VENTANA
HIGH SENSITIVITY SPECTROMETER

Installation and Operation Manual
Document Number 891-00000-200-02-201305

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HALMA
GROUP
COMPANY

ELITE SPECTROMETERS
BY OCEAN OPTICS

Table of Contents

About This Manual

Document Purpose and Intended Audience

This document provides the user of the Ventana Spectrometer with instructions for setting up, calibrating and performing experiments with their spectrometer.

Document Summary

Chapter	Description
Chapter 1: *Introduction*	Contains descriptive information about the Ventana Spectrometer and how sampling works. It also provides a list of system requirements, interface options, and shipment components.
Chapter 2: *Installing*	Provides installation and configuration instructions.
Chapter 3: *Troubleshooting*	Contains recommended steps to isolate and correct common problems.
Appendix A: *Calibrating the Wavelength of Ventana*	Provides instructions for calibrating the Ventana Spectrometer.
Appendix B: *Specifications*	Contains technical specifications for the Ventana 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. Or, use the **Search by Model Number** field at the bottom of the web page.

- Detailed instructions for OceanView Software is located at:
  http://www.oceanoptics.com/technical/operatinginstructions.asp.

Engineering-level documentation is located on our website at *Technical → Engineering Docs.*

- **Ventana Data Sheet**

You can also access operating instructions for Ocean Optics products from the *Software and Technical Resources* CD that ships with the product.

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://www.oceanoptics.com/warranty.asp**

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

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

Chapter 1

Introduction

Product Overview

The Ventana series of high-sensitivity spectrometers is part of the Ocean Optics Elite family of modular, high-performance fiber optic spectrometers. Its exclusive design maintains high sensitivity and throughput for low-light level applications such as Raman analysis or fluorescence without the need for long integration times or high-power excitation sources. This spectrometer uses an HD Volume Phase Holographic (VPH) Grating, low f/# design and anti-reflection coatings to allow more of the coupled light into the spectrometer. The internal optics have been selected to minimize light loss and provide superior image quality.

Ventana models include the following,

- Ventana-785-Raman -- preconfigured for 785 nm excitation Raman measurements; includes a cooled (down to 15 °C) NIR-enhanced, back-thinned detector with low noise electronics
- Ventana-532-Raman -- preconfigured for 532 nm excitation Raman measurements
- Ventana-785L-Raman -- preconfigured for 785 nm excitation Raman measurements with integrated 785 nm laser; free-space coupling to maximize sensitivity; front-end laser matches the $f/1.3$ spectrometer input to maintain maximum efficiency; hard-coated filters used to maximize transmission and minimize Rayleigh scattering
- Ventana-VIS-NIR -- preconfigured with 430-1100 nm bandwidth, 50 micron slit; low $f/2$; configuration optimized for low signal VIS-NIR measurements (430 to 1100 nm) such as fluorescence; low f/# with custom lens design and optic coatings providing superior image quality and high transmission
- Ventana-785-Probe -- Raman-coupled fiber probe for 785 nm excitation; FC connector (excitation), SMA connector (collection); 11.0 mm working distance; 250-2000 cm^{-1}; comes with 600 um 0.39 NA detection and 100 um 0.22 NA excitation fibers to maximize sensitivity

The integrated linear CCD array is powered and read out through the integrated USB port and Ocean Optics spectrometer operating software. A complimentary single-use software license is included with the purchase of a Ventana spectrometer.

Ventana's modular design is ideal for those looking for a cost-effective alternative to expensive integrated systems to measure low-light level Raman and fluorescence samples. Applications include life sciences, clinical diagnostics, pharmaceutical R&D, counterfeit detection, and many more.

Ocean Optics Ventana Spectrometer

Features

- HD Volume Phase Holographic (VPH) Grating
- Electrical Performance
    - 16 bit A/D converter
- Communications: USB
- Software compatibility:
    - OceanView (1 complimentary license included with purchase)
    - SpectraSuite
    - OmniDriver (sold separately)
    - SeaBreeze (sold separately)
- Optical input: SMA 905
- Regulations:
    - CE Mark
    - RoHS

System Requirements

You can use the Ventana's USB connectivity with any computer that meets the requirements for the spectrometer operating software being used (Windows XP/Vista/Windows 7, Mac OS X and Linux). See *About OceanView*.

EEPROM Utilization

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

About OceanView

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.

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 more information (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 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 OOI software.

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

Modular Sampling Accessories

In addition to the Ventana spectrometers, the Ventana-785-Probe offers a Raman-coupled fiber probe for 785 nm excitation; FC connector (excitation), SMA connector (collection); 11.0 mm working distance; 250-2000 cm-1; comes with 600 µm 0.39 NA detection and 100 µm 0.22 NA excitation fibers to maximize sensitivity.

Ocean Optics offers a complete line of spectroscopic accessories for use with Ventana. 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 Ventana has a USB connector, enabling you to connect the spectrometer to a desktop or notebook computer via a USB port.

Computer Interface	Operating System Requirements	Part Needed	Description of Part
Computer via USB Port	OceanView: Windows 2000/XP/Windows 7 for PC (32- and 64-bit); OS X version 10.0 or later for Mac, or Red Hat 9 or later, Fedora (any version), Debian 3.1 or later (Sarge), and SUSE (9.0 or later); Centos and Ubuntu for Linux	USB-CBL-1 (included)	Cable that connects from USB port on Ventana to a USB port on desktop or notebook PC

Shipment Components

❑ Ventana Spectrometer
❑ Power supply (12 Volts 5 Amp)
❑ USB cable
❑ Single-user OceanView license
❑ Manufacturing Acceptance Test Certificate

The following information and documentation also ships with the Ventana 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. Your spectrometer operating software reads this calibration data from your spectrometer when it interfaces to a computer via the USB port.

Note

Please save the Wavelength Calibration Data Sheet for future reference.

❑ **Software and Technical Resources CD**

Each order ships with the Ocean Optics *Software and Resources CD*. This disc contains software, operating instructions, and product information for all Ocean Optics software, spectrometers and spectroscopic accessories. You need Adobe Acrobat Reader version 6.0 or higher to view these files. Ocean Optics includes Adobe Acrobat Reader on the *Software and Technical Resources CD*.

All Ocean Optics software requires a password or product key during the installation process. You can locate passwords for the other purchased software applications on the back of the *Software and Technical Resources CD* package.

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**
❑ **Analyze IQ chemometric software**

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Chapter 2

Installing Ventana

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Overview

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

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

Ventana Installation

This section contains instructions for connecting the Ventana in USB mode. To connect the Ventana to a computer via the USB port, the computer must be running a Windows 2000/XP/7 (32- or 64-bit), Mac OS X or Linux operating system.

► *Procedure*

Follow the steps below to connect the Ventana 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 Ventana.
3. Insert the square end of the cable into the side of the Ventana.
4. Insert the rectangular end of the cable into the USB port of the PC.
5. Connect the power supply that you received with your Ventana to the spectrometer, and then plug the transformer into an AC power wall outlet.

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Caution

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Be sure plug the Ventana power supply into the AC wall outlet <u>last.</u>

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

Configuring Ventana in OceanView

The Ventana 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.
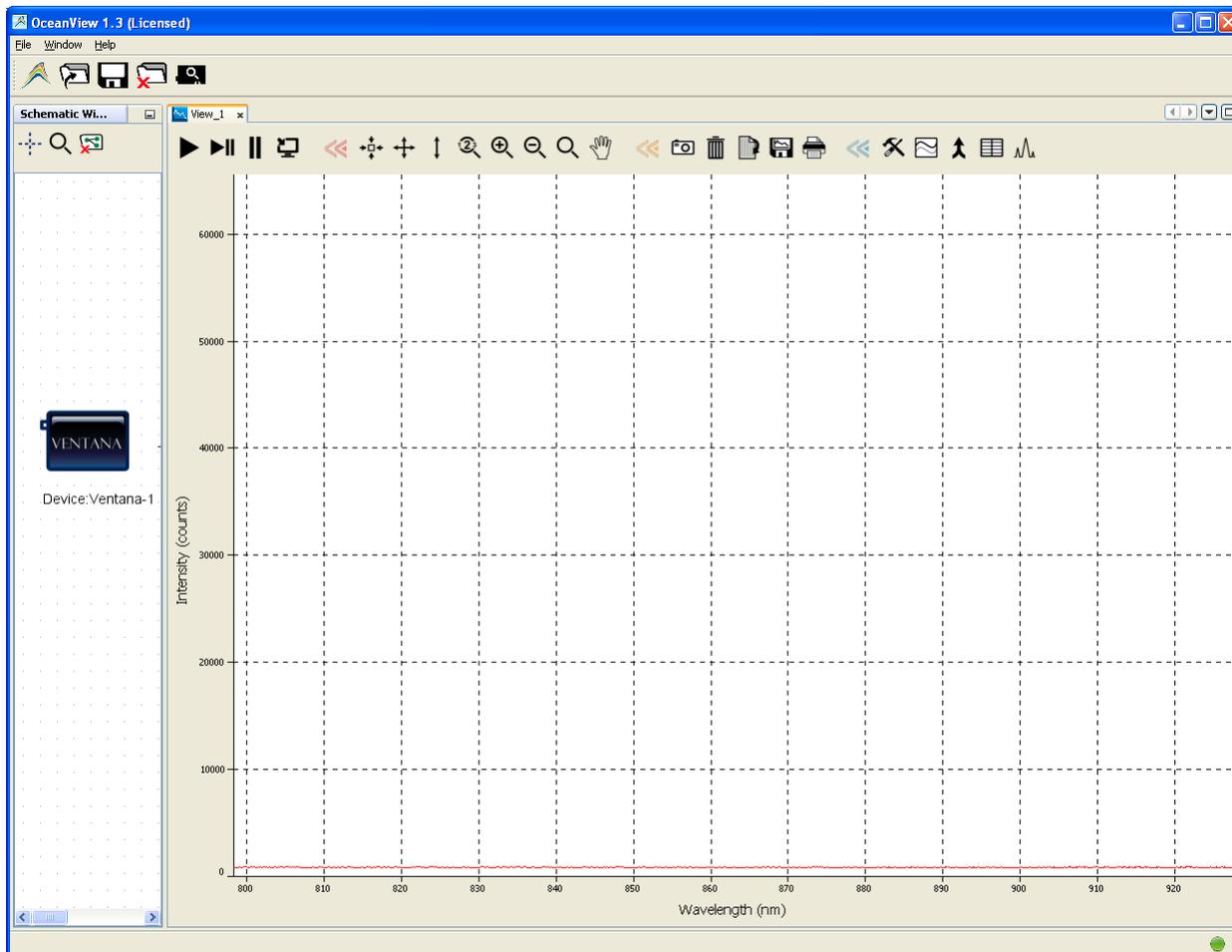
Connect Spectroscopic Accessories

To find operating instructions for Ventana-compatible products (such as light sources, sampling chambers, and probes), consult the *Software and Technical Resources* CD or the Ocean Optics website at **http://www.oceanoptics.com/technical/operatinginstructions.asp**.

Troubleshooting

Overview

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

Ventana Connected to Computer Prior to Software Installation

Windows Operating Systems

If you connected your Ocean Optics Ventana device to the computer prior to installing your spectrometer operating software application on a Windows platform, 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://www.oceanoptics.com/technical/engineering/correctingdevicedriverissues.pdf**.

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 Ventana 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.

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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 Ventana Spectrometer in a Mac operating system, you should not encounter any problems if you installed the spectrometer before the operating software.

Linux Operating Systems

For Linux operating systems, all you need to do is install the 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 Ventana

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 Ventana.

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)

You will be calculating the value for I and the three Cs.

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 for wavelengths up to 922 nm. For wavelengths above 922 nm, we recommend the XE-1 Xenon Light Source. 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.

- A Ventana 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 spectrometer operating software into 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.
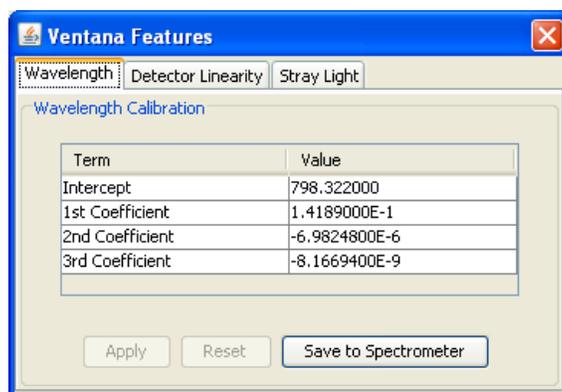
Saving the New Calibration Coefficients

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

You can overwrite old calibration coefficients on the EEPROM if you are using SpectraSuite software.

► *Procedure*

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

1. Ensure that the Ventana is connected to the PC.

2. Open SpectraSuite software.

3. Select **Spectrometer | Spectrometer Features** from the menu, or right-click on the Ventana in the Data Sources pane and select **Spectrometer Features**.

4. Select the Wavelength tab.

5. Enter the new values acquired in Steps 5 and 6 of the *Calibrating the Wavelength of the Spectrometer* section in this appendix.

6. Click **Save to Spectrometer**. The new wavelength calibration coefficients are now loaded onto the EEPROM memory chip on the Ventana.

Appendix B

Specifications

Overview

This appendix contains information on spectrometer specifications. For more information about the Ventana Spectrometer, refer to the technical notes on our Ocean Optics Elite Spectrometer website: **www.elitespectrometer.com**.

Ventana Specifications

The following sections provide specification information for the CCD detector in the Ventana Spectrometer, as well as the Ventana Spectrometer itself.

CCD Detector Specifications

Specification	Ventana 532	Ventana 785	Ventana 785L	Ventana Vis/NIR
Detector	Hamamatsu S11510-1006 Back-thinned NIR-enhanced CCD			Hamamatsu S10420-1006 Back-thinned CCD
Detector active area (mm)	14.336 x 0.896			
Pixel format	1024 x 64			
Pixel size	14 µm square			
Well depth	300 Ke$^-$			
Read noise	6 e- RMS			
Dynamic range	17000:1 (Typical)			
CCD QE	78% peak, 60% average in Raman			75% peak
CCD Cooling	None	15°C		None

Ventana Spectrometer Specifications

Specification	Ventana 532	Ventana 785	Ventana 785L	Ventana VIS/NIR
Dimensions (LxWxH)	170 mm (6.7 in.) x 110 mm (4.3 in.) x 50 mm (1.9 in.)	125 mm (4.9 in.) x 110 mm (4.3 in.) x 50 mm (1.9 in.)	127 mm (5 in.) x 158.75 mm (6.25 in.) x 50.8 mm (2 in.)	170 mm (6.7 in.) x 110 mm (4.3 in.) x 50 (1.9 in.)
Weight	0.9kg (2 lb)		Spectrometer:1.2kg (2.6 lb) Power Supply: 0.5kg (1.10 lb)	0.9kg (2 lb)
Temperature Operation	0 to 50°C (noncondensing)		5 to 45°C (noncondensing)	0 to 50°C (noncondensing)
Power	12 VDC			
Gratings	1600 lpmm HD VPG		1625 lpmm HD VPG	450 lpmm at CWL 580 nm
Diffraction efficiency	85% peak at 610 nm	83% average for S&P		65% avg for S&P
Optical input	SMA 905			
Slit Size	.05 mm x 2 mm	50 mm	50 mm x 2 mm	40 nm
Fiber diameter	Optimized for 600μm, NA = 0.39 fiber input			
Resolution (FWHM) cm^{-1}	20 cm^{-1}	10 cm^{-1}@ 810 nm		N/A
Resolution (FWHM) nm	0.6 nm	0.7 nm $^@$ 810 nm		4.0 nm
f/#	1.3			2.0
Signal-to-noise ratio	~550:1 (Typical)			
Integration time	22 ms – 4 min			
Wavelength Range	533 – 690 nm	800 – 940 nm	800 – 940 nm	430 – 1100 nm
Interface	USB 2.0 (no external accessory connector access)			

Ventana 785L Laser Specifications

Ventana 785L Laser
Specifications

Working Distance	21.95 mm
Image Spot Size	10 mm
Sample Spot Size	75 mm
Laser type	Single-mode laser diode stabilized with VBG
Laser control	Enable/disable
Laser power stability	< 1% after 30 seconds from being enabled

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