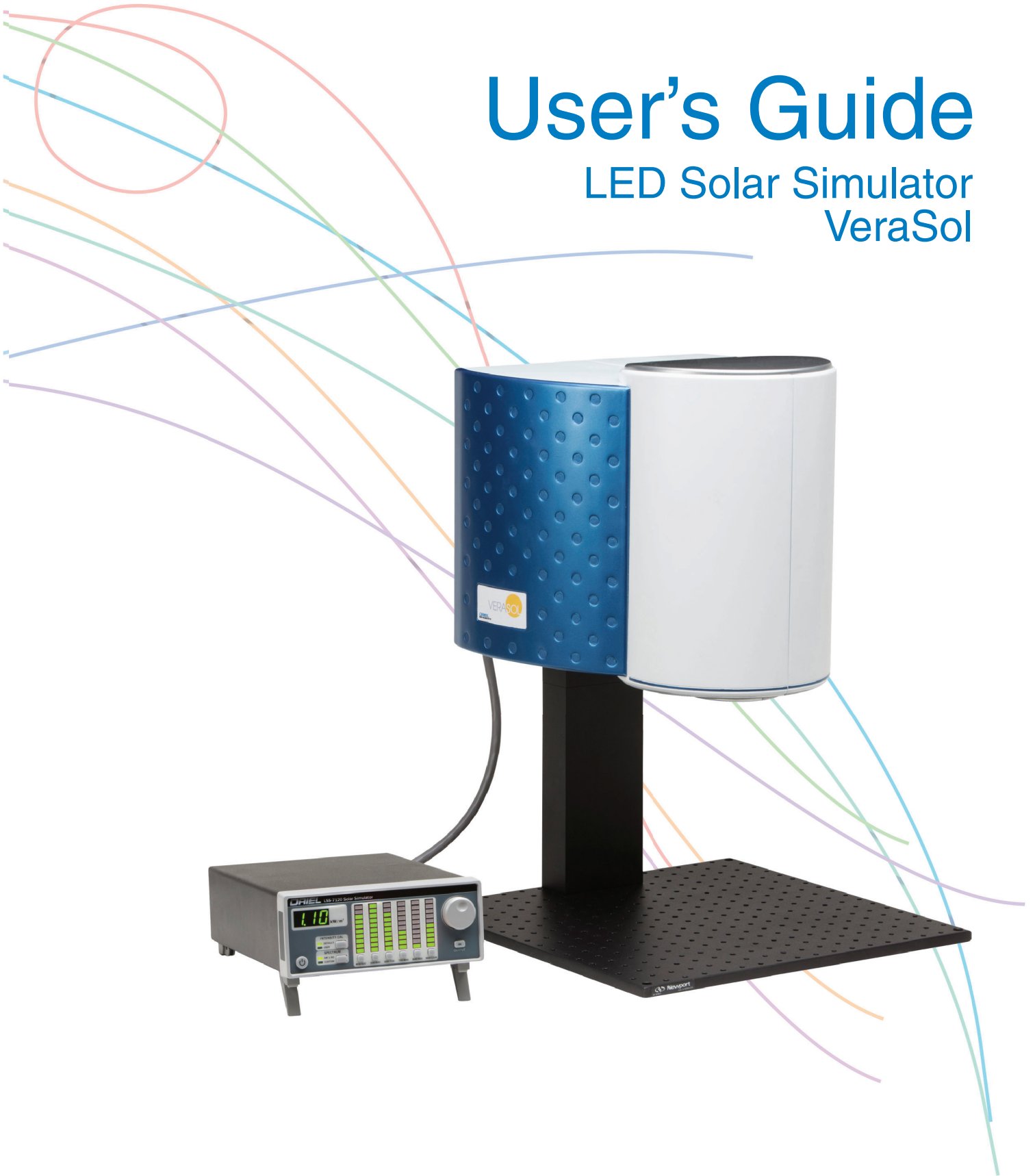


# User's Guide

## LED Solar Simulator VeraSol



**Newport Corporation**  
31950 Frontage Road Bozeman, MT, USA

PHONE: 1-800-459-9459 1-406-556-2481 FAX: 1-406-586-9405 EMAIL: sales@ixlightwave.com  
Complete listings for all global office locations are available online at [www.newport.com/contact](http://www.newport.com/contact)

[www.newport.com](http://www.newport.com)

Newport Corporation, Irvine and Santa Clara, California and Franklin, Massachusetts; Evry and Beaune-La-Rolande, France; Stahnsdorf, Germany and Wuxi, China have all been certified compliant with ISO 9001 by the British Standards Institution.



# Table of Contents

Safety Information and the Manual .....	1
General Safety Considerations .....	1
Safety Symbols .....	2
Safety Marking Symbols .....	3
Warranty .....	3
Limitations.....	3
Returning an Instrument .....	4
Comments, Suggestions, and Problems.....	5
Chapter 1: Introduction and Specifications .....	7
Safety Considerations.....	7
Initial Inspection .....	7
Product Overview.....	8
Options and Accessories .....	11
Specifications.....	12
Chapter 2: Assembly Instruction .....	13
Chapter 3: General Operation.....	17
Grounding Requirements.....	17
AC Line Power Requirements.....	17
The Power Up Sequence.....	17
Firmware Upgradeability .....	18
USB Communication.....	18
Tilt Foot Adjustment.....	18
Rack Mounting .....	18
Head Orientation.....	18
Front Panel Operation.....	19
LSH-7520 LED Head Operation.....	23

Chapter 4: Remote Operation .....	25
USB Communication.....	25
Command Syntax .....	25
Chapter 5: Command Reference .....	27
Remote Command Reference Summary.....	27
Command Reference.....	28
Chapter 6: Remote Control Software .....	31
Installation.....	31
Operation .....	32
Chapter 7: VeraSol Replicator .....	35
Input / Output Controls.....	35
Input File .....	35
Output File .....	37
Location Controls .....	37
Latitude / Longitude.....	37
UTC Time Zone.....	37
Date.....	37
Hour.....	37
Location Helper.....	38
Map .....	38
UTC.....	39
VeraSol Controls.....	39
VeraSol Storage Location .....	39
Generate Spectrum.....	39
Download to VeraSol .....	40
Version.....	40
Chapter 8: Calibration and Troubleshooting .....	41
Troubleshooting Guide.....	41

# Safety and Warranty Information

---

- ✓ Details about cautionary symbols
- ✓ Safety markings used on the instrument
- ✓ Information about the warranty
- ✓ Customer service contact information

## Safety Information and the Manual

Throughout this manual, you will see the words Caution and Warning indicating potentially dangerous or hazardous situations which, if not avoided, could result in death, serious or minor injury, or damage to the product.



Caution indicates a potentially hazardous situation which can result in minor or moderate injury or damage to the product or equipment.



Warning indicates a potentially dangerous situation which can result in serious injury or death.

## General Safety Considerations

If any of the following conditions exist, or are even suspected, do not use the instrument until safe operation can be verified by trained service personnel:

- Visible damage
- Severe transport stress
- Prolonged storage under adverse conditions
- Failure to perform intended measurements or functions

If necessary, return the instrument to Oriel Instruments, or an authorized local Oriel Instruments distributor, for service or repair to ensure that safety features are maintained.

All instruments returned to Oriel Instruments are required to have a Return Merchandise Authorization Number assigned by an official representative of Oriel Instruments. See Returning an Instrument for more information.

## **Safety Symbols**

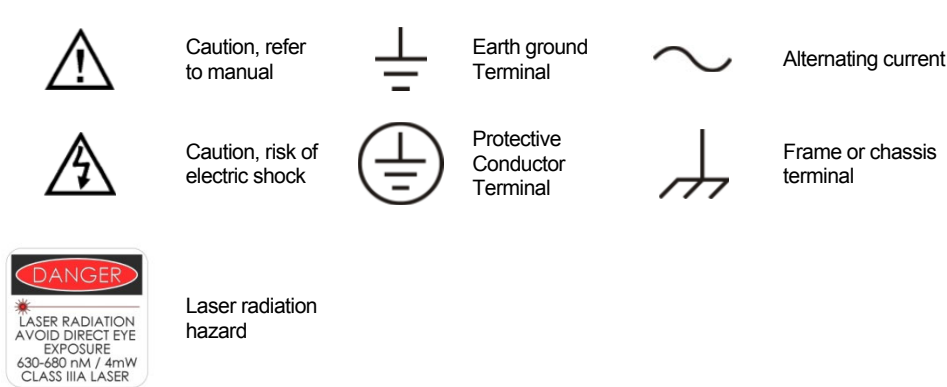
This section describes the safety symbols and classifications.

Technical specifications including electrical ratings and weight are included within the manual. See the Table of Contents to locate the specifications and other product information.

- Indoor use only
- Ordinary Protection: This product is NOT protected against the harmful ingress of moisture.
- IEC Class I Equipment (grounded type)
- Mains supply voltage fluctuations are not to exceed  $\pm 10\%$  of the nominal supply voltage.
- Pollution Degree II
- Installation (overvoltage) Category II for transient over-voltages
- Maximum Relative Humidity:  $< 85\%$  RH, non-condensing
- Operating temperature range of  $20\text{ }^{\circ}\text{C}$  to  $30\text{ }^{\circ}\text{C}$
- Storage and transportation temperature of  $-40\text{ }^{\circ}\text{C}$  to  $70\text{ }^{\circ}\text{C}$
- Maximum altitude: 3000 m (9843 ft.)
- This equipment is suitable for continuous operation.

## Safety Marking Symbols

This section provides a description of the safety marking symbols that may appear on the instrument. These symbols provide information about potentially dangerous situations which can result in death, injury, or damage to the instrument and other components.



## Warranty

Oriel Instruments warrants this instrument to be free from defects in material and workmanship for a period of one year from date of shipment. During the warranty period, Oriel Instruments will repair or replace the unit, at our option, without charge.

## Limitations

This warranty does not apply to fuses or defects caused by abuse, modifications, or to use of the product for which it was not intended.

This warranty is in lieu of all other warranties, expressed or implied, including any implied warranty of merchantability or fitness for any particular purpose. Oriel Instruments shall not be liable for any incidental, special, or consequential damages.

If a problem occurs, please contact Oriel Instruments with the instrument's serial number, and thoroughly describe the nature of the problem.

## **Returning an Instrument**

If an instrument is to be shipped to Oriel Instruments for repair or service, be sure to:

- Obtain a Return Merchandise Authorization number (RMA) from Oriel Instruments Customer Service.
- Attach a tag to the instrument identifying the owner and indicating the required service or repair. Include the instrument serial number from the rear panel of the instrument.
- Attach the anti-static protective caps that were shipped with the instrument.
- Place the instrument in the original packing container with at least 3 inches (7.5 cm) of compressible packaging material. Shipping damage is not covered by this warranty.
- Secure the packing box with fiber reinforced strapping tape or metal bands.
- Send the instrument, transportation pre-paid, to Oriel Instruments. Clearly write the RMA number on the outside of the box and on the shipping paperwork. Oriel Instruments recommends you insure the shipment.
- If the original shipping container is not available, place your instrument in a container with at least 3 inches (7.5 cm) of compressible packaging material on all sides.
- Once repairs have been made, the instrument will be returned with transportation pre-paid. Repairs are warranted for the remainder of the original warranty or for 90 days, whichever is greater.

## **Claims for Shipping Damage**

When you receive the instrument, inspect it immediately for any damage or shortages on the packing list. If the instrument is damaged, file a claim with the carrier. The factory will supply you with a quotation for estimated costs of repair. You must negotiate and settle with the carrier for the amount of damage.



## Comments, Suggestions, and Problems

To ensure that you get the most out of your Oriel product, we ask that you direct any product operation or service related questions or comments to Oriel Instruments Customer Support. You may contact us in whatever way is most convenient:

Phone (949) 863-3144

Fax (949) 253-1680

[orielPV.sales@newport.com](mailto:orielPV.sales@newport.com)

Mail to:

Oriel Instruments  
31950 East Frontage Road  
Bozeman, Montana, U.S.A 59715-8642  
<https://www.newport.com/b/oriel-instruments>

When you contact us, please have the following information:

- ✓ Model Number
- ✓ Serial Number
- ✓ End-user Name
- ✓ Company
- ✓ Phone
- ✓ Fax
- ✓ Description of the problem

If Oriel Instruments determines that a return to the factory is necessary, you will be issued a Return Merchandise Authorization (RMA) number. Please mark this number on the outside of the shipping box.

You or your shipping services are responsible for any shipping damage when returning the instrument to Oriel Instruments; Oriel recommends you insure the shipment. If the original shipping container is not available, place your instrument in a container with at least 3 inches (7.5 cm) of compressible packaging material on all sides.

We look forward to serving you even better in the future!



# Chapter 1: Introduction and Specifications

---

This chapter is an introduction to the VeraSol LED Solar Simulator (*patented*) consisting of the LSS-7120 LED Controller and LSH-7520 LED Head.

- ✓ Safety Considerations and unpacking information
- ✓ Product Overview
- ✓ Options and accessories
- ✓ Specifications

## Safety Considerations



**If any of the following symptoms exist, or are even suspected, remove the LSS-7120 and LSH-7520 from service. Do not use the LSS-7120 or the LSH-7520 until trained service personnel can verify safe operation.**

- Visible damage
- Severe transport stress
- Prolonged storage under adverse conditions
- Failure to perform intended measurements or functions

**If necessary, return the LSS-7120 and LSH-7520 to Oriel Instruments for service and repair to ensure that safety features are maintained.**

## Initial Inspection

When you receive your VeraSol Solar Simulator verify that the following items were shipped with the instrument:

- LSS-7120 LED Controller
- Power Cord
- LSH-7520 LED Head
- CC720 Interconnect Cable
- LSH-7520 Vertical Adjustment Assembly
- Shipping Kit
  - USB Thumb Drive (Includes Manual and Test Data)
  - Screws for Assembly
  - 5/16" Ball Hex Driver

Note: The optical bread board and 90 degree LED Head mount adapter are sold separately.

## Product Overview

Newport is proud to introduce the first in a series of innovative solar simulator designs utilizing LED light sources. The Oriel® VeraSol (*patented*) is made up of the LSS-7120 LED Controller and the revolutionary LSH-7520 LED Head. The system provides a variable output from 0.1 SUN to 1.0 SUN over a 2" X 2" illumination area at the specified working distance.

The VeraSol-2 is certified Class AAA to IEC, JIS, and ASTM standards for Spectral Match, Uniformity of Irradiance, and Temporal Stability. Oriel Instruments puts each LED based system through rigorous testing for all aspects of the standard to ensure compliance and provides a certificate of calibration.

This innovative design independently drives multiple wavelengths of LED's spaced over the spectrum of 400 nm to 1100 nm to ensure a spectral match of AM1.5G meeting Class A requirements. The independent control of each LED wavelength allows the user to tune the output to the specific requirements of their test. This adjustment can be done from the front panel for the entire spectrum or individual band adjustment. The user can adjust individual LED wavelengths for output intensity through the USB port. The spectral modifications can be saved for recall in the controller through the USB interface.

The typical lifetime of LEDs of over 10,000 hours removes the need to change expensive and hazardous bulbs. Additionally, the LEDs come up to a stable operating power quickly. This allows the unit to be shut off between tests without having to wait for the lamp to stabilize or sacrificing the integrity of the test results. This results in an effective lamp usage several times over a conventional lamp and eliminates the need for shutters on the output.

Features of the LSS-7120 LED Controller include:

- 19 independently controlled LED wavelengths from 400 nm – 1100 nm
- Front panel control of the 6 IEC wavelength bands
- Rapid turn-on / turn-off
- Factory calibrated AM1.5G spectral match preset
- Store and recall user defined spectral profiles
- Factory calibrated intensity
- User configurable intensity offset
- Front panel LED Fault indication
- USB communications



Figure 1.1 – LSS-7120 LED Controller

Features of the LSH-7520 LED Head include:

- Fast turn on time, < 100ms –no shutter required
- 10,000 hour LED lifetime
- PV Cell Placement Indicator
- Optical support rod for easy height adjustment
- Can be mounted pointing up, down, or to the side with 90° rotational accessory (sold separately)
- Temperature controlled for stable LED output



Figure 1.2 – LSH-7520 LED Head Assembly

## Options and Accessories

Options and accessories available for VeraSol-2 LED Solar Simulator:

DESCRIPTION	MODEL / PART NUMBER
Single Rack Mount Kit	RM-144
Solid Aluminum Optical Breadboard, 18 x 24 in., 1 in. 1/4-20 Grid	SA2-18X24
Solid Aluminum Optical Breadboard, 450 x 450 mm, 25 mm M6 Grid	M-SA2-18X24
LED Head Interconnect Cable	CC720
90 Degree Head Mount Adapter	MA701

## Specifications

PERFORMANCE SPECIFICATIONS <sup>1</sup>		
Illumination Area (in.) [mm]	2 x 2 [50 x 50]	
Maximum Output Power	100 mW/cm <sup>2</sup> (1.0 SUN)	
Variable Output Control	0.1 to 1.0 SUN	
Wavelength Range	400 – 1100 nm	
Nominal Working Distance (in.) [mm]	8.0 [200]	
Alignment	Laser Diode-Based Optical Alignment	
Z Axis Head Adjustment from Base (in.) [mm]	9.0 – 14.3 [230 – 360]	
Head Rotation	0° or 180° (90° with MA701 adaptor)	
Remote Interface	USB 2.0 (B-Type)	
1. All values are specified after a five minute warm up period.		
ELECTRICAL AND MECHANICAL SPECIFICATIONS		
	LSH-7320 (VeraSol-2 Head)	LSS-7120 (VeraSol-2 Controller)
Weight lbs. [kg]	39 [17.7]	11 [4.9]
Dimensions inches [mm]		
Height	23.4 – 28.7 [594 – 729] (on vertical assembly stand)	3.4 [86]
Width	14.7 [373]	3.4 [86]
Depth	18.4 [467]	3.9 [100]
Operating Temperature Range (°C)	20 to 30	10 to 40
Storage Temperature Range (°C)	-40 to 70	
Humidity	<85%, relative, non-condensing	
Power Requirements	-	110-130 VAC, 50-60 Hz, 220-240 VAC, 50-60 Hz
CERTIFICATIONS		
CE Certification	Yes	
Spectral Match Classification	A- IEC 60904-9 (2007), JIS 8904-9 (2017), ASTM E 927-10 (2015)	
Uniformity Classification <sup>1</sup>	A- IEC 60904-9 (2007), JIS 8904-9 (2017), ASTM E 927-10 (2015)	
Temporal Stability Classification	A- IEC 60904-9 (2007), JIS 8904-9 (2017), ASTM E 927-10 (2015)	
1. Certified over a 1.9" [48 mm] diameter circle within the 2" x 2" illumination area		



# Chapter 2: Assembly Instruction

This chapter describes the assembly process for the VeraSol system. The VeraSol kit includes the following parts:

A	8	6-32 x 5/16" Flat Head Philip Screws
B	1	Cover Plate
C	4	1/4-20 x 2" Socket Head Cap Screws
D	1	Vertical Adjustment Assembly
E	4	1/4-20 x 1" Socket Head Cap Screws
F	4	M6 x 1 x 25mm Socket Head Cap Screws (provided for metric optical tables)
G	1	LSH-7520 LED Head
H	1	Optical Bread board (sold separately)

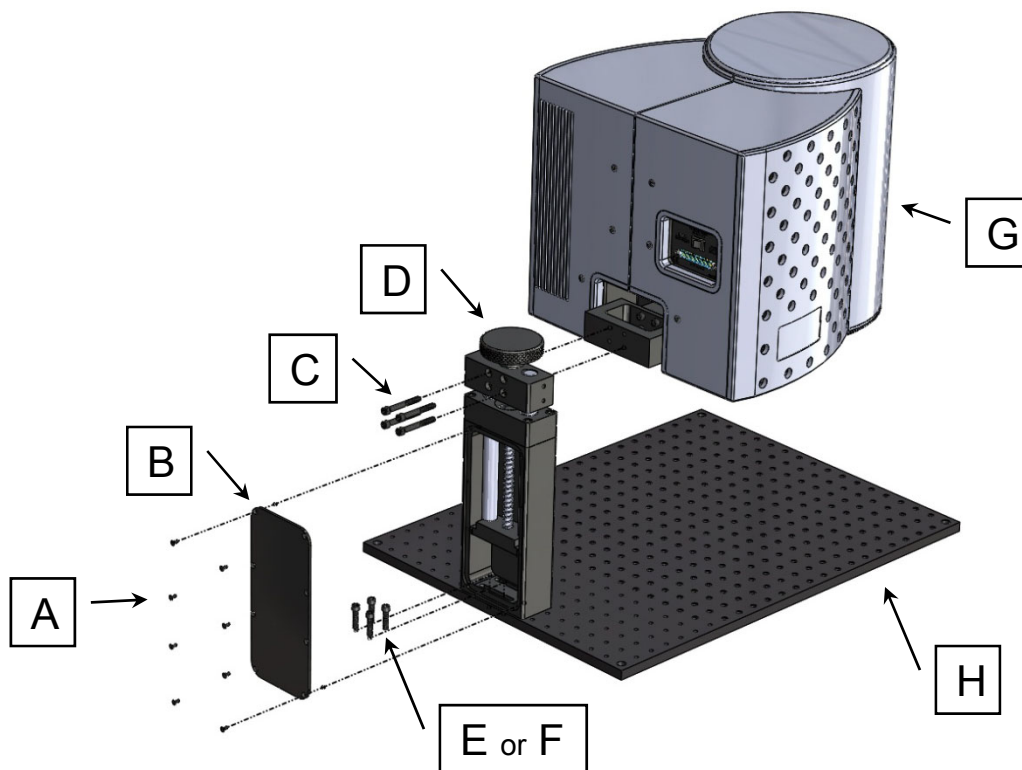


Figure 2.1 LSH-7520 VeraSol Head Assembly

## Tools Required:

- #1 Phillips Screw Driver
- 5/16<sup>th</sup> inch Ball Point Hex Driver (provided)
- 5mm Ball Point Hex Driver for assembly to metric optical bread board only

## Step 1:

Secure (D) Vertical Adjustment Assembly to (H) Optical Bread Board. If you are securing it to an imperial units bread board use (E) 4 - 1/4-20 x 1" Socket Head Cap Screws and a 3/16<sup>th</sup> Ball Point Hex Driver. If securing to a metric units breadboard use (F) 4 - M6 x 1 x 25mm Socket Head Cap Screws and a 5mm Ball Point Hex Driver

### **CAUTION**

Be careful to select the correct screws that match your bread board. Selecting the wrong screws may damage the threads on the screws or bread board.

## Step 2:

Secure (B) Cover Plate to the back of (D) Vertical Adjustment Assembly using (A) 8 - 6-32 x 5/16" Flat Head Philip Screws and a #1 Phillips Screw Driver.

## Step 3:

Secure (G) LSH-7520 LED Head to (D) Vertical Adjustment Assembly using (C) 4 - 1/4-20 x 2" Socket Head Cap Screws. The head may be mounted with the output lens facing up or down. A separate mounting kit is required to mount the head 90 degrees. Refer to the Options and Accessories table in Chapter 1 for applicable rack mount accessory part numbers.

### **CAUTION**

The LSH-7520 LED Head is heavy and fragile. To avoid personal injury or damage to the unit it is advised that you get assistance when mounting the head to the vertical assembly.

## 90 Degree Head Mounting Instructions

The LSH-7520 may be mounted at a 90 degree orientation by using the MA701 90 Degree Head Mount Adapter sold separately.

To install the MA701 head mounting adaptor complete the following:

### MA701 Parts List

J	4	1/4-20 x 1.75" Socket Head Cap Screws
K	4	90 Degree Adaptor Block

### Standard LSH-7520 Parts

C	4	1/4-20 x 2" Socket Head Cap Screws
D	1	Vertical Adjustment Assembly
G	1	LSH-7520 LED Head

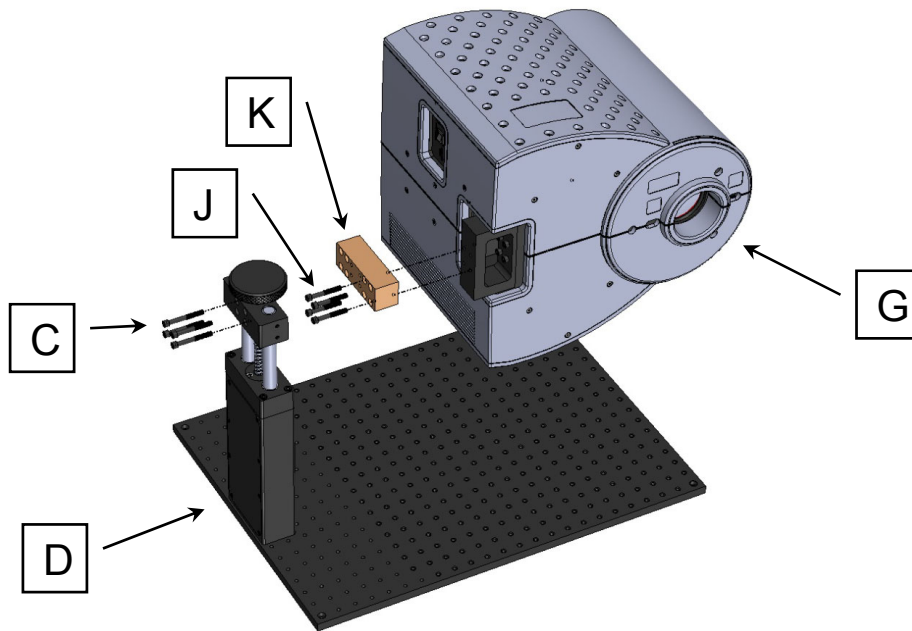


Figure 2.2 MA701 Head Mount Adaptor Assembly

### Step 1:

Secure (K) 90 Degree Adaptor Block to (G) LSH-7520 LED Head using (J) 4 - 1/4-20 x 1.75" Socket Head Cap Screws and a 5/16" Ball Point Hex Driver.

### Step 2:

Secure (G) LSH-7520 LED Head and adaptor block assembly to (D) Vertical Adjustment Assembly using (C) 4 - 1/4-20 x 2" Socket Head Cap Screws.



# Chapter 3:

## General Operation

---

This chapter is an overview of the operation of the VeraSol-2 LSS-7120 LED Controller and LSH-7520 LED Head.

- ✓ Power requirements
- ✓ Front panel operation
- ✓ General operating procedures

### Grounding Requirements

The LSS-7120 LED Controller comes with a three conductor AC power cable. The power cable must be plugged into an approved three-contact electrical outlet or used with a three-contact to two-contact adaptor with the grounding wire connected to an electrical ground (safety ground). Oriel Instruments recommends only connecting the instrument to properly earth grounded receptacles. The power cord connector and power cable meet IEC safety standards.


### AC Line Power Requirements

The LSS-7120 LED Controller can operate at line voltages between 100 and 240 VAC.

### The Power Up Sequence



**Prior to power up ensure the fan inlet located on the right hand side of the instrument as well as the exhaust holes on the back of the instrument have no obstructions that would impede airflow.**

With the LSS-7120 LED Controller connected to an AC power source, pressing , supplies AC line power to the instrument and initiates the power up sequence where each display lasts two to three seconds.

- All front panel indicators are ON, 7 Segment display shows the firmware version
- Front panel indicators OFF
- Display shows current operating condition

During the front panel indicator test, the LSS-7120 performs a self-test to ensure that the internal hardware and software are communicating. After the self-test, the LSS-7120 configuration is set to the same state as when the power was turned off. The output is left in the off state.

## **Firmware Upgradeability**

The firmware on the LSS-7120 can be upgraded via USB. Contact Oriel Instruments technical support for information on upgrading the software.

## **USB Communication**

The USB connector is located on the rear panel. The USB connector is the square "B"-style connector. A standard USB A/B cable is required to communicate with the instrument. Please refer to Chapter 4 for more detailed instructions on operating the instrument through USB.

## **Tilt Foot Adjustment**

The LSS-7120 has front legs that extend to make it easier to view the display. To use them, rotate the legs downward until they lock into position.

## **Rack Mounting**

The LSS-7120 Controller may be rack mounted in a single or dual configuration by installing the appropriate rack mount flange on either side of the enclosure. All rack mount accessory kits contain detailed mounting instructions. Refer to the Options and Accessories table in Chapter 1 for the applicable rack mount accessory part number.

## **Head Orientation**

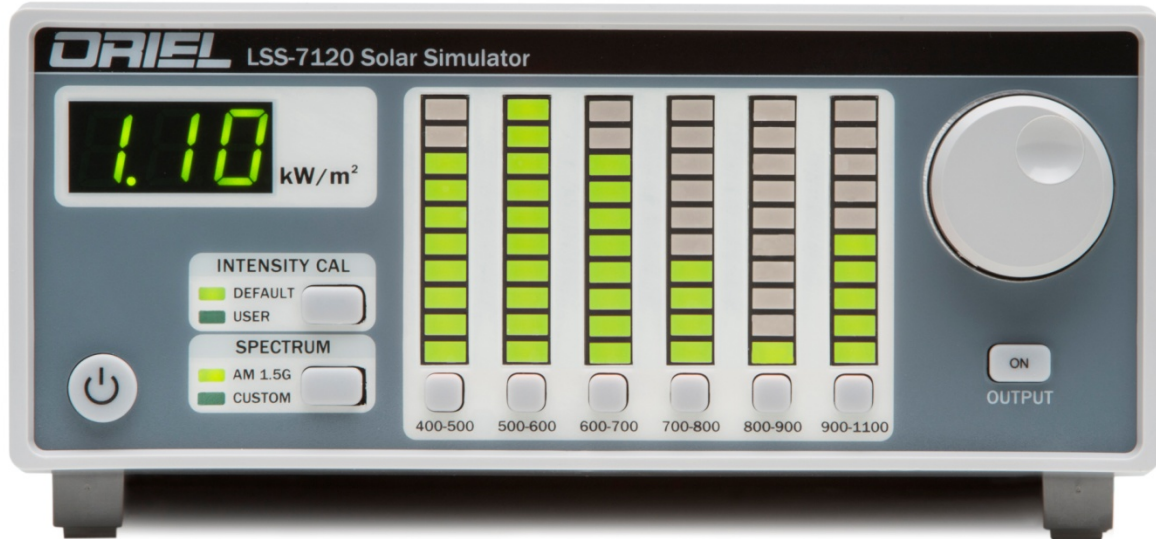
The LSH-7520 LED Head may be removed from the height adjustment provided by removing the four mounting screws on the back of the head. The head may be rotated 180 degrees and remounted with the light pointing upwards. A mounting kit is available to allow the user to mount the head rotated 90 degrees. Refer to the Options and Accessories table in Chapter 1 for applicable rack mount accessory part numbers.

### **CAUTION**

The LED head emits wavelengths in the Near IR bands. These wavelengths are not visible to the human eye. Caution should be taken when pointing the light upwards or to the side to ensure operators do not look directly into the output port of the head.

## Front Panel Operation

This section describes the fundamentals of operation for the LSS-7120 Controller and the LSH-7520 LED Head.



is the AC power on/off button. Pressing the POWER button applies power to the LSS-7120 Controller and starts the power up sequence described above. When turned on, the instrument provides power to temperature control the head. The head remains temperature controlled whether the output light is on or off.

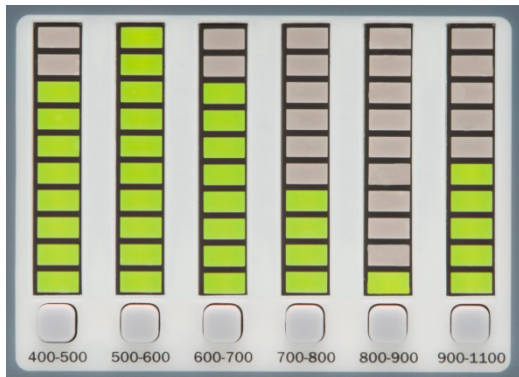
---

## Numerical Display



The numeric display consists of three seven-segment LED displays. The display provides an AM1.5G normalized output intensity in  $\text{kW}/\text{m}^2$ . In normal operation it displays the output power at the working plane. When one of the six IEC bands is selected, the display shows the power of the selected band at the working plane.

## Bar Graph Display



This bar graph display consists of six vertical banks of ten LEDs. Each LED can be green, red, or orange.

When the output is Off the LEDs are orange. When the output is On the LEDs are green. When a band is selected for adjustment the LEDs will turn Red.

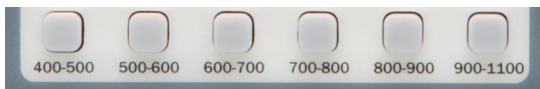
A band's bar will flash when a fault is detected in that band. The unit should be returned to Oriel Instruments for service.

Each LED bank shows the **relative** power of the specific band of wavelengths in the spectrum. The height of the bar indicates the band power relative to the other bands.

Each led in the bar represents a power of one-tenth the maximum displayed power. The band with the highest power will have all ten LEDs in its bar turned on. The other bars will be referenced to that maximum value. However, if the maximum is less than 0.10 sun, then 0.10 sun is used as the maximum power for display purposes.

---

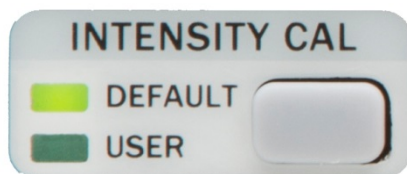
## Band-Select Buttons



The band-select buttons for 400-500, 500-600, 600-700, 700-800, and 900-1100 allow the user to adjust the intensity in that band. All of the LEDs in the band are adjusted proportionally together. When a button is selected it specifies which band is being adjusted by the knob. When the button is pressed the LEDs in that band will turn Red. If there is no knob-turn for three seconds the adjustment knob returns to normal operation and the LEDs go back to either Green or Orange.

---

## Intensity CAL



The instrument has been calibrated to display the correct intensity at the working height when in Factory Default mode. To allow for variations in testing the user can put in an offset calibration. To utilize this function the user would place their sample under the light and adjust the output until they measure 1.00 sun relative to their sample. This set point can be saved as a User Intensity Calibration constant.

### Press Button

- Toggles between Factory Default and User Calibration factors

### Press and Hold Button for 3 seconds

- Resets calibration factors for each LED to the current set point and rescales the display output to 1.00 sun.



- The 7 segment display will then read 1.00 to reflect the above change.

### Default Mode

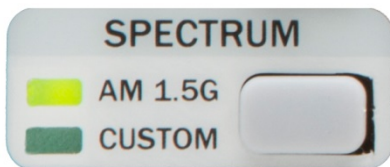
- Instrument utilizes factory calibrated amplitude values for each LED.
- Default mode can be activated by either the front panel or remotely through USB.

### User Mode

- Instrument uses amplitude values scaled to 1.00 sun based on the set point stored by pressing and holding the Intensity CAL button. The initial preset values equal the factory calibration values.
- User Mode can be activated by either the front panel or remotely through USB.

---

## Spectrum



This feature allows the user to select one of two spectra that are stored in non-volatile memory: factory set AM 1.5G and a user defined Custom spectrum.

### Press Button

- Toggles between AM 1.5G and Custom Spectrum

### Press and Hold Button for 3 seconds

- The current spectrum is stored in the user-spectrum area of non-volatile memory. This allows the user to make adjustments to a spectrum, save the changes, and recall it later.

### AM 1.5G

- Instrument uses factory determined amplitude values for each LED corresponding to the AM1.5G spectrum as a percentage of a 1.00 sun output.
- The overall output intensity does not change but the relative percentages of output remain consistent with an AM1.5G spectrum
- AM 1.5G spectrum can be activated by either the front panel or remotely through USB

### Custom

- Instrument uses user-determined preset amplitude values for each LED corresponding to the User defined spectrum as a percentage of a 1.00 sun output.
- The overall output intensity does not change but the relative percentages of output remain consistent with the user defined spectrum.
- The Custom Spectrum can be activated by either the front panel or remotely through USB.

## Output On Button & Adjustment Knob



Pressing the Output button turns the output on and off. When the output is on, the LEDs in the bar graph are all green. When the output is off, the LEDs are orange.

If the output-on button is pressed to turn on the output, but there is no head connected, a message will briefly appear in the Numeric Display. This message will be “HEd”.

The knob adjusts output power. In the normal operating mode the total output intensity is adjusted when the knob is turned. The relative output percentage difference between each LED is maintained throughout the adjustment range.

If a band is selected, the LED display for that band will turn red, and turning the knob will adjust the output power for that band only.

## **LSH-7520 LED Head Operation**

The LSH-7520 is designed to reduce the amount of user adjustment required to ensure a uniform consistent output. The only user adjustment to the LED Head is the height adjustment and head orientation.

### **Connection to LSS-7120 Controller**

The VeraSol system comes with the LSS-7120 Controller, Interconnect cable CC720, and LSH-7520 LED Head. The interconnect cable must be attached to the LED head for proper operation. All of the power requirements for the head are supplied through the interconnect cable. No AC power cord is required for the head. The cable connection can be found on the rear of the LSH-7520 LED Head. When connecting the cable ensure the screws are tightened on the connector so the cable remains solidly connected to the unit. If the cable is not connected or is loose the LSS-7120 may show an error message on the front panel 7 segment display (HEd).

### **Working Plane Height Adjustment**

The LSH-7520 LED head is calibrated at the factory at a working height of 8 inches (203 mm). To ensure the irradiance measurement displayed on the front panel of the LSS-7120 controller is within specification the working plane needs to be adjusted to calibrated working height below the output lens. Adjusting the working plane will also affect the illumination area and uniformity.

To aid in setting the correct working plane height the LSH-7520 LED Head has a pair of red laser pointers to indicate the height the unit was calibrated to at the factory. The laser pointers can be turned on via a rocker switch located on the rear of the unit.

A large round knob located on the rear of the unit can be turned to move the head up and down. The procedure for adjustment is as follows:

1. Place the test sample under the LED head light source.
2. Turn the Laser Pointers on via the rocker switch on the rear panel.
3. Adjust the height of the head via the control knob on the rear of the unit until the two red dots converge to a single point. You are now at the calibrated working plane.
4. Turn the laser pointers off.

### **Head Orientation**

The LSH-7520 LED head can be oriented with the light source facing down, up, or to either side. The orientation does not affect the calibration or operation of the unit. The user should show extra care not to place anything on the unit when the light source is facing upward. Scratches and/or dirt on the output optics will affect the irradiance parameters.

The head can be mounted pointing up or down with provided hardware. See Chapter 2 for assembly instructions. To mount the head at a 90<sup>0</sup> rotation the user will need to purchase the MA701 mounting kit.



# Chapter 4:

## Remote Operation

---

This chapter is an overview of the remote operation of the LSS-7120 Controller.

- ✓ Fundamentals of Remote Operation
- ✓ Command Syntax
- ✓ Status Reporting

USB (Universal Serial Bus) is the common serial communication protocol used by most computers for relatively fast communication. Everything that can be done from the front panel can also be done remotely, and in some cases, with more flexibility. For instance, in remote mode, there is access to functionality and modes not available from the front panel, such as commands that will allow the user to adjust intensity of each individual LED wavelength. The following sections explain the fundamentals of operating the LSS-7120 Controller remotely through the USB computer interface. The LSS-7120 is designed to conform to the USB 2.0 standard and USBTMC (USB Test and Measurement Class) 488 substandard. Drivers for the USBTMC are available through the NI-VISA package from National Instruments, or the IO Libraries Suite from Agilent Technologies, or the Visa Shared Components package from IVI.

### USB Communication

All commands received by the USB interface are acknowledged by the instrument transmitting “Ready” when the command operation is complete. Queries are acknowledged by the specific query response message. Multiple commands/queries separated by semicolons and issued as one command string are only acknowledged with a “Ready” response if the entire command string contains no queries. (See the Command Separators section later in this chapter for additional details.)

### Command Syntax

This section describes command syntax and structure. This information must be understood in order to effectively write USBTMC control programs. The syntax of USBTMC commands follows the rules defined in the IEEE 488.2 standard.

### Letters

USB commands must contain all of the letters shown in uppercase in the command definition. Optional letters shown in lowercase for some device-dependent commands in the command reference (Chapter 5) are useful for clarity. If any of the optional letters are included, they must all be included, and in the correct sequence. The LSS-7120 accepts either upper or lower case. Some examples of what works and what does not are shown below.

**Table 3.1** – Acceptable and Not Acceptable Spelling

DEFINITION	ACCEPTABLE	NOT ACCEPTABLE
OUTput	OUT or output	OU or outp
AMPLitude	AMPLitude or AmPL	AMP or AMPLIT

### White Space

“White space” is any number of space characters (space bar). A white space must separate a command from its parameters or data. For example:

ACCEPTABLE	NOT ACCEPTABLE
output 1	Output1

A query has no space between the mnemonic and the question mark. For example:

ACCEPTABLE	NOT ACCEPTABLE
*IDN?	*IDN ?

### Terminators

A program message terminator identifies the end of a command string. Valid terminator sequences are <NL> (newline), <^END> (end message) and <NL><^END> (newline + end message). The LSS-7120 terminates its responses with <NL><^END>.

### Command Separators

More than one command may be placed in the same command string if each command is separated by a semicolon. The semicolon can be preceded by one or more spaces. For example:

```
OUTPUT ON;*IDN?;;SYSTEM:ERROR?
OUTPUT ON ; *IDN?; :SYST:ERROR?
```

The instrument will respond to multiple queries within the same command string by separating each response with a command separator.

### Parameters

Some commands require a parameter. The parameter must be separated from the command by white space. The syntax symbol <numeric\_value> refers to the flexible numeric representation described by section 7.7.2.1 of IEEE 488.2. Some numbers may be represented with or without a decimal point and with or without exponent. Whitespace is not accepted on either side of the decimal or after the sign character, but is acceptable on either side of the “e/E” exponent character. For example the number “twenty” may be represented by any of the following ASCII strings:

NR1	Integer	20	+20
NR2	Floating Point	20.0	+20.0
NR3	Scientific Notation	2 E 1; 2.0e+1	+2.0E+1; +2.0 e1

Refer to the command reference section to determine what forms of <CHARACTER PROGRAM DATA> a command accepts.

# Chapter 5:

## Command Reference

This chapter is a guide to all of the commands for the LSS-7120 LED Controller. .

- ✓ Overview of the remote commands
- ✓ List of remote commands in alphabetical order

### Remote Command Reference Summary

This section contains all of the commands for the LSS-7120.

**Table 4.1** – Remote Command Summary

NAME	FUNCTION
*IDN?	Returns the Device Identification string.
AMPLitude	Sets the output amplitude in Suns
AMPLitude?	Reports the output amplitude in Suns
ERRor?	Queries the errors in the error queue.
LEDPOWer	Set individual LED power
LEDPOWer?	Report individual LED power setting
LEDTEST:POWER?	Perform LED test: turns LED's on sequentially
LEDTEST:RESULT?	Recall test power
LEDWAVElength?	Report wavelength of LED
LEDMAXPOWER?	Report LED's maximum power setting
OUTput ON OFF 1 0	Turn output (light) on off
OUTput?	Reports output status
SPECTrum:STORe	Store current spectrum
SPECTrum:RECAll	Recall a spectrum
SPECTrum:ACTIVe?	Report current spectrum ID (storage number).
STATus?	Report instrument status
USERCAL:PERFORM	Execute User cal
USERCAL:SELECT	Select user or factory calibration constant
USERCAL:SELECT?	Report user-cal selection

## Command Reference

The following pages contain a reference of commands for the LSS-7120 LED Controller.

---

### \*IDN?

#### Instrument Identification

<b>Description</b>	Requests the instrument to identify itself
<b>Parameters</b>	None
<b>Notes</b>	Returns a string of instrument identification information. The string contains a comma separated list of manufacturer, model number, serial number, and firmware revision.
<b>Examples</b>	"*IDN?" Responds with "Newport Corporation,LSS-7120,71201234,1.01" (serial # 71201234, rev 1.01)

---

### AMPLitude <suns> AMPLitude?

<b>Description</b>	Sets or reports the output power of the Head relative to number of suns (1 kW/m <sup>2</sup> )
<b>Parameters</b>	suns – output intensity
<b>Reset Value</b>	1.0

---

### ERRor?

<b>Description</b>	Requests errors that may have occurred.
<b>Parameters</b>	None
<b>Response</b>	ASCII character string containing an error number and a brief description.
<b>Notes</b>	If more than one error has occurred, repeated error queries are required until the response is "0, No error". See chapter 6 for a list of error numbers.
<b>Examples</b>	ERR?- Response "0, No error" means no errors to report. Error? - Response "-109, Missing parameter": a parameter was missing from a command.

---

### LEDMAXPOWer? <LED #>

<b>Description</b>	Requests the maximum power for an LED (in kW/m <sup>2</sup> ).
<b>Response</b>	A floating-point number representing the LED's maximum available power.
<b>Example</b>	LEDMAXPOWER? 7<cr> Response: 0.02, indicating that LED 7's maximum power setting is 0.02.

---

### LEDPOWer <LED #>,<power> LEDPOWer? <LED #>

<b>Description</b>	Sets the individual LED (1-24) power level. If the requested level is more than the led's maximum power setting, no action is taken (see the "ledmaxpower?" command.)
<b>Parameter</b>	LED # - 1 – 24 0.0 – 1.0 (kW/m <sup>2</sup> )
<b>Reset Value</b>	AM 1.5G relative intensity per LED #

---



---

## LEDTEST:POWER?

<b>Description</b>	Sequentially turns on each LED while measuring the output power.
<b>Parameters</b>	None
<b>Return</b>	Returns 1 when the test is finished. Returns 0 if the test fails due to a hardware problem. <b>NOTE:</b> the test takes several seconds before it returns a result.

---

## LEDTEST:RESULT? <LED #>

<b>Description</b>	Returns the powers measured during factory led test and during user led test.
<b>Parameters</b>	Led number
<b>Return</b>	user-measured power, factory-measured power

---

## LEDWAVElength? <LED #>

<b>Description</b>	Requests the peak wavelength of each LED (in nm).
<b>Response</b>	A floating-point number representing the main LED wavelength.
<b>Example</b>	LEDWAVE? 5<cr> Response: 505, indicating that LED 5's peak wavelength is 505 nm.

---

## OUTPut ON|OFF|1|0 OUTPut?

<b>Description</b>	Controls whether the output is enabled or not
<b>Parameters</b>	ON/1: Turns the output on OFF/0: Turns the output off
<b>Reset Value</b>	OFF

---

## SPECTrum:STORE <location>

<b>Description</b>	Store the current spectrum into memory locations 1-10.
<b>Parameter</b>	1 – 10 – memory location; location 0 is reserved for AM 1.5G factory determined spectrum

---

## SPECTrum:RECAll <location>

<b>Description</b>	Recalls a spectrum saved into memory location. Adjust LED intensity to match saved spectrum.
<b>Parameters</b>	0-10 – Location 0 is reserved for the factory default AM1.5G Spectrum. Location 1 is the "custom" spectrum available from the front panel.

---

## SPECTrum:ACTIVE?

<b>Description</b>	Returns the location number of the current active spectrum.
<b>Parameters</b>	None

---

## STATus?

<b>Description</b>	Requests the status of the LSS-7120.
<b>Response</b>	A decimal number containing bit-encoded information: If bit 0 is set, the output is on. Bit 1: reserved If bit 2 is set, the head is disconnected (check the cable). If bit 3 is set, the head has not yet warmed up to its optimum operating temperature. If bit 4 is set, the head temperature is above its optimum operating range.
<b>Example</b>	Response: 8 (binary 00001000) means the head is not yet warm (bit3 = 1), and the output is off (bit0 = 0).

---

## USERCAL:SELECT 1|0 USERCAL:SELECT?

<b>Description</b>	Select or report user-cal selection (factory or user-performed)
<b>Parameters</b>	1 – User calibration offset 0 – Factory Calibration
<b>Reset Value</b>	0

---

## USERCAL:PERFORM

<b>Description</b>	Offsets the current output intensity to indicate 1.0 sun on the display.
<b>Parameters</b>	None

# Chapter 6:

## Remote Control Software

---

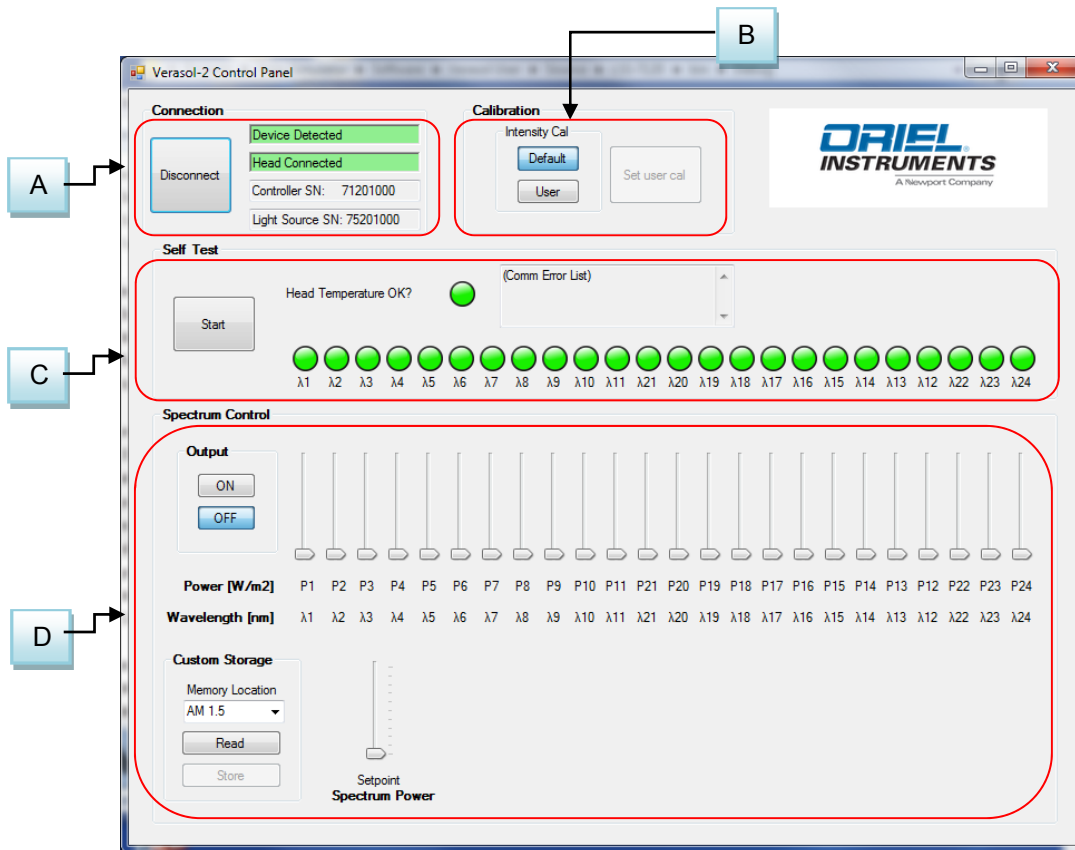
The VeraSol system includes a remote software application to aid the user in setting custom spectrums and to perform system functional tests. The software can be found on the USB thumb drive provided with the unit. Setup executables on the thumb drive will update the USB drivers to allow access to the instrument, and also load the VeraSol Control Panel application.

### Installation

- Step 1: Installation of the drivers requires administrator privileges on the computer. Make sure that there are no other applications running, because it is likely the computer will have to be re-started at some point. Make sure that the VeraSol is not yet connected to the computer.
- Step 2: Open the thumb drive on your computer. Run the “setup.exe” application and follow the instructions on the screen. This will install VeraSol control, VeraSol Replicator, and all required system drivers. When the installation process finishes, the computer will need to be re-started.
- Step 3: When the computer has re-booted, plug the VeraSol control unit into a USB port on the computer.

*Note: the computer may take several seconds to initiate the USB driver if the application has not run previously. The “Connect” button in the application will not initiate a connection to the VeraSol until the computer has loaded and run the driver.*

# Operation



## A – Connection

This section is used to connect to the instrument. You must first connect a USB cable between your computer and the instrument. Follow the installation instructions above to load and install the appropriate drivers for the system.

This area displays:

- The Connection Status
- The LSS7120 controller serial number
- The LSH7520 LED head serial number

## B – Calibration

This section mimics the front panel controls for Intensity CAL described in the preceding sections.

## C – Self Test

The self-test cycles through each of the various wavelengths and performs a power measurement at that wavelength. If the measured power is the same as the power measured at the factory, the indicator light will be green. If the power is less, the indicator light will be red.

The test also measures the operating temperature of the LEDs. The LEDs are temperature controlled to ensure consistent output power. A green head-temperature indication means the LEDs are operating at the specified temperature. The unit typically takes 15 minutes to reach nominal operating temperature. The LEDs' temperature is controlled whenever the unit is powered. The LEDs do not need to be illuminated for the temperature to be controlled.

The self-test reports any error conditions from the head.

## **D – Spectrum Control**

The spectrum control section allows the user to control each wavelength individually in the head. There are a total of 19 independent wavelengths in the LSH7520 LED Head. The display shows the wavelengths in the LSH7520 and the current power set point. The spectrum created by the user can be saved into memory by selecting a memory storage location Custom 1-10 and pressing the Store button. The Spectrum can be recalled by selecting the memory location Custom 1-10 and pressing the Read button.

Memory location AM 1.5 is reserved for the AM1.5G factory stored spectrum. The user cannot store a new spectrum in this location.

Once a spectrum is defined the user can adjust the output proportionally for all wavelengths simultaneously by adjusting the Spectrum Power slide bar.

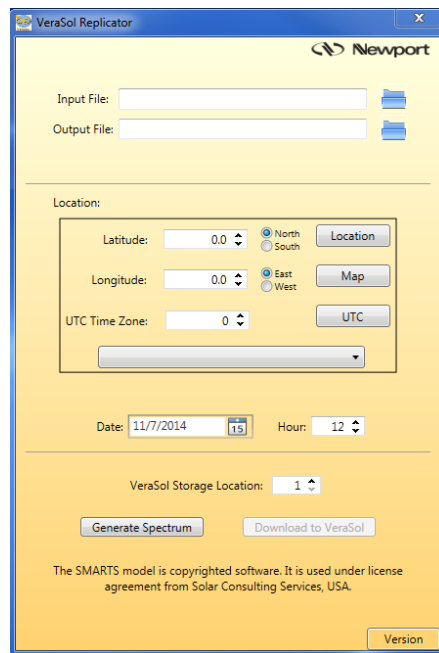


# Chapter 7: VeraSol Replicator

This chapter is to help guide the user through the use of the VeraSol Replicator software. VeraSol Replicator gives the user a method to generate a solar spectrum based on geographic location, as well as date and time of day. This spectrum is used to generate a VeraSol LED spectrum, replicating the solar spectrum.

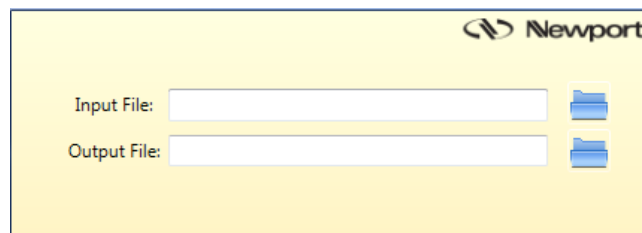
## Input / Output Controls

The Input / Output controls provide the user a convenient mechanism for loading user named VeraSol Replicator position data as input as well as saving VeraSol position and spectrum data to a user named location.

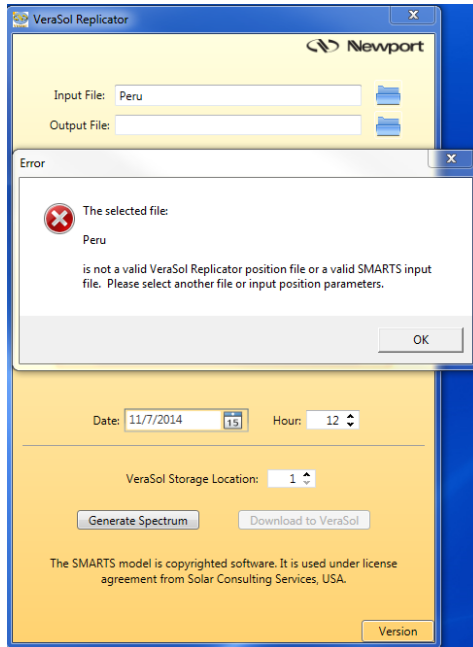


## Input File

Specifying an input file designation is optional. If not provided, the input defaults to the "VeraSolReplicator" file located in the "C:\Users\\Documents\VeraSolReplicator Data" directory. *NOTE: if this file does not exist, it will be created and used the first time the "Generate Spectrum" request is successfully executed.*

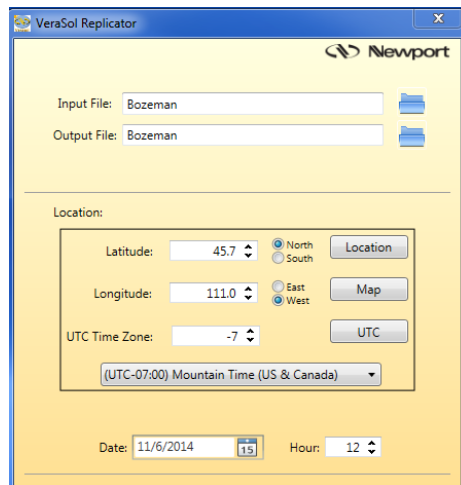


A file search capability as designated by the folder icon allows the user to locate a file of choice. When entering the file name directly via the Input File text box, only the preface part of the file name is required. If the file cannot be located, an appropriate error message will be presented to the user.



If the file is located and is valid, the settings are loaded. This will set the Latitude / Longitude, UTC Time Zone, Date, and Hour values. If a matching time zone description can be found in the time zone pull down, it is updated accordingly, otherwise it is cleared to an unselected option.

If an output file specification has not been made and the input file specification was manually entered by the user via the keyboard, it is defaulted to the name of the input file, allowing quicker updates to existing data sets.





## Output File

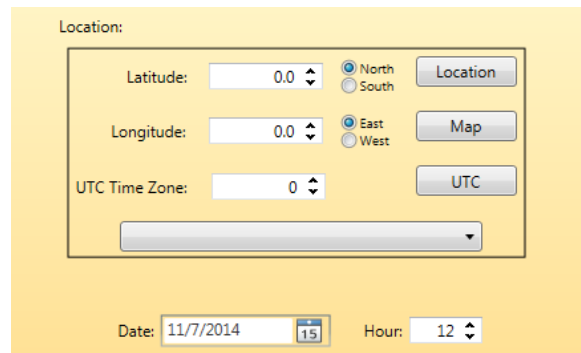
Specifying an output file designation is optional. If not provided, it results in the default creation of the position file in the default “C:\Users\\Documents\VeraSolReplicator Data” directory.

The name provided by the user in the Output File text box is used in the creation of the resulting position data file, VeraSol Simulator data file, and screen shot of the generated spectrum report. A directory search capability is provided as designated by the Folder icon.

## Location Controls

The location controls consist of:

- Latitude
- Longitude
- UTC Time Zone Offset
  - Time Zone pull down menu helper
- Hour of the Day
- Date Picker
- Location Helper Button
- Map Helper Button
- UTC Helper Button



## Latitude / Longitude

Latitude and longitude units are in decimal degrees with positive values being North / East and negative values being South / West respectively. Additionally, the text box contains a numeric adjuster allowing the user to step up or down the value in 1 degree increments.

*NOTE: the latitude and longitude values, in conjunction with the Date and Hour specifications, are used by the UTC Lookup Helper in automatically calculating a correct UTC Time Zone offset.*

## UTC Time Zone

The UTC time zone offset units are positive and negative integer values. As a helper function, a Time Zone pull down helper function has been provided to assist the user in making a manual Time Zone UTC offset specification.

The UTC Time Zone offset value can either be specified or overridden manually, or via the Location and/or UTC helper functions as provided by their respective buttons. The UTC Time Zone offset can be used to account for Daylight Savings Time.

## Date

Input of the date value is supported through a date picker. Changing the date value can affect the UTC offset calculation resulting in an UTC Time Zone offset change.

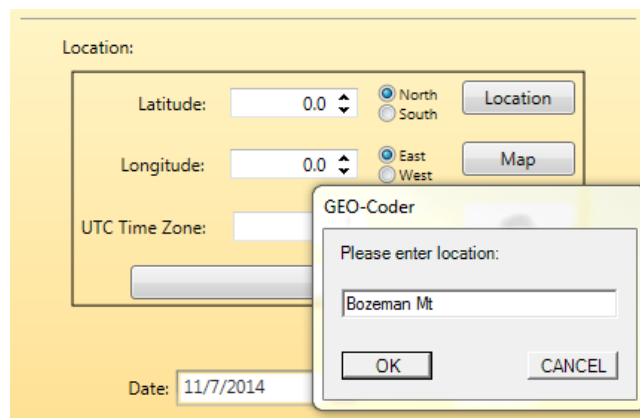
## Hour

The hour value is used in conjunction with the Date and UTC offset values in generating the simulated solar values. Units are positive integer values ranging from 0 to 23. Changing the hour value can affect the UTC offset calculation resulting in an UTC Time Zone offset change.

## Location Helper

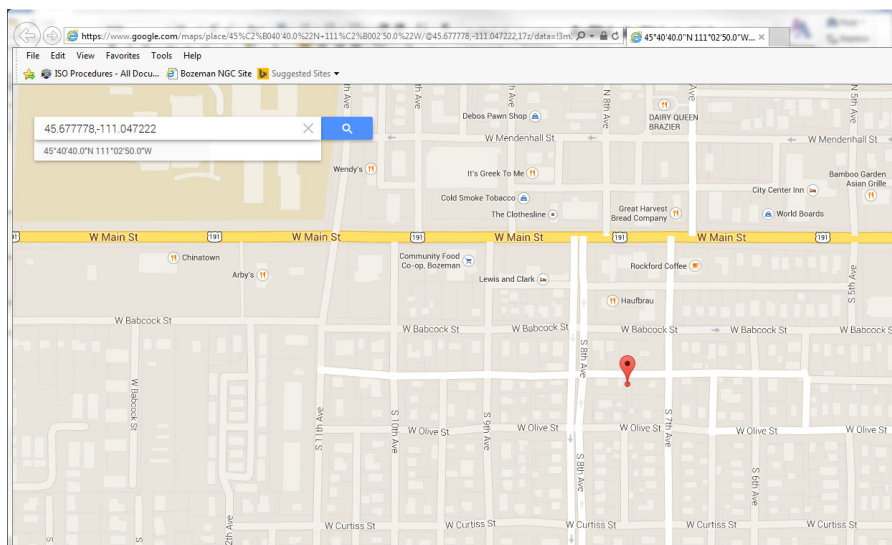
A location helper function has been incorporated into the dialog, assisting the user in setting correct values for position (latitude / longitude) and UTC Time Zone offset. Selecting the Location button provides the user with a pop-up dialog for entering location information to be used by a Geo-coder in doing a search. This information generally consists of street addresses, city names, zip codes, county names, state names, and country names used in any combination depending upon how specific a search is desired. The results of the search are used in conjunction with the Date and Hour values to calculate the correct UTC Time Zone offset and Latitude / Longitude values when possible.

*NOTE: To make maximum use of the Location Helper, ensure the Date and Hour values have been specified prior to invocation, since they are used to correctly ascertain the UTC offset. However, the UTC helper function can be used to recalculate the UTC offset as a situation warrants.*



## Map

The map helper can be used to visualize the position information entered by the user or extracted by the Geo Lookup helper. Upon selecting the Map button, the default web browser is activated and directed to Google Maps for the target latitude / longitude specification. Internet access is required for this feature to function.



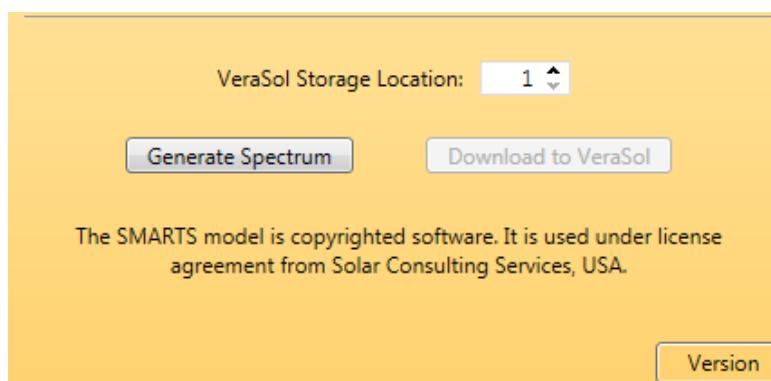
## UTC

A UTC helper function has been incorporated into the dialog, to assist the user in setting correct values for UTC Time Zone offset. Selecting the UTC button uses the latitude / longitude specification, in conjunction with the Date and Hour specification, to calculate the correct UTC Time Zone offset. If a matching Time Zone specification is found in the Time Zone pull down menu, it will be updated to reflect that identifier. The UTC helper function accounts for Daylight Savings Time. Internet access is required for this feature to function.

## VeraSol Controls

### VeraSol Storage Location

The LSS-7120 Solar Simulator has ten user addressable storage locations available for the user in supporting the preservation of solar simulation data sets. The VeraSol Storage Location text box allows the user to choose which storage location to use when the simulation data is downloaded to the LSS-7120.

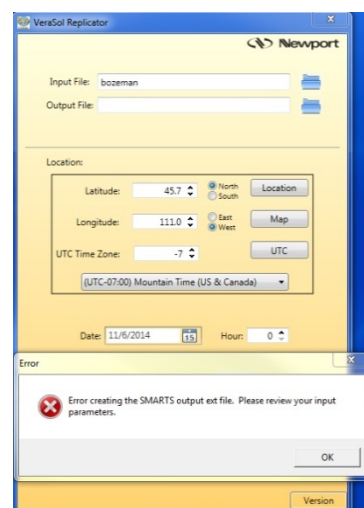


### Generate Spectrum

The Generate Spectrum Button uses the location data and input / output data in conjunction with the SMARTS solar simulator to generate a solar simulation data set suitable for driving the LSS-7120 Solar Simulator.

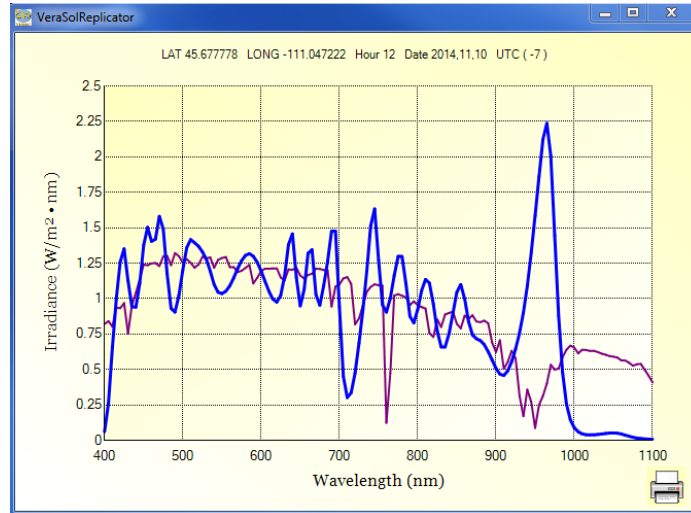
If the input parameters provided are inconsistent with operational guidelines of the SMARTS solar simulator, such as asking for a solar simulation at midnight (see example), the user is presented with an appropriate error message.

Upon successful completion of the solar simulation, a chart displaying the results of the simulation is generated and presented to the user for viewing and printing. This allows the user to review and preserve any particular solar simulation and ascertain its viability prior to performing a download.<sup>1,2</sup>



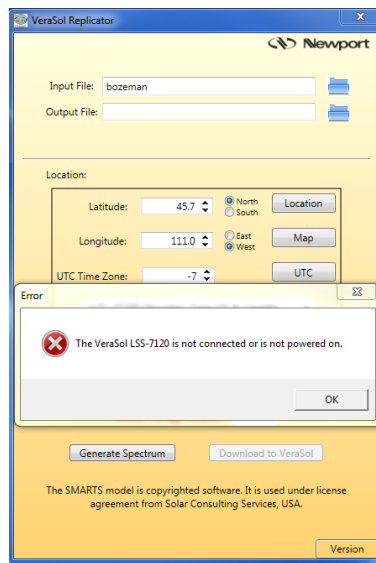
<sup>1</sup> The solar spectrum is generated using the SMARTS model under licensing agreement with Solar Consulting services, USA.

<sup>2</sup> The derived spectrum is an approximation based on the atmospheric conditions of ASTM G173. The conditions are fixed, only the air mass is modified to the user's input. The derived spectrum is an approximation and may not represent the actual geographical location conditions.



## Download to VeraSol

The Download to VeraSol button downloads the appropriate LED intensity settings to VeraSol that most closely represent the solar spectrum. If the LSS-7120 is offline, a pop-up error message will be presented to the user indicating that fact. Upon completion of the download, the user is presented with an indication of a successful download via another pop-up dialog.



## Version

Shows the current version of the application.

# Chapter 8:

## Calibration and Troubleshooting

---

This chapter is to help you resolve any problems you may experience with your LSS-7120 Controller or LSH-7520 LED Head. If you need additional help, please contact Oriel Instruments Customer Service. See page viii for contact information.

Oriel Instruments provides in-house calibration services. International customers may contact our services centers for regional calibration support. Oriel factory calibrations employ NIST traceable measurement instrumentation, and our calibration engineers and technicians use automated test equipment to accurately and efficiently capture and record calibration data. An original certificate of calibration authenticity is provided with all instrument calibrations, and a detailed report showing any pre-calibration out-of-tolerance conditions is available upon request.

Calibration turn-around times are normally five business days or less. Please contact Oriel Customer Support (see Comments, Suggestions, and Problems on page viii for contact information) for additional calibration information.

### Troubleshooting Guide

This section lists some common problems and corrective actions. In the event that the corrective action does not resolve problem; please contact Oriel Instruments.

SYMPTOM	CORRECTIVE ACTION
The instrument does not power up	Check the power cord to make sure that it is properly connected and check the wall outlet by connecting to a known operational device.
The instrument reads "HEd"	The LED head is not connected to the control unit. Check to see the CC720 is securely connected to both the LSH-7520 head and the LSS-7120 controller. Tighten the screws on both connectors.
The head does not seem to be putting out enough power.	Check to see that the head is at the correct working height. See page 15 – Working Plane Height Adjustment. OR The output adjustment is set to below 1.0 sun. Verify the Intensity CAL button is in the Default mode. See page 12.
The output is a strange color. Not AM1.5G.	Ensure the unit is set to the default AM1.5G output. See page 13 – Spectrum.
No LEDs seem to be operating	Perform the Self Test routine provided in the System software. If all of the indicators are green the unit is working properly. If the indicators are RED return to factory for repair.
One or more of the bar graphs are flashing.	This indicates you may have an LED failure in that band. Return the unit to the factory for repair.
The instrument reads "HOT".	The temperature of the LED head is above its optimum operating temperature.

## Error Messages

A user may see the errors the unit has stored in the error queue by sending the “ERROR?” query. The unit retrieves and sends one error from the queue in response to the “ERROR?” query. To see all the errors, continue to send the “ERROR?” query until the response is “0”.

ERROR CODE	EXPLANATION
-104	Data type error - <i>The parameter data could not be converted to a number</i>
-113	Undefined header - <i>The command string is not recognized as an LSS_7120 command</i>
-115	Unexpected number of parameters - <i>The wrong number of parameters was sent</i>
-123	Exponent too large - <i>There is a problem with a floating-point numbers parameter</i>
-224	Illegal parameter value - <i>The input parameter is outside of the range of the expected type</i>
-420	Query unterminated - <i>This error will typically occur when a user sends a query string, doesn't read the response, then sends another query</i>