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**Dual Optical Ultra-Wide Band Laser
Eyewear Transmission Field Evaluation
Device
OPERATION MANUAL**

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1.0 INTRODUCTION

Dual Optical Ultrawide-Band Laser Eyewear Transmission (DOUBLET) Field Evaluation Device was developed by POC to meet the Air Force need for a simple device to measure the optical density (OD) of laser eye protection (LEP) spectacles, goggles, and visors with the OD 0 to 5, a precision of ± 0.1 OD at OD=1 and ± 0.5 at OD=5, across the VIS-NIR (400 nm to 1400 nm) spectral range. DOUBLET does not use wavelength scanning technology, so it can perform a nearly instantaneous measurement of the OD spectrum of laser eye protection (LEP).

2.0 PRECAUTIONS

The DOUBLET spectrometer incorporates sensitive optical and electronic equipment. Do not subject the device to harsh treatment such as excessive vibrations.

3.0 DOUBLET Software

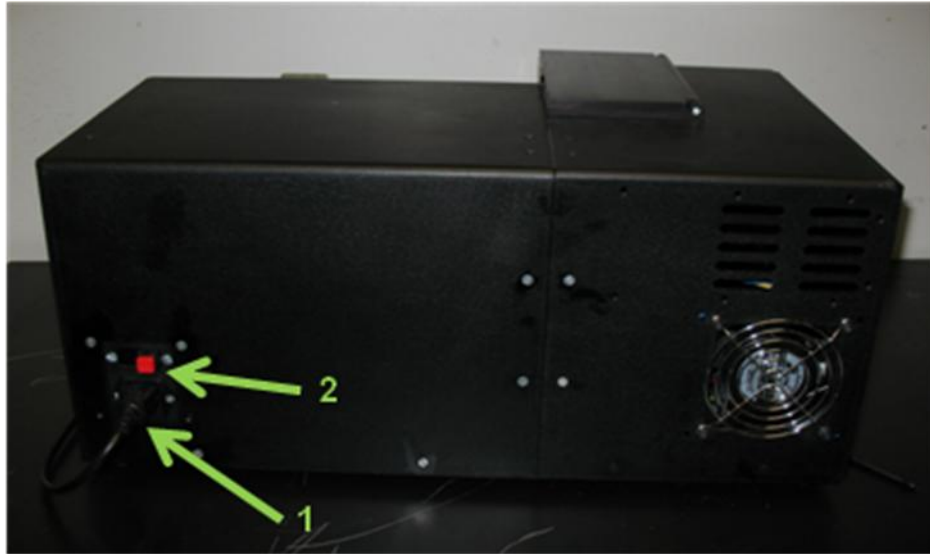
3.1 Switching the DOUBLET Spectrometer On and Off

To switch on the DOUBLET spectrometer:

- 1) Connect the power cable to the wall power outlet (see Figure 1a);
- 2) Press momentarily the red button on the back of the device (Figure 1a); this will start the main power supply and air fan;
- 3) Gently push the slider in the front of the DOUBLET (Figure 1b) momentarily to the right; this will start the DOUBLET computer;
- 4) Wait until the computer loads the operation system completely and start the DOUBLET application (see the following text)

To switch the DOUBLET spectrometer off:

- 1) Shut off the DOUBLET application; this will automatically switch off the light source if it was on;
- 2) Switch off the computer;
- 3) Momentarily press the red button on the back of the spectrometer; this will switch off the fan and the electricity to the spectrometer; the battery of the DOUBLET power supply will be still charging if the device is plugged into the power outlet.



(a)



(b)

Figure 1 Switching on the DOUBLET spectrometer. (a) The rear view of the spectrometer: 1- power cable connection; 2 – momentary on/off button; (b) front view of the spectrometer: to power the computer gently slide the switch to the right

3.2 Working with the DOUBLET Software

Before starting the DOUBLET application, make sure that the Windows operating system has finished loading. Otherwise, the DOUBLET application may start before the operating system recognizes the attached hardware and will not be able to access it. The executable file of the DOUBLET application is in the “c:\DOUBLET\” folder. To start the DOUBLET application the user can double click on the DOUBLET application icon placed on the desktop (Figure 2). This will invoke the logon window (Figure 3). The user must enter the user name and a password.

The current version of the DOUBLET software implements only the demonstration version of the logon. Currently it supports two users: 1) Username “Mark”, password “123” – with full access rights; 2) Username “Lot”, password “123” – with restricted access rights. In the current

demonstration version, if the user enters a different name or password the application will show a dialog window and display the required usernames and password.

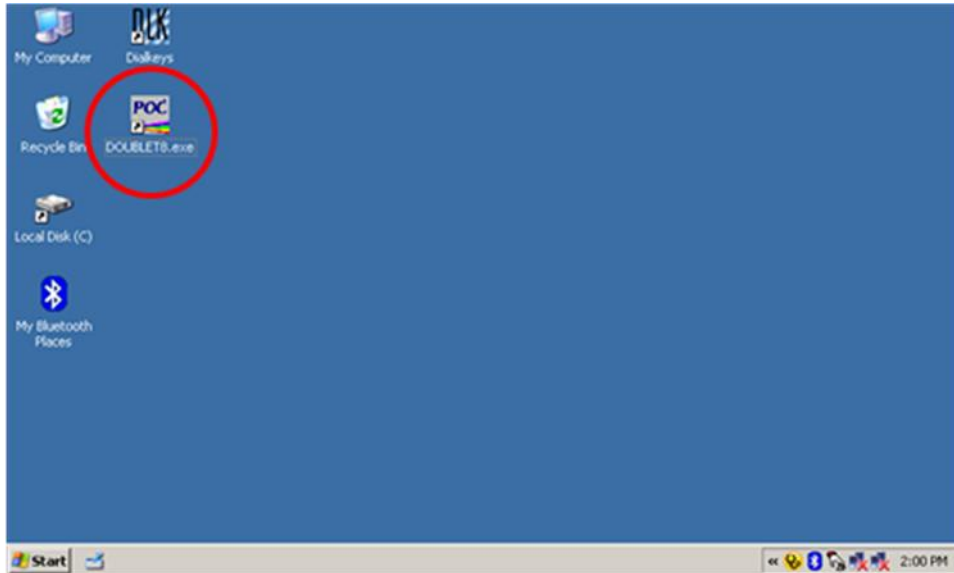


Figure 2 Starting the DOUBLET application – double click on the DOUBLET icon placed on the desktop

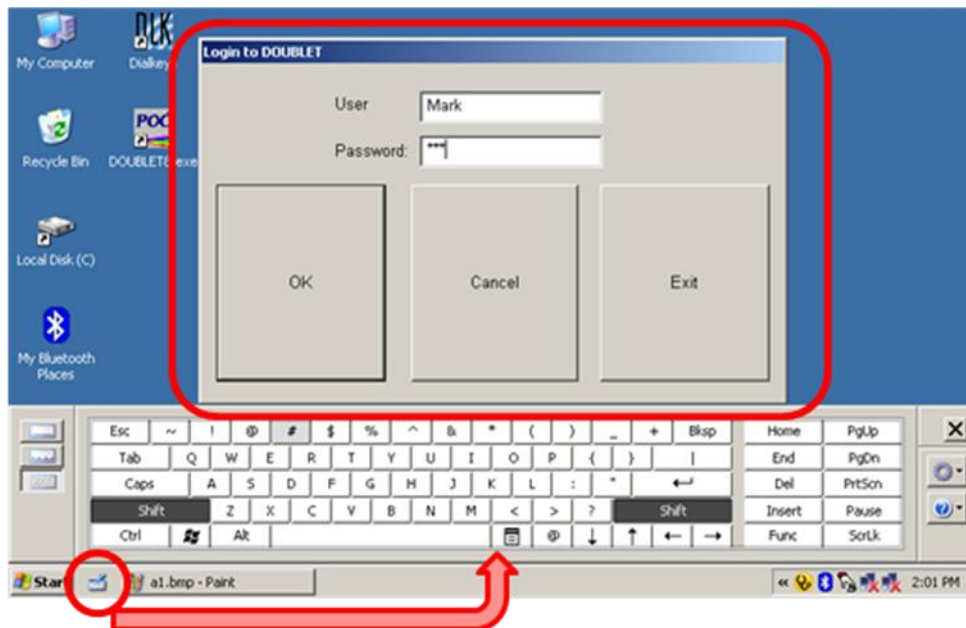


Figure 3 DOUBLET logon

In order to enter the alphanumeric information into the dialog windows the user can click on the virtual keyboard icon (shown in red circle in Figure 3) situated on the main Windows toolbar.

After the successful logon, the main window of the DOUBLET application will be displayed (Figure 4). Nine buttons at the top of the window allow the user to perform the main functions. From left to right, the first button is “Exit,” which causes the controlled exit from the DOUBLET application; this will automatically switch off the light source if it was switched on. The second button, “Log Out,” allows the current user to log out and will return to the logon screen. The DOUBLET application will still be running in this case. The “Lamp” button switches the DOUBLET lamp on and off. The “Shutter” button allows manual control of the DOUBLET mechanical shutter. The “OD” button opens the window that supports the data acquisition of new spectra for the test article. The “I” button opens a window with information on the internal hardware of the DOUBLET. The “P” opens the dialog window that allows the user to manually set the parameters for data acquisition. The “Input” button allows the user to monitor the current input of the spectrometer. The “View” button allows the user to view previously saved data. More detailed information on the operations performed by these buttons in the DOUBLET main window will be provided as this manual describes the process of making a measurement.

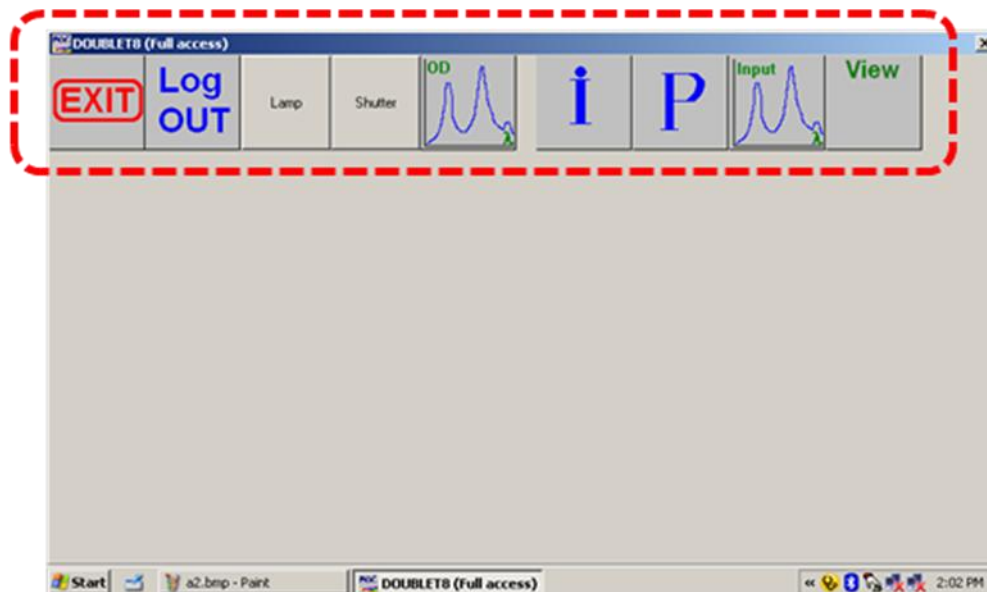


Figure 4 DOUBLET main window in the full access mode

After the DOUBLET application is started, the user must switch on the lamp source of the DOUBLET by pressing the “Lamp” button. Because it takes some time for the DOUBLET lamp source to stabilize, the lamp source should be turned on for at least 30 minutes prior to making the first measurement.

Clicking on the “OD” button will invoke the “Measure OD” dialog window (Figure 5) which supports the procedure for measuring the optical density. Initially, only two top buttons are enabled: the “0. Start new measurement” and the “Cancel” buttons (their functions are self

explanatory). Pressing the left button will start the data measurement sequence that includes the following steps:

- 1) Input of the scan code and notes
- 2) Selection of the data acquisition parameters
- 3) Reading the dark signal spectrum (signal from the detectors when the source is off)
- 4) Reading the lamp source spectrum
- 5) Acquiring the LEP sample spectrum
- 6) Calculation of the optical density
- 7) Saving the acquired data

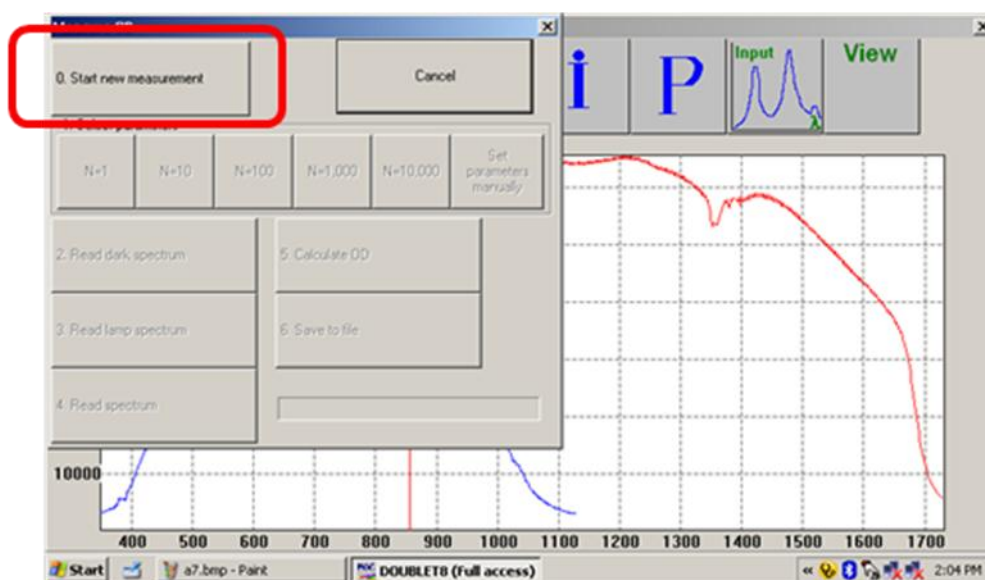


Figure 5 Measurement of the optical density with the “Measure OD” window

The acquisition sequence is enforced by sequential enabling of the buttons of the next step in the procedure. At the same time, any previous steps in the sequence can be repeated and re-measured if needed.

To begin the optical density measurement sequence, click on the “0.Start new measurement button” (Figure 5). This will display the “Scan Code and Notes Input” window (Figure 6). Here the user has the option of entering a code for the LEP to be evaluated and/or plain text notes relevant to the measurement, which will be stored together with the measured spectrum data. Pressing the “OK” button will close the window and will allow the user to proceed to the next step of the sequence by enabling the “1. Select Parameters” radio buttons (Figure 7). The first five radio buttons set the number of spectra that will be measured and averaged during the measurement (N=1, 10, 100, 1000, and 10000). The acquisition time for a single spectrum is set to 10 ms. The last radio button “Set parameters manually” will open the “Acquisition

Parameters” window (Figure 8); the same window can be also opened by clicking on the “P” button in the main application window. This window allows setting the integration time for the

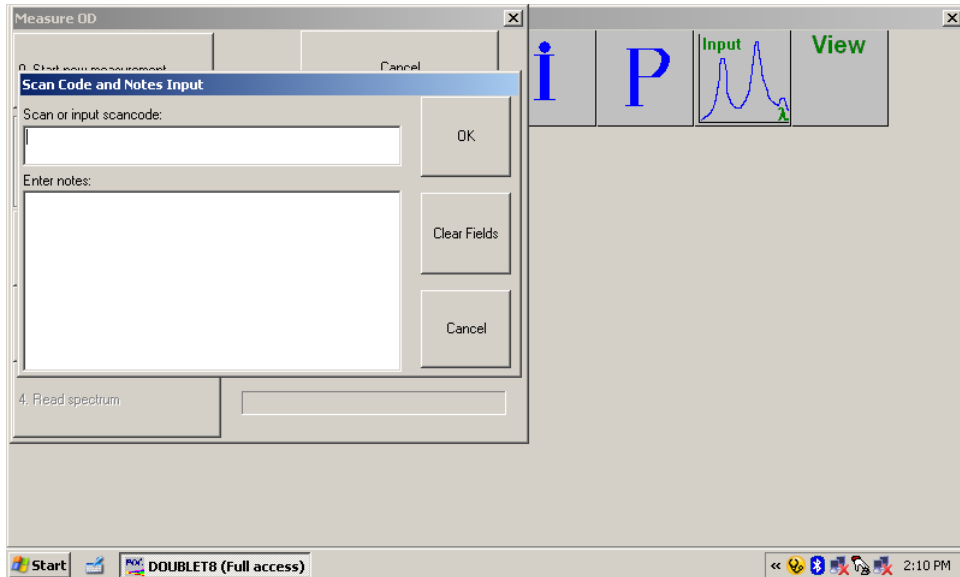


Figure 6 “Scan Code and Notes Input” window

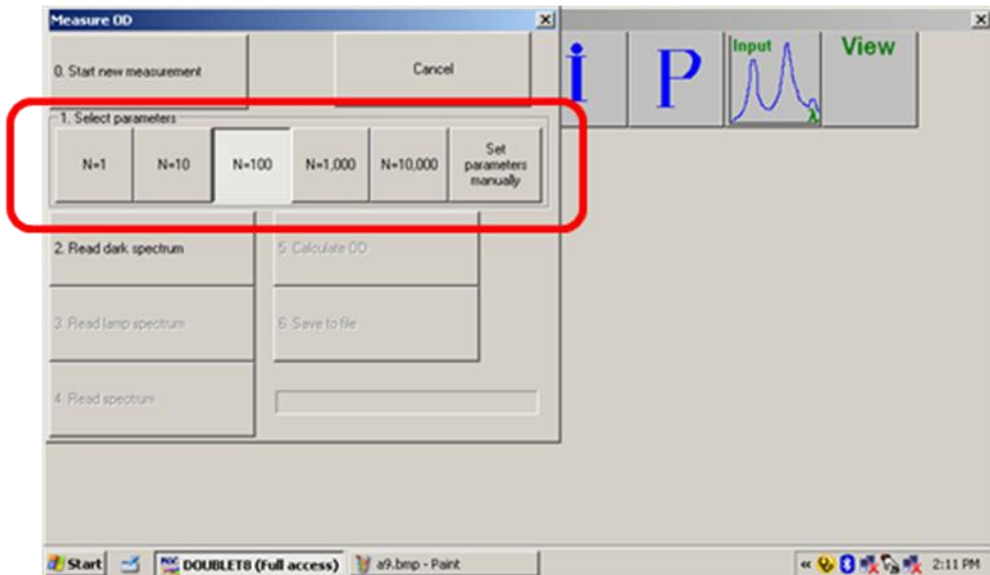


Figure 7 Selection of the acquisition time for the measurement

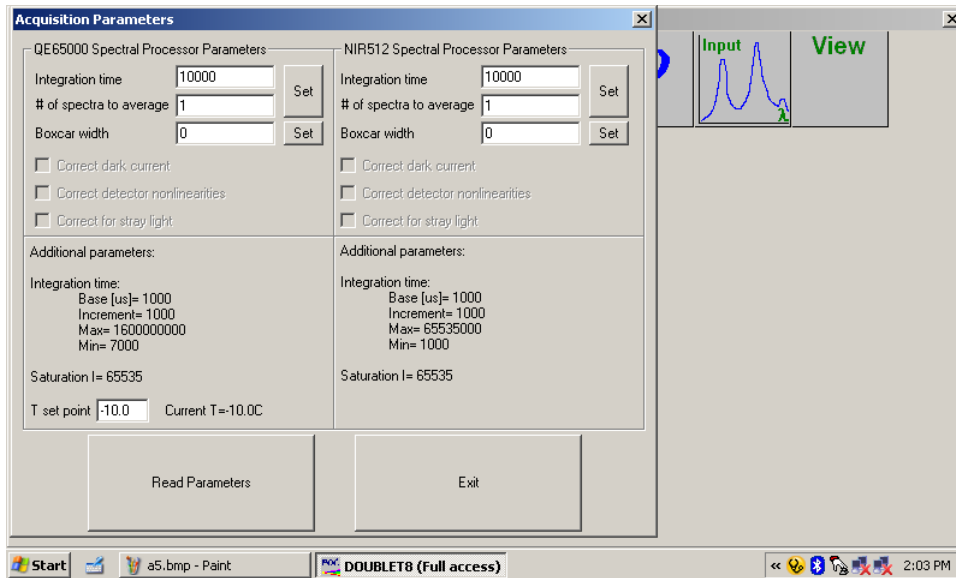


Figure 8 Setting acquisition parameters for the DOUBLET hardware

visible and infrared spectrometers. The integration time is measured in μs and the minimal set time is 10,000 μs ; i.e. the light source nearly saturates the detector at its shortest acquisition time. Access to this parameter is allowed in the full mode because the ability to change the acquisition time may be useful when replacing or adjusting the light sources. Changing this parameter blindly is not recommend since acquisition times longer than 10 ms will saturate the detectors during the measurement. It is better to change the total acquisition time by changing the number of spectra in the “# of spectra to average” edit box, instead of changing the integration time. In

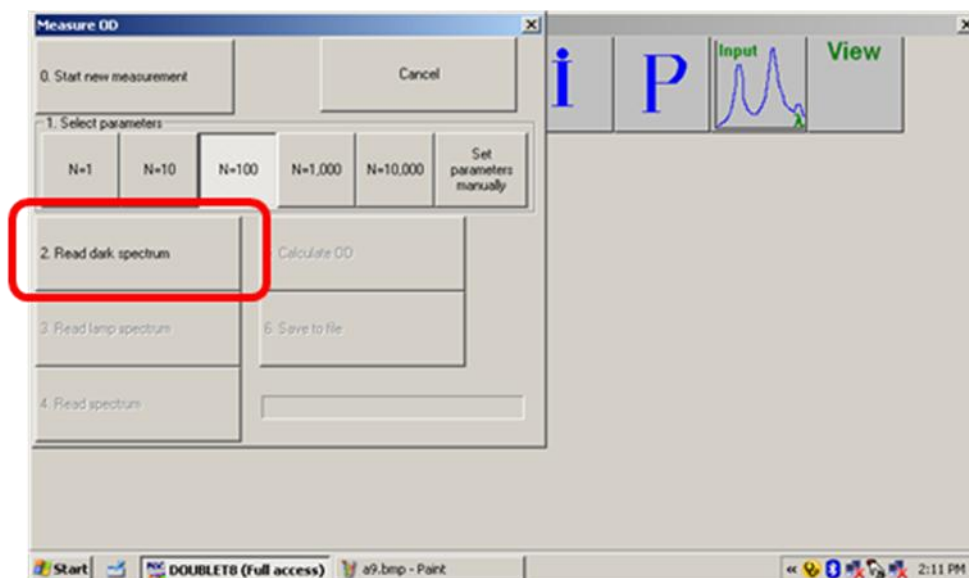


Figure 9 Acquisition of dark spectrum the restricted mode the user will not have access to this parameter

The last parameter, the “Boxcar width,” allows smoothing the spectra by applying a running averaging process over several adjacent points. Whenever a new value for any of these parameters is entered, the user must press the “Set” button to the right of the edit control.

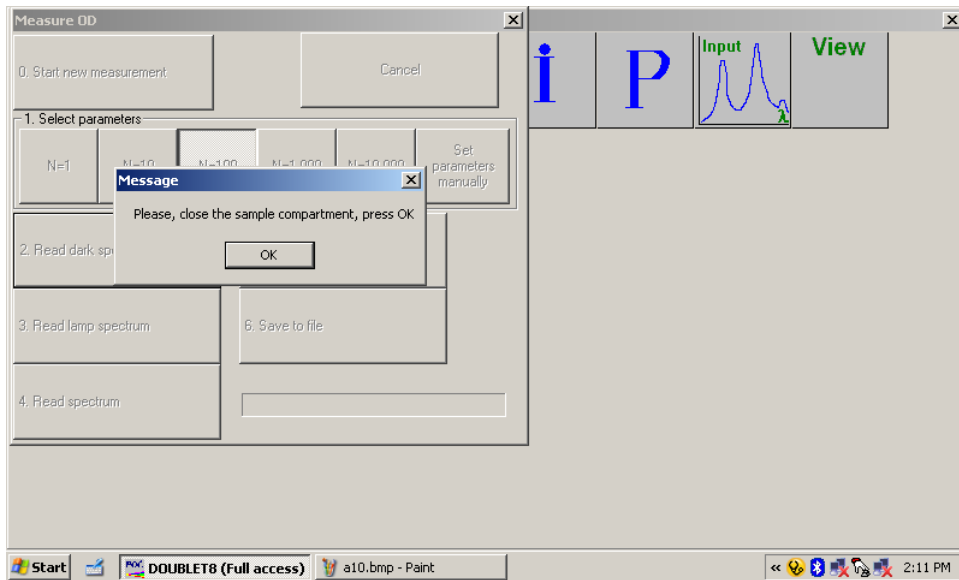


Figure 10 Message box appears just before the dark spectrum will be measured

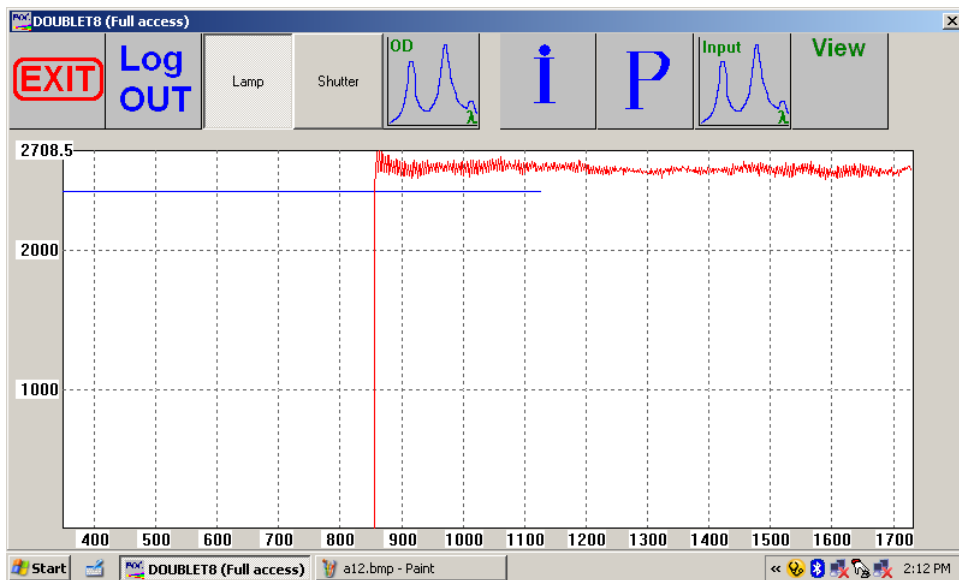


Figure 11 Example of the acquired dark spectra

Once the acquisition parameters are set, the “2. Read dark spectrum” button becomes available (Figure 9). Clicking this button will invoke the message box (Figure 10) asking the user to close the sample compartment. The user must ensure that the sample compartment does not contain any previous samples and close the compartment lid. Pressing the “OK” button will initiate the

acquisition of the dark spectra. During the acquisition, all buttons in the “Measure OD” window are disabled; they are re-enabled once the spectra are acquired. After the dark spectra are acquired, the user can close the “Measure OD” window and inspect the spectra (Figure 11). Clicking on the “OD” button in the main window returns you to the “Measure OD” dialog window.

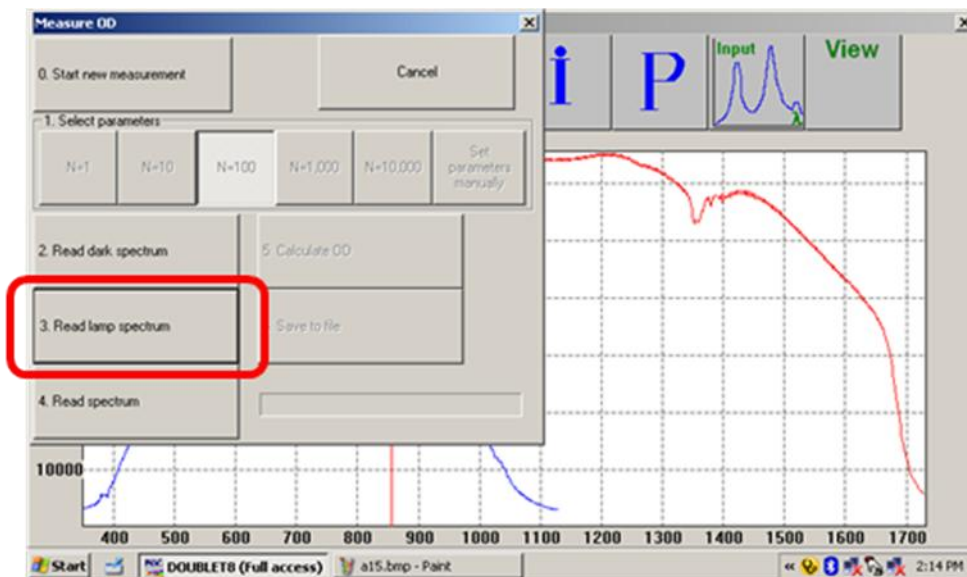


Figure 12 Reading the lamp spectrum

Next, the user clicks on the “3. Read lamp spectrum” button (Figure 12). The shutter will be opened automatically and the lamp spectra will be read (Figure 13). At this time the user must insert the sample into the sample compartment, making sure that the sample to be measured completely covers the light beam aperture and that other parts of the sample (e.g. temple piece on a spectacle) do not obstruct the path of the light beam. Then close the lid and press the “4. Read spectrum button”. This will invoke a message box (Figure 14). Press “OK” to start the data acquisition. After the spectrum is acquired, it can be inspected (Figure 15). To calculate the optical density, press the “5. Calculate OD” button (Figure 16 and Figure 17).

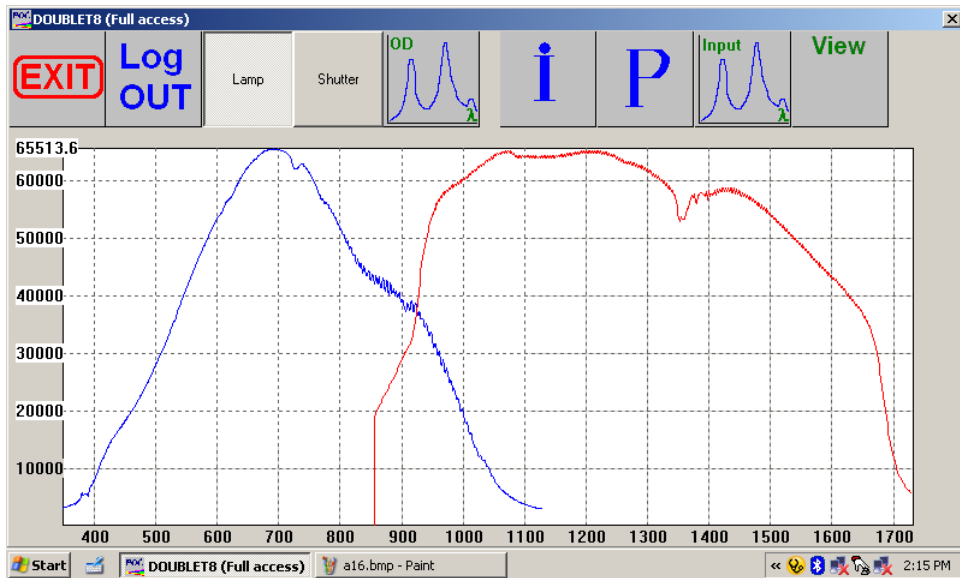


Figure 13 Example of the acquired lamp spectra

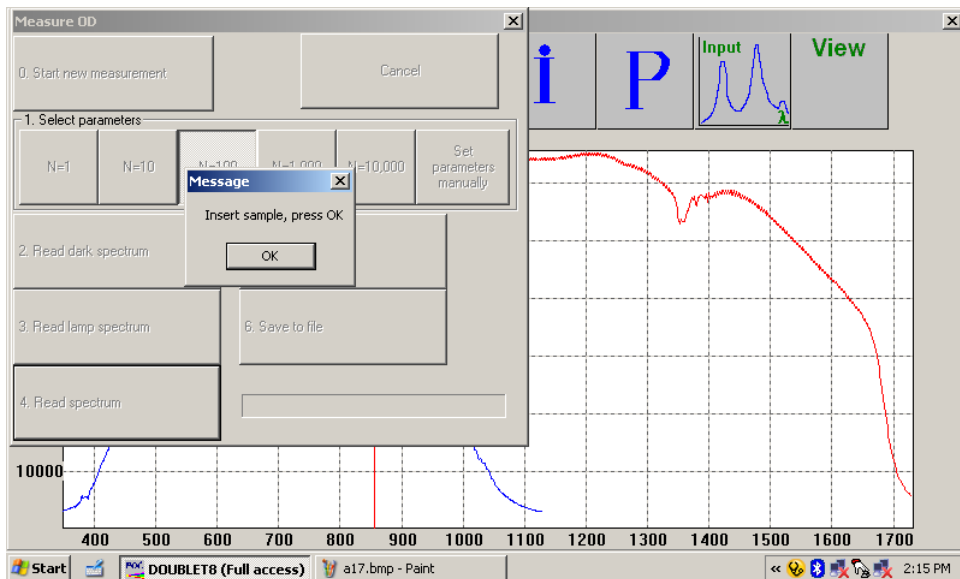


Figure 14 Message box appears after pressing “4. Read spectrum button”

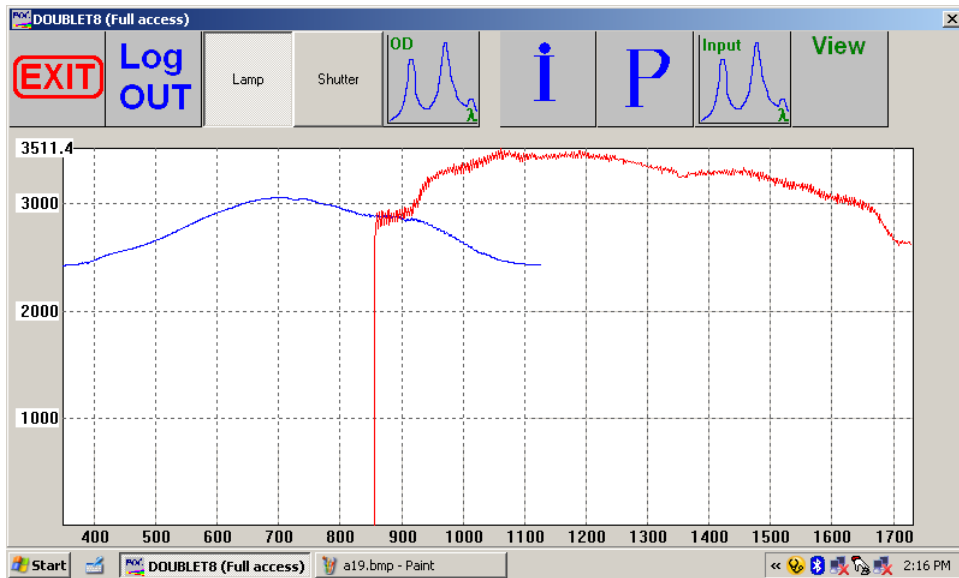


Figure 15 Example of the sample spectrum

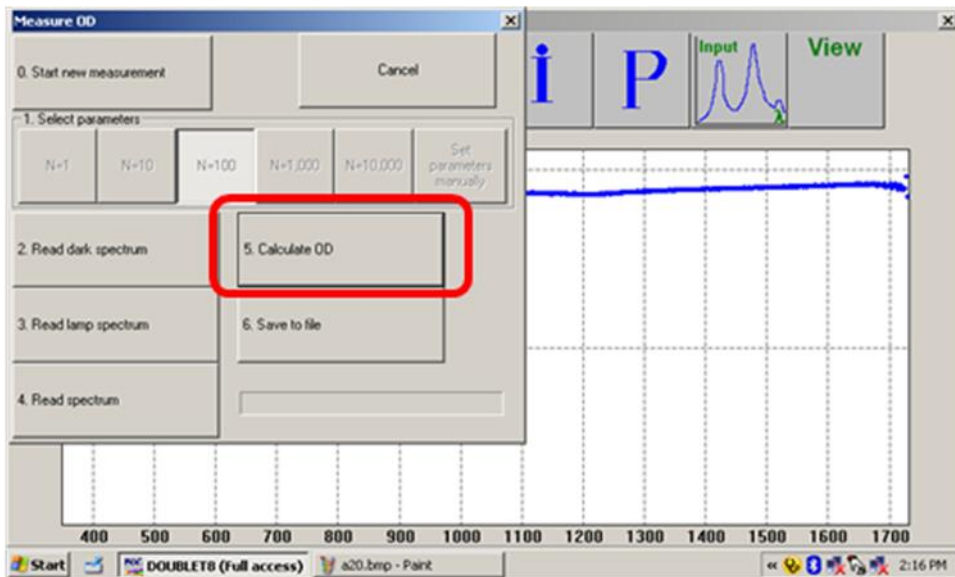


Figure 16 To calculate the optical density press the “5. Calculate OD” button

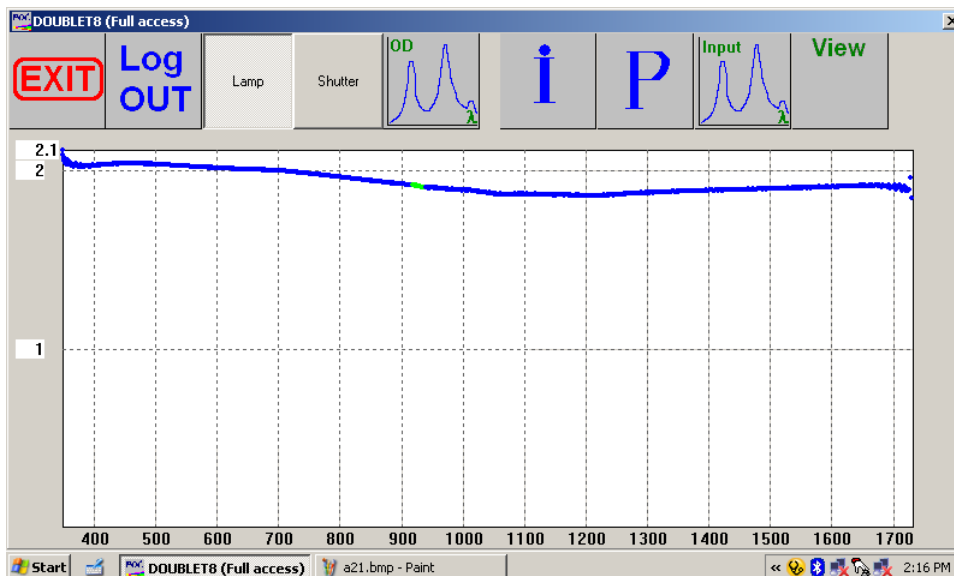


Figure 17 Example of calculated optical density

To save the data press the “6. Save to file” button; this will open the standard “Save As” dialog (Figure 18). The user can select the folder in which the files will be written and the file name. The acquired data will be saved as a set of files. The information about the measurement will be saved in a “name_info.txt” file (Figure 19). The raw data from the measurement will be also saved in:

“name_vis-D.dat”	“name_nir-D.dat”	← Dark spectra in visible and infrared regions
“name_vis-L.dat”	“name_nir-L.dat”	← Lamp spectra
“name_vis-S.dat”	“name_nir-S.dat”	← Sample spectra
“name_vis-OD.dat”	“name_nir-OD.dat”	← OD spectra
and “name_OD.dat”		← stitched OD spectrum.

To view the saved data at some later time, press the “View” button in the main window to bring up the “Open” file dialog box (Figure 20). The user can then select any file that starts with the desired name. Pressing on the “Open” button will display the “Select data to show” dialog box (Figure 21). The data can be viewed by selecting the appropriate button (see Figure 22 through Figure 25).

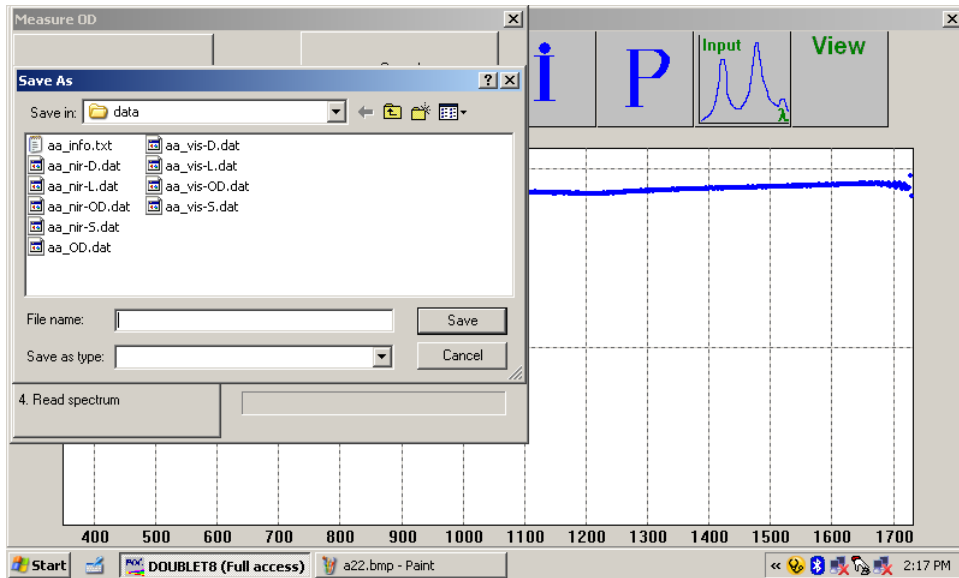


Figure 18 Saving the measurement results

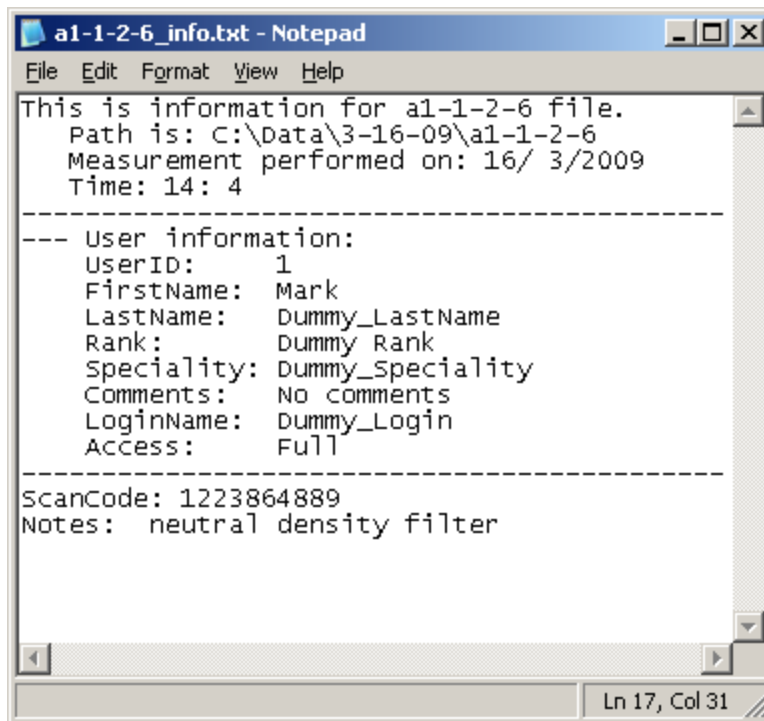


Figure 19 Example of the information saved after measurement in "name_info.txt" file

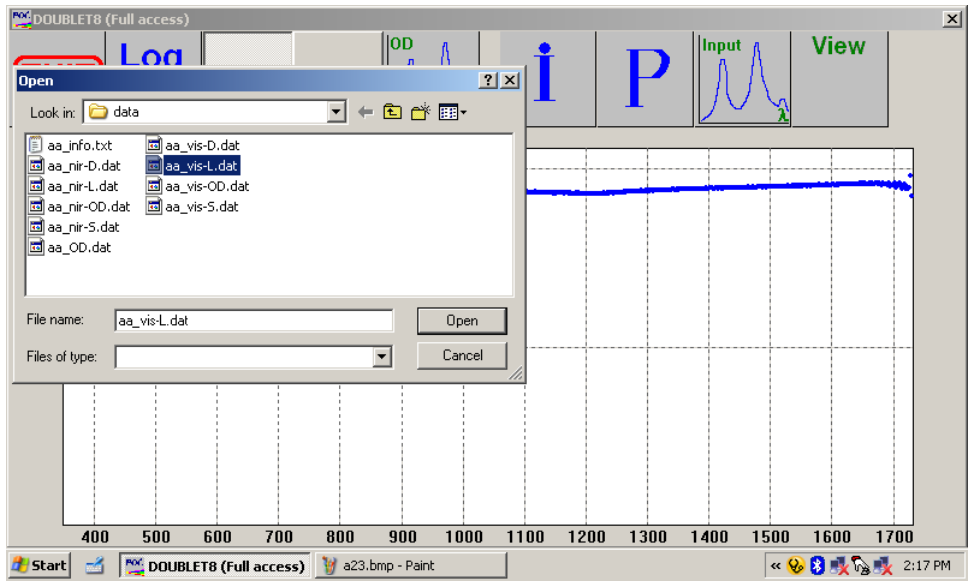


Figure 20 "Open" file dialog to select the data to view

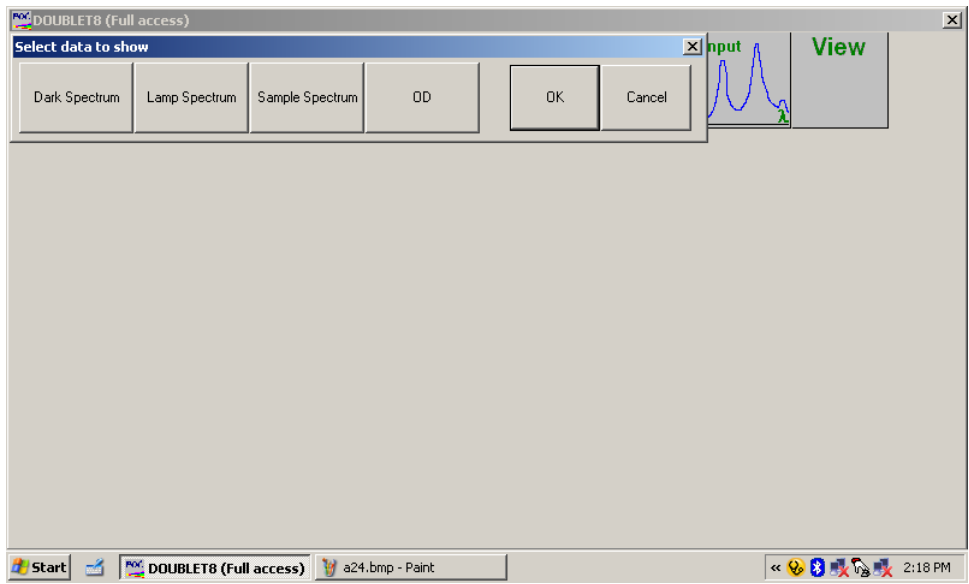


Figure 21 Viewing the previously saved data

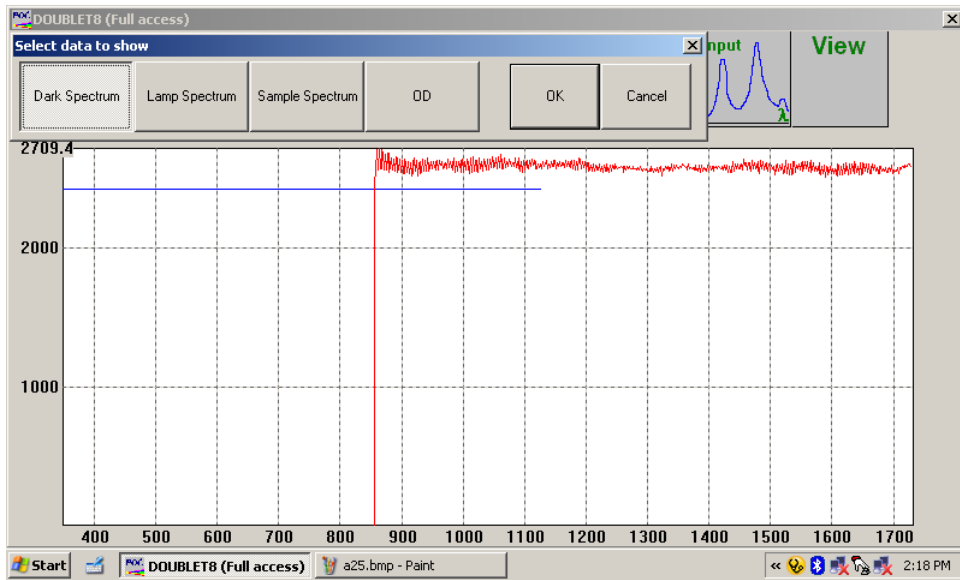


Figure 22 Viewing the previously saved dark spectrum

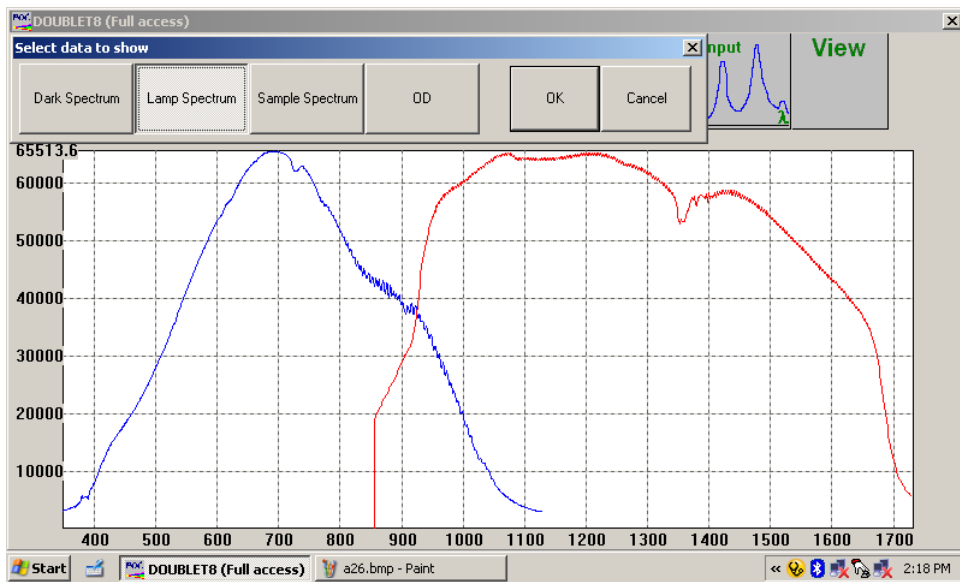


Figure 23 Viewing the previously saved lamp spectrum

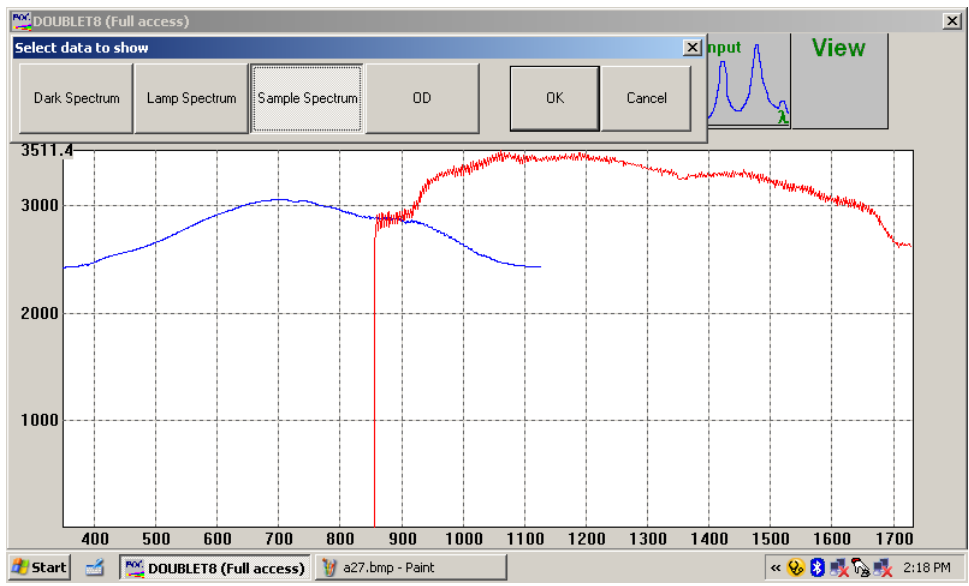


Figure 24 Viewing the previously saved sample spectrum

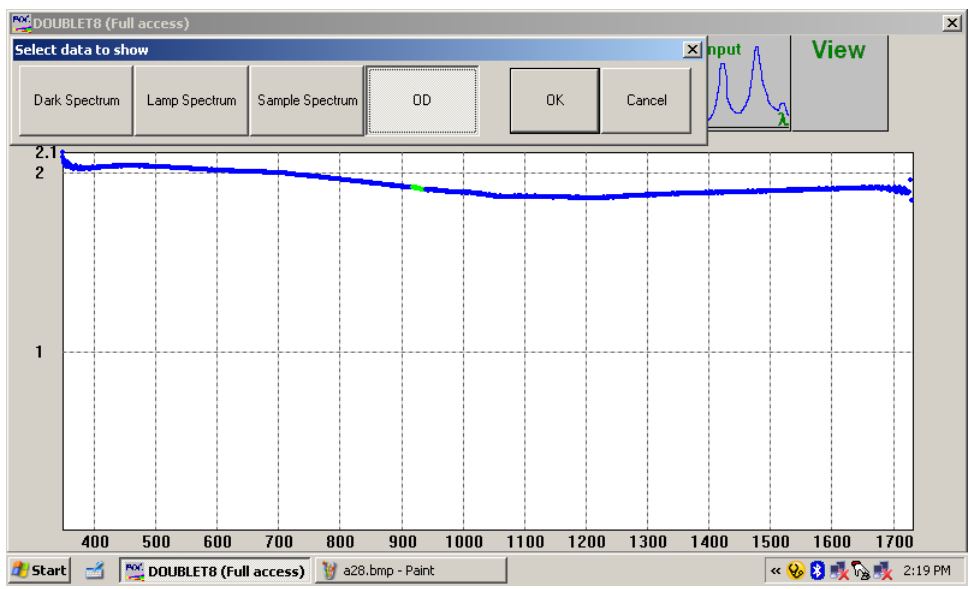


Figure 25 Viewing the previously saved optical density spectrum