Spectra Lab Instruction Manual Rev 2

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1. Introduction

Welcome to Spectra Lab. Spectra Lab is an app that allows you to control and operate Ocean Optics™ spectrometers from your android powered tablet.   The following document will guide you through some of the basics of operation as well as some important information regarding the app. Please take the time to carefully review the requirements and the currently supported spectrometers listed below. If you have any additional questions or problems please contact us at:

support@mobilecontrolsoft.com

2. Requirements

- Android 3.1 or Higher
- 10.1" Tablet with
    - 1 Full USB 2.0 Port **OR**
    - 1 OTG 30pin to USB FEMALE Connector (or similar) for most newer 10.1" tablets

Figure A. Example of an OTG connector

3. Supported Spectrometers

Spectra Lab currently supports the following spectrometers

<u>Ocean Optics</u>
- HR2000
- HR4000
- USB2000
- USB2000+
- USB4000
- QE65000
- Torus

4. Setup Connection

Once you launch the Spectra Lab app. You will be taken to the main screen similar to the one shown in figure 1.
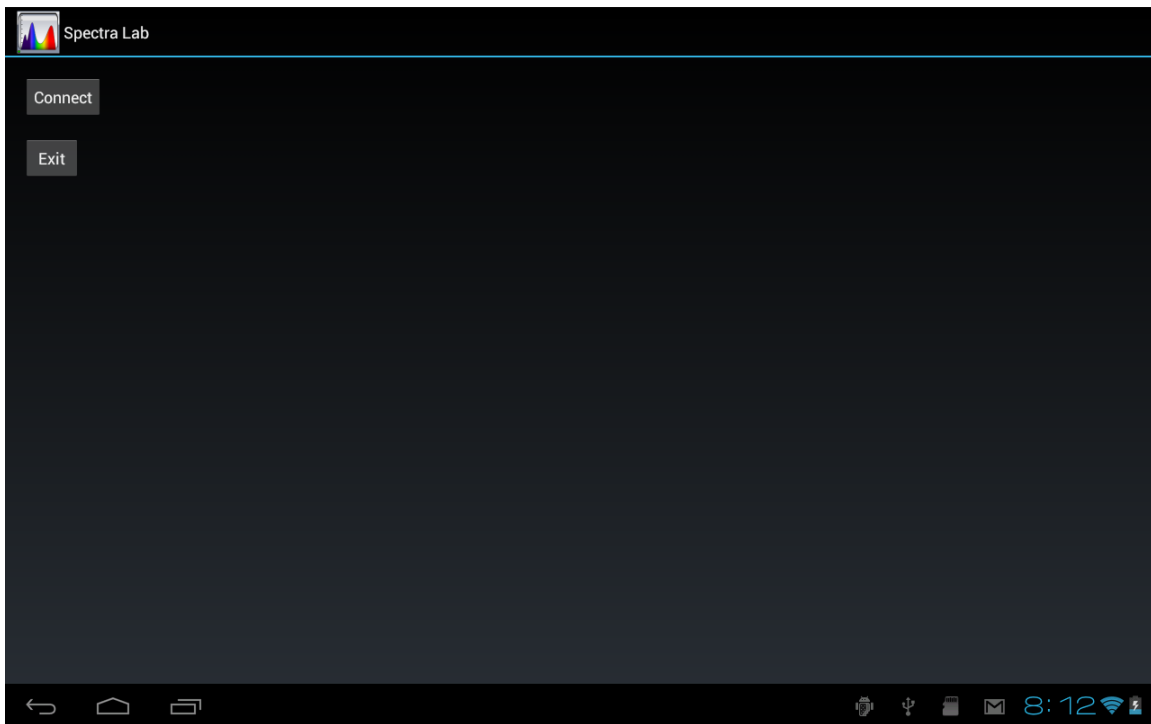

Figure 1. Main screen

Connect your spectrometer to the **FULL USB** port found on the side of your tablet or to the **Female USB Connector** at the end of your **30pin** (or similar) **OTG connector**. If your cable is not properly connected, the app will throw an error message once you try to connect.
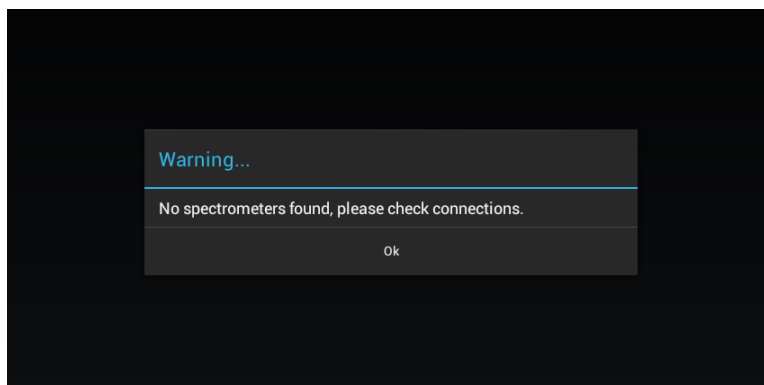

Figure 2. Bad cable connection

If the cable is properly connected, you will see a request to allow the app to access the USB Device. Accept the request by pressing **"OK".**
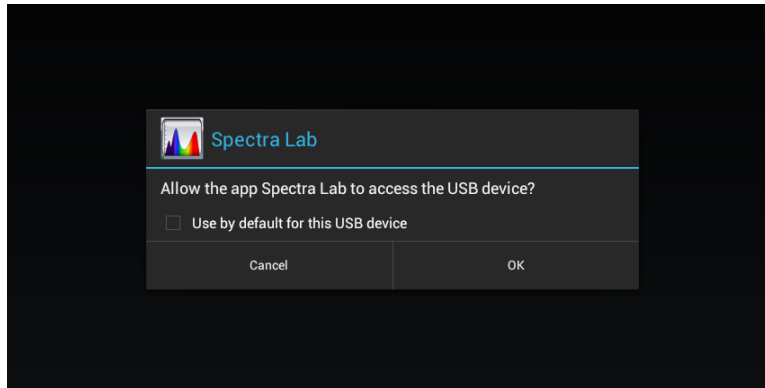
Figure 3. Allow USB access

If you cancel the request, the app will throw an error. Simply tap the **"Connect"** button to try again.
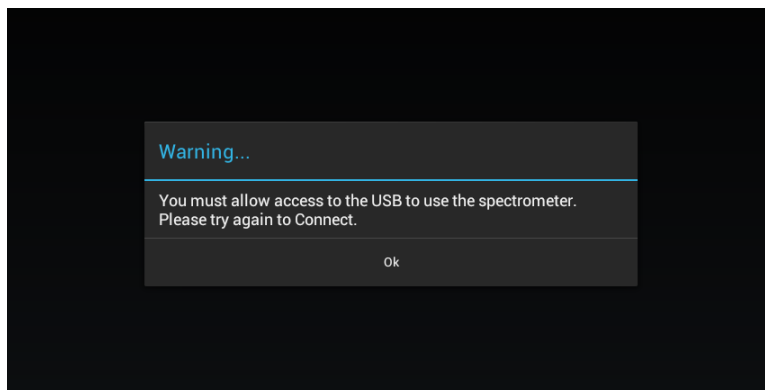

Figure 4. Failed USB permission

5. Spectrometer Screen

Once Spectra Lab successfully connects to the spectrometer you will be brought to the main screen similar to the one in figure 5.
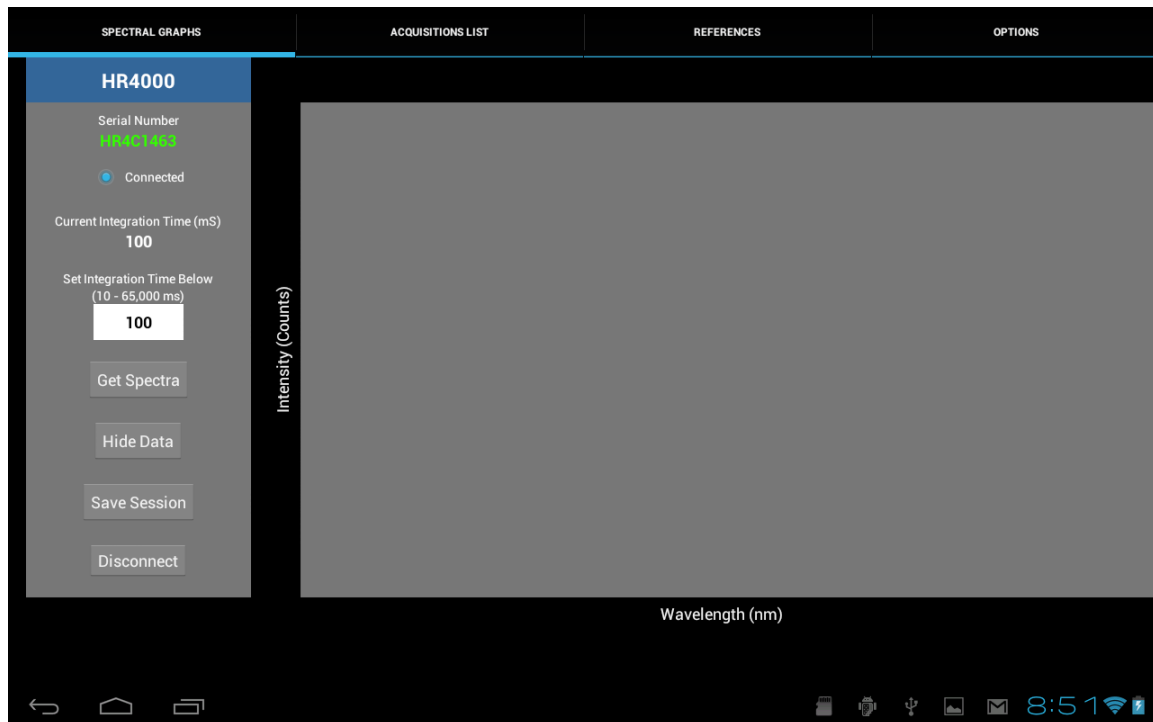

Figure 5. Spectrometer Screen

The spectrometer screen is broken down into four tabs (**five** if you use a QE65000):

1. Spectral Graphs
2. Acquisitions List
3. References
4. Options
5. QE65000 (for the QE65000 model only)

6. Spectral Graphs Tab

The Spectral Graphs tab has two areas of interest:
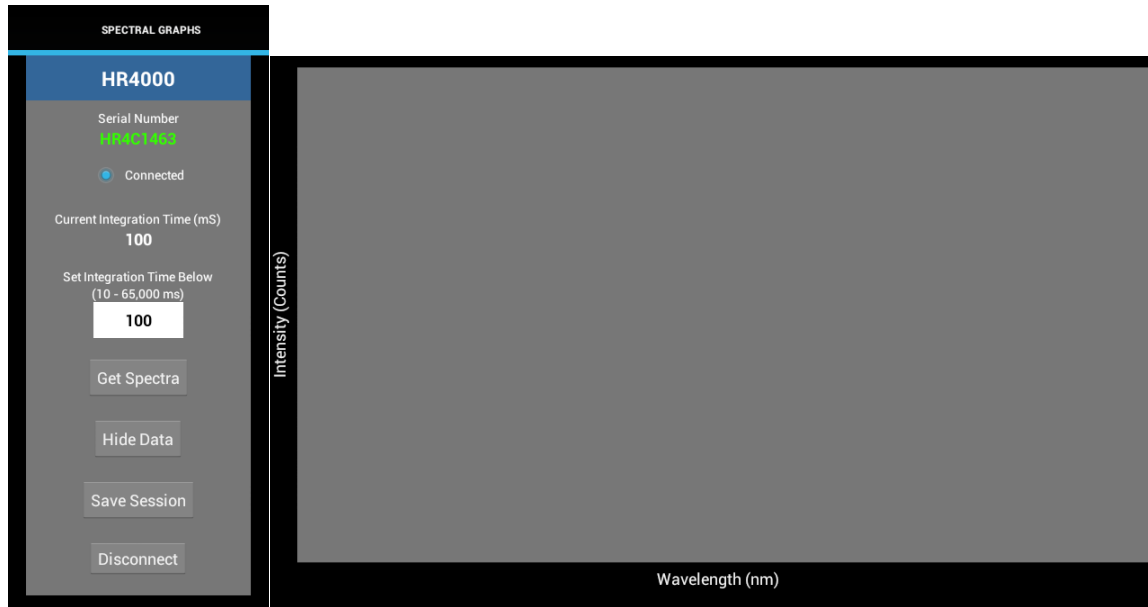1. The control panel to the left
2. The graph area to the right

Figure 6. Spectral Graphs Tab

6.1 Control Panel

The control panel on the left displays the following information:

1. **Spectrometer Model:** Given at the top of the panel directly underneath the Spectral Graphs tab.
2. **Serial Number:** The spectrometer serial number given from the factory
3. **Connection Indicator:** When properly connected the indicator will light up blue and indicate **"Connected"**. If the spectrometer is disconnected, the blue indicator will disappear and show **"Disconnected".**
4. **Current Integration Time:** The current integration time. Units are given in milliseconds.
5. **Set Integration Time:** The command box where the user can input a new integration time. Integration times are sent to the spectrometer and updated every time an acquisition is made. Units are given in milliseconds
6. **Get Spectra:** Acquires a spectral signal. Acquired data is graphed on the right in the graphing area.

7. **Hide Data:** Hides all data that has been acquired so far by activating the hide option for all data in the "Acquisitions List" tab. Newly acquired data will appear normally in the graph area on the right.
8. **Save Session:** Allows the user to save all acquisition data, references, and session hardware information.
9. **Disconnect:** Safely disconnects the spectrometer from the tablet. This sends the user back to the main screen.

6.2 Connection Indicator

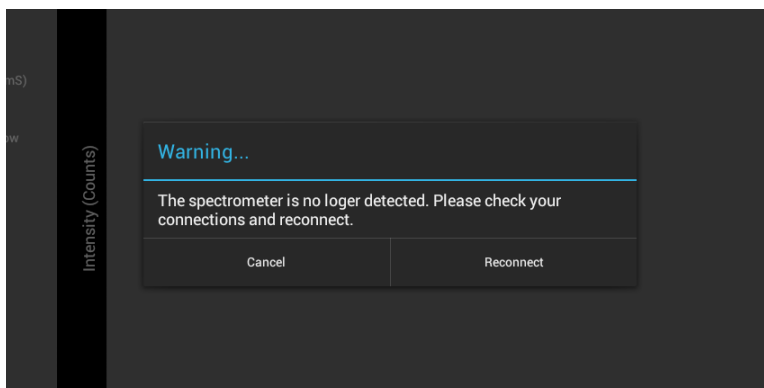In the event the spectrometer is disconnected the system will notify you.

Figure 7. Disconnected spectrometer

Check the USB connections and press the **"Reconnect"** button. In the event the **"Cancel"** button is pressed or the USB connection is still loose, you will be taken back to the main screen. The connection indicator will continue to read **"Disconnected"**
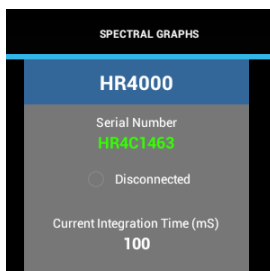

Figure 8. Connection indicator

To attempt to reconnect again to the spectrometer, simply press the **"Get Spectra"** button and the system will re-prompt you.
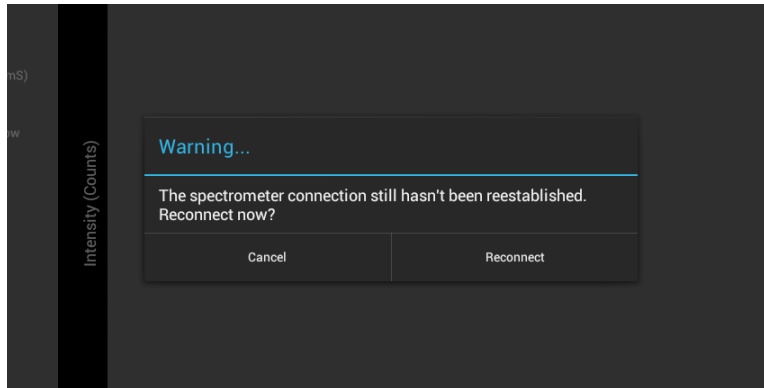
Figure 9. Reconnection request

If successful, the app will request USB permission again. If permission is denied, the spectrometer will remain disconnected until permission is granted.
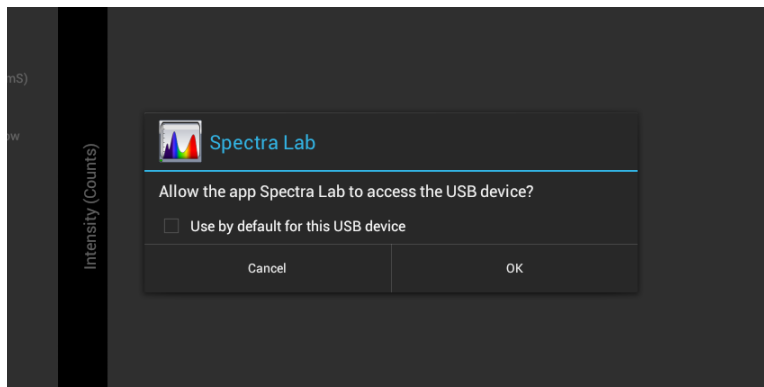

Figure 10. USB permission

6.3 Connecting a new spectrometer

To connect a new spectrometer, simply disconnect the current spectrometer from USB port or OTG Connector and plug in another spectrometer. Following the same steps as above, the app should recognize the new spectrometer and update all the hardware values accordingly.

*IMPORTANT: It is HIGHLY recommended that you save your session **BEFORE** connecting a new spectrometer. Should a hardware failure occur in the process of switching spectrometers your current data may be lost. In addition, a hardware file is generated with every new spectrometer connection. If the session is not saved before connecting a new spectrometer, this information will be overwritten by the newly connected hardware.*

6.4 Acquiring Spectra

Once your spectrometer is connected and your integration time is set, press the **"Get Spectra"** button located inside the control panel on the left. A plot should then appear (depending on your integration time and number of averages) on the

graphing area to the right. Each spectra is assigned a randomly generated color, and its name and color appear on a legend on the bottom right hand side of the graph.
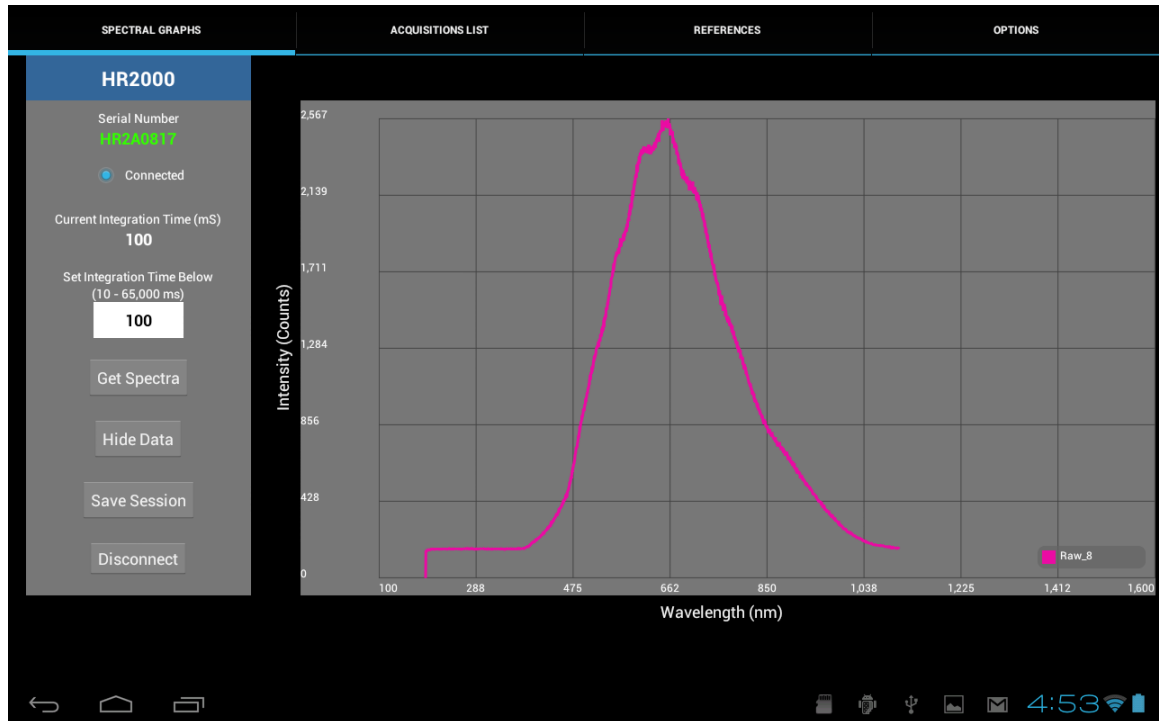

Figure 11. Graphed data

The graphing area is dynamic and can handle traditional pinch and zoom gestures. This allows you to observe signal data in greater detail. By default (and for performance reasons), Spectra Lab shows only the newest 4 acquisitions at any given time. This feature can be changed in the **"Options"** tab under **"Graph Options"**.

IMPORTANT: The graphing software always scales to meet the requirements of the largest data values. If multiple signals are plotted in the graphing area, it may be necessary to hide all the other graphs before zooming in on desired plot in order to reveal a greater level of detail. Hiding and unhiding signal data can be performed under the "Acquisitions List" tab.

6.5 Saving Your Session

Once you are ready to save your data, simply press the **"Save Session"** button located on the bottom left of the **"Spectral Graphs"** Tab. Spectra Lab should prompt you with a similar screen shown below in figure 12.

*IMPORTANT: You must have acquired and kept at least **ONE** spectra before Spectra Lab will allow you to save the session.*
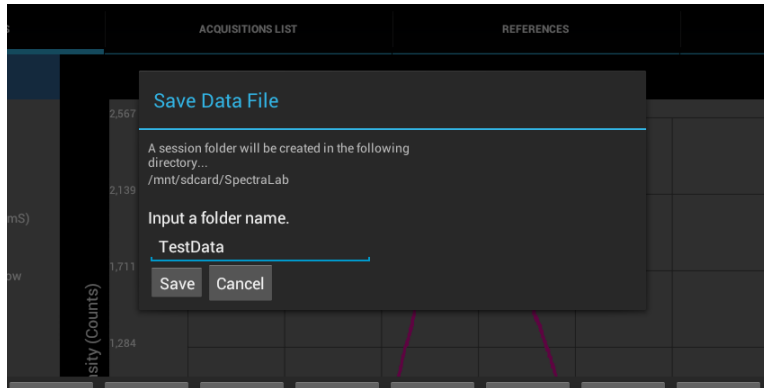
Figure 12. Save data dialog

The dialog will prompt you for a folder name. The new folder will be created inside the "SpectraLab" folder on your smart device. For this example, "TestData" was chosen for the session name.

To access your data, find the app icon labeled **"File Manager"** or **"My Files"** and press it.
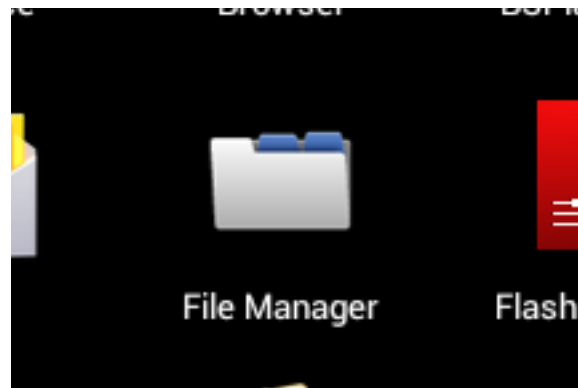

Figure 13. File Manager Icon

Once inside, look for the folder labeled **"SpectraLab"** and press it.
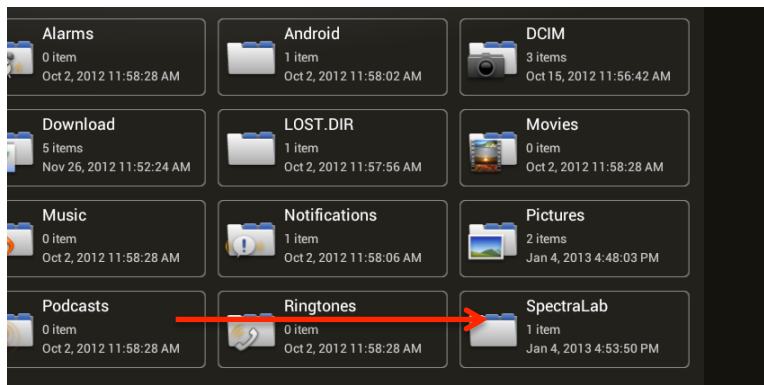

Figure 14. Spectra Lab folder

The system will then take you to the directory where your saved sessions are located.
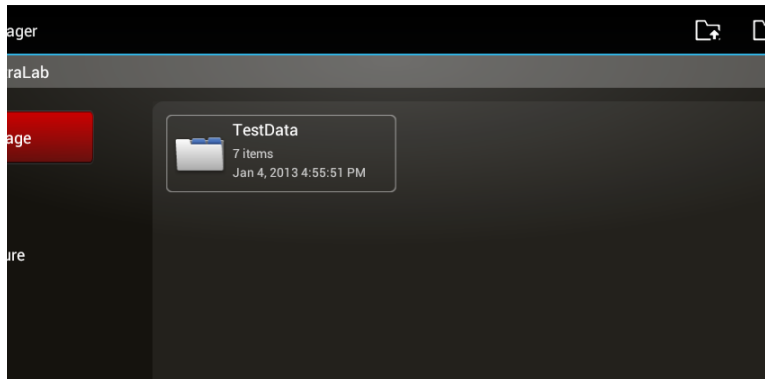

Figure 15. Session folders

In this case, our recently saved session folder labeled "TestData" is available.

Inside you saved session folder you will find ".txt" files. These files contain the retained data from the Spectra Lab session. Any text editor or word processor is capable of opening the text files. Typically, each session folder will contain the following types of files

- Hardware Configuration file
- Dark and Light References File (If any references were taken)
- Raw, Absorbance, Transmission, and/or Reflectance files
- Any custom named files

The current version of Spectra Lab does not allow the direct saving of sessions to a SD card. You can however, copy and paste the SpectraLab folder onto an SD card.
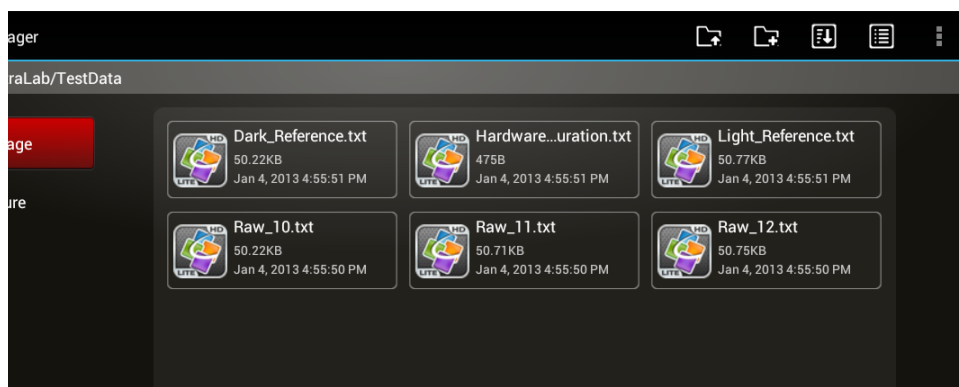

Figure 16. Saved session files

<u>IMPORTANT</u>: *Each manufacturer may have a slightly different name for their "File Manager" icon where you can access your files. Refer to your tablet's user manual.*

7. Acquisitions List Tab

The Acquisitions List tab contains all the signal acquisitions collected from the spectrometer.

Figure 17. Acquisitions List

Each acquisition cell has displays the following information:
1. **Name:** The acquisition name generated by Spectra Lab or, the name given by the user.
2. **Hide:** By selecting this checkbox you can hide or unhide the selected data graphed on the plot located in the **"Spectral Graphs"** tab.
3. **Delete:** With this checkbox you are preparing to delete the acquisition cell. Deletion is fully executed once you press...
4. **Apply:** By pressing the apply button you commit to deleting the selected acquisition. Please note that merely pressing the apply button doesn't delete the acquisition. You must check the delete box before pressing the apply button.
5. **View Data:** Allows you to view the selected acquisition data in a tabular format on the right.
6. **Rename Data:** Allows you to rename the selected acquisition.

IMPORTANT: Do not use the same name for multiple acquisitions when manually renaming data. Your data will not be saved correctly if you do.

8. References Tab

The references tab is laid out similarly to the "**Acquisitions List**" tab with the addition of a small graphing area on the bottom. The graphing area works exactly like the larger one found under the **"Spectral Graphs"** tab and can be pinched and zoomed for a more detailed look at the acquired signals. Only two references can be taken and used at any given time.

IMPORTANT: Remember to retake your references every time you change:

- The number of averages
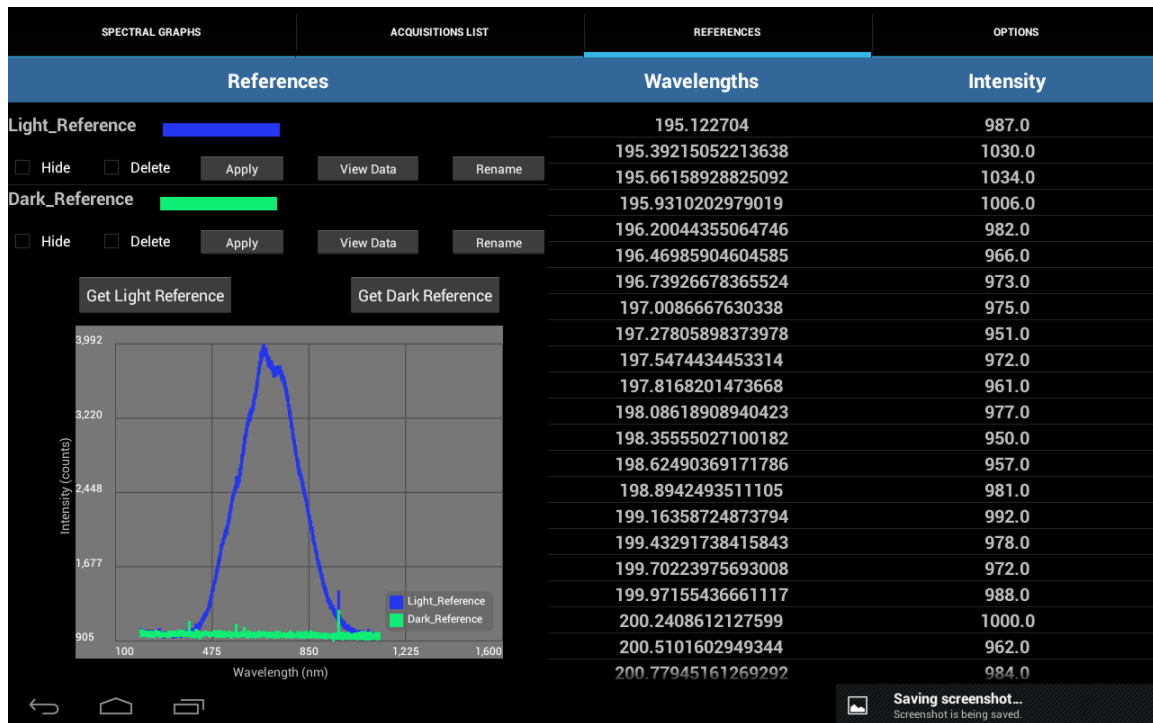- Integration time
- Toggle nonlinearity correction

Figure 18. References Tab

9. Options Tab

The Options tab provides you with a number of useful and necessary parameters for data acquisition.

Figure 19. Options Tab

The Options tab contains the following parameters.

1. **Acquisition Mode:** Allows you to change between Raw (scope), Absorbance, Transmission, and Reflectance measurements. Two things occur when you change from **Raw** to any of the other 3 modes.
   a. Spectra Lab will **Hide** any data that is not of the same mode. This is done for graphing and scaling purposes. It would be difficult to see an absorbance graph of 1.3 AU when you have a 15,000 count raw plot on the same graph.
   b. Spectra Lab will not let you acquire a spectra until you've generated a **Light** and **Dark Reference.**

2. **Signal Options:** Here you can implement nonlinearity corrections for every subsequent acquisition as well as setting the number of averages. Always remember to acquire new **Light** and **Dark Reference** after any changes made here.

3. **Graph Options:** You can set the number of spectra that appear in the graphing area under the **"Spectral Graphs"** tab by adjusting the **"Set Rolling Value"**. The Rolling Value controls the number of trailing Spectra

that will be shown starting from the newest acquisition to the oldest. For example with the default value of "4", if 5 acquisitions are taken only 4,3,2 and 1 will appear on the graph plot. Spectra Lab toggles the **"Hide"** button for the last one automatically (Counting starts at "0"). If the Rolling Value were changed to "3" then only 3, 2 and 1 would be shown and so on.

*<u>**Important:**</u> The default setting for the **"Rolling Graph Value"** is 4. This is done purely for performance reasons. You can elect to have a larger rolling value, but you may experience significant slow down during signal acquisition and in pinching and zooming on the graph details.*

4. **Data Options:** If you've generated a significant number of acquisitions, and would prefer not to have to manually delete all of them, you can delete all the acquisitions with this option. Just press the **"Check to Activate Box"** and hit the **"Delete All Acquisitions"** button and Spectra Lab will delete all the data in your **"Acquisitions List"**. The checkbox will then untoggle itself to prevent any accidental deletions.

5. **Save Options:** Here you can set your own bulk save names regardless of the Acquisition Mode you're in. Enable the "Bulk Save Name" option by pressing the **"Enable"** check box, and then press the text field to enter your custom name. All acquisitions will be generated with that name plus a counter value. For example if your custom name is "River_Data", then Spectra Lab will generate River_Data_0, River_Data_1,…, River_Data_n". Every time a new name is given, the counter value will reset to zero.

6. **Hardware Configuration Viewer:** Displays the relevant hardware information provided by the manufacturer about the spectrometer. This information is saved to a .txt file when you save your session

10.   QE65000 Tab

If you're using a QE65000 Spectrometer then you will have one more Tab to select from in addition to the other ones previously mentioned. This is the QE65000 specific tab as shown below in figure 20.

Figure 20. TEC Cooler

The tab allows you to read and adjust the temperature setting of the integrated TEC (Thermo Electric Cooler).   As stated in the Tab, the temperature setting is adjusted by inputting a range of 0 – (-250) into the field to the right of the **"Set Detector Temperature"** button. The negative integer values correspond to a decimal temperature value. After setting the temperature, you can press the **"Get Detector Temperature"** button to read the current detector temperature. The default setting for the TEC is -10.0°C.

Important: *While a value of zero can be inputted into the temperature field, it is likely that the TEC will only achieve a value of ~ -5 °C.*

11.   Known Issues

1. **HR2000** & **USB2000:** For some reason the data received from the first acquisition after these systems have been newly connected is almost always offset. I believe this has to do with the way these older units power up their internal electronics as the USB4000 HR4000 and Torus

show none of these issues. Just simply generate and discard the first acquisition when connecting these units for the first time.

12. Problem Solving

1. I plugged in my spectrometer and it says no spectrometers found.

    Sometimes it takes a few seconds for the spectrometer to power-up, so Spectra Lab may not detect the spectrometer if you immediately plug it in and hit "Connect" or "Get Spectra".

2. I can't activate the Nonlinearity Correction.

    Under the Options Tab, look at the Hardware Configuration Viewer on the right. Are the nonlinear correction coefficients zero? If so, Spectra Lab disables the nonlinearity correction option.

3. The app really slows down every time I try and acquire a spectra or when I zoom into the plotted data.

    You may have set the "Rolling Value" under the "Options Tab" too high, and/or you may have too many acquisitions plotted on the graph.   Reduce the amount of graphs on the plot by using the hide options and/or adjust the "Rolling Value". If this doesn't improve performance you may have other apps in the background that are using up system resources.

4. I switched spectrometers and the app says, "The hardware did not initialize properly".

    Every once in awhile some spectrometers simply won't power up correctly. This is usually the case with the older HR2000 and USB2000. Simply follow the directions given in the pop up window and the spectrometer should initialize correctly.

5. In Absorbance, Reflectance or Transmission mode, when I view the tabulated data, I see a lot of "0.01234" values.

    *When your signal is close to the inherit noise level of the system, a **divide by zero** or **infinity** value may occur when absorbance, reflectance or transmission values are calculated. In order to allow the app to graph the*

calculated data points without throwing an error, dummy values are inserted instead when this issue arises.