

# Vernier SpectroVis Spectrophotometer

(Order Code: SVIS)



SpectroVis is a portable, visible light spectrophotometer.

## What is included with the SpectroVis?

- One SpectroVis unit
- 15 plastic cuvettes and lids
- One standard USB cable
- User's Guide (this document)

## Software Requirements

Logger Pro 3 (version 3.6 or newer) software is required if you are using a computer. The LabQuest application version 1.1 or newer is required if you are using a LabQuest. Visit the downloads section of [www.vernier.com](http://www.vernier.com) to update your software.

## Using SpectroVis with a Computer

1. Install Logger Pro 3 software (version 3.6 or newer) on your computer before using SpectroVis.
2. Connect the SpectroVis to a powered USB port or a powered hub.
3. The first time you connect a SpectroVis, your computer may ask you a few questions. **Note:** Do not go online for device drivers. The device drivers were installed when you installed Logger Pro 3.

## Calibrate SpectroVis

1. To calibrate the SpectroVis, choose Calibrate ► Spectrometer from the Experiment menu.
2. Fill a cuvette about  $\frac{3}{4}$  full with distilled water and place it in the cuvette holder.
3. Follow the instructions in the dialog box to complete the calibration, and then click .

## Collect Data

There are three general types of data collection measuring absorbance – absorbance vs. wavelength, which produces a spectrum, absorbance vs. concentration for Beer's law experiments, and absorbance vs. time for kinetics experiments.

## Measure the Absorbance Spectrum of an Aqueous Sample (Absorbance vs. Wavelength)

1. Fill a cuvette about  $\frac{3}{4}$  full of the solution to be tested. Place the sample in the cuvette holder of the SpectroVis.

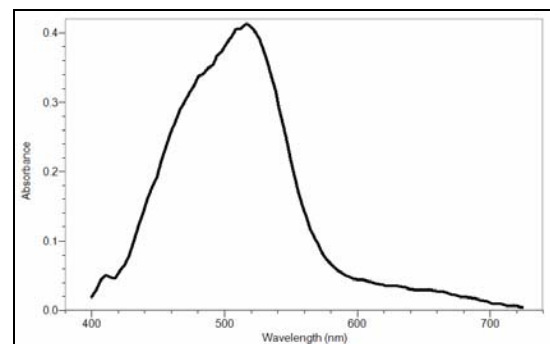




Figure 1: Typical absorbance spectrum

2. Click . Click  to end data collection.

## Conduct a Beer's Law Experiment (Absorbance vs. Concentration)

1. Measure an absorbance spectrum as described above.
2. Click on the Configure Spectrometer Data Collection button, .
3. Select Abs vs. Concentration as the collection mode. The wavelength of the maximum absorbance will be automatically selected. Click  to continue or click  and select a wavelength on the graph or in the list of wavelengths.
4. Place your first Beer's law standard solution in the cuvette slot. Click  and then click . Enter the concentration of the sample and click .
5. Place your second standard sample in the SpectroVis. After the absorbance readings stabilize, click . Enter the concentration of the second sample and click .
6. Repeat Step 5 for the remaining standard samples. After you have tested the final standard, click  to end the data collection.
7. Click linear fit, , to see the best fit line equation for the standard solutions.
8. Place an unknown sample of solution in the cuvette holder. Choose Interpolation Calculator from the Analyze menu. A helper box will appear, displaying the absorbance and concentration of the unknown. Click .

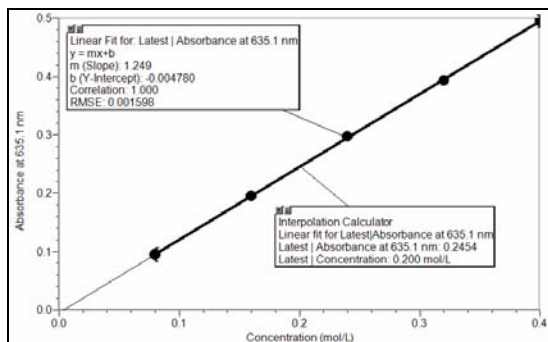




Figure 2: Typical Beer's law analysis of an unknown sample

### Conduct a Kinetics Experiment (Absorbance vs. Time)

1. Measure an absorbance spectrum as described above.
2. Click the Configure Spectrometer Data Collection icon, .
3. Select Abs vs. Time as the data collection mode. The wavelength of maximum absorbance will be selected. Click  to continue or click  and select a wavelength on the graph or in the list of wavelengths.
4. The default settings are 1 sample per second for 200 seconds. If you wish to change the data-collection parameters for your experiment, choose Data Collection from the Experiment menu and make the necessary changes. Click .
5. Mix the reactants, transfer ~2 mL of the reaction mixture to a cuvette and place the cuvette in the SpectroVis. Click . You may click  to end the data collection early.
6. Click Curve Fit,  to calculate a function for your data.

### Using the Spectrometer to Measure Emission Spectra

SpectroVis can be used to measure the emission spectrum of a light source such as an LED or a gas discharge tube. The purchase of a SpectroVis Optical Fiber (order code: SVIS-FIBER) is required.

### Measure an Emission Spectrum

1. Insert the Optical Fiber into the SpectroVis, lining up the white triangles. Start Logger Pro 3 software.
2. Choose Change Units ► Spectrometer ► Intensity from the Experiment menu. Intensity is a relative measure.
3. Aim the tip of the optical fiber cable at a light source. Click . Click  to end data collection.

If the spectrum maxes out (flat and wide peaks), increase the distance between the light source and the tip of the optical fiber cable or reduce the sample time. If you are conducting a flame test, place the tip of the optical fiber no closer than 4-5 cm from the flame.

To adjust the data-collection parameters, choose Set Up Sensors ► Spectrometer

from the Experiment menu. Set the Sample Time to a suitable value and decrease the Samples to Average to 1.

### Changing the Settings in Logger Pro 3

#### Spectrometer Dialog Box

The Spectrometer dialog box lists all of the settings for the device. To display this box choose Set Up Sensors ► Show All Interfaces from the Experiment menu.

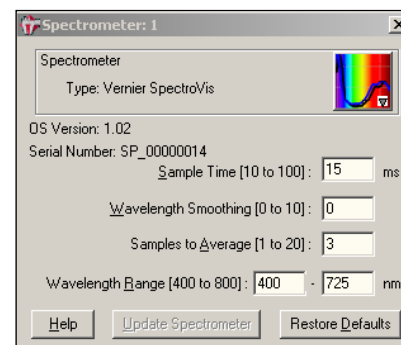


Figure 3

There are four parameters listed in the dialog box.

- Sample Time: similar to the shutter speed of a camera. Logger Pro automatically selects the proper sample time during calibration. **Note:** For emission studies, you may need to change the sample time manually.
- Wavelength Smoothing: the number of adjacent readings on either side of a given value that is used to calculate an average value.
- Samples to Average: the number of readings taken at a given wavelength to calculate an average reading.
- Wavelength Range: the range is determined by the type of spectrometer in use.


By clicking on the picture of the spectrometer in this dialog box, you will gain access to four options: calibrate, configure data collection, go to support web page, and units of measure. Click on an item to select it.

#### Configure Spectrometer Data Collection Dialog Box

To display this box, click on the Configure Data Collection button, .

There are three regions in this box.

- Graph: The graph displays a full spectrum analysis of the sample in the cuvette holder. By default, the wavelength of greatest absorbance (peak) will be marked with a box. You may select other wavelengths by clicking on the plot at the desired wavelength. A checkbox beneath the graph allows you select a portion of the graph and analyze it as a single range of wavelengths.
- Set Collection Mode: Three options for data collection are offered. A full spectrum analysis (Abs vs. Wavelength) is the default.
- Full Spectrum/Select Wavelength: This column lists all the available

wavelengths. It becomes active when you select Abs *vs.* Concentration or Abs *vs.* Time. Check the box for each wavelength you wish to use in an experiment. When you select a wavelength from the list, a box appears on the graph. Use the  button to remove all of the wavelengths selected on the graph.

### Determining the Wavelength(s) to Use in an Experiment

When you conduct a Beer's law lab or a kinetics lab, it is common to select one wavelength at which to follow the experiment. However, in Logger *Pro* 3 you may select as many wavelengths as you wish. There are three ways to select the wavelength or wavelengths.


#### 1. Perform a Full Spectrum Analysis of the Solution to Be Tested

Collect the absorbance spectrum of a sample of solution and examine the graph. Go to the Configure Spectrometer Data Collection dialog box and select Abs *vs.* Time or Abs. *vs.* Concentration. The wavelength of maximum absorbance will be automatically selected.

#### 2. Use a Sample of Solution to Determine the Peak Absorbance

This is a variation of the previous method, when you don't wish to keep a copy of the full spectrum analysis. After calibrating the SpectroVis, insert a sample of solution and go to the Configure Spectrometer Data Collection dialog box. Select Abs *vs.* Time for a kinetics experiment, or select Abs *vs.* Concentration for a Beer's law experiment. The wavelength of maximum absorbance will be automatically selected.

#### 3. Select the Wavelength of Maximum Absorbance Manually

This method can be used when you already know the precise wavelength to be used in an experiment. After calibrating the SpectroVis, go to the Configure Spectrometer Data Collection dialog box. Select Abs. *vs.* Concentration or Abs. *vs.* time. Click . Select a wavelength on the graph or in the list of wavelengths.

### Selecting a Range of Wavelengths to Use in an Experiment

You may wish to measure the absorbance or %T of a sample over a group of wavelengths rather than a single wavelength. There are two ways to select a group of wavelengths from the Configure Spectrometer Data Collection dialog box.

- Select the wavelengths one at a time by checking the boxes in the Select Wavelength column.
- Place the cursor on the graph in the dialog box. Left click and drag across the region of wavelengths that you wish to analyze. Make sure to check the "Treat Contiguous Wavelengths as a Single Range" box.

### Measurement

SpectroVis can measure absorbance or % transmittance. The default is absorbance. To make a change, choose Change Units ► Spectrometer from the Experiment menu. Click on your choice from the list. You can also measure intensity. To do this, you will need to purchase the SpectroVis Optical Fiber accessory, sold separately.

### Using SpectroVis with a LabQuest

1. Use the USB cable to connect the SpectroVis to a LabQuest.
2. Turn on the LabQuest. The LabQuest app will launch automatically and the meter screen will be displayed.

### Calibrate SpectroVis

1. Fill a cuvette about  $\frac{3}{4}$  full with distilled water and place it in the cuvette holder. Align the cuvette so a clear side of the cuvette is facing the light source.
2. Choose Calibrate ► USB:Spectrometer from the Sensors menu. At the prompt, select Finish Calibration. After the message "Calibration Completed." appears, select OK.

### Measure the Absorbance Spectrum of an Aqueous Sample (Absorbance *vs.* Wavelength)

1. Fill a cuvette about  $\frac{3}{4}$  full of the solution to be tested. Place the sample in the cuvette slot of the SpectroVis.
2. Start the data collection. Tap the red Stop button to end the data collection.

### Conduct a Beer's Law Experiment (Absorbance *vs.* Concentration)

1. Measure an absorbance spectrum as described above. On the Meter screen, tap Mode. Change the mode to Events with Entry.
2. The wavelength of maximum absorbance ( $\lambda_{\text{max}}$ ) is automatically selected. If you wish to choose another wavelength, you can tap on the graph to select a new wavelength or you can use the arrow keys on the keypad to move the cursor to a new wavelength.
3. Enter the Name (Concentration) and Units (mol/L). Select OK.
4. A message will appear warning you to either save or discard the full spectrum run. Make your choice and proceed with data collection.
5. Place your first Beer's law standard solution in the cuvette slot. Start the data collection. After the absorbance reading stabilizes, tap Keep. Enter the concentration of the solution and select OK.
6. Place your second standard sample in the SpectroVis. After the absorbance readings stabilize, tap Keep. Enter the concentration of the second sample and select OK.
7. Repeat Step 5 for the remaining standard samples. After you have tested the final standard, tap the red Stop button to end the data collection.
8. To calculate a best fit line equation for your standards, choose Curve Fit from the Analyze menu. Select Linear for the Fit Equation, and then select OK. The graph screen will appear again with the linear regression equation displayed.
9. Place a cuvette containing an unknown sample of solution in the SpectroVis. Tap the Meter tab and write down the displayed absorbance value. Tap the graph tab and trace the linear regression equation to determine the concentration of the unknown.

## Conduct a Kinetics Experiment (Absorbance vs. Time)

1. Measure an absorbance spectrum as described above.
2. The wavelength of maximum absorbance ( $\lambda_{\text{max}}$ ) is automatically selected. If you wish to choose another wavelength, you can tap on the graph to select a new wavelength or you can use the arrow keys on the keypad to move the cursor to a new wavelength.
3. On the Meter screen, tap Mode. Change the data-collection mode to Time Based.
4. You can change the rate, interval, and/or length of time of data collection, if desired. Select OK when you are ready to proceed. A message will appear warning you to either save or discard the full spectrum run. Make your choice and proceed with the data collection.
5. Mix the reactants, transfer ~2 mL of the reaction mixture to a cuvette and place the cuvette in the SpectroVis. Start the data collection. You may tap the red Stop button to end the data collection early.
6. To calculate a function for your data, choose Curve Fit from the Analyze menu. Select the Fit Equation, and then select OK. The graph screen will appear again.

## Using the Spectrometer to Measure Emission Spectra

You can use a SpectroVis to measure the emission spectrum of a light source such as an LED or a discharge tube. To do so, you need to purchase a SpectroVis Optical Fiber (order code: SVIS-FIBER). If you are conducting a flame test, place the tip of the optical fiber no closer than 4-5 cm from the flame.

## Measure an Emission Spectrum

1. Insert the SpectroVis Optical Fiber into the SpectroVis, lining up the white triangles.
2. Turn on LabQuest. The LabQuest App will launch automatically and the meter screen will be displayed.
3. On the meter screen, choose Change Units ► USB:Spectrometer ► Intensity from the Sensors menu. The SpectroVis measures intensity in relative units.
4. Choose Sensors ► Data Collection. Change the sample time to 40 ms.
5. Aim the tip of the optical fiber cable at a light source. Start data collection. Tap the red Stop button to end the data collection.

If the spectrum maxes out (flat and wide peaks), increase the distance between the light source and the tip of the optical fiber cable or reduce the sample time.

To adjust the data collection parameters, tap Sensors and choose Data Collection. Set the Sample Time to a suitable value and decrease the Samples to Average to 1.

## Determining the Wavelength to Use in an Experiment

After you collect a full absorbance spectrum of a sample, LabQuest will identify the wavelength of maximum absorbance ( $\lambda_{\text{max}}$ ). If you wish to select a different wavelength, tap on the full spectrum graph or use the arrow keys on the keypad to identify the wavelength of choice. Another way to change the wavelength is to navigate to the meter screen, tap on the meter itself, and select Change Wavelength. Enter the wavelength of your choice and select OK. If the wavelength you type in is

not measured by the SpectroVis unit, LabQuest will automatically choose the wavelength closest to your choice.

## Sample Experiments

There are several experiments available for use with the SpectroVis. You may download the labs from our web site ([www.vernier.com/spectroscopy](http://www.vernier.com/spectroscopy)).

## Specifications

Dimensions: 14.5 cm × 8.4 cm × 3.8 cm

Power: from computer via USB cable

Light Source: LED-based, approximately 100,000 hour lifetime

Wavelength Range: 400 nm–725 nm

Pixel Resolution: ~3 nm

## Warranty

Vernier warrants this product to be free from defects in materials and workmanship for a period of one year from the date of shipment to the customer. This warranty does not cover damage to the product caused by abuse or improper use.



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**Note:** 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 case the user will be required to correct the interference at his own expense.



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