ABET TECHNOLOGIES

Function Focused Innovation™

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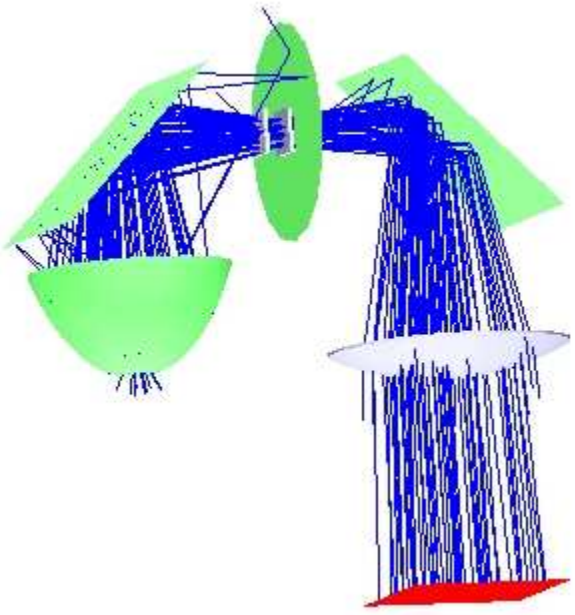
Manual

Solar Simulators
and
Uniform Exposure Systems



M-SS Current Control

February 2008

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Introduction

This manual explains the safe and effective use of Abet Technologies' Solar Simulators and Uniform Illuminators. From here on we will refer to all of them as Solar Simulators, this product line shipping more units, and mention the uniform illuminators used for exposure or other applications only when their use or safety concerns require additional explanation.

Please review this manual so that you may use your Solar Simulator in a safe and productive manner.

This **high intensity** source is designed to deliver **high brightness**, **high UV** content light from a **high pressure** arc lamp excited by **high current**, ignited by **high voltage** and running at very **high temperatures**. All these "**high's**" can cause unsafe conditions if basic safety considerations are not understood by the user. The mercury containing lamps in Hg and HgXe lamp based Uniform Illuminators add the potential for mercury contamination with all its risks and concerns. However, it is a perfectly safe instrument when used as intended. The built-in door and over-temperature interlocks provide an additional margin of safety.

⚠ Please do not skip the Safety section that follows this page.

The overall layout and the Gen II optical design of Abet Technologies' uniform illumination sources were conceived to allow you to accomplish the hard tasks of your profession without having to worry about your tools:

- An integrated system: no additional boxes or cables to clutter your work space
- Greatly improved optical throughput allowing lower wattage lamps to deliver the required work plane irradiance
- Built-in lamp focus imaging device facilitating alignment functions
- A selection of spectral and irradiance level controls
- Wide range of working distances
- The modular design of Abet uniform illuminators allows for easy integration into your own instrument as any OEM will appreciate
- Particle filtered cooling air extends the life of critical optical components
- The only routine maintenance functions, changing the lamp and air filter, are easily accomplished without the need for any tools

Safety

A number of hazards are present when operating any arc lamp based system, like your Abet Technologies' Solar Simulator. The most significant hazards are listed below together with safe usage suggestions. If in doubt, consult your company's Safety Officer or call/e-mail us.

Hazards associated with high intensity light are always present, as this is the design function of this source. The built-in interlock system was designed to protect you from other hazards. Do not defeat the interlocks.

Lamp ignition involves a low energy, high voltage discharge that does not cause any issues with most electronic instruments. However, you may choose to turn off any very sensitive electronic instruments or computers located in close proximity before starting your illuminator.

Radiation

Abet Technologies' uniform illuminators are designed to produce high intensity light output with, depending on filtering options used, UV, visible and/or infrared content.

⚠ Hazard: Eye damage
Solution: Wear appropriate eye protection when light output is not contained. Avoid looking at the output or its reflections.
⚠ Hazard: Skin damage
Solution: Wear protective clothing when light output is not contained.

Lamp Explosion

Arc lamps used with your Solar Simulator contain high pressure gas and may explode if not handled properly.

Avoid touching the glass section of the lamp. If touched, use isopropyl alcohol and a clean soft tissue to wipe off any fingerprints as they will weaken lamp envelope.

Avoid scratching the glass – do not use a lamp with scratched envelope.

Install the lamp with proper polarity of electrical connections.

Do not stress the glass parts when tightening electrical connections.

Make sure that all plastic packaging has been removed from the lamp before installation.

Replace the lamp when it reaches its lifetime limit (a built-in Elapsed Time Meter lets you keep track of lamp operating hours). An old lamp, with a darkened glass envelope, has a high likelihood of exploding and should be replaced.

⚠ Hazard: Eye damage
Solution: Wear appropriate eye protection when replacing a lamp.
⚠ Hazard: Skin damage
Solution: Wear protective clothing when replacing a lamp.

Mercury (Hg)

Some of the uniform illuminators utilize mercury based arc lamps (Hg or HgXe). Mercury contamination can occur in case of lamp breakage or explosion. Please consult with your company Safety Officer on proper handling of Mercury contamination.

⚠ Hazard: Mercury (Hg)
Solution: Locally approved decontamination

Ozone

Short wavelength UV light converts oxygen into ozone. When using high UV output lamps ozone can become a major irritant to the user. Even ozone free lamps can produce enough ozone to be uncomfortable for very ozone-sensitive persons. Most of Abet Technologies' Solar Simulators and Uniform Illuminators use ozone free lamps. However, if a deep UV HgXe source is ordered additional ventilation considerations need to be addressed before the system is put into use.

⚠ Hazard: Ozone
Solution: Proper ventilation

Electrical shock

In normal operation the user is protected from contact with any energized electrical connections. However, electrical shock danger will occur if interlocks are defeated or power supply section opened without the unit being unplugged from the mains.

⚠ Hazard: Electrical shock
Solution: Unplug the unit from the mains before replacing the lamp or servicing the power supply section.

Heat

Arc lamp envelope reaches very high temperatures during normal operation and can cause severe burns if touched.

⚠ Hazard: Skin burn
Solution: Let the lamp cool at least 15 minutes before opening lamp compartment door.

Unpacking

Please note, it is strongly suggested that at least two people engage in the system setup as its weight and size may be more than a single person can safely handle.

Your shipment will typically consist of the Solar Simulator and the lamp you selected, power cord appropriate for your country, this manual and any accessories you ordered packed in a large box equipped with skids allowing the use of standard lift equipment. The box is equipped with shock indicator labels. If any of them have been activated, indicating an unsafe handling during the shipping, please advise the shipper and Abet Technologies so that we can jointly address any potential equipment damage issues.

Allow your light source to come to room temperature before opening the box, if the unit was just received, to avoid the danger of water condensation shorting any electrical functions.

You will need to cut the plastic strapping and adhesive tape holding the box together, remove the top cover and the side walls to expose the contents of the package. Your Solar Simulator is shipped lying on its side with the accessories that were part of the order located in the open areas around the instrument.

Please remove and secure all the packages with accessories and then lift the solar simulator out of the box. Set it upright on its rails and remove the protective plastic packaging.

NOTE:

- **Avoid pressing on the large condenser lens at the output of the Solar Simulator while handling the system**
- **Avoid subjecting the instrument to mechanical shocks as damage to optical components can occur. In particular, the optical homogenizer lens array assembly can literally disintegrate if subjected to excessive shocks.**

Some of the larger field systems are shipped with their supports removed to minimize shipping box size and thus lessen shipping costs. For those systems use the provided hardware and tools to first attach the supports.

Setup

System mounting options

Solar Simulators are typically shipped with a set of stabilizing rails attached. The rails prevent the instrument from tipping forward. They can be removed if the system is to be attached to its mounting support (use a 3 mm hex key to remove the securing bolts). Both metric, 25 mm centers, and inch hole patterns are compatible with the mounting holes locations in the system legs.

Lamp insertion

⚠ Warning: Lamps will be damaged if mounted with incorrect orientation or if the connections are not securely tightened. The larger electrode end (anode), marked with a " + " sign, needs to be on top and the cathode end on the bottom for proper Xe or HgXe lamp operation. For Hg lamps, the opposite holds true – cathode on top and anode on the bottom. Most lamps have an "UP" sign on the appropriate end to facilitate proper insertion technique.

⚠ Warning: Lamps can be damaged if fingerprints are left on their glass envelopes. Powder free gloves facilitate clean lamp handling. Handle the lamp only by the metal ends. Wipe any contamination off the glass with an isopropyl alcohol wetted soft tissue.

⚠ Warning: Glass-to-metal seals can get damaged if too much torque is applied to them. When possible, hold the metal end being tightened. If other mechanical components prevent access to the part of the lamp being attached use only gentle finger pressure or torque to secure the lamp while holding the opposite end.

Open the optical compartment door, identified by the CAUTION information label, by unscrewing its retaining thumbscrews and set it aside. It is always a good idea to use powder free gloves when working inside the optical compartment.

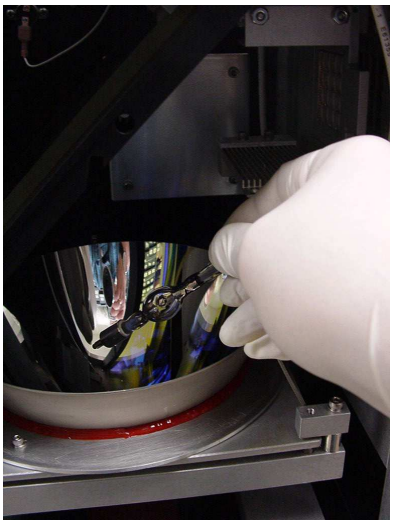
Replace the door and tighten the thumbscrews when finished with lamp and filter insertion activities described below.

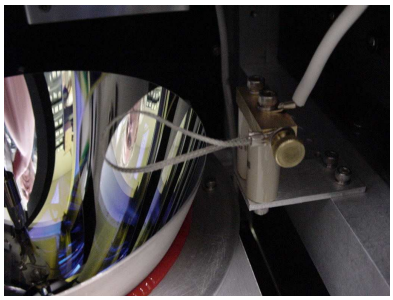
At this point please take note of the Elapsed Time Meter reading so that you can keep track of the lamp operating hours and replace it in a timely manner.

Your Solar Simulator may have been shipped with a shipping adapter (a small aluminum cylinder) to allow lamp mount tightening during the transport. If so, loosen the wing nut securing lamp clamp and remove it before inserting the lamp shipped with your Solar Simulator. Systems utilizing lamps which screw into their mounts do not require this shipping adapter.

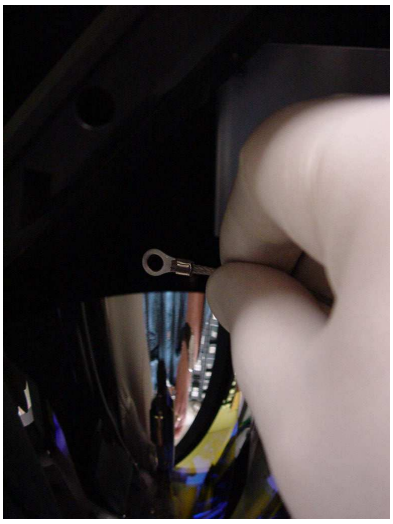
Remove the lamp form its protective packaging and mount it in the system, with the correct end up. Some lamps screw into their adapter and other lamps are inserted into their mount, after the shipping rod has been removed, and the mount is tightened with the wing nut below the elliptical reflector.

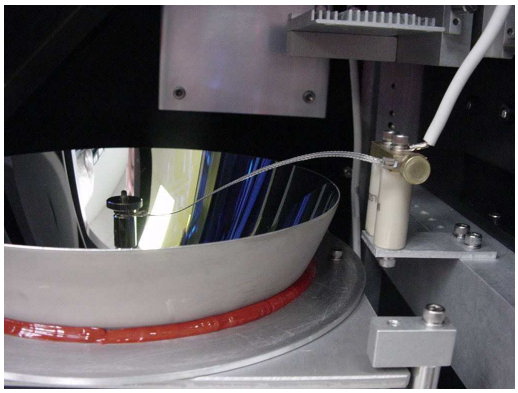
150-200 W lamps





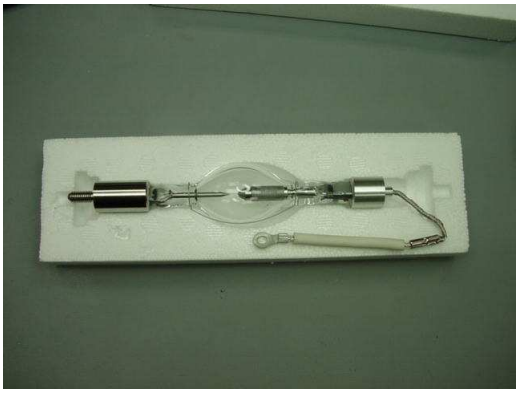
Systems based on lower power lamps, 150-200 W, are shipped with a High Voltage lead attached.

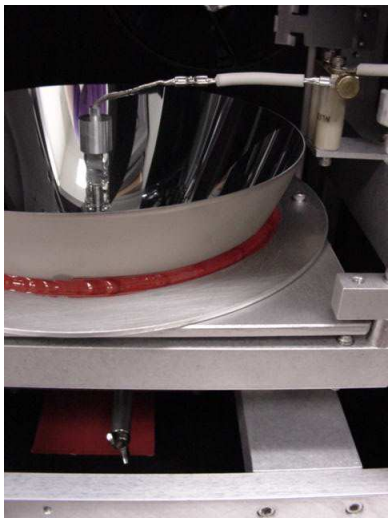




Remove one end of the lead and secure it to the top of the lamp making sure that it is securely attached at both ends but does not put any strain on the lamp end. Length of the lead has been designed so that a strain free connection is possible while the lead cannot make electrical contact with the reflector and prevent proper operation of the lamp. Replacement leads are available when you order new lamps from Abet Technologies or our Distributors.

550 W lamps



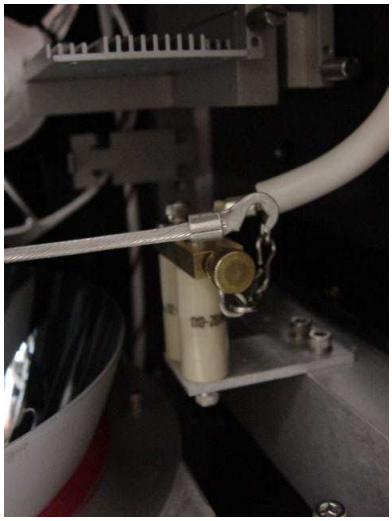


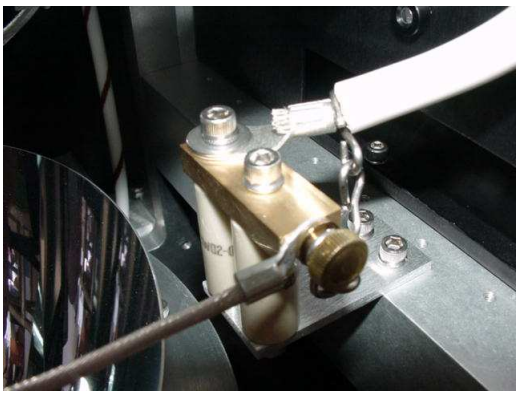
550 W lamps come with their connection lead attached. Insert the lamp into the socket at the bottom of the reflector and secure it by tightening the wing nut below the ellipse. Only gentle finger pressure is required. Connect the lead to the High Voltage bar thumb screw. Make sure that the lead does not pull on the top of the lamp or lamp will get damaged. Lead should be straight but easily moved when pushed with your finger.

1 kW lamps

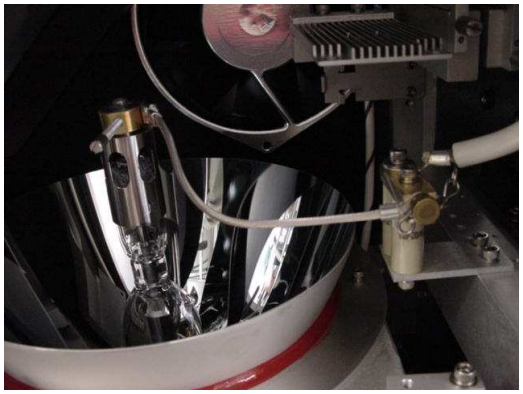
Insert the threaded end of the 1 kW lamp into the ellipse and screw it gently but firmly into the base plate.

Loosen the slotted thumbscrew on the 1100-254 lamp connection assembly and place it over the top of the lamp. Do not tighten the thumbscrew yet.





Take the wire end with a hook terminal and secure it with the thumbscrew on the high voltage terminal.



Gently tighten the long slotted thumbscrew on top of the lamp taking care not to push too hard on the lamp. Make sure that the lead does not pull on the top of the lamp or lamp will get damaged. Lead should be gently curved and easily moved when pushed with your finger.

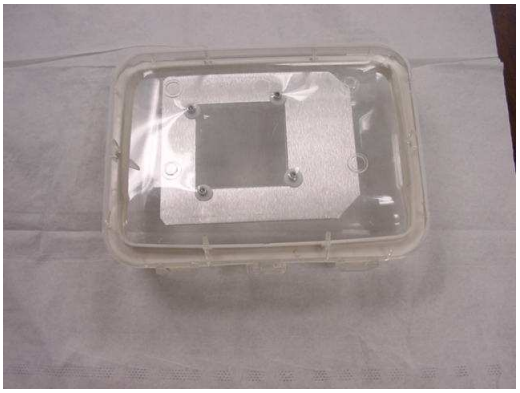
NOTES:

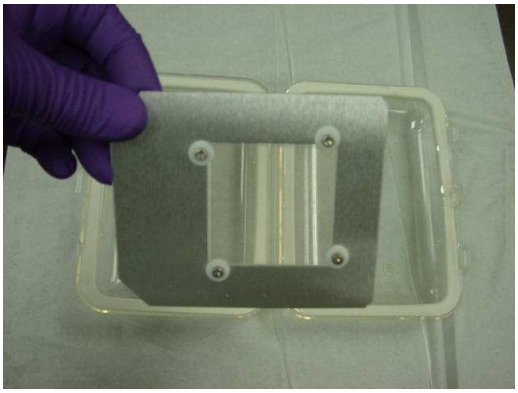
- These two connections carry currents which can reach 55 A – they need to be very secure.
- The lead should be fairly level and kept away from the elliptical reflector to avoid the possibility of a flash-over during lamp ignition.

Filters and Attenuators

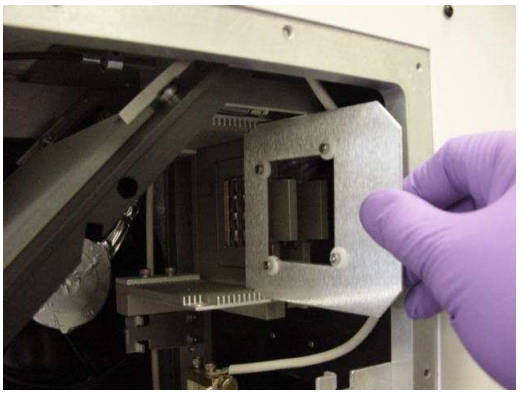
Abet Technologies' Solar Simulators frequently require spectral shaping filters and/or attenuators to achieve the desired optical performance.

Filters





Smaller filters might have already been installed in the system or they may have been shipped separately in a secure, clean shipping container captured between two elastic membranes. Please remove the filter from its container and insert it into its designated location within the filter rack, preceding the homogenizer optics. 2 inch filters need to be close to the homogenizer on the right so as not to vignette the beam. 3 inch filters should be located in the leftmost part of the rack for best heat load distribution. A spring loaded bracket retains the filters in place.



Larger filters, made from more heat sensitive glasses, are located in an expanded beam area preceding the large collimator lens. Remove system cover to the right of lamp door to insert these filters into the Solar Simulator.

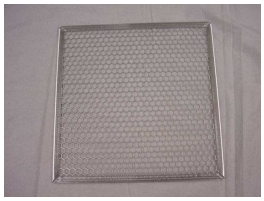
Pull out the filter support rod and insert filter frame into the unit as shown above.

Let filter frame tabs bracket the internal light shield on the left, raise the rounded right side to fit between mirror rails and insert support rod to secure its position.

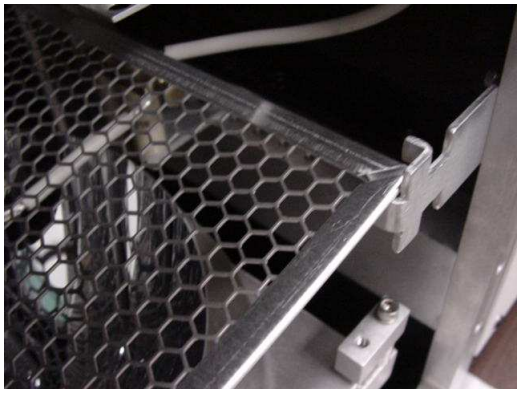
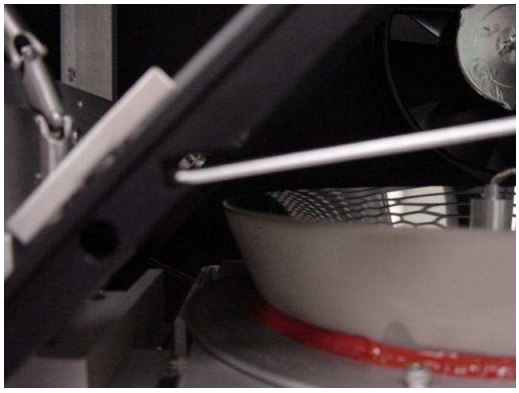
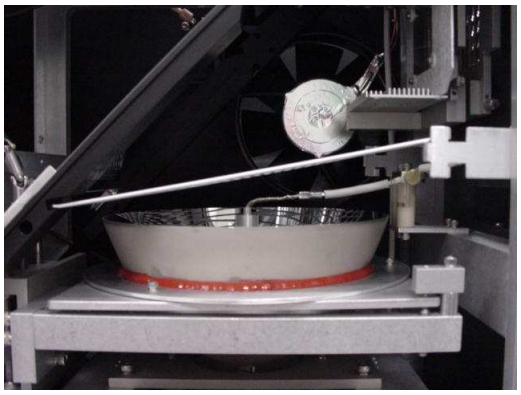
Replace lens section door when filter has been fully installed.

Attenuators

Wavelength independent perforated metal attenuators can be utilized to moderate system output without spoiling its spatial or spectral uniformity.



These are held in place in the notches in mirror support rails and by the support brackets.

Please make sure that the high voltage lamp supply cable runs roughly parallel to the mounted attenuator so that no arc-over occurs.

Starting up the system

⚠ Warning: High intensity light, frequently with high UV content, is emitted by your Solar Simulator. Avoid exposure to the light by using appropriate eye and skin protection.

- Check that the power switch is in the OFF (0) position. Plug the power cord into the unit.
- Position the unit so that light exiting the condenser lens will point toward some safe surface (a wall, a screen or similar) and not at any person.
- Plug the cord into the mains and turn the mains switch ON (1). Cooling fans will start and the lamp current display will light up. Shutter timer display may or may not light up depending on the positions of the two shutter timing control switches.
- Check the lamp current preset operation point and adjust it as desired as follows:
- Press and hold the lamp control switch in PRESET position to observe its value. Use the lockable adjustment knob to modify it within the limits of the particular arc lamp allowed values (e.g. 15-28 A for 550 W lamps, 30-55 A for 1 kW lamps). Release the switch once the desired value is set and lock the adjustment knob to avoid accidental set point changes.
- The system is now ready to start. Make sure that SHUTTER switch is in the middle position, shutter closed, to avoid unnecessary exposure to system output.

- Press the lamp control switch to ON position to ignite the lamp. Once lamp is lit the green LAMP ON LED button lights up, lamp operating current is displayed and the Elapsed Time Meter starts accumulating time to allow lamp life monitoring.

- Some of Abet Technologies' power supplies will continue to generate high voltage pulses until lamp ignites. Other units have an ignition time-out feature. For those it may take a second or third attempt (lamp enable switch Off and then On again) to get some harder to ignite lamps to start. After 5-15 minutes of lamp warm-up time, depending on lamp type, your Solar Simulator output will be stable and dependable.

⚠ Warning: If lamp fails to ignite within a few seconds turn the unit off and review the Troubleshooting section below.

- You may now proceed to the alignment and focusing section below or turn the system off if you plan to do the optical alignment later.

Using your Light Source

Lamp controls

System operating point can be preset before lamp is energized and also adjusted once lamp is lit.

- Press and hold the lamp control switch in PRESET position to observe its value. Use the lockable adjustment knob to modify it within the limits of the particular arc lamp allowed values (e.g. 15-28 A for the 550 W lamps, 30-55 A for 1 kW lamps). Release the switch once the desired value is set and lock the adjustment knob to avoid accidental set point changes.
- Once the switch is released it returns to the Lamp Off position

- Press the lamp control switch to ON position to ignite the lamp. Once lamp is lit the green LAMP ON LED button lights up, lamp operating current is displayed and the Elapsed Time Meter starts accumulating time to allow lamp life monitoring.

- Some of Abet Technologies' power supplies will continue to generate high voltage pulses until lamp ignites. Other units have an ignition time-out feature.

For those it may take a second or third attempt (lamp enable switch Off and then On again) to get some harder to ignite lamps to start. After 5-15 minutes of lamp warm-up time, depending on lamp type, your Solar Simulator output will be stable and dependable.

- Once the lamp is running its operating point can be adjusted to the desired point with the lockable knob.
- All power supplies in Abet Technologies' Solar Simulators are equipped with hardware limits which protect lamps from being driven beyond their safe operating range.

Shutter

The Sun 2000 shutter can be controlled with a number of internal and external inputs to provide ON, OFF and timed operation. A lit red LED indicates shutter open state.

Internal shutter control

Internal shutter controls are enabled when the SHUTTER CONTROL switch is pressed to the top position. In this mode shutter can be opened or closed with the SHUTTER switch or else placed in a TIMED mode.

When in the TIMED mode the built in electronic timer lights up and allows setting of the exposure time using the Up/Down acting buttons below its display. Shutter opening can be triggered either by the front panel START button or an external switch closure (mechanical or low TTL state connected through the "SHUTTER INPUT" BNC connector).

WARNING: Running the shutter at higher than 3 Hz repetition rates for extended periods of time will lead to shutter solenoid overheating and early failure.

Timer programming

The built in timer comes preprogrammed for the most common mode of usage. You may reprogram it if your needs are not fully served by the default settings. Here we will list a simple set of possible modifications accessible from the front panel. A more complete set of options can be found on the website of the manufacturer of this commercial timer (Omron Model H5CX-ASD-AC24/DC12-24).

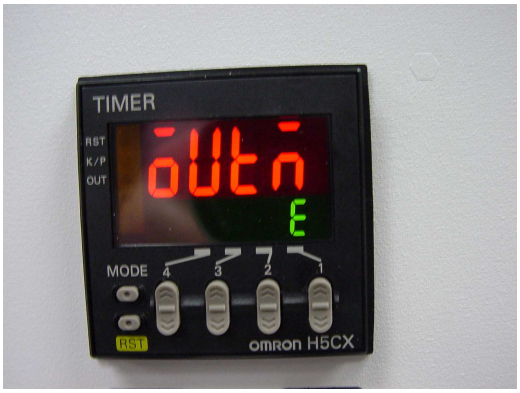
Press and hold the MODE button until display changes from run time mode to the setup mode. Holding the MODE button again at any time ends the setup activities, saves the changes and returns the unit to its run mode condition.

The first screen allows changing of time range from the preset xxx.x s to a number of ranges varying in resolution from 0.01 s to 1 hour. Pressing the Up/Down switches brings on display changes for the different time ranges.

Press MODE button once to move to the next setup screen.

The timer comes preprogrammed to count down from the set point to show the remaining time of the programmed exposure. Here you may choose to switch to an up counting mode.

Press MODE button once to move to the next setup screen.



The timer comes preprogrammed to work in Interval timing mode (mode E). It should remain in this mode.

Press MODE button once to move to the next setup screen.

The timer comes preprogrammed to respond to switch or TTL signals of at least 1 ms duration. This can be also chosen to be 20 ms minimum to further reduce chances of accidental actuation.

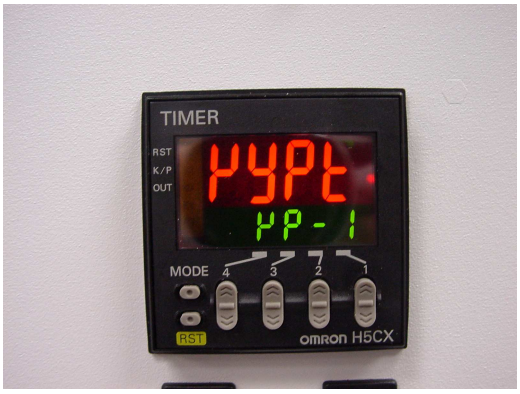
Press MODE button once to move to the next setup screen.

The timer comes preprogrammed to use its NPN transistor driver circuit. It should remain in this mode.

Press MODE button once to move to the next setup screen.

The timer comes preprogrammed to always us red color for control time. Other options here accessible allow the color to be chosen as green or as changing between green and red depending on timer being active or waiting for a command.

Press MODE button once to move to the next setup screen.



The timer offers a number of key protection schemes to minimize chances of accidental changes. We suggest using the µP-1 setting preprogrammed into the unit.

Press MODE button once to move back to the first screen or press and hold it to save the changes and return to the Run mode display shown below.

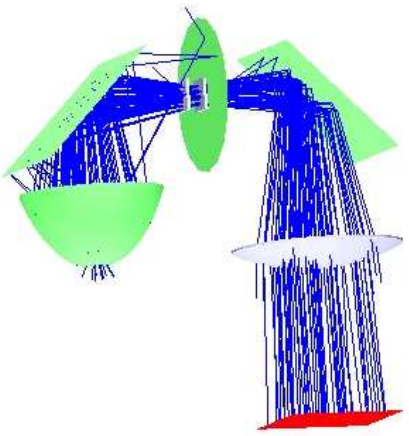
External shutter control

Pressing the SHUTTER CONTROL switch to the EXTERNAL position allows shutter activation with any TTL (+5 V) signal generating timer. Apply the signal to the SHUTTER INPUT BNC connector and shutter will remain open as long as the signal is present.

WARNING: Running the shutter at higher than 3 Hz repetition rates for extended periods of time will lead to shutter solenoid overheating and early failure.

System Alignment and Optimization

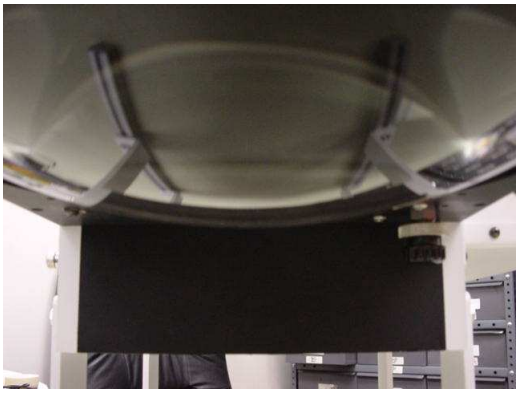
Elements of the optical system



- A high radiance arc lamp located near one focus of an elliptical reflector produces light flux
- The elliptical reflector captures the flux and refocuses it toward the second focus point
- A 90 ° reflector, full spectrum or dichroic, directs the light flux toward a set of homogenizing lenslets
- Spectrum shaping filters are inserted in the path, preferably before the homogenizer to assure spectrally uniform illumination, to modify spectral shape of the light as needed
- Adjustable spacing lenslet arrays provide both the homogenization of the beam and allow slight adjustment of the size of the illuminated field
- A second 90 ° reflector is used in most systems to fold the optical path again and provide vertical illumination
- A large, field size dependent condenser lens collimates the beam and, working jointly with the previous optical components, creates a uniformly illuminated area within a specified range of working distances

Alignment

Abet Technologies' Solar Simulators have been designed to arrive to your facility being very close to optimal alignment. Therefore it should take only a short time to optimize the optical components positions for your application.



Indicator dial equipped alignment actuators and focus imaging accessory included in each system make the alignment fast, intuitive and reproducible.

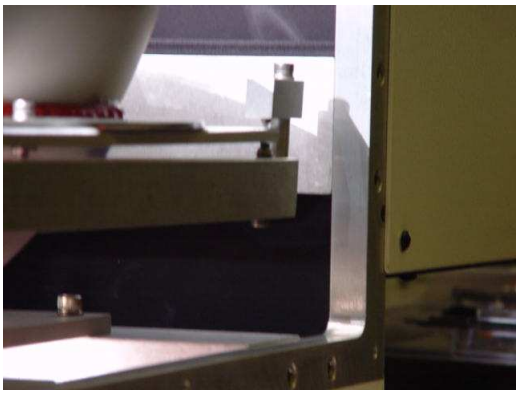
Turn the knob located next to the output condenser lens, seen here in center right, fully counter clockwise to place the focus imaging fixture in its active location. Open the shutter once system lamp has been lit and allowed to

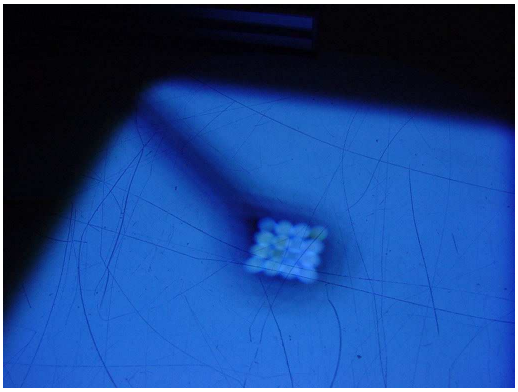
stabilize. An image of the homogenizer array illumination can be seen on a screen (piece of paper) a few inches away from the condenser lens and can be used to guide alignment optimization.

WARNING: wear appropriate eye and skin protection during alignment and operating times as needed.

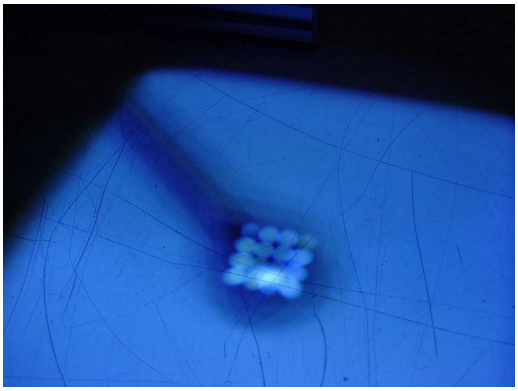
NOTE: Do not "overadjust". If a few turns of any adjustment knob do not produce desired results it is best to stop and inspect adjusters involved. It is possible to completely unscrew some of them and this may lead to a need for a technical service activity. Always record the dial settings before starting on any adjustments so that system can be returned to its original state if all else fails.

Please note the starting readings of the dials so that, in case of alignment troubles you can get back to the starting point. Typically only small adjustments, on the order of ¼ turn of the knobs, are required to see performance change. The need to make very large adjustments may indicate that incorrect lamp was installed or that it was not properly inserted into its holder and it may lead to total system misalignment and even motion component damage. In particular, please make sure that the reflector support plate is located between the stabilizer screws which should just gently touch it without binding its lateral motion.





A well aligned system will produce a reasonably symmetrical pattern of spots representing the 4x4 homogenizer array. For most homogeneous illumination all the spots should be fully illuminated.



Some degree of misalignment can be expected after lamp replacement. Any asymmetric homogenizer illumination pattern, a sample shown to the left, can be corrected by utilizing the Lateral Alignment controls and Focus control indicator knobs.

Increased irradiance can be achieved, with some loss of uniformity, by under-filling the homogenizer (corner spots partially illuminated). Focus control can be used to adjust this property.

Homogenizer adjustment also impacts irradiance level. It should be left at factor setting for optimum uniformity. However, if some loss of uniformity can be tolerated then clockwise adjustment will lead to field size reduction and irradiance level increase. (**Please Note**: field size adjustment is possible only within a limited range for any particular condenser lens size. Homogenizer lenslet frames are typically separated by about 5mm from each other when in normal operating alignment. Departing too far from this nominal setting will reduce illumination uniformity). If irradiance is still too high when field size and lamp power controls have been minimized, an attenuator can be inserted into the optical path of some systems to provide step-wise irradiance control.

Note: Please make sure to rotate the focus fixture out of the optical path when not in use or irradiance uniformity will be destroyed.

Accessories and spare parts

Numerous spectral shaping and intensity modifying accessories are available for the Solar Simulator and Uniform Illuminator products from Abet Technologies. Those come with their own instruction sheets as needed.

Replacement lamps and connectors as well as replacement air filters to keep your instrument in a top operating condition can be ordered from Abet Technologies or the distributor in your area. For safe and optimal operation we suggest replacing lamps when their specified lifetime has been reached or when their glass envelopes start darkening.

Air filters should be replaced every three months under normal operating conditions. They should be replaced more often in a dusty environment or not used at all if the unit is used in a class 100 or better clean room.

Maintenance

Standard maintenance consists of replacing the lamp, when it reaches its specified lifetime or when its glass envelope is darkened and replacing the air filter every three months or at other frequency as the operating environment dictates. Replaceable high voltage leads should also be replaced every few lamp changes as they will harden with use and may start fraying.

Please contact your distributor or the factory for any other maintenance needs.

Troubleshooting

There are very few user serviceable or replaceable items in the Solar Simulator. They are basically limited to the lamp, air filter, fuses, homogenizer assemblies and any filters or attenuators that need replacement.

Symptom: Cooling fans not turning when unit is powered up

- Check if the power cord is properly plugged in and if the fuses are not burned out**.** Contact Abet Technologies' service department if these actions do not resolve the issue.

Symptom: Lamp not lit within few seconds after the LAMP ON switch is pressed and fans are running (for power supplies without ignition timeout)

- **PLEASE NOTE:** Do not leave power on for more than a few seconds if lamp does not turn on or ignition circuit life will be significantly shortened.
- For power supplies with ignition timeout – actuate the LAMP ON switch once or twice before moving onto more diagnostics or contacting the Abet Technologies' service department.
- Check to make sure that power (or current) preset is close to the lamp's operating point rating
- Unplug the unit, open the lamp compartment and check if lamp connections are tight and that lamp is properly oriented (anode on top for Xe or HgXe lamps, bottom for Hg lamps). If all is as it should be, try another lamp if available. If still no light, then contact the Abet Technologies' service department.

Symptom: Lamp repeatedly turns itself off after it runs for some time

- Check if lamp compartment fan is running – it should run even if lamp compartment door is open. Contact Abet Technologies' service department if it is not.

- Check if power supply section fan is running and if air input or output ports are being blocked. Contact Abet Technologies' service department if the system continues to shut down with an unimpeded cooling air flow.

Warranty and returns

Abet Technologies warrants that all goods described in this manual (except consumables such as lamps, filters, etc.) shall be free from defects in material and workmanship. Such defects become apparent within the following period:

All products described here, except spare parts: one (1) year after delivery of the goods to the buyer.

Spare parts: ninety (90) days after delivery of goods to the buyer.

Abet Technologies' liability under this warranty is limited to the adjustment, repair and/or replacement of the defective part(s). During the above listed warranty period, Abet Technologies shall provide all materials to accomplish the repaired adjustment, repair or replacement. Abet Technologies shall provide the labor required during the above listed warranty period to adjust, repair and/or replace the defective goods at no cost to the buyer ONLY IF the defective goods are returned, freight prepaid, to a Abet Technologies designated facility. If goods are not returned to Abet Technologies, and the user chooses to have repairs made at their premises, Abet Technologies shall provide labor for field adjustment, repair and/or replacement at prevailing rates for field service, on a portal-to-portal basis.

Abet Technologies shall be relieved of all obligations and liability under this warranty of:

The user operates the device with any accessory, equipment or part not specifically approved or manufactured or specified by Abet Technologies unless buyer furnishes reasonable evidence that such installations were not the cause of the defect. This provision shall not apply to any accessory, equipment or part which does not affect the safe operation of the device.

The goods are not operated or maintained in accordance with Abet Technologies' instructions and specifications.

The goods have been repaired, altered or modified by other than authorized Abet Technologies personnel.

Buyer does not return the defective goods, freight prepaid, to an Abet Technologies facility within the applicable warranty period.

IT IS EXPRESSLY AGREED THAT THIS WARRANTY SHALL REPLACE ALL WARRANTIES OF FITNESS AND MERCHANTABILITY. BUYER HEREBY WAIVES ALL OTHER WARRANTIES, GUARANTEES, CONDITIONS OR LIABILITIES, EXPRESSED OR IMPLIED, ARISING BY LAW OR OTHERWISE, WHETHER OR NOT OCCASIONED BY ABET TECHNOLOGIES' NEGLIGENCE.

This warranty shall not be extended, altered or varied except by a written document signed by both parties. If any portion of this agreement is invalidated, the remainder of the agreement shall remain in full force and effect.

CONSEQUENTIAL DAMAGES

Abet Technologies shall not be responsible for consequential damages resulting from misfunctions or malfunctions of the goods described in this manual. Abet Technologies' total responsibility is limited to repairing or replacing the misfunctioning or malfunctioning goods under the terms and conditions of the above described warranty.

INSURANCE

Persons receiving goods for demonstrations, demo loan, temporary use or in any manner in which title is not transferred from Abet Technologies, shall assume full responsibility for any and all damage while in their care, custody and control. If damage occurs, unrelated to the proper and warranted use and performance of the goods, recipient of the goods accepts full responsibility for restoring the goods to their condition upon original delivery, and for assuming all costs and charges.

RETURNS

Before returning equipment to Abet Technologies for repair, please call the Customer Service Department at (203) 540-9990. Have your purchase order number available before calling Abet Technologies. The Customer Service Representative will give you a Return Material Authorization number (RMA). Having an RMA will shorten the time required for repair, because it ensures that your equipment will be properly processed. Write the RMA on the returned equipment's box. Equipment returned without a RMA may be rejected by the Abet Technologies Receiving Department. Equipment returned under warranty will be returned with no charge for the repair or shipping. Abet Technologies will notify you of any repairs not covered by the warranty, with the cost of the repair, before starting the work.

Please return equipment in the original (or equivalent) packaging. You will be responsible for damage incurred from inadequate packaging, if the original packaging is not used.

Include the cables, connector caps and antistatic materials sent and/or used with the equipment, so that Abet Technologies can verify correct operation of these accessories.