



# International**Light** TECHNOLOGIES

## **Spectrometer Software Manual**

### **Spectr**l**Light III**

## SpectrILight III Quick Start Reference Guide

First install or update your installation SpectrILight III software and the Spectrometer drivers as needed.

If you do not have a newer model ILT950 with Calibration file saved in the eeprom, you must copy the calibration file from the CD manually. The file is located in the Cal\_File folder on the installation disk. Copy and paste the file(s) ending in .cal into the Calibration folder located in the International Light folder.

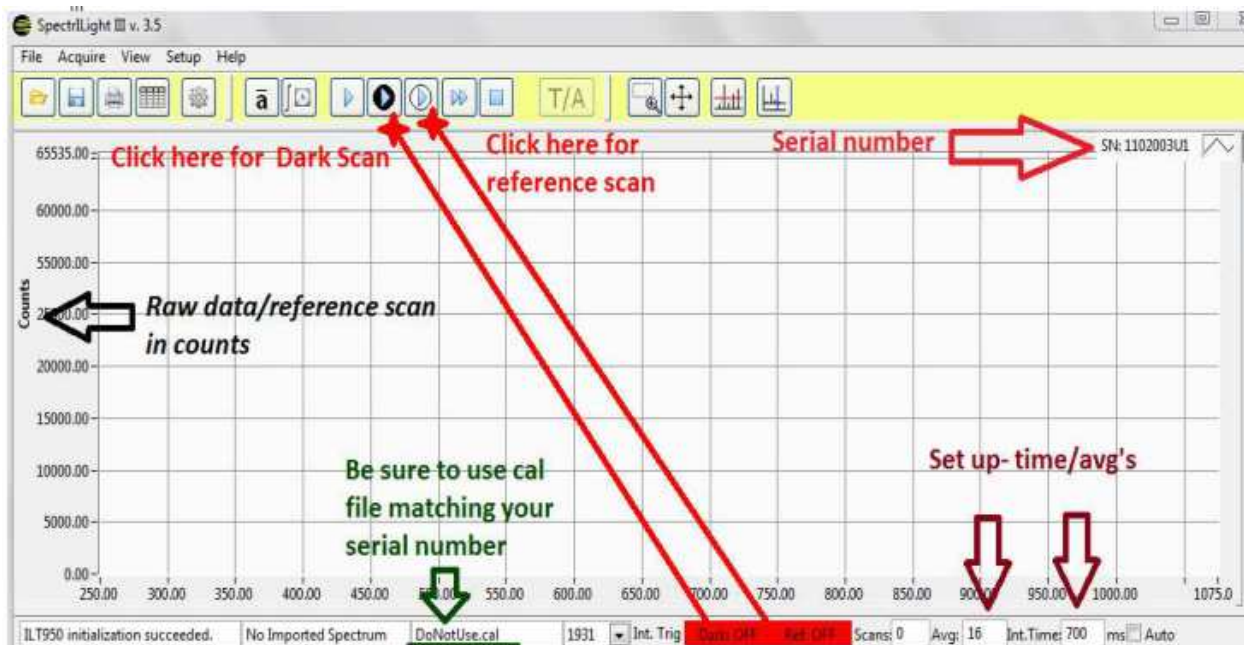
Common paths: C:\Program Files\International Light\SpectrILight III\Calibration, or  
C:\Users\Username\AppData\Local\International Light\SpectrILight III\Calibration

With your spectrometer plugged into the computer, Click on the SpectrILight III icon on your desktop

Using the command bar will allow you to access most of the software features:



- (1). **LOAD:** You can load a saved binary file with extension “\*.ilt” by clicking the Folder (1) icon in the command bar, by pressing Control O or by selecting File\Load Spectrum. The graph will be displayed and will replace the current spectrum.
- (2). **SAVE:** You can save a (\*.ilt) file by clicking the save file (2) icon in the command bar or by selecting File\Save Spectrum. Select the file name and path as needed and click OK.
- (3). **PRINT:** Prints the information on your screen. Press the print icon (3) in the command bar or select File\Print\Print Window. Select the printer from the drop down list. If you have multiple pages, use the printer drop down box to select the page(s) you wish to print and click OK.
- (4). **EXCEL:** Exports the current scan to Excel. Select the format in Pixel or 1 nm Resolution.
- (5). **CALIBRATION:** Uploads the calibration file(s) from the calibration folder.
- (6). **AVERAGE:** Sets the average number of scans taken during one scan or acquisition.
- (7). **INTEGRATION TIME:** Sets the integration time for one scan or acquisition.
- (8). **SINGLE SCAN:** Performs a single scan.
- (9). **DARK SCAN:** Performs a dark scan.
- (10). **REFERENCE SCAN:** Performs a reference scan.
- (11). **CONTINUOUS SCANNING:** Starts Continuous Scanning.
- (12). **STOP CONTINUOUS SCANNING:** Stop Continuous Scanning.
- (13). **TRANSMISSION / ABSORPTION:** Performs a transmission or absorption scan.
- (14). **ZOOM BOX:** Toggles the zoom box feature ON and OFF.
- (15). **RESET ZOOM BOX:** Resets the zoom to the original scaling.
- (16). **PEAK FIND:** Displays the peaks for the current spectrum on the graph.
- (17). **SINGLE CURSOR:** Toggles the single cursor feature ON and OFF on the graph.



### Taking your first measurement.

Click (6) average and set number of scans to 16

Click (7) integration time and set the integration time to 500 ms.

Cover the Input optic with an opaque object and Click (9) Dark Scan.

When using the spectrometer the very first time, the dark-scan may appear noisy. Take a second dark scan Align to source and Click (10) to view your reference scan.

Check the graph for potential saturation/low signal issues. A peak signal of about 85% of the maximum is recommended.

Click (5) the gear to load the calibration file.

Click (8) single scan.

Click (14) and try out the zoom, then click (15) to cancel zoom.

Click (16) to display the peaks find results

Click (17) and then use the left and right arrow keys to move to cursor to different wavelengths.

Click (11) continuous scanning and let the system run for a couple of minutes

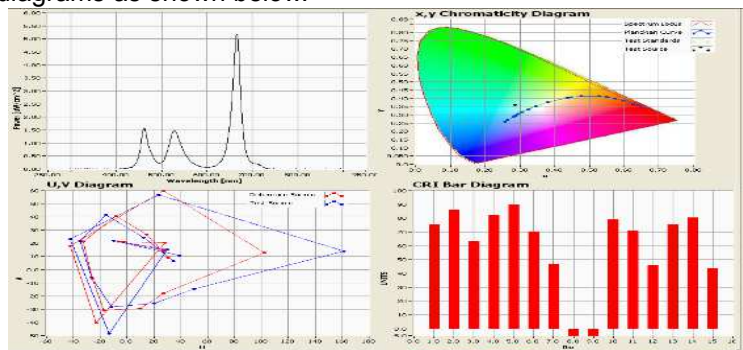
Click (12) to stop the scanning.

Click (4) to save the file to excel in either pixel or 1 nm increments. Open the file in excel and view the table.

### Additional Features

On the upper right of your screen are 5 tabs. The standard tab is the Graph tab as shown to the right. On this tab is the Display box with numerous options which you can select by clicking on them. In this picture, dark scan is selected.

To see additional color data, check the Color Data box. This changes the graph to show 4 diagrams: x, y 1931, Chromaticity Diagram, U V Plot, & CRI Bar diagrams as shown below.



Irradiance, Power and Radiance tabs may or may not be accessible depending on the calibrations performed. Clicking on these tabs will display the total readings of specific bands such as UVA, UVB and VIS etc as well as various color parameters such as x, y, u, v, CCT, CRI and Duv.

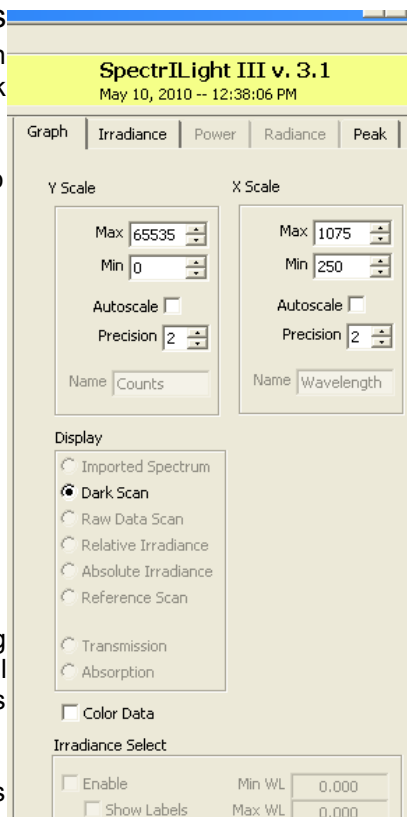
The peak tab displays a table of the peak readings in a tabular format and applies peak values to the graph.

The menu bar



The Menu Bar contains five options: **File, Acquire, View, Setup and Help**. When you click on any of these options, you get a new drop down menu showing a full list of the functions available using the particular task. For example you can click on "Acquire" and see your options of Single Scan, Continuous Scan etc. Most of these features can be accessed using command buttons which have been previously explained.

For additional features please refer to the full SpectrILight III operations manual below.

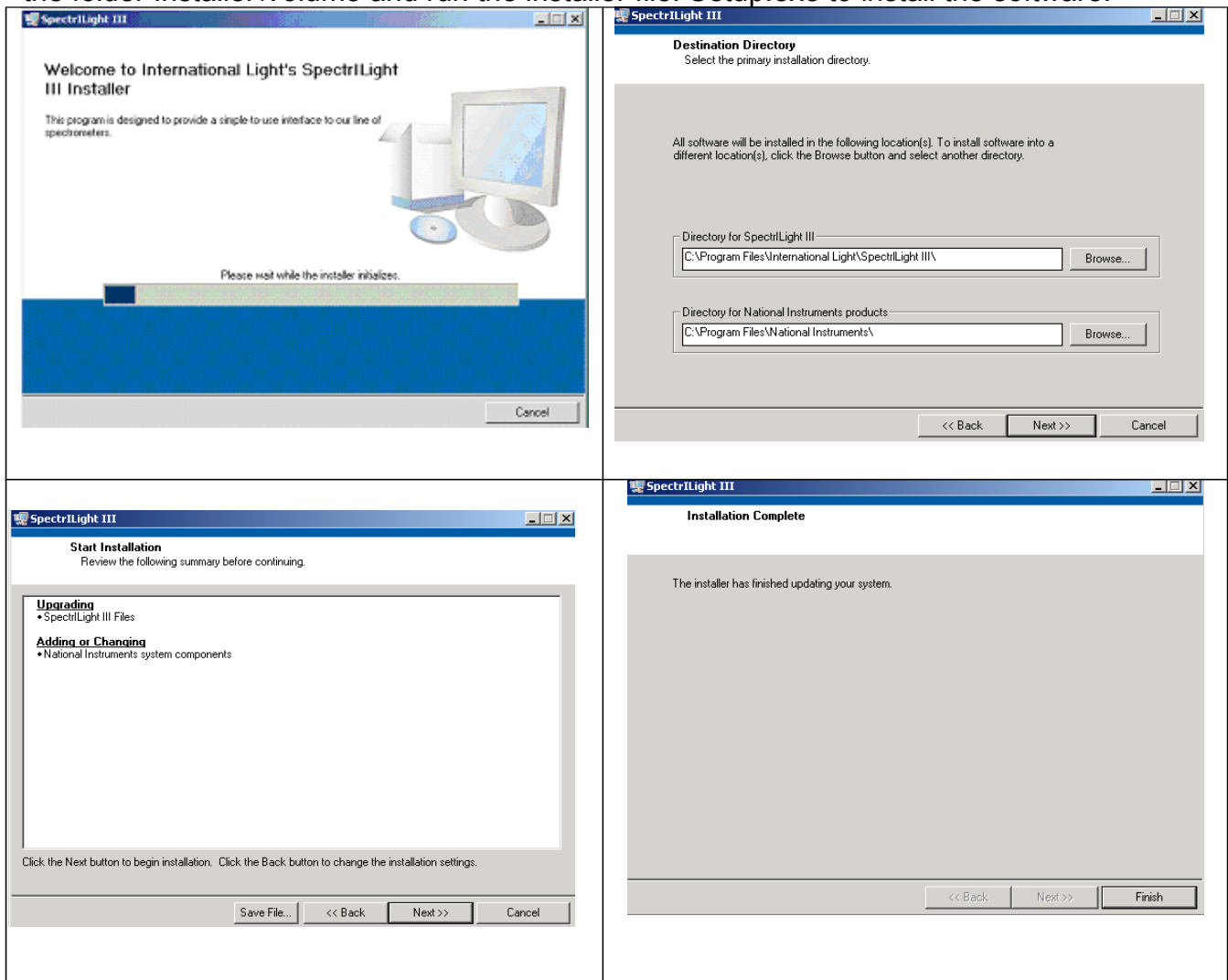


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# 1. Initial installation of SpectrILight III software

With the spectrometer disconnected, insert the CD, or USB stick in the drive. Navigate to the folder Installer\Volume and run the installer file: Setup.exe to install the software.



Once you click finish, you can plug in the ILT spectrometer. The computer may take a few minutes while searching for the correct driver. If the drivers are not located you will receive an error message “drivers not found”

To manually install the driver go to “ILT<sup>model</sup> Driver” folder on the CD and choose the appropriate driver according to the Spectrometer model and operating system. See ILT550 driver example below :

 ScanSpec_USB_Driver_Win7x64_Setup.exe	12/3/2013 10:05 AM	Application	2,807 KB
 ScanSpec_USB_Driver_Win7x86_Setup.exe	12/3/2013 10:06 AM	Application	2,669 KB
 ScanSpec_USB_Driver_XP_Setup.exe	12/3/2013 10:06 AM	Application	2,669 KB

Follow the onscreen prompts unit complete. Plug in the Spectrometer and wait a few minutes while drivers are applied and a COM port is assigned.



Launch the software by clicking on the shortcut icon on the desktop.

Once the spectrometer is recognized by the software and the software & hardware are ready for use, you will see the message “ILT`model` initialization succeeded” in the Information bar. Click OK to proceed to the main screen.



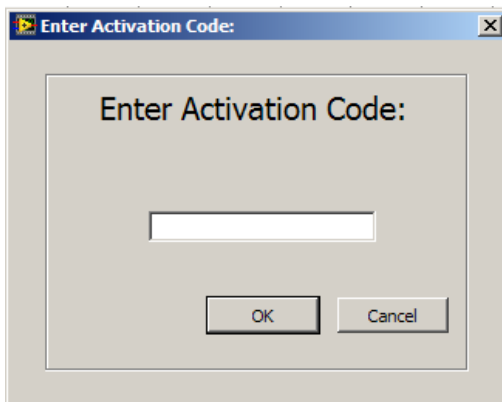
(Note: SpectrILight Software may only be run in simulation mode when no spectrometer is connected)

## 2. Installation of a newer version of SpectrILight III

When your spectrometer is re-calibrated at ILT, it may be shipped with a newer version of SpectrILight III. You will need to install the new software (for example version 3.5) over your old software (for example version 3.3). Copy and paste the latest folder Volume ## (ie Volume v. 3.1.30 located in folder Installer) on your desktop and click setup.exe. Follow the instructions and enter your password to re-activate the software. Copy and paste your new calibration file for example ILT2935W2SP.cal into the calibration folder and reload the calibration file. When finished, you can delete the folder Volume v.## from your desktop.

## 3. Activation of your software

To activate the ILT SpectrILight III software, select from the Help menu the “Enter Activation Code...” and enter the 5 character code printed on the CD. Exit the program using File\Exit and your software is ready for use. If you decide not to activate the code, you have a 30 day trial period.



## 4. Save & Upload the Calibration file

**SAVE:** After the installation of the software, you may need to move the specific calibration file for (ie ILT1234RAA4.cal, ILT1003073U1W2.cal) to the Calibration folder. This calibration file is located in the Cal\_File folder on the installation disk. Copy and paste this file into the Calibration folder using the appropriate path to the Calibration Folder. Once you have saved the file, the software will remember the path and you will not need to repeat these steps unit after your next calibration. (Note the newer model ILT950's store their calibration file on the internal memory/eprom so this step is not required)

C:\Users\Username\AppData\Local\International Light\SpectrLight III\Calibration

**UPLOAD:** To perform calibrated measurements you must upload the calibration file. Click on the “Gear” button in the command bar (or click, set up, calibration, enable calibration) to upload the cal file. Select the correct file by double clicking on the file name. If you have two inptic optics, you may have two similar files. It is important to verify the correct calibration file is in use by verifying the spectrometer serial number and the input optic

For example ILT1234RAA4.cal is composed of the following guide numbers:

ILT: International Light Technologies

1234: The serial number of the spectrometer

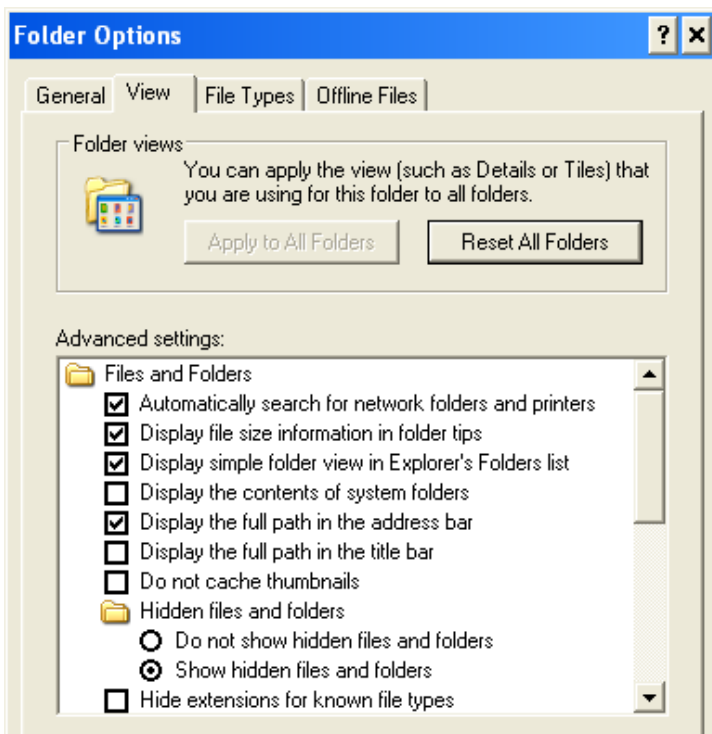
RAA4: Type of input optics

If you also had an INS250N integrating sphere calibration, you may see two files:

ILT1234RAA4.cal

ILT1234INS250N.cal

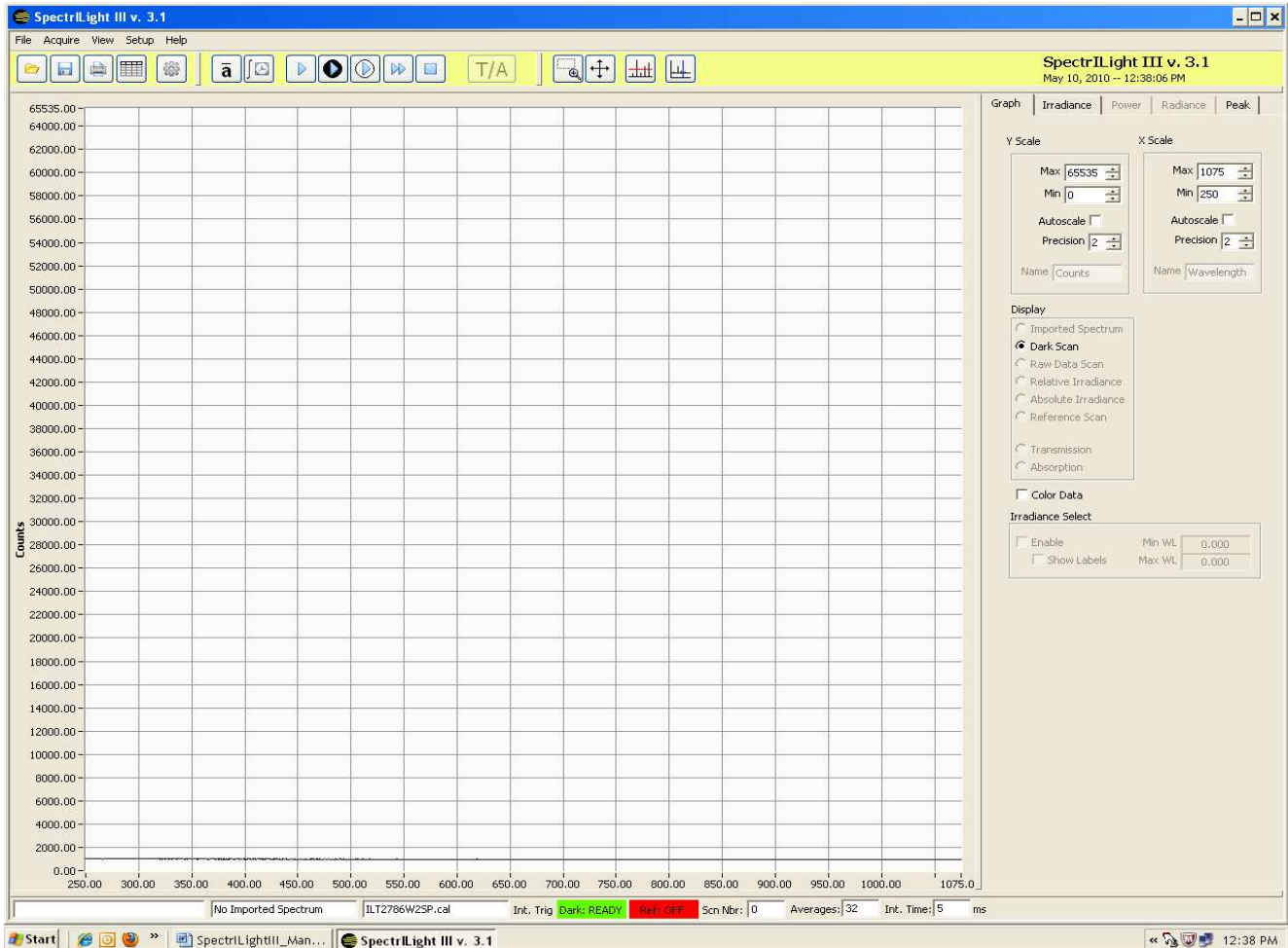
**HINT:** To view the hidden folders such as *Local Settings*, set the radio button “Show hidden files and folders” in Folder Options.





## 5. The Main Screen

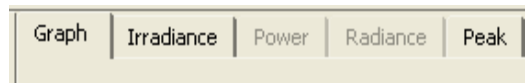
The main screen consists of a menu bar, information bar, command bar, main graph area and five tab pages in the upper right. Most of the system operating functions can be easily realized by using the command buttons.



The main graph display consists of a Y-axis and an X-axis. The X axis is always the wavelength range in nanometers. When using un-calibrated mode the Y-axis represents a relative intensity scale in counts. The maximum number of counts is 65,536 for a 16-bit A/D spectrometer and 16,384 for a 14-bit A/D. The Software will automatically select the correct scale.

When calibration is applied, the units of the Y-axis are dependent on the type of calibration (irradiance  $\mu\text{W}/\text{cm}^2/\text{nm}$ , total flux  $\mu\text{W}/\text{nm}$ , or radiance  $\mu\text{W}/\text{cm}^2/\text{sr}/\text{nm}$ ). The maximum value for Y will vary in calibrated mode based on the individual model type, optics used, as well as the calibration factor in use.

The 5 display controls tab are located in the upper right of the display. If a tab is gray, it cannot be accessed as there is no calibration factor to allow measurements.





**Graph** enables the user to adjust the X and Y scale ranges for the graph display by entering the min and max values. The feature “Auto-scale” adjusts the Y scale for optimal viewing of data based on the peak result. It can be enabled or disabled by clicking inside the box. Precision increases/decreases the number of decimal places shown in the Y scale, starting at 0.

**Display** allows the user to select which data will be shown.

**Imported spectrum** is used to view a saved (.ilt) files. It is also used with the Overlay features where a baseline is applied to the displays background and current scans are viewed on top of the baseline for a quick visual of differences/changes with out exporting.

**Dark Scan** shows the last dark reading.

**Raw Data Scan, Raw-Dark Scan** (Replaces Relative Irradiance) are often used for trouble shooting.

**Imported spectrum** is used to view a saved (.ilt) files.

**Reference Scan** is used to verify the signal strength and avoid saturation.

When **Color Data** is checked/applied the display changes from one large spectral graph to four separate graphs representing the selected Spectrum, the CIE 1932 x, y diagram, the U\*, V\* diagram and the CRI bar diagram. To return to 1 graph, simply un-check the box.

When **Irradiance Select** is enabled, users can manually change the range of wavelengths displayed in the graph as well as the range used for irradiance calculations in the Irradiance tab.

The 3 Calibrated measurements tabs are Irradiance, Power and Radiance. These tabs display many important parameters that are related to CIE color calculations such as x, y, z, u, v, CCT, Duv, CRI, DWL and CWL.

The Peak-tab is used in determining the peaks in a spectrum. The number of peaks, peak locations and intensities are conveniently recorded in a table. The peak find routine can also be applied for a selected plot area by using the Peak Find button and the zoom box.

The screenshot shows the 'Graph' settings panel. It is divided into several sections:

- Y Scale:** Contains input fields for 'Max' (65535) and 'Min' (0), an 'Autoscale' checkbox (unchecked), a 'Precision' spinner (set to 2), and a 'Name' text field (Counts).
- X Scale:** Contains input fields for 'Max' (1075) and 'Min' (250), an 'Autoscale' checkbox (unchecked), a 'Precision' spinner (set to 2), and a 'Name' text field (Wavelength).
- Display:** A list of radio buttons for selecting the data type: 'Imported Spectrum', 'Dark Scan' (selected), 'Raw Data Scan', 'Relative Irradiance', 'Absolute Irradiance', 'Reference Scan', 'Transmission', and 'Absorption'.
- Color Data:** A checkbox (unchecked).
- Irradiance Select:** Contains an 'Enable' checkbox (unchecked) and a 'Show Labels' checkbox (unchecked). To the right are two input fields: 'Min WL' (0.000) and 'Max WL' (0.000).

## 6. Integration Time and Number of Scans

**Setting the integration time and the number of scans is an important step.** Too long of an integration time can cause saturation. Too short an integration time can generate noisy results.

Integration time is adjusted using the command buttons (Fig. 1) in the Command bar or by using the indicators in the Information bar below the graph (Fig. 2) Click the Set button (Fig. 3) to save the settings and close the dialog window.



Fig.1



Fig.2

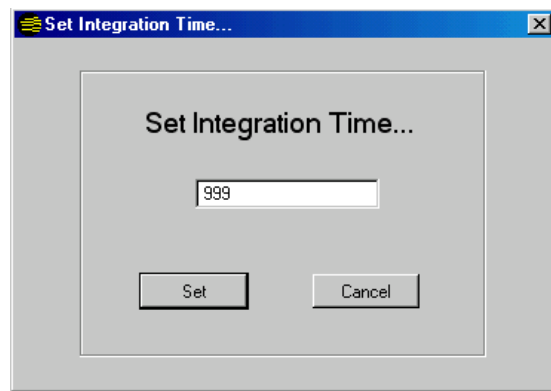
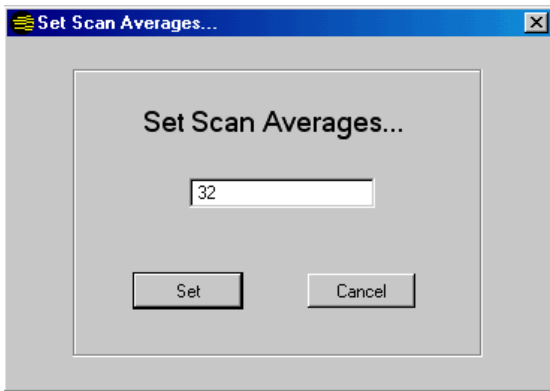


Fig.3

The exposure time, expressed in milliseconds, is the time the light falls on the sensor during a measurement. Adjusting this parameter changes the overall sensitivity of the instrument, as changing the exposure time does for a camera. The minimum integration time varies by instrument with a minimum of .5 msec and a maximum of about 10 minutes per scan. A practical setting is in the range of 3 to 999 ms depending on the light intensity.

The integration time should be adjusted for a signal which does not exceed the maximum of 65,536 counts 16 bit, 16,384 for 14 bit CCD. Saturation occurs when the integration time is set too high. Typically a peak signal of about 75-85% of the maximum is a good target and yields a good S/N ratio. (ie 60K counts or 16K counts )

The scan average is the number of scans that are averaged. Other things being equal, the Signal-to-Noise Ratio (SNR) of the collected spectra improves by the square root of the number N of scans averaged. For example, if 16 spectral scans are averaged, the SNR is improved by a factor of 4 over that of a single scan.

**Auto integration** (for ILT950 broadband UV-NIR units only)The auto integration feature allows customers using the ILT950 broadband system for full spectrum measurements to skip system configuration for integration time. To enable automatic integration, click the box to the left of auto in the lower right of the display which will turn on auto integration. SpectrILight III will take a test scan and adjust the integration time to assure the counts are close to 50,000. When you turn auto on, Integration time will be grayed out.If you attempt to take a reading using Auto integration and the light level is too weak, SpectrILight will provide a warning that the signal is too low. To proceed you will need to disengage

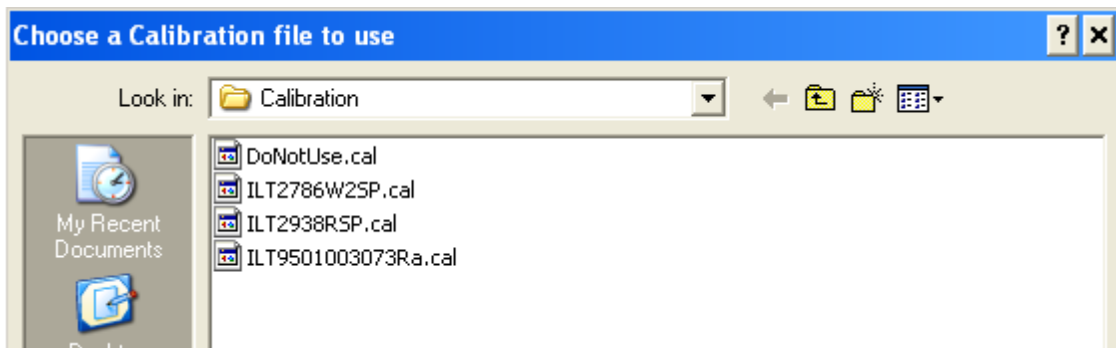
auto and manually set the integration time to a very long time, such as 999 ms, increase the input signal by moving closer to the source or increasing the output of the source. Auto integration will **not** provide a warning if you have saturated (Light is too strong). Signs of saturation include stray dips in readings or flat/truncated areas. If you are measuring a very strong light, and notice any areas that seem unusually low, you will need to disengage the auto and perform a reference scan using a small integration time such as 2 msec. Then gradually increase until you reach approx 50K counts.

## 7. Calibration

When the spectrometer is uncalibrated or calibration is disabled, the information bar will display “UNCALIBRATED”. To perform calibrated measurements you must load the correct calibration file.



Click the “Gear” button in the command button bar. Double click on the correct file name showing your spectrometer SN and input optic. (see section 4 above if no calibration factors are listed) After selecting the calibration file, the name of the file appears in the Information bar. You can also enable or disable the calibration file using the menu bar by selecting Setup\ Calibration\Enable or Disable Calibration File.



## 8. Dark Scan

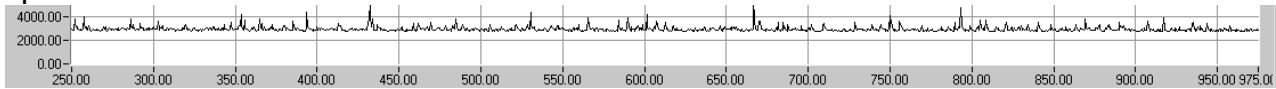
All spectrometers generate some level of noise. There are three primary sources for dark signal noise: detector dark current, light scattered within the instrument, and ambient light in the test area. Usually the most important of these is the detector dark current or electronic noise, which can be very significant for integration times of 300 ms and longer. Typically the longer the integration time, the greater the total dark noise you will see in your dark scan.

To minimize the effects of noise, SpectrLightIII requires a dark scan be taken before taking readings.



The software opens with the Dark Scan button highlighted in black and with Dark: OFF in the information bar at the bottom of the screen. Cover your input optic or shut off all lights and click the dark scan button to take a dark scan. With a very short integration time, this may appear as a flat straight line near zero, or it may contain small spikes as shown. It

may be necessary to do more than one dark scan to reduce the counts over the entire spectrum.



The Dark: READY box will turn green when the Dark scan is complete. NOTE: Every time the integration time is changed, a new Dark Scan must be taken.



**AMBIENT DARK SCAN:** In some cases a small amount of background light may need to be present during the dark scan. (ie light from your computer monitor) In this case, the dark scan should be performed with the test lamp off or covered and the input optic open(cap removed). Keep in mind this reading is subtracted from all future readings. If the ambient/background light is not stable, you will want to take frequent dark scans to improve the accuracy of your dark value.

**Raw-Dark Scan.** By clicking on Raw-Dark you can view the results of the raw scan data less the subtracted dark value. The dark scan value can be dark noise, taken by covering the input optic to assure no light is present, or a low level background light. Which ever condition you use (low level ambient, or completely dark) SpectrILight will record the dark value and subtract the dark reading from all future readings allowing accurate irradiance measurements.

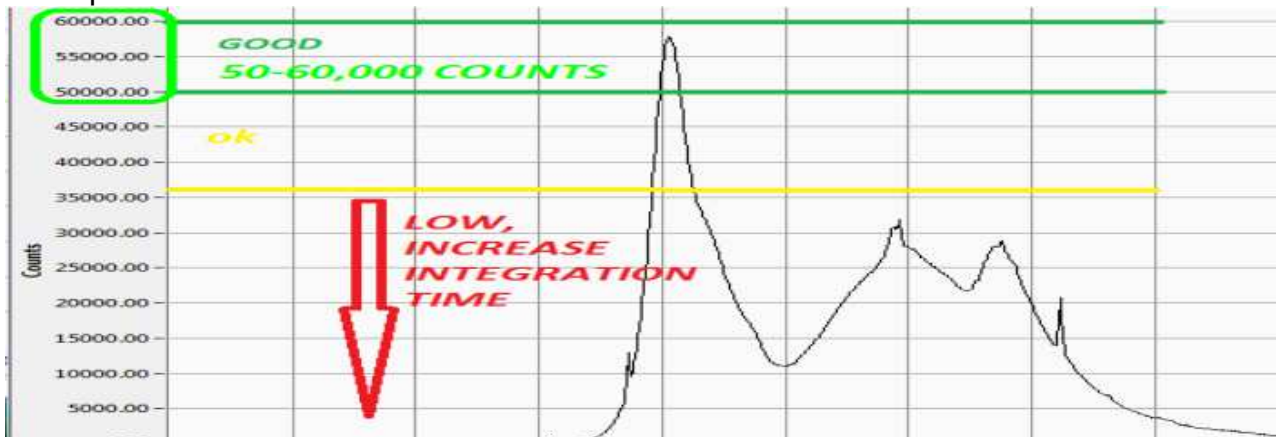
## 9. Taking Measurements

To start a measurement, turn on your light source and allow it to warm up for the required time period. The simplest way to take measurements is using the command bar buttons as shown below. These features can also be accessed using the Acquire tab.

(1) (2) (3) (4) (5)



First cover the optic and take as discussed in section 8. uncover the input optics and align the input optic to the light source. Click on reference scan (3) to verify the integration time is properly set to generate 75-85% of allowable counts. ( 65,536 counts 16 bit, 16,384 for 14 bit.CCD). Note: Reference Scan is also used to set the baseline for Transmission and Absorption measurements



Click the Single Scan button (1) for a single measurement. The Single Scan will take one scan only and it stops automatically.

Continuous Scans (4) will take continuous readings until you hit the Stop Button (5). The "Scn Nbr" in the information bar shows the number of scans taken. The number of continuous scans per minute depends of the integration time and amount of averaging.

Scn Nbr: **5** Averages: **16** Int. Time: **500** ms

## 10. Display Modes

Using the Display radio buttons in the graph tab, you can toggle to Imported Spectrum, Dark Scan, Raw Data Scan, Relative Irradiance, Absolute Irradiance and Reference Scan. Simply click the radio button to move between each display mode.

**Imported Spectrum:** The main graph shows a scan imported by the import wizard (\*.txt) or a scan loaded by using the load command (\*.ilt). It is also used with the Overlay features where a baseline is applied to the displays background and current scans are viewed on top of the baseline for a quick visual of differences/changes with out exporting.

**Dark Scan:** Shows a background scan that is subtracted from the Raw Data Scan for computing the Relative Irradiance. The units are shown in Counts.

**Raw Data Scan:** Raw data is displayed in units of counts. There is no correction for the relative spectral sensitivity of the CCD array.

**Raw-Dark Scan (or Relative Irradiance in older revisions):** This is a Raw Data Scan minus the Dark Scan in Counts.

**Absolute Irradiance:** This is the standard display of a calibrated measurement in units of micro Watts/cm<sup>2</sup>/nm. This measurement requires the use of a ILT calibration file.

**Reference Scan:** This scan is used in Transmission/Absorption measurements for normalization.

**Transmission:** Displays the current scan divided by the reference scan in units of percentage [%].

**Absorption:** Displays the current scan divided by the reference scan in logarithm units of absorption [log].

## 11. Color Data

To use the color software, put a check mark in the Color Data box by clicking inside the box. To return to the standard display mode uncheck the Color Data box Note: While in Color Data you can still access the radio buttons to change the graphs from raw data to relative data, etc.

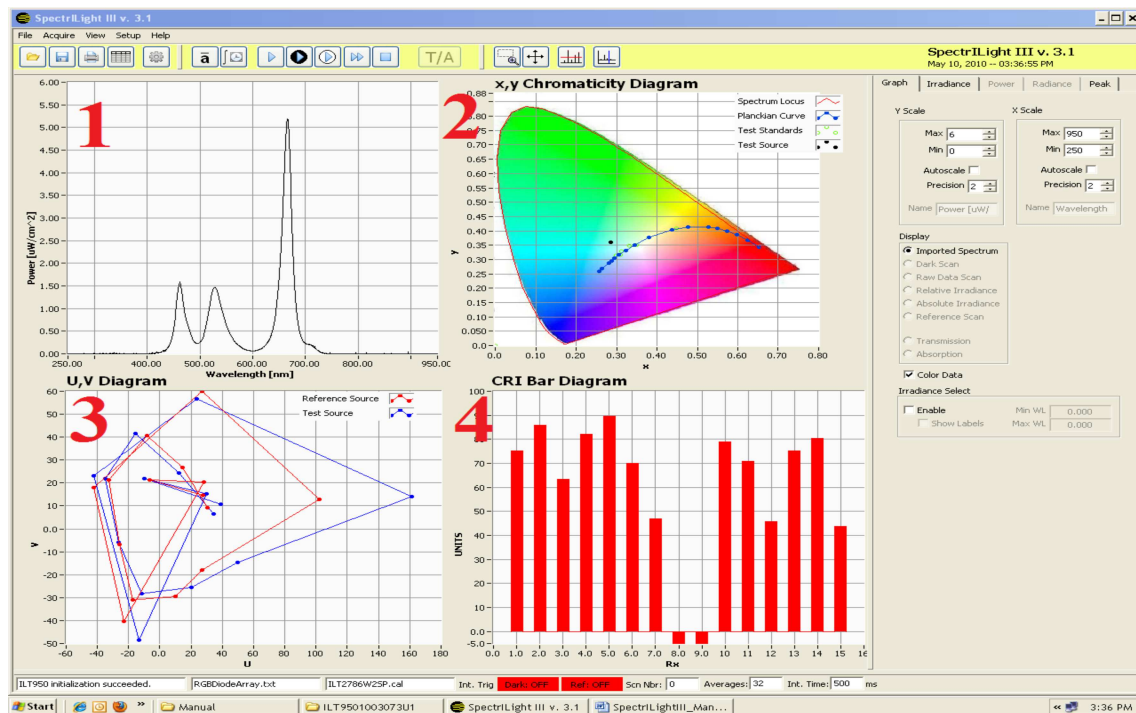


☒ Color Data

Irradiance Select

☐ Enable      Min W/L

☐ Show Labels      Max W/L



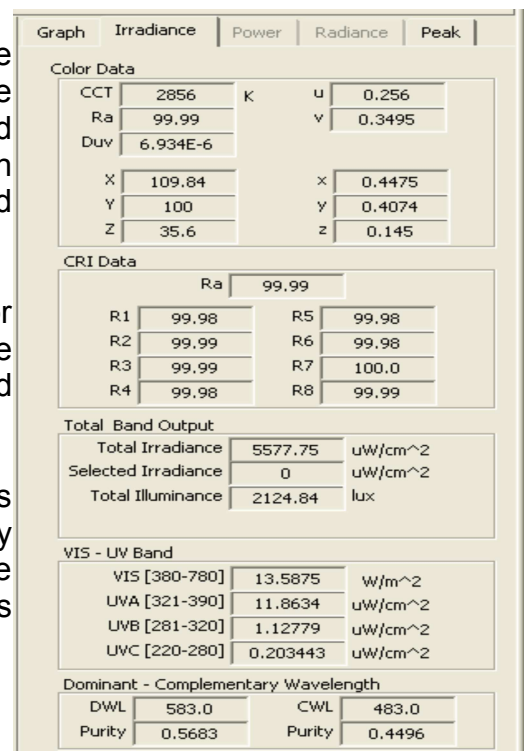
1. Single Scan results: This is the scan that is displayed in the main graph when you have not selected Color Data.
2. x, y 1931 Chromaticity Diagram
3. U, V Plot
- 4 CRI Bar diagram

## 12. Calculations

Click on the Irradiance, Power or Radiance Tab in the upper right portion of the screen to view all of the photometric and radiometric data (Irradiance, Power and Radiance are only available when a matching calibration file is enable. When calibration for Watts is applied Power becomes available and Irradiance is grayed out)


Numerical tables are displayed listing various color parameters such as x, y, u, v, CCT, CRI and Duv. The total Irradiance output and UV-VIS bands are calculated as well.

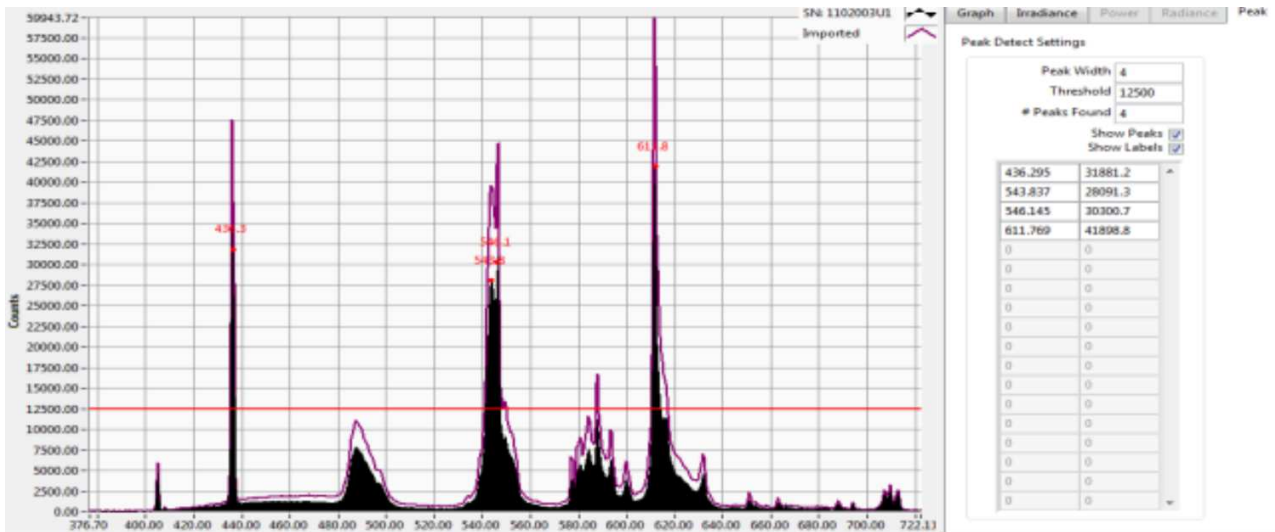
PAR Photosynthetically active radiation, also sometimes referred to as Photosynthetic Photon Flux Density (PPFD) is based on a weighted measurement of the Visible light spectrum from 400-700nm. The value is calculated for direct readout in  $\mu\text{mol}/\text{m}^2/\text{s}$ .



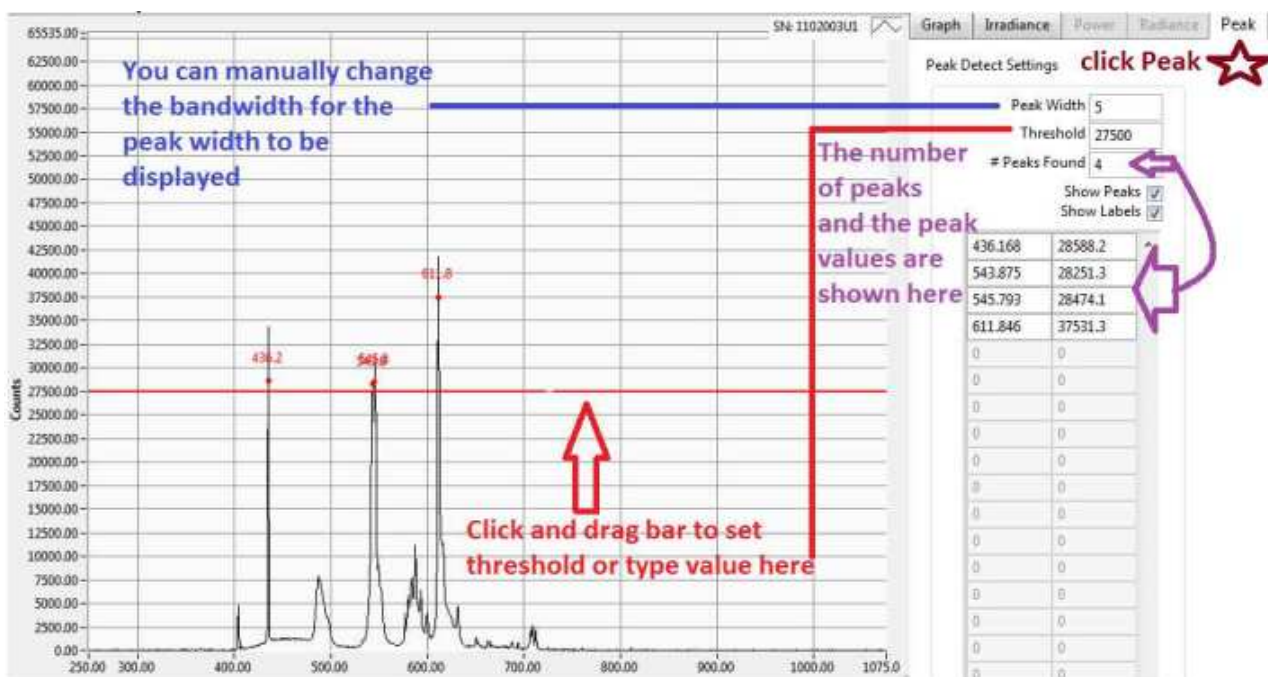


## 13. Peak Find

Peak find generates an easy to read display and table of peak values for the current scan based on user established parameters. Using the “Peak” Tab or Enable Peak Detect  button, the peaks of a spectrum can be viewed. Peak width should be set to 3, 4 or 5 for best results. **Using zero will yield no results.** Peak threshold allows selection of the highest peak values and prevents display of noise in low light level readings. # Peaks provides a count of the peaks at the current settings. Peak find can be used without overlay as shown above, or with overlay as shown below.



You can use the check box Show Peak Labels to add the labels in the graph. You can grab the red horizontal line by left clicking the mouse and moving it vertically up or down to add or eliminate levels of peaks to be displayed. In the peak find example above, the zoom feature was used to increase the size of the graph for the visible spectrum and





reduce the spectrum that was displayed. This feature is very useful for comparing multiple readings in and out of the peak tab.

## 14. The Command Bar



(1). **LOAD:** You can load a saved binary file with extension “\*.ilt” by clicking the Folder (1) icon in the command bar, by pressing Control O or by selecting File\Load Spectrum. The graph will be displayed and will replace the current spectrum.

(2). **SAVE:** You can save a (\*.ilt) file by clicking the save file (2) icon in the command bar or by selecting File\Save Spectrum. Select the file name and path as needed and click OK.

(3). **PRINT:** To print the information on your screen, you press the print icon (3) in the command bar or select File\Print\Print Window. Select the printer from the drop down list. If you have multiple pages, use the printer drop down box to select the page(s) you wish to print and click OK.

(4). **EXCEL:** To export a file to Excel. Select the format in Pixel or 1 nm Resolution.

(5). **CALIBRATION:** To upload the calibration file from the Calibration folder.

(6). **AVERAGE:** Average number of scans taken during one scan or acquisition.

(7). **INTEGRATION TIME:** The integration time for one scan or acquisition.

(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:** Button to stop Continuous Scanning.

(13). **TRANSMISSION / ABSORPTION:** To perform a transmission or absorption scan.

(14). **ZOOM BOX:** This is an ON/OFF button to use the zoom box.

(15). **RESET ZOOM BOX:** Resets the graph to the original scaling.

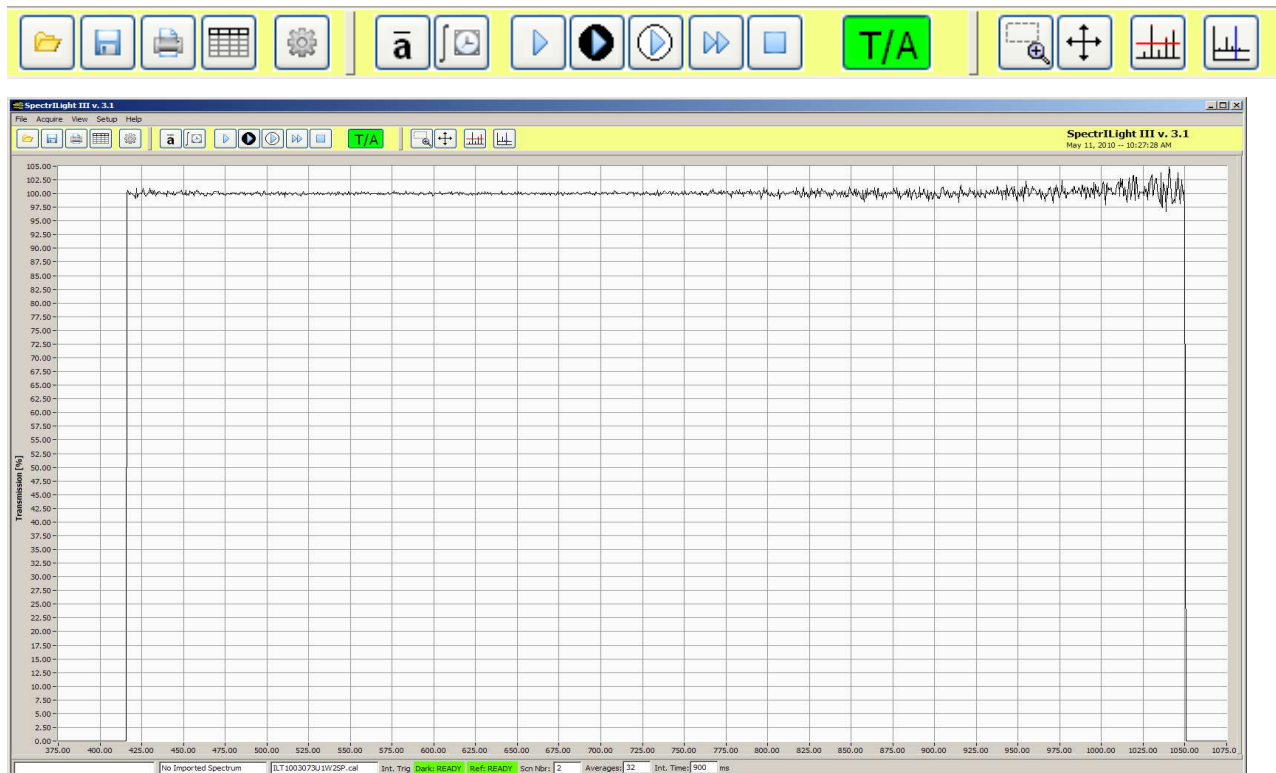
(16). **PEAK FIND:** Using the “Enable Peak Detect” button, the peaks of a spectrum can be recorded.

(17). **SINGLE CURSOR:** ON/OFF button to drop a single vertical cursor on the graph.

## 15. Transmission and Absorption

To perform a transmission measurement, you must upload a calibration file in order to access the Reference Scan button. With no test sample inserted, set the integration time such that the CCD array is not saturated. For best results, maximize the Relative Irradiance to about 90% of available counts (65,536 for a 16-bit A/D spectrometer and 16,384 for a 14-bit A/D). Tune the integration time by taking consecutive dark and single scans and view the Raw-dark scan in the display. The scan average can be set between 12 and 32 scans.

After the dark scan has been taken, the reference button will become available. Click the reference button to take a reference scan of the lamp. Trans/Abs button and verify the button has turned green.



When you click the Trans/Abs button, the system will automatically select the transmission mode and the Transmission button will be highlight in the Display box.

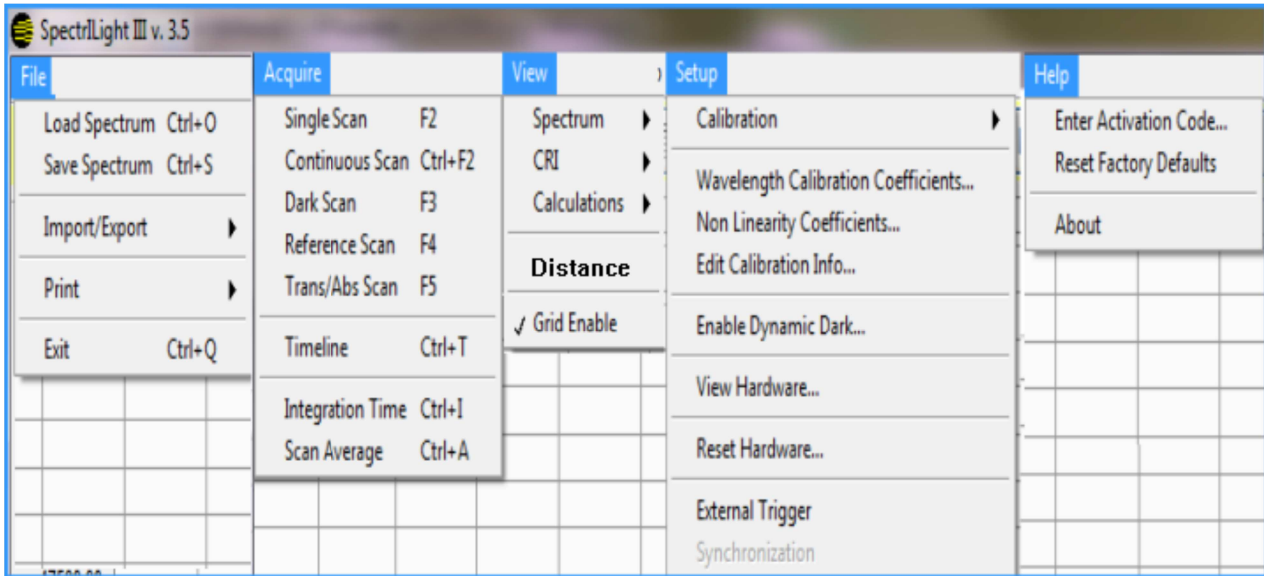
With no test sample inserted, press the single scan button and view the plot in the Transmission display.

Insert the test sample between the lamp and the input optics and press the Single Scan button in the command bar. You can also take continuous scans by pressing the Continuous Scan button. **Regularly refresh the dark and reference scans.** You can print and save the data using the save or export functions. To stop taking Transmission measurements, click the TRANS/ABS button again.

To change from Transmission to Absorption, click apply Absorption in the Display box.

## 16. The Menu Bar

The Menu Bar (1) contains five options: *File, Acquire, View, Setup and Help*. When you click on any of these options, you get a new drop down menu showing a full list of the available functions. See expanded list below:



Many of these features can be accessed using command buttons which have been previously explained. For example Setup/Calibration can be used in place of the “Gear” button to upload a calibration file.

## 17. View Information Windows

The View drop down menu includes 5 selections. View **Spectrum** allows the same functionality as the Display box settings within the Graph tab.

View **CRI** expands to include RI Indices BB and RI table. The CRI indices are tabulated for 15 different color test samples with reference to an Illuminant of equal Color Temperature (CCT), an Illuminant A at 2856K and a Daylight lamp at 6500K.

# CRI Color Rendering Index Table

Color #	CIE BB	CIE A	CIE D65
CCT	2856K	2856K	6500K
Ra	99.99	99.97	49.42
1	99.98	99.97	60.01
2	99.99	99.99	88.38
3	99.99	99.98	27.20
4	99.98	99.96	33.34
5	99.98	99.97	62.35
6	99.98	99.99	72.96
7	100.00	99.97	44.25
8	99.99	99.95	6.84
9	99.98	99.91	-69.55
10	99.97	99.99	59.52
11	99.97	99.95	32.53
12	99.97	99.99	45.86
13	99.98	99.98	76.10
14	100.00	99.98	55.84
15	99.99	99.96	37.66

# CRI Color Rendering Index

Reference Illuminant
CC
3354.3
K

R1 =
91.60

R8 =
68.37

R15 =
86.63

R2 =
94.72

R9 =
16.59

R3 =
85.17

R10 =
74.68

R4 =
89.01

R11 =
82.48

R5 =
87.92

R12 =
74.92

R6 =
90.11

R13 =
93.82

R7 =
88.48

R14 =
89.43

Ra  
(mean value of R1-R8)
86.92

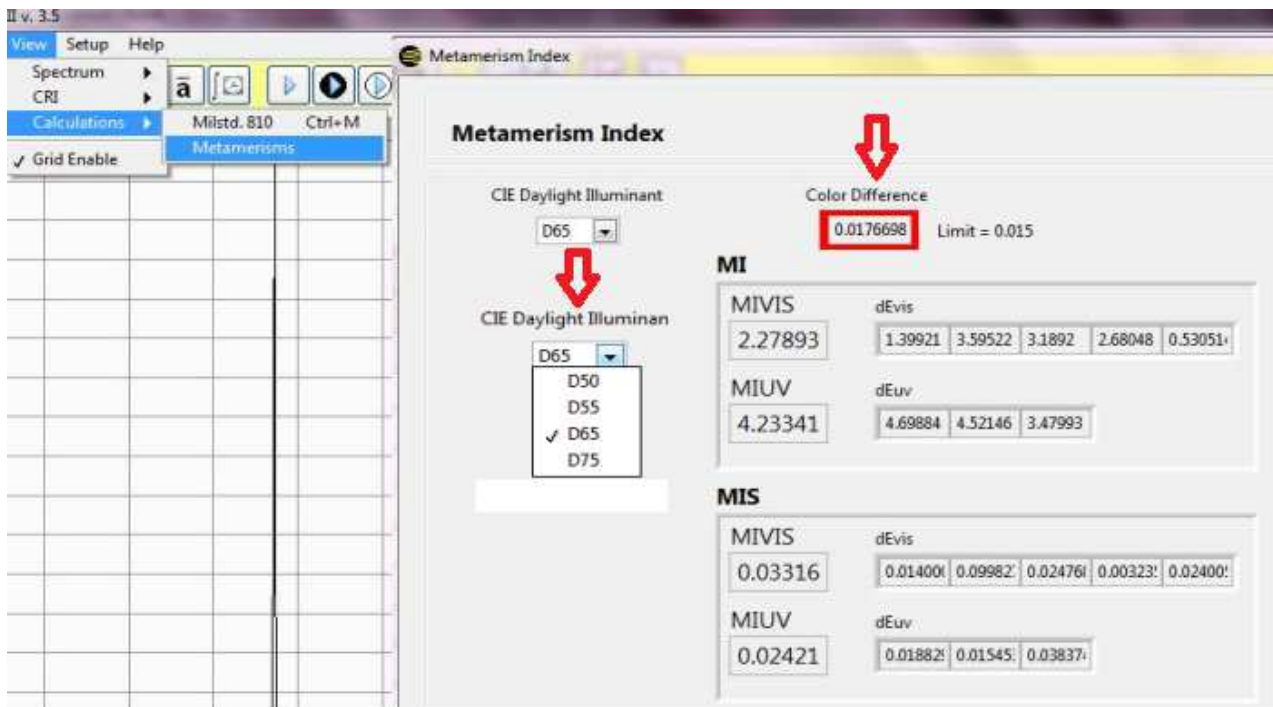
Close

## Metamerism

Metamerism is a phenomenon that occurs when the color of an object changes under different lighting conditions. The condition occurs when two objects have the same tristimulus values but different spectral stimuli. Conditions that affect color are vast including; light source, reflection from colored surfaces, and the observer. The basis for most available color reproduction processing including; photography, printing, TV, fabric, plastic and paint is the ability to make metameric color matches. The ILT metamerism calculations have all been based on the CIE DS 012.1/E, ISO23603:2005 Standard method of assessing the spectral quality of daylight simulators for visual appraisal and measurement of color.

Calculations can be accessed after you have completed a single scan. Metamerism

calculation use both 1931 2° and 1964 10° observers. Metamerism Index Color matching attempts to provide two colors the same spectral reflectance characteristic, making them a good metameric match with a low degree of metamerism, reducing the resulting color match to changes in illuminant or differences between observers.



Within the Metamerism Index box you have the option to select the appropriate CIE daylight illuminant by clicking on the down arrow to open up the drop down menu. You can choose from D50, D55, D65, D75 illuminants. Once you select the appropriate illuminant, view the Color Difference box to verify you have not exceeded the maximum difference of .015. If the color difference is greater than .015 the color difference value will be highlighted with a red box around the number. This indicates the test source is not a good match to the reference source selected. Below the color difference box is the MI box. MI is the CIE Metamerism Index which is derived by calculating the mean color differences of eight metamers (5 VIS and 3 UV). MI can be broken down into Mlvis and MlUV if only one portion of the spectrum is present. ILT software shows all 8 metamers and

their corresponding values, plus the Mlvis and Miuv for easy review. MIS, are the fixed known values for the CIE daylight illuminant samples and are noted for reference only

Below the color difference box is the MI box. MI is the CIE Metamerism Index which is derived by calculating the mean color differences of eight metamers (5 VIS and 3 UV). MI can be broken down into Mlvis and Miuv if only one portion of the spectrum is present. ILT software shows all 8 metamers and their corresponding values, plus the Mlvis and Miuv for easy review. MIS, are the fixed known values for the CIE daylight illuminant samples and are noted for reference only.

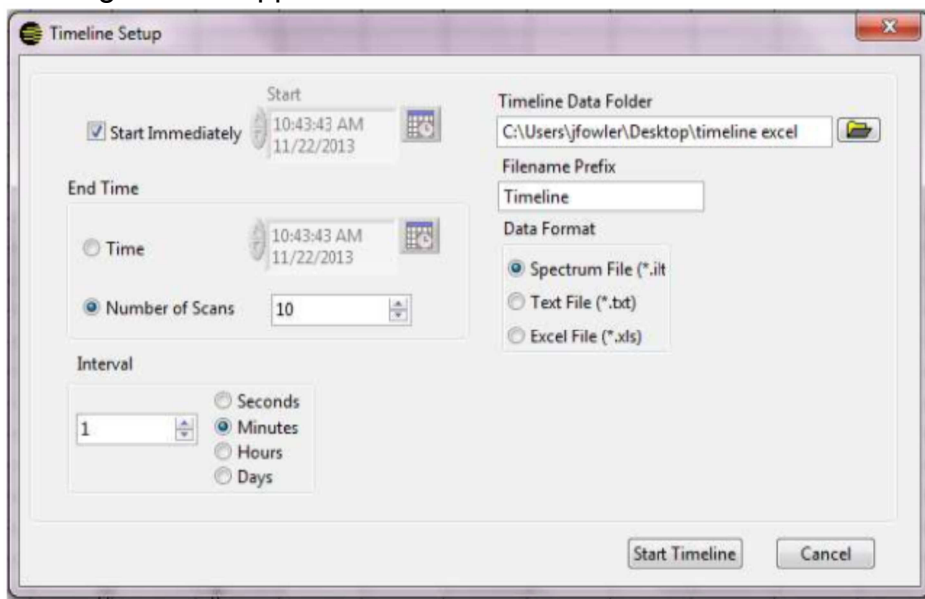
**MILSTD. 810** provides a summary table of the irradiance values for the required bands over the range of 280 to 800 nm.

**Distance** is used to calculate Candela based on the user supplied distance in meters. Enter the distance in the box and click set. Assure the input optic is the correct distance from the light source and take a calibrated irradiance measurement. View the Irradiance tab to see luminous intensity in candela.

**Grid** can be enabled and Disabled by clicking on the word grid in the view drop down menu.

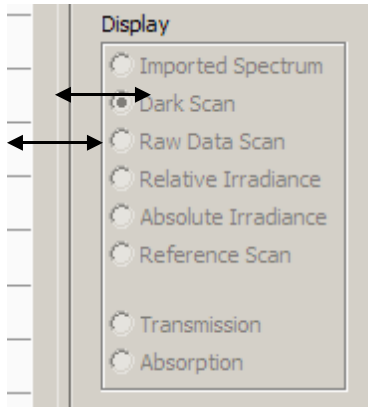
## 18. TimeLine

TimeLine is a tool that allows you to schedule measurements at specific times and intervals. It is accessed through the menu bar by clicking Acquire, Timeline or by with Control T. When the Timeline box opens you can set up the parameters needed to schedule a reading at a specific time. You can also select important parameters such as start time, end time, number of scan, location and format for data storage. You must complete a dark scan and reference scan prior to entering into the TimeLine function. (Cover the sensor and press Dark Scan then uncover and press the Reference Scan) If you attempt to configure a reading without having performed these tasks, a warning box will appear.

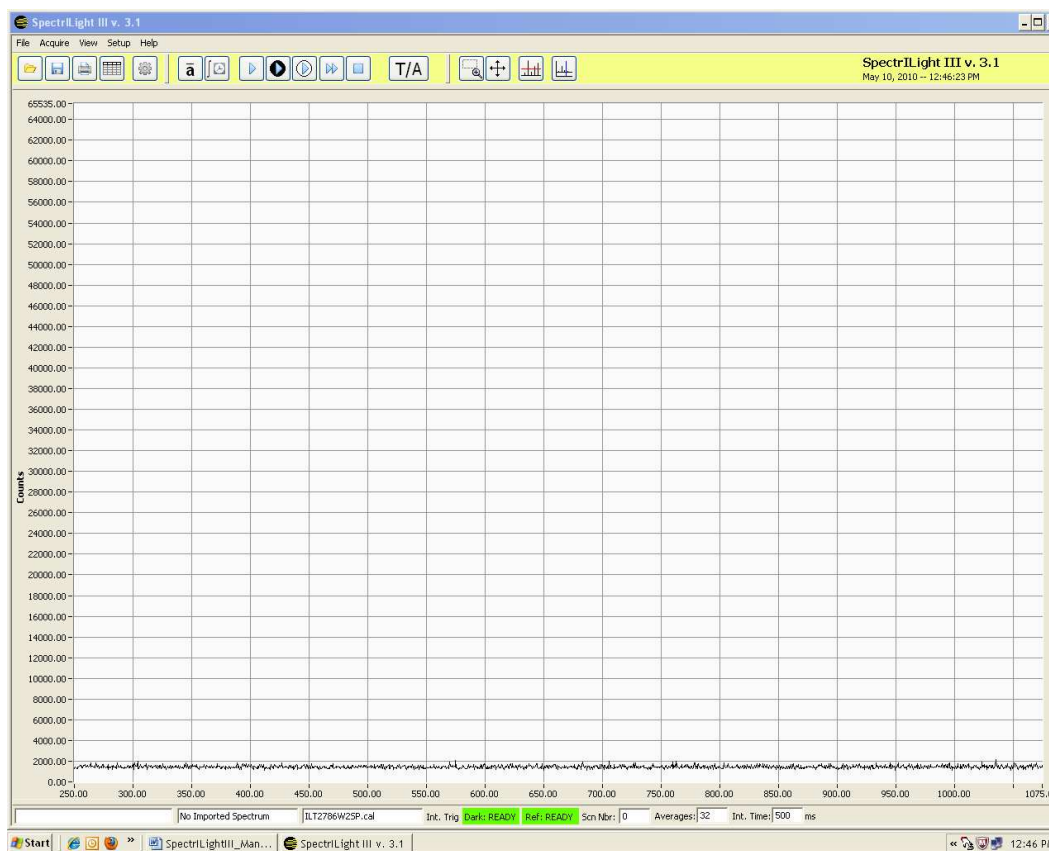


## 19. Expansion of Graph window

This feature can be initiated by moving the cursor over the separator bar and clicking when the 4-arrow “Move” icon becomes visible. To restore the screen, click on the far right separator bar.



The screen below is an expanded screen. Click the far right separator bar to restore the screen to its original size.





## 20. Overlay

The overlay feature was designed to allow customers to save a baseline reading and then compare current measurements to the saved baseline without exporting the results to excel. This time saving feature allows users to quickly and accurately compare numerous lamps, make comparisons, and track changes in both spectrum and intensity.

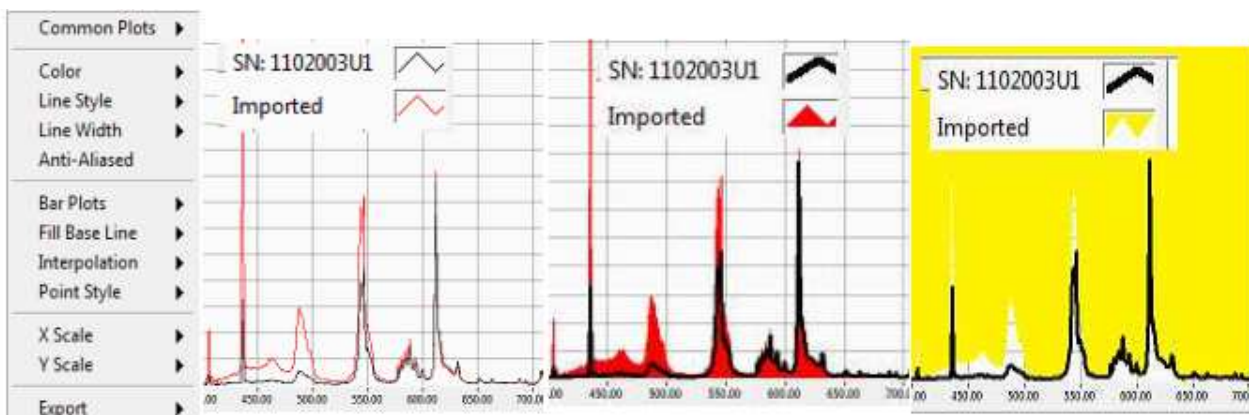
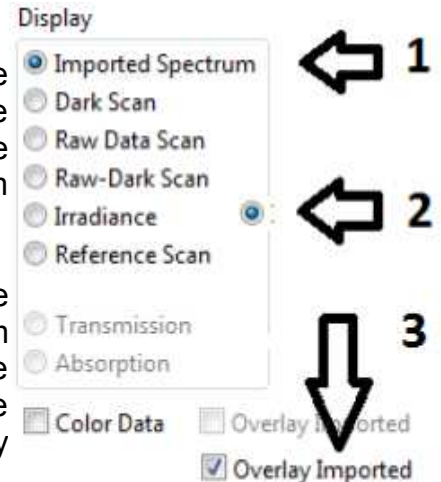
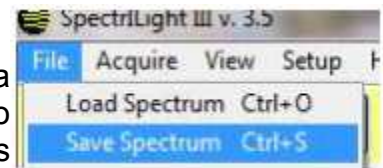
**Create a baseline:** If you have not already created a baseline file in .ilt format, you will need to take and store the baseline reading. Follow the measurement instruction above using the single reading button. Hit "Control S" or click file, save spectrum and name the file.

**Configuring Overlay:** Load the baseline: Hit "Control O" or file load spectrum to open the baseline reading. Imported spectrum will automatically be selected in the display box. The filename will be displayed next to the cal file name. Take a single scan. The irradiance button will turn on (blue), and Overlay Imported will no longer be grayed out. Click inside the box to the left of Overlay Imported to turn Overlay on. View the graph showing the baseline and current scan.

**Edit the structure of overlay.** Locate the design boxes in the upper right. The SN: box is the current scan. The Imported box is your baseline.

**Manipulate graphs for easy comparisons:** You can manipulate the design and color of each of these graphs by right clicking on the graph box. Once overlay is configured, you can continue to take additional readings using either single scan, or continuous scan. The baseline reading will remain in the format you have set up, until you shut down the system.

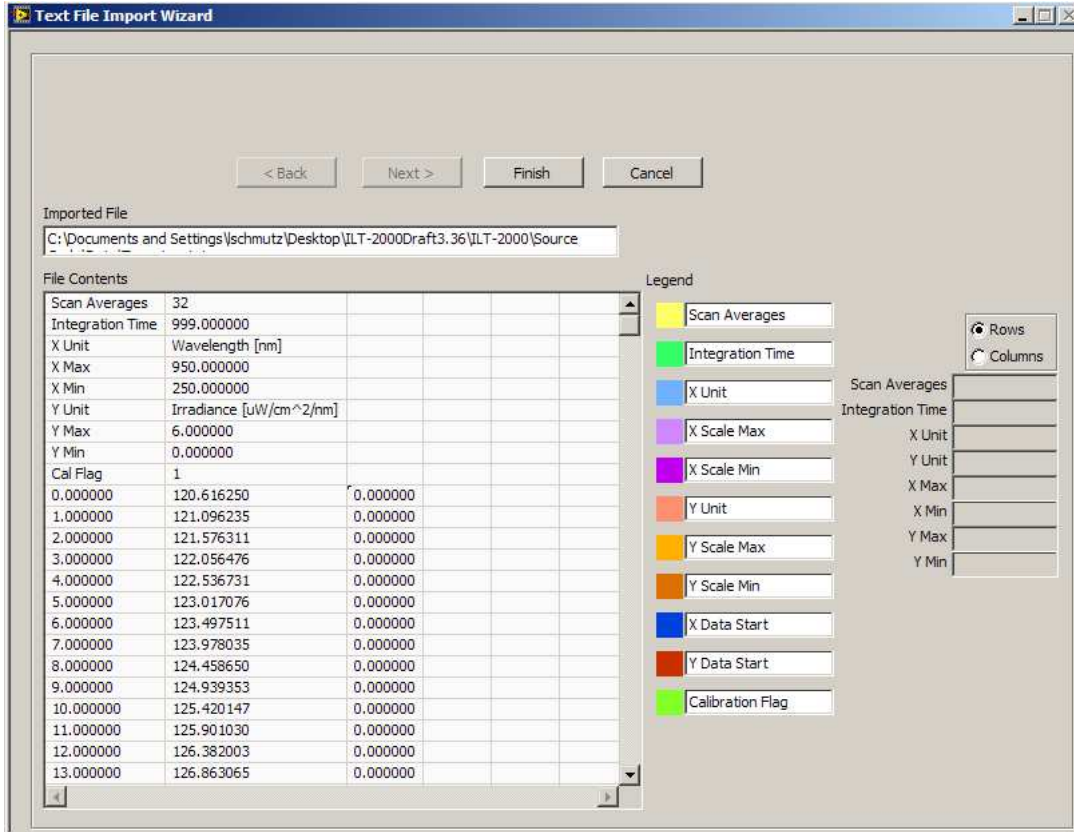
Right click    Standard configuration    Baseline Filled Red    Baseline filled infinity





## 21. Text File Export/Import Wizard

The function Export allows the saving of calibrated and non calibrated spectral data to a text data file in ASCII format. The current scan in the main graph display will be saved as a Tab Delimited text file under a file name with file extension “txt” and in a location chosen by the user. The default folder is the Data folder. This is a fast and all purpose way to save data and its file format is seen in the screen shot below. The data can be edited in such applications as Notepad or pasted into Excel.



The text files can be easily imported using the Import Wizard. Follow the instructions displayed in the Import Wizard. The Import Wizard allows for import of previously saved data that is generated in the current application.

## 22. Save/Load of Files

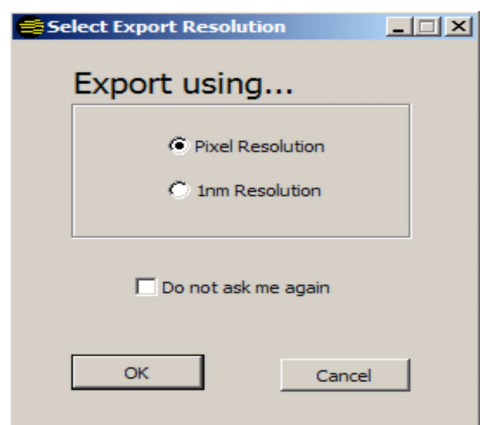
Calibrated or non calibrated data displayed in the main graph can be saved in binary format with file extension \*.ilt. The files in binary format can not be edited by the user. These files can later be reloaded into the main graph for evaluation.

## 23. Excel Export



(1)

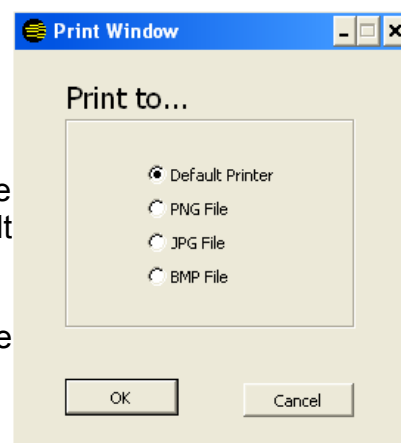
The data can be exported to Excel using wavelength data in pixel resolution (fractional wavelength) or in 1 nm increments. When selecting 1 nm Resolution or Pixel Resolution and checking “Do not ask me again”, the export routine will remember to save the data in the selected resolution without launching the Select Export Resolution window again. The default setting is restored using Help\Reset Factory Defaults.



## 24. Print Window

To print or save the Screen, use File\Print\Print Window. The Screen can be saved in PNG, JPG or BMP format. Use Default Printer to print the Screen.

The user can Print Screen to send the screen information to file formats such as Default Printer, PNG, JPG and BMP.



## 25. Help

The Help menu selection accesses data on the current software revision and ILT web page. The manual is currently available in PDF documents included on the CD-ROM. If the computer has Internet access, clicking the Home Page button will connect the user to the International Light home page using the computer's default browser.

## 26. Setup Calibration

The calibration menu function accesses Calibration\Create, Enable and Disable calibration File. The Create Calibration File mode is normally reserved for use by International Light Technologies

International Light Technologies and can not be accessed without a password. Enable and Disable allow the user to take relative measurements in counts (disable) or absolute results (calibration enabled)

## 27. Wavelength Coefficients

The Wavelength Calibration Coefficients A0, A1, A2 and A3 can be displayed by navigating to Setup\Wavelength Calibration Coefficients. The wavelength coefficients are specifically for your spectrometer and should not be edited by the customer.

The screenshot shows a window titled "Wavelength Calibration Coefficients". Inside, it displays the formula  $W = A_0 + A_1 * P + A_2 * P^2 + A_3 * P^3$ . Below the formula, it defines  $W$  as Wavelength (nm) and  $P$  as Pixel. There are four input fields for coefficients:  $A_0$  (1.81730893486051E+2),  $A_1$  (5.96399094796057E-1),  $A_2$  (-1.44782723279618E-5), and  $A_3$  (-2.74982391514993E-9). A "Close" button is at the bottom.

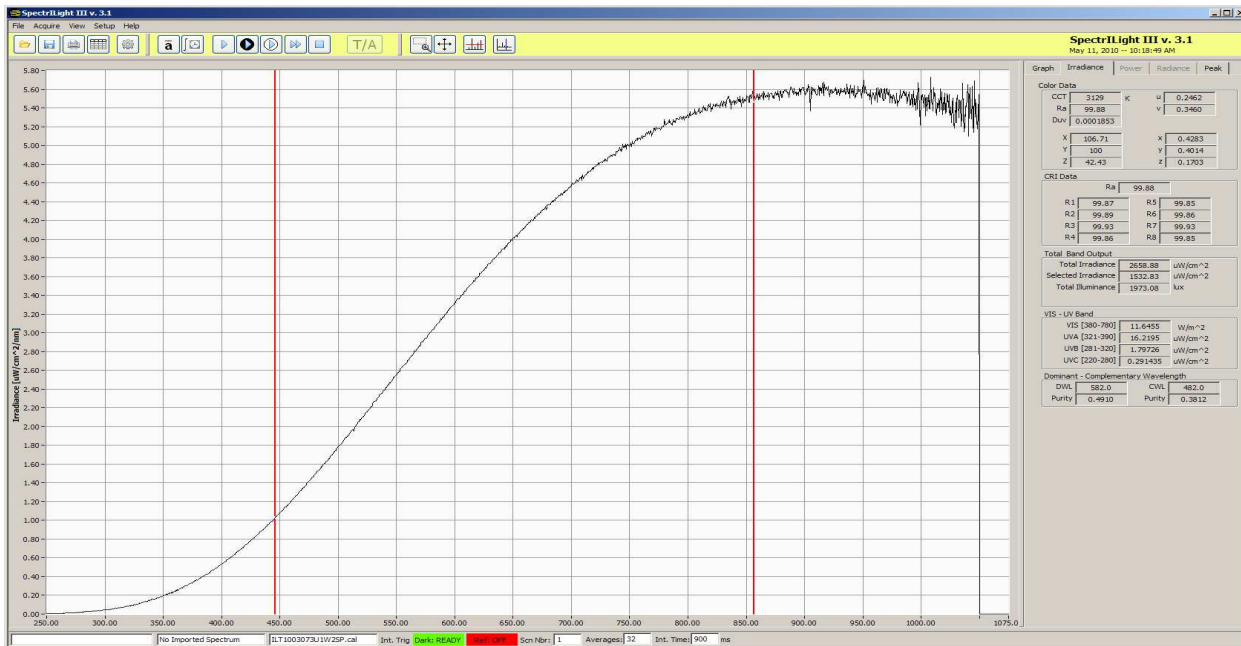
## 28. Edit Calibration File

The Edit Calibration Information can be displayed by navigating to Setup>Edit Calibration Info. The Calibration File information is inherent to your calibration file and should not be edited by the customer. We recommend that the system be re-calibrated one year from the Calibration Date in the Edit Calibration File window.

The screenshot shows a window titled "Spectrometer Calibration Information". Inside, under "Calibration Info", there are several fields: "Serial Number" (2786), "Scan Averages" (32), "Integration Time (ms)" (999), "Calibration Type" (Irradiance), "Y Unit" ( $\mu W/cm^2/nm/counts$ ), "Calibration Factor" (1), and "Calibration Date" (2:19:32.593 PM 2/16/2010). At the bottom, there are three rows for "Corrected Wavelength" (1, 2, and 3 nm) each with a value of 0.000 and a corresponding "pixel #" field (0). "Save" and "Close" buttons are at the bottom.

## 29. Irradiance Select

When selecting the check box Irradiance Select, two vertical cursors will appear on the screen. Using the mouse, these cursors can be moved such a specific area is selected. The total Irradiance of this selected area can be read in the Selected Irradiance indicator.



## 30. Single Vertical Cursor

(1)



Click the Cursor button (1) in the toolbar and a blue vertical cursor line will appear. You can move the line to the left or to the right when positioning and pressing the mouse over the line. The left and right arrow keys can be used as well. The wavelength indicator shows the wavelength position of the vertical cursor.



## 31. The SpectrLight.ini File

The SpectrLight.ini file can be edited in some occasions. For example, the users of the ILT900CR should change xaxis\_max to 600 and CutOffWLH to 575. Prior to editing SpectrLight.ini, the program SpectrLight III needs to be closed. The user can select other values for xaxis\_max and CutOffWLH.

```
[COMMON]
coefs_a0=181.730893486050830E+0
coefs_a1=596.399094796056910E-3
coefs_a2=-14.478272327961759E-6
coefs_a3=-2.749823915149930E-9
coefs_b0=0.000000000000000E+0
coefs_b1=0.000000000000000E+0
coefs_b2=0.000000000000000E+0
coefs_b3=0.000000000000000E+0
inttime=900.000000
averages=32
trigger_mode=10
xaxis_data_reverse=0
[SPECTROMETER]
spectrometer_type=1
[ILT650]
pixelnumber=2048
array_size=2048
input_mode=1
xaxis_min=340
xaxis_max=880
yaxis_min=0
yaxis_max=16383
CutOffWLH=860
CutOffWLL=360
[ILT950]
pixelnumber=2048
array_size=2048
input_mode=1
xaxis_min=250
xaxis_max=1075
yaxis_min=0
yaxis_max=65535
CutOffWLH=1050
CutOffWLL=250
PollScanDelay=5
[ILT900]
pixelnumber=2048
array_size=2080
input_mode=1
xaxis_min=250
xaxis_max=975
yaxis_min=0
yaxis_max=65535
CutOffWLH=950
CutOffWLL=250
[CALIBRATION]
cal_enable_flag=1
cal_filepath="/C:/Program Files/International Light/SpectrLight III/Calibration/ILT1003073U1W2SP.cal"
aFitCoeff=44.408865
bFitCoeff=-4786.617300
cFitCoeff=1.179906
dFitCoeff=2.769323
eFitCoeff=218314.520000
fFitCoeff=-57227959.000000
gFitCoeff=2908584600.000000
[SpectrLight]
server.app.propertiesEnabled=True
server.ole.enabled=True
server.tcp.servic=My Computer/VI Server
server.vi.propertiesEnabled=True
WebServer.DirectoryIndex=index.htm
WebServer.LogPath=C:\Program Files\National Instruments\LabVIEW 8.5\www.log
WebServer.MimeTypes=htm;text/html;gif:image/gif;jpg:image/jpeg/png:image/png;txt;text/plain;html;text/html;jpeg:image/jpeg;css;text/css;llb;application/x-labview-llb;vi;application/x-labview-vi;doc;application/msword;dot;application/msword;bin;application/octet-
```

```

stream;exe;application/octet-
stream;rtf;application/rtf;pdf;application/pdf;ai;application/postscript;eps;application/postscript;ps;application/postscript;cs;application/
x-csh;gtar;application/x-gtar;gz;application/x-gz;sh;application/x-sh;tar;application/x-tar;zip;application/zip;hqx;application/mac-
binhex40;ua;audio/basic;wav;audio/wav;tif;image/tiff;tiff;image/tiff;xbm;image/x-
xbitmap;rtx;text/richtext;qt;video/quicktime;mov;video/quicktime;avi;video/x-msvideo;movie;video/x-sgi-
movie;aif;audio/aif;aifc;audio/aif;aiff;audio/aif;aim;application/x-aim;dif;video/x-dv;div;video/x-dv;js;application/x-javascript;pntg;image/x-
macpaint;xl;application/vnd.ms-excel;xls;application/vnd.ms-excel;ppa;application/vnd.ms-powerpoint;ppt;application/vnd.ms-
powerpoint;pps;application/vnd.ms-powerpoint;pot;application/vnd.ms-powerpoint;pwz;application/vnd.ms-
powerpoint;mid;audio/mid;midi;audio/mid;enc;video/mpeg;m1v;video/mpeg;mp2;video/mpeg;mpa;video/mpeg;mpe;video/mpeg;mpeg;
video/mpeg;mpg;video/mpeg;psd;image/x-photoshop;bmp;image/bmp;pic;image/pic;ra;audio/vnd.rn-realaudio;rf;image/vnd.rf-
realfash;rm;application/vnd.rn-realmedia;rp;image/vnd.rn-realpik;ram;audio/x-pn-realaudio;rmm;audio/x-pn-
realaudio;rmx;application/vnd.rn-realplayer;rt;text/vnd.rn-realtex;rv;video/vnd.rn-
realvideo;smi;application/smil;ssm;application/streamingmedia;sithqx;application/mac-binhex40;sit;application/x-stuffit
WebServer.RootPath=C:\Program Files\National Instruments\LabVIEW 8.5\www
WebServer.TcpAccess=c+*
WebServer.ViAccess=+*
DebugServerEnabled=False
DebugServerWaitOnLaunch=False

```

END OF DOCUMENT