Mini Spectrometer User Guide

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About the Mini Spec App

The application for the Mini Spectrometer (Mini Spec App) is licensed under GNU, granting users the freedom to modify it and distribute their own versions. Feel free to edit, improve and share your customized version without restrictions.

The application is written in Python 3. To run it, you will need the following additional Python 3 libraries: Matplotlib and PySerial. Other libraries are either included in the standard Python 3 package or delivered with the Mini Spec App files.

How to Begin

1. Turn on the PC.

2. Connect the Mini Spectrometer to the PC using a USB cable.

3. The spectrometer will indicate readiness by blinking the green LED twice.

4. Navigate to the directory where you have stored the mini spec app python files.

5. Identify the COM Port Used by the Mini Spectrometer:
   - On Windows, open the Device Manager and navigate to *Ports (COM&LPT)*. Find *USB Serial Port (COM 3)* or a similar entry. Note the COM port number (e.g., COM3).

- On Linux, open the terminal and execute the command *dmesg | grep tty*. Look for a line like "*FTDI USB Serial device converter now attached to ttyUSB0*." Note the port name (e.g., ttyUSB0).

6. Set COM setting into the settings file *mini_settings.py*:
   - Open the mini_settings.py file.
   - For Windows, set *comport_name = "COM3"* (replace with the actual COM port number).
   - For Linux, set *comport_name = "/dev/ttyUSB0"* (replace with the actual port name).
   - Save the modified *mini_settings.py* file.

7. Set calibration coefficients into the settings file *mini_settings.py.* Locate the correct calibration coefficients in the device registration document.
   - Open the mini_settings.py file.
   - Locate and edit the values of the calibration coefficient variables (e.g., *calib_a0, calib_b1*) to match the values specified in the registration document.
   - Save the changes made to the *mini_settings.py* file.

8. In that directory open the terminal (Linux) or Command Prompt (Windows) or PowerShell (Windows).

9. Execute command ***python mini_main.py*** (If your system has both Python 2 and Python 3 installed use command ***python3 mini_main.py***).

10. Following text will appear on terminal or command prompt:

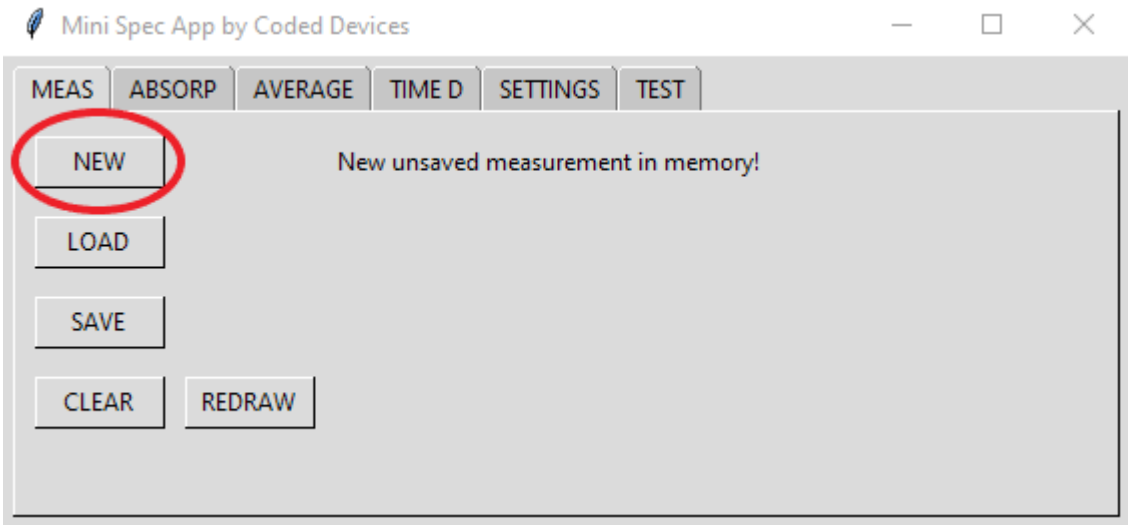
```
*** Mini Spec ***
Copyright (c) 2024 Coded Devices Oy
PC Software version 2024-3-28
Connecting to hardware...

Firmware version : 1.0.3.1
Source intensity : 5
```

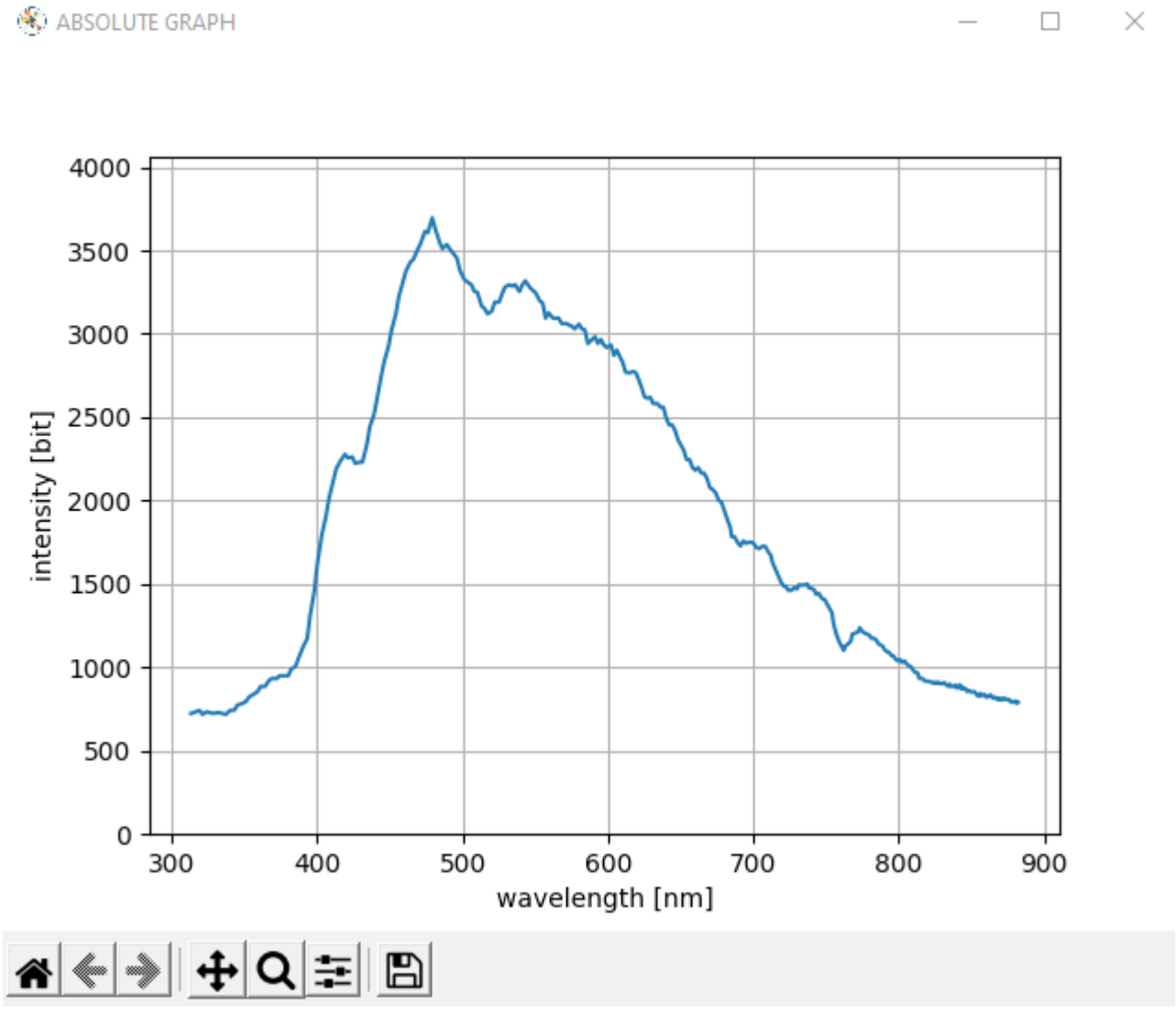
And the Mini Spec App control panel opens on the screen. You are ready to start.

How to Record a Spectrum

On the *MEAS* page, press the *NEW* button.



After about three seconds a newly recorded spectrum will appear in the *ABSOLUTE GRAPH* window. Below is an example of daylight spectrum measured indoors.



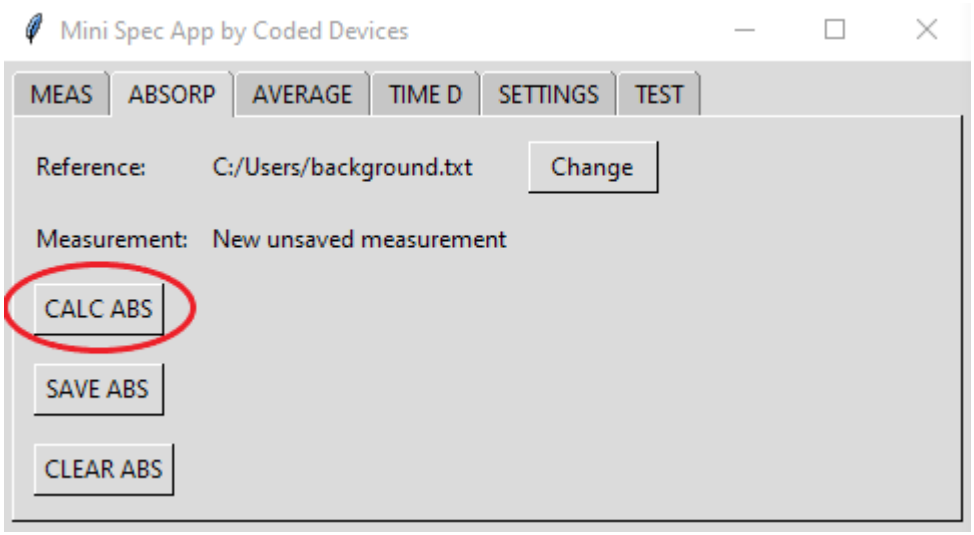
Now, you can decide whether to save the spectrum into a file, add it to an average spectrum, or use it in an absorption calculation.

How to Calculate a Relative Absorption

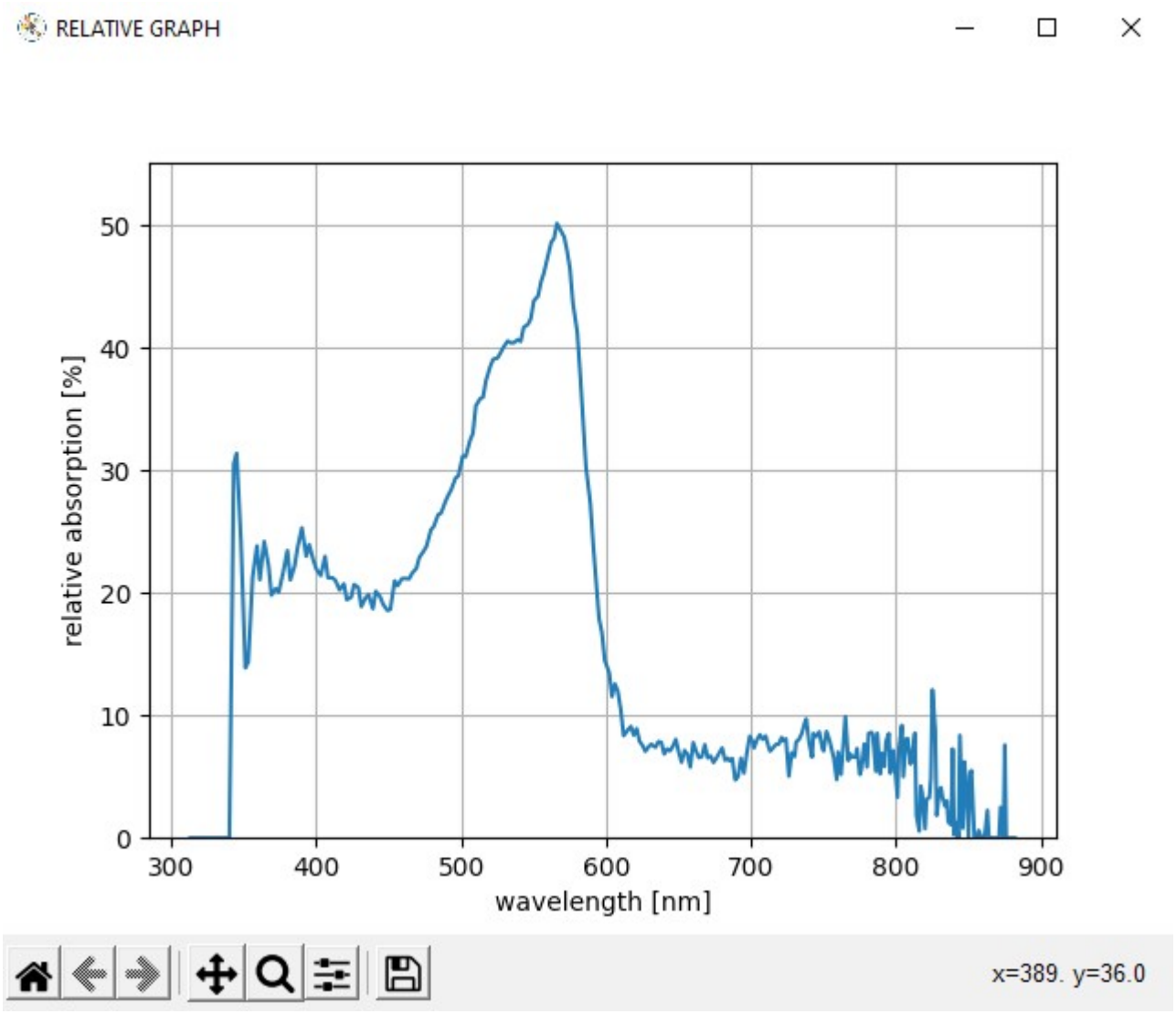
First, you need a reference spectrum that lacks absorption in the region of interest. Then, you measure a spectrum that shows absorption in that region. The relative absorption is calculated pointwise as *(measured[i] – reference[i]) / 100*.

Go to the *ABSORP* page. The file for the reference spectrum is displayed with the label *'Reference'*, while the actual measurement containing the absorption data is displayed with the label *'Measurement'*. The measurement is always the most recent one recorded or loaded on the *MEAS* page.

Press *CALC ABS* to make the absorption calculation, and the relative absorption spectrum will then appear on the screen.

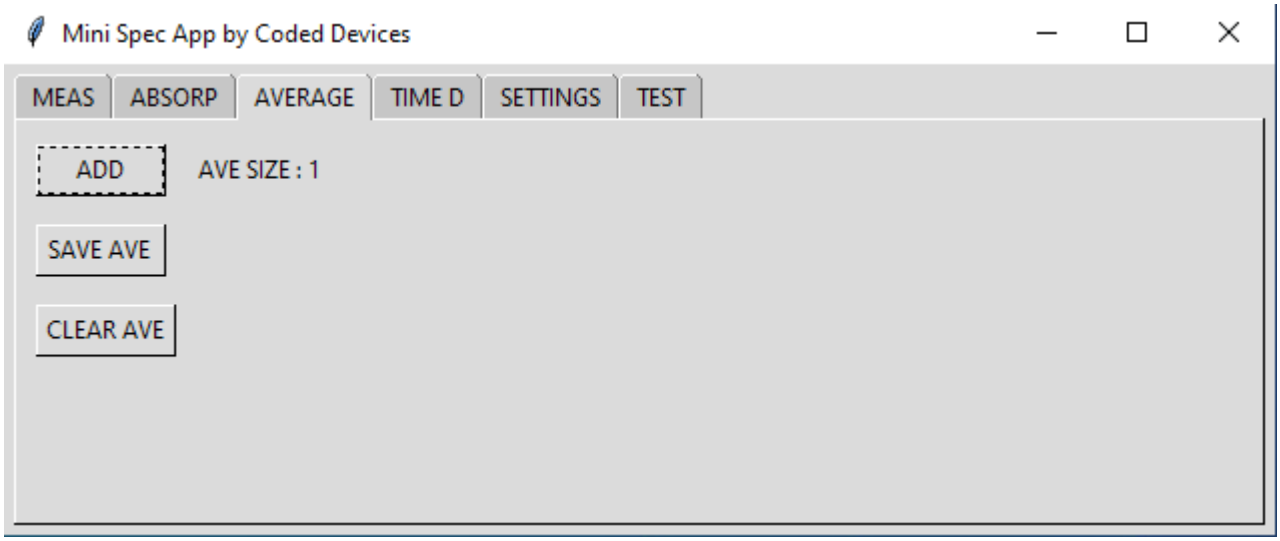


Below is an example of an absorption spectrum of a pink colored plastic film.



You can save the absorption spectrum by pressing the *SAVE ABS* button. To load a saved absorption spectrum, navigate to the *MEAS* page and press the *LOAD* button.

Create an Average Spectrum



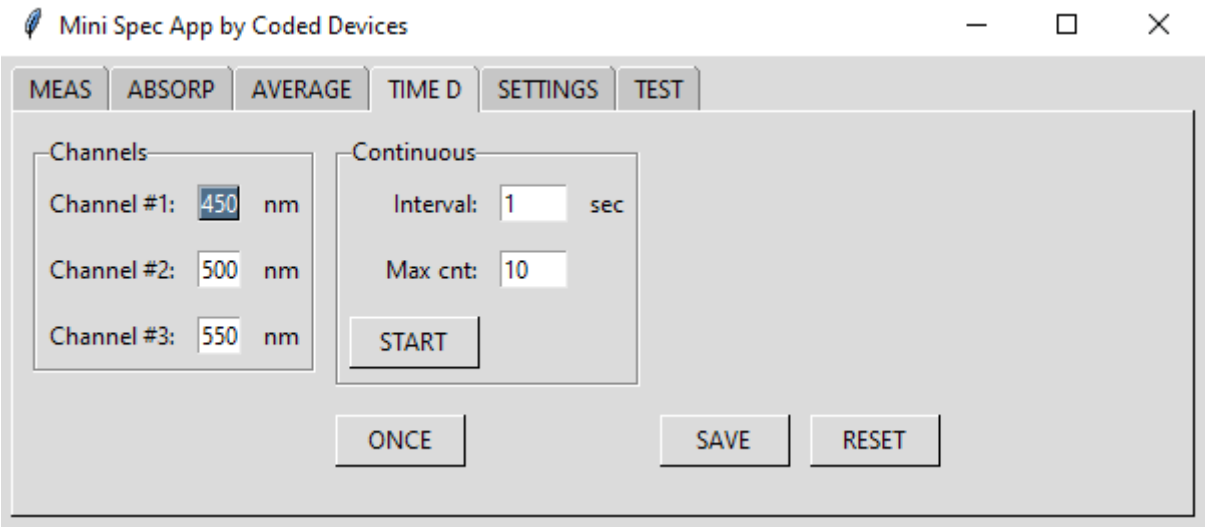
Use several measured spectrums to create an average spectrum. This is a simple method to attenuate noise and other irregularities found in measured signals. It is effective as long as the measuring conditions stay unchanged.

After measuring or loading a new spectrum, open the *AVERAGE* page. There you'll find ADD button, which adds the spectrum currently in the memory into the average. Number of spectrums contributing to the average is shown next to the button.

Once you have created the average you can save it as spectrums normally. Use the button *SAVE AVE*. And if you want to clear the current average and start a new, press *CLEAR AVE*.

To open a saved average spectrum do as with other saved spectrums; go to *MEAS* page and press *LOAD* button.

Time D – what is it?

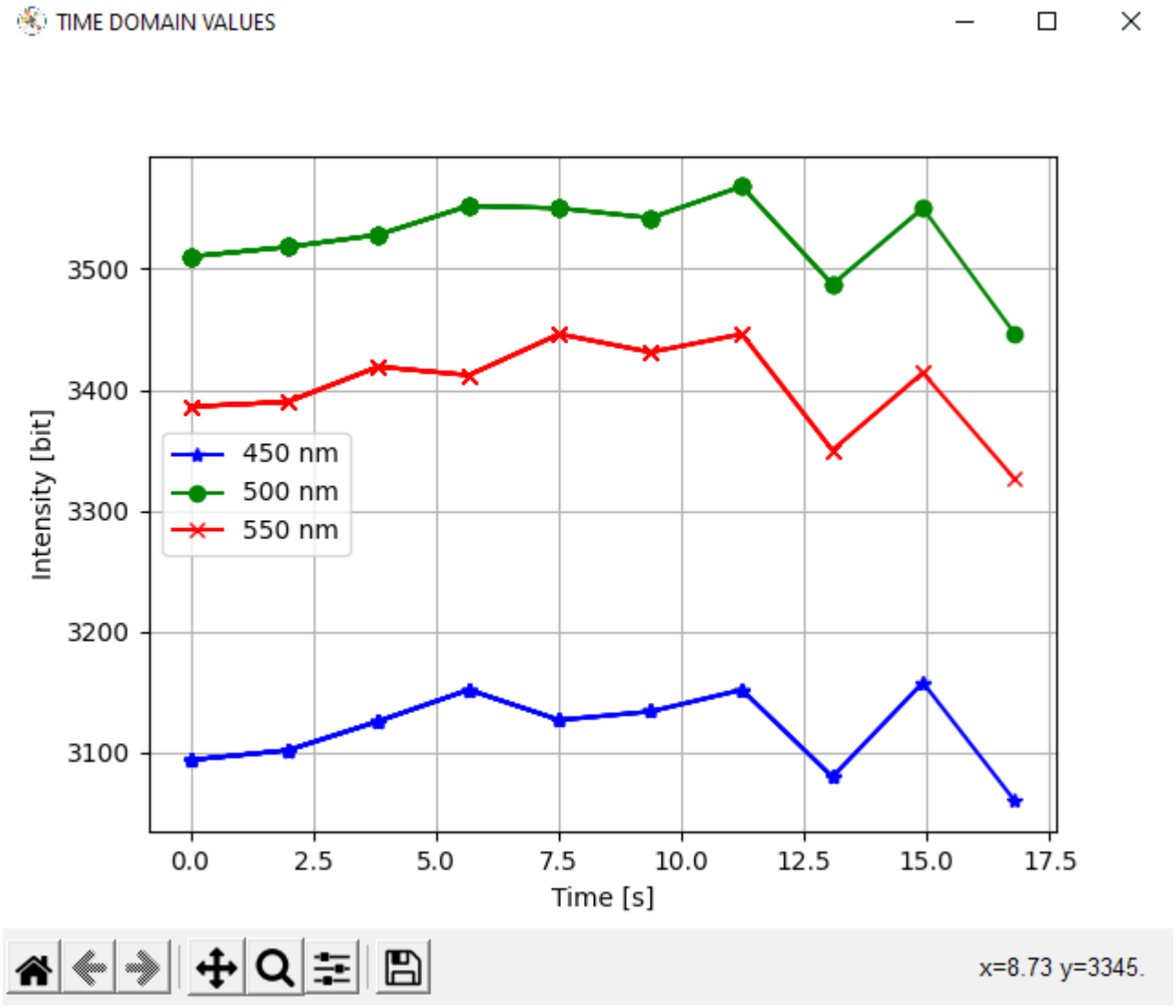


Time D is the page for making measurements in the time domain, specifically generating time series data for selected wavelengths.

Specify the wavelengths you wish to measure to select the three channels. The software will then automatically determine the appropriate channel corresponding to each specified wavelength.

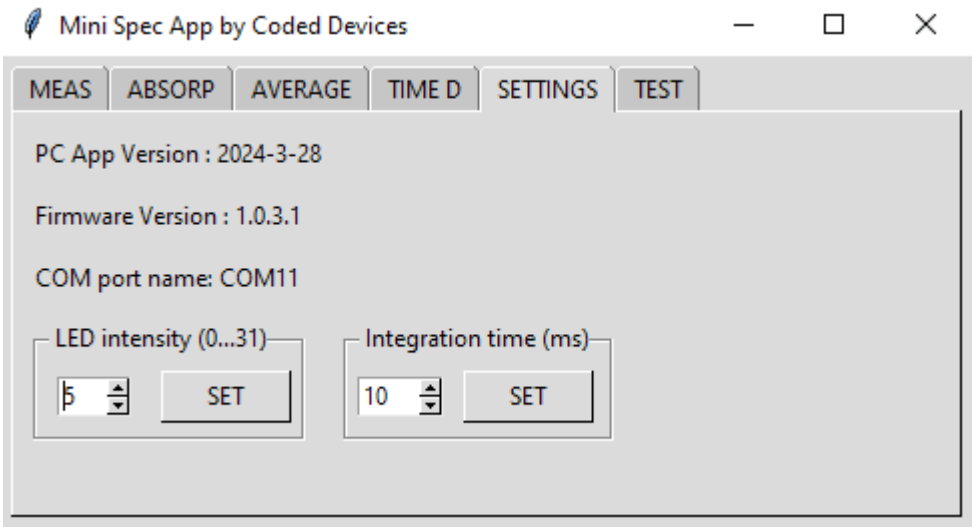
Press *ONCE* button to get one set of readings from the selected channels.
Press *START* to initiate the collection of the defined number of sets of readings (*Max cnt*). You can predominantly stop the series measurement by pressing *STOP*.

Below is an example measurement of daylight values of three selected channels measured indoors.


TIME DOMAIN VALUES
Intensity [bit]
3500
3400
3300
3200
3100
450 nm
500 nm
550 nm
0.0
2.5
5.0
7.5
10.0
12.5
15.0
17.5
Time [s]
x=8.73 y=3345.

System Settings

System info and settings can be accessed via *SETTINGS* page.



PC App Version is the value of a version variable in the `mini_main.py` file that serves as the general software version, although other files within the project may have their own distinct versions.

Firmware Version is the version of the firmware currently programmed into the micro controller.

COM port name is the name of the serial port currently used with the Mini Spectrometer. This can be selected in the settings file mini_settings.py.

LED Intensity (0...31) adjusts the output of the LED controller of the Mini Spec board. Max value 31 sets the output to maximum and min value 0 turns the source off.

The Integration time (ms) setting adjusts the integration time of the sensor head, which defines how long the sensor collects photons during a measurement. Dim targets may require a longer integration time for a clear spectrum, while with bright targets, a longer integration time may lead to a saturated measurement.

Testing

The TEST-page is used for different tests and may change often. These tests include examples and quickly created solutions for specific applications. Therefore the documentation of the TEST page may not be up-to-date or correct.