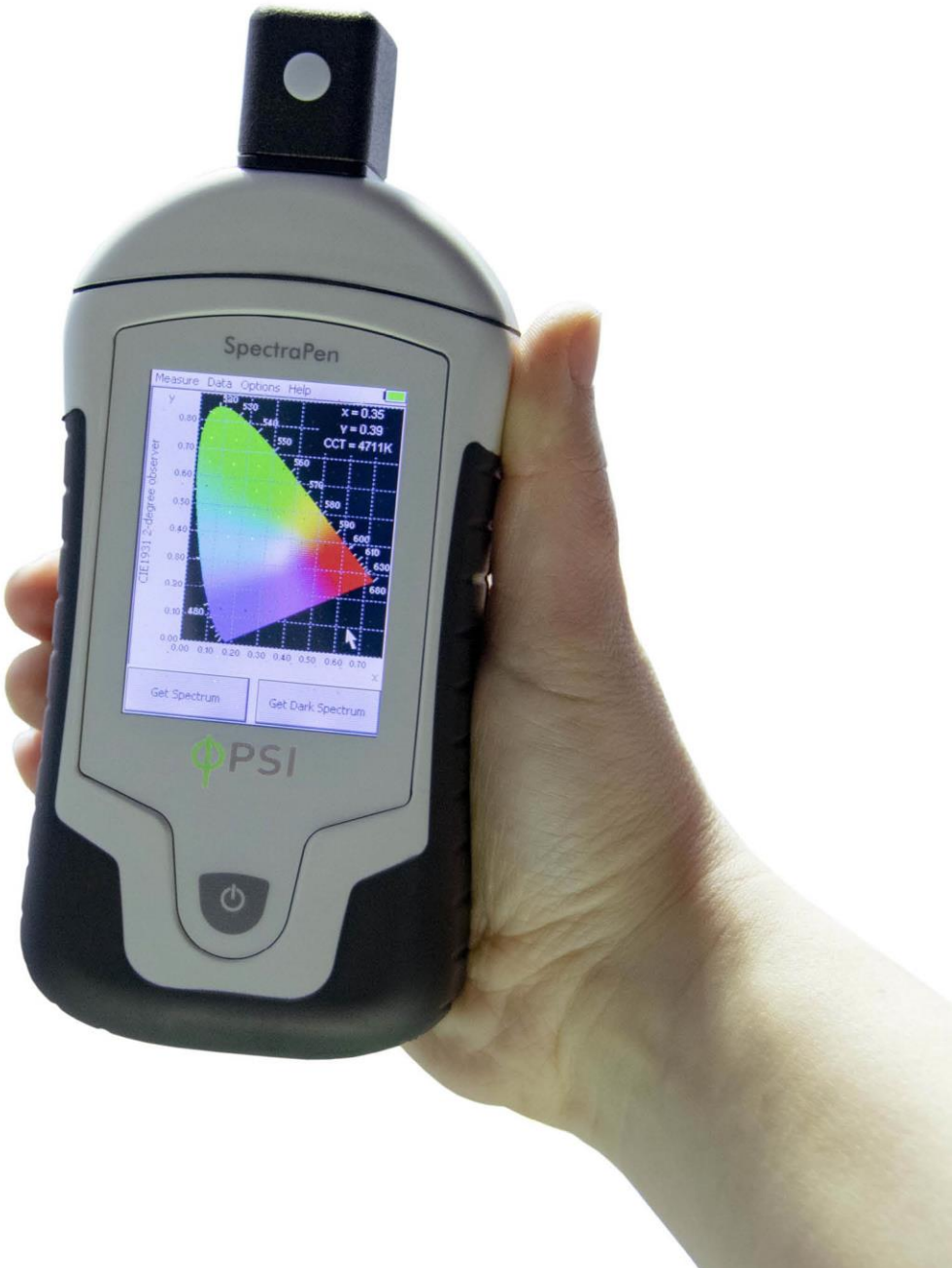
Instruction Guide

PHOTON SYSTEMS INSTRUMENTS

SpectraPen LM 510

Please read the Guide before operating this product



Manual Version: 2025/04

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The contents of this manual have been verified to correspond to the specifications of the device. However, deviations cannot be ruled out. Therefore, a complete correspondence between the manual and the real device cannot be guaranteed. The information in this manual is regularly checked, and corrections may be made in subsequent versions.

The visualizations shown in this manual are only illustrative.

This manual is an integral part of the purchase and delivery of equipment and its accessories and both Parties must abide by it.

TABLE OF CONTENT

1 About this Manual

Read this manual carefully before operating the device. If you are not sure about something in the manual, contact the manufacturer for clarification.

Always follow corresponding manuals while working with the SpectraPen device or doing the maintenance. It is forbidden to interfere with the hardware or software of the SpectraPen device in any way without previous agreement with the manufacturer.

The following table presents basic highlight symbols used in this manual:

Symbol	Description
	Important information, read carefully.
	Complementary and additional information.

Table 1 Used symbols.

2 GENERAL INFORMATION

2.1 DEVICE DESCRIPTION

SpectraPen LM 510 is a handheld portable spectroradiometer that is ideal as a general-purpose instrument for research and for agricultural applications. The built-in rechargeable Li-Ion battery, GPS module and splash-proof case make the device ideal for outdoor use. The device is well suited for wide scope of environmental, agricultural and ecological applications such as monitoring of artificial lighting used in horticulture industry or light source testing.

SpectraPen LM 510 measures in radiometric or photometric units intensity of electromagnetic radiation and is calibrated for visible light in the range of 340 – 790 nm or for radiation in the range of 640 – 1,050 nm. The intensity can be measured qualitatively as a spectrum intensity profile or quantitatively as intensity in a defined range of spectrum. When measuring in visible light the device also measures light color and color temperature parameters.Each SpectraPen device is calibrated with the certified light source AvaLight - DH-BAL-CAL. Spectrapen calibration certificates are provided upon requests from individual customers. The detector integration time can adjust automatically according to the ambient light intensity.When connected to a computer several additional control and data management become available.

The SpectraPen device is switched ON or OFF with the power button (Fig. 1) and is controlled via color touch display and a stylus. The optical sensor on top of the device has two versions: in horizontal version the cosine corrector is on the display side and in vertical version the cosine corrector is on top of the optical head. For recharging or controling the device via computer the device is connected to the connector at the bottom side of the device.

Fig. 1 LM 510-H device description

⚠	The sensor should be always clean and protected when not in use. Any scratches on the surface might interfere with the measurement.

	No sharp objects should be used when operating the SpectraPen via touch screen. It is recommended to use the provided stylus when making selections on the touch screen.

2.2 SpectraPen versions

The UVIS version was designed for measurements in the visible part of the spectrum (range 340 – 790 nm) and the NIR version for spectrum range 640 – 1,050 nm. Depending on the device version the cosine corrector is mounted on the display side of optical head (horizontal version) or on top of the optical head (vertical position).

LM 510-H/UVIS (Fig. 2A)	Horizontal version for use in limited space Cosine corrector is on the display side, wavelength range 340 – 790 nm
LM 510-H/NIR (Fig. 2A)	Horizontal version for use in limited space Cosine corrector is on the display side, wavelength range 640 – 1,050 nm
LM 510-V/UVIS (Fig. 2B)	Vertical version for use in open field or greenhouse with tripod mount Cosine corrector on the top of the optical head; wavelength range 340 – 790 nm
LM 510-V/NIR (Fig. 2B)	Vertical version for use in open field or greenhouse with tripod mount Cosine corrector on the top of the optical head; wavelength range 640 – 1,050 nm

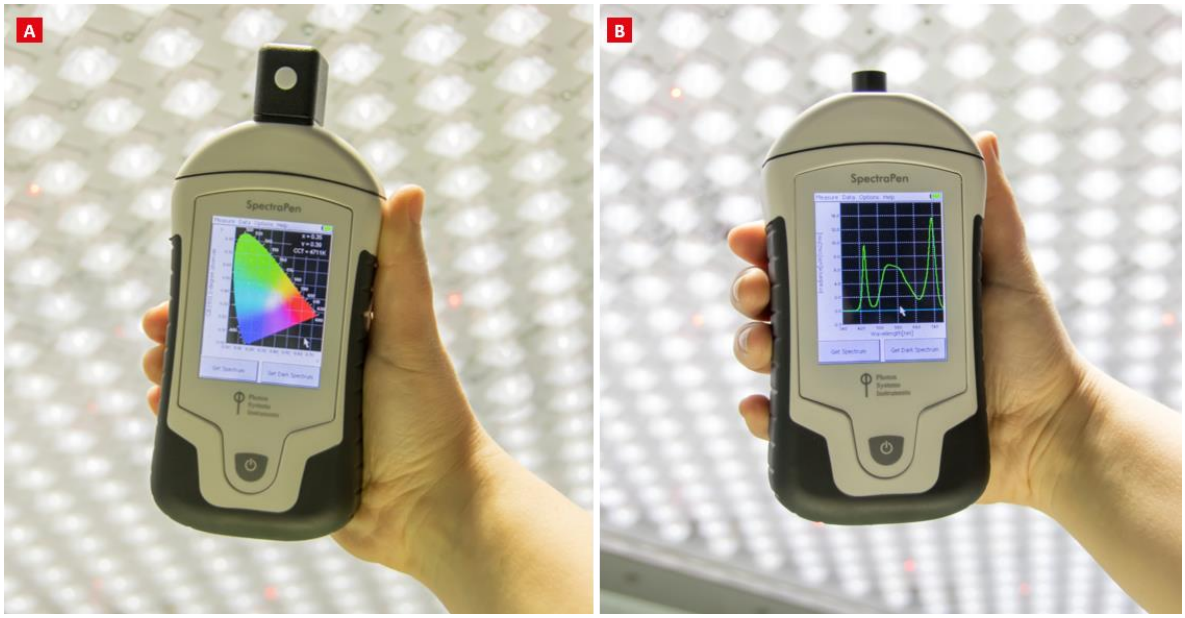

Fig. 2 A) SpectraPen LM 510-H. B) SpectraPen LM 510-V

2.3 LIST OF EQUIPMENT AND CUSTOMER INFORMATION

Standard version of the SpectraPen device package contains:

- SpectraPen
- Carrying Case
- Textile Strap for Comfortable Wearing
- SpectraPen Operating Manual and software (on a USB flash disc)
- USB cable
- Stylus
- Other Accessories or Optional Features (according to your specific order)

	In case an item is missing, please, contact the manufacturer. Also check the carton for any visible external damage. If any damage is found, notify the carrier and the manufacturer immediately. The carton and all packing materials should be retained for inspection by the carrier or insurer. For customer support, write to: support@psi.cz

2.4 MEASURED PARAMETERS

SpectraPen is especially useful for rapid measurements of spectral light quality and quantity in radiometric or photometric units.

Scope as spectrum intensity profile as Irradiance [µW.cm^{-2}.nm^{-1}] or Photon flux density [µmol.m^{-2}.s^{-1}.nm^{-1}]

Light intensity in defined range of the spectrum. The range can be adjusted by the user. Four calibrations are available

- Irradiance [W.m^{-2}] in user defined range of the electromagnetic spectrum
- Photon flux density [µmol.m^{-2}.s^{-1}] in user defined range of the electromagnetic spectrum
- Illuminance [Lux] - total luminous flux incident on a surface, per unit area
- PAR [µmol.m^{-2}.s^{-1}]*

Chromaticity Diagram CIE1931 - quality of color space and color temperature of the light source

- CIE color coordinates*
- Correlated color temperature – for LED *
- Color rendering index

* Valid only for LM 510-UVIS version of SpectraPen LM 510

2.5 TECHNICAL SPECIFICATION

Spectral range	340 nm – 790 nm (LM 510 UVIS) 640 nm – 1050 nm (LM 510 NIR)
Spectral response half width	9 nm
FWHM bandwidth	7 nm
Wavelength reproducibility	+/- 0.5 nm
Spectral Straylight	-30 dB
Integration time	from 5 ms to 10 s, set automatically
Number of pixels	256
Dimension of pixel	0.5 x 15.8 mm
Internal memory capacity	Up to 16 Mbit
Internal data logging	Up to 4,000 measurements
Data transfer	USB cable
PC software	SpectraPen 1.1.0.22 (Windows 10 or higher)
Battery type	Li-Ion rechargeable battery

Battery capacity	2,600 mAh
Max. charging current	0.5 A
Charging	Via USB port - PC, power bank, USB charger, etc.
Battery life	300 - 500 measurements until low battery indication
Optical entrance	Cosine corrector
Display	Touchscreen 240 x 320 pixel; 65535 colors
Built in GPS module	Ultra-high sensitivity down to -165dBm High accuracy of <1.5 m in 50 % of trials
Size	180 x 75 x 40 mm
Weight	300 g
Operating conditions	Temperature: 0 to +55 °C Relative humidity: 0 to 95 % (non-condensing)
Storage conditions	Temperature: -10 to +60 °C Relative humidity: 0 to 95 % (non-condensing)

2.6 MAINTENANCE AND CLEANING

- The device should not come in contact with any organic solvents, strong acids or bases
- The device water protection qualifies as splashproof, do not submerge the device in water
- Do not use sharp objects for controlling touch display
- Keep the cosine corrector clean and dry
- To prolong battery lifespan do not store the device completely discharged or fully charged and avoid extreme temperatuires

	Recalibrating the device at least once every two years to maintain optimal performance is recommended.

Clean the surface witch soft and wet non-abrasive tissue. For cleaning the whole top chamber with clip can be removed. Unscrew the bolts on the optical head and wipe the inner surfaces carefully with a wet cloth or cotton bud.

3 GETTING STARTED

3.1 CHARGING DEVICE WITH USB CABLE

SpectraPen comes with a USB cable that is required for charging the battery. The same cable is also used for data transfer to a PC after measurement. To connect physically the USB cable to the SpectraPen device follow the picture instructions below. Please note that a lock in system is used to secure the USB cable to the SpectraPen and extreme caution has to be used when setting up this connection to avoid damage to the cable pins.

⚠	When connecting the USB cable take extra caution to prevent damage to the cable connector pins. Ensure correct orientation of the cable as shown in the pictures below so the circled portion of the plug and the cable in photo A and B are perfectly lined up prior to pushing them together. Once this connection is achieved the cable may be secured in position by turning the metal cover of the cable and locking the cable in position.

1. Take the round connector end of the provided USB cable
2. Insert the round connector end to the round USB socket at the bottom of the device (Fig. 3A-D).
3. Screw and tighten the connector on the cable side (Fig. 3E-F).
4. Connect the other end of the USB cable to a PC, power bank or a USB charger
5. The device starts to charge automatically
6. When switched OFF large charging icon appears on the device display. When ON the battery icon on the display (Fig. 4) indicates the actual charge status.

Fig. 3 Picture instructions on how to connect the USB cable to the Spectrapen.A) connector on the SpectraPen device. B) Portion of the USB cable with pins. C – E) Position the cable horizontally and line up the green circled parts of the cable and the connector, plug in the inlet and screw the securing screw. F) Correct connection of the USB cable and Pen device.

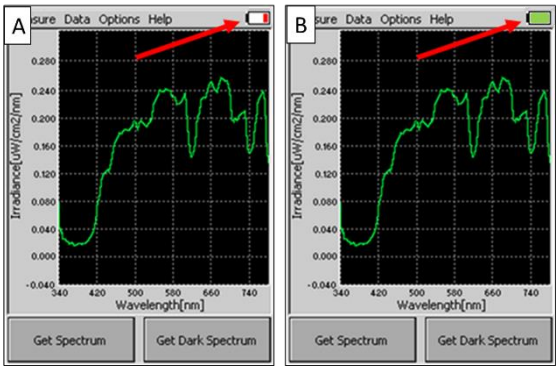

Fig. 4 Battery status indicator showing battery status: discharged A, charged B

⚠	Before starting a series of mesurements ensure the device is fully charged. When fully charged a maximum of 500 measurements can be done. Avoid using the device with discharged battery (red icon)

The device is switched OFF by pressing the power button again and confirming the dialog on the display by *OK* button. Alternatively holding the power button for 2 seconds can also switch the device OFF.

ℹ	In case the device has *Button measure* enabled switching the device OFF is possible only by pressing and holding the power button for 2 seconds.

3.2 DARK SPECTRUM CALIBRATION

Take the dark spectrum reading everytime the device is switched ON or before each series of measurements. The dark spectrum scan is equivalent to zeroing the instrument and no readings can be taken without this step.

1. Select *Get Dark Spectrum* -> tap OK (Fig. 5).
2. Cover the cosine corrector and tap OK (Fig. 5). Use dark cloth to ensure that the cosine corrector is covered completely. No ambient light should reach the detector during calibration.
3. Wait until Getting dark spectrum changes to Dark spectrum saved.
4. The Dark spectrum calibration step is completed and automatically stored in device memory. For future measurements the dark spectrum calibration scan is normalized to the surrounding temperature and relative to the detector integration time.

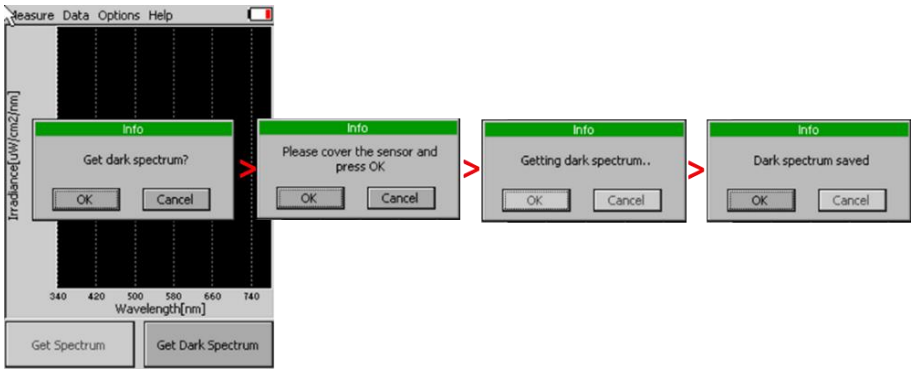

Fig. 5 Dark spectrum calibration

ℹ	In case surrounding temperature is rapidly changed during the calibration step or during the measurement, the SpectraPen will automatically ask for new dark spectrum calibration.

3.3 MEASUREMENT

1. **Select a type of measurement** under *Measure* menu (Fig. 6). Three options exist: **Scope** is spectrum intensity profile quantified as Irradiance [µW.cm^{-2}.nm^{-1}] or Photon flux density [µmol.m^{-2}.s^{-1}.nm^{-1}] **Light intensity** is total intensity value in a spectrum range defined in the *Options* settings. **Chromaticity diagram** is light color and correlated color temperature (CCT).
2. **Position the device** the cosine corrector level should be perpendicular to the light source.
3. **Tap the *Get Spectrum* button.** Hold the device until the *Spectrum Saved* allert appears. If the *Button measure* feature is enabled optional use of ON/OFF button instead of tapping *Get Spectrum* button is enabled.
4. **Confirm the** *Spectrum Saved ID# *** allert with OK button. The ID number is unique for the actual series of measurement. The actual (last) measurement can be erased in *Data -> Erase last.*

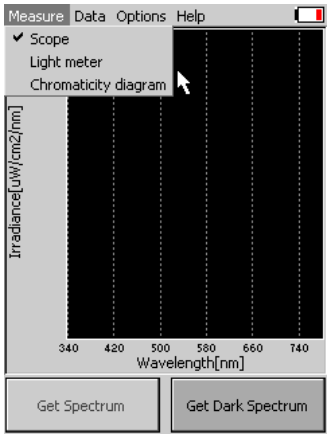

Fig. 6 Selecting type of measurement

	Each reading is stored with a unique ID irrespective of erasing a measurement. After erasing the last reading the erased ID is not reused for a next measurement. This applies when erasing measurements in the Spectrapen software after data download.

4 DISPLAY MENU

4.1 MEASURE

4.1.1 SCOPE

Scope is spectrum intensity profile quantified as Irradiance [µW.cm^{-2}.nm^{-1}] or Photon flux density [µmol.m^{-2}.s^{-1}.nm^{-1}].

To take the *Scope* measurement select *Scope* in the *Measure* menu (*Measure -> Scope -> Get Dark Spectrum/Get Spectrum*). The spectrum data is stored to the device memory, dark current is subtracted and and displayed in a graph.

	Select the units displayed on the graph in *Options -> Settings*.

4.1.2 LIGHT METER

The light meter is used for measurements of light intensity at defined range of wavelengths (Fig. 7).

Three calibrations are available:

1) Irradiance [W.m^{-2}] in user defined range of the electromagnetic spectrum
2) Photon flux density [µmol.m^{-2}.s^{-1}] in user defined range of the electromagnetic spectrum
3) Iluminance [Lux] - total luminous flux incident on a surface, per unit area

To take the measurement, select Light Meter in the *Measure* menu (*Measure -> Light Meter -> Get Spectrum*).

Light intensity of the light source is displayed and stored to the device memory.

The Light Meter integrates the value based on the wavelength range defined. For LM 510/UVIS this is in range 340-780 nm. The user can redefine the wavelength range in the *Options -> Settings -> Graph* section. To measure photosynthetically active radiation (PAR) change the settings to 400 to 700 nm.

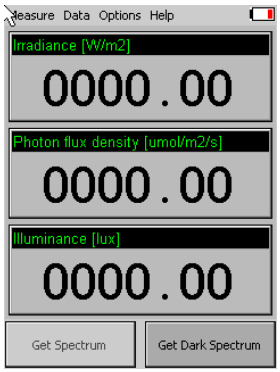

Fig. 7 Light meter screen

4.1.3 CHROMATICITY DIAGRAM

Chromaticity diagram is used for determination of light color and correlated color temperature (CCT) using the International Commission on Illumination (CIE) techniques (Fig. 8). All light colours can be uniquely identified standard coordinates of the 1931 CIE colorimetric system. A color space is a uniform representation of visible light. It maps all of the colors visible to the human eye onto an x-y grid and assigns them measureable values. This allows us to make uniform measurements and comparisons between colors.

To perform the measurement, select from the top menu of the main screen: *Measure -> Chromaticity diagram -> Get Spectrum*

The color of the light source in the CIE1931 colorimetric system is marked by black cross. The x- and y- coordinates of the measured light source will be determined and the CCT value will be calculated and displayed on the screen. The CCT values are not stored automatically.

Each measurement gives the folowing parameters:

- CIE1931 color coordinates *
- Correlated color temperature - for LED *
- Color rendering index

* Valid only for LM 510-UVIS version of SpectraPen LM 510

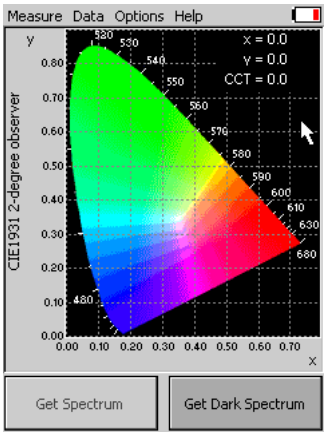

Fig. 8 Chromaticity diagram

4.2 DATA MANAGEMENT

In **Data** menu 4 options are available (Fig. 9):

Browse displays data browse dialog box. The user can browse the list of data in two tables: *Scope* and *PAR*. Each row starts with the unique ID number followed the date and time of measurement. In the *Scope* table the readings selected in the checkbox in the column on the right side the data can be viewed in a graph on the display. In the *PAR* table PAR intensity values are shown on the right side.

Memory info displays info on current status of device memory

Erase all is used to erase internal data memory

Erase last marks the actual (last) reading as invalid and removes the reading from the data table

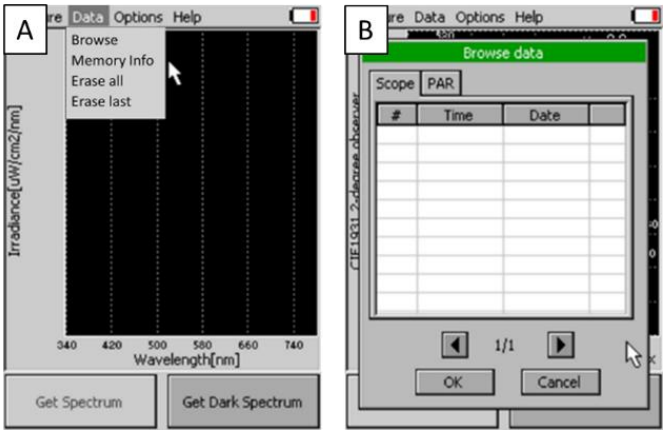

Fig. 9 A. Data menu and B. Data browse

4.3 OPTIONS

Select *Options -> Settings* to open the *Settings* table (Fig. 10). The table menu contains four settings groups.

4.3.1 GRAPH

Graph displays options for setting the wavelength range and graph features (Fig. 10A)

Zoom enable – enables the zoom feature. Select a rectangle by moving the stylus over the graph obliquely in left to right direction. To zoom out back repeat the movements in right to left direction.
Marker enable – enables to display exact numeric value for the point selected in the Scope graph window. Exact wavelength and light irradiance are displayed for the point touched on the graphical display. In top right corner of the LCD display the exact value of wavelength in nm is displayed for the user selected position of the spectrum. In addition, light irradiance for the given nm is shown.
Smoothing – enables noise reduction of the graphical display by Smoothing the noise in the spectrum at the expense of spectral resolution.
Wavelength range – defines the range of wavelengths considered for light meter measurements of Irradiance and Photon flux density. Desired wavelength range can be adjusted by selecting the wavelength and by using the arrows up and down.

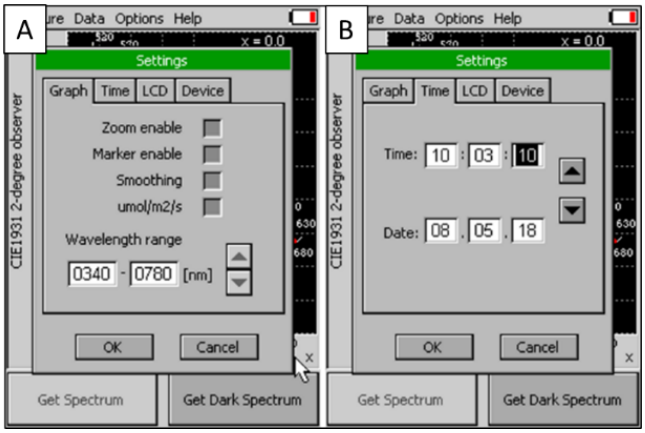

Fig. 10 A) Graph settings B) Time setting.

	The wavelength range setting applies only to the light meter mode of measurement and for direct viewing or browsing the intensity values in the Spectrapen. For data upload the device allways saves the whole spectrum and the light intensities are calculated from the whole spectrum.
	The wavelength range setting is not active for Illuminance.

4.3.2 TIME

The time feature is used to date all measured data. To set the time and date use the up and down arrows on the right side of the settings window (Fig. 10-B).

4.3.3 LCD

Two parameters can be adjusted on the LCD display (Fig. 11-A):

Backlight intensity – move slider to adjust back light intensity in percentage

Backlight time-out – move slider to adjust backlight time-out between 5 and 60 s (time of inactivity required before backlight will dim out to save battery life).

4.3.4 DEVICE

The *Options - > Device* menu has 3 items (Fig. 11)

GPS enable activates the GPS built-in module. The GPS coordinates cannot be displayed on the device display, but they are exported together with data and visualized in SpectraPen software on the computer after download.

Button measure The power ON/OFF button can be used for taking measurements same way as the software *Get Spectrum* button.

Average –Average function is used for adjusting the number of scans for each reading. Averaging of more scans results in a higher signal-to-noise ratio but increases the time required for each reading that appears on the screen. Move slider to set the number of measurements to be acquired for averaged values.

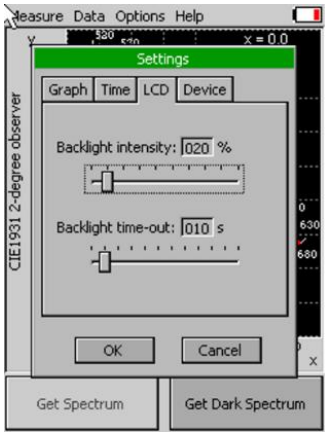

Fig. 11 LCD settings

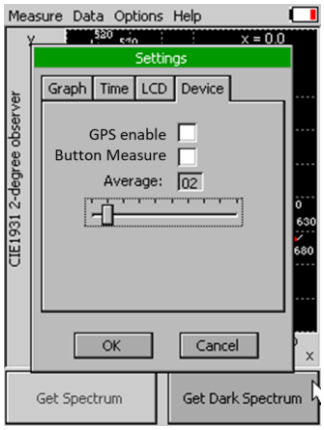

Fig. 12 Device settings

4.4 HELP

In the *Help* menu select *About…* to view information about the device

- name and type
- serial number
- hardware version
- software version

4.5 USB DRIVER UPDATE

In case of any connection problems first check that the USB cable is properly connected (for instructions see paragraph 3.1., page 12).

	Updating the USB driver is not required if the SpectraPen package installation was completed sucessfully.

If the problem persists update the USB driver with these steps:

1. Insert the USB stick provided with the device to a PC and copy the *Software -> driver* folder to the PC
2. Press Windows *Start* and Select *Device Manager* (Fig. 13)
3. Connect the SpectraPen device to the PC and switch the device ON
4. In the Device Manager find Ports (COM & LPT) and right click the item
5. Select Update Driver

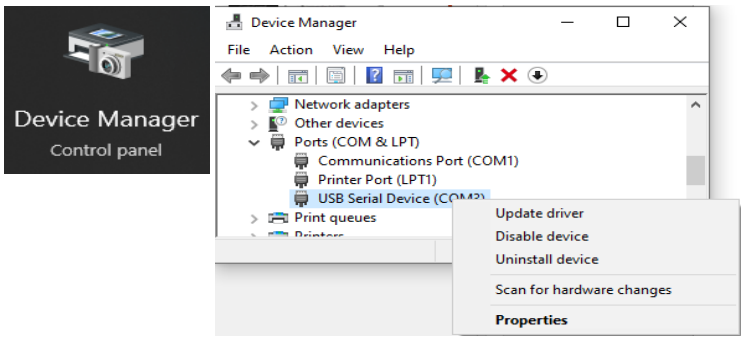

Fig. 13 Device Manager icon in the Windows Start menu and the detected USB Serial Device with options

6. Select Browse my computer for driver software
7. In the next window select the *Software - > Driver* folder copied from the USB stick (Fig. 14, Fig. 15)
8. In case a warning message appears click *Allow the installation procedure*
9. Installation of the driver is complete. USB connection icon appears on the SpectraPen device display (Fig. 16).

Fig. 14 Choose the driver from the USB disc.

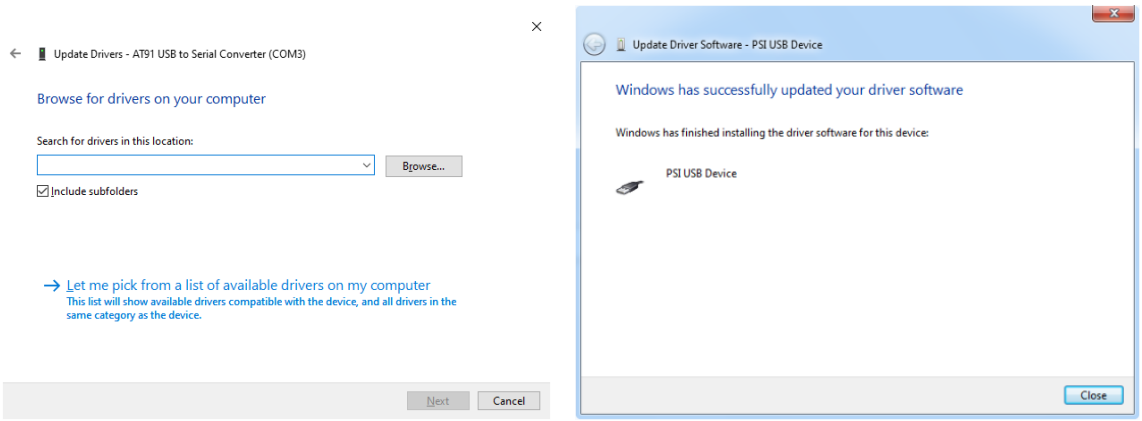

Fig. 15 Browse for Drivers and Update completed windows

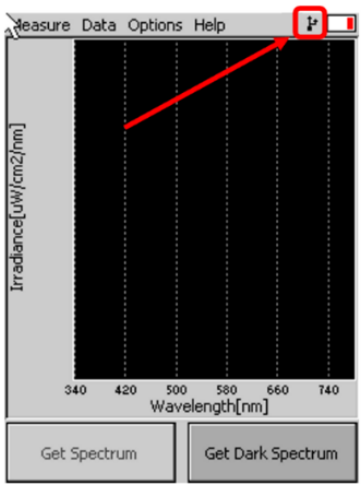

Fig. 16 Icon on the SpectraPen device display indicating the USB connection.

5 SPECTRAPEN SOFTWARE

5.1 SOFTWARE PREPARATION

5.1.1 SW INSTALLATION

To download data from the device install *SpectraPen* software on a computer that runs on a Microsoft Windows Operating System. The software installation is done automatically by executing the *SpectrapenPenPackageInstaller.exe* file.

1. Insert the provided USB stick to the computer or download the file from PSI web page ("Software" section) *https://psi.cz/support/downloads/hd001/spsp001/*
2. Find the downloaded file in the *Software* folder on the USB stick or open the *Downloads* folder
3. Run the installer file by left clicking the exe file (Fig. 17).

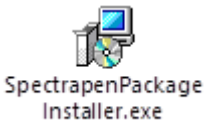

Fig. 17 Installer exe file icon

4. The SpectraPen Package installation wizard opens. Proceed through the steps as is shown in Fig. 18.
5. When completed the Spectrapen app is stored locally (*C:\Program Files (x86)\PSI\Spectrapen* by default), the USB driver is up to date and a shortcut icon for the SpectraPen app appears on the desktop.

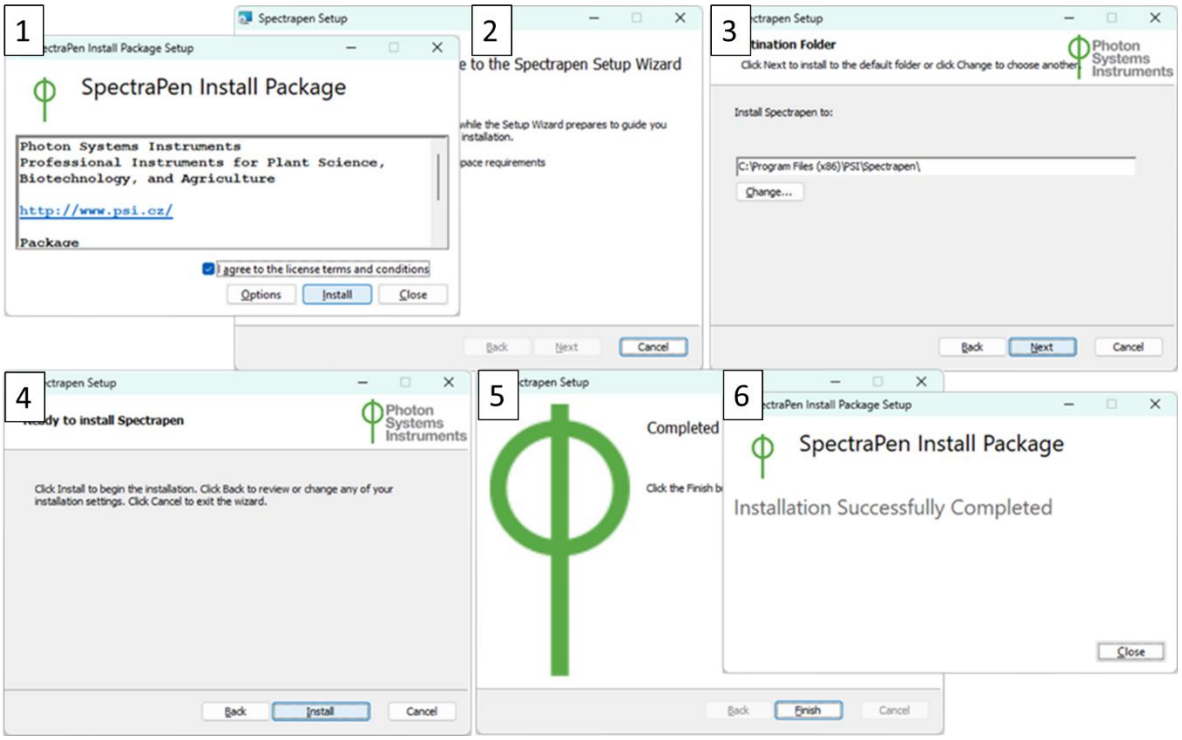

Fig. 18 Spectrapen installation procedure

5.1.2 ESTABLISHING COMMUNICATION

1. Connect the device with USB cable
2. Switch the device ON by pressing the power button
3. Open the Spectrapen application by clicking the Spectrapen.exe file in the PSI\Spectrapen folder

4. In the Spectrapen app go to *Device –> Connect.* The software searches for the device and indicates the status on the bottom bar of the window. This step usually takes several seconds.

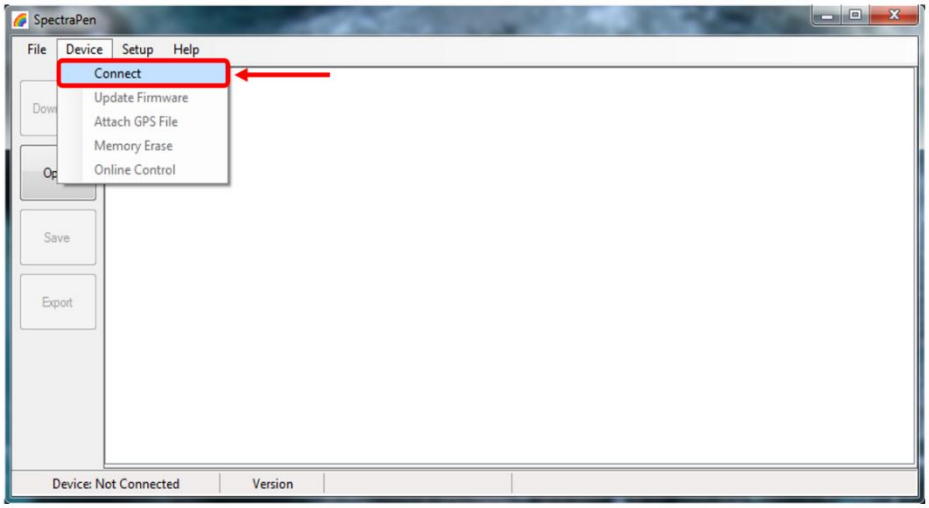

Fig. 19 Connecting the Spectrapen software

5.1.3 DEVICE REGISTRATION

To enable downloading feature in the SpectraPen software proceed with device registration (Fig. 20).

1. Open a text file *Registration code.txt* in the *Software* folder on the USB stick provided with the device
2. Select *Help -> Register and e*nter your registration number
3. Click *Register, t*he SpectraPen *Download* button activates with the registration.

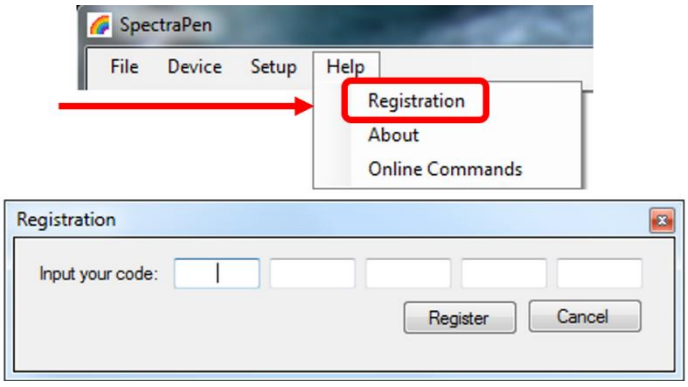

Fig. 20 Software registration.

	Software registration is requried for downloading data from the SpectraPen device.

5.2 MAIN MENU

5.2.1 FILE

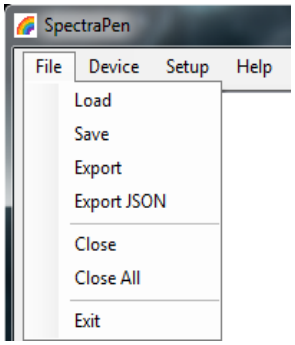

Fig. 21 Menu File.

Load	Loads previously saved data files.
Save	Saves data to hard disc.
Export	Exports data in .txt format.
Export to JSON	Exports data in JavaScript Object Notation.
Close	Closes the current experiment.
Close All	Closes all open experiments.
Exit	Exits the program.

5.2.2 DEVICE

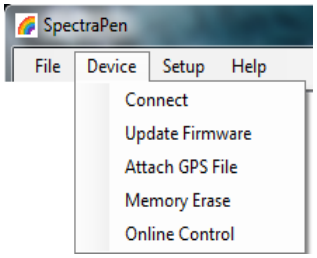

Fig. 22 Menu Device.

Connect	Detects and connects the device.
Update Firmware	Reinstall device software
Attach GPS File	Download data from the GPS module 9 (applies to SpectraPen LM 500).
Memory Erase	Erases data from the SpectraPen memory.
Online Control	Online control of SP device.

5.2.3 SETUP

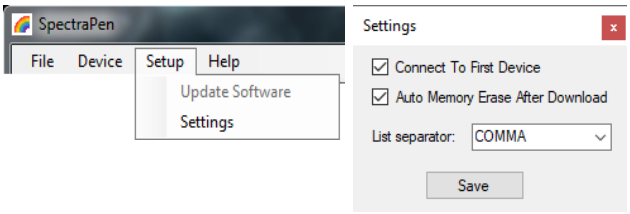

Fig. 23 Menu Setup and Settings options

Update Software	Activates when a new version of Spectrapen software is available online
Settings	On/Off – Auto memory erase after download. Selection of separator for the csv file after its export and following opening in Excel (TAB, SEMICOLON, COMMA, SPACE).

5.2.4 HELP

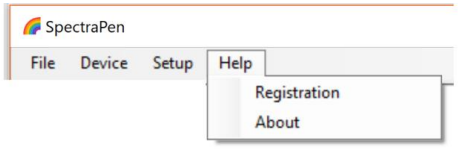

Fig. 24 Menu Help.

Registration	Used for device registration.
About	Offers basic information about the program.

5.3 DATA MANAGEMENT

5.3.1 DATA DOWNLOAD AND VISUALIZATION

Connect the device to a PC for data download and further analysis.

1. Switch the device ON
2. Start the SpectraPen software. In the *Device* menu select *Connect*.
3. When connected upload data with the *Download* button or select *Load* in the *File* menu.
4. All data stored currently in the SpectraPen device will be uploaded and shown in the main window view. The data are store and displayed/listed with the time stamp of measurement.
5. Scope mode window is always displayed by default. To view irradiance data, select the Irradiance tab (Fig. 25).

6. All data that are downloaded are displayed in the Scope window after download from the SpectraPen. The user can select the set of measurements to be displayed by marking and unmarking the data from the selection list (Fig. 25).

	Please note that if there are no data stored in the memory, the download function is not active.
	Scope mode represents non-calibrated spectrum.

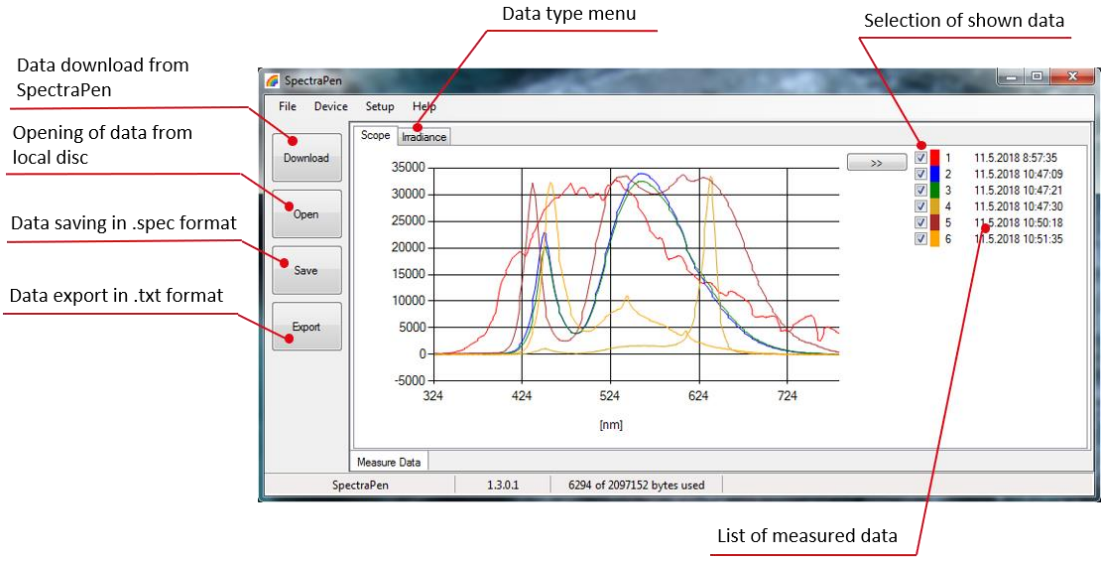

Fig. 25 Scope spectra

7. Right click on the list of measured data to edit data name, delete selected measurement or show and hide all measured data in the graph– Select all measure and clear all measure (Fig. 26).

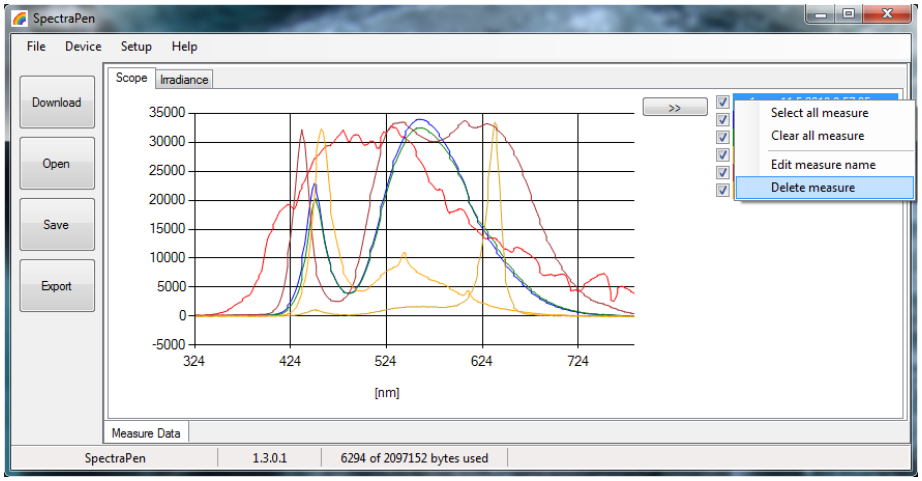

Fig. 26 Options for list of data

8. In the graph **marker** feature is available, which enables display of the numeric values for wavelength and light irradiance for the selected wavelength of the scan (Fig. 27). Use the mouse to select the given point. In top right corner of the graph (red rectangle) is displayed exact value for the selected point on the x-axis and y-axis.

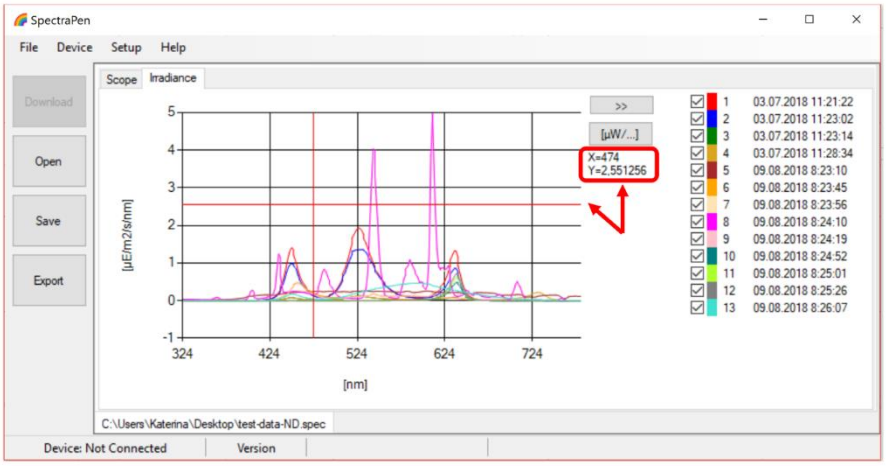

Fig. 27 Marker feature.

9. Select **Irradiance tab** to view the irradiance data stored either as µmol.m^{-2}.s^{-1}.nm^{-1} or per µW.cm^{-2}.nm^{-1} . To change the units in which the spectra is displayed click on the unit icon on the right side of the graph.

10. To view the light meter data for the spectral scans acquired click on the unit icon as depicted by red arrow in Fig. 28. Irradiance and illuminance **light meter numerical values** for each scan are displayed as LUX, PAR or IRRADIANCE values (Fig. 28).

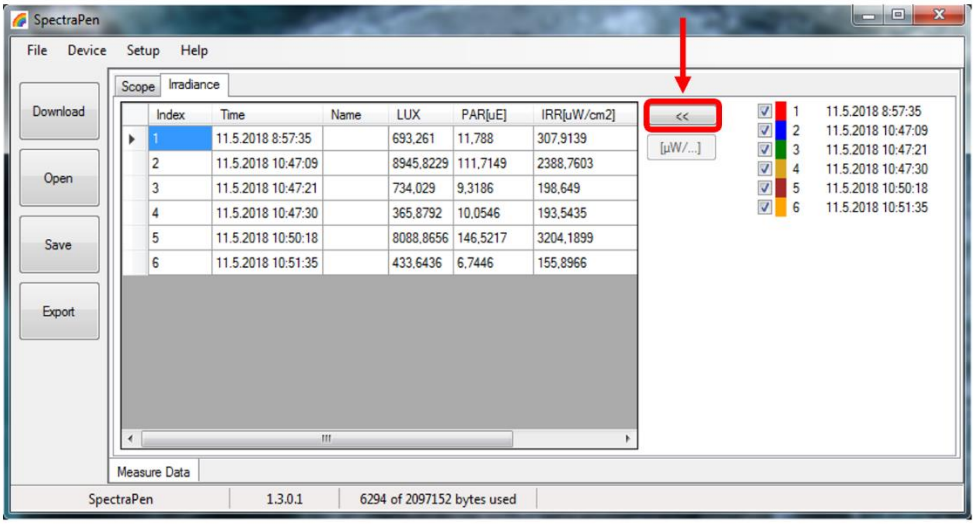

Fig. 28 Numerical values of measured light intensities.

11. To Save all data stored in the device select **File > Save** and create a name and path for storing a binary .spec file. This file can be later reopened in the Spectrapen software. All data stored in the device memory will be saved irrespective of the data selection in the SpectraPen softwareData Export.

12. To export data ***File->Export***. The *Export* window allows to select which type of data should be exported (Fig. 29).

    Raw Data raw data only, along with light readings dark current readings are exported

    Scope light intensities with dark current subtracted, no calibration to irradiance units

    Irradiance dark current subtracted and calibrated to 1) *Irradiance [µW/cm2/nm] µmol.m^{-2}.s^{-1}.nm^{-1}* and/or *Photon Flux Density [µmol/m2/s/nm]* (Fig. 29).

    Computed Data The export of computed data is based on the editable *formulas.txt* file. Two types of computed data can be exported: Scope using intensities at individual wavelengths or Irradiance with intensities based on integration (Fig. 29B).

Export interpolation –intensity profiles of measured bands are recalculated to 1 nm wide bands. For each measurement the device interpolates the reflectances measured at bands (e.g. 528.3, 530.2, 532,533.9,..) to distinct wavelength lengths defined by whole numbers (e.g. 528, 529, 530, 531,…).

13. In the Export window click *Expor.* In the *Export File Settings* window (Fig. 29C) select data and file type.

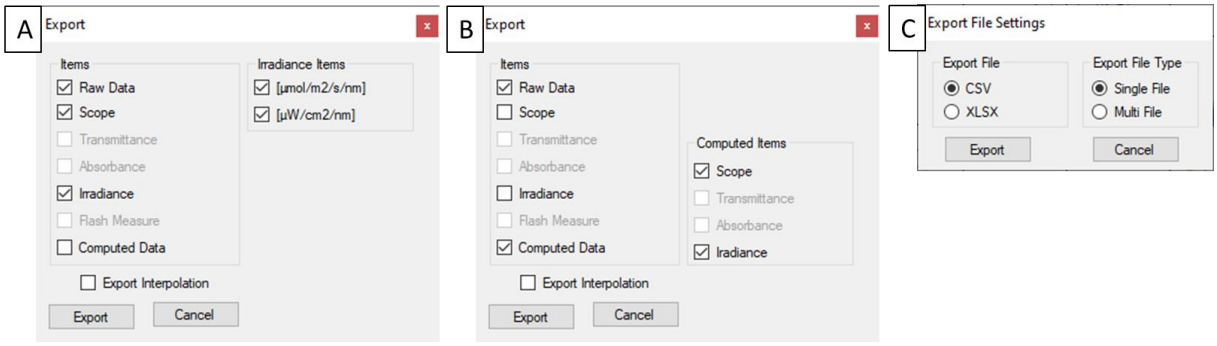

Fig. 29 Export options

5.3.2 EXPORT OF COMPUTED DATA

Choose the option “Computed values” and selected spectrum in the export table.

5.3.3 PROGRAMMING CUSTOM INDEX

The SpectraPen software enables programming custom indexes, which can be used for wide range of calculation based on the measured spectrum.

1. **Open the SpectraPen folder in your PC.** Usually the program installs in the *Program Files* folder (*C:\Program Files (x86)\PSI*)
2. **Open Formulas.txt** file located in Config folder (*C:\Program Files (x86)\PSI\Spectrapen\Config*)
3. **Write your index into the .txt file** The text file *Formulas.txt* can be edited to create formulas for different light intensity or light index calculation. The newly defined formulas can be created based on predefined template formulas (see the text in red). When editing new formulas follow a few rules summarized in the appendix of this manual on page 32.

```
Irradiance:LUX:LUX:683*integral(IrradianceL,360nm,780nm)

Irradiance:PAR[umol/m2/s]:PAR[umol/m2/s]:integral(IrradianceE, 400nm, 700nm)

Irradiance:IRR[uW/cm2]:Irradiance[uW/cm2]:integral(IrradianceW, 340nm, 780nm)

Irradiance:IRR_NIR[uW/cm]:Irradiance[uW/cm2]:integral(IrradianceW, 640nm, 1050nm)

Irradiance:R/FR ratio:Red-to far-red ratio:integral(IrradianceE, 650nm, 670nm)/
integral(IrradianceE, 720nm, 740nm)

Scope:PSIindex:PSI test index:Scope[600nm]/ Scope[500nm]
```

Irradiance: or ***Scope*** defines the field in which the index is used. In *Scope* only formulas calculating intensity ratio at two wavelength cane be calculated. In *Irradiance* only integration of light intensity in defined range can be used.

PSIindex: or ***R/FR ratio:*** short name of the index displayed in the SpectraPen software and in the exported data

PSI test index or ***Red-to far-red ratio****:* Full name of the index, is not displayed or exported

Scope[600nm]/ Scope[500nm]: or **Integral(IrradianceE, 650nm, 670nm)/integral(IrradianceE, 720nm, 740nm)** are the actual formulas for index calculation

4. Save the txt file and r**estart the SpectraPen Software**
5. **The new index is displayed in the SpectraPen software** (Fig. 30, red rectangles). Select *Irradiance* or *Scope* bookmark in the main window (Fig. 30-1) and switch to the data sheet with the << button (Fig. 30-2).

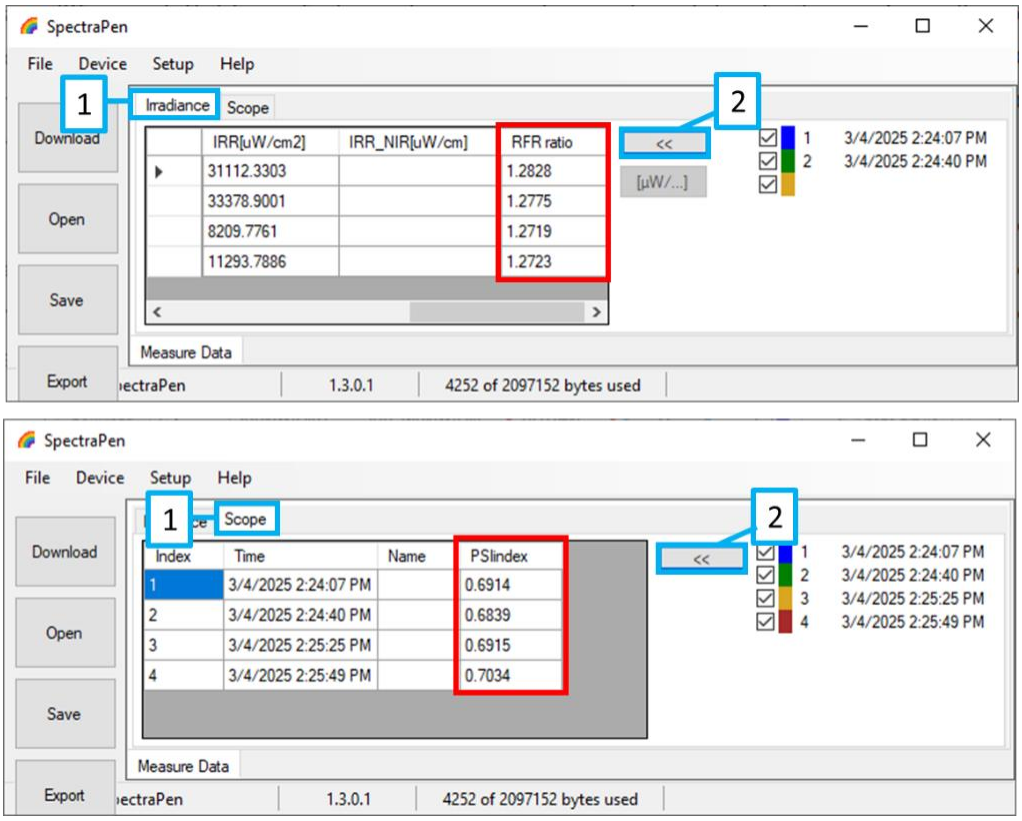

Fig. 30 Names of newly defined indices appear in the Irradiance or Scope tables

5.4 Online Control

Menu Online Control

This function can be used for remote - online control of the SpectraPen device after connection with the PC. Online control enables to make changes in device setting and also perform remote measurement using PC.

Select: **Menu > Device > Online Control** (Fig. 31)

Remote measurement (Fig. 32)

Using this function **Irradiance**, **Photon flux density** and **PAR** can be measured.

- For manual remote measurement click on Get button.
- Setting for automated remote measurement is possible using the button with three dots (next to "Get" button in the window of the software). Here the time interval of the measurement is set. To apply this setting use the option Use settings (in "Settings Form" window) and confirm by clicking OK. The measurement stars immediately and continues until it is manually stopped (Stop button).
- Use the export option for exporting the data to .csv file.
- Clear function serves for erasing of data measured by Online Control.

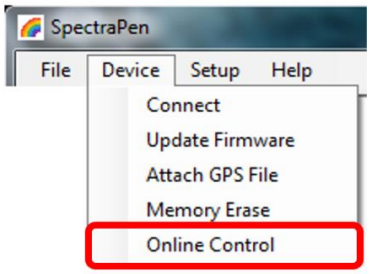

Fig. 31 Online control.

	Please note that the Dark Spectrum Calibration should be done manually prior to the measurement. Otherwise error allert ID:1 appears.

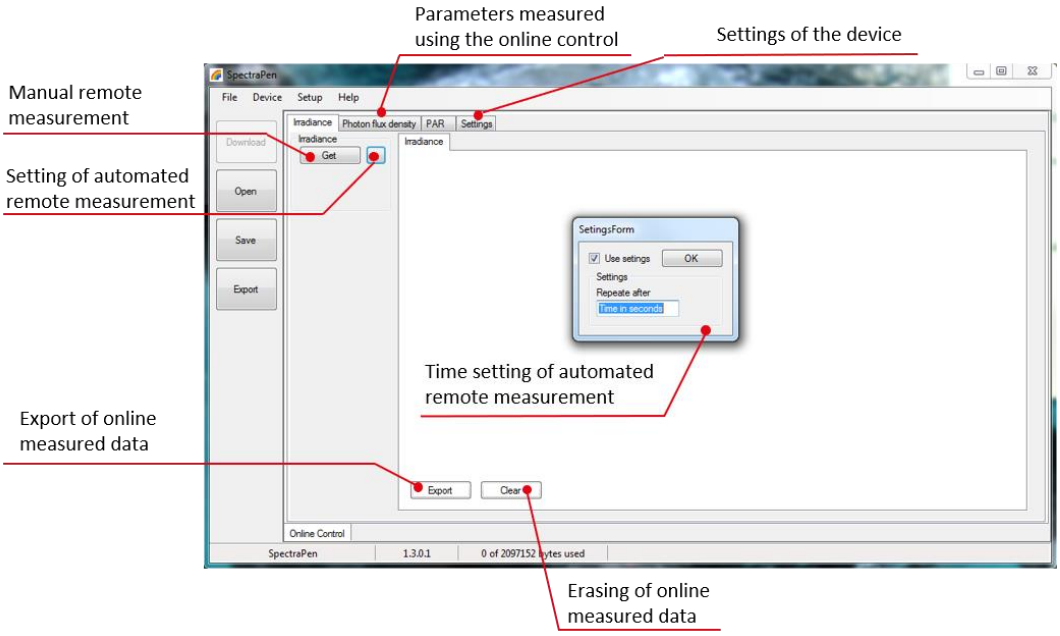

Fig. 32 Remote measurement.

Settings (Fig. 33)

Here the following functions may be set up for remote operation of the SpectraPen:

- Time synchronization of the device and PC
- GPS built-in module activation
- Averaging of measurement (1 – 10 measurements)
- Selection of the wavelength range for measurements
- Integration time (0 – 10 s)

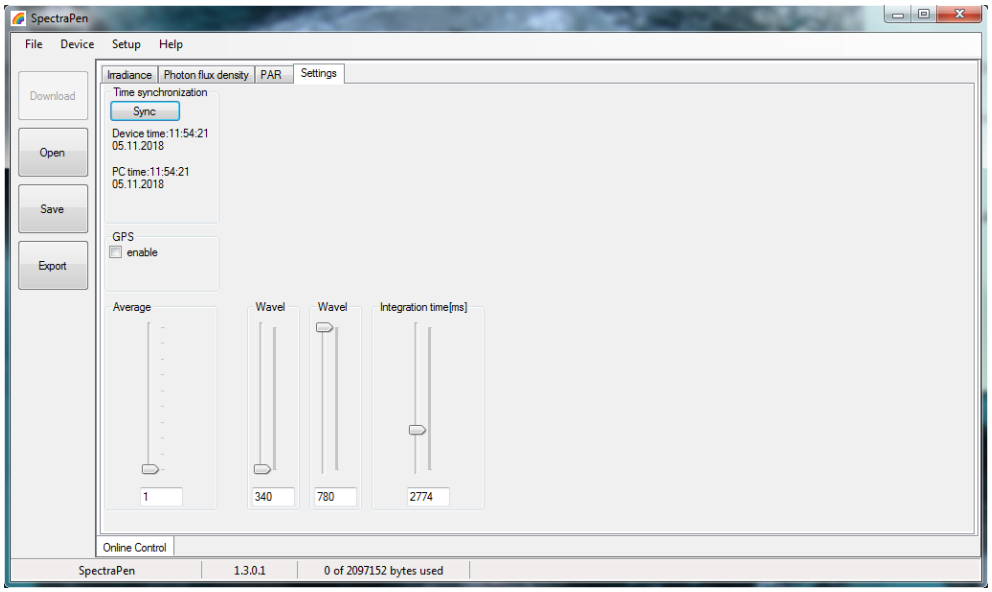

Fig. 33 Online control settings.

5.5 FIRMWARE UPDATE

Update of the device firmware is done upon manufacturer's request. To update the firmware upload a FW file provided by PSI.

	All data in the SpectraPen memory are erased during the firmware update! Incompatible firmware version can cause device malfunction.

1. Connect the device
2. In the SpectraPen main menu Select: *Setup -> Update Firmware From File*
3. Select the provided *.bxn* file and click *Open*.
4. Select: OK to upload of the update. The bottom bar indicates the progress (Fig. 34)

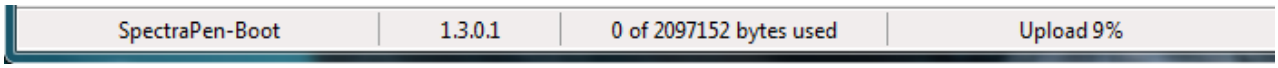

Fig. 34 Firmware update running.

6 GPS MODULE

SpectraPen device LM 510 allows to access to location and timing signals from satellites. The integrated GPS module can be switched on for geotagging the readings with with accuracy around 4 meters. When measuring with activated GPS module geographic coordinates are automatically saved and can be displayed or later downloaded with the readings.

⚠	For proper function of the GPS module accurate time settings in the SpectraPen device and rthe computer is necessary.

MEASURING WITH GPS

1. Check the time setting on the SpectraPen device: **Settings > Date & Time**
2. Switch the GPS module "ON" on the SpectraPen device by following these steps in the SpectraPen menu:
   - Select: Options > Settings > Device
   - Click on the check box for GPS (Fig. 35)
   - Wait until the position flag icon in the upper menu stops flashing (Fig. 35). You may need to move to open space area to accquire sattelite signal
3. Perform measurements
4. Connect the SpectraPen to the computer and in the SpectraPen software download the measured data. Example of data tagged with GPS coordinates is shown in Fig. 36.

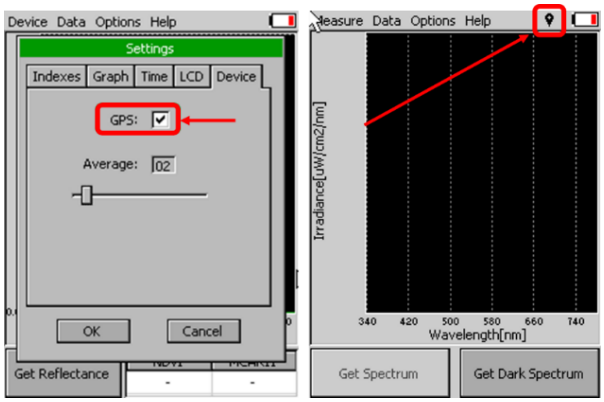

Fig. 35 Activation of GPS

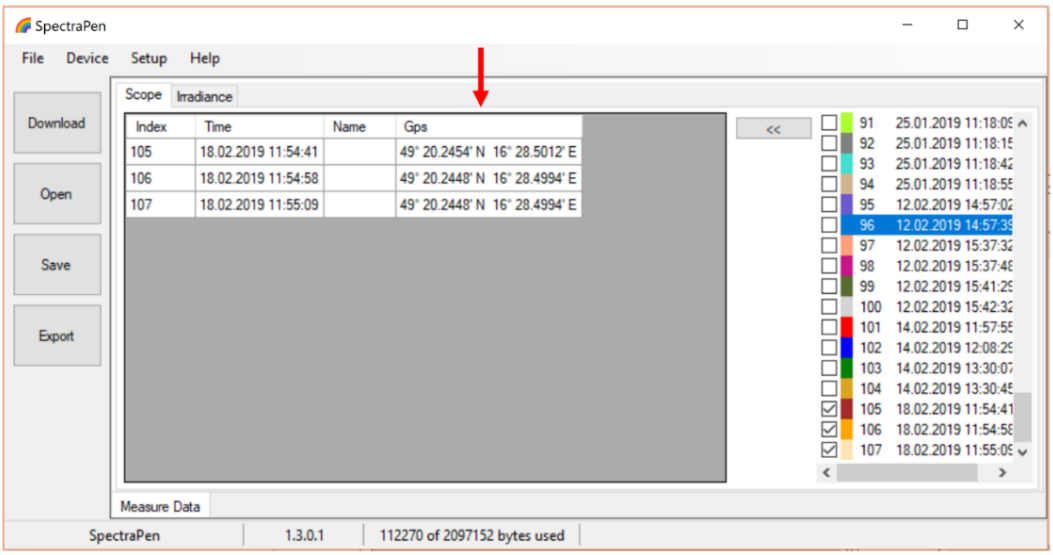

Fig. 36 Data tagged with GPS coordinates.

7 Warranty and Service Support

7.1 Waranty Terms and Conditions

This Limited Warranty applies only to the SpectraPen device. It is valid for one year from the date of shipment.

If at any time within this warranty period the instrument does not function as warranted, return it and the manufacturer will repair or replace it at no charge. The customer is responsible for shipping and insurance charges (for the full product value) to PSI. The manufacturer is responsible for shipping and insurance on return of the instrument to the customer.

No warranty will apply to any instrument that has been (i) modified, altered, or repaired by persons unauthorized by the manufacturer; (ii) subjected to misuse, negligence, or accident; (iii) connected, installed, adjusted, or used otherwise than in accordance with the instructions supplied by the manufacturer.

The warranty is return-to-base only and does not include on-site repair charges such as labor, travel, or other expenses associated with the repair or installation of replacement parts at the customer's site.

The manufacturer repairs or replaces faulty instruments as quickly as possible; the maximum time is one month.

The manufacturer will keep spare parts or their adequate substitutes for a period of at least five years.

Returned instruments must be packaged sufficiently so as not to assume any transit damage. If damage is caused due to insufficient packaging, the instrument will be treated as an out-of-warranty repair and charged as such.

PSI also offers out-of-warranty repairs. These are usually returned to the customer on a cash-on-delivery basis.

Wear & Tear Items (such as sealing, tubing, padding, etc.) are excluded from this warranty. The term Wear & Tear denotes the damage that naturally and inevitably occurs as a result of normal use or aging even when an item is used competently and with care and proper maintenance.

7.2 Product and Contact Information

Name of product	SpectraPen LM 510
Manufacturer	PSI (Photon Systems Instruments, spol. s r. o.)
Address	Prumyslova 470, 664 24 Drasov
Country of Origin	Czech Republic

7.3 Troubleshooting and Customer Support

For information about the device

- visit our web page at https://handheld.psi.cz/products/spectrapen-lm/
- contact your local distributor
- send an email to *info@psi.cz*.

In case of problems with the device or Spectrapen software

- review our FAQs at https://handheld.psi.cz/faqs/#general-questions or https://handheld.psi.cz/faqs/#spectrapen-lm
- contact your local distributor or
- send an email to customer support at *support@psi.cz*.

8 APPENDIX

List of syntax rules for programming new indices in *SpectraPen* software

Min, max – minimum or maximum value

min(value1, value2) where value1 or value 2 is a number, variable, function

min(array) where array is an array of numbers

example1: max(Scope)

example2: min(Irradiance)

example3: min(Scope[760nm], max(Scope[450], Scope[680]))

example4: max(Irradiance[550nm], (5+4)*4)

---

ln – natural logarithm with base *e*

ln(value) where value is a number, variable, function

example1: `ln(5)`

example2: `ln(Irradiance[760nm])`

example3: `ln(max(Irradiance [550nm], Irradiance[480nm]))`

example4: `ln((5+4)*4)`

---

log – logarithm with base definition.

logB(value) where value is a number, variable, function and B is base number

example1: `log2(5)`

example2: `log5(Scope[760nm])`

example3: `log10(max(Scope[550nm], Scope[480nm]))`

example4: `log10((5+4)*4)`

---

sqrt – the square root of a number

sqrt(value) where value is a number, variable, function

example1: `sqrt(5)`

example2: `sqrt(Scope[760nm])`

example3: `sqrt(max(Scope[550nm], Scope[480nm]))`

example4: `sqrt(((5+4)*4) + 6)`

---

^ - exponentiation of a base raised by exponent (power)

value^power where value is a number, variable, function and power is a number, variable, function

example1: `Irradiance[760nm]^ Irradiance[550nm]`

example2: `min(Irradiance[760nm], Irradiance[550nm])^max(Irradiance[435nm], Irradiance[430nm])`

example3: `Transmitance[760nm]^0.5`

---

integral - express the area under the curve of a graph of the function in the interval

integral(function_values, from, to) where from,to are limit values and function_values are input values for integral compute

example1: `integral(IrradianceL, 360nm, 700nm)`

example2: `integral(IrradianceE, 360nm, 700nm) * IrradianceE[450nm]`

9 LIST OF FIGURES