



Operating Instructions

VIS/NIR Spectrophotometer Probe **Table of Contents**

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Warranty

Veris Technologies warrants this product to be free of defects in materials and workmanship for a period of one (1) year from the date of delivery to the purchaser. Veris Technologies will repair or replace any product returned to Salina, Kansas, which appears upon inspection to be defective in materials or workmanship. Veris Technologies will have shall have no obligation under this warranty for the cost of labor, down-time, transportation charges, or for the repair or replacement of any product that has been misused, carelessly handled, modified, or altered.

ALL OTHER WARRANTIES OF ANY KIND, WHETHER EXPRESSED OR IMPLIED, INCLUDING BUT NOT LIMITED TO ANY IMPLIED WARRANTY OF MERCHANTABILITY OR OF FITNESS FOR A PARTICULAR PURPOSE AND ALL CLAIMS FOR CONSEQUENTIAL DAMAGES, ARE SPECIFICALLY DISCLAIMED AND EXCLUDED.

Safety

Look for Safety Symbol

The SAFETY ALERT SYMBOL indicates there is a potential hazard to personal safety involved and extra safety precaution must be taken. When you see this symbol, be alert and carefully read the message that follows it. In addition to design and configuration of equipment, hazard control and accident prevention are dependent upon the awareness, concern, prudence and proper training of personnel involved in the operation, transport, maintenance and storage of equipment.



Be Aware of Signal Words

Signal words designate a degree or level of hazard seriousness.

DANGER indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury. This signal word is limited to the most extreme situations, typically for machine components that, for functional purposes, cannot be guarded.



WARNING indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury, and includes hazards that are exposed when guards are removed. It may also be used to alert against unsafe practices.



CAUTION indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury. It may also be used to alert against unsafe practices.



Important! Read the following SAFETY PROCEDURES before operating the Veris MSP

- Escaping fluid under pressure can penetrate the skin causing serious injury. Avoid the hazard by relieving pressure before disconnecting hydraulic lines. Use a piece of
- Use paper or cardboard, NOT BODY PARTS, to check for suspected leaks.
- Wear protective gloves and safety glasses or goggles when working with hydraulic and high-pressure wash systems.
- If an accident occurs, see a doctor immediately. Any fluid injected into the skin must be surgically removed within a few hours or gangrene may result.

WARNING

- Pinch point hazard: to prevent injury, stand clear when raising or lowering any part of the Veris P4000.
- Install all transport locks before transporting or working underneath.
- Detach and store implements in an area where children normally do not play. Secure implement by using blocks and supports.
- Keep feet clear of foot and probe when lowering.
- Do not probe where utility lines may be present. Use 'Call Before You Dig' services.
- Use paper or cardboard, NOT BODY PARTS, to check for suspected leaks.
- Wear protective gloves and safety glasses or goggles when working with hydraulic and high-pressure wash systems.
- If an accident occurs, see a doctor immediately. Any fluid injected into the skin must be surgically removed within a few hours or gangrene may result.

CAUTION

- Read Operations Manual before operating machine
- Review safety instructions with operators before operating machine and at least annually
- **Riders obstruct the operator's view. They could be struck by foreign objects or thrown from the machine.**
- Never allow children to operate equipment.
- To prevent possible electrical shock, or damage to the instrument, do not connect to any power source greater than twelve (12) volts DC.
- Do not grease or oil implement while it is in operation.
- Disconnect battery ground cable (-) before servicing or adjusting electrical systems or before welding on implement.
- Remove buildup of mud, oil or debris.
- Be prepared if a fire starts
- Keep a first aid kit and fire extinguisher handy.
- Be careful when touching the probe after use, the sapphire window gets hot.

Section 2

VERIS P4000 Probe Platform System Overview

Before you begin using your P4000, it's important to familiarize yourself with the basic components and controls

Pre-operation checks:

- 1) Engine oil Level – refer to Honda GX 670 engine manual
- 2) Hydraulic fluid -- fluid level should be at or near upper black line on sight gauge of hydraulic reservoir. (Figure 1). If not add suitable ISO 32 hydraulic fluid with a viscosity index of 95- 140. Unit is filled at factory with Mobilfluid 424.
- 3) Check gas level – unleaded gasoline only
- 4) Check for any loose fasteners or hydraulic leaks.



Figure 1

Controls:

- 1) **Engine controls** are located on the engine itself. (figure 2) . Refer to Honda engine manual for detailed information.



Figure 2

Hydraulic Controls

All **system monitoring and probe control functions** are contained on the console mounted to the right of the probe, referred to as the “foot”. (Figures 3,4)

- a) Voltage meter – monitors battery voltage
- b) Side shift control – allows lateral movement of probe for multiple insertions at a given location.
- c) Extension control -- used to extend probe from transport to field use position
- d) Fold control – folds probe from transport to use position
- e) Probe speed flow control – controls insertion speed of NIR/EC Force Probe to operator preference
- f) Hydraulic pressure gauge – monitors system pressure during hydraulic cycling
- g) Hour meter—monitors engine operation for routine maintenance
- h) Foot Control – Raises and lowers foot
- i) Rotation control – aids in soil core insertion in tough soils. Down is clockwise-direction required for coring.
- j) Probe control – Raises and lowers probe assembly
- k) Engine emergency stop – immediately shuts down engine if need arises.
- l) 12VDC power switch for auxiliary and spectrometer power.

Figure 3

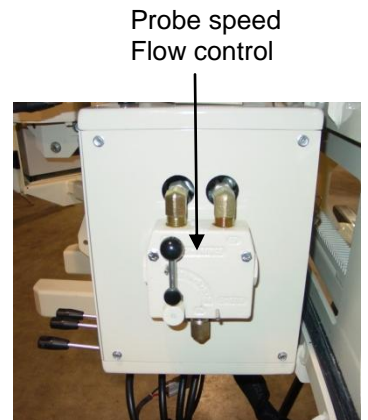
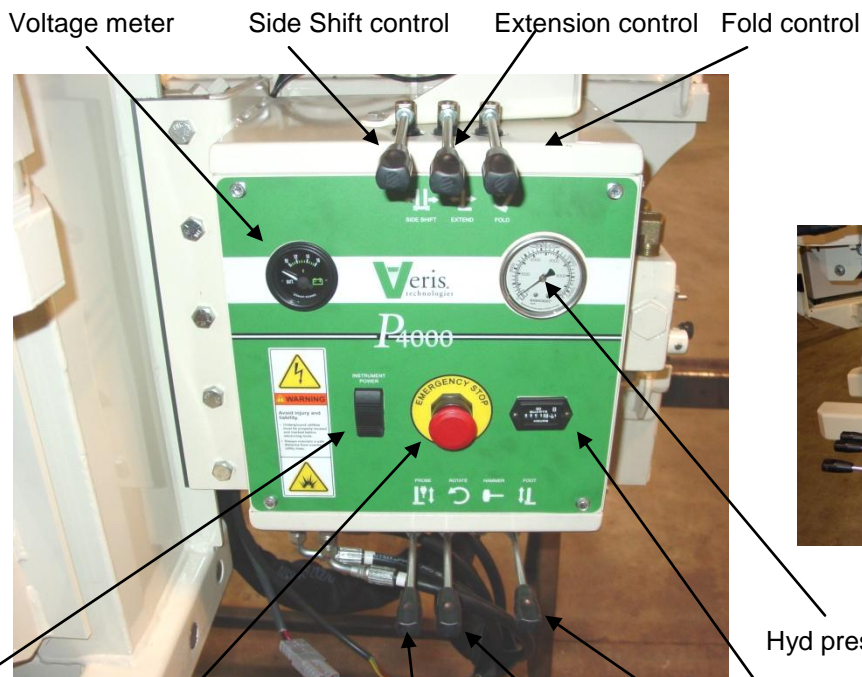


Figure 4

12v power switch Engine emergency stop Probe control Rotation control Foot control

Electronics

System diagram

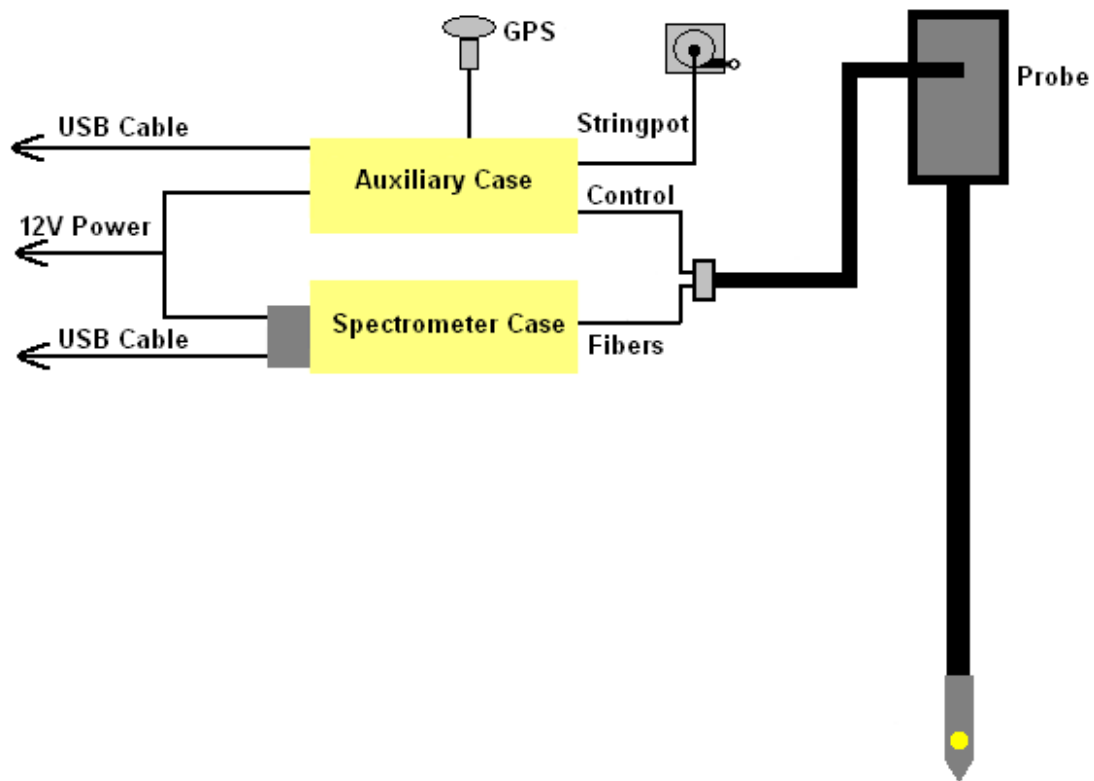
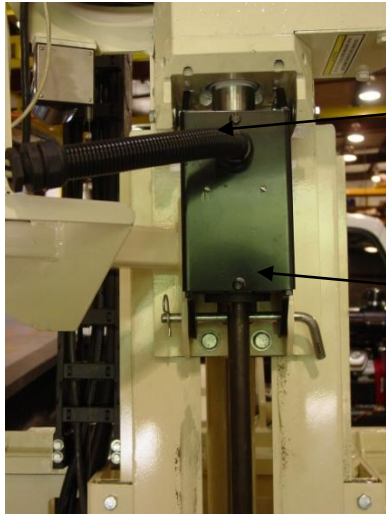


Figure 5



Figures 6 and 7



Cable that includes fiber, motor control and lamp power

Probe module
#34848

Figure 8&9



Garmin GPS
21221 – for U.S. customers only

GPS adaptor cable #30727
Note: This adaptor cable is required in order for compatibility with the provided Garmin GPS.

Figure 10



GPS serial adaptor cable
#35482

This will connect the serial port of a GPS to the GPS port on the auxiliary case, for using an alternate GPS to the Garmin. External power is required for the GPS to function.

Figure 11



External reference blocks
which are used to calibrate
instrument during the system
check. (Labeled ER1 – ER4)

Figure 12



Reference block to be used for the manual reference check, which needs to be taken every 10 mins or after every samples.

#38841

Figure 13



5-meter USB cables
#30281

Figure 14

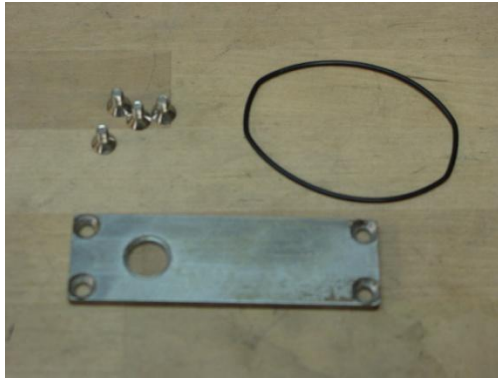


Power cable
#39985

This is used to power the instrument from a vehicle (for field use).

Note: Only use 15-amp fuse

Figure 15



Probe Wear plate assembly
#38847

Figure 16



String Pot #SC160
String Pot Cable #38866

Figure 17

Section 3

Software Installation and Setup

Software Installation

Note: For computers outside the United States of America, please make the following change to the computer's regional settings before installing the Veris Spectrophotometer Software.

Step 1: Open control panel and double click on **Regional and Language Options**

Step 2: Click on **Customize**, the following screen will appear. The **Decimal symbol** needs to be a "." while the **Digit grouping symbol** needs to be a ",". This will ensure proper operation of the software. Once the changes have been made click **OK** and proceed with installation.

Veris Spectrophotometer Software Installation

The Veris Spectrophotometer Software installer will guide the user through installation of the Veris operating software and the necessary drivers needed to run the spectrometers. **Note: Do not plug in USB cables for cases at this time.**

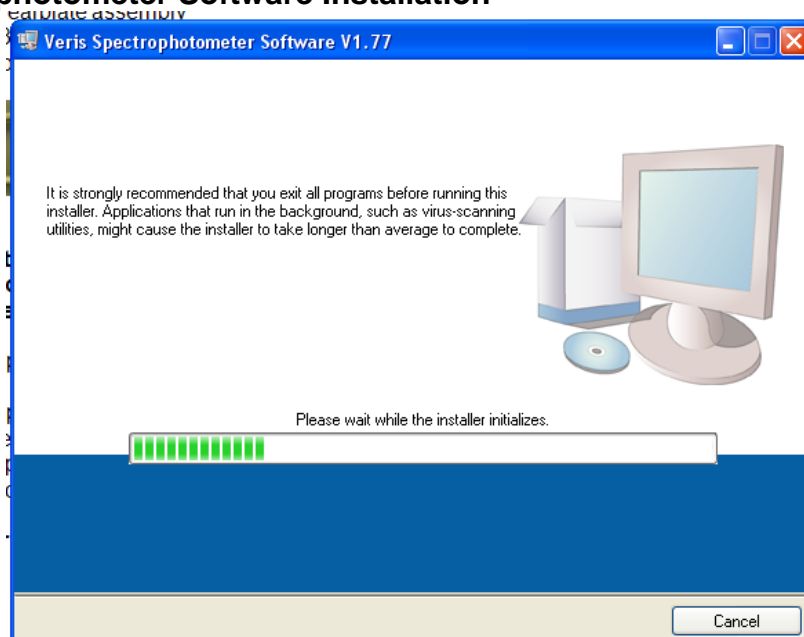


Figure 1

Veris Spectrophotometer Software V1.77 and up will run on either Windows XP, Vista or 7—32 bit operating systems only

Keep the default
directory and click next

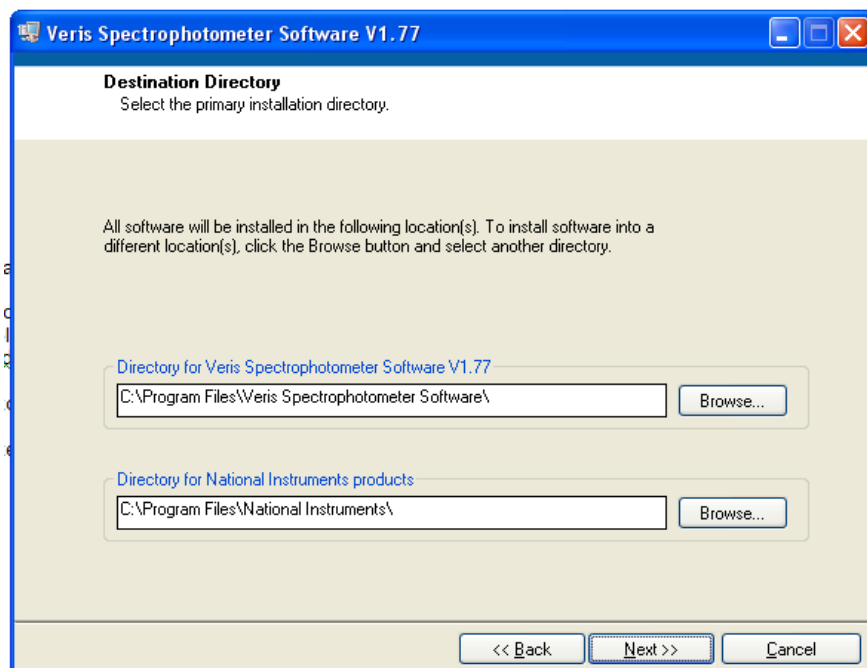


Figure 2

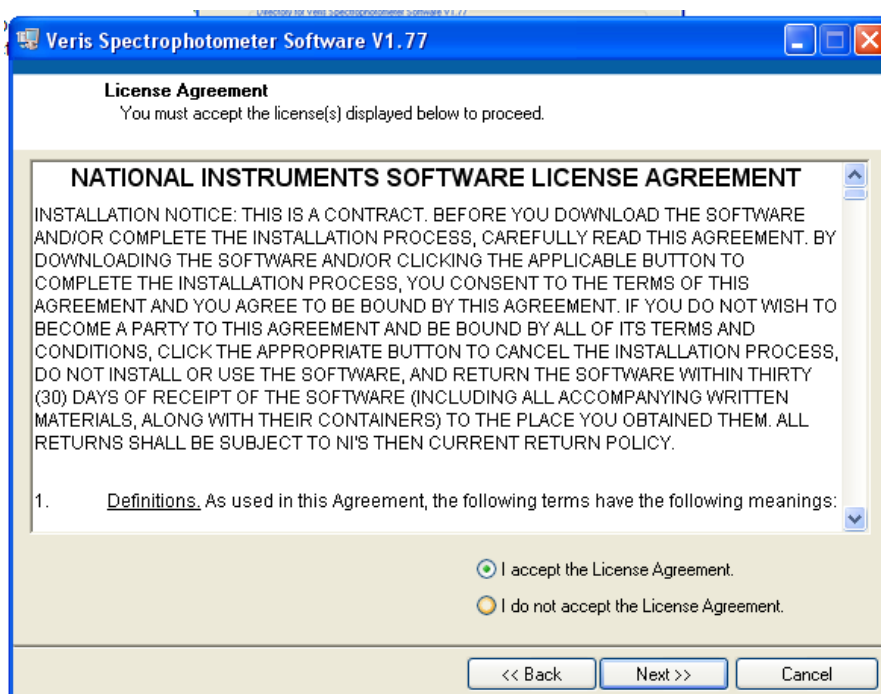


Figure 3

Select next to
complete install

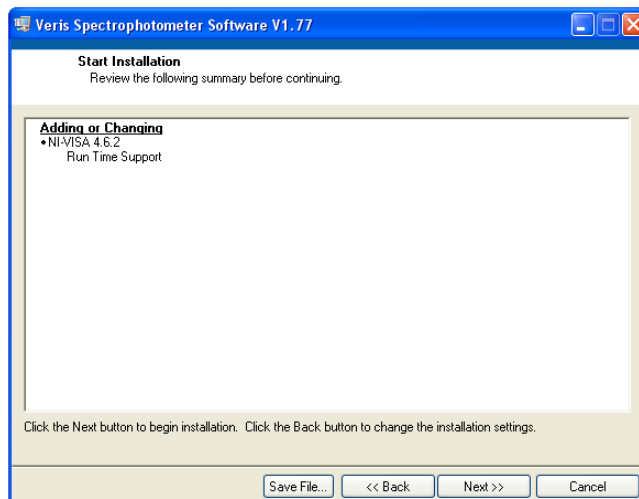


Figure 4

Now the ocean optics
drivers will be installed.
Select language and
continue.

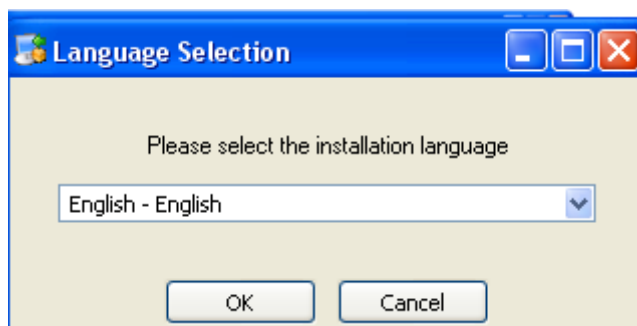


Figure 5

Leave the default
directory and click next

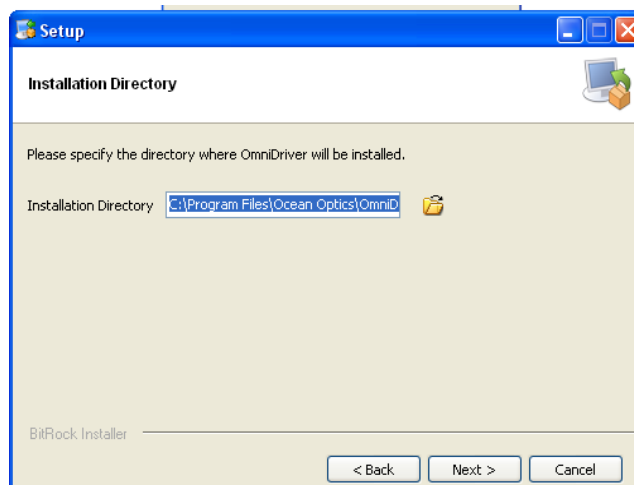


Figure 6

Next the Hamamatsu Minispectrometer installation guide will appear. Click next two process through the installer

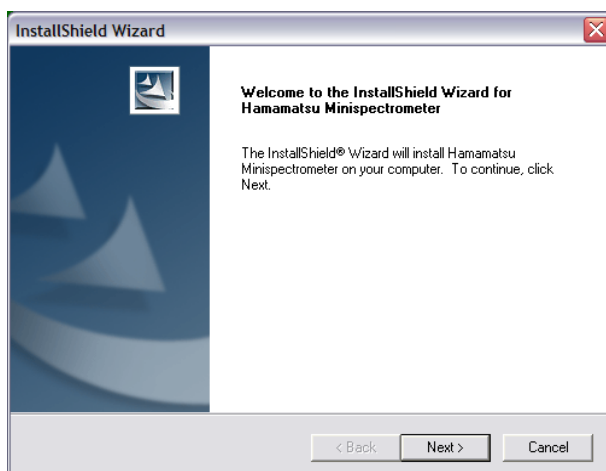


Figure 7

At this point it is OK to restart the computer

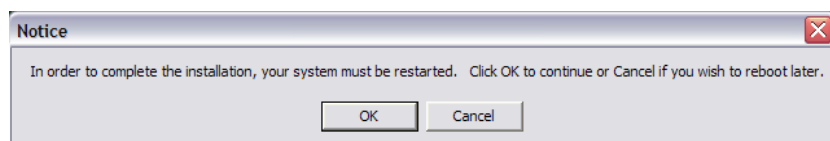


Figure 8

Once the restart is complete, plug in the USB cables for the auxiliary and spectrometer cases

MS Windows may then bring up the following screens about the Ocean Optics spectrometer and the Hamamatsu spectrometer.

Select Install the software automatically, then click Next to complete the hardware installation.

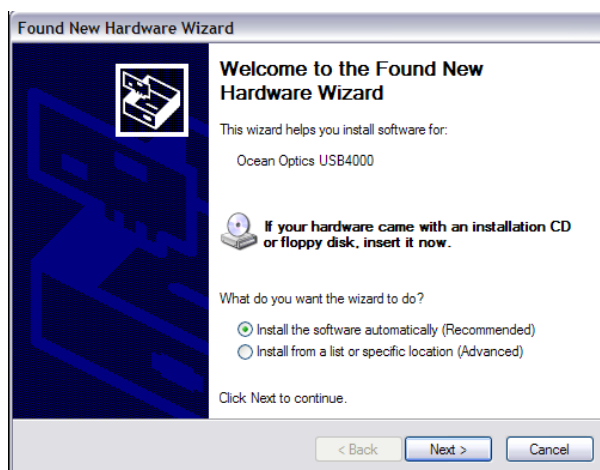


Figure 9

Windows will automatically find the correct drivers for the Ocean Optics USB4000.

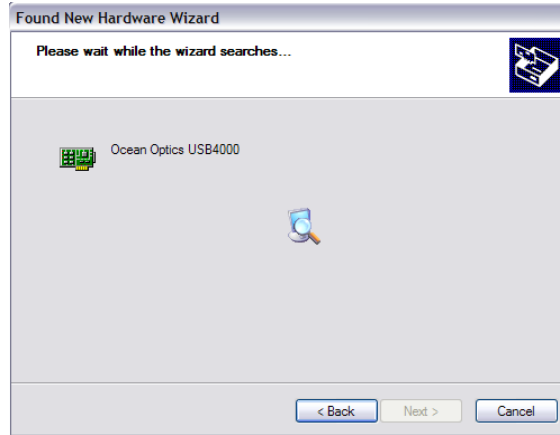


Figure 10

After completing the Ocean Optics MS Windows installer, the Hamamatsu installer may appear. **Note: These installers may appear in any order.**

For the Hamamatsu installation select Install the software automatically then Next to complete installation.

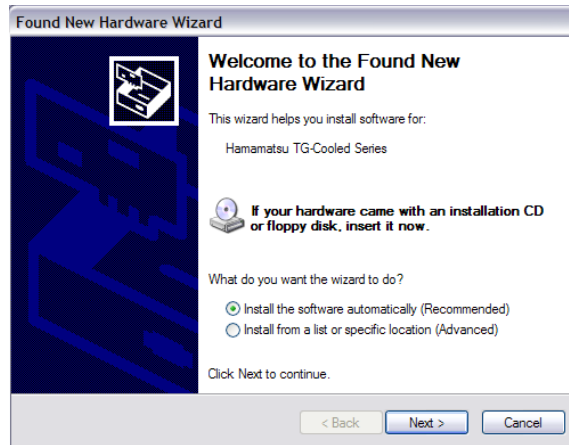


Figure 11

If this screen appears asking for the driver version to be installed always use the specu1a.inf, then select Next.

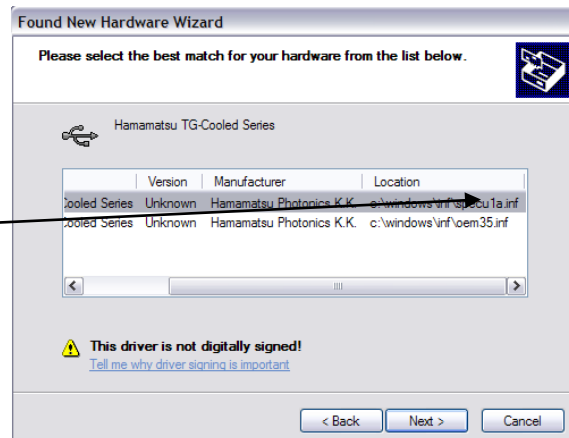
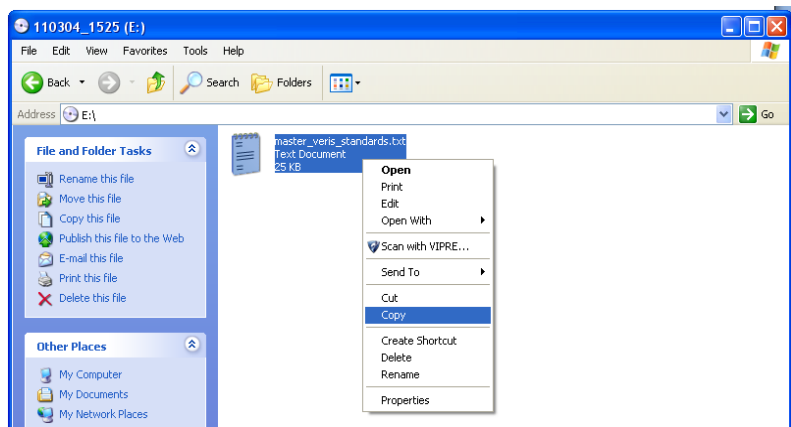


Figure 12

Installation of Calibration Files

This **must** be complete for the software to be operational

Copy the master_veris_standards.txt file from the calibration CD into the C:\Veris directory



The master_veris_standards file is specific to your external references and is provided by Veris.

Figure 13

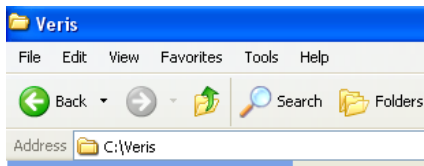


Figure 14

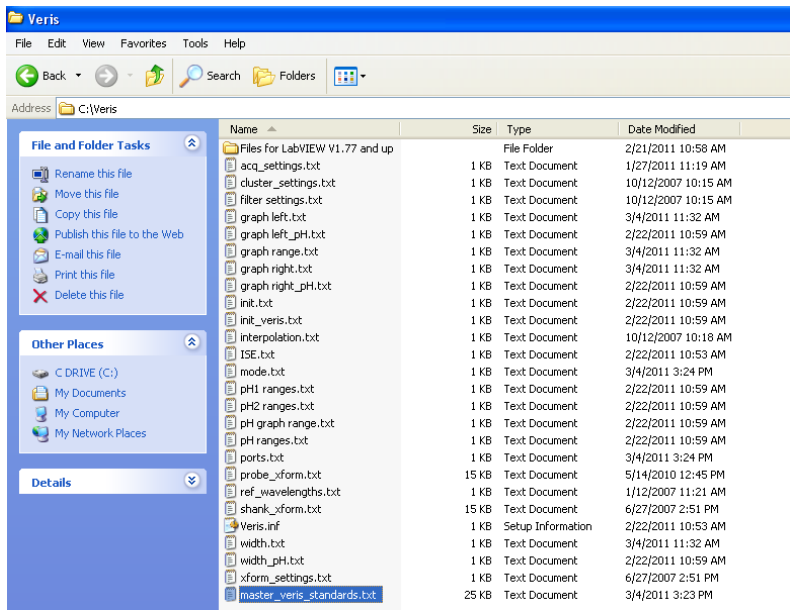


Figure 15

Ocean Optics Spectrometer Configuration

Only necessary for Veris Spectrophotometer Software V1.76 and below

Step 1: Open OOIBase32 Software

Start Ocean Optics software (Start → programs → Ocean Optics → OOIBase32)

- a. If software asks for a default spectrometer file click cancel

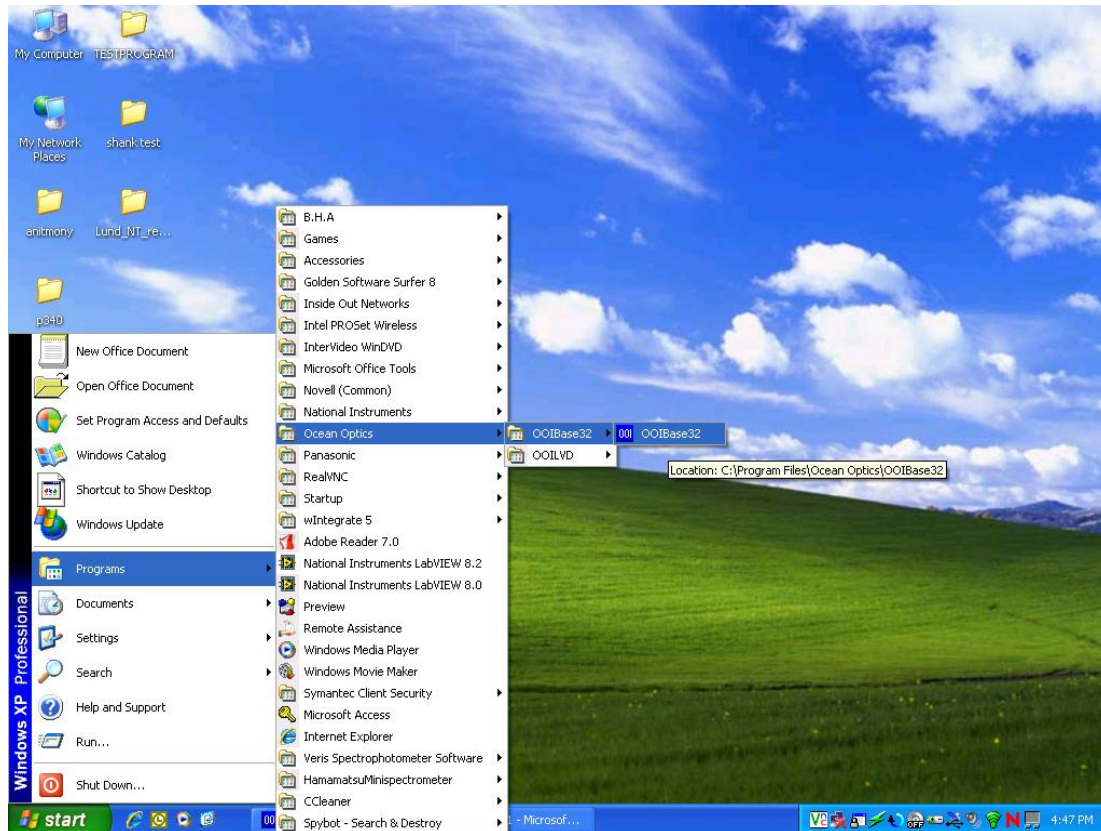


Figure 16

If it asks for a spectrometer configuration click, OK

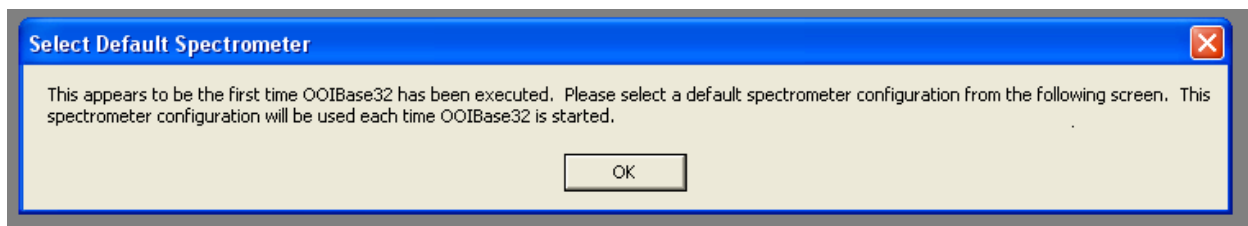


Figure 17

If software asks for a default spectrometer file click Cancel

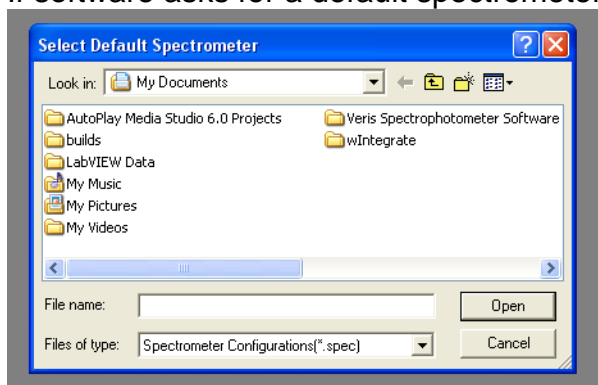


Figure 18

Step 2: Open Configuration

Click on Spectrometer in the toolbar at the top and then select Configure

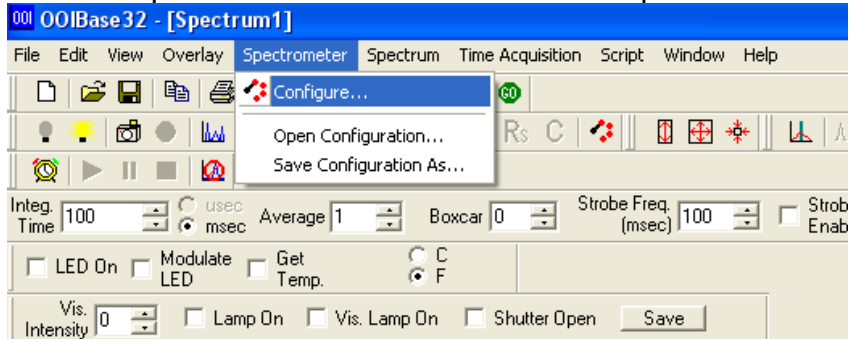


Figure 19

On the configuration screen select the A/D Interface tab

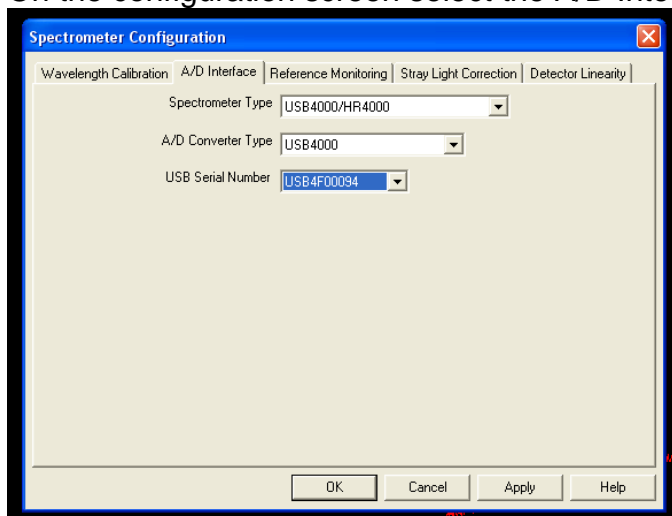


Figure 20

Note: Under Spectrometer Type if USB4000/HR4000 is not available select S4000

Under serial # only one spectrometer number should be present. If no serial number is present close out of the software, unplug the USB cable and reinsert the USB cable, wait to see if windows recognizes a new device, then proceed to the open the Ocean Optics software and try again.

Click OK and a spectrum will be present on the screen.

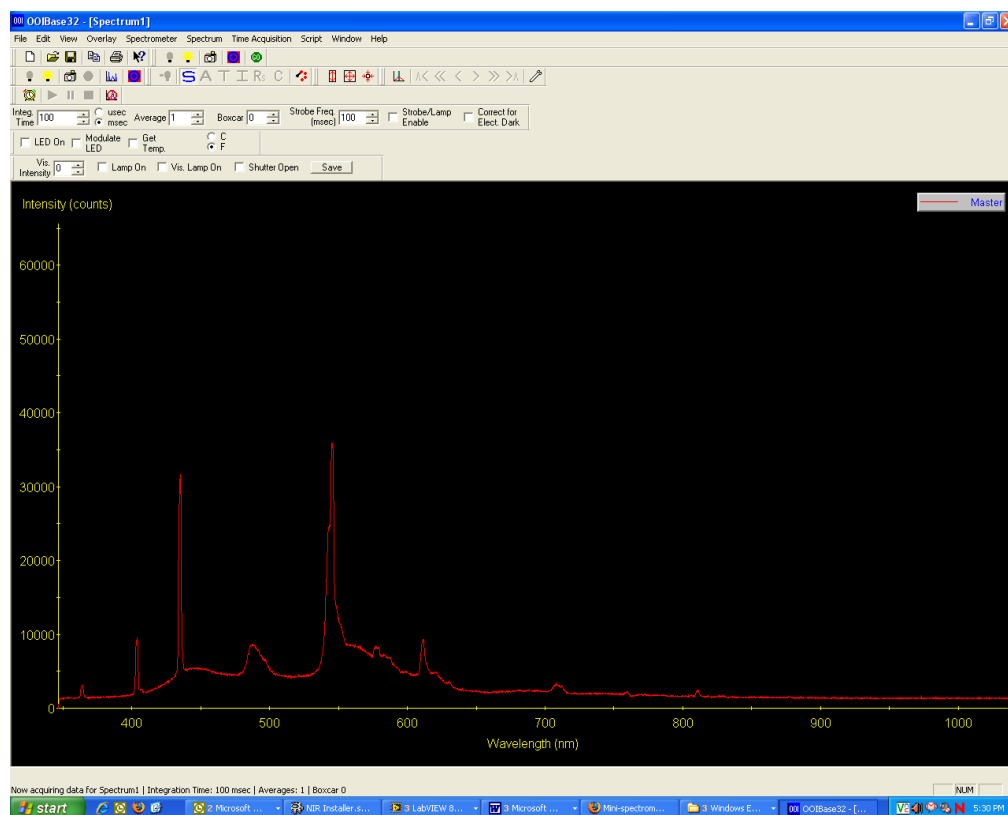


Figure 21

Example of spectrum that should be shown on screen (when light is on at probe).

Step 3: Save Configuration

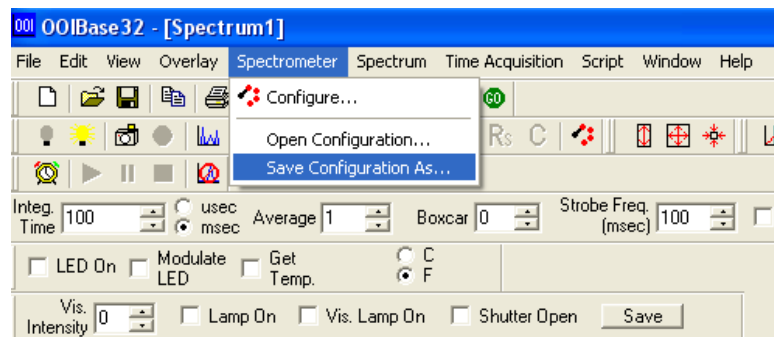


Figure 22

Click on Spectrometer then Save Configuration As.

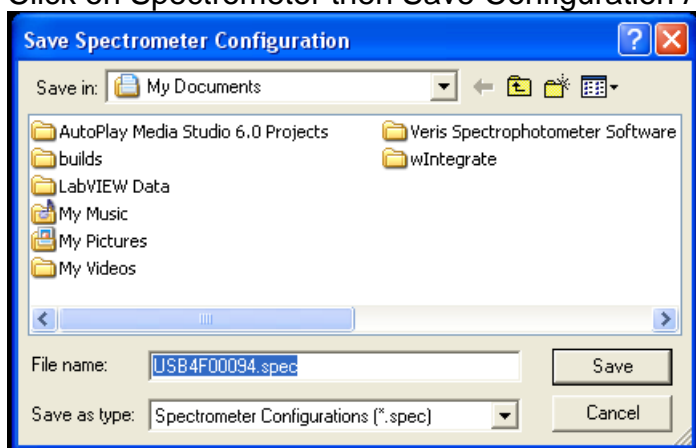


Figure 23

The Save Spectrometer Configuration should automatically fill in the file name with the serial number. Click Save.

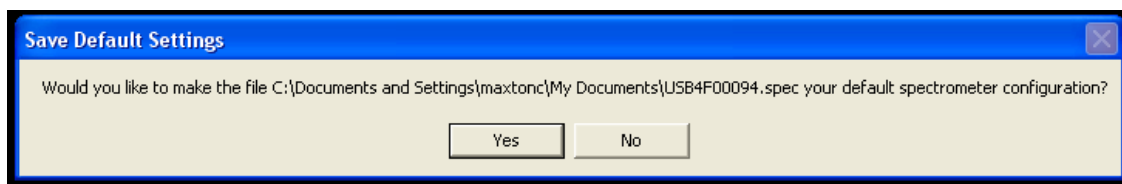


Figure 24

Choose yes to make the spectrometer configuration the default settings.

The spectrometer has now been configured.

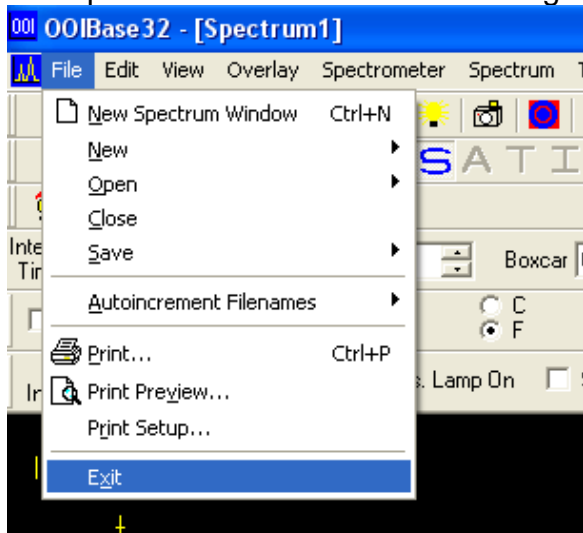


Figure 25

Exit the software.

Setting Port Order

1. Check Device Manager for port order (Start → settings → control panel → system → hardware tab → device manager → double click ports)
2. Ports will be listed in order, as they should be set in software.

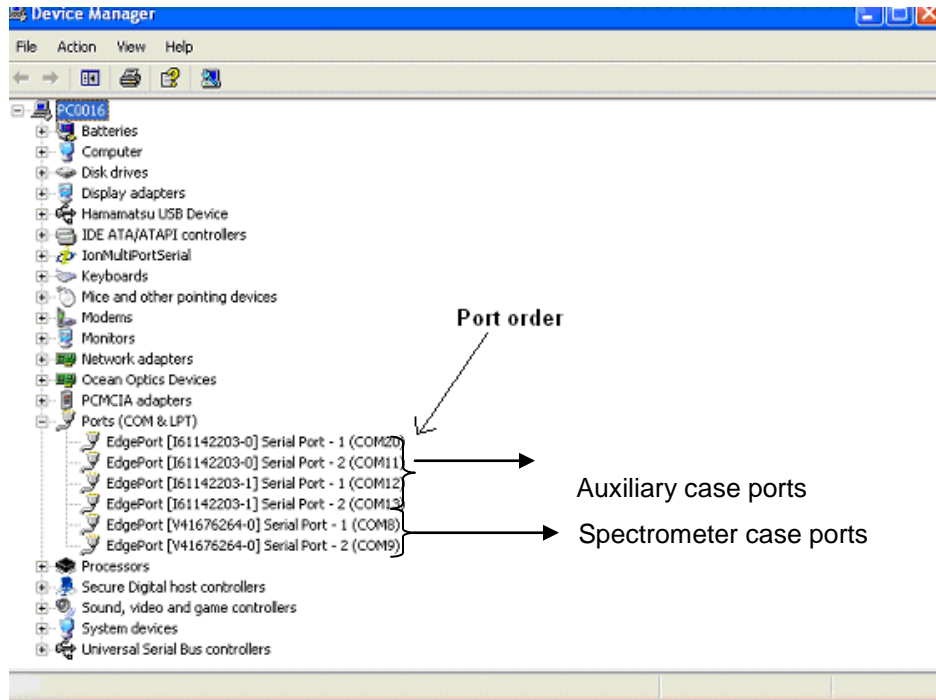


Figure 26

In this example the order to set the ports would be as follows: (see Figure 25.) Different computers will have the ports in different orders; however if the software is used on one computer only, the ports will never change. The ports will always be in the order of spare, GPS, temp, control, and spectrometer. For future reference, make note of the com port order your computer is using.

| | |
|---------------|-------|
| Spare: | COM20 |
| GPS: | COM11 |
| Temp: | COM12 |
| Control: | COM13 |
| Spectrometer: | COM8 |

The last port (COM9) will not be used.

The software could increment the number of the ports by one depending on the computer. For example, the device manager shows ports 20,21,22,23,9 but the software shows 21,22,23,24,10. Just use the incremented numbers if this situation occurs.

Setting Integration Time:

The integration time is the amount of time the spectrometers collect the spectral data for averaging. It is important to have this set correctly because too much light will saturate the spectrometer, while too little light won't allow the full range of the detector to be used. The integration time needs to be set before acquiring spectral data. **This is especially important for users switching between probe and shank modules as the optics are different and the amount of light seen between each device varies.**

Step 1: Open the Veris Spectrophotometer Software and start the system check. After the first Dark and Reference measurements are stored, check the ref spectra display (example shown below). The two peaks shown should be around 40000.00 counts. The first peak is controlled by the oo int time, while the second peak is controlled by the ham int time. If peaks are too high, then lower the integration time. If peaks are too low then raise the integration time.

Step 2: Once it has been determined which way to move the integration time, exit the software and open the acq_settings.txt file located in the C:\Veris directory.

0.010 12.000 5.000 8.000 0.150 0.150 0.300 0.150 2.000

Example of data stored in acq_settings.txt

The second value represents the ham int time, while the third value represents the oo int time. Raise or lower these values then save the file, open the Veris Spectrophotometer Software, run a dark and reference measurement, and then check these values again to see how the peaks changed.

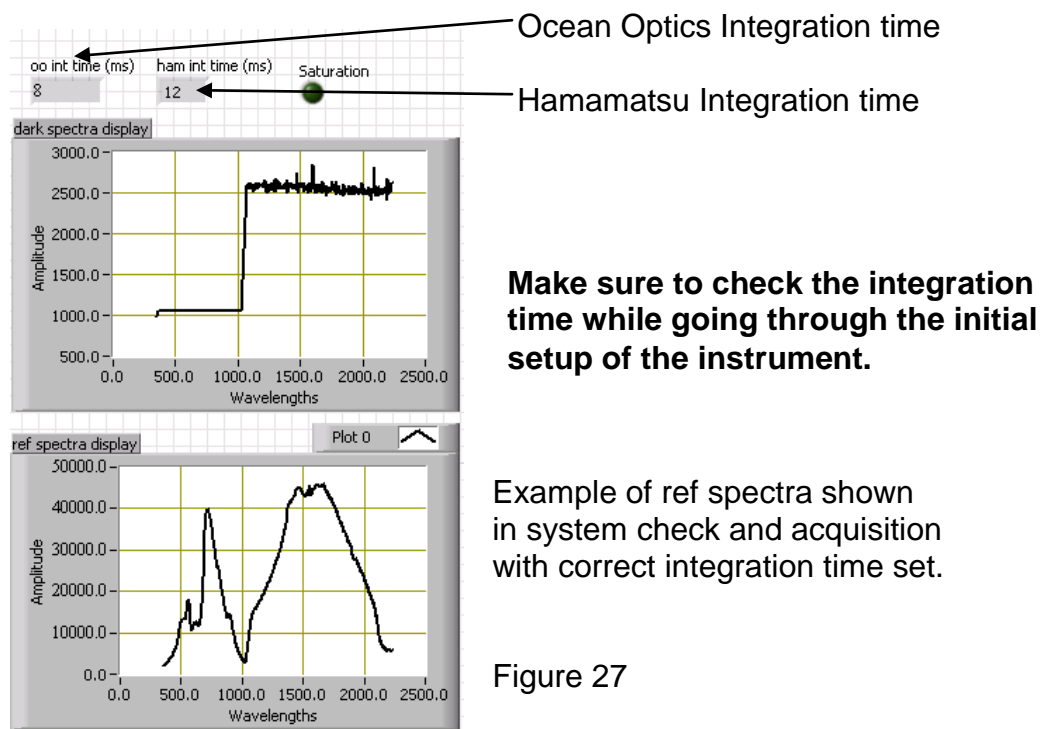


Figure 27

Section 4

Field Operation - Electronics

Operating software - This will need to be completed every time the software is started.
Open Veris operating software:

Folder icon to select working directory.
A field folder must be selected before any steps can be completed. Note:
Each field or site must have its own folder.

Set software for either probe or shank mode. If the incorrect mode is selected and system check or acquisition entered, then the auxiliary case will need to be reset by shutting off power and turning back on before entering software again.

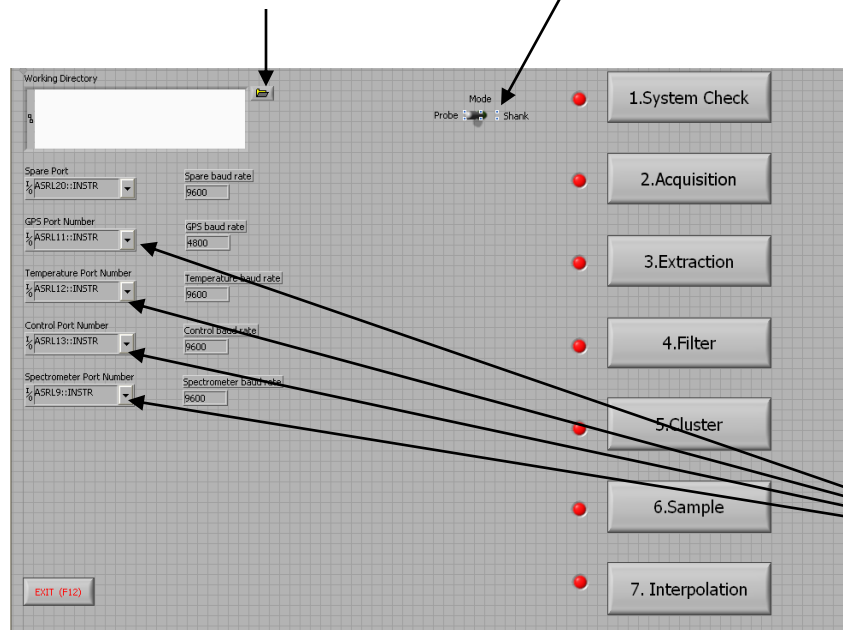


Figure 1

BEFORE STARTING:

1. Before taking any data let system run for 20 minutes to allow the spectrometers to stabilize.
2. Connect spectrometers to PC.
3. Open Veris software
4. The port order must be set (see Setting Port Order). This needs to be done the first time the software is run on a machine, after that the port order will be stored for future use. Port terminology may be labeled COM or ASRL. Both are acceptable if port number is correct.

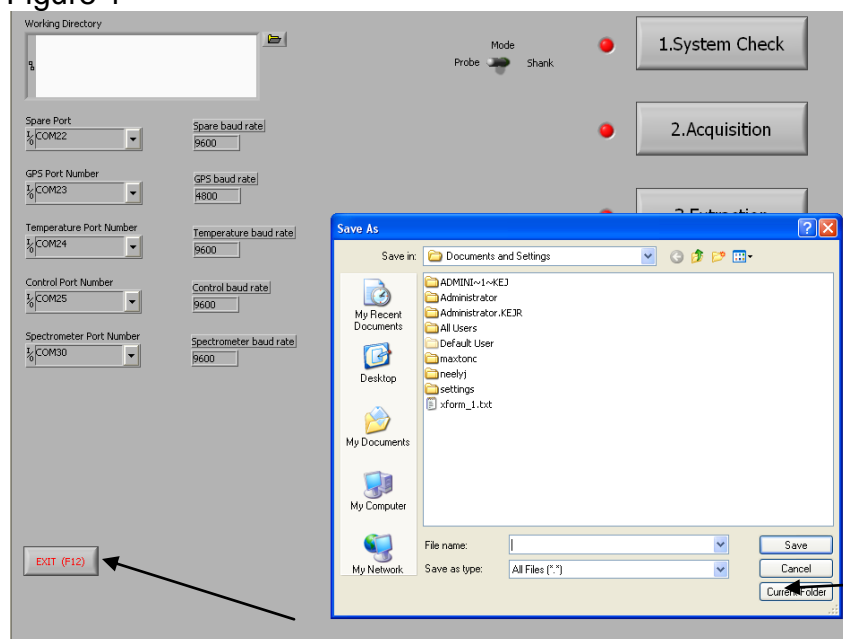
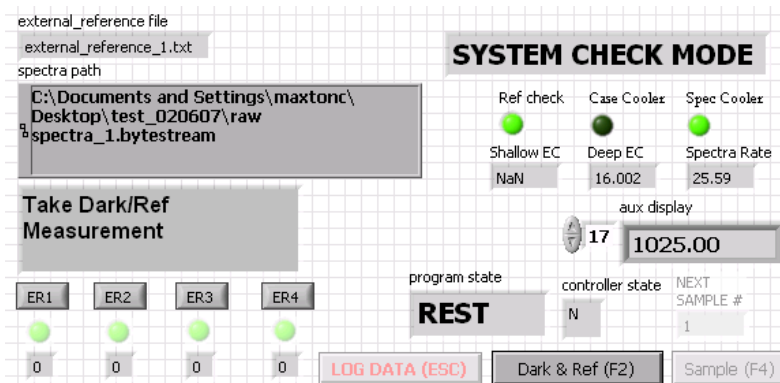


Figure 2

Press EXIT or F12 when ready to quit the software; this will ensure the port order will be saved.

How to take Manual Reference

In order to calculate reflectance a dark and reference measurement must be taken initially when the software starts, and then every 10 minutes to ensure all measurements are accurate and to compensate for any discrepancies in the spectrometer or light source due to temperature. The software will alert the user when these conditions occur by displaying Take manual reference in the system message as well as the ref check light flashing.



Example of what screen will look like when manual reference needs to be taken.

Figure 3

Before placing the reference block on top of the wear plate window wipe the wear plate window clean of any debris.



Figure 4

Reference block to be used for dark/ref measurements. This is the block stamped dark/ref.

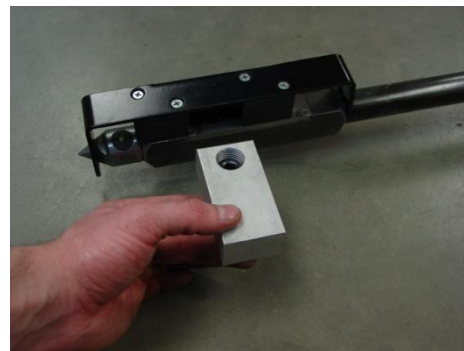


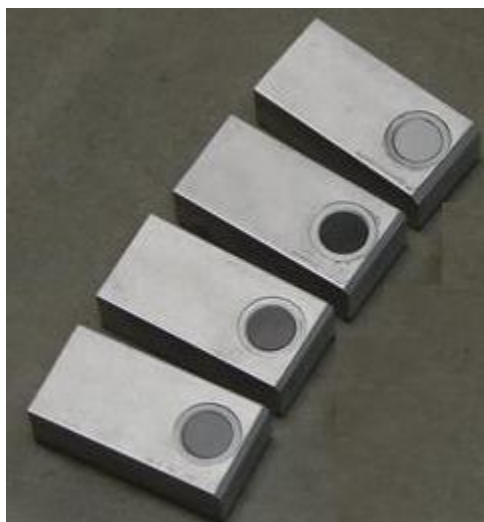
Figure 5A & 5B

First place the reference block holder on the end of the probe as shown

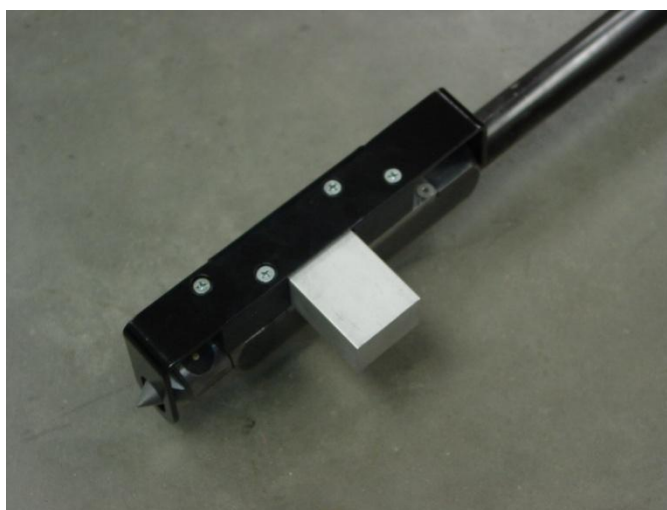
Then slide references in front of window. Be sure reference material is facing the window

1. System Check – This step calibrates the spectra data to known standards to ensure data integrity. This is accomplished by: A) manually placing four external reference standards against the window and collecting spectra measurements for each standard; and B) transforming the data to a master set of data provided by Veris.

A) Before running the external references make sure the window on the probe and the window on the reference are clean. When program state reads REST and controller is in neutral (N), place the correct external reference adjacent the probe window and then press the corresponding external reference button. If the External Reference (ER) failure light is yellow, check to make sure the correct external reference was placed adjacent wear plate and that the correct external reference button was pressed, and then run the external reference again. Once ER light illuminates, proceed to next reference, after taking a manual reference. Once each external reference has been run at least once, press end or F12. This will exit this program and initiate the create transform program, which will take the data just acquired and compare it to the master data to create a current transform. If the transform is created successfully, then that transform will be applied to all spectra data acquired during the acquisition.



External References
Figure 6A & 6B



External References securely in place

Place the ER securely onto the probe wear-plate. Make sure to align the window on the ER to the window on the probe, and magnets hold the ER firmly in place. The reference material goes towards the ground and lines up directly adjacent the sapphire window on the wear-plate.

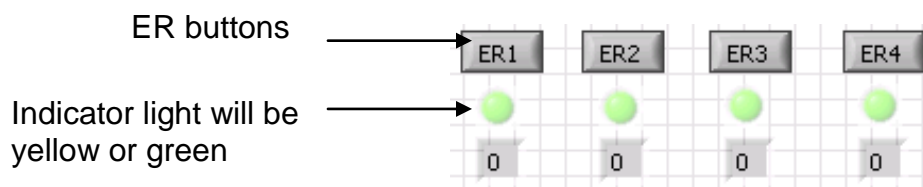


Figure 7

Reference check light is green for good references and red for a failed reference. If a reference fails, press F2 to store a new dark and reference.

Auxiliary data can be scrolled through by the up and down arrows on the left of the indicator. Data corresponds to chart listed on the right of indicator. Note: a reading of -1.50 indicates failure of that component or communication problem. See Glossary for Auxiliary data information table.

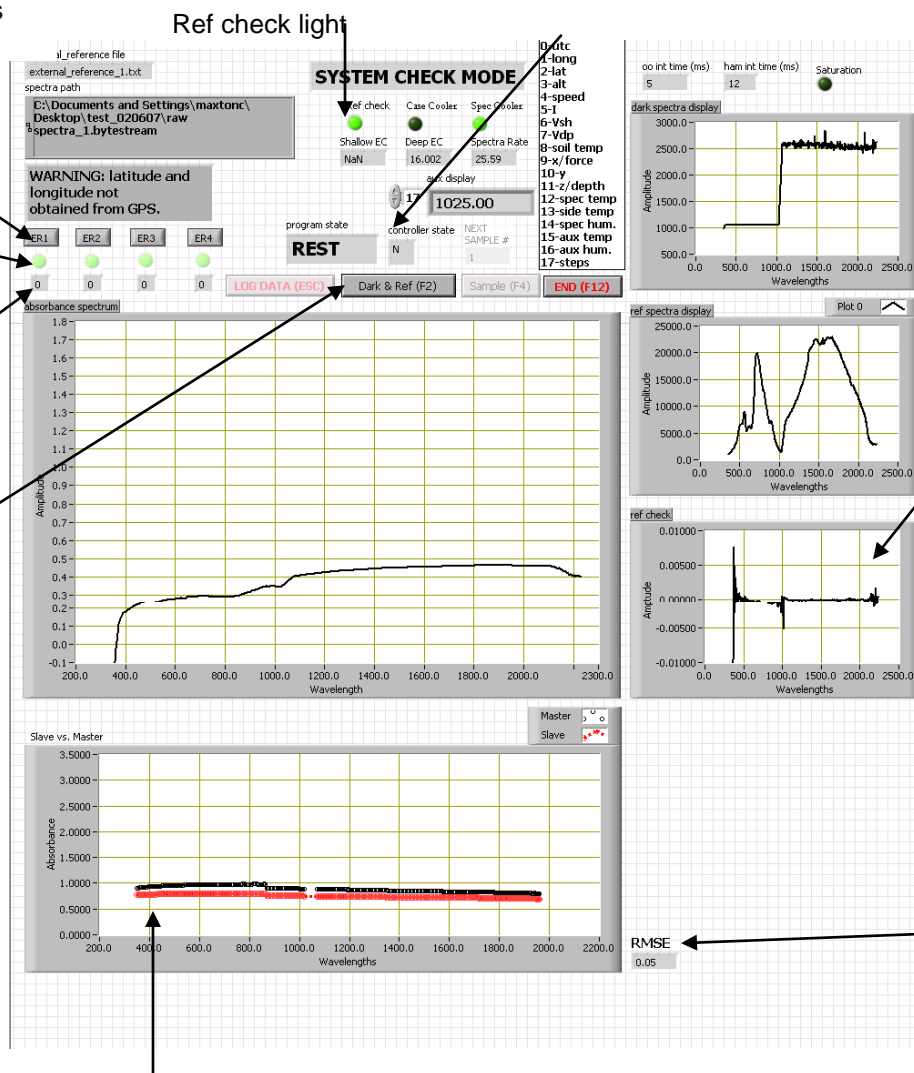
A yellow ER light indicates possible problem. Regard as a good reference unless transform step fails.

External Reference buttons

Failure light

Number of times each reference has been ran, since system check was opened.

Manually stores dark/reference data. This should be done if there is a failed reference check. This could be caused by the shank steps not being within specification, or one of the spectrometers is not running. Try to clear out the reference by pressing F2. If problem persists shut down system and restart.



Ref check graph:

This should be close to a straight line except for the edges and the center. The reference check light will indicate if this is an acceptable reference check.

Root mean squared error of current external reference.

By default the RMSE should be within .10 for references 1,2,& 4 and within .15 for reference 3.

This compares the slope of the previous transform to the current transform

Graph that compares current external reference to master reference. These should correlate to one another if system check has been completed before.

Figure 8

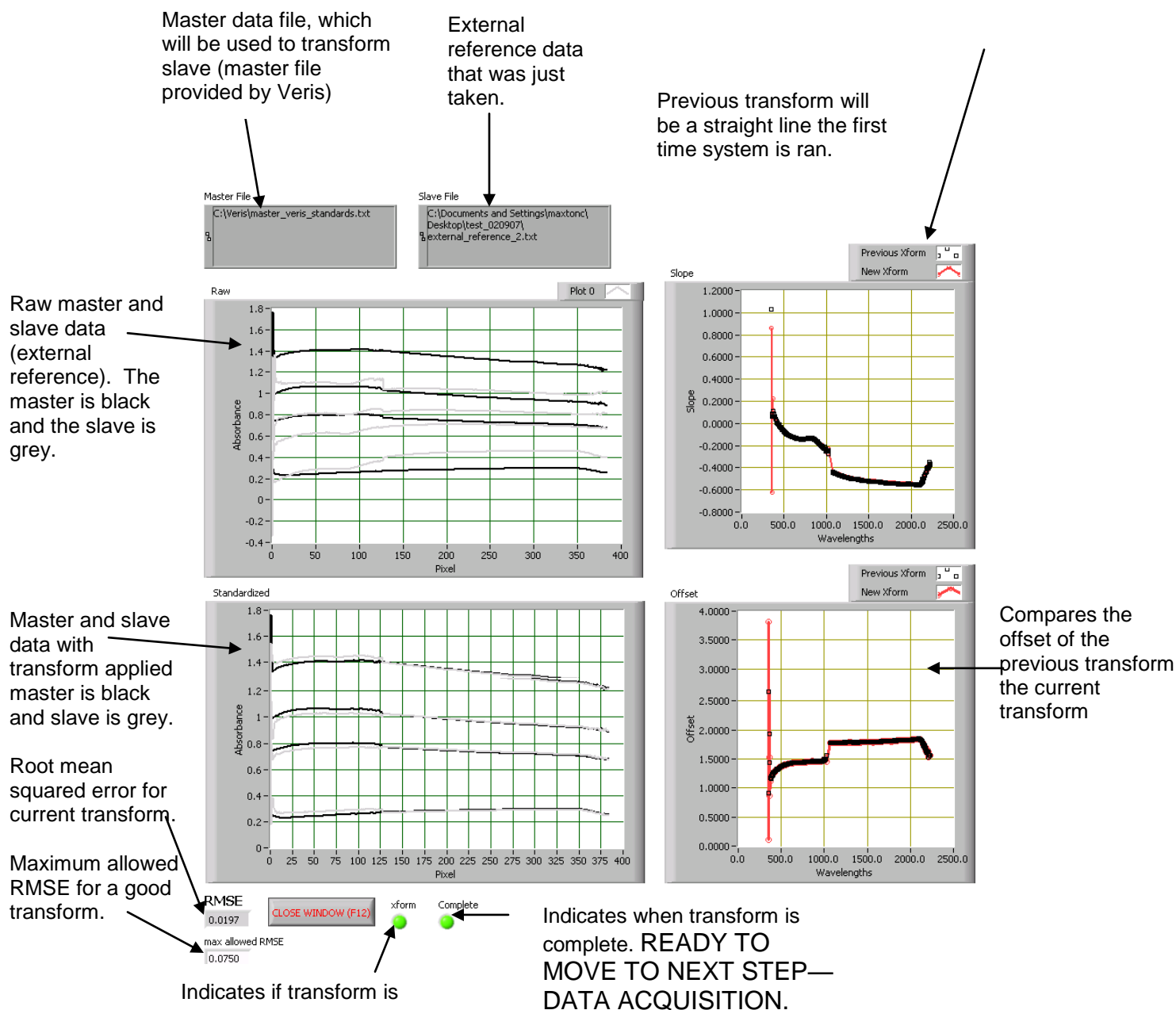


Figure 9

Once the transform is complete press close window or F12. If the transform was successful, the software will inform the user and continue on to acquisition. If the transform failed, the program will enter the system check again so the references can be ran once more. If the transform fails again, either there is a system problem (spectrometer malfunction, window is dirty, or references not taken properly) or the tolerance for the maximum allowed RMSE could be set too low; see program modifications to change this.

2. Data Acquisition – The collection of spectral and auxiliary data in the field. Data is streamed to a file in a compact format.

Pressing the PROBE button stores spectrum data as absorbance and auxiliary data, which includes EC data, the PROBE button key has been pressed again or the probe pulled out of the ground. No data can be logged if there is no GPS signal or there is a bad ref check. No data, including EC data, will be stored unless the program is in LOG mode.

System will alert the user to take a dark and reference every 10 minutes—the next time the PROBE button is pressed after a 10-minute period.

If an extra dark and reference is desired, pressing F2 or Dark & Ref stores a new reference and dark spectrum. Pressing F4 or sample will store transformed spectrum data as absorbance into the acquisition_samples file located in the field directory.

Once all data has been acquired press F12 or End to return to the main interface.

Soil EC is recorded simultaneously with NIR data. When EC is being collected, EC value will appear in the shallow window. The deep will be a -1 because it is not used with the probe. Note: unit must be in Log mode for EC to be recorded. Also, see Maintenance section for information on testing EC system output.

Before mapping complete the following:

- ☐ Start system at least 20 minutes before starting to map to ensure the spectrometers have stabilized
- ☐ Make sure auxiliary sensor data is coming in (see Glossary for auxiliary sensor data definition).
- ☐ Make sure all auxiliary lights are green.
- ☐ Complete all steps above. Make sure Reference Check (Ref Check) light is green, and GPS data are being received.

Note: Make sure to run through the setting the integration time procedure after starting up system for the first time or after switching between probe and shank mode

These indicate the temperatures and the humidity of the system. If they are not within range (see **specifications**) the indicator light will be red, if this occurs the system should be shut down.

Log and GPS lights—must be green for data to be recorded

Any data can be collected by pressing the up or arrow to the left of the indicator. The auxiliary data corresponds to the chart listed on the right of the indicator.

Pressing PROBE stores spectrum data as absorbance and auxiliary data, which includes EC data, until probe has been hit again or logging stops automatically when probe pulled out of ground. No data can be logged if there is no GPS signal or there is a bad ref check. Use PROBE to store data while mapping a field. No data, including EC data, will be stored unless it program is in LOG mode.

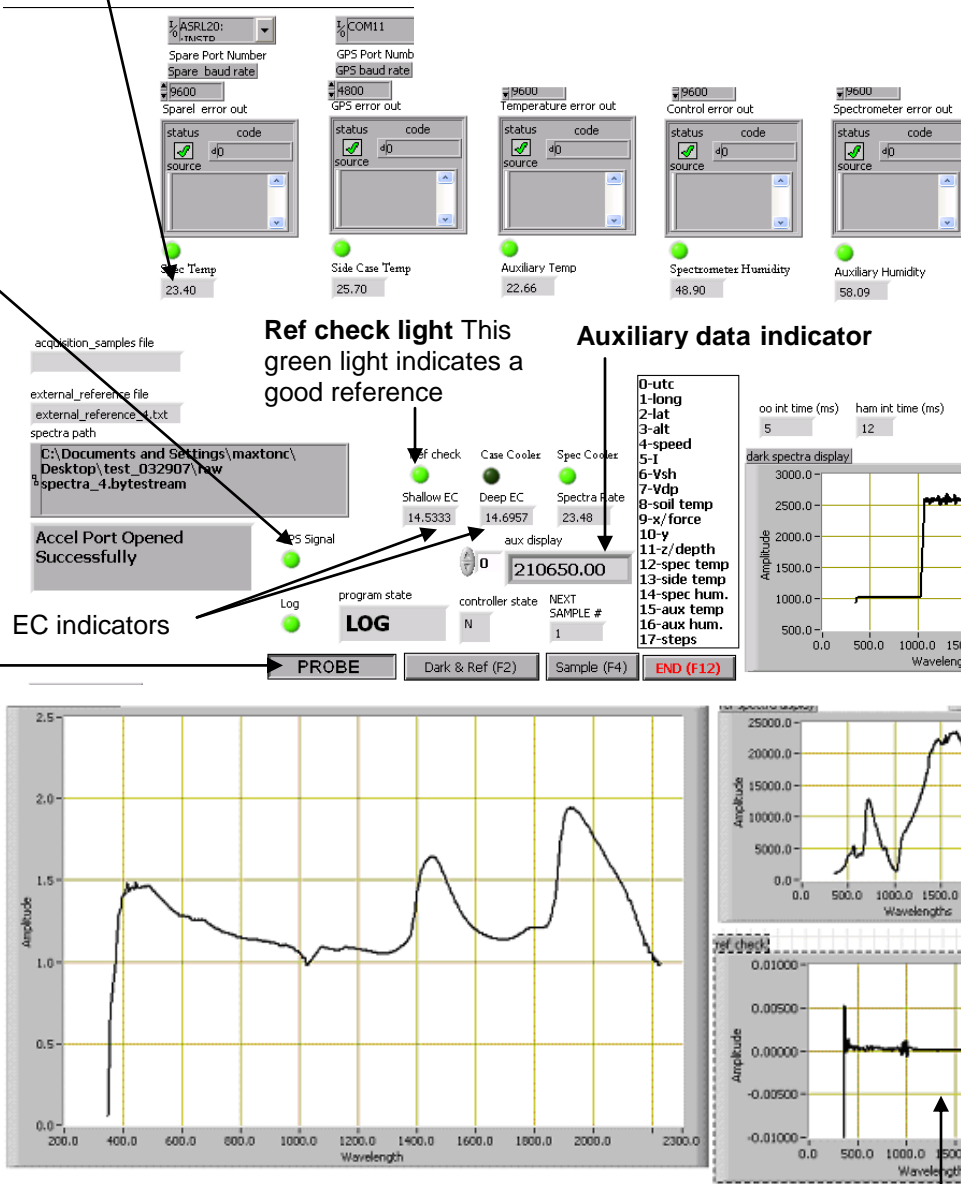


Figure 10

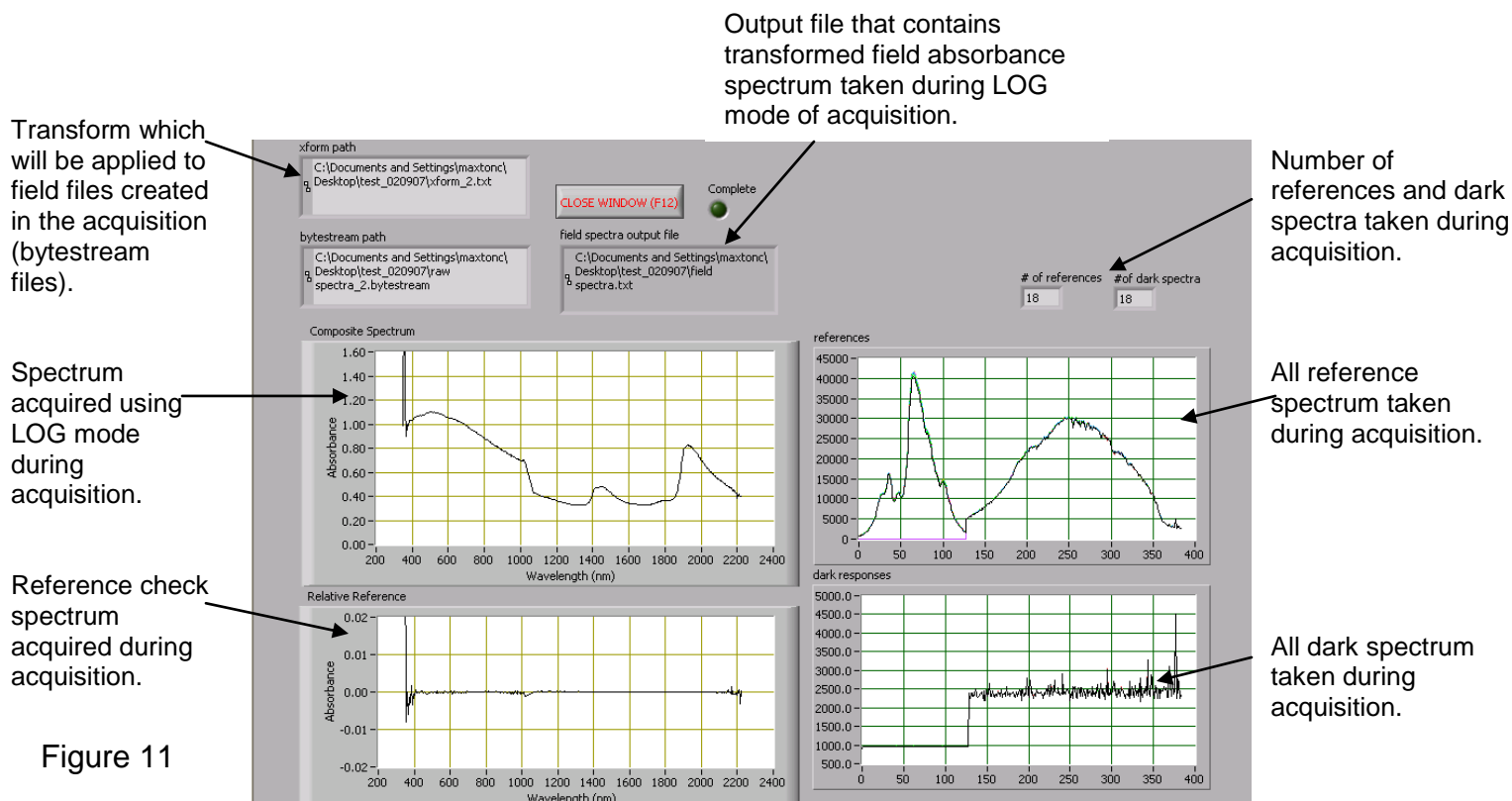
As in system check, this should be close to a straight line except for the edges and the center. Since this is a bad reference it is indicated by the ref check light at the top of the screen. In this situation press F2 to store a new reference.

As long as the acquisition software is closed properly using F12, all data is saved and the acquisition can be opened at a later time with new data being appended to the data taken previously.

How to know you're collecting high quality NIR measurements:

- Log light and GPS lights are both green
- Ref check light is green
- Spectrum absorbance doesn't jump as the probe is pushed down
- Absorbance spectrum shows a typical soil spectra pattern (Figure 52), and is changing slightly as the data is collected.
- External references can be attached to probe at any time in Data Acquisition mode. Absorbance should be highest for ER3 and lowest for ER4.
- Wear plate window is not broken, or cracked. This is caused by excess wear, or rocky fields. Be sure to check window during these situations and replace probe wear plate if necessary.

3. Data Extraction – The spectra and auxiliary data are read out of the compact format (bytestream) file and averaged, then the output is stored in an ASCII format. EC data is extracted into file named ec.txt. The extraction program will extract all the bytestream files and apply the appropriate transform, then output the data into a single text file. Once all the data has been processed, indicated by a green complete light, click on close window or F12 to return to main interface.



4. Filtering -The spectra are compressed using principal components compression, and outliers are removed. Maps of each principal component (up to 10) are displayed, and the results of the PC analysis and filtering are output to ASCII formatted files.

Score plots of spectrum data that indicate grouping of spectra.

Number of outlying spectra removed during filtering.

Total number of spectra.

Wavelengths used by the spectrometers. There are 384 total wavelengths.

Graphs of each principal component; this is an ASCII text file and may be imported into other mapping software. The PC data are in the field folder, and are named PC scores.txt

Loadings of each principal component.

Once all the data has been filtered and the complete light is green press close window or F12 to return to main interface.

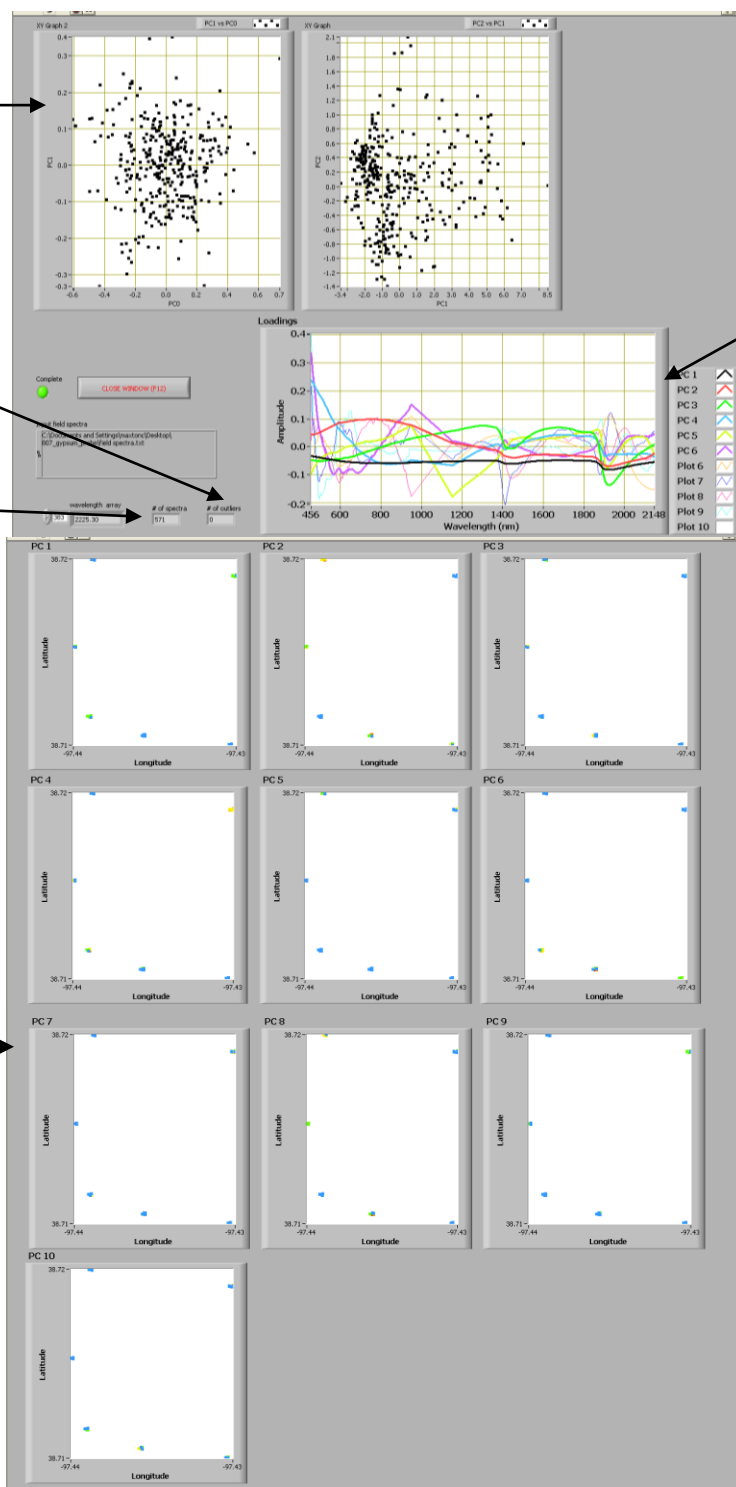


Figure 12

5. Clustering— Clusters the principal components (PC's) of the spectra into the same number of clusters as desired sample points. When the clustering program opens it will ask if the settings are correct. The settings this refers to are the number of clusters or sample locations, and the number of PC's to use for clustering. By default there will be 3 PC's used and 15 locations to sample. If more sample locations are desired, then this can be changed at this time. Up to 10 PC's can be chosen, however 95% of the data is contained within the first 3 PC's. If these settings are acceptable, then select YES or, to update the settings press NO. If NO was selected, update the settings and press continue to begin clustering the data. Once the data has been clustered, the program status will say done and the complete light will be lit. Press close window or F12 to return to the main interface.

For **Probe** mode the program will suggest which GPS locations along with which 10cm increment of soil will provide optimal calibration based on the spectral variability.

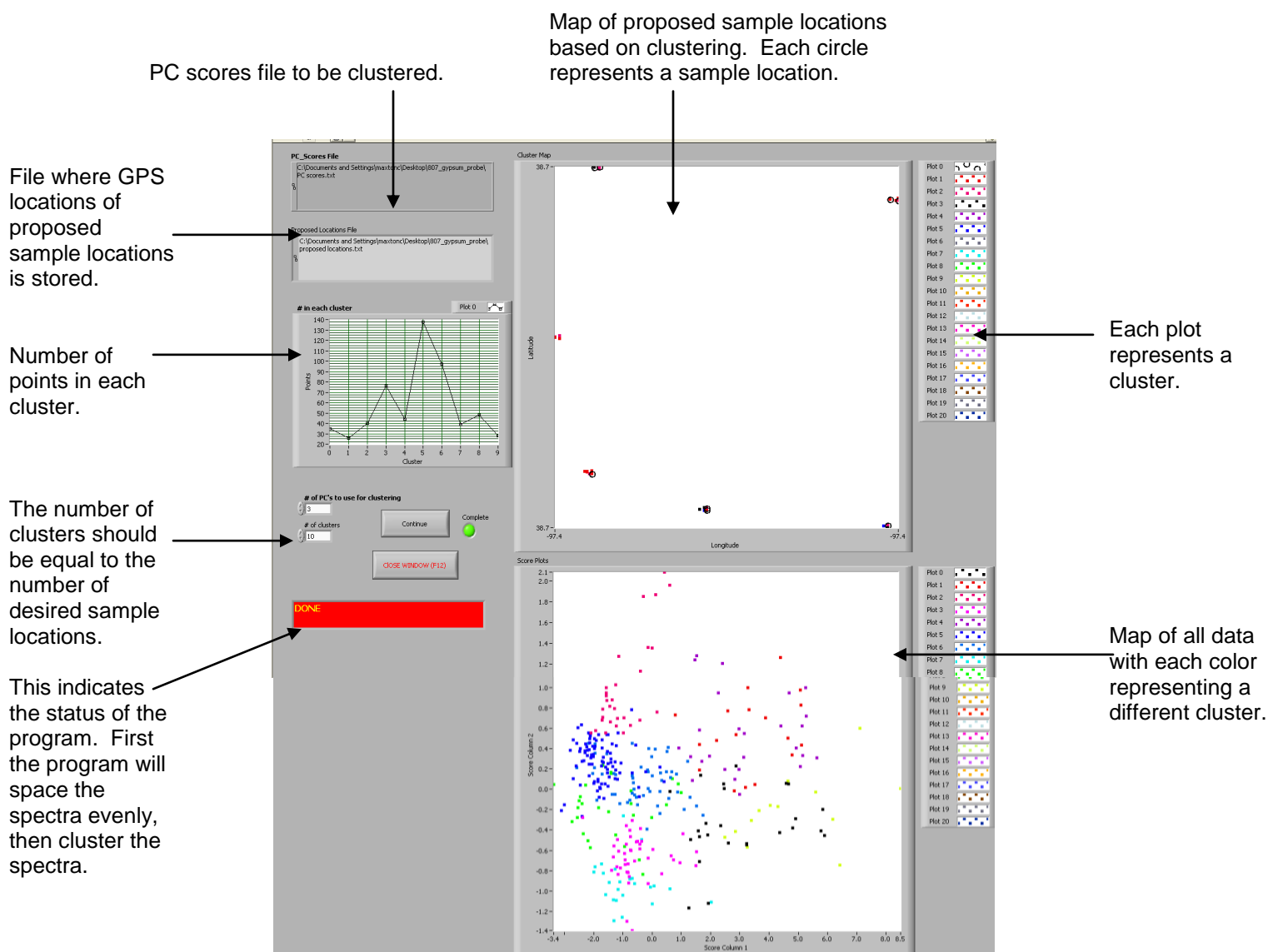


Figure 13

6. Soil Sampling— Allows the user to navigate to the GPS coordinates of desired sample locations (from Step 5), and record actual sample locations. The actual locations that are saved during sampling program will be used for the interpolation of the spectra in the next step.

Map of the proposed locations (black circles) and the actual locations (black squares). The cursor (not shown) will show the user their current location when the cursor is over the proposed location or the location desired to be sampled, then press OK or enter to store that location as an actual location that was sampled and take a sample of the soil.

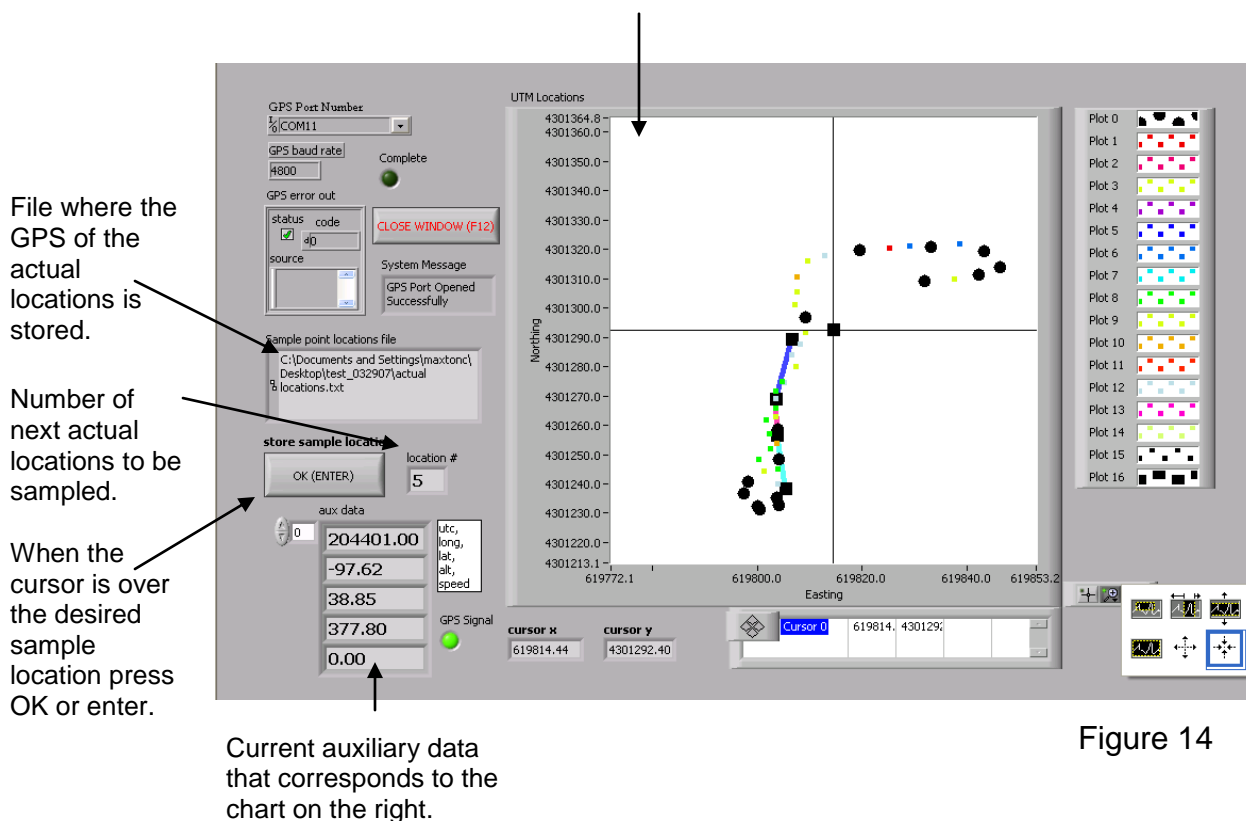


Figure 14

Once all the desired sampled locations have been stored, press close window or F12 to return to the main interface.

7. Interpolation – Uses a Gaussian weighting to average spectra near a sampled location, so the data can be matched up with properties of interest for calibration. Spectra near to the location are weighted higher than spectra far away. Also, this will interpolate several probes into one value if desired. Outputs a file named spectra@locations.txt to the working directory. This file contains the spectra and auxiliary data for each sampled GPS location.

Once the interpolation begins it will ask if the settings are correct. The settings this refers to are a, b, and the depth increments. By default a and b will be 3 meters, if a larger search area is desired then these can be updated. If the settings are fine press YES, if the settings need to be updated select NO. After selecting NO and updating the settings then press continue to begin the interpolation. After the interpolation is done the complete light will be green, then press close window or F12 to return to the main interface.

For **Probe** mode the depth increments determine how to split up the data taken. If .1 is chosen then that data will be split up into 10cm increments and the output file will show depths of .05, .15, .25...95. This is because the interpolation searches half of the depth increment in each direction so the .05 measurement is from data at 0-10cm in depth and the .15 measurement is from 0-20cm in depth and so on. The output file will include data from the whole core profile, not just the specific depth suggested from the clustering. **See examples on next page.**

Distance in meters to search for spectra in the z direction. This is half of the distance of the depth increments. **This is only used for the probe mode.**

Distance in meters to search through spectra in the x direction

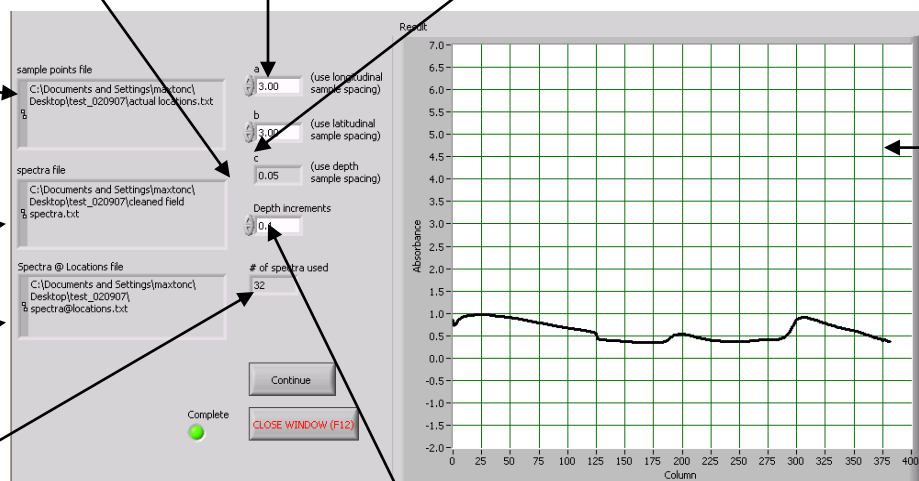
Distance in meters to search through spectra in the y direction

Input sampled locations to interpolate

Input field data

Output file with data at each sampled location

Number of spectra at each location



Spectral data is graphed as it is found in the interpolation program.

Figure 15

Increments in meters to space out the 1 meter of depth for the probe data. **This is only used in probe mode.**

Note: always use exit button or press F12 to close out of Veris NIR software.

Interpolation (continued)

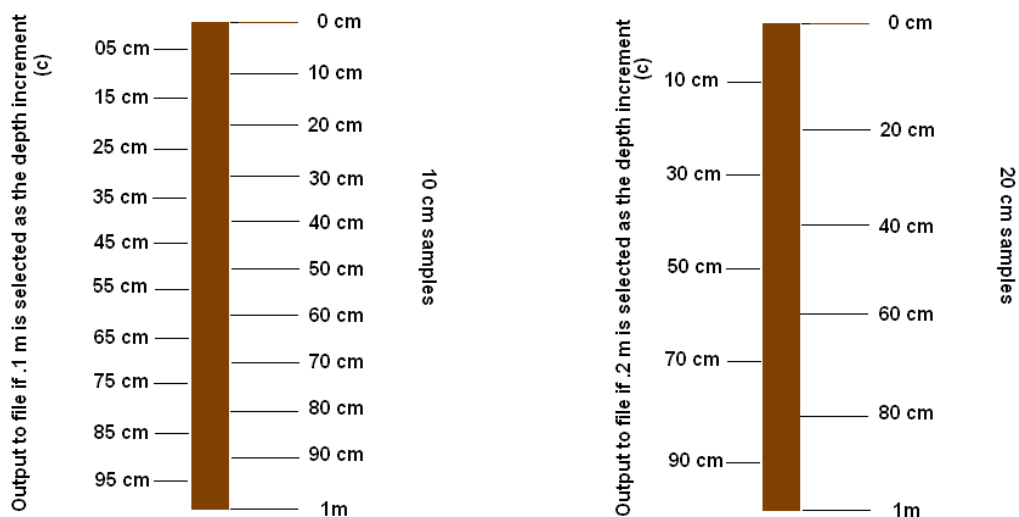


Figure 16

This example on the left shows the interpolated output vs. the sampling depth increments. If a core was taken and cut into 10 cm depth increments the output file will show 05 cm thru 95 cm, but the 05 cm data corresponds to the interpolated value using 0-10 cm data, not the data at precisely 05 cm. This continues down the probe until through the 95 cm measurement. Likewise, in the example on the right a 20 cm depth increment was used and the output file shows depths from 10 cm thru 90 cm. The 10 cm measurement corresponds to the interpolated data found between 0 – 20 cm. This continues for every 20 cm increment of soil.

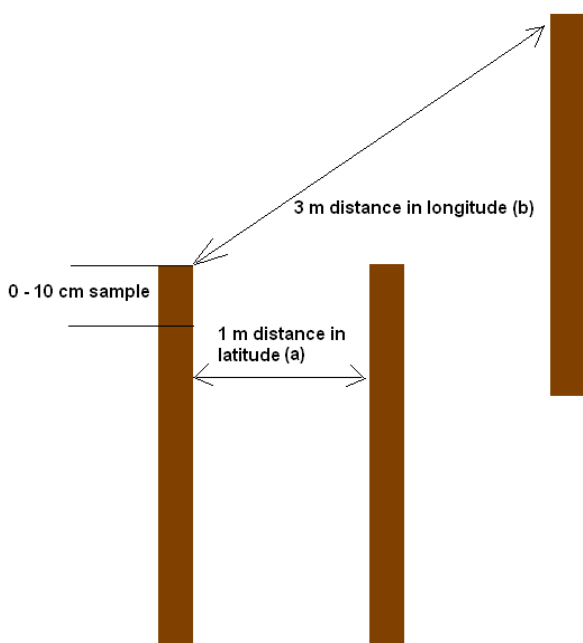


Figure 17

The example on the left illustrates how the interpolation can use multiple cores to obtain one value. If the **a** distance was equal to 3m and the **b** distance equal to 3m, then all three probes would be interpolated into one to obtain the value for the 10cm sample. If this is not desired then make sure that **a** and **b** are less than the actual probe spacing.

Importing sample locations for interpolation

Versions 1.4 and later.

This is only to be used when sampling is not completed in the Veris software. By following these steps the user could map a field and then flag the GPS locations where samples were collected and use those locations to get the interpolated values from the Veris software.

Step 1: Collect field data, then extract and filter the data. Exit the Veris Spectrophotometer Software once these steps have been completed.

Step 2: Create a file of the GPS coordinates of the sampled locations. The file should be created in the following format. Column A is the sample number, column B is the longitude, and column C is the latitude. Save the file as actual locations.txt in the working directory, where the field data has been stored.

| | | | | |
|-----------|----------|------------|-----------|----------|
| A1 | | 1 | | |
| | A | B | C | D |
| 1 | 1 | -97.722445 | 36.390117 | |
| 2 | 2 | -97.723045 | 36.389405 | |
| 3 | 3 | -97.724388 | 36.389383 | |
| 4 | 4 | -97.726347 | 36.389778 | |
| 5 | 5 | -97.728430 | 36.389203 | |
| 6 | 6 | -97.722883 | 36.388938 | |
| 7 | 7 | -97.721807 | 36.389272 | |
| 8 | 8 | -97.72071 | 36.38939 | |
| 9 | 9 | -97.721272 | 36.390157 | |
| 10 | | | | |

Figure 18

Example of actual locations.txt file

Step 3: Open the Veris Spectrophotometer Software and chose interpolation. The software will use the locations stored in the actual locations.txt file, and give an interpolated spectra, and auxiliary data for each location. The output will be a file called spectra@locations.txt, which will be created in the working directory.

Bench top Usage

To use the spectrophotometer to obtain measurements in the a bench top setting, first complete the system check as described in the field usage steps, then proceed to the acquisition. Mount the probe on the probe bench top stand. Place a soil sample in the sample holder and place the holder against the face of the probe window. Use the sample button or F4 to store a dark, reference, and then a sample spectrum. These transformed spectra are stored in the acquisition_samples.txt file located in the field folder.

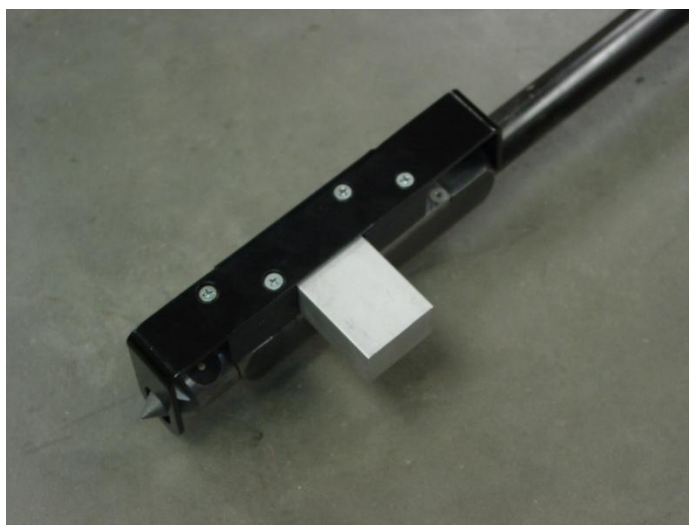


Figure 19

Sample holders
with soil.

Make sure the
soil is level with
the top of the
sample holder to
ensure a tight fit
with the probe.

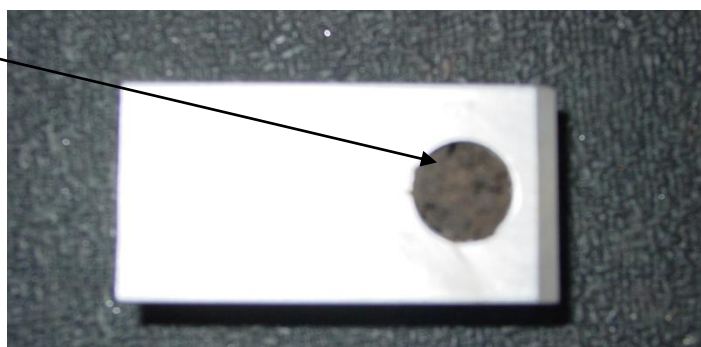


Figure 20

Test/Example Data

In order to gain experience with the software before mapping, test/example datasets are included with the Veris software. This allows the user to experiment with the system, without logging data or having GPS signal.

1. Start Operating software (Start → programs → Veris Spectrophotometer Software → Veris Data Processing)
2. Select working directory by clicking on folder icon.

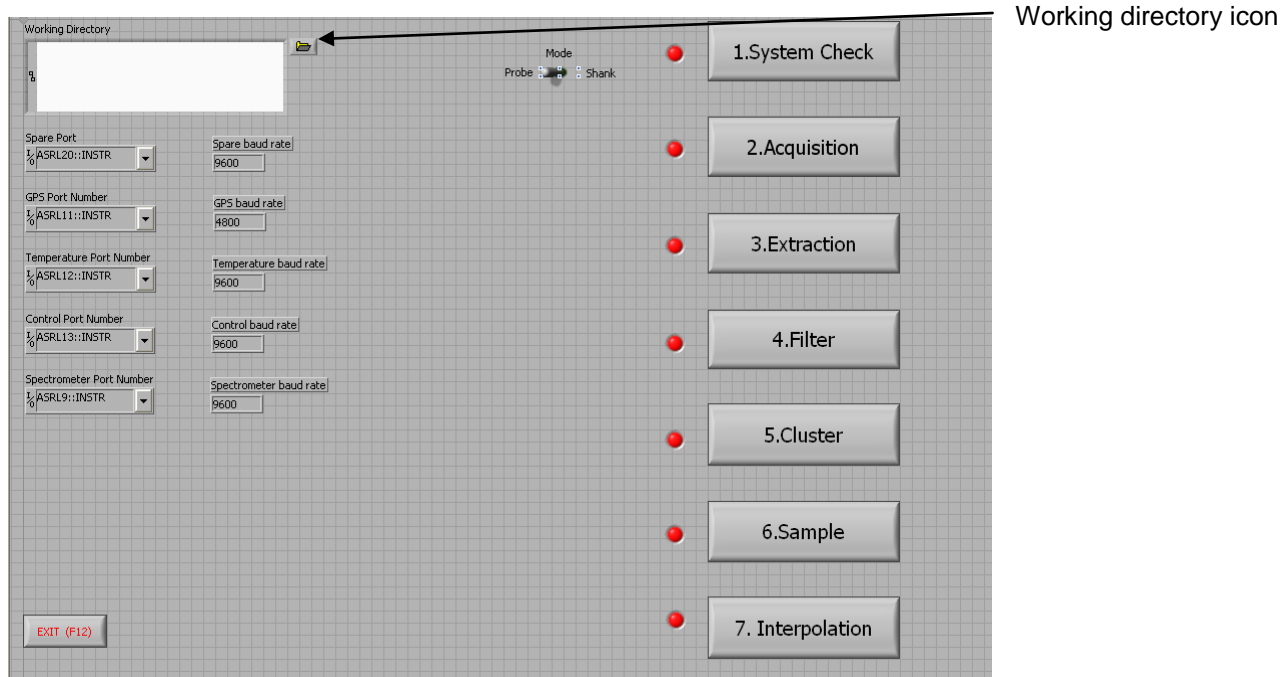


Figure 21

3. Set ports (see setting port order)
4. Click on system check (see system check for more information).
 - a. Run through all four external references
 - b. Exit system check
 - c. Start acquisition
5. Close acquisition and exit Veris software.
6. Go to C:\Veris\test data probe copy all files into the directory that was setup in step 2.
7. Start software again and proceed through the extraction, filter, cluster, sample (no locations can be stored without GPS), and interpolation. For more information on each of these steps, see Field Operations.

Section 5

Field Operation

P4000-S

Installation

The P4000-S is designed to be installed in $\frac{3}{4}$ ton – 1 ton pickups and due to the wide range of bed and frame dimensions on the market, there are no mounting holes in lower frame flange. Some drilling and fabrication will be required. You may choose to perform this on your own, or may wish to have a local welding or truck shop do this for you.

Steps:

- 1) Properly lift probe assembly in folded position with a minimum of two nylon straps and lower into pickup bed.
- 2) Center side-to-side in bed and so rear portion of skid frame rail is 14" forward of farthest point on rear bumper (Figure 1). This will ensure that foot will not contact bumper when the skid is in the retracted position.
- 3) Ideally 4 mounting bolts ($\frac{1}{2}$ " Gr5) are adequate for fastening the probe skid to the frame of the truck. Choose mounting location based on frame obstructions such as spring hangers, fuel tank hoses, etc. This will take some time, measuring both top and underneath the bed to make sure bolts will align with skid frame
- 4) Locate all four positions and fabricate "L" straps from at least $\frac{3}{8}$ " material and bolt or weld to frame. Make sure that fuel tanks, fuel line, and brake lines are not in danger of being drilled or welded. Drilling is preferable and two $\frac{1}{2}$ " bolts in the vertical position are adequate. (Figure 2)



14" from rear edge
to rear of bumper

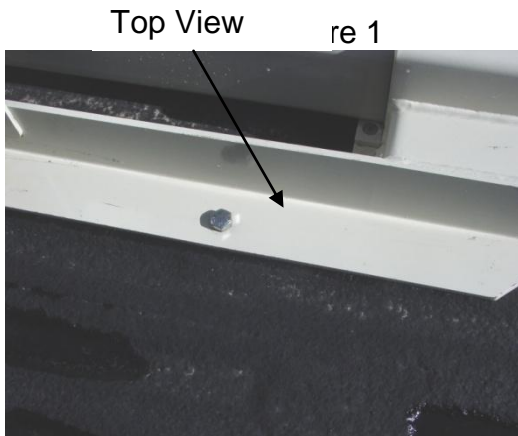


Figure 2A & B

Start out with 1/4"
pilot hole for
drilling up through

- 5) Using the "L" straps as templates, you can drill the hole through the bottom side of the skid frame rail. Tip: If you start out with small pilot holes (1/4" or less) it takes less effort to drill through the bed and frame rail, then drill out to full dimension from on top.
- 6) If for some reason you must locate one or two of lower "L" mounts ahead or behind the skid frame rail, you can fabricate some clips to hold down in place. Ideally at least two bolts should go through the skid frame to ensure that probe is properly connected to bed (Figure 3)



Figure 3

- 7) Securely bolt down and connect power cable to battery of vehicle.

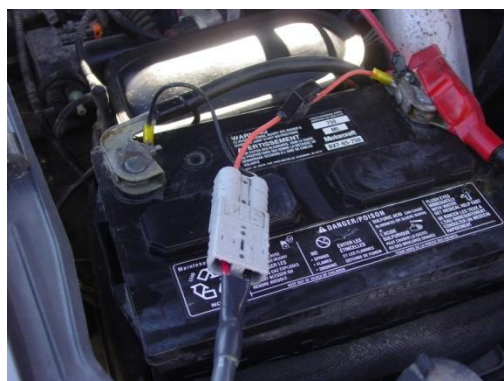


Figure 4

Field Operation Probe Platform

- Start engine and allow it to warm a minute or two before cycling – a few minutes if during cold weather.
- Extend to full rear position
- Fold into upright position (figure 5)
- Lower foot to soil
- Raise probe (figure 6)
- Install Probe or core sampling components



Figure 5



Figure 6

! CAUTION

**KEEP FEET CLEAR OF
FOOT AND PROBE**

Important! -- When folding and retracting the platform make sure that probe mast clears engine muffler. This can be achieved by shifting left to right as you fold the unit.

Field Operation VIS/NIR Probe

Checking Electrical Signal Continuity and Electrode Isolation

It is recommended that you routinely check the EC signal to verify that all functions are working properly. See Maintenance and Lubrication Section for a step-by-step procedure. It is advisable to perform this test on a routine basis (weekly or every 20-25 hours of data collection) to ensure you are obtaining reliable data.

Operation

Before probing refer to Section 4 for electronics operation. Remove hairpin from string pot piston (Figure 7). Set probe speed --- not recommended over **3cm/sec**. This is adjustable via the probe speed flow control on the side of the control panel. (Figure 9)

- Begin probing: with probe mast vertical, insert probe into soil until top of window is not visible. (Figure 8.) This starting position is recommended so ambient light will not be collected.
- Pressing Probe button begins storing spectrum data and auxiliary data until probe is stopped or raised. Once insertion is initiated, do not stop or reverse unless problem has occurred or desired depth is achieved. Data recording stops when probe is raised. GPS and Log lights must be green for data to be recorded.
- While probing monitor the following: Streaming spectra rate and Streaming Aux Display. If either of these is not streaming, stop immediately and diagnose the problem. See Section 7 Troubleshooting.

After 10 minutes the program will alert the user to take a manual reference. Several manual references may be required.



Figure 7



Figure 8

! CAUTION
KEEP FEET CLEAR
OF FOOT AND



Figure 9

Operational tip

- Use side-shift function to move probe to adjacent probing locations.
- Do not let stringpot cable snap back into spool; factory stringpot repair will be required if cable retracts too rapidly.
- For best results, clear plant residue from probe insertion area.

Field Operations Soil Coring

Once you have completed probing, remove NIR/EC force probe as outlined in Section 6.

- Install drive coupler to rotating head by means of drive retainer (Figure 10)
- Install PETG liner onto cutting shoe and thread into sampling tube (Figure 11)
- Install sampling tube into drive coupler and push into soil.



Figure 10



Figure 11

Use slow and steady insertion speed and minimal rotation to push core sampler into the soil. A brief rotation at bottom of stroke will snap off the core in tight clay, giving you a fuller core as you retract. (Figure 12) Excessive rotation may affect the condition of your cores.



Figure 12

Remove sampler tube and remove cutting shoe from sampling tube by tapping and rotating, or by use of wrench (provided). (Figure 13)

Cap the lower end of core with black vinyl cap, and the top with red. (Figures 14-15)



Figure 13



Figure 14



Figure 15

Field Operations Probe Rotation Option

An optional accessory for the P4000 is the Probe Inverter Option. This allows the operator to quickly rotate the NIR/EC force probe upwards to allow access to the coring tools without removal of the probe itself.

Below Figure 16 shows the NIR/EC force probe rotated down. To rotate upwards first pull the quick latch as shown in Figure 16

Next rotate the probe to the up position as shown in Figure 17



Figure 16



Figure 17

Once in the up position (Figure 18) ensure the quick latch is locked as shown in Figure 19. If the latch is not locked the probe may rotate round and cause personal injury.



Figure 18



Figure 19

Field Operations Optional Anchoring System

In some field conditions it may be necessary to drive soil anchors into the soil to obtain adequate depth with probe or core sampler. If this is the case, you will need PN 40209 Anchoring Package.

Installation and Removal

- Retract probe until is in the most forward position.
- Side shift to the far right and lower foot.
- Place anchor in center of foot opening and lower probe drive until hex enters hex drive on probe. (Figure 20)
- Drive in slowly using Probe and Rotation controls. Apply adequate force to push as you rotate. If you rotate too rapidly, the anchor will simply auger a hole, and will not anchor properly --- Drive in until all flighting is below ground level and probe is at bottom of stroke.
- Raise foot, side shift to far left, and repeat this process. (Figure 21)



Figure 20



Figure 21

1. Extend platform out to full extension
2. Attached chain binders on each side of probe
3. Slip anchor plates over anchors and bind down each side (figure 22)



Figure 22

Anchoring will limit your side travel somewhat, but you should still be able to take multiple cores with the anchors installed.

- **Do not use extension control while anchors are connected**
- Remove the anchors in reverse sequence.
- If anchors have shifted during use and you are unable to slide the hex head of the anchor back into the hex drive – use the foot to gently nudge the anchor back into re-alignment.

Note: Be careful when lowering the probe with the instrument cases in place. Remove left hand anchor first – otherwise you might push the head of the anchor into the instrument mount when lowering probe to remove RH anchor.

Field Operations

P4000T Removal and Tractor installation

The P4000 is designed to work equally well on a tractor, or as a skid mount unit.

Removing probe from skid –

- Install three point stabilizer stands into probe and temporarily lock in mid position with $\frac{3}{4}$ " pinch bolt.
- Extend and unfold the probe.
- Lower foot to ground level.
- Remove fold cylinder pin, and carefully retract fold cylinder until it is fully retracted. You may have to gently move fold control valve back and forth to relieve pressure on pin for removal. (Figure 23)



Figure 23 P & T Hoses



Figure 24

- Carefully remove lower link pins and lower probe down by retracting foot cylinder
- Lower stabilizer stands and lock with $\frac{3}{4}$ " bolt
- Retract probe platform and shut of engine. (Figure 23)
- Disconnect wiring and 4 hoses on bottom of console (Figure 24)
- Disconnect main Pressure and Tank hose from platform (Figure 25)



Figure 25

Fold and
Extend hoses

Disconnect
wiring

Installing on Tractor –

- All bushings and pins are provided for Category I and II three-point hitches.
- Connect lower links – make sure you include the stabilizer link bushings(Figure 26)
- Connect top link
- Raise three point to desired height and level with top link
- Install lower stabilizer mount on drawbar and tighten 5/8" bolts
- Connect LH and RH stabilizer to upper and lower points, adjust, and lock with jam nut.
- Connect hydraulic hoses noting P and T
- Retract stabilizer stands and engage hydraulics -- locking valve into detent with tarp strap or other device. Make sure that flow is correct or controls will be backward.



Figure 26

Stabilizer
link bushing

Section 6

Maintenance and Lubrication

Proper maintenance and lubrication of the Veris P4000G will allow you to collect high quality NIRS and EC data, and greatly extend the useful life of the unit. Veris Technologies strongly suggests that you follow the following guidelines:

MAINTENANCE: Storage of Spectrophotometer

Spectrometer and Auxiliary cases are water resistant; store NIRS system indoors or under roof. Water damage to spectrometers and electronic components is not covered by warranty.

MAINTENANCE: Electrical Continuity and Isolation

It is advisable to perform this test on a routine basis (weekly or every 20-25 hours of data collection) to ensure you are obtaining reliable data.

- 1) **Probe electrode isolation** – Check isolation of the dipole to the point with a Digital Multi Meter if the coulter electrode is properly isolated, a reading of 12K ohm should be obtained.



Figure 1

Instrument Signal Testing – The Veris Auxiliary Instrument is shipped with an **Instrument Test Load** (Part No. 10447) that will enable you to quickly check the instrument to ensure that it is functioning properly. To perform this test, do the following:

- 1) Disconnect the signal cable from the amp pin (signal) terminal on the auxiliary case.
- 2) Connect the test load to the signal terminal.
- 3) Switch on the unit and perform System Check and Data Acquisition.
- 4) The display should show: (See Figure 30)

| | |
|---------|-----------------------------|
| Shallow | 3 (approx.) |
| Deep | -1 (Not used in Probe Mode) |
- 5) If the readings vary significantly (more than one whole number) contact Veris service department.
- 6) Once the test is complete, remove the test load and reinstall the implement signal cable.



Test Load

Figure 2

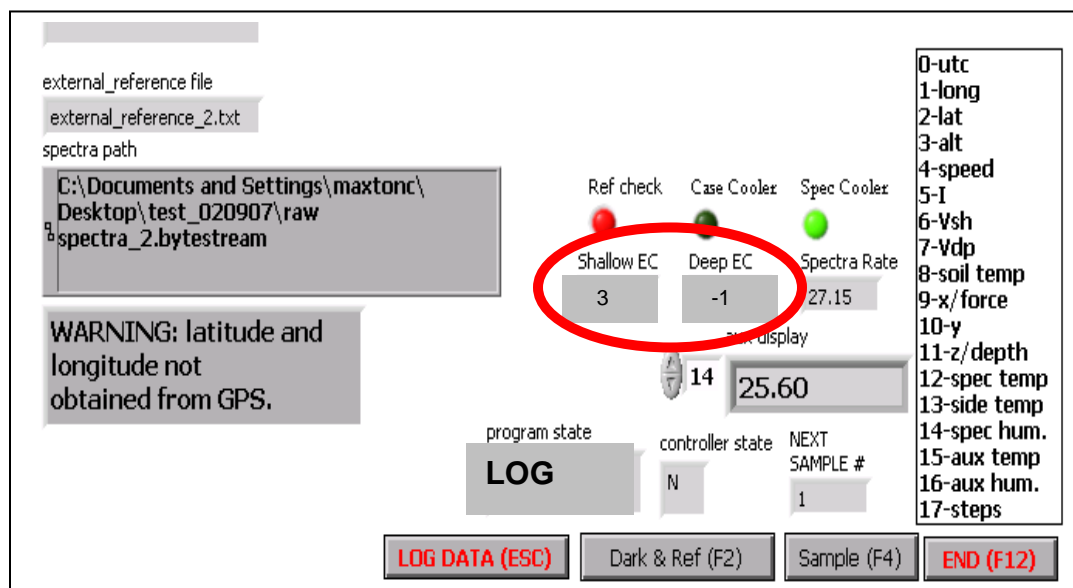


Figure 3

Maintenance: NIRS Wear-plate Replacement

Step 1:

With the probe out of the ground remove the wear-plate using a 3/32 hex wrench.

Step 2:

Insert new O-ring into new shank wear-plate

Step 3:

Make sure both the surface of the wear plate and the surface of the probe are clean before placing the new probe wear plate onto probe and securing with four new bolts.

Step 4:

Put the wear-plate back on and secure using a 3/32 hex wrench



Figure 4



Figure 5

EC Point Replacement Procedure

While replacing the EC point take extra care to not damage the fiber optic cable.



Figure 6
Remove window sheath by loosening the four hex screws.



Figure 7
Clean hex screw with some pointed tool. Then loosen the hex screw on the side of the housing to release the reflection module.



Figure 8
Clean hex screw with some pointed tool. Then loosen the hex screw on the side of the housing to release the reflection module.



Figure 9

Remove the bolts on the front cover to gain access the terminal block.

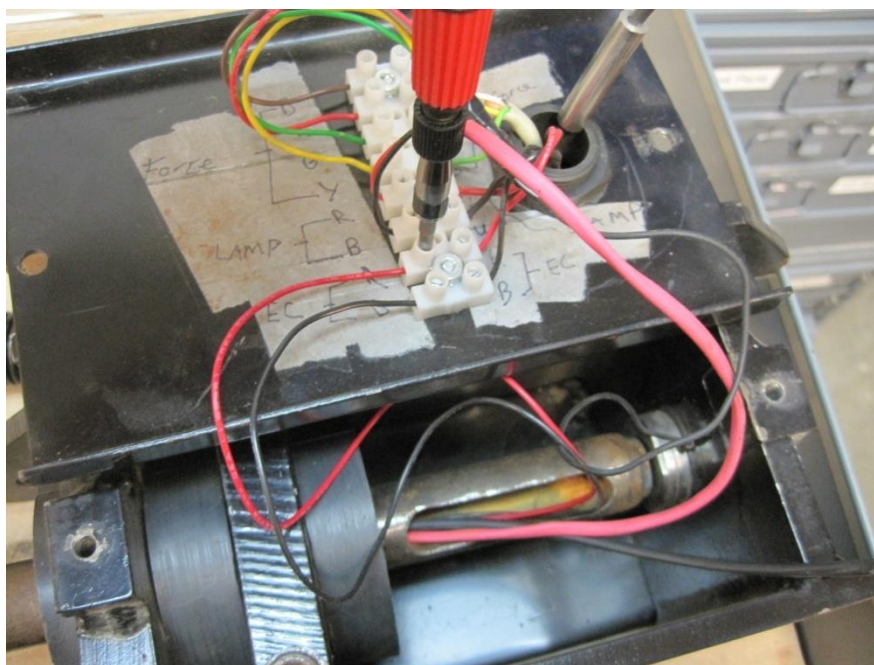


Figure 10

Now disconnect the EC Point wires from the terminal block. Use an ohm meter to check witch wires to disconnect. The dipole on the EC point will be red 22ga wire. The case of the EC point will be black 22ga wire.



Figure 11
Using two wrenches unscrew the EC point from the probe housing.



Figure 12
Once the EC point is unscrewed pull the wires out.



Figure 13
New replacement EC point.

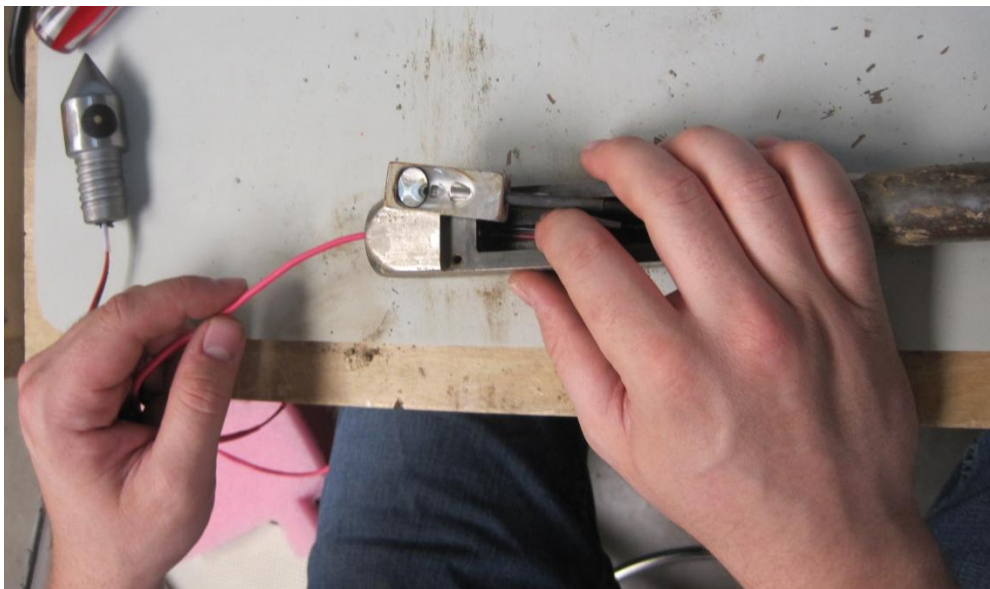


Figure 14
Feed the wires of the new EC point down the probe. Using two wrenches tighten down the EC point to the probe housing.



Figure 15

Make sure the o-ring is pressed in the groove all the way before installing the window sheath. Now secure the window sheath using the four hex screws. Tighten down the hex screw on the side of the window housing. Move up to the top and connect the EC point wires to the terminal block. Be careful with the fiber optic cable when putting the front cover back on. It can be pinched between cover and probe. Once cover is on secure with the bolts.

Probe Removal

This procedure is needed when removing the probe for bench top use, road transport, or for soil coring.

Step 1:

Disconnect the fibers from the spectrometer case, and the cables to the auxiliary case.

Step 2:

Remove loom from clip.

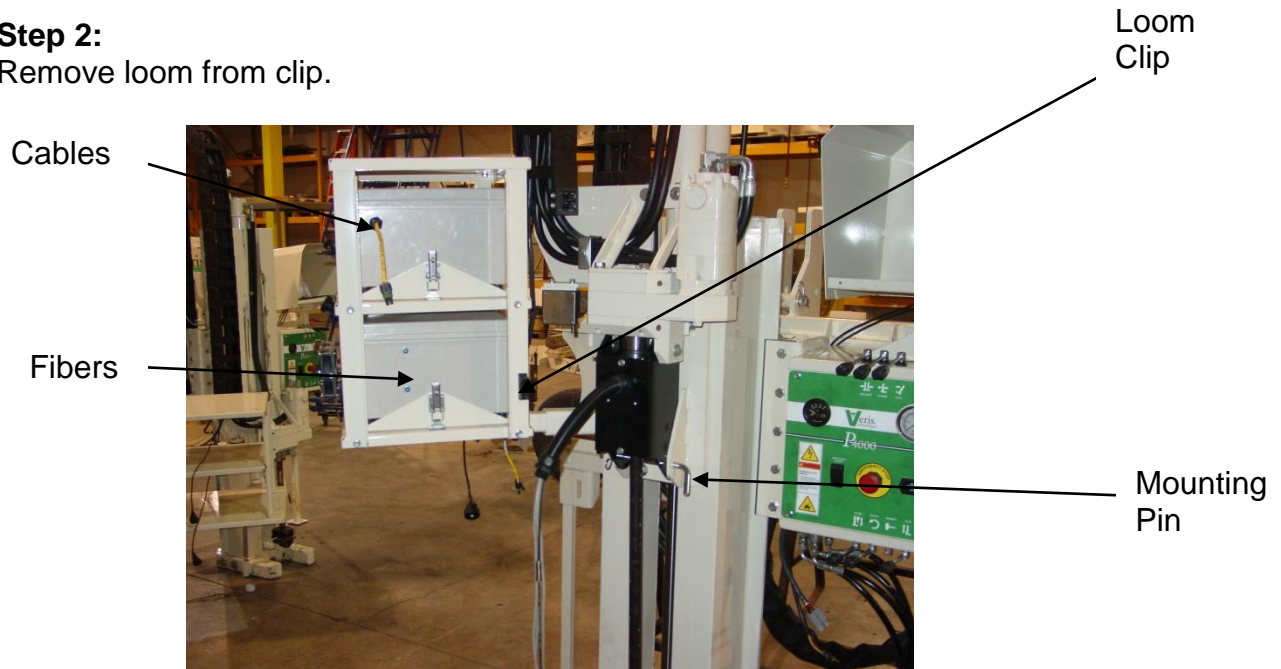


Figure 16

Step 3:

Firmly grasp probe, and remove the mounting pin holding the probe on the platform.

Case Removal and Installation

When the spectrometer and auxiliary cases need to be removed for storage, repair, or bench top use follow these instructions.

First disconnect all wires and the optical fibers connected to the auxiliary and spectrometer cases.

Each case is secured with two latches, and case and latch assembly can be removed as a unit.

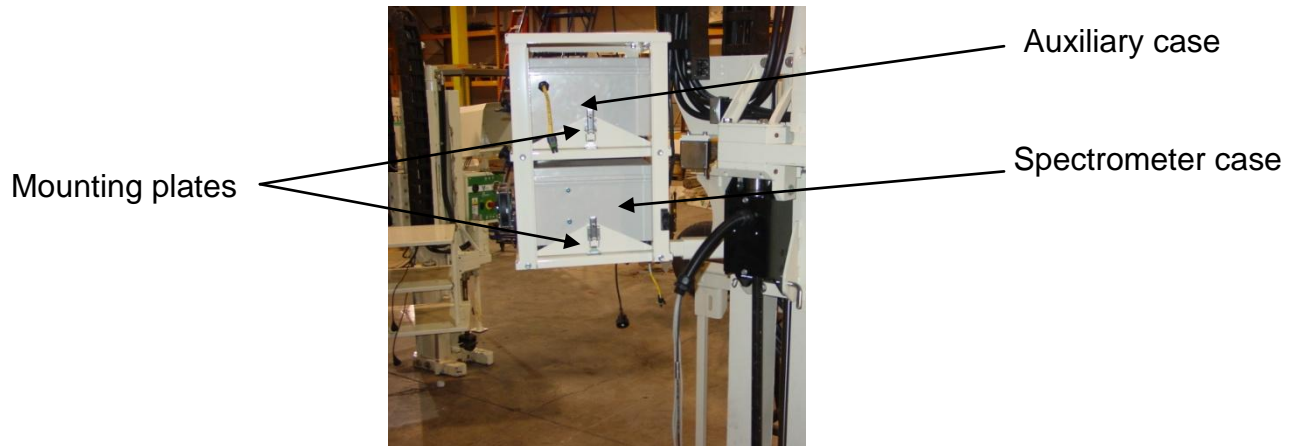


Figure 17

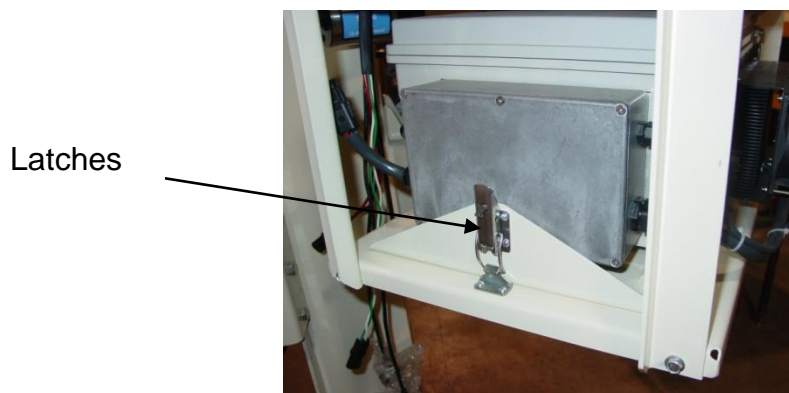


Figure 18

Section 7 Troubleshooting

Troubleshooting EC module

Data missing from display reading –

1. Unit must be in contact with soil to record data points
2. Check GPS and DGPS signal; Veris instrument is programmed to eliminate all non-DGPS geo-referenced points.
3. Shut power off and restart
4. Check electrical continuity
5. Check input voltage, 12 v minimum required

Troubleshooting NIRS

No spectrum is present on graph or spectrum is not updating in Acquisition

1. Ensure USB cables are tightly connected
2. Shut down software and cases and restart system
3. Check port settings
4. Open each spectrometer individually in the manufactures software(procedure #7 & 8)

MS Windows brings up an new hardware found wizard when I plug in my cases

1. Select 'Install software automatically' and allow hardware wizard to configure device

Ports won't save in Veris Spectrophotometer Software

1. Make sure the **Exit** button is being used to close out of the software, not the X in the upper right hand corner.

No GPS data is coming in during acquisition

1. Check to ensure nothing is obstructing GPS signal (ex. buildings)
2. Is the GPS plugged into the correct port? (second one from the right on auxiliary case)
3. Check to make sure GPS adaptor is in place
4. Follow the steps of the GPS troubleshooting guide to further diagnose problem

System check only allows one External Reference to be taken

1. Check to ensure the Ref Check light is green
2. Check the shutter movement distance (auxiliary indicator #17, should be 5.21 +/- .05
3. Check for green lights on the temperature and humidity indicators

Transform does not pass during System Check

1. Check to ensure the correct ER was placed under the shank and the correct ER button was pressed during the system check.
2. Make sure instrument had a 20 minute warm up period
3. Make sure ER was pressed firmly in place, so little ambient light entered the shank
4. Run System Check again – run all four external references

Computer crashes or has been hard reset while acquiring data

1. Once computer has restarted open Veris Spectrophotometer Software again.
2. Step through software till clustering has been complete. The cluster program will generate a map, which will let the user know the last point where data was stored. Using the map as a guide open the acquisition and begin to store data again. The acquisition will append the new data to the previous data stored.

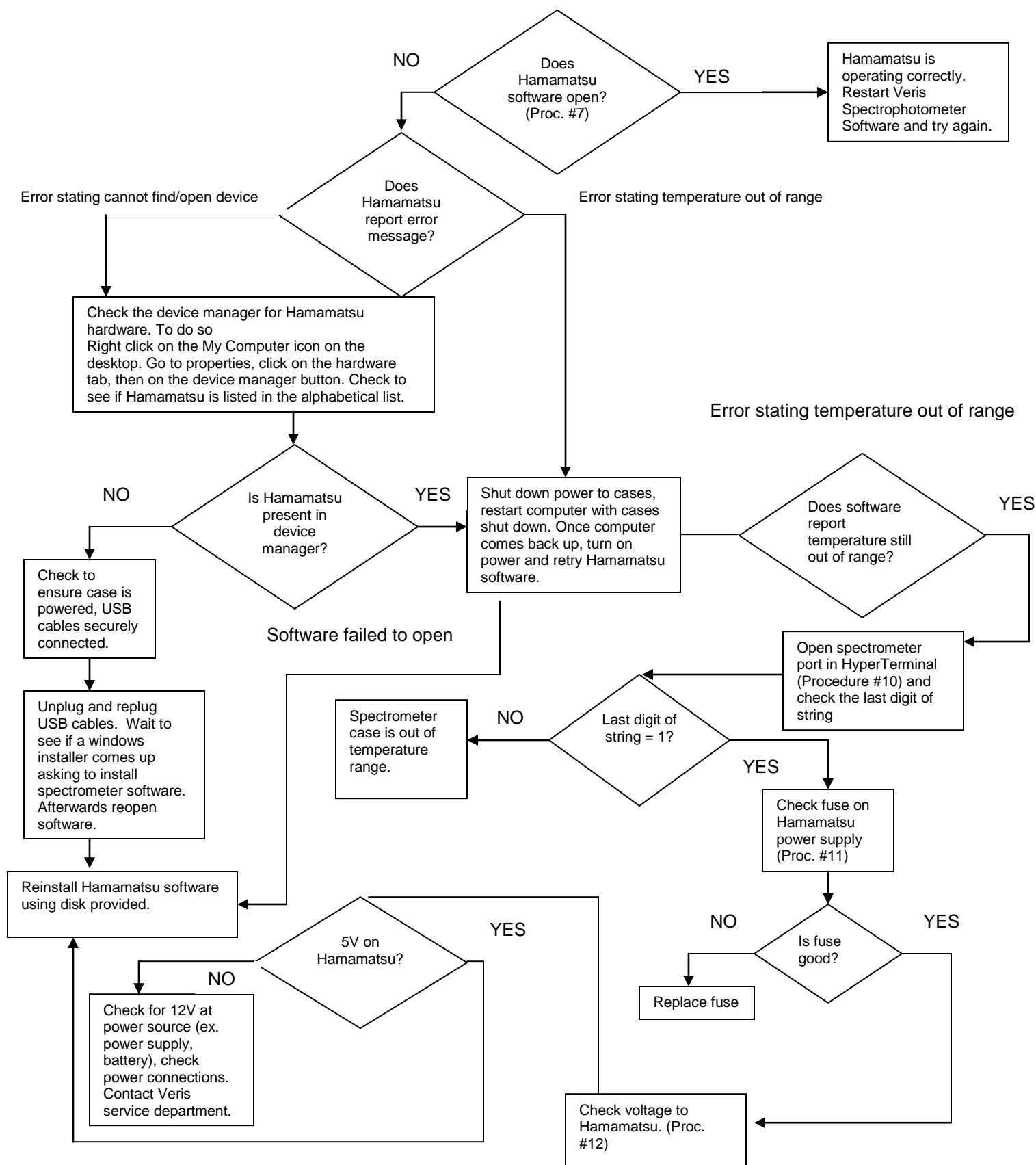
Reference check will not pass after several tries or steps are out of range

1. Close out of software
2. Shut down power/ restart power to cases
3. Check the port settings
4. Restart software and run dark/reference again
5. Complete procedure #9, on shutter movement.

Auxiliary data not updating or ports not setting up correctly

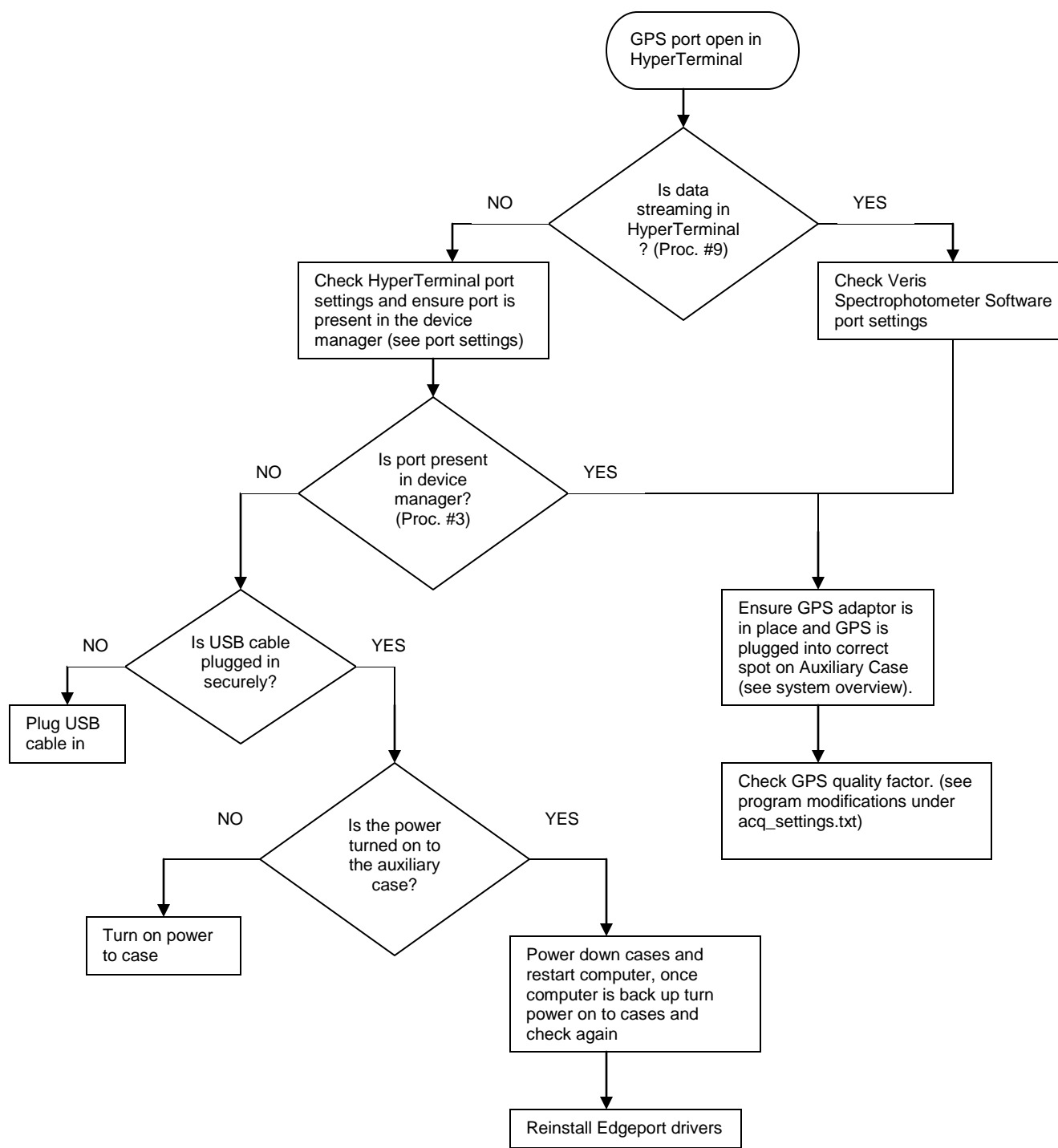
1. Shut down power, and restart cases
2. Ensure USB cables are secured tightly
3. Follow the steps outlined in procedure #10, to ensure data is present on the ports.

Problem: No response from Hamamatsu Spectrometer (1100-2200nm)



Troubleshooting GPS

If GPS fails to come in it could be for a variety of reasons. The easiest way to isolate the problem is to open the GPS port in HyperTerminal (see troubleshooting with HyperTerminal).



How to check Ocean Optics spectrometer

- 1) Click on start → Programs → Ocean Optics → OOIBase32 → Start OOIBase32 software
- 2) Check graph it see if spectrum is present (see figure below). The spectrum should change as different objects are placed in front of the window on the probe.

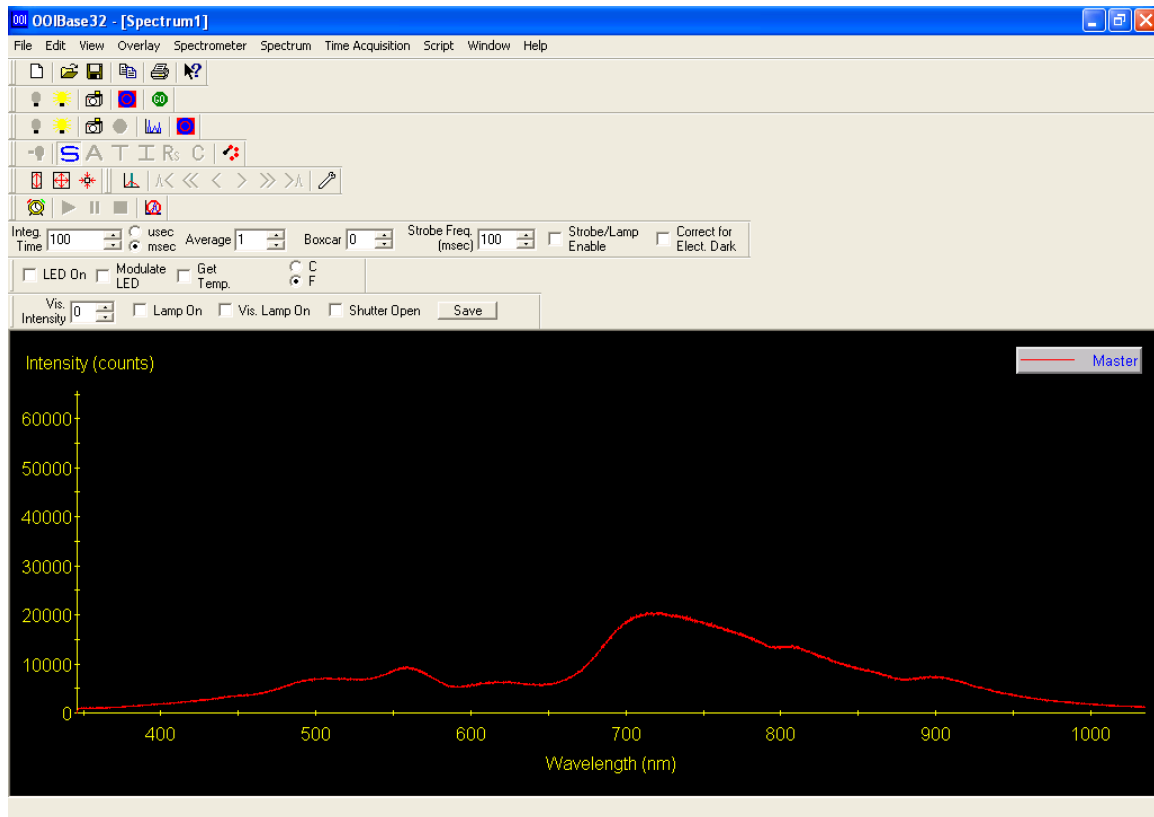


Figure 1

- 3) If there is no spectrum present or graph does not update as objects are placed beneath the shank. Then the spectrometer needs to be configured. To configure click on spectrometer → configure → A/D Interface tab

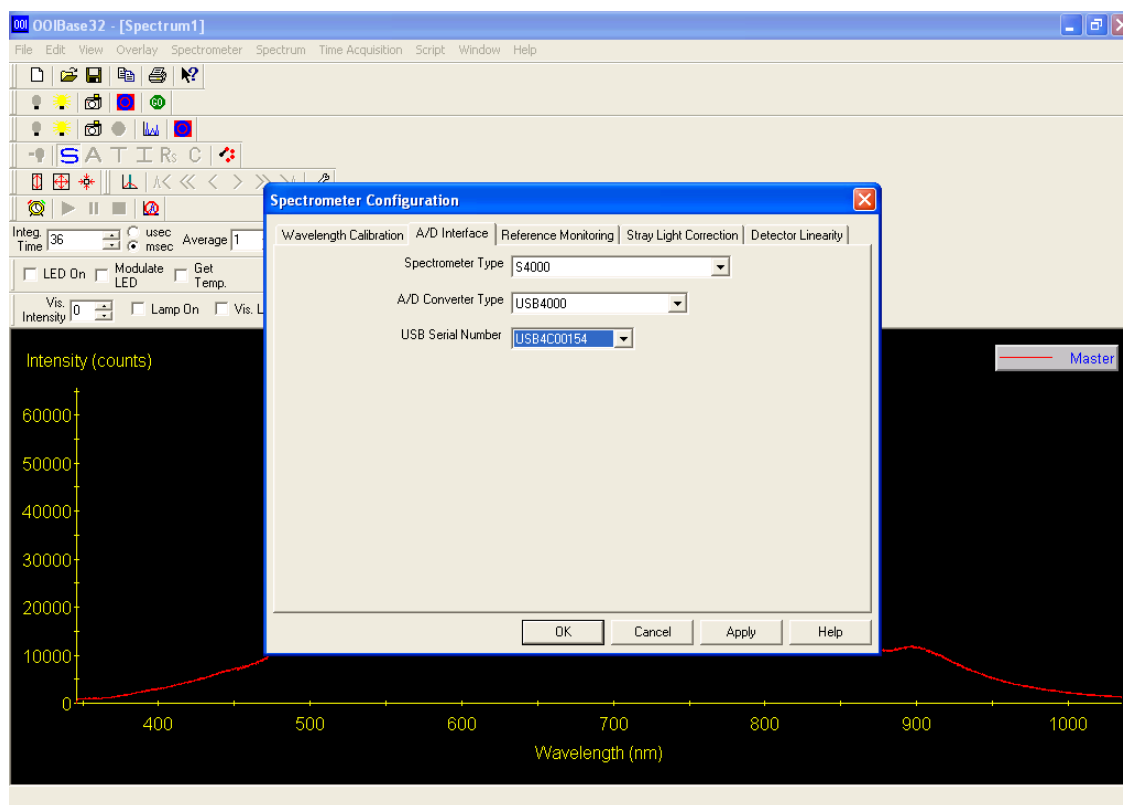


Figure 2

- 4) Under Spectrometer Type select S4000. For the A/D Converter Type select USB4000. The USB Serial Number will have one serial number present, which is unique to each spectrometer, select the available serial number.
- 5) Click OK to save the settings and return to the main screen. A spectrum should now be present.
- 6) Close OOIBase32 software, restart computer, and open Veris Spectrophotometer Software to begin mapping again.

To open Hamamatsu spectrometer individually

- 1) Click on Start → Programs → HamamatsuMinispectrometer → EvaluationSoftware → SpecEvaluation
- 2) Click on open spectrometer

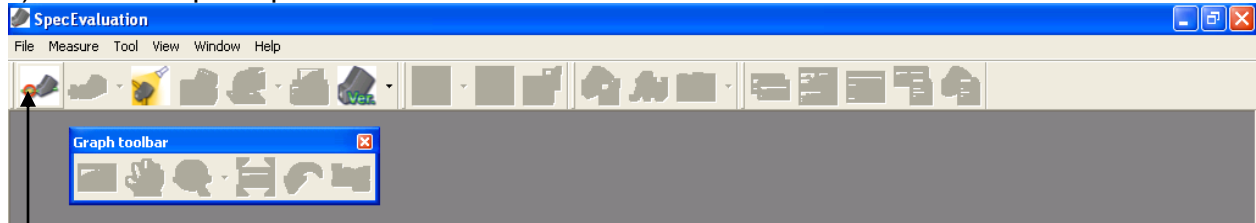


Figure 3

Open spectrometer icon

- 3) Click on Open under Select Spectrometer

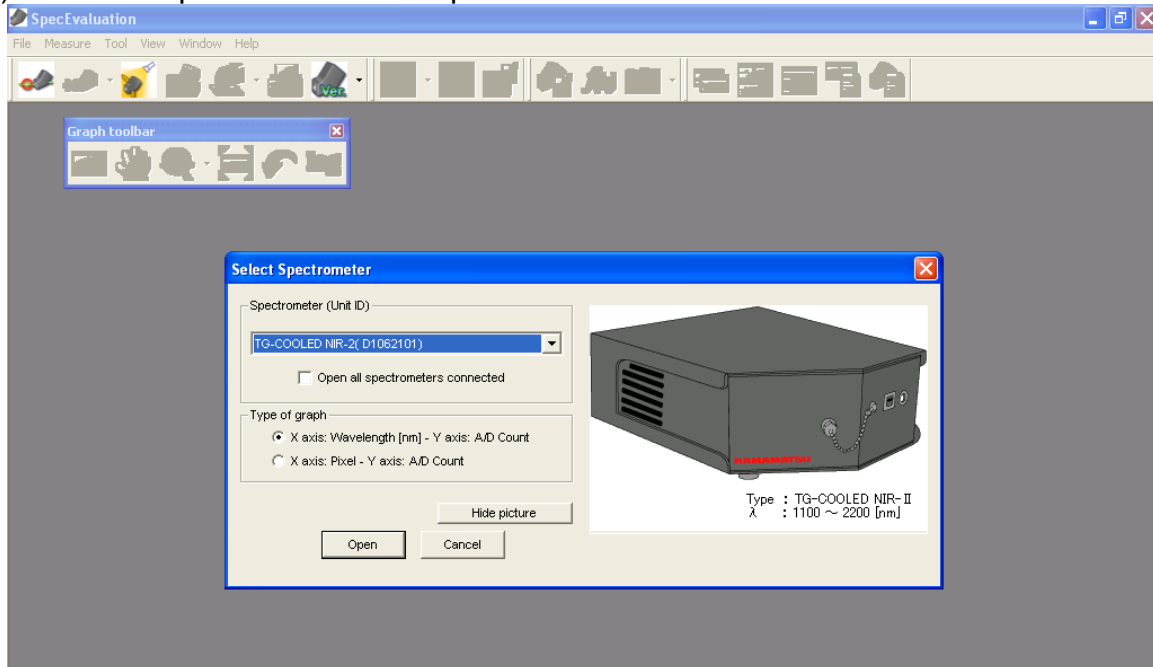
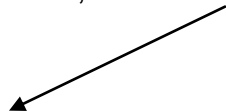


Figure 4

- 4) Click on start and check to see if spectrum graph changes as different objects are placed adjacent the probe window. This ensures the Hamamatsu spectrometer is working properly. If this is not the case then close Hamamatsu software, shut down power, restart computer and try Hamamatsu software again.



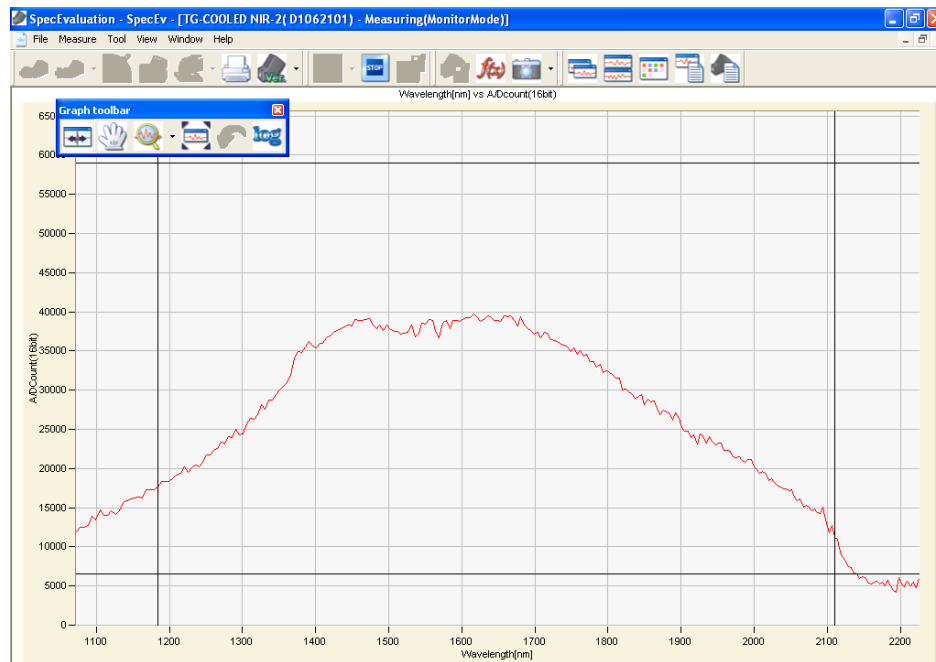


Figure 5

Troubleshooting NIRS with HyperTerminal

If auxiliary data fails to come in properly, then the port and device can be verified outside of the software by utilizing the HyperTerminal. If the port works properly here then the data should be present in the Veris Operating software. If the ports fail to open or does not have any data present then check the physical connections to the auxiliary box, unplug the USB cords, shut down the system, and restart the computer, then check for the auxiliary data again.

- **How to open HyperTerminal**

- On MS Windows 2000 or XP machine
- Start → Programs → Accessories → Communications → HyperTerminal
- Enter name of connection ex. com3@9600
- Click OK

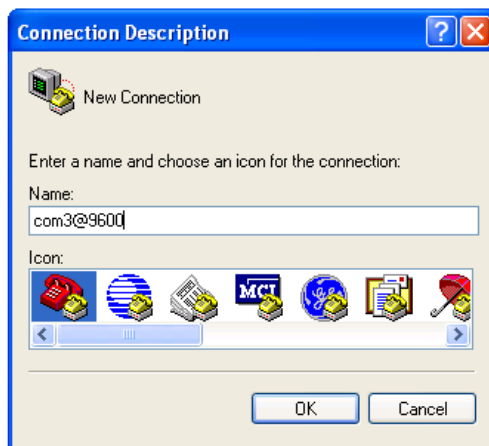


Figure 6

- Select the correct com port from the connect using option.
- Click OK



Figure 7

Enter com port properties for your device. See the **Port Properties** section for the standard settings.

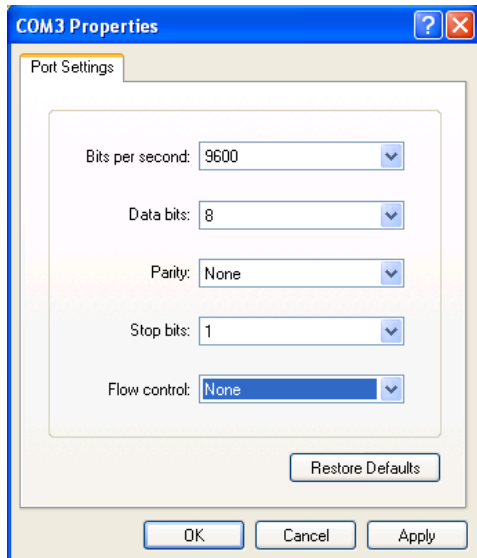


Figure 8

- Click OK
- HyperTerminal session now open and data should be present. See **Port Definitions** for example HyperTerminal data.

Port Properties

- Temperature Port
 - Bits per second: 9600
 - Data bits: 8
 - Parity: None
 - Stop bits: 1
 - Flow control: None
- GPS
 - Bits per second: 4800
 - Data bits: 8
 - Parity: None
 - Stop bits: 1
 - Flow control: None
- Control Port
 - Bits per second: 9600
 - Data bits: 8
 - Parity: None
 - Stop bits: 1
 - Flow control: None

- Spectrometer Port
 - Bits per second: 9600
 - Data bits: 8
 - Parity: None
 - Stop bits: 1
 - Flow control: none

- **Port Definitions**

- Temperature Port – Reads in soil temperature.

```

C T0022.0
C T0022.0
C T0022.0
C T0022.0 ← Example of temperature port connected in HyperTerminal

```

- GPS Port – Reads in GPS coordinates.

```

$GPRMB,0.0,200,,,K,,N,W*28
$PGRMM,WGS 84*06
$GPGSA,A,1,,,,,,,,,,,,,*1E
$GPGSV,3,1,12,01,00,000,00,02,00,000,00,03,00,000,00,04,00,000,00*7C
$PGRME,,M,,M,,M*00

```

Example of GPS port connected in HyperTerminal.

- Control Port – Reads in EC, Auxiliary case temperature and humidity, and shutter steps. After opening this port if no data is present type S for shank mode or P for probe mode. The letter after E represents the shutter state. In the case below the shutter is in neutral or rest. If the case reads R the shutter is in reference or if there is a D the shutter is in dark. To manually move the shutter type N for neutral, then R for reference, then D for dark.

```

EN,1000,488,305*
EN,1011,467,291*
T22.90,22.79,1025,0,0*
EN.1022.507.286*

```

Example of Control Port connected in HyperTerminal.

How to read control port data strings

Shank Mode

E shutter position, current, voltage deep, voltage shallow *

T temperature, humidity, shutter steps, 0, 0*

- Spectrometer Port – Reads in Spectrometer temperature and humidity, side box temperature, cooler state, and spectrometer cooler state.

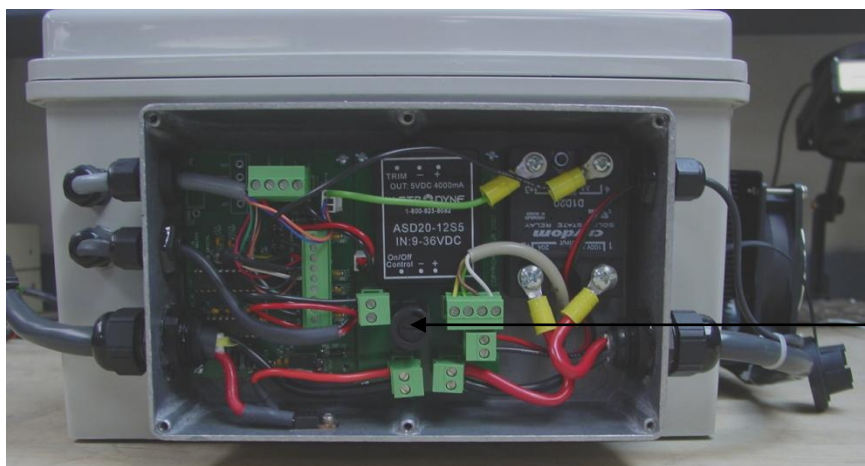
| | | | |
|-------|-------|-------|-----------|
| I, N, | 22.8, | 29.6, | 43.5,0,1* |
| T, N, | 22.8, | 29.6, | 43.6,0,1* |
| T, N, | 22.9, | 29.5, | 43.6,0,1* |

Fuse replacement

There are two fuses inside the spectrometer case and one inside the auxiliary case. To locate and replace these fuses, follow these steps. First remove the cases see the following

Spectrometer case fuses

The first fuse is on the side control box. This is a four-amp fuse, which protects the power to the Hamamatsu spectrometer as well as the internal microcontroller. To locate this fuse take off the six screws securing the mounting plate on the side of the box.



Use a flat head screwdriver to remove fuse

Figure 9
Internal wiring of the spectrometer case control box



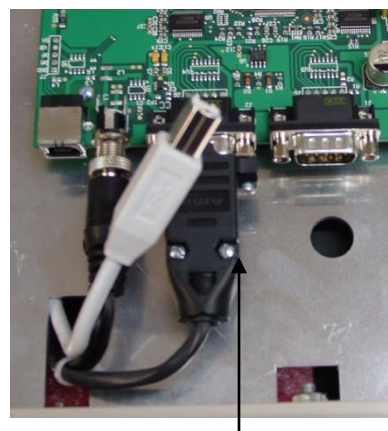
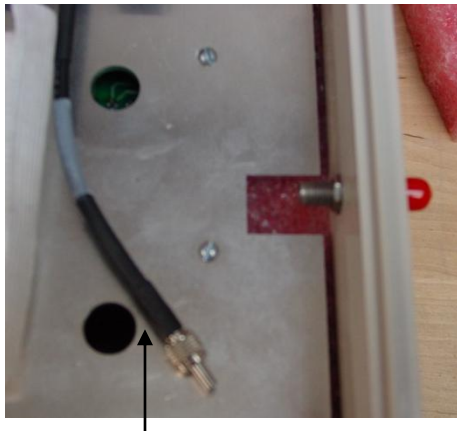
Figure 10
Fuse and fuse holder once removed

The other fuse is located inside the spectrometer case underneath the mounting shelf. This fuse protects the power to the Edgeport hub, which sends data out through the USB port.



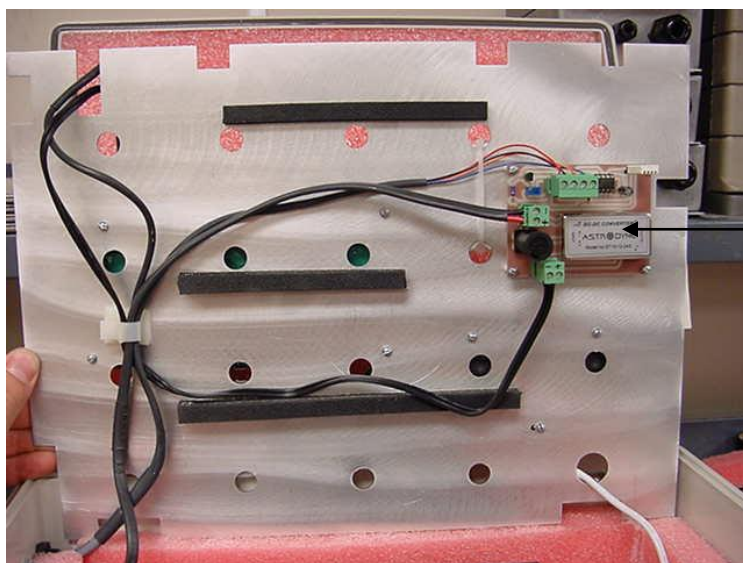
Figure 11
Inside view of spectrometer case mounting shelf

To reach the fuse for the Edgeport first disconnect the fiber optic cable to the USB4000, then disconnect the USB output cable.



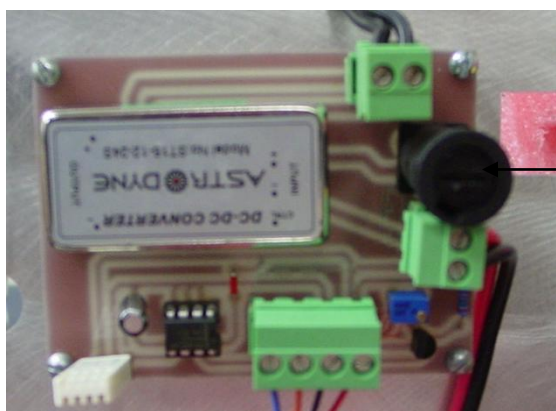
Figures 12 and 13

Once the fiber optic cable and the USB output cable have been disconnected, the shelf can be tilted up and the case will be exposed.



Edgeport hub power board, also the temperature and humidity readings are monitored from this board

Figure 14
Spectrometer case mounting shelf tilted back.



Fuse can be removed using screwdriver. Replace only with 3-amp fuse.

Figure 15

The fuse for the auxiliary case protects the voltage for the electrical conductivity board and the lamp. To replace the fuse open the case and locate the black fuse holder

Fuse holder. Replace only with a 4-amp fuse.

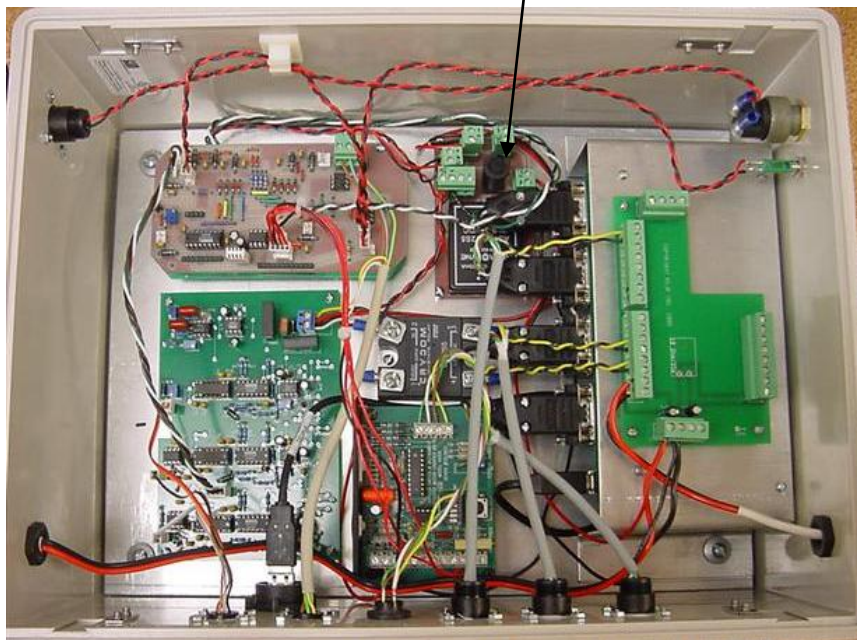


Figure 16

Internal wiring of auxiliary case

Checking Spectrometer Input Voltage and Hamamatsu Voltage

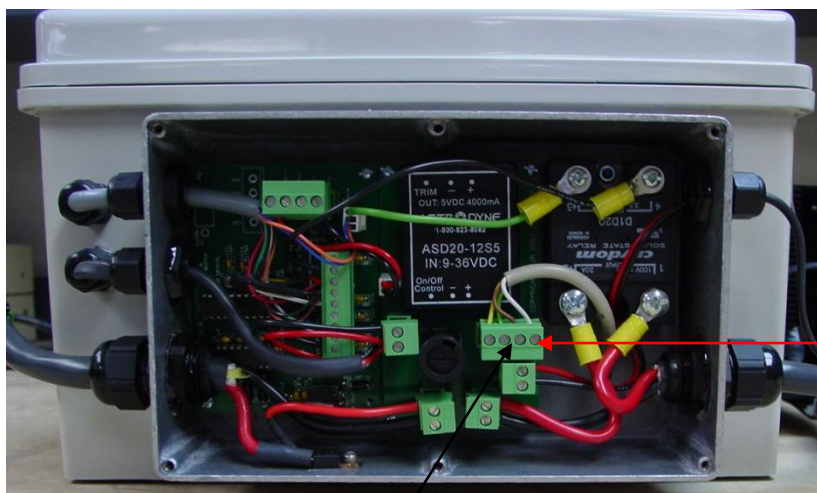


Figure 17

Connect negative lead from voltmeter here (brown wire)

Connect the positive lead from the voltmeter here (white wire)

Voltage should read 5V, as long as spectrometer case is within temperature range.

Section 8

Glossary

Spectrophotometer – A complete system for making spectral measurements. The system includes a light source, means for collecting light that has interacted with the material under test, and a spectrometer to measure the collected light.

Spectrometer – Instrument to measure the quantity of light over a spectrum of wavelengths. The spectrometer is the "measurement engine" of the spectrophotometer.

Auxiliary Data (in system check and acquisition)

| Number | Name | Description |
|--------|-----------|---|
| 0 | UTC | Universal Time Coordinated hhmmss.cc hh = hours, mm = minutes, ss = seconds, cc = hundredths of seconds |
| 1 | Long | GPS Longitude |
| 2 | Lat | GPS Latitude |
| 3 | Alt | GPS Altitude |
| 4 | Speed | Speed (Km/h) |
| 5 | I | Current used to calculate EC data |
| 6 | Vsh | Voltage shallow |
| 7 | Vdp | Voltage deep |
| 8 | Soil temp | Soil temp |
| 9 | X/force | Spare for Shank mode or force for probe mode |
| 10 | Y | Spare |
| 11 | Z/depth | Spare for Shank mode or depth for probe mode |
| 12 | Spec temp | Spectrometer case temperature |
| 13 | Side temp | Side control box on spectrometer temperature |
| 14 | Spec hum. | Spectrometer case humidity |
| 15 | Aux temp | Auxiliary temperature |
| 16 | Aux hum. | Auxiliary humidity |
| 17 | Steps | Steps shank moves during dark/reference check |

All temperatures are in degrees C. If no data is present for an auxiliary data item a –1.50 will be output.

Field Auxiliary output definitions

EC_Sh – Electrical conductivity shallow.

EC_Dp - Electrical conductivity deep.

Temp – Soil temperature

Spec_T – Spectrometer case temperature

Ctrl_T – Control box temperature (this is the metal box on the side of the spectrometer case)

Spec_H – Spectrometer case humidity

Aux_Te – Auxiliary case temperature

Aux_Hu – Auxiliary case humidity

Specifications

Max ambient temperature to operate system: 110 degrees F

Max spectrometer case temperature: 30 degrees C

Max spectrometer case humidity: 90% RH

If spectrometer case humidity reaches this point, the silica packet inside spectrometer case needs to be replaced.

Max side case (control box) temperature: 65 degrees C

Max aux case temperature: 65 degrees C

Max aux case humidity: 90% RH

Field Files

acquisition_samples_*.txt

Description

Transformed samples in absorbance taken during acquisition.

| | A | B | C | D | E | F | G | H | I | J | K | L |
|---|----|-----------|------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| 1 | -4 | 348.84732 | 354.87067 | 360.88406 | 366.88748 | 372.88089 | 378.86426 | 384.83755 | 390.80072 | 396.75378 | 402.69666 | 408.6295 |
| 2 | 1 | 0.8793300 | 1.0757098 | 0.9788782 | 0.7476866 | 0.9783308 | 0.9800657 | 0.9809719 | 0.9960332 | 0.9828883 | 0.9957049 | 0.9884825 |
| 3 | 2 | 0.8771030 | 1.8820783 | 1.3554615 | 1.0508933 | 1.2740126 | 1.3587264 | 1.4503951 | 1.4259125 | 1.4189563 | 1.4306035 | 1.4472805 |
| 4 | 3 | 0.8362141 | -0.3396210 | 0.2052869 | 0.3544656 | 0.3009072 | 0.2849204 | 0.2744934 | 0.2809735 | 0.2672946 | 0.2760836 | 0.2749224 |

Figure 1

The first column represents the sample number, except for the first value of -4, which indicates that the row is the spectrometer wavelength values. There will be a total of 384 wavelength values, which also represents the number of columns in each sample file. In this example a total of three samples were taken, for each wavelength there is an absorbance value, so for sample 1 at wavelength 348.84732 the absorbance was .8793300.

master_veris_standards.txt

External reference data in reflectance standardized against Avian grayscales. (provided by Veris)

external_reference_*.txt

Untransformed external reference data in reflectance taken during system check.

xform_*.txt

Transform created by comparing master_veris_standards and latest external_reference files.

raw_spectra_*.bytestream

Field data taken in compact bytestream format. **Note: Each time system check is ran a new .bytestream file and xform.txt file will be created. Once system check has been completed**

successfully, then the .bytestream file will automatically be appended to if acquisition is stopped and started again later.

field spectra.txt

Auxiliary sensor data and field data in absorbance extracted and transformed.

| | A | B | C | D | E | F | G | H | I | J | K | L |
|---|------------|-----------|-----------|-----------|-----------|--------|-----------|-----------|-----------|-----------|-----------|-------|
| 1 | Long | Lat | Altitude | EC SH | EC DP | Temp | Spec T | Ctrl T | Spec H | Aux Te | Aux Hu | Steps |
| 2 | -97.622662 | 38.853339 | 373.25 | 57.897087 | 48.018773 | 9.192 | 21.799999 | 18.700001 | 25.700001 | 19.99 | 31.583333 | 1025 |
| 3 | -97.622528 | 38.853283 | 373.20001 | 53.384047 | 50.278643 | 8.9 | 21.799999 | 18.6 | 26 | 20.055 | 31.48 | 1025 |
| 4 | -97.622528 | 38.853284 | 373.20001 | 57.015384 | 53.45108 | 8.98 | -1 | -1 | -1 | 20.050001 | 31.51 | 1025 |
| 5 | -97.622513 | 38.853295 | 373.20001 | 53.662772 | 53.06524 | 10.768 | 21.799999 | 18.6 | 25.799999 | 20.04 | 31.526667 | 1025 |
| 6 | -97.622513 | 38.853317 | 373.29999 | 51.317202 | 47.210872 | 10.444 | 21.799999 | 18.700001 | 25.9 | 20.005 | 31.665 | 1025 |
| 7 | -97.622513 | 38.853339 | 373.34999 | 43.702147 | 44.515386 | 9.992 | 21.9 | 18.700001 | 25.799999 | 20.09 | 31.52 | 1025 |

Figure 2

The first 17 columns of the field spectra file represent the auxiliary sensor data (see glossary for definition), each is labeled by a header, following the header is the wavelength values. The next 384 columns are the absorbance data at each wavelength. A value of -1 represents no data was present at that time.

Probe field spectra.txt

This is output after the extraction is ran and has all the hole data interpolated to the same depth increments.

cleaned field spectra.txt

Filtered field spectra can be used for applying calibration.

loadings.txt

Principal components loadings.

PC_scores.txt

Principal component scores.

interp_PC scores.txt

Interpolated PC scores.

proposed_locations.txt

Proposed sample locations based on clustering.

actual_locations.txt

Actual locations stored during sampling program.

spectra@locations.txt

Interpolated spectra and auxiliary data at actual locations.

| | A | B | C | D | E | F | G | H | I | J | K | L |
|---|--------|------------|-----------|--------|--------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| 1 | a | b | c | | | | | | | | | |
| 2 | 3 | 3 | 0.05 | | | | | | | | | |
| 3 | P Samp | P Long | P Lat | P Dept | # Spec | Altitude | EC SH | EC DP | Temp | Spec T | Ctrl T | Spec H |
| 4 | 1 | -97.624123 | 38.853761 | 0.5 | 28 | 373.24473 | 43.396379 | 56.583761 | 14.389692 | 23.232850 | 25.773950 | 25.210855 |
| 5 | 2 | -97.624626 | 38.855445 | 0.5 | 36 | 373.31500 | 32.696318 | 34.133374 | 12.950006 | 23.533954 | 22.322405 | 22.454411 |
| 6 | 3 | -97.623146 | 38.854442 | 0.5 | 20 | 373.8 | 65.796084 | 76.076737 | 13.640369 | 23.567317 | 21.238522 | 23.326088 |
| 7 | 4 | -97.623779 | 38.855181 | 0.5 | 32 | 372.79114 | 35.729872 | 40.347413 | 9.9245511 | 23.493523 | 26.426533 | 23.849188 |
| K | L | M | N | O | P | Q | R | S | T | U | | |

Figure 3

The P_Sample, P_Long, P_Lat, P_Depth are the actual sample number, longitude, latitude, and depth. The # Spec refers to the number of spectra found near each sample location. These are the locations that were selected in the sampling program. The depth is only used in the probe mode. The next 17 columns are the interpolated data found near each of those actual locations. Then the next 384 columns are the interpolated spectra data found near each of the actual locations.

Settings Folder

These files are used to store values and paths for the Operating software. These files are automatically created and should not be altered.

| | |
|-------------------|---|
| boolean.txt | Stores steps of Operating software. |
| configuration.txt | Stores aux data length and spectrum length. |
| spectra path.txt | Stores spectra path. |
| xform path.txt | Stores xform path. |

Appendix

#1 Program Modifications

The files in the C:\Veris directory are used to store configuration settings for the Veris Operating software. These are set to default values, but can be changed.

Veris directory files

Description

acq_settings.txt

Stores acquisition settings, these can be configured by the user.

Ex. 0.010 19.000 5.000 15.000 0.150 0.150 0.300 0.150 2.000

These values represent the following controls in this order:

Reference check tolerance
 Hamamatsu integration time (ms)
 Seconds of data to average
 Ocean Optics integration time (ms)
 External reference #1 max allowed RMSE
 External reference #2 max allowed RMSE
 External reference #3 max allowed RMSE
 External reference #4 max allowed RMSE
 GPS Quality Factor (2 = DGPS 1 = GPS 0 = No GPS)

cluster_settings.txt

Stores cluster settings, which can be configured by the user

Ex. 3 15

These values represent the following controls in this order:

Number of principal components to use
 Number of clusters

interpolation.txt

Stores interpolation settings, which can be configured by the user.

Ex. 0.100 1.000 2.000 1.000 15.000 0.000 3.000

These values represent the following controls in this order:

Depth increments (probe mode only)
 Sample points longitude column

Sample points latitude column
 Spectra latitude column
 Spectra depth column (probe mode only)

ports.txt

Stores ports and baud rates from previous time system was run.

ref_wavelengths.txt

Stores values of the useable wavelengths for each spectrometer, which can be configured by the user. These wavelengths will be used to filter the data.

Ex. 450.000 950.000 1150.000 2150.000

These values represent the following controls in this order:

Ocean Optics minimum usable wavelength
 Ocean Optics maximum usable wavelength
 Hamamatsu minimum usable wavelength
 Hamamatsu maximum usable wavelength

probe_xform.txt

Stores latest transform.

wlc *.txt

Stores Hamamatsu calibration coefficients these are provided by Veris.

xform_settings

Stores settings for creating transforms, which the user can configure.

Ex. .075

This value represents the maximum allowed RMSE, when comparing the previous transform to the current transform.