Absolute Irradiance
Installation and Operation Manual

For Products: JAZ-IRRAD
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A HALMA COMPANY

AMERICAS & WORLD HEADQUARTERS

Phone: +1 727-733-2447
Fax: +1 727-733-3962

Sales: info@oceanoptics.com
Orders: orders@oceanoptics.com
Support: techsupport@oceanoptics.com

Ocean Optics, Inc.
830 Douglas Ave.
Dunedin, FL 34698
USA

Manufacturing & Logistics
4301 Metric Dr.
Winter Park, FL 32792
USA

EUROPE, MIDDLE EAST & AFRICA

Phone: +31 26-319-0500
Fax: +31 26-319-0505
Email: info@oceanoptics.eu

Germany : +49 711-341696-0
UK : +44 1865-811118
France : +33 442-386-588

Sales & Support
Geograaf 24
6921 EW Duiven
The Netherlands

Manufacturing & Logistics
Maybachstrasse 11
73760 Ostfildern
Germany

ASIA

Phone: +86 21-6295-6600
Fax: +86 21-6295-6708
Email: asiasales@oceanoptics.com

Japan & Korea: +82 10-8514-3797

Ocean Optics Asia
666 Gubei Road
Kirin Tower Suite 601B
Changning District
Shanghai
PRC, 200336

www.oceanoptics.com

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About This Manual

Document Purpose and Intended Audience

This document provides the users of Jaz with instructions for setting up, calibrating and performing experiments with their Jaz unit.

What's New in this Document

This version of the *Jaz Absolute Irradiance Installation and Operation Manual* updates software instructions.

Document Summary

Chapter	Description
Chapter 1: *Introduction*	Contains descriptive information about Jaz.
Chapter 2: *Calibration*	Provides calibration instructions.
Chapter 3: *Jaz Setup for Absolute Irradiance*	Provides instructions for setting up Jaz to measure absolute irradiance, including editing parameters in the config.txt file and copying the calibration file to the SD card.
Chapter 4: *Operation*	Contains information for optimizing your absolute irradiance measurement, taking a measurement, saving your measurement data, and loading this data into SpectraSuite.

Product-Related Documentation

You can access documentation for Ocean Optics products by visiting our website at **http://www.oceanoptics.com**. Select *Technical Operating Instructions*, then choose the appropriate document from the available drop-down lists

- ***Jaz Installation and Operation Manual***
- Detailed instructions for OceanView Spectrometer Operating Software are located at: **http://oceanoptics.com///wp-content/uploads/OceanViewIO.pdf**.
- Detailed instructions for SpectraSuite Spectrometer Operating Software are located at: **http://oceanoptics.com///wp-content/uploads/SpectraSuite.pdf**.

Ocean Optics offers a Glossary of spectroscopy terms to help you further understand your state-of-the-art products and how they function, located at: **http://oceanoptics.com/glossary/**.

Upgrades

Occasionally, you may find that you need Ocean Optics to make a change or an upgrade to your system. To facilitate these changes, you must first contact Customer Support and obtain a Return Merchandise Authorization (RMA) number. Please contact Ocean Optics for specific instructions when returning a product.

Warranty

Our 3-Year Warranty covers Ocean Optics miniature fiber optic spectrometers, light sources and sampling accessories – regardless of the application – from manufacturing defects. It also covers fibers and probes for a full 12 months: **http://oceanoptics.com/services/exclusive-3-year-warranty/**

This comprehensive warranty ensures you of the highest level of craftsmanship and reliability for years to come. No other manufacturer offers such a solid guarantee of quality and reliability.

The Ocean Optics 3-Year Warranty applies to Ocean Optics equipment (excluding OEM configurations) purchased on or after July 1, 2010. The warranty covers parts and labor needed to repair manufacturing defects that occur during the warranty period. We also will cover the costs of shipping warranty-related repairs from our customers to Ocean Optics and from us to our customers.

Chapter 1

Introduction

Jaz Overview

Jaz is a community of stackable, modular and autonomous component modules that combine to create a community of smart sensing instruments that is unfettered by the limits of traditional optical sensing instrumentation: a powerful microprocessor and onboard display eliminate the need for a PC; stackable, autonomous instrument modules allow users to customize the system to their changing application needs; and Ethernet connectivity plus SD card data storage capability facilitate remote operation.

The Jaz Irradiance application allows you to do onboard absolute irradiance measurements using the JAZ. Users will now be able to go into the field, measure light sources and even perform post processing (Lumen, Lux, PAR, Watt) without the need of a computer.

The Jaz Irradiance application is resident on an SD card. When used with the Jaz Lightmeter, Jaz becomes a true light meter for use in field measurements. Your Jaz must have an Ethernet module or Battery module to read the SD card.

Stack of Jaz Modules

Jaz Modules

Jaz consist of a stack of individual spectroscopic instruments specified by the user to suit their unique application. Modules available for the Jaz stack to do irradiance measurements include the following:

Module	Description
JAZ-S	Spectrometer and grating (up to 8 can be configured in a stack)
JAZ-DPU	Processor (CPU), OLED display and keypad
JAZ-E	Ethernet and memory module. Includes one slot for an SD card (up to 2 GB).
JAZ-B	Battery (lithium-ion) and memory module. Includes two slots for an SD card (up to 2 GB each).
JAZ-UV-VIS	Deuterium-tungsten halogen light source
JAZ-VIS-NIR	Tungsten-halogen light source
JAZ-L640	640 nm red LED
JAZ-L590	590 nm yellow LED
JAZ-L450	450 nm blue LED
JAZ-L395	395 nm UV LED
JAZ-WHITE	White LED

A Jaz Combo consists of a combination of up to three JAZ-S spectrometer modules and a JAZ-DPU module.

Chapter 2

Calibration

Overview

Before starting using your Jaz and configuring it for absolute irradiance, make sure you've configured Jaz for use with the Jaz-A-IRRAD application. If you've ordered your Jaz with the JAZ-A-IRRAD your spectrometer and SD card are already configured correctly.

Calibration

Absolute Irradiance mode allows you to measure optical power in various parameters and determine color coordinates of emissive devices such as LEDs, light sources, plasmas, etc. These parameters may be available during measurement (on-board post-processing) or during post-processing using SpectraSuite operating software. Jaz can measure absolute irradiance with JAZ-A-IRRAD. Currently, Jaz requires SpectraSuite to calculate color.

Using the Jaz spectrometer in Absolute Irradiance mode requires calibration. When measuring absolute irradiance using Jaz, the instrument plus the probe must be calibrated using a reference standard. This reference standard is often a calibration light source. The calibration can be done by Ocean Optics (SPEC-CAL or SPEC-CAL-UV) or by using your purchased Ocean Optics calibration light source.

The probe used can be one of the following:

- Direct attached cosine corrector
- Fiber optics patch cord (with or without cosine corrector)
- Integrating sphere

To perform a correct measurement, you must know the specifications of these parts when setting up the spectrometer and software.

When performing the irradiance measurement, make sure you have an up-to-date calibration file of the spectrometer available. Also, be sure not to uninstall the probe from the spectrometer after creating your calibration file, otherwise you must recalibrate.

Note

If you used Ocean Optics' SPEC-CAL service, the fiber or fiber with cosine corrector must not be removed from the spectrometer or the calibration data will become void.

If you have a calibration file available (via SpectraSuite or SPEC-CAL) go on to Chapter 3: *Jaz Setup for Absolute Irradiance*.

If you are performing your own calibration, use the following procedure.

Performing a Calibration Using OceanView

If you have purchased a calibration light source though Ocean Optics, you can use this lamp to create the absolute irradiance calibration of the spectrometer and probe. The procedure below describes how to acquire this calibration file using OceanView.

► *Procedure*

1. Connect the spectrometer to the fiber optics probe (fiber, cosine corrector or integrating sphere).
2. Connect the fiber optics probe to the calibration light source.
3. Turn on the light source. Allow for proper warming up of the light source as stated in the light source's manual.
4. Start OceanView. The OceanView Welcome screen appears.

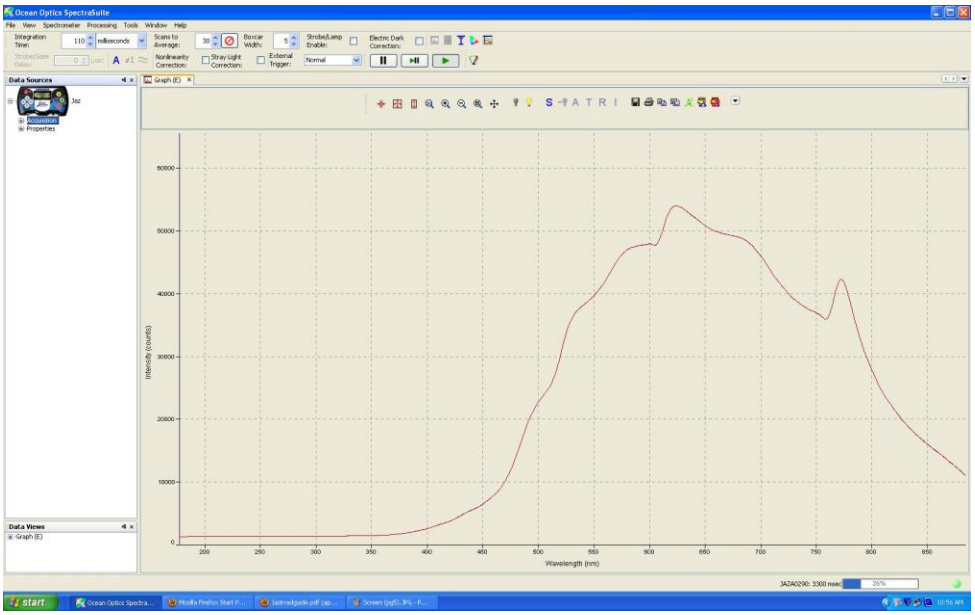
5. Invoke the Absolute Irradiance wizard by clicking **Spectroscopy Application Wizards**, then **Absolute Irradiance**.
6. Select the desired spectrometer to set up the measurement. Click **Next**.
7. Select **New Calibration** since you are calibrating the spectrometer with a light source. This selection creates a new irradiance calibration for the spectrometer using a calibrated light source and associated lamp file (.lmp). This option also allows you to save the new calibration as a .cal file that can be loaded at a later time. Click **Next**.
8. Load the lamp file that is associated with the calibrated light source used for the irradiance calibration. The file must be a .lmp file. The message in the lower left corner of the window will update upon successful loading of the lamp file.
9. Save the calibration. This panel allows you to set the collection type and area used in the irradiance calibration. Select the appropriate type of collection and enter the associated value (if applicable). If you choose Use Integrating Sphere, the collection area will automatically be set to **1**. Click **Save to File** to save the calibration specifications for future use. The calibration information will be saved in a .cal file.

Performing a Calibration Using SpectraSuite

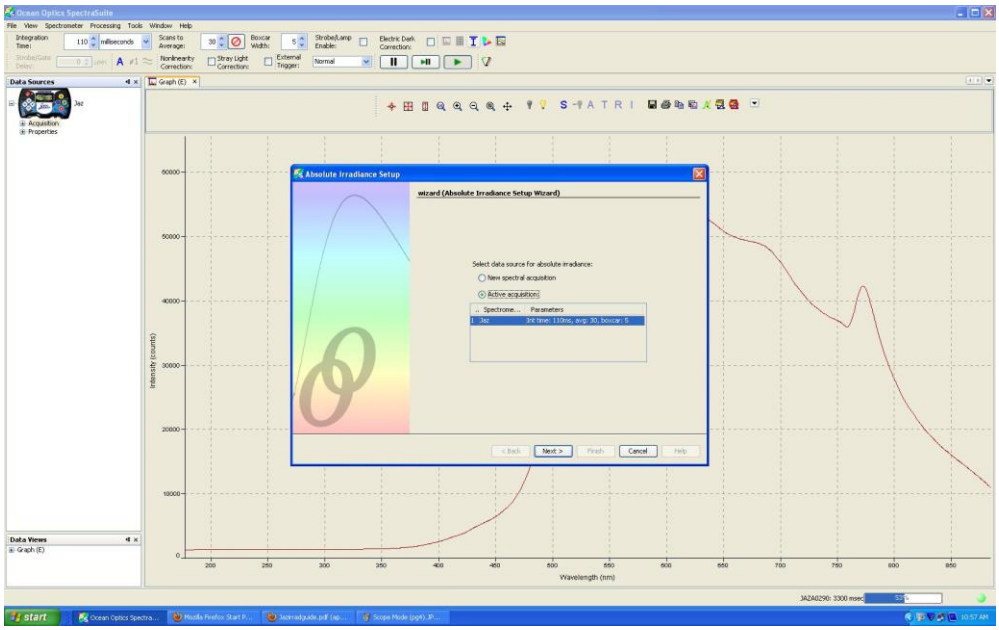
The procedure below describes how to acquire the calibration file using SpectraSuite.

► *Procedure*

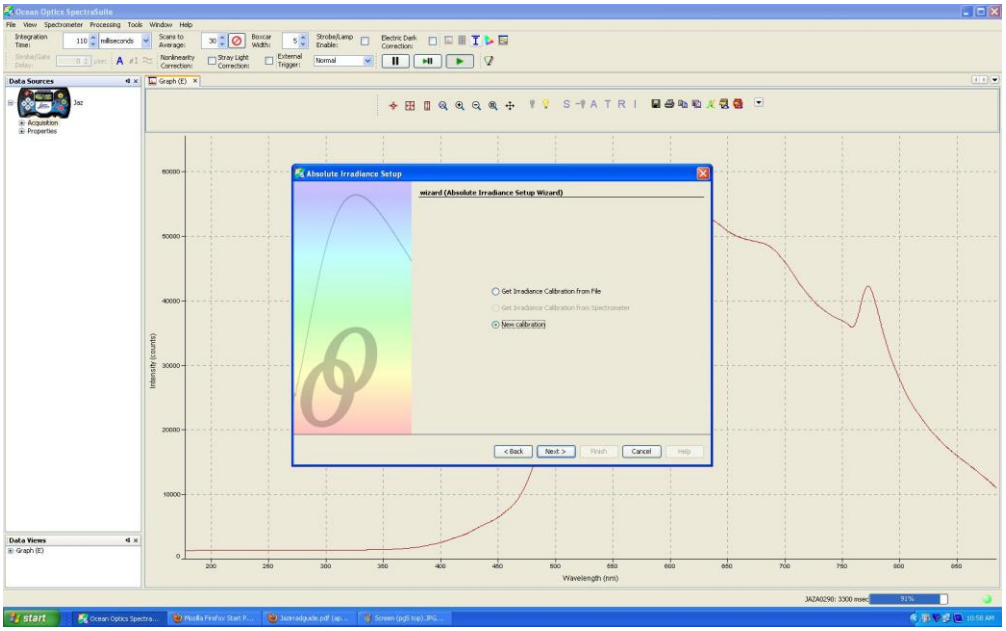
1. Connect the spectrometer to the fiber optics probe (fiber, cosine corrector or integrating sphere).
2. Connect the fiber optics probe to the calibration light source.
3. Turn on the light source. Allow for proper warming up of the light source as stated in the light source's manual.
4. Start SpectraSuite. The raw spectrometer data appears on the screen (Scope mode).



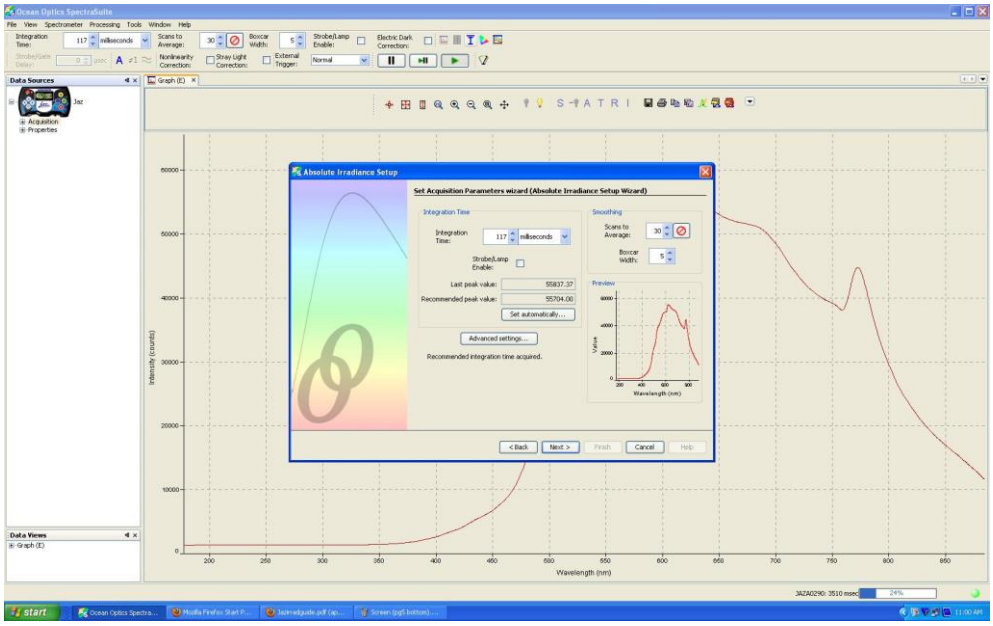
5. Navigate to **File | New | New Absolute Irradiance Wizard** to launch the Absolute Irradiance wizard.



6. Select the desired spectrometer to set up the measurement. Click **Next**.



7. Select **New calibration** since you are calibrating the spectrometer with a light source. Click **Next**.

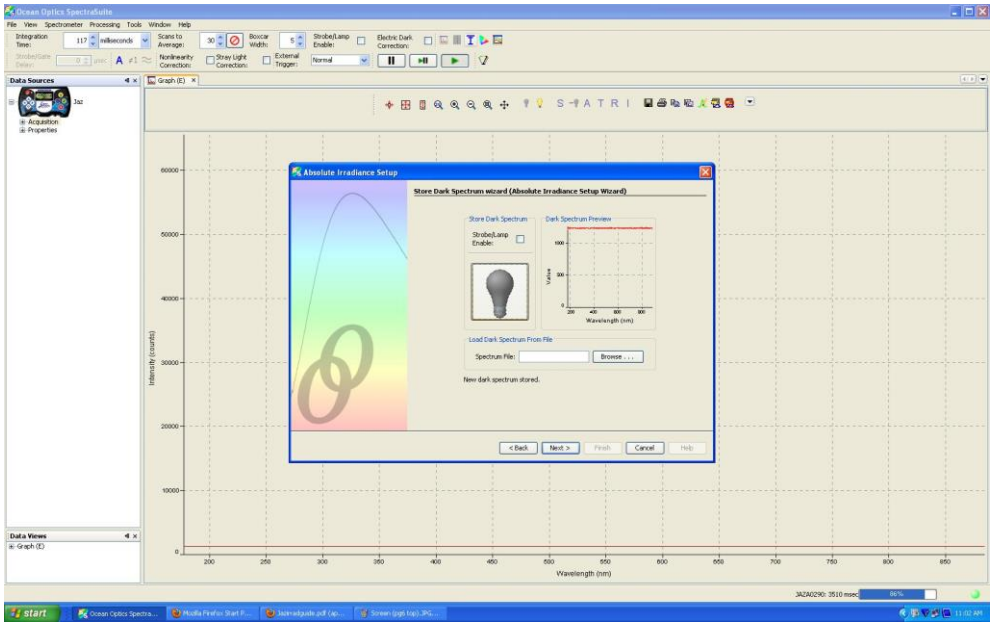


8. Set the spectrometer for the optimal signal-to-noise ratio by clicking **Set Automatically** or making the following individual selections:

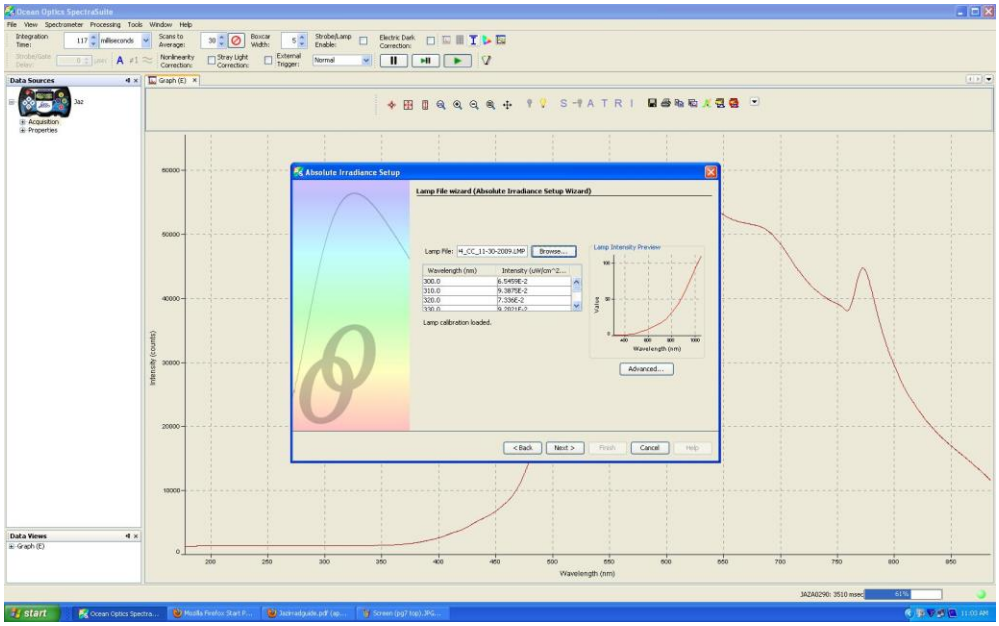
   - **Integration Time:** The peak of the signal should be close to 55,704 counts *without* saturation of the detector (peak > 64,000 counts).
   - **Scans to Average: 30**
   - **Boxcar width:** Leave setting at **5**.

   Click **Next** when settings have been selected.

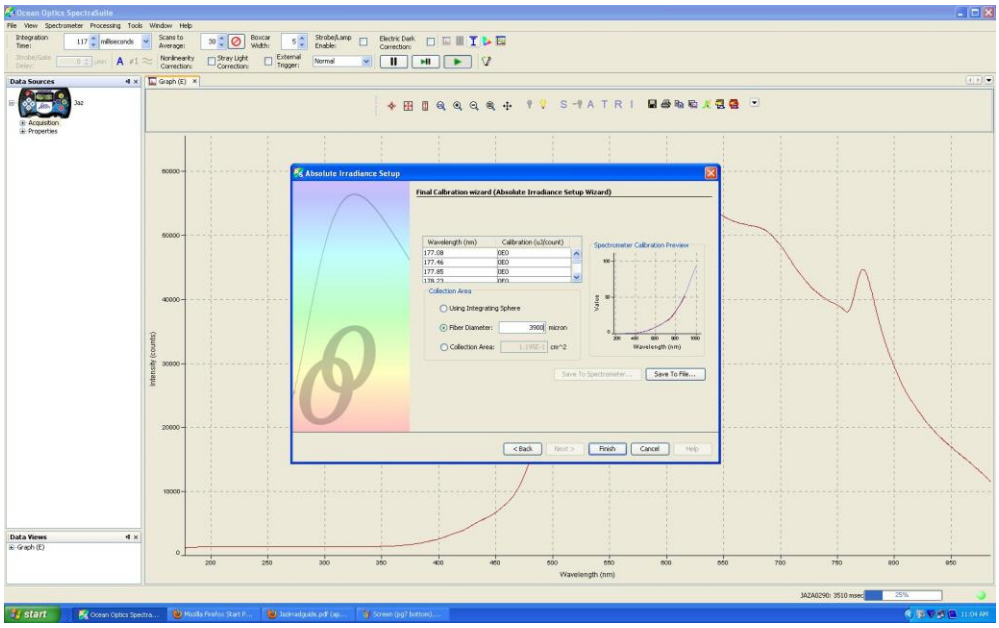
9. Click  to take a reference measurement. This data will be compared with the calibrated data of your light source. Click **Next**.



10. Completely block the light source for a dark spectrum. Click  to take the dark measurement. Click **Next**.



11. Click **Browse** to find the light source calibration (reference) file. This file was included on the CD that came with your light source and has an extension **.LMP**. Once you have located the file, click **Next.**



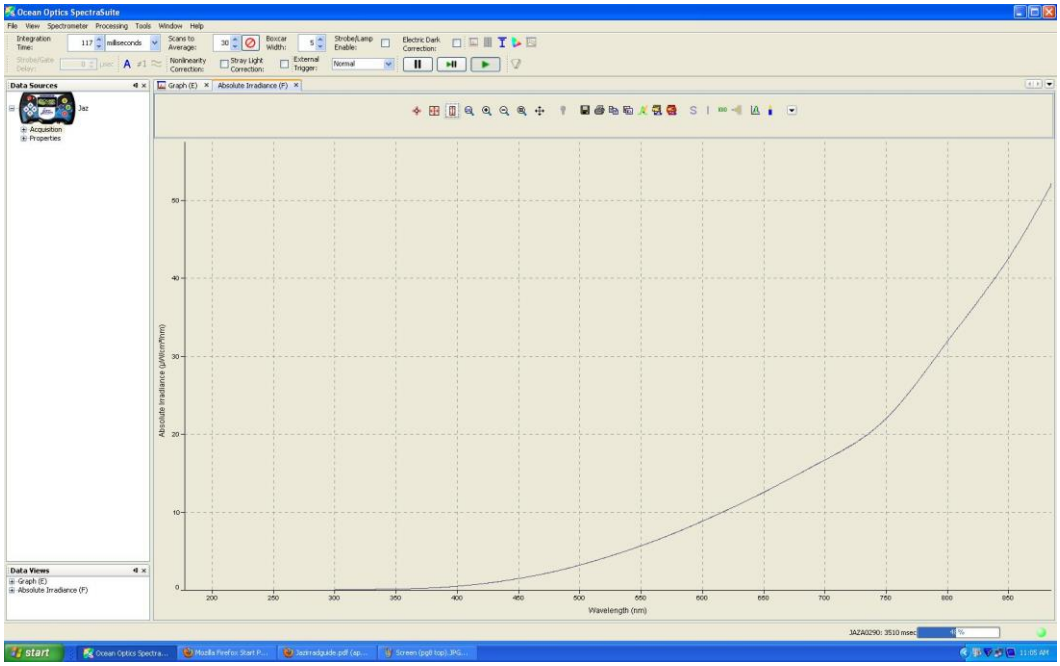
12. Select the correct diameter of your probe from the following:

    - If you are using an integrating sphere, select the **Use Integrating Sphere** option.
    - If you are using a bare fiber or a cosine corrector, select **Fiber Diameter** and enter the appropriate value. See the following examples:

Cosine Corrector	Fiber Diameter	Area in cm^2
CC-3	3900 microns	0.119459061
CC-3-UV	3900 microns	0.119459061
CC-3-DA	7140 microns	0.400392842
QP600-2-VIS/BX fiber	600 microns	0.002826

    - If you know the collection area, select **Collection Area** and enter the value. Remember the area in cm^2 to enter it in the config.txt file on the SD Card. If you enter the diameter in micrometers, the software will calculate the area in cm^2 automatically.

13. Click **Finish**. If you unblock the calibration light source, you will be able to view the calibrated output power of the light source in absolute irradiance units (uWatt/ cm^2/nm).



14. Compare the values at three points on the curve to the values in the lamp file (.lmp) for your calibration lamp. The lamp file has two columns: wavelength (nm) and absolute irradiance in $\mu W/cm^2/nm$.
15. Select points near the low, middle and high values of the x axis that are very close to the wavelength values in the lamp file. If these point values are within +/- 5% of the corresponding lamp file values, then your calibration was done correctly. If not, repeat the calibration procedure until the values match appropriately.

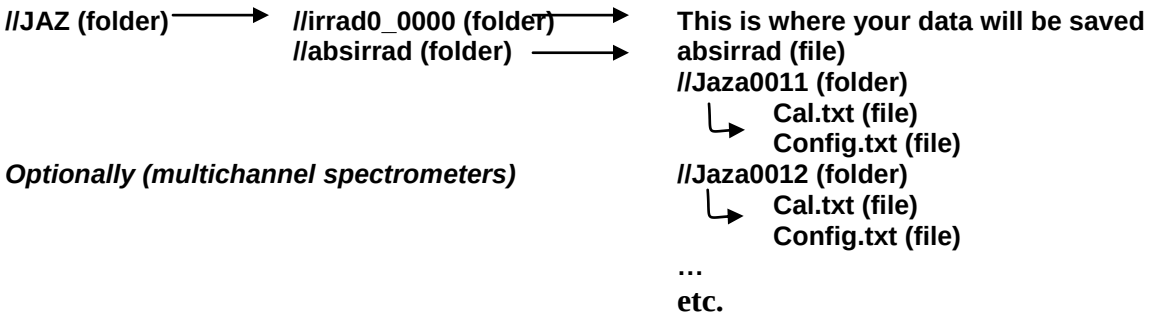
Chapter 3

Jaz Setup for Absolute Irradiance

Overview

Once you have the calibration file and know the surface area of your probe you are ready to set up Jaz to measure absolute irradiance. To do this, you must set the desired parameters in the config.txt file, then copy your settings to the SD card. You must also copy the calibration file to the SD card.

The SD card has the following file structure:



Configuring the Config.txt File

The config.txt file for each Jaz module contains the configuration parameters and default parameters for that module. This file will allow you to start up Jaz with your settings so that you can immediately start measuring in the field.

You can view and change the config.txt file settings in the directory of the Jaz module (listed by serial number) you are using to measure absolute irradiance. To do this, use Notepad or some other text editor to open the config.txt file. Do **NOT** use Word as this program will corrupt the text file.

Note

The int_sphere and collection_area fields are required if the int_sphere field is set to NO. All other fields are optional.

The following settings can be changed:

int_sphere=NO	***// Select YES if using an integrating sphere***
collection_area=0.119459061	***// Be sure to use the correct collection area in cm^2****
boxcar_width=5	***// JAZ can use boxcar smoothing. Select the value here.***
scans_to_average=2	***// Select averaging of your spectra.***
electric_dark=ON	***// Turn on the electrical dark feedback loop. ON or OFF***
graph_x_min=400.0	***// Start wavelength [nm] on screen (file includes total range)***
graph_x_max=700.0	***// Stop wavelength [nm[on screen***
graph_y_min=0.0	***// Y axis start in uW/cm^2/nm on screen***
graph_y_max=10.0	***// Y axis stop in uW/cm^2/nm on screen***
single_wavelength=OFF	***// Choose spectrum or specific Y-value on screen***
base_filename=OUTPUTFILE	***// Choose filename description.***
default_proc=ALL	***// Choose which processed parameter to display on screen. Choices are: LUMEN, LUX, PAR, WATT, or ALL (all 4 parameters)***
scientific_notation=OFF	***// Choose processed parameters to be displayed in scientific mode or generic values***
max_int_time=3	***// Max integration time in [s] for 'auto adapt' algorithm. If the algorithm does not reach the maximum counts levels at this time, it will stop the procedure.***

*Some example area values to be entered in this file:

- CC-3-UV: Diameter 3900, area 0.119459061 cm^2.
- CC-3-DA: Diameter 7140, area 0.400392842 cm^2.
- QP600-2-VIS/BX fiber: Diameter 600. area 0.002826 cm^2.

Once you have set the desired parameters, copy this config.txt file to the correct folder on your SD card.

Copying the Calibration File to the SD Card

You must copy the calibration file (see Chapter 2: *Calibration*) to the same directory that contains your config.txt file.

Your current calibration file should have a filename similar to **xxxx.cal** . Be sure that the file contains one column of data. Change the calibration filename to the default 'cal.txt' and copy it to the correct directory of your Jaz module on the SD card.

Now you are ready to start using Jaz and perform absolute irradiance measurements. See Chapter 4: *Operation*.

Chapter 4

Operation

Overview

This chapter contains information for optimizing your absolute irradiance measurement, taking a measurement, saving your measurement data, and loading this data into SpectraSuite.

Setting Up Jaz for Absolute Irradiance

Without the JAZ-A-IRRAD SD card inserted into the Jaz bench, the spectrometer will start up with the default menu measurement wizards like absorbance, transmission and reflection. By plugging in the JAZ-A-IRRAD SD Card and restarting the Jaz, the operation and functionality of Jaz will be set up for absolute irradiance measurements.

► *Procedure*

To set up Jaz to measure absolute irradiance,

1. Plug the SD card into the Jaz SD card slot.
2. Restart the Jaz spectrometer.

   After the initial Jaz splash screen, Jaz will indicate that it's loading the calibration file into memory. Once finished, it will display the startup screen:

Optimizing Measurements

For proper measurements, it is important to adapt Jaz to your light source and take a dark measurement before saving any data.

► *Procedure*

To optimize your absolute irradiance measurements,

1. Make sure that the Jaz module contains the SD card with the absolute irradiance configuration and calibration files and Jaz has been restarted so that the following screen is displayed:

2. Point the probe at your sample (LED or other emissive light source) and press the ▲ key for the Adapt to Light selection. This starts the optimization procedure to adjust the Jaz instrument for the appropriate lighting conditions. Once Jaz has finished (within a few seconds), the following screen appears:

3. Take a dark measurement. To do this, cover the probe and press the # key for the Dark selection. Once Jaz has finished, the following screen appears:

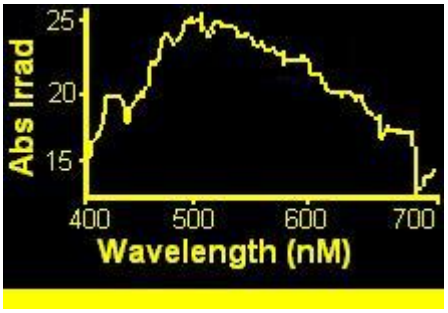
Jaz has now been optimized to take absolute irradiance measurements.

Taking Measurements

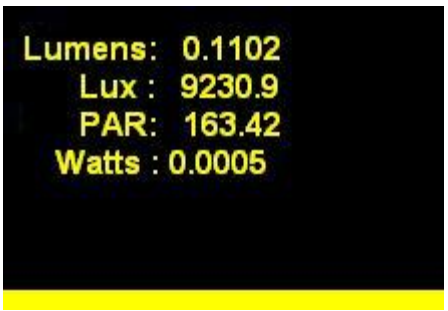
► *Procedure*

To take an absolute irradiance measurement,

1. Press the ● key for the Graph selection to start measuring your light source. The following is an example of a solar measurement graph:



2. Press the Home button ( ) to return to the Main Absolute Irradiance menu. From there, you can select the * key for the Analyze Data selection to enter Post Processing mode. In this mode, the screen displays one or more calculated parameters based on your current measurement and config.txt settings..



3. Check the yellow status bar at the bottom of the screen for important messages. For example, if the status bar indicates 'Saturated,' the light intensity entering the spectrometer is too high. You will need to redo the Adapt to Light function by pressing the Home button ( ) to return to the Main Absolute Irradiance menu, and then pressing the ▲ key for the Adapt to Light selection (see *Optimizing Measurements*).

Caution

If you save data while the measurement is saturated, the outcome will be not correct. The spectrum shape will be affected, as will the calculated power values.

Quick Tips:

- To adjust the graph display, press the Accept () button. Auto scaling, X and Y axis scaling and number display can be set here. Press the Cancel () button to go back to the graph.
- Press the Home button () button to go back to the Absolute Irradiance main menu to adjust the measurement conditions.
- From the Absolute Irradiance main menu, pressing the Cancel () button takes you to the Jaz main menu where Jaz settings can be changed (display rotation, network configurations, etc.).

Saving Data

At any time while the screen is displaying the graph, you can store data on the SD card using the Save () button. A file will be created with a filename based on your settings inside the config.txt file.

This file contains the following data:

- W: Wavelength [nm]
- S: Sample or Raw data measurement (in counts)
- D: Dark measurements data (in counts)
- P: Processed measurement data (in uW/cm^2/nm). You can use this in your post processing.
- Calibration data of your spectrometer

Your spectroscopy operating software can read this file to perform post-processing of the data. You can calculate power parameters such as lumen, lux, watt, watt/m, joules, PAR, etc. Also, you can derive color parameters such as CIE values, CRI values, x,y,z, etc.

Loading Jaz Data into SpectraSuite

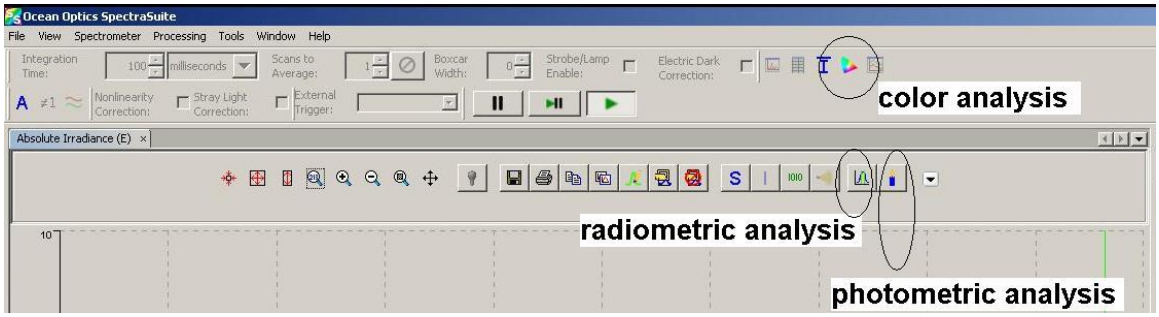
Color coordinates

Once you have collected your measurement data on the SD card, you can load this data into SpectraSuite for further processing. These files that you have stored on your SD card have the extension *.JAZZIRRAD.

► *Procedure*

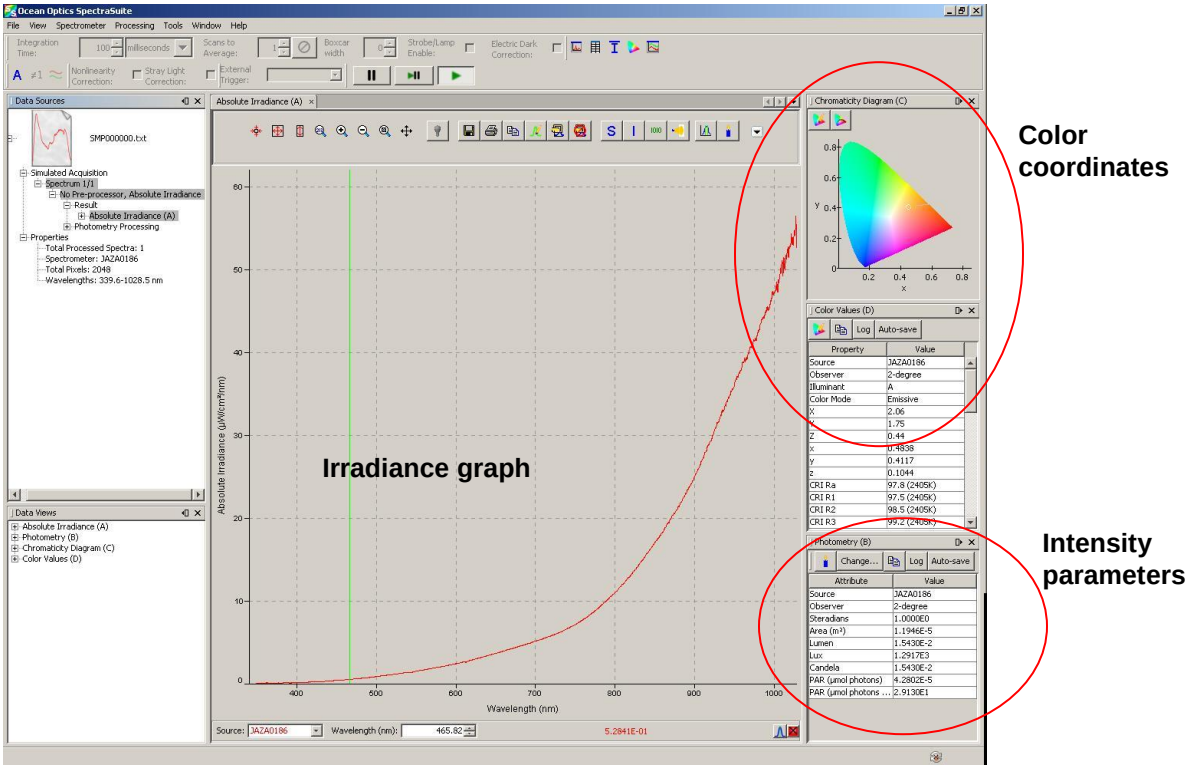
1. Navigate to **Processing | Absolute Irradiance | Load Jaz Absolute Irradiance Measurement**. Once the file is loaded, SpectraSuite automatically opens a graph of the Absolute Irradiance Measurement data. The data file appears in the **Data Sources** pane. From here, you can display the raw data or save to a different file format.
2. Once the graph is displayed, you can start a color analysis, radiometric analysis, or photometric analysis of the spectrum by selecting the appropriate icons as shown below:

Intensity parameters



3. After opening these analysis tools, you can view key parameters such as Lux, Lumen, PAR, Watts, CIE color coordinates, CRI values, etc. The figure below is an example of using both optical power processing and color analysis tools to analyze a tungsten halogen light source.

   For more information on the post processing capabilities of Spectrasuite, see the SpectraSuite Installation and Operation Manual (see *Product-Related Documentation*).



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