corresponds to maximal spectral value in its segment. This can be useful if you are dealing with a line spectrum and don't want to have too many points in your output file.

The window 'Output preview' shows directly entire contents of the file that will be created.

## 7.6 Instrument Systems Data .isd

Use File > Export as Instrument Systems Data File .isd menu command to store the selected measurement as a *Instrument Systems Data*-compatible spectrum file.

Structure of ISD-files that *JETI LiVal* produces looks like following:

*[Curve Information]*
*Name=#1*
*Data=#1*
*Class=TLWNumNode*

*[Comment]*

*[Measurement Conditions]*
*Measurement Mode=SpectralAnalysis*

*[Data]*
*Name=#1*
*Type=Double*
*NumberOfDataX=401*
*NumberOfDataY=2*
*X-MIN=380*
*X-MAX=780*
*X-Unit=nm*
*Y-Unit=W/m^2 sr nm*
*Data*
*380 1.220848E-04*
*381 1.136782E-04*
*382 1.303770E-04*
*383 1.423191E-04*
*...*
*780 2.663549E-04*

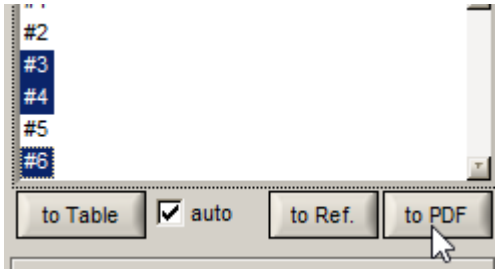
Depending on the measuring mode, these measuring units are possible for Y-Unit:

- Radiance: W/m^2 sr nm
- Irradiance: W/m^2 nm
- Radiant flux: W/nm
- Radiant intensity: W/sr nm

## 7.7 Export as PDF Report

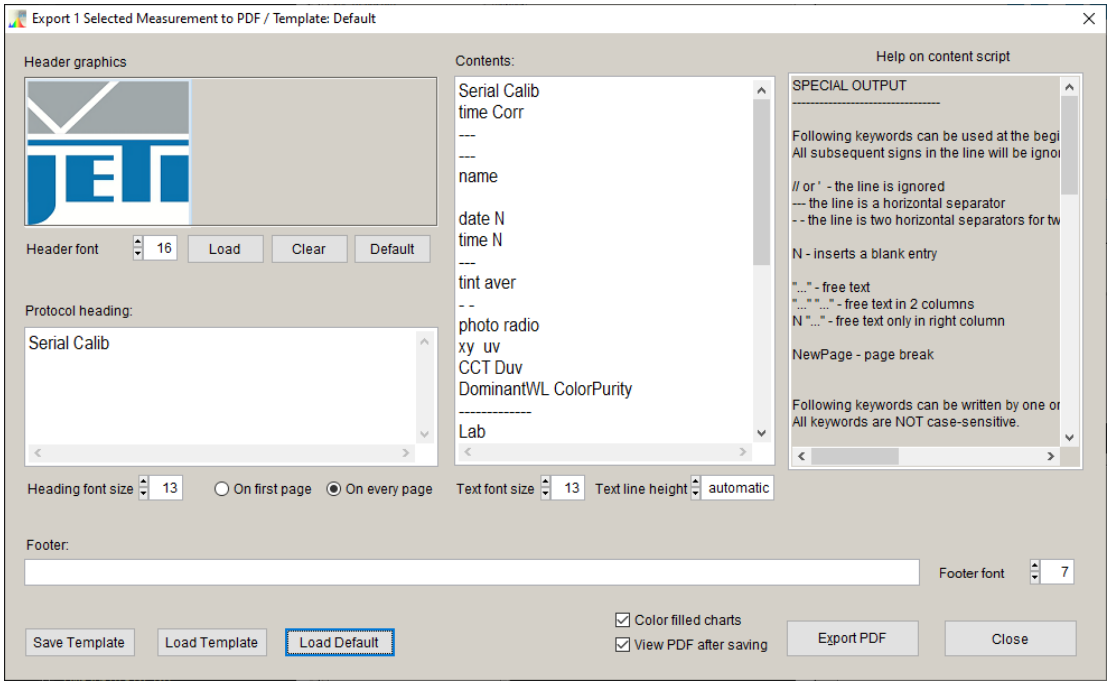
*JETI LiVal* has a powerful tool to create PDF reports from measuring results. It is possible to define contents of an output file freely using a special script editor.

- Select some measurements in the legend (use Ctrl and Shift in a usual way to select several single measurements or a block of subsequent measurements).
- Click to PDF below the legend.



The following window will be opened, which allows to set several options and to define the contents of the report.




| **Hint:** | Click on Load Default in the lower left and confirm with 'Yes'. A default script will be loaded. |
|---|---|

The area in the left upper corner of the window sets possible header images. They will appear on the top of every page of the PDF file. Their height is fixed and limited by the height of the header; their width is adjusted to preserve aspect ratio.

Load allows to load any user defined images (must be in 'JPG' format)
Clear allows to create documents with no images in the header and
Default lets you use the standard *JETI* logo as the header graphics.

In the area below, you can add an additional headline and notes to the Header. It can consist of several lines. The keywords Serial and Calib are interpreted in the same way as in the contents script. Other keywords are not allowed here. Notes and remarks have to be placed in quotation marks to be included in the PDF. It is also possible to place them into 2 columns.
If the radio button ⊙ On first page is activated, the headline is only shown on the first page, otherwise, on every page.

The area to the right displays help on keywords which can be used in the script.

Measured values and graphics can be placed in one or two columns by simply entering them in seperate lines or adjacent to each other in one line. Empty lines and horizontal separators are allowed to arrange the data. There are two types of horizontal separators: to get a continuous line, you can set it by '---' (minus-minus-minus); to get two

separate lines appropriate for two columns, you can set them as '- -' (minus-space-minus).

Basic-style or C-style comment signs ('’' and '//') can be used to comment a line out.

Numeric values and graphics may have different proportions and widths. Some of them can be placed adjacent to each other by writing them in a single line in the script. Others might have to be placed on separate lines. Just play with the settings to get the best result.

Notes and remarks are also possible. If there is text in quotation marks in a line, keywords are ignored for this line.

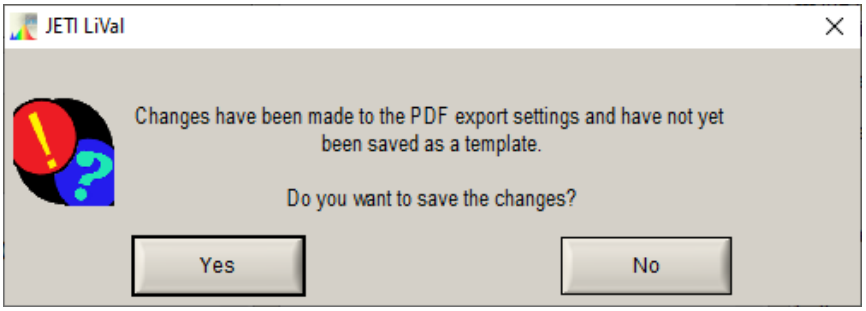
| | |
|---|---|
| **Hint:** | Keywords that *JETI LiVal* cannot interpret are ignored, but the space in the column is still reserved. You might use this possibility to shift some values or graphics to the left or right column (look at the usage of 'N' in the default script). |

You can also set a footer at the bottom of the window. Here, the text does not have to be in quotation marks, since only text input is possible.

With ⬍ header font , ⬍ heading font size , ⬍ Text font size and ⬍ footer font you can change the font size for header, headline, content and footer.

The PDF-settings can be stored as a template file ( Save Template and Load Template buttons). The path of the currently loaded template is displayed in the title bar.

If you close the window, and the current settings no longer match the loaded template, a warning will appear:

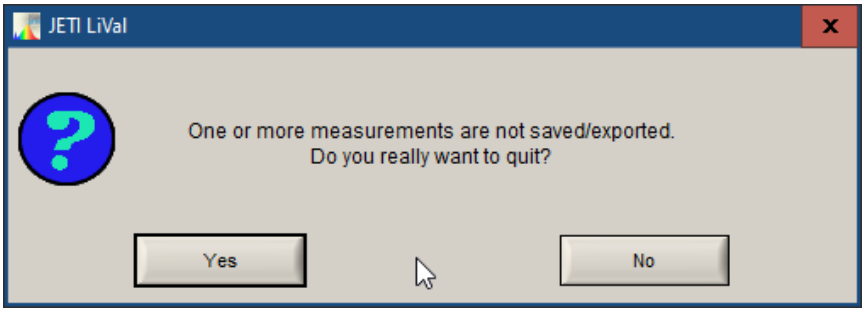



Yes causes the action to be aborted, so that the changes can be saved using the button Save Template.

# 8 Finishing the Program

The program can be closed by selecting the Quit button or using the hotkey Alt + Q. If one or more measurements were not stored, the following window will appear to avoid data loss:



# 9 Session Logging

| **Note:** | The folder that contains system files of *JETI LiVal* mentioned below can be easily accessed through File > Open AppData directory. |
|---|---|

*JETI LiVal* generates a log-file '`lival_session.log`' for each session (*JETI LiVal* overwrites it at every program start), which is normally located under `C:` ▸ `Users` ▸ `[username]` ▸ `AppData` ▸ `Roaming` ▸ `JETI` ▸ `LiVal`. The file contains important information about internal calls of system functions which are responsible for communication with the device.
If you notice any reproducible error, you can backup this file after the error has happened but before you restart *JETI LiVal* and send it to *JETI* with an explanation of what exactly has happened. This can help us to make *JETI LiVal* better in the future.

The name of another log-file which is created ends with the device number and a suffix '`_parameters.log`'. These files are created for every individual device number and contain basic parameters (like firmware version) of the device. These files are also overwritten at every program start, though they are never deleted, so their total number always correspond to the number of devices ever used with the current *JETI LiVal*.

# 10 Calibration

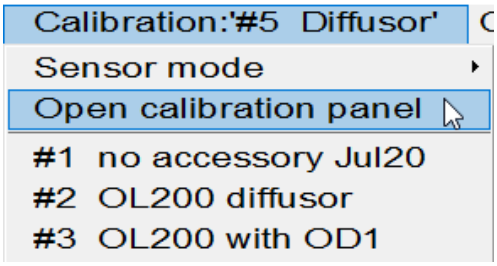
## 10.1 Sensor Mode


The two sensors in the measuring head recognize the accessory attached to the device automatically. They can detect up to four different accessories and the software will use the appropriate calibration file. By default, the first position is reserved for the Luminance mode measurement without an accessory.

The software can manage up to 8 (12 for specbos 1211) calibration files related to different accessories. If more than 4 files are stored it is necessary to select the numbers from 5 to 8 (12) manually. Click Calibration » Sensor mode » Sensor disabled. Afterwards, the appropriate calibration file can be selected in the lower section of the menu Calibration.

| **Remark:** | If the sensor is disabled, always make sure that the right calibration file is selected, to obtain correct measuring results. |
|---|---|

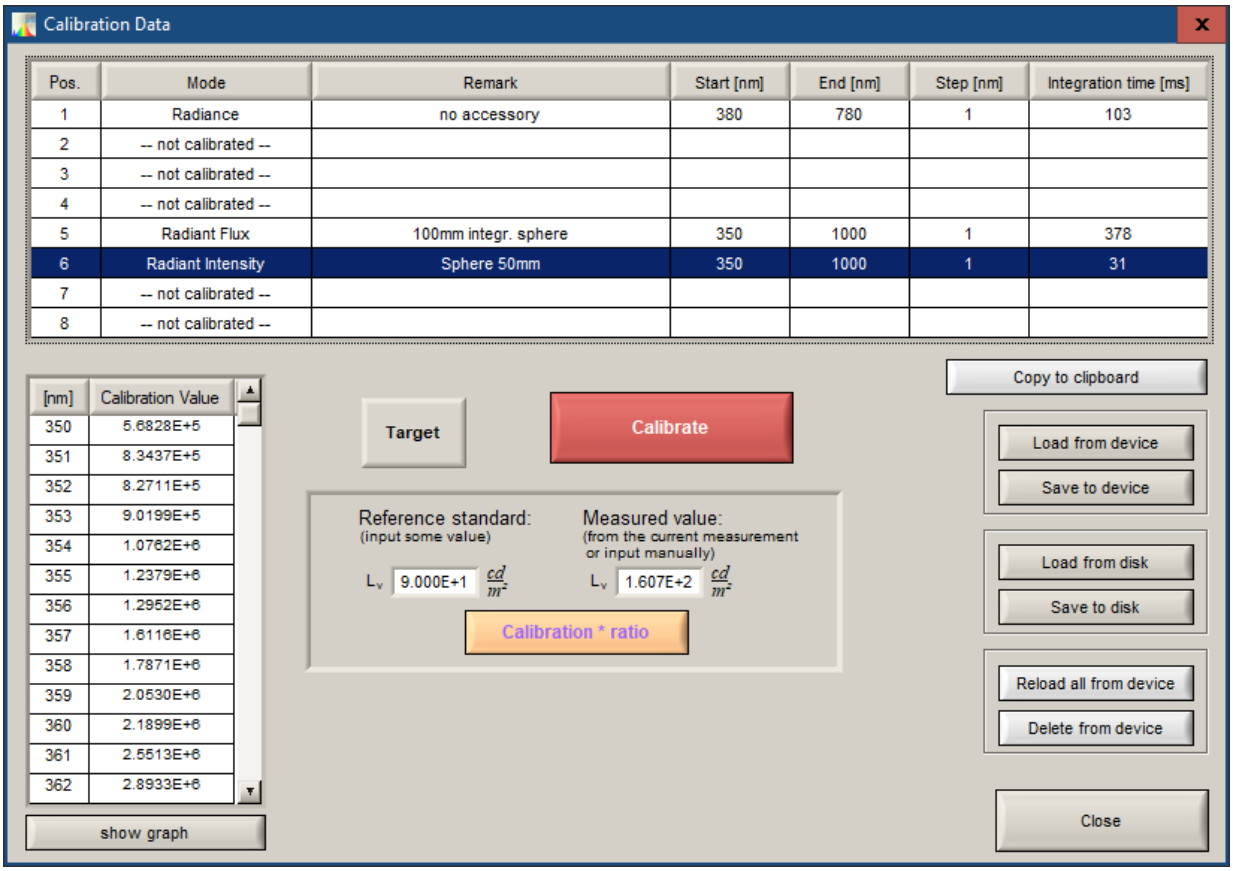
## 10.2 Handling of Calibration Data




| **Note:** | This menu point is password protected. |
|---|---|

*JETI* spectroradiometers are delivered in a calibrated status. The calibration data are saved in the device. A separate file exists for each measuring mode and each accessory.

The menu point Calibration > Open calibration panel... displays all calibrations that are stored in the device and lets to (re)calibrate it.




Calibrate:
Starts calibration procedure.

Copy to clipboard:
Copies the whole contents of the table to clipboard. After doing this one can easily paste it into an Editor or Excel document.

Load from device:
Load the selected calibration file.

Save to device:
Save the selected calibration file to the device.

Load from disk:
Load a calibration file from the disk and show this at the selected file place.

Save to disk:
Save the selected calibration file to the disk.

Reload all from device:
Load all calibration files from the device.

Delete from device:
Delete the selected calibration file.

## 10.3 New Calibration

The recalibration of the sensitivity data can be done by the user if a suited calibration lamp with the latest spectral radiometric data is available.

The **lamp file** needs to have the following structure in ASCII format:

*Measuring mode ('Radiance', 'Irradiance', 'Radiant flux' or 'Radiant intensity'; not case-sensitive)*
*Remark*
*Begin of wavelength range*
*End of wavelength range*
*Wavelength step (only 1 nm allowed)*
*First spectral value*
*Second spectral value*
*....*
*Last spectral value.*

The unit of the spectral data has to be as follows:

| | |
|---|---|
| Radiance | $W/(m^2 \cdot sr \cdot nm)$ |
| Irradiance | $W/(m^2 \cdot nm)$ |
| Radiant flux | $W/nm$ |
| Radiant intensity | $W/(sr \cdot nm)$ |

| **Remark:** | All calibrations are done independently. |
|---|---|

First press the red Calibrate button. Now the user has to make sure that the right lamp is adjusted in a proper way in front of the device. If so, the user can confirm the calibration. These steps can be repeated for other modes in the same manner.

The new calibration data are stored in a file with the extension '.cal' on the PC as well as directly in the device.

A **calibration file** has the following structure:

*Measuring mode (same as of used lamp file)*
*Remark*
*Begin of wavelength range*
*End of wavelength range*
*Wavelength step*
*Integration time*
*First spectral value*
*Second spectral value*
*....*
*Last spectral value*

The units of the spectral data are as follows:

| | |
|---|---|
| Radiance | $\frac{\text{counts/s}}{\text{W/(m}^2 \cdot \text{sr} \cdot \text{nm)}}$ |
| Irradiance | $\frac{\text{counts/s}}{\text{W/(m}^2 \cdot \text{nm)}}$ |
| Radiant flux | $\frac{\text{counts/s}}{\text{W/nm}}$ |
| Radiant intensity | $\frac{\text{counts/s}}{\text{W/(sr} \cdot \text{nm)}}$ |

# 11 LiVal file types

The following file formats are used in LiVal:

- **‘.csv’, ‘.xls’ / ‘.xlsx’:**
  Measured data displayed in the table view can be saved in ‘.csv’ or ‘.xls’ / ‘.xlsx’ file formats.
- **‘.spc’, ‘.csv’:**
  Measured spectra can be saved in JETI LiVal’s own file format ‘.spc’ or alternatively in ‘.csv’ format. The structure of the csv file is described in chapter 7.2.4 ‘CSV file format’, page 126.
- **‘.spcd’:**
  Measurements can be also stored in a Zemax-compatible spectrum file ‘.spcd’ (see chapter 7.5 ‘Zemax .spcd’, page 129).
- **‘.isd’:**
  An export of the measurements as Instrument System Data file ‘.isd’ is also possible (see chapter 7.6 ‘Instrument Systems Data .isd’, page 130).
- **‘.lmp’, ‘.cal’:**
  Calibration: The structure of the lamp file (‘.lmp’) and the created calibration file (‘.cal’) is described in chapter 10.3 ‘New Calibration’, page 138.
- **‘.aux’:**
  To compensate for the self-absorption of a sample in an integrating sphere with auxiliary lamp, a correction spectrum can be measured and stored as a binary ‘.aux’-file (see chapter 4.3.4 ‘Luminous Flux Measurement Mode with Self-Absorption Correction’, page 23).
- **‘.pdf’, ‘.txt’:**
  PDF reports can be created from the measurement results, as described in chapter 7.7 ‘Export as PDF Report’, page 131. Template files in ‘.txt’- format can be created and loaded for different PDF report contents.
- **‘.jpg’, ‘.bmp’, ‘.png’:**
  A snapshot of the whole screen or just the widget’s window can be saved as ‘.jpg’, ‘.bmp’ or ‘.png’ file (see chapter 7.4 ‘Snapshot’, page 128).

# 12 Shortcut Keys

| | |
|---|---|
| F1 | About box (including product/ vendor ID, virtual COM port number, baudrate, firmware version) |
| Shift + F1 | Battery status (**spectraval** and **specbos 1211-BT**) |
| Tab | Change view to the next preset |
| Shift + Tab | Change view to the previous preset |
| F2 | Change view to ‘spectrum’ preset |
| F3 | Change view to ‘chromaticity xy’ preset |
| F4 | Change view to ‘chromaticity u’v’’ preset |
| F5 | Change view to ‘raw spectrum’ preset (dark signal corrected) |
| F6 | Change view to ‘rank view’ preset |
| F8 | Change view to ‘summary table’ preset |
| F9 | Start the measurement |
| F10 | Change view to ‘custom’ preset or go to the next ‘custom’ preset. |
| F11 | Snapshot into file |
| Shift + F11 | Snapshot to printer |
| F12 | Display of the current integration time and maximum counts in spectrum (including dark counts) |
| Esc | Abort a running measurement |
| Ctrl + D | Open the distance panel of luminous intensity measurement |
| Ctrl + I | Disconnect /Reconnect the device (it will be available for a different application) |
| Ctrl + Shift + S | Save |
| Ctrl + Shift + O | Load |
| Ctrl + S | Export table in Excel |
| Ctrl + T | Open/ Close the panel with integrating time options |
| Space | Start of a measurement (only if Measurement button is active) |
| Ctrl + A | Select all measurements |
| Shift + Del | Clear active measurement |
| Ctrl + Shift + Del | Clear all measurements (with accepting window) |
| Ctrl + L | Switch the laser on/off |
| Alt + Q | Quit the program |

# 13 Error Messages

The instrument needs no permanent maintenance, if you use it carefully. It is recommended to recalibrate it every year. Ask your dealer or the producer (see chapter 14 ‘Service’, page 146 for details).

| Error message | Reason | Removal |
|---|---|---|
| Could not connect to device! Please restart the software. | Trying to reconnect the device, whereas something on its state is changed (e.g. it is connected to another port or switched off). | Restart the software. |
| Could not connect to device! Switched to offline mode. | Device was found, but communication is impossible due to e.g. incompatibility of the firmware version. | Check the version of the firmware, and update it if necessary. |
| Stray light matrix file not found. Please select the correct stray light matrix file. | No internet connection available or no suitable stray file found. | See chapter 2.1 ‘Stray light correction’, page 12. |
| Could not delete calibration file! | Internal device memory or communication error. | Contact your supplier. |
| Could not determine flicker frequency! | Unknown flicker frequency measuring error. | Use the normal mode (without Sync) for the measurement. |
| Could not determine flicker frequency! It seems there is no modulation of the light source. | Flicker frequency measuring sensor was not triggered by the light source, i.e. the intensity of the light source is constant without modulation. | Use the normal mode (without Sync) for the measurement. |

| | | |
|---|---|---|
| Could not determine flicker frequency! Light source modulation is too fuzzy. You might enter the sync frequency manually. | No systematic in triggering signals received by flicker frequency measuring sensor could be found. The reason may be some other disturbing light sources. | If the frequency is not known, it might help to use some averages to stabilize the readings. If the frequency is known, type it in manually. |
| Could not load calibration file! Invalid wavelength step-width. | Only the wavelength step of 1 nm is valid for calibration files. | Take another calibration file or change your file through in- or extrapolation to make its wavelength step equal to 1 nm. |
| Could not open lamp file. | Lamp file opening error. | Try another file name or directory. |
| Could not perform measurement! | Some error during the measurement is occurred. | Check you measurement conditions and try again. |
| Could not print snapshot! | Printing error. | Check your printer settings. |
| Could not read parameter from device! | Internal device memory error. | Contact your supplier. |
| Could not send calibration file to device! | Internal device memory or communication error. | Contact your supplier. |
| Could not send calibration file to device! Device not calibrated. | Internal communication error. | Contact your supplier. |
| Error creating directory. | *JETI LiVal* tries to save its configuration in a config.ini file in a `JETI`▸`LiVal` subdirectory, but has no access. | Create this subdirectory `C:`▸`Users`▸`[username]`▸`AppData`▸`Roaming`▸`JETI`▸`LiVal` manually. |
| File not compatible! | Wrong format of a file loaded for calculation purposes. | Check the file format. For example see chapter 7.2 ‘JETI LiVal Own Files’, page 123. |

| | | |
|---|---|---|
| Firmware of *JETI* device is not compatible! | *JETI LiVal* needs at least the firmware version 2.0 for *JETI* device 1201 and 3.0 for *JETI* device 1211. | Contact your supplier. |
| Interval doesn't fit. | Wavelength range chosen for PAR (photosynthetically active radiation) calculation doesn't fit the wavelength range of the measured spectrum. | Choose another wavelength range. |
| Invalid function file! | Invalid file with spectral weighting function. | Check format of the function file. |
| Laser turns off after flash. | Laser has low intensity. | See chapter 6.1.5 'Target', page 99. |
| Lost device connection! Device was switched off. To reconnect switch device on and press Ctrl+I. | Device has been switched off. | Switch the device on and press Ctrl + I. |
| Lost device connection! To reconnect switch device on and press CTRL+I. | USB connection error. | Only if the blue lamp on the rear side of the instrument is off: Pull out the USB cable and connect it again. Switch on the instrument (only Bluetooth version). Then: Press Ctrl + I. |
| Missing calibration data. Device is not calibrated for this measuring mode! | There is no suitable calibration saved in the device. | Change measuring mode or calibrate the device for it. |
| No device found! Switched to offline mode. | Device not connected or USB driver not installed correctly. USB drivers were installed with connected instrument. | Connect the device to the PC/ reconnect it or check the installation of the device driver (see chapter '*JETI* USB Driver Installation Guide' in the device operating instructions). Install drivers again without connected instrument. |

| | | |
|---|---|---|
| No message. Software freezes in after start. | Conflict with a Bluetooth part. | See chapter ‘Installation of Bluetooth Device *JETI* specbos 1211-BT’ in the device operating instructions. |
| Overexposure! Measurement failed. | The measured object is too bright to be measured correctly with minimum exposure time of the instrument. | Reduce the intensity with calibrated filters.(see https://www.jeti.com/Products/Accessories/Neutral-density-filters) |
| Please enter a value between 0.01...60000 milliseconds! | Fixed integration time is valid only in the range 0.01 ms to 60 000 ms. The real lower limit for older *JETI* device devices is higher: 4 nm–5 nm. | Enter a value between 0.01 ms and 60 000 ms. |
| Please load a file with single reference! | Trying to load a function from a CSV file with multiple data sets. | Choose another file or change your file so that it has only one data set. |
| Table is empty! | No data are transferred to the table. | Select measurements you would like to save from the list and click to Table button. Note, it can be done automatically with ☑ auto option switched on. |
| Warning. Underexposure! Please increase intensity. | The measured object is too dark. | If you use manual settings of the integration time, make it longer. If not, try to turn your light source brighter. |
| Wrong lamp file! | Lamp file was not readable or did not fit the requirements. | Change lamp file or ensure the correct file access. |

# 14 Service

Please contact in case of any question or technical problem:

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