

# Vernier Fluorescence/UV-VIS Spectrophotometer

(Order Code VSP-FUV)



The Vernier Fluorescence/UV-VIS Spectrophotometer is a portable ultraviolet and visible light spectrofluorometer. It is a combined fluorometer with a UV-VIS spectrometer. Exchangeable LEDs ensure you get the exact excitation wavelength needed.

**Note:** Vernier products are designed for educational use. Our products are not designed nor are they recommended for any industrial, medical, or commercial process such as life support, patient diagnosis, control of a manufacturing process, or industrial testing of any kind.

## What's Included

- Vernier Fluorescence/UV-VIS Spectrophotometer
- AC Power Supply
- Fluorescence quartz cuvette
- Mini USB cable
- LED cartridges (3): 375 nm, 450 nm, 525 nm

## Compatible Software and Interfaces

See [www.vernier.com/manuals/vsp-fuv](http://www.vernier.com/manuals/vsp-fuv) for a list of interfaces and software compatible with the Vernier Fluorescence/UV-VIS Spectrophotometer.

## Getting Started

1. Connect the AC power supply to the spectrophotometer. Turn the power switch to the ON position. Wait for the lamp indicator LED to remain green (required for measuring Absorbance/% Transmittance only).
2. Connect the spectrophotometer directly to the USB port of the computer or LabQuest.
3. Start the appropriate data-collection software (Logger Pro, LabQuest App) if not already running, and choose New from File menu.

The software will identify the sensor and load a default data-collection setup. You are now ready to continue your experiment.

If you are collecting data using a Chromebook™, or a mobile device such as iPad® or Android™ tablet, please see the following link for up-to-date connection information:

[www.vernier.com/start/vsp-fuv](http://www.vernier.com/start/vsp-fuv)

## Using the Product with Logger Pro

Connect the Spectrophotometer following the steps in the Getting Started section of this user manual.

## Select the Type of Data (or Units) You Want to Measure

There are three general types of data collection that measure absorbance or transmittance—absorbance (or %T) vs. wavelength, which produces a spectrum, absorbance (or %T) vs. concentration for Beer's law experiments, and absorbance (or %T) vs. time for kinetics experiments.

The default data type is absorbance. If you want to measure the absorbance of a solution, proceed directly to the Calibrate section below.

If you want to measure %T, fluorescence, or intensity, do the following:

1. Choose Change Units ► Spectrophotometer from the Experiment menu.
2. Select the unit or data type you wish to measure.

## Calibrate (Optional if Measuring Fluorescence or Intensity)


1. To calibrate the Spectrophotometer, choose Calibrate ► Spectrophotometer from the Experiment menu. **Note:** For best results, allow the Spectrophotometer to warm up for a minimum of ten minutes.
2. Fill a cuvette about 3/4 full with distilled water (or the solvent being used in the experiment) to serve as the blank. After the Spectrophotometer has warmed up, place the blank cuvette in the Spectrophotometer. Align the cuvette so the clear side of the cuvette is facing the light source.
3. Follow the instructions in the dialog box to complete the calibration, and then click .

## Collect Data with Logger Pro

### Measurement vs. Wavelength (Generate a Spectrum)

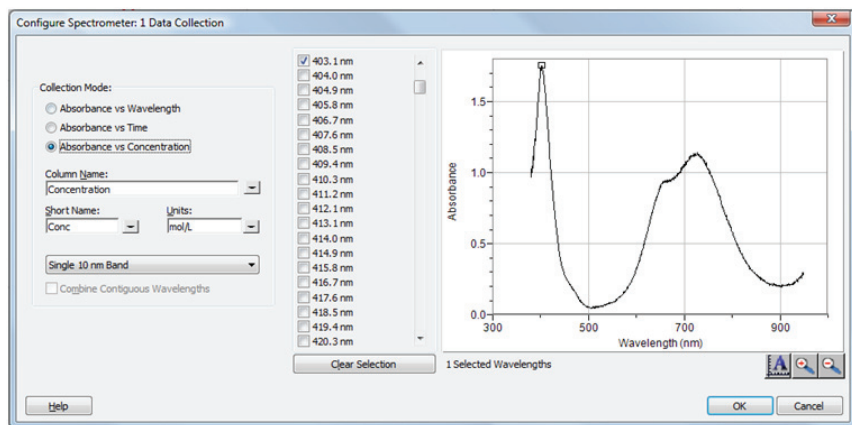
1. Fill a cuvette about 3/4 full of a sample of the solution to be tested. Place the sample in the Spectrophotometer and click . Click  to end data collection.
2. To store the spectrum data, choose Store Latest Run from the Experiment menu.

### Measurement vs. Concentration (Beer's Law Studies)


1. Generate a spectrum as described above.
2. Click the Configure Spectrophotometer Data Collection button, .

There are three regions in this box:

- **Collection Mode** The three options for data collection are offered. If the measurement (Absorbance in this example) vs. Time or vs. Concentration is selected, a wavelength or wavelengths will need to be chosen.
- **Graph** The graph displays a full-spectrum analysis of the sample in the cuvette holder. By default, the wavelength with the maximum measured value will be selected. You may wish to choose a different wavelength by tapping on the graph or selecting wavelength(s) from the list.
- **List of wavelength options** This column lists all the available wavelengths. It becomes active when either the Concentration or Time mode is selected.





Configure Spectrometer data-collection dialog box

3. Select Absorbance (or %T) vs. Concentration as the data-collection mode. The wavelength with the maximum value from the spectrum ( $\lambda_{\text{max}}$ ) will be automatically selected. There are three options when choosing a wavelength (or wavelengths) for subsequent measurements.
  - **Option 1** The default option is to use a single 10 nm band. This measures the average absorbance from ~5 nm on either side of the chosen wavelength. You can change the center wavelength value by clicking on the graph or by choosing a wavelength from the list.
  - **Option 2** If you wish to use the  $\lambda_{\text{max}}$  chosen by Logger Pro, but you want the absorbance to be measured only at that one wavelength, change Single 10 nm Band to Individual Wavelengths. You may then select up to ten wavelengths to measure at the same time.
  - **Option 3** If you wish to measure an average over a range of contiguous wavelengths of your choice, change Single 10 nm Band to Individual Wavelengths. Click **Clear Selection**. Select boxes in the list or drag your cursor on the graph to select up to ten contiguous wavelengths. Check Combine Contiguous Wavelengths.
4. Click **OK** to continue.
5. Click **Collect**. Place your first sample in the cuvette slot of the Spectrophotometer. After the readings stabilize, click **Keep**. Enter the concentration of the sample and click **OK**.
6. Place your second sample in the cuvette slot. After the readings stabilize, click **Keep**. Enter the concentration of the second sample and click **OK**.
7. Repeat Step 6 for the remaining samples. When finished, click **Stop** to end data collection.
8. Click Linear Fit, , to see the best fit line equation for the standard solutions.
9. If doing Beer's law to determine the concentration of an unknown, place the unknown sample 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 **OK**.

### Measurement vs. Time (Kinetics)

1. Generate a spectrum as described above.
2. Click the Configure Spectrophotometer Data Collection button, .
3. Select Absorbance vs. Time as the data-collection mode. The wavelength of maximum absorbance will be selected. Click **OK** to continue or select a wavelength on the graph or in the list of wavelengths. See the previous section for more details.
4. The default settings are 1 sample per second for 200 seconds. To change the data-collection parameters for your experiment, choose Data Collection from the Experiment menu and make the necessary changes. Click **Done**.
5. Mix the reactants. Transfer ~2 mL of the reaction mixture to a cuvette and place the cuvette in the Spectrophotometer. Click **Collect**. Click **Stop** if you wish to end data collection early.
6. Click Curve Fit, , to calculate a function for your data.

### Measure Fluorescence with Logger Pro

You may use your Spectrophotometer to measure the fluorescence spectrum of an aqueous sample, such as chlorophyll, quinine, and fluorescein. Fluorescence is the emission of light by a compound after it has absorbed a particular wavelength of light. Under most circumstances, the emission of light will occur at a longer wavelength than the light used to excite it. The spectrometer comes with three LEDs (375 nm, 450 nm, and 525 nm) that serve as the excitation wavelengths. Additional excitation LEDs can be purchased separately.

There are three general types of data collection that measure fluorescence—fluorescence vs. wavelength, which produces a spectrum, fluorescence vs. concentration, and fluorescence vs. time for kinetics experiments. Once the units have been changed to Fluorescence from the Experiment menu, follow the instructions in the section titled Collect Data with Logger Pro to collect these types of data.

These are some additional features in fluorescence mode that may improve your data quality:

#### Adjusting the LED Brightness

1. Open the Spectrometer dialog box to set the LED intensity. To display this box choose Set Up Sensors ► Spectrometer from the Experiment menu in Logger Pro.
2. The LED Intensity is set to 50 by default. Adjust it between 0 and 100. A setting of 0 turns the LED off while a setting of 100 is the maximum LED intensity. **Note:** If you adjust this value during data collection, you may want to recalibrate or perform a manual baseline adjustment with a calculated column.

#### Adjusting the Sample Time

1. Open the Spectrometer dialog box to set the Sample Time. To display this box choose Set Up Sensors ► Spectrometer from the Experiment menu in Logger Pro.

2. By default, this value is set to 100 ms. The Sample Time is the amount of time the detector is exposed to the emission light. The longer the sample time, the greater the signal, and the longer the time it takes to collect data. 100 ms is a good starting point for data collection. You may adjust this value while data collection is active. If you do this, the spectrum will update in real time. **Note:** If you adjust this value during data collection, you may want to recalibrate or perform a manual baseline adjustment with a calculated column.

#### Calibrate Fluorescence

1. Fill a cuvette about 3/4 full with distilled water (or the solvent being used in the experiment) to serve as the blank.
2. To calibrate the spectrophotometer, choose Calibrate ► Spectrometer from the Experiment menu. The calibration is done automatically.

#### Measure Emission Spectra with Logger Pro

You may use your Spectrophotometer to measure the emission spectrum of a light source such as an LED or a gas discharge tube. To do so, you will need to purchase an optical fiber assembly (order code: VSP-FIBER).

#### Measure Intensity of Light Emissions

1. Insert the Spectrophotometer Optical Fiber into the Fluorescence/UV-VIS Spectrophotometer, lining up the white triangles.
2. Aim the tip of the optical fiber cable at a light source. Click **Collect**. Click **Stop** to end data collection. **Note:** The Spectrophotometer is not calibrated for measuring intensity.

If the spectrum maxes out (flat and wide peaks at a value of 1), increase the distance between the light source and the tip of the optical fiber cable or reduce the sample time (see Change the Settings in Logger Pro).

To increase the sample time, or if data collection is unusually slow, choose Set Up Sensors ► Spectrophotometer: 1 from the Experiment menu. Set the Sample Time (begin with 75 ms, with subsequent reductions by 20 ms) to a suitable value and decrease the Samples to Average to 1.

#### Use the Stored Emissions Files in Logger Pro

Logger Pro contains a folder of emissions graphs from selected discharge tubes, including: argon, helium, hydrogen, mercury, oxygen, sodium, and xenon. You can display and analyze these graphs without a spectrometer connected to your computer. Follow these steps to view one of these graphs.

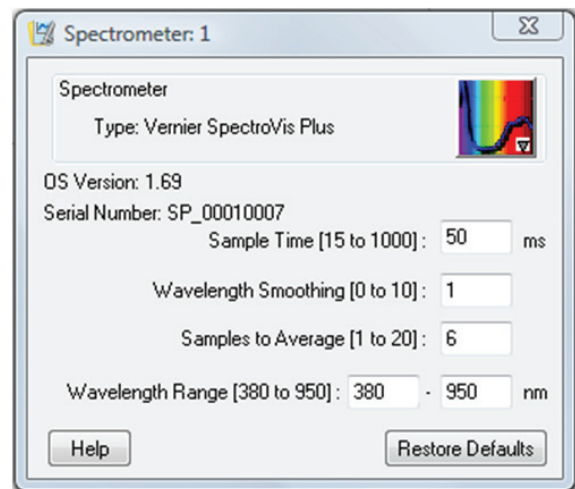
1. Choose Open from the File menu.
2. Open the Sample Data folder.
3. Inside the Sample Data folder, open the Physics folder.
4. Inside the Physics folder, open the Gas Discharge Spectra. Open the desired file.

You can use the mercury emissions graph to test fluorescent lighting for the presence of mercury.

#### Change the Settings in Logger Pro

##### Spectrophotometer Dialog Box

The Spectrophotometer dialog box lists all the settings for the device. To display this box choose Set Up Sensors ► Spectrophotometer from the Experiment menu.



*Spectrometer dialog box*

For most experiments, the default settings work well.

There are five parameters listed in the dialog box.

- **Sample Time:** This is 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:** This is the number of adjacent readings on either side of a given value that is used to calculate an average value. **Note:** Be careful adjusting this parameter as it may shift your wavelength values slightly.
- **Samples to Average:** This is the number of readings taken at a given wavelength to calculate an average reading.
- **Wavelength Range:** The range is determined by the type of Spectrophotometer in use.
- **LED Intensity:** This allows you to change the intensity of the excitation LED.

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

#### Using the Spectrophotometer with LabQuest

##### Select the Type of Data (or Units) You Want to Measure

There are three general types of data collection that measure absorbance or transmittance—absorbance (or %T) vs. wavelength, which produces a spectrum, absorbance (or %T) vs. concentration for Beer's law experiments, and absorbance (or %T) vs. time for kinetics experiments.

The default data type is absorbance. If you want to measure the absorbance of a solution, proceed directly to the Calibrate section.

If you want to measure %T, fluorescence (excited at 405 nm or 500 nm), or intensity, do the following:

1. From the Sensors menu, choose Change Units ► USB: Spectrophotometer.
2. Select the unit or data type you wish to measure.

#### **Calibrate the Spectrophotometer (Not Required if Measuring Intensity or Fluorescence)**

1. Choose Calibrate ► USB: Spectrophotometer from the Sensors menu. **Note:** For best results, allow the Spectrophotometer to warm up for a minimum of five minutes.
2. Fill a cuvette about 3/4 full with distilled water (or the solvent being used in the experiment) to serve as the blank. After the Spectrophotometer has warmed up, place the blank cuvette in the Spectrophotometer. Align the cuvette so a clear side of the cuvette is facing the light source.
3. Follow the instructions in the dialog box to complete the calibration, and then tap OK.

#### **Collect Data with LabQuest**

##### **Measurement vs. Wavelength (Generate a Spectrum)**

1. Fill a cuvette about 3/4 full of the solution to be tested and place it in the Spectrophotometer.
2. Start data collection by tapping on the Start button in the lower left corner of the screen. Tap the Stop button to end data collection.
3. Select wavelength. **Note:** The wavelength of maximum absorbance ( $\lambda$  max) is automatically selected. This  $\lambda$  max will be used for any subsequent data collection, such as a Beer's law experiment (abs vs. conc.) or a kinetics experiment (abs vs. time). If you wish to choose another wavelength, you can tap on the graph to select a new wavelength. Another way to change the wavelength is to navigate to the Meter screen, tap on the meter, and select Change Wavelength. Enter the wavelength of your choice and select OK. If the wavelength you type in is not measured by the unit, LabQuest will automatically choose the wavelength closest to your choice.
4. To store the spectrum data, tap on the file cabinet icon in the upper right of your screen.

##### **Measurement vs. Concentration (Beer's Law Studies)**

1. Generate a spectrum as described above. On the Meter screen, tap Mode. Change the mode to Events with Entry.
2. Enter the Name (e.g., Concentration) and Units (e.g., mol/L). Select OK.
3. A message will appear warning you to either save or discard the full spectrum run. Make your choice and proceed with data collection.
4. Place your first Beer's law standard solution in the Spectrophotometer. Start data collection. After the absorbance reading stabilizes, tap Keep. Enter the concentration of the solution and select OK.
5. Place your second standard sample in the Spectrophotometer. After the absorbance readings stabilize, tap Keep. Enter the concentration of the second sample and select OK.

6. Repeat Step 5 for the remaining standard samples. After you have tested the final standard, tap the Stop button to end data collection.
7. 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.
8. Place a cuvette containing an unknown sample of solution in the Spectrophotometer. Tap the Meter tab and write down the displayed absorbance value. Tap the Graph tab and choose Interpolate from the Analyze menu. Trace the linear regression equation to determine the concentration of the unknown.

##### **Measurement vs. Time (Kinetics)**

1. Generate a spectrum as described above. On the Meter screen, tap Mode. Change the data-collection mode to Time Based.
2. You can change the rate, interval, and/or duration of time of data collection, if desired. Select OK when you are ready to proceed.
3. A message will appear warning you to either save or discard the full spectrum run. Make your choice and proceed with data collection.
4. Mix the reactants, transfer ~2 mL of the reaction mixture to a cuvette and place the cuvette in the Spectrophotometer. Start data collection. You may tap the Stop button to end data collection early.
5. 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.

##### **Measure Fluorescence with LabQuest**

You may use your Spectrophotometer to measure the fluorescence spectrum of an aqueous sample, such as chlorophyll, quinine, and fluorescein. Fluorescence is the emission of light by a compound after it has absorbed a particular wavelength of light. Under most circumstances, the emission of light will occur at a longer wavelength than the light used to excite it. The spectrometer comes with three LEDs (375 nm, 450 nm, and 525 nm) that serve as the excitation wavelengths. Additional excitation LEDs can be purchased separately.

There are three general types of data collection that measure fluorescence—fluorescence vs. wavelength, which produces a spectrum, fluorescence vs. concentration, and fluorescence vs. time for kinetics experiments. Once the units have been changed to Fluorescence from the Experiment menu, follow the instructions in the section titled Collect Data with LabQuest to collect these types of data.

These are some additional features in fluorescence mode that may improve your data quality:

##### **Adjusting the LED Brightness**

1. To set the LED intensity, tap on the red meter and select Set LED.
2. The LED Intensity is set to 50 by default. Adjust it between 0 and 100. A setting of 0 turns the LED off while a setting of 100 is the maximum LED intensity. **Note:** If you adjust this value during data collection, you may want to recalibrate or perform a manual baseline adjustment with a calculated column.



### Adjusting the Sample Time

1. On the Meter screen, tap Mode to set the Sample Time.
2. By default, this value is set to 100 ms. The Sample Time is the amount of time the detector is exposed to the emission light. The longer the sample time, the greater the signal, and the longer the time it takes to collect data. 100 ms is a good starting point for data collection. You may adjust this value while data collection is active. If you do this, the spectrum will update in real time. **Note:** If you adjust this value during data collection, you may want to recalibrate or perform a manual baseline adjustment with a calculated column.

### Calibrate Fluorescence

1. Fill a cuvette about 3/4 full with distilled water (or the solvent being used in the experiment) to serve as the blank.
2. To calibrate the spectrophotometer, choose Calibrate ► Spectrometer from the Sensors menu.
3. Follow the instructions in the dialog box to complete the calibration, and then click .

### Measure an Emission Spectrum with LabQuest

You may use your Spectrophotometer to measure the emission spectrum of a light source such as an LED or a gas discharge tube. To do so, you will need to purchase an optical fiber assembly (order code: VSP-FIBER).

### Measure Intensity of Light Emissions

1. Insert the Spectrophotometer Optical Fiber into the Fluorescence/UV-VIS Spectrophotometer, lining up the white triangles.
2. Aim the tip of the optical fiber at a light source. Start data collection. Tap the Stop button to end data collection. **Note:** The Spectrophotometer is not calibrated for measuring intensity.

If the spectrum maxes out (flat and wide peaks at a value of 1), increase the distance between the light source and the tip of the optical fiber cable or reduce the sample time (see Change the Settings in LabQuest below).

To increase the sample time, or if data collection is unusually slow, choose Set Up Sensors ► Spectrophotometer: 1 from the Experiment menu. Set the Sample Time (begin with 75 ms, with subsequent reductions by 20 ms) to a suitable value and decrease the Samples to Average to 1.

### Change the Settings in LabQuest

#### Data Collection Screen

The Data Collection Screen in LabQuest lists all the settings for the device. To display this box choose Sensors ► Data Collection from the Meter screen.

For most experiments, the default settings work well.

There are five parameters listed in the dialog box.

- Sample Time: This is similar to the shutter speed of a camera. LabQuest automatically selects the proper sample time during calibration. **Note:** For emission studies, you may need to change the sample time manually.

- Wavelength Smoothing: This is the number of adjacent readings on either side of a given value that is used to calculate an average value. **Note:** Be careful adjusting this parameter as it may shift your wavelength values slightly.
- Samples to Average: This is the number of readings taken at a given wavelength to calculate an average reading.
- Wavelength Range: The range is determined by the type of Spectrophotometer in use.
- LED Intensity: This allows you to change the intensity of the excitation LED. This setting is only available in fluorescence mode by tapping on the meter.

### Specifications

Detection modes	Absorbance and Fluorescence
Dimensions	18.5 cm × 17 cm × 7 cm
Power supply	AC adapter (included)
Power consumption	3 A start-up, 500 mA continuous
Absorbance light source	Deuterium (UV) and Incandescent (VIS)
Detector	Linear CCD
Emission light source	Exchangeable LED included (375 nm, 450 nm, 525 nm)
Wavelength range	220 nm–850 nm
Wavelength reporting interval	~1 nm
Optical resolution	3.0 nm (as determined with 486 nm hydrogen emission spectral line FWHM)
Wavelength accuracy	± 2.0 nm (as determined with holmium oxide NIST standard)
Absorbance photometric accuracy	± 5.0% (as determined with potassium dichromate NIST standards)
Typical scan time	~2 s
Sample format	10 mm × 10 mm cuvette (UV fluorescence cuvette included)
Fluorescence emission detection limit	1 mg/L quinine sulfate dihydrate in 0.1 M H <sub>2</sub> SO <sub>4</sub>

### Safety

- Always wear UV blocking safety glasses or goggles when using this device. The light source emits ultraviolet radiation and can cause eye damage.
- When this instrument is in data-collection mode labeled Intensity, the light source will be blocked or turned off. Continue to use proper safety precautions.
- This instrument contains an internal high-voltage power source. Position the

instrument where the ON/OFF switch can be easily reached. Do not move the instrument when it is running. Do not attempt to open or remove the case at any time.

- Do not remove or modify any of the installed safety components of this device. Doing so will create an unsafe operating condition and will void the product warranty.
- No user-serviceable parts are in this device. Do not attempt to open or modify this device. Contact Vernier for all repairs and service including lamp replacement.
- Handle the device with care. This instrument can be damaged if it is dropped.
- Do not use this instrument if it is damaged in any way. Contact Vernier Technical Support for troubleshooting and technical assistance.
- Do not use this instrument for clinical or diagnostic procedures.

## Troubleshooting

1. If you plan on only taking fluorescence data, the power cable does not need to be attached, nor does the power switch need to be on. This will help save your deuterium lamp for absorbance measurements.
2. In fluorescence measurements, the inner-filter effect is always a consideration. The inner filter effect results in an apparent decrease in emission quantum yield and/or distortion of bandshape as a result of reabsorption of emitted radiation. To avoid this, it is best to perform fluorescence measurements on samples that have an absorbance below 0.1.

Find troubleshooting tips here: [www.vernier.com/tit/3918](http://www.vernier.com/tit/3918)

## Repair Information

- The UV light source in the Vernier Fluorescence/UV-VIS Spectrophotometer is a deuterium lamp. The lifetime of this source is rated at approximately 1000 hours. Lifetime is defined as the amount of time it takes the lamp to decrease to 50% of its original output. Deuterium lamp life is also inversely proportional to the number of ignitions, so it is best to limit the number of times you ignite the bulb if you wish to prolong its life.
- The deuterium lamp is covered by a one-year warranty or 1000 hours, whichever comes first.
- Contact Vernier for all repairs and service including lamp replacement
- No user-serviceable parts are in this device. Do not attempt to open the case of the device. Do not attempt to change or repair the lamp. Doing so will create an unsafe operating condition and will void the product warranty.

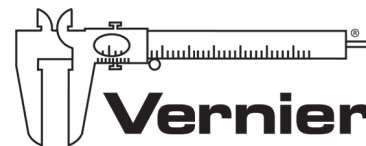
If you have watched the related product video(s), followed the troubleshooting steps, and are still having trouble with your Vernier Fluorescence/UV-VIS Spectrophotometer, contact Vernier Technical Support at [support@vernier.com](mailto:support@vernier.com) or call 888-837-6437. Support specialists will work with you to determine if the unit needs to be sent in for repair. At that time, a Return Merchandise Authorization (RMA) number will be issued and instructions will be communicated on how to return the unit for repair.

## Accessories/ Replacements

Item	Order Code
Cuvette Rack	CUV-RACK
Fluorescence/UV Quartz Cuvette	CUV-QUARTZ-FUV
Spectrophotometer Optical Fiber	VSP-FIBER
Mini USB Cable	CB-USB-MINI

## Warranty

Vernier warrants this product to be free from defects in materials and workmanship for a period of five years from the date of shipment to the customer. This warranty does not cover damage to the product caused by abuse or improper use. This warranty covers educational institutions only. The light source is covered for three years.



MEASURE. ANALYZE. LEARN.™

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Rev. 3/1/17

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