Operation and user manual
sonnen eco Gen 3.1

sonnen

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sonnen

Dear sonnen battery owner,

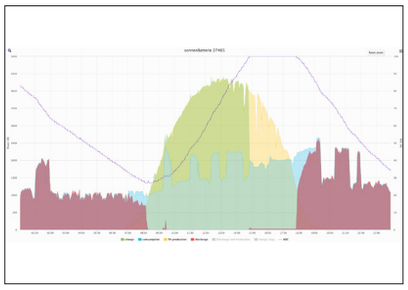
Welcome to the future of energy storage with your sonnen smart energy management system! By adding a sonnen energy storage system to your home, you are joining a **growing community of over 35,000 households** around the world who are using clean and reliable energy to power their lives.

Below are instructions on how to virtually access your sonnen smart battery system using the sonnen Web Portal and the sonnenApp. Your login information is:

Serial Number	**User Name**	**Password** (keep this private)

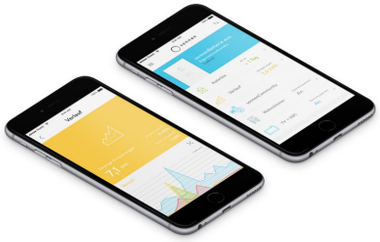
The sonnen Web Portal

You can access our Internet portal from any web browser. The Portal shows the energy produced and consumed by your home and stored in your sonnen smart battery, throughout the day.



1. Log into **https://my.sonnen-batterie.com**
2. Enter the username and password shown above
3. Refer to page 13 for more information

sonnenApp
sonnen GmbH



The sonnenApp

With the sonnenApp, you can also use a smartphone or tablet to monitor your sonnen smart battery on the go.

1. Download the sonnenApp for Android or Apple
2. Create an account and select “Pair new sonnenBatterie”
3. Enter the serial number and password above and “Pair now”
4. Use on screen options to navigate

This manual refers to:
Product: eco Gen3.1
Latest revision: 08/2019
Version: 1.0
If you need help or service, contact sonnen Service Line at
1 (818) 824-6363 Monday-Friday 8AM-8PM EST,
or email at service@sonnenbatterie.com.

Disclaimer

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About this manual

This manual describes the installation and operation of the sonnen eco Gen 3.1 storage system. Read this manual carefully before beginning work and keep it near the storage system.

Target audience

This document is intended for the following audiences:

- Installer of the storage system
- Operator and end user

Some actions described in this document must only be performed by a trained and certified electrician. These actions are marked as follows:

Trained, electrically qualified person only!

Trained, electrically qualified persons are:

- Service partners authorized by sonnen Inc.
- Trained, electrically qualified persons with knowledge of all applicable regulations and standards.
- Trained, electrically qualified persons who have attended the training provided by sonnen.

Terminology

This document refers to the sonnen eco Gen 3.1 as a storage system.

This manual refers to the building being serviced by the storage system as a “house,” but the sonnen eco Gen 3.1 can be installed in any number of buildings or sites powered by AC electricity.

For a full glossary of terms used in this manual, refer to Appendix 2.

Symbols used

Warnings

WARNING WORD

Warnings are indicated by this symbol and a warning word, which indicates the severity of the danger. Along with the warning are instructions for avoiding the danger.

The following warning words are used:

- **ATTENTION** indicates possible material damages.
- **CAUTION** indicates a possible hazardous situation which could result in minor or moderate injury.
- **WARNING** indicates a possible hazardous situation which could result in death or serious injury.
- **DANGER** indicates an imminent hazardous situation which will result in death or serious injury.

Important information

Important information without danger to injury, death, or material damage is indicated by this symbol.

Actions

Actions to be taken are marked with a ►. For example:

► Read this manual thoroughly before operating the storage unit.

Electrical symbols

 Indicates protective earth (ground).

N indicates the connection for the neutral conductor on permanently installed equipment.

Safety

Intended use

Any use of the system other than the intended use can cause serious injury, death, and damage to the product or other assets.

- The storage system must only be used to store electrical power.
- The storage system must only be used with the battery modules provided.
- The storage system is intended for indoor use only.
- The intended use includes knowledge and application of the information in this installation and operating manual as well as all delivered product documentation.

Failure to comply with the warranty conditions and the information listed in this installation and operating manual will void any warranty claims.

Prohibited uses

DANGER

Danger to life due to electric shock!

Even if the utility grid fails, the storage system will continue delivering power. Before servicing the storage system:

- ► Turn off the storage system.
- ► Turn off the main disconnect circuit breaker.

Only authorized electrically qualified persons can perform work on electrical parts.

- Do not use the storage system in vehicles.
- Do not use the storage system in wet locations.
- Do not use the storage system in areas at risk of explosion (flour dust, sawdust, etc.).
- Do not expose the storage system to direct sunlight.
- Do not use the storage system in areas where the ammonia content of the air exceeds 20 ppm.
- Do not use the storage system when corrosive gases are present.
- Do not use the storage system higher than 9,842 feet (3,000 meters) above sea-level.
- Do not operate the storage system at temperatures outside of the allowed ambient temperature range of 41°F - 113°F (5°C - 45°C).
- Do not operate the storage system at a humidity higher than 90%.

General warnings

ATTENTION

Damaging of the battery modules by deep discharge!

If the battery modules are disconnected from a power source for longer than six months, they can be damaged by excessive discharge.

- ► If the storage system has been disconnected from an AC source for six months, connect it to the AC power source and allow it to charge the battery modules to 100%.

General safety instructions

- Do not modify the storage system.
- Do not use the storage system if it has been damaged.
- Ensure the following regulations are observed in the installation and connection of the storage system and the PV system:
  - Local, regional, national, and international regulations and guidelines
  - National Electric Code
  - ANSI/NFPA 70
  - Requirements of the servicing utility
- Ensure that all safety systems are in perfect

working order.

- Read this installation and operating manual with care.
- When installing and maintaining the storage system, wear personal protective equipment, including safety glasses, insulated gloves, and safety shoes.

WARNING

Residual voltage always present on DC terminals, even when battery is turned off.

Although the green POWER LED may be off, there is still a small amount of voltage present on the battery terminals. Keep the plastic terminal inserts attached to the battery terminals until later in the installation process.

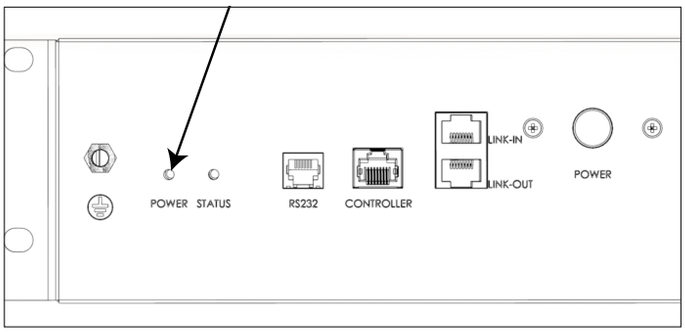


Fig. 1 Power LED

WARNING

Risk of burns!

When working on the storage system:

- ► Take off metallic jewelry.
- ► Turn off the storage system.
- ► Turn off the main disconnect.
- ► Use insulated tools
- ► Wear personal protective equipment, including safety glasses, insulated gloves, and safety shoes.

Fire-related instructions

CAUTION

Risk of injury from escaping electrolyte

The battery modules in the storage system are protected by a number of security devices for safe operation. Despite diligent construction, cells inside the battery modules can still degrade or melt components in the event of mechanical damage, heat, or a fault. Possible effects include:

- Heating of battery modules.
- Escaping electrolyte fluid.
- Smoke, which can irritate skin, eyes, and throat.

Consequently:

- Do not open battery modules.
- Do not physically damage battery modules (puncture, deform, disassemble, etc).
- Do not modify battery modules.
- Keep battery modules away from water.
- Do not allow battery modules to heat up.
- Only operate battery modules in the allowed temperature range.
- Do not short circuit battery modules or bring them into contact with metal.
- Do not use a battery module after it has short-circuited.
- Do not exhaustively discharge battery modules.

If contents escape:

- Do not enter the room.
- Avoid contact with the escaping electrolyte.
- Contact your fire department.

Despite all of the care that goes into the design of the storage system, fires are still possible. A fire can release substances contained in the battery modules.

In the event of a fire in the storage system or its surroundings:

- Only fire fighters wearing proper protective clothing (including gloves, masks, and breathing apparatus) may enter the room with the burning storage system.
- A fire in the storage system can be extinguished by conventional agents.
- As a last resort, water may be used to cool the battery modules that are still intact.

Battery module information

Pertinent information on battery modules include:

- The battery modules have a rated voltage of 48 VDC and are thus in the range of protective extra-low voltage (below 60 VDC).
- The battery modules contain no metallic lithium.

Specifications

	eco 5	eco 7.5	eco 10	eco 12.5	eco 15	eco 17.5	eco 20
Total capacity (@ 90% DOD)	5 kWh	7.5 kWh	10 kWh	12.5 kWh	15 kWh	17.5 kWh	20 kWh
Nominal power rating (off-grid output at 25 deg C)	3 kW	4 kW	8 kW	8 kW	8 kW	8 kW	8 kW
Nominal power rating (grid-tied output at 25 deg C)	3 kW	3.6 kW	7 kW	7 kW	7 kW	7 kW	7 kW
Weight (approximate)	394 lbs	447 lbs	543 lbs	596 lbs	724 lbs	777 lbs	830 lbs
Dimensions W"/H"/D" (approximate)	26/57/19				26/84/19		

Off-grid specification

	eco 5	eco 7.5	eco 10	eco 12.5	eco 15	eco 17.5	eco 20
Continuous AC output current	12.5 A	16.67 A	33.3 A				
Max AC power	100 ms - 8.5 KVA 5 s - 6 KVA 30 m - 4.5 KVA		100 ms - 17 KVA 5 s - 12 KVA 30 m - 9 KVA				
Max AC current (charge/discharge)	1 ms - 50A 100 ms - 35.35 A 5 s - 25 A 30 m - 18.75 A		1 ms - 100A 100 ms - 70.7 A 5 s - 50 A 30 m - 37.5 A				

General specification

Grid integration	AC coupled
Applications	Self-consumption, Backup power, Time-of-use
Transfer switch	Automatic, integrated
Usable capacity	2.25 kWh per battery module, up to 8 modules
Listed and recognized components	System certified – UL9540; Battery modules – UL1973; Inverter – UL1741; Transfer switch – UL1008; AC Breaker – UL489
Warranty	Visit: https://sonnenusa.com/en/warranty/
Inverter efficiency	92.5% CEC weighted, 95.0% peak
Roundtrip efficiency % (Grid<>Battery)	>= 86%
Temperature range	41 °F - 113 °F
Ventilation/Noise	Forced Air / 70dBA MAX
Communication protocols / Control / Ports	SunSpec Alliance / API available to select partners / Ethernet
EMC / EMI protection	FCC Part 15B
Device protection	Short circuit, overload, over temperature
Overcurrent protection needed	50 Amp
Total harmonic distortion	<5% L1-L2 & <2% L-N

Max recommended AC coupled PV inverter size

eco 5-7.5	4 KW
eco 10-20	8 KW

Battery specification

DC battery input voltage	44.5–53.5 VDC
Max charge current	50 A per module
Cell chemistry / discharge	Lithium iron phosphate ($LiFePo_4$) / 2.5kWh with 90% DoD
Overcharge protection	MOSFET & Fuse protection

AC specification

AC grid voltage	120/240 VAC (Split phase)	
AC passthrough current	200A @ 240 VAC	
Nominal AC (grid-tied operation)	**Output current**	**Output power**
eco 5	12.5 amps	3000 W
eco 7.5	15 amps	3600 W
eco 10-20	29 amps	7000 W
Nominal frequency	60 Hz (adjustable +/- 0.7 Hz from nominal)	
Metering capability	Power meter for load and PV production (not revenue grade)	
Tare losses (W)	60 watts	
Transient protection	IEEE C62.41 Class B	

Transfer switch specification

Current rating	200A switching & overcurrent protection
Contacts	Silver-plated
Fault current @240V	22,000 Amps

Table 1 Specifications

Dimensions

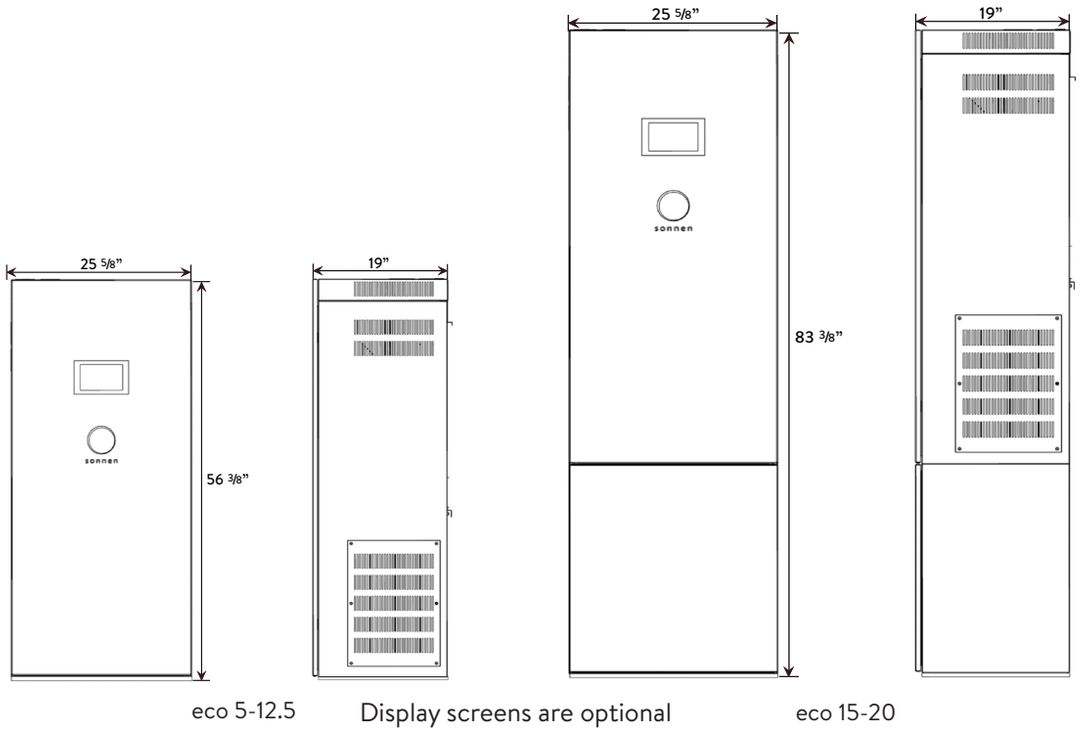


Fig. 2 Storage system dimensions

Key components

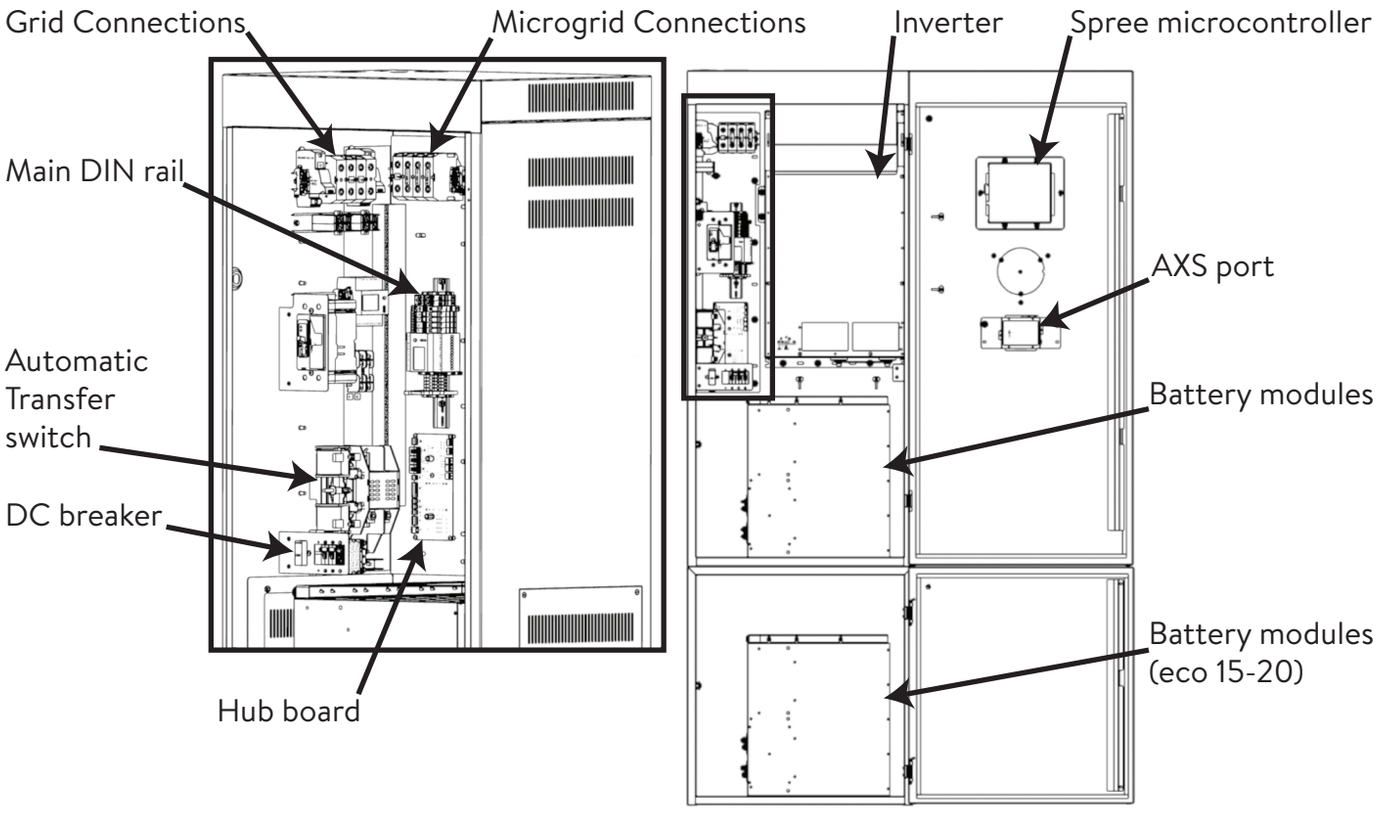


Fig. 3 eco Gen 3.1 key components

Description of use

The sonnen eco Gen 3.1 is an intelligent storage system that monitors and controls energy production, consumption, and storage in the house.

The sonnen eco Gen 3.1 can work with existing or newly installed PV systems. The solar inverter and eco Gen 3.1 storage system connect to the same distribution panel. Solar modules do not connect to the sonnen directly.

The storage system uses two power meters to monitor solar power production and energy consumption. When production is higher than consumption, such as at midday, the eco Gen 3.1 stores the excess energy in its lithium iron phosphate (LiFePo4) battery modules. In some operating modes, when consumption is higher than production, such as in the evening, the storage system releases the energy. In doing so, the storage system allows you to use solar power at night, reducing your power bill and increasing the value of your investment in renewable energy.

The storage system also acts as a backup power supply, meaning that if the utility grid goes out, your appliances will be powered by the unit's stored energy.

The illustration below shows how the storage system manages solar power (1) and power from the utility grid (2) to maximize your energy independence and savings on your power bill.

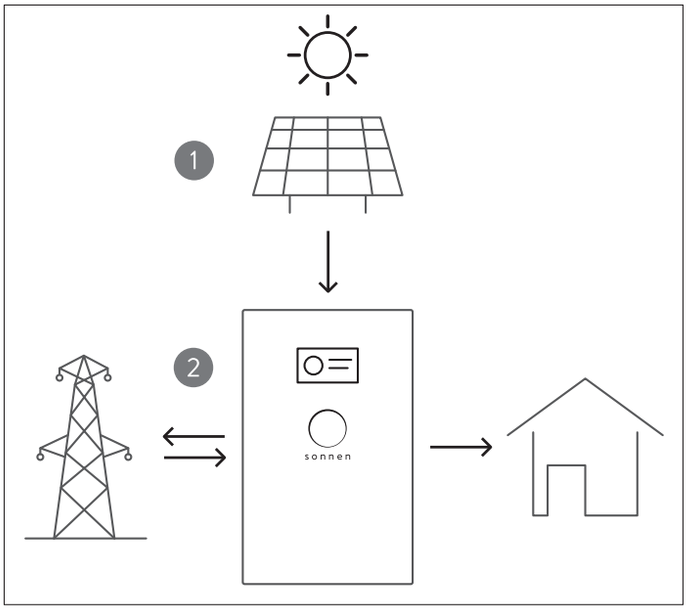


Fig. 4 Energy flow

Modes of operation

The sonnen eco Gen 3.1 offers three complementary modes of operation: Self-consumption, Backup, and Time of Use. Self-consumption mode ensures that you are using the power you generated even when utility grid power is available; backup mode makes that self-generated power available in the event of a grid power outage.

Many utility companies are moving to a Time of Use-based billing scheme, in which electricity costs more during high-demand time periods. The sonnen eco Gen 3.1 can maximize your cost savings by using your stored battery power during the high-cost part of the day and recharging from solar and optionally with electricity purchased from the grid during the times when the rates are low.

Self-consumption mode

The following images illustrate the interaction between the storage system, the PV system, and the utility grid in self-consumption and backup modes:

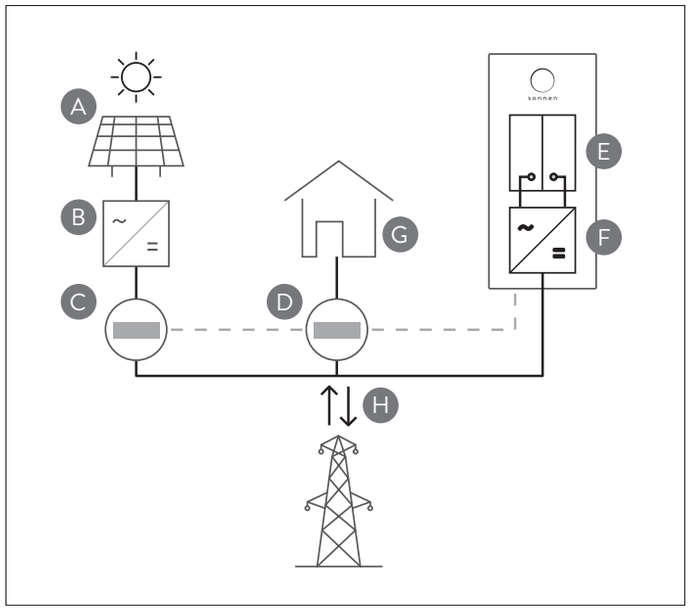


Fig. 5 Self-consumption mode

The DC power that is generated by the PV array (A) is converted to AC power by means of an inverter (B). The storage system's internal meters (C) and (D) measure the current electrical power

in watts. The production meter (C) measures the PV power production, the consumption meter (D) measures the power consumption (energy usage) in the house.

If the production is higher than the consumption, the surplus will be stored in the battery modules (E). The storage system's inverter (F) converts the AC power to DC power to charge the battery modules (E). When the PV production is lower than the consumption, the batteries will then discharge to power the loads. The storage system's inverter (F) converts the DC power of the battery modules (E) to AC power. The utility meter (G), measures the power supplied to the house and the power fed back to the grid (H) by the PV array (if applicable). The storage system will not discharge its batteries to the grid in normal operation.

Time of use mode

This mode is very similar in function to self consumption except that the storage system will charge the batteries from the grid during programmed time periods designated by the operator selectable parameters. This mode is often described as a "focused" self-consumption in that the system is operating exactly as described in the self consumption mode, but only during a specific time period (user selectable).

Refer to the "Logging in to the sonnen eco" section for instructions on how to change the time periods. Check your local utility rate schedule before making changes to these parameters.

Backup mode

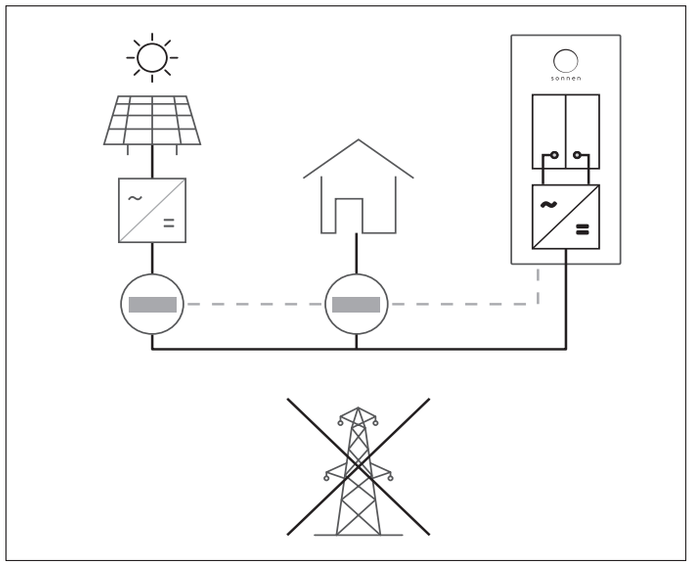


Fig. 6 Backup mode

In backup mode, the storage system remains at a high state of charge until there is a utility grid failure. In the event of a grid failure, the house is powered by the energy stored in the battery modules and generated by the PV array. During that time, the power from the PV array powers the house or charges the battery modules, depending on production and consumption levels. The storage system can also turn the PV array off if the battery modules become fully charged.

The storage unit will isolate the micro-grid from the utility grid using a 200A automatic transfer switch (ATS). A separate, external ATS is not required. When this occurs, the storage unit will produce grid-quality voltage and frequency so that any grid-tied PV inverters in the micro-grid will continue to operate.

The PV array will first power the loads on the AC panel, with any excess energy charging the batteries in the storage unit. If there is insufficient PV to cover the loads, the storage unit will discharge its batteries to meet demand.

To prevent battery overcharging while in backup mode, the storage unit will perform a frequency shift to 60.9 Hz (or 60.9-64.9Hz user defined value depending on PV inverter operating range) when its state of charge reaches 95 percent. Because the PV inverter is still subject to UL1741 conditions, it will think that the "grid" is out of spec for the frequency threshold (59.3 - 60.5 Hz)

and will disconnect from the micro-grid. When the storage unit's state of charge drops to 89 percent, it will reduce the frequency to 60 Hz. The PV inverter will see that the frequency is within the UL1741 range and start re-connect countdown sequence (typically 5 min) before it attempts to reconnect to the micro-grid and produce power. These frequency ranges are adjustable to accommodate island frequencies.

If the loads are small and the PV production is high, then this behavior could occur multiple times per day.

ATTENTION

Altering a PV inverter's frequency could damage the PV inverter, the storage system, and the installation site.

It is the installer's responsibility to ensure the PV inverter is suitable for use with the sonnen storage system.

ATTENTION

Risk of low battery state of charge and damage.

To maintain consistent and proper operation, the storage system must be fully charged to 100% once every 30 days. This could be a challenge in an off-grid application utilizing PV alone since we have designed the system to turn off the PV inverter at 95% to avoid overcharging.

Therefore, it is necessary that a compatible generator be installed on site to achieve the full charge request. Failure to meet this expectation could result in warranty liability.

If the storage system has reached a low state of charge, the grid is unavailable, and the PV system, the sonnen eco Gen 3.1 can provide a start signal for a generator to provide power. When these criteria are met, the storage system will start the generator and keep it running until the battery modules have reached a pre-configured state of charge, the grid becomes available, or the PV system begins producing power. It is highly recommend that an on-site generator is available for off grid applications.

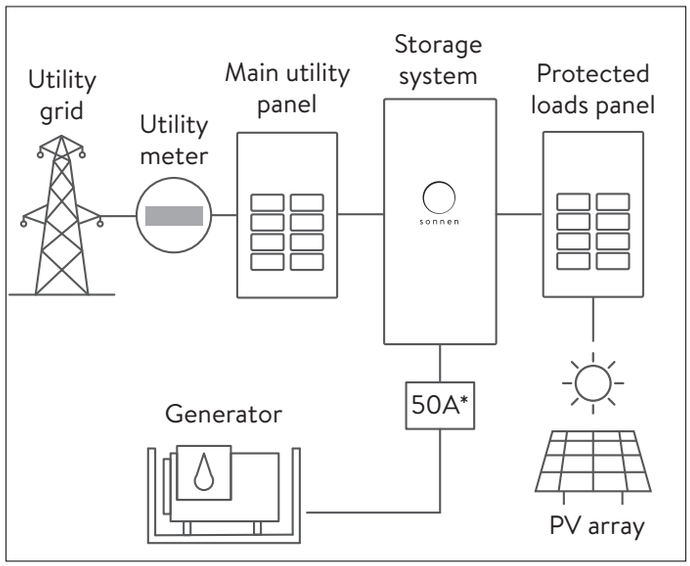


Fig. 7 Generator auto-start functionality

*If the generator is larger than 12kW then sonnen requires placing a 2 pole 50A breaker (shown above) between the generator and the storage system to prevent a generator pull greater than 12kW.

When a generator request is successful, not all available generator power will be used to charge the battery modules, if there is a load on the system. Depending on the user defined generator set point, the generator will provide power to the loads with the remainder going to charge the battery modules. It is highly recommended that the generator be connected directly to the storage unit using the internal generator terminals. Please consult the installation manual for hardware and wiring option.

Recommended generator characteristics

- Two wire DC auto start
- 240 VAC (120V L-N; 240V L-L)
- < 5% THD
- Max size of 12kW
- Pure/true sine wave

Electrical connection

The storage system has two primary AC terminals: one for the utility grid and one for the micro-grid. These AC connections must be made for the storage system to operate.

The Grid terminal inside the storage system must be connected to grid service, usually at the main utility panel. A main disconnect between the storage system and the utility grid of equal or greater rating than the supply feeder connection, up to 200 amps, is recommended.

The storage system can pass through up to 200A from the grid to the protected loads panel when the grid is available.

If you will be using a protected loads panel, design the panel for a nominal current of 33A. Although the unit has a 200A pass-through rating, the system has a 33A continuous output when the grid is down.

Special care must be taken to ensure the main panel and the protected loads panel are electrically isolated from each other when the storage system is in backup mode. L1, and L2, and N must have no connection between the two panels outside of the storage system internal AC terminals.

If you are not using a protected loads panel, you can use the storage system's built-in, 200-amp automatic transfer switch to provide backup power for your whole house.

Special care must be taken with this type of configuration since all loads in the house will be powered when the grid goes down. Typically, this results in severely reduced backup times and poor customer experiences.

In either case, the AC panel with the loads that will be powered by the storage system (protected loads panel) is connected to the micro-grid terminals inside the storage system. The storage system's built-in transfer switches will disconnect the utility when a loss of utility power is detected. The micro-grid will now be powered by energy produced by the PV array and the energy stored in the storage system battery modules.

Off grid applications

The sonnen storage system can also be used in off grid applications where no utility power is available. This is an extreme application for the storage system since it operates best when it is connected to the grid and has a source of AC coupled solar. However, there are many examples of successful off grid systems using the sonnen offerings, but those systems were designed with assistance from the sonnen Design team. It is highly recommended that any off grid system receives this assistance before purchasing the product. Failure to do so could result in a loss of warranty conditions.

It is necessary to fully charge the storage system (100% SOC) in an off grid application at least once a month. This could be a challenge in an off-grid application using only PV since the system has been designed to turn off the PV inverter at 95% (while in backup mode) to avoid overcharging. Therefore, it is mandatory that a compatible generator be installed on site to achieve the full charge request. Failure to meet this expectation could result in warranty liability.

Powering up

Turning the system on

WARNING

Risk of electric shock!

Use extreme care when turning on the storage system. Although the unit may be off, there is still voltage present on the inside. Do not touch any internal components except when directed.

- Remove all jewelry when turning the storage system on.

WARNING

Risk of burns!

When the battery module green LED is ON, the battery module is capable of producing potentially dangerous voltages.

Turning the battery modules on

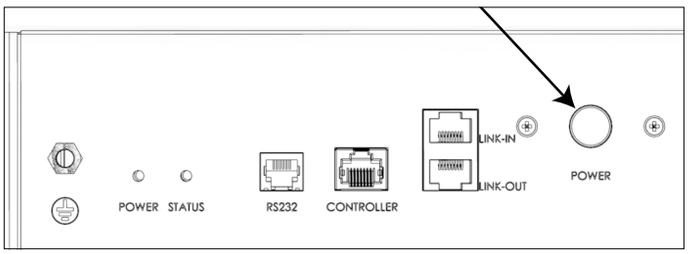


Fig. 8 Battery module power button

- ► Identify battery module with the white label #0.
- ► Turn ON the battery system by depressing the GREEN "Power" button on battery module 0 for 5 sec. The POWER and STATUS LED will light up for 2 seconds, then turn off, the POWER LED will continue to blink.
- ► Verify all battery modules then turn on in sequence.
- ► Wait 20 seconds before turning on system using the main DC breaker.

If the batteries do not detect a signal from the storage system BMS after 10 minutes of being turned on the batteries will power themselves off. If this occurs, turn the batteries back on using the above procedure and ensure the storage unit is turned on.

Turning the storage unit on

The main DC circuit breaker F1 and the button switch S1 are located in the interior of the main cabinet.

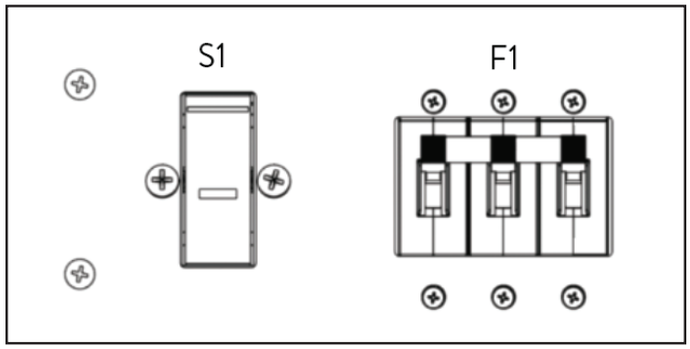


Fig. 9 Pre-charge switch and circuit breaker

(1) Pre-charge Switch (S1)

(2) Main circuit breaker (F1)

ATTENTION

Damage of the storage system by high currents!

High currents can damage components of the storage system if the process is not followed properly.

- ► Turn on the storage system only according to the steps below.

1. If an emergency switch is installed, ensure it is not activated.
2. Depress button S1 for at least 7 seconds and keep it pressed for the next step.
3. When an audible click is heard, flip on main circuit breaker F1 of the main cabinet.
4. Release switch S1.

Powering down

Shutting the storage unit down

- ► Shut off the grid source to the storage unit e.g. main AC breaker in main service entrance, AC service disconnect, etc.
- ► Determine if your storage unit has a front panel display screen.

With front panel display screen.

- ► Press the icon with the 6 dots in the upper right hand corner of the screen.
- ► Press "Settings".
- ► Press "Shutdown".

The storage unit will take approximately 60 seconds to completely shutdown.

Without front panel display screen

- ► Open cabinet.
- ► Turn off power switch (F1).

Turn off battery modules

- ► Press the power button on battery #0 for 3 seconds.
- ► Wait for all battery power LEDs to go off.
- ► Ensure both the "Power" and "Status" LEDs are off on each battery module.

Emergency switch-off

In case of an emergency, the storage system can be switched off by the main circuit breaker F1 or the external emergency switch (if installed).

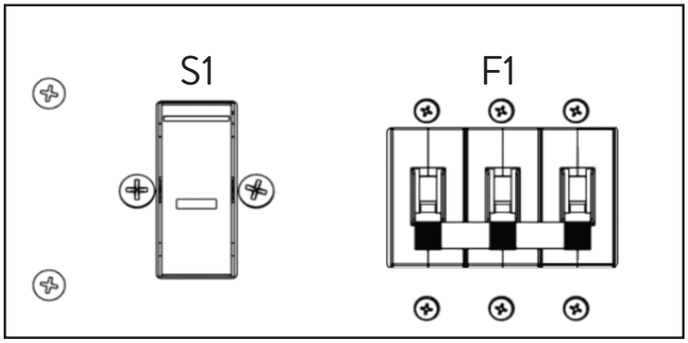


Fig. 10 F1 circuit breaker

- ► In case of an emergency, switch off the main circuit breaker F1 in the interior of the main cabinet or the external emergency switch (if installed).
- ► Only switch off the main circuit breaker F1 if it can be reached without danger.
- ► If possible, shut off battery modules by depressing the "Power" button for 3 seconds, the batteries may take several seconds the power down.

Recycling and certificates

This battery system complies with RoHS and contains none of the following substances: lead, cadmium, mercury, hexavalent chromium, polybrominated biphenyl (PBB) and polybrominated diphenyl ether (PBDE).

- ► To dispose of the storage system:
  - Do not dispose of the storage system and its battery modules in your household refuse!
  - Contact service or the company that installed your storage system and commission them to disassemble and dispose of the storage system.

Your battery modules will be recycled and disposed of in an environmentally friendly manner.

Digital interface

Internet portal

The eco Gen 3.1 must connect to sonnen's servers to enable control of the storage system via the Web portal and smart-phone app. This connection is protected by industry-standard security against unauthorized access. Sonnen and service partners will only access the storage system for maintenance and monitoring.

An anonymized evaluation of log data enables further improvements and monitoring of hardware and software.

Establish connection to the Internet

- ► Connect the storage system's Ethernet cable to your router.
- ► Make sure your router acts as a DHCP server and configures newly connected network devices automatically.
- ► Ensure the following outbound TCP and UDP ports are permitted for the following services in the router:

The listed ports are generally pre-configured on the routers.

TCP Port	Service
22	SecureShell (ssh)
37	Time Server (ntp)
80	Online Check (http)
222	VPN (Server connection, ssl)
232	VPN (backup)
443	App control (https)
UDP Port	
1196	(Server connection, ssl)

Table 2 Required open ports for storage system

The storage system connects automatically with the Internet. There are no further steps required.

Internet portal

You can observe real-time and historical data regarding your storage system via the Internet portal.

- ► Log in to the portal

1. Type the following address to your Internet browser: **https://my.sonnen-batterie.com/**

The following login window will appear:

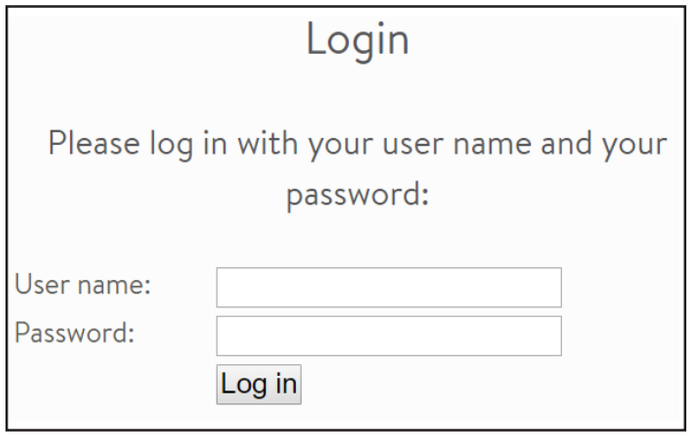


Fig. 11 Login window

- ► Enter the login information that you received with your delivery. This is not the same login used for direct access to the storage unit parameters. The user name should start with "psb" followed by a number: example: psb65006

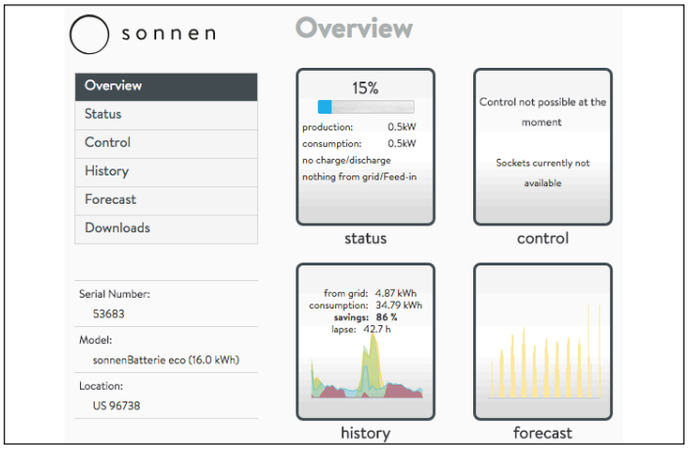


Fig. 12 Portal overview screen

There are 4 icons that are also labeled on the left side pane of the page.

- Status - shows the overall flow of power for the storage system and associated components.
- Control - not used in the U.S. Future development.
- History - displays system data in an easy to read graph. Can display data in various time formats.
- Forecast - shows past production and consumption data and predicted PV production and consumption data. This data is for display purposes only and does not influence the charging/discharging behavior of the storage system.
- Downloads - allows user to gather various data in a spreadsheet compatible format.

Status view

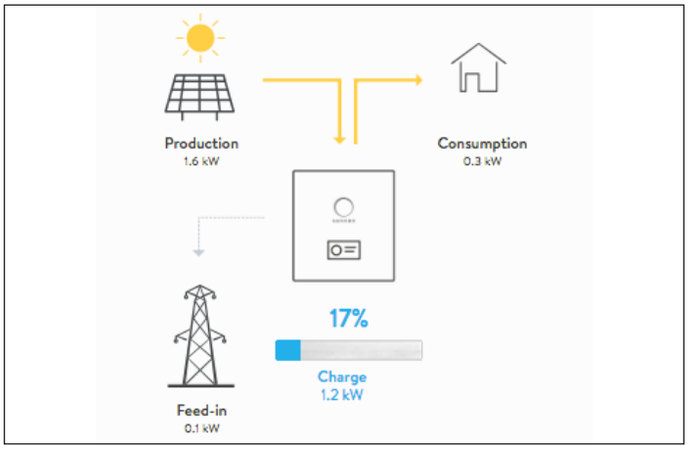


Fig. 13 Status view

This display shows 5 key pieces of information regarding where the power is going in the entire system using yellow line indicators:

- Production - indicates the amount of power the PV system is producing as measured by the storage system.
- Consumption - a measure of how much power is being consumed by the loads the storage system is supplying.
- Feed-In - the amount of excess PV that is passed through the storage system towards the utility.

In this example, you are looking at an eco unit running in self consumption mode AC coupled with an 8kW PV system. It is early in the morning and the solar is producing 1.6kW of power. There is also 300W (.3kW) of consumption by the loads that are being fed by the storage unit. Since there is more solar than load, 300W of the solar production is consumed by the loads and the remaining 1.2kW is then fed to the sonnen to charge the batteries. We can see that the Charge value (light blue) is 1.2kW and the current state of charge is 17%.

There is a small amount of excess PV (100W) that is being fed into the grid.

It is important to understand that the sonnen eco unit only gets the excess PV that is left over after feeding the loads on the panel that is downstream of it. If this customer had a larger load turned on, such as an electric stove that requires 2000W of power, the 1.6Kw of production would all be consumed by the stove and either the storage unit or the grid would have to supply the other 400W.

History view

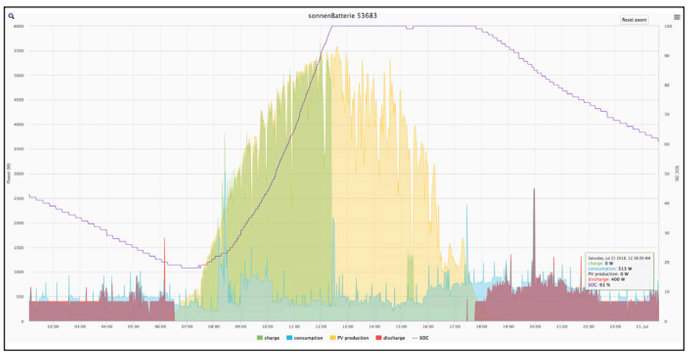


Fig. 14 History view

This display is the most informative and provides a visual indication of PV production, consumption, battery charge, battery discharge and state of charge. For the first time, homeowners will now have a complete picture of their consumption habits and be able to change them. This display yields the most A-ha! moments. But to get to these moments it is important to understand how the information is being displayed.

- Left axis - PV or consumption power measured in watts
- Right axis - battery state of charge
- Bottom axis - time (expressed in 24 hour time)
- There are also labeled overlays associated with each color on the graph:
- Yellow - PV production as measured by the storage system
- Blue - amount of power sent to the loads
- Green - amount of power being used to charge the batteries
- Red - amount of power the batteries are discharging to meet demand

The overlays can be toggled to either show or leave out the selected color. Click on the name of overlay to toggle. Here is an example of all overlays toggled off except for the PV production:

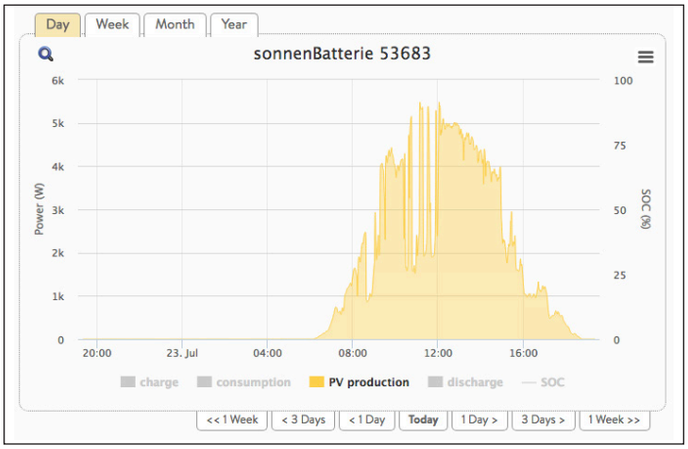


Fig. 15 History view overlays

Toggling overlays can be a valuable analysis tool. For example, this customer might typically reach a full state of charge around 10 a.m., however they notice on this day that the batteries were not fully charged until noon. By just looking at the PV production we can see that the morning hours were cloudy and that reduced production caused the batteries to take a little longer to reach a full charge.

Historical information can be displayed in four different time periods: by day (default), week, month or year. Here is an example of the selected week view:

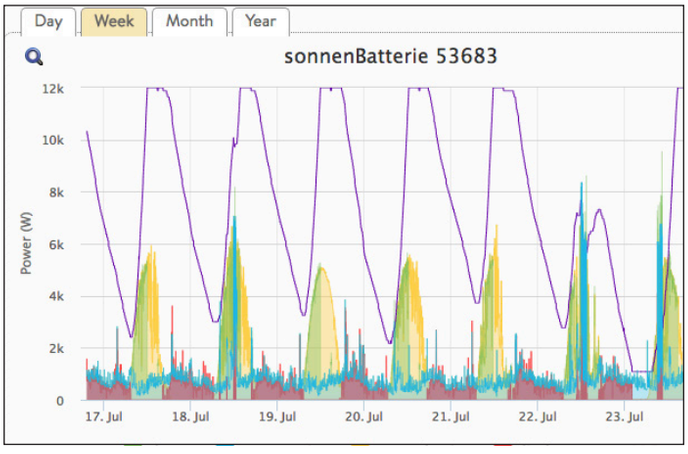


Fig. 16 History view week view

While in any of the multiple day/month/year views, simply left click and highlight the time frame that you would like to view on the graph, to be able to view that section.

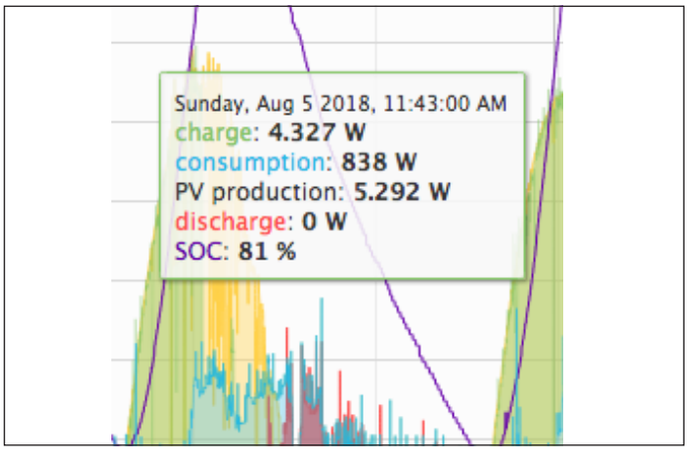


Fig. 17 Specific data history

The cursor can also be used to show specific data on the history view when you hover over the main graph area. In this example, the cursor box shows the date, charging watts (from solar), consumption watts (from loads and other appliances, solar inverter production watts, the battery discharge in watts and the current state of charge.

The following page dissects a typical historical graph of a system running in self consumption mode. By analyzing the behavior of the PV, loads, battery charging and discharging, the homeowner can see just how much power throughout the entire day that they are consuming, at what times and where their energy is coming from - either from their PV system, their battery bank, the utility grid or a combination of all three.

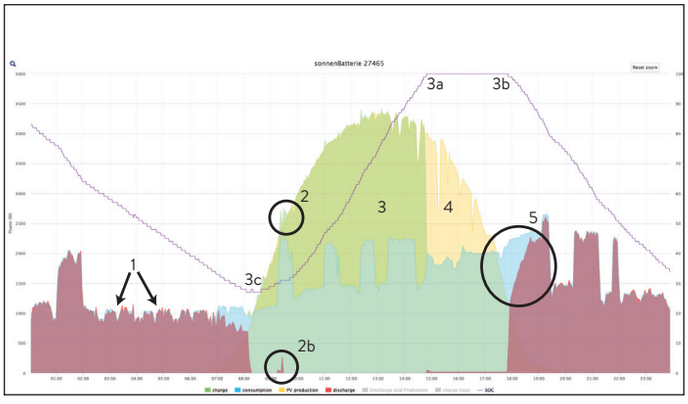


Fig. 18 Typical history graph

- **1** - These spikes throughout the nighttime hours are caused by the kitchen refrigerator. This unit has a run time of about 30 minutes, which is indicative of an older refrigerator that could probably be replaced with a more energy efficient model. Typical energy star compliant refrigerators will run for about 15 minutes an hour, or 6 hours a day.
- **2a** - There is a spike of consumption during this time of the morning that the solar production could not sustain since the tip of the blue spike is outside of the yellow curve.
  2b - The storage unit recognized the spike was beyond the PV production value and discharged a small amount of energy to cover the spike. Consequently, the homeowner did not have to pay for that spike of energy.
- Green indicates battery charging. This system completed the battery charging process around 3 p.m.
  3a - The state of charge line shows a 100% capacity at the same time the green line stopped.
  3b - the state of charge started to go down as the batteries started to discharge due to decreased PV production.
  3c - The low state of charge for this day was 28% before the batteries started charging from solar.
- Since the batteries are full at 3 p.m. and there is still excess solar production, this 2.5 hours of yellow indicates that the excess was sent to the grid.
- At first glance it may appear that the storage unit did not start discharging to cover this light blue event in the late afternoon when the solar production started to decline. Using the cursor will help to clarify what is being displayed.

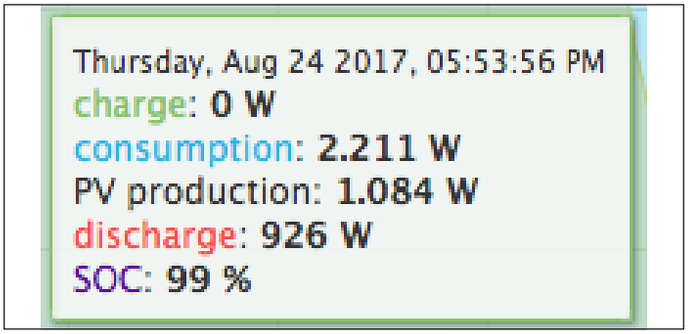


Fig. 19 Typical history graph values

At 5:53 the system was no longer charging the batteries (0W) and the load on the system was 2,211W. There was still 1,084W of solar production

but it was not enough to supply the demand so the storage system only discharged enough to fulfill the remainder (926W). We can see this same behavior at point 2b when the system discharged just enough to cover what the solar could not.

Direct access to the storage unit

The end user can gain direct access to the sonnen eco Dashboard to view, and make changes to, some system settings. To log in:

- Ensure you are using a device that can be connected to the Internet (computer, laptop, smart tablet, etc.)
- Verify that the device is on the same network as the storage unit.
- Open a web browser (Chrome, Internet Explorer, etc.)

1. Identify storage unit

► Navigate to this URL:

https://find-my.sonnen-batterie.com

This website will list all of the units on the network.

► Identify the system you want to view

► Select the “Configure” button.

Fig. 20 Storage unit configure

► Log into the storage unit

► Dashboard

Fig. 21 Storage unit dashboard

The dashboard provides an informative overview of the energy flow in the system to include the solar production, the home consumption (loads that are turned on in the home), the solar feed-in to the grid (if any) and the grid power going into the home. Battery state of charge (SOC) and any power provided by the battery or power used to charge the battery will also be displayed.

In this example, the solar production (2,800W) is enough to power the loads in the house (1800W) and export into the grid (1000W). The yellow arrows show solar production flow. If, for example, the home consumption increased to 3500W, then the arrow connecting the grid to the sonnen would change direction towards the sonnen unit and the description would change from Feed-In to Consumption and the numeric value would then read 700W.

Charge power represents the amount of power that is currently being used to charge the batteries. This source could be either the grid or the solar. Discharge power is the amount of power the storage system is sending to the home from the batteries.

The green state of charge indicator will change based on how full the battery bank is.

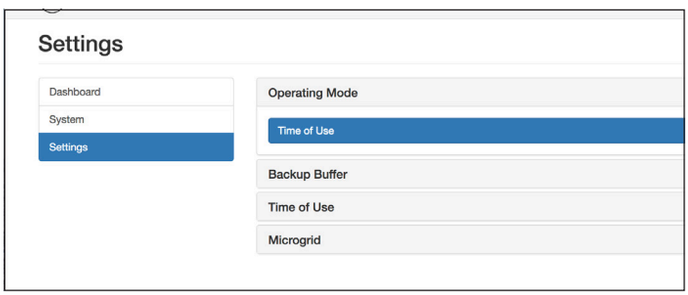


Fig. 22 Operating mode settings

Operating Mode - selects the operating mode for the storage system.

- Time of Use - used in areas with high peak rates during specific times. The grid is used to charge the batteries during off peak times.
- Self Consumption - maximizes solar self consumption. The solar is used to power loads and charge batteries. When there is not enough solar to power loads the batteries will discharge to cover consumption. This mode does not use the grid to charge the batteries.
- Backup - the storage system remains at a full charge until the grid power is lost. Solar will work during the grid outage and can be used to both power loads and charge the batteries if there is any excess solar to do so. The grid is also used to charge the batteries.

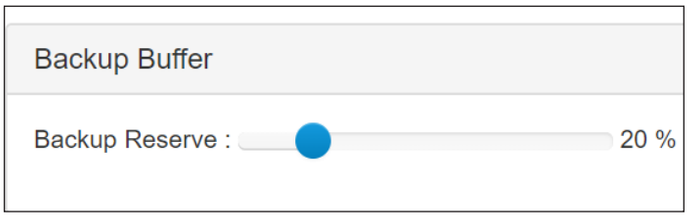


Fig. 23 Backup buffer

Backup Buffer - Only used in Self Consumption mode.

- ► Sets a battery reserve so that there is some capacity remaining for an unsuspected grid outage. For example, if the backup buffer is set to 20%, then the batteries will stop discharging at 20% instead of the default 5% SOC. The homeowner would have 15% of usable capacity when the system switches to backup mode.

Time of Use - Allows user to set the high peak time periods for focused self consumption. Check with the local utility for the rate schedule.

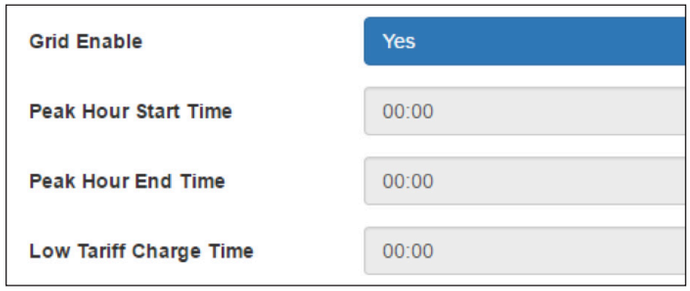


Fig. 24 Grid enable option

- Grid enable - The storage system will use the grid to charge the batteries immediately after the peak hour end time. Default setting is YES. Changing this setting to NO will cause the storage system to only charge the batteries using solar. The risk of using the NO setting is that the batteries might not be charged up during the day before the high peak rate period begins.
- Peak hour start time - the beginning of the high peak rate time
- Peak hour stop time - the end of the high peak rate time
- Low tariff charge time - an alternative time to start charging the batteries from the grid during a different low peak time. For example, if there is a low peak period from 10 p.m. to 6 a.m. then the low tariff charge time could be set to 3:00 a.m. to ensure the batteries are fully charged before the next higher peak period begins.

Microgrid

Fig. 25 Re-enable microgrid

This parameter allows the user to set three different “wake up” time periods for the storage system in the event of a grid outage. If the battery

state of charge drops below 7% then the system will go into standby and will not provide power to the home. The system will automatically wake up during the three time periods for 6 minutes in an attempt to find some way to charge the batteries- either using solar or a generator. If no source is detected then the system will go back into standby until the next time period.

Although the times can be customized, a suggested setting for the microgrid times are 0800, 1000 and 1200. If the system can't find a charging source by noon, then there is probably a bigger issue with the system charging, e.g. low PV production, generator is out of fuel, dead generator battery, etc. The timers will be disregarded by the system if the Re-enable Microgrid setting is switched to NO.

System

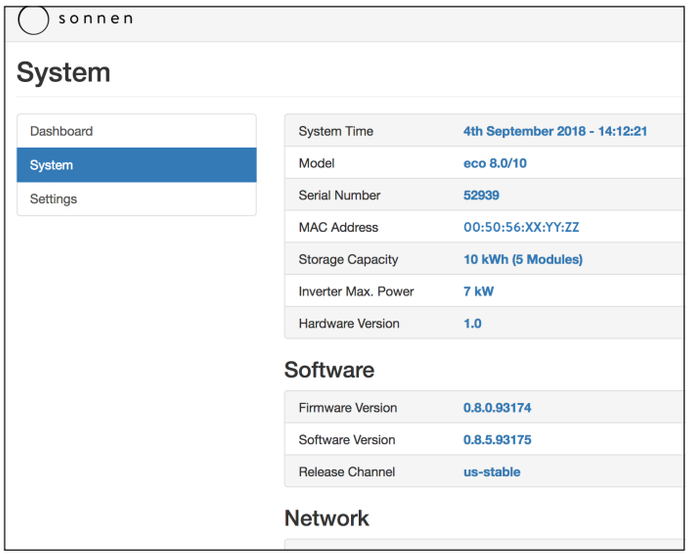


Fig. 26 System information

This screen shows various information about the storage system that could be useful in troubleshooting.

Maintenance and care

To ensure failure-free operation, safety, reliability and longevity, you must perform periodic cleaning and function control of the storage system.

Function control

Every two weeks, check if messages are shown on the screen (if installed).

Care of the storage system

ATTENTION

Risk of damage by improper cleaning utensils!

- Only use cleaning solutions and tools listed in this chapter.
- Do not use high-pressure cleaning equipment.
- Do not use abrasive cleaners.

Cleaning the screen

► When the screen appears dirty, clean it with a damp cloth with a small amount of dish liquid.

Cleaning the enclosure

► When the cabinet appears dirty, clean the exterior with a soft, damp cloth. Do not clean the interior of the cabinet.

Checking the storage unit

Monthly:

► Check the area around storage unit for safety hazards or potential maintenance issues, including debris and chemical vapors that can degrade electrical insulation.

Appendix 1. Nameplates and labels

Manufacturer
Sonnen, Inc.
2048 Weems Road
Tucker, GA 30084

sonnen

Model:	ECO5
Voltage/frequency/ph:	120/240VAC/60Hz/split phase
Output current:	max. 16.5A
Utility interactive current:	max. 15A
Output power:	max. 4000W
Utility interactive power:	max. 3600W
Energy output:	max. 8kWh
DC short circuit rating:	max. 10kA
Ambient temperature range:	41°F - 113°F (5°C - 45°C)
Environment:	Indoor Only
Protection class/protection:	NEMA 12

C ETL LISTED US
Intertek
5005340

Certified To ANSI/CAN/UL STD 9540

Part No. 28326 Rev. 1

Made in North America

Manufacturer
Sonnen, Inc.
2048 Weems Road
Tucker, GA 30084

sonnen

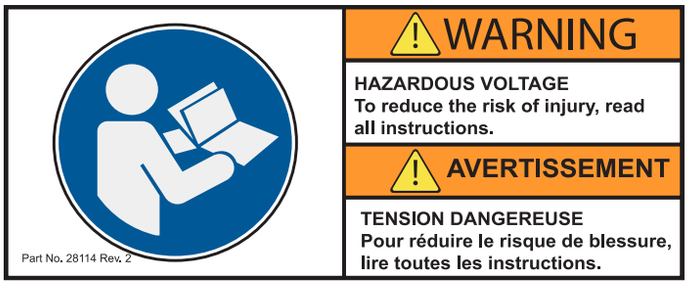
Model:	ECO10
Voltage/frequency/ph:	120/240VAC/60Hz/split phase
Output current:	max. 33A
Utility interactive current:	max. 30A
Output power:	max. 8000W
Utility interactive power:	max. 7200W
Energy output:	max. 20kWh
DC short circuit rating:	max. 10kA
Ambient temperature range:	41°F - 113°F (5°C - 45°C)
Environment:	Indoor Only
Protection class/protection:	NEMA 12

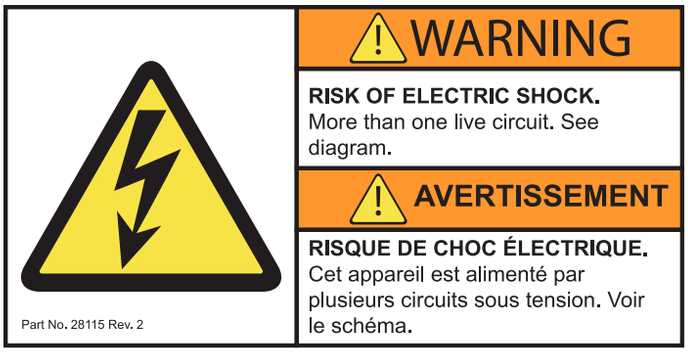
C ETL LISTED US
Intertek
5005340

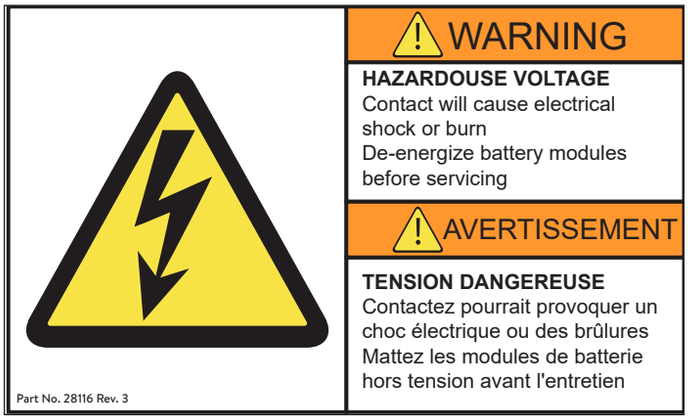
Certified To ANSI/CAN/UL STD 9540

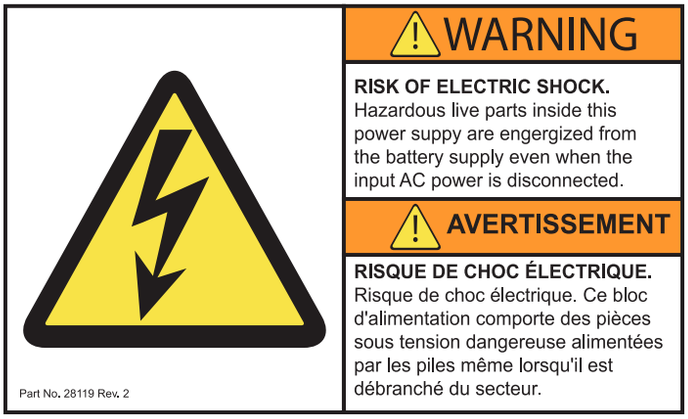
Part No. 28324 Rev. 1

Made in North America









sonnen

Fuse replacement chart

F1, F2, F5, F6: 2A, 250V, 35AIC
0218002.MXP
F3-F4: 50A, 690V, 200KAIC
5012406.50

WARNING

Replace only with the same ratings and type of fuse.

AVERTISSEMENT

N'utiliser que des fusibles de même calibre et de même type que le fusible d'origine.

Part No. 28091 Rev. 1

4kW Models

sonnen

Fuse replacement chart

F1 - F2: 2A, 690V, 200KAIC
5017906.2
F3-F4: 50A, 690V, 200KAIC
5012406.50
F5-F6: 2.5A, 250V, 35AIC
5ST 2.5-R
F7-F8: 2A, 250V, 35AIC
0218002.MXP

WARNING

Replace only with the same ratings and type of fuse.

AVERTISSEMENT

N'utiliser que des fusibles de même calibre et de même type que le fusible d'origine.

Part No. 28092 Rev. 2

8kW Models

Safety Instructions

1. Switching off
The storage unit can be switched off via the display or via the main safety swtich F1, which is in the main cabinet.

2. Batteries used
The LiFePO4 lithium-ion batteries used contain no metallic lithium.

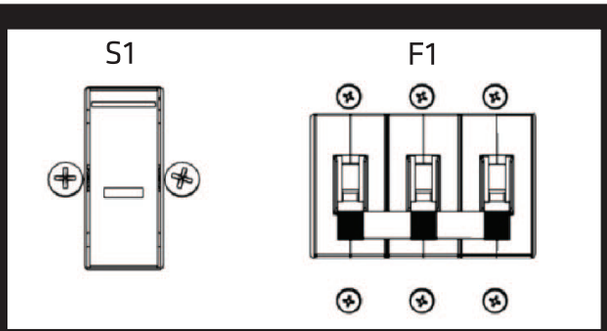
3. Voltage
The storage system is a low-voltage system with 120/240 volt output voltage. Setting the main safety switch F1 to OFF deactivates the storage system as an energy source. The battery modules run on max 60 volt DC safety extra-low voltage. De-energize battery modules before servicing.

4. Information for the fire department
Fires in the vicinity of the storage system and battery fires must be fought with conventional extinguishing agents. Storage system and battery cell fires can generally be extinquished with water.

5. Measures in the event of the accidental release of substances
In the event of the release of electrolytes: avoid contact with eyes and skin, leave the room as quickly as possible, and ensure adequate ventilation if possible.

More information can be found in the manuals.

Part No. 28023 Rev 3



Turning on the storage system

1. Press and hold button S1 for at least 7 seconds
2. Turn circuit breaker F1 on
3. Release S1

Emergency shutoff

► Turn circuit breaker F1 off
If there is no emergency, shut down the storage system using the the touchscreen.

Part No. 1000139 Rev. 1

Appendix 2. Glossary

Appliances: Devices that consume power. These may include small appliances, such as a blender, or large ones, such as a water heater.

Autonomy: A measurement of how little you rely on the grid for energy. The more renewable energy you produce and consume, the higher your autonomy.

Backup mode (or off-grid mode): A mode of operation in which the sonnen eco Gen 3.1 provides power stored in its battery modules when the utility grid power is unavailable.

Backup readiness: When the storage system emphasizes backup readiness, it maintains a specified state of charge, such as 85%, in its battery modules to provide power in the event of an outage.

Battery modules: The energy storage modules in the sonnen eco Gen 3.1.

Capacity: The amount of energy that can be stored in the sonnen eco Gen 3.1, measured in kilowatt-hours.

Consumption: The amount of power being used by appliances.

Deep discharge: Bringing the battery module's charge to such a low level that it damages the battery. For the modules used by the eco Gen 3.1, this requires leaving a module at an extremely low level (0%-1%) for weeks or months.

Discharge: When the storage system provides power to your house or building.

Feed-In: When the storage system provides power to the utility grid.

Grid: The power source provided by utility companies, as opposed to self-generated power.

Kilowatt-hour: A measurement of energy equal to one kilowatt delivered for one hour.

Load-shedding: The method of removing power to appliances either to keep the load within power requirements or to maximize battery time.

Main disconnect circuit breaker: A circuit breaker that cuts all power to and from the storage system when opened.

Main service panel: The main panel to which all appliances are connected.

Micro-grid: The grid created by your power generation system, as opposed to the utility grid.

Modbus: A serial protocol that enables communications between smart devices.

Photovoltaic: A photovoltaic system of solar-power panels.

Production: The power generated by your solar panels.

Protected loads panel: A panel providing power to the most important appliances in the house or building, such as a refrigerator, freezer, or heater. This sub-panel is isolated from the main service panel by a switch to prevent electrical feedback.

Self-consumption: The method of using solar power to power appliances rather than using grid power.

State of charge: The percentage of charge available in the storage system's battery modules.

Storage system: The sonnen eco Gen 3.1, which combines an inverter, battery modules, and other hardware and proprietary algorithms to make solar power an even more cost-effective power source.

Transfer switch: A switch, either manual or automatic, that changes the power source from the utility grid to self-generated power in the event of a loss of power.

Appendix 3. Warranty

The warranty provided at https://sonnenusa.com/en/warranty/ overrides any printed versions of sonnen's warranty.

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sonnen

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