



SpectrILight III Manual

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1.

1. Introduction

SpectrLight III is a user interface to acquire spectrographs using the International Light Technologies (ILT) spectrometers. This software provides the raw spectral data as well as calibrated irradiance, calibrated flux and calibrated radiance, and features the key photometric analysis of these data.

2. Installation

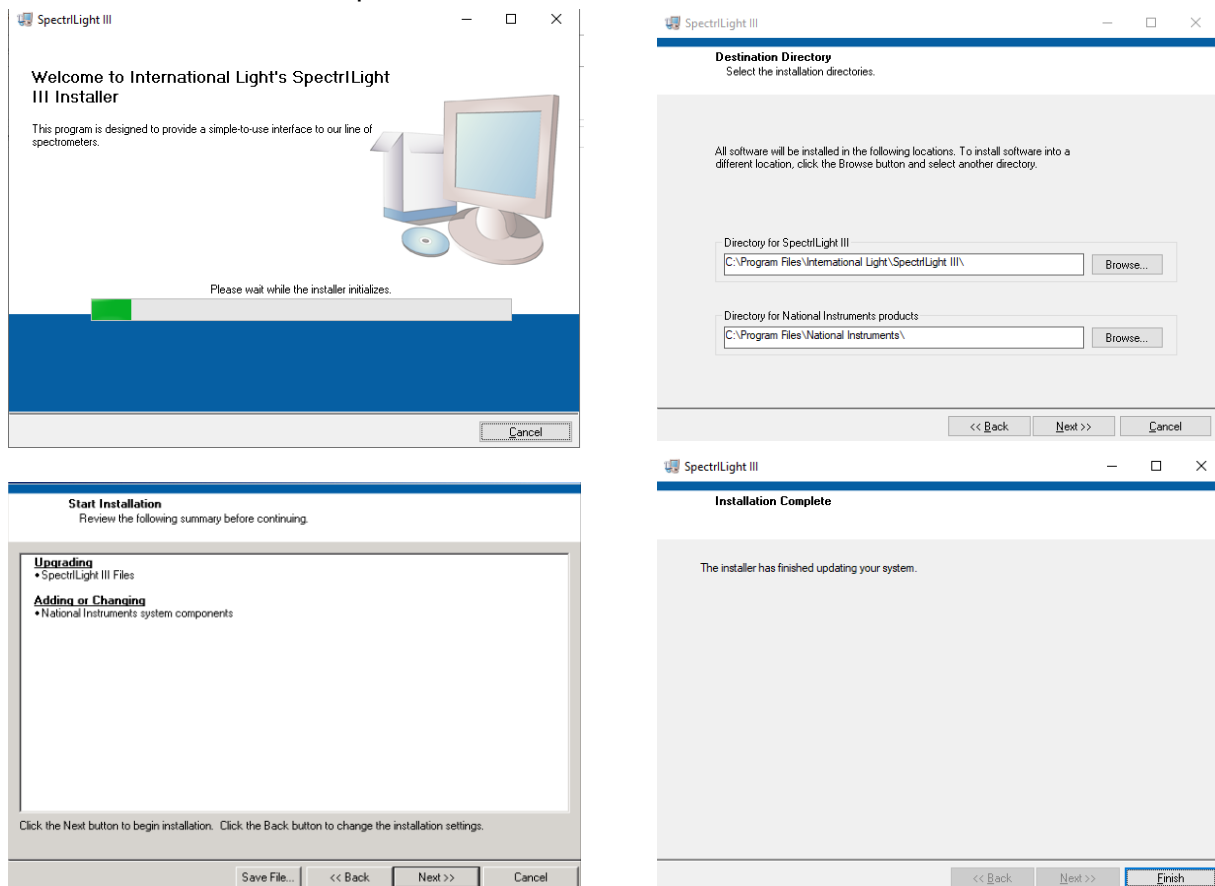
Before installation, ensure that your system meets the following minimum system requirement:

Processor: 1GHz; RAM: 1GB; Hard Disk: 100MB; Screen Resolution: 1024x768

Operating system: Windows 10 or later

Microsoft .Net Framework 3.5 above need to be installed and enabled.

Run the installer file “Setup.exe” to install the software.



Launch the software by double clicking the shortcut icon on your computer.

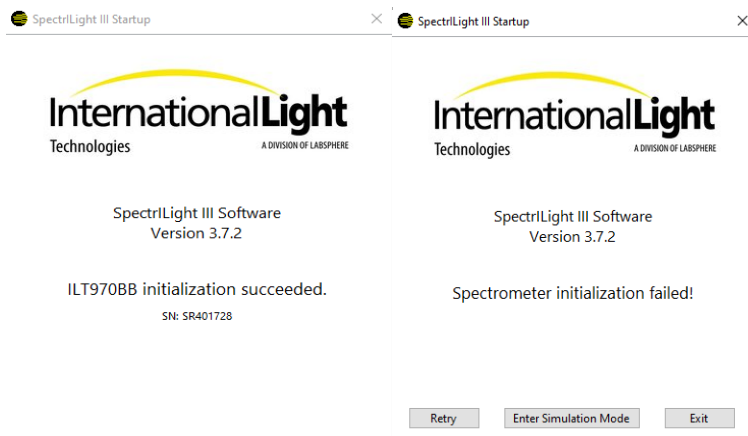


2.1. Initialization

Before initialization, ensure that the driver for the specific spectrometer model has been installed successfully, and the spectrometer is connected to the computer through USB cable.

If the spectrometer is recognized by the software, a pop-up window appears with the spectrometer model name and serial number. If the initialization fails, make sure the spectrometer is connected to the computer and click “Retry” button.

Use “Enter Simulation Mode” to enter the main GUI window without a spectrometer. This mode allows you to import and view previously saved spectral data only.

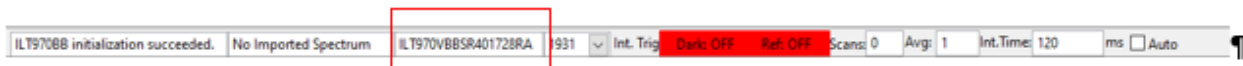


Initialization pop-up windows example: (left-succeeded) (right- failed)

2.2. Loading the Calibration file

Calibration file(s) is provided by ILT in the “Cal File” Folder. Copy-Paste the files to C:\Users\<Username>\AppData\Local\International Light\SpectrLight III\Calibration

The highlighted box in the **Information bar** at the bottom of the main GUI shows the loaded calibration file. Box shows “Uncalibrated” if no calibration file has been selected. To load the calibration file, click on the box and select the correct file.

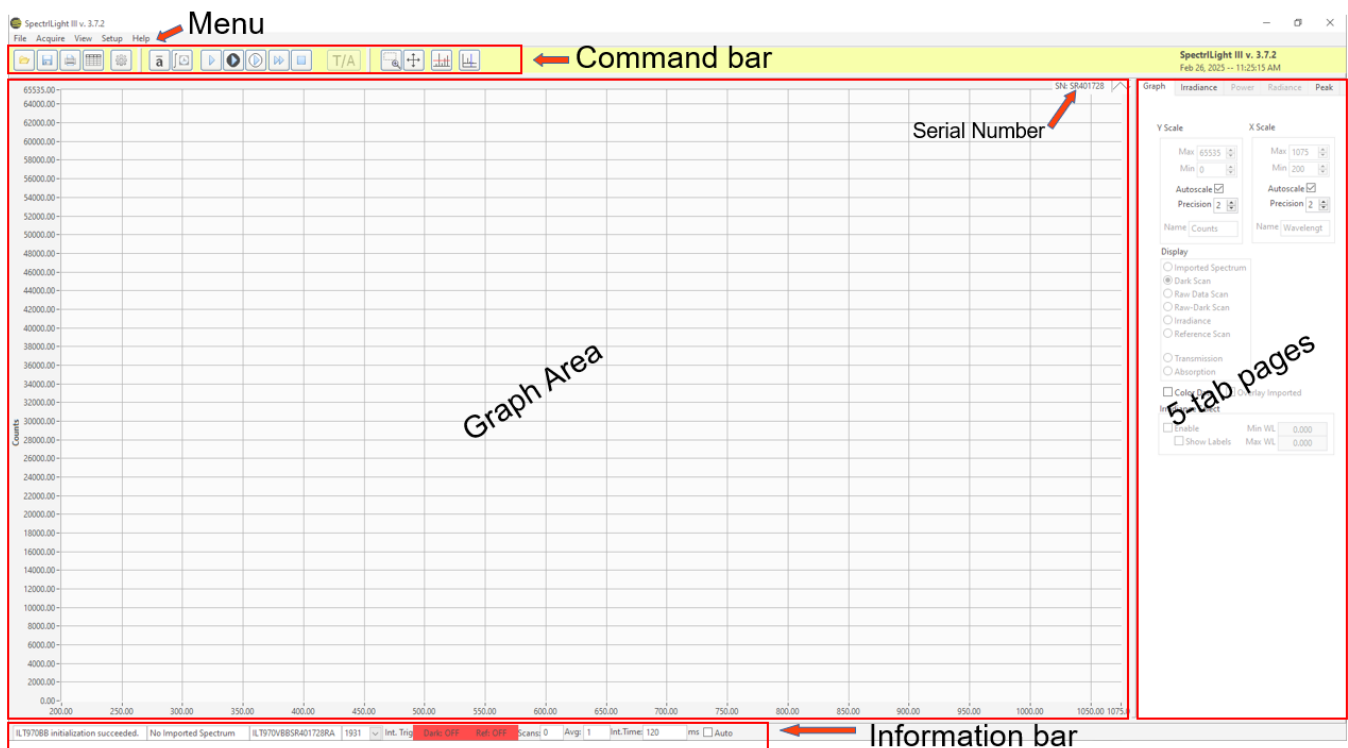


For some of the models, the box shows “EEPROM” and this indicates that the calibration file (one of the calibration files, if spectrometer was calibrated with multiple optical inputs) is saved in the spectrometer EEPROM and the file was automatically loaded.

3. The Main GUI

The main Graphical User Interface (GUI) consists of a **Menu** bar, **Command bar**, **Information bar**, **Graph area** and **5-tab pages**.

Menu Bar	Contains all the measurement, photometric assessment and calibration features in the software.
Command Bar	Provides the user with shortcuts to the basic measurement functions
Information Bar	Provides information on initialization, calibration file, status of dark and reference scans, average and integration time. It also allows the user to click on the textbox to change the values.
Graph Area	Displays the spectral response of the spectrometer for all types of scans (e.g. Dark, Reference, single, transmission, colorimetry e.t.c)
5-tab Pages	Gives the user control over the scan to be displayed and provides photometric information.



Each section has been described in detail below:

3.1. Menu

The Menu contains five options: *File*, *Acquire*, *View*, *Setup* and *Help*. When you click on any of these options, a drop-down menu appears showing a full list of the available menu selection. Some of the most used menu options have keyboard short-cut listed besides them and are displayed as icon command buttons in the **Command bar** as well.

File



3.1.1 Load Spectrum

Loads the saved binary file with file extension *.ilt. Spectrum appears on the **Graph**.

3.1.2 Save Spectrum

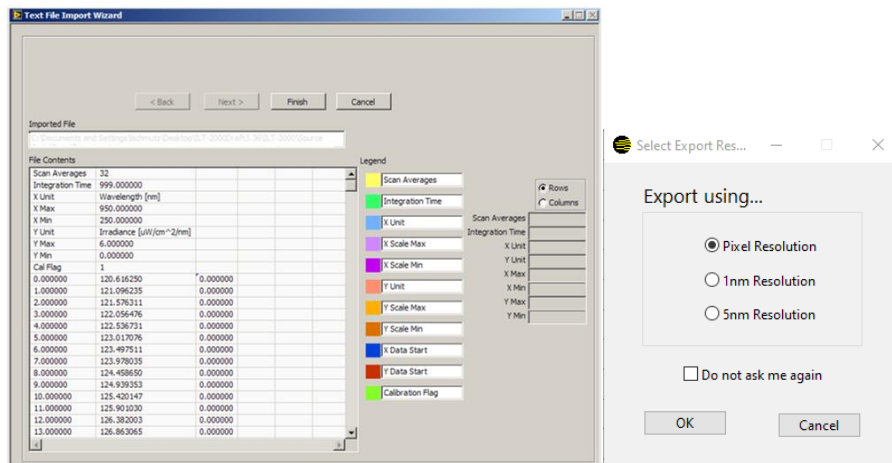
Saves the displayed spectrum data in the **Graph** in binary format with file extension *.ilt.

3.1.3 Import Text File

Select a .txt file saved with SpectrLight III and the spectrum appears on the **Graph**.

3.1.4 Export to Text File

Exports data in the ASCII format of Tab Delimited text file. File format is as shown below. Data can be saved using wavelength data in pixel resolution or in 1 nm or 5nm increments.



3.1.5 Export to Excel File

Exports data with .xls extension. Data can be saved using wavelength data in pixel resolution or in 1 nm or 5nm increments.

Checking “Do not ask me again”, the export routine will remember the resolution selection and the above pop-up window will not launch again. The default setting can be restored using Help\Reset Factory Defaults.

3.1.6 Print\Print Window

Prints the main GUI window. The screen can be saved in PNG, JPG or BMP format.

3.1.7 Exit

Closes the application. Current configuration such as integration time, scan average, calibration file path gets saved to SpectrLight.ini configuration file right before exit.

Acquire**3.1.8 Scan Average**

The number of averages defines the number of acquisitions that are averaged for one scan output.

3.1.9 Integration Time

The integration time controls the CCD exposure time in millisecond. Adjust until the raw count on reference scan is satisfactory.

3.1.10 Dark Scan

Saves the acquired raw counts (S) as dark scan ($S_d=S$). A dark scan is necessary after every integration time alteration.

Tips: While adjusting the integration time, user may click on the “Dark scan” to view the raw count until signal level is satisfactory before performing any formal measurements.

3.1.11 Reference Scan

Displays the current raw counts with dark scan subtracted ($S_{ref}=S-S_d$).

3.1.12 Single Scan

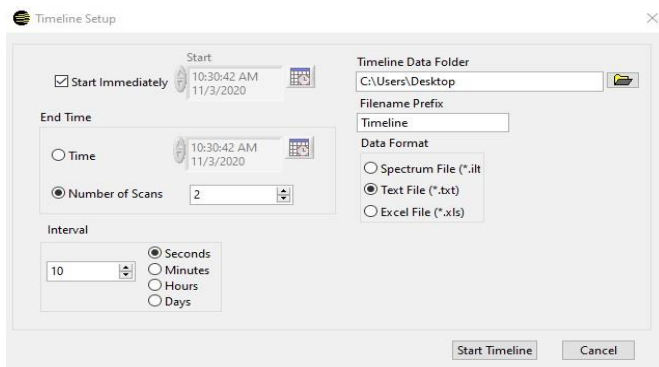
Applies the calibration factor C in the calibration file to the reference scan and shows the calibrated spectrum $S_{cal}=C*(S-S_d)$. Calibration factor can be for Irradiance ($\mu W/cm^2.nm$), Power (W/nm) or Radiance ($\mu W/cm^2.nm.sr$)

3.1.13 Continuous Scan

Continuously performs “Single scan” until the user hits the stop button on the command bar.

3.1.14 Timeline

Programs scheduled acquisition at specific times and intervals. A “Dark Scan” and “reference scan” must be performed prior to entering the Timeline mode. Setup the information on the Timeline Popup window and press “Start Timeline”. Wait until all the measurements are done. Data is automatically saved to the specified folder as multiple columns.



3.1.15 Trans/Abs Scan

Calculates the Transmission/Absorption of a sample placed between the source and the input optics. In T/A mode with “Trans/Abs” checked, take a “Reference Scan” without the sample. Insert the sample and press “Single scan” to get the transmission/Absorption spectrum, which is calculated as the ratio of the acquired spectrum to the saved reference scan, i.e. $T=(S-S_d)/S_{ref}$.

View**3.1.16 Spectrum**

Allows user to toggle the display of spectra collected during a measurement. For example, the calibrated measurement results are displayed when checking the “*Absolute Irradiance*” menu. In T/A mode, the ratio spectrum can be displayed in percentage or logarithm scale when “*transmission*” or “*absorption*” checked. Alternatively, users can toggle between the spectrum in the **Graph tab page**)

3.1.17 CRI

Displays calculated color rendering index. The rendering index values are tabulated for 15 different color test samples with reference to black body illuminant with the same measured CCT “Ri Indices BB”, an Illuminant A at 2856K and a D65 lamp at 6500K “Ri Table”.

3.1.18 Additional Calculations

Additional calculations based on the current spectral acquisition are also provided for various applications and standards including MIL-STD-810 standards, Metamerisms and IESTM-30-15 for solid state illumination.

3.1.19 Distance

Allows the user to enter the distance of the input optics to the light source under measurement, which is used for luminous intensity calculation (Visible in **Irradiance tab page**).

3.1.20 Grid Enable

Allows user to remove or display the grid lines in the graph.

Setup**3.1.21 Enable and Disable Calibration**

Allows user to load or erase calibration file.

3.1.22 Create Calibration File and Store Calibration File to EEPROM

For ILT purpose only.

3.1.23 Wavelength Calibration Coefficients

Displays A0-3 Wavelength Calibration Coefficients.

3.1.24 Edit Calibration Info

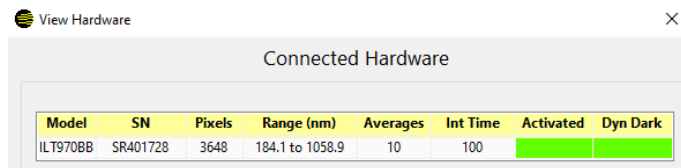
Displays calibration parameters for the loaded calibration file. This information should not be edited by the customer.

3.1.25 Non-Linearity Correction and Enable Dynamic Dark

They should be turned on by default to take full advantage of the system's dynamic range for more accurate measurements.

3.1.26 View Hardware

Lists the setup information about the spectrometers connected to the computer and recognized by the software.



The screenshot shows a window titled 'View Hardware' with a close button (X) in the top right corner. Inside the window is a table titled 'Connected Hardware'. The table has the following columns: Model, SN, Pixels, Range (nm), Averages, Int Time, Activated, and Dyn Dark. There is one row of data with the following values: Model: ILT970BB, SN: SR401728, Pixels: 3648, Range (nm): 184.1 to 1058.9, Averages: 10, Int Time: 100, Activated: (green box), and Dyn Dark: (green box).

Model	SN	Pixels	Range (nm)	Averages	Int Time	Activated	Dyn Dark
ILT970BB	SR401728	3648	184.1 to 1058.9	10	100		

3.1.27 Reset Hardware

Closes the connection and reinitializes the communication to the device. This is usually used when a spectrometer is disconnected from the computer and connected again without exiting the program.

3.1.28 External Trigger

When “*External Trigger*” is enabled, the spectrometer acquires the spectrum after the specified type of external trigger is received. Please check with customer service if a specific model supports external trigger.

Help**3.1.29 Reset Factory Defaults**

Allows user to go back to the default setting of export and import files.

3.1.30 “About”

Accesses the current software version information.

3.2. Command Bar

Most of **menu** items under file and acquisition sections can also be realized by directly clicking buttons on the command bar for quicker and easier access.



- (1). **LOAD:** Loads an .ilt file (same as “File>>Load Spectrum” on **Menu**)
- (2). **SAVE:** Saves the current spectrum as .ilt file (same as “File>>Save Spectrum” on **Menu**)
- (3). **PRINT:** Prints the current display (same as “File>>Print>>Print Window” on **Menu**)
- (4). **EXCEL:** export a file as .xls
- (5). **CALIBRATION:** load the calibration file into the software
- (6). **AVERAGE:** the number of scans to be averaged for one output spectral data.
- (7). **INTEGRATION TIME:** The integration time in milisecond for one scan.
- (8). **SINGLE SCAN:** Single scan button.
- (9). **DARK SCAN:** Dark scan button.
- (10). **REFERENCE SCAN:** Reference scan button.
- (11). **CONTINUOUS SCANNING:** Starts Continuous Scanning.
- (12). **STOP CONTINUOUS SCANNING:** Stops Continuous Scanning.
- (13). **TRANSMISSION / ABSORPTION:** Enter the transmission/absorption mode
- (14). **ZOOM:** A rectangular area defined by mouse will be zoomed to the whole graph area when this button is pressed down
- (15). **RESET ZOOM:** Resets the graph to the original scale.
- (16). **PEAK DETECT:** Enables finding local peaks of the plotted spectrum. The peak position and its wavelengths are labeled on the graph window and listed in the “Peak” tab page at the right side of the main window as well.
- (17). **CURSOR:** When pressed a blue vertical cursor line will appear. Move the line using your mouse to the desired place and its wavelength position will be shown in the WL indicator besides this button.

3.3. 5-Tab pages

Various controls, indicators and selections are grouped into **5-tab pages** on the right side of the main GUI for convenient access. “Graph” and “Peak” pages are always enabled. Depending on the type of calibration file (Irradiance/Power/Radiance), a third tab gets enabled after a Single Scan.

3.3.1 Graph tab page

The “Graph” tab page always appears on top by default. It has operations directly related to the main graph area.

Plot scaling

Y Scale	X Scale
Max 65535	Max 1075
Min 0	Min 250
Autoscale ☒	Autoscale ☒
Precision 2	Precision 2
Name Counts	Name Wavelength

The above section allows autoscaling or manual scaling for the X and Y axes.

Note: the zoom function doesn’t work when “Auto-scale” is enabled.

Display

Display

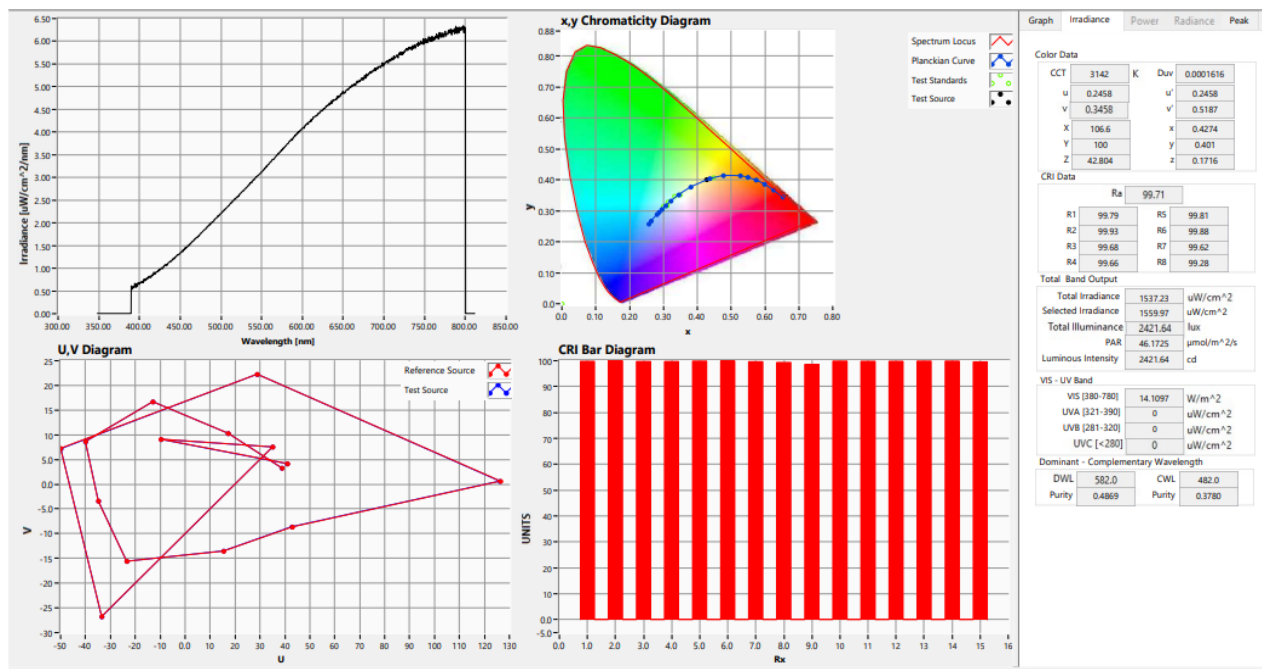
- ☐ Imported Spectrum
- ☐ Dark Scan
- ☐ Raw Data Scan
- ☐ Raw-Dark Scan
- ☒ Irradiance
- ☐ Reference Scan
- ☐ Transmission
- ☐ Absorption

The above section allows users to switch between display mode (Same function as View>>Spectrum on **Menu**).

Color Data and Overlay Imported Spectrum

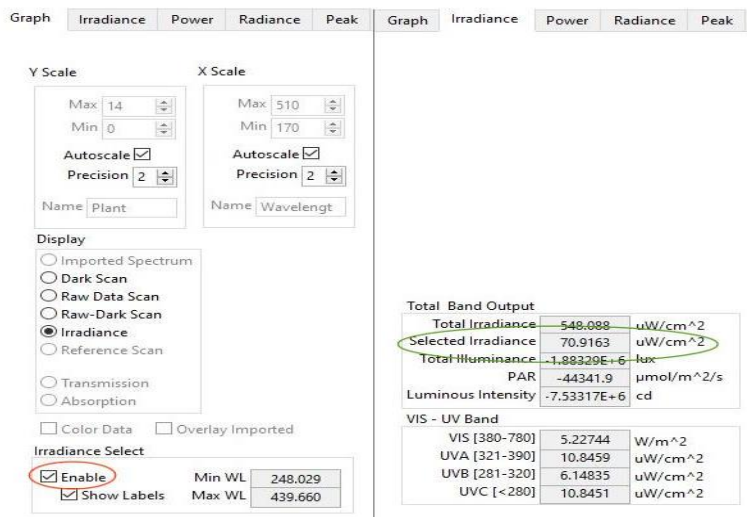
☐ Color Data ☐ Overlay Imported

With “Color Data” enabled, the graph area changes to 4 subplots to display multiple colorimetric plots: (1) current spectrum, (2) CIE chromaticity diagram, (3) U*, V* diagram and (4) CRI bar chart for 15 test color samples specified by CIE standard.



When the “overlay imported spectrum” box is checked, the measured spectrum gets plotted together with the spectrum imported from the file.

Selected Irradiance Display



Checking the box “Enabled” (marked by red circle below) turns on the “Irradiance Select” section in “irradiance” display mode and two vertical cursors appear in the graph area. Move these two vertical lines by left-clicking the mouse to define the minimum and maximum wavelengths of interest. The total integrated area for the plotted spectrum over this selected wavelength range gets updated in the “Selected Irradiance” indicator (see green circle in below) on the “Irradiance” tab page. The min and max wavelength can be also entered in the “Min WL” and “Max WL” boxes.

3.3.2 Irradiance/Power/Radiance calculation Page

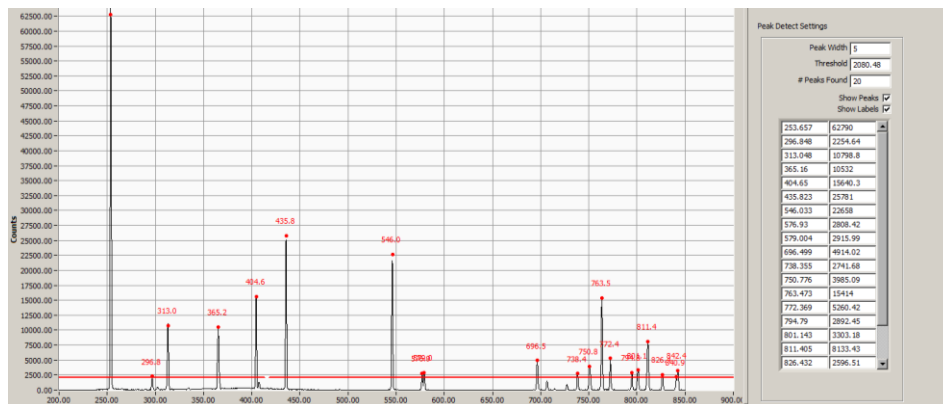
Some of the photometric and radiometric values calculated from the measured spectrum are displayed in the tabs: “Irradiance”, “Power” and “Radiance”. The page that is enabled depends on the loaded calibration file since the display units are different for these physical quantities.

Photometric data include color coordinates for various color spaces, CCT, CRI (color rendering index) for the first 8 samples and dominant-complementary wavelength. The “Total Band Output” section displays the integrated quantities over the entire spectral range as well as the selected range by the user. The “UV-VIS Band” section shows the total radiometric data integrated over various popular preset spectral range.

Note: the distance of the input optics to the light source required for the “Luminous Intensity” calculation is entered through menu “View>>Distance”.

3.3.3 Peak tab page

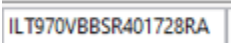
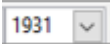
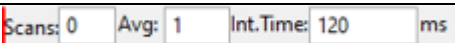
The “Peak” page gets automatically selected when “Peak Detect” button in the command bar is pressed and vice versa. The red horizontal line on the graph represents the baseline threshold and can be moved up and down by clicking and dragging the mouse on the line. The number of peaks, peak locations and intensities gets listed on the peak tab page.



3.4. Information bar

The information bar provides quick information about the spectrometer configuration and measurement status.

Section	Description
ILT9708B initialization succeeded.	Shows initialization status
No Imported Spectrum	Indicates whether a file has been imported and if yes, displays the imported file name. Double-clicking the box opens a file selection dialog window to select a file to import.

Section	Description
	“UNCALIBRATED” means no calibration factors are loaded. “EEPROM” means the calibration is loaded from the internal EPROM of the device. - Cal File name is displayed when the calibration factors are loaded from a calibration file. Double-clicking the box opens a file selection dialog window to select a calibration file.
	Shows which tristimulus functions are used in the colorimetric calculation: 10° observer for “1964” and 2° observer for “1931” standard.
	Shows trigger type
	Shows the current status of dark and reference spectrum. Green means that a spectrum has already been saved in the software as dark or reference spectrum.
	Keeps track of number of measurements performed by “single scan”. “Avg and Int. Time” displays the number of average and integration time used for the data acquisition. You can also change these settings by double clicking the text boxes.
	Enables the software to automatically set the integration time. The algorithm takes the current integration time and doubles or halves it within the range of 2ms-2s until the maximum of the spectrum in raw counts reaches between 40% to 80% of the full scale. However, if the signal is too low or too high to meet this target within the range of integration time, it flashes a “signal is low” or “signal is saturating” warning window. Since multiple scans are performed automatically to determine the proper integration time, it might take a while for the software to respond depending on measured light intensity Tips: To expedite this process is to set the average to 1 and start with short integration time like 10-20ms.

4. Measurement setup and data acquisition consideration

Setting an appropriate integration time and number of averages is very critical to obtain data with a good Signal to Noise ratio (S/N), and this may require a trial-and-error process.

4.1.1 Integration Time

Longer integration time and larger number of averages can usually lead to a better S/N for the same light intensity. However, the integration time cannot be set too high as this may saturate the detector. For spectrometers with full scale of counts based on 16 bits A/D is 2^{16} (65536). A good practice to find a proper integration time is to adjust the integration time until the peak signal reaches about 75% of the maximum scale. The software automatically sets at this level when the auto integration time on the information bar is enabled.

Exception: For a weak signal, a higher integration time is required to obtain one scan, which could be too long and not practical. Moreover, averaging increases the acquisition time. In this case, a compromise must be made to have a reasonable S/N and realistic acquisition time.

4.1.2 Average

The S/N of the collected spectra improves by the square root of the number of scans averaged. For example, 16 averages are 4 times that of 1 average in S/N, keeping everything else the same. Typically, an average number between 4 and 32 is a good starting point.

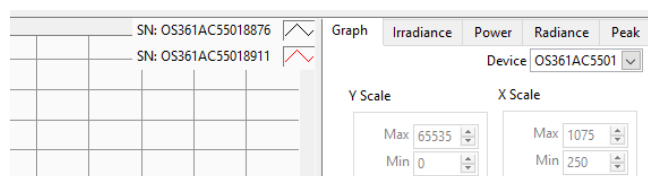
4.1.3 Measurement steps

1. Block the light source (e.g. by a shutter or a blackout fabric or board). Take a **Dark scan**. This dark scan accounts for all the background light as well as the inherent electric dark noise.
2. If necessary, check the effectiveness of the dark scan subtraction by taking a reference scan right after the dark scan without unblocking the source. The reference spectrum should appear to be a noisy signal with an average at around zero.
3. Unblock the light source. Take a **Reference scan** under the same measurement setup and integration time as the dark scan, except for the source blockage.
4. Adjust the integration time and average following the instructions above.
5. Choose the correct Calibration file. Take a **Single scan** for the calibrated irradiance/radiance/flux measurement.

5. Multiple Device Support

The software supports operating multiple devices simultaneously for these combinations:

- Multiple ILT950s
- Multiple ILT960s
- ILT970VNIR + ILT970BB + ILT970NIR + ILT570VIS

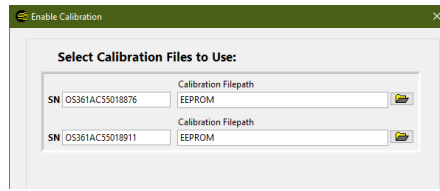


5.1.1 Initialization

Connect spectrometers that can be operated simultaneously. Press Setup>>Reset Hardware. Wait until the serial number of all the spectrometers that were successfully initialized are listed on the top right of the graph. Toggle between the spectrometers using the drop-down list on the top right of the tab pages.

5.1.2 Calibration File

The process of selecting the calibration file for the spectrometer is the same as while using a single spectrometer, except the file browser appears on a pop-up window as shown below.



5.1.3 Acquisition

The process of acquisition is the same as for a single spectrometer. Clicking on the average and integration time allows changing them for each spectrometer. Scans for all the spectrometers are also displayed and saved together.

6. Configuration file

The configuration file SpectrLight.ini for SpectrLight software is in the User Application Data directory:

C:\Users\<Username>\AppData\Local\International Light\SpectrLight III\

The current spectrometer and calibration settings are saved in the ini file in a section labeled with its serial number before exiting the program. SpectrLight III loads it at the next initialization of the device. A configuration file will be created with default values if an ini file is missing in the above directory.

6.1. Edit cut-off Wavelength

The ini file contains the calibration cut-off wavelength for the spectrometer model. The calibrated spectrum outside of the specified range is forced to zero, even if the calibration file has calibration factor for those wavelengths.

Find the spectrometer model in the ini file. CutOffWLH and CutOffWLL for high and low limits, respectively. If the spectrometer is a UV model, change CutOffWLH_uv and CutOffWLL_uv. Save the file after modification and the new configurations will be loaded the next time the application is launched.

Note: Close SpectrLight III software before making any changes to the ini file.