PSR-1100
Portable Spectroradiometer
Operator's Manual

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1 Introduction

This manual contains data concerning the PSR-1100 field-portable spectroradiometer system. The system consists of a UV-visible-NIR range spectrometer with integrated lens (or optional fiber optic input) that produces output calibrated to units of spectral radiance ($W/m^2/nm/sr$). Energy enters the spectrometer from an external illumination source by way of the lens. The spectrometer is a dispersive PDA system operating in the range of 320–1100 nm with a 512-element array detector.

All electronics for controlling the PSR-1100 system operation are built into the instrument. The instrument incorporates manual controls and on-board storage for self-contained field operation, as well as the capability to connect to a host computer system using the provided application software via USB or Bluetooth communications interface. The instrument is powered by a Li-Ion battery pack (provided with each system).

The PSR-1100 contains an internal microprocessor that controls the data acquisition of the detector array, the communication interface to the host PC, and provides data storage. Calibration data and spectral data (collected in standalone mode, described below) are stored in flash memory. The PSR-1100 has a built-in shutter for automatic dark measurements. The dark current data are retained in RAM and the microprocessor automatically performs mathematical functions on collected spectral scan data, including dark subtraction and automatic integration adjustment.

2 Hardware and Interface Description

2.1 Part Identification

2.1.1 Spectrometer

The spectrometer component of the SR-1100 is a crossed Czerny-Turner configuration using a ruled grating as the dispersive element. Energy enters the spectrometer and is collimated before being reflected off the grating and refocused onto the PDA detector. The detector is a 512-element array, covering the spectral range 320–1100 nm. The spectrometer and controlling electronics are contained in the housing.

2.1.2 Battery Pack

The PSR-1100 uses a Li-Ion battery pack as a power source, supplied with the system. The Li-Ion battery runs at a nominal 7.4V and is designed to provide more than 3 hours operation following a full charge. When the battery voltage falls too low to power the instrument, it will turn off and go to 0 volts. Remove the battery from the instrument for recharging with the supplied charger. Refer to **Section 0:**

Battery Charger for charging details.

2.1.3 Optical Input

The PSR-1100 comes with a standard fixed 4° field-of-view lens foreoptic installed. Custom configurations may replace the lens with alternate foreoptics such as a 25° FOV fiber optic input.

The entire spectrometer/foreoptic system is factory-calibrated for radiance using a NIST-traceable source. The calibration coefficients are stored in flash memory by the internal microprocessor. The application software retrieves these coefficients and applies them to acquired scan sample data to convert to radiometric units.

2.1.4 Serial Communications

Communications with the PSR-1100 are conducted using USB or Bluetooth.

USB communications require a standard cable with USB-B connector to fit the receptacle on the control panel. The first time the host PC is connected to the instrument, Windows® will need to install drivers for the virtual COM port functionality. These drivers are included on the CD-ROM that was provided with your unit. Once the drivers are loaded, the provided Windows® application software interacts with the spectroradiometer using a virtual COM port in the same fashion as a standard RS-232 serial port (115200 baud, 8 data bits, 1 stop bit, no parity).

The PSR-1100 is also enabled for wireless communications with the application software provided the user has installed a Bluetooth serial port on the host PC. Depending on your Bluetooth adapter's configuration utility, you will need to enter an identifier for your instrument type (typically called its PIN key or pairing code) the first time you use your PSR-1100. This code is "psr1100". Your Bluetooth utility will recognize the instrument by a unique name with the syntax "PSR-1100 ####", where #### is replaced by the serial number of the unit.

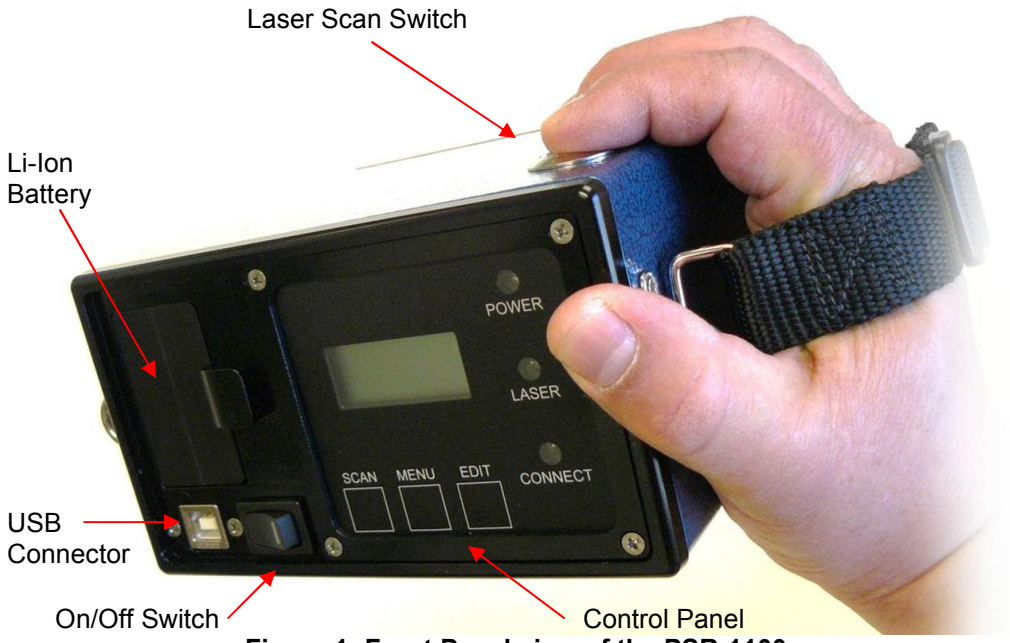

Figure 1: Front Panel view of the PSR-1100

2.1.5 Front Panel

The front panel of the PSR-1100 contains the on/off switch, USB connector, battery receptacle and a control panel with membrane switches and LCD display. A handstrap is permanently attached and near the front panel are two mounting brackets for attaching a shoulder strap. See **Section 3: Control Panel** for more information.

2.1.6 Back Panel

The opposite end of the PSR-1100 contains the optical input (lens or SMA fiber optic input), Bluetooth antenna and optional tripod mount.

2.1.7 Laser Scan Switch

The Laser Scan switch is located on the top cover of the spectroradiometer. Depressing the switch actuates the sighting laser and can be optionally configured to initiate the start of a standalone spectral scan.

DANGER: DO NOT LOOK INTO THE LASER BEAM AT ANY TIME, INCLUDING INSTRUMENT SETUP OR OPERATION.

For more information see **Appendix A: Laser Safety**.

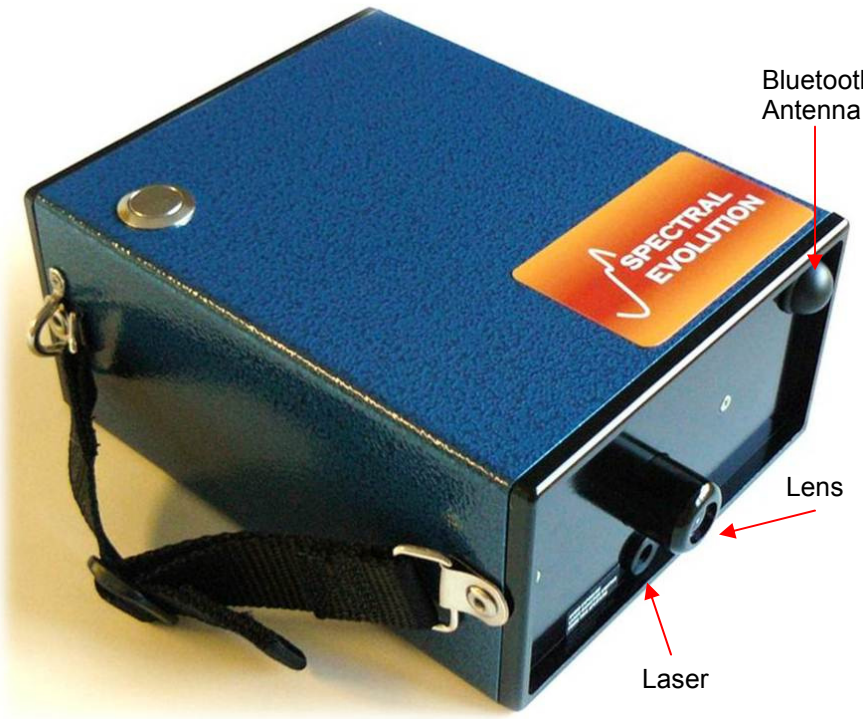

Figure 2: View of PSR-1100 optical components

2.2 Interface Specification

2.2.1 Battery Pack

Your PSR-1100 is supplied with one or more Li-Ion battery packs that fit into the recess on the front panel. Slide the spring-loaded catch to the side (away from the recess) with a finger to insert or remove the battery.

Important: See **Section 0:**

Battery Charger for details on charging the external battery and safe operation.

2.2.2 USB Serial Connector

For communications via USB, the front panel is equipped with a USB Type-B receptacle connector, compatible with all standard USB cables with Type-B plug.

Pin 1: +5V
Pin 2: D-
Pin 3: D+
Pin 4: GND

2.2.3 Serial Communications via USB or Bluetooth Virtual COM Port

Baud Rate: 115200 bps
Parity: none
Data Length: 8
Stop bit: 1
Flow Control: none

2.2.4 ESD protection:

+/- 15 KEV human body model,
+/- 8KEV contact discharge

3 Control Panel

The control panel of each PSR-series spectroradiometer contains the controls and displays that are required for the stand-alone operation of the instrument.

3.1 Indicators

The Control Panel has 3 LED status indicators.

Power LED: The power indicator is illuminated when the power is on.
Laser LED: The laser indicator is illuminated when the laser is on.
Connect LED: The connect indicator is illuminated when the instrument is NOT connected to a computer via Bluetooth communication link.

3.2 Switches

3.2.1 Power Switch

The power switch provides on/off control of the unit.

3.2.2 Membrane Switches

The three (3) membrane push button switches provide control of the unit during standalone operation and the capability of modifying the unit's operation. The functions of the switches are detailed below.

3.2.3 Switch Function

Scan: Steps through scan options (Reference/Target/Dark Scans)
Menu: Steps through the menu options (Memory Scan#/Dark Scan Mode/Scan Timer/Optic/Laser Scanning)
Edit: Toggles or cycles through parameter lists for each menu option

3.3 LCD Display

The LCD display is an eight (8) character, two (2) row display that shows the selected scan and status messages.

ROW 1 displays the scan types, status messages, and battery voltage. The SCAN button allows the user to select the type of scan to perform.
ROW 2 displays the parameter menu. The MENU button allows the user to scroll through a set of available parameters, and the EDIT button changes the parameter settings.

3.3.1 Scan Types

The next type of scan to be collected is displayed in row 1 as follows:

REF x.xx - Indicates that a spectral measurement will be stored as a Reference Scan; current battery voltage is x.xx volts, or “LBAT” (Low BATtery) when indicated.

TAR x.xx - Indicates that a spectral measurement will be stored as a Target Scan; current battery voltage is x.xx volts, or “LBAT” (Low BATtery) when indicated.

DRK x.xx - Indicates that a dark measurement will be acquired. The dark measurement will be stored in volatile memory (not flash) and used for subsequent scaled dark measurements. The current battery voltage is x.xx volts, or “LBAT” (Low BATtery) when indicated.

Pressing the SCAN button cycles through these options. Note that after a REF scan is taken, the instrument automatically switches to collecting TAR scans.

3.3.2 Status Messages

These messages are also displayed on row 1:

SCANNING - Indicates that a spectral data acquisition is being performed.
BUSY - Indicates that the instrument is performing a lengthy internal operation.

3.3.3 Parameter Menu

The parameter menu is displayed on row 2. The MENU button allows the user to cycle through the following parameters. The EDIT button changes the parameter values.

MEM# xxx - Displays the memory slot that will hold the next acquired scan. The allowable values are from 1 to 500. The memory slot cannot be adjusted by the keypad, with the exception of completely erasing all memory.
To erase all memory and set MEM# to one (1), the <MENU> and <EDIT> keys must be pressed simultaneously. **IMPORTANT!** This operation permanently erases all internally stored scans taken in standalone operation mode.

DRK xxxx - Selects the dark subtraction mode:
AUTO - Automatic Dark mode is selected. Dark current measurement will be acquired automatically prior to each scan. The dark currents will be acquired at the same settings as the target scan.
SCLD - Scaled Dark mode is selected. Dark Current for each scan will be scaled, based on the integration time and the Dark Scan that was acquired manually using the Dark scan.

STIM xxx - STIM xxx is the scan averaging time. The allowable values are from 1 to 30. The length of time for a scan is xxx seconds, for each light and dark scan.

O:xxxxxx - Entrance optic option. **This must be set to the entrance optic in use for correct calibration factors to be applied**. There can be up to eight (8) optic calibration options stored in a single instrument. Some possibilities are listed below:
(1) LENS 4 – 4 degree FOV lens
(2) FIBER1 – standard 25 degree FOV fiber optic

(3) LENS14 – 14 degree FOV lens
(4) RAW DN – no calibration applied

LSCN xxx - Laser Scan Switch function. This can be set to ON or OFF. When the Laser Switch is depressed, the sighting laser is (always) turned on. When LSCN is set to ON, a stand alone scan will be acquired when the switch is released. When LSCN is set to OFF, no scan will be acquired.

3.3.4 Modifying a Parameter

(1) Depress the MENU button to locate the parameter you wish to edit.
(2) Modify the parameter by depressing the EDIT button. The push button switches are programmed to scroll the menu of available options.
(3) Depress the MENU button again to save the selected parameter setting.

4 Operational/Functional Description

All Spectral Evolution PSR series spectroradiometers operate as portable field instruments with onboard data storage and an easy-to-use manual control panel for standalone operation. Combined with a host PC, the PSR can also be controlled for acquisition in real time and for retrieval and display of the stored scan data.

4.1 Setup

To use the PSR-1100, install a fully charged battery pack by inserting it into the battery slot located on the instrument's front panel. Switch the power switch to the ON position. After a brief initial power-on period, the LCD indicator will display the message "REF" followed by a battery voltage reading and "O: LENS4".

4.2 Standalone Operation

Dark Measurement Overview

A dark measurement must be taken prior to taking reference or target measurements. Dark measurements are taken automatically by the instrument in AutoDark Mode, or are taken manually by the operator when in Scaled Dark Modes.

In AutoDark Mode, the internal shutter automatically closes and dark measurement taken immediately prior to the reference or target scan; there is no need to ever take a dark measurement manually.

If Scaled Dark Mode is used, however, a dark measurement must be taken manually. A new dark measurement should taken periodically, more often under changing environmental conditions.

Using AutoDark Mode ensures that the latest dark values are subtracted on every scan; however, enabling AutoDark doubles the amount of time the scan requires to complete. The dark measurement is subtracted from the Reference and Target measurements. Dark measurements are stored in the PSR's RAM and are not saved when the power is cycled.

Reflectance Measurement Overview

A reflectance measurement takes the scan of a reference (white plate) and calculates the ratio of the target scan to that reference. Unless the instrument is set to AutoDark Mode (where it takes a new dark reading with every scan) - if any of the below conditions exist, a new dark measurement should be taken:

· After instrument power-up and warm-up, but before acquiring any reference/target scans.
· Every 3-5 minutes thereafter; more often if time and conditions allow, or if lighting or environmental conditions are changing.

If any of the below conditions exist, a new reference measurement should be taken before a series of target measurements:
· Beginning of a new set of scans.
· Any change in the collection optics.
· The instrument has been idle for an extended period, or has been turned off.

· Lighting conditions have changed or are variable.

When in doubt, take a reference measurement!

Taking a DARK Measurement (Skip these steps in AutoDark Mode)
1. Check that the LED Power Indicator is illuminated, indicating that the power is enabled.
2. Press the Menu membrane switch unit the LSCN menu item appears; press the Edit membrane switch so that ON appears.
3. Press the Menu membrane switch until the DRK menu item appears; press the Edit membrane switch so that SCLD appears. This enables the Scaled Dark Mode for standalone operation.
4. Press the Scan membrane switch until the DRK x.xx scan message appears on the LCD. (x.xx indicates battery voltage) Check to see if battery is adequately charged.
5. Press and release the Laser Scan button on the side of the unit. The instrument will close the shutter and take dark data for approximately 15 seconds. Since the shutter closes in order to take the dark measurement, no particular target needs to be sighted by the instrument optics during a dark measurement. Dark measurements do not take up a memory location within the instrument's stand-alone scan memory.
6. The dark measurement just taken is associated with all succeeding measurements until a new Dark measurement is established. Dark measurements are stored in volatile memory (not flash) and must be retaken whenever the instrument power is cycled.

Taking a REFERENCE Measurement
1. Check that the LED Power Indicator is illuminated, indicating that the power is enabled.
2. Press the Menu membrane switch unit the LSCN menu item appears; press the Edit membrane switch so that ON appears.
3. Press the Scan membrane switch until the REF x.xx scan message on the LCD. (x.xx indicates battery voltage) Check to see if battery is adequately charged.
4. Place a reference at the point of measurement making sure to completely fill the field of view of the instrument. This reference measurement is associated with all succeeding measurements until a new reference measurement is established.
5. Press and hold the Laser Scan button to activate the sighting laser and verify the placement of the reference plate relative to the laser spot as required to fill the field of view.
6. Release the Laser Scan button to record the measurement. The LCD counter increments to display the next available memory location.

Taking a TARGET Measurement
1. Check that the LED Power Indicator is illuminated indicating that the power is enabled.
2. Press the Menu membrane switch until the LSCN menu item appears; press the Edit membrane switch so that ON appears.
3. Press the Scan membrane switch until the TAR x.xx scan message on the LCD. (x.xx indicates battery voltage) Check to see if battery is properly charged.
4. Place a reference at the point of measurement making sure to completely fill the field of view of the instrument. This reference measurement is associated with all succeeding measurements until a new reference measurement is established.

5. Press and hold the Laser Scan button to activate the sighting laser and verify the placement of the target to be measured relative to the laser spot as required to fill the field of view.
6. Release the Laser Scan button to record the measurement. The LCD counter increments to display the next available memory location. **Additional target measurements may be made by pressing and releasing the Laser Scan switch.**

4.3 Operation with a host PC

The PSR-1100 interacts with Spectral Evolution's DARWin SP software (provided with your instrument) running on the host PC via USB or Bluetooth virtual COM port connection.

The primary tasks that can be performed by running DARWin SP while connected to your spectroradiometer are:

1. Controlling the instrument remotely and collecting and displaying scan data in real time, with expanded control options, and
2. Retrieving and displaying scan data collected and stored during standalone operation.

Be sure to install the software (and any USB/Bluetooth communications drivers as needed) prior to the first time you connect to the instrument.

When running DARWin SP make sure your instrument has a charged battery and that it is powered and that the proper communications interface has been enabled. Once communications have been established, a brief initialization sequence follows and then your system is ready for use.

For detailed information on how to use DARWin SP with your PSR Series spectroradiometer, see the DARWin SP User Manual included with your instrument.

5 Battery Charger

5.1 Introduction

The provided battery charger is used to charge one lithium-ion battery (nominal 7.5VDC, 2800 mA-h). The charger operates from 110/240 volt AC line supply. Follow all directions for proper, safe operations. Only charge batteries indoors in a cool place.

5.2 Operation

To charge the external battery pack:

1. Remove the battery pack from the instrument.
2. Plug the charger's round male plug into the battery pack's female jack.
3. Plug the charger into an AC outlet.

The charger's *RED* LED will be illuminated during charging; when charging is complete the charger's *GREEN* LED will be illuminated.

Charging a battery from empty to full capacity (approximately 8.4VDC) will take approximately 2-3 hours.

5.3 Information and Warnings

Cells: 18650 Li-ION cells with IC protection are used inside the battery pack

Protection: 4A max polyswitch is installed in the battery pack for double over-discharging protection.

The battery will be automatically cut off to zero (0) volts when its voltage falls too low for PSR operation.

WARNINGS:

- Avoid heavy impact to the battery pack; this may cause the battery pack to malfunction.
- Do not expose the battery pack to fire or extreme heat; this may cause the battery pack to malfunction.
- Do not use any DC power supply or charger other than the dedicated battery charger supplied with your instrument; this may cause the battery pack to malfunction.

Also, always power the PSR Series instrument with its battery only. *NEVER* use the dedicated battery charger to provide power to the instrument.

Appendix A: Laser Safety

The PSR Series Spectroradiometers use a Class 3R laser beam that complies with IEC 60825-1, Ed. 1.2. The source of laser energy in the PSR is a nominal 3 mw, continuous, 635 nm diode laser. No maintenance or adjustments are required in order to keep this product in compliance with the above specifications.

DANGER:
Do not look into the laser beam at any time including instrument setup or operation.

The laser is operated by pressing the Laser Scan Switch located on the top surface of the instrument. See **Section 2: Hardware and Interface Description** for the location of this control.

CAUTION - Use of controls or adjustments or performance of procedures other than those specified herein may result in hazardous radiation exposure.

There are no user serviceable components within this device. The unit should be returned to the manufacturer in case of malfunction.

LABELING:
The following labels are required for the PSR Series instrument. Each label is described below. If the instrument does not have the appropriate labels, contact the manufacturer to ensure that your unit is in compliance.

(1) Explanatory Label

Location – Bottom of instrument, on the product information label.

(2) Supplementary Explanatory Label

Laser Power: 3 mW, Laser Wavelength 635 nm.
Laser conforms to IEC 60825-1, Ed 1.2.

Location – Bottom of instrument, on the product information label.

(3) Warning Label

Location – Bottom of instrument, on the product information label

(4) Aperture Label

Location - Next to the laser aperture.

Appendix B: PSR-1100 Specifications

Performance Specifications

Spectral Range	320–1100 nm
Spectral Resolution nominal	<= 3.2 nm
Spectral Sampling Bandwidth nominal	1.5 nm
Detector	512 element Si PDA
A/D Converter	16 bit
Wavelength Accuracy	.5 nm
Wavelength Reproducibility	.1 nm
Integration Time	8-2000 ms

Physical Specifications

Power	Supplied 2800 mA-h Li-Ion battery pack with charger, 7.5V nominal
Size	7” x 3.25” x 5.75”
Weight	< 4 lbs
Communications Interface	USB and Bluetooth virtual COM ports
Foreoptics	4° lens provided (other options available)
Onboard Storage	> 500 scans in stand-alone mode
Targeting	Internal red laser

Environmental Specifications

Operation	
Temperature	15 - 35° C (note: wvl drift 18 - 27° C)
Humidity	15 – 90 % non - condensing
Storage	
Temperature	0 - 70° C
Humidity	15 – 90 % non - condensing

Appendix C: Bluetooth Information

Bluetooth Versions Supported: V1.1
Bluetooth Class: Class I
Bluetooth Connection Type: Virtual COM Port
Bluetooth Connection Pin Key/Pairing Code: psr1100

Revision Tracking	Changes		Date
1.0	Original Draft		4/5/11

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