



Technical Information

SMA SMART HOME - Load Control via CAN Time Period Example: Pool Pump

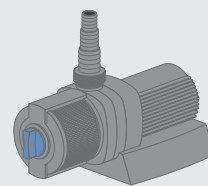
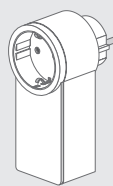
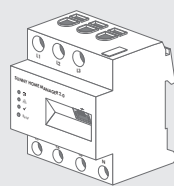
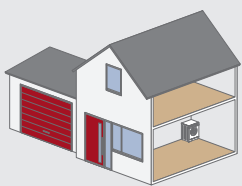


Table of Contents

1	Application	3
2	Connection	4
3	Configuration	5
3.1	Configuring Load Characteristics	5
3.2	Configuring the Time Period.....	8
4	Operation	11
4.1	Selecting Automatic Mode	11
4.2	Selecting Manual Mode	11
5	Control via Sunny Home Manager	12
6	Display on Sunny Portal	15
7	Things To Know	16

1 Application

A load (such as a pool pump) in the SMA Smart Home needs to be switched on and run for a predefined minimum duration during a configured time period on an *optional* basis. In other words, the load only runs if a certain condition has been met. You want Sunny Home Manager to automatically switch the load on and off.

When configuring the load on Sunny Portal, you can choose between two conditions:

- Only operate the load when a **minimum proportion of the PV energy** is expected for a certain time period (environmental optimization).
- Only operate the load when the expected available PV energy falls below a predefined **cost limit** over a certain time period (economic optimization).

The load should be able to be switched on at any time. In other words, Sunny Home Manager can select one or more periods within the user-defined time frame in which it can switch the load on or off.

The load will not be switched on if the configured conditions are not met. The load may thus not be operated at all during the defined time period depending on the selected conditions and energy availability.

Background information

The SMA Smart Home distinguishes between two types of loads:

- Non-program-controlled loads
- Program-controlled loads

Non-program-controlled loads

These loads must be able to switch on and off as needed. Typical non-program-controlled loads include pool pumps or heating rods in hot water storage tanks.

When loads are controlled by Sunny Home Manager, they can optionally be switched on whenever there is enough PV energy or whenever the actual energy costs fall below the configured maximum threshold. The load can also be switched off temporarily if the switch-on condition is no longer met, as when the weather suddenly changes. To prevent loads from being switched on and off too frequently, you can configure a minimum switch-on time and a minimum switch-off time when configuring the load characteristics on Sunny Portal.

To see an application example that uses relays or contactors to control a non-program-controlled load in the SMA Smart Home, see the "SMA SMART HOME - Load Control Using Relays or Contactors (Example: Heating Rod)" technical information in the download area of Sunny Home Manager at www.SMA-Solar.com

Program-controlled loads

A program-controlled load runs through a preset program during operation. The program is typically selected by the user prior to operation and started by pressing the start button on the load. Once the program has started, the load should no longer be switched off. Typical program-controlled loads include washing machines, dishwashers and dryers.

Sunny Home Manager can only control a program-controlled load if, after an interruption in the power supply, the load's program picks up at the point where the power supply was interrupted.

To see an application example that uses a program-controlled load in the SMA Smart Home, see the "SMA SMART HOME - Load Control via MUST Time Period (Example: Washing Machine)" technical information in the download area of Sunny Home Manager at www.SMA-Solar.com.

Example: Using a pool pump in the SMA Smart Home

A **pool pump** with **constant power consumption (120 W)** circulates water in a garden pool and powers a small fountain. However, the condition of the garden pool remains acceptable even if the pool pump runs very briefly or not at all on some days. You do not want your pool pump to run before **8:00 am** or after **8:00 pm** to prevent noise caused by splashing water. To prevent the pool pump from failing prematurely from being switched on and off too frequently, it should **remain on for at least 10 minutes after being switched on** and **stay off for at least 5 minutes** after being switched off. All told, the pool pump should run for **no more than 5 hours per day**.

2 Connection

The pump is integrated into the SMA Smart Home as a load by connecting it to a radio-controlled socket. The radio-controlled socket is placed right between the wall socket and the pool pump's power plug.

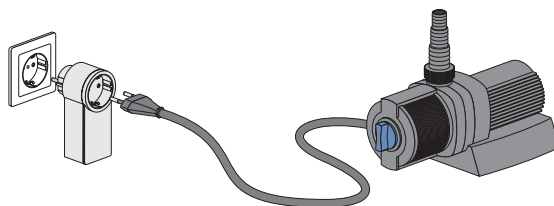



Figure 1: Connecting the pool pump to the radio-controlled socket





















3 Configuration

3.1 Configuring Load Characteristics

Once the pool pump has been integrated into your SMA Smart Home with a radio-controlled socket, you will have to configure the load characteristics and time periods for operating the load in your Sunny Home Manager system on Sunny Portal. Sunny Portal is the user interface for Sunny Home Manager (for registration and login information, see the Sunny Home Manager installation manual).

This example illustrates how to control loads via CAN time periods and recommends settings for load characteristics and time periods in the SMA Smart Home.

Load characteristics 

Type of Load:	Self-configured 
Programmability:	<input type="radio"/> Yes <input checked="" type="radio"/> No 
Name of Load:	Pool Pump 
Power Consumption:	120 W  
Minimum Switch-on Time:	10 min 
Minimum Switch-off Time:	5 min 
Priority of the load:	low high   
Radio-controlled socket:	No assignment 
After Run of Load Cycle, Radio-controlled Socket is:	Off  
Measuring and switching:	Radio-controlled socket is to measure and switch (intelligent power consumption) 
Load has automatic switching:	<input type="radio"/> Yes <input checked="" type="radio"/> No  
Status during communication disturbance:	Off
Load icon:	 
Load color:	 







     

Figure 2: Configuring load characteristics

Position	Setting/Explanation
-	Enter a new load called "Pool pump" on Sunny Portal.
A	Type of load Select Self-configured as the type of load.
B	Programmability The pool pump runs whenever it has power. It does not run through a special program, so select No .
C	Name of load You can name the load here, e.g. "Pool pump". Maximum number of characters: 24

Position	Setting/Explanation
D	<p>Power consumption</p> <p>Enter the power consumption of the pool pump (see manufacturer's information on the type label for the pool pump). This value must be stated in watts (1 kW = 1000 W), example: 120 W</p>
E	<p>Minimum switch-on time</p> <p>This value represents the minimum number of minutes that the pool pump must stay on after being switched on.</p> <p>Loads are easier to plan in energy management if the minimum switch-on time is 5 minutes (default) or less.</p> <p>An average minimum switch-on time of 15 minutes is acceptable.</p> <p>Planning difficulties occur if the minimum switch-on time is long, particularly if it exceeds 30 minutes. Once the minimum switch-on time exceeds 30 minutes, Sunny Home Manager may be unable to easily find enough continuous power in its forecast over this relatively long period of time. In these cases, the load may not be switched on at all based on the CAN condition in the time period (see Section 3.2, page 8) despite the presence of enough PV power generation to power the load for shorter periods.</p> <p>Also read the information about configuring the switch-on and switch-off times below this table.</p>
F	<p>Minimum switch-off time</p> <p>Enter the minimum number of minutes that the pool pump needs to stay off once it has been switched off.</p> <p>Also read the information about configuring the switch-on and switch-off times below this table.</p>
G	<p>Priority of the load</p> <p>Enter the priority that Sunny Home Manager should give to the pool pump when planning loads.</p> <p>Information on energy allocation:</p> <ul style="list-style-type: none"> • Loads with MUST time periods receive excess PV energy first (see the "Load control via MUST time period (example: washing machine)" technical information in the download area of Sunny Home Manager at www.SMA-Solar.com). • Any surplus PV energy left over will be first allocated to the storage battery of any available Sunny Boy Smart Energy or Sunny Island before any loads with CAN time periods are considered. • Any energy left over after this step will be allocated to loads with CAN time periods based on the conditions defined for these loads. • If there are several loads with CAN time periods, the lowest-cost energy will be allocated to the load which you have given the highest priority using the slider. If there is not enough low-cost PV energy for all loads with CAN time periods, lower-priority loads may not be switched on at all.

Position	Setting/Explanation
H	<p>Radio-controlled socket</p> <p>Select the radio-controlled socket that the pool pump is plugged into.</p> <p>The drop-down list shows all the available radio-controlled sockets in the system along with their names (generally with several digits from their serial number for identification). Some radio-controlled sockets are already assigned to other loads, as indicated by an asterisk (*) next to their name, and cannot be selected for the current load.</p> <p>You have the following options if the pool pump is not yet connected to a radio-controlled socket:</p> <ul style="list-style-type: none"> • Connect the pool pump to a new radio-controlled socket and add the new radio-controlled socket to the Sunny Home Manager system as a new device. • Disconnect a radio-controlled socket currently assigned to another load from this other load. To do this, edit the load characteristics for the load and assign the radio-controlled socket to the pool pump. Then, plug the pool pump into the radio-controlled socket. <p>If needed, you can save the configured load characteristics without assigning a radio-controlled socket. This will render the pool pump inactive, though. It will not be controlled by Sunny Home Manager, nor will it appear in the load diagrams.</p> <p>Once you assign the pool pump to a radio-controlled socket (at a later time), the pool pump will have its energy consumption tracked and will be actively included in energy management.</p>
I	<p>After Run of Load Cycle, Radio-controlled Socket is...</p> <p>The pool pump will only stop running if its power supply is interrupted. That means you have to select Off for this option. This will turn off the radio-controlled socket once the time period elapses and during any downtime that may occur during the time period.</p> <p>If the radio-controlled socket is unplugged from the wall socket and then plugged back in, it is becomes possible that the radio-controlled socket will go into a different operating state. Refer to the manual from the respective manufacturer for information on the behavior of the radio-controlled socket.</p>
K	<p>Measuring and switching</p> <p>Select Radio-controlled socket is to measure and switch (intelligent power consumption) if it is not already set by default.</p>
L	<p>Load has automatic switching</p> <p>The pool pump does not have automatic switching and runs whenever it has power, so select No.</p> <p>If the load has automatic switching, select Yes. This will pull up two additional settings:</p> <ul style="list-style-type: none"> • Threshold for disconnection (default: 50 W): If the load is automatically switched off by an automatic switching function, its power consumption will drop to less than 50 W. • Detection time for disconnection (default: 60 s): If the load's power consumption drops below 50 W for 60 seconds, the radio-controlled socket will switch off as well. <p>Information: Heating rods, fan heaters, etc. have automatic switching functions. An integrated thermocouple ensures that the device automatically switches off upon reaching a configurable temperature threshold. Sunny Home Manager detects the disconnection through the above process and switches off the radio-controlled socket as an added precaution once the defined response time has elapsed.</p>
M	<p>Load icon</p> <p>The system has a default icon. If you wish, you can upload your own icon from your local hard drive and use that instead. The image will be automatically cropped (supported file formats: JPG, JPEG, PNG, GIF, BMP).</p>

Position	Setting/Explanation
N	<p>Load color</p> <p>Select the color to be used when displaying the pool pump's measured values in the energy and power diagrams.</p> <p>The system will automatically assign a color if you do not select one yourself. You can change the color in the load characteristics at any future point in time.</p>
O	<p>Save</p> <p>Save the settings in order to continue configuring the time periods. An information message will appear if you have not assigned a radio-controlled socket to the pool pump. You can also assign the radio-controlled socket later while updating the load characteristics.</p>

i Information about configuring switch-on and switch-off times

Loads are not designed to be switched on and off an infinite number of times during their service life. Internal components such as relays can fail after several thousand switching cycles. In fickle weather conditions with highly variable PV power generation, the load may be switched on and off every few minutes because there is only enough surplus PV energy for brief periods.

You can set minimum switch-on and switch-off times when configuring the load characteristics in order to prevent loads from being switched on and off too frequently and experiencing too many switching cycles. If this is done, however, power may be drawn from the utility grid to operate the load if PV power generation drops briefly. Conversely, surplus PV energy may be "lost" during switch-off times.

If you select a long minimum switch-on time, by contrast, the load may not be switched on very often since there are very few adequately long periods in the PV power generation forecast with enough power to operate the load during the overall minimum switch-on time.

It is worth trying out different time settings in order to gradually find the best values for each load.

3.2 Configuring the Time Period

The "Configure time period" window will show different options depending on the configured load characteristics. The **Load running** setting uses daily time windows by default. In other words, this time period applies to every day of the week in the same way:

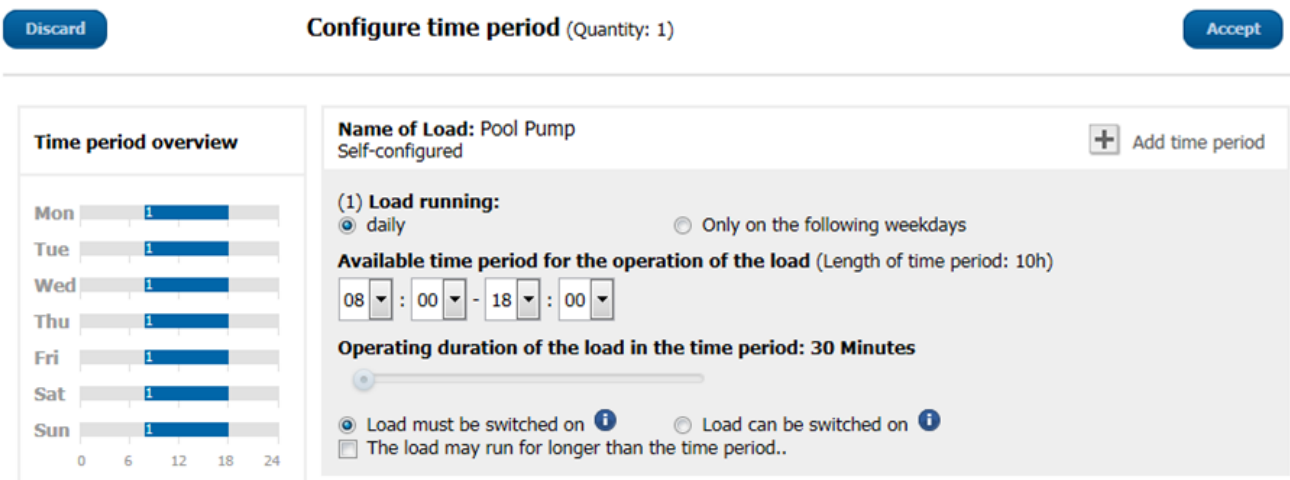


Figure 3: Configuring a time period for every day of the week (example)

Alternatively, you can define day-specific time periods for one or more days of the week:

Configure time period (Quantity: 1)

Name of Load: Pool Pump
Self-configured

(1) Load running:
 daily
 Only on the following weekdays

Mon Tue Wed Thu Fri Sat Sun

Available time period for the operation of the load (Length of time period: 12h)
 08 : 00 - 20 : 00

Maximum operating duration of the load in the time period: 300 Minutes

Load must be switched on
 Load can be switched on

Load will be switched on depending on:
 Proportion of the PV energy
 Maximum permitted energy costs

Purchased electricity: 20 %
 PV power generation: 80 %
 Surplus PV energy: 0 %

-- Limiting of the active power feed-in

Figure 4: Configuring time periods for certain days of the week (example)

Position	Setting/Explanation
A	<p>Load running</p> <p>Select whether you want the pool pump to run every day or only on certain days of the week (e.g. you want the pool pump to run every other day during the week and every day on the weekend; the days selected in the example are Tuesday (Tu), Thursday (Th), Saturday (Sa) and Sunday (Su)).</p>
B	<p>Available time period for the operation of the load</p> <p>The default time period set at the factory is 8:00 am to 6:00 pm. For the pool pump in the application example in Section 3.1, page 5, you would have to change the setting to 8:00 am to 8:00 pm (12-hour time period). The length of the time period is automatically calculated from the configured times and displayed in parentheses.</p>
C	<p>Maximum operating duration of the load in the time period</p> <p>Use the slider to set the maximum operating duration of the pool pump in the time period.</p> <p>Information:</p> <ul style="list-style-type: none"> The configured value should correspond to the load's function. The configured value may not exceed the total duration of the time period minus the minimum switch-off time (see Section 3.1 "Configuring Load Characteristics", page 5). In our example, this means: 12 hours - 5 minutes = 11 hours and 55 minutes. The pool pump in our example should not be on for more than 300 minutes per day, however, so the value is set to 300 minutes (which is equal to 5 hours).

Position	Setting/Explanation
D	<p>Select Load can be switched on.</p> <p>To learn more about loads set to Load must be switched on, see the "SMA SMART HOME - Load control via MUST time window" technical information in the download area of Sunny Home Manager at www.SMA-Solar.com.</p>
E	<p>Load will be switched on depending on</p> <p>Specify the condition that must be met before the pool pump can be switched on. There are two options:</p> <ul style="list-style-type: none"> • Proportion of the PV energy <li style="padding-left: 20px;">or • Maximum permitted energy costs <p>See Section 5, page 12 for details.</p>
F	<p>[+ Add time period]</p> <p>If necessary, you can use this button to add more time periods for the same day or for other days of the week.</p> <p>Depending on what you want your load to do, you can control it with a series of multiple CAN time periods or a combination of MUST and CAN time periods.</p> <p>Information: The time periods must not overlap. If they are configured to overlap, the Time period overview (see position G) will show the conflicts in red.</p>
G	<p>The Time period overview visualizes the configured time periods using colored bars.</p>

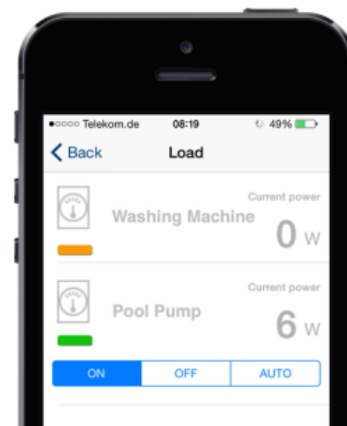
4 Operation

4.1 Selecting Automatic Mode

If the radio-controlled socket is in automatic mode, Sunny Home Manager will control the load based on the configured load characteristics and time periods.

Procedure:

- Pull up the free Sunny Portal app (available for iOS and Android at www.sunnyportal.com) or go to Sunny Portal, access the **Load Overview and Planning** page and select the **[AUTO]** button for the desired load.



4.2 Selecting Manual Mode

If you have a non-program-controlled load (like the pool pump in our example), the radio-controlled socket controlled by Sunny Home Manager will always remain in automatic mode unless it is manually switched on or off. If needed, you can switch the load on or off manually and thus exit automatic control mode by Sunny Home Manager. However, don't forget to start automatic mode again if you manually switch the load on or off (see Section 4.1, page 11)! If you fail to start automatic mode again, Sunny Home Manager will not be able to automatically control the load.

Procedure:

- Pull up the free Sunny Portal app or go to Sunny Portal, access the **Load Overview and Planning** page, and select the **[ON]** (to activate manual mode) or **[OFF]** button (to deactivate manual mode) for the desired load.



5 Control via Sunny Home Manager

i Loads with CAN time periods can only be controlled in automatic mode

Sunny Home Manager can only take control of a load with a CAN time period if the radio-controlled socket connected to the load is in automatic mode (see Section 4.1, page 11). If the load has been manually switched on or off, you will have to reactivate automatic mode for the radio-controlled socket.

One of the steps in configuring the time period is to define the CAN condition that Sunny Home Manager uses to control the load. Sunny Home Manager is constantly adjusting the allocation of energy to the loads based on its PV power generation forecast and the consumption of energy in the home.

The following parameters determine whether the radio-controlled socket is used to switch on a load with a CAN time period:

- Parameters configured in the load characteristics:
 - The load's **Power consumption** must be covered.
 - There must be enough power to operate the load for at least the **Minimum switch-on time** according to the energy availability forecast and the defined CAN condition.
 - After the load is switched off, it has to remain switched off for the **Minimum switch-off time** even if there is enough power to operate it again.
 - The available power is distributed among the loads in the configured order of **Priority**.
- Parameters configured in the "Configure time period" window:
 - The current time must be within the configured time period.
 - The **Proportion of the PV energy** or **Maximum permitted energy costs** switch-on condition is met.

The next section describes the configuration options for switch-on conditions in CAN time periods in detail.

"Proportion of the PV energy" Switch-On Condition

If you select **Proportion of the PV energy**, you will use a slider with a light bulb to indicate the minimum proportion of PV energy that must be present before Sunny Home Manager will switch on the load during the configured time period. The percentage for each energy type is displayed on the right next to the slider:

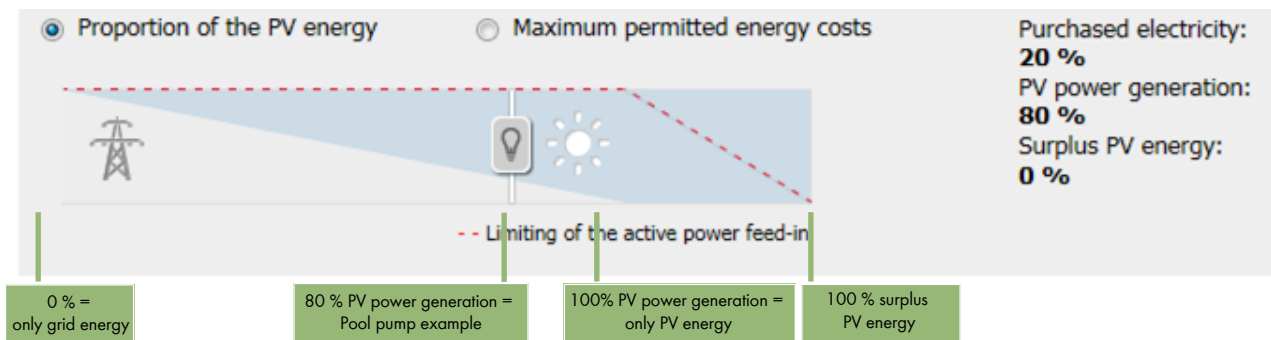


Figure 5: Configuring the **Proportion of the PV energy** switch-on condition

0% PV power generation (= only grid energy)

Grid energy is always available so the load is operated for the entire **Maximum operating duration of the load in the time period**.

80% PV power generation (pool pump example)

1. The load is switched on if the PV power generation forecast calls for a PV power surplus equal to at least 80% of the load's power consumption for the configured minimum switch-on time. If no more than 80% of the PV power surplus is available, 20% of the power needed to operate the load will be taken from the utility grid.
2. The PV power surplus may fall below 80% during the minimum switch-on time.

3. The load will remain on if over 80% of the PV power surplus is still available after the minimum switch-on time has elapsed.
4. If the PV power surplus falls below 80% after the minimum switch-on time elapses, the load will be switched off immediately and will stay off for the configured minimum switch-off time.
5. Once the minimum switch-off time has elapsed, the load can be switched on again as soon as Sunny Home Manager expects to have a PV power surplus that is at least equal to 80% of the load's power consumption for the configured minimum switch-on time.

The above process repeats at the end of the configured time period.

Example: Pool pump

Selecting **80% PV power generation** for the pool pump with the above load characteristics (see Section 3.1, page 5) will produce the following control behavior:

- Sunny Home Manager will switch on the radio-controlled socket if the PV power generation forecast calls for a PV power surplus of at least 96 W for 10 minutes. Once the pool pump is switched on, it stays on for at least 10 minutes even if the forecast proves to be wrong and the PV power surplus declines during this 10 minute window.
- The radio-controlled socket will remain on if a PV power surplus of 96 W is still available after 10 minutes. After that point, Sunny Home Manager will immediately switch off the radio-controlled socket as soon as the PV power surplus falls below 96 W. The radio-controlled socket will remain off for at least 5 minutes even if the available PV power surplus exceeds 96 W again during this period.
- Sunny Home Manager will switch off the radio-controlled socket if the available PV power surplus falls below 96 W after 10 minutes. The radio-controlled socket will remain off for at least 5 minutes even if the available PV power surplus exceeds 96 W again during this period.

100% PV power generation (= only PV energy)

The load is only switched on if the PV power surplus can cover the total power consumption for the configured minimum switch-on time. This process (see **80% PV power generation**) repeats at the end of the configured time period.

100% surplus PV energy

If your system has active power limitation, active power can only be fed into the utility grid up to a predefined threshold (e.g. 70% in Germany). If this value is exceeded, the PV inverters will be regulated down. As a result, any PV energy generated above this threshold is lost as "surplus PV energy". Surplus PV energy, however, can be used effectively if it is available when a load happens to be switched on. The surplus PV energy is free (0 ct/kWh) since it would not have been fed into the utility grid anyway due to the active power limitation requirements.

Sunny Home Manager considers surplus PV energy in its PV power generation forecast. If the slider is set to **100% surplus PV energy**, the load will only be switched on if the forecasted surplus PV energy can cover the total power consumption for the configured minimum switch-on time.

This process (see **80% PV power generation**) repeats at the end of the configured time period.

"Maximum permitted energy costs" switch-on condition

If you select **Maximum permitted energy costs**, you can use the light bulb slider to set the maximum energy costs at which Sunny Home Manager will still switch on the load during the configured time period. The costs are displayed in Eur/kWh to the right of the slider:

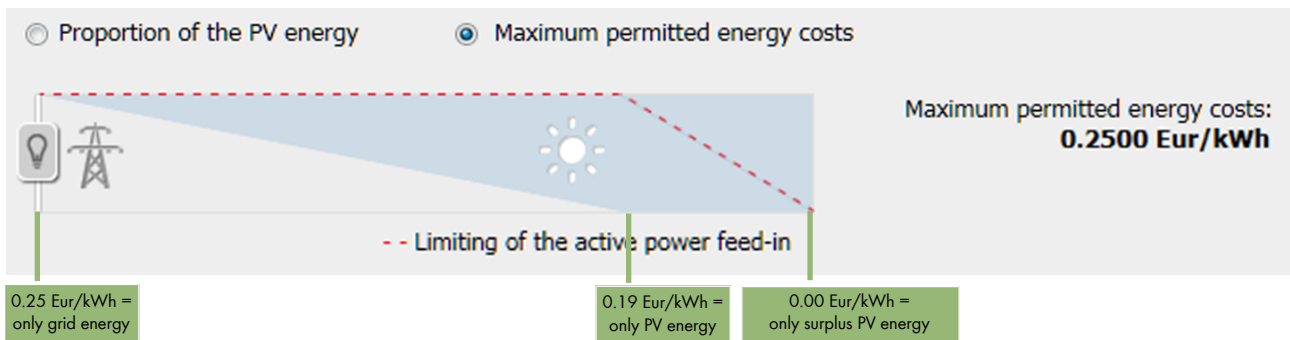


Figure 6: Configuring the **Maximum permitted energy costs** switch-on condition

0.25 Eur/kWh (= only grid energy)

This rate equals the cost of purchasing electricity from the grid, as configured in the system properties. Grid energy is always available so the load is operated for the entire **Maximum operating duration of the load in the time period**.

0.19 Eur/kWh (= only PV energy)

This rate is equal to the feed-in tariff for PV energy that is configured in the system properties. You do not receive a feed-in tariff for PV energy if it is consumed by a load in your home instead of being fed into the utility grid. Put another way, the PV energy that could otherwise have been fed into the grid "costs" as much as the feed-in tariff. The load is controlled in the same way as with **100% PV power generation** in the **Proportion of the PV energy** section.

0.00 Eur/kWh (= only surplus PV energy)

As described in the section "Proportion of the PV energy" Switch-On Condition, PV energy that is not fed into the grid due to the active power limitation is "free". The load is controlled in the same way as with **100% surplus PV energy** in the **Proportion of the PV energy** section.

The energy costs for areas in between these points are calculated based on the proportionate mix of energy types.

6 Display on Sunny Portal

Display of power consumption in the load balance

The power values measured by the radio-controlled socket are displayed in a diagram on the **Load Balance and Control** page on Sunny Portal.

Information: Due to storage space limitations on Sunny Portal, the power consumption diagram uses 15-minute average values. The power curve is thus smoothed out somewhat and does not show maximum power values. You can increase the resolution (one value every five minutes) by purchasing the Sunny Portal Professional Package as an add-on in the SMA Online Store.

Display of load planning in the forecast

Since Sunny Home Manager reactively allocates PV power to loads with CAN time periods, the **Current Status and Forecast** page on Sunny Portal cannot show a concrete plan for these loads in the forecast. The forecast only shows loads with MUST time periods (see the "SMA SMART HOME - Load control via MUST time period (example: washing machine)" technical information in the download area of Sunny Home Manager at www.SMA-Solar.com).

7 Things To Know

If the minimum switch-on time is greater than 5 minutes, selecting **100% PV power generation** will often prevent large loads with CAN time periods and high power consumption from being switched on. This happens because it is difficult to find a continuous time period in which the PV power generation forecast expects to constantly see more power than the load's minimum power consumption, especially if the load consumes a lot of power.

SMA Solar Technology AG recommends the following settings:

- Minimum switch-on time less than 5 minutes with CAN condition **100% PV power generation**
- Minimum switch-on time between 6 and 15 minutes with CAN condition **95% PV power generation**
- Minimum switch-on time between 16 and 30 minutes with CAN condition **85% PV power generation**
- Minimum switch-on time between 30 and 60 minutes with CAN condition **70% PV power generation**

Special considerations when planning optional energy consumption

- If the minimum switch-on time is less than 5 minutes, the loads will be switched on based on the chosen CAN condition as soon as the CAN condition is met during the time period.
- If the minimum switch-on time is more than 5 minutes, Sunny Home Manager will plan the loads and determine whether and when the forecast calls for enough continuous PV energy for the duration of the minimum switch-on time. The load will not be turned on until the right moment indicated by the plan.

Further information

- If two loads with CAN time periods have the same priority, Sunny Home Manager will prefer the load that can consume more energy during the configured time period.
- Sunny Home Manager always picks the earliest possible starting time when planning loads with CAN time periods. As a result, the load may reach the maximum device run time early on in the defined time period and may not run again for the remainder of the time period.
- Storage batteries in SMA storage systems (Sunny Boy Smart Energy and Sunny Island) will be allocated energy for charging before loads with CAN time periods. If you want to use another order of priority, our service team can change the settings for you (contact details at www.SMA-Solar.com).

SMA Solar Technology

www.SMA-Solar.com

