Technical Documentation

MORNINGSTAR
c o r p o r a t i o n

SunSaver MPPT Lighting

Lighting Control and Configuration

v02

Abstract:

Version 09 of the SunSaver MPPT firmware introduced a new programmable lighting control feature which can be configured using the Morningstar MSView software. Older SunSaver MPPTs will need to be updated to the latest firmware before configuring lighting control. This document explains the process of updating the SS-MPPT firmware and how to correctly configure the updated controller for the desired lighting functionality.

Firmware Update

STEP 1: Download MSLoad and v09 (or newer) Firmware Update

A) MSLoad is the utility used to upload new firmware files to Morningstar products. This utility is included in the .zip file containing the v09 update (available in the Tech Support section of the Morningstar website, www.morningstarcorp.com). Download and save the v09 (or newer) update .zip file to your computer.

B) Extract the .zip file to your Desktop. The extraction folder should contain three items:
> **i)** SSMPPT_Update_v09.msc (or newer)
> **ii)** README.txt
> **iii)** MSLoad.exe

STEP 2: Prepare SunSaver MPPT to Receive Update

A) Connect the PC to the serial (9 pin) input of the PC MeterBus Adapter (model: MSC) using a direct serial connection or a USB/Serial adapter. Use the serial cable provided with the MSC adapter.

B) Connect the MSC MeterBus output (RJ-11) to the METER port on the SunSaver MPPT using the RJ-11 cable provided with the MSC adapter. Make sure the cable is pushed in all the way to the METER port until you hear a 'click'.

C) Using a battery or adjustable power supply (battery or supply voltage must be 8V-36V), connect the battery/supply NEGATIVE to the Battery (-) terminal on the SunSaver MPPT.

D) DO NOT connect the battery/supply POSITIVE to the controller at this time. However, have the cable close by and ready for connection to the controller.

STEP 3: Upload New Firmware to SunSaver MPPT

A) Launch the MSLoad utility by double-clicking on the MSLoad.exe file from STEP 1.

MSLoad

B) Read the Warnings and click *Next>*.

C) Read the Welcome text and click *Next>*.

D) MSLoad now requests the firmware file you wish to use. Click the Browse button and find the SSMPPT_Update_v09.msc (or newer) file from STEP 1. Hightlight the file and click Open. The file path for the firmware file should now be visible in the previously blank white box to the left of the Browse button. Click *Next>*.
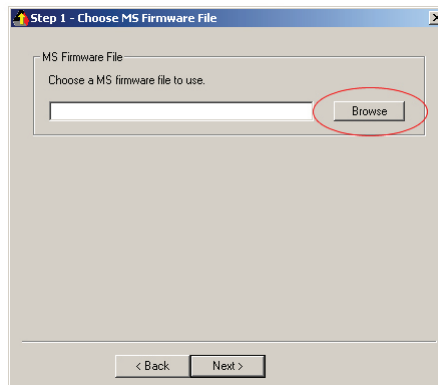
E) MSLoad now needs to know to which COM port the SunSaver MPPT is connected. Use the dropdown list to select the appropriate COM port. *Note: If using a direct serial connection, the COM port will likely be COM1 or COM2. If using a USB/Serial adapter, the COM port may be something very different. You can verify the COM port number when using a USB/Serial adapter by going to the Windows Device Manager.* Click *Next>*.
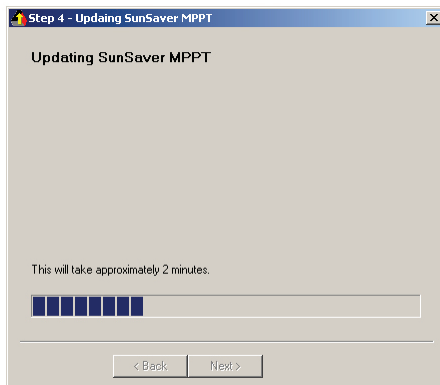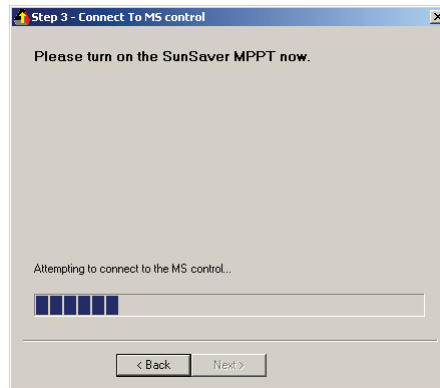> **i)** If you receive an error "Unable to open port...", the COM port you have chosen is incorrect. Choose another COM port.
> **ii)** If every COM port option available returns this error, there may be a problem with the computer's serial port or the USB/Serial adapter drivers have not been installed correctly.

F) MSLoad should now read "Please turn on SunSaver MPPT now" and a blue search bar should indicate that the utility is attempting to connect to the controller. You may now connect the battery/supply POSITIVE to the Battery (+) terminal on the SunSaver MPPT.

After doing so, MSLoad will begin the update. This may take a few minutes to complete; a green checkmark will appear when complete. Click **Finish**.

> **i)** If a red X appears instead of the green checkmark, the update has failed. Return to STEP 2 and repeat the procedure.
>
> **ii)** If still unsuccessful after several tries, please contact your authorized Morningstar Dealer for assistance.

Step 3 - Connect To MS control

Please turn on the SunSaver MPPT now.

Attempting to connect to the MS control...

< Back   Next >

Step 4 - Updaing SunSaver MPPT

Updating SunSaver MPPT

This will take approximately 2 minutes.

< Back   Next >

Step 5 - SunSaver MPPT Updated Successfully

SunSaver MPPT updated successfully

Important: Remember to turn product off and then back on to resume normal operation.

Exit

G) Reboot the controller by disconnecting the battery/supply POSITIVE from the controller, waiting 10 seconds, and then re-connecting the wire.

THE FIRMWARE UPDATE IS NOW COMPLETE.

Proceed to Lighting Control Configuration.

Lighting Control Configuration

STEP 1: Download and Install MSView Software

IMPORTANT: If you already have the MSView software on your PC, you may skip to STEP 2.

IMPORTANT: Much older versions of MSView currently on your PC may need to be uninstalled before installing the most recent MSView version. The install wizard will inform you of this if necessary.

A) The MSView software is used to configure the SSMPPT for lighting control. MSView is available for download in the Tech Support section of the Morningstar website, www.morningstarcorp.com. Download and save the MSView .zip file to your computer.

B) Extract the .zip file to your Desktop.

C) In the MSView extraction folder, find the Setup icon and double-click on it to begin the installation process.

D) Follow the steps in the installation wizard to install MSView on your PC. When finished, an MSView icon will appear on your Desktop.

STEP 2: Launch SunSaver MPPT Setup Wizard

A) Open MSView using the MSView icon on the Desktop from STEP 1.

MSView

B) Go to *Tools -> SunSaver MPPT Setup Wizard*. Read the Warning and click **OK**.

C) A blank Custom Settings Summary screen will appear. Click **Create New**.
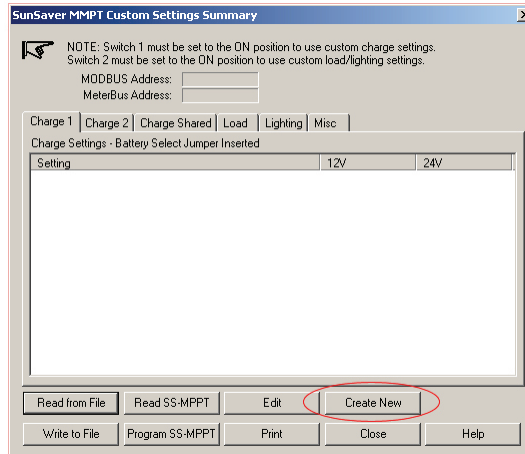
D) A new set of custom controller settings will appear populated with default values. Click **Next>** *4 successive times*, leaving all default charging settings unchanged for each page.

IMPORTANT: This guide only addresses Lighting Control and does not cover adjustment of other custom parameters such as charge settings and load low voltage disconnect settings. For more info on these, please refer to the MSView Help File, found under the Help menu -> Help Topics in MSView.

E) You should now be looking at the *Lighting Mode - Timers* configuration screen. Two clock graphs are provided; the left shows each of the 4 individual timing channels while the right shows the combination of all 4 channel timers. The 4 channels combine to create the total load functionality displayed by the right clock graph. For each of the clock graphs, the green shaded areas indicate times of the day when the load will be powered.

STEP 3: Adjust Lighting/Load Timing

IMPORTANT: This section explains the procedure for configuring Dusk-to-Dawn lighting control (lights/load on at sundown, remain on throughout the night, off at sunrise, remain off throughout the daylight hours). Other example timing schemes are explained in detail in Appendix I.

A) Channel data will initially be 'greyed-out' and uneditable. Click the **Enable Lighting** checkbox. Channel data should now be editable.
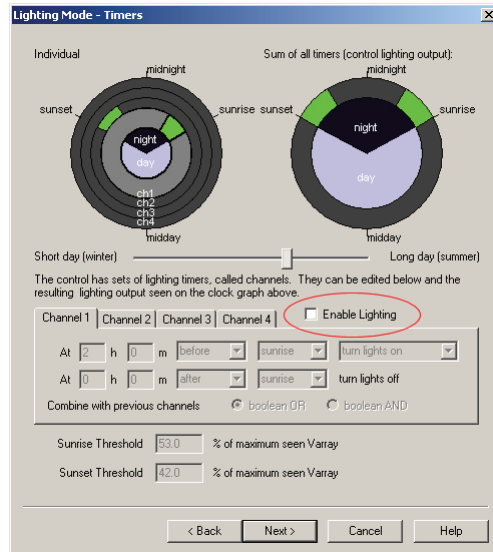
B) Make sure the Channel 1 tab is active (you are now making changes to Channel 1). Configure Channel 1 to read:

<div align="center">

At   **0** h   **0** m   **after**   **sunset**   **turn lights on**
At   **0** h   **0** m   **after**   **sunrise**   turn lights off

</div>

Notice the changes to the left and right clock graphs. The left clock graph, which shows each individual Channel configuration separately, has changed to show Channel 1 on from sunset to sunrise. The right clock graph, which shows the total lighting/load behavior, may have changed as well (depending upon how Channels 2/3/4 are presently configured).
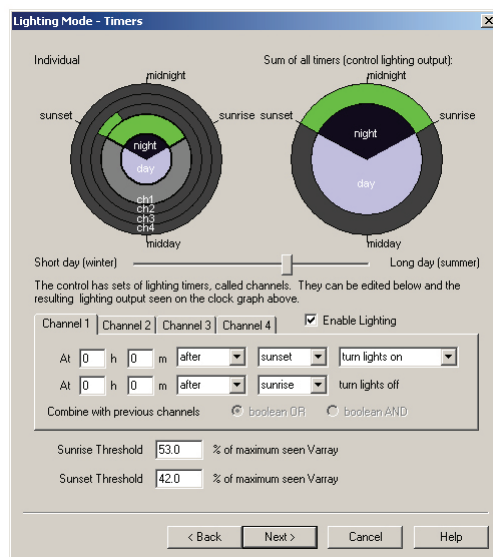
C) Click on the Channel 2 tab to make Channel 2 active. Configure the action drop down box to read *Do Nothing*. This will cause Channel 2 in the left graph to go dark, indicating Channel 2 is no longer contributing to the lighting/load control and has been disabled. (This may or may not cause a change to the right graph.)
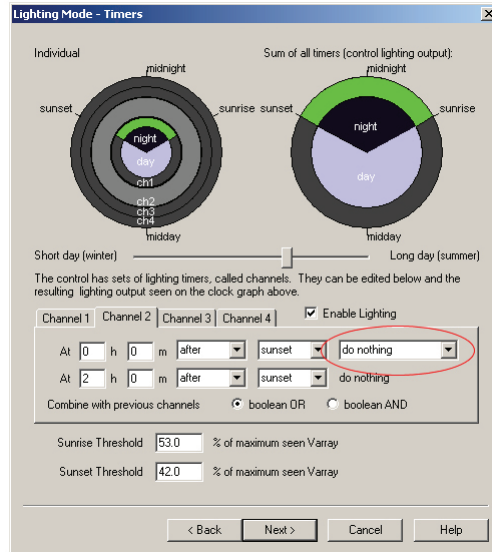

D) Repeat *C)* above for Channels 3 and 4. (This may or may not cause a change to the right graph.)

E) Now that Channel 1 has been set for sunset to sunrise and Channels 2/3/4 have been disabled, the left graph will only show Channel 1 lit from sunset to sunrise. The right graph will show the lighting control output sunset-to-sunrise (Dusk-to-Dawn); a direct representation of how the lighting/load will be powered by the controller.
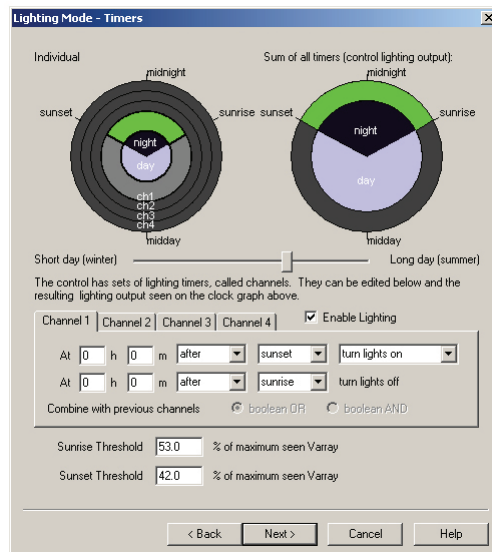
F) The slider bar can be dragged from left (winter) to right (summer) in order to give a visual representation as to how the lighting/load behavior will change with the seasons. *Note: The position of this bar does not affect the load control configuration, it is simply a visualization tool.*
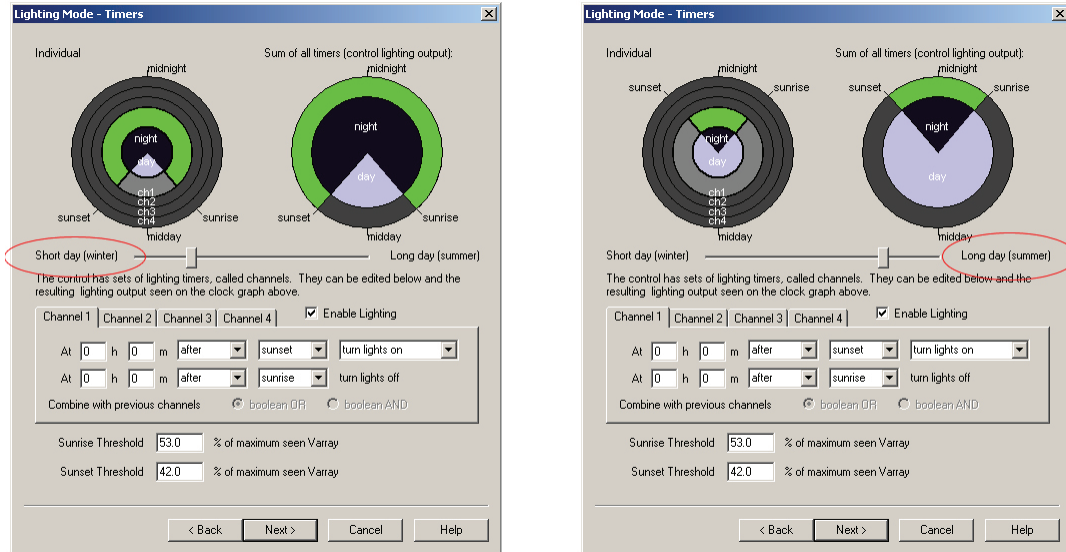

G) No changes need to be made to the Sunrise/Sunset Threshold percentages. Leave the default values unchanged.

IMPORTANT: Please see Appendix II for a detailed explanation of the Sunrise Threshold and Sunset Threshold percentages.

H) Click **Next>** once and then **Finish**. Do not make any changes to the Misc Settings page.

STEP 4: Review Custom Lighting Settings

A) The previously blank Custom Settings Summary window should now be populated with the newly configured settings. Tabs at the top of the summary box show the different settings categories. Click on the **Lighting** tab to view the lighting/load timing configuration.
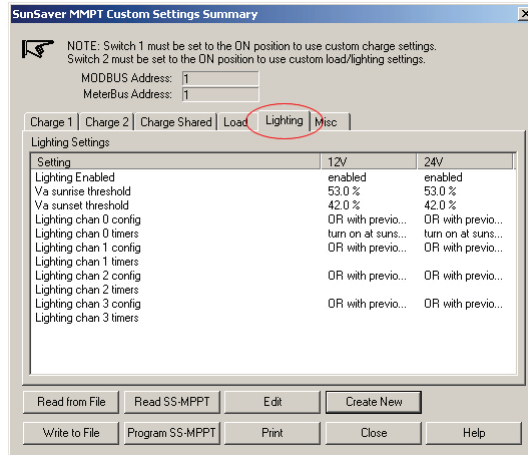
B) Verify that *Lighting Enabled* reads *"enabled"*. Verify that *Lighting chan 0 timers* reads *"turn on at sunset, turn off at sunrise".* Note that the 12V/24V settings are the same and that you can stretch the columns to see any text which has been cut-off.
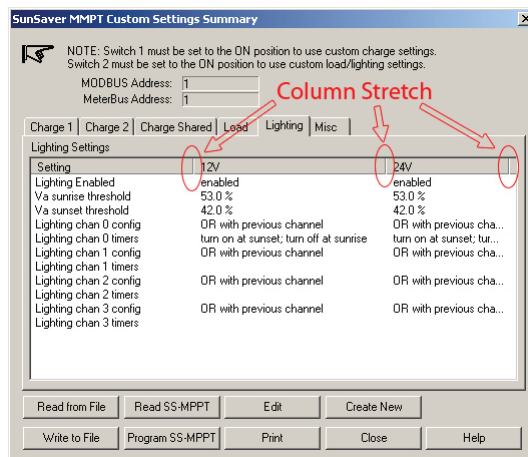
C) *Do not* close the SSMPPT Setup Wizard.

STEP 5: Prepare SunSaver MPPT for Programming

A) The SSMPPT now needs to be programmed with the new lighting/load control settings. Connect the PC to the serial (9 pin) input of the PC MeterBus Adapter (model: MSC) using a direct serial connection or a USB/Serial adapter. Use the serial cable provided with the MSC adapter.

B) Connect the MSC MeterBus output (RJ-11) to the METER port on the SunSaver MPPT using the RJ-11 cable provided with the MSC adapter. Make sure the cable is pushed in all the way to the METER port until you hear a 'click'.

C) Make sure DIP Switch #4 is in the UP (ON) position. This allows the controller to talk MODBUS™, the communications protocol used by MSView.

D) Using a battery or adjustable power supply (battery or supply voltage must be 8V-36V), connect the battery/suppply (+/-) to the Battery (+/-) terminals on the SSMPPT. The controller will turn on.

STEP 6: Program SunSaver MPPT with New Lighting Settings

A) Go back to the SSMPPT Custom Settings Summary screen from STEP 4 and click **Program SS-MPPT**.
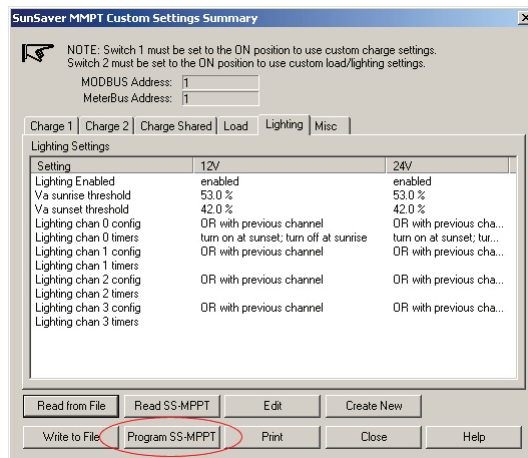
**B)** MSView now needs to know to which COM port the SunSaver MPPT is connected. Use the dropdown list to select the appropriate COM port. *Note: If using a direct serial connection, the COM port will likely be COM1 or COM2. If using a USB/Serial adapter, the COM port may be something very different. You can verify the COM port number when using a USB/Serial adapter by going to the Windows Device Manager.*
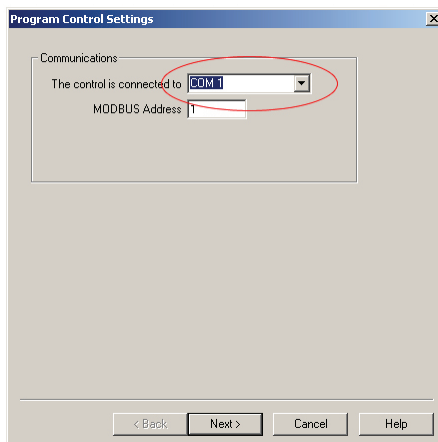
C) The MODBUS Address for this controller is programmed as '1' from the factory. Unless you have programmed a different address during a previous MSView session, the SSMPPT default address will still be '1'. Click **Next>**.

D) MSView will now write the new settings to the controller. A blue bar at the top of the window will indicate progress. When programming is complete, click **Finish**.
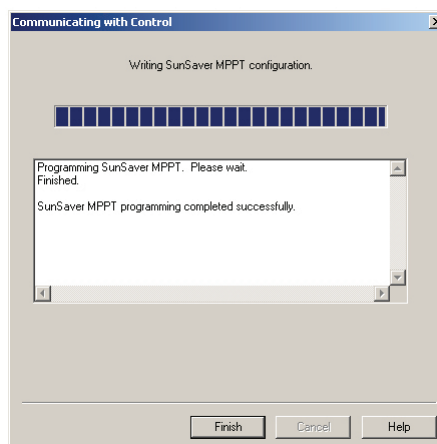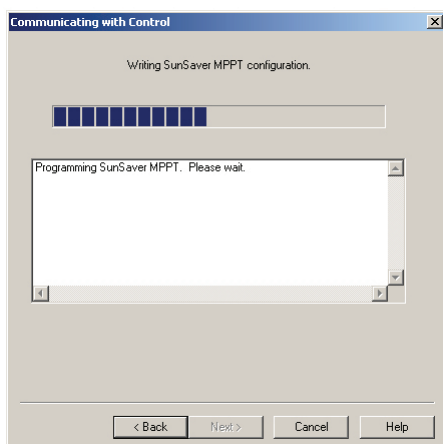
IMPORTANT: Before closing the SSMPPT Custom Settings Summary window, you may want to save your lighting/load configuration to the PC. Click **Write to File** to save this configuration for later use.

IMPORTANT: To use these newly programmed settings, *DIP Switch #2 MUST BE IN THE UP (ON) POSITION.*

E) The SSMPPT LEDs will now be sequencing. This is to indicate that there has been a programming change and a restart of the controller is required. Remove one of the battery/supply connections so that the LEDs turn off, wait 10 seconds, and re-apply the connection. The controller will boot through its normal LED sequence.

THE LIGHTING CONTROL PROGRAMMING IS NOW COMPLETE.

Appendix I - Advanced Timing Examples

Example #1

Desired Timing:
- On from sunset to 3hrs after sunset
- On from 3hrs before sunrise to sunrise
- Off all other times

A) Channel 1 will be responsible for turning the lights on at sunset and keeping them on until 3hrs after sunset. Click **_Enable Lighting_** checkbox and make sure the Channel 1 tab is active. Configure Channel 1 to read:

At	**0** h	**0** m	**after**	**sunset**	**turn lights on**
At	**3** h	**0** m	**after**	**sunset**	turn lights off

The left clock graph will now show Channel 1 ON from sunset to 3hrs after sunset.

B) Channel 2 will be responsible for turning the lights on 3hrs before sunrise and keeping them on until sunrise. Click the Channel 2 tab and configure it to read:
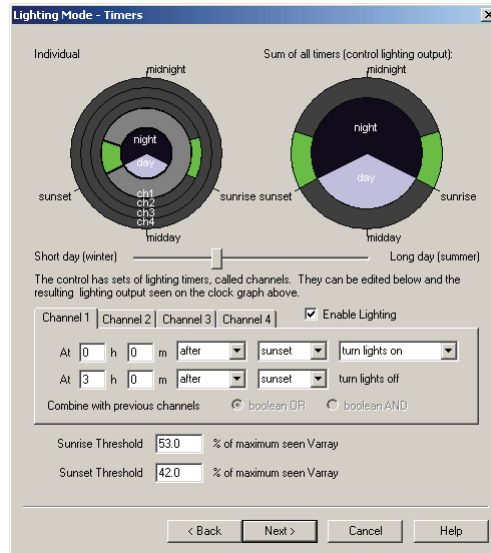
At	**3** h	**0** m	**before**	**sunrise**	**turn lights on**
At	**0** h	**0** m	**after**	**sunrise**	turn lights off

C) Select *boolean OR* for Channel 2. This will keep each channel independent so that the full configurations of both channels are preserved. The left clock graph will now show Channel 1 ON from sunset to 3hrs after sunset and Channel 2 ON from 3hrs before sunrise to sunrise.

D) Click on the Channel 3 tab and configure the action drop down box to read **_Do Nothing_**. Channel 3 in the left graph should be dark, indicating Channel 3 is not contributing to the lighting/load control and has been disabled.

E) Repeat *D)* above for Channel 4.

F) Now that Channel 1 has been set for sunset to 3hrs after sunset, Channel 2 has been set for 3hrs before sunrise to sunrise, and Channels 3/4 have been disabled, the right graph will show the final lighting control output (the Desired Timing listed above); a direct representation of how the lighting/load will be powered by the controller.

Example #2

Desired Timing:
- On from 2hrs before sunset to 2hrs after sunset
- On from 3hrs before sunrise to 3hrs after sunrise
- Off all other times

A) Channel 1 will be responsible for turning the lights on 2hrs before sunset and keeping them on until 2hrs after sunset. Click **Enable Lighting** checkbox and make sure the Channel 1 tab is active. Configure Channel 1 to read:

At   **2** h   **0** m   **before**   **sunset**   **turn lights on**
At   **2** h   **0** m   **after**   **sunset**   turn lights off

B) Channel 2 will be responsible for turning the lights on 3hrs before sunrise and keeping them on until 3hrs after sunrise. Click the Channel 2 tab and configure it to read:

At   **3** h   **0** m   **before**   **sunrise**   **turn lights on**
At   **3** h   **0** m   **after**   **sunrise**   turn lights off

C) Select *boolean OR* for Channel 2. This will keep each channel independent so that the full configurations of both channels are preserved.

D) Click on the Channel 3 tab and configure the action drop down box to read **Do Nothing**.

E) Repeat *D)* above for Channel 4.

F) Now that Channel 1 has been set for 2hrs before sunset to 2hrs after sunset, Channel 2 has been set for 3hrs before sunrise to 3hrs after sunrise, and Channels 3/4 have been disabled, the right graph will show the final lighting control output (the Desired Timing listed above); a direct representation of how the lighting/load will be powered by the controller.
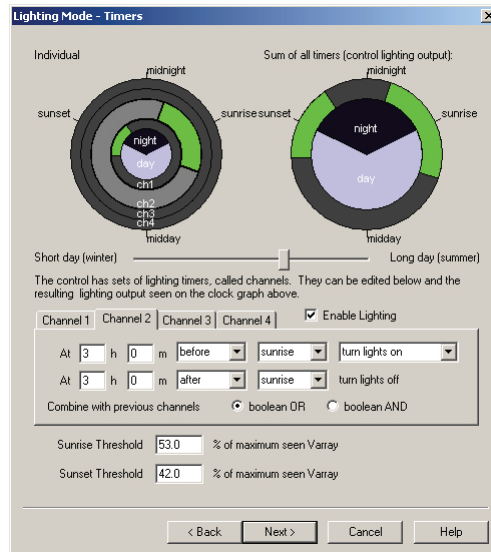
Example #3

Desired Timing:
- On from 1hr before sunrise to 2hrs before midday
- On from 3hrs after midday to 1hr after sunset
- On from 2hrs before midnight to 1hr after midnight
- Off all other times

A) Channel 1 will be responsible for turning the lights on 1hr before sunrise and keeping them on until 2hrs before midday. Click **_Enable Lighting_** checkbox and make sure the Channel 1 tab is active. Configure Channel 1 to read:

At	**1** h	**0** m	**before**	**sunrise**	**turn lights on**
At	**2** h	**0** m	**before**	**midday**	turn lights off

B) Channel 2 will be responsible for turning the lights on 3hrs after midday and keeping them on until 1hr after sunset. Click the Channel 2 tab and configure it to read:

At	**3** h	**0** m	**after**	**midday**	**turn lights on**
At	**1** h	**0** m	**after**	**sunset**	turn lights off

C) Select *boolean OR* for Channel 2. This will keep each channel independent so that the full configurations of both channels are preserved.

D) Channel 3 will be responsible for turning the lights on 2hrs before midnight and keeping them on until 1hr after midnight. Click the Channel 3 tab and configure it to read:

<div align="center">

At   **2** h   **0** m   **before**   **midnight**   **turn lights on**

At   **1** h   **0** m   **after**   **midnight**   turn lights off

</div>

E) Select *boolean OR* for Channel 3. This will keep each channel independent so that the full configurations of all channels are preserved.

F) Click on the Channel 4 tab and configure the action drop down box to read ***Do Nothing***.

G) Now that all 3 Channels have been configured, the right graph will show the final lighting control output (the Desired Timing listed above); a direct representation of how the lighting/load will be powered by the controller.
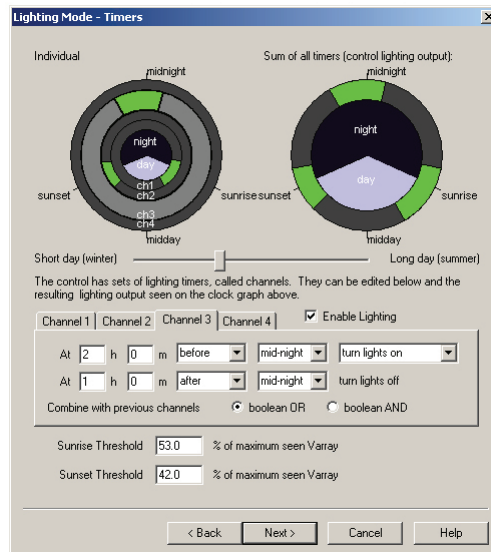
Appendix II - Sunrise/Sunset Thresholds

Description:

The SunSaver MPPT uses the array voltage (Varray) to determine whether it is daytime or nighttime. It is essential for the controller to know when transitions from day-to-night or night-to-day occur in order to keep accurate control of the lighting/loads. To do this, the controller looks for when Varray rises above a certain level or falls below a certain level.

During sunrise (assuming clear skies), Varray steadily climbs until it reaches its rated maximum. The Sunrise Threshold is used to determine at what voltage the SSMPPT should recognize a night-to-day transition. Conversely, during sunset, Varray steadily decreases as less and less sunlight strikes the panels. The Sunset Threshold is used to determine at what voltage a day-to-night transition should be recognized.

These thresholds are specified as percentages of the maximum seen Varray; the highest array votlage recorded by the controller since the controller was last restarted. It can safely be assumed that the maximum seen Varray is approximately the Open Circuit Voltage (Voc) rating of the array (found on module datasheets). For example, if the Voc of the array is *20.0V* and the Sunrise Threshold is set to *60%*, the controller will recognize sunrise as occurring when the array voltage reaches *12.0V* (20.0V * 0.6 = 12.0V).

The Sunrise Threshold percentage must always be set higher than the Sunset Threshold percentage.

Tips for Use:

IMPORTANT: *The default threshold percentages will be sufficient for the large majority of systems. Only make changes to the percentages if absolutely necessary.*

- Allow the system to operate in real-world conditions before considering changes to the thresholds. After the system has been operating in the field, changes can be made to the threshold percentages in order to tweak exactly when the lights come on / go off.

- It is best to keep the sunrise and sunset percentages at least 10% away from each other. If the percentages are too close, rapidly changing lighting (sunlight) conditions can cause undesired light/load operation.

- During the day: Trees or other objects that cast shadows on the solar array tend to cause 'mini-sunsets' (where the array output voltage drops, but not as much as during true sun-set). To prevent the controller from detecting a sunset event during temporary shading

conditions during the day, adjust the sunset threshold percentage lower.

- During the nighttime: Ambient light from streetlights, headlights, landscape lighting, etc tend to cause 'mini-sunrises' (where the array output voltage rises, but not as much during true sunrise). To prevent the controller from detecting a sunrise event during temporary illumination at night, adjust the sunrise threshold percentage higher.

- It may take several rounds of threshold adjustment to get the system operating exactly as desired. The amount of adjustment needed varies greatly from installation to installation.