

How to do the irradiance calibration in SM32Pro

Introduction:

Spectrometers are excellent instruments to measure the spectral signals of various lights from samples or the light sources themselves. But they only can give relative spectral data that are OK for all relative measurements such as transmission, reflection, and absorption. However, if the absolute irradiance of a broadband light source is needed, the spectrometers should be calibrated radiometrically. For most irradiance calibrations for spectrometers, an NIST traceable standard light source is used, and the spectrometers get calibrated against it. This kind of irradiance calibration for SP's SM series spectrometers can be done using SP's basic SM operating software, SM32Pro. The process of the irradiance calibration in the SM32Pro is given in this application note.

Preparation of the reference lamp data:

The irradiance calibration using the SM32Pro requires the proper irradiance data file for the reference light source to be used. The "SPLAMP.txt" is the file that contains the irradiance data of the (NIST traceable) reference light source and is in the SM32Pro software folder (usually, C:\Spectral

Products\SM32ProForUSB). The irradiance data of the reference light source to be used should be saved in this "SPLAMP.txt" file with the proper format described below.

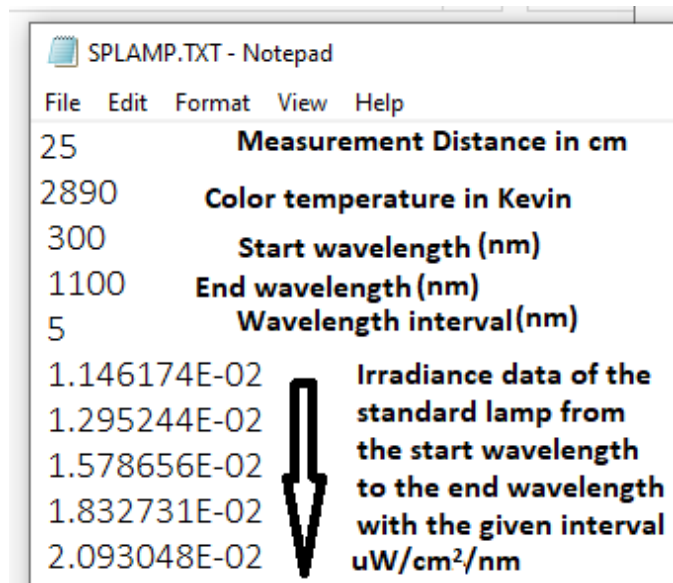
The first line in the file is the measurement distance in "cm" that the reference light source was calibrated.

The second line is the reference light source's color temperature (Kevin).

The third and the fourth lines are the start wavelength and the end wavelength both in nm.

The fifth line is the wavelength interval in nm.

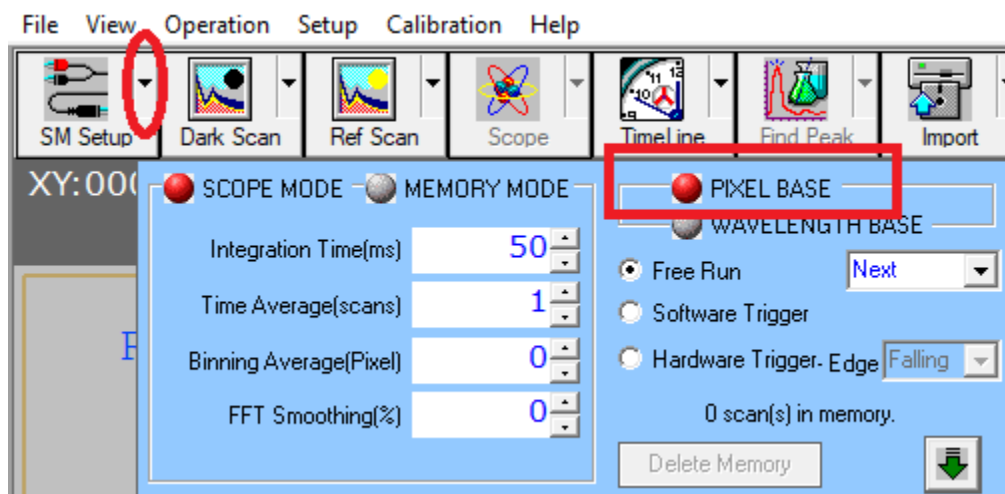
From the sixth line to the end, the reference light source irradiance data are given in $\mu\text{W}/\text{cm}^2/\text{nm}$, from the start wavelength to the end wavelength with the given interval.



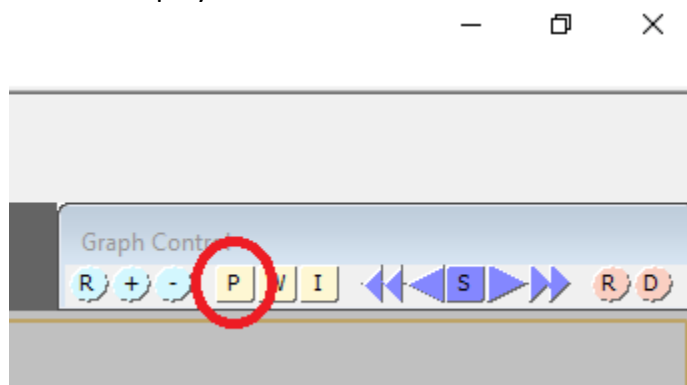
Irradiance Calibration Procedure:

1. Set the SM32Pro as the PIXEL BASE / Pixel display mode

The SM32Pro should be set as the PIXEL BASE / PIXEL display mode to go to the irradiance calibration mode. First, open the SM Setup dialog and choose the “PIXEL BASE” mode.



And then, click the “P” button in the Graph Control pane which is at the upper right corner of the main screen, to set the Pixel display mode.

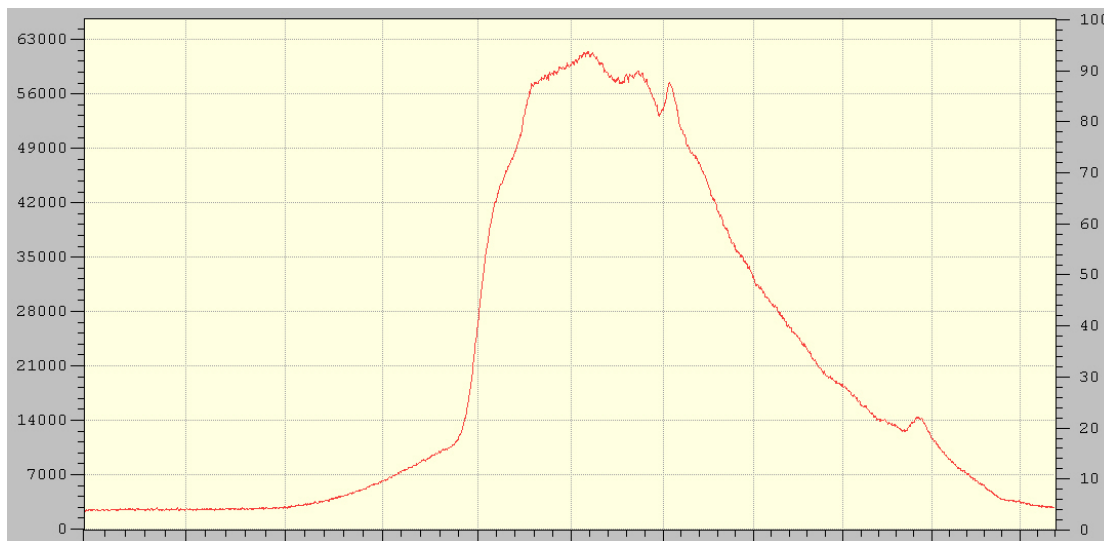
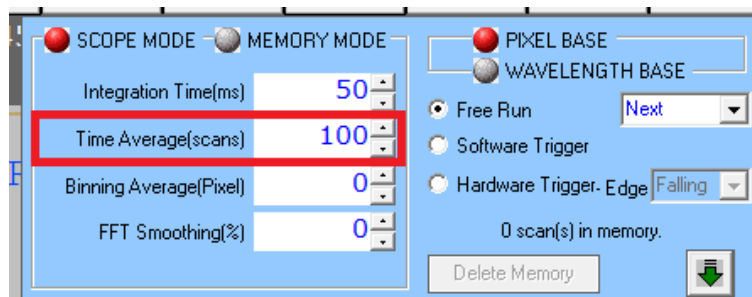


The X-axis should show the pixel number. Please check if the displayed X-axis is properly representing the total pixel number of the detector used in the spectrometer. If they don't match, please contact SP for help.

2. Set up the reference light source and the SM spectrometer

In the dark room, set up the reference light source, turn it on and warm it up enough. Place the SM spectrometer at a certain distance in front of the light source with matching the optical axis properly. If any accessory is used, such as an optical fiber, a cosine corrector, or an integrating sphere, the entrance of the accessory should be on the optical axis of the light source. The light should go into the entrance at a normal angle.

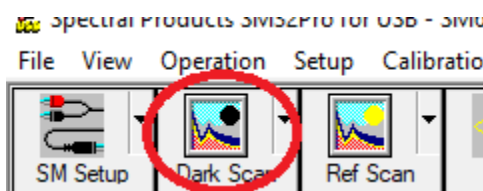
By adjusting the integration time, and/or the distance from the light source to the entrance of the spectrometer, make the peak light signal on the spectral data screen is under the saturation level. Until controlling the peak signal is not saturated, the higher the signal level is, the better the irradiance calibration would be. To have a better noise level, it is strongly recommended to use some time averaging at least 10 or higher (50+ is recommended).



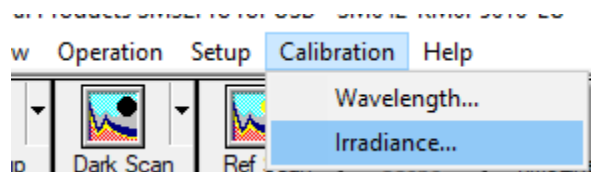
NOTE: Before doing the irradiance calibration, the old calibration files need to be backed up or renamed, if needed. Please check the software folder and see if there're "SP Irrad_#.cal" and "SP Irrad_#.txt" files. The "#" indicates the assigned channel number of the spectrometer. If you're using only one unit, it would be "0" as a default. After calibrating, the old cal file and the txt file will be overwritten. If multiple reference light sources are used, the "SP Irrad_#.cal" file and the "SP Irrad_#.txt" that were generated with a previous reference light source should be renamed.

3. Run the Irradiance calibration menu

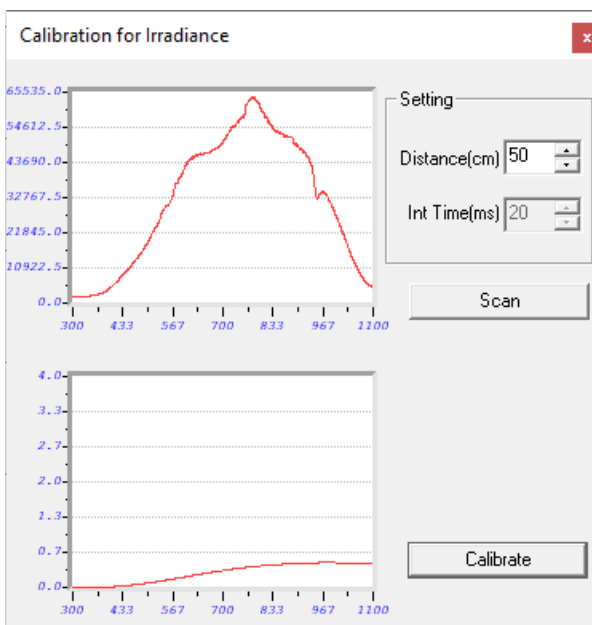
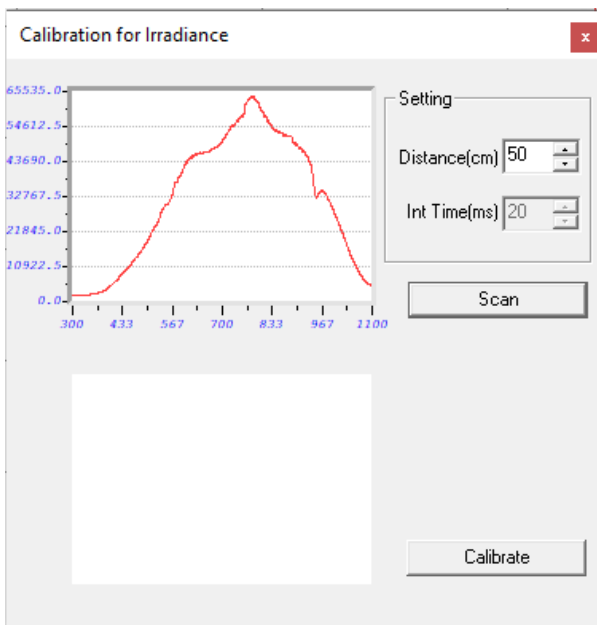
To activate the irradiance calibration menu, block the input light and do the “dark scan” by clicking the “Dark Scan” toolbar button.



Once the dark scan is done, the irradiance calibration menu will be activated. Please click the “Calibration” menu in the menu bar and select the “Irradiance...” menu to pop up the irradiance calibration window.



In the irradiance calibration window, the “distance” should be set first. The distance is measured from the reference light source to the entrance slit of the spectrometer if it is calibrated only, or the entrance surface of the accessory used with the spectrometer. The scale unit is cm.





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If needed, you can click the “Scan” button again to read the spectral data again. And when everything is ready, click the “Calibrate” button to execute the irradiance calibration. Once it is clicked, the new “SP Irrad_#.cal” file and “SP Irrad_#.txt” file will be generated or overwritten on the old cal & txt files.

After this irradiance calibration, to check the irradiance data of a certain broadband light source, please refer to the application note for the absolute irradiance calibration mode, “Absolute Irradiance.pdf” file.

NOTE:

- *If the irradiance calibration requires multiple reference light sources due to the limitation of the emission range of each light source, please back up or rename the saved “SP Irrad_#.cal” file and the “SP Irrad_#.txt” file, and then start again from the “Preparation of the reference lamp data”.*
- *If multiple irradiance calibrations are needed to cover the wide wavelength range for a single spectrometer and all the calibration data files need to be combined as a single calibration file, please contact Spectral Products. The detailed calibration conditions per calibration should be provided to SP to combine the multiple data into one to adjust the calibration coefficient properly according to each calibration condition.*



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