



Spectra Vista Corporation

LC-RP PRO

USER MANUAL

Revision 2.4

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Figure 2 Using the LC-RP PRO in Contact Mode

Features

Fiber Optic Coupling

The LC-RP PRO mates to standard fiber optic cables supplied with SVC's line of spectroradiometer products. The fiber can be attached to the probe easily and reliably in seconds without tools. Since the fiber mates into a removable sleeve insert, special sleeve inserts can be supplied to mate to other spectroradiometer manufacturer's fibers, as long as they are not too large.

Tungsten Halogen Bulb

The bulb supplied is rated for 5W, with a color temperature of 3000 °K, and a 600 hour lifetime.

Regulated Power

Bulb voltage is regulated to within $\pm 0.1\%$, regardless of battery voltage for reliable reflectance measurements.

Built-in White/Black Disk

The probe's integrated Sample Holder holds a Spectralon® material White Disk, as well as a low-reflectance Black Disk made from a material which has extremely low reflectivity. Having these components integrated into the probe reduces the number of pieces of equipment that the operator needs to carry into the field. A mechanism with a locking feature allows the disks to stay detracted

from the window. The Sample Holder is also detachable from the probe when not needed and can be stored on the side of the probe housing.

Power

The probe's input power is provided thru a special cable from the SVC i-Series spectroradiometer rear panel to the control / power cable connection jack on the probe using a locking multi-pin miniature circular connector. The power is supplied using the same battery pack and charger supplied with the SVC i-Series spectroradiometers. The same cable also provides the reference/target scan control connections from the probe to the spectroradiometer.

When using the LC-RP Pro with the older SVC HR-1024 spectroradiometer or other spectroradiometers, an optional external battery pack is used to supply the power to the probe.

Slide Switch Selections

Three slide switches on the front cover assembly of the probe allow selection of the following parameters: 1. Power on/off to the lamp, 2. High and low lamp brightness, 3. Reference/Target measurement selection.

Power LED

The Power LED is located on the probe's front cover assembly. When the LED is illuminated, the lamp is on.

Small Spot Measurement

A special optional fiber optic sleeve with an internal lens and baffle is available to enable measurements with a smaller size spot on the sample.

Measurement Switch

A pushbutton switch built into the actuator for the Sample Holder provides a convenient/ergonomic way to taking multiple measurements in the stand-alone configuration.

Using the Reflectance Probe

Connections And Instrument Settings

The LC-RP Pro connects to the instrument using the Control / Power Cable (gray) and Fiber Optic Cable (black) as shown in the next figure.

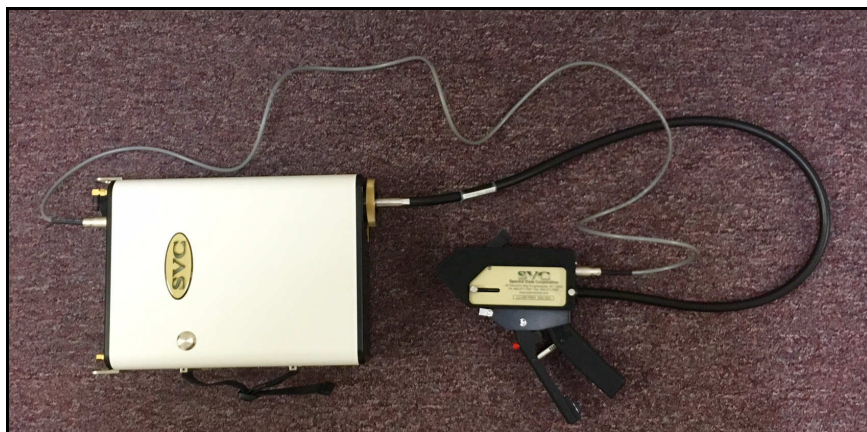


Figure 3 Instrument Connection Overview

The Control / Power Cable attaches to the AUX connector located on the instrument's back panel. See the figure below. As shown in the LCD setup screen, it is suggested to use FOREOPTIC: LENS 4 to use the default LENS 4 calibration table when acquiring reflectance measurements.

When acquiring stand-alone scans, you must select either TRIGGER: SCAN ONLY (shown) or TRIGGER: LASER + SCAN. This setting is needed in order to enable the red Pushbutton Measurement Switch, which acquires stand-alone scans that are stored internally to the instrument.

When acquiring real-time scans (via PC/PDA software), change the trigger setting to the default TRIGGER: LASER ONLY in order to disable the red Pushbutton Measurement Switch and prevent accidental scan triggering.

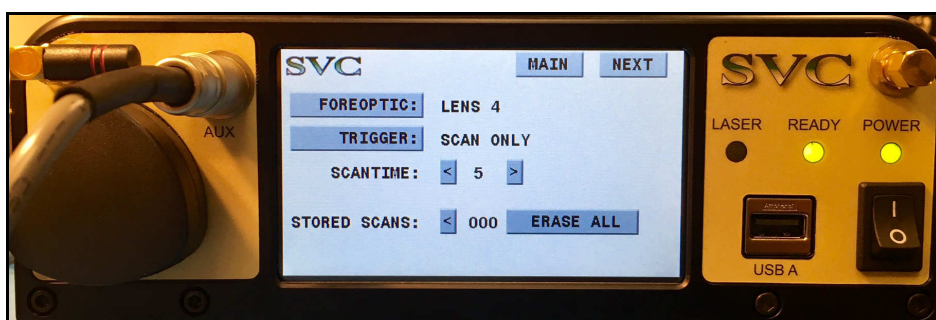


Figure 4 Control / Power Cable AUX Connection and Stand-Alone Scan LCD Setup

Controls & Features

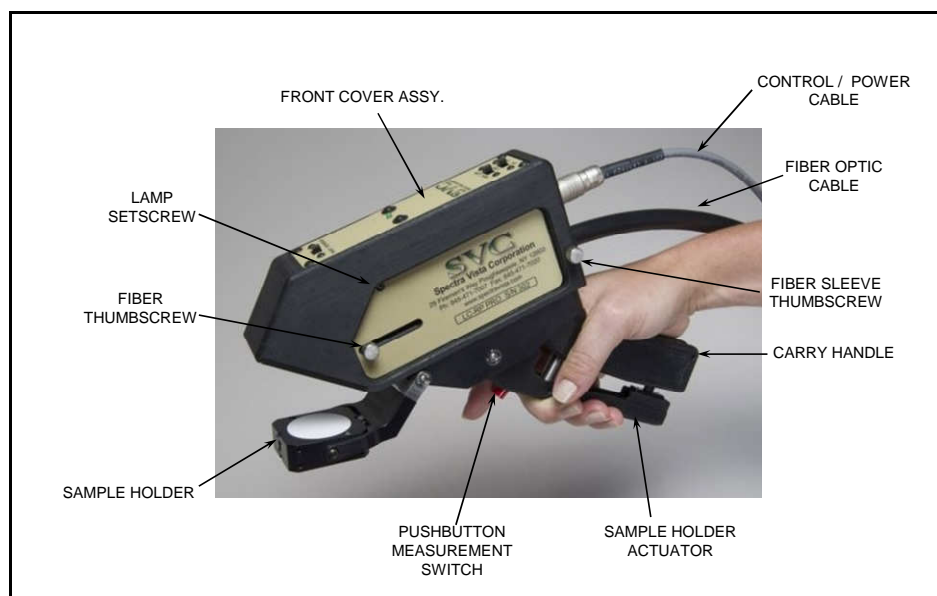


Figure 5 Controls and Features View 1

- **Lamp Setscrew** – Holds the internally-mounted lamp in place, and should only be loosened when necessary to replace a burned-out lamp
- **Fiber Thumbscrew** – Holds the fiber optic cable within the fiber optic cable sleeve in place.
- **Fiber Sleeve Thumbscrew** – Holds the fiber optic cable sleeve in place. The sleeve should only need replacing in order to use a different fiber, or to change to a different measurement spot size.
- **Sample Holder** – Holds both the White and Black Disks used for reference and target measurements by positioning either disk against the window.
- **Pushbutton Measurement Switch** – In stand-alone mode, initiates acquisition of a reference or target scan. In PC or PDA mode, the connected computer initiates scan acquisition.
- **Sample Holder Actuator** – Moves the Sample Holder via a linkage.
- **Control / Power Jack** – Connects LC-RP Pro via the Control / Power Cable to the SVC i-Series spectroradiometer; or optionally, to an external battery pack.

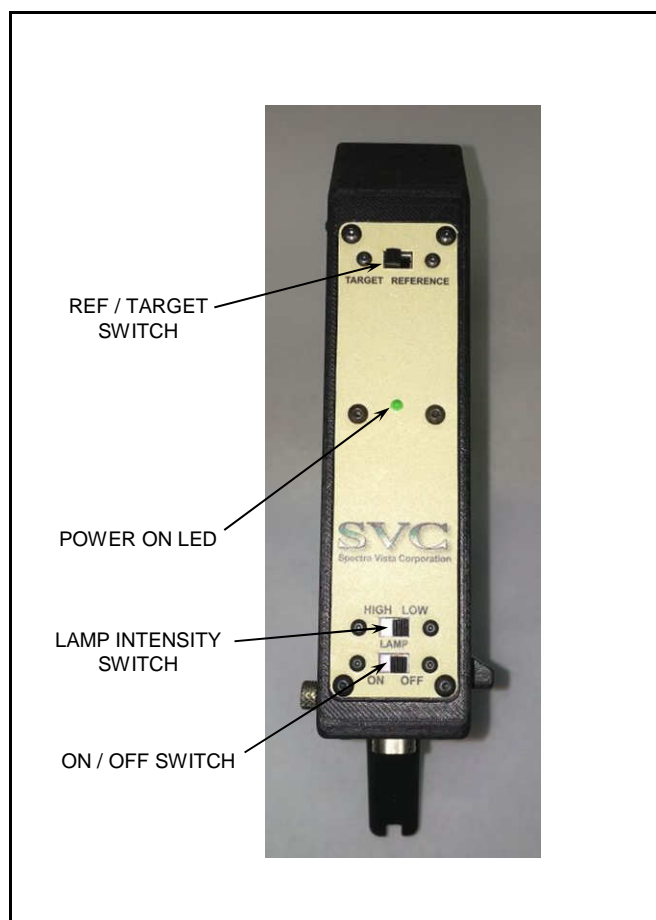


Figure 6 Controls and Features View 2

- **Lamp Intensity Switch** – Allows the selection of either high or low lamp intensity.
- **Power on LED** – Verifies power to the probe.
- **On / Off Switch** – When ON, power is supplied to the internal lamp. This switch should remain in the OFF position when not needed in order to conserve battery power.
- **Reference / Target Switch** – In stand-alone mode, this switch is used to select whether a push-button initiated measurement is acquired as a reference or target scan. In PC or PDA mode, the scan type is controlled by the computer and the setting of the Reference / Target Switch is ignored.

Sample Holder Mechanism

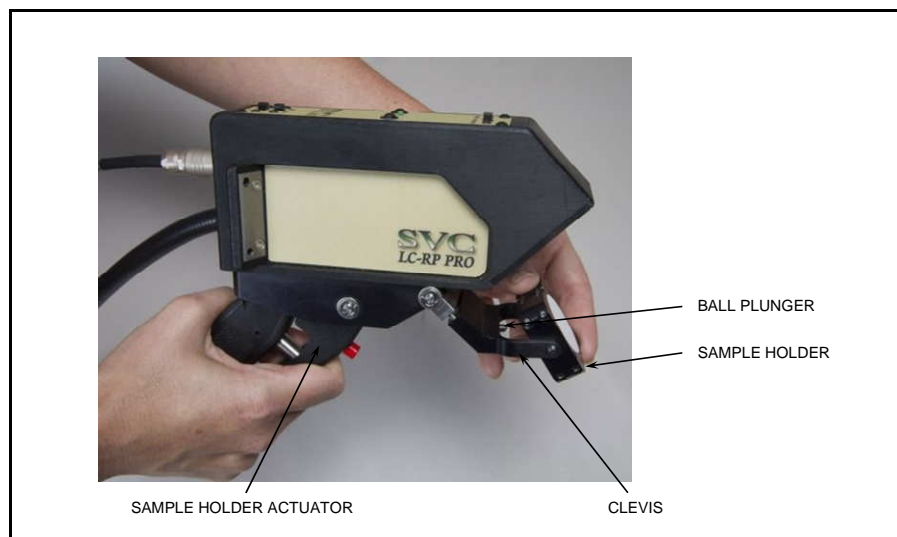


Figure 7 Operation of the Sample Holder Mechanism

- **Sample Holder Actuator** – By squeezing this actuator a coil spring will be compressed while the Sample Holder retracts from the window via a linkage. The spring force was balanced to provide an optimum force for the sample against the window while the user is holding the probe about the handle and actuator.
- **Actuator Latch** – is incorporated into the actuator lever and handle and holds the Sample Holder open and away from the window against the spring when the actuator is sufficiently squeezed. Thus the actuator does not have to be constantly squeezed to hold the Sample Holder open. It is released by squeezing the actuator more to cause the latch to release.
- **Sample Holder Pivot** – allows the Sample Holder to pivot about a transverse axis to accommodate different thickness samples while keeping the Sample Holder parallel to the window. The pivot is kept within a range of about $\pm 8^\circ$ which thus will accommodate a sample up to about 0.3 inch (8 mm) thick. There is a small amount of drag about the pivot while the Sample Holder is restricted from pivoting further by using a ball plunger within the clevis, which can be overcome by rotating the Sample Holder by hand to switch over to the other disk.
- **Sample Holder Removal** – a pair of high strength magnets and locating pins within the clevis allows the removal of the Sample Holder when it is not needed. The removal is done by simply pulling it off.

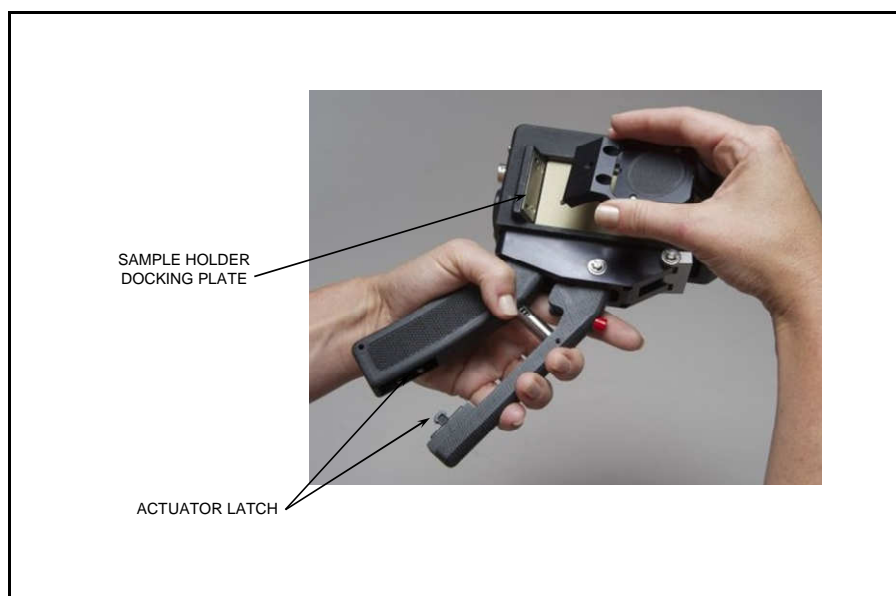


Figure 8 Sample Holder Storage

- **Sample Holder Storage** – a magnetic docking plate on the left side of the probe allows the storing of the Sample Holder assembly when it is not in use.

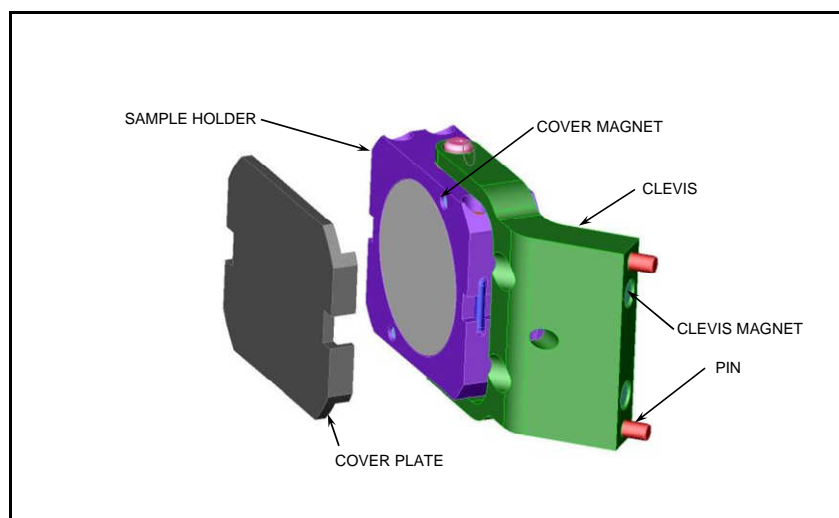


Figure 9 Sample Holder Cover

- **Sample Holder Cover** – is a stainless steel plate that is held in place with the magnets in the Sample Holder. It provides protection to either the Black or White Disk but is recommended to be used primarily on the latter. It does not interfere with rotation of the Sample Holder about the clevis.

Dual Spot Size Capability



Figure 10 Fiber Sleeve Removal

- **Optional spot size** – the fiber can view either the standard large target size or with the optional Small Spot Sleeve view or small target size. See Figure 11.
- **Fiber sleeve removal** – is achieved by removing the fiber thumbscrew (see Figure 5), removing the fiber optic cable from the sleeve, loosening the sleeve thumbscrew then pulling out the fiber sleeve. Installation is the reverse. There is an orientation pin for the sleeve to align the sleeve so that the fiber thumbscrew can feed into its tapped hole on the sleeve to hold the fiber optic cable.

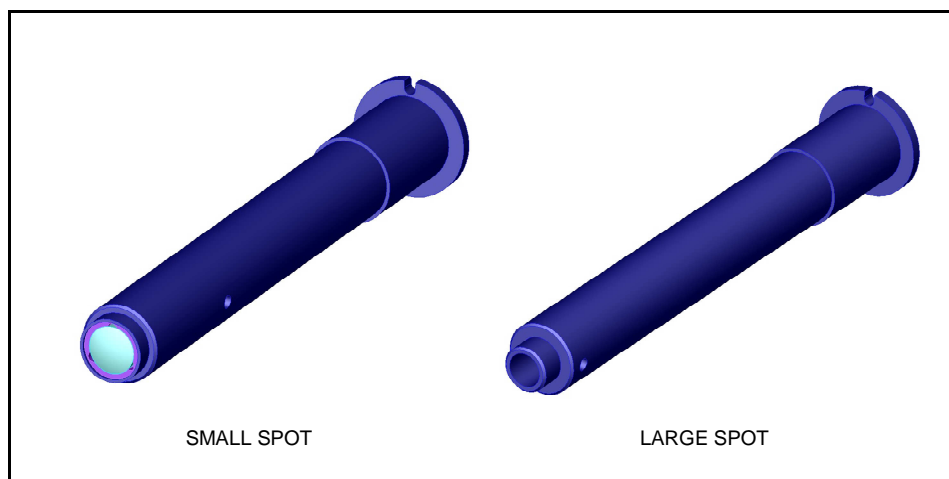


Figure 11 Fiber Optic Sleeves Showing the Standard Large Spot and Optional Small Spot

- Using 2 different fiber optic sleeves, the probe can be setup to view a standard (large) spot and a optional (small) area of the target. See the Specifications section for spot sizes.
- Custom designed sleeves can be provided to accommodate other fiber optic cable sizes than used for the SVC spectroradiometers.

Optional Leaf Press Adapter

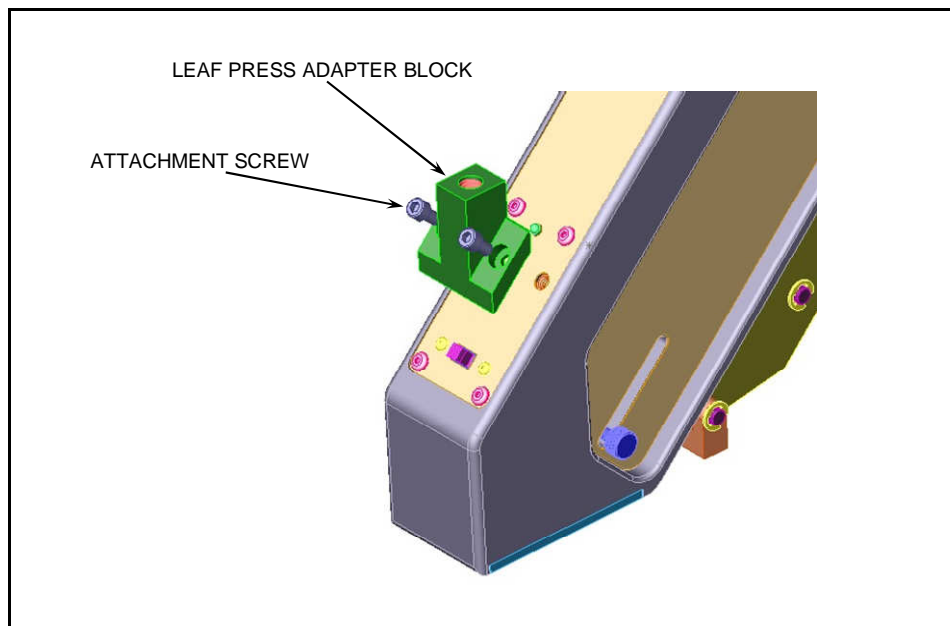


Figure 12 Leaf Press Adapter Block

- An optional Adapter Block needs to be installed to use the optional SVC Leaf Press Device. This Adapter Block includes a 1/4-20 UNC threaded insert for attachment to the SVC Leaf Press Device.
- This Adapter Block would be installed on top of the Front Panel just below the LED power indicator lamp as shown in the above Figure 12.
- For probes using the Leaf Press Device, holes in the front panel overlay will be added for the Adapter Block screws.

Taking Measurements with the SVC LC-RP Pro

General Tips and Notes for Best Results

- Always allow the i-Series instrument at least 10 minutes of warm up time after initial cold power-up prior to acquiring scans.
- After applying power and turning on the probe's lamp, wait at least 90 seconds in order to allow the lamp to stabilize.
- When scanning vegetation, do not expose the vegetation to the lamp's heat for any longer than necessary, as the lamp may eventually begin to affect the sample.
- Caution should be used when interpreting data below 450 nm when using the probe. The artificial illumination diminishes rapidly below 450 nm. As such, the data reliability is decreased in this region and should be closely reviewed for each application.
- Be sure to fully insert the fiber optic cable into the fiber optic sleeve prior to use. If in doubt, for the large spot the end of the fiber may be seen by looking through the sample window and it should be flush with the end of the sleeve. For the small spot this will not be possible. Also the fiber for the small spot will not insert as far into the sleeve.
- Ensure that the spectroradiometer battery is fully charged prior to the start of field work.

Connect the Probe's Fiber and Electrical Cables

Refer to Figure 3, Figure 5, and Figure 10 for fiber/electrical connections.

- At the instrument, install the fiber optic cable / adapter. Refer to the instrument's User Manual for more details.
- At the probe, fully insert the fiber optic cable into the fiber optic cable sleeve, and lock it into place by gently tightening the Fiber Thumbscrew. Ensure that the fiber optic cable sleeve is fully inserted and that its thumbscrew is tight.
- With the probe's Lamp power switch set to the OFF position, use the Control / Power Cable to connect the probe to either the instrument's AUX port (**i-Series instruments only**) or to the optional probe external battery pack (**other instruments**).

LC-RP Pro measurements may be acquired in either stand-alone mode or the real-time (PC / PDA) mode. Operation in each mode is described below.

Measurement Procedure – Stand-alone Mode (i-Series Instruments)

In stand-alone mode, scan data is acquired and stored internally to the spectroradiometer; no PC or PDA is required for stand-alone scan acquisition. The acquired scans are later downloaded from the instrument to a PC.

In this mode, the probe's Reference / Target slide switch controls the type of acquired scan.

1. In order to enable the probe's red Pushbutton Measurement Switch to acquire stand-alone scans, the instrument's "TRIGGER:" setting (found on LCD setup screen #1) must be set to either "LASER + SCAN" or just "SCAN". See Figure 4 for the LCD setup screen.
2. Turn on the probe's lamp by way of the on/off slide switch on the electrical panel. The LED indicator should be ON and the lamp's light should be visible through the glass window on the bottom of the probe.
3. Wait at least 90 seconds after initially turning on the lamp to allow it to stabilize.
4. Select "Reference" on the slide switch on the front panel.
5. Position a reference sample (either the probe's built-in White Disk, or another operator-supplied white plate) under the glass window.
6. Take a reference scan by pressing the red Pushbutton Measurement Switch on the actuator.
7. Select "Target" on the slide switch on the front panel
8. Place a target sample under the glass window. The probe's built-in White or Black Disk may be used to back the target sample:
 - Use the Black Disk for reflectance measurements (most often used).
 - Use the White Disk for trans-reflectance measurements.
9. Take a target scan by again pressing the red Pushbutton Measurement Switch.

Measurement Procedure – Real-time (PC / PDA) Mode

In real-time mode, the instrument's PC/PDA software is used instead of the red Pushbutton Measurement Switch to acquire scan data. Scans acquired this way are returned to and stored immediately in the PC/PDA file system as .sig files.

In this mode, the scan type (reference or target) is controlled by the PC/PDA software, and probe's Reference / Target slide switch is ignored.

1. Connect the PC / PDA software to the instrument. Refer to the instrument's User Manual for more details.
2. If using an i-Series instrument, disable the probe's red Pushbutton Measurement Switch. The instrument's "TRIGGER:" setting (found on LCD setup screen #1) must be set to "LASER". See Figure 4 for the LCD setup screen
3. Turn on the probe's lamp by way of the on/off slide switch on the electrical panel. The LED indicator should be ON and the lamp's light should be visible through the glass window on the bottom of the probe.
4. Wait at least 90 seconds after initially turning on the lamp to allow it to stabilize.
5. Position a reference sample (either the probe's built-in White Disk, or another operator-supplied white plate) under the glass window.
6. Take a reference scan by pressing the PC / PDA software's "Reference" button.
7. Place a target sample under the glass window. The probe's built-in White or Black Disk may be used to back the target sample:
 - Use the Black Disk for reflectance measurements (most often used).
 - Use the White Disk for trans-reflectance measurements.
8. Take a target scan by pressing the PC / PDA software's "Target" button.

Maintenance

Supplied Tools

The following maintenance tools are supplied with the SVC LC-RP Pro:

SHORT PHILLIPS #1

5/64 INCH HEX WRENCH

1/16 INCH HEX WRENCH

0.05 INCH HEX WRENCH

CLEANING TOOL

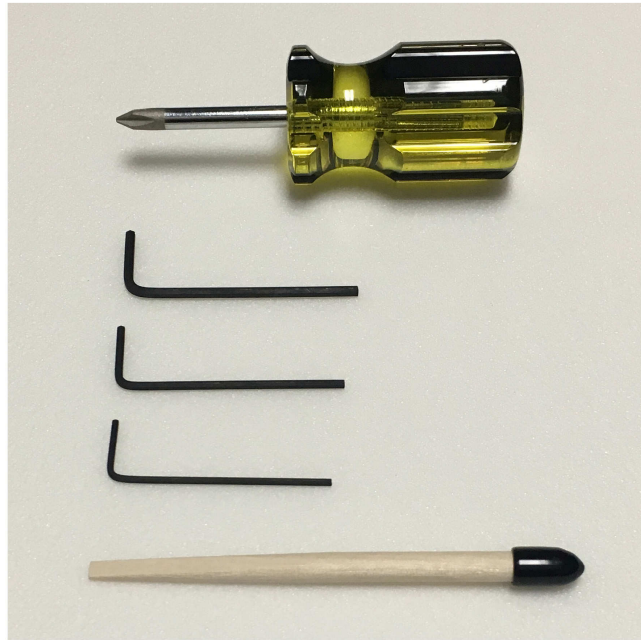


Figure 13 Supplied Maintenance Tools

- 1/16 Inch Hex Wrench – used on the 4 Front Cover fasteners and Sample Holder pivot.
- 5/64 Inch Hex Wrench – used on the shoulder screw fasteners that mount the white/black reflectance disks into the Sample Holder.
- 0.05" Inch Wrench – used on Lamp Setscrew.
- Cleaning Tool – used when changing the foam gasket, to remove excess glue and debris from the gasket mating channel.
- Short Phillips #1 – used on the Phillips head screws that hold the Window Plate to the housing.

Supplied Replacement Parts

White/Black Reflectance Disks

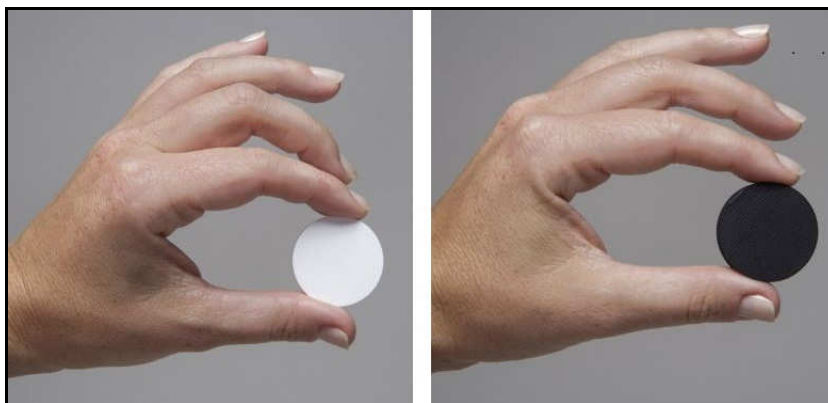


Figure 14 Replacement White/Black Reflectance Disks

Lamp Assembly



Figure 15 Replacement Lamp Assembly

Windows / Foam Gasket Parts

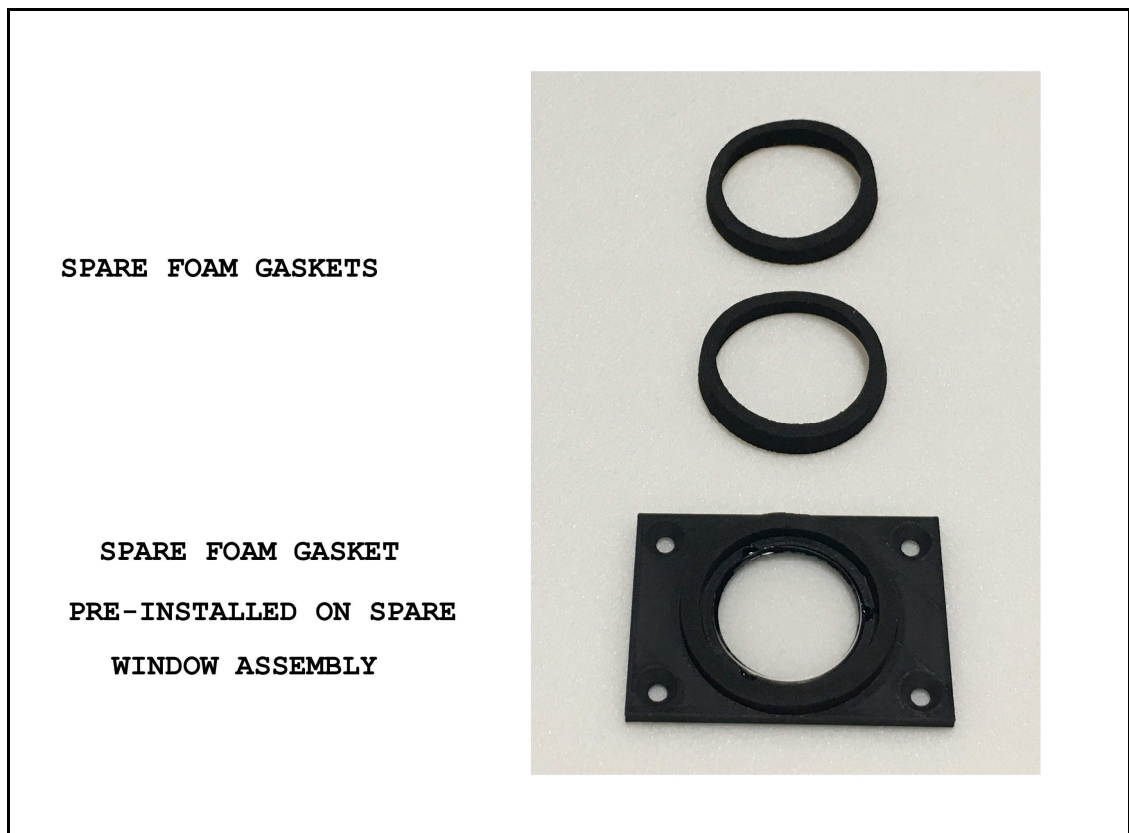


Figure 16 Replacement Gasket / Window Assembly

Two spare foam gaskets, and one additional spare foam gasket that is pre-installed on a spare windows assembly, are supplied with the LC-RP Pro.

Miscellaneous Parts

Various other small mechanical replacement parts (fasteners, etc) are supplied with the LC-RP Pro.

Removing the Front Cover

1. Place the Probe on its bottom on a soft anti-static surface.
2. Remove the four (4) fasteners holding the front cover at its corners (see Figure 17) using the 1/16" hex wrench. **ONLY REMOVE the 4 corner fasteners, DO NOT REMOVE any of the other fasteners.**

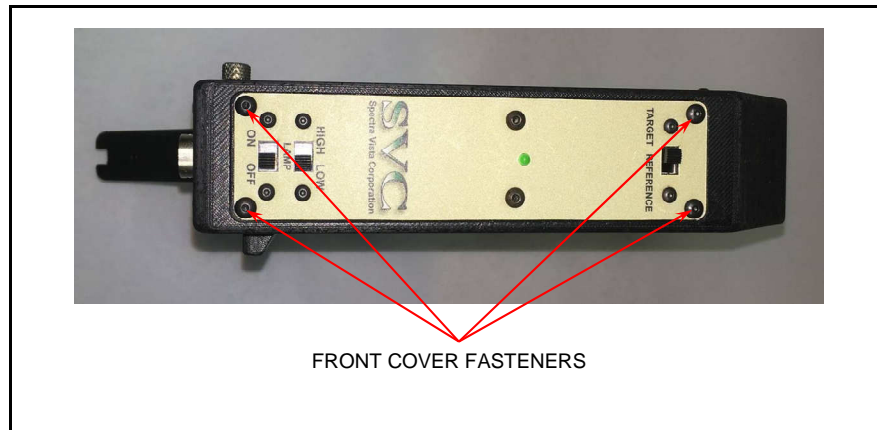


Figure 17 Front Cover Fasteners

3. Attached to the inside of the front cover is a PC board with wires attached. Gently remove the cover and lay it flat next to the probe, with the wires still attached, as shown below.

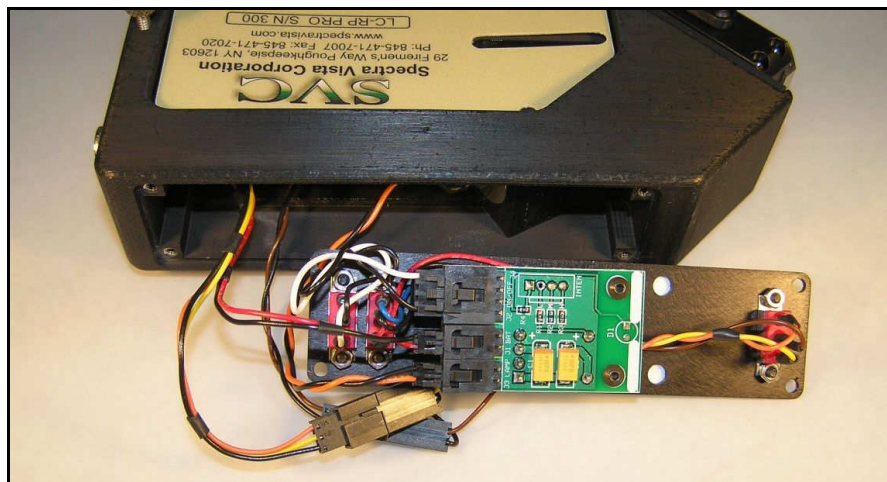


Figure 18 Front Cover Detail Showing Internal Wiring

4. There are 3 connectors still attaching the front cover PCB to the probe; from top to bottom in the figure above:
 - 4 position/2 conductor (**black/nc/nc/white**) wire going to the Lamp Power Switch.

- 2 conductor (**black/red**) wire going to the round Control/Power Input Connector.
 - 2 conductor (**black/orange**) wire going to the Lamp Assembly.
5. There is one additional connection that carries the Pushbutton Measurement switch to the Control/Power Input Connector:
- 2 conductor (**brown/black**) wire going to the Pushbutton Measurement switch.

WARNING – Note for re-assembly: CAREFULLY OBSERVE the wire color of the 2-pin Lamp Power Input connectors listed above.

6. Remove each of the three connectors from the PCB by pressing down on the release tabs on each of the three connectors (see Figure 19), and remove the front cover completely.

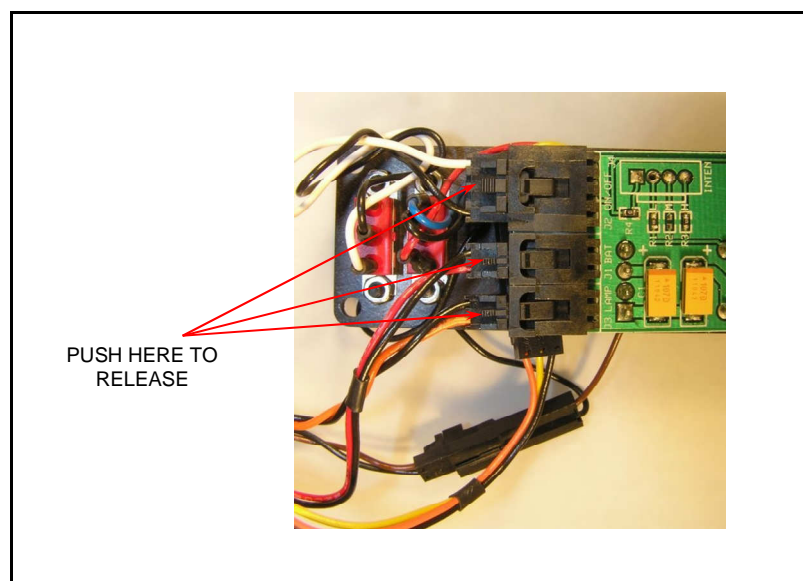


Figure 19 PCB Cabling Release Tabs



Figure 20 Cover Completely Removed

Cleaning the Glass Window

The inner surface of the glass window may need to be cleaned of contamination.

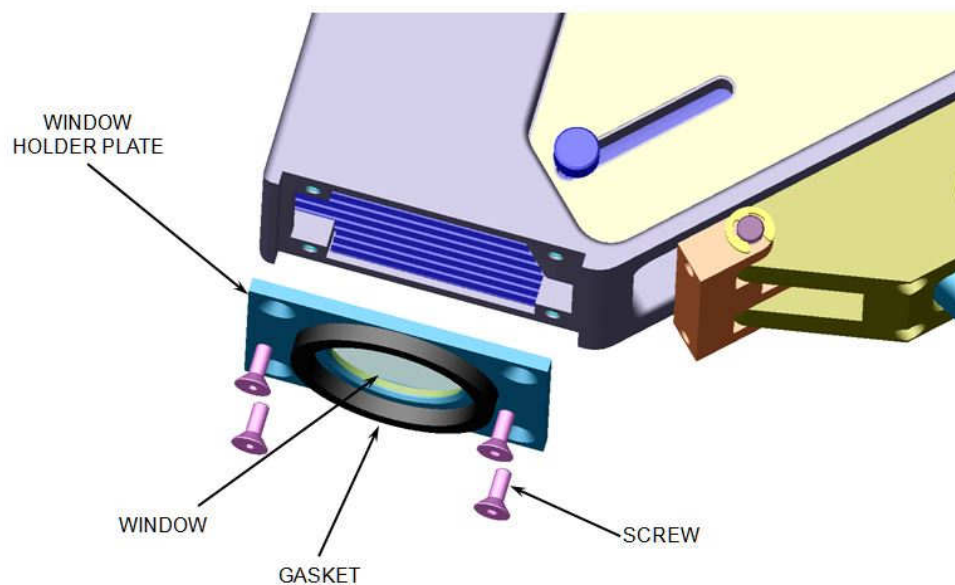


Figure 21 Window Assembly Removal

WARNING: Do not attempt to clean the glass window immediately after operation. The glass may become hot. Allow the unit to cool before attempting this maintenance procedure.

WARNING: Do not over-tighten the 4 screws that hold the Window Holder Plate; this may crack the Window or Window Holder Plate.

1. Retract or remove the Sample Holder Assembly as described earlier
2. Remove all 4 of the flathead screws that attach the window holder plate to the probe housing bottom using the Phillips screwdriver.
3. Remove the Window Assembly from the housing block. The Window Assembly consists of a glass window bonded into a polymer frame surrounded by a foam light gasket.
4. Using lint-free material (lens tissue or lens swabs) clean the top surface of the glass window. If necessary, slightly dampen the tissue/swab with a small amount of alcohol, followed by a dry tissue/swab.
5. Examine the cleanliness of the glass surface by looking through the glass.
6. Reinstall the Window Assembly, reversing the previous removal steps. Take care not to over-tighten the 4 Philips head screws that hold the Window Holder Plate to the body of the LC-RP Pro. Note that the window assembly is symmetric and thus can be installed either way.

Removing the White/Black Disks from the Sample Holder

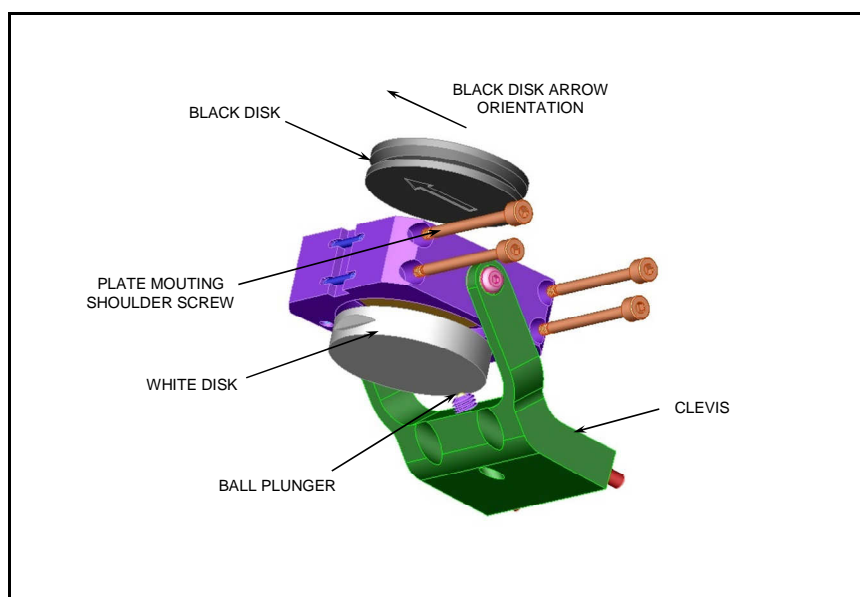


Figure 22 White/Black Disk Removal

1. Remove the 2 shoulder screws for the disk you want to remove using the 5/64" hex wrench. If needed the shoulder screw can be pushed out from the threaded end with the help of the 0.05" hex wrench (see Figure 22).
2. Remove the disk from the Sample Holder.
3. When reinstalling the Black Disk note the arrow imprinted into the disk, as it should be parallel to the arrow in Figure 22 and on the non-exposed side. This arrow orientation is important for providing the lowest reflectivity from the Black Disk.

4. When reinstalling the White Disk note the bevels on the side that interface with the shoulder screws (see Figure 22). The White Disk may be installed with either face out.
5. When reinstalling either disk a small amount of compressive force might have to be applied to the disk in order to push it against an internal foam spacer to enable the shoulder screws to feed back in.

Cleaning the Spectralon® White Disk

For light soiling, air brush the surface with a jet of clean dry air or nitrogen. **Do not use Freon or other chemicals on the surface.**

For heavier soiling:

1. Remove the White Disk from the Sample Holder (See Removing the White/Black Disks from the Sample Holder above.)
2. Clean the White Disk material using distilled water, lightly sanding with a 220-240 grit waterproof emery paper until water beads and runs off the surface. Sand the disk using a figure-eight motion. Dry the surface with clean air or nitrogen, or allow it to air dry. Ensure that the surface is thoroughly dry before using it for measurements.
3. Replace the White Disk in the Sample Holder as described previously.

Changing the Lamp Assembly

Warning: Do not attempt to change the lamp immediately after operation. The bulb may become extremely hot. Allow the unit to cool before attempting this maintenance procedure.

1. Remove the Control/Power cable and Fiber Optic Cable from the Probe.
2. Remove the Front Cover (See Removing the Front Cover section above.)
3. With the front cover removed, look into the interior cavity of the probe body. The lamp is mounted in a cylindrical hole within the cavity (see Figure 20).
4. Use the .05 Inch Hex Wrench to loosen the Lamp Set Screw located on the side of the probe housing (see Figure 5) a few turns. This will free the lamp from the probe housing.
5. Carefully reach into the cavity and gently pull upwards on the lamp's orange/black wiring to completely remove the lamp assembly from the cavity.
6. Insert the replacement lamp into the cavity, gently guiding the lamp housing into the cylindrical hole in the bottom of the chassis.

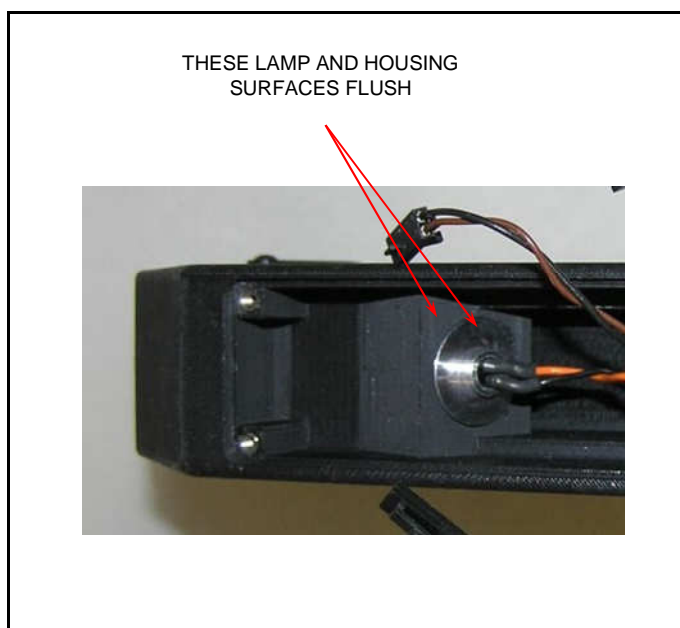


Figure 23 Lamp Replacement

7. Lower the lamp housing until the lamp housing and housing surfaces identified in Figure 23 line up flush. Use the .05" hex wrench to tighten the lamp setscrew. **Warning: inserting the lamp assembly too far into the cylindrical cavity will increase the light/heat energy that the sample is exposed to, which may rapidly degrade some samples (especially vegetation) during scanning. Furthermore the spectral data may show some anomalies.**
8. Reattach the front cover, reversing the prior removal steps.

Replacing The Foam Gasket

When worn, the foam gasket surrounding the window must be replaced in order to prevent light leaks.

Note that, if available, the complete spare Window Assembly with Pre-Installed Gasket (see Figure 16 above) may be used in the field to quickly replace the entire window/gasket as one piece. See the procedure "Cleaning the Glass Window" above for details on how to remove/replace the entire window assembly.

To replace just the foam gasket:

1. Retract or remove the Sample Holder as described earlier
2. Using your finger tips and cleaning tool, remove the worn foam gasket from it's groove around the window. Be sure to clean out all gasket pieces and glue residue to leave a clean surface in the round groove (see Figure 21 above).
3. Remove the paper backing from the spare foam gasket.
4. Carefully insert the spare foam gasket into the round groove, pressing the gasket evenly.
5. Replace the Sample Holder.

Specifications

Unit Size	10.07 inch long, 6.14 inch high, 2.12 inch deep 25.6 cm long, 15.6 cm high, 5.4 cm deep
Unit Weight	1.19 lbm. (0.54 kg)
Input Power	6.5 – 8.0 VDC @ 1.0 A (Max)
Lamp	Tungsten Halogen Power (Hi): 4.7 Watts Power(Lo): 2.9 Watts Typical Filament Life: 600 H
Sample Window Material	Pyrex Glass, Ø1.00 inch (25.4 mm)
Fiber target size (large spot) Using the HR-512i VNIR instrument	0.58 inch log, 0.40 inch wide 14.8 mm long, 10.1 mm wide
Fiber target size (large spot) Using full-range i-Series instruments	0.83 inch long, 0.57 inch wide 21.0 mm long, 14.5 mm wide
Fiber target size (optional small spot) Using full-range i-Series instruments	0.40 inch long, 0.29 inch wide 10.2 mm long, 7.4 mm wide
Fiber target size (optional very small spot) Using full-range i-Series instruments	0.24 inch long, 0.14 inch wide 6.2 mm long, 3.5 mm wide
Environmental	Temperature: -10C to +40C Humidity: <90%, non-condensing
Cleaning	Wipe down exterior with soft, dry cloth only.

Appendix A – Application Notes

Typical Black Disk Reflectance Curve

The graph below shows a typical Black Disk reflectance curve relative to the White Disk:

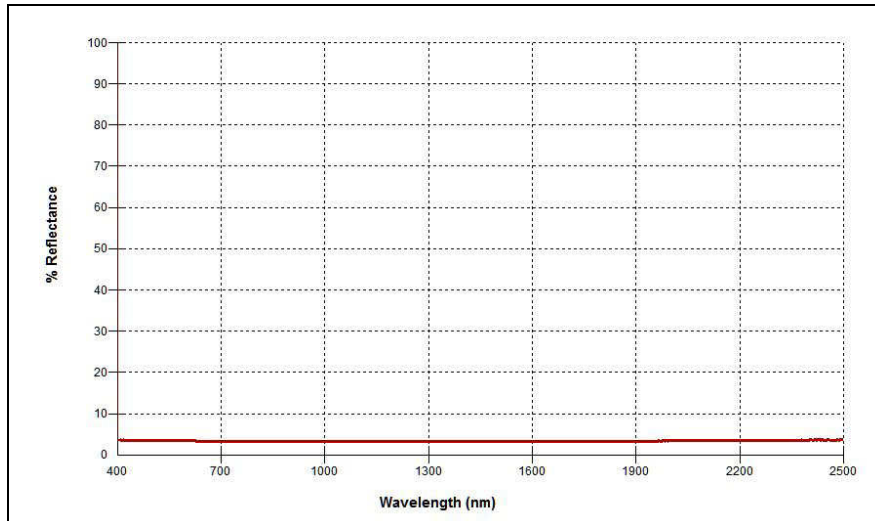


Figure 24 Typical Black Disk Reflectance Curve

SVC LC-RP Pro User Manual
Document Revision Sheet

[illegible]