HR4000 and HR4000CG-UV-NIR Series Spectrometers
Installation and Operation Manual

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Table of Contents

About This Manual

Document Purpose and Intended Audience

This document provides the user of HR4000 Series Spectrometers (both HR4000 and HR4000CG-UV-NIR) with instructions for setting up, calibrating and performing experiments with their spectrometer.

What's New in this Document

This version of the *HR4000 and HR4000CG-UV-NIR Series High-Resolution Fiber Optic Spectrometers HR4000 / HR4000CG-UV-NIR Installation and Operation Manual* updates the specifications.

Document Summary

Chapter	Description
Chapter 1: *Introduction*	Contains descriptive information about the HR4000 Spectrometer and how sampling works. It also provides a list of system requirements, interface options, and shipment components.
Chapter 2: *Installing the HR4000*	Provides installation and configuration instructions.
Chapter 3: *Troubleshooting*	Contains recommended steps to isolate and correct common problems.
Appendix A: *Calibrating the Wavelength of the HR4000*	Provides instructions for calibrating the HR4000 Series Spectrometer.
Appendix B: *Specifications*	Contains technical specifications and connector pinouts for the HR4000 Series Spectrometer.
Appendix C: *HR4000CG-UV-NIR Spectrometer*	Contains features and specifications unique to the HR4000CG-UV-NIR Spectrometer.

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.

Document for…	Document Location
OceanView software	http://oceanoptics.com///wp-content/uploads/OceanViewIO.pdf
SpectraSuite software	http://oceanoptics.com///wp-content/uploads/SpectraSuite.pdf
HR-4 Breakout Box	http://oceanoptics.com///wp-content/uploads/HR-4-Breakout-Box.pdf
External triggering for firmware versions below 3.0	http://oceanoptics.com///wp-content/uploads/External-Triggering-Options.pdf
External triggering for firmware versions 3.0 and above	http://oceanoptics.com///wp-content/uploads/External-Triggering-Options_Firmware3.0andAbove.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.

WARNING

This is a Class A product. In a domestic environment this product may cause radio interference in which case the user may be required to take adequate measures.

ISO Certification

Ocean Optics, the industry leader in miniature photonics, has been certified for ISO 9001:2008 certification applicable to the design and manufacture of electro-optical equipment since 2009.

⚠ WARNING

This is a Class A product. In a domestic environment this product may cause radio interference in which case the user may be required to take adequate measures.

FCC COMPLIANCE

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which the user will be required to correct the interference at his own expense.

⚠ **WARNING: The authority to operate this equipment is conditioned by the requirement that no modifications will be made to the equipment unless the changes or modifications are expressly approved by the manufacturer.**

Chapter 1

Introduction

Product Overview

The HR4000 High-Resolution Miniature Fiber Optic Spectrometer provides optical resolution as good as 0.025 nm (FWHM). The HR4000 is responsive from 200-1100 nm, but the specific range and resolution depends on your grating and entrance slit selections.

The HR4000 is perfect for applications where high resolution is necessary, such as absorbance of gases or atomic emission lines (for solution chemistry or for color measurements, the USB4000 is more appropriate).

Data programmed into a memory chip on each HR4000 includes wavelength calibration coefficients, linearity coefficients, and the serial number unique to each spectrometer. Our spectrometer operating software simply reads these values from the spectrometer — a feature that enables hot swapping of spectrometers among computers.

The HR4000 Spectrometer connects to a notebook or desktop computer via USB port or serial port. When connected to the USB port of a computer, the HR4000 draws power from the host computer, eliminating the need for an external power supply. The HR4000, like all our USB devices, can be controlled by our OceanView software, a Java-based spectroscopy software platform that operates on Windows, Macintosh and Linux operating systems.

Ocean Optics HR4000 High-Resolution Fiber Optic Spectrometer

System Requirements

You can use the HR4000's USB connectivity with any computer that meets the following requirements:

- Microsoft Windows – Windows 2000/XP/7/10; 32-bit and 64-bit and Windows Vista (32-bit only)
- Apple Macintosh –version 10.5 Intel or later
- Linux – Any version released for an x86 or amd64 platform since 2010

Alternately, the HR4000 has serial port adaptability for connecting to PCs, PLCs, and other devices that support the RS-232 communication protocol. However, this connection method requires an external power supply to power the HR4000, the Breakout Box (HR4-BREAKOUT), and a serial cable.

EEPROM Utilization

An EEPROM memory chip in each HR4000 contains wavelength calibration coefficients, linearity coefficients, and a serial number unique to each individual spectrometer. The software application reads these values directly from the spectrometer, enabling the ability to "hot-swap" spectrometers between PCs without entering the spectrometer coefficients manually on each PC.

About OceanView Software

OceanView is the latest generation of operating software for all Ocean Optics spectrometers. It is a completely modular, Java-based spectroscopy software platform that operates on Windows, Macintosh and Linux operating systems. The software can control any Ocean Optics USB spectrometer and device.

OceanView is a user-customizable, advanced acquisition and display program that provides a real-time interface to a variety of signal-processing functions. With OceanView, you have the ability to perform spectroscopic measurements (such as absorbance, reflectance, and emission), control all system parameters, collect and display data in real time, and perform reference monitoring and time acquisition experiments. Consult the OceanView manual for hardware requirements when using OceanView (see *Product-Related* Documentation).

Sampling System Overview

How Sampling Works

Ocean Optics components function in a sampling system as follows:

1. The user stores reference and dark measurements to correct for instrument response variables.

2. The light from the light source transmits through an optical fiber to the sample.

3. The light interacts with the sample.

4. Another optical fiber collects and transmits the result of the interaction to the spectrometer.

5. The spectrometer measures the amount of light and transforms the data collected by the spectrometer into digital information.

6. The spectrometer passes the sample information to spectrometer operating software.

7. The software compares the sample to the reference measurement and displays processed spectral information.

Modular Sampling Accessories

Ocean Optics offers a complete line of spectroscopic accessories for use with the HR4000. Most of our spectroscopic accessories have SMA connectors for application flexibility. Accordingly, changing the sampling system components is as easy as unscrewing a connector and replacing an accessory.

Interface Options

The HR4000 has both USB and serial port connectors (with the use of an adapter), enabling you to connect the spectrometer to a desktop or notebook PC via a USB port. However, you must create custom software if using the serial port. OceanView software is available if you are connecting via the USB port.

Breakout Box

Ocean Optics also offers the Breakout Box (HR4-BREAKOUT), a passive module that separates the signals from their 30-pin port to an array of standard connectors and headers, enabling easy access to a variety of features found in Ocean Optics' HR4000 Spectrometer. In addition to the accessory connector, the breakout box features a circuit board based on a neutral breadboard pattern that allows custom circuitry to be prototyped on the board itself.

Note

The HR4000 Breakout Box is compatible with HR4000 Spectrometers with Revision B or greater. HR4000 Spectrometers with serial numbers beginning with HR4**A** are *not* compatible with the HR4000 Breakout Box.

Shipment Components

The following information and documentation ships with the HR4000 Spectrometer:

❑ **Packing List**

The packing list is inside a plastic bag attached to the outside of the shipment box (the invoice arrives separately). It lists all items in the order, including customized components in the spectrometer (such as the grating, detector collection lens, and slit). The packing list also includes the shipping and billing addresses, as well as any items on back order.

❑ **Wavelength Calibration Data Sheet**

Each spectrometer is shipped with a Wavelength Calibration Data Sheet that contains information unique to your spectrometer. OceanView reads this calibration data from your spectrometer when it interfaces to a computer via the USB port.

<div align="center">

Note

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Please save the Wavelength Calibration Data Sheet for future reference.

Other Accessories Available

Visit us at **www.OceanOptics.com** for a complete list of products available for all of your spectroscopy needs.

- ❑ **Fibers**
- ❑ **Light Sources**
- ❑ **Integrated Sampling Systems**
- ❑ **Cuvettes**
- ❑ **Filter Holders**
- ❑ **Lithium Ion Battery Pack**
- ❑ **HR4-BREAKOUT Breakout Box**

Chapter 2

Installing the HR4000

Overview

You must install the operating software application prior to connecting the HR4000 Spectrometer to the computer. The Ocean Optics spectrometer operating software installs the drivers required for the HR4000 spectrometer installation. If you do not install the software first, the system will not properly recognize the HR4000.

If you have already connected the HR4000 to the computer prior to installing the operating software, consult *Chapter 3: Troubleshooting* for information on correcting a corrupt HR4000 installation.

HR4000 Installation

This section contains instructions for connecting the HR4000 via both USB and serial modes.

USB Mode

Note

The USB port on a computer can power up to five HR4000 spectrometer channels. Systems with more than five channels require a powered USB hub.

► *Procedure*

Follow the steps below to connect the HR4000 to a computer via the USB port:

1. Install the spectrometer operating software on the destination computer.
2. Locate the USB cable (USB-CBL-1) provided with the HR4000.
3. Insert the square end of the cable into the side of the HR4000.
4. Insert the rectangular end of the cable into the USB port of the PC.

If you installed the spectrometer operating software prior to connecting the HR4000, the software installs the HR4000 drivers. If the drivers do not successfully install (or if you connected the HR4000 to the computer before installing the software), consult *Chapter 3: Troubleshooting*.

Once you install the software and hardware, and establish your sampling system, you are ready to take measurements.

Serial Port Mode

To use the serial port capacity of the HR4000 Spectrometer, the PC must be running a 32-bit version of the Windows operating system.

► **Procedure**

Follow the steps below to connect the HR4000 to the PC via serial port:

1. Connect the serial cable adapter block to the appropriate pins of the HR4000's 30-Pin Accessory Connector.

2. Connect one end of the 9-pin serial cable to the adapter block on the HR4000, and then connect the other end to a serial port on the PC.

3. Note the number of the serial port (COM Port) to which you connected the HR4000 (some PCs may not have numbered ports; handheld PCs typically have only one serial port).

4. Plug the 5 VDC external power supply into an outlet and connect it to the HR4000.

Connect Spectroscopic Accessories

To find operating instructions for HR2000+-compatible products (such as light sources, sampling chambers, and probes), consult the Ocean Optics website at http://oceanoptics.com/support/technical-documents/.

HR4000 Configuration

The HR4000 can be used with OceanView operating software when connected to the USB port.

If you have followed the previous steps and started OceanView, the spectrometer is already acquiring data. Even with no light in the spectrometer, there should be a dynamic trace displayed in the bottom of the graph. If you allow light into the spectrometer, the graph trace should rise with increasing light intensity. This means the software and hardware are correctly installed.

External Triggering Options

You can trigger the HR4000 using a variety of External Triggering options through the 30-pin Accessory Connector on the spectrometer. For HR4000 firmware versions below 3.0, see the External Triggering Options document located at http://oceanoptics.com///wp-content/uploads/External-Triggering-Options.pdf. For HR4000 firmware version 3.0 and above, see the External Triggering Options document located at http://oceanoptics.com///wp-content/uploads/External-Triggering-Options_Firmware3.0andAbove.pdf. The triggering document contains instructions for configuring External Triggering options for the HR4000.

Chapter 3

Troubleshooting

Overview

The following sections contain information on troubleshooting issues you may encounter when using the HR4000 Spectrometer.

HR4000 Connected to Computer Prior to Operating Software Installation

Windows Operating Systems

If you connected your Ocean Optics HR4000 device to the computer prior to installing your spectrometer operating software application, you may encounter installation issues that you must correct before your Ocean Optics device will operate properly.

Follow the applicable steps below to remove the incorrectly installed device, device driver, and installation files.

Note

If these procedures do not correct your device driver problem, you must obtain the *Correcting Device Driver Issues* document from the Ocean Optics website: http://oceanoptics.com///wp-content/uploads/Correcting-Device-Driver-Issues.pdf

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Remove the Unknown Device from Windows Device Manager

► *Procedure*

1. Open Windows Device Manager. Consult the Windows operating instructions for your computer for directions, if needed.
2. Locate the **Other Devices** option and expand the **Other Devices** selection by clicking on the "**+**" sign to the immediate left.

Note

Improperly installed USB devices can also appear under the Universal Serial Bus Controller option. Be sure to check this location if you cannot locate the unknown device.

3. Locate the unknown device (marked with a large question mark). Right-click on the **Unknown Device** listing and select the **Uninstall** or **Remove** option.

4. Click the **OK** button to continue. A warning box appears confirming the removal of the Unknown Device. Click the **OK** button to confirm the device removal.

5. Disconnect the HR4000 from your computer.

6. Locate the section in this chapter that is appropriate to your operating system and perform the steps in the following *Remove Improperly Installed Files* section.

Remove Improperly Installed Files

► *Procedure*

1. Open Windows Explorer.

2. Navigate to the **Windows | INF** directory.

Note

If the INF directory is not visible, you must disable the Hide System Files and Folders and Hide File Extensions for Known File Types options in Windows Folder Options. Access Windows Folder Options from Windows Explorer, under the **Tools | Folder Options** menu selection.

3. Delete the **OOI_USB.INF** in the INF directory. If your computer is running either the Windows 2000 or XP operating system, you must also delete the **OOI_USB.PNF** file in the INF directory.

4. Navigate to the **Windows | System32 | Drivers** directory.

5. Delete the **EZUSB.SYS** file.

6. Reinstall your Ocean Optics application and reboot the system when prompted.

7. Plug in the USB device.

The system is now able to locate and install the correct drivers for the USB device.

Mac Operating Systems

Since there are no device files for the HR4000 Spectrometer in a Mac operating system, you should not encounter any problems if you installed the spectrometer before the spectrometer operating software.

Linux Operating Systems

For Linux operating systems, all you need to do is install the spectrometer operating software, then unplug and replug in the spectrometer. Technically, the driver files for Linux simply give nonprivileged users permission to use newly connected hardware. There isn't any long-term harm to plugging in the device before installing the software.

Calibrating the Wavelength of the HR4000

Overview

This appendix describes how to calibrate the wavelength of your spectrometer. Though each spectrometer is calibrated before it leaves Ocean Optics, the wavelength for all spectrometers will drift slightly as a function of time and environmental conditions. Ocean Optics recommends periodically recalibrating the HR4000.

About Wavelength Calibration

You are going to be solving the following equation, which shows that the relationship between pixel number and wavelength is a third-order polynomial:

$$\lambda_p = I + C_1 p + C_2 p^2 + C_3 p^3$$

Where:

λ = the wavelength of pixel p

I = the wavelength of pixel 0

C_1 = the first coefficient (nm/pixel)

C_2 = the second coefficient (nm/pixel^2)

C_3 = the third coefficient (nm/pixel^3)

R_λ = the reference intensity at wavelength λ

You will be calculating the value for *I* and the three *C*s.

Calibrating the Spectrometer

Preparing for Calibration

To recalibrate the wavelength of your spectrometer, you need the following components:

- A light source capable of producing spectral lines

Note

Ocean Optics' HG-1 Mercury-Argon lamp is ideal for recalibration. If you do not have an HG-1, you need a light source that produces several (at least 4-6) spectral lines in the wavelength region of your spectrometer.

- An HR4000 spectrometer
- An optical fiber (for spectrometers without a built-in slit, a 50-μm fiber works best)
- A spreadsheet program (Excel or Quattro Pro, for example) or a calculator that performs third-order linear regressions

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Note

If you are using Microsoft Excel, choose **Tools | Add-Ins** and check **AnalysisToolPak** and **AnalysisTookPak-VBA**.

Calibrating the Wavelength of the Spectrometer

► *Procedure*

Perform the steps below to calibrate the wavelength of the spectrometer:

1. Place the operating software into Quick View (Scope) mode and take a spectrum of your light source. Adjust the integration time (or the A/D conversion frequency) until there are several peaks on the screen that are not off-scale.

2. Move the cursor to one of the peaks and position the cursor so that it is at the point of maximum intensity.

3. Record the pixel number that is displayed in the status bar or legend (located beneath the graph). Repeat this step for all of the peaks in your spectrum.

4. Use the spreadsheet program or calculator to create a table like the one shown in the following figure. In the first column, place the exact or true wavelength of the spectral lines that you used.

   In the second column of this worksheet, place the observed pixel number. In the third column, calculate the pixel number squared, and in the fourth column, calculate the pixel number cubed.

Independent Variable	Dependent Variables			Values Computed from the Regression Output	
True Wavelength (nm)	Pixel #	Pixel #^{2}	Pixel #^{3}	Predicted Wavelength	Difference
253.65	175	30625	5359375	253.56	0.09
296.73	296	87616	25934336	296.72	0.01
302.15	312	97344	30371328	302.40	-0.25
313.16	342	116964	40001688	313.02	0.13
334.15	402	161604	64964808	334.19	-0.05
365.02	490	240100	117649000	365.05	-0.04
404.66	604	364816	220348864	404.67	-0.01
407.78	613	375769	230346397	407.78	0.00
435.84	694	481636	334255384	435.65	0.19
546.07	1022	1044484	1067462648	546.13	-0.06
576.96	1116	1245456	1389928896	577.05	-0.09
579.07	1122	1258884	1412467848	579.01	0.06
696.54	1491	2223081	3314613771	696.70	-0.15
706.72	1523	2319529	3532642667	706.62	0.10
727.29	1590	2528100	4019679000	727.24	0.06
738.40	1627	2647129	4306878883	738.53	-0.13
751.47	1669	2785561	4649101309	751.27	0.19

5. Use the spreadsheet or calculator to calculate the wavelength calibration coefficients. In the spreadsheet program, find the functions to perform linear regressions.

   - If using Quattro Pro, look under **Tools | Advanced Math**
   - If using Excel, look under **Analysis ToolPak**

6. Select the true wavelength as the dependent variable (Y). Select the pixel number, pixel number squared, and the pixel number cubed as the independent variables (X). After executing the regression, you will obtain an output similar to the one shown below. Numbers of importance are noted.

Regression Statistics

Multiple R	0.999999831
R Square	0.999999663 ← R Squared
Adjusted R Square	0.999999607
Standard Error	0.125540214
Observations	22

Intercept

	Coefficients	Standard Error	
Intercept	190.473993	0.369047536	First coefficient
X Variable 1	0.36263983	0.001684745	
X Variable 2	-1.174416E-05	8.35279E-07	
X Variable 3	-2.523787E-09	2.656608E-10	Second coefficient

Third coefficient

7.   Record the Intercept, as well as the First, Second, and Third Coefficients. Additionally, look at the value for R squared. It should be very close to 1. If not, you have most likely assigned one of your wavelengths incorrectly.

Keep these values at hand.

Saving the New Calibration Coefficients: USB Mode

Ocean Optics programs wavelength calibration coefficients unique to each HR4000 onto an EEPROM memory chip in the HR4000.

You can overwrite old calibration coefficients on the EEPROM if you are using the HR4000 via the USB port. If you are using the HR4000 via the serial port, consult the *Error! Reference source not found.* section later in this appendix.

► *Procedure*

To save wavelength calibration coefficients using the USB mode, perform the following steps:

1.   Ensure that the HR4000 is connected to the PC and that you have closed all other applications.

2.   Point your browser to http://oceanoptics.com/support/software-downloads/ and scroll down to **Microcode**. Select **USB EEPROM Programmer** for your computer version.

3.   Save the setup file to your computer.

4.   Run the **Setup.exe** file to install the software. The **Welcome** screen appears.

5.   Click the **Next** button. The **Destination Location** screen appears.

6.   Accept the default installation location, or click the **Browse** button to specify a directory. Then, click the **Next** button. The **Program Manager Group** screen appears.

7.   Click the **Next** button. The **Start Installation** screen appears.

8.   Click the **Next** button to begin the installation. Once the installation finishes, the **Installation Complete** screen appears.

9.   Click the **Finish** button and reboot the computer when prompted.

10.   Navigate to the **USB EEPROM Programmer** from the Start menu and run the software.

11.   Click on the desired HR4000 device displayed in the left pane of the **USB Programmer** screen.

12.   Double-click on each of the calibration coefficients displayed in the right pane of the USB Programmer screen and enter the new values acquired in Steps 5 and 6 of the *Calibrating the Wavelength of the Spectrometer* section in this appendix.

13.   Repeat Step 12 for all of the new values.

14.   Click on the **Save All Values** button to save the information, and then **Exit** the USB Programmer software.

The new wavelength calibration coefficients are now loaded onto the EEPROM memory chip on the HR4000.

Appendix B

Specifications

Overview

This appendix contains information on spectrometer operation, specifications, and system compatibility. It also includes accessory connector pinout diagrams and pin-specific information.

How the HR4000 Works

Below is a diagram of how light moves through the optical bench of an HR4000 Spectrometer. The optical bench has no moving parts that can wear or break; all the components are fixed in place at the time of manufacture. Items with an asterisk (*) are user-specified.
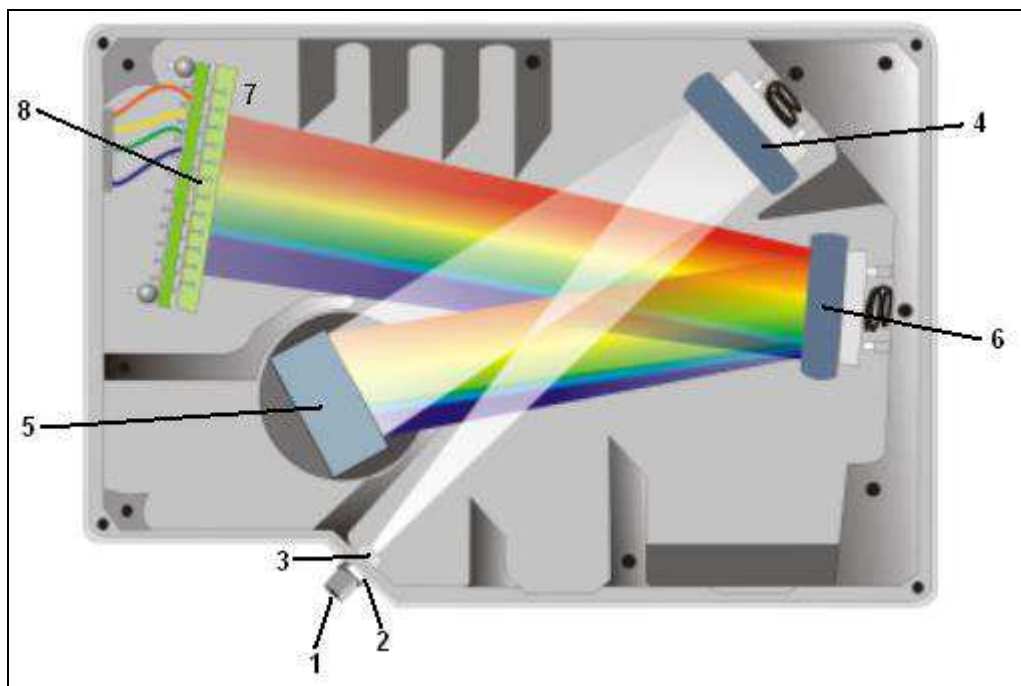
HR4000 Spectrometer with Components

See *HR4000 Components Table* on the following page for an explanation of the function of each numbered component in the HR4000 Spectrometer in this diagram.

HR4000 Components Table

Ocean Optics permanently secures all components in the HR4000 at the time of manufacture. Only Ocean Optics technicians can replace interchangeable components, where noted.

Item	Name	Description
1	SMA Connector	Secures the input fiber to the spectrometer. Light from the input fiber enters the optical bench through this connector.
2	Slit	A dark piece of material containing a rectangular aperture, which is mounted directly behind the SMA Connector. The size of the aperture regulates the amount of light that enters the optical bench and controls spectral resolution. You can also use the HR4000 without a Slit. In this configuration, the diameter of the fiber connected to the HR4000 determines the size of the entrance aperture. Only Ocean Optics technicians can change the Slit.
3	Filter	Restricts optical radiation to pre-determined wavelength regions. Light passes through the Filter before entering the optical bench. Both bandpass and longpass filters are available to restrict radiation to certain wavelength regions. Only Ocean Optics technicians can change the Filter.
4	Collimating Mirror	Focuses light entering the optical bench towards the Grating of the spectrometer. Light enters the spectrometer, passes through the SMA Connector, Slit, and Filter, and then reflects off the Collimating Mirror onto the Grating.
5	Grating	Diffracts light from the Collimating Mirror and directs the diffracted light onto the Focusing Mirror. Gratings are available in different groove densities, allowing you to specify wavelength coverage and resolution in the spectrometer. Only Ocean Optics technicians can change the Grating.
6	Focusing Mirror	Receives light reflected from the Grating and focuses the light onto the CCD Detector or L2 Detector Collection Lens (depending on the spectrometer configuration).
7	L2 Detector Collection Lens	An optional component that attaches to the CCD Detector. It focuses light from a tall slit onto the shorter CCD Detector elements. The L2 Detector Collection Lens should be used with large diameter slits or in applications with low light levels. It also improves efficiency by reducing the effects of stray light. Only Ocean Optics technicians can add or remove the L2 Detection Collection Lens.
8	CCD Detector (UV or VIS)	Collects the light received from the Focusing Mirror or L2 Detector Collection Lens and converts the optical signal to a digital signal. Each pixel on the CCD Detector responds to the wavelength of light that strikes it, creating a digital response. The spectrometer then transmits the digital signal to the spectrometer operating software application.

HR4000 Specifications

The following sections provide specification information for the CCD detector in the HR4000, as well as the HR4000 Spectrometer itself. HR4000CG-UV-NIR specifications are listed in *Appendix C: HR4000CG-UV-NIR Spectrometer*.

CCD Detector Specifications

Specification	Value
Detector	Toshiba TCD1304AP linear CCD array
No. of elements	3648 pixels
Sensitivity	100 photons per count at 800 nm
Pixel size	8 µm x 200 µm
Pixel well depth	-100,000 electrons
Signal-to-noise ratio	300:1 (at full signal)
A/D resolution	14 bit
Dark noise	8 RMS counts
Corrected linearity	>99.8%
Maximum pixel rate	Rate at which pixels are digitized is 1 MHz

HR4000 Spectrometer

Specification	Value
Dimensions	148.6 mm x 104.8 mm x 45.1 mm
Weight	570 g
Power consumption	450 mA @ 5 VDC
Detector	3648-element linear silicon CCD array
Detector range	200-1100 nm
Gratings	14 gratings available
Entrance aperture	5, 10, 25, 50, 100 or 200 µm wide slits

Specification	Value
Order-sorting filters	Installed longpass and bandpass filters
Focal length	f/4, 101 mm
Optical resolution	Depends on grating and size of entrance aperture
Dynamic range	2×10^9 (system); 2000:1 for a single acquisition
Fiber optic connector	SMA 905 to single-strand optical fiber (0.22 NA)
Data transfer rate	Full scans into memory every 4 milliseconds with USB 2.0 port, every 600 milliseconds with the serial port
Integration time	3.8 ms to 10 seconds
Interfaces	USB 2.0, 480 Mbps (USB 1.1 compatible); RS-232 (2-wire); SPI (3-wire); I^2C Inter-Integrated Circuit 2-wire serial bus

Operating systems:
  USB Port
  Serial Port
	
	Windows 7/Vista/XP, Mac OS X, and Linux
	Any 32-bit Windows operating system

Onboard GPIO	10 user-programmable digital I/Os
Analog channels	One 13-bit analog input and one 9-bit analog output

System Compatibility

The following sections provide information on hardware and software requirements for the HR4000.

Compatibility for Desktop or Notebook PCs

To use the HR4000, you must have a PC that meets the following minimum requirements:

- Microsoft Windows: Windows 2000/XP/7; 32-bit and 64-bit and Windows Vista (32-bit only)
- Apple Macintosh: OS X version 10.0 or later
- Linux: Any version released for an x86 or amd64 platform since 2010
- Computer interfaces: USB 2.0 @ 480 Mbps; RS-232 (2-wire) @ 115.2 K baud
- Peripheral interfaces: I^2C inter-integrated circuit

30-Pin Accessory Connector Pinout

The HR4000 features a 30-pin Accessory Connector, located on the side of the unit as shown:
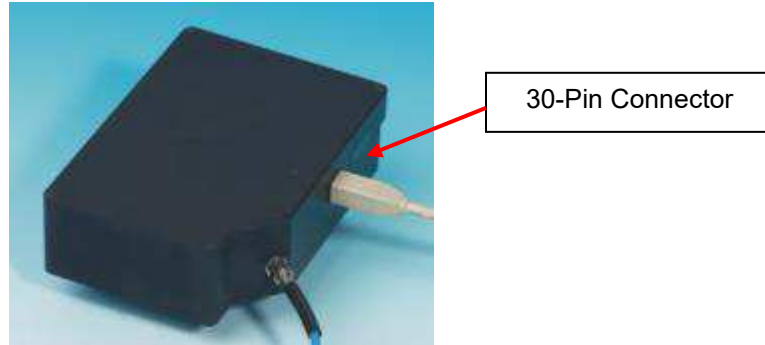
30-Pin Connector

Location of HR4000 30-Pin Accessory Connector

30-Pin Accessory Connector Pinout Diagram

When facing the 30-pin Accessory Connector on the front of the vertical wall of the HR4000, pin numbering is as follows:

USB Port		2	4	6	8	10	12	14	16	18	20	22	24	26	28	30
		1	3	5	7	9	11	13	15	17	19	21	23	25	27	29
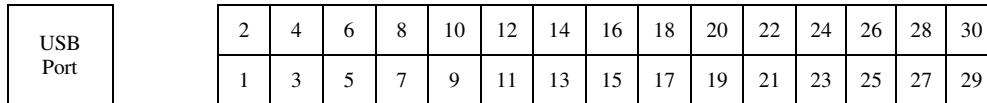
30-Pin Accessory Connector Pinout Diagram

30-Pin Accessory Connector – Pin Definitions and Descriptions

The following table contains information regarding the function of each pin in the HR4000's 30-Pin Accessory Connector:

Pin #	Function	Input/Output	Description
1	RS232 Rx	Input	RS232 receive signal – Communicates with a PC over DB9 Pin 3
2	RS232 Tx	Output	RS232 transmit signal – Communicates with a PC over DB9 Pin 2
3	GPIO (2)	Input/Output	General purpose software-programmable, digital input/output (channel number)
4	V5_SW	Output	Regulated 5 Volt power pin – Supplies 50 mA (maximum)
5	Ground	Input/Output	Ground

Pin #	Function	Input/Output	Description
6	I^{2}C SCL	Input/Output	I^{2}C clock signal for communication to other I^{2}C peripherals
7	GPIO (0)	Input/Output	General purpose software-programmable, digital input/output (channel number)
8	I^{2}C SDA	Input/Output	I^{2}C data signal for communication to other I^{2}C peripherals
9	GPIO (1)	Input/Output	General purpose software-programmable, digital input/output (channel number)
10	Ext. Trigger In	Input	TTL input trigger signal – See External Triggering Options document for info.
11	GPIO (3)	Input/Output	General purpose software-programmable, digital input/output (channel number)
12	V$_{CC}$, V$_{USB}$, or 5V$_{IN}$	Input or Output	Input power pin for HR4000 – When operating via USB, this pin can power other peripherals – Ensure that peripherals comply with USB specifications
13	SPI Data Out	Output	SPI Master Out Slave In (MOSI) signal for communication to other SPI peripherals
14	V$_{CC}$, V$_{USB}$, or 5V$_{IN}$	Input or Output	Input power pin for HR4000 – When operating via USB, this pin can power other peripherals – Ensure that peripherals comply with USB specifications
15	SPI Data In	Input	SPI Master In Slave Out (MISO) signal for communication to other SPI peripherals
16	GPIO (4)	Input /Output	General purpose software-programmable, digital input/output (channel number)
17	Single Strobe	Output	TTL output pulse used as a strobe signal – Has a programmable delay relative to the beginning of the spectrometer integration period
18	GPIO (5)	Input/Output	General purpose software-programmable, digital input/output (channel number)
19	SPI Clock	Output	SPI clock signal for communication to other SPI peripherals
20	Continuous Strobe	Output	TTL output signal used to pulse a strobe – Divided down from the master clock signal
21	SPI Chip Select	Output	SPI Chip/Device Select signal for communication to other SPI peripherals
22	GPIO (6)	Input/Output	General purpose software-programmable, digital input/output (channel number)

Pin #	Function	Input/Output	Description
23	Analog In (0-5V)	Input	13-bit analog-to-digital input with a 0-5V range
24	Analog Out (0-5V)	Output	9-bit programmable output voltage with a 0-5V range
25	Lamp Enable	Output	TTL signal driven Active HIGH when the Lamp Enable command is sent to the spectrometer
26	GPIO (7)	Input/Output	General purpose software-programmable, digital input/output (channel number)
27	Ground	Input/Output	Ground
28	GPIO (8)	Input/Output	General purpose software-programmable, digital input/output (channel number)
29	Ground	Input/Output	Ground
30	GPIO (9)	Input/Output	General purpose software-programmable, digital input/output (channel number)

30-Pin J2 Accessory Connector - Part Numbers

The part numbers for the 30-pin accessory connector on the HR4000 Spectrometer are as follows:

- The connector is Pak50™ model from 3M Corp. Headed Connector – Part Number **P50–030P1–RR1–TG**.
- The mating connector is Part Number **P50–030S–TGF**.
- Mating the two components requires two 1.27 mm (50 mil) flat ribbon cables (3M 3365 Series is recommended).

If you are customizing your HR4000 Spectrometer system or configuring External Triggering, you may need these part numbers to complete your setup.

HR4000 15-Pin Accessory Cable Pinout

Pin #	Description	Pin #	Description
1	Single_strobe	9	GPIO-9
2	ContStrobe	10	GND_SIGNAL
3	V5_SW	11	SDA
4	ExtTrigIn	12	SCL
5	ExtTrigIn	13	LampEnable
6	GPIO-8	14	A_IN
7	A_OUT	15	GPIO-7
8	ExtTrigIn		

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Appendix C

</div>

HR4000CG-UV-NIR Spectrometer

The HR4000CG-UV-NIR Composite Grating Spectrometer has a new proprietary grating and order-sorting filter to provide a 200-1100 nm wavelength range with 0.5 nm optical resolution in one spectrometer.

The HR4000-CG-UV-NIR is functionally similar to the standard HR4000 Spectrometer. Follow the instructions in *Chapter 2*: *Installing the HR4000* to configure the HR4000CG-UV-NIR.

HR4000CG-UV-NIR Features

The HR4000CG-UV-NIR contains the following features that differ from the standard HR4000:

New HC-1 Landis Composite Grating

The HR4000CG-UV-NIR uses the new HC-1 Landis grating designed to provide a 200-1100 nm wavelength range. The HC-1 is fixed in place at the time of manufacture.

Variable Order-Sorting Filter

The HR4000CG-UV-NIR contains a new OFLV-200-1000 variable order sorting filter to eliminate second and third order effects.

HR4000CG-UV-NIR Spectrometer Specifications

Specification	Value
Dimensions:	148.6 mm x 104.8 mm x 45.1 mm
Weight	570 g
Power consumption	450 mA @ 5 VDC
Detector	3648-element linear silicon CCD array
Wavelength range	200-1100 nm
Optical resolution	0.75 nm FWHM

Specification	Value
Gratings	HC-1, 300 lines per nm grating
Entrance aperture	5 μm-wide slit
Order-sorting filters	OFLV-200-1100 installed
Focal length	f/4, 101 mm
Dynamic range	2 X 10^9 (system); 2000:1 for a single acquisition
Fiber optic connector	SMA 905 to single-strand optical fiber (0.22 NA)
Data transfer rate	Full scans into memory every 4 milliseconds with the USB 2.0, every 18 ms with the USB 1.1, every 600 milliseconds with the serial port
Integration time	Continuous – 4 milliseconds to 20 seconds Shutter – 10 microseconds to 4 milliseconds
Onboard GPIO	10 user-programmable digital I/Os
Analog channels	One 13-bit analog input and one 9-bit analog output

Index

Numbers

15-pin accessory cable
    pinouts, 23
30-pin accessory connector
    diagram, 20
    part numbers, 22
    pin definitions, 20

A

accessories, 4, 6
Accessories, 3
accessory connector
    pinout, 20

B

breakout box, 3

C

Calibrating, iii, 11
calibration, 11
    preparing for, 12
    procedure, 12
calibration coefficients
    saving in USB mode, 14
CCD, 18
CCD Detector, 17
collimating mirror, 17
compatibility, 19
    Desktop or Notebook PCs, 19
Components Table, 17

D

detector, 18
Detector Collection Lens, 17
document
    audience, iii

purpose, iii
summary, iii

E

EEPROM, 2
External Triggering, 6

F

filter, 17, 25
focusing mirror, 17

G

grating, 17

H

HC-1 Landis Composite Grating, 25
HR4000
    specifications, 18
HR4000CG-UV-NIR, 25
    features, 25
HR4000CG-UV-NIR Spectrometer
    specifications, 25

I

Installation, 5
    Serial Port mode, 6
    USB mode, 5
installed filter, 17
Interface, 3
ISO certification, v

L

L2 Detector Collection Lens, 17
Lens, 17

M

memory chip, 2
mirror, 17

O

OceanView, 2
Options
   Interface, 3

P

packing list, 3
power supply (external), 2
product-related documentation, iii

S

Sampling
   Accessories, 3
   System, 2
Serial Port mode, 6
setup, 5
shipment components, 3
slit, 17
SMA Connector, 17
specifications, 16
   detector, 18
   HR4000, 18
   HR4000CG-UV-NIR Spectrometer, 25
spectroscopic accessories, 6
System Requirements, 2

T

Triggering, 6
troubleshooting
   Linux systems, 9
   Mac systems, 8
Troubleshooting, 7

U

upgrades, iv
USB mode, 5

W

warranty, iv
Wavelength Calibration
   about, 11
Wavelength Calibration Data File, 3
Wavelength Calibration Data Sheet, 3
what's new, iii

OceanView
Installation and Operation Manual

For Products: OceanView

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Table of Contents

About This Manual

Document Purpose and Intended Audience

This document provides you with an installation and configuration instructions to get your system up and running.

What's New in this Document

This version of the *OceanView Spectrometer Operating Software Installation and Operation Manual* updates the Open Project procedure for Version 1.5.2.

Document Summary

Chapter	Description
Chapter 1: *Introduction*	Provides an overview of the OceanView operating software.
Chapter 2: *Installation*	Contains instructions for installing and configuring the OceanView software.
Chapter 3: *User Interface*	Describes how to operate OceanView with the user interface provided. Descriptions include views possible, and the controls and menus available.
Chapter 4: *Wizards*	Provides procedures for using the OceanView wizards to capture your measurement data.
Chapter 5: *Schematic View*	Contains instructions for using the OceanView schematic view. A full description for each of the schematic view icons is provided.

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.

Document for…	Document Location
OceanView software	http://oceanoptics.com///wp-content/uploads/OceanViewIO.pdf
ADC1000-USB	http://oceanoptics.com/support/technical-documents/adc1000-usb-operating-instructions/

Document for…	Document Location
Apex	http://oceanoptics.com///wp-content/uploads/Apex.pdf
External triggering	http://oceanoptics.com///wp-content/uploads/External-Triggering-Options_Firmware3.0andAbove.pdf
Flame	http://oceanoptics.com/wp-content/uploads/flame.pdf
Flame-NIR	http://oceanoptics.com/wp-content/uploads/FlameNIR.pdf
HR2000 and HR2000CG-UV-NIR	http://oceanoptics.com/wp-content/uploads/hr2000.pdf
HR2000+	http://oceanoptics.com/wp-content/uploads/hr2000-.pdf
HR4000 and HR4000CG-UV-NIR	http://oceanoptics.com///wp-content/uploads/hr4000.pdf
IDRaman micro	http://oceanoptics.com/wp-content/uploads/IDRaman-micro.pdf
IDRaman mini	http://oceanoptics.com///wp-content/uploads/IDRamanmini.pdf
IDRaman mini 2.0	http://oceanoptics.com/wp-content/uploads/IDRamanmini2manual.pdf
IDRaman reader	http://oceanoptics.com/wp-content/uploads/IDRaman-reader-Installation-and-Operation-Manual.pdf
Jaz	http://oceanoptics.com///wp-content/uploads/Jazinstallationandoperation.pdf
Maya2000 Series	http://oceanoptics.com///wp-content/uploads/Maya.pdf
MayaLSL	http://oceanoptics.com///wp-content/uploads/MayaLSL.pdf
NIR Series	http://oceanoptics.com/wp-content/uploads/nir.pdf
NIRQuest Series	http://oceanoptics.com///wp-content/uploads/nirquest.pdf
OOINLCorrect	http://oceanoptics.com/support/technical-documents/ooinlcorrect-linearity-coeff-proc/
QE65000	http://oceanoptics.com/wp-content/uploads/QE65000.pdf
QE65Pro	http://oceanoptics.com///wp-content/uploads/QE65Pro.pdf
QE *Pro*	http://oceanoptics.com///wp-content/uploads/QEPro.pdf
Red Tide	http://oceanoptics.com///wp-content/uploads/USB-650-Red-Tide-Installation-and-Operation-Instructions.pdf
STS	http://oceanoptics.com///wp-content/uploads/STS-Install.pdf

Document for…	Document Location
USB2000	http://oceanoptics.com/wp-content/uploads/USB2000-Operating-Instructions.pdf
USB2000+	http://oceanoptics.com/wp-content/uploads/USB2000-Operating-Instructions1.pdf
USB4000	http://oceanoptics.com/support/technical-documents/
Ventana	http://oceanoptics.com///wp-content/uploads/Ventana.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/**.

Chapter 1

Introduction

Product Overview

Ocean Optics has taken Java-based spectroscopy software to the next level with OceanView. This next logical step in the evolution of spectrometer software provides good stability, persistence of user settings, a broad scope of device features, and consistent file saving and loading procedures.

OceanView operates on 32- and 64-bit Windows, Macintosh and Linux operating systems. The software can control any Ocean Optics USB spectrometer.

For the latest release notes, see OceanView on our [Software Downloads](#) page.

USB Spectrometer and Device Control

OceanView easily manages multiple USB communication spectrometers – each with different acquisition parameters – in multiple windows, and provides graphical and numeric representation of spectra from each spectrometer. Using OceanView, you can combine data from multiple sources for applications that include upwelling/downwelling measurements, dual-beam referencing and process monitoring.

OceanView can be used with the following Ocean Optics spectrometers when they are interfacing to a computer through their USB port:

- Apex 785 Raman Spectrometer
- Flame -S and Flame-T Spectrometers
- HR2000 High-resolution Spectrometer
- HR2000+High-resolution Spectrometer
- HR4000 High-resolution Spectrometer
- Jaz System
- Maya 2000 and Maya2000-Pro Spectrometers
- Maya LSL Spectrometer
- NIR-512 Near-IR Spectrometer
- NIR256-2.1 and NIR256-2.5 Near-IR Spectrometers
- NIRQuest512-1.7, NIRQuest512-1.9, 512-2.2 and 512-2.5 Near-IR Spectrometers
- NIRQuest256-2.1 and 256-2.5 Near-IR Spectrometers

- QE65000 Scientific-grade Spectrometer

- QE65 Pro Scientific-grade Spectrometer

- QE *Pro* Spectrometer

- STS Micro Spectrometers

- Torus Spectrometer

- USB650 Spectrometer

- USB2000 Spectrometer

- USB2000+ Spectrometer

- USB2000-FLG Spectrometer

- USB4000 Spectrometer

- Ventana High Sensitivity Spectrometers

OceanView also supports the following USB devices:

- ADC1000-USB A/D Converter

- Flame Direct Attach UV-VIS Integrated Sampling System

- Flame Direct Attach VIS-NIR Integrated Sampling System

- IDRaman micro

- IDRaman mini

- IDRaman mini 2.0

- IDRaman reader

- ISS-UV-VIS

- USB-AOUT Analog Output Module

Features

- Customizable user-interface that allows you to choose what data you want to display and which items to display on the toolbars and menus.

- Persistence of user settings including:

    - File locations
    - Acquisition parameters
    - Menu settings (hiding/showing of menu items)
    - Graph view customization

- Capability of manually saving project settings (source, processing type, acquisition parameters, data view customization) and reloading them again later.

- Ability to perform specialized calculations on spectral and other measurement data, including:

    - Derivatives and integrals of spectral data

- Spectral arithmetic
- Ratiometric on the same spectrum or between 2 different spectra
- Interpolation, subsetting and concatenation of a spectrum

- Support of the following experiments/processing modes:

  - Quick View (formerly Scope Mode)
  - Quick View Minus Background
  - Absorbance
  - Reflection
  - Fluorescence
  - Transmission
  - Raman
  - Quick View Fluorescence
  - Relative Irradiance
  - Absolute Irradiance
  - Color
  - Photometry
  - Concentration
  - Energy, Power, Photons
  - Strip Charts
  - Spectral Math/Arithmetic
  - Spectral Splicing
  - Color
  - Photometry
  - Peak metrics

- Schematic view for processing spectral data on the fly and for customizing your experiment (data acquisition)

Spectroscopic Functions

OceanView allows you to perform the three basic spectroscopic experiments – absorbance, reflectance and emission, as well as absolute irradiance and Raman. Signal-processing functions such as electrical dark-signal correction, boxcar pixel smoothing and signal averaging are also included. Scope mode, the spectrometer operating mode in which raw data (signal) is acquired by the detector, allows you to establish these signal-conditioning parameters. The basic concept for the software is that real-time display of data allows users to evaluate the effectiveness of their experimental setups and data processing selections, make changes to these parameters, instantly see the effects and save the data. Most spectrometer-system operating software does not allow such signal-conditioning flexibility.

With OceanView, you can perform time-acquisition experiments for kinetics applications. As part of the time-acquisition function (strip charts), you can monitor and report single wavelengths, and you can average between wavelengths and find the integral between two wavelengths. In addition, you can perform reference monitoring in a variety of ways: single wavelength (1 or 2 channels), integrated intensity (starting and ending wavelengths for 1 or 2 channels) and wavelength-by-wavelength (2 channels).

OceanView gives you complete control of setting the parameters for all system functions such as acquiring data, designing the graph display, and using spectra overlays. OceanView has the benefit of providing various software-controlled triggering options for external events such as laser firing or light source pulsing.

Other advanced features give you several data-collection options. You can independently store and retrieve dark, reference, sample and processed spectra. All data can be saved to disk using autoincremented filenames. You can save data as ASCII files. One feature prints the spectra and another copies spectral data into other software such as Excel and Word.

Getting Updates

OceanView software features one year of free web-based, automatic upgrades when you buy the software. OceanView alerts you when updates are available with a pop-up in the lower right corner of your screen. You can also get updates using the menu item **Help | Check for Updates**.
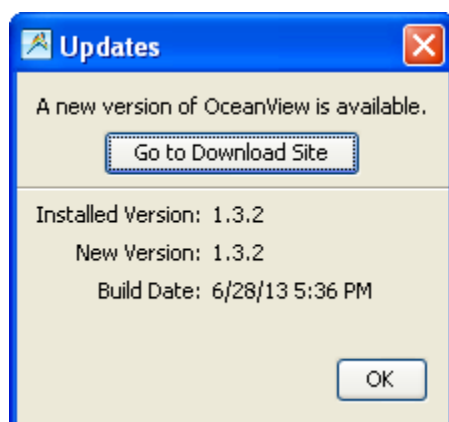
Installation

Overview

The following sections will guide you in installing OceanView on a Windows, Macintosh or Linux operating system.

Caution

Do NOT connect the spectrometer to the computer until you install the OceanView software. Follow the instructions below to properly connect and configure your system.

OceanView Minimum System Requirements

Monitor resolution:	1024 X 768 or higher
RAM:	1.5 GB or higher
Processor:	Intel Core II Duo @ 1.4 GHz or better
	Intel Core Duo @ 2.0 GHz or better
	AMD Athlon Neo X2 @ 1.6 GHz or better
	Intel Atom @ 2.13 GHz or better
	AMD Athlon 64 x2 @ 1.7 GHz or better
HD Space:	300 MB free space

Note

Most processors produced in 2010 and later should work well with OceanView. OceanView does not run on tablets with ARM processors.

Installation

Download OceanView from the link you received in your e-mail. If you have purchased a CD, download the file appropriate for your computer system from the CD.

Installation instructions are included below for installing OceanView on each of the following operating systems:

- Microsoft Windows – XP, Vista, 7, 8, 8.1, 10; 32-bit and 64-bit

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Note

</div>

Do not install OceanView on a Windows 32-bit computer that is currently running SpectraSuite or OmniDriver (and using EZUSB).

- Apple Macintosh – OSX 10.5 or higher on Intel processor
- Linux – Any version released for an x86 or amd64 platform since 2010

    Example: CentOS(Version 5.5), and Ubuntu (version 10.4LTS)

Installing on a Windows Platform

Total download is approximately 64 MB (32-bit) or 71 MB (64-bit).

► *Procedure*

1. Close all other applications running on the computer.

2. Start Internet Explorer.

3. Navigate to the link you received to the OceanView software in your email and click on the OceanView software appropriate for your Windows operating system.

4. Save the software to the desired location. The default installation directory is **\Program Files\Ocean Optics\OceanView**.

5. The installer wizard guides you through the installation process. The OceanView icon location is **Start | Programs | Ocean Optics | OceanView | OceanView** and the current user's desktop.

Device Driver Issues

Hardware device driver installation is seamless on Microsoft Windows operating systems when you connect your spectrometer to your computer. However, some Windows systems can require a bit more care when connecting your spectrometer for the first time.

If your spectrometer is not recognized by OceanView running on your computer, you need to manually install the spectrometer drivers using the procedure below.

Windows Driver Manual Installation Process

Use the following procedure when connecting your spectrometer to a Windows system. Steps may vary slightly depending on the version of Windows.

► *Procedure*

1. Open the Control Panel and click **Device Manager**.

2. Under **Other devices**, right-click on the Ocean Optics spectrometer and choose update driver software. The following screen appears:
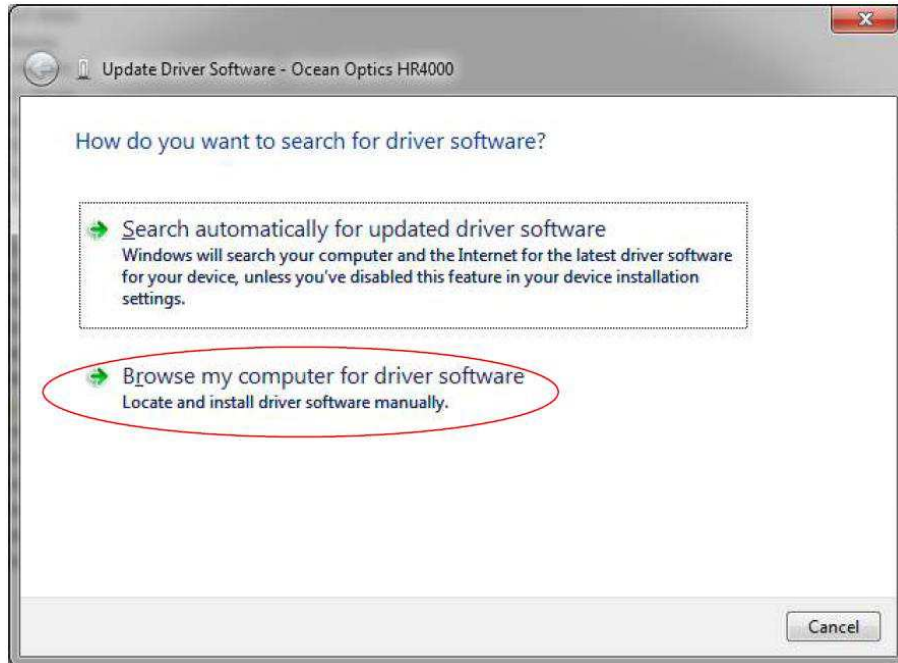
3. Choose **Browse my computer for driver software**.

4. Navigate to C:\Program Files\Ocean Optics\OceanView\SystemFiles and click **OK**. Then click **Next**.

5. When the following pop-up screen appears, choose **Install this driver software anyway**.
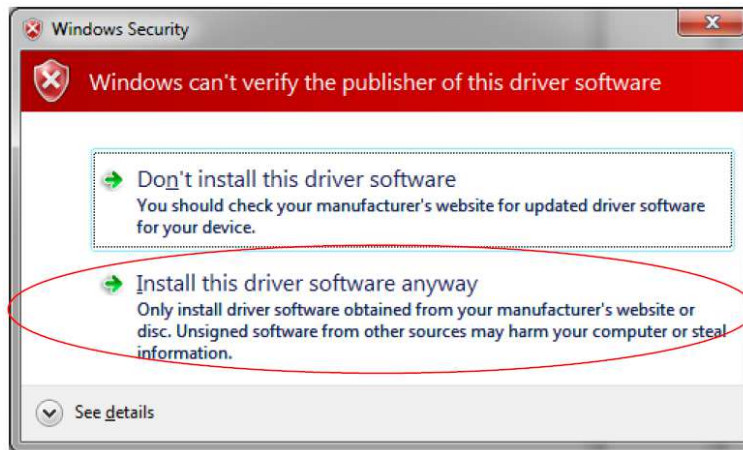
6. When the driver installation is successful, the software will recognize your spectrometer.

Installing on a Macintosh Platform

You must be logged on as an administrative user to install OceanView on your Mac. Total download is approximately 35 MB.

Note

Newer versions of MacOSX do not ship with Java so you may need to manually install a recent Java release before installing OceanView. Instructions to download a recent Java release for different versions of OSX can be found at: http://support.apple.com/kb/HT5648

There is also a direct link for the Java for OSX 10.7.3 and newer at: http://www.java.com/en/download/manual.jsp#mac

► *Procedure*

1. Navigate to the link you received to the OceanView software and download the installer (OceanViewSetup_Mac.dmg).

2. Double-click the OceanViewSetup_Mac.dmg file to mount the disk image. A new OceanView icon resembling a disk drive appears on your desktop. The new icon should open automatically (if it doesn't, double-click it).

3. Drag the OceanView.app icon to the Applications folder icon to install. OceanView can then be launched from the Applications folder. If desired, double-click the Applications folder and drag the OceanView icon from Applications to the Dock to be able to launch it more conveniently.

4. When the installation is complete, drag the OceanView drive icon to the trash can.

Installing on a Linux Platform

Total download is approximately 75 MB (32-bit) or 67 MB (64-bit).

► *Procedure*

1. Navigate to the link you received to the OceanView software in your email and download the appropriate Linux OceanView installer.

Note

The example below is for a 64 bit installer downloaded to the desktop. Change 64 to 32 and the file location as needed for your installation.

2. Start a terminal window and enter the following commands:

   chmod 755 ~/Desktop/OceanViewSetup_Linux64.bin
   gksudo ~/Desktop/OceanViewSetup_Linux64.bin

   You are prompted for your password, which allows you to execute the setup as root. Contact your system administrator if you do not have the password. If the gksudo command does not work (it may not be set up for your user account), then enter the following:

   su
   (enter password for root)
   ~/Desktop/OceanViewSetup_Linux64.bin

The Linux version of OceanView requires some libraries that may not be installed by default, depending on the Linux distribution. The following are libraries are required and are not provided as part of OceanView:

- libstdc++ version 6 or newer
- libXp version 6 or newer
- libusb version 0.1.10 or newer (should be provided in a libusb package or can be downloaded from http://libusb.sourceforge.net/download.html#stable)

3. It may be necessary to modify SELinux (Security Enhanced Linux) restrictions before OceanView will run. It is possible to remove SELinux auditing by running 'setenforce Permissive' as root or by customizing your SELinux policies. The OceanView installer does not modify system security settings.

Note

The default installation directory is /usr/local/OceanOptics/OceanView.

A symbolic link is put in /usr/bin so that you can enter OceanView on any command line to start the program.

The OceanView icon location varies by installation, but will be under either Applications or Other under the Application Launcher menu.

Retrieving from a CD

If you purchased a CD for OceanView, use this procedure to retrieve the installation files.

► *Procedure*

1. Insert the CD that you received containing your OceanView software into your computer.

2. Select the OceanView software for your computer's operating platform via the CD interface. Then follow the prompts in the installation wizard.

--OR--

Browse to the appropriate OceanView set-up file for your computer and double-click it to start the software installation. Set-up files are as follows:

- Windows 32-bit: OceanViewSetup_Windows32.exe
- Windows 64-bit: OceanViewSetup_Windows64.exe
- Mac: OceanViewSetup_Mac.dmg
- Linux 32-bit: OceanViewSetup_Linux32.bin
- Linux 64-bit: OceanViewSetup_Linux64.bin

Product Activation

Licensing

You can activate your OceanView software conveniently online by selecting **Help --> Licensing** and entering the product key in the **OceanView Licensing** dialog box that you received when you purchased the software when you first install the software.

If you do not have an Internet connection, click **Offline Registration** to display the Product Activation wizard. Using this wizard, you can then save an activation request file and send it to Ocean Optics via an Internet-connected device. Ocean Optics will then reply with your Activation Request file that you must apply using Step 3 of the Product Activation wizard.

The **OceanView Licensing** dialog box also allows you to deactivate your software license.

Starting Your 10 Day Free Trial

If you have downloaded OceanView with the 10-day free trial, you will have access to full functionality when you activate your license. All data and projects saved during your 10 day free trial will be available when the software is activated using a valid product key. Contact info@oceanoptics.com to purchase OceanView licenses.

► *Procedure*

1. Double-click the OceanView icon on your Desktop to start the software.
2. Click the **Cancel** button in the OceanView Product Activation dialog box that opens to start your 10 day free trial with a fully functional version of OceanView.

Using Your Product Key to Activate Your Software

Note

An Internet connection is required to activate your software using a valid product key. If an Internet connection is not available, contact info@oceanoptics.com for the offline activation procedure.

► *Procedure*

1. Double-click the OceanView icon ( ) on your Desktop to start the software.
2. Click **Next** in the OceanView Product Activation dialog box to enter your product key.
3. Copy the product key from the email you received and paste it into the product key box.
4. Click the **Register Software** button to validate your product key.
5. Click **Finish** to complete the software registration.

If you see the message below, check your Internet connection and click the **Register Software** button again. If the computer is connected to the Internet and you still cannot register your software, contact info@oceanoptics.com for assistance.

There is a problem with Licensing.
Contact Ocean Optics, Inc. for help.

Deactivating Your Product Key for Software Installation on Another Computer

With the exception of multi-license packs, your product key is only valid for use on two computers at a time. A deactivation option is available in OceanView if you want to deactivate your product key on one computer so you can use it on another computer.

► *Procedure*

1. Go to Help | Licensing.

2. Click **Deactivate**. The following warning will appear:
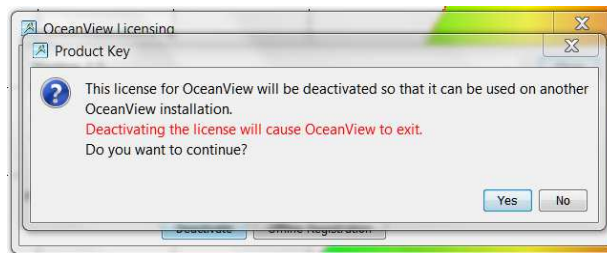
3. Click **Yes** to deactivate the license. OceanView closes and the license will be available for use on another computer.

Connecting Your Spectrometer

Once you have installed OceanView, you can install your spectrometer. Most Ocean Optics spectrometers connect to your computer using a USB cable. However, refer to your spectrometer manual for specific spectrometer installation instructions (see *Product-Related Documentation*). Be sure to allow sufficient time for the drivers to install before starting OceanView.

Chapter 3
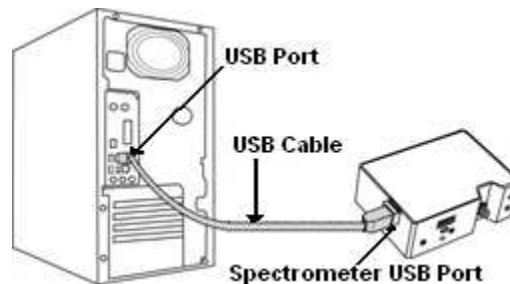
User Interface

Launching OceanView

Once you have installed your software and connected your spectrometer, you are ready start using OceanView. Launching OceanView differs, depending on your operating system and where you have placed your OceanView program files.

For PCs running Microsoft Windows, the default location is **Start | Programs | Ocean Optics | OceanView | OceanView.**

For Mac computers, the default location is the Applications folder.

Welcome Screen

When you start OceanView, a Welcome screen appears asking what you would like to do.

Select from the following tasks:

- **Quick View** -- Displays the spectrum in Quick View mode showing raw, unprocessed data. This is uncorrected for instrument response vs. wavelength. Quick View shows you a live shot of what the spectrometer is "seeing." From Quick View you can construct modes for different techniques.

- **Load a Saved Project** – Loads a previously saved project. Click **Restore Last Session** to reload the schematic and views as they were when the software was last closed.

- **Spectroscopy Application Wizards** – Use this function to set up a measurement using simple step-by-step wizards. A large range of applications is available. See *Spectroscopy Application Wizards*.

You can skip this window in the future by unchecking **Show on startup** at the bottom of the screen.

Click **OK** once the selection is made on this window.

Quick View

Select **Quick View** to display spectra for all the attached devices in a raw, unprocessed data view useful for setting acquisitions parameters and troubleshooting. This mode was previously referred to as Scope mode in Ocean Optics' SpectraSuite and OOIBase32 software. This is the raw signal from the detector and is proportional to the voltage induced by the light falling on the detector.

It is very important to realize that this is uncalibrated data and that a counts signal does not represent a particular power or energy from one wavelength to the next. Because the response of the detector is linear, twice the counts at a particular wavelength do indicate that the amount of light at that wavelength has "doubled." However, a small peak relative to a big peak does not indicate that there is less or more light at a particular wavelength relative to another. To understand the true relationship you need to do a relative measurement (including relative irradiance), or if you want a quantified result, an absolute irradiance measurement.

To display a Quick View spectrum for all the attached devices, do one of the following:

- Select the Quick View option from the Welcome Screen and click **OK**.
- Click the **x** in the upper right corner of the Welcome Screen.

Tip

Remove the checkmark from the **Show on startup** option in the Welcome Screen and the software will also start in Quick View.

Spectroscopy Application Wizards

► *Procedure*

1. Select **Spectroscopy Application Wizards** and click **OK** to open the Wizard selection dialog box.

2. Select the processed mode you want to enter and click **Next**. The wizard will take you through all the necessary steps to optimize your acquisition and enter the desired processing mode.

The wizards can also be accessed by clicking the **Create a new spectroscopy application** button ( ) or by selecting the **File | Create a new spectroscopy application** menu item. See Chapter 4: *Wizards* for more information on using OceanView wizards.

Load a Saved Project

With the new persistence functionality and ability to save and reload projects, you can quickly enter a processed mode by reloading a previously saved project.

► *Procedure*

1. Select **Load a Saved Project** to view the list of previously saved projects.

2. Select the project you want to load and click **OK**. Your project will reload and even warn you if you are reloading Reference or Background data that should be updated to ensure accurate measurements.

Note

To load a project, you must have the same spectrometer(s) that were used to create the project connected to the computer before you can load the project. The project will not load if the spectrometers used to create it are not connected to the computer.

You can also load a project by clicking the Open Project button ( ) or by selecting the **File | Open Project** menu item.

Save projects by clicking the Save project button ( ) or selecting the **File | Save Project** menu item.

Restore Last Session

Select **Restore Last Session** and click **OK** to open the software just as you left it when you last closed it. The settings and customization from the previous session will reload. If the previous session included Reference and Dark data, you will be warned that you are reloading data that should be updated to ensure accurate measurements.

Note

To restore a previous session, you must have the same spectrometer(s) that were connected when you last closed OceanView attached to the computer before you can reload the session. The session will not load if the spectrometers used to create it are not connected to the computer.

Views

OceanView offers two different views: *Graph View* and *Schematic View*.

Graph View

The Graph view shows the spectrum graph as well as offering Graph Layer Options, Strip Charts, Spectral Splicing, and Peak finding. See *Acquisition Parameter Controls* for information about the parameter controls in the Acquisition Group window.
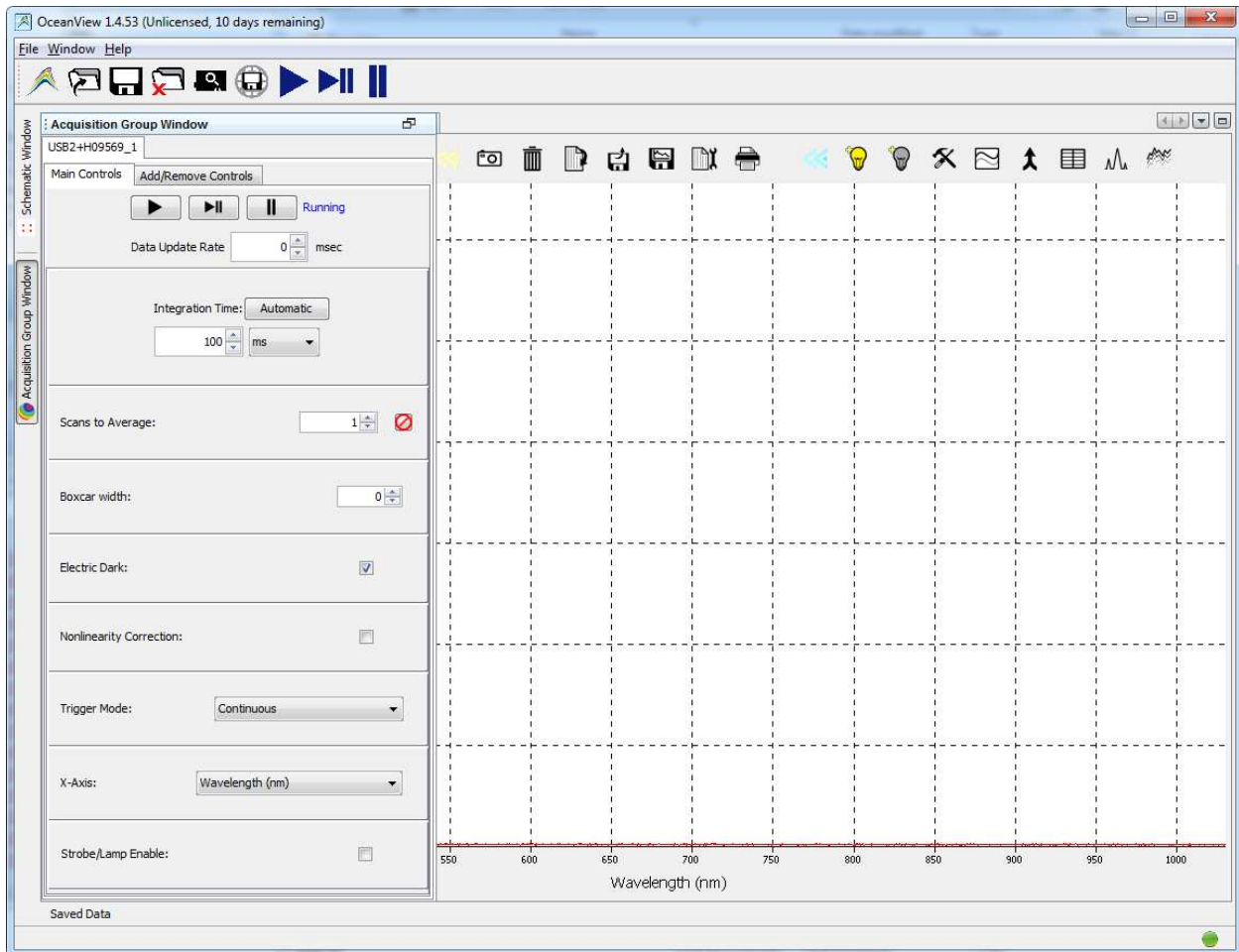
Schematic View

The Schematic View presents data from your device(s) in a diagram format. The Schematic View provides you with all of the functionality of the Window view, plus the following enhanced capabilities:

- Algorithm nodes – allow for math functions such as ratios, adding multiple spectra, and adding a constant to spectra.

- Set a subrange – ability to focus on a specific subset of the spectrum

- Interpolate spectral data – evenly space data from two or more spectra to analyze them mathematically

- Retrieve device properties such as serial number, firmware version, wavelength and total number of pixels

- Send a single value (such as TEC temperature, integral, average over a specific wavelength range) from the device to the Scalar view to analyze the value over time

- Preview spectra in graphs at every step in your process

- Easily add new Graph and Table Views

See Chapter 5: *Schematic View* for more information.

Online Help

OceanView has extensive context sensitive help. Click the Help button in any dialog box for more details. Tooltips are also available by hovering over a button or window for more information. Help is also available using the Help option in the top menu.

Main Window Controls

Note

Different types of acquisitions are available for different devices including Spectrometer, I²C, SPI, Board Temperature, Thermo-Electric Cooling and Analog In. The controls available in the Acquisition Parameters Controls vary based on the type of acquisition is selected.

The Main Window controls at the top of the OceanView screen allow you to perform the following tasks:

- *Creating a New Spectroscopy Application*
- *Opening a Project*
- *Saving a Project*
- *Removing a Project*
- *Using the Device Manager*

Creating a New Spectroscopy Application

Click to choose the application to build. This function is also available from the *File Menu*.

- Absorbance
- Raman
- Relative Irradiance
- Transmission
- Fluorescence
- Photometry, Photons, Power and Energy
- Reflectance
- Absolute Irradiance
- Color

Opening a Project

Click to navigate to and open a previously stored project. You can also type the shortcut Ctrl + O. This function is also available from the *File Menu*.

Saving a Project

Click to save a project in a location that you specify. A single ACII file of that acquisition is saved to the folder specified; this folder then persists as the default save location every time you use OceanView.

The icon turns red while the save is in progress. When saving a continuous series of acquisitions, all spectra are saved starting when you first click this icon until you click it again. Configre the save options using ![icon] (see *Configure Graph Saving*).

Removing a Project

Click ![icon] to delete a previously stored project. You can also type the shortcut Ctrl + X. This function is also available from the *File Menu*.

Using the Device Manager

Click ![icon] to display the Device Manager dialog box.
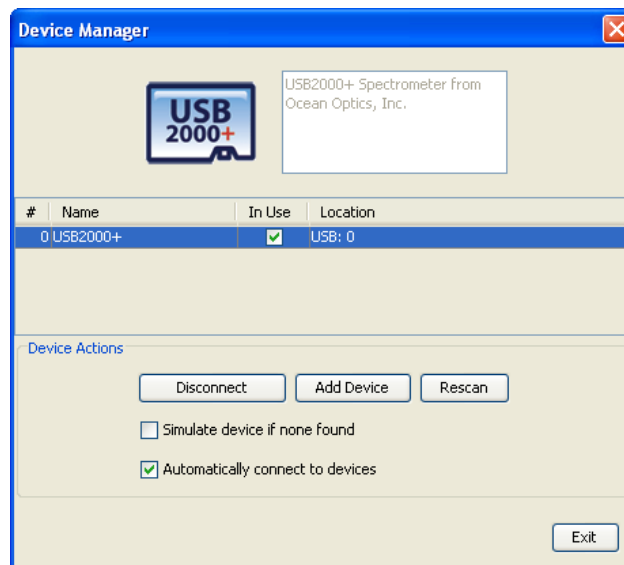
Use this dialog box to perform the following functions:

- Connect/disconnect the device from OceanView

- Add another device to OceanView

- Rescan for devices

- Simulate a device

- Automatically connect to the device when it is attached to the network

Start All File Writers

Click ![icon] to start all the file writers to start saving all previously configured graph view saves at once.

Control All Acquisitions

Use these global controls for all the current acquisitions. These controls are especially useful for experiments using multiple spectrometers and to start multiple acquisitions simultaneously.

Control	Function
▶	Start a continuous series of acquisitions.
▶❚❚	Take a single acquisition (play/pause).
❚❚	Pause all acquisitions.

Acquisition Parameter Controls

Acquisition parameters in the Acquisition Group Window allow you to establish signal-conditioning settings for your processed data. By using the graph real-time display of data you can evaluate the effectiveness of your experimental setups and data processing selections, make changes to these parameters, instantly see the effects and save the data. The options available can change based on device.

The Acquisition Group Window displays next to the Graph window.

The Acquisition Control Panel can also be accessed in the Schematic window by clicking the Acquisition Controls node ().

Acquisition Group Window
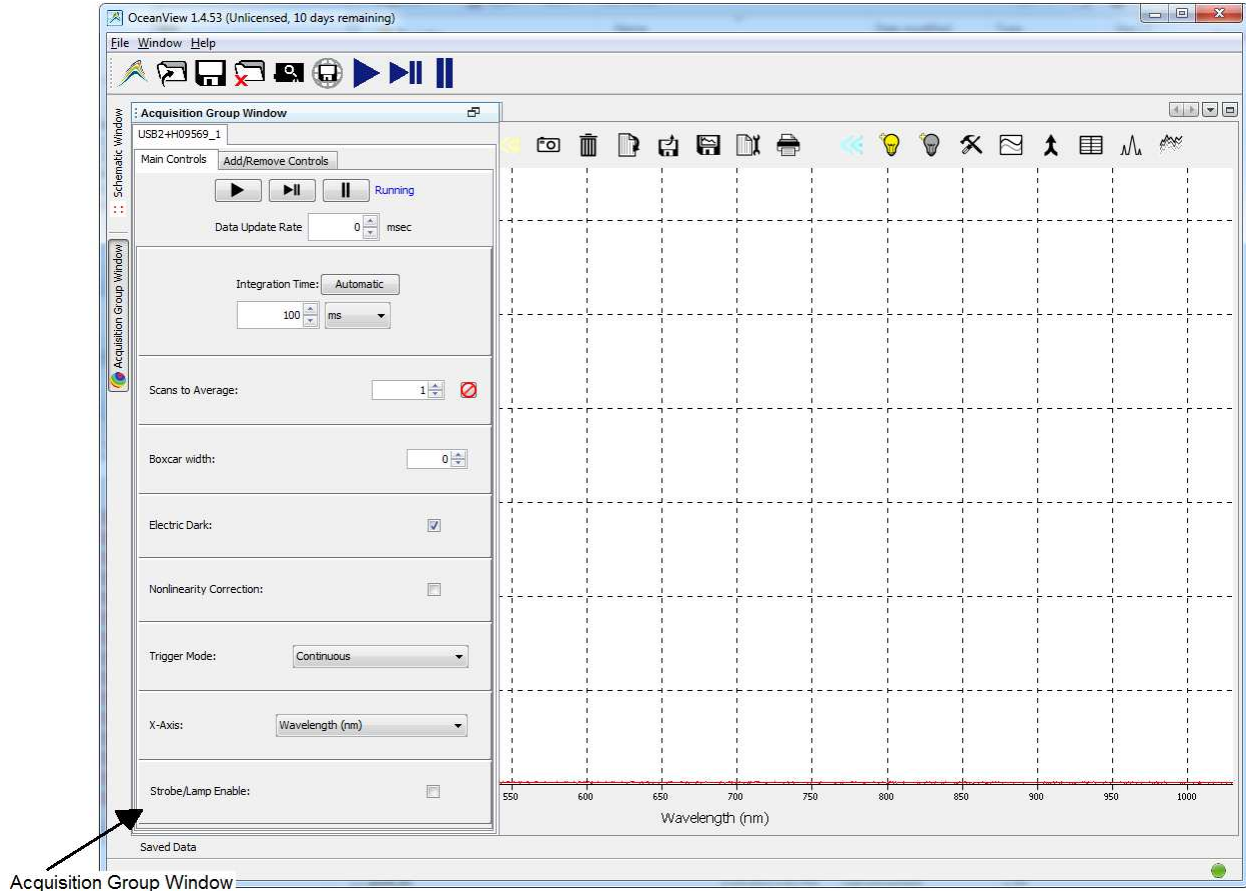
Add additional acquisition controls to the **Main Controls** tab by clicking the **Add/Remove Controls** tab and checking the boxes next to the desired feature. When checked, the controls for these features will show up on the **Main Controls** tab. Unchecking a feature does not disable the feature. It only hides the controls on the **Main Controls** tab. The spectrometer type will determine which controls are available in the **Add/Remove Controls** tab. The **Spectrometer** feature is already checked and grayed out. This feature places certain necessary spectrometer controls on the **Main Controls** tab and cannot be removed.

Note

If a control is shown in the **Main Controls** tab, by selecting it in the **Add/Remove Controls** tab, that setting will be pushed to the device before every update. If multiple acquisitions have visible controls for the same feature on the same device, the device will alternate between them, possibly resulting in rapid changes of state (e.g., lamp control).
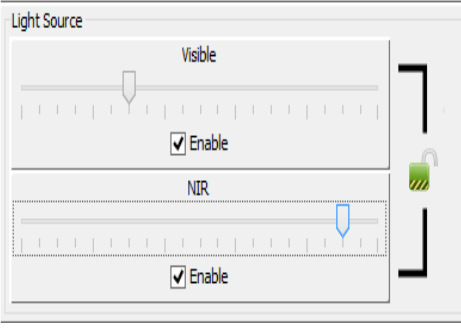
Main Controls Tab
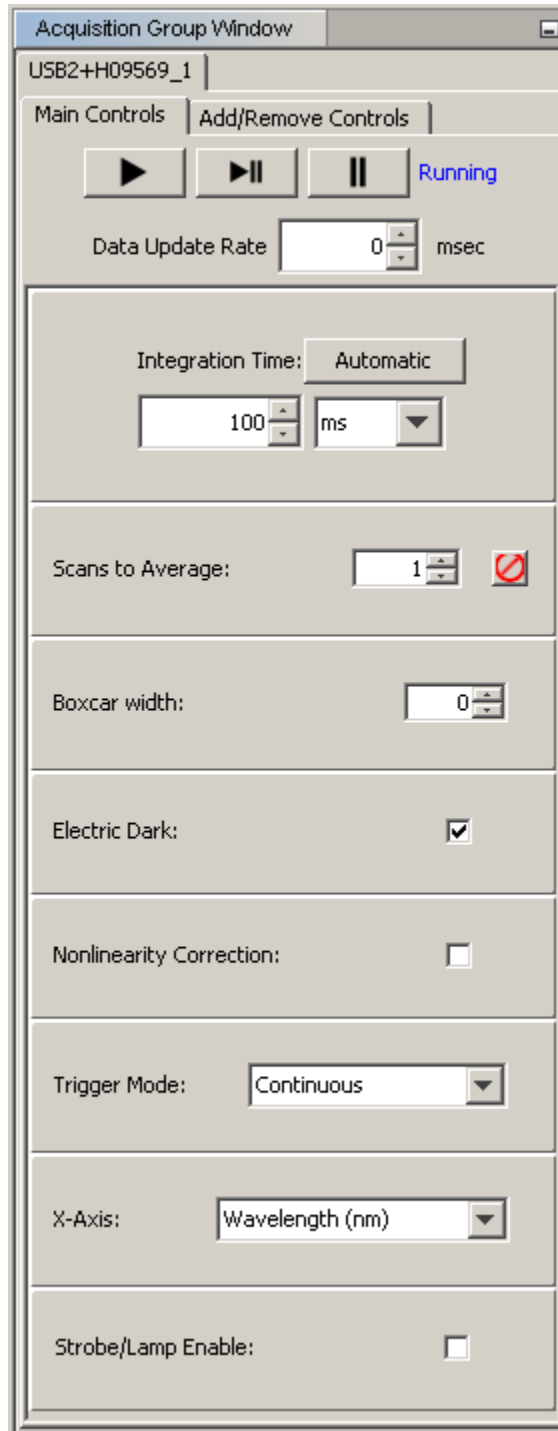
Controls at the top of the window determine whether the acquisition should request data continuously (with an optional delay between updates), stop acquiring (pause), or take single measurements. The rest of the controls are described below:

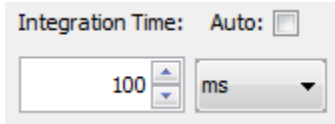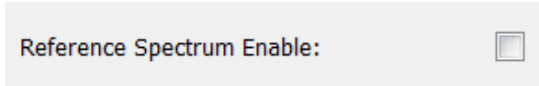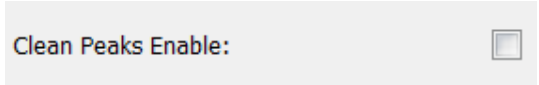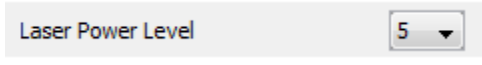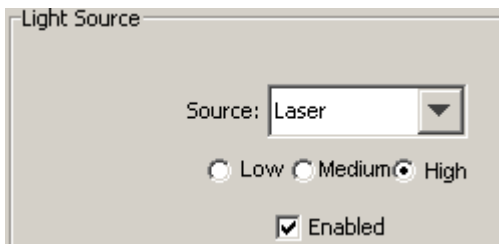| Control	Function
Integration Time	Specifies the integration time of the spectrometer, which is analogous to the shutter speed of a camera. The higher the integration time, the longer the detector monitors the incoming photons. If your Quick View intensity is too low, increase this value. If the intensity is too high, decrease this value. Adjust the integration time so that the greatest amount of light that you anticipate for your application causes a signal of about 85% of spectrometer's capability (for example, 3500 for spectrometers with a total of 4096 counts, 14000 counts for spectrometers with a total of 16384 counts, 50000 for spectrometers with a total of 65535 counts). The horizontal blue line is set at 85%. While watching the graph trace, adjust the integration time until the signal intensity level is appropriate for the device. Clicking **Automatic** sets the integration time to 85% of the spectrometer's dynamic range.
Scans to Average	Specifies the number of discrete spectral acquisitions that the device driver accumulates before OceanView receives a spectrum. The higher the value, the better the signal-to-noise ratio (S:N). The S:N will improve by the square root of the number of scans averaged.
Boxcar Width	Sets the boxcar smoothing width, a technique that averages across spectral data. This technique averages a group of adjacent detector elements. A value of 5, for example, averages each data point with 5 points to its left and 5 points to its right. The greater this value, the smoother the data and the higher the signal-to-noise ratio. If the value entered is too high, a loss in spectral resolution will result. The S:N will improve by the square root of the number of pixels averaged.
Electric Dark	Enables or disables the correction of the spectral data for electrical dark signal. For example, if the first 24 pixels in the spectrometer, while producing an electrical signal, do not respond to light then this option subtracts the average value of these first 24 pixels from the entire spectrum.
Nonlinearity* Correction	Enables or disables the detector linearity feature.
Trigger Mode	Selects the trigger mode for the device. Trigger modes available vary based on the device being used.
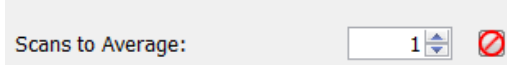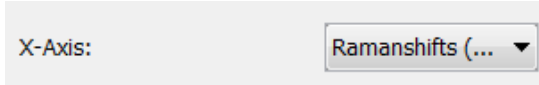
Control	Function
X-Axis	Allows you to alter the x-axis units of the current Graph View. Select the desired x-axis unit in the drop-down menu and click **OK** to update the graph. Select from the following: • **Wavelengths** displays the wavelength of the x-axis in units of nanometers • **Pixels** displays the index number of each element in the spectrometer's detector beginning at 0 and ending at n-1 (where n is the total number of pixels in the device) • **Microns** displays the wavelength of the x-axis in units of micrometers • **GigaHertz** displays the x-axis frequency in units of GigaHertz (GHz) • **Wavenumber** displays the x-axis in units of inverse centimeters (cm^{-1})
Strobe/Lamp Enable	Enable this option to turn on the lamp.
GPIO	Set the parameters for the GPIO pins. Output determines whether the pin is an input (not checked) or output (checked). Value automatically checks or unchecks depending on whether a voltage value is sensed on that pin. Alt is for checking alternate functions such as Master Clock.
Single Strobe	Set the hold-off time and pulse width for the strobe lamp.
Continuous Strobe	Set the continuous strobe period.
Acquisition Delay	Set the trigger delay.
Baseline Correction	This control appears only for STS spectrometers. Check this box to display the nonlinearity correction control.
	This control appears only for the Flame direct-attach light source accessories. Adjust the light source voltages (visible and NIR for the FLAME-DA-CUV-VIS-NIR, UV and visible for the FLAME-DA-CUV-UV-VIS). The lock control binds the two sliders so that they adjust together. The settings persist when you log out and then back in to OceanView.

*Electric Dark must be enabled to use nonlinearity correction. Otherwise, this control will be grayed out. This control will not appear in the panel if the stored coefficients are invalid or missing.

Note
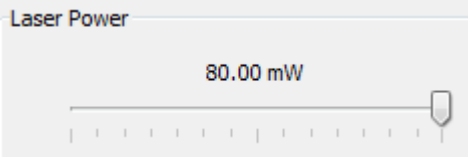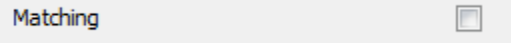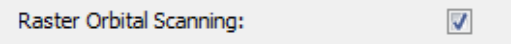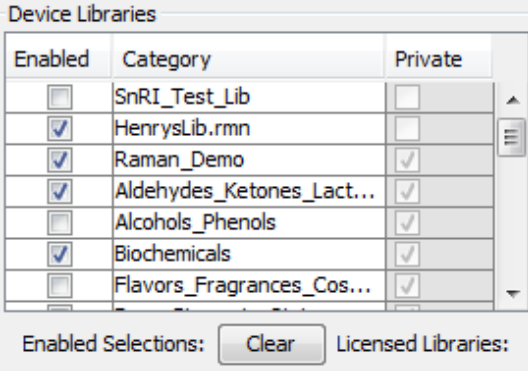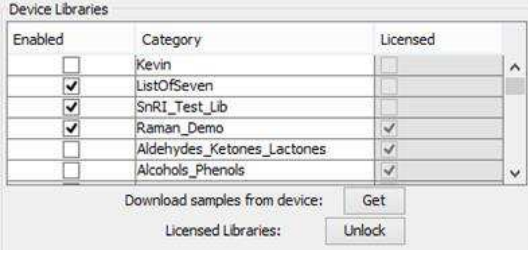
For NIRQuest spectrometers, a dark spectrum must be stored first. A dark spectrum is different from a background spectrum since a dark spectrum is totally devoid of light. A dark spectrum is stored by clicking **Store Now** in the **No dark spectrum stored** section of the Acquisition Parameter Controls panel. Once a dark spectrum is stored, nonlinearity can be set.

IDRaman Controls

The controls for the IDRaman products are listed below.

| Control	Function
▶	Take continuous acquisitions. This control is not recommended for systems such as the IDRaman mini 2.0 that use a laser due to laser safety issues.
▶❙❙	Take a single acquisition. Every time this control is activated, the laser fires and a measurement is captured.
❙❙	Pause acquisitions.
Integration Time: Auto: ☐ 100 ms	Select the desired integration time and units (μm, ms, or seconds). The default is 100 ms. Check **Auto** for auto integration. This setting sets integration automatically by waiting for the peak to hit 35000 counts. Maximum auto integration is 8 seconds.
Scans to Average: 1 ⊘	Enter the number of scans to average. Click ⊘ to stop averaging.
X-Axis: Ramanshifts (... ▼	Select the units for the x-axis, Ramanshifts or Pixels on the detector (useful for calibration only).
Reference Spectrum Enable: ☐	Check the box to enable a reference spectrum.
Clean Peaks Enable: ☐	Check the box to enable the Clean Peaks function.
Laser Power Level 5 ▼	For IDRaman mini 2.0. Select the laser power level (0 to 5), where 0 = off.
Light Source Source: Laser ▼ ○ Low ○ Medium ◉ High ☑ Enabled	For IDRaman mini. Select the laser power. This is the power at the sample: High (full power, 70 mw), Medium, or Low. Check the box to enable the laser.

| Control	Function
Laser Power 80.00 mW	For IDRaman reader and IDRaman micro. Use the slider to select the laser power. This is the power at the sample.
Matching ☐	Check this box to match the sample's spectrum to data in one or more libraries.
Raster Orbital Scanning: ☑	Check this box to enable raster orbital scanning.
Device Libraries Enabled / Category / Private ☐ SnRI_Test_Lib ☑ HenrysLib.rmn ☑ Raman_Demo ☑ ☑ Aldehydes_Ketones_Lact... ☑ ☐ Alcohols_Phenols ☑ ☑ Biochemicals ☑ ☐ Flavors_Fragrances_Cos... ☑ Enabled Selections: [Clear] Licensed Libraries:	This table presents a list of libraries available on the device. Enabled – The library is included in the sample matching Private – The are libraries that have been purchased Clear – Clears the checkmarks
Device Libraries Enabled / Category / Licensed ☐ Kevin ☑ ListOfSeven ☑ SnRI_Test_Lib ☑ Raman_Demo ☑ ☐ Aldehydes_Ketones_Lactones ☑ ☐ Alcohols_Phenols ☑ Download samples from device: [Get] Licensed Libraries: [Unlock]	For the IDRaman mini 2.0, this table presents a list of libraries available on the device. Enabled – The library is included in the sample matching Licensed – These are libraries that have been purchased Download samples from device – Download samples from device to specified directory. Licensed Libraries – Unlock encrypted libraries with an access file that you purchased.

Flame Direct-Attach Accessories

The Flame direct-attach accessories consist of the following sampling systems:

- The FLAME-DA-CUV-VIS-NIR is a snap-on, direct-attach 1 cm, illuminated cuvette holder with tungsten bulb and violet LEDs (300 – 900 nm) that is well suited for color and simple environmental measurements such as PAR, water turbidity and chlorophyll absorbance.
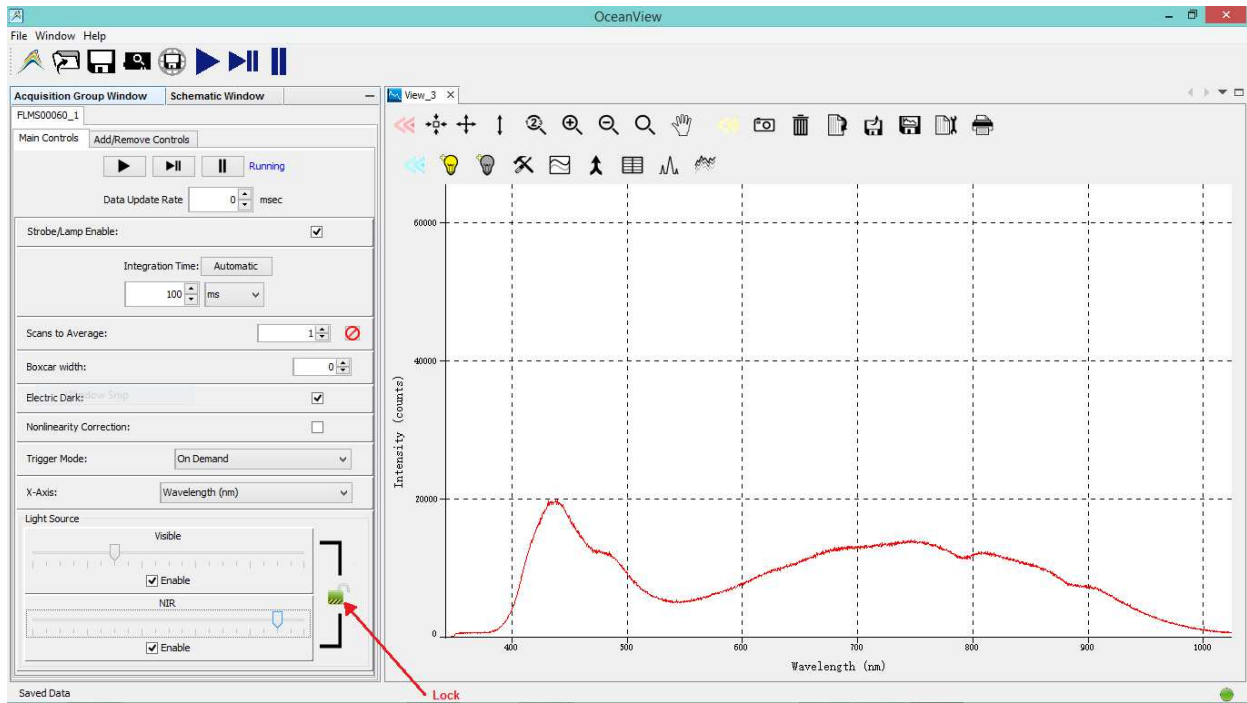
- The FLAME-DA-CUV-UV-VIS is a snap-on, direct-attach 1 cm cuvette holder and UV/VIS light source (200-1100 nm) combination for general purpose absorbance and transmission spectroscopy. The deuterium tungsten light source receives control instructions via the accessory connector on the spectrometer.
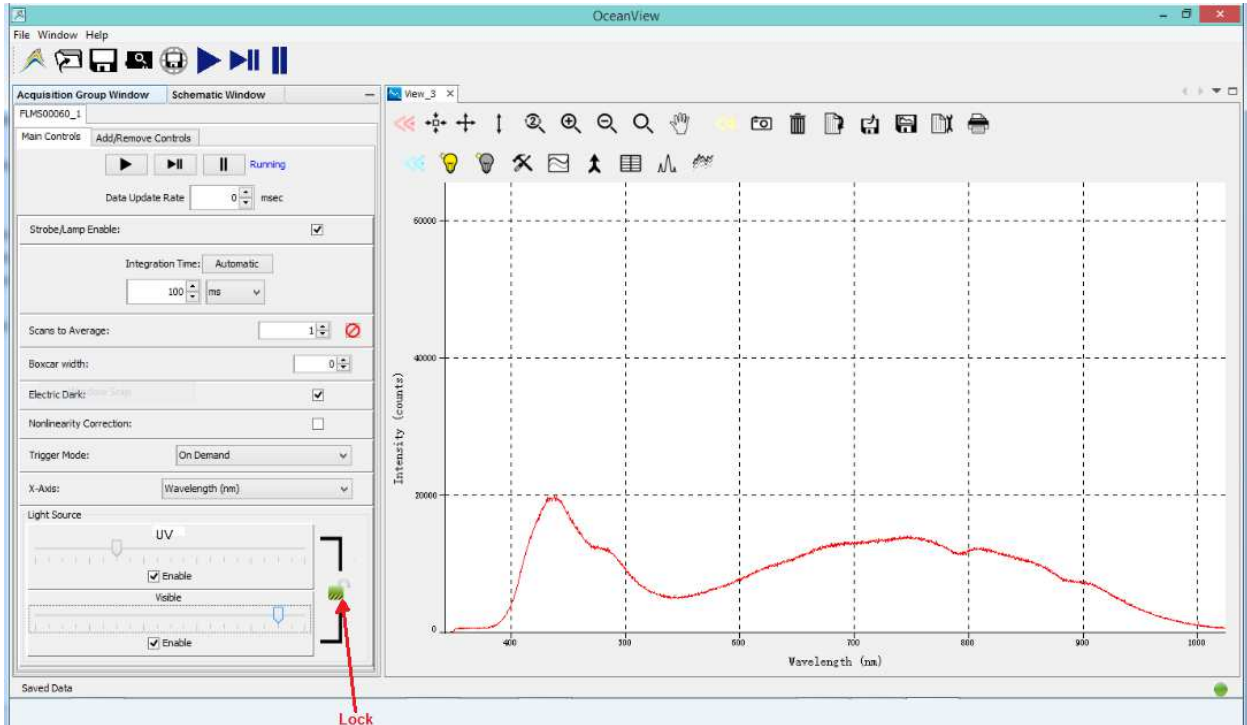
Use the Light Source slide controls to adjust the voltage to the LEDs (0 to 100%). The Lock control binds the two sliders so that they adjust together. The settings persist when you log out and then back in to OceanView.

Add/Remove Controls Tab

Select this tab to add or remove functionality from the Main Controls tab on the Acquisition Parameters Controls dialog box.

- Adding a control will cause those settings to be applied every time this acquisition requests new input data.

- Removing a control means that its settings will be left alone by this acquisition. If multiple acquisitions are sharing a single data input, you might want to remove controls from all but one so that the settings can be changed in just one place for all of the acquisitions.

Note

The controls for the feature that the acquisition was started for cannot be removed. These settings will always be used prior to each request for data. For example, if an acquisition was started for a spectrometer, then its features (such as integration time) may be provided by default and cannot be removed. However, controls for certain supporting features (such as lamp enable or shutter) may be enabled by default but can be removed if desired.

GPIO Function

In the Acquisition Parameter Controls panel, the GPIO table consists of three separate controls for each GPIO pin in the device: Value, Out?, and Alt?.

► *Procedure*

1. Determine if you will be using a particular pin as an input or an output.

    • Output -- If you are using the pin to control an external device (i.e., to turn a lamp on and off) or you plan to read the voltage of the pin with an external device (like a volt meter), then you are using the pin as an output. Check the Out? box to set that pin into output mode.

    • Input -- If you are going to supply a voltage to the pin using an external source (like a signal generator) or you plan on using the voltage on the pin to monitor the high/low state of an external device (like the on/off state of an electronic shutter), then you are using the pin as an input. Uncheck the Out? box to set that pin into input mode.

2. If you have determined that the pin will be used as an output, then you need to decide if you will be using the pin's alternative (or alt) function to monitor internal device characteristics. Using the device's data sheet, you can determine the alt function of any of the GPIO pins. On a USB2000+ spectrometer, for example, GPIO-1 outputs the spectrometer's master clock when its alt function is enabled. In the alt output configuration, monitoring this pin using an oscilloscope should show a 48 MHz signal. Some pins on certain devices may not have any associated alt function.

3. If you need to monitor any of the internal device characteristics, check the Alt? box for the appropriate GPIO pin. If the Alt? box is left unchecked, then you may manually toggle the output state of the pin using the Value control. Checking this box will raise the GPIO pin to a high state that outputs a fixed voltage. Leaving the Value box unchecked will cause the device to output a low signal, or 0 volts (relative to the ground pin).

--OR--

4. If the pin is to be used as an input, the Value box will act as an indicator rather than a control. If the voltage applied to the pin by an external source is above the threshold value, then the Value box in the GPIO table will register a check mark. If the voltage applied to the pin below the threshold value, then the Value box will not register a check mark.

Note

In Schematic View in the Output Control (Output Control) node, the GPIO table consists of three separate rows of controls for each GPIO pin in the device: output value, output enable, and alt function. There are two columns for each row:

- Latest Value -- contains the control/indicator check box

- Data Input -- allows you to choose how the check box will be controlled.

Before using GPIO in the Output Control (Output Control) node, make sure that the GPIO feature in the Acquisition Parameter Controls panel has been disabled.

The controls perform the same functions as their counterparts in the Acquisition Parameter Controls panel. The main difference is that the check box state for any row in the table can be controlled manually or by a scalar node in the schematic diagram. A positive value from the scalar node enables the check box, whereas a negative value disables the check box.

To have a node in the software control the state of a check box, wire a scalar-producing node into the output control node. This can be a static scalar (like a Constant (Const) node) or a dynamic scalar (like a Running Average (RunAvg) node). Once the scalar node is wired into the Output Control, use the drop-down menu in the Data Input column to select the appropriate control for that row in the GPIO table. If the drop-down menu is left blank, the check box will be controlled manually.

Graph View Controls

Ocean View offers the following controls from the Graph View:

Control	Function
	Zoom out to maximum. Displays a full view of the spectrum graph (maximum x- and y-axis values, depending on spectrometer type).
	Scale graph to fill window. Adjusts the graph display so that the section of the graph relevant to the spectrum line is shown, but no more. Both the x and y axis are adjusted.
	Scale graph height to fill window. Zooms in on a graph so that the full height of the spectrum line is shown, but no more. Unlike the **Scale graph to fill window** control, only the y axis is adjusted.
	Manually set numeric ranges. Sets the exact zoom coordinates. When you click on the control, the **View Properties Dialog Box** appears so that you can enter the desired minimum/maximum X and Y coordinates. In addition, you can specify a name for the node. This name will appear on the View window tab and the node in the Schematic View.

Control	Function
⊕	Zoom in to graph. When you click this control, a magnifying glass (with + sign) appears and the display zooms in. Each time you click on the graph, the display zooms in further around the location of the magnifying glass. Clicking this control again exits the zoom function and returns the mouse cursor to an arrow.
⊖	Zoom out. Reverses the zoom in process. When you click this control, a magnifying glass (with - sign) appears and the display zooms out. Each time you click on the graph, the display zooms out further around the location of the magnifying glass. Clicking this control again exits the zoom function and returns the mouse cursor to an arrow.
○	Zoom to manual selection. Zooms in on part of the graph. When you click the control, a magnifying glass (with a box inside) appears on the screen enabling you to box-in a region to zoom in on.
✋	Toggle graph panning mode. Click on this control and use the hand tool that appears on the graph to "grab" onto the graph and drag it to the desired position. Click the control again to return the hand tool to a cursor.
📷	Convert active spectrum to overlay. Takes a snapshot of the currently displayed spectrum and overlays it on the graph. Each subsequent overlay displays in a different color.
🗑	Delete overlay spectrum. Removes an overlaid spectrum from the graph.
📋	Copy data to clipboard. Copies spectral data to your computer's clipboard.
💾	Load data in an existing ASCII file to the graph. Only Ocean Optics ASCII files can be loaded.
💾	Save graph to file as a text file according to your configured save format. The default setting is to save a single acquisition when the button is clicked to your OceanView/records folder unless another folder has been set. You can configure your save to fit your specific needs using the Save Configuration toolbox. When saving is active this icon will turn red.
📑	Save content over time to one or multiple files (depending on how it is configured). See *Configure Graph Saving*. When combined with external triggering, this feature can be used to automatically save full spectra timed to one or more external events. After this is selected once, press the spacebar for additional saves.
🖨	Print graph. Prints the spectrum graph. Displays the **Print Spectrum Dialog Box** to set print options. You can enter a title and notes for your graph and select their font size, as well as adjust the width of the x and y gridlines.
✗	Set graph layer options. Displays the Graph Layer Options window.

Control	Function
∿	Create strip chart. Invokes the *Strip Chart Wizard*.
⚔	Splice data. See *Splicing Spectral Data*.
⊞	View results in table form.
⋀⋀	View spectrum peaks. Invokes the *Peak Metrics Wizard*.
≋	Trend trails displays a selectable number of previous acquisitions (using ✕ in *Graph View Controls*), each fading in color as it ages. Use this function to observe changes in spectra over time across the entire wavelength.
💡	Update background data for this acquisition if you have set up the measurement using a wizard.
💡	Update reference data for this acquisition if you have set up the measurement using a wizard.
💡	Create a reference measurement in while in Quick View mode.
💡	Create a dark measurement in while in Quick View mode.

Configure Graph Saving

OceanView provides the capability of saving and exporting processed data for each graph view to an ASCII file.

Click [icon] to display the Algorithm Parameter Controls dialog box.

By default OceanView will save data as a single "snapshot" acquisition. By configuring the save, you can set the save behavior to fit your measurement needs, from single snapshots to a continuous stream of data over time.
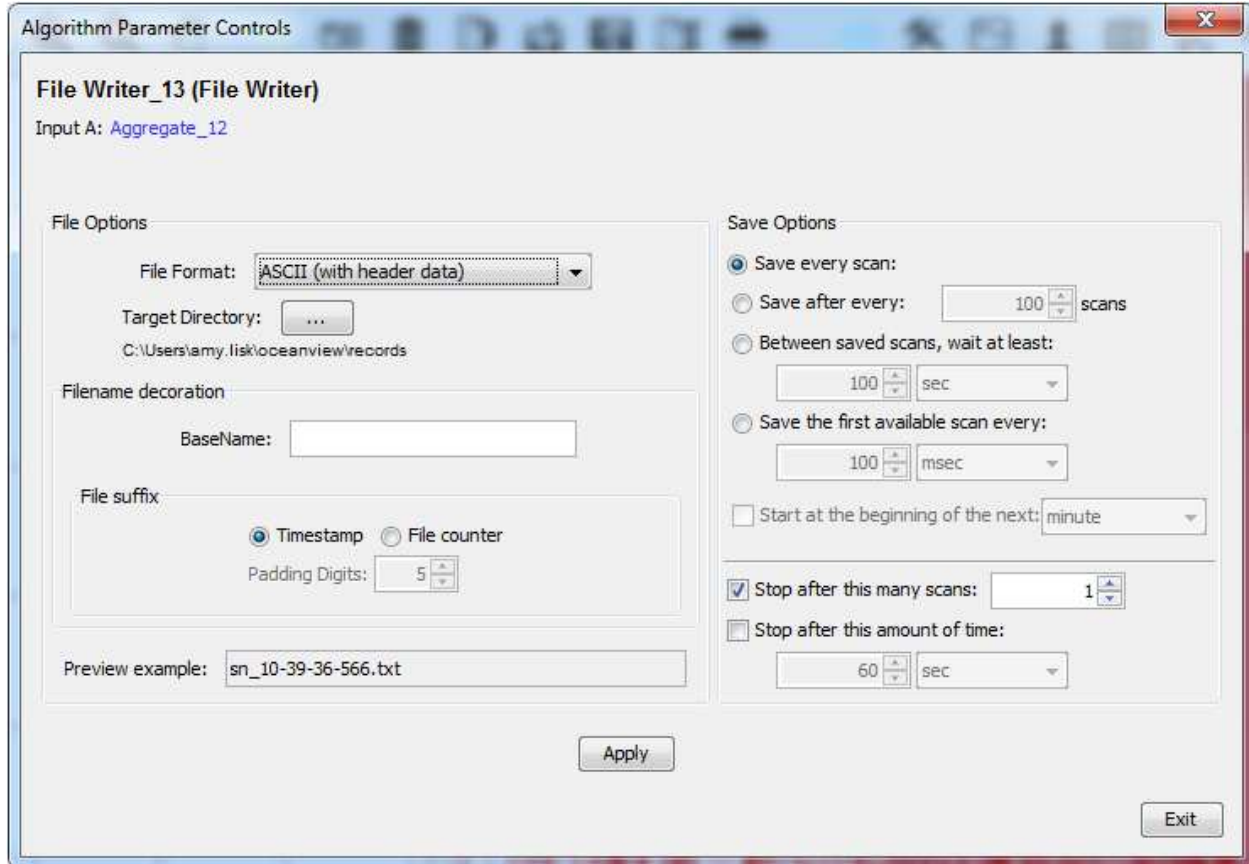
File Options:

Field	Selections
File Format	Tab sep. with Headers, Tab separated data, or Columned data
Target Directory	Browse to the desired directory. Once this is set, it persists until updated.
Basename	Adds a custom prefix in front of the file name for a better description of the saved session. OceanView will automatically add a suffix that identifies the acquisition and either a digital counter or a timestamp.
File suffix	Adds a timestamp or file counter to each file name.
Padding digits	The number of digits to be used when appending to a file (enter 3 to save hundreds of files, enter 4 to save thousands, etc. up to 15), for example: spectrumfile001 through spectrumfile999 if 3 is selected. The default is 5.
Preview example	Displays a preview version of the file

Save Options:

Field	Selections
Save every scan	Saves after every scan
Update after every *x* scans	Saves after the number of scans selected
Between saved scans, wait at least	Saves each scan according to the selected the interval
Save the first available scan every	The first scan occurs after the interval selected
Start at the beginning of the next	Start the scan at the next minute, hour, or day
Stop after this many scans	Stops saving after the number of scans selected
Stop after this amount of time	Stops saving after the amount of time selected.

Once the saving of graph data has been configured, you can save the graph data to a file or files.

Saved Data Panel

The saved data panel lets you see your data as it is saved and preview data. It also makes it simple to add overlays of saved data to your screen.
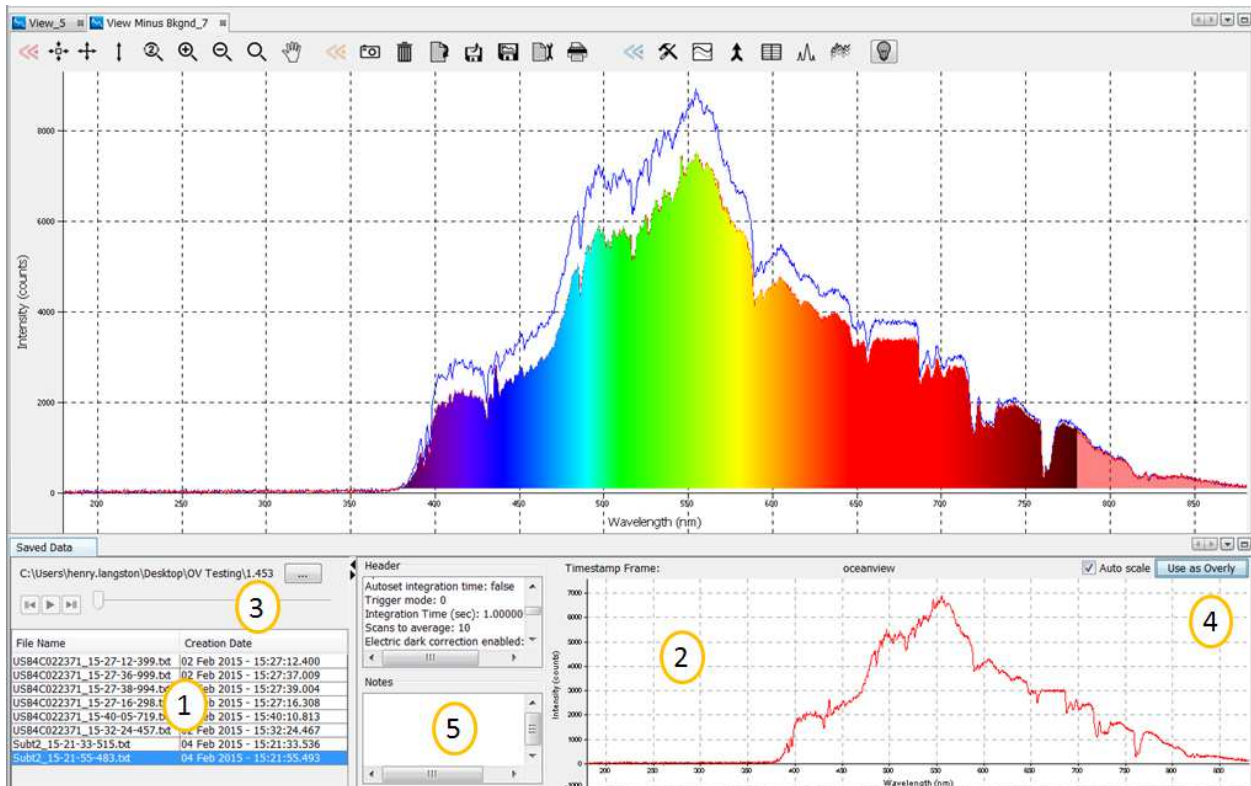
Saved Data Panel

1. Saved Files	List of saved files currently in the saved directory. Arrange by name or date.
2. Preview	Shows a preview of the saved spectra, time series or appended series saved data that can be stepped through, acquisition by acquisition, using the controls above the saved files list.
3. File Path	Set the file directory.
4. Overlay	Set the previewed spectra as an overlay on the active view.
5. Notes	Enter notes about the saved spectra. Notes are saved with the same file name as a separate .tsv file. These can be viewed or edited with any text viewer such as Notepad.

Graph Layer Options Window

Select the Graph layer options by clicking .

The Graph Layer options are divided into the following functions, each accessed in its own window:

- *General Window*
- *Keymap Window*
- *Miscellaneous Window*
- *Graph Layer Window*

General Window

Click General from the Graph Layer Options Window to display the General screen to set proxy settings.
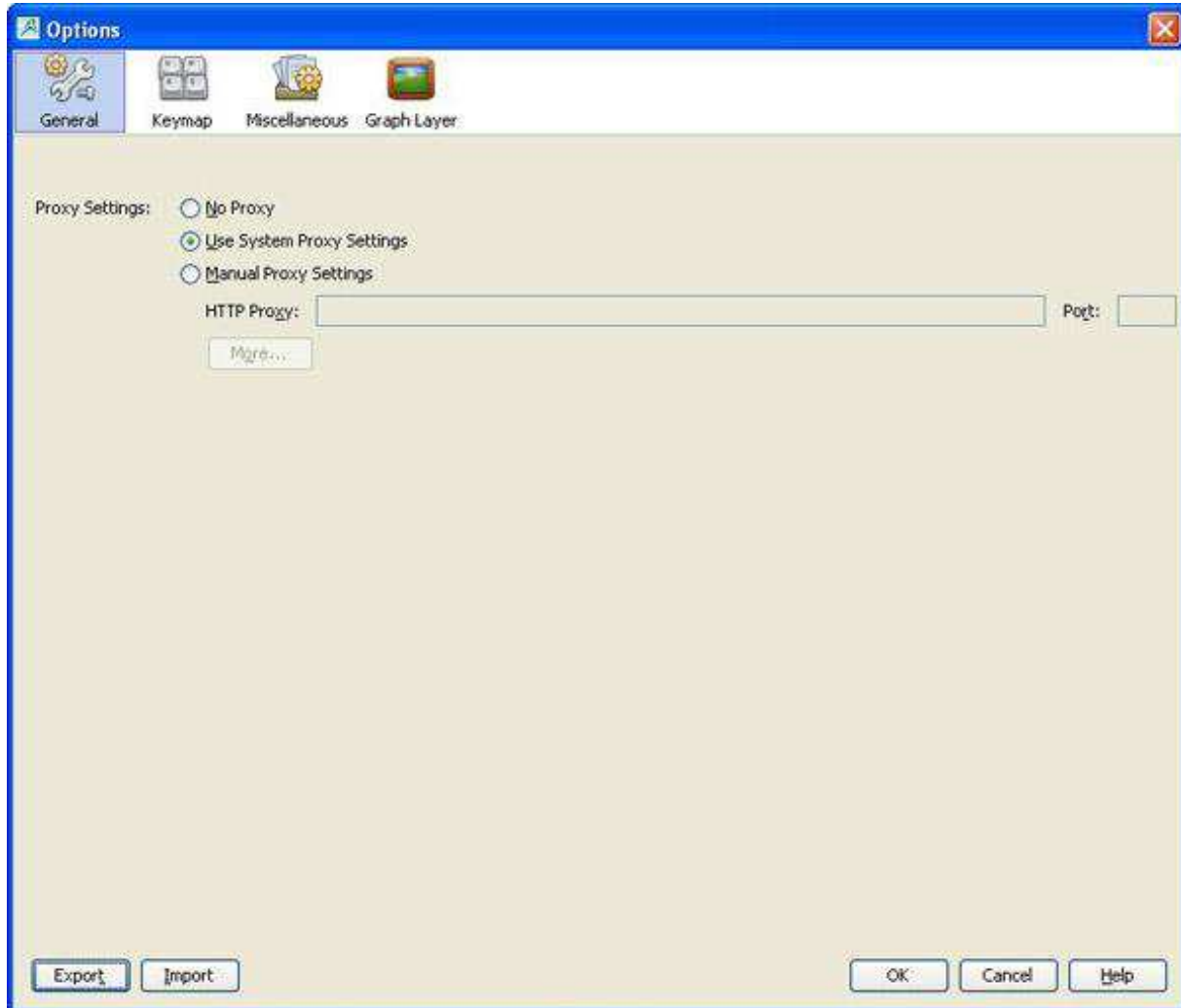
Keymap Window

Click ![Keymap] from the Graph Layer Options Window to display the Keymap screen to create key shortcuts for selected actions.
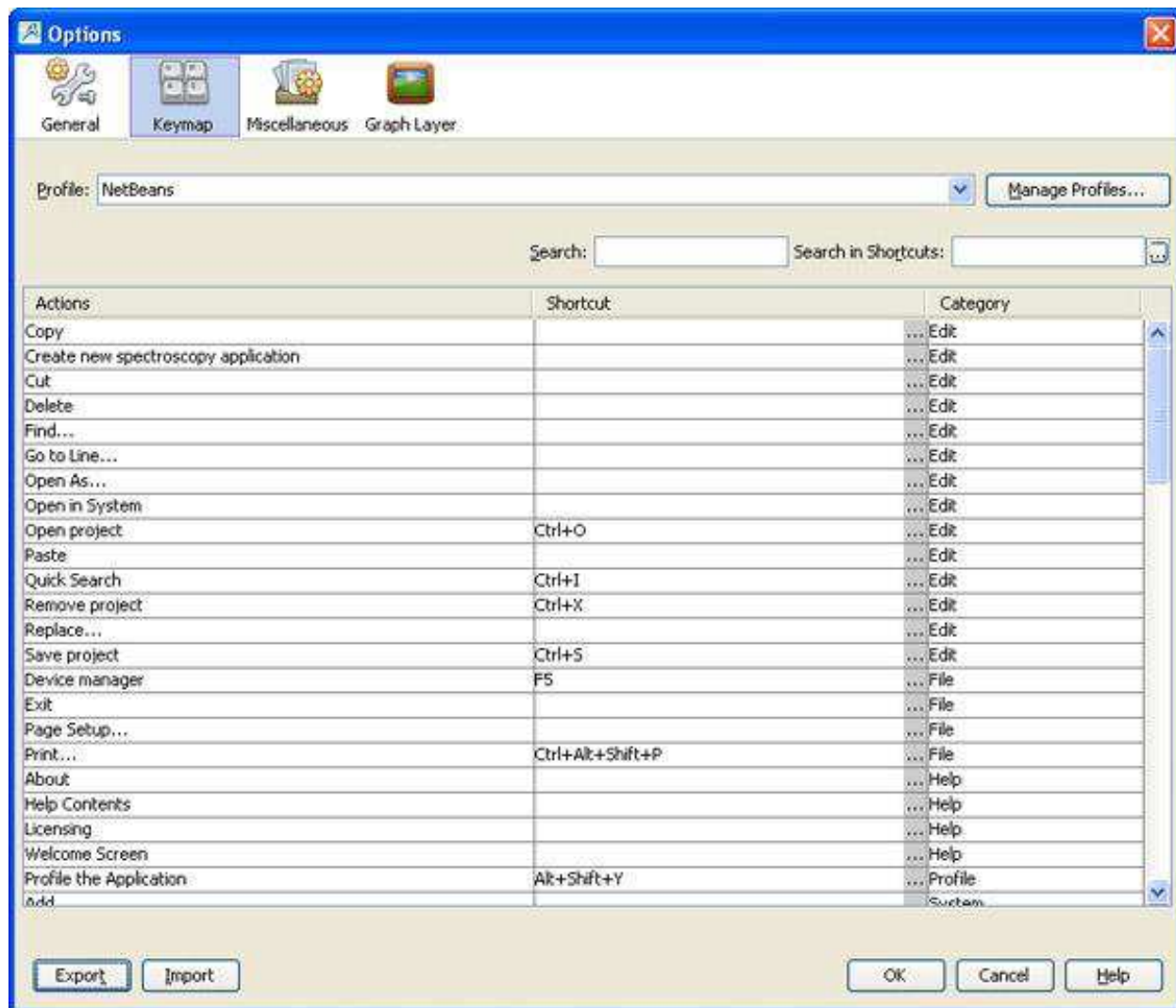
Miscellaneous Window

Click from the Graph Layer Options Window to display the Miscellaneous screen. Miscellaneous options include settings for the following functions:

- **Appearance** – Allows you to select functions that affect window behavior such as the ability to drag a window and snap it to a location. You can also select to activate the most recent document upon closing.

- **Files**

Graph Layer Window

Select the Graph Layer options by clicking in the Graph Layer Options Window. This window contains the following tabs for more customized control over the customization of your Graph View:

- *Annotations Tab*

- *Chart Tab*

- *Visible Spectrum Tab*

- *Trendline Tab*

- *Unit Precision Tab*

- *Scalar Tab*

Annotations Tab

This tab allows you to add text or an image to a specific location on the graph. Annotations are associated with a specific Graph View (selectable), and when the Graph View is removed, the annotations associated with it are also removed.

► *Procedure*

1. To add a new annotation on a graph,

2. Make sure Show annotation layer is selected in the **Layered Properties** section at the top of the window.

3. Use the drop-down **Select view** menu to choose the graph for the new annotation. This drop-down menu shows all available Graph Views.

4. Once you have selected the appropriate graph, click New Annotation and enter the desired text in the pop-up window.

5. When finished, click **OK** to place the annotation in the center of the graph.

Notes

To hide a graph's annotations without deleting them, select Hide annotation layer in the Layered Properties box.

To adjust the position of the annotation, enter values into the Annotation position X and Y boxes or use the up/down arrows next to the boxes. These boxes list the position of the annotation using the same units as the current axes of the graph. If you switch the x-axis units of the graph, you must then come back to the Annotations tab and reposition your annotation on the graph using the Annotation position X and Y boxes.

After exiting the Graph Layer Options panel you can also move the annotation around the graph by grabbing and dragging it by holding down the left-click button on the mouse.

Chart Tab

Modifies the appearance of the graph such as chart area, gridlines and graph axes.

- **Chart Area** – alters the color, pattern, and width of the gridlines on the graph. The gridlines for the X and Y axes can be toggled on or off using the appropriate **Set gridlines** check boxes. Adjust the colors of the gridlines and the background chart area with the **Gridline Color** and **Chart Area Color** boxes. Click either of these buttons to open a **Color Selection** window to choose the color of the chart or grid lines using a set of predetermined color swatches, by adjusting Hue, Saturation, and Brightness color values (HSB), or by choosing Red, Green, and Blue color coordinates (RGB). A preview of the new color is shown in the **Preview** section.

- **Axes Area** – alters the size, style, and spacing of the axis labels and values. The fields beginning with "Label" control the appearance of the axis quantity and units. The fields beginning with "Tick Mark" control the numerical X and Y axis values. The **Increase** and **Decrease** buttons increase or decrease the spacing between adjacent numerical values on the X or Y axis.

Visible Spectrum Tab

Overlays a colored, graphical representation of the visible spectrum of light onto any OceanView graph.

- **Layer Properties** – shows or hides the visible overlay as well as extends the overlay past the visible (380 nm to 780 nm) into the ultraviolet and infrared regions of the graph. To enable either the UV or the IR regions of the spectrum, check the appropriate boxes in this section.

- **Visible Spectrum Properties** – adjusts how and where the visible spectrum will be displayed.

  - Display the visible overlay as a bar located at the x-axis of the graph by selecting Show Visible Spectrum as Bar in X Axis. The visible overlay remains clipped to the x-axis regardless of the spectral activity. Or select Clip Visible Spectrum to Trendline for the visible overlay to fill in the section between the spectral trend line and the x-axis. The visible overlay rises and falls as the light intensity changes.
  - Check the **Invert** box to fill in the section between the spectral trend line and the top of the graph. The visible overlay will still grow and shrink as the light intensity changes, although this time in the opposite direction.

- **Trend Line Selection** – allows you to choose which spectral trend line the visible overlay will be clipped to. If only one trend line is fed into the graph, then this section is blank. If two or more trend lines are displayed on the graph, a selection table appears in this section. Choose the spectral trend line that will control the visible overlay by clicking on the appropriate row in the table. There will be no change in the display if the visible overlay is shown as a bar on the x-axis.

Trendline Tab

Allows you to change the colors that OceanView uses to display the spectral trend lines and overlays for each graph.

► *Procedure*

1. Click and hold on the color(s) you want to change (up to 20), then drag the cursor around the pop-up window to the desired hue for the selected color.

2. Click **Reset Colors** to reset the trendline color to the default shade.

3. Select the desired line width.

4. Select the number of trendline trails to include on the graph and the number between scans.

5. When you are satisfied with your selections, click **OK** to finish.

Unit Precision Tab

Allows you to specify the precision reported for the wavelength and intensity. You can also set the X and Y axis range and select the units reported on the X axis.

- **Range Precision** – alters the precision and visual display of data used in calculations. OceanView rounds the data to the value set in the **X Axis decimal places** and **Y Axis decimal places** boxes. Due to space limitations, the X and Y axes will not alter to display more digits on the graph. You can see the change when data is saved to a file or copied and pasted into an outside program. The change

in the number of displayed digits is also shown with data in the Scalar View. To adjust the number of decimal place digits that are displayed in a Scalar View, change the value in the **Y Axis decimal places** box. Check the **Use scientific notation** box to copy, save, and display the appropriate data in scientific notation.

- **Axis Range** – saves a set of customized values that you can use to quickly rescale your graph to a default range. The axis values entered here can be applied when you click **Use 'Options' setting** in the **View Properties** Dialog Box. The values entered in this section of the **Unit Precision** tab populate the display boxes of the View Properties Dialog Box. You must click **Apply** and then **Exit** in **View Properties** Dialog Box to rescale the graph to the desired values.

Scalar Tab

Allows you to set the font size, style, and color for Scalar View windows.

► *Procedure*

1. To set the background color or font color,

2. Click and hold the left mouse button over the color you wish to alter. This will open a color selection window.

3. Move the mouse cursor over the color you wish to use and release the left mouse button.

4. When you are finished making changes, click **Apply** to update the Scalar View.

Menus

OceanView provides the following menus located at the top of the screen:

- *File Menu*
- *Window Menu*
- *Help Menu*

File Menu

The File menu consists of the following menu selections:

- *Create New Spectroscopy Application*
- *Open Project*
- *Save Project*
- *Tools*
- *Start All File Writers*
- *Page Setup*
- *Exit*

Create New Spectroscopy Application

Select **File|Create** to start a new spectroscopy application.

This menu selection opens the *Select Spectroscopy Wizard* for you to choose the application to build:

- Spectroscopy
- Color
- Photometry
- Concentration
- Energy, Power, Photons

See Chapter 4:*Wizards* for more information.

Open Project

Select **File | Open Project** to navigate to and open a previously stored project. You can also type the shortcut Ctrl + O or click ⬀.

To find projects saved in previous versions of OceanView after upgrading to version 1.5.2, use the following procedure:

► *Procedure*

1. Select **File | Open Project**. You can also type the shortcut Ctrl + O or click ⬀.

2. Navigate to the Applications directory where OceanView version 1.5.2 (or above) stores projects from previous versions. The full path is C:\Users\<Username>\oceanview\applications.
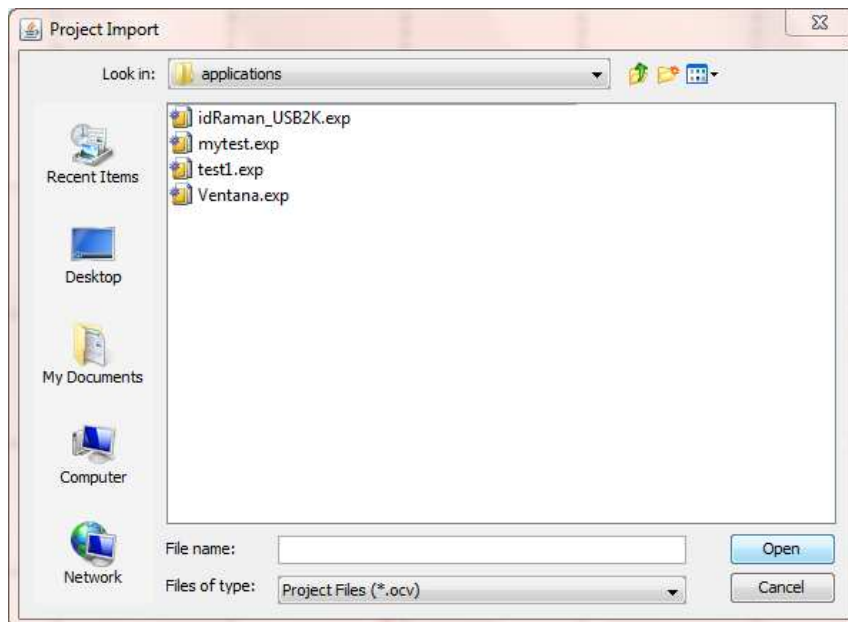
3. Select the project file (should have the extension .exp) and click **Open** to open your project.

Save Project

Select **File | Save Project** to save a project in a location that you specify You can also click 💾.

Tools

Select **File | Tools** to display the Tools menu to choose from the following selections:

- **Combine Calibration** – This feature allows you to combine two spectrometer calibration files *that you have created*; one file using a calibrated deuterium lamp source (UV) and th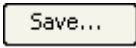e other using a calibrated tungsten lamp source (VIS). This will result in a spectrometer calibration file that can be used across the entire spectral range.

► *Procedure*

1. Select File | Tools | Combine Calibration.

   2.Enter the file name of the spectrometer calibration file you created with the deuterium lamp source or browse to the desired file.

2. Enter the file name of the spectrometer calibration file that you created with a tungsten lamp source or browse to the desired file.

3. In the Boundary Wavelength field, select the wavelength at which point the two files will be joined or go on to Step 5 to just accept the value provided by OceanView.

4. Click Save… . The graph of the combined files appears in the **Spectrometer Calibration Preview**.

- **Raw USB** – This is password-protected area providing raw read/write USB capability. OceanView always acts as the master (in terms of initiating writes). The device returns with the results.

Start all file writers

Select **File | Start** for all file writers to start saving all previously configured graph view saves at once.

Single graph views are saved by clicking 📄.

Page Setup

Select **File | Page Setup…** to display the **Page Setup** dialog box to allow you to set printing parameters.
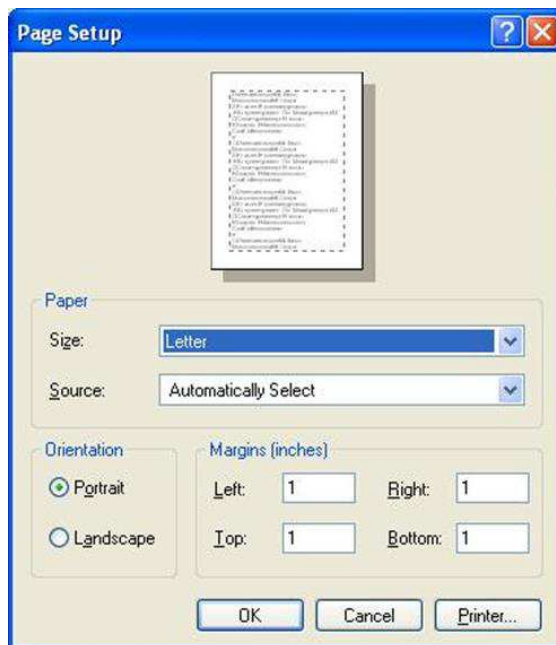
Exit

Select **File | Exit** to close the OceanView software.

Window Menu

The Window menu consists of the following menu selections:

- *Acquisition Group*
- *Schematic*
- *Library*
- Saved Data
- *Favorites*
- *Configure Window*

Acquisition Group

Select **Window | Acquisition Group** to display the *Acquisition Parameter Controls*.

Schematic

Select **Window | Schematic** to display your project in OceanView's Schematic view. See Chapter 5: *Schematic View* for more information on the Schematic view.

Library

Opens the Raman-based library window. Refer to the *IDRaman mini 2.0 Installation and Operation Manual* for more information about working with Raman libraries (see *Product-Related Documentation*).

Saved Data

Opens the saved spectrum file preview window.
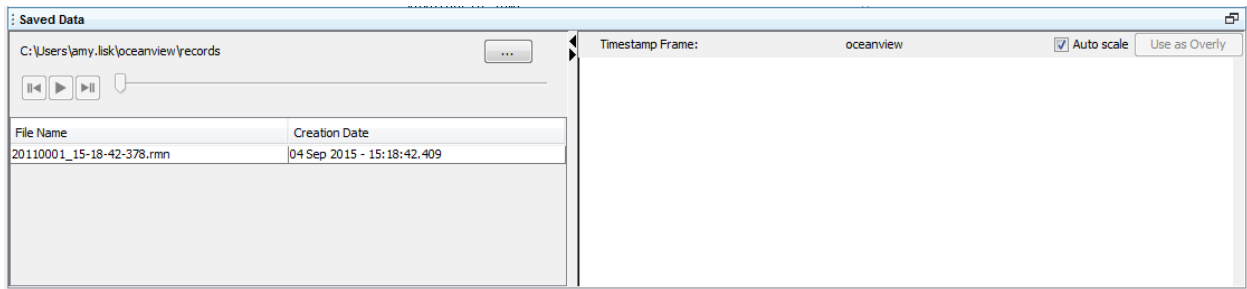
Favorites

Select **Window | Favorites** to open a panel in OceanView to browse to your stored files and folders.

Configure Window

Select **Window | Configure Window** to access the following functionality to customize your screen display:

- **Maximize** – Enlarges the selected view to full window size. You can also access this function with the Maximize toggle control on the right side of the screen.
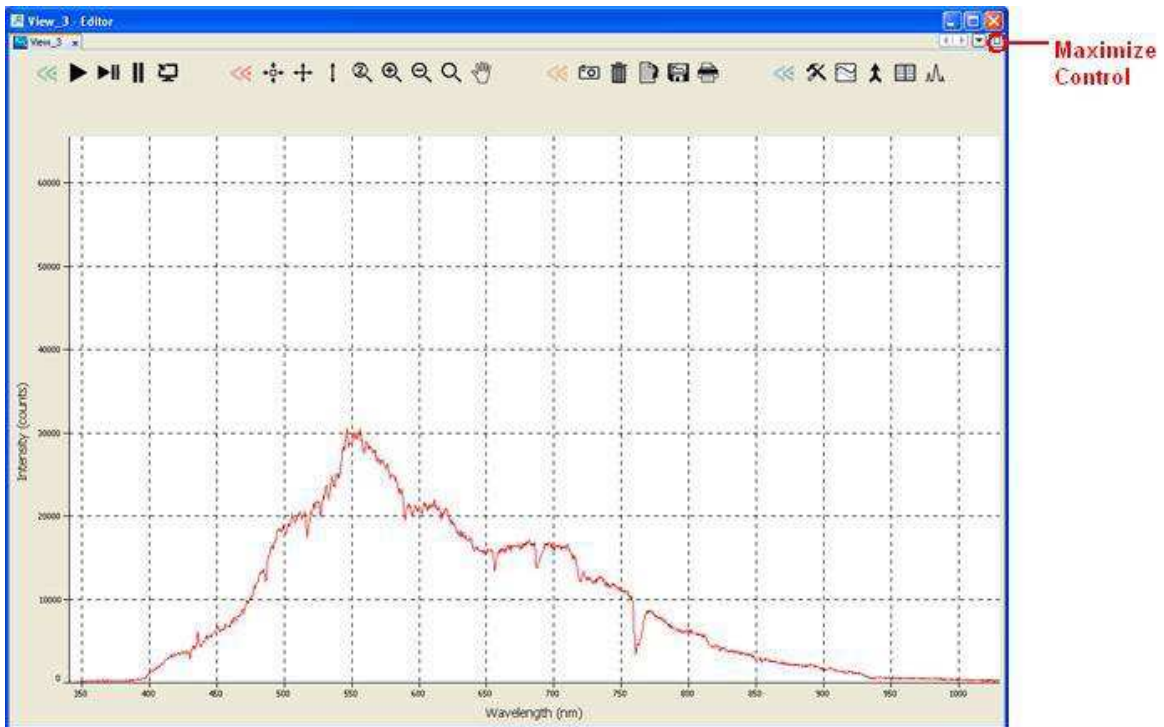
- **Float** – Opens the selected window in a new pane that you can drag to a desired location by pressing the left mouse button while in the header and moving the mouse. This function toggles with Dock.

- **Float Group** – Undocks the window with all views (minimized into tabs at the top of the window) in a pane that you can drag to a desired location by pressing the left mouse button while in the header and moving the mouse. This function toggles with Dock Group.
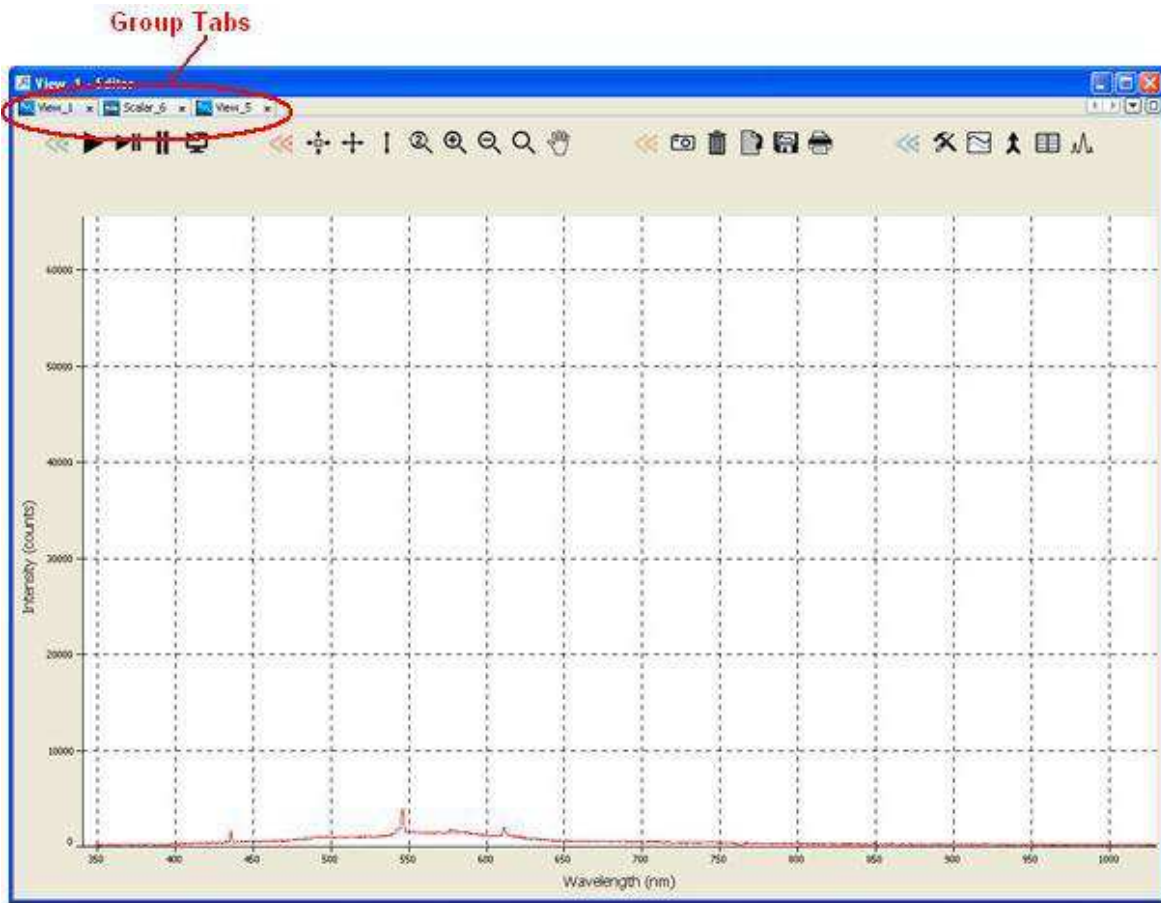
- **Minimize** – Shrinks all views in the window.

- **Dock** – Anchors a floating view to the main window. This function toggles with Float. Shortcut keys are also available for this function: Alt + Shift + D.

- **Dock Group** – Anchors all floating views to the main window. This function toggles with Float Group.

- **New Document Tab Group** – Displays the views stored as tabs in a split-screen window. Selecting **New Document Tab Group** displays the last view created. You can continue to select this option until all views are visible.
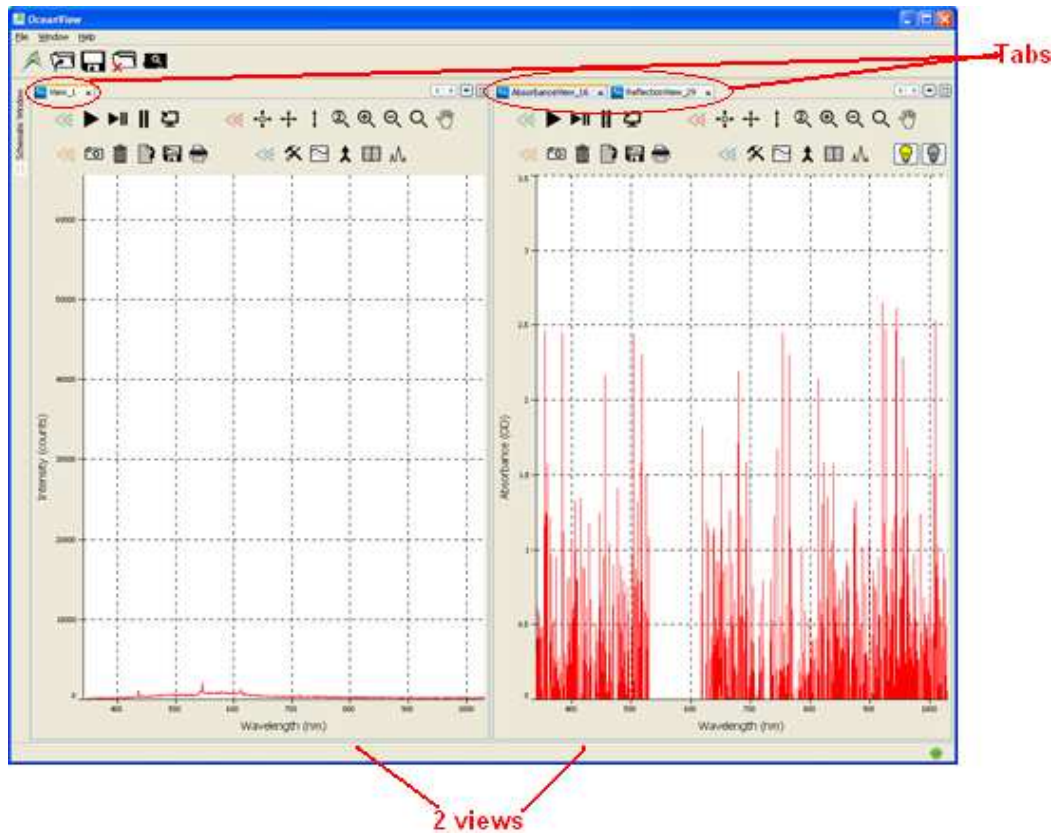
- **Collapse Document Tab Group** – Combines all views into the active window. The other open views are stored as tabs at the top of the window.
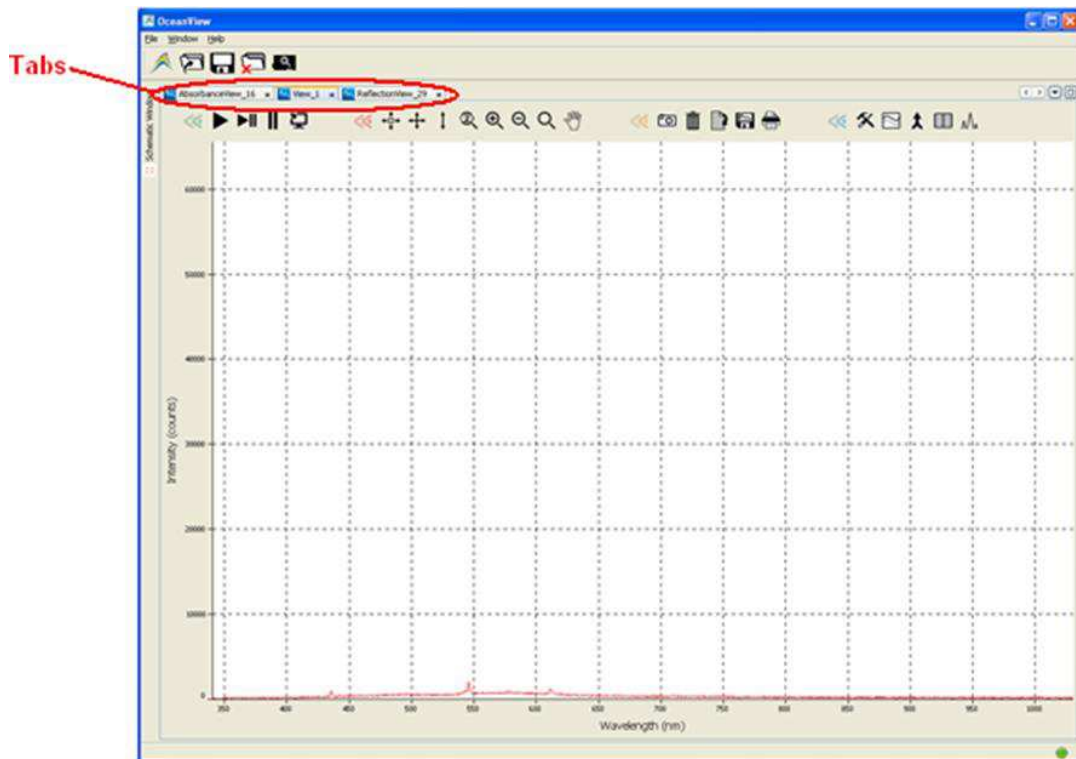
Help Menu

The Help menu consists of the following menu selections:

- *Welcome Screen*

- *Licensing* – Allows you to register your product. Also displays the software build date.

- **Help Contents** – Displays the full content of the OceanView help file

- **Check for Updates** – Connects to the Ocean Optics site to check for any updates to your OceanView software. OceanView software features one year of free web-based, automatic upgrades when you buy the software.

- **About** – Displays certain software and system specifications.

Chapter 4

Wizards

Overview

OceanView provides you with a wealth of functionality to capture, store and process your data. This chapter contains descriptions of wizards and other functionality. Also see Chapter 3: *User Interface* for more information on the menus and control buttons available on the OceanView user interface.

Select **File |Create new spectroscopy application** or click the Create new spectroscopy application icon to access the wizards.

Select Data Source Wizard

Selects the spectrometer to be used for the chosen wizard. When multiple devices are present, the selected one is shown in blue.

Set Acquisition Parameters Wizard

Sets the spectrometer measurement parameters and controls before any data capture occurs in the wizards. The panel has two tabs:

- **Main Controls** – Set the basic and advanced features of the attached spectrometer. The **Automatic** button in the **Integration Time** control box automatically adjusts the spectrometer's integration time to bring the highest point of the signal to 85% of full saturation value. This value is represented by the horizontal blue line on the preview graph.

  The integration time may also be set manually by using the numeric spinner control and the drop-down units menu. Note that the **Nonlinearity Correction** control is grayed out until the **Electric Dark** control is enabled. Also note that once a triggering mode for the spectrometer has been set, the device will wait for an external trigger before continuing. It will appear as though the spectrometer has locked up and no further data acquisitions will occur until the External Trigger pin on the device receives a signal.

Caution

If you have accidentally entered a trigger mode without an external trigger available, you must disconnect and reconnect the spectrometer to continue.

- **Add/Remove Controls** – Select which feature controls are displayed on the Main Controls tab. To enable a control, check the box next to that feature. Note that the Spectrometer feature is already checked and grayed out. This feature places certain necessary spectrometer controls on the **Main Controls** tab and cannot be removed.

- The Feature Control section allows you to control certain features of the spectrometer such as lamp and trigger controls.

► *Procedure*

1. To capture a reference spectrum,

2. Remove any samples.

3. Click the 💡 on the screen.

Select Spectroscopy Wizard

This wizard enables you to select one of the following spectroscopy wizards for processing your data:

- *Absorbance*
- *Concentration*
- *Transmission*
- *Reflectance*
- *Raman*
- *Fluorescence*
- *Absolute Irradiance*
- *Relative Irradiance*
- *Photometry, Photons, Power and Energy*
- *Color*

Absorbance

Absorbance spectra are a measure of how much light a sample absorbs. For most samples, absorbance relates linearly to the concentration of the substance. OceanView uses an equation to determine the concentration of a species in solution (illustrated below). The software uses this equation to evaluate each pixel on the detector and produce the absorbance spectrum:

$$A_\lambda = - \log_{10} \left(\frac{S_\lambda - D_\lambda}{R_\lambda - D_\lambda} \right)$$

Where:

A = Sample intensity at wavelength λ

D = Background intensity at wavelength λ

R = Reference intensity at wavelength λ

The concentration of a species in a solution directly affects the absorbance of the solution. This relationship, known as Beer's Law, is expressed as:

$$A_\lambda = \varepsilon_\lambda c\,\ell$$

Where:

A = Absorbance at wavelength λ,

ε_λ = Extinction coefficient of the absorbing species at wavelength

c = Concentration of the absorbing species and l is the optical path length of the absorption.

► *Procedure*

1. Invoke the Absorbance wizard from the Spectroscopy Application Wizards screen on the Welcome screen or by clicking the Create new spectroscopy application icon.

2. Select Absorbance only.

3. Set Acquisition Parameter controls.

4. Store Reference spectrum.

5. Store Background spectrum.

Concentration

Concentration is the amount of a specified substance in a solution. Graphs of absorbance vs. concentration are known as Beer's Law plots. These are prepared by measuring the light absorbed by a series of solutions with different known concentrations.

The length of the sample, such as the path length of our cuvette holder, and the wavelength chosen for monitoring the amount of light absorbed are constants. A linear plot from taking scans of these standard solutions with known concentrations is then obtained. The plot is then used to determine the unknown concentrations of substances in solutions.

► *Procedure*

1. Invoke the Concentration wizard from the Spectroscopy Application Wizards screen on the Welcome screen or by clicking the Create new spectroscopy application icon.

2. Select Concentration.

3. Choose between two different concentration models:

    a. Beer-Lambert Law -- Use this model when you know the Molar Extinction Coefficient (ε) and Path Length (*l*) of the unknown solution.

   b. Calibrate from solutions of known concentration using a series of known solutions

 4. Use the **Existing Absorbance** panel to select the absorbance process used to calculate the concentration data.

   c. If no absorbance process already exists, select **New** to begin. You will complete the steps for the _Absorbance_ wizard before being brought back to complete the Concentration wizard.

   d. If an Absorbance wizard has already been run, select it under **Select existing Absorbance process**.

Beer's Law

 5. Use the **Beer's Law** panel to set the parameters for your Beer-Lambert concentration experiment.

   a. The **Wavelength** box determines at what wavelength the absorbance will be evaluated. The concentration based on absorbance at this wavelength will be displayed in a scalar window upon completion of the wizard.

   b. **Concentration Units** allows you to enter in the appropriate units for display in the scalar window. Note that the units for the Molar Extinction Coefficient units will update when you click off of this box.

   c. **Molar Extinction** allows you to enter the Molar Extinction Coefficient of your solution. Note that the units on this coefficient are set by the previous box. For your final concentration to be displayed correctly, the Molar Extinction Coefficient must be converted to the appropriate units.

   d. **Path Length** allows you to enter the path length of the sample holder used in your concentration experiment. Note that the units of path length default to centimeters and cannot be changed.

   e. **Compound Name** allows you to set the name of the solution used in your concentration experiment. This name will be displayed in the scalar window upon completion of the wizard.

 6. Click **Finish** to complete and exit the wizard.

--OR--

Known Solutions

 5. Use **Calibrate from solutions of known concentration** to calibrate your concentration experiment using solutions of known concentration.

  - If you have a valid concentration file from a previous experiment that you would like to use, click Load File and select the appropriate .con file. The file will populate all necessary fields.

   - --OR--

  - If you are beginning a new experiment, begin by entering the Compound Name and Concentration Units in the boxes at the top of the panel. The Notes box is convenient for capturing any comments pertaining to the experiment.

   a. Build a table of known concentration and absorbance values. Begin by placing a sample of known concentration in the sample holder.

   b. Enter the sample's concentration in the **Concentration** box.

c. Click **Get Absorbance**. Note that you may need to click **Get Absorbance** twice to get an accurate value.

d. When you are satisfied with the absorbance value for the given concentration, click **Add Sample Point** to add the values to the data table.

e. Remove the sample and place a sample with a different concentration in the sample holder.

f. Repeat the above steps C -- E for all of your known sample concentrations.

g. Note that the graph in the lower left corner of the panel populates each new data point that is added and shows the trend line that best fits your data. If you need to remove a point from the data table, click on that row in the table to highlight it and then click **Remove Sample Point.** This point will be removed from the table and the graph.

6. Use the **Regression** box in the lower right corner of the panel to select between a first order (linear) regression and a second order (quadratic) regression.

a. The **Zero Intercept** check box will force the trend line to pass through the point 0,0 if selected.

b. If the **Zero Intercept** check box is not selected, the regression will use only the points listed in the above data table.

7. Click **Save File** near the top of this panel to save your data in a new concentration (.con) file that can be used to quickly set up this experiment in the future.

8. Click **Finish** to complete and exit the wizard.

Transmission

Transmission is the percentage of energy passing through a sample relative to the original reference amount. This is also the spectral processing mode used for reflection spectroscopy, as the math necessary to compute reflection is identical to that required for transmission. The wizard leads you to first store reference and background spectra before you can access Transmission mode.

OceanView calculates the transmission of a solution using the following equation:

$$\%T_\lambda = \frac{S_\lambda - D_\lambda}{R_\lambda - D_\lambda} \times 100\%$$

Where:

S_λ = Sample intensity at wavelength λ

D_λ = Background intensity at wavelength λ

R_λ = Reference intensity at wavelength λ

► *Procedure*

1. Invoke the Transmission wizard from the Spectroscopy Application Wizards screen on the Welcome screen or by clicking the Create new spectroscopy application icon .

2. Select either an active acquisition or start a new one.

3.   Set Acquisition Parameter controls.

4.   Store Reference spectrum.

5.   Store Background spectrum.

Reflectance

Reflectance is the return of radiation by a surface, without a change in wavelength. Reflection mode is also the spectral processing mode used for transmission spectroscopy, as the math necessary to compute transmission is identical to that required for reflectance.

Follow the wizard to take reference and background spectra before you can access Reflection mode.

OceanView calculates the reflection of a solution using the following equation:

$$\%T_\lambda = \frac{S_\lambda - D_\lambda}{R_\lambda - D_\lambda} \times 100\%$$

Where:

S_λ = Sample intensity at wavelength λ

D_λ = Background intensity at wavelength λ

R_λ = Reference intensity at wavelength λ

► *Procedure*

1.   Invoke the Reflectance wizard from the Spectroscopy Application Wizards screen on the Welcome screen or by clicking the Create new spectroscopy application icon .

2.   Select either an active acquisition or start a new one.

3.   Set Acquisition Parameter controls.

4.   Store Reference spectrum.

5.   Store Background spectrum.

Raman

► *Procedure*

1.   Invoke the Raman wizard from the Spectroscopy Application Wizards screen on the Welcome screen or by clicking the Create new spectroscopy application icon .

2.   Select either an active acquisition or start a new one.

3.   Set Acquisition Parameter Controls.

4.   Configure Raman:

   a.   Store Background spectrum.

   b.   Set the laser wavelength. This value allows the x-axis of the final graph to be converted to wavenumbers expressed in inverse centimeters.

c. Enter the correct laser wavelength (in nm) and then click **Apply**.

Fluorescence

A fluorescence measurement is a type of relative irradiance measurement in which the energy given off by materials excited by light at shorter wavelengths is measured. Advantages of fluorescence include high sensitivity, high speed (intensity changes on the order of picoseconds), and safety (nondestructive to sample and no hazardous by-products).

► *Procedure*

1. Invoke the Quick View Fluorescence wizard from the Spectroscopy Application Wizards screen on the Welcome screen or by clicking the Create new spectroscopy application icon .

2. Select either an active acquisition or start a new one.

3. Set the Acquisition Parameter controls.

4. Store a Background spectrum.

Absolute Irradiance

Irradiance is the amount of light present on a particular area, such as the fiber's cross-section at its tip, a cosine corrector's surface (CC-3 and CC-3-UV have a diameter of 3900, while the CC-3-DA is 7140), or the integrating sphere's surface (measures the total optical output of a light source inserted into the integrating sphere).

Absolute Irradiance Mode calculates the true irradiance of a spectrum, displayed in actual uW/cm^2/nm (or uW/nm when using an integrating sphere) incident on the probe's collection area. You do not need to store reference spectrum first since absolute irradiance is not relative to another measurement. However, you must store a background spectrum and have a calibration file before you can measure absolute irradiance.

If your spectrometer was calibrated by Ocean Optics, you should have received a CD containing the Radiometric Calibration Files specific to your spectrometer. If you have these files, select **Get Irradiance Calibration from File**.

If you do not have these files, select **New Calibration** to create your own spectrometer calibration files using calibrated light sources that have known spectral output (microwatts per square centimeter per nanometer).

► *Procedure*

1. Invoke the Absolute Irradiance wizard from the Spectroscopy Application Wizards screen on the Welcome screen or by clicking the Create new spectroscopy application icon .

2. Select either an active acquisition or start a new one.

3. Select the calibration source to begin the irradiance calibration of your spectrometer:

    - **Get Irradiance Calibration from File**: Loads a previous irradiance calibration using an existing .cal or OOIIrrad.cal file.

    - **New Calibration:** 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.

4. Load a previous irradiance calibration file into the wizard. The file must be a .cal or OOIIrrad.cal file. The spectrometer serial number and collection area will be automatically set based on information stored in the file. The message in the lower left corner of the window will update upon successful loading of the calibration file.

5. 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.

6. 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.

Relative Irradiance

Before you can access Relative Irradiance mode, the wizard leads you take a reference spectrum of a blackbody of known color temperature. Then, you must obtain a background spectrum by removing the fiber from the reference lamp and preventing light from entering it.

Relative irradiance spectra are a measure of the intensity of a light source relative to a reference emission source. OceanView calculates relative irradiance using the following equation:

$$I_\lambda = B_\lambda \left(\frac{S_\lambda - D_\lambda}{R_\lambda - D_\lambda} \right)$$

Where:

B_λ = Relative energy of the reference calculated from the color temperature

S_λ = Sample intensity at wavelength *l*

D_λ = Background intensity at wavelength *l*

R_λ = Reference intensity at wavelength *l*

▶ *Procedure*

1. Invoke the Relative Irradiance wizard from the Spectroscopy Application Wizards screen on the Welcome screen or by clicking the Create new spectroscopy application icon .

2. Select either an active acquisition or start a new one.

3. Set Acquisition Parameter controls.

4. Store Reference spectrum.

5. Store Background spectrum.

6. Select **Color Temperature**. Set the color temperature of the light source used for the reference spectrum. The color temperatures of several Ocean Optics light sources are shown in the table. Click on any of the sources in the table to populate the Color Temperature box at the top of the window with the appropriate value.

Photometry, Photons, Power and Energy

This wizard enables you to take photometry measurements such as luminous flux (lumen), illuminance (lux), and luminous intensity (candela). Photopic/Scotopic values are calculated over a 380 to 780 nm wavelength range. Scotopic conditions are defined when the luminance is between 10-2 and 10-6 of a candela per square meter (cd/m2). The difference between this scotopic vision (low-level condition) compared to a photopic (high-level condition) affects the calculations for luminous flux (lumen), illuminance (lux), and luminous intensity (candela) by using the $V'(\lambda)$ scotopic luminosity function instead of the $V(\lambda)$ photopic luminosity function.

This wizard also enables you to measure integrated intensities. Radiometric values require that you specify the wavelength range.

► *Procedure*

1. Invoke the Photometry, Photons, Power and Energy wizard from the Spectroscopy Application Wizards screen on the Welcome screen or by clicking the Create new spectroscopy application icon ( ).

2. Select the absolute irradiance process used to calculate the Photometry, Photons, Power and Energy data.

   a. If an absolute irradiance wizard has already been run, you can select it with **Get Calibration from File** or **Get Irradiance Calibration from Spectrometer**.

   --OR--

   b. If no absolute irradiance process already exists, select **New Calibration** to begin.

3. Follow the remaining steps in the wizard to get the desired data.

Color

With OceanView, you can calculate and report the Color Rendering Index (CRI) and Correlated Color Temperature (CCT) for your samples. OceanView will compute all color measurements except RGB.

- Emissive color measurements – Require a spectrometer, which has been calibrated to take irradiance readings (either relative or absolute). OceanView gives you the option of choosing to measure either emissive or reflective color from either absolute or relative irradiance.

- Reflective color measurements – Do not require an irradiance calibration, but they do require a reference spectrum. This reference scan is taken with the same optical configuration, except a perfect reflector is placed at the same location as the samples.

► *Procedure*

1. Invoke the Color wizard from the Spectroscopy Application Wizards screen on the Welcome screen or by clicking the Create new spectroscopy application icon .

2. In the **Color Source** panel, select the processing method used to calculate color data. By choosing any of the first three options, the wizard will guide you through the steps associated with your choice before being brought back to complete the color wizard. If there is a suitable existing process that has already been completed, this will be available to select under the last option, **Existing processing**. Select the desired process and click Next. Note that Correlated

Color Temperature (CCT) and Color Rendering Index (CRI) will not be available if you choose a Percent Reflection as your processed data source.

3. In the **Color Setup** panel, the Display Parameters portion allows you to choose which color values are displayed upon completion of the wizard. All applicable values will be added to a color table for display. Note that Correlated Color Temperature (CCT) and Color Rendering Index (CRI) will not be available if you chose Percent Reflection as your processed data source.

Peak Metrics Wizard

Create thresholds on your spectral graph to isolate peaks using the Peak Metrics Wizard.

► *Procedure*

1. Invoke the Configure Peak Metrics wizard by clicking the View spectrum peaks icon .

2. Use the **Select Processed Node** panel to choose which data node supplies the information for the calculation of peak values. Select the desired device or node by clicking on that row in the table. The selected source will be highlighted in blue. Click **Next** to proceed.

3. Use the **Configure Baseline** panel to subtract off any underlying spectral structures that may obscure the peaks that you are trying to identify.

    -   **None** -- The peak finder will evaluate all peaks at any y-axis value.

--OR--

    -   **Advanced** -- Allows you to adjust the spectrum to eliminate any non-pertinent data. **Advanced** activates the advanced features and the window's preview graph illustrates how the changes affect which peaks will be evaluated. As the advanced parameters are adjusted, the preview spectrum in the graph changes position. Only peaks visible above the preview graph's x-axis will be evaluated by the peak finder.

    -   Use the **Horizontal threshold** adjustment when your data has a relatively flat baseline structure with protruding peaks (like the spectrum of an Ocean Optics HG-1 mercury line light source). The value entered into the horizontal threshold box is subtracted off the y-axis value of each pixel. As the horizontal threshold value gets larger, the preview spectrum drops closer to the x-axis and fewer peaks will be analyzed.

    -   **Curve fit regression** attempts to eliminate any underlying base structure by subtracting off a best fit polynomial from the spectrum. This is useful when there is an underlying curve with superimposed peaks. An Ocean Optics PX-2 pulsed xenon light source is a good example of a blackbody curve with protruding atomic emission peaks. In order to eliminate the underlying blackbody structure and expose the emission peaks, a curve fit regression can be used to match and subtract the blackbody shape. A curve fit regression of order 0 subtracts a constant that best fits the data (the average). A first order polynomial subtracts off a straight line that best fits the data. A second order regression subtracts off a parabola that most closely matches the data shape. As the order number increases, the underlying curve is more closely matched and subtracted away, leaving only the sharper peaks.

4. Click **Next** after selecting the desired settings.

5. Use the **Peak Finder** panel to characterize which of the remaining spectral features should be evaluated. Different methods of peak analysis may be used as well as different filtering options to reduce unwanted noise effects. The preview graph at the bottom of this panel displays the adjusted spectrum from the previous panel.

c. There are two peak finding methods available:

Local Maxima -- searches for all of the local maxima that fall within the user-defined search parameters established in the previous wizard panel.

--OR--

Derivative -- selecting this option requires that you choose a derivative order number. A first derivative search will locate all points where the first derivative of the spectrum is zero (stationary points). A second derivative search will locate all points where the second derivative of the spectrum is zero (inflection points). For either method, you must choose a minimum peak width. This parameter, measured in nanometers, will exclude any peaks that are narrower than the user-defined value. This is useful for eliminating small, random fluctuations due to noise. Note that the number of peaks shown in the blue text in the **Controls** section will vary based on user-defined parameters entered in the **Peak Finder** and **Baseline Estimation** wizard panels.

d. **Smoothing** -- To apply spatial filtering to reduce adjacent pixel discrepancies and the unwanted effects of noise, choose from the following:

Boxcar -- Simple boxcar filtering is a specialized case of Savitzky-Golay filtering where the polynomial order is 0.

--OR--

Savitzky-Golay -- For a Savitzky-Golay filter, the Polynomial order number must be less than the **total** number of pixels used in the filter. If the Filter Span is set to 2, the Polynomial order number must be set to 4 or less.

--OR--

None -- To proceed without any spatial filtering.

e. **Filter Span** -- Be aware that the number of pixels used in the filter is actually 2n+1, where n is the number displayed in the user-defined box. If 2 is entered in the box, for example, a total of 5 pixels are used in the filter (2 to the left + 1 center pixel + 2 to the right).

6. Click **Next** after selecting the desired settings.

7. Use the **Select Displayable parameters** panel to select which values will be calculated and displayed on the graph.

8. Click the **Show table of values** box to display these same values in a table. Check the box next to any values you wish to display. The **Rotate text on View Graph** option will change the displayed values from a vertical orientation to a horizontal orientation on the graph.

9. Click **Finish**.

Strip Chart Wizard

OceanView allows you to use Strip Charts to track processes, perform kinetic analyses, and monitor spectral events all as a function of time. The Strip Chart shows you how the value that you selected appears over time. This value can be any of the following:

- One pixel (a single wavelength)

- A ratio of two pixels (a ratio of two wavelengths)

- The average of a range of pixels

- An integral calculated by one of three methods representing the area beneath the graph's trend line

You can acquire this data using any processing mode (transmission, absorbance, etc.).

► *Procedure*

1. Invoke the Strip Chart wizard by clicking the Create strip chart icon ▱.

2. Use the **Source Selection** panel to select the source of data for the strip chart. Data can be pulled from different devices and different schematic nodes. Select the desired device or node by clicking on that row in the table. The selected source will be highlighted in blue.

3. In the **Wavelength Selection** box, choose,

    - **Range Selection** to chart data from a single wavelength, the average over a range of wavelengths, or integrate over a range of wavelengths and display the result

    --OR--

    - **Ratio of Wavelength** to choose different values for the numerator and denominator and display the ratio of the two values. When choosing the values for numerator and denominator, select data from a single wavelength, the average over a range of wavelengths, or integrate over a range of wavelengths.

4. Use the **Update Rate** panel to set the data update rate and time parameters for the strip chart. Data can be plotted on the strip chart after every scan or every nth scan, where n is a user selected value.

    To plot data after every scan, select the first option in the window.

--OR--

    To plot data after every nth scan, select the second option in the window and enter your value for *n* in the active box.

5. Select how long the strip chart runs before stopping using the following buttons:

    a. Click **Stop after this many scans** and enter a value in the active box so that the strip chart will only run for the desired number of integration cycles before stopping.

    --OR—

    b. Click **Stop after this amount of time** and two boxes will become active. Enter a numerical value in the active box to the left and select the desired units in the active box to the right. Now the strip chart will only run for the specified length of time before stopping.

--OR--

    c. Click **Never Stop** so that the strip chart will continue to run without stopping.

6. Use the **Wavelength Selection** panel, the **Select Numerator** panel and the Select Denominator panel to choose to select among the following values for the wavelength, numerator, and denominator respectively:

    a. Click the button next to **One wavelength** and enter the desired value to select a single wavelength to chart. Make sure your value falls within the wavelength range of the selected spectrometer or data node. OceanView will select the pixel that is closest to the value entered.

--OR--

    b. You may choose to display the average result from a range of wavelengths by selecting **Average from**. When you select this option, two boxes become active. These boxes represent the lower and upper wavelength values over which OceanView will compute an average value.

--OR--

    c. You may also choose to display the integrated result over a range of wavelengths by selecting **Integrate over**. When you select this option, three boxes become active. The top two boxes represent the lower and upper wavelength bounds over which OceanView will compute an integral. The last box allows you to set the integration method. You may choose between Rectangular, Trapezoidal, or Simpson's Rule.

The Strip Chart offers the same functionality available with the Graph View Controls with the addition of the Strip Chart Configure Time Control.

Strip Chart Configure Time Control

The ⊘ control on the Strip Chart displays the Algorithm Parameter Controls dialog box, which allows you to adjust the trend update rate.
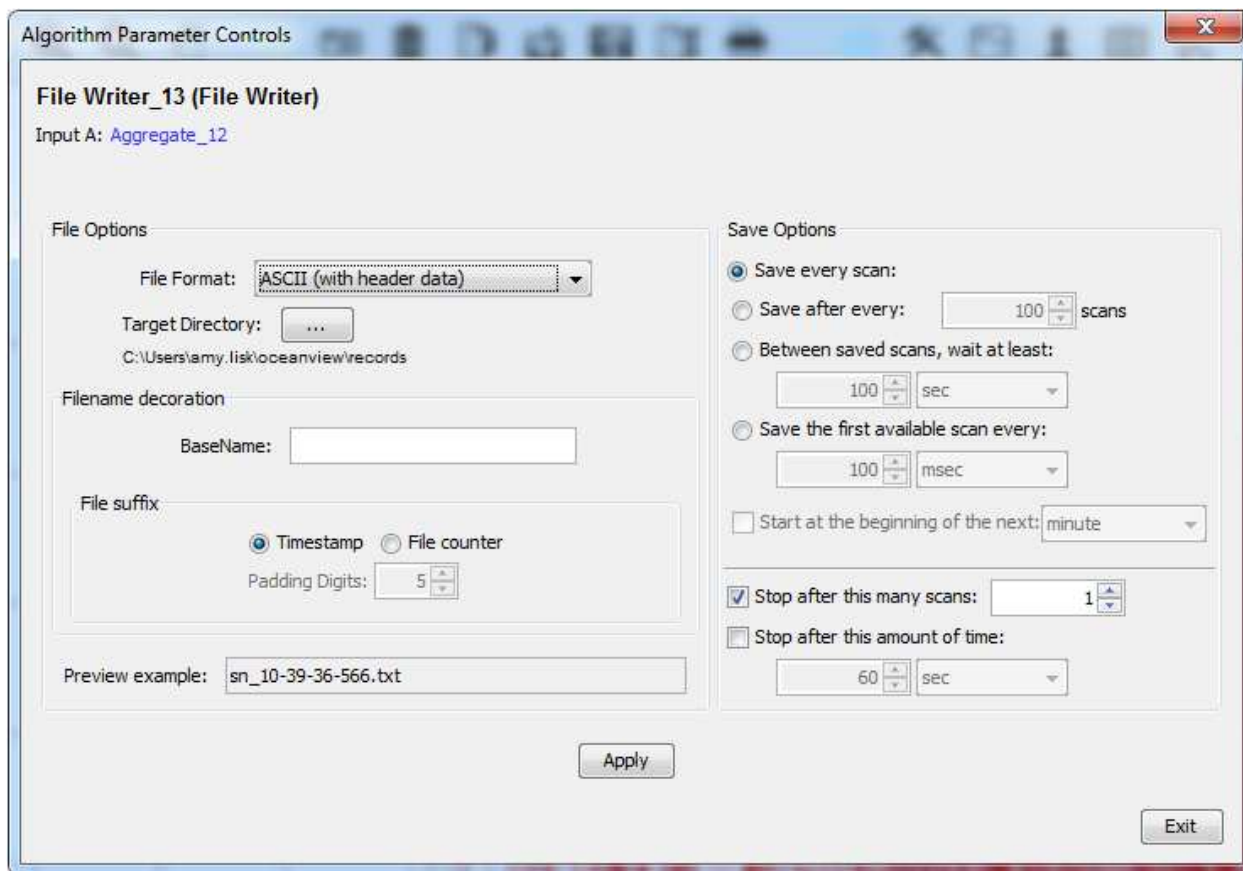
Splicing Spectral Data

OceanView has a post-processing mode that allows you to splice spectral data from multiple spectrometers into a single spectrum. Note that spectral splicing can only be done with processed spectra: Absorbance, Reflection, Transmission, Relative Irradiance or Absolute Irradiance.

► *Procedure*

1. Open the Splice Spectra dialog box by clicking the Splice Spectra button (⋏) in the Graph View window.

2. Click the **Add Range** button to select sources of processed data for the spliced spectrum.
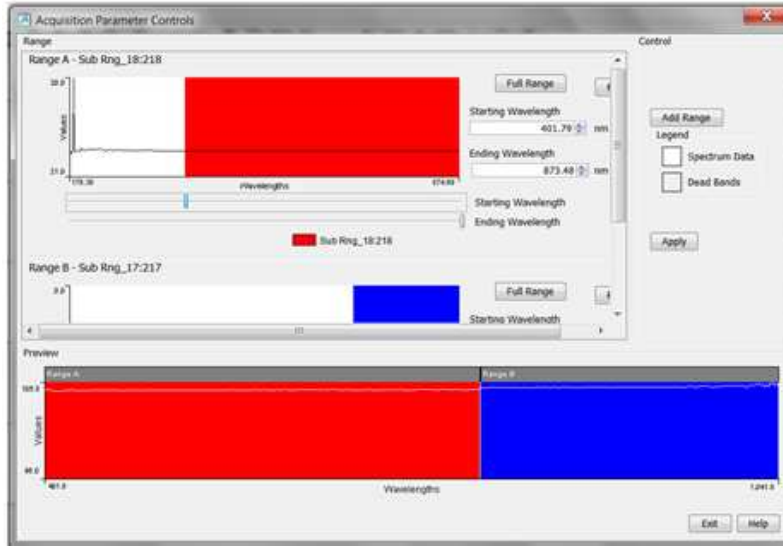
3.   Adjust the spectral ranges for the sources and click **Apply** to splice the spectra into a single spectrum.

Chapter 5

Schematic View

Overview

The Schematic View presents data from your device(s) in a diagram format with icons representing the different devices and processes in your project as nodes and links between the nodes. In the Schematic, you can view and manipulate the flow of data from your spectrometer through your processing steps. Data flow is represented by the use of arrows and lines that connect different nodes. The nodes represent points where data is processed or manipulated. The Schematic View provides you with all of the functionality of the Window view, plus the following enhanced capabilities:

- Algorithm nodes – allow for math functions such as ratios, adding multiple spectra, and adding a constant to spectra.

- Set a subrange – ability to focus on a specific subset of the spectrum

- Interpolate spectral data – evenly space data from two or more spectra to analyze them mathematically

- Retrieve device properties such as serial number, firmware version, wavelength and total number of pixels

- Send a single value (such as TEC temperature, integral, average over a specific wavelength range) from the device to the Scalar view to analyze the value over time

- Preview spectra in graphs at every step in your process

- Easily add new Graph and Table Views

Using the Schematic View

Spectrometers

All spectrometers detected by the software are automatically placed on the Schematic.

- Add new devices to the Schematic using the Device Manager button ( ) or pressing the F5 key. Click Rescan to scan and connect to new devices.

- Double-click the spectrometer icon to open the Device Features window and view all available device characteristics (serial number and firmware version).

Acquisitions

Start a new acquisition for a spectrometer by right-clicking the spectrometer icon and selecting New Acquisition to choose from the list of available acquisitions.

- Double-click the Acquire node to open the Acquisition Parameter Controls menu and configure the acquisition.

- Adding Nodes to the Schematic: Add a data view (Graph, Scalar or Table view windows) or processing nodes to the Schematic by right-clicking on an empty region of the Schematic and selecting a node from the menu.

- To connect nodes:
    - For PC users: Hold down the Control key and left-click on the first node. While still holding the mouse button, drag a wire from the first node to the second node. When the cursor is over the second node, release the mouse button and the Control button: Control + Click + Drag
    - For Mac users: Hold both the Shift key and the Control key while wiring a connection: Control + Shift + Click + Drag

- Double-click a node to view available feature controls and access context sensitive help.

- Delete a connection between node by moving the cursor over the wire, right-clicking on it and selecting **Delete Connection**. Right-click the node to Rename, Duplicate or Delete it.

- Double-click a View node to go to the **Data View** window for that node.

- If two nodes cannot be connected, OceanView will not allow you to make the connection. View the context sensitive help for the node to determine the proper connection by double-clicking the node and clicking the **Help** button.

Tip

Use the Wizards to create your Schematic and customize as desired using more than 70 algorithm nodes.
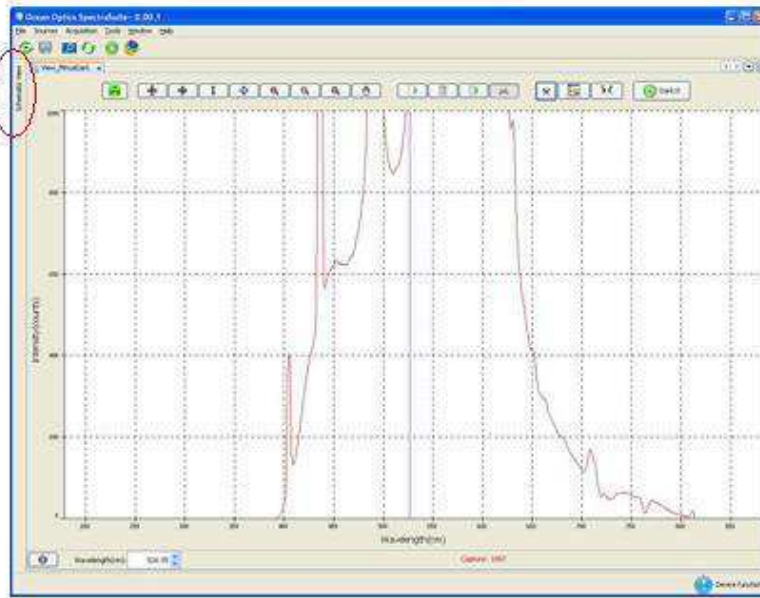

Displaying the Schematic View

When you first invoke OceanView, the Schematic View is minimized on the left side of the View Window.
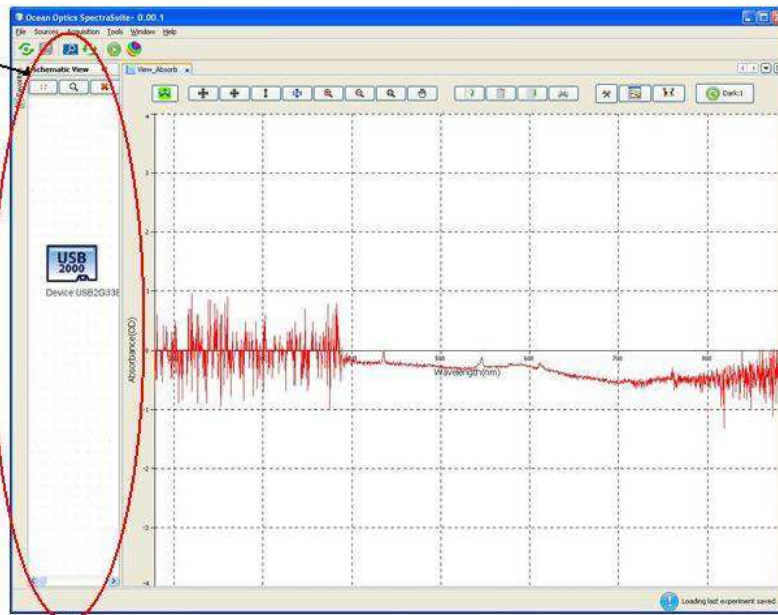
Sizing the Schematic View

The Schematic View can appear on your OceanView screen in one of three sizes as shown below:
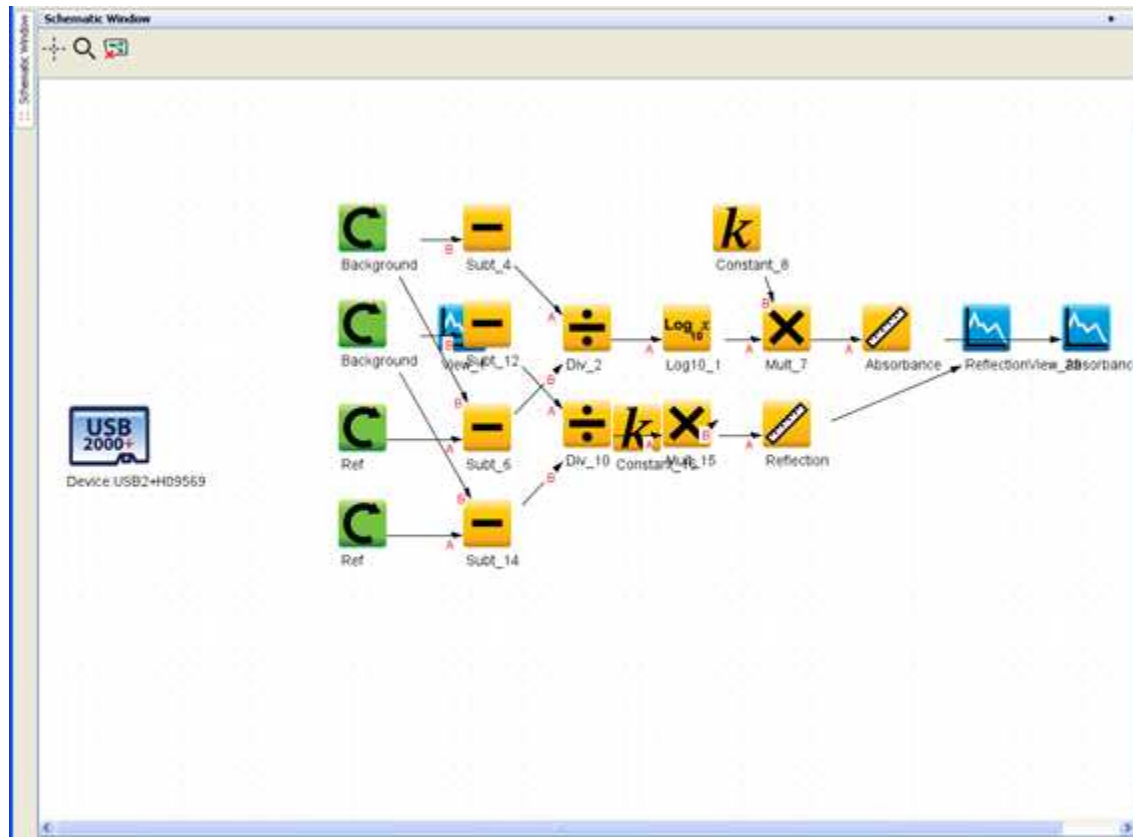
Docked Schematic View

Minimized Schematic View

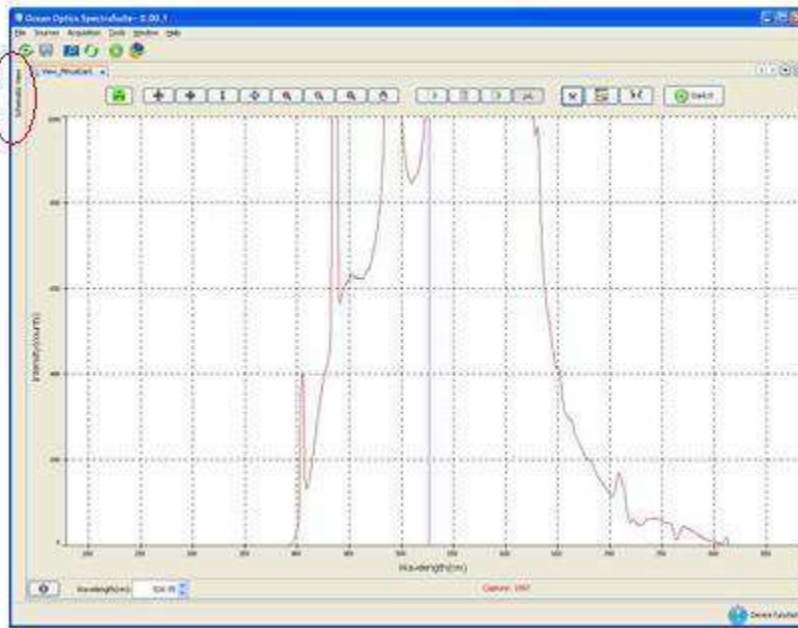**Maximized Schematic View**

Resizing from Docked View

When the Schematic View is totally collapsed and docked on the top-left side of your screen, click on or just hover over the words **Schematic View** docked on the left side of the window to maximize this view. This is a toggle control so clicking on the words again or sliding cursor off the window collapses the Schematic View and docks it again.
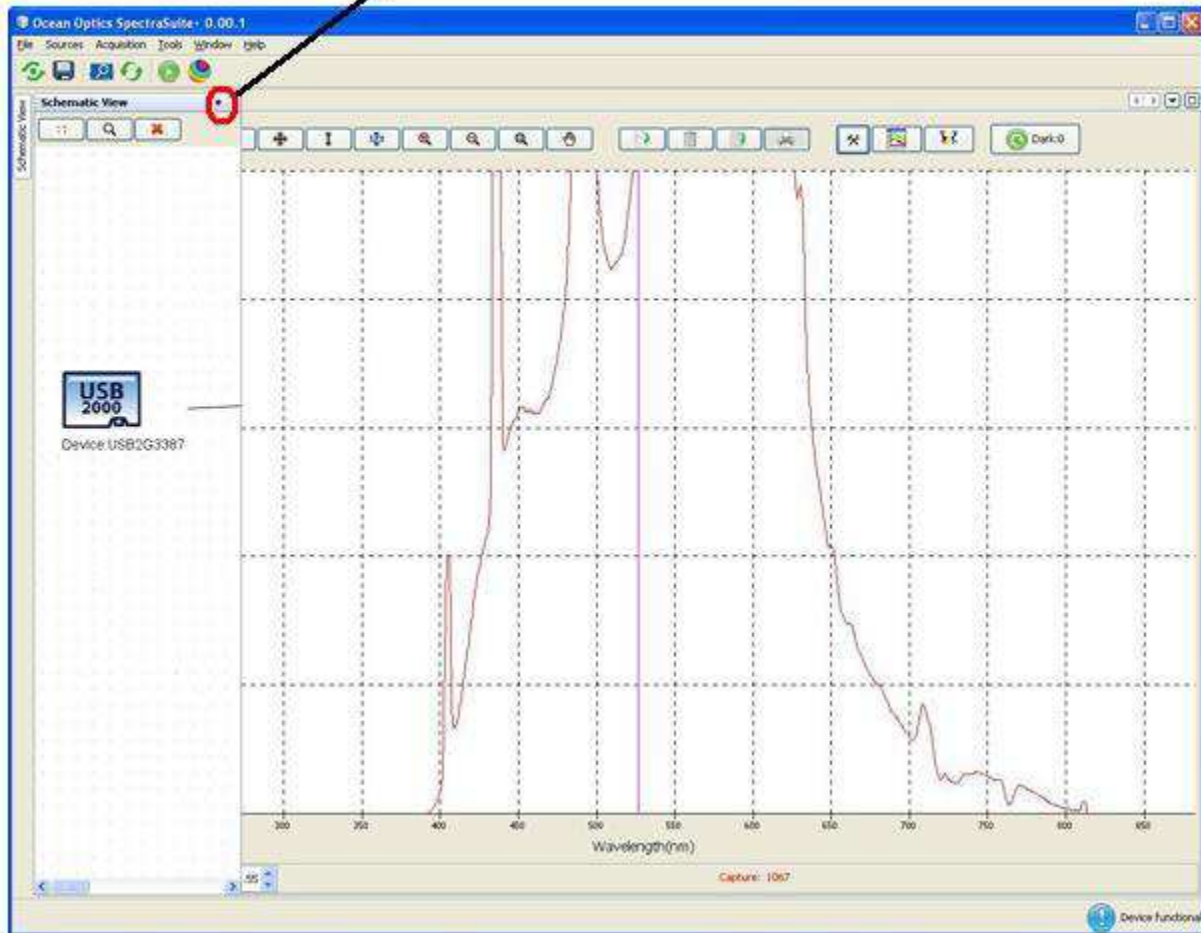
Click to display Schematic View

Resizing from Minimized View

To resize the schematic to the Minimized view when it is docked, you must first maximize it, and then click the pin in the upper-right corner. Once you have pinned the view, you can minimize using the Minimize control (⏮).

Views can also be sized by dragging on the edge to the desired size.

Minimizing

Use the Minimize control (available once the view has been pinned) or drag the view from its edge to the desired size.
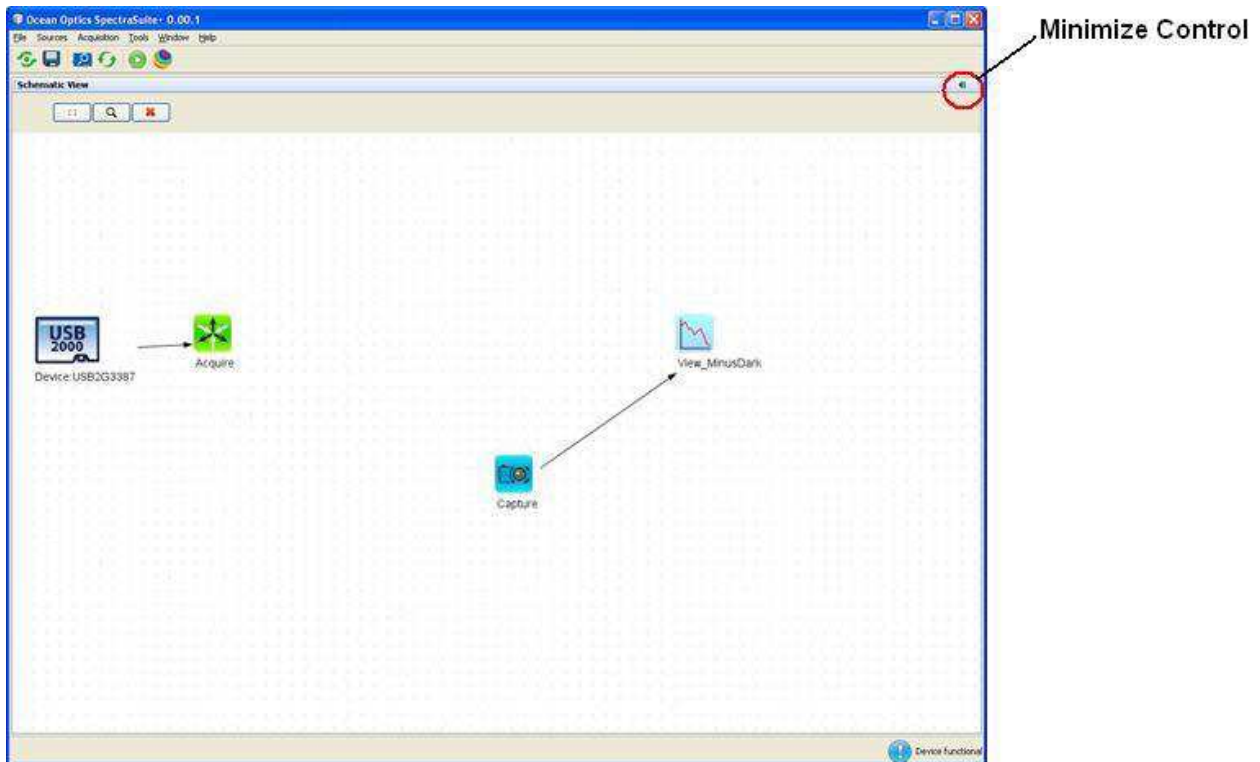
Schematic Icons

The Schematic View provides you with a visual way of controlling your method devices, connections and operations.

Schematic View icons consist of devices, nodes, connectors, and controls.

Devices

A unique device icon should be present on the schematic for each device managed by OceanView. Below each device icon is the device serial number as shown in the following example:

To delete a device from the schematic, right-click on the desired device icon and select **Remove Device**.

Nodes

Nodes graphically represent a static data capture from an acquisition on the Schematic View. Nodes are categorized in OceanView based on their function as follows:

- Acquire Node

- Constant Nodes

- Basic math Nodes

- Advanced Math Nodes

- Source Nodes

- Bounds Nodes

- Views Nodes

► *Procedure*

To create a schematic node,

1. Right-click on the schematic, and then select the desired node from the list.

2. Double-click on the node to display its associated Node Parameter Controls dialog box.

3. Make your selections.

4. Connect the appropriate nodes as shown in the tables below to view the output.

To delete a node, right-click on the node and select **Delete**.

Acquire Node

The Acquire node () is the source of your data acquisition. An Acquire node should be present for each device managed by OceanView. Create an Acquire node on the schematic by one of the following methods:

- Right-click on the desired device and select **New Acquisition**.

- Select Acquisition | New Acquisition from the menu.

- Click on the New Acquisition control () in the toolbar.

- Type the shortcut Ctrl + N

Double-click on the Acquisition node to display the Acquisition Node Parameter Controls dialog box.

To create a new view of the selected acquisition, right-click on the Acquisition node and select **New View**.

To delete the acquisition node and all connected nodes, right-click on it and select **Remove Acquisition**.

Creating a Schematic View

A schematic view can be created by selecting **Window | Schematic**.

► *Procedure*

1. The first step to using OceanView in the Schematic View is to place a spectrometer on the schematic. Each time you start OceanView, the software looks for attached devices. Any detected spectrometers are automatically placed on the schematic diagram.

If no device is present when you start OceanView, you will be asked if you wish to add a simulated spectrometer. The simulated spectrometer produces a wide variety of idealized spectral data which can be fed into different nodes for processing or viewing.

   a. If no spectrometers are present on the schematic, or you wish to add an additional spectrometer, click **Device Manager** at the top of the window or press the F5 shortcut key.

   b. In the **Device Manager** window, click **Rescan** and OceanView will automatically check for USB-connected devices. If the "Automatically connect to devices" box is checked, OceanView will add all detected spectrometers to the schematic. If the box is not checked, all detected devices will be listed in the table.

   c. To add a specific device from the list to the schematic, click on the spectrometer you want to add and click Connect.

   d. To add an Ethernet-connected device (like a Jaz spectrometer), click **Add Device**. In the pop-up menu, add the IP address of the device and click **Accept**.

2. Once a spectrometer has been added to the schematic, an Acquisition (Acquire) node is necessary to extract information from the device. To drop an Acquisition (Acquire) node on the schematic, right-click on the spectrometer icon and select **New Acquisition** to see a list of available choices. The type of device determines which Acquisition (Acquire) nodes are available.

3. To collect spectral data from the device, click **Spectrometer**. This node is automatically wired to the spectrometer and cannot be duplicated or transferred to a different device.

4. To access and alter device features, double-click on the Acquisition (Acquire) node to open the Acquisition Parameter Controls menu. Here you can see a graph preview and adjust various parameters like Integration Time and Signal Averaging. These represent the basic spectrometer controls. Add additional controls to the **Main Controls** tab by clicking on the **Add/Remove Controls** tab and checking the boxes next to the desired feature. The controls for these features will show up on the **Main Controls** tab. Unchecking a feature only hides the controls; it does not disable that feature. The spectrometer type will determine which controls are available in the **Add/Remove Controls** tab.

5. Once you have a spectrometer icon and an Acquisition (Acquire) node on your schematic, you are ready to add data processing nodes. In OceanView, data can be static (unchanging) or dynamic (fluctuates in time). Data can be further classified as scalar (a single value) or array (set of values). Arrays can be one dimensional (for example, the set of wavelength values that represent each pixel in the spectrometer) or two dimensional (the set of wavelength and intensity values for each pixel; this is what comes out of a Spectrometer Acquisition (Acquire) node). Each schematic node can be described by the type of data it accepts (input) and by the type of data it produces (output). By understanding the input/output characteristics of the different nodes, you can see how they can be wired together.

6. To place a new node on the schematic, right-click on an empty section of the schematic diagram. A menu containing a categorized list of all available nodes pops up. Navigate through the menu

and select the appropriate node by left-clicking on it. The new node will be dropped on the schematic panel in the location where you originally right-clicked.

7. For most nodes, right-clicking on the node allows you to Rename, Duplicate, or Delete that node. Right-clicking on an Acquire node also allows you to take a snapshot of that node. A snapshot captures the most recent spectral acquisition and stores it within a Data Source (DataSource) node. Right-clicking on the spectrometer icon allows you to place a variety of Acquisition (Acquire) nodes and Output Control (Output Control) nodes (depending on the spectrometer model). Output Control (Output Control) nodes feed data into the spectrometer allowing you to alter its feature parameters using the schematic node data as opposed to making adjustments through the Acquisition Parameter Controls within the Acquisition (Acquire) node.

8. To access and adjust the feature controls of any node on the schematic diagram you must double-click on it. A window opens allowing you to view the data at that point and to make any necessary changes. The only exceptions are the blue View nodes and the spectrometer icon. Double-clicking on a View node exits the Schematic view and activates the Graph View window, allowing you to see your data. Double-clicking on the spectrometer icon opens the Device Features window, allowing you to see all available device characteristics (such as serial number and firmware version).

9. On the schematic diagram, arrows represent the direction in which data flows. To wire a connection between two nodes, make sure that the output data type of the first node matches the input data type of the second node.

  - For PC users, hold down the Control button and left-click on the first node. While still holding the mouse button, drag a wire from the first node to the second node. When the cursor is over the second node, release the mouse button and the Control button.
  - For Mac users, hold both the Shift button and the Control button while wiring a connection.

10. If the input/output data types are incompatible, OceanView will not allow you to make the connection. To delete a connection between nodes, move the cursor over the wire and right-click on it. Select "Delete Connection" to erase the wire. On the OceanView schematic, solid lines represent data that is periodically updated whereas dashed lines indicate data that is only sent one time (like in the case of a Data Source (DataSource) node).

11. The actual location of individual nodes on the schematic diagram is purely cosmetic and nodes can be moved around without impacting the data flow path. The connection between nodes stretches or shrinks as well as changes direction when nodes are moved around. To change the position of a node, move the cursor over the node and left-click and hold the mouse button down while dragging the node to its new location.

12. Using the grid dots on the schematic can help you keep your diagram organized. To shut off the grid dots, click ✛ in the Schematic Window toolbar.

13. As your schematic diagram grows, you may need to expand the size of the schematic window. You can do this by dragging any node past the edge of the window and dropping it. Scroll bars will appear at the edge of the schematic window to allow you to move around the newly enlarged area. Once you have expanded your schematic window, you can use 🔍 in the Schematic Window toolbar to see an overview of the diagram. By dragging the gray box in the overview, you can quickly move to any area of the schematic diagram.

14. The final way to adjust the size of the schematic window is by holding down the Control key on the keyboard and rotating the center wheel on the mouse. This will zoom the schematic window in or out depending on which way it is turned.

15. The ![icon] button clears all nodes (except the spectrometer icon) from the schematic diagram, allowing you to start with a clean slate.

16. Once data has been acquired and processed, the end result can be displayed in the Graph View using the blue View nodes. Spectral data can be shown by wiring it into a Graph View or Table View node.

   • Multiple spectra can be fed into one Graph View node or one **Table View** node for display.

   • Scalar data can be displayed using a **Scalar View** node.

   •The **Color View** node is used for displaying the CIE x and y color space values from a Reflective Color (Refl Color) or Emissive Color (Emiss Color) node. Both the **Scalar View** and **Color View** nodes can only accept one data input. Placing any of these view nodes on the schematic will cause the associated panel to open on the Graph View window. Each of these views has a set of controls that is accessible through the Graph View.

Order of Operations

Use the following sequence to connect nodes in the Schematic View.

► *Procedure*

1. Right click on the spectrometer in the schematic window and select New Output Control.
2. Select the GPIO and set up your GPIO options.
3. Connect the GPIO node to the Acquire node as shown above.
4. Call up the other nodes, sub range, subtract, and constant.
5. Enter a wavelength value in the subrange node and connect it to the Acquired node.
6. Enter a value into the constant node.
7. Connect the subrange and constant nodes to the subtract node.
8. Connect the subtract node to the GPIO node.

Icon Definitions

The Schematic View Icons are described in alphabetical order below.

Absolute Value (Abs)

Outputs the absolute value of the input data.

Location: Basic Math-->Absolute Value

Number of Inputs: 1

Type of Inputs: scalar or array

Type of Output: scalar or array

User Controls: N/A

Acquisition (Acquire)

Acquires data from a device and allows you to monitor and alter certain device parameters.

Location: Right-click a device icon and choose one of the options under the New Acquisition menu.

Number of Inputs: 1

Type of Inputs: device

Type of Output: Depends on the type of acquisition and the device.

User Controls: Depends on the type of acquisition and the device.

Notes: Different types of acquisitions are available for different devices. Acquisition choices may include: Spectrometer, I²C, SPI, Board Temperature, Thermo-Electric Cooling, and Analog In. The user controls that are available vary based on the type of acquisition selected.

Add Color View (Color)

Adds a new CIE 1931 chromaticity diagram to the View Window.

Location: Views -->Add CIE.1931 Color View

Number of Inputs: 1

Type of Inputs: EmissChrom node or ReflChrom node

Type of Output: N/A

User Controls: Planckian Locus on window view may be toggled on or off.

Notes: Click the Color node to open the Color View window. The Planckian Locus button is located in the upper left corner of the Color View window.

Add Graph View (View)

Adds a new graph to the View Window.

Location: Views -->Add Graph View

Number of Inputs: infinite

Type of Inputs: array

Type of Output: N/A

User Controls: See the Graph View window

Notes: Click the Graph View node to open the Graph View window.

Add Scalar View (Scalar)

Adds a scalar view to the View Window.

Location: Views -->Add Scalar View

Number of Inputs: 1

Type of Inputs: scalar

Type of Output: N/A

User Controls: The Configure View Parameters button in the upper left corner of the Scalar View changes the background color, font color, font style, and font size in the Scalar tab of the options window.

Notes: Click the Scalar View node to open the Scalar View window

Add (Add)

Adds the values of inputs together.

Location: Basic Math -->Add

Number of Inputs: 2

Type of Inputs: scalar or array

Type of output: scalar or array

User Controls: Swap inputs

Aggregate (Aggregate)

Aggregates individual scalar values to display in a Table View.

Location: Advanced Math -->Filtering -->Aggregate

Number of Inputs: infinite

Type of Inputs: scalar

Type of Output: Multiple scalar values

User Controls: N/A

Notes: The output of the Aggregate node must be fed into a Table View for display.

Average (Avg)

Outputs an average of an array.

Location: Basic Math -->Average

Number of Inputs: 1

Type of Inputs: array

Type of Output: scalar

User Controls: N/A

Background Estimation (Bk Est)

Removes the underlying background structure in the input spectra to reveal the desired peaks.

Location: Advanced Math -->Filtering --> Background Estimation

Number of Inputs: 1

Type of Inputs: array

Type of Output: array

User Controls: Horizontal Threshold, Curve fit regression

Notes:

As the user-defined values are altered, the spectrum in the preview graph changes shape and position. Only pixels that display information above the x-axis of the preview graph are evaluated for peak features when the data leaves this node.

When a value is entered in the Horizontal threshold box, that value is subtracted off the intensity values for each pixel in the spectrum. This is useful for eliminating a relatively flat background.

The Curve fit regression box allows you to change the order number of the polynomial used to curve fit the data. The specified polynomial order curve fit is calculated and subtracted off the spectrum.

Blackbody (Blkbdy)

Outputs an ideal blackbody spectrum.

Location: Sources -->Blackbody

Number of Inputs: 1

Type of Inputs: array

Type of Output: array

User Controls: Color Temperature

Notes: This node must have an input array to establish the wavelength range over which it outputs data. It is convenient to connect an input from the spectrometer's Acquire node.

Boxcar Filter (Bxcr)

Applies a Boxcar filter to smooth the input data.

Location: Advanced Math -->Filtering --> Boxcar

Number of Inputs: 1

Type of Inputs: array

Type of Output: array

User Controls: Span/ Order

Notes:

When adjusting the Span / Order value, be aware that the number of pixels used in the filter is actually 2n+1, where n is the number displayed in the user-defined box. If 2 is entered in the box, for example, a total of 5 pixels are used in the filter (2 to the left + 1 center pixel + 2 to the right).

Simple boxcar filtering is a specialized case of Savitzky-Golay filtering where the polynomial order is 0.

Ceiling (Ceiling)

Rounds the input data up to the next integer value.

Location: Bounds -->Ceiling

Number of Inputs: 1

Type of Inputs: array or scalar

Type of Output: array or scalar

User Controls: N/A

CIE L*a*b* (L*a*b*)

Outputs the CIE 1976 L*a*b* color space values based on the input data.

Location: Color Math -->CIE L*a*b*

Number of Inputs: 1

Type of Inputs: EmissChrom node or ReflChrom node

Type of Output: 5 scalar coefficients (hab, C*ab)

User Controls: N/A

CIE u'v'w' (u'v'w')

Outputs the CIE 1976 u'v'w' color space values based on the input data.

Location: Color Math -->u'v'w'

Number of Inputs: 1

Type of Inputs: EmissChrom node or ReflChrom node

Type of Output: 5 scalar coefficients (u', v', w', huv, suv)

User Controls: N/A

CIE uv (uv)

Outputs the CIE 1960 uv color space values based on the input data.

Location: Color Math -->uv

Number of Inputs: 1

Type of Inputs: EmissChrom node or ReflChrom node

Type of Output: 2 scalar coefficients (u, v)

User Controls: N/A

CIE xyz (xyz)

Outputs the CIE 1931 x, y,and z chromaticity coordinates based on the input data.

Location: Color Math -->xyz

Number of Inputs: 1

Type of Inputs: EmissChrom node or ReflChrom node

Type of Output: 3 scalar coefficients (x, y, z)

User Controls: N/A

CIE XYZ (XYZ)

Outputs the CIE 1931 X, Y,and Z tristimulus color values based on the input data.

Location: Color Math -->XYZ

Number of Inputs: 1

Type of Inputs: EmissChrom node or ReflChrom node

Type of Output: 3 scalar coefficients (X, Y, Z)

User Controls: N/A

Color Rendering Index (CRI)

Outputs color rendering index values based on the input data and user-selectable Observer.

Location: Color Math -->CRI

Number of Inputs: 1

Type of Inputs: array from Unit Labels (Units) node (Absolute or Relative Irradiance)

Type of Output: 18 scalar values (CRI Ra, CRI R1 through CRI R15, CRI DC, DC<5.4 x 103 true or false)

User Controls: Observer

Constant (Const)

Outputs a constant value.

Location: Constant -->Constant

Number of Inputs: 0

Type of Inputs: N/A

Type of Output: static scalar

User Controls: Enter constant value, Select mathematical constant from drop-down menu

Notes: Can be a user-entered value or selected from a list of mathematical constants.

Correlated Color Temperature (CCT)

Outputs the correlated color temperature based on the input data and user-selectable illuminant.

Location: Color Math -->CCT

Number of Inputs: 1

Type of Inputs: array from Unit Labels (Units) node (Absolute or Relative Irradiance)

Type of Output: 1 scalar value (CCT)

User Controls: Illuminant Type

Cosine (Cos)

Outputs the cosine of the input data.

Location: Advanced Math-->Trigonometry --> Cosine

Number of Inputs: 1

Type of Inputs: scalar or array in radians

Type of Output: scalar or array

User Controls: N/A

Data Property (DataProp)

Provides access to acquisition parameters and spectrometer properties.

Location: Constant -->Data Property

Number of Inputs: 1

Type of Inputs: Acquire Node

Type of Output: scalar

User Controls: Select data property by left-clicking on appropriate row

Notes: After connecting the DataProp node to an Acquire node, open the DataProp node and select the property you wish to output.

Data Source (Outdated)

Captured data is outdated and needs to be refreshed.

Location: N/A

Number of Inputs: 1

Type of Inputs: array or scalar

Type of Output: static array or static scalar

User Controls: Take Snapshot, Export to File

Notes: This icon is replaced the standard Data Source icon if you open a saved project or restore the previous session. Note that the line that is drawn between the Data Source (DataSource) node and the source is dashed, indicating that the input data is not continuously updated. When the Data Source (DataSource) node receives data from a scalar input, data cannot be exported to a file.

Data Source (DataSource)

Allows you to capture and export data from a variety of input nodes.

Location: Sources -->Data Source

Number of Inputs: 1

Type of Inputs: array or scalar

Type of Output: static array or static scalar

User Controls: Take Snapshot, Export to File

> ► *Procedure*

1. Select a Data Source (DataSource) node. A drop-down appears with a list of available data sources.

2. Choose the appropriate source.

3. Click **OK**.

Note that the line that is drawn between the Data Source (DataSource) node and the source is a dash, indicating that the input data is not continuously updated. The data will only update when the Take Snapshot button within the Data Source (DataSource) node is pressed.

When the Data Source (DataSource) node receives data from a scalar input, data cannot be exported to a file. This icon will appear with red circle and slash over it if the data needs to be updated. This will happen if you open a saved project or restore the previous session.

If this node is placed on the schematic as the result of a wizard, it will be called one of the following, depending on what data is represented by the DataSource node:

- Background – the stored data represents a background light capture

- Ref – the stored data represents a reference light capture

- BkGnd – used in a Raman wizard when the stored data represents a background light capture (either with or without laser light, depending on experimental setup).

Delta x (Delta x)

Outputs the wavelength distribution function for the input data array.

Location: Advanced Math -->Array Math --> Delta x

Number of Inputs: 1

Type of Inputs: array

Type of Output: array
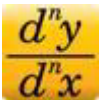
User Controls: N/A

Notes:

Delta x is a function that determines how many nanometers a given pixel represents.

Delta x is expressed as a graph with units of nm/px on the y-axis and nm on the x-axis.

Derivative -- spatially based (Deriv)

$$\frac{d^n y}{d^n x}$$

Calculates and outputs the spatially based derivative of the input data array.

Location: Advanced Math-->Calculus --> Derivative

Number of Inputs: 1

Type of Inputs: array

Type of Output: array

User Controls: Select derivative order number

Notes: Pass data through a SubRange node first to differentiate over a specific wavelength range

Divide (Div)

Outputs the quotient of input values.

Location: Basic Math -->Divide

Number of Inputs: 2
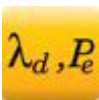
Type of Inputs: scalar or array

Type of Output: scalar or array

User Controls: Swap inputs

Notes: The first input that is connected is the dividend (numerator) and the second input that is connected is the divisor (denominator).

Dominant Wavelength & Purity (Purity)

$$\lambda_d, P_e$$

Outputs the Dominant Wavelength and Excitation Purity based on the input data.

Location: Color Math -->Purity

Number of Inputs: 1

Type of Inputs: EmissChrom node or ReflChrom node

Type of Output: 2 scalar coefficients (d, pe)

User Controls: N/A

Emissive Color (Emiss Color)

Applies user-configured parameters of Observer and Illuminant type to input data from an Irradiance Unit Labels (Units) node.

Location: Color Math -->Emissive Color

Number of Inputs: 1

Type of Inputs: array from Unit Labels (Units) node (Absolute or Relative Irradiance)

Type of Output: data must be output to Color View or a color parameter calculation node for further processing

User Controls: Observer, Illuminant type

Energy, Power, Photons (EPP)

Calculates and outputs radiometric quantities for an absolute irradiance-calibrated spectrometer.

Location: Advanced Math -->Array Math --> Energy, Power, Photons

Number of Inputs: 2

Type of Inputs: Unit Labels node (Absolute Irradiance), Data Property (DataProp) (Integration Time)

Type of Output: Data must be output to a Table View.

User Controls: Integration endpoints and method

Notes:

► *Procedure*

1. When connecting the EPP node you must,

2. Wire the Absolute Irradiance Unit Converter node.

3. Connect the Data Property (DataProp) node. The Data Property (DataProp) node should be set to output Integration Time.

Within the EPP node, you may alter the integration method and endpoints.

Evaluate Function (FnEval)

The Function Evaluator outputs the y value of a polynomial function based on the x value input and the polynomial coefficients.

Location: Advanced Math -->Array Math --> Evaluate Function

Number of Inputs: 2

Type of Inputs: 1 Regression node and 1 scalar

Type of Output: scalar

User Controls: N/A

Notes:

►   *Procedure*

1. When connecting to the FnEval node,

2. Wire the scale coefficient information from a Regression node.

3. Connect the scalar x value.

Exponential (Exp)

Outputs Euler's number, e, raised to the power of the input data.

Location: Basic Math-->Exponential

Number of Inputs: 1

Type of Inputs: scalar or array

Type of Output: scalar or array

User Controls: N/A

File (File)

Outputs the data from a saved file.

Location: Sources -->File

Number of Inputs: 1

Type of Inputs: N/A

Type of Output: N/A

User Controls: File Load

Notes: This node only opens files with a tab delimited format.

File Writer

Provides the capability of saving and exporting processed data for each graph view to an ASCII file.

Location: Sources-->File Writer

Number of Inputs: 1

Type of Inputs: scalar and array

Type of Output: file-based

User Controls: Link to existing Configure Graph Saving

Notes: To save more than one input, the File Writer node should use an Aggregate node as its input.

Floor (Floor)

Rounds the input data down to the previous integer value.

Location: Bounds -->Floor

Number of Inputs: 1

Type of Inputs: array or scalar

Type of Output: array or scalar

User Controls: N/A

Hunter Lab (Lab)

Outputs the CIE 1948 Hunter Lab color space values based on the input data.

Location: Color Math -->Hunter L,a,b

Number of Inputs: 1

Type of Inputs: EmissChrom node or ReflChrom node

Type of Output: 3 scalar coefficients (L, a, b)

User Controls: N/A

Integral (Integr)

Outputs the integral of the input data array.

Location: Advanced Math-->Calculus -->Integral

Number of Inputs: 1

Type of Inputs: array

Type of Output: scalar

User Controls: Select between three different integration methods: Rectangular, Trapezoidal, Simpson's Rule

Notes: Pass data through a SubRange node first to integrate over a specific wavelength range.

Interpolation (Interp)

Outputs the input data array with the specified x-axis intervals and range.

Location: Advanced Math-->Array Math --> Interpolation

Number of Inputs: 2

Type of Inputs: array

Type of Output: array

User Controls: Swap Inputs, Interpolation Method

Notes: This node is used when converting the x-axis range and/or the number of pixels in the input data array to match the characteristics of a different array. The input that is designated "Input B" is the data array whose x-axis range and/or number of pixels will be altered. The input designated "Input A" determines the x-axis range and/or number of pixels for Input B. The x-axis source may be a static array (like a File (File) node) or a dynamic array (like an Acquire node). The Swap Inputs button will reverse the effect of the above inputs. The interpolation method may also be set in this node selecting one of three buttons: LaGrange, Cubic, or Linear.

Linear Regression (Reg)

Outputs the scalar coefficients for a linear or polynomial regression of the input data array.

Location: Advanced Math -->Array Math --> Linear Regression

Number of Inputs: 1

Type of Inputs: array

Type of Output: between 2 and 10 scalar coefficients

User Controls: Polynomial Order number, zero intercept checkbox

Notes: The polynomial order of the Regression node is user selectable up to the 9th order by using the spinner control within the node. The y-intercept can float or be forced to zero by using the checkbox.

Logarithm - base 10 (Log10)

Outputs the base 10 logarithm of the input.

Location: Basic Math -->Logarithm

Number of Inputs: 1

Type of Inputs: scalar or array

Type of Output: scalar or array

User Controls: N/A

Maximum Value (Max)

Outputs the larger of two input values.

Location: Bounds -->Maximum

Number of Inputs: 2

Type of Inputs: array or scalar

Type of Output: array or scalar

User Controls: N/A

Minimum Value (Min)

Outputs the smaller of two input values.

Location: Bounds -->Minimum

Number of Inputs: 2

Type of Inputs: array or scalar

Type of Output: array or scalar

User Controls: N/A

Multiply (Mult)

Outputs the product of input values.

Location: Basic Math -->Multiply

Number of Inputs: 2

Type of Inputs: scalar or array

Type of Output: scalar or array

Natural Logarithm -- base e (Ln)

Outputs the natural logarithm of the input.

Location: Basic Math -->Natural Logarithm

Number of Inputs: 1

Type of Inputs: scalar or array

Type of Output: scalar or array

User Controls: N/A

Negate (Neg)
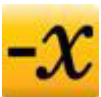
Changes the sign of the input data. Positive values become negative and negative values become positive.

Location: Basic Math-->Negate

Number of Inputs: 1

Type of Inputs: scalar or array

Type of Output: scalar or array

User Controls: N/A

Output Control (Output Control)

Enables adjustment of certain spectrometer settings using the output of other schematic nodes.

Location: Right-click a Spectrometer icon and choose one of the options under the New Output Control menu.

Number of Inputs: 1

Type of Inputs: scalar

Type of Output: Scalar to spectrometer node.

User Controls: Depends on the type of control output.

Notes: Different types of output controls are available for different devices. Output control choices may include Strobe/Lamp Enable, GPIO, Single Strobe, External Trigger Delay, Continuous Strobe, Acquisition Delay, and Analog-Out.

The user controls that are available vary based on which type of output control is selected.

► *Procedure*

1. Wire a scalar input into the Output Control node.

2. Double-click the node to open it.

3. Select the appropriate input source for the desired property by using the drop-down menu in the far right column of the appropriate data property. This scalar value will be sent to the spectrometer. If no input source is selected in the drop-down menu in the right column, the control can be adjusted manually.

4. Click on the numerical value for the desired property to reveal up/down control arrows. This static scalar value will be sent to the spectrometer.

5. Make sure the Enabled box is checked (where applicable). Check boxes can be controlled by wiring positive (on) or negative (off) scalar values to them.

Peak Metrics (Metrics)

Outputs the user-selected information that describes the peaks found by the Peaks node.

Location: Advanced Math -->Array Math --> Evaluate Function

Number of Inputs: 1

Type of Inputs: Peaks Node

Type of Output: array

User Controls: Check boxes to activate the output of the following values:

- Peak
- FWHM
- FWQM
- Center

- Centroid

- Integrate

- 90% Bandwidth

- Rotate Text on View Graph

Peaks (Peaks)

Calculates and outputs the location of peaks using user-defined selections and input data.

Location: Bounds -->Peaks

Number of Inputs: 1

Type of Inputs: array

Type of Output: must be output to Metrics node

User Controls: peak finding method, minimum peak width, spatial filtering options

Notes: There are two peak finding methods available:

- Local Maxima – searches for all of the local maxima that fall within the user-defined search parameters

- Derivative – requires that the user choose a derivative order number. A first derivative search locates all points where the first derivative of the spectrum is zero (i.e., stationary points). A second derivative search locates all points where the second derivative of the spectrum is zero (i.e., inflection points).

For either method, you must choose a minimum peak width.This parameter, measured in nanometers, will exclude any peaks that are narrower than the user-defined value. This is useful for eliminating small, random fluctuations due to noise.

Additionally, you can apply spatial filtering to reduce adjacent pixel discrepancies and the unwanted effects of noise. When adjusting the Filter Span, be aware that the number of pixels used in the filter is actually 2n+1, where n is the number displayed in the user-defined box. If 2 is entered in the box, for example, a total of 5 pixels are used in the filter (2 to the left + 1 center pixel + 2 to the right). If the Filter Span is set to 2, the Polynomial order number must be set to 4 or less. You can choose:

- simple Boxcar filtering -- A specialized case of Savitzky-Golay filtering where the polynomial order is 0.

- Savitzky-Golay filtering -- The Polynomial order number must be less than the total number of pixels used in the filter.

Photometry (Phtmet)

Calculates and outputs photometric quantities for an absolute irradiance-calibrated spectrometer.

Location: Advanced Math -->Array Math --> Photometry

Number of Inputs: 2

Type of Inputs: Unit Converter node (Absolute Irradiance), Constant (Const) (light collection area)

Type of Output: Data must be output to a Table View.

User Controls: Swap Inputs, Observer, Solid Angle (steradian)

Notes:

> ► *Procedure*

1. When connecting the Phtmet node,

2. Wire the Absolute Irradiance Unit Converter node.

3. Connect the Constant (Const) node.

Within the Phtmet node, you can alter the observer parameters and solid angle. For observer, use Photopic or Photopic (Modified) for high-light conditions and Scotopic for low-light conditions. The solid angle is set in the box marked Steradian.

Power (Pwr)

Outputs the input data raised to the specified power.

Location: Basic Math-->Power

Number of Inputs: 2

Type of Inputs: base: scalar or array; exponent: scalar only

Type of Output: scalar or array

User Controls: Swap Inputs

Notes: The first input that is connected is the base and the second input that is connected is the exponent.

Reflective Color (Refl Color)

Applies user-configured parameters of Observer and Illuminant type to input data from a Reflection Unit Labels node.

Location: Color Math -->Reflective Color

Number of Inputs: 1

Type of Inputs: array from Unit Labels (Units) node (Reflection)

Type of Output: data must be output to Color View or a color parameter calculation node for further processing

User Controls: Observer, Illuminant type

Round (Round)

Rounds the input data up or down to the nearest integer value.

Location: Bounds -->Round

Number of Inputs: 1

Type of Inputs: array or scalar

Type of Output: array or scalar

User Controls: N/A

Running Average (RunAvg)
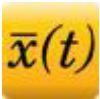
Calculates and outputs a weighted running average of the input data.

Location: Time Series -->Running Average

Number of Inputs: 1

Type of Inputs: dynamic scalar

Type of Output: dynamic scalar

User Controls: Running average weight factor

Notes: The weight factor adjusts how many of the most recent values will be averaged together before data is displayed:

- A low weighting factor will show more short term fluctuations and will be less stable than a larger weighting factor.

- A larger weighting factor may not accurately reflect the most recent changes in the input data.

Savitzky-Golay Filter (SGolayFilt)

Applies a Savitzky-Golay filter to smooth the input data.

Location: Advanced Math -->Filtering --> Savitzky-Golay Filter

Number of Inputs: 1

Type of Inputs: array

Type of Output: array

User Controls: Point filter span, Polynomial order

Notes: When adjusting the Point filter span, be aware that the number of pixels used in the filter is actually 2n+1, where n is the number displayed in the user-defined box. If 2 is entered in the box, for example, a total of 5 pixels are used in the filter (2 to the left + 1 center pixel + 2 to the right).

For a Savitzky-Golay filter, the Polynomial order number must be less than the total number of pixels used in the filter. If the Point filter span is set to 2, the Polynomial order number must be set to 4 or less. Simple boxcar filtering is a specialized case of Savitzky-Golay filtering where the polynomial order is 0.

Selector (Select)

Strips off and outputs one dimension of a multidimensional array.

Location: Advanced Math -->Filtering --> Selector

Number of Inputs: 1

Type of Inputs: array

Type of Output: array

User Controls: Select Parameters drop-down menu

► *Procedure*

1. Wire an array into the Select node.

2. Double-click the Select node to access the Select Parameters menu.

3. Use the drop-down menu to select which information the Select node will output. For example, if you use the Select node on an Acquire node, the Select Parameters options will be Wavelength and Intensity.

4. Select which aspect of the array you wish to output and click **Apply**.

Simulated Spectrometer

Simulates a spectrometer so that you can use OceanView without a spectrometer being connected.

Location: Available at software start-up or through the Device Manager window.

Number of Inputs: 9

Type of Inputs: Only output control nodes can be wired into the Simulated Spectrometer node.

Type of Output: array

User Controls: Play/Pause Controls, Acquisition Delay, Gaussian Light Source, Blackbody Light Source, Daylight Light Source, Test Color Sample Feature, Shutter, Integration Time, Baseline Offset, Readout Noise, Digitization, Scans to Average, and Boxcar Width.

These features are controlled through the simulated spectrometer's Acquire node.

Notes: The simulated spectrometer can only be used when no real devices are connected to the computer.

► *Procedure*

1. To enable the simulated spectrometer,

2. Click the box in the Device Manager window that says "Simulate device if none found."

3. Press **Rescan**. The name "Device: Spectrometer" displays under the icon for the simulated spectrometer.

Right-click on this node to bring up a selection menu for additional input and output options.

Sine (sine)

Outputs the sine of the input data.

Location: Advanced Math-->Trigonometry --> Sine

Number of Inputs: 1

**Type of Inputs:** scalar or array in radians

Type of Output: scalar or array

User Controls: N/A

Notes: Input is expected in radians

Spectral Overlay (Capt)

There is a spectral overlay on a Graph View node.

Location: N/A

Number of Inputs: N/A

Type of Inputs: N/A

Type of Output: array

User Controls: Export to File

Notes: This node is placed on the schematic when you press the Convert to Overlay button above the graph.

Spectrometer

Enables you to input data to and output data from the connected spectrometer.

Location: Click the Device Manage button and select Rescan or Add Device to insert a new spectrometer node on the schematic diagram.

Number of Inputs: Varies based on the spectrometer model.

Type of Inputs: Only output control nodes can be wired into the spectrometer node.

Type of Output: scalar or array

User Controls: Varies based on the spectrometer model.

Notes:

The icon for this node varies depending on the type of spectrometer connected. The serial number for the device appears under the icon.

Right-click on this node to bring up a selection menu for additional input and output options.

Double-click on the Spectrometer node to display a list of device features and specifications.

Splice (Splice)

Combines multiple arrays into one larger array and outputs the combination.

Location: Advanced Math -->Array Math --> Splice

Number of Inputs: infinite

Type of Inputs: SubRange Node

Type of Output: array

User Controls: Starting Wavelength slider, Ending Wavelength slider, Full Range button, and Remove Data Range button for each SubRange node; Apply and Add Range buttons

Notes: A SubRange node must feed into the Splice node for each data array to be spliced together. To keep the y-axis units consistent, the SubRange nodes should not get their data from different source types (e.g., relative irradiance and absolute irradiance).

► *Procedure*

1. Once all the SubRange nodes have been wired into the Splice node, double-click the Splice node to open it and set the x-axis ranges for the different arrays. The slider bars allow easy selection of starting and ending values for each array. The final combination is shown in the bottom graph.

2. After the starting and ending values have been set, click **Apply**. This sets the SubRange nodes to the correct values for each array. After clicking **Apply**, note that the individual graphs for each data array rescale to the values you have set.

3. To enlarge the x-axis data range for a particular array after clicking **Apply**, click the **Full Range** button next to the graph. The graph for that array returns to its maximum endpoint values.

4. To remove a SubRange completely, click the **X** button next to the graph for the appropriate array.

5. To finish, click **Exit**.

The output of a Splice node can be fed into any node that will accept an array. Note that the Add Range button is only used when using the Splice Wizard.

Square Root (SqRt)

Outputs the square root of the input.

Location: Basic Math -->Square Root

Number of Inputs: 1

Type of Inputs: scalar or array

Type of Output: scalar or array

User Controls: N/A

Standard Deviation (StdDev)

Outputs the standard deviation of an array of data.

Location: Basic Math-->Standard Deviation

Number of Inputs: 1

Type of Inputs: array

Type of Output: scalar

User Controls: N/A

SubRange (SubRng)

Limits the x-axis bounds of an array and outputs the truncated array.

Location: Advanced Math -->Array Math --> Subrange

Number of Inputs: 1

Type of Inputs: SubRange Node

Type of Output: scalar, array

User Controls: Start range, End range

Notes: If the user-defined Start range or End range values do not exactly match the values in the data array, the SubRange node will interpolate each to the nearest pixel value.

If the user-defined Start range or End range values exceed the bounds of the data array, the SubRange node will use the appropriate data range endpoint value.

If the user-defined Start range and End range values are the same, the SubRange node will interpolate to the nearest pixel and output the scalar value for that single pixel.

Subtract (Subt)

Outputs the difference of input values.

Location: Basic Math -->Subtract

Number of Inputs: 2

Type of Inputs: scalar or array

Type of Output: scalar or array

User Controls: Swap inputs

Notes: The first input that is connected is the minuend and the second input that is connected is the subtrahend.

Tangent (tan)

Outputs the tangent of the input data.

Location: Advanced Math-->Trigonometry --> Tangent

Number of Inputs: 1

Type of Inputs: scalar or array in radians

Type of Output: scalar or array

User Controls: N/A

Notes: Input is expected in radians

Time Derivative (Dx/Dt)
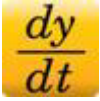
Calculates and outputs a time-based derivative of the input data.

Location: Time Series -->Time Derivative

Number of Inputs: 1

Type of Inputs: dynamic scalar

Type of Output: dynamic scalar

User Controls: N/A

Time Trend (Trend)

Adjusts the memory buffer used for strip chart acquisitions.

Location: Time Series -->Time Trend

Number of Inputs: 1

Type of Inputs: dynamic scalar

Type of Output: dynamic scalar

User Controls: Buffer Mode, Buffer Size, Clear Buffer

Notes: A circular buffer stores and displays a fixed number of data points. Once the maximum number of data points has been reached, each new data point acquired will cause the deletion of the oldest data point in the buffer. The buffer size is held at a constant value and data acquisition does not stop.

A linear buffer stores a fixed number of points. Data acquisition will stop when the buffer's maximum number of data points is reached. Use the Buffer Size control to choose how many data points will be retained in the memory buffer.

The output of this node must be fed into a Unit Labels node or a Graph View node.

Unit Labels (Units)

Alters the x-axis and y-axis labels and units on a graph view or provides the unit on a scalar view.

Location: Constant -->Unit Labels

Number of Inputs: 1

Type of Inputs: scalar or array

Type of Output: scalar or array

User Controls: Title X label, Unit X label, Title Y label, Unit Y label

Notes: The output can be fed directly into the following:

- Graph View – When fed into a Graph View, the x-axis and y-axis labels and units of the graph can be set. When fed into a Strip Chart Graph View, the y-axis label and unit can be set with the "Title Y label" and "Unit Y label" fields.

- Scalar View node – When fed into a Scalar View, the "Unit X label" field sets the unit for the scalar.

The scalar or array output of the Units node can be fed into other applicable nodes for further data processing.

Update Rate (Rate)

Adjusts the time-based scanning parameters and allows you to change how frequently the input data is updated and stored.

Location: Time Series -->Update Rate

Number of Inputs: 1

Type of Inputs: dynamic scalar

Type of Output: dynamic scalar

User Controls: Trend Update Rate parameters

Whiteness (Whiteness)

Outputs the CIE Whiteness and CIE Tint values based on the input data.

Location: Color Math -->Whiteness

Number of Inputs: 1

Type of Inputs: EmissChrom node or ReflChrom node

Type of Output: 2 scalar coefficients (W, Tw)

User Controls: N/A

Index

M

Mac
    installation on, 7
Main Controls, 22
Main Window controls, 18
maximize window, 43
Maximum Value (Max), 89
menus, 39
    File, 39
    Window, 42
minimizing schematic view, 70
Minimum Value (Min), 89
Miscellaneous window, 36
Multiply (Mult), 90

N

Natural Logarithm -- base *e* (Ln), 90
Negate (Neg), 90
new document tab group, 45

O

Opening a Project, 18, 40
Output Control (Output Control), 90

P

Page Setup, 41
Peak Metrics (Metrics), 91
Peak Metrics wizard, 57
Peaks (Peaks), 92
Photometry (Phtmet), 92
Photometry, Photons, Power and Energy wizard,
    56
Power (Pwr), 93
product activation, 10
product description, 1
product key, 10

Q

Quick View, 14

R

Raman wizard, 53
Reflectance Wizard, 53
Reflective Color (Refl Color), 93
Relative Irradiance wizard, 55
Removing a Project, 19
requirements
    system, 5
restore last session, 15
Round (Round), 94
Running Average (RunAvg), 94

S

Saving a Project, 18, 41
Savitzky-Golay Filter (SGolayFilt), 94
Scalar tab, 39
schematic view, 16
    acquisitions, 65
    creating, 71
    displaying, 65
    icons, 70
    resizing from docked view, 67
    resizing from minimized view, 68
    sizing, 65
    spectrometers, 64
    using, 64
schematic view icons
    Absolute Value (Abs), 74
    Acquire node, 71
    Acquisition (Acquire), 75
    Add (Add), 76
    Add Color View (Color), 75
    Add Graph View (View), 75
    Add Scalar View (Scalar), 76
    Aggregate (Aggregate), 76
    Average (Avg), 77
    Background Estimation (Est), 77
    Blackbody (Blkbdy), 78
    Boxcar Filter (Bxcr), 78
    Ceiling (Ceiling), 78
    CIE L*a*b* (L*a*b*), 79
    CIE uv (uv), 79
    CIE u'v'w' (u'v'w'), 79
    CIE xyz (xyz), 80
    CIE XYZ (XYZ), 80
    Color Rendering Index (CRI), 80
    Constant (Const), 81

W

Z