

# Custom User Manual

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# List of Manual Abbreviations

<b>Abbreviation</b>	<b>Definition</b>
<b>Bias</b>	A1 Light Line light source
<b>CAL</b>	Calibration
<b>IV</b>	Current- voltage
<b>LL</b>	A1 Light Line
<b>Mono</b>	Monochromatic light source (light from tunable light source)
<b>QE</b>	External Quantum Efficiency
<b>RunIV</b>	Software for measuring current-voltage measurements
<b>RunQE</b>	Software for measuring calibration, quantum efficiency and spectral response
<b>SciLPControl</b>	Sciencetech Lamp Power Control
<b>SR</b>	Spectral Response
<b>TLS</b>	Tunable Light Source

**Please read through this manual, the SciPV: RunQE and RunIV manuals, and the Sciencetech Lamp Power Control manual before attempting to starting up your PTS system!!**

# 1. Overview of Components

This manual describes how to assemble and use your custom PTS system. Your custom system consists of 4 main parts: (1) Sensitive Equipment, (2) Tunable Light Source, (3) A1 Light Line, (4) sample chamber. All of these components are controlled by the computer provided with your system.

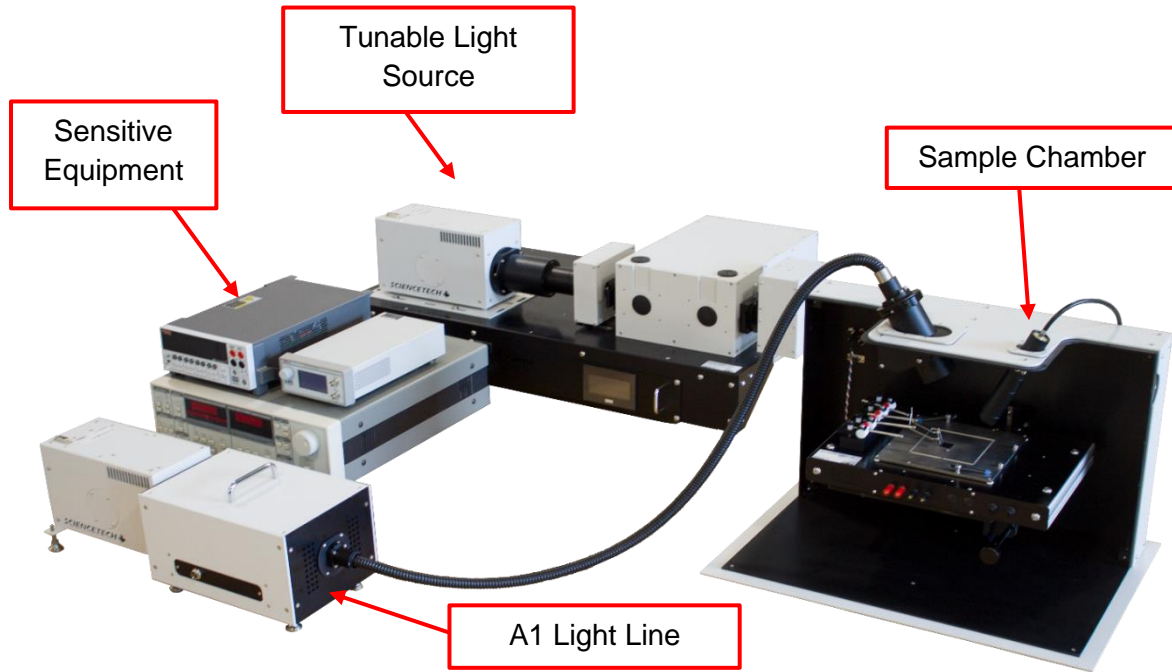


Figure 1 : Labelled PTS Components



Figure 2 : Custom PTS system on table with lower rack

## 1.1 Computer

All Sciencetech PTS systems come with a computer with preinstalled SciPV software for controlling the PTS system. Your custom system also comes with the remote lamp power control software for the power supplies of your TLS-55-X300 and A1-Lightline. The USB ports on your computer are labelled to indicate where certain components should be connected. If you do not follow the labels on the computer ports then you will have to update the configuration files on the computer to correct COM ports.

## 1.2 Sensitive Equipment

This does not include the power supply for your illumination systems (i.e. tunable light source and light line).

- Lock-in Amplifier
- Chopper Control Unit
- Keithley

These components will communicate with the computer that will run the SciPV software needed to take current-voltage (IV), spectral response (SR) and quantum efficiency (QE) measurements.

## 1.3 Tunable Light Source

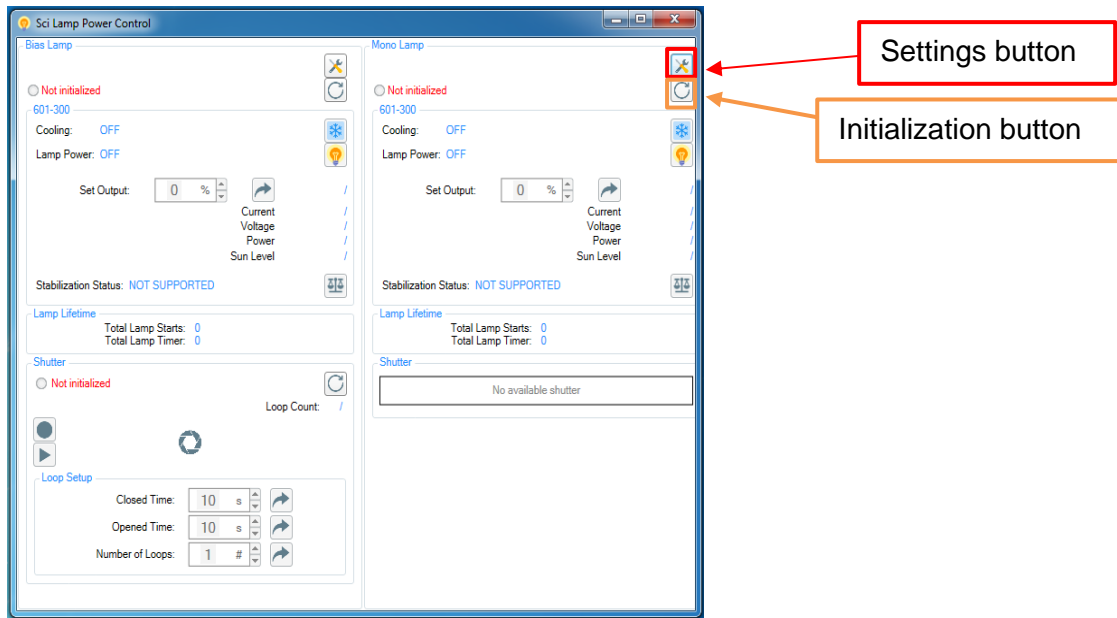
This part of your system will produce your monochromatic light that should be focused onto your sample. The light from the tunable light source is modulate by a chopper that is attached between the output slit of mono and the light guide that goes to the sample chamber. The chopper is controlled by the chopper control unit while the filter wheel and monochromator are controlled by the computer. The power supply of the tunable light source can be controlled by a RS232 to USB connection at the back of the power supply. Please review the *Initializing Lamps on SciLPControl*

*Please read **through this manual, the SciPV manual and the Sciencetech Lamp Power Control manual before attempting to starting up your PTS system!!***

With your custom system, both the bias and monochromatic light source power supplies can be controlled through one application called SciLPControl. The SciLPControl is already installed on your system's computer. **SciLPControl will not turn on the power supplies. This program only allows control of the power supply after it has been manually turned on.**

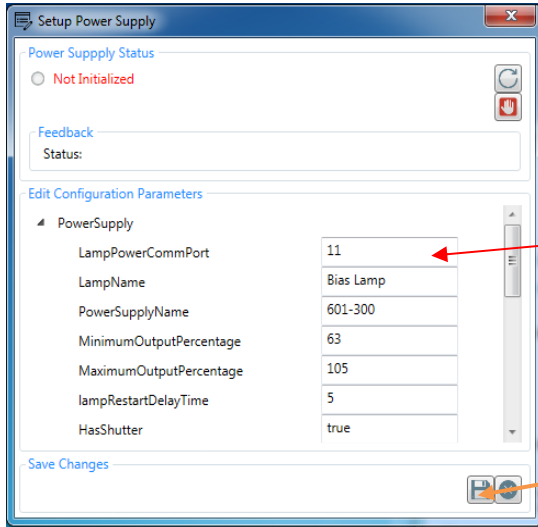
To control the lamp power supplies, you will first need to initialize the lamp on SciLPControl by following the steps below. Before using SciLPControl please review the Sciencetech Lamp Power Control User Manual and the instructions below.

1. Double click on the SciLPControl icon on the desktop. The software window will look as shown below.



**Figure 9 : SciLPControl software window with lamps not initialized**

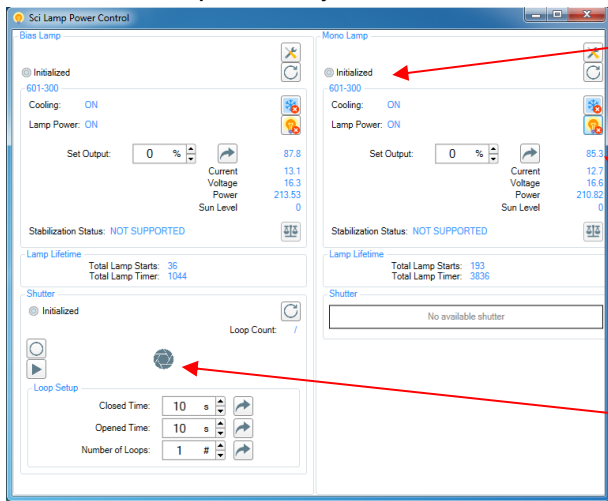
2. Every time this application is open you will need to initialize the lamps on the application to control the lamp power supplies remotely. Note that closing this application will not cause the lamp power supplies to turn off nor will restarting the computer. This application only turns off the lamp and fans if this input has been given to the program.
  - a. If you close the program and reinitialize the lamps the program will display whatever state the lamp settings were left in just before you closed the program.
  - b. To turn off the power supply you will need to turn off the power supply from the power switch. **Do not turn off the lamp power supplies before first turning the lamp off followed by the fan!**
  
3. Click on the settings button and enter the correct COMPort for the lamp. The COMPort value for both lamps should already be entered but if there are issues when trying to initialize then these COMPort values may have changed and will need to be updated.



1) Enter lamp COMPort value

2) Save changes made

- Next you will need to initialize the lamp(s). To initialize the lamp(s), you will have to click the initialize button for each lamp. After pressing the initialize button the SciPLControl will then provide information on the current state of the respective lamp and allow you to control the lamp remotely.



Lamp initialized

Lamp and fan are ON

Current lamp power supply setting

Shutter status

**Start Up Protocol (Custom Instructions)** and *Initializing Lamps on SciLPControl* sections in this manual in addition to the *Sciencetech Lamp Power Control* manual before starting this system.

## 1.4 A1 Light Line

The Light Line component of your PTS system is used as bias light for collecting QE and IV measurements. The power supply of the Light line can be controlled by a RS232 to USB connection at the back of the power supply. For operation instructions for the light line, you should review the *Light Line Solar Simulator User Manual* and the *Sciencetech Lamp Power Control User Manual*.

To control the filter wheel in the A1 light line, please review the *SciUSB Filter Wheel User Manual*. The filter wheel has mesh filters installed to remotely adjust the irradiance without having to change the power setting on the power supply. The filter wheel has two open positions which allow the user to reach the one sun value using the power supply setting specified in the QC report for this system. The SciUSB filter wheel has position settings for reducing the irradiance to 50%, 30%, 20% and 10%. The positions are labelled appropriately in the SciUSB Filter Wheel application on the system's computer.

**Note: On the SciUSB Filter Wheel application, please select cfg01 in order to control the filter wheel for the A1 light line.**

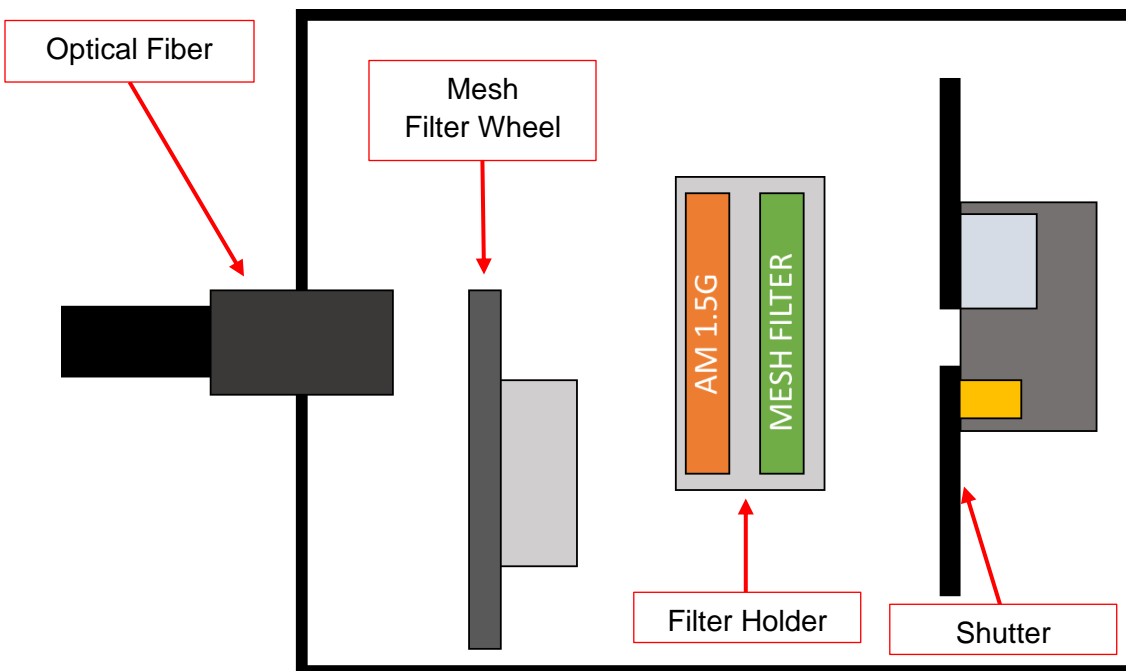


Figure 3: A1 Light line with mesh filter wheel and filters



## 1.5 Sample Chamber

Every wall except for the back wall of the PTS is removable. The side, top and front walls are held in place by magnets and should be removed in the order of the number marked on the panel. If only one panel needs to be removed then the number of the panel does not matter and the panel can be removed without having to remove the other panels first. However, if multiple panels need to be removed then the panels should be removed in ascending order according to the number of the panel. For example, to remove panels 1 and 2 you should first remove panel 1 then remove panel 2.

Panels of the sample chamber should be replaced in descending order. For example, if panels 1 and 2 have already been removed from the sample chamber then to put these panels back on panel 2 should be put back on first followed by panel 1.

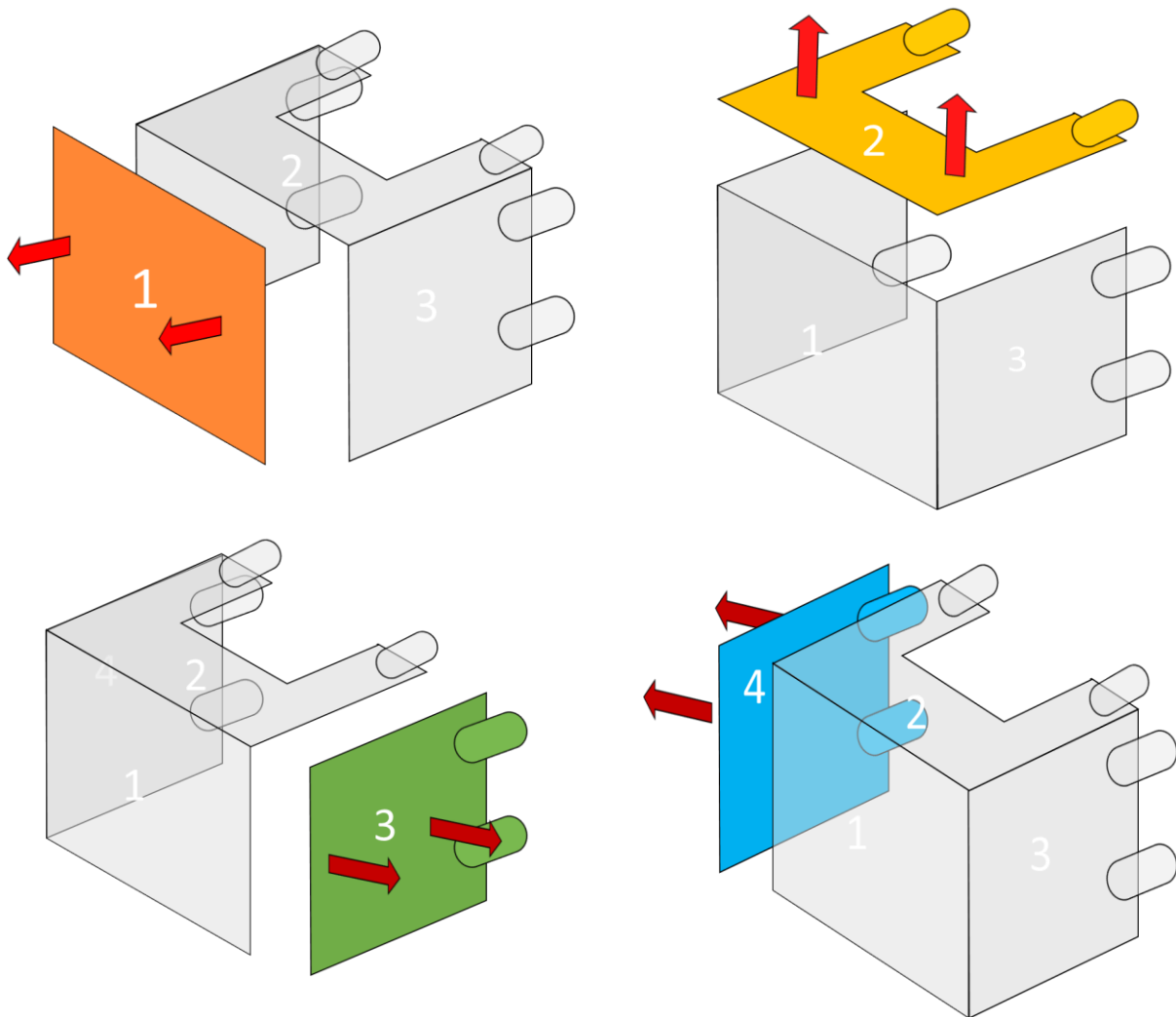


Figure 4: Sample chamber

## 1.6 Reference Detector

The back side of the reference detector has flock paper on the backside to prevent you from scratching the cell chuck sample plate. Do not peel off or remove this flock paper from the backside of the reference.

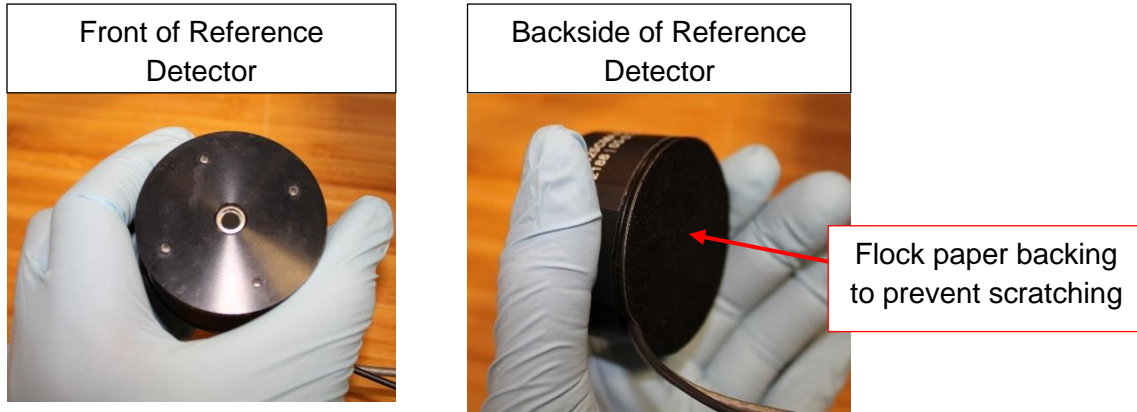


Figure 5 : Images of Reference Detector

## 1.7 Work Distance Jig

The working distance jig is to be used for getting the distance between your sample and bias to the working distance for 1 Sun. If you are collecting the IV measurement at the focal point of the mono beam then your sample will already be at the working distance for 1 Sun.

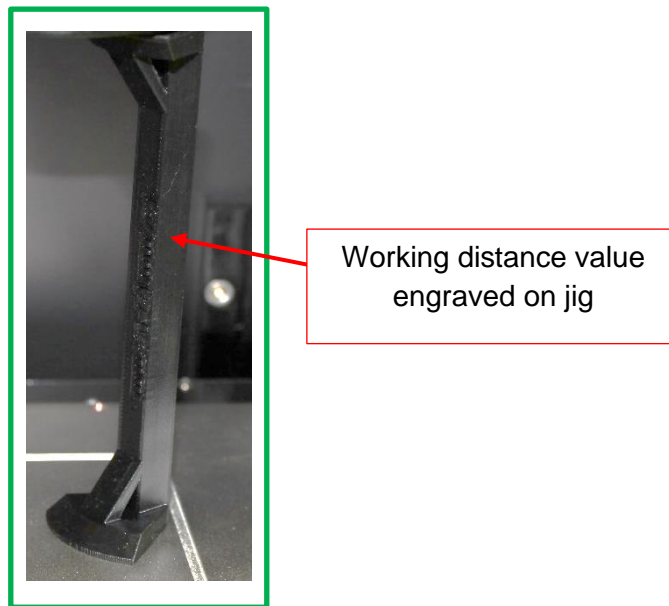


Figure 6 : Image of working distance jig

## 2. Unpacking and Installation

Unpack all components and place the main PTS assembly in the desired location for operation. Lay out all components and cables for the installation process.

Below are two layout options for your PTS system. Option 1 is for a table with a bottom rack while option 2 is for an extra-large table with no bottom racks.

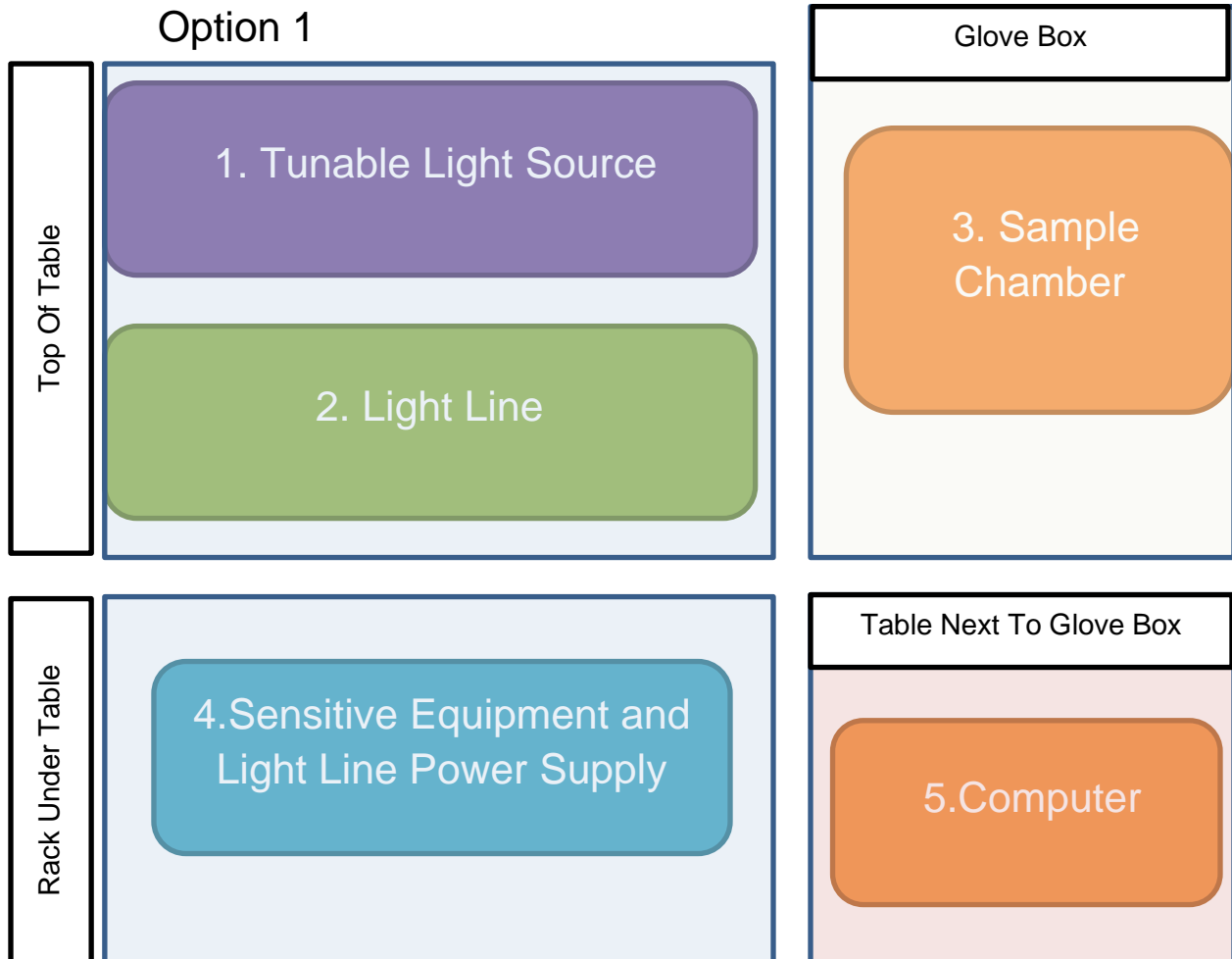


Figure 7 : Layout Option 1

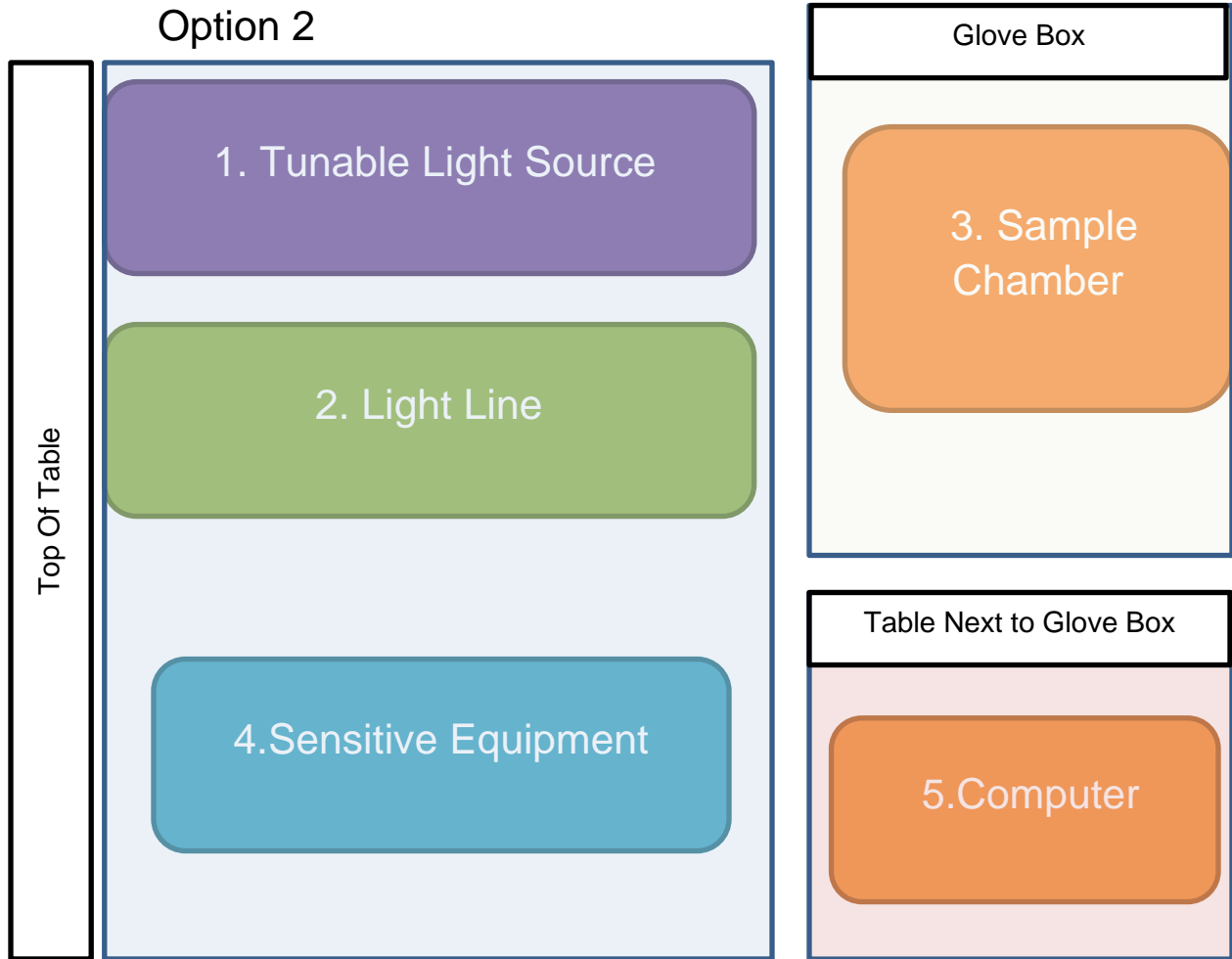
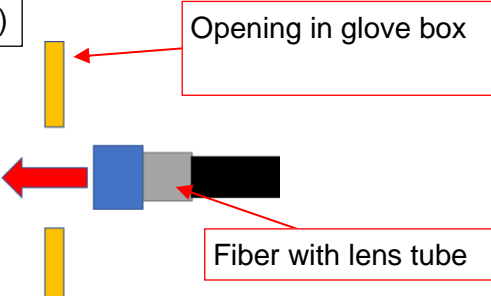
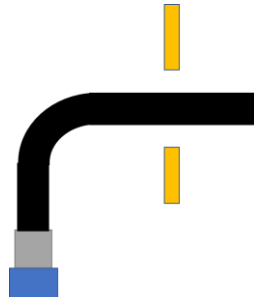
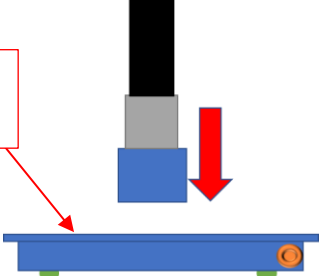
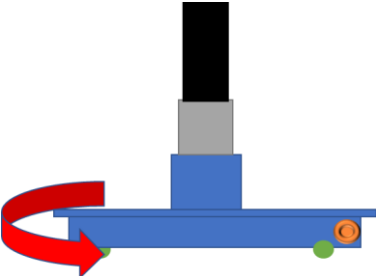



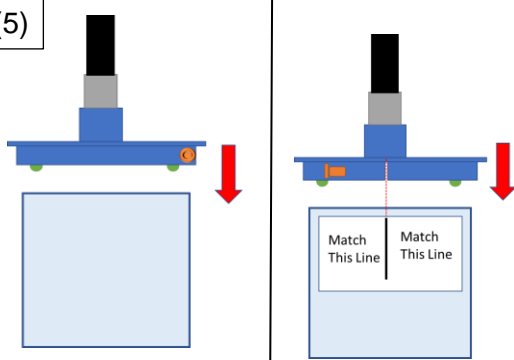
Figure 8 : Layout option 2

## 2.1 Installing Fibers

### 2.1.1 Connecting Light Line Fiber to Chamber

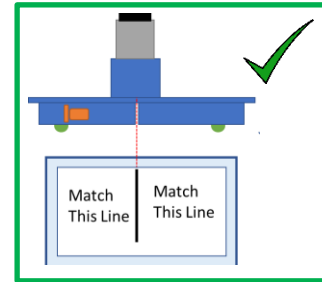
<p>(1)</p>  <p>Opening in glove box</p> <p>Fiber with lens tube</p>	<p>First pass the light line fiber through the glove box opening into the glove box.</p>	
<p>(2)</p> 	<p>Make sure that when you are working with the fiber that you never bend it to a radius less than the bending radius of the fiber which is 1.5" to 2".</p>	
<p>(3)</p>  <p>2" lens tube adapter</p>	<p>Now attach the fiber to the 2" lens tube adapter. See step 4 for attachment instructions.</p>	
<p>(4)</p> 	<p>You will need to screw the 2" lens tube adapter to the 1" lens tube on the end of the light line fiber.</p>	

(5)

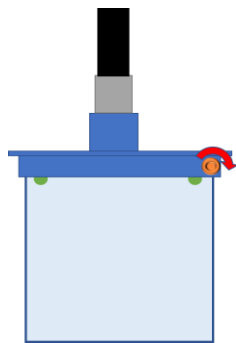


With the fiber now attached to the 2" lens tube adapter, slide this assembly on to the 2" lens tube secured in the sample chamber.

Make sure that the gap of the clamp on adapter line up with marked line on the 2" lens tube.

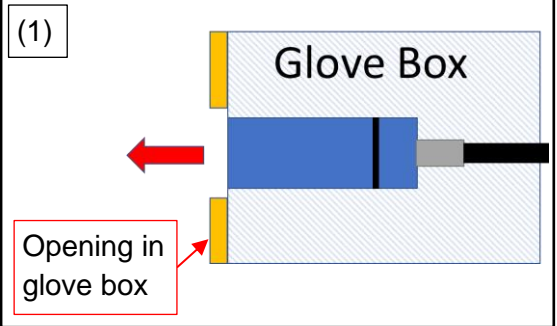
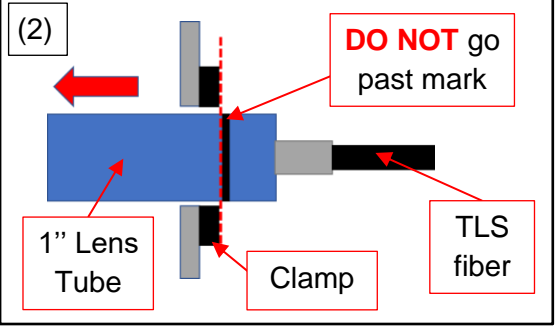
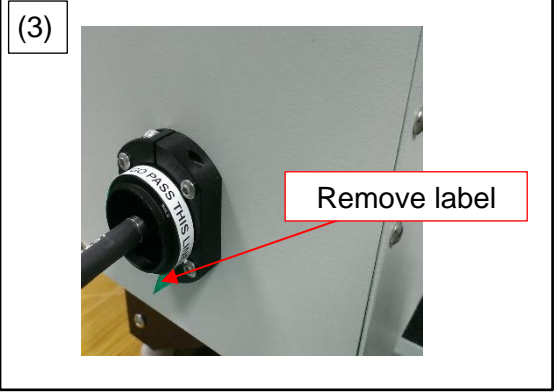


(6)



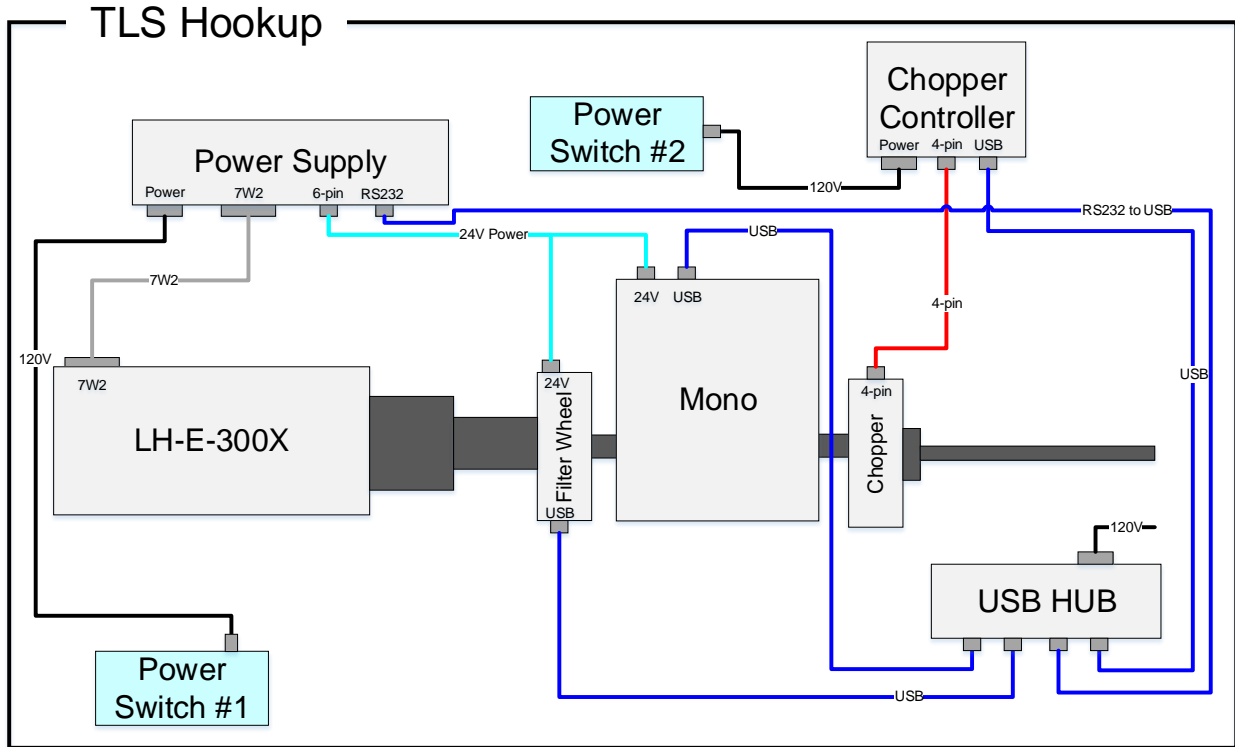
Once the adapter is properly aligned to the clamp on the lens tube, tighten the screw on the 2" lens tube adapter.

## 2.1.2 Connecting TLS Fiber to TLS

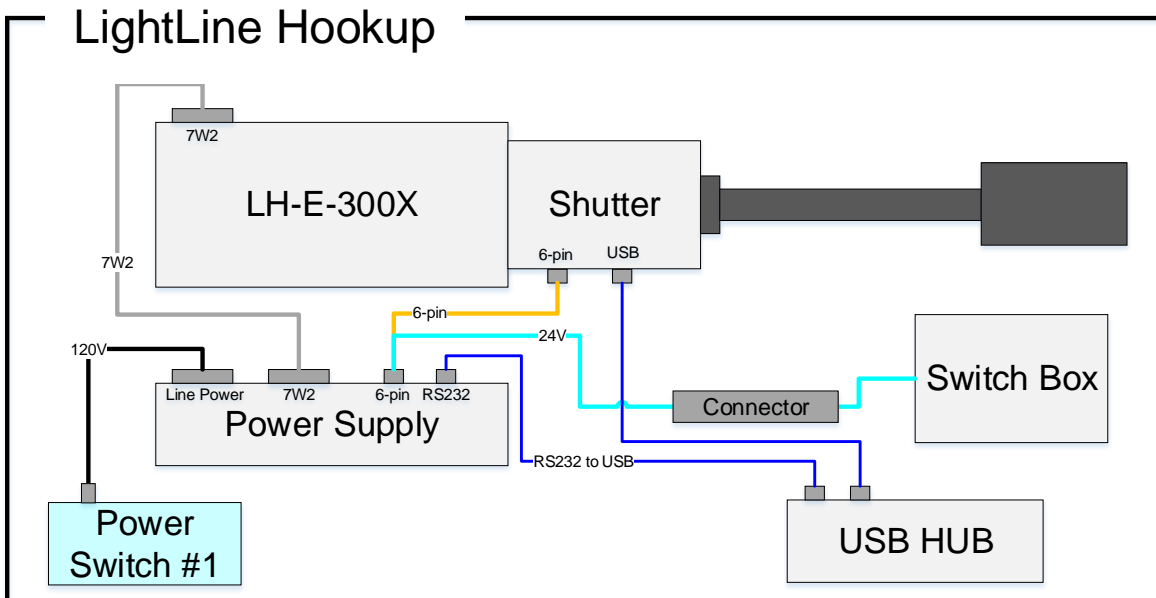
<p>(1)</p>  <p>Pass the TLS fiber through the opening in glovebox and gently feed it through to the TLS.</p>	
<p>(2)</p>  <p>Slide the 1" lens tube connected to the TLS fiber through the opening of the TLS chopper. Do not let the 1" lens tube go further than the marking on the 1" lens tube. Then tighten the clamp using the screw on the side of the clamp.</p>	
<p>(3)</p>  <p>Once the 1" lens tube is installed and secured, you can remove the marking label on the lens tube.</p>	

### 3. Hookup Instructions

#### 3.1 TLS Hookup



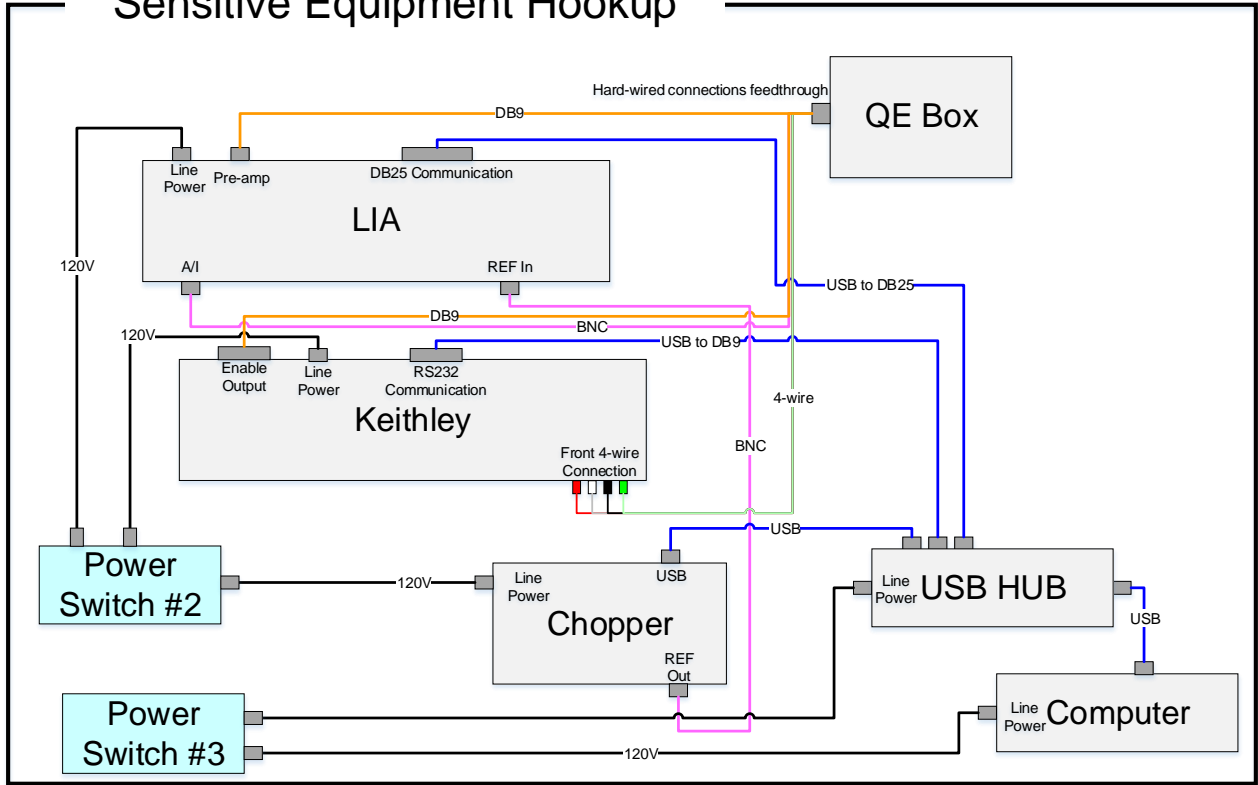
#### 3.2 Light Line Hookup





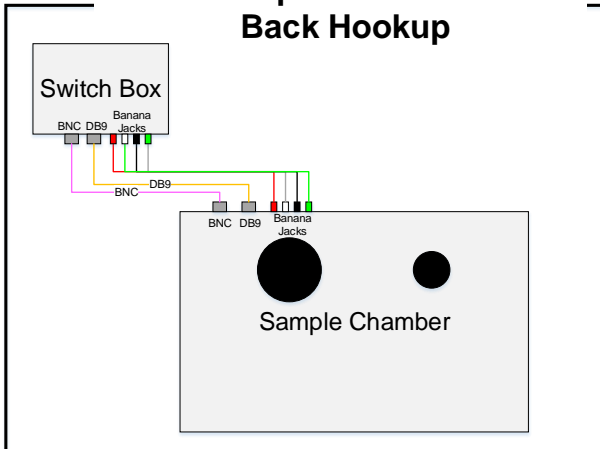
### 3.3 Sensitive Equipment Hookup

#### Sensitive Equipment Hookup

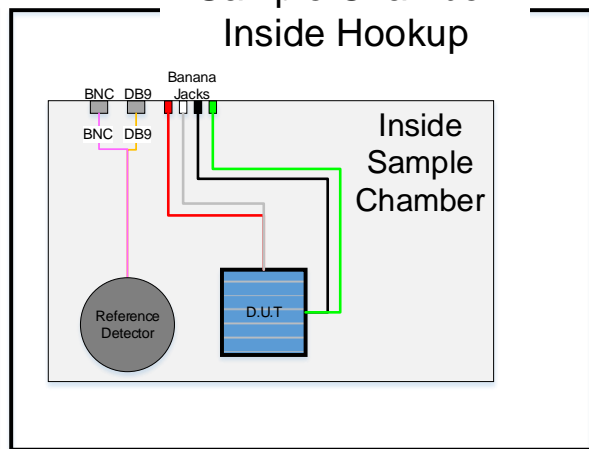


### 3.4 Sample Chamber Hookup

#### Sample Chamber Back Hookup



#### Sample Chamber Inside Hookup



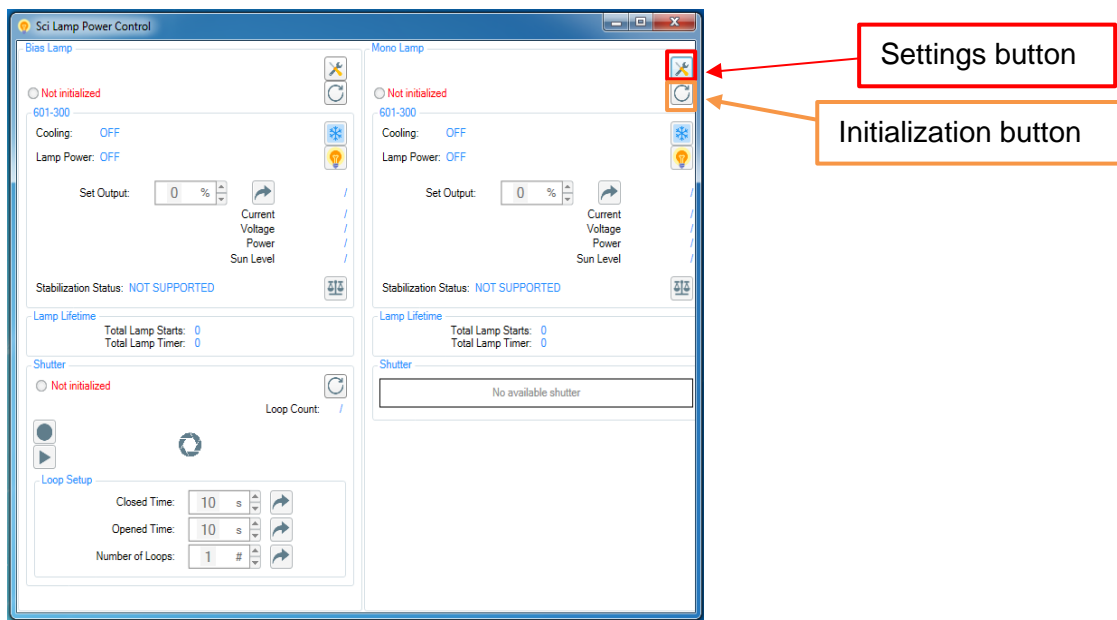
## 4. Initializing Lamps on SciLPControl

**Please read through this manual, the SciPV manual and the Sciencetech Lamp Power Control manual before attempting to starting up your PTS system!!**

With your custom system, both the bias and monochromatic light source power supplies can be controlled through one application called SciLPControl. The SciLPControl is already installed on your system's computer. **SciLPControl will not turn on the power supplies. This program only allows control of the power supply after it has been manually turned on.**

To control the lamp power supplies, you will first need to initialize the lamp on SciLPControl by following the steps below. Before using SciLPControl please review the Sciencetech Lamp Power Control User Manual and the instructions below.

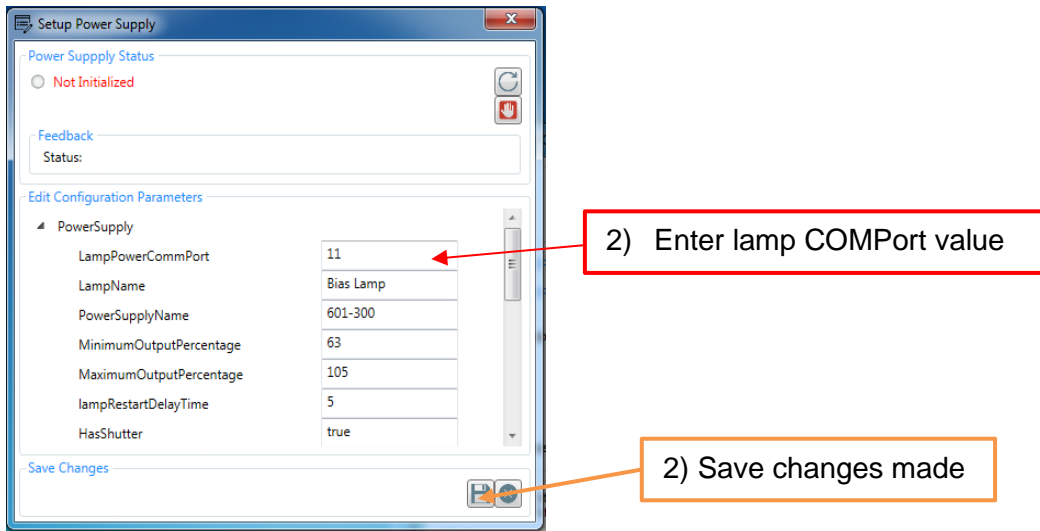
5. Double click on the SciLPControl icon on the desktop. The software window will look as shown below.



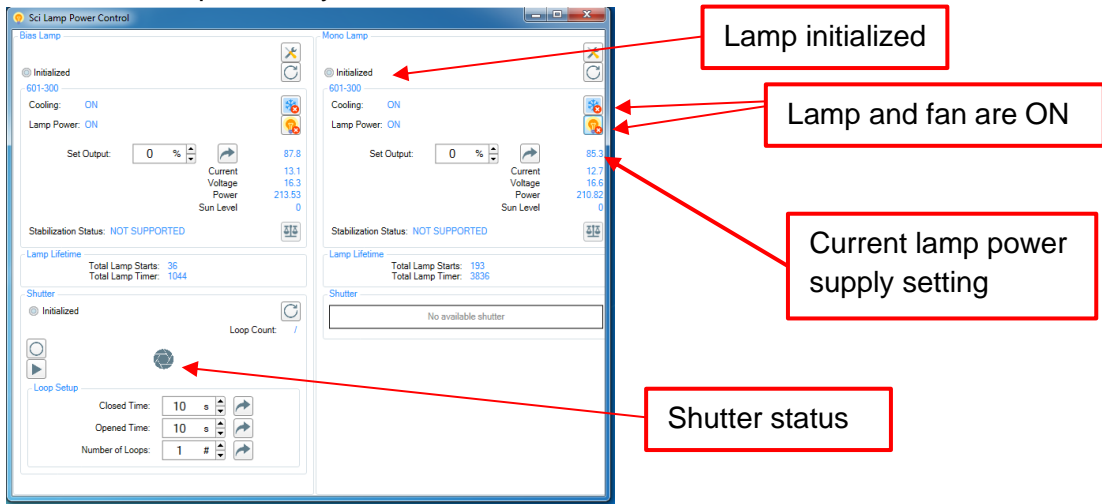
**Figure 9 : SciLPControl software window with lamps not initialized**

6. Every time this application is open you will need to initialize the lamps on the application to control the lamp power supplies remotely. Note that closing this application will not cause the lamp power supplies to turn off nor will restarting the computer. This application only turns off the lamp and fans if this input has been given to the program.
  - a. If you close the program and reinitialize the lamps the program will display whatever state the lamp settings were left in just before you closed the program.
  - b. To turn off the power supply you will need to turn off the power supply from the power switch. **Do not turn off the lamp power supplies before first turning the lamp off followed by the fan!**

- Click on the settings button and enter the correct COMPort for the lamp. The COMPort value for both lamps should already be entered but if there are issues when trying to initialize then these COMPort values may have changed and will need to be updated.



- Next you will need to initialize the lamp(s). To initialize the lamp(s), you will have to click the initialize button for each lamp. After pressing the initialize button the SciPLControl will then provide information on the current state of the respective lamp and allow you to control the lamp remotely.



## 5. Start Up Protocol (Custom Instructions)

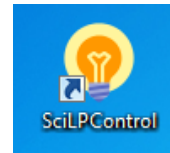
**Please read through this manual, the SciPV manual and the Sciencetech Lamp Power Control manual before attempting to starting up your PTS system!!**

1. Turn on bias and main lamp supplies. Please note that for taking measurements the switch box for your system draws power from the bias lamp power supply therefore the bias lamp power supply must be on even if the lamp is not turned on. If you do not need the bias lamp for measurements then the lamp does not need to be turned on as the lamp does not need to be on in order for the switch box to receive the power it needs.
2. Turn on bias and main lamps as needed for your experiment. **WARNING: DO NOT** ignite the lamps if the lock-in, chopper or Keithley are turned on as this may cause damage to these components of your PTS system. If you are accessing the lamp power supply remotely from the computer you will need to use the SciLPControl (Sciencetech Lamp Power Control) program. Otherwise, you can use the display panel on the lamp power supply to control the lamp.

### Instructions for remote lamp power control:

Full details on using SciLPControl program can be found in the Sciencetech Lamp Power Control User Manual provided with your system. **Please review this manual before attempting to use the remote lamp power control.** The following instructions are written under the assumption that you have reviewed the Sciencetech Lamp Power Control User Manual and the *Initializing Lamps on SciLPControl* section in this manual.

- a. With the power supplies of the lamps turned on, open SciLPControl by double clicking the icon on the computer desktop and then initialize the lamp(s).
  - b. Then turn on the fan for the lamp(s) (bias and/or main lamp depending on your need). Do not ignite the lamp without the fan being on first.
  - c. Then ignite the desired lamp(s) you need.
    - i. If you will need the bias lamp later on it is recommended that you turn this lamp on and close shutter until the bias light source is needed for your experiment.
    - ii. If you will need the bias lamp for measurements first and then the main lamp, then you can set the main lamp source to 100nm (or any wavelength below the fiber's lower cut-off) in the SciPV. This will allow you to warm up the main lamp until you need it later for you other measurements without the need to turn on and off the sensitive equipment in order to ignite the main lamp.
3. If you have turned on the main lamp, you should turn on the chopper soon after igniting this lamp. If the chopper, lock-in and Keithley are connected to the same power bar switch, as recommended in the hook-up instructions, then you should turn this switch on soon after igniting the main lamp. Only turn on the sensitive equipment (chopper, lock-in and Keithley)



**Figure 10 :**  
SciLPControl  
desktop icon

after you have ignited the lamp(s) you need to use. **Do not have the sensitive equipment on when you are igniting the main and/or bias lamp!!! If you have to ignite any of the lamps later the sensitive equipment must be turned off to prevent damage to the hardware.**

4. If the chopper, lock-in and Keithley are not yet turned on, please do so now. Please wait for these units to initialize before proceeding to the next step. This should take about a minute or less. If these systems do not initialize properly, please refer to the troubleshooting section in this manual.
5. Now that your chopper, lock-in and Keithley are turned on and initialized, you can open the SciPV software on the computer provided with your PTS by double clicking on the desktop icon.
6. To access the cell chuck inside the sample chamber, remove the thumb screws on the front panel of the sample chamber. The entire front section can also be removed for greater access but for the most part just opening the front panel should give you enough room to access the inside of the sample chamber.
7. The lamp should be given about 10 to 15 mins to warm up before starting measurements.
8. Your system is now properly started and you can proceed to take measurements.
9. For instructions on performing a CAL, SR, QE and/or IV measurement, please see the *Measurements Protocol* section.

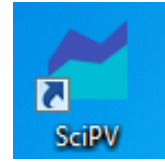


Figure 11 :  
SciPV desktop  
icon

## 6. Measurement Protocols

### 6.1 CAL Measurement Protocol (Hardware Set Up)

1. Close the shutter on the bias light using the SciLPControl (customized Lamp Power control for remotely both the bias and mono lamp power supplies).
2. Then move the bias lamp to the vertical position, see image below.

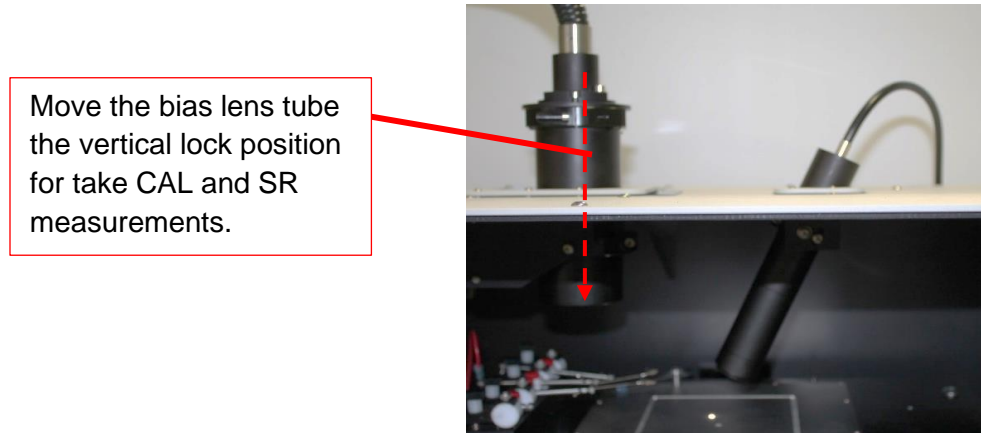


Figure 12: Bias lens tube in vertical lock position

3. Connect the reference detector to the connections on the back wall of the sample chamber.
4. Now you can place the reference detector on to the cell chuck and focus the mono light on to the detector by raising or lower the sample stage. The mono beam should underfill the detector area. This is easiest if the mono wavelength is set to 0 (see software user manual details on setting monochromator wavelength). Once focused you can change the wavelength to 100 nm or cover the detector window to prevent the lock-in from overloading. You can remove this cover when you are ready to take a measurement.

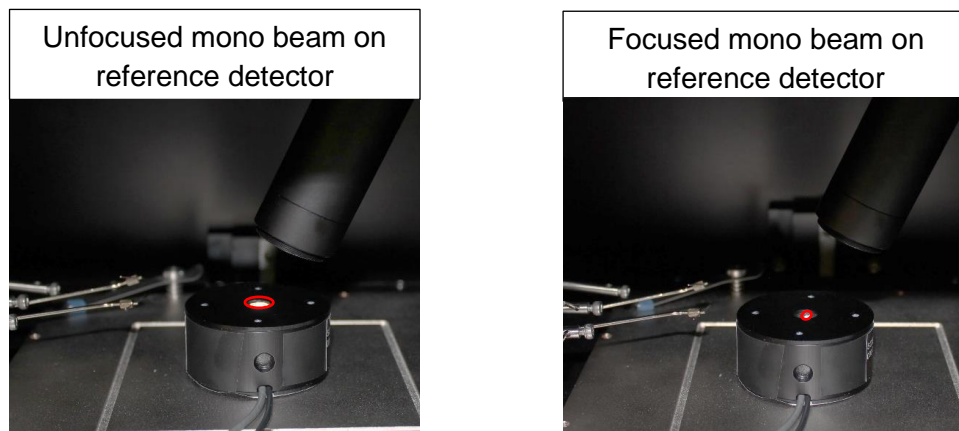


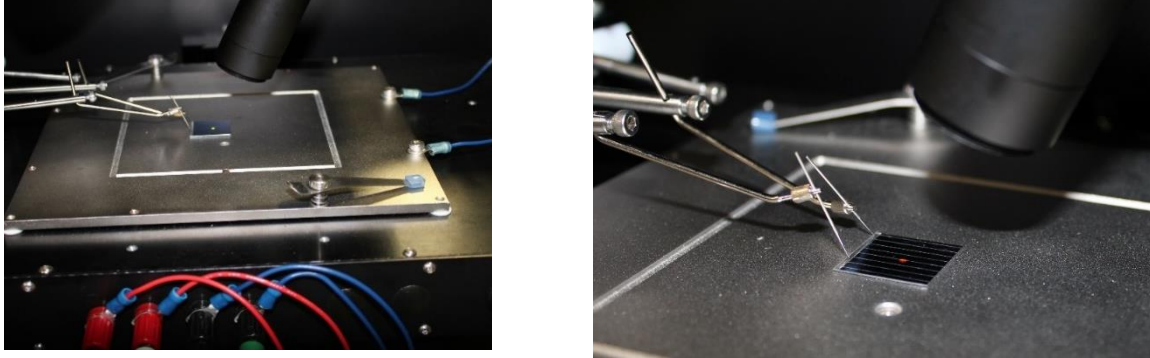
Figure 13: Focusing monochromatic light on reference detector

5. You are now ready to take a CAL measurement. Please see CAL measurement software instructions located in the SciPV:RunQE software user manual.

## 6.2 SR Measurement Protocol (Hardware Set Up)

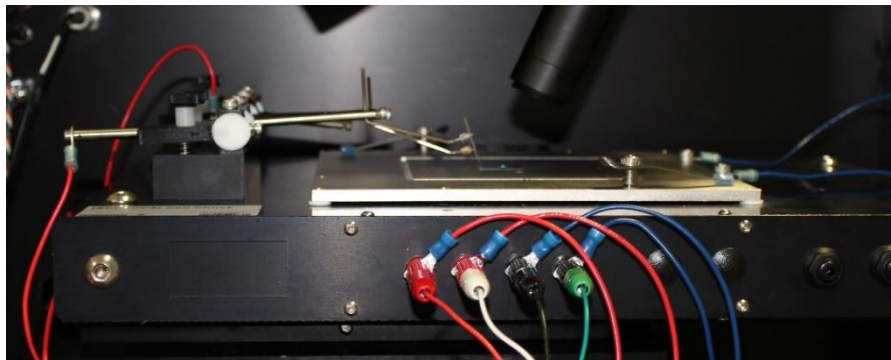
Before starting a SR measurement, you should follow these instructions:

1. Close the shutter on the bias light using the SciLPControl (customized Lamp Power control for remotely both the bias and mono lamp power supplies).
2. Then move the bias lamp to the vertical position, see Figure 12.
3. Then place your sample on the cell chuck plate and focus the mono light on to the sample.



**Figure 14: Monochromatic light on sample**

4. Once the mono light is focused on your sample connect the probes to the sample and connect the probe wires to the front of the cell chuck
  - a. If you are taking a 2-wire measurement, instead of a 4-wire measurement then you will need to short the other two wires. If the wires are not shorted then you will get an error when you run the software as measurements are taken using a 4-wire set up.
5. Next connect the backwall banana cables to the front of the cell chuck, see the picture below.



**Figure 15: 2-wire connection**

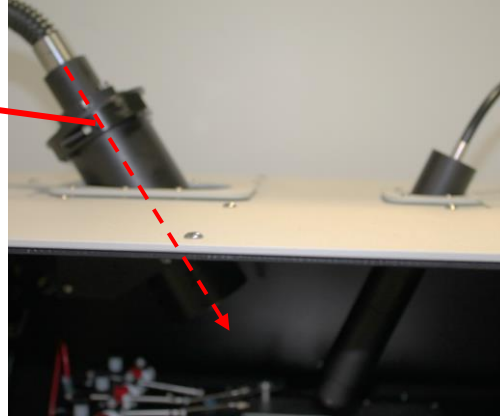
6. You are now setup for a SR measurement. Please see SR measurement software instructions located in the SciPV: RunQE software user manual.



### 6.3 QE Measurement Protocol (Hardware Set Up)

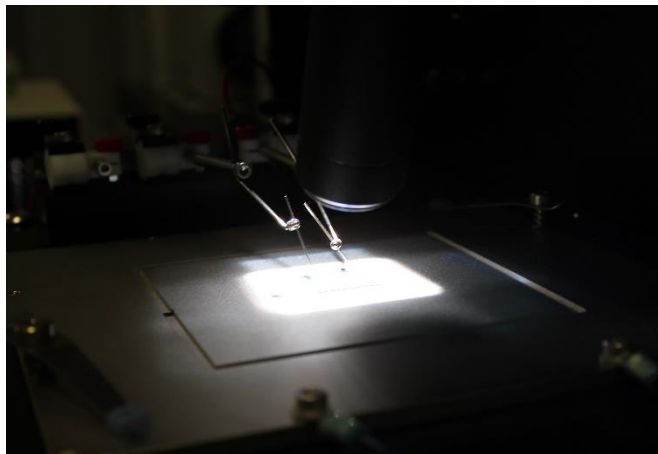
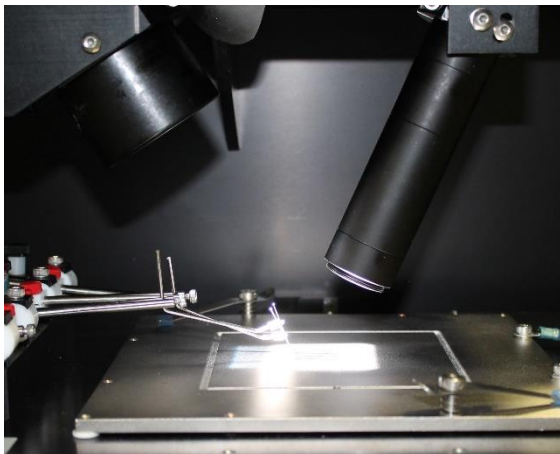
1. Close the shutter on the bias light using the SciLPControl software (customized Lamp Power control for remotely both the bias and mono lamp power supplies).
2. Then move the bias lamp to the angled position, see the image below.

Move the bias lens tube the angled lock position for take QE measurements.



**Figure 16: Bias lens tube in angled lock position**

3. Place your sample on to the cell chuck plate and focus the mono beam on the sample.
4. With mono light focused on your sample, connect the probes to the sample and connect the probe wires to the front of the cell chuck.
  - a. If you are taking a 2-wire measurement, instead of a 4-wire measurement then you will need to short the other two wires. If the wires are not shorted as shown then you will get an error when you run the software as measurements are taken using a 4-wire set up.
5. Now open the shutter on the bias lamp using the SciLPControl software. When the mono light is focused on your sample the bias lamp is at its working distance for 1 Sun.



**Figure 17: Bias lens tube in vertical lock position with shutter open**

6. You are now setup for a QE measurement. Please see QE measurement software instructions located in the SciPV: RunQE software user manual.



## 6.4 IV Measurement Protocol (Hardware Set Up)

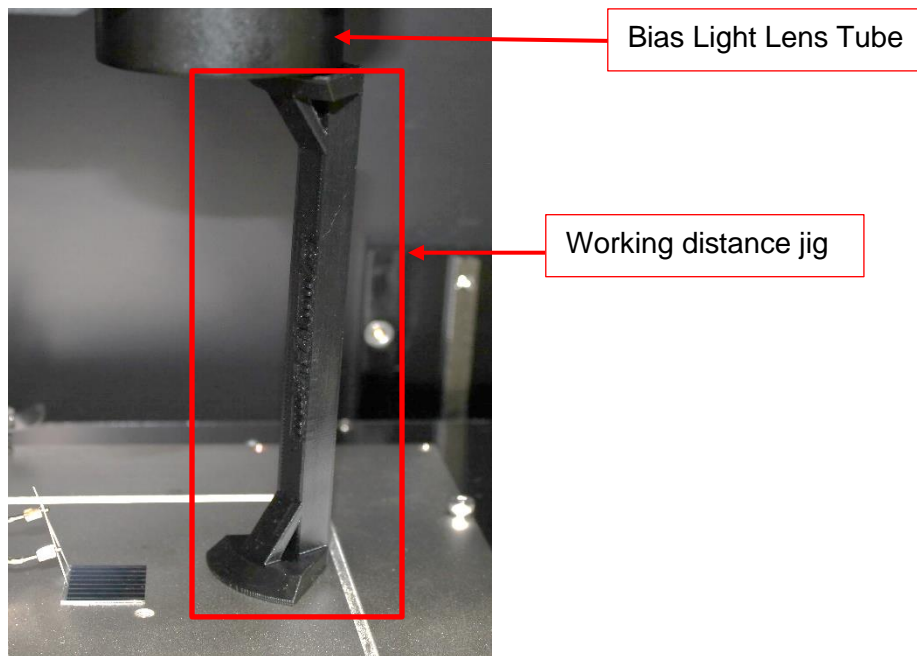
There are two options for taking an IV measurement.

### 6.4.1 Option 1 (Angled Bias Light):

1. Set the bias light power for 1Sun. Refer to QC report for this lamp power setting.
2. Close the shutter on the bias light using the SciLPControl software (customized Lamp Power control for remotely both the bias and mono lamp power supplies).
3. Then move the bias lamp to the angled position, see Figure 16.
4. Place your sample on to the cell chuck plate and focus the mono beam on the sample. Then position your sample such that it is centered around the monochromatic light beam spot.
5. With monochromatic light focused on your sample, connect the probes to the sample and connect the probe wires to the front of the cell chuck. For details on changing the monochromatic light wavelength value please refer to *Setting Monochromator Wavelength* in the PTS software user manual.
6. Now open the shutter on the bias lamp using the SciLPControl software. When the mono light is focused on your sample the bias lamp is at its working distance for 1 Sun.
7. For IV measurements the monochromatic light should not be on the sample. You can either turn off the monochromatic light if it will not be used again or if you do need to use the monochromatic light after your IV measurement you can set the monochromator wavelength to 100nm. For help with setting monochromatic light source wavelength please review the section: *Setting Monochromatic Wavelength* in the PTS software user manual.
8. You are now setup for an IV measurement. Please see IV measurement software instructions located in the SciPV: RunQE software user manual.

### 6.4.2 Option 2 (Vertical Bias Light):

1. Set the bias light power for 1Sun. Refer to QC report for this lamp power setting.
2. Close the shutter on the bias light using the SciLPControl software (customized Lamp Power control for remotely both the bias and mono lamp power supplies).
3. Then move the bias lamp to the vertical position, see Figure 17
4. Now open the shutter on the bias lamp using the SciLPControl software.
5. Place your sample on to the cell chuck plate and center it under the bias light.
6. Connect the probes to the sample and connect the probe wires to the front of the cell chuck.
7. Now use the height jig provided to adjust the height of your sample to the working distance the bias lamp is at its working distance for 1 Sun.



**Figure 18 : Bias Light Lens Tube with Working Distance Jig**

8. You are now setup for an IV measurement. Please see IV measurement software instructions located in the SciPV: RunQE software user manual.

## 7. Important Notice

All electrical instruments may be dangerous if not handled in accordance with proper instructions and common precautions. Sciencetech Inc. will not be responsible for any damage caused by such units if instructions herein are not followed and repairs are not attended to or performed by company-trained or licensed personnel. All instruments should be operated with proper grounds on power line and should not be opened or handled as to electrical or electrically operated components without being switched off and disconnected from power receptacle.

Sciencetech Inc. reserves the right to make adjustments or improvements in its product without notice and without obligation to subsequent purchasers and without being required to make corresponding changes or improvements in products theretofore manufactured and sold.

We have done our very best in the manufacture and packing of this material. The transportation carrier is now responsible for delivering it to you in its original good condition, since all purchases are FOB London.

If the shipment is NOT delivered in good order and in accordance with quantity shown on Bill of Lading or Packing Slip, have the shortage or damage noted by the Carrier on both the delivery receipt and the freight bill, or by special form provided by United Parcel or the Post Office.

The Interstate Commerce Commission has ruled that Transportation Companies will not honor any losses or shortage claims unless exceptions are noted on the freight bill at the time of delivery. It is the buyer's responsibility to make a complete inspection immediately upon receipt of purchased goods.

If you accept shipment from the Transportation Carrier short of what is enumerated on the Bill of Lading – or in damaged condition – without having proper notation made by the Carrier, you do so at your own risk.

If bundles or crates are in apparent good order, but on opening contents are found to be damaged, call Carrier for adjuster to view same and have the Transportation Company/United Parcel/Post Office mark the freight bill or packing slip relative to such concealed damage. Make your claim at once for the Transportation Company/United Parcel/Post Office has a limited time for presentation of claims.

We are willing to assist you in every possible manner in collecting claims for loss or damage on this shipment, but this willingness on our part does not make us responsible for filing or collecting claims or replacing materials. Claims for Loss or Damage on shipment may not be deducted from out invoice, nor pay of the invoice withheld awaiting adjustment of such claims, as we cannot guarantee safe delivery.

**Important:** Do not return goods without written authority.

Contact factory for return material authorization.

Returned goods will not be accepted by us from the Transportation Company/United Parcel/Post Office unless written authorization has been issued by Sciencetech Inc.

Return of special or non-stock items cannot be authorized. Credit for goods returned - under authorization - will depend on the value to us based on our selling price, less a fair charge to cover the expense of shipping - re-handling - transportation - refinishing, etc, providing material is received in good condition - transportation charges prepaid - credit rendered to be used against future purchases.

All equipment manufactured by Sciencetech Inc. has been subjected to extensive performance and quality control testing. In order to constantly improve our product, we ask your assistance. Upon installation of our equipment, please fill out the attached card and return to us.

By completing the card and returning it to Sciencetech, you will register your instrument in warranty and enable us to provide you with the best possible service.

## 8. Warranty and Assistance

All Sciencetech products are warranted against defects in materials and workmanship. This warranty applies for one year from the date of delivery, or, in the case of certain major components listed in the operating manual, for the specified period. Products sold or resold, but not manufactured by Sciencetech, carry the warranty, if any of the original manufacturer. We will repair or replace products that prove to be defective during the warranty period or employ our best efforts to effect repair or replacement of equipment sold, but not manufactured, by Sciencetech. No other warranty is expressed or implied.

We are not liable for consequential damages.

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