

Operating instructions | for operators

sonnenBatterie hybrid 9.53

IMPORTANT

- ▶ Read this documentation carefully before installation / operation.
- ▶ Retain this document for reference purposes.

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ANNEX 31

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1 Information about this document

This document describes the operation of the sonnenBatterie hybrid 9.53.

- ▶ Read this document in its entirety.
- ▶ Keep this document in the vicinity of the sonnenBatterie.

1.1 Target group of this document

This document is intended for the storage system operator.

1.2 Designations in this document

The following designations are used in this document:

Complete designation	Designation in this document
sonnenBatterie hybrid 9.53	Storage system

1.3 Explanation of symbols



DANGER

Extremely dangerous situation leading to certain death or serious injury if the safety information is not observed.



WARNING

Dangerous situation leading to potential death or serious injury if the safety information is not observed.



CAUTION

Dangerous situation leading to potential injury if the safety information is not observed.

NOTICE

Indicates actions that may cause material damage.



Important information not associated with any risks to people or property.

Symbol	Meaning
▶	Work step
1. 2. 3. ...	Work steps in a defined order
✓	Condition
•	List

Table 1: Additional symbols

2 Safety

2.1 Intended Use

The sonnenBatterie hybrid 9.53 is a battery storage system which can be used to store electrical energy. Improper use of this system poses a risk of death or injury to the user or third parties as well as damage to the product and other items of value. The following points must therefore be observed in order to comply with the intended use of the product:

- The storage system must be fully installed in accordance with the installation instructions.
- The storage system must be installed by an authorised electrician.
- The storage system is only allowed to be operated with PV generators of Class A rating according to IEC 61730.
- The storage system must only be used at a suitable installation location.
- The transport and storage conditions must be observed.

Especially the following uses are not permissible:

- Operation in flammable environments or areas at risk of explosion.
- Operation in locations at risk of flooding.
- Operation outdoors.
- Operation of the battery modules outside of its storage system.



Failure to comply with the conditions of the warranty and the information specified in this document invalidates any warranty claims.

2.2 Operating the storage system

Incorrect operation can lead to injury to yourself or others and cause damage to property:

- The storage system must only be operated as described in the product documentation.
- This device can be used by children from the age of eight (8) years old and individuals with impaired physical, sensory or mental capabilities or individuals with limited knowledge and/or experience of working with the device, as long as they are supervised or have been trained to safely use the device and understand the resulting risks of doing so. Children must not play with the device. Cleaning and user maintenance must not be carried out by children without supervision.

2.3 Product modifications or changes to the product environment

- Only use the storage system in its original state - without any unauthorised modifications - and when it is in proper working order.
- Safety devices must never be overridden, blocked or tampered with.
- The interfaces of the storage system must be wired in accordance with the product documentation.
- All repairs on the storage system must be performed by authorised service technicians only.

2.4 Voltage in and on the storage system



The storage system contains live electrical parts, which poses a risk of electrical shock.

Therefore:

- ▶ Do not open the storage system.



The plug-in connectors on the top side of the storage system are directly connected to the PV generator of the PV system. This means, there is voltage present on the PV plug-in connectors when the PV system generates electricity, even if the PV disconnecter has been switched off.

Therefore:

- ▶ Do not disconnect the PV plug-in connectors at the top of the storage system.

2.5 Handling the battery modules



The battery modules installed in the storage system are protected by multiple protective devices and can be operated safely. Despite their careful design, the battery cells inside the battery modules may corrode or experience thermal runaway in the event of mechanical damage, heat or a fault.



This can have the following effects:

- High heat generation on the surface of the battery cells.
- Electrolyte may escape.
- The escaping electrolyte may ignite and cause an explosive flame.
- The smoke from burning battery modules can irritate the skin, eyes and throat.

Therefore, proceed as follows:

- ▶ Do not open the battery modules.
- ▶ Do not mechanically damage the battery modules (pierce, deform, strip down, etc.)
- ▶ Do not modify the battery modules.
- ▶ Do not allow the battery modules to come into contact with water (except when extinguishing a fire in the storage system).
- ▶ Do not heat the battery modules. Operate them only within the permissible temperature range.
- ▶ Keep the battery modules well away from sources of ignition.
- ▶ Do not short-circuit the battery modules. Do not allow them to come into contact with metal.
- ▶ Do not continue to use the battery modules after a short circuit.
- ▶ Do not deep-discharge the battery modules.

In the event that module contents are released:

- ▶ Do not enter the room under any circumstance.
- ▶ Avoid contact with the escaping electrolyte.
- ▶ Contact the fire services.

2.6 Conduct in case of a fire

Fire may occur with electrical equipment despite its careful design. Likewise, a fire in the vicinity of the equipment can cause the storage system to catch fire, releasing the contents of the battery modules.

In the event of a fire in the vicinity of the product or in the storage system itself, proceed as follows:

- ▶ Only firefighters with appropriate protective equipment (safety gloves, safety clothing, face guard, breathing protection) are permitted to enter the room where the burning storage system is located.

There is a danger of electrocution when extinguishing fire while the storage system is switched on. Therefore, before starting to extinguish the fire:

- ▶ Switch off the storage system to electrically isolate it (see Switching the storage system off to electrically isolate it).
- ▶ Switch off the mains fuses in the building.

If the storage system and/or mains fuses cannot be safely switched off:

- ▶ Observe the minimum distances specified for the extinguishing agent used. The storage system works with an output voltage of 230 V (AC) and is therefore considered a low-voltage system. However, the voltage of the PV system that is connected to the storage system (through the PV connectors on the top of the storage system) can be up to 750 V (DC).
- A storage system fire can be extinguished using conventional extinguishing agents.
- Water is recommended as an extinguishing agent in order to cool the battery modules and therefore prevent thermal runaway in battery modules which are still intact.

Information on the battery modules:

- The battery modules have a nominal voltage of 48 V (DC) and therefore fall into the range of protected extra-low voltage (under 60 V DC).
- The battery modules do not contain metallic lithium.

3 Product description

3.1 Technical data

sonnenBatterie hybrid	9.53/2,5	9.53/5	9.53/7,5	9.53/10	9.53/12,5	9.53/15
System data (AC)						
Nominal voltage	230 V					
Nominal frequency	50 Hz					
Nominal power	4,600 W					
Nominal current	20 A					
Charging / Discharging power	1,100 W	2,500 W	3,300 W	3,300 W	3,300 W	3,300 W
Charging / Discharging current	4.8 A	10.9 A	14.3 A	14.3 A	14.3 A	14.3 A
Power factor range	0.9 cap. ... 0.9 ind.					
Current (Max. continous)	20 A					
Max. output fault current	120 mA					
Inrush current	0 A					
Mains connection	single-phase, L / N / PE					
Max. ext. overcurrent protection	25 A, 1ph					
Mains topology	TN / TT					
Mains connections fuse	Miniature circuit breaker Type B 20 - 25 A					
Photovoltaic (PV) input (DC)						
Number of PV inputs / MPP Tracker	2					
Min. input voltage	75 V					
Max. input voltage	750 V					
Initial input voltage	100 V					
MPP voltage range	75 V ... 600 V					
Max. input power	6,500 W					
Max. input current	13 A					
Backfeed current to array	0 A					
Short-circuit current (I _{sc})	15 A					
Battery data (DC)						
Cell technology	lithium iron phosphate (LiFePO4)					
Max. capacity	2.5 kWh	5.0 kWh	7.5 kWh	10.0 kWh	12.5 kWh	15.0 kWh
Usable capacity	2.25 kWh	4.5 kWh	6.75 kWh	9.0 kWh	11.25 kWh	13.5 kWh
Nominal voltage	48 V					
Current (Max. continous)	75 A					
Short-circuit current(I _{sc})	90 A					
Min. number of battery modules	1					
Max. number of battery modules	6					

Dimensions / weight without extension cabinet (from 2.5 up to 5 kWh)

Dimensions (H/W/D) in cm	88/67/23	-	-	-	-
Weight in kg	58	81	-	-	-

Dimensions / weight with small extension cabinet (from 2.5 up to 10 kWh)

Dimensions (H/W/D) in cm		137/67/23			-	-
Weight in kg	74	97	120	143	-	-

Dimensions / weight with big extension cabinet (from 2.5 up to 15 kWh)

Dimensions (H/W/D) in cm	186/67/23					
Weight in kg	85	108	131	154	154	200

Safety

Protection class	I / PE conductor
Required fault current monitoring	Residual current device (RCD) Type B 30 mA
Degree of Protection	IP30
Rated short-withstand current (I_{cw})	10 kA
Separation principle PV -> AC	no galvanic isolation, transformer-less
Separation principle Batt. -> AC	galvanic isolation (functional insulation)

Power meter

Voltage measurement inputs	Nominal voltage (AC): 230 V (L-N), 400 V (L-L) max. connectible conductor cross-section: 1.5 mm ²
Clamp-on current transformer	Max. measurable current: 60 A (standard), optional up to 400 A

Ambient conditions

Environment	indoor (conditional)
Ambient temperature range ¹	-5 °C ... 45 °C
Storage temperature range	0 °C ... 40 °C
Transport temperature range	-15 °C ... 50 °C
Max. rel. humidity	90 %, non-condensing
Permissible installation altitude	2,000 m above sea level
Pollution degree	2

Additional ambient conditions:

- The installation location must not be at risk of flooding.
- Installation room can be ventilated.
- The currently applicable building codes must be observed.
- Even floor, suitable for heavy loads.
- Observe fire control standards.
- Free from corrosive and explosive gases (ammonia content max. 20 ppm).
- Free from dust (especially flour dust or sawdust).
- Free from vibrations.
- Free access to the installation location.

¹ Optimal: 5 °C ... 30 °C | Derating possible below 5 °C / above 30 °C.

- No direct sunlight.
- Smoke detectors must be installed both at the installation location and in bedrooms.

3.2 Type plate

The type plate for the storage system is located on the outer surface of the system. The type plate can be used to uniquely identify the storage system. The information on the type plate is required for the safe use of the system and for service matters.

The following information is specified on the type plate:

- Item designation
- Item number
- Technical data of the storage system

3.3 Symbols on the outside of the storage system

Symbol	Meaning
	Warning: flammable materials.
	Warning: hazards due to batteries.
	Warning: electrical voltage.
	Warning: electrical voltage. Wait five minutes after switching off (capacitor de-energising time).
	Warning: Equipment with multiple sources of supply (PV generator, AC mains and battery).
	Warning: product is heavy.
	CE mark. The product meets the requirements of the applicable EU directives.



WEEE mark. The product must not be disposed of in household waste; dispose of it through environmentally friendly collection centres.



Observe the documentation. The documentation contains safety information.

3.4 Function

3.4.1 Basic principle

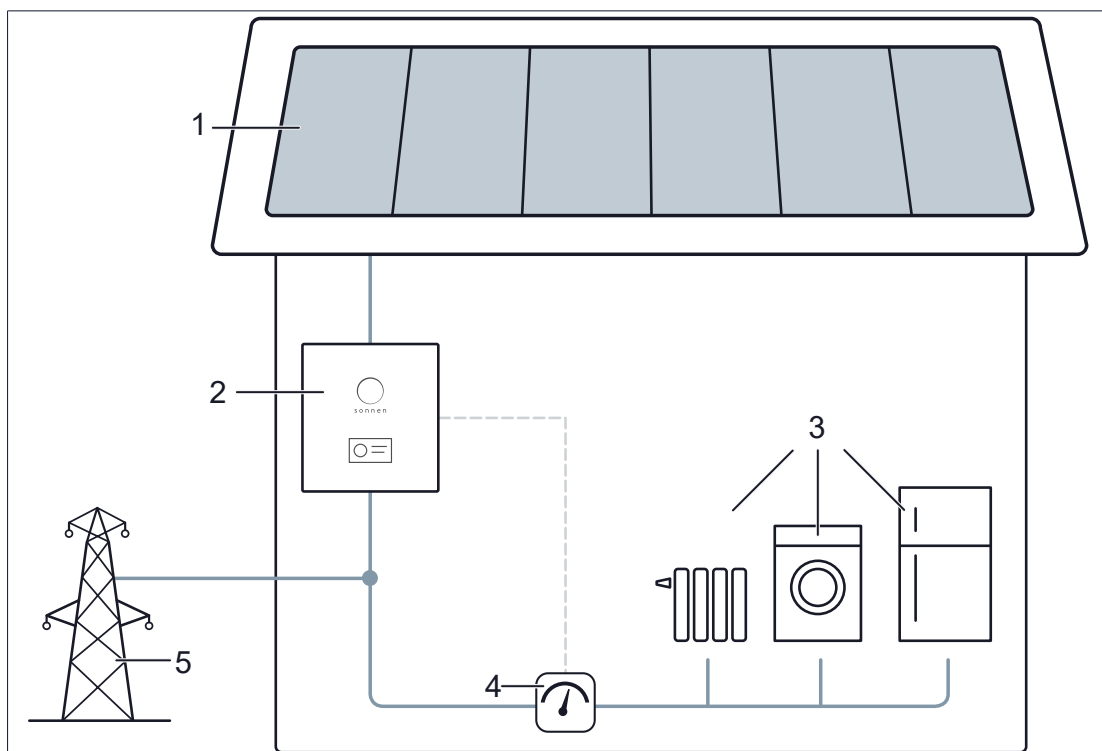


Illustration 1: sonnenBatterie function

- | | | | |
|---|---|---|----------------------------|
| 1 | PV system | 2 | Storage system |
| 3 | Consumers in building (e. g. washing machine, hob, lamps, refrigerator, etc.) | 4 | Measurement of consumption |
| 5 | Public electrical mains | | |

The storage system (2) is connected to the PV system (1) and the public electrical mains (5). Furthermore the current consumption of the consumers in the building (3) is constantly measured (4).

Generation > Consumption

If the generation of power is greater than the consumption, there is a surplus of electrical energy. In this case as much as possible of this surplus is used to charge the battery of the storage system.

If the entire portion of the surplus can not be charged into the battery, the remaining surplus is fed into the public electrical grid.

Consumption > Generation

If the consumption is greater than the generation of power, there is a deficit of electrical energy. In this case the battery is discharged to even out as much of the deficit as possible. If the entire deficit can not be compensated by discharging the battery, the remaining deficit is covered by the public electrical grid.

3.4.2 Feed-in limit

PV systems are subject to a feed-in limit in some circumstances. The feed-in limit restricts the PV system's feed-in power at the mains connection point.

Example

Nominal power of PV system: 10 kWp

Power limit: 50%

Maximum feed-in power: 5 kW

In this example, the feed-in power of 5 kW must not be exceeded. The following figure shows an example of the PV system's production over the course of a day.

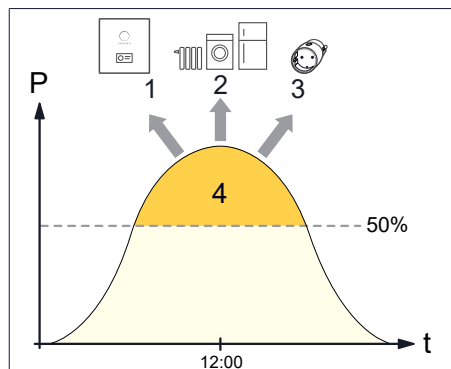


Illustration 2: Example: feed-in limit at 50% of nominal power

To prevent production reduction – and therefore energy loss – the excess energy is first stored in the storage system (1) and consumption is increased by switching on consumers (2, 3). Production is only reduced if these measures do not lead to the desired limit.

- 1 Charging of storage system
- 2 Switch-on of consumers via self-consumption switch
- 3 Switch-on of consumers via sonnenSmart plug
- 4 Midday peak, which must not be fed into the electrical mains

Measures for limiting feed-in are explained in detail in the following. The individual measures are carried out one after the other. Only when one measure does not achieve the desired reduction is the next measure introduced.

1. Charging of battery

Excess energy is directed to the storage system battery. In order for this to occur, there must be sufficient storage capacity available in the battery. For this reason, on sunny days it is often a good idea to reduce the charging power in the morning hours in order to reserve sufficient remaining capacity of the battery for midday. The charging behaviour is intelligently controlled for this purpose (see Intelligent charging management [P. 14]).

2. Activation of the self-consumption switch

Consumers connected to the permanently wired switch output are switched on here.

3. Switch-on of consumers (via sonnenSmart plug)

The consumers are activated as soon as the feed-in limit is exceeded. The consumers are deactivated again once the level has dropped below the limit and stayed there for at least three minutes.

4. Reduction of PV power

Production is reduced via an integrated switch contact on the inverter. This limited the PV inverter to a set power output. In order for this to occur, the inverter must support power reduction using a switch contact or an external solution (e.g. a solar datalogger). Configuration and connection are carried out by an authorised electrician.

3.4.3 Intelligent charging management

The charging behaviour of the storage system is controlled via intelligent charging management. The aims of this intelligent control are as follows:

- Storage of the midday peak in the storage system (sufficient storage capacity must still be available for this)
- Full charging of the storage system until evening (so there is sufficient energy for night-time)

The intelligent charging management only takes effect in storage systems which are operated together with PV systems for which a feed-in limit is activated.

Functional principle of intelligent charging management

The storage system is connected to a server via the internet. This server creates a consumption and production forecast for the individual hours of the day in question. The production forecast is based on

- the weather forecast,
- the nominal power of PV system and
- the orientation of the PV system.

The consumption forecast is calculated based on actual consumption from the previous week.

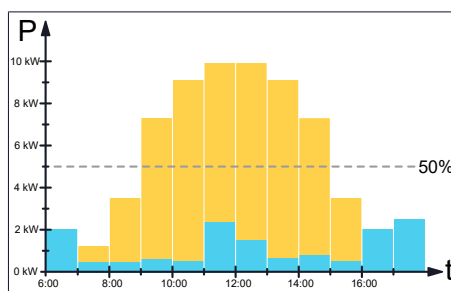


Illustration 3: Production forecast (yellow) and consumption forecast (blue)

The figure on the left shows an example of a production and consumption forecast. In this example, an average consumption of 0.5 kW and a production of approx. 9 kW are calculated for the time between 10 and 11 a.m.

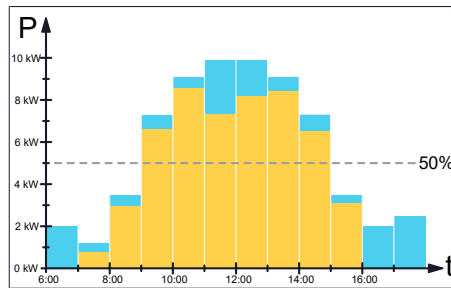


Illustration 4: Forecast surplus

Subtracting the consumption (blue) from the production (yellow) gives you the forecast surplus (8.5 kW in this example). The consumption bars have been placed on top of the production bars in the diagram.

In this example, feeding in the entire surplus at midday would lead to the feed-in limit (of 5 kW) being exceeded. For this reason it is ideal if as much of the energy surplus as possible exceeding the feed-in limit is used to charge the battery.

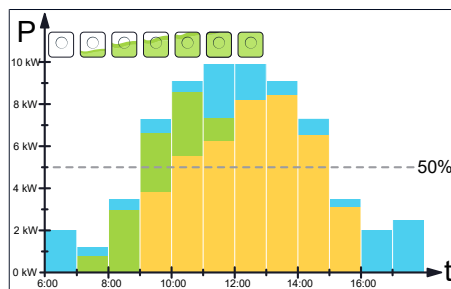


Illustration 5: Charging behaviour without intelligent charging management

Without intelligent charging management, the storage system would immediately use the surplus to charge the battery (until the maximum charging power is reached). In this example, this behaviour would result in the storage system being fully charged before midday, meaning that the surplus exceeding the feed-in limit after this point would no longer be able to be stored in the battery.

yellow forecast production
blue forecast consumption
green charging of storage system

To stay within the Feed-in limit [P. 13], the power of the PV system would need to be reduced. This would lead to an energy loss and therefore also a financial loss. Intelligent charging management attempts to avoid fully charging the battery too early. To this end, the storage system receives a charging plan for the day early in the morning from the server.

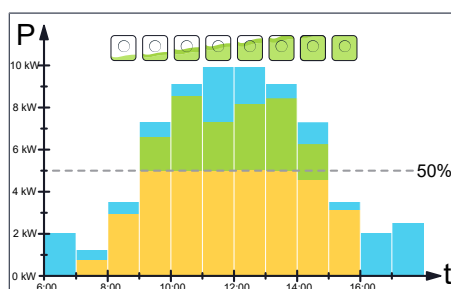


Illustration 6: Charging behaviour with intelligent charging management

In this example, charging of the storage system is avoided in the morning hours. At midday the storage system is charged only enough so that the feed-in limit can be observed.

yellow forecast production
blue forecast consumption
green charging of storage system

Intelligent charging management adaptation

After commissioning the intelligent charging management system has to adapt to conditions on site. The production forecast, for example, depends on the weather forecast and the orientation, roof angle, shading, etc. of the PV system.

The consumption forecast depends on individual consumption and the electrical consumers in use.

Statistical consumption and production data is required in order for intelligent charging management to take these complex factors into account. Since none of this necessary information exists immediately after the storage system is installed, this data must first be collected. For this reason, intelligent charging management requires approx. seven days for calibration. During this time the charging behaviour may not be ideal. After these seven days have passed, intelligent charging management will have adapted to match your individual consumption and production profile.

Intelligent charging management limits

The effectiveness of intelligent charging management depends on how accurate the production and consumption forecasts are.

- An incorrect weather forecast results in an incorrect production forecast.
- The consumption forecast depends on consumption from the previous week. Drastically fluctuating consumption therefore negatively impacts the quality of the consumption forecast. The more consistent the consumption, the more accurate the consumption forecast.

3.5 Function of the sonnen Eclipse

The sonnen Eclipse (light ring in the sonnen logo on the front of the storage system) indicates the current status of the storage system when it is switched on.

The following operating statuses may be indicated:

Colour	Mode	Operating status
White	Pulsing	Storage system is in normal operation.
Green	Pulsing	<p>The connection to the public electrical grid is interrupted. If there is still no connection to the public grid after about five minutes, the sonnen Eclipse switches off.</p> <p>For storage systems with emergency power function only*: storage system is in emergency operation.</p>
Orange	Pulsing	<p>No internet connection.</p> <p>For storage systems with emergency power function only*: an overload has been detected in emergency operation.</p>
Red	Constant	<p>Problem detected.</p> <p>► Contact the installer of the storage system or the sonnen service team!</p>

*Optional accessories sonnenProtect or sonnenBackup-Box.

Further troubleshooting procedures can be found in the Troubleshooting [P. 28] section.

4 Switching on the storage system



The storage system can only be switched on if the public network voltage has been switched on first.

4.1 Switching on the grid voltage

- Switch on the grid voltage using the AC miniature circuit breaker.

4.2 Switching on the PV disconnecter SPV

The PV disconnecter (SPV) makes the connection between the PV system and the inverter.

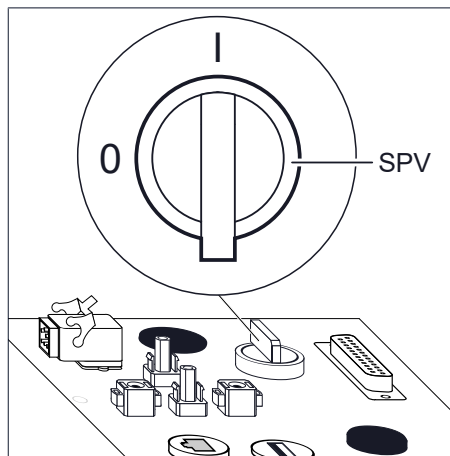


Illustration 7: Switching SPV on

- Switch the PV disconnecter (SPV) on.
- If there are external DC isolating switches:
- Switch these on too.

4.3 Switching on the fuse switch F1

NOTICE

If the storage system can't be switched on:

- Do not attempt switching on the storage system more than three times.
 - Contact the service!
- ⇒ Further attempts can damage the battery modules.

Fuse switch F1 establishes the connection between the battery and the inverter.

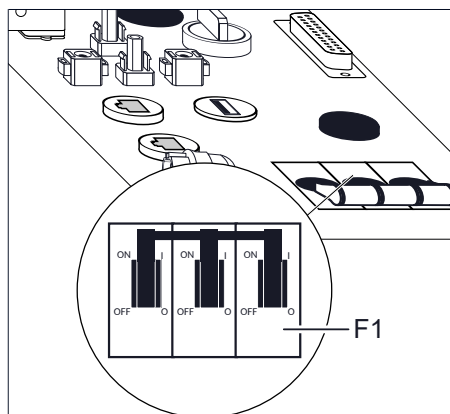


Illustration 8: Fuse switch F1 at the top side of the storage system

- Switch on fuse switch F1.

The storage system then starts up and performs a self-test. Once the self-test is successful, the storage system is ready to operate.

When the storage system has started up and is running in normal operation, the sonnen Eclipse pulses white (see Function of the sonnen Eclipse [P. 16]).

5 Using the optional display



The storage system is not delivered with a display as standard. Retrofitting the display is not possible.

The installed display is a multi-touch screen. It can be controlled with movements of the hand (like a standard smartphone).

5.1 Activating the display

When the display is not touched for a longer period of time, the screen goes dark.

- Touch the display anywhere to reactivate the screen.

5.2 Home screen

The home screen displays the most important current data for the storage system.

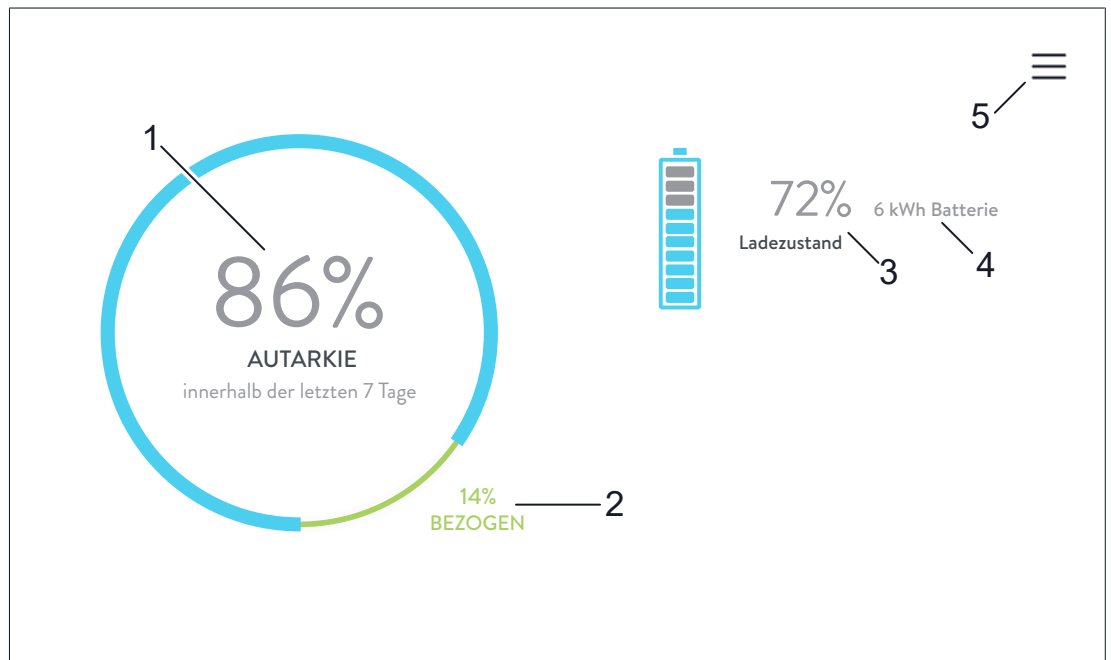


Illustration 9: Home screen

No.	Description
1	Self-sufficiency. Indicates the proportion of total consumption over the last 7 days which was self-generated.
2	Usage. Indicates the proportion of total consumption over the last 7 days which was drawn from the public grid.
3	Stage of charge of the storage system. Indicates the proportion of total capacity that is currently available.
4	Total capacity. Indicates the power that can be taken from a fully charged battery.
5	Main menu button. ► Press the button to switch to the main menu.

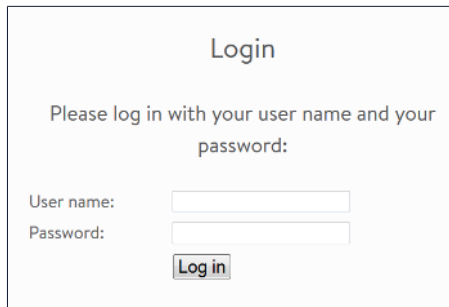
Table 2: Description of the home screen components

6 Internet portal

You can access current and saved data for your storage system on the internet portal.

6.1 Logging into the internet portal

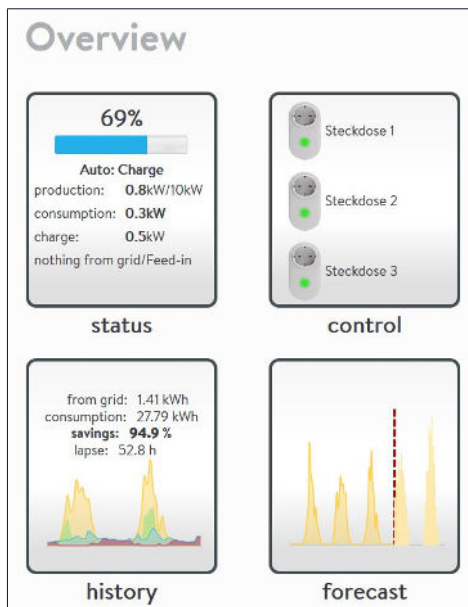
To log into the internet portal, proceed as follows:



The login form is titled "Login". It contains the instruction "Please log in with your user name and your password:". Below this, there are two input fields: "User name:" and "Password:". At the bottom right of the form is a button labeled "Log in".

1. Enter the following web address in the browser:
<https://my.sonnen-batterie.com>
2. The login window opens, as shown on the left.
3. Enter your access data, which was provided as part of the scope of delivery.
4. Click on the **Log in** button.

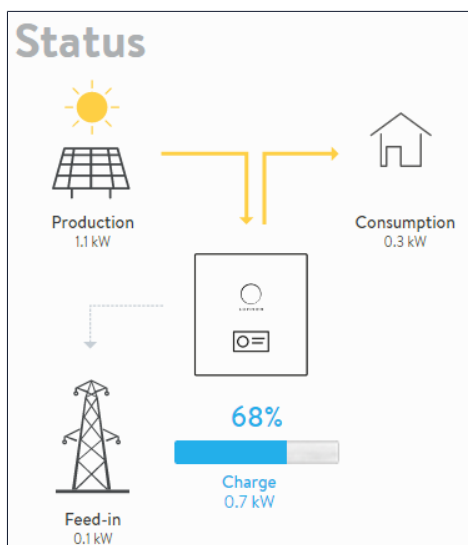
6.2 Using the overview page



The overview page shows a summary of all of the information which can be seen on the portal.

- You can click on the **status**, **control**, **history** and **forecast** buttons in order to open the specific page.

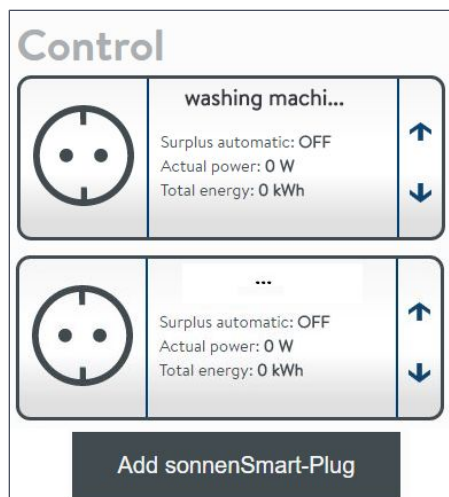
6.3 Using the status page



The status page shows the following current measured values:

- Current generation
- Current consumption
- Current usage/current feed-in
- Current charging status

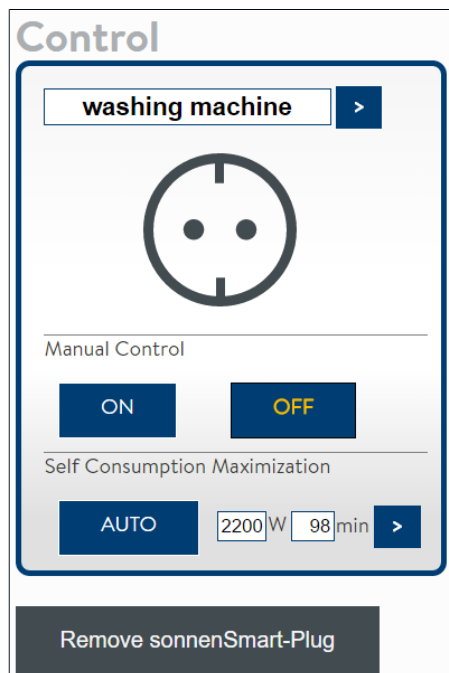
6.4 Using the control page



The control page contains an overview of the connected sonnenSmart-Plugs.

- Click on the relevant button to select a smart plug (e. g. washing machine).
- Click on the ↑ or ↓ button to change the order of the smart plugs.

- Click on **Add sonnenSmart-Plug** to set up a new Smart-Plug. The program guides you through the necessary steps.



The name of the smart plug can be selected and replaced.

- Click > to confirm the new name of the smart plug.
- Click on the **ON** or **OFF** button to activate or deactivate the smart plug (manual control).
- To have the storage system automatically activate or deactivate the smart plug, click on the **AUTO** button.

- Under 'Self Consumption Maximization', set the excess energy level at which the consumer should be activated and the minimum duration for which the consumer should stay activated (minimum activation time). These parameters must be adapted to suit the connected consumer.

Example: Your washing machine has a nominal power of 2200 watts. Your selected washing programme takes one hour and 38 minutes to complete. Enter the following values under 'Self Consumption Maximization': 2200 W; 98 minutes.

- Confirm the values by clicking on >.
- Click on the **Remove sonnenSmart-Plug** button to remove the selected smart plug from storage system control.

6.5 Using the history page

The history page shows all relevant energy flows in a graph.



The values displayed are subject to measuring instrument tolerances and rounding errors. The only information that is relevant in terms of your energy bills is the data taken from the utility company's meters.

6.5.1 Elements of the power graph

The power graph presents the different energy flows in relation to time.

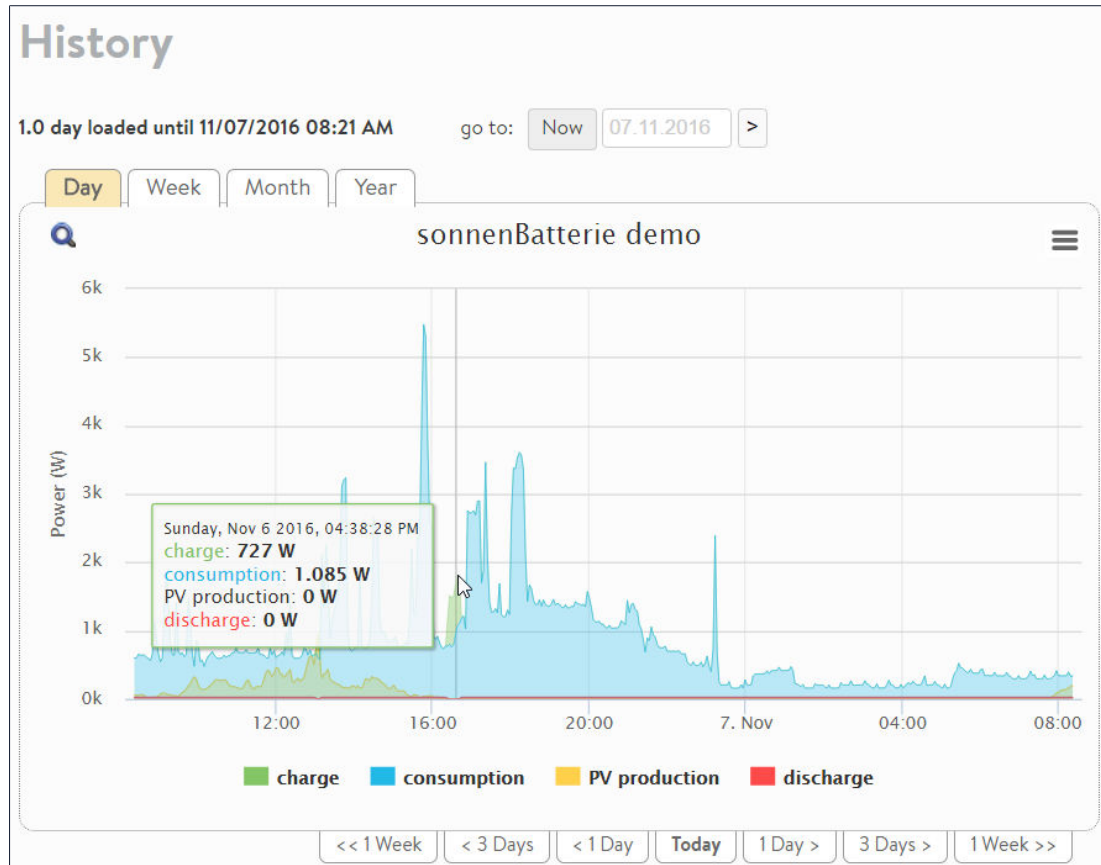


Illustration 10: Power graph on the history page

No.	Description
1	<ul style="list-style-type: none"> ▶ Clicking on the input field to the right of go to allows you to select a date. ▶ Clicking on the button > confirms the date selection.
2	<ul style="list-style-type: none"> ▶ Clicking on the day, week, month or year button defines the time frame shown in the graph.
3	<ul style="list-style-type: none"> ▶ Clicking on the button provides the option of printing out the displayed graph.
4	<ul style="list-style-type: none"> ▶ Clicking on the magnifying glass activates or deactivates full-screen mode.
5	The power is shown in watts (W) on the y-axis. The abbreviation 'k' stands for the prefix 'kilo'. 3,0 k therefore corresponds to 3,0 kilowatts or 3000 watts.
6	<ul style="list-style-type: none"> ▶ Positioning the mouse cursor over the graph shows the exact values for the energy flows at this time. ▶ By clicking and dragging, you can select a smaller time frame in the graph.
7	Time is shown on the x-axis (in the above example, the time frame shown on the x-axis is one day).

No.	Description
8	<p>This legend shows which energy flows are displayed in which colour in the graph (f. e. consumption is shown in blue).</p> <p>► Clicking on the desired energy flow (e.g. consumption) shows or hides this flow in the graph.</p>
9	<p>► Clicking on one of the buttons below the graph allows you to navigate to previous or later time frames. By clicking on < 1 Day for example the specified period will scroll back one day.</p>

Table 3: Description of the power graph elements

6.5.2 Analysis of power diagram

Given the high density of information, analysis of a power diagram is not too simple. For better understanding, some points in time of a power diagram are analysed in what follows.



The example below shows how it works in a facility with limitation of the feed-in to the public grid. This power limitation is a special feature that is used only in cases where the network owner demands it. If requirements are imposed on such an feed-in limitation, it can be controlled by the storage system.

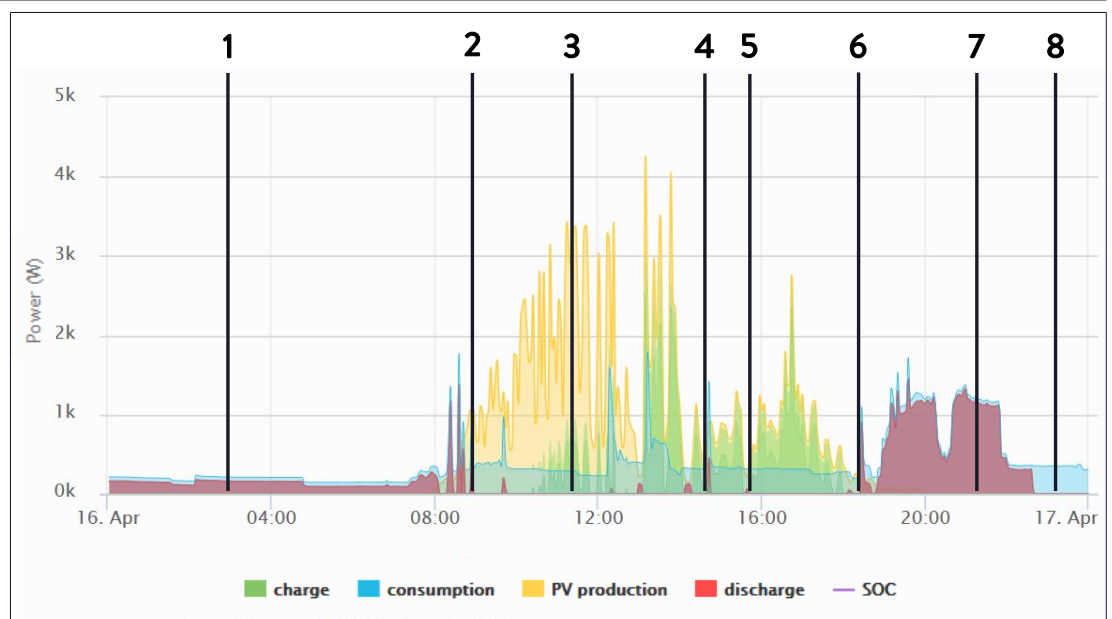


Illustration 11: Analysis of power diagram

Additional information:

- Nominal Power PV system: 5 kWp
- Feed-in Limitation: 50 % of the nominal power (here: 2.5 kW)

No.	Description
1	It is dark (no generation (yellow)). Consumption (blue) and discharging (red) have the same value. Consumption is therefore covered by the discharging of the storage system.
2	Generation (yellow) is approx. 1000 watts. This is used to cover consumption (blue). The intelligent charging management system has postponed charging; the charging buffer is needed to avoid breaching the feed-in limit. The energy that is not required is fed into the grid.

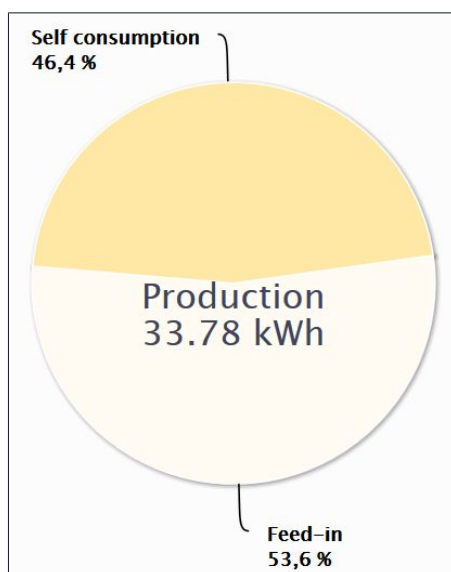
No.	Description
3	Generation has increased to approx. 3300 watts. This is used to cover consumption (blue) and charge the storage system (green) at a minimal level. Charging with higher power is prevented by the intelligent charging management system. This function ensures that storage capacity is kept free in order to store part of the midday peak in the storage system later.
4	Consumption (blue) exceeds generation and must be supplemented by the storage system.
5	A breach of the feed-in limit is no longer expected. PV generation covers consumption (blue) and the surplus is stored in the battery (green) so that it will be fully charged by evening.
6	From this point PV generation is no longer sufficient to cover consumption. The difference is discharged from the storage system.
7	The storage system discharge (red) covers total consumption.
8	The storage system is discharged and consumption is covered by usage from the public grid.

Table 4: Description of the power graph elements

6.5.3 Analysing pie charts

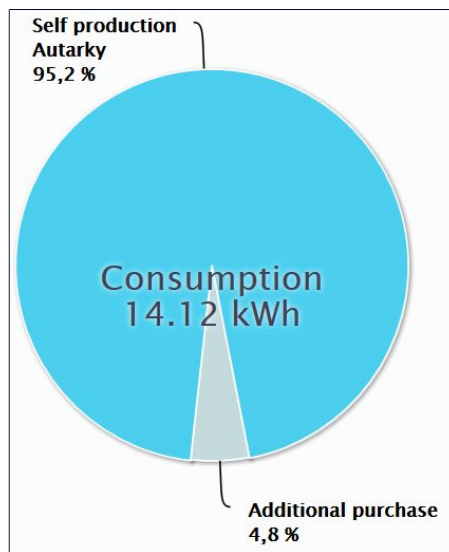
Two pie charts are shown below the power graph. The pie charts always refer to the time frame shown in the power graph.

Production pie chart



The pie chart symbolises the electrical power gained by the generator in the analysed time frame. The feed-in power is marked white in the chart. The yellow part represents self consumption. Self consumption is the part of the generated power that has not been fed in, but has instead been stored temporarily in the battery or has been consumed.

Consumption pie chart



The pie chart shows the power that was required in the building during the analysed time frame.

Purchased power (taken from the mains) is marked in grey in the chart. The blue part represents self production. Self production is the part of the consumed energy that was not taken from the mains.

6.6 Using the forecast page

The forecast page shows the probable course of consumption and production in future.

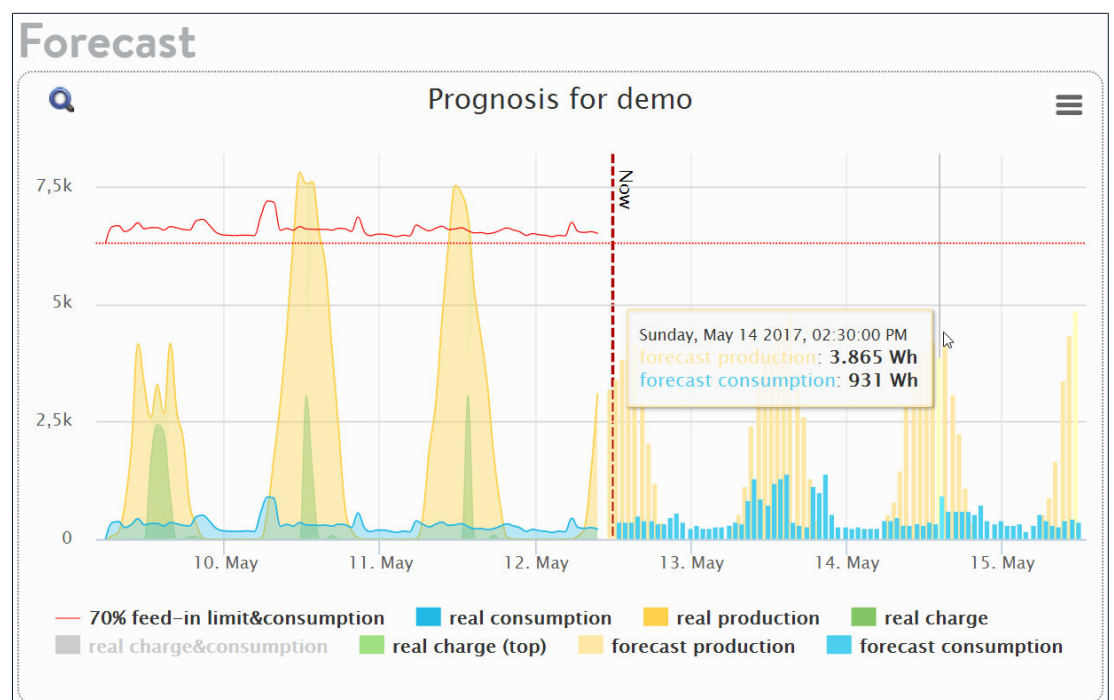


Illustration 12: Forecast page

The storage system is able to forecast consumption in the near future (blue) based on previous consumption trends. Accessing weather data can also produce a production forecast (yellow).

7 Maintenance

For fault-free, safe, reliable and long-lasting operation of the storage system, it is essential to carry out regular function checks and cleaning.

The battery modules installed in the storage system do not require maintenance.

7.1 Checking function

Maintenance interval	Action to be taken
Every 2 weeks	► Check whether there is a fault with the storage system.
Every 6 months	► Check for changes to the charging status. If functioning properly, the storage system should be charged to 100 % on a sunny day and the charging status should drop significantly overnight.

Table 5: Checking function

7.2 Cleaning

NOTICE

Use of unsuitable cleaning agent and/or excessive water

Material damage because of scratched surfaces and/or damage caused by penetration of water!

- Do not use scouring cloths, sponges or cleaning agent.
- Take particular care when cleaning the display (if applicable) and the LED ring, since these can easily be scratched.
- Use only moist cloths, not wet cloths, to clean the system.
- Do not use water jets.

- Carefully clean the outside of the storage system with a clean, moist cloth. For tougher dirt, use a small amount of household dishwashing detergent on a moist cloth.

8 Decommissioning

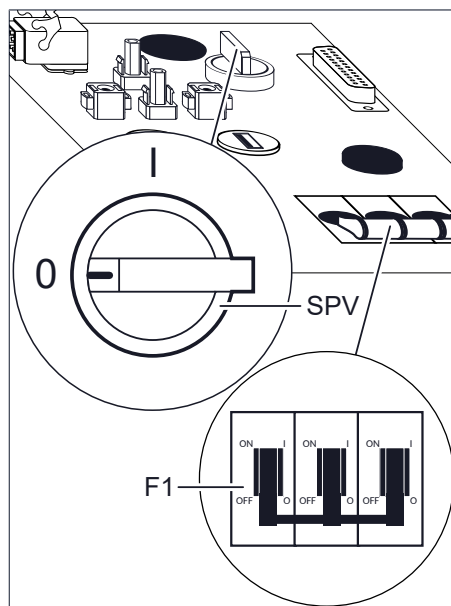
NOTICE

Deep-discharge of the battery modules

Destruction of the battery modules!

- ▶ Do not disconnect the storage system from the public grid for long periods of time.
- ▶ Never continue to operate battery modules which have been deep-discharged.

8.1 Switching the storage system off



- ▶ Switch off fuse switch F1.
- ▶ Switch off the PV disconnect (SPV).
- ▶ Switch off the grid voltage using the AC miniature circuit breaker.

Illustration 13: Fuse switch F1 and PV disconnect

9 Troubleshooting

Disturbance	Possible reason(s)	Correction																				
No connection to the internet portal https://my.sonnen-batterie.com	No connection between the storage system and the server.	<div><div>► Make sure that the Ethernet line between the storage system and the Router of the home network is correctly connected.</div><div>► Make sure that the Router of the home network allows connections on the following ports:</div><table><tr><th>TCP Port</th><th>Service</th></tr><tr><td>22</td><td>ssh</td></tr><tr><td>80</td><td>http</td></tr><tr><td>8080</td><td>http</td></tr><tr><td>443</td><td>https</td></tr><tr><td>3333</td><td>debug</td></tr><tr><th>UDP Port</th><th>Service</th></tr><tr><td>1194</td><td>VPN</td></tr><tr><td>123</td><td>NTP</td></tr><tr><td>1196</td><td>VPN</td></tr></table></div>	TCP Port	Service	22	ssh	80	http	8080	http	443	https	3333	debug	UDP Port	Service	1194	VPN	123	NTP	1196	VPN
TCP Port	Service																					
22	ssh																					
80	http																					
8080	http																					
443	https																					
3333	debug																					
UDP Port	Service																					
1194	VPN																					
123	NTP																					
1196	VPN																					
The sonnen Eclipse of the storage system pulses orange.	The internet connection to the storage system has been interrupted.	<div><div>► Check whether the home network router is able to establish an internet connection.</div><div>If so:</div><div>► Ensure that the network cable for the storage system is connected to the home network router.</div></div>																				
The sonnen Eclipse of the storage system illuminates red.	The storage system has detected a problem that is preventing normal operation or may cause damage to the storage system.	<div><div>► Please contact the sonnen service team to get help resolving the problem.</div></div>																				
The sonnen Eclipse of the storage system pulses continuously green or pulses green and turns off after about 5 minutes.	The storage system is not connected to the public electricity grid.	<div><div>► Check that the circuit breaker in the supply line of the storage system is switched on.</div><div>If so:</div><div>The public electricity grid does not provide any electrical energy (grid outage).</div><div>► It can only be waited until the public electrical grid supplies energy again. Thereafter, the storage systems resumes normal operation.</div></div>																				

Storage system with emergency power function only*: The storage system is not connected to the public electricity network and is in emergency operation. No troubleshooting necessary.

*Optional accessories sonnenProtect or sonnenBackup-Box.

10 Uninstallation and disposal

10.1 Uninstallation

DANGER

Improper uninstallation of the storage system

Danger to life due to electrocution!

- ▶ The storage system must only be uninstalled by authorised electricians.

10.2 Disposal

CAUTION

Improper transport of battery modules

Fire outbreak at battery modules or emission of toxic substances!

- ▶ Transport the battery modules in their original packaging only. If you no longer have the original packaging, new packaging can be requested from sonnen GmbH.
- ▶ Never transport damaged battery modules.

The storage system and the batteries it contains **must not** be disposed of as domestic waste!

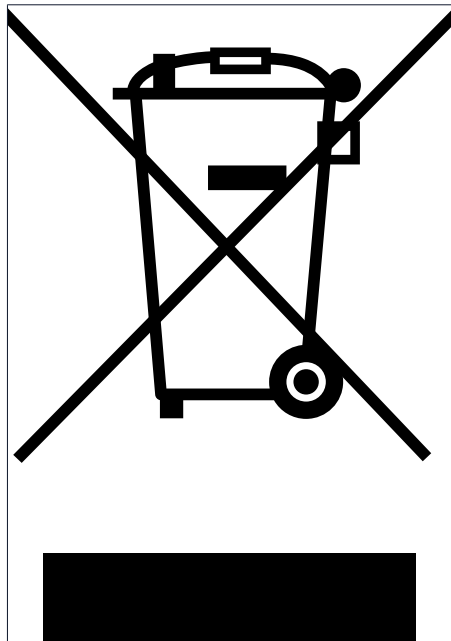


Illustration 14: WEEE symbol

- ▶ Dispose of the storage system and the batteries it contains in an environmentally friendly way through suitable collection systems.
- ▶ Contact sonnen GmbH to dispose of old batteries.

In accordance with the German Battery Act (BattG 2009), sonnen GmbH will accept old batteries free of charge. Please note that the cost of transporting old batteries is not covered.

ANNEX

1. Warranty

You can find the manufacturer's warranty on the following pages.

1. Subject Matter of the Warranty

1.1 These warranty terms and conditions apply for all sonnenBatterien of the version eco 7.0 or higher as well as the version hybrid 8.1 or higher commissioned as of July 2017 if they have been verifiably bought as new devices from sonnen or one of sonnen's authorised and certified wholesale or specialist traders or an authorised and certified specialist installation company and have been commissioned by this professional installer. The warranty is exclusively referring to the sonnenBatterie described in the commissioning certificate with its serial number ("warranty eligible product"). The commissioning certificate shall be provided to the customer as copy in written or electronic form, e.g. as download.

1.2 If the customer has an expansion of the battery modules made afterwards, they shall receive a separate commissioning certificate thereof, containing the serial number and the modules of the expansions, the then applying warranty terms and conditions as well as the duration of the warranty.

1.3 The proof according to figure 1.1 is regarded as brought forward if the commissioning certificate is transferred to sonnen, containing the warranty eligible product (indication of battery number), the installation site, the certified company taking the sonnenBatterie into operation as well as the warranty eligible operator. The commissioning certificate is to be authorised by the parties.

1.4 The warranty and its conditions are applicable, limited to the warranty duration for the first delivered warranty eligible product or a replacement device for a warranty eligible product which is initially installed by sonnen or by an authorised and certified partner or has been exchanged due to a warranty case in fulfilment of the warranty claims according to figure 8.

2. Update Services

2.1 sonnen continuously improves the software used in the sonnenProducts. Updates of the software include the adjustment of interfaces to other products and systems, as far as required for the operation of the respective sonnenProduct, improvements of the system integration, the removal of occurring bugs or as well installation of updates with new features.

2.2 Based on the read-out machine data, sonnen makes suggestions for a further optimisation of the plant and plant control in terms of an increase in efficiency as well improvement of the sonnenProduct's cost effectiveness. Reference is made to Figure 12.1 and Figure 12.9.

2.3 The update of installations requires that sonnen can access the sonnenProduct online. Reference is made to Figure 12.8. The technical requirements needed for the online access to sonnenProducts are to be provided by the customer at their own expense and are to be maintained during the contractual term. The required broadband internet connection must have a download speed of at least 1 Mbit/s and an upload speed of 512 kB/s. If deviating requirements exist, they are defined in the offer and order confirmation.

2.4 Published updates shall be delivered by sonnen and installed on sonnenProducts. If updates are not installed the consequence of which can be that contractual services cannot be delivered at all or just limited.

3. Warranty Eligible Operator, Premium Warranty

3.1 sonnen provides a **Premium Warranty** only to those operators that operate warranty eligible products for their own purposes ("warranty eligible operator"). Traders, regardless of what type and trade level, do not acquire any rights and claims against sonnen resulting from the manufacturer's warranty.

3.2 If a sonnenBatterie has been provided to a user within the scope of a rental agreement, the warranty eligible operator is the lessor of the sonnenBatterie. Claims resulting from the warranty can be exerted exclusively by the lessor as the warranty eligible operator. Reference is made to Figure 8.3 explicitly.

4. Conclusion of Warranty

4.1 The Premium Warranty is an offer of sonnen directly towards the warranty eligible operator at the conclusion of a warranty agreement subject to the respectively applying regulations.

4.2 With the consent of both parties, the warranty agreement is directly concluded between sonnen and the warranty eligible operator. The consent for the conclusion of a warranty agreement shall be declared by sonnen after the transmission of the commissioning certificate authorised by the installer and the customer according to figure 1.3 vis-à-vis the warranty eligible operator.

5. Relation of Warranty to Other Claims

5.1 The warranty grants the warranty eligible operator to the extent and according to the stipulations of these regulations, claims complimentary to the legal warranty claims.

5.2 Claims for the removal of defects against the respective seller as well as legal product liability claims remain unaffected by the warranty.

6. Duration and Exertion of Warranty

6.1 The **Premium Warranty** applies for all warranty cases (according to following Figure 7) which happen verifiably until the end of the 10th year after commissioning of a warranty eligible product according to Figure 1.1, 1.2 ("warranty duration") or during the use of up to 10,000 full loading cycles. A full loading cycle is equal to the complete loading and unloading of the battery's net capacity – partial cycles are therefore only considered proportional to the battery's net capacity. As soon as one of the two conditions is exceeded, the Premium Warranty ends.

6.2 Regarding properly repaired or replaced warranty eligible products or their system components; the warranty applies until the end of the warranty duration granted for the initially delivered warranty eligible product or system component.

6.3 Legal and/or contractual warranty claims occurring during a legal or contractual warranty period cannot be derived from the warranty.
6.4 Any claims resulting from the warranty are to be exerted in writing by the warranty eligible operator within the warranty period against sonnen. Warranty claims can also be submitted via an authorised and certified partner.

7. Warranty Cases Covered by Warranty

7.1 sonnen grants the warranty eligible operator a warranty for the warranty eligible product during the warranty duration. The warranty case occurs if the capacity of the battery cells falls below 70 % (seventy percent) of the nominal capacity or a deviation of more than 10 % (10 percent) of the agreed or assured performance features is determined for all other system components.

7.2 In case of an occurring defect in terms of Figure 7.1, the warranty eligible operator is entitled to the claims resulting from Figure 8.

8. Rights within Premium Warranty (Warranty Claims)

8.1 sonnen's Premium Warranty does not only match the fair value replacement warranty presupposed by the reconstruction loan corporation for the participation in its funding programmes, but also offers further services to the warranty eligible operator.

8.2 Upon occurrence of a warranty case, sonnen shall replace the defect system component. The required working time for the replacement of the defect system component is to be paid by the warranty eligible operator at sonnen's compensation rates applicable at the occurrence of the warranty case. The current hourly rate when entering into this agreement is EUR 52 gross. The hourly rate can be adjusted from time to time and may vary for different countries about which sonnen will inform its customers when entering into a warranty agreement. The current hourly rate can be requested under our service number (+49 8304 92933444). Working time in terms of this regulation also includes the journey and departure time from sonnen to the location of the warranty eligible product's installation.

8.3 Any replacement, repair or collection of the warranty eligible product shall exclusively be done at the location to which the warranty eligible product was originally delivered and installed. Additional costs resulting from a non-coordinated transport to another location are to be paid by the warranty eligible operator.

8.4 Any claims exceeding the replacement of the system component, especially claims for lost profits or replacement of damages caused by defective products are exempt.

8.5 If no warranty case causing defect has been determined for the warranty eligible product within the scope of the examination, or no Premium Warranty claim is resulting from the listed circumstances in Figure 9 and the warranty eligible operator has not determined such due to gross negligence, sonnen can demand the payment of the costs accrued within the scope of the examination. Used working time as well as costs for journey and departure time shall be charged at sonnen's current rates.

8.6 It is at sonnen's discretion to take out a respective insurance for securing the warranty eligible operator's claims resulting from this warranty.

8.7 Any claims from the warranty (including warranty claims) lapse six months after acknowledgement of the defect by the warranty eligible operator, or the point in time in which they should have acknowledged it without gross negligence, at the latest, however, three months after termination of the warranty period.

9. Technical Requirements, Fact of Exclusion

The warranty claims are – if the asserted defect has been also caused hereby – excluded in the following cases:

- Not intended use according to the respectively current manual or instructions by the warranty eligible operator or commissioned third parties;
- Non-appropriate and non-professional or non-standard installation, or installation not according to installation instructions or tips (including the installation and operating manual for the warranty eligible product) undertaken by the warranty eligible operator or commissioned third parties;
- Unprofessional, incorrect handling or operation or handling or operation against the operation instructions and tips of the warranty eligible product; environmental moisture and temperature must be within the required limit values;
- Deep discharge of battery cells which could have been determined and prevented within the scope of a regular appropriate supervision of the sonnenBatterie's operation or upon presence of a proper online connection (see Figure 2.2);
- Unauthorised changes or repairs of any kind;
- Utilisation of spare parts and complements that do not correspond to sonnen's predefined original specifications;
- Non-implementation of an on-going maintenance in accordance with the maintenance instructions and tips;
- Non-implementation of the regular examination of the proper mains connection.
- Removal, damage or destruction of the label by the warranty eligible operator if a defect resulted from this;
- Outside influence and force majeure;
- Transport damages sonnen is not responsible for;
- Occurring excess voltages in the power voltage supply to which the warranty eligible product is connected.

10. Transferability of the Warranty

The warranty, including the warranty claims resulting from it, can only be transferred from a warranty eligible operator to a third party with sonnen's prior written consent.

11. Claim for Defects, Liability

11.1 It is regarded as material defect if the goods do not display the condition agreed upon or are not suited for the utilisation agreed upon in the agreement.

11.2 Changes in the execution of the services as well as other changes benefiting the technical advancement are not regarded as defects.

11.3 If nothing to the contrary has been agreed upon and ordered, the suggestions as well as quantity and measurement records shall be made by sonnen in a generally non-binding manner.

11.4 sonnen is liable according to the legal regulations if the customer exerts claims for damages that are based on intent or gross negligence, including the intent or gross negligence of sonnen's representatives or fulfilment agents.

11.5 sonnen is liable according to the legal regulations if sonnen has culpably violated an essential obligation of the agreement. A liability is excluded for a simple negligent violation of non-essential obligations of the agreement.

11.6 If the customer is entitled to a claim for replacement of the damages instead of the service, sonnen's liability is generally limited to the replacement of the foreseeable, typically occurring damages. The same applies if the customer is entitled to claims for damages instead of the service.

11.7 The liability due to injuries to life, body or health shall remain unaffected. This also applies for the obligatory liability according to the product liability act as well as liability due to malicious concealment of a defect or due to the taking over of a warranty.

11.8 A warranty for the condition of the object or that the object shall retain a specific condition for a specific duration exceeding the legal rights to the removal of defects is exclusively taken over by sonnen if this has been explicitly agreed upon in writing.

11.9 Performance and product warranties of the manufacturers of used components (e.g. photovoltaic modules and inverters) shall exclusively be granted by the respective manufacturer if no deviating written agreements have been made. After the expiration of the warranty deadline, claims resulting from these warranties shall be directly addressed to the respective manufacturer.

11.10 A further liability is excluded, irrespective of the legal nature of the claim exerted. sonnen is specifically not liable for damages that have not been caused to the goods itself, e.g. lost profit and other financial losses.

11.11 In so far as the liability is excluded or limited, this also applies for the personal liability of sonnen's employees, workers, staff, representatives and fulfilment agents.

11.12 Should the examination of the notice of defects reveal that the case is not covered by warranty, the costs caused within the scope of the examination and rendering of services are to be paid by the customer.

11.13 The legal limitation period applies for claims for defects.

11.14 If a liability for damages due to slight negligence and not based on injury to life, body or health of the customer is not excluded, such claims shall lapse within one year, starting from the emergence of the claim.

12. Data Protection / Approval

12.1 Within the scope of a rendering of the contractual services and the update services, sonnen shall access those sonnenProducts online which are approved by the customer for surveillance and control. The data generated in the sonnenProduct shall be read, evaluated, processed and saved for the purpose of rendering of services, increase of efficiency, for terms of the ongoing optimization and enhancements of the sonnenProducts.

12.2 The updates for the used software shall generally be installed online.

12.3 The customer's data may be forwarded to sonnen's fulfilment agents or sonnen's fulfilment agents shall access the sonnenProducts online to render the agreed services. As far as data has to be transferred to third parties in fulfilment of the contractual performances and if these data cannot be transferred anonymised sonnen has entered into agreements with these companies which are in compliance with the requirements of the applicable law.

12.4 For the purpose of benchmarking or research, the data read-out from the sonnenProduct may be forwarded to third parties in anonymised form.

12.5 With the conclusion of the warranty agreement, the customer agrees to the collection, processing, utilisation and forwarding of their anonymised data.

12.6 The data received from the customer shall be treated confidentially and according to the regulations of Germany's Federal Data Protection Act as well as the German Telemedia Act.

12.7 The customer is entitled to disagree with sonnen's utilisation, processing, saving and forwarding of their data or withdraw their given approval at any time.

12.8 If the customer disagrees with the online access to the sonnenProduct, the update services may not be rendered at all or not to the agreed extent or only against the payment of the higher costs resulting from the deactivation of the online access. The costs of an update to be performed on site consist of sonnen's journey and departure costs to the location of the warranty eligible product's installation and the working costs in terms of Figure 8.2. The installation of an update on site generally takes an hour.

12.9 Reference is made to sonnen's data utilisation conditions which the customer approved at the conclusion of the agreement.

13. Intellectual Property Rights, Software Utilisation

13.1 sonnen shall remain owner of all copyright and exploitation rights for all plans, construction drawings, presentations as well as all illustrations, drawings, records, construction and circuit diagrams and other documents entrusted to the customer within the scope of the order fulfilment, regardless if in written or electronical form, that have been created by sonnen. Without the consent of sonnen they must not be made accessible to third parties or utilised by the customer. Upon sonnen's request, they are to be handed back with the assurance that no copies have been made. The customer is liable for any utilisation of the information in their possession that is contrary to these conditions.

13.2 Regarding the software contained in the delivery as well as updates, upgrades and extensions delivered for this purpose, the customer shall be granted a non-exclusive, non-transferable right to utilise the delivered software, including its documentation to the extent which is required for the appropriate operation of the sonnenProduct in accordance with the regulations of the supplied manual and instructions.

13.3 The utilisation right shall exclusively apply to the delivery object with which the software has been delivered. The customer's isolated utilisation of the software or utilisation in connection with other devices and products is not allowed.

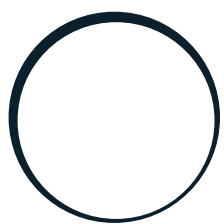
13.4 The customer's further utilisation, especially the change, processing, reproduction, translation of the software as well as conversion from object code to source code is not allowed.

1354 The utilisation limitation also includes the customer's accesses at system level for the purpose of changing ex works configured parameters, functions and utilisation limitations unless assured properties of the sonnenProduct are affected by these limitations due to the made agreements.

14. Closing Provisions

14.1 This agreement is exclusively subject to the law of the Federal Republic of Germany under exclusion of the regulations of the international private law (conflict of laws) and the UN Convention on Contract for the International Sale of Goods.

14.2 The exclusive place of jurisdiction for all disputes resulting from or in connection with this agreement is Ulm if the warranty eligible operator (i) is a trader, (ii) an entrepreneur in terms of § 14 of the BGB [German Civil Code] or (iii) a private person without a place of general jurisdiction within the Federal Republic of Germany. Otherwise, the places of jurisdiction are those stipulated in the ZPO [German Code of Civil Procedure].



sonnen

energy is yours

sonnen GmbH

Am Riedbach 1

D-87499 Wildpoldsried