Installation instructions | for Electricians

sonnenBatterie 10

with sonnenModule 4

EN

IMPORTANT

- This entire document must be read carefully.
- This document must be kept for reference purposes.

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Table of contents

1 Information about this document

This document describes the installation of the sonnenBatterie 10.

- ▶ Make sure you read this entire document carefully.
- ▶ Keep this document for reference purposes.

1.1 Target group of this document

This document is intended for authorized electricians. The actions described here must only be performed by authorized electricians.

1.2 Designations in this document

The following designations are used in this document:

Complete designation	Designation in this document
sonnenBatterie 10	Storage system
sonnenProtect 4000	sonnenProtect
sonnenModule 4	Battery module
Authorised electrician	Electrician performing the installation/Installer
Person who purchased the storage system and on whose premises the system is installed	Operator

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

2 Safety

2.1 Proper use

The sonnenBatterie 10 is a battery storage system which can be used to store electrical energy. Improper use 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 be observed at all times in order to ensure **proper use**:

- The transport and storage conditions must be observed.
- The storage system must only be used at a suitable installation location.
- The storage system must be fully installed in accordance with the installation instructions.
- The storage system must be installed by a authorized electrician. Country-specific regulations concerning electrical installations must be observed at all times.
- The interfaces of the storage system must be connected in accordance with the product documentation.
- Only use the storage system in its original state - without any unauthorised modifications - and when it is in proper working order.
- Repairs to the storage system must be carried out by authorised service technicians only.

Especially the following uses are not permissible:

- Operation in flammable environments or areas at risk of explosion.
- Operation in locations at risk of flooding.
- Outdoor operation.
- Operation of the battery modules outside of its storage system.
- Bypassing, blocking or tampering with protective devices.

Danger due to electrical voltage

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

The storage system inverter also contains components with internal stored energy, which carry voltage even after the storage system is switched off.

Therefore:

▶ Disconnect the storage system from the power supply before any work on the system is started (see Switching the storage system off to electrically isolate it [P. 100]).

Operating the storage system

- The storage system may 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.

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

2.2 Intended use of the sonnenProtect

The sonnenProtect 4000 is an backup power unit designed to supplement the sonnenBatterie 10. The sonnenProtect - in conjunction with the appropriate storage system of the sonnen GmbH - serves to supply power in the event of a power failure.

Improper use 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 be observed at all times in order to ensure **proper use**:

- Only operate the sonnenProtect together with the right storage system.
- The sonnenProtect must be installed by an authorised electrician.
- The sonnenProtect must only be used in its original state without any user modifications and only when in perfect working order.
- The sonnenProtect must only be connected to the storage system as described here.
- The interfaces of the sonnenProtect and the storage system must be connected in accordance with the product documentation.
- Generators (e. g. a PV system) must never be connected to the output line (AC line to backup circuit, see Overview lines [P. 76]) of the sonnenProtect.
- The sonnenProtect must only be installed and used at suitable installation location.
- The transport and storage conditions must be observed.
- All repairs on the sonnenProtect must be performed by authorised service technicians only.

Especially the following uses are not permissible:

- Operation in flammable environments or areas at risk of explosion.
- Operation in locations at risk of flooding.
- Bypassing, blocking or tampering with protective devices.

Danger due to electrical voltage inside the sonnenProtect

The sonnenProtect contains live electrical parts, which poses a risk of electrical shock. The storage system inverter also contains capacitors which carry voltage even after the storage system is switched off. As the sonnenProtect is connected to the inverter of the storage system, this means that the voltage from the inverter also flows into the sonnenProtect.

Therefore:

▶ Disconnect the sonnenProtect and the storage system from the power (see Decommissioning the sonnenProtect [P. 86]).

Only then can the sonnenProtect be opened.

Operating the sonnenProtect

- The sonnenProtect 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.

2.3 Qualified electricians

Installation and commissioning must be performed by authorised electricians only. Installation by unqualified and/or unauthorised persons may cause injury and/or component damage.

People who meet the following requirements are generally considered authorised electricians:

- The electrician must be a person with a technical knowledge or sufficient experience to enable him/her to avoid dangers which electricity may create.
- The electrician has successfully completed the sonnen certification training.

2.4 Handling battery modules

The battery modules compatible with the storage system are protected by multiple protective devices and are safe when used properly. Improper use or a fault may cause the battery cells inside the battery modules to be damaged.

This can have the following effects:

- High heat generation on the surface of the battery cells.
- Leaking of electrolyte, vapours and/or smoke.
- The escaping electrolyte may ignite and cause an explosive flame.
- Irritation or burns to skin, eyes, respiratory tract and mucous membranes due to steam or smoke from burning battery modules.

In order to ensure **proper use**:

- ▶ Do not open the battery modules.
- ▶ Do not inflict mechanical damage (pierce, deform, disassemble, etc.) on the battery modules or otherwise modify them.
- ▶ Do not heat the battery modules. Keep them away from sources of ignition and operate them only within the permissible temperature range.
- ▶ Do not allow the battery modules to come into contact with water (except to extinguish a fire involving the storage system).
- ▶ Do not short-circuit the battery modules.
- ▶ Never continue to use the battery modules if they are damaged in any way.
- ▶ Do not deep-discharge the battery modules or charge them using external chargers.
- ▶ Do not operate battery modules outside of the storage system.
- ▶ Remove metal jewellery when handling battery modules.
- ▶ Do not place any tools or metal objects on the battery modules.

Transporting battery modules

The battery modules contain lithium-ion batteries. These are classed as hazardous goods and must be transported in compliance with certain regulations.

- ▶ Observe the information in section Transporting battery modules [P. 12] at all times.

2.5 Conduct in the event of a fault or fire

If contents are escaping:

1. Leave or do not enter the room in which the storage system and battery modules are located.
2. Avoid contact with the escaping electrolyte. If contact occurs, rinse the affected area thoroughly with water. In the case of irritation of the skin, eyes or mucous membranes, seek medical attention.
3. Contact the sonnen service team (+44 3301 114559).

A fire may occur even with electrical devices that are designed with care. A nearby fire can also cause the storage system to ignite. This may also lead to the contents of the battery modules being released.

If the battery modules or storage system is on fire:

1. Leave or do not enter the room in which the storage system and battery modules are located.
2. Avoid contact with escaping smoke or steam. If contact occurs, rinse the affected area thoroughly with water. In the case of irritation of the skin, eyes or mucous membranes, consult a doctor.
3. Contact the fire services.
4. Contact the sonnen service team (+44 3301 114559).

There is a danger of electrocution when extinguishing a fire while the storage system is switched on. In the event of a fire in the vicinity of the product or in the storage system itself, proceed as follows before beginning any extinguishing measures:

- ▶ Switching the storage system off to electrically isolate it [P. 100]. The battery modules will continue to carry voltage.
- ▶ Switch off the mains fuses in the building.
- ▶ Only firefighters with appropriate personal protective equipment are permitted to enter the room where the storage system is located.

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

- ▶ Observe the minimum distances applicable for the specific extinguishing means used. The storage system works with a nominal voltage of 230 V (AC) and 204.8 V (DC).

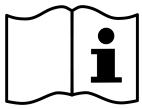
Extinguishing agents

- 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

- A single battery module has a nominal voltage of 102.4 V (DC).
- Two battery modules each are connected in series, resulting in a operating voltage of 204.8 V (DC).
- The battery modules do not contain metallic lithium.

2.6 Symbols on the product

	Warning: electrical voltage. Wait five minutes after switching off (capacitor de-energising time).
	Warning: flammable materials.
	Warning: hazards due to batteries.
	Warning: product is heavy.
CE	CE mark. The product meets the requirements of the applicable EU directives.
UK CA	UKCA marking. The product meets the requirements of the applicable directives of the United Kingdom.
	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.
	Protective earthing. Labelling earthing points.

3 Storage and transport

3.1 Storage

Storage describes the condition when the storage system is not connected to the public electricity grid and the battery modules cannot be automatically charged.

3.1.1 Ensuring correct ambient conditions during storage

▶ Make sure during storage that the required ambient conditions (see Technical data [P. 105]) are met.

3.1.2 Storing the battery modules

NOTICE

Deep-discharge of the battery modules

Destruction of the battery modules!

▶ Do not disconnect the storage system from the public electricity grid for long periods of time.

▶ Never continue to operate battery modules which have been deep-discharged.

During storage the battery modules automatically discharge at a minimal level. Battery modules are only permitted to be stored for a limited amount of time, as a deep discharge of the batteries may lead to damage to or destruction of the battery modules.

Observe the following points:

- Battery modules are delivered with a charging status of **30 %**.
- Battery modules are only allowed to be stored for **maximum 6 months**.
- After 6 months at the latest, the battery modules must be installed in a storage system and commissioned.

3.2 Transport

3.2.1 Ensuring correct ambient conditions during transport

▶ Make sure during transport that the required ambient conditions (see Technical data [P. 105]) are met.

3.2.2 Transporting battery modules

⚠ CAUTION

Improper transport of battery modules

Fire outbreak at battery modules or emission of toxic substances!

▶ Only transport battery modules in packaging that meets applicable regulations.

▶ Never transport damaged battery modules.

Lithium-ion batteries are hazardous goods. Therefore the following points must be observed when transporting the battery modules:

▶ Observe the general transport regulations based on the mode of transport as well as all legal regulations.

- Consult an external hazardous goods expert.
- Under the *ADR* treaty on dangerous goods, non-functional battery modules must be classified before they are transported. The sonnen Partner Portal contains a checklist for this. The battery module classification may incur additional requirements for dangerous goods transport.

Hazardous goods class	UN number	Battery module mass
9	UN 3480 'lithium-ion batteries'	40 kg max.

Table 1: Battery module data relevant for transport

3.2.3 Checking for transport damage

⚠ CAUTION

Insulation fault when storage system is damaged

Danger of electric shock when touching damaged insulation elements!

- Inspect the storage system for transport damage.
- Do not use a damaged storage system under any circumstance.

⚠ CAUTION

Fault due to use of damaged battery modules

Fire outbreak at battery modules or emission of toxic substances!

- Check each battery module for transport damage.
  - ⇨ If damage (deformation, defects, emission of substances and the like) is discovered:
- Never use damaged battery modules.

- Check each delivery upon arrival in the presence of the shipping agent for completeness and damage.

Transport indicator on the packaging

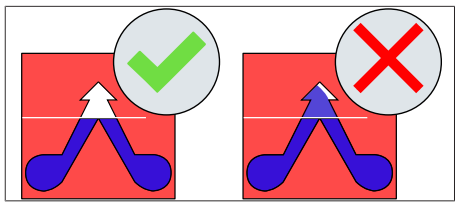


Illustration 1: Transport indicator on the packaging

- Check the transport indicator in the presence of the shipping agent.

The goods have not been transported properly if blue powder has reached the arrow of the transport indicator.

Reporting transport damage

Report transport damage immediately to the shipping company and to sonnen GmbH.

- Refuse to accept the delivery if the discovered defects are serious.
- Document the defect in a brief report and make the notation 'Conditional acceptance' on the delivery note/shipping slip.
- Have the shipping agent review the report and confirm by countersigning.
- Make note of the name of the shipping agent and the registration number of the delivery vehicle.

- ▶ Create a detailed defect report if necessary. Send this within the reporting time frame (seven days for freight forwarders; 24 hours for parcel couriers) to the shipping company and sonnen GmbH.

Damage claims cannot be settled if the above mentioned documentation is not submitted within the stated reporting time frames.

3.2.4 Transport to the installation location

⚠ WARNING

Risk of injury due to heavy weight of components

Crushing or straining due to incorrect lifting or dropping of components of the storage system!

- ▶ Wear safety shoes when transporting and setting up the system.
- ▶ Use a manual or electric sack truck to move components.
- ▶ Ensure components are stable.

3.2.5 Acclimating the power module before installation

NOTICE

Forming of condensation

Damage to the storage system!

- ▶ Check the inside of the storage system for condensation before installation.
- ▶ Only install the storage system if there is no condensation on the surfaces.

If the temperature of the packed power unit or battery modules upon delivery is significantly lower than the ambient temperature at the place of installation, condensation may form on the surfaces of the electronic components.

- ▶ Proceed as follows if the **power unit has been transported at temperatures below 0 °C**:

1. Unpack the power unit at a location with suitable ambient conditions (see Technical data [P. 105]).
2. Let the power unit sit until it can be ensured that there is no more condensation on the surfaces. Depending on ambient conditions, this may take up to 24 hours.
3. Only then can the power unit be installed and commissioned.

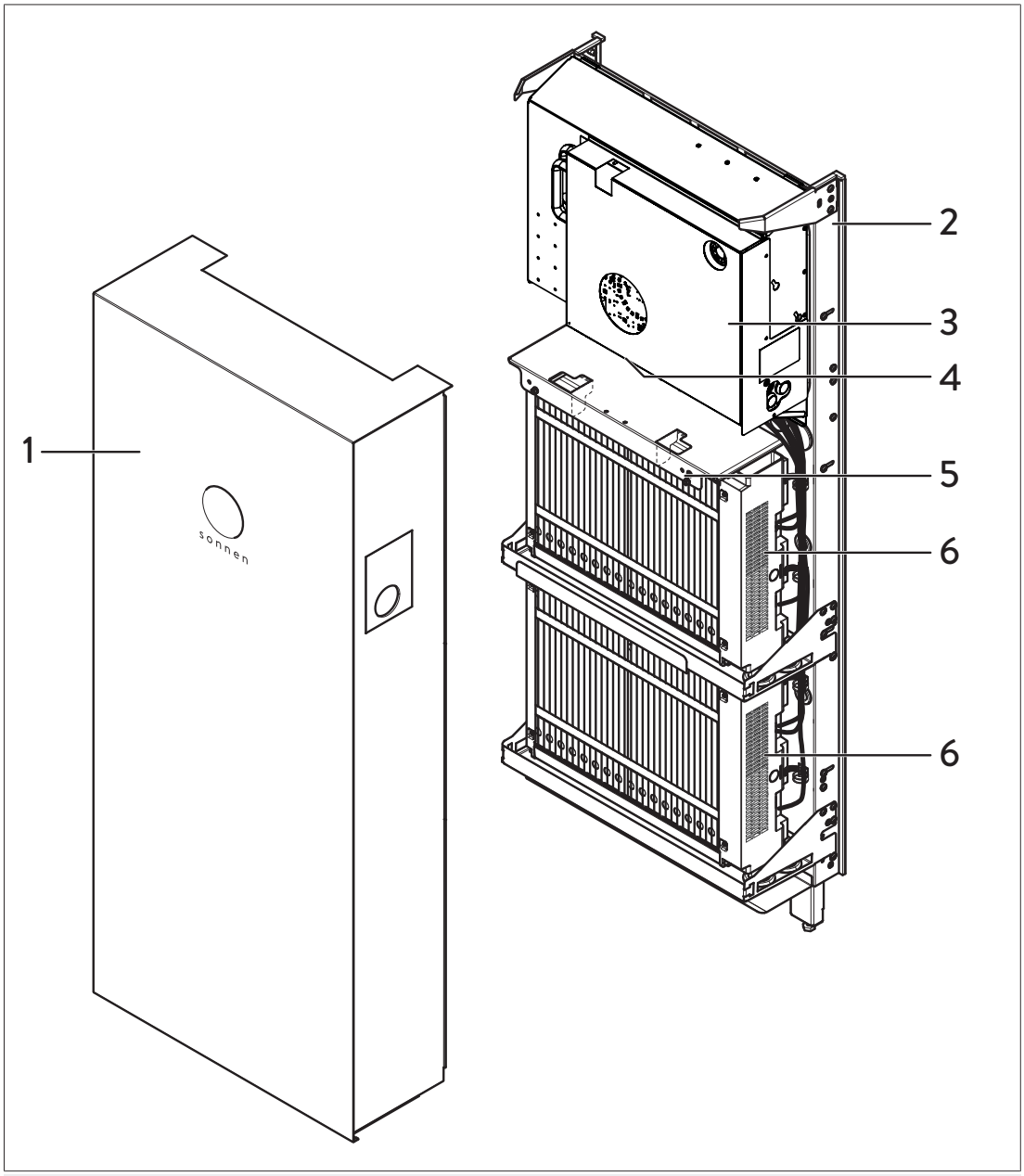
- ▶ Proceed as follows if the **battery modules have been transported at temperatures below 5 °C**:

1. Unpack the battery modules at a location with suitable ambient conditions (see Technical data [P. 105]).
2. Let the battery modules sit until it can be ensured that there is no more condensation on the surfaces and the battery modules have completely warmed to at least 5 °C. Depending on ambient conditions, this may take up to 24 hours.
3. Only then can the battery modules be installed and commissioned.

4 Product description

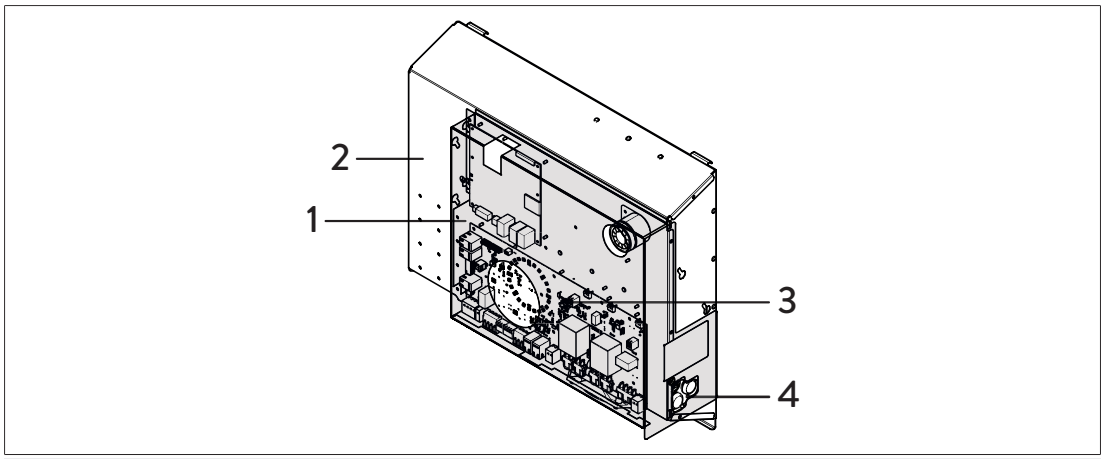
4.1 System components

Overview of storage system



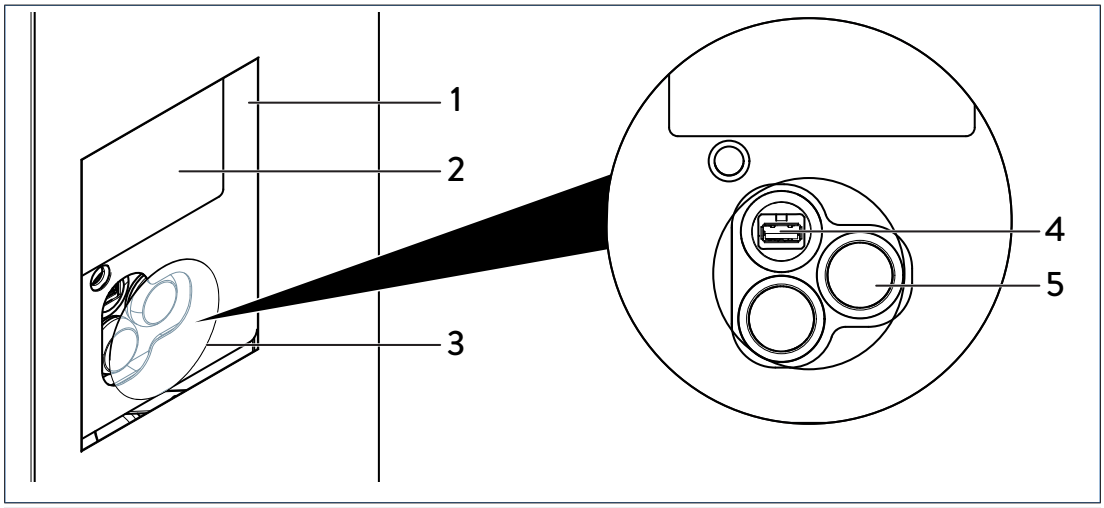
No.	Designation	Function
1	Cover	Cover for the storage system.
2	Mounting frame	Mounting frame with integrated bracket for securing it to the wall and for compensating for uneven surfaces.
3	Power module	Power module with integrated inverter and switch panel.
4	Cable entry point	Sealed entry point for lines to be routed into the storage system from the back.
5	Battery screws	For securing the battery modules.
6	Battery modules	Storage of electrical power.

Overview of power module



No.	Designation	Function
1	Touch protection	Cover for controls and central unit as touch protection.
2	Power module	Modular unit (with integrated inverter) for fastening to the mounting frame.
3	Central unit	Connection for storage system power and data lines.
4	Switch panel	Storage system switch panel protected by switch cover with inspection window.

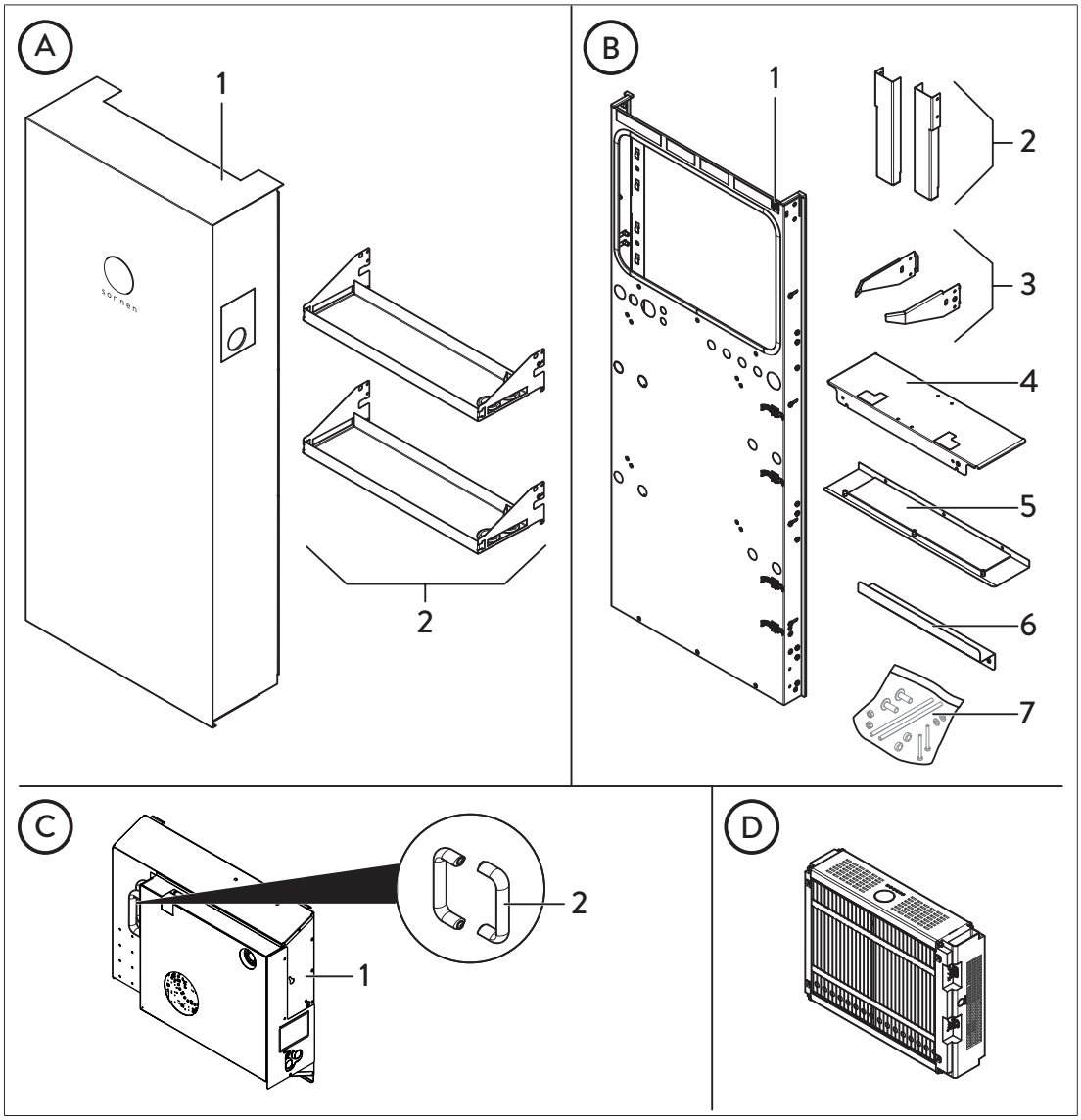
Overview of switch panel



No.	Designation	Function
1	Inspection window	Cover and protection for control elements on the switch panel.
2	Type plate	Technical data and other information for identifying the storage system.
3	Switch cover	Silicone cap that can be removed for operating the storage system.
4	USB socket	Socket for connecting a USB device.
5	ON/OFF switch	Switch for switching the storage system on and off.

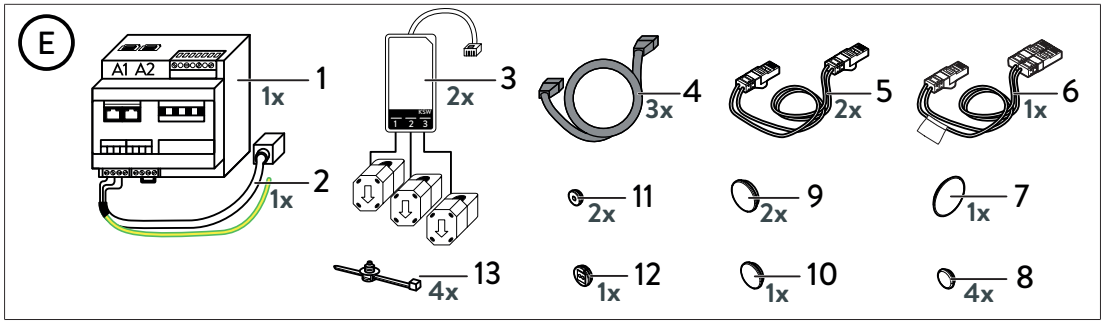
4.2 Scope of delivery

▶ Check the following scope of delivery to ensure it is complete.



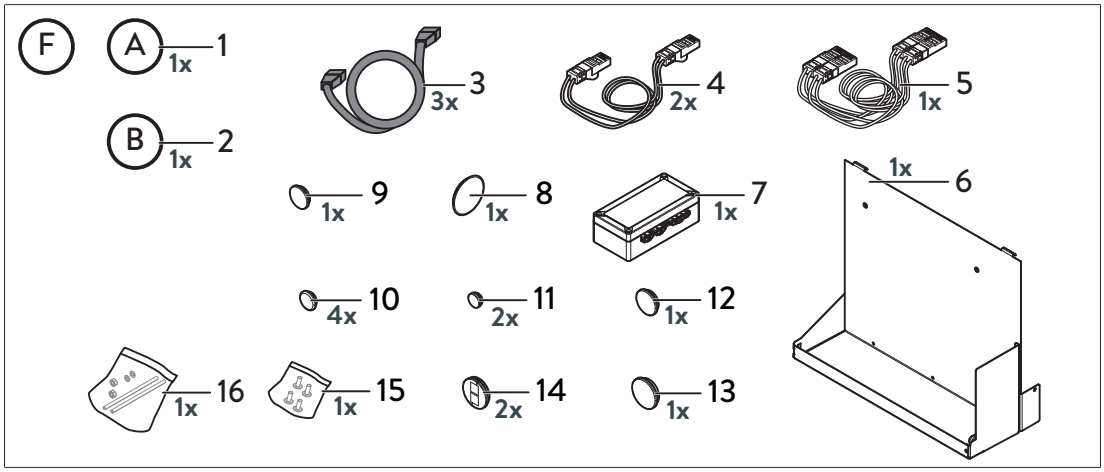
* The illustrated battery modules are examples only.

A	**Housing set**		
1	Cover	2	Battery shelves
B	**Mounting frame**		
1	Mounting frame	2	Feet
3	Supports	4	Spacer plate
5	Floor plate	6	Fixing bracket
7	Installation equipment pack (see Content of the installation equipment pack [P. 19])		
C	**Power module**		
1	Power module	2	Mounting handles for Power module
D	**Battery module**		



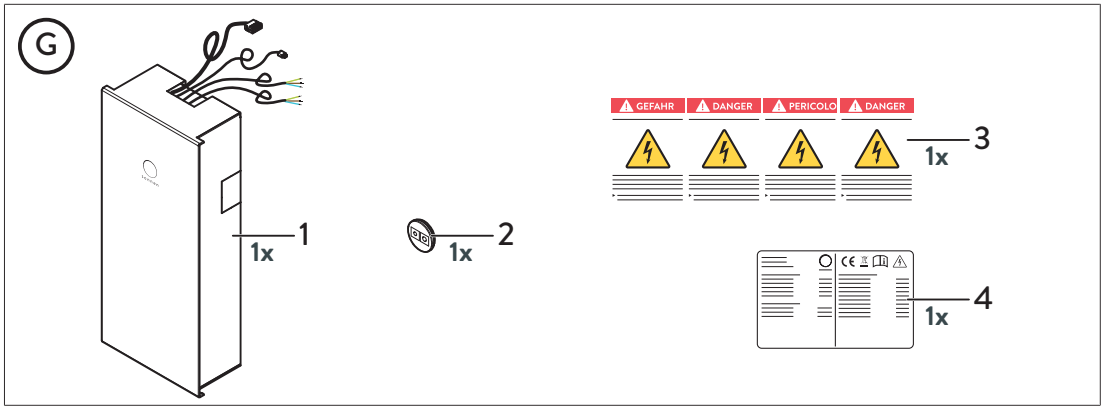
E **Accessory kit**

1	WM271 power meter	2	Modbus line with RJ45 coupling
3	Transformer interface with *CT*	4	BMS communication line (grey)
5	Battery line (black)	6	Battery line for 1 x sonnenModule 4
7	Switch cover	8	Dummy plugs (Ø 27.8 mm)
9	Dummy plugs (Ø 50 mm)	10	Dummy plug (Ø 40 mm)
11	Cable entry plates (Ø 20.5 mm)	12	Cable entry plate (Ø 32 mm)
13	Fixing tie		



F **Extension set (optional)**

1	Housing set	2	Mounting frame
3	BMS communication line (grey)	4	Battery line (black)
5	Double battery line	6	Battery shelf
7	Battery coupling	8	Switch cover
9	Dummy plug (Ø 32 mm)	10	Dummy plugs (Ø 27.8 mm)
11	Dummy plugs (Ø 20,5 mm)	12	Dummy plug (Ø 40 mm)
13	Dummy plug (Ø 50 mm)	14	Cable entry plates (Ø 50 mm)
15	Screws, thread-forming, 50x16	16	Battery screws M6x202 and washers M6



G	**sonnenProtect 4000 (optional)**		
1	sonnenProtect incl. connection lines (each about 5 m)	2	Cable entry plate (Ø 50)
3	Safety label	4	Type plate sonnenProtect 4000

4.2.1 Content of the installation equipment pack

The installation equipment pack is part of the **B Mounting frame** scope of delivery and contains the following:

29 x	Hexagon socket screw M6x16 ISO 7380	4 x	Battery screws M6x202
18 x	Contact disc M6	4 x	Washer (plastic) M6 DIN 125
8 x	Dummy plug Ø 32 mm	2 x	Levelling element M8x50
4 x	Hexagon nut M6 DIN 934		

4.3 Type plate

The type plate for the storage system is located on the Power module and can be viewed from the outside through the inspection window. The type plate can be used to uniquely identify the Power module and thus the storage system. You need the information on the type plate for safe use and to obtain assistance from sonnen service if you have any questions. The information on the type plate is required for safe use and for service matters.

The following information is specified on the type plate:

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

The battery capacity and the nominal power of the storage system differ depending on the number of battery modules installed. For this reason the installed battery capacity must be ticked on the type plate by the electrician installing the system (see Filling in the type plate [P. 94]).

4.4 Optional accessories

The following optional accessories can be added to the storage system in order to extend its functionality:

Designation	Description	Item number
Accessories for extending the sonnenBatterie 10		
Extension set	Second mounting frame with cover. For installation of two additional sonnenModule 4 battery modules (see Installing the extension cabinet [P. 55]).	4000030 + 3000357
sonnenProtect 4000	Backup box for power supply in the event of a grid outage (see sonnenProtect 4000 [P. 71]).	3000083
Power meter WM271 and clamp-on current transformers	For integration of further measurement points in the power measurement (e.g. additional electrical generator for AC microgrid).	30459 + 21028
Clamp-on current transformer up to 400 A	For measuring and recording amperages higher than 60 A. Available for maximum amperages up to 100 A, 200 A or 400 A.	11215, 11216, 11659
Additional sonnen products for extending storage system functionality		
sonnenCharger	Charging station for electric vehicles for intelligent control by the storage system.	Different versions available
sonnenKNX modules	Mounting rail modules for integration of the storage system in a KNX infrastructure.	4000050

4.5 Additional parts and tools required

The following materials and tools must be provided. With these materials and tools, and the materials included in the scope of delivery, the storage system can be fully installed and connected.

Lines, circuit breakers

Designation	Use	Specification
Plastic-sheathed cable	AC connection	• Type: NYM-J 3 × 2.5 mm² or NYM-J 3 × 4 mm² • Length adapted to installation situation.
RJ45 line	Data transfer between router and storage system	• RJ45 connector, category Cat 6, shielded. • Cable diameter: 6 mm • Length adapted to installation situation.
RJ45 line	Data transfer between power meter and storage system	• RJ45 connector, category Cat 6, shielded. • Cable diameter: 6 mm • Length adapted to installation situation.
Signal lines	Digital inputs/outputs	• Type: LiYY • Line cross-section of single conductors: 0.25–0.75 mm² • Number of single conductors adapted to installation situation. *Other required components (terminals, contactors, relays, etc.) must be acquired as needed for the individual installation situation (see* Digital inputs and outputs [P. 62]*).*

Residual current device (RCD)	Personal protection	• Required in networks with TT earthing. • For specification see section Placing components in the distributor [P. 34].
Miniature circuit breaker (MCB)	Fault protection for storage system	• Tripping characteristic: B • Rated current: 20 A or 25 A
Miniature circuit breaker (MCB)	Fault protection for power meter	• If fuse protection is not already possible using existing circuit breakers. • Tripping characteristic: B • Rated current: 6 A

Material

Quantity	Designation	Use
8 /16*	Screws	• For securing the mounting frame to the wall. For specification see section mounting materials [P. 24].
8 /16*	Washers	• For establishing contact between the screws and mounting frame.
8 /16*	Wall plugs	• For anchoring the screws to the wall. Type and length adapted to suit the screws used.
1	Laptop with LAN connection	• For establishing a connection to the storage system. • For running the commissioning assistant.
1	Permanent marker	• For filling out the type plate.
1	Touch display for power meter WM271	• **If necessary:** for configuring the power meter.

*When mounting with extension cabinet.

The list of tools refers to the materials contained in the scope of delivery for the storage system. Other individual tools are required based on the type of building installation and the additional parts selected.

Tool

Designation	Use
Drill	• For drilling holes for securing the mounting frame.
Utility knife	• For opening packaging.
Hexagonal torque screwdriver | AF 4 (adjustable to 8 Nm)	• For securing feet to the mounting frame. • For completing the mounting frame. • For securing the power module to the mounting frame. • For securing the cover.
Torque spanner | AF 10 (adjustable to 4 Nm)	• For securing the battery modules.
Allen key | AF 4	• For straightening and levelling the mounting frame.
Torx screwdriver | TX 25	• **If necessary:** Mount the battery coupling in the extension cabinet.
Cross-slot screwdriver | PZ 2	• For opening and closing screw-type terminals on circuit breakers.
Multimeter	• For measuring the battery module voltages.
Flat-head screwdriver | max. 5.5 mm	• **If necessary:** for removing the cover of the power meter.
Sack truck	• For transporting components to the installation location.
Wire cutters	• For cutting electrical lines or wires.
Spirit level	• For straightening and levelling the mounting frame.

5 Installing the storage system

- sonnen recommends installing the storage system with the accompanying feet so that while it is secured to the wall, part of the load is still supported by the feet.
- The storage system can be installed without feet. The storage system must be installed **10 cm from the floor**, as otherwise the cover cannot be mounted and secured correctly.

Level	Total height of storage system
Lowest	172 cm
Middle	178 cm
Highest	184 cm
Without feet (10 cm from floor)	171 cm

Table 2: Height of the storage system depends on whether feet are used

5.1 Selecting the installation location

NOTICE

Failure to observe ambient conditions

Damage to the electronic components of the storage system!

▶ Observe the required ambient conditions when selecting the installation location (see Technical data [P. 106]).

NOTICE

Insufficient load-bearing capacity of wall for mounting

Damage to storage system and surrounding area!

The wall mounting selected for the installation of a storage system must be able to support a total weight of 552 kg.

▶ Ensure that the mounting material and the wall have the required load-bearing capacity.

▶ Use all of the mounting points on the mounting frame of the storage system.

5.1.1 Observing minimum distances

▶ Observe the specified minimum distances to neighbouring objects, walls and ceilings.

▶ If you install the storage system without feet, maintain a minimum distance of 10 cm from the floor.

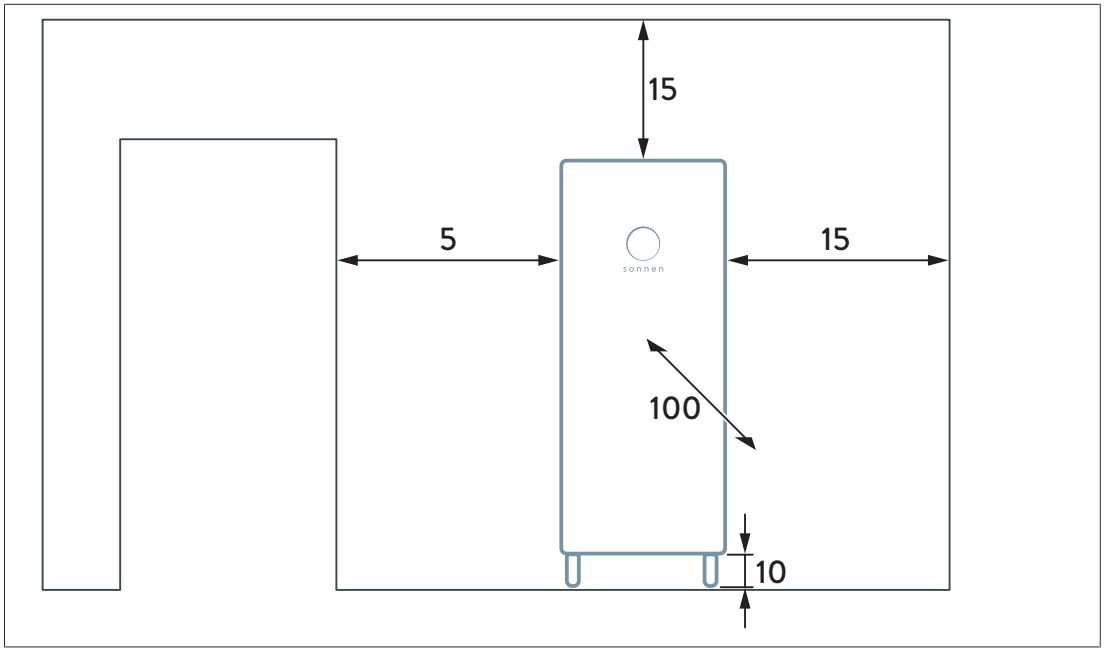


Illustration 2: Minimum distances around the storage system (figure not true to scale – all measurements in centimetres)

The minimum distances ensure that the following conditions are met:

- Sufficient heat dissipation.
- Easy opening of the storage system.
- Sufficient space for installation and maintenance work.

5.1.2 Planning line entry

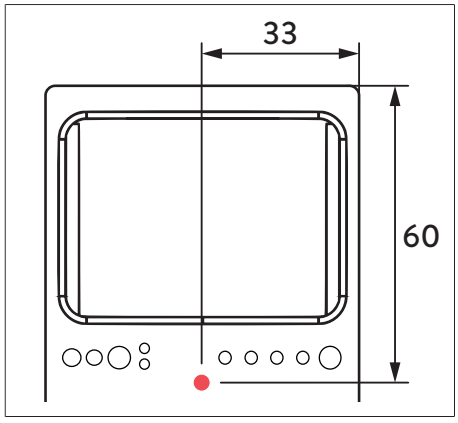


Illustration 3: Position for optimal line entry (figure not true to scale – all measurements in centimetres)

sonnen recommends routing the lines for the storage systems out of one opening in the wall directly behind the storage system.

The position of the optimal origin of the lines is shown in the figure here.

Alternatively, the lines can be routed from below or above behind the mounting frame of the storage system.

Tips for line routing from above

- Guide the lines in a cable duct behind the mounting frame.
- Secure the lines to the back of the mounting frame using cable ties.

Tips for line routing from below

- Route the lines through a cable duct to the right of the storage system up to approx. 15 cm above the floor.
- Route the lines from there behind the feet into the mounting frame.

- If an extension cabinet or sonnenProtect is installed, the lines for this can be routed through the same cable duct and to the storage system.

5.2 Securing the mounting frame

⚠ DANGER

Insufficient earthing due to incorrect installation

Danger to life due to electrocution!

The connections on the storage system that are relevant for protective earthing are labelled with earthing symbols.

▶ Ensure that all components at the marked earthing points are installed in the correct order.

▶ Tighten the screw connections with the prescribed torque in each case.

5.2.1 Selecting the mounting materials

- The lengths of the screws and wall plugs used must be suitable for the nature of the wall.

▶ Use screws with the following properties:

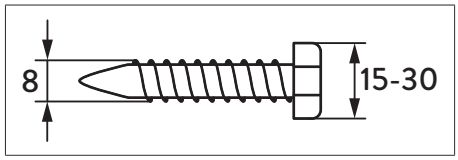


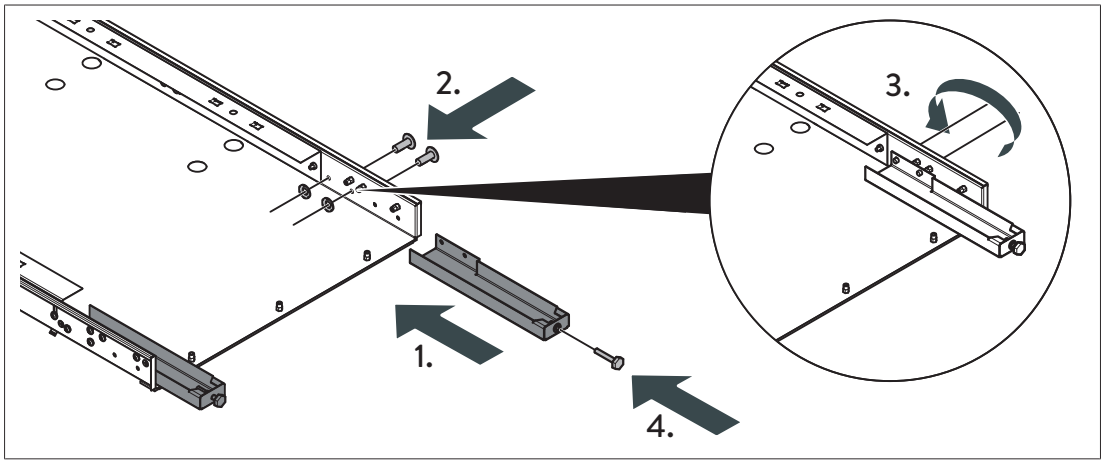
Illustration 4: Parameters for screws to be used (figure not true to scale – all measurements in millimetres)

- Minimum diameter of screw head: 15 mm
- Maximum diameter of screw head: 30 mm including any tools
- Screw diameter: 8 mm

▶ Select washers and wall plugs that suit the screws.

5.2.2 Installing the feet (optional)

- The total height of storage system may vary depending on how the feet are set. The height can be changed in three stages by a maximum of 12 cm by choosing the highest or lowest setting (see table with total height options [P. 22]).
- The levelling elements from the installation equipment pack can be used to compensate for uneven points in the floor.



▶ Use two of the four possible drilled holes on the mounting frame each to define the height of the storage system.

- ▶ Install the two feet using the screws and contact discs from the installation equipment pack (1. - 2.).
- ▶ Tighten the screws with a torque of **8 Nm** (3.).
- ▶ Install the levelling elements on the feet (4.).

5.2.3 Drilling the holes

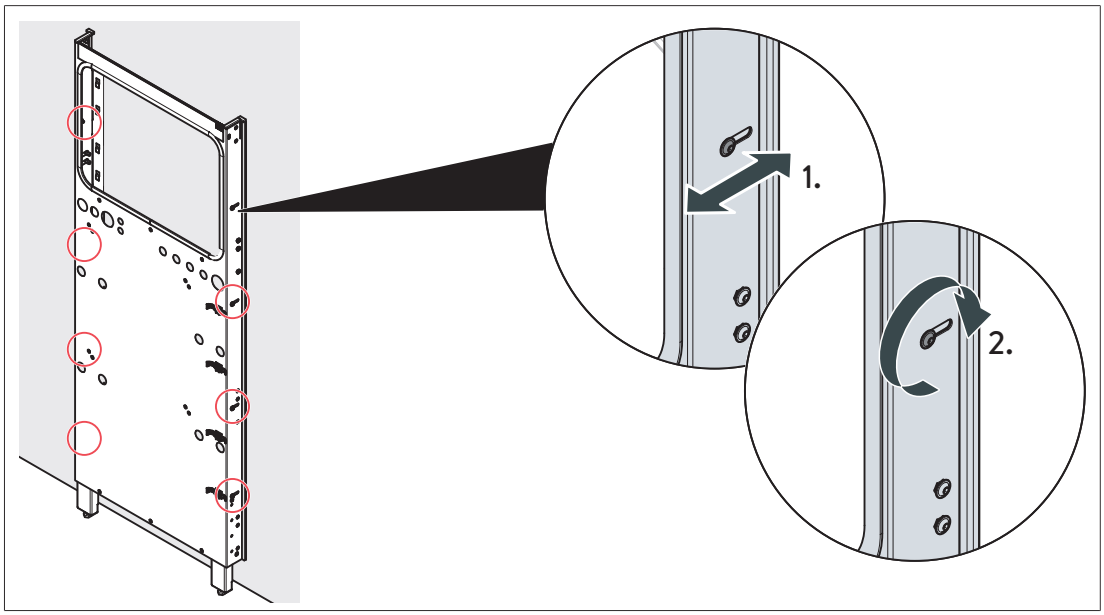
- ▶ Lean the mounting frame with the installed feet on the wall at the installation location.
- ▶ **When installing the storage system without feet:** Place the mounting frame on a suitable object so that the required 10 cm distance from the floor can be achieved. Alternatively, you can install the feet on the mounting frame in order to mark out the holes, and then remove the feet again.
- ▶ Mark out the eight holes for the wall bracket. The **outer openings** for wall mounting should be used in each case.
- ▶ Drill the holes with a suitable diameter for the selected mounting material.
- ▶ Insert suitable wall plugs in the holes.

5.2.4 Securing the mounting frame to the wall

- ▶ Use suitable screws and washers to secure the mounting frame to the wall (see Selecting the mounting materials [P. 24]).
- ▶ Ensure that the mounting frame is flat against the wall.

5.2.5 Straightening and levelling the mounting frame

- Use the slotted holes and screws (four per side) on the outer edges of the mounting frame to straighten it.

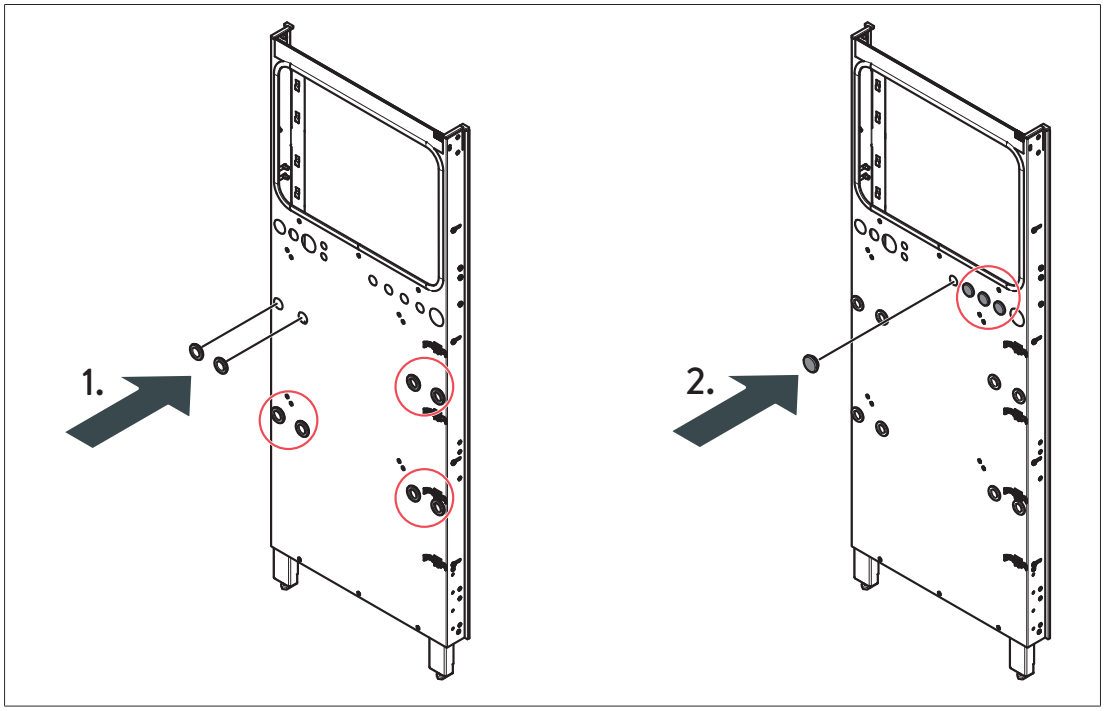


- ▶ Loosen the screws in the slotted holes. The screws are not fully tightened when delivered. The contact discs must not be removed.
- ▶ Push the mounting frame into the desired position. Use a spirit level to ensure that the mounting frame is straight and level (1.).
- ▶ Tighten the screws with a torque of **6 Nm** (2.).

5.2.6 Sealing the openings

The specified degree of protection for the storage system and therefore touch protection and protection against the ingress of foreign bodies is only achieved when all openings on the storage system are sealed as described in the product documentation.

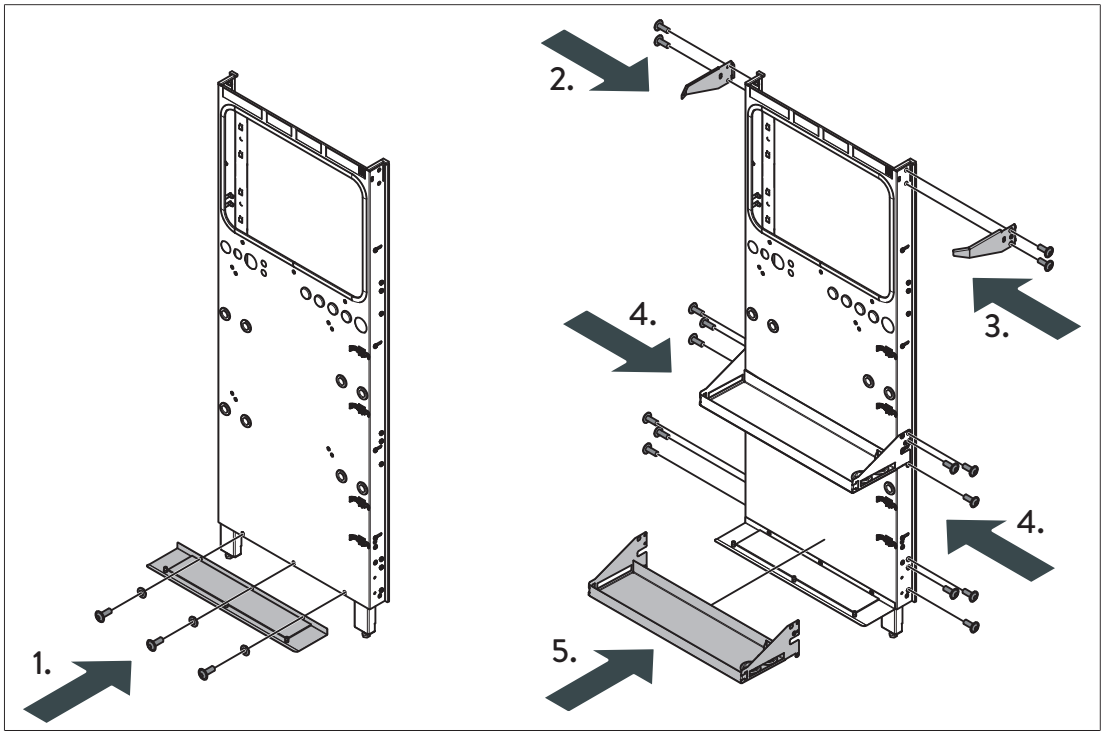
- The openings on the mounting frame must be sealed in order for the specified degree of protection for the storage system to be achieved.



- ▶ Seal the eight openings on the mounting frame shown in the figure using the dummy plugs (diameter: 32 mm) from the installation equipment pack (1.).
- ▶ Seal the four openings in the top right section of the mounting frame using suitable dummy plugs (diameter: 27.8 mm) from the accessory kit (2.).

5.2.7 Completing the mounting frame

- The individual components of the housing set must be added to the mounting frame.

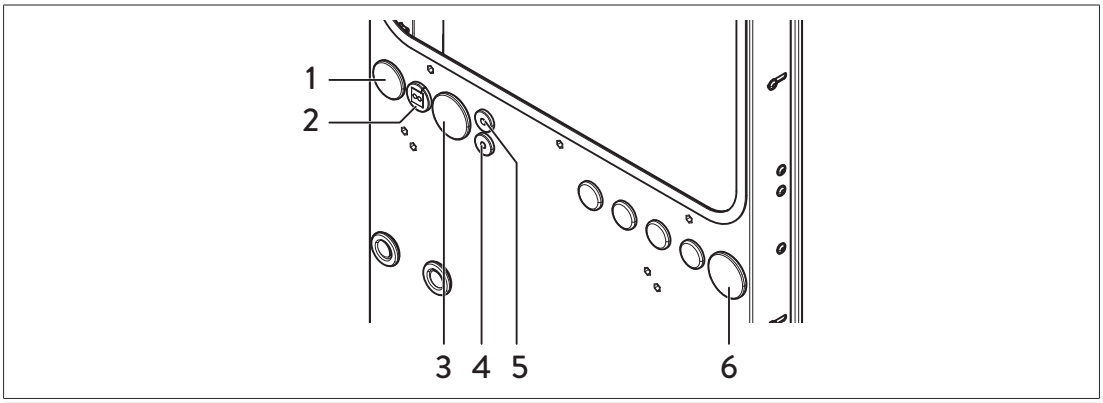


- ▶ Mount the floor plate to the mounting frame with three screws and contact discs from the installation equipment pack (1.).
- ▶ Mount the two supports for the cover and the two battery shelves on the mounting frame as shown in the figure. Use the screws from the installation equipment pack for this purpose (2. - 5.).
- ▶ Tighten the screws with a torque of **6 Nm**.

5.3 Routing lines into the system

The specified degree of protection for the storage system and therefore touch protection and protection against the ingress of foreign bodies is only achieved when all openings on the storage system are sealed as described in the product documentation.

- The openings on the mounting frame are sealed with cable entry plates and dummy plugs.
- All lines to be routed into the storage system must be directed through the designated cable entry plate.



No.	Type	Use
1	Dummy plug (Ø 40)	Reserve (DC module)
2	Cable entry point (Ø 32) with grommet for two lines	Modbus line, Ethernet line
3	Dummy plug (Ø 50)	Reserve (sonnenProtect 4000)
4	Cable entry point (Ø 20.5) for one line	Signal line for digital input/outputs
5	Cable entry point (Ø 20.5) for one line	Mains line (AC connection)
6	Dummy plug (Ø 50)	Reserve (extension cabinet)

Correct assembly must be observed when inserting the grommets into the cable entry plates. The flat side of the grommet must always be facing the flat side in the cutout of the cable entry plate.

- ▶ The position and type of cable entry point designated in each case can be seen in the figure.
- ▶ Use the cable entry points and grommets, if any, from the accessory kit to direct the lines into the storage system.
- ▶ Seal the remaining openings using he dummy plugs provided for this purpose in the accessory kit.

5.4 Installing the power unit

NOTICE

Danger due to touching live components on the power module

Damage to components of the power module due to electrostatic discharge (*ESD*)!

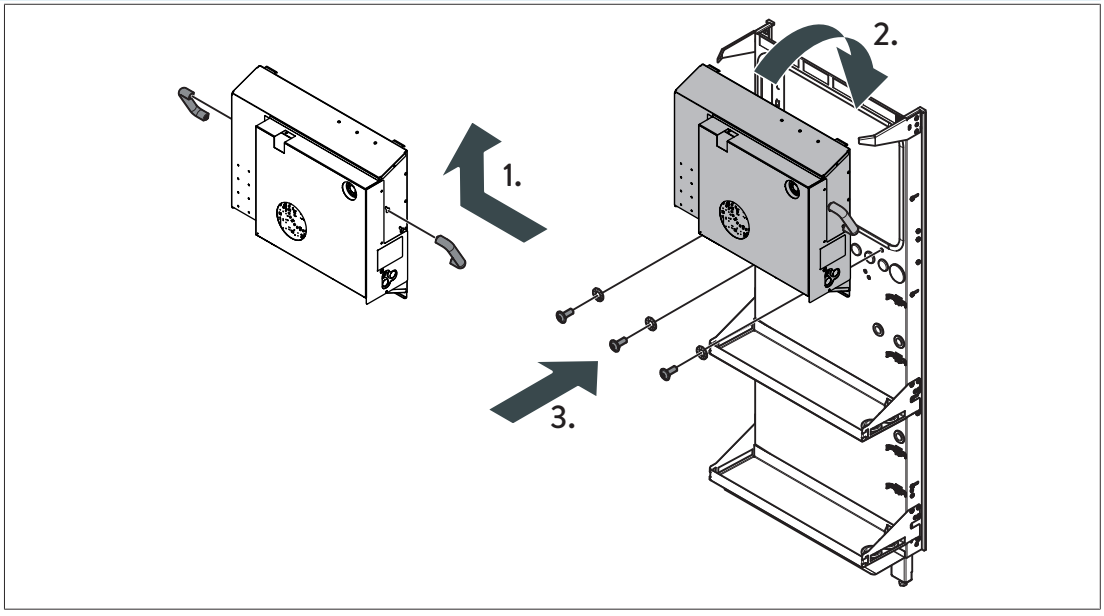
- ▶ Do not remove the touch guard on the power module and do not open the power module.
- ▶ Do not touch any components under the touch guard on the power module.
- ▶ Do not touch any components of the inverter by opening the power module.

NOTICE

Danger due to lifting the power module by the touch guard

Damage to the power module!

- ▶ Never lift the power module by the touch guard.



- ▶ Lift the power module by bringing the mounting handles on the right and left side of the module into the openings and moving them up (1.).
- ▶ Hang the power module in the middle on the top edge of the mounting frame (2.).
- ▶ Secure the power module to the three drilled holes using the screws and contact discs from the installation equipment pack (3.).
- ▶ Tighten the screws with a torque of **6 Nm**.
- ▶ Hang the two mounting handles on the touch guard. The mounting handles remain in the storage system.

6 Connecting the storage system

⚠ DANGER

Electrical work on the storage system and electrical distributor

Danger to life due to electrocution!

- ▶ Switch off the storage system to electrically isolate it.
- ▶ Disconnect the relevant electrical circuits.
- ▶ Secure against anyone switching on the device again.
- ▶ Wait five minutes so the capacitors can discharge.
- ▶ Check that the device is disconnected from the power supply.
- ▶ Only authorized electricians are permitted to carry out electrical work.

⚠ DANGER

Touch voltage in the event of a fault

Danger to life due to electrocution!

- ▶ Install a selective residual current device with a nominal differential current of 300 mA in TT networks. Nominal differential currents of 100 mA or 30 mA are also possible. The type of RCD must be selected depending upon the local conditions of the network.

NOTICE

Danger due to touching live components on the power module

Damage to components of the power module due to electrostatic discharge (*ESD*)!

- ▶ Do not remove the touch guard on the power module and do not open the power module.
- ▶ Do not touch any components under the touch guard on the power module.
- ▶ Do not touch any components of the inverter by opening the power module.

6.1 Electrical connection overview

All of the circuit diagram overviews are for illustrative purposes only. Specific *DNO* requirements concerning the connection must be taken into account and observed. As a result, the connection to be actually implemented may differ from the following circuit diagram overviews.

- ▶ Choose the right installation version before you start the installation. The differences between the installation versions are as follows:

- The **single-phase** storage system can be integrated both in single-phase and three-phase building mains. The power measurement works in one or three phases accordingly.
- There are three different measurement concepts for recording the power. The following figures show the **consumption measurement** (standard measurement concept).
- The **PV inverter** can be single-phase or three-phase regardless of the building mains. The power measurement for production must be installed accordingly.

- ▶ Ensure that the maximum permissible unbalanced phase load is observed when using a single-phase PV inverter together with a single-phase storage system in three-phase building mains. This means that the PV inverter and storage system must not be installed on the same phase, if applicable.
- ▶ If the storage system needs to be installed with a **sonnenProtect**, use the instructions provided in the section sonnenProtect 4000 [P. 71] to install the components.
- ▶ For installation with **AC microgrid**, see section Connecting an AC microgrid [P. 87].

Installation with three-phase building mains

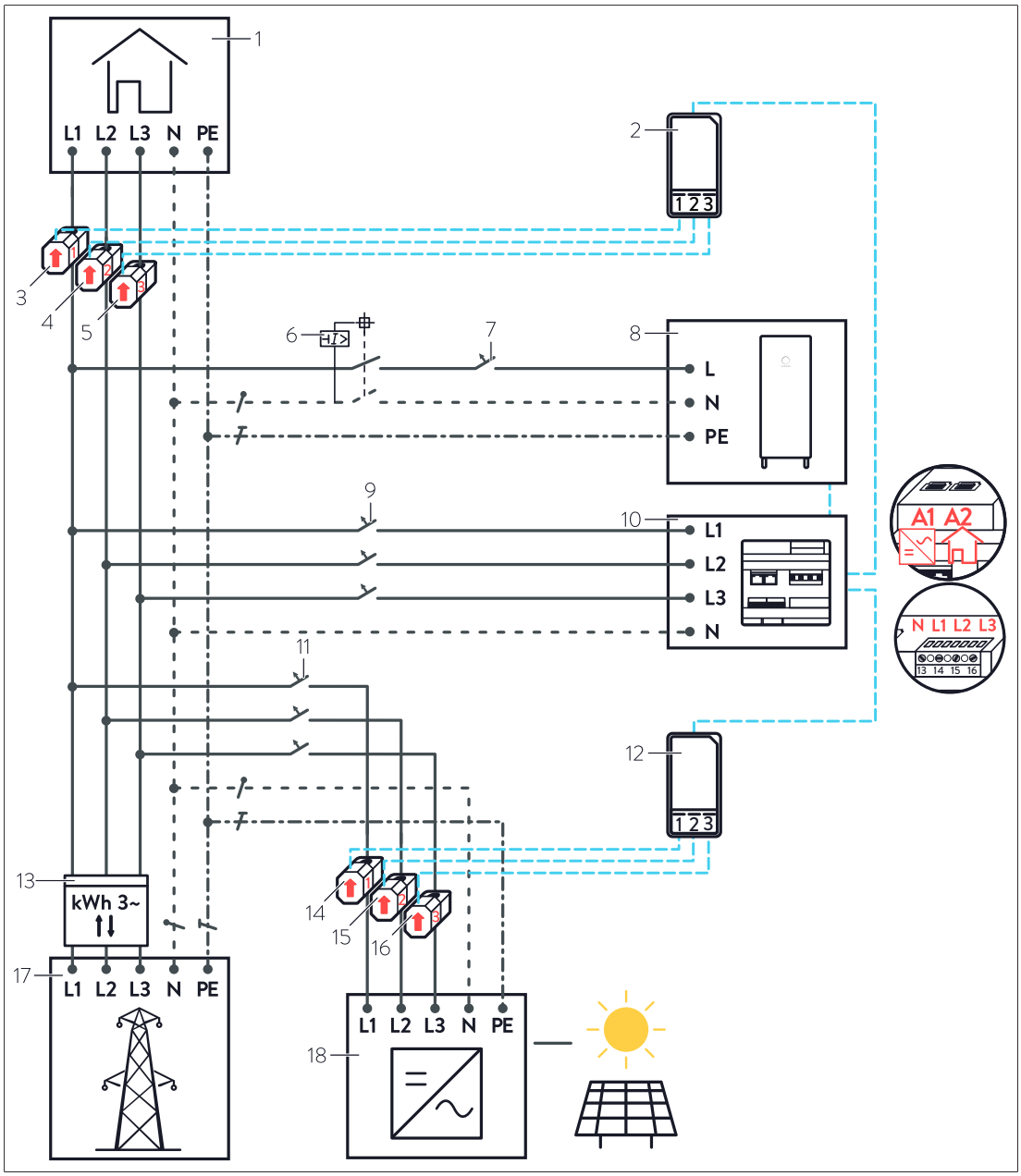


Illustration 5: Circuit diagram overview – sonnenBatterie 10 in three-phase mains

1 Consumers in building
2 Transformer interface for consumption (A2)
3 *CT* for consumption – L1
4 *CT* for consumption – L2
5 *CT* for consumption – L3
6 *RCD* (in TT networks[1])
7 *MCB* B20/B25
8 Storage system
9 *MCB*[2]
10 Power meter WM271
11 *MCB* for PV inverter
12 Transformer interface for production (A1)
13 Bidirectional counter
14 *CT* for production – L1
15 *CT* for production – L2
16 *CT* for production – L3
17 Public electrical mains
18 *PV* inverter

[1] Nominal differential current of 300 mA, 100 mA or 30 mA. Type of RCD depends on local conditions. Observe country-specific requirements.
[2] Fuse protection of line must be ensured.

Installation with single-phase building mains

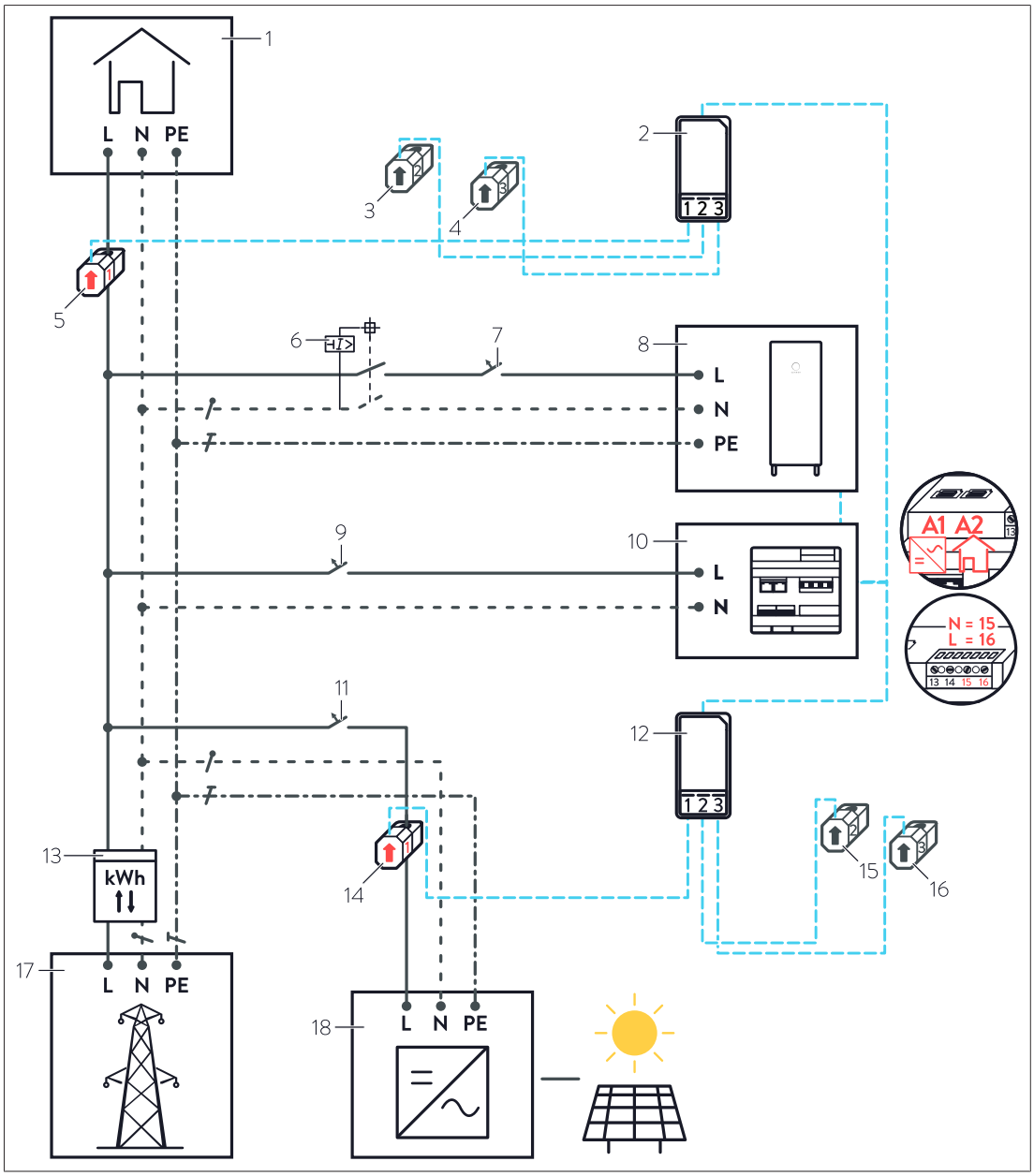


Illustration 6: Circuit diagram overview – sonnenBatterie 10 in single-phase mains

1 Consumers in building
2 Transformer interface for consumption (A2)
3 *CT* for consumption - L1
4 *CT* for consumption - L2 (not connected)
5 *CT* for consumption - L3 (not connected)
6 *RCD* (in TT networks[3])
7 *MCB* B20/B25
8 Storage system
9 *MCB*[4]
10 Power meter WM271
11 *MCB* for PV inverter
12 Transformer interface for production (A1)
13 Bidirectional counter
14 *CT* for production - L1
15 *CT* for production - L2 (not connected)
16 *CT* for production - L3 (not connected)
17 Public electrical mains
18 *PV* inverter

[3] Rated differential current of 300 mA, 100 mA or 30 mA. Type depending on the local conditions. Country-specific requirements must be observed.

[4] Protection of the line must be ensured.

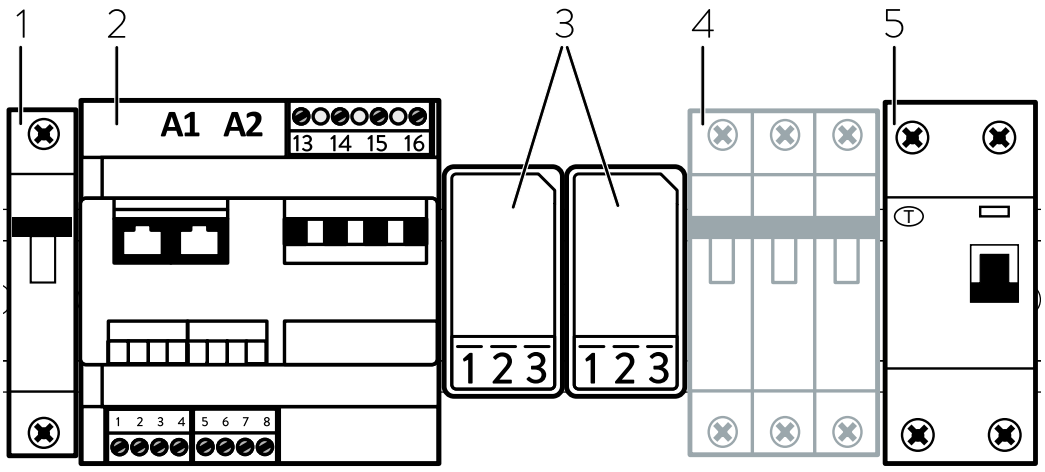
6.2 Placing components in the distributor

The scope of delivery includes two different current transformers, which differ in the maximum measurable amperage and the size of the opening of the clamp-on current transformers.

- ▶ Install the KSW 60-3 current transformer for the measurement of the production.
- ▶ Install the KSW 100-3 current transformer for the measurement of the consumption.

- ▶ Mount the following components necessary for electrical connection of the storage system in the electrical distributor.

Up to 23 cm of free space on mounting rails is needed for the components.



1	Miniature circuit breaker B20/B25 (not included in scope of delivery)
2	WM271 power meter
3	Transformer interfaces
4	Miniature circuit breaker (B6) for power meter (not included in scope of delivery)
5	Residual current device (not included in scope of delivery)

Explanations for the components:

- The miniature circuit breaker (1) protect the mains line of the storage system.
- The power meter (2) and the transformer interfaces (3) are used to measure the consumption and production of power in the building.
- The power meter is protected using a type B6 miniature circuit breaker (4). An additional miniature circuit breaker can be avoided if there is already an appropriate circuit breaker (see Connecting the power meter [P. 35]).
- A residual current circuit breaker (5) must be installed in networks with TT earthing. An RCCB type A with a rated differential current of 300 mA is sufficient for this. RCCBs with a rated differential current of 100 mA or 30 mA can also be used. This has been tested under EN 62109-1, EN 62109-2 and EN IEC 62040; country-specific requirements must be observed in each case. Depending on the local conditions of the public electricity grid, a different type may be required.

6.3 Wiring the components and storage system

▶ Wire the components previously placed in the electrical distributor. Follow the instructions in the **following sections** for this.

The figures in section Electrical connection overview [P. 31] show the building installation after all components have been fully connected.

6.4 Installing the power meter

Further information on power measurement and the power meter can be found in the power meter instructions[5]. These instructions explain, among other things, the different measurement concepts and how to use multiple power meters.

6.4.1 Connecting the power meter

The following points must be observed when connecting power meters:

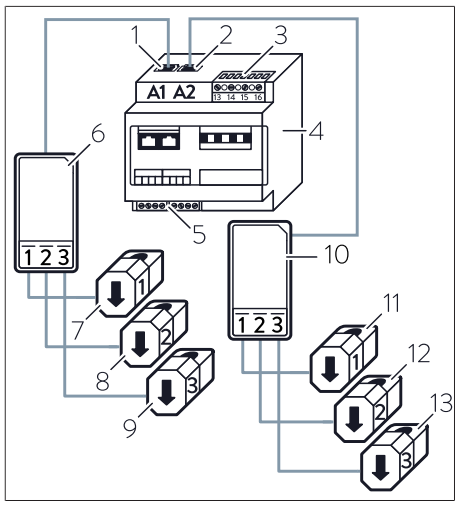


Illustration 7: Power meter WM271 components

- **Never confuse inputs A1 (input for generation) and A2 (input for consumption)!**
- The lines connected to the voltage measurement terminal strip must be protected by suitable miniature circuit breakers. Additional miniature circuit breakers do not have to be installed if the lines are already protected in accordance to the relevant, currently applicable regulations and standards.

1	A1 – input for production	8	*CT* for production – L2
2	A2 – input for consumption	9	*CT* for production – L3
3	Terminal strip for voltage measurement	10	Transformer interface for consumption
4	Power meter	11	*CT* for consumption – L1
5	Modbus terminal strip	12	*CT* for consumption – L2
6	Transformer interface for production	13	*CT* for consumption – L3
7	*CT* for production – L1		

[5] Document number: 401

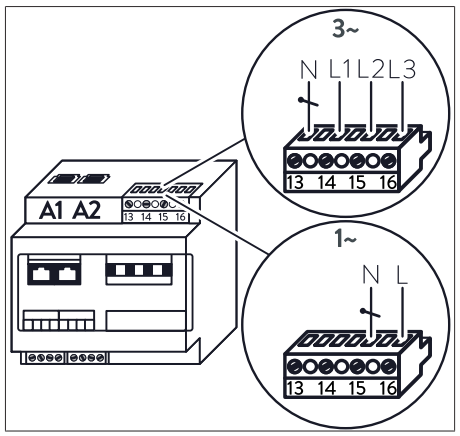


Illustration 8: Connection to the voltage terminal strip at single-phase (1~) and three-phase (3~) mains

- The connection to the voltage terminal strip depends on the number of phases. In the case of a single-phase (1~) mains, the voltage terminal strip must be wired like it is shown on the bottom part of the figure on the left. In case of a three-phase (3~) mains wire as shown on the top part of the figure.

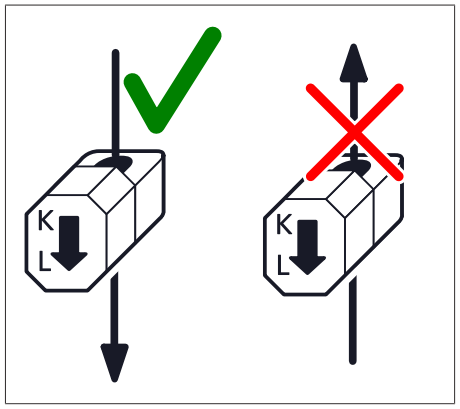


Illustration 9: left: correct energy flow direction / right: incorrect energy flow direction

- The clamp-on current transformers are clamped across the affected lines. The energy flow direction of the clamp-on current transformer must be observed.

The energy flow in the line must run from ***K to L.***

- In the case of a one-phase PV inverter or a single-phase mains, only the clamp-on current transformer for the phase in question is connected. The other two clamp-on current transformers must not be connected.

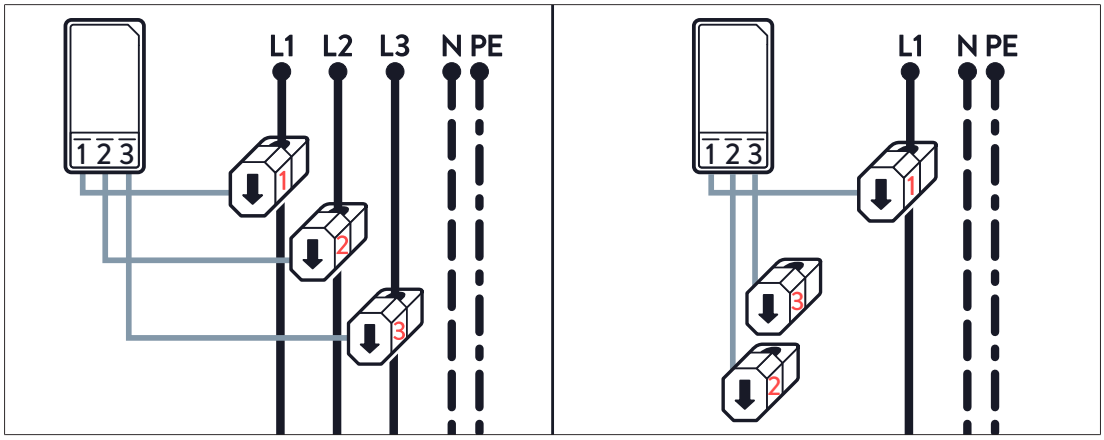


Illustration 10: Connecting the clamp-on current transformers for three-phase (left) and single-phase (right) installation

- **Do not confuse the phases!** Power measurement only works if the current and voltage of the same phase are measured.

Example: The clamp-on current transformer L1 (marked with number 1) must be connected to phase L1. This phase L1 must also be connected to terminal L1 of the voltage measurement terminal strip. Only then the correct power for phase L1 can be determined.

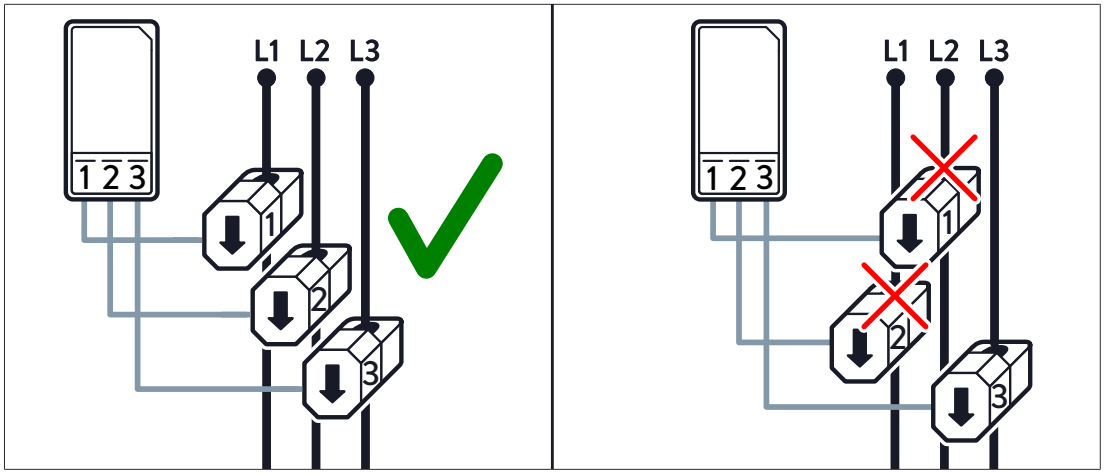


Illustration 11: Connecting the clamp-on current transformers: incorrect (right) and correct (left)

6.4.2 Configuring the power meter (optional)

Prerequisite:

✓ The power meter must be disconnected from the voltage supply in order to mount the touch display.

Tools:

- Touch display for power meter WM271

Three-phase measurement mode

The power meter only provides correct measured values when the right measurement mode is activated on the device. The **single-phase measurement mode** is the default setting. With a three-phase grid, then, the measurement mode must be switched to three-phase measurement.

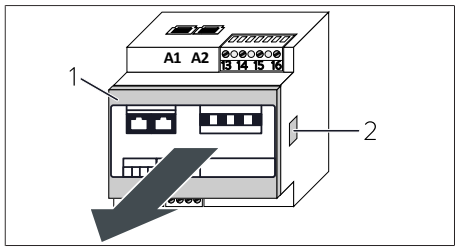


Illustration 12: Removing the front cover

- ▶ Press the clips (2) on both sides of the power meter. You might use a small screwdriver.
- ▶ Remove the front cover (1).

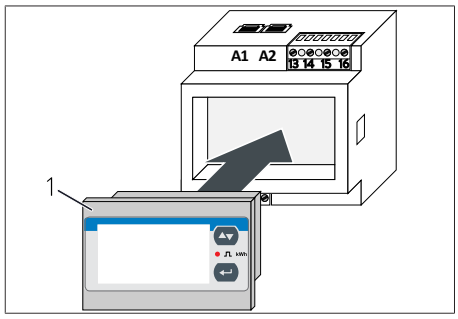


Illustration 13: Inserting the touch display

- ▶ Insert the touch display (1) into the power meter.
- ▶ Supply the power meter with energy.

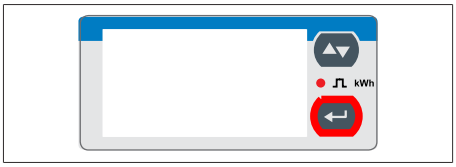


Illustration 14: Touch display

▶ Press ↵ for 3 seconds.

The **PASS ?** screen appears.

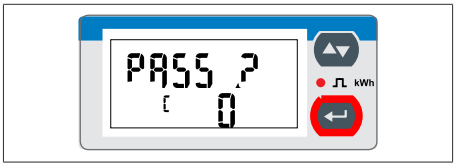


Illustration 15: Password entry screen

▶ Press ↵ for 3 seconds.

The **CnGPASS** screen appears. The power meter is now in programming mode.

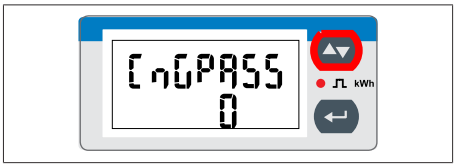


Illustration 16: CnGPASS screen

▶ Press ▲▼ once.

The **SYS** screen appears.

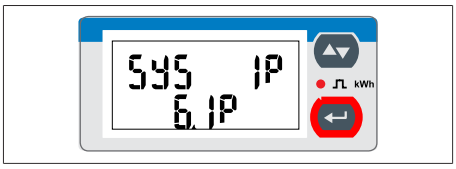


Illustration 17: SYS screen

▶ Press ↵ once.

Now it is possible to change the measuring mode.

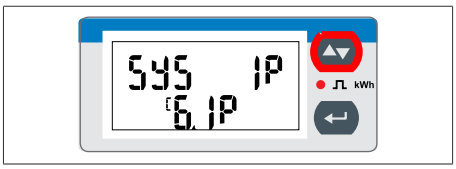


Illustration 18: SYS screen - change of measuring mode

▶ Press ▲▼ twice until the setting 3P | 2.3P appears.

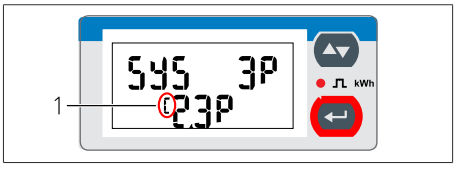


Illustration 19: SYS screen - setting 3P | 2.3P

▶ Press ↵ for a longer period of time until the sign (1) disappears.

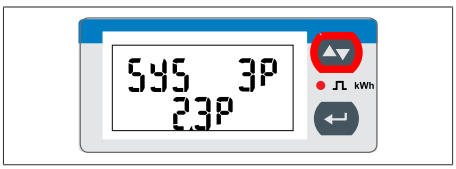


Illustration 20: SYS screen after changing the measuring mode

▶ Press ▲▼ ten times.

The **end** screen appears.

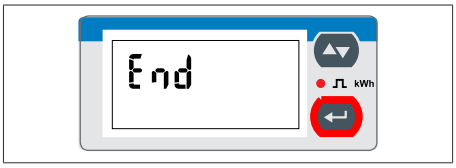


Illustration 21: End screen

▶ Press ↵ once.

The three-phase measuring mode is now activated.

- Remove the touch display.
- Insert the front cover into the power meter.

6.4.3 Connecting the Modbus line

NOTICE

Communication lines too long

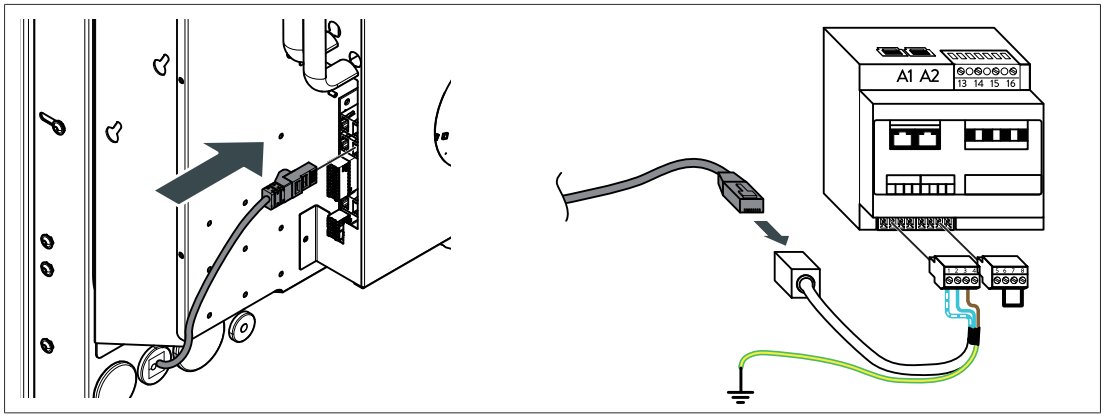
- ▶ The Ethernet line connected to the storage system must not exceed a maximum length of **100 m**.
- ▶ The Modbus line connected to the storage system must not exceed a maximum length of **150 m**.

- Measurement data is transmitted from the power meter to the storage system using the Modbus line.
- The Modbus line is connected to the power meter and the central unit of the storage system.

It is essential to ensure that a screened line is used and that the screen of the Modbus line is earthed in order to ensure optimal data transmission.

▶ Use a cable with the following properties as the Modbus line:

- The cable is Cat 6.
- The cable is shielded.



▶ Connect the line to the central unit of the storage system (**MOD [Meter]**).

▶ Use the fixing ties from the accessory kit to affix the attached line to the power module.

▶ Connect the other end of the cable to RJ-45 socket of the pre-assembled modbus line on the power meter.

▶ Earth the screen extension of the Modbus line for the power meter.

If there is no jumper on the Modbus terminal strip between pins 6 and 8:

▶ Install a jumper between pins 6 and 8 on the Modbus terminal strip.

6.4.4 Using an alternative power meter (EM357)

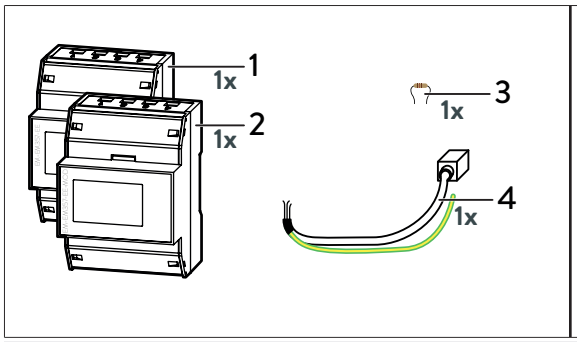
In addition to the standard accessories set, an alternative accessories set is offered which includes EM357 power meters.

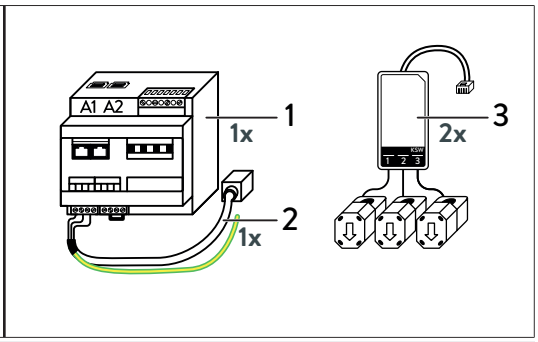
▶ Note the following information regarding the use of the alternative power meter when installing the storage system.

- The EM357 power meter is a direct meter.
- An EM357 power meter represents one measurement point.
- Installing the power measurement with EM357 power meters differs from power measurement with the WM271 power meter as follows:
  - Two EM357s are required instead of one WM271.
  - No transformer interfaces or clamp-on current transformers are used.
  - Positioning in the electrical distributor must take place where the cables to be measured are installed.
  - Programming for single-phase or three-phase measurement is not required. The power meter automatically detects the connected phases.
  - The direction of energy flow is indicated by arrows on the power meter. With the standard installation (shown on the display), the measurement direction is from top to bottom.
  - The maximum measurable amperage is 100 A.

Scope of delivery

- The content of the alternative accessories set differs from the standard scope of delivery as follows:





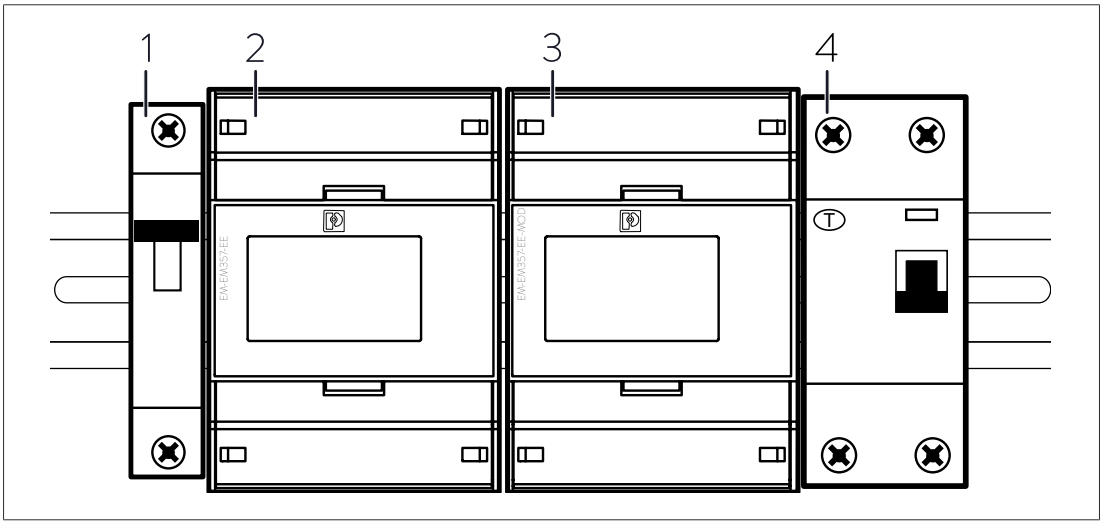
Alternative accessories set		Standard accessories set	
1	EM357-EE power meter	1	WM271 power meter
2	EM357-EE-MOD power meter	2	Modbus cable with RJ45 coupling
3	Terminating resistor (part of EM357-EE-MOD)	3	Inverter interface with clamp-on current transformer
4	Modbus cable with RJ45 coupling		

Placing components in the distributor

The power meters must be protected by fault protection with max. 100 A on the AC side. If this is already done, for example, by the *SMCB switch* of the on-site connection, no additional *MCB switch* has to be installed.

- ▶ Mount the following components necessary for electrical connection of the storage system in the electrical distributor.

Approx. 20 cm (corresponds to 11 *TE*) of free space on mounting rails is required for the components.



1	Miniature circuit breaker B20/B25 (not included in scope of delivery)
2	EM357-EE power meter (Modbus address 1)
3	EM357-EE-MOD power meter (Modbus address 10)
4	Residual current device (not included in scope of delivery)

Differences in the overview circuit diagram

The overview circuit diagrams in this document always show the power measurement using the standard power meter. The following illustration shows how the alternative power meter is installed in comparison.

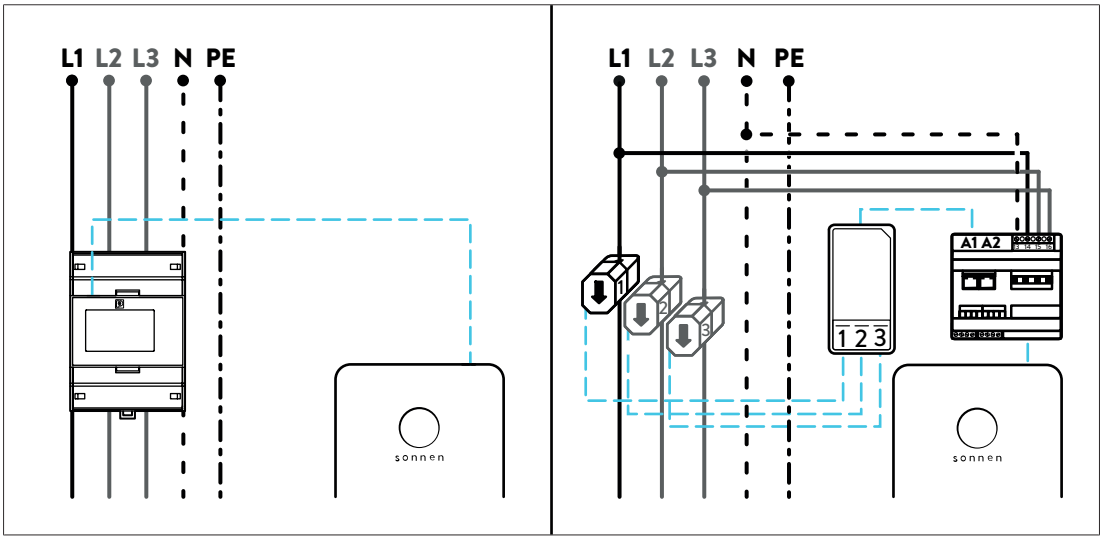


Illustration 22: Representation of a measurement point in single-phase or three-phase mains: EM357 power meter (left) and WM271 (right)

Connecting AC lines (three-phase mains)

Cables with a conductor cross-section of 1.5 to 25 mm² can be connected to the power meter (torque for connection: 2.5 Nm).

- Open or remove the top flaps on the power meters. Removal simplifies the connection of the cables.
- Open the bottom flaps on the power meters.
- Remove the cover (communication shield) from the top of the power meters.
- Connect the AC lines (L1, L2, L3, N). Ensure that the direction of energy flow for each power meter is from top to bottom.

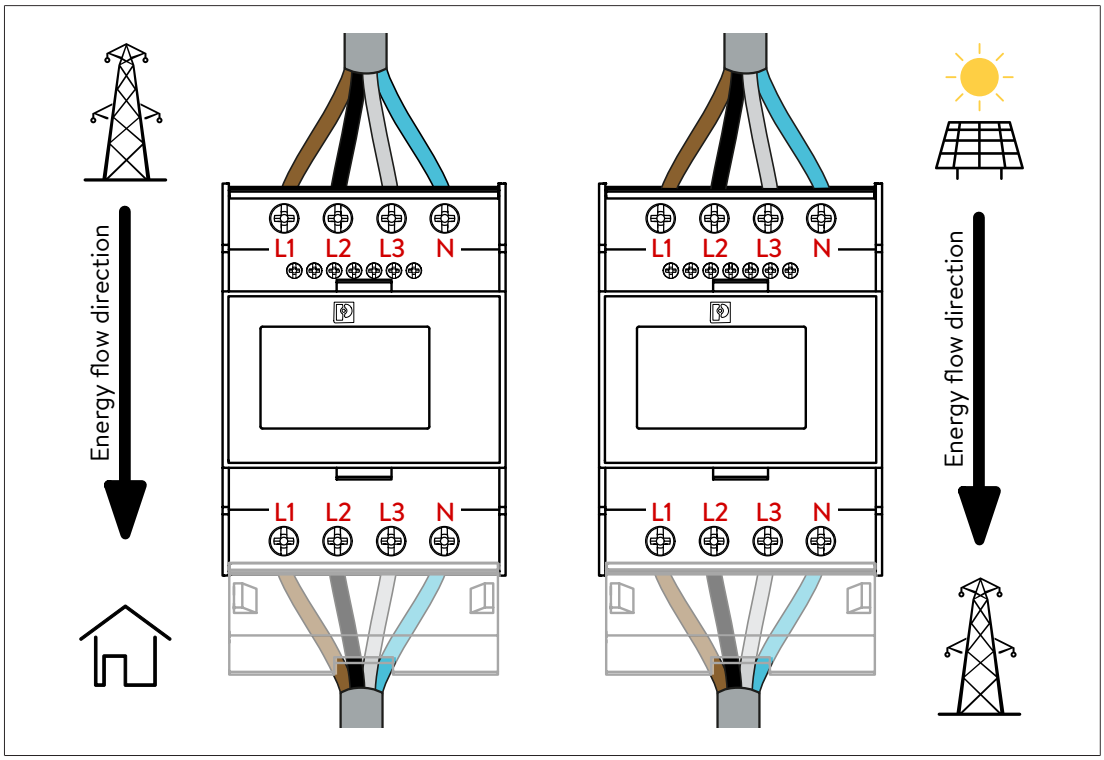


Illustration 23: Connection of EM357 power meter in three-phase mains

- Attach the previously removed cover (communication shield) to the power meters.
- Close the bottom flaps on the power meters.

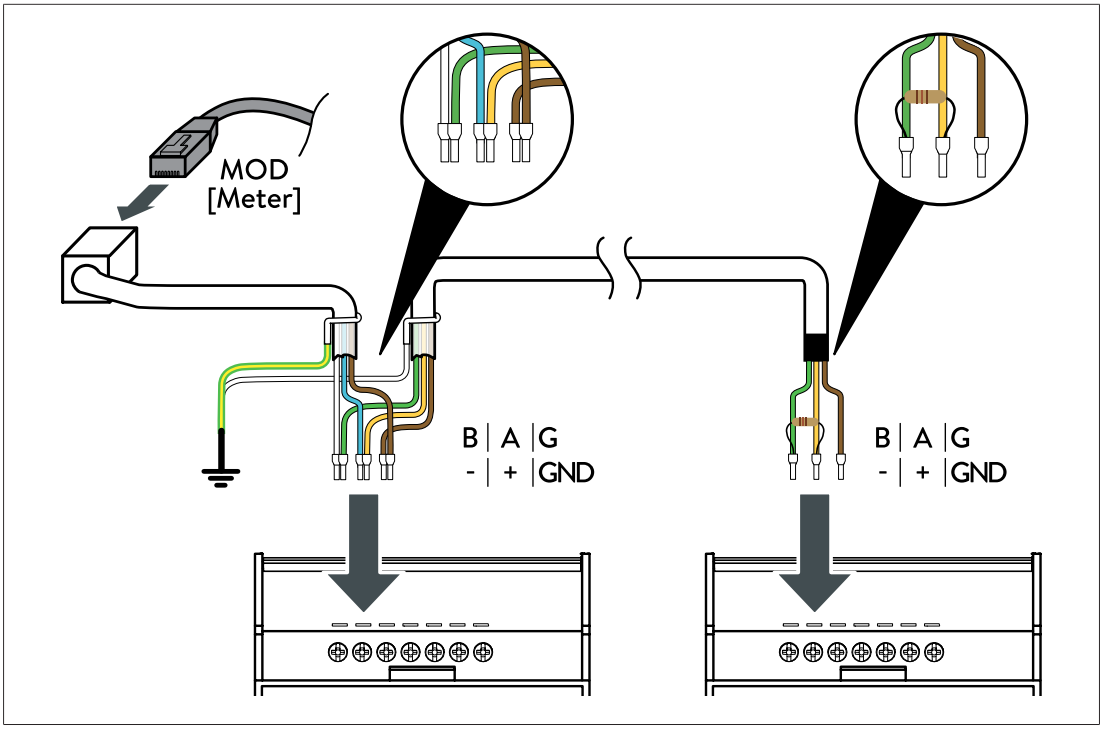
Connection in single-phase mains

Single-phase mains are connected in the same way as three-phase mains. There is no need to configure the power meter.

- Use connectors L1 and N of the power meters to connect the cables for single-phase mains.

Connecting the communication lines

- Use cable UNITRONIC® BUS LD 2x2x0.22 (Manufacturer: Lapp) or a patch cable (Cat 6/screened) as the communication lines.
- Attach wire end ferrules and the terminating resistor (included in the scope of delivery) to one end of the communication line.
- Attach wire end ferrules to the other end of the communication line and prepare a shield tap for the earth connection.



▶ Connect the communication line and the Modbus line (included in the scope of delivery) to the two power meters.

- Assignment of the premounted Modbus cable:
  - white-blue = -
  - blue = +
  - brown = GND

▶ Earth the shield tap and the premounted earthing cable of the Modbus cable.

▶ Close the top flaps (possibly previously removed) on the power meters.

Setting up the power meter

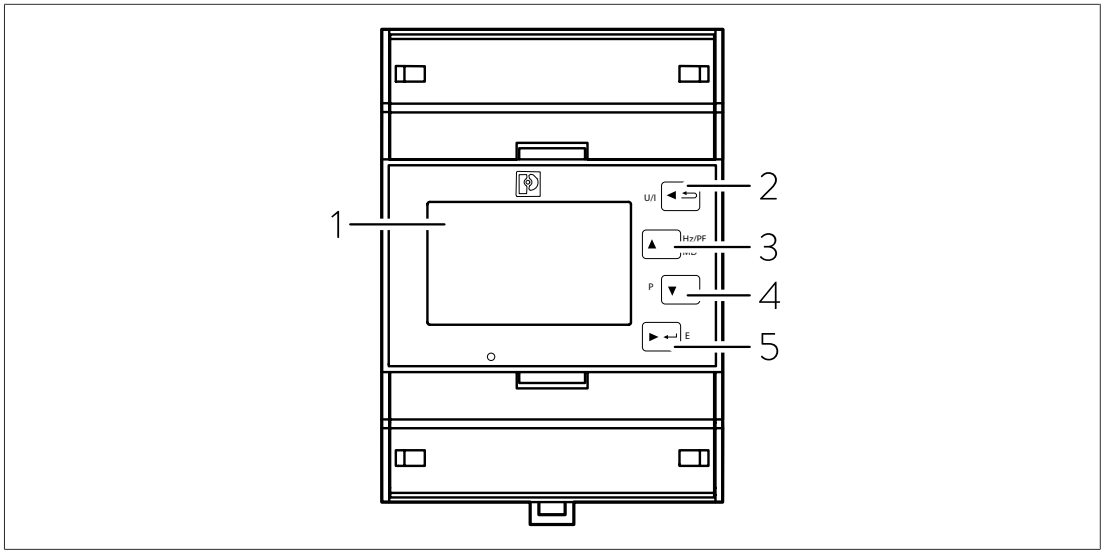
When commissioning the storage system using the commissioning assistant [P. 97], the following must be taken into account when **configuring the power measurement**.

Meter	Direction	Modbus ID	Channel	Measurement value	Edit
EM357	P - Production	10	1	3260.98 **W**	Delete
EM357	C - Consumption	1	1	494.75 **W**	Delete
				-	Add

- Type EM357 must be selected as the **meter**.
- The correct **measurement point** type (consumption or generation) must be assigned to both power meters based on the Modbus address.
- The EM357-EE power meter is preset to **Modbus address** (**Modbus ID**) **1**.
- The EM357-EE-MOD power meter is preset to **Modbus address** (**Modbus ID**) **10**.
- **Channel 1** must be selected for both power meters.

Configuring the power meter (optional)

The keys and the display can be used to make settings on the power meter. By default, the power meter is in display mode and displays current energy values.



1	LCD screen	4	Down key
2	Left/ESC key	5	Right/enter key
3	Up key		

Switch to setting mode

To switch to setting mode:

- ▶ Press enter key for at least three seconds.

PASS appears on the display.

- ▶ Enter the password (the default is '1000').
- ▶ Press enter key for at least three seconds.

If the password is correct, the setting mode is opened.

The display **PASS Err** appears if the password is incorrect.

Changing the Modbus address

To change the default Modbus address:

- ▶ Press the down key until the display **SEt Addr** appears.
- ▶ Press enter key for at least three seconds.

The value flashes when it is in edit mode.

- ▶ Press the up or down key to change the value.
- ▶ Press the enter key to save the set value.

The value is saved. The next setting value flashes automatically.

- ▶ Press enter key for at least three seconds.

The power meter is still in setting mode.

Exiting setting mode

- ▶ Press the ESC key to return to display mode.

If no operation is performed for more than 60 seconds, the power meter automatically returns to display mode.

6.5 Establishing an internet connection

NOTICE

Communication lines too long

- ▶ The Ethernet line connected to the storage system must not exceed a maximum length of **100 m**.
- ▶ The Modbus line connected to the storage system must not exceed a maximum length of **150 m**.

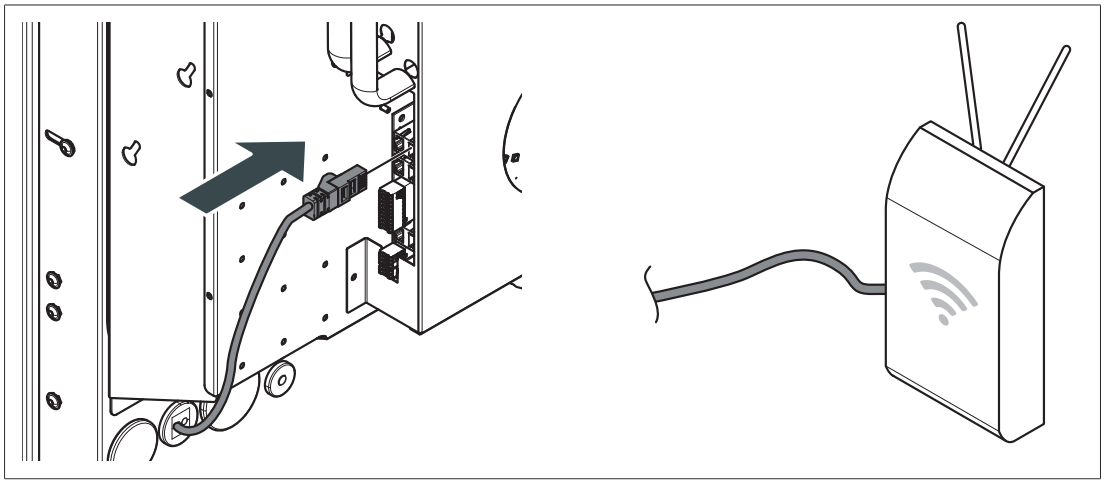
Having a constant internet connection is one of the conditions of the warranty, as sonnen can use this to access the storage system and monitor it for correct function and import software updates.

- ▶ Please inform the operator of the storage system that the internet connection should not be interrupted for long periods of time.
- ▶ Additional information can be found in the currently applicable warranty conditions.

- The storage system establishes a connection to the internet using the Ethernet line.
- The Ethernet line is connected to the building network router and the central unit of the storage system.

▶ Use a cable with the following properties as the Ethernet line:

- The cable is Cat 6.
- The cable is shielded.



- ▶ Connect the line to the central unit of the storage system (**ETH [Router]**).
- ▶ Use the fixing ties from the accessory kit to affix the attached line to the power module.
- ▶ Connect the other end of the cable to the building network router.

When the Ethernet line has been connected correctly, the storage system will automatically establish a connection once it has been commissioned for the first time.

If the connection to the internet is not established after commissioning:

- ▶ Follow the instructions in section Troubleshooting [P. 102].

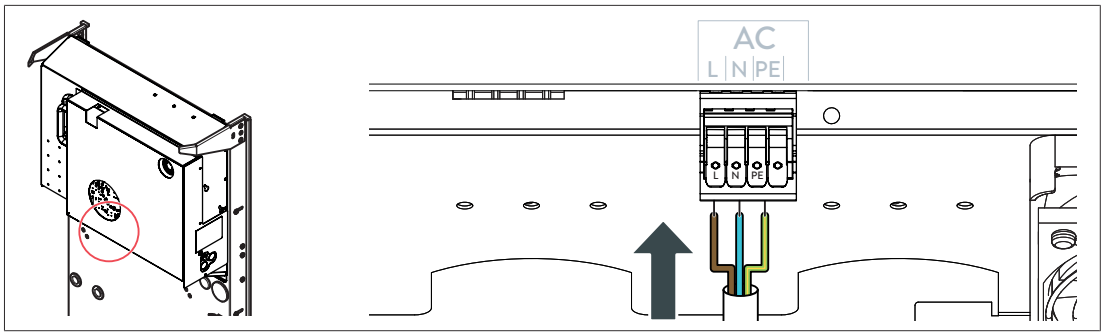
6.6 Connecting the mains line

NOTICE

Connection lines too long

- ▶ Ensure that the mains and signal lines are dimensioned so that the selected conductor cross-section is sufficient for the required line length. sonnen recommends a maximum line length of 30 m for the mains and signal lines.

- The mains line is connected to the central unit of the storage system.



- ▶ Select the mains line based on the specification (see Parts required [P. 20]).
- ▶ Connect the individual wires (L, N, PE) of the mains line as labelled on the central unit (**AC**).

6.7 Installing the sonnenModule 4 battery modules

⚠ WARNING **Risk of injury due to heavy weight of battery modules**

Crushing or straining due to lifting or dropping of the battery modules!

- ▶ Wear safety shoes when transporting and installing the modules.
- ▶ Ensure modules are stable.
- ▶ Two people should carry the battery modules, if possible.

NOTICE **Risk due to lifting battery modules on steel straps**

Damage to the battery modules!

- ▶ Never lift battery modules on steel straps.

- Correctly installed battery modules are completely controlled by the storage system. They cannot be switched on and off manually.

6.7.1 Measuring the battery module voltage

NOTICE **High compensating currents**

Damage to the battery modules!

- ▶ Do not install battery modules when the voltage between the modules differs by more than 2 V.

- ▶ Measure the voltage between the battery module plus pole (+) and the battery module minus pole (-) in each case and note down the measured voltage.
- ▶ Use this method to measure the voltage of all battery modules to be installed in the storage system.
- ▶ Compare the measured voltages for the battery modules and determine the maximum difference.

If the maximum difference is greater than 2 V:

- ▶ Do not install the battery modules.
- ▶ Contact the sonnen service team for more information.

If the maximum difference does not exceed the limit, you can continue with the installation.

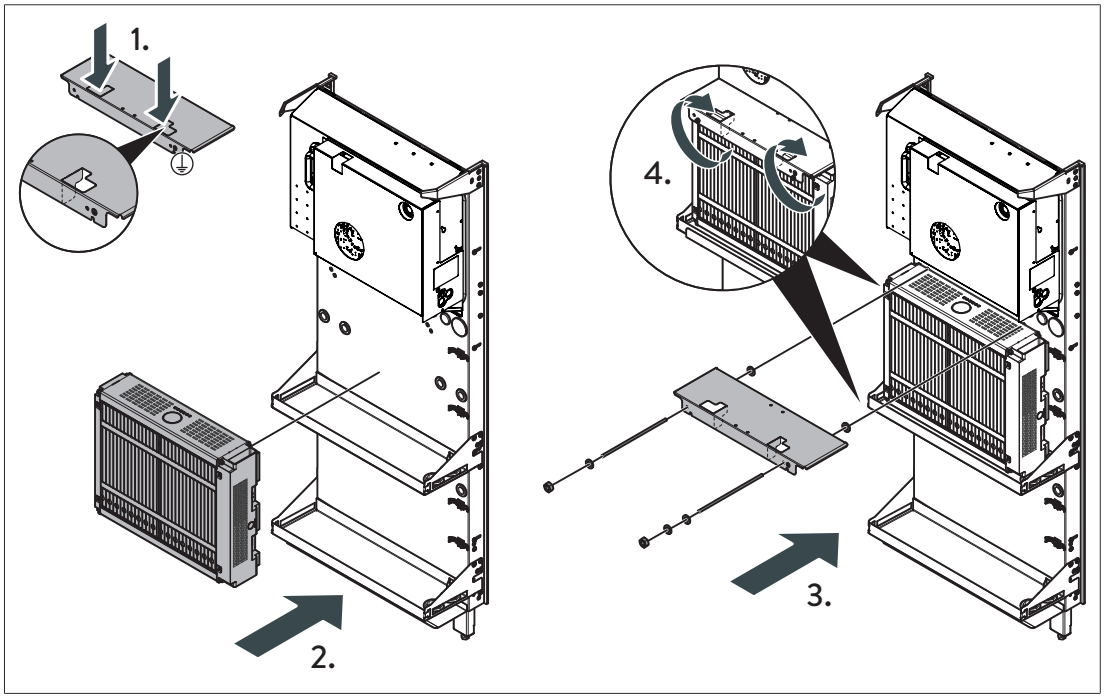
- ▶ When assembling pairs of battery modules, the best case scenario is a low voltage difference between the two. To create this situation, pair up battery modules with similar voltages.

6.7.2 Mounting the battery modules

- The battery module connections must face right in each case.
- Install one battery module per battery shelf.

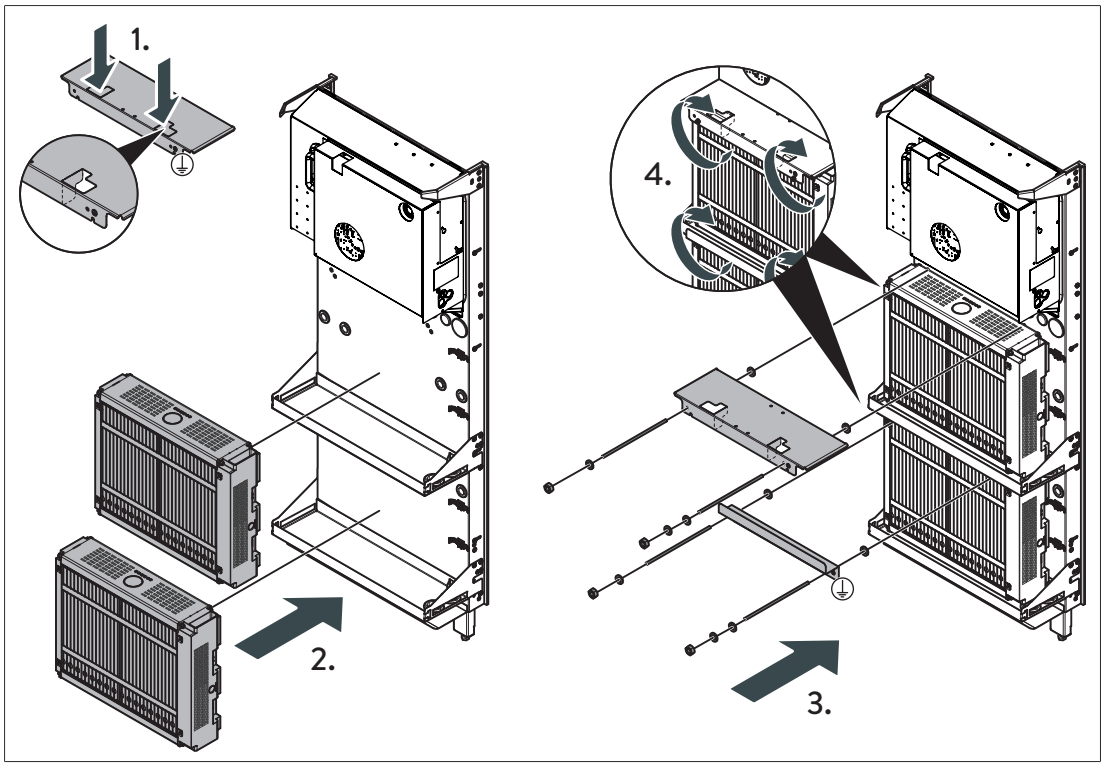
If you install only one battery module, make sure you always mount it with the spacer plate on the top battery shelf.

Install a battery module



- ▶ Fold down the two perforated lugs on the spacer plate (1).
- ▶ Place the battery module on the top battery shelf (2).
- ▶ Use the battery screws to fasten the spacer plate to the mounting frame (3).
- ▶ Install the contact disc between the nut for the battery screw and the spacer plate (3).
- ▶ Install the two washers (plastic) between the spacer plate and the battery module (3).
- ▶ Tighten the battery screws with a torque of **4 Nm** (4.).

Installing two battery modules



- Fold down the two perforated lugs on the spacer plate (1.)
- Place a battery module on each battery shelf (2.).
- Use the battery screws to fasten the spacer plate to the mounting frame (3.).
- Install the contact disc between the nut for the battery screw and the spacer plate (3.).
- Install the two washers (plastic) between the spacer plate and the battery module (3.).
- Secure the bracket for the lower battery module. Install the battery screws, washers and contact disc in the same way as on the spacer plate (3).
- Tighten the battery screws with a torque of **4 Nm** (4.).

The upper battery module is battery module 1 and the lower module is battery module 2.

6.7.3 Connecting the battery modules

⚠ DANGER

High battery voltage (> 200 V)

Danger to life due to electrocution!

When battery lines are connected, the central unit always carries the voltage of the battery modules, even if the storage system and mains voltage are switched off.

To disconnect the battery voltage from the central unit:

▶ Unplug the battery lines from **all** battery modules.

⚠ WARNING

Damage to battery lines due to improper routing

Danger to life due to electrocution!

▶ Direct the battery lines through the openings in the battery shelves and secure with cable clips.

▶ Route the battery lines so that they are not kinked or crushed when the cover is mounted or removed.

The scope of delivery includes the battery lines, BMS communication lines and battery screws for the highest extension level of the storage system. If the maximum number of battery modules is not being installed:

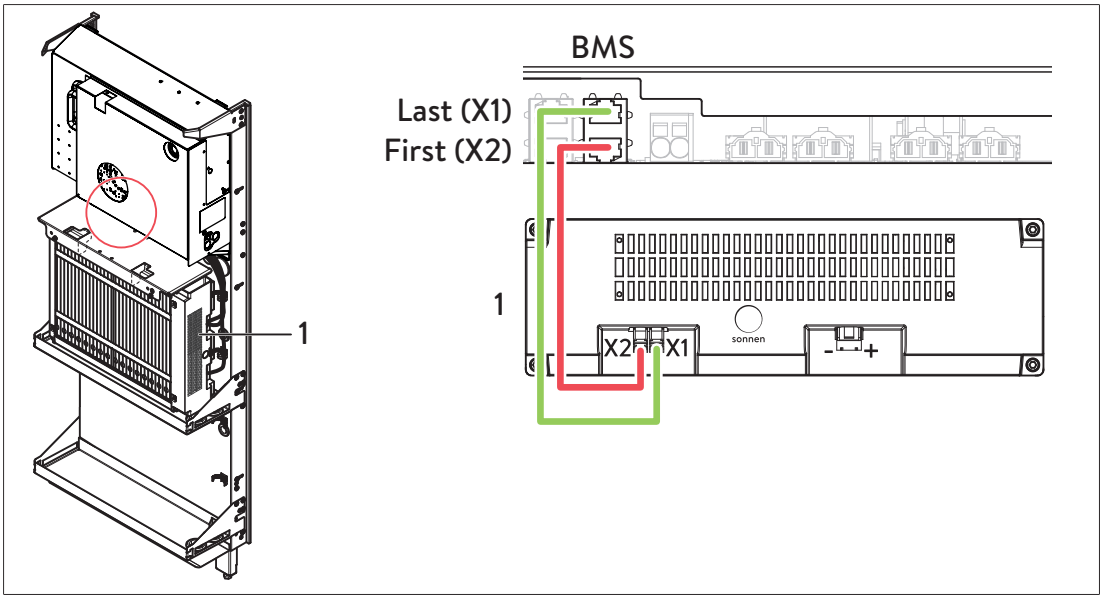
▶ Store the surplus components in the storage system (e.g. on the floor plate). These will then be on hand if additional battery modules are installed later.

▶ Ensure that the components are not damaged (e.g. when the cover is attached and removed).

- The battery modules are connected to the central unit of the storage system.
- The battery cables run from the individual battery module to the corresponding socket on the central unit of the storage system.
- When you install two battery modules, this has the effect of connecting two battery modules in series. Battery module pairs are connected in parallel on the central unit.

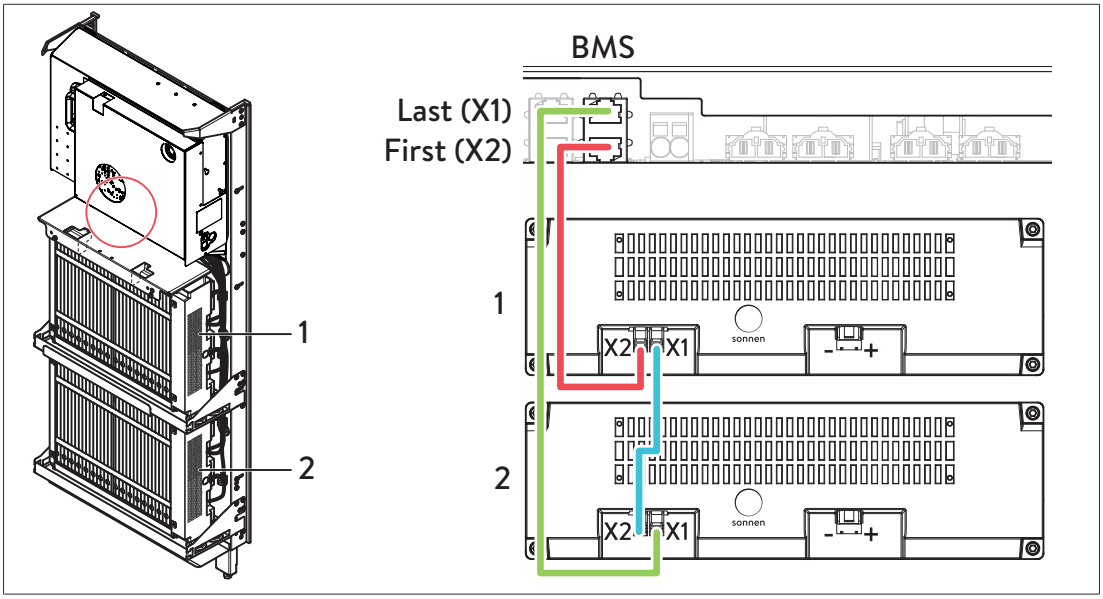
▶ Direct the lines through the openings in the battery shelves and secure them to the mounting frame using cable clips.

Connecting BMS communication cables – Connecting 1 battery module



- Connect a BMS communication cable to socket **BMS – First (X2)** on the central unit. Connect the other end to the battery module (**X2**).
- Connect a BMS communication cable to socket **BMS – Last (X1)** on the central unit. Connect the other end to the battery module (**X1**).

Connecting BMS communication cables – Connecting 2 battery modules



- Connect the first BMS communication line to socket **BMS First (X2)** on the central unit. Connect the other end to battery module 1 (**X2**).
- Connect the BMS communication line for the last battery module (number 2 or 4) to socket **BMS Last (X1)** on the central unit. Connect the other end to the battery module (**X1**).
- Connect the remaining battery modules one after the other by connecting the BMS communication lines from socket **X1** to socket **X2** of the next battery module in each case.

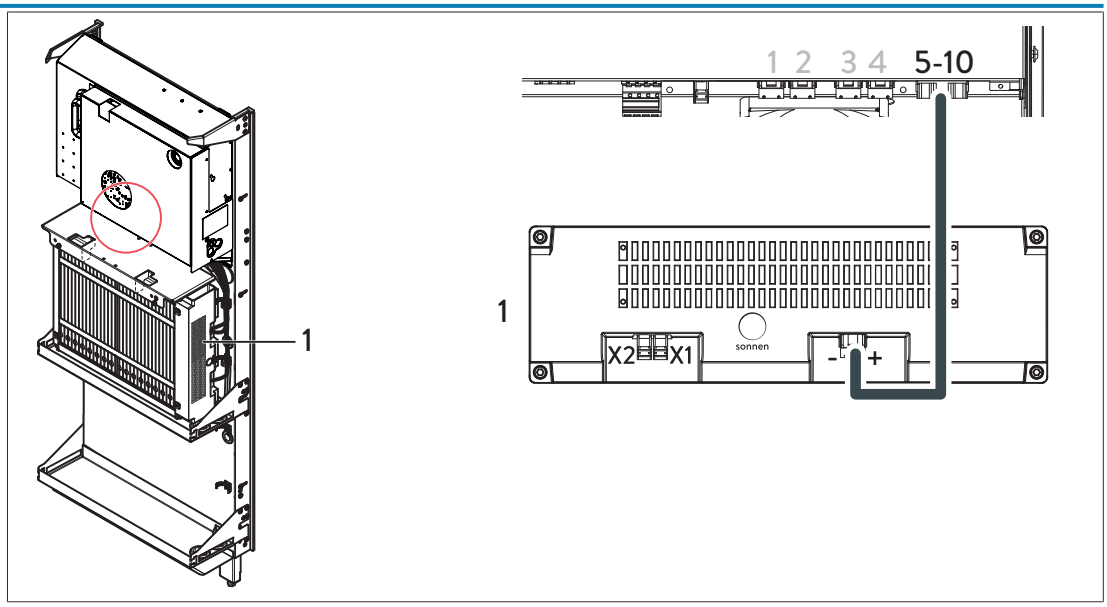
Connecting battery cables – Connecting 1 battery module

NOTICE

Incorrect use of the battery cable for 1 x sonnenModule 4

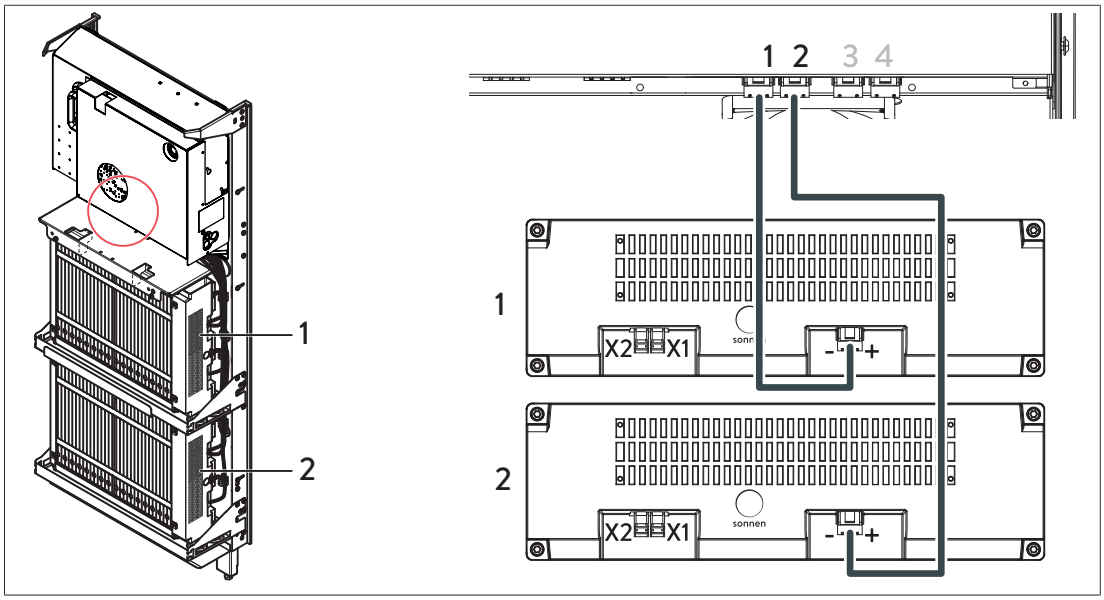
Damage to the power unit and battery modules!

- Do not connect lines to the sockets DC (BATT) 1, 2, 3, 4 when the special battery cable for one sonnenModule 4 is used.



- Use the special battery cable to connect a battery module (1 x sonnenModule 4) from the scope of delivery.
- Connect a battery cable between battery module 1 and socket **DC (BATT) – 5-10** on the central unit.

Connecting battery cables – Connecting 2 battery modules



- Connect a battery line between battery module 1 and socket **DC (BATT) – 1** on the central unit.
- Connect a battery line between battery module 2 and socket **DC (BATT) – 2** on the central unit.

6.8 Subsequent extension of storage capacity

NOTICE

Destruction of the battery modules or storage system if specifications for extending storage capacity are not observed.

Damage to or destruction of the battery modules if storage capacity is extended without observing the relevant specifications and if the battery modules are connected in series in the storage system.

▶ Always extend the storage capacity by two additional battery modules (exception: 1 x sonnenModule 4).

Battery modules installed within a storage system (including extensions and cascades) must be the same type!

- The storage system must only be extended using battery modules of the same type of those already installed in the system.
- Observe the serial connection between the battery modules when extending the storage capacity. This means you must always install at least two battery modules (**exception**: 1 x sonnenModule 4).
- The battery modules to be installed must have an *SOC* of approx. 30 %. Observe the information in section Storing the battery modules [P. 12] concerning this.

▶ Use the commissioning assistant to set the Operating Mode Battery-Module-Extension (30%). **NOTICE! This must take place at least 24 hours before extension, as this is the only way the voltage of the installed battery modules can sufficiently adjust to the voltage of the new battery modules to be installed.**

▶ Disconnect the power supply to the storage system [P. 100].

▶ Remove the cover.

▶ Install the additional battery modules [P. 49].

▶ Check or add to the battery cables and BMS communication lines of all installed battery modules. The connection sequence described in section Connecting sonnenModule 4 [P. 51] must be followed.

▶ Mark the new storage capacity on the type plate of the storage system (on the switch panel of the power module). Clearly void out the marking for the old storage capacity.

▶ Attach the cover and the earthing screws.

▶ Switch on the storage system [P. 97].

▶ Change the operating mode from module extension to the right operating mode (e.g. Automatic - Self-Consumption) in the commissioning assistant.

7 Installing the extension cabinet (optional)

NOTICE

Damage to the battery modules when installing the extension cabinet after initial commissioning

If an extension cabinet is added to the storage system after the system has already been commissioned, the battery modules may be damaged. Therefore:

▶ Observe the information in section Extension of storage capacity [P. 54] if you are retrofitting an extension cabinet to the storage system.

- One extension cabinet can be added to the storage system. An extension set, housing set with mounting frame and the desired number of battery modules are required for this (for list of components, see Scope of delivery [P. 17]).
- The nominal storage capacity of the storage system can be extended from 11 kWh (2 x sonnenModule 4) to up to 22 kWh (4 x sonnenModule 4).

7.1 Mounting the extension cabinet

- The extension cabinet is essentially mounted similarly to the storage system (see Installing the storage system [P. 22]).
- **Differences in mounting are described in the following sections.**

7.1.1 Selecting the installation location

NOTICE

Insufficient load-bearing capacity of wall for mounting

Damage to storage system and surrounding area!

The wall selected for the installation of the storage system and extension cabinet must be able to support a weight of 850 kg for each unit.

▶ Ensure that the mounting material and the wall have the required load-bearing capacity. Ensure that the correct distances between the storage system and extension cabinet are observed.

▶ Use all of the mounting points on the mounting frame of the storage system and the extension cabinet.

- The extension cabinet can be mounted to the left or right of the storage system.

▶ Maintain the minimum distances for the storage system and for the extension cabinet (see Minimum distances [P. 22]). The distance between the storage system and the extension cabinet can be reduced compared to the required minimum distances, but must always be **at least 15 cm**.

▶ Do not select a distance that is too great between the storage system and extension cabinet.

The supplied double battery line (length: 5 m) must be routed from the power unit of the storage system through the cable entry points to the battery coupling inside the extension cabinet. The double battery line must not be extended because this would cause increased voltage drops and malfunctions.

▶ Note the size of the connector on the battery lines in terms of routing the line (e.g. when guiding it through the cable ducts).

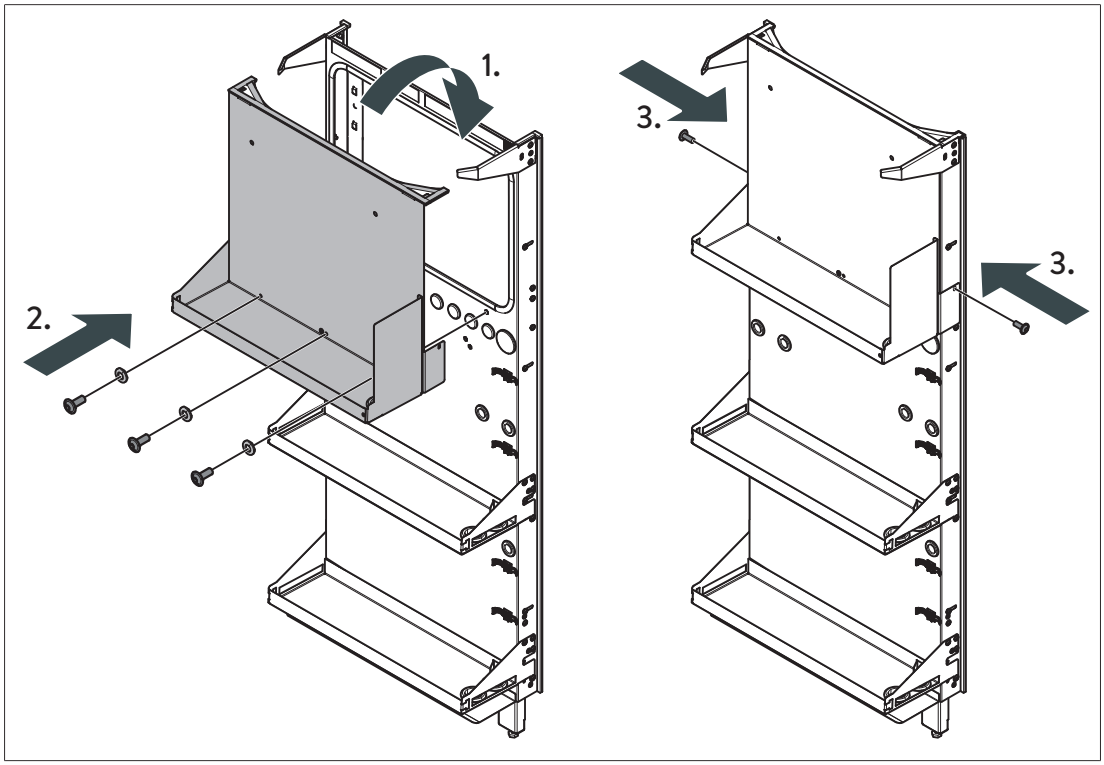
7.1.2 Installing the mounting frame

- Install the mounting frame on the wall as described in section Securing the mounting frame [P. 24].

Sealing the openings [P. 26]:

- Remove the four dummy plugs (diameter: 27.8 mm) for the extension cabinet from the extension set.

Completing the mounting frame [P. 27]:

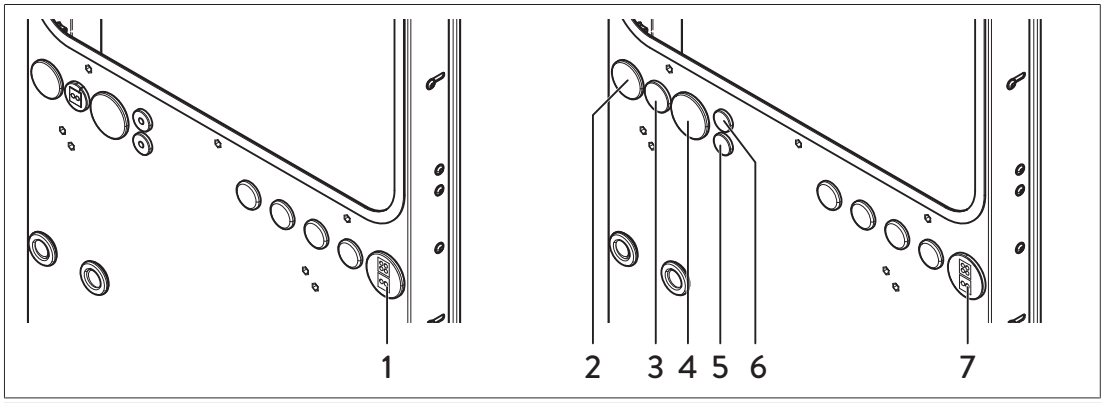


- Install the battery shelves included in the extension set on the mounting frame as shown in the figure. To do this, use the three screws with contact discs provided in the installation equipment pack and the pre-assembled screws on the mounting frame.
- Tighten the screws with a torque of **6 Nm**.

7.1.3 Line entry point

The specified degree of protection for the storage system and therefore touch protection and protection against the ingress of foreign bodies is only achieved when all openings on the storage system are sealed as described in the product documentation.

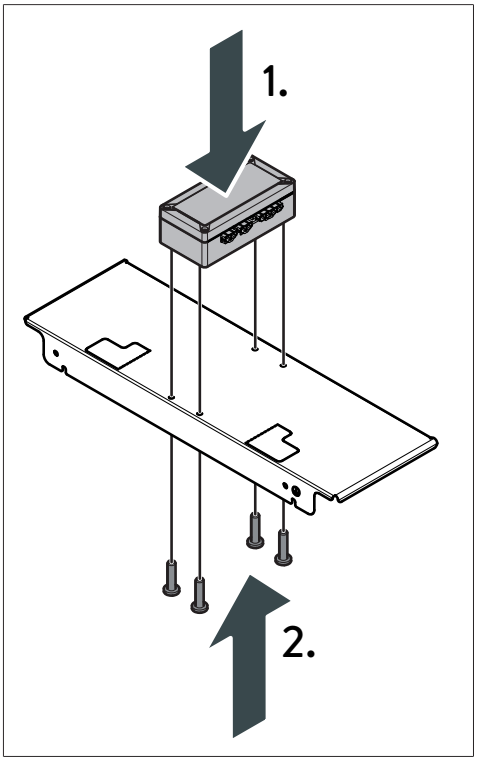
- Remove the reserve dummy plug (∅ 50) for the extension cabinet on the storage system.
- Use the cable entry points and grommets, if any, from the extension set to direct the lines into the storage system and the extension cabinet.



No.	Type	Use
1	Cable entry plate (∅ 50)	**Top:** battery line (four individual lines) **Bottom:** 2 × BMS communication lines
2	Dummy plug (∅ 40)	For sealing
3	Dummy plug (∅ 32)	For sealing
4	Dummy plug (∅ 50)	For sealing
5	Dummy plug (∅ 20.5)	For sealing
6	Dummy plug (∅ 20.5)	For sealing
7	Cable entry plate (∅ 50)	**Top:** battery line (four individual lines) **Bottom:** 2 × BMS communication lines

Correct assembly must be observed when inserting the grommets into the cable entry plates. The flat side of the grommet must always be facing the flat side in the cutout of the cable entry plate.

7.1.4 Mounting the battery coupling



- Mount the battery coupling from the extension set to the spacer plate using the four supplied screws.

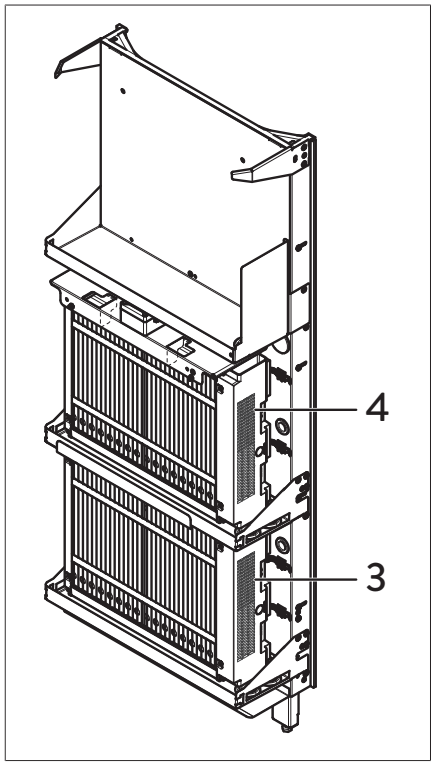
7.2 Connecting the extension cabinet

The scope of delivery includes the battery lines, BMS communication lines and battery screws for the highest extension level of the storage system. If the maximum number of battery modules is not being installed:

- Store the surplus components in the storage system (e.g. on the floor plate). These will then be on hand if additional battery modules are installed later.
- Ensure that the components are not damaged (e.g. when the cover is attached and removed).

7.2.1 Positioning the battery modules

If two sonnenModule 4 battery modules are installed in the extension cabinet, the upper battery shelf remains empty.



- Place the battery modules in the extension cabinet as shown in the figure.
- Mount the battery modules like those in the storage system (see Mounting battery modules [P. 49]).

7.2.2 Connecting the BMS communication lines

- The first and last battery module are connected to the central unit of the storage system using two BMS communication lines. These two lines are guided through the cable entry plates on the storage system and on the extension cabinet.
- The battery modules are connected to each other via the BMS communication lines as described in section Connecting the battery modules [P. 51].

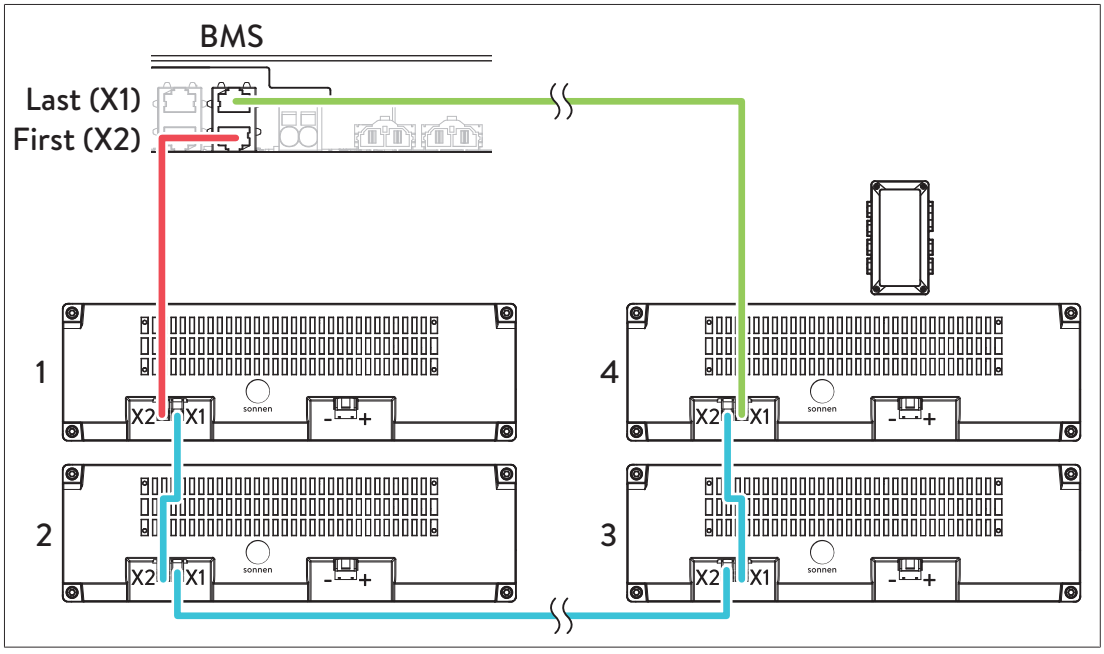


Illustration 24: sonnenModule 4 battery modules

▶ Connect the BMS communication lines as shown in the figure.

The first battery module (in the storage system) is connected to the **BMS First (X2)** socket on the central unit of the storage system. The last battery module (in the extension cabinet) is connected to the **BMS Last (X1)** socket on the central unit of the storage system.

7.2.3 Connecting the battery lines

⚠ DANGER

High battery voltage (> 200 V)

Danger to life due to electrocution!

When battery lines are connected, the battery coupling always carries the voltage of the battery modules, even if the storage system and mains voltage are switched off.

To disconnect the battery voltage from the battery coupling:

▶ Unplug the battery lines from **all** battery modules.

- The battery modules in the extension cabinet are connected to the battery coupling using the battery lines.
- The battery coupling is connected to the central unit of the storage system using the double battery line.

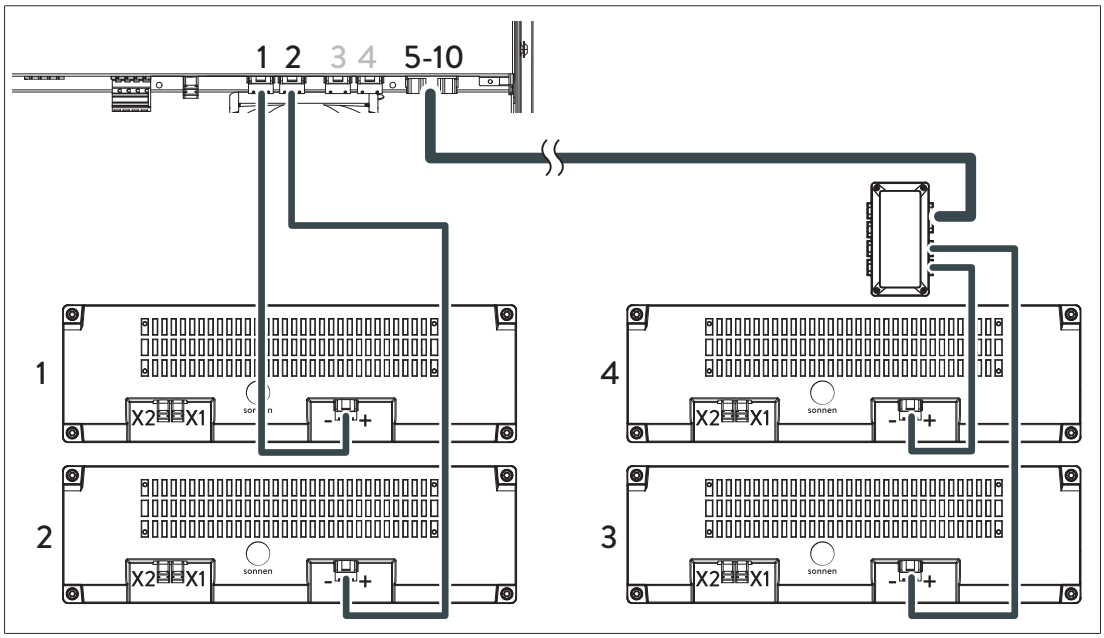


Illustration 25: sonnenModule 4 battery modules

▶ Connect the two battery modules to sockets **9 and 10** on the battery coupling as shown in the figure.

7.3 Completing the extension cabinet installation

Filling out and adding to the type plate

✓ If the storage system is being commissioned with the extension cabinet for the first time:

▶ Mark the relevant values on the type plate (see Filling in the type plate [P. 94]).

✓ If the storage system has already been commissioned for the first time without an extension cabinet:

- Invalidate the existing storage capacity notation on the type plate of the storage system.
- Mark the new installed storage capacity on the type plate.

Mounting the cover and switch cover

- Mount the extension cabinet completely, similarly to the storage system (see Attaching the cover [P. 94] and Attaching the switch cover [P. 95]).

Continuing the installation of the storage system

- When the extension cabinet is completely mounted and sealed, continue with section Checking the installation [P. 95].

8 Using digital inputs/outputs (optional)

NOTICE

Connection lines too long

▶ Ensure that the mains and signal lines are dimensioned so that the selected conductor cross-section is sufficient for the required line length. sonnen recommends a maximum line length of 30 m for the mains and signal lines.

NOTICE

Over voltage when switching off electromagnetic relays

Damage to components!

▶ Only use electromagnetic relays with a protective circuit (e. g. with a free-wheeling diode) or semiconductor relays.

The wiring configurations described in the following are examples only; they do not apply universally and serve only as a guide for the electrician performing the installation. The electrician performing the installation is responsible for connecting the system correctly. In some cases, the permission of the distribution network operator (DNO) or power supply company may be required.

External components (terminals, contactors, relays, etc.) needed to wire up the digital inputs/outputs are not supplied.

8.1 Overview of digital inputs and outputs

- The signal line for using digital inputs and outputs is connected directly to the central unit of the storage system. This approach ensures flexible use of the special functions, as only the required connections are used and the line lengths can be adapted individually to the on-site conditions.
- The connections on the central unit of the storage system are marked as **DI/DO** with numbers 1–20. The following table shows which number stands for which digital input or output and indicates the possible wire cross-sections for the signal lines used.
- Two relays are additionally installed on the central unit, which are required in order to use PV reduction. These relays are labelled as **PV red.**.

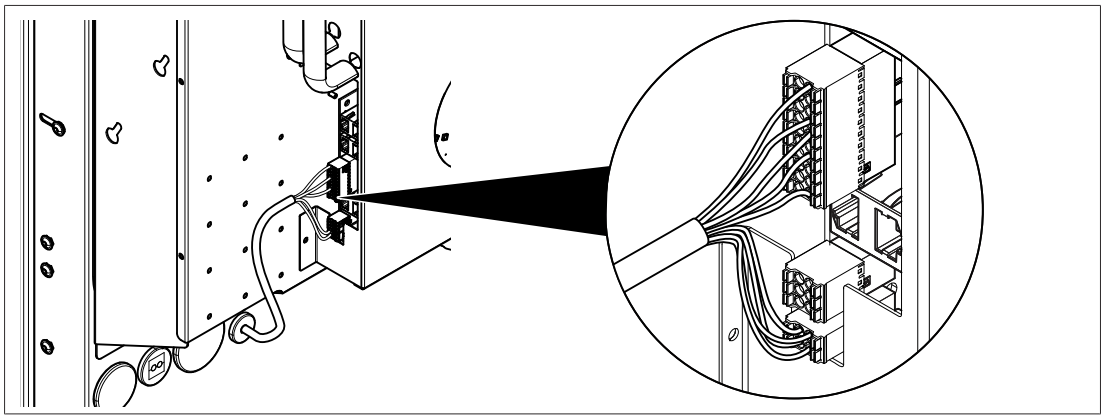


Illustration 26: Position of connections on the central unit

▶ Use the fixing ties from the accessory kit to affix the attached line to the power module.

Label	Function	Wire cross-section [mm²][6]	Voltage [VDC]	Max. amperage [mA]
1 DO GND	Digital output *GND*	0.25–1.5	0	350
2 DO GND	Digital output *GND*	0.25–1.5	0	350
3 DO RES	Reserve	0.25–1.5	-	-
4 DO RES	Reserve	0.25–1.5	-	-
5 DO CHP	Digital output *CHP*	0.25–1.5	24	50
6 DO SCR	Digital output for self-consumption switch	0.25–1.5	24	50
7 DO GEN	Reserve	0.25–1.5	-	-
8 DO RES	Reserve	0.25–1.5	-	-
9 DI 24V	Supply voltage for digital inputs	0.25–1.5	24	50
10 DI 24V	Supply voltage for digital inputs	0.25–1.5	24	50
11 DI FLAT	Digital input for sonnenFlat	0.25–1.5	24	50
12 DI CHP	Digital input *CHP*	0.25–1.5	24	50
13 DI RES	Reserve	0.25–1.5	-	-
14 DI CEI0-21 E	Digital input CEI 0-21 external signal	0.25–1.5	24	50
15 DI CEI0-21 L	Digital input CEI 0-21 local signal	0.25–1.5	5	25
16 DI CEI0-21 T	Digital input CEI 0-21 remote shut-off	0.25–1.5	5	25
17 N.C.	Reserve	0.25–1.5	-	-
18 CEI 0-21 GND	CEI 0-21 *GND*	0.25–1.5	0	50
19 ATS	Reserve	0.25–1.5	-	-
20 ATS GND	Reserve	0.25–1.5	-	-

Table 3: Technical data for digital inputs (DI) and outputs (DO)

PV red. (1 | 1)	PV reduction 1	0.25–1.5	5-60 (*SELV*)	300
PV red. (2 | 2)	PV reduction 2	0.25–1.5	5-60 (*SELV*)	300

Table 4: Load capacity of relays for PV reduction

8.2 Connecting digital inputs/outputs

8.2.1 Implementing PV reduction

No external relays are needed for PV reduction, as the necessary relays are already integrated in the central unit of the storage system.

NOTICE

Overloading of relays for PV reduction

Damage to relays on the central unit!

- Only load the relays for PV reduction (PV red. 1 and PV red. 2) up to a maximum voltage of 60 V (*SELV*) and a maximum amperage of 300 mA.

Using the PV reduction digital outputs - PV reduction 1 and 2 - is a good idea if the feed-in power of the PV system must not exceed a fixed value (feed-in limit).

[6] The use of flexible conductors with end ferrules with plastic sleeves allows the following conductor cross-sections: 0.14–0.75 mm².

The PV reduction digital outputs can be used to automatically control the output power of the PV inverter so that the feed-in power does not exceed the required value in a 10-minute average interval.

Function

The **PV red. 1** and **PV red. 2** connections on the central unit of the storage system are **potential-free contacts**. PV reduction 1 and 2 are activated and deactivated automatically by the storage system depending on the current feed-in power.

When the feed-in power falls below the feed-in limit, both contacts are deactivated. This corresponds to level 0. As soon as power reduction is required, the contacts are activated in levels as shown in the following table. If level 1 does not achieve the desired effect, for example, then level 2 is activated, and so forth.

Relay / Level	0	1	2	3
PV red. 1				
PV red. 2				

Table 5: Make contact positions depending on activated level

Connecting PV reduction

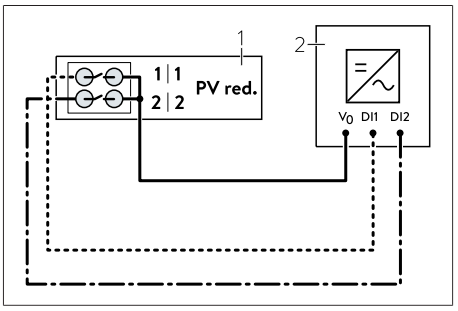


Illustration 27: Connecting PV reduction

1 Connecting PV reduction to the storage system

2 PV inverter with interface for power control

Prerequisite:

✓ The PV inverter has a suitable interface for power control (e. g. an interface for a ripple control receiver).

▶ Wire PV reduction as shown in the figure here.

Configuring settings

- The reduction levels for the PV system are set in the commissioning assistant and on the PV inverter of the PV system.

▶ Set the desired reduction levels in the commissioning assistant of the storage system on page PV System and on the PV inverter.

Level	Max. active power
0	100 % of the PV system power
1	Feed-in limit of PV system in % **plus** 10
2	Feed-in limit of PV system in % **minus** 15
3	1 %

A power specification of 0 % causes some PV inverters to disconnect from the grid, stopping energy production and leading to a complete restart. This behaviour is not required to operate the storage system and may reduce the service life of the PV inverter. Sonnen therefore recommends setting reduction level 3 to 1 % as a default.

The values for levels 1 and 2 depend on the **individual** feed-in limit of the PV system in question. The addition or subtraction of the stated percent values leads to an optimal regulation by the storage system.

Example: The feed-in of the PV system is limited to 50 % of the rated power. The following values need to be set:

Level 1	**60 %** (50 % plus 10)
Level 2	**35 %** (50 % minus 15)
Level 3	**1 %**

Important note: The percentages specified refer to the nominal power of the PV system in each case. If the inverter power is not identical to the PV system power, it may be necessary to convert the percentages to the inverter power, depending on the type of inverter and the setting options.

For the above example:

- The PV power is 9 kWp and the inverter power is 8 kWac.

Calculation: 80 % * 9 kWp = 7.2 kW; 7.2 kW / 8 kWac = 90 %

Result**:** Enter 90 % (not 80 %) on the inverter for level 1!

8.2.2 Using electrical consumers for self-consumption optimisation

When **digital output** (*DO*) **Self-consumption switch** is used, the controls of the storage system activate an external electrical consumer in certain circumstances, which holds the existing surplus of electricity.

Function

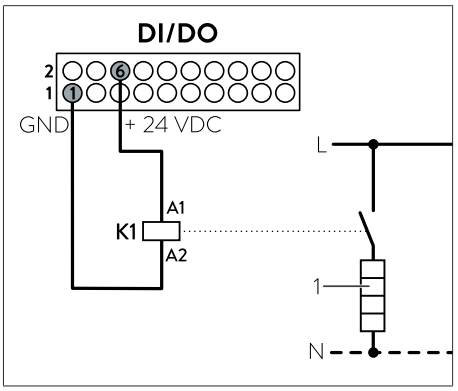
Digital output 'Self-consumption switch' is activated as soon as a defined production surplus (= production - consumption - charging of storage system) has been reached. The production surplus is defined by the Threshold to start (in watts). If the surplus electricity exceeds this limit, the digital output remains activated for the duration of the defined Minimal on time (in seconds).

Configuring settings

The switching behaviour of the self-consumption switch is controlled using the commissioning assistant.

- ▶ Adapt the Threshold to start and Minimal on time for the connected electrical consumer.

Application example



1 Heating element

K1 External contactor

Activating and deactivating a heating element

The heating element (1) is connected to digital output 'Self-consumption switch' via an external contactor and can be activated or deactivated as needed. The nominal power of the heating element (1) was set as Threshold to start.

NOTICE! The heating medium must be prevented from excessive heating using suitable safety measures.

8.2.3 Using additional external electrical generators

If **digital output** (*DO*) **CHP** is used, the controls of the storage system activate an external electrical generator, e.g. a combined heat and power station, as soon as defined charging state conditions are met.

Function

As soon as the state of charge (*SOC*) of the storage system drops below a defined value (Charge state to start CHP), the digital output is activated. The digital output and thus the electrical generator remain activated until the state of charge (*SOC*) of the storage system reaches a defined maximum charging state (Charge state to stop CHP). Surpluses of electricity from the electrical generator are used to charge the storage system. In order for this to be included in calculations correctly when controlling the flows of energy in the building, the power output of the electrical generator must be recorded (see Recording constant power of an electrical generator [P. 68]).

Using a combined heat and power station as an electrical generator

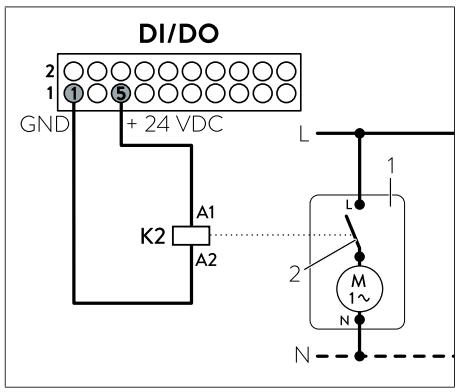
If a combined heat and power station is used as an electrical generator, it must be ensured that it mostly functions as a heat provider, i.e. the highest priority for production is the hot water supply, while production of electricity generally takes second priority. This means that when digital output CHP of the storage system is activated, the combined heat and power station may not start producing electricity immediately.

Configuring settings

The switching behaviour of the digital output is controlled using the commissioning assistant.

- ▶ Set the lower limit of the charging state at which the digital output and therefore the electrical generator are activated (Charge state to start CHP).
- ▶ Set the upper limit of the charging state at which the digital output and therefore the electrical generator are deactivated (Charge state to stop CHP).

Application example



1 CHP
2 Contact for activating CHP unit
K2 External relay

Activating and deactivating a CHP unit

The combined heat and power station (1) is activated or deactivated using digital output CHP. The prerequisite for this is that the CHP unit must be available via a suitable interface (2) for activation/deactivation.

8.2.4 Recording constant power of an electrical generator

The use of digital inputs/outputs described here is **only permitted for electrical generators with a constant power output**. Generators with fluctuating power output, such as modulating combined heat and power stations, must **not** be connected in this way.

If **digital input** (*DI*) **CHP** is used, the controls of the storage system include the power of the connected electrical generator (e.g. a combined heat and power station) in calculations for controlling flows of energy.

Function

When digital input *CHP* is activated, the storage system adds the power output of the electrical generator to current production calculations. The power output of the electrical generator must be constant for this, as the digital input only detects the statuses of activated or deactivated.

Configuring settings

The power generated by the electrical generator is specified in the commissioning assistant.

- ▶ Activate the combined heat and power station on page Features.
- ▶ Specify the constant power of the combined heat and power station (Power).

Application example

The type of connection for digital input CHP depends on whether the CHP unit has a potential-free operating contact or not.

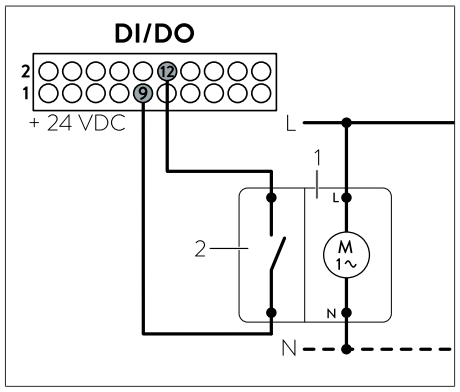


Illustration 28: Example: CHP unit with operating contact

1 Combined heat and power station

2 Potential-free operating contacts of the CHP unit (open if the station is not operating, closed if it is)

Combined heat and power station with operating contact

If the combined heat and power station (1) has a potential-free operating contact (2), it can be connected as shown in the figure. As soon as the operating contact (2) closes, digital input CHP will be activated.

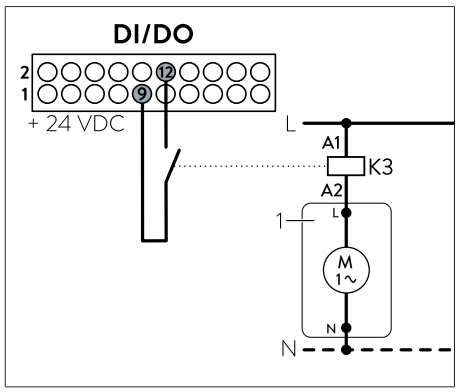


Illustration 29: Example: CHP unit without operating contact

1 Combined heat and power station

K3 Relay

Combined heat and power station without operating contact

If the combined heat and power station (1) does not have a potential-free operating contact, it can be connected as shown in the figure. In this set-up, a relay is used to detect whether the generator is active. This information is forwarded to the storage system via a potential-free make contact in the relay.

8.2.5 Recording fluctuating power of an electrical generator

- The power of an electrical generator that does not produce constant output cannot be recorded via digital input *CHP* (see Recording constant power [P. 68]).

▶ Instead, the electrical generator has to be integrated in the power measurement via a separate measurement point. This may require an additional power meter and the corresponding setting of the additional measurement point in the commissioning assistant.

Further information on power measurement and the power meter can be found in the power meter instructions[7]. These instructions explain, among other things, the different measurement concepts and how to use multiple power meters.

[7] Document number: 401

Example: combined heat and power station with CP measurement concept

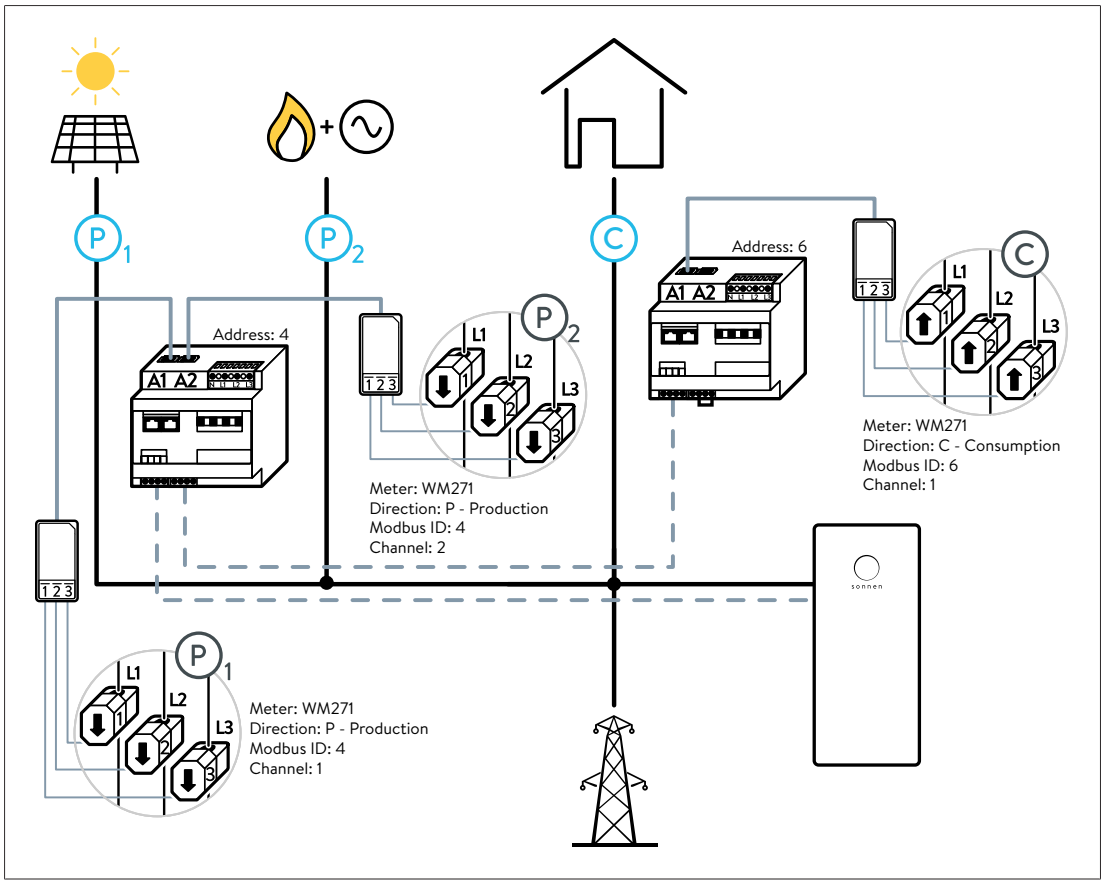


Illustration 30: Example of implementation of CP measurement concept with a CHP unit as additional generator

Information for the example

- Storage system without PV connection.
- Measurement concept: CP (Consumption Measurement).
- Measurement point C: measurement point for recording consumption in the building.
- Measurement point P_1: measurement point for recording production for the PV system.
- Measurement point P_2: measurement point for recording production for the CHP unit.
- The circuits show the connection of the clamp-on current transformer at the measurement points.

9 sonnenProtect 4000 (optional)

- Both when the sonnenBatterie 10 is first being installed and after the fact, a sonnenProtect 4000 can be added to the system.

▶ Observe the Safety [P. 7] information for the storage system and sonnenProtect at all times!

▶ Observe the Storage and transport [P. 12] instructions for the storage system at all times, as these also apply to the sonnenProtect.

▶ Note that if installed after the fact (after the storage system has already been commissioned without sonnenProtect), changes may be needed to the power measurement and electrical installation in the building.

Connection options for the sonnenProtect

Single-phase mains only: The sonnenProtect can be installed so that backup power is supplied to the entire building network in the event of a grid outage (**connection option 1**). This is possible for the on-site connection **up to an amperage of 20 A**.

If the on-site connection is three-phase or designed for a higher amperage, **separate backup circuits** must be installed (**connection option 2**). In this case, when there is a grid outage only the electrical consumers connected to the backup circuits are supplied with electricity from the sonnenProtect.

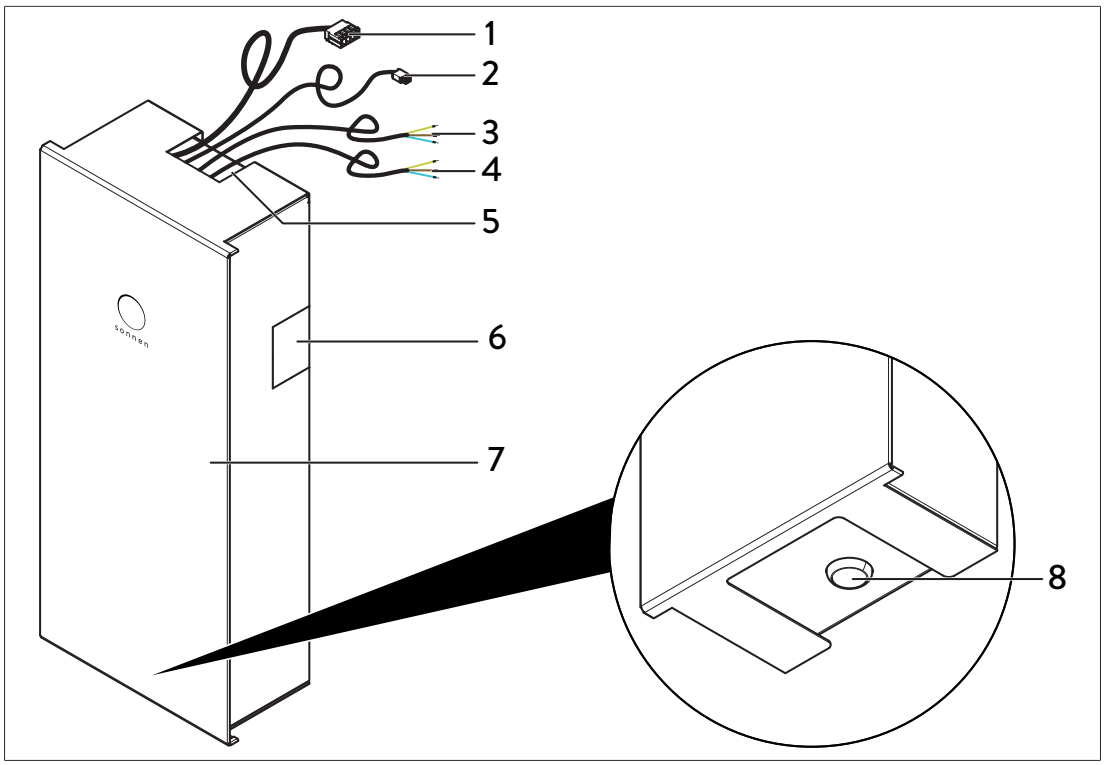
Both connection options can be implemented as a standalone power system using an electrical generator (e.g. PV system) (see Connecting AC microgrid (optional) [P. 87]).

▶ Note that the following descriptions indicate which connection option they are valid for.

Adding a sonnenProtect to the storage system allows the system, once installed, to be able to operate both with backup power and in an isolated network. These are functionalities that must be specified when a storage system is registered with a *DNO*.

▶ Check whether the storage system data needs to be changed with the *DNO* or whether the system needs to be re-registered.

9.1 System components of the sonnenProtect



1	IN line from storage system	5	Cutout for cable duct
2	Signal line to storage system	6	Cutout for additional cable duct
3	OUT line to backup circuit	7	sonnenProtect
4	IN line from building distributor	8	Illuminated switch

9.2 Illuminated switch function

- The illumination of the illuminated switch indicates that the electrical consumers connected to the sonnenProtect are causing excessive power consumption.
- Backup operation is stopped when an overload is detected until there is no more overload and the illuminated switch has been pressed for approx. 2 seconds.

When the illuminated switch lights up:

▶ Switch off electrical consumers in the backup circuit or do not connect any electrical consumers to the backup circuit if their power consumption exceeds the nominal power or (when switching on) the maximum power of the sonnenProtect.

▶ Press the illuminated switch for approx. 2 seconds.

⇨ Backup operation has started successfully when the illuminated switch no longer lights up.

In certain situations it may take up to three minutes for backup operation to start after the illuminated switch is pressed.

▶ Further information for specific situations can be found in section Troubleshooting [P. 102].

9.3 Type plate

The type plate is located on the outer surface of the sonnenProtect. The type plate can be used to uniquely identify the sonnenProtect. 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

A duplicate of the type plate for the sonnenProtect 4000 must be affixed by the installer to the storage system (see Attaching type label [P. 84]).

9.4 Additional parts required

- **In addition** to the materials specified in section Additional parts and tools required [P. 20], the following parts and tools are required to assemble and install the sonnenProtect.
- The lines and circuit breakers required differ depending on the selected connection option and on whether this option is installed as an AC microgrid.

Cables, circuit breakers

Designation	Use	Specification
Connection option 1 (backup power supply for entire 1-phase mains connection)		
Residual current device (RCD)	Personal protection	• Fuse protection for the backup circuit(s). • Nominal differential current: max. 300 mA • Type depends on local grid conditions.
Miniature circuit breaker (MCB)	Fault protection for on-site connection	• Rated current: max. 20 A
Miniature circuit breaker (MCB)	Fault protection for electrical generators (e.g. PV inverters) *(for AC microgrid only)*	• Observe the manufacturer's specifications.
Relay	Implements PV reduction when output > 3.4 kW *(for sB10/5.5 with AC microgrid only)*	• Coil voltage: 230 V • 1 break contact. • e.g. manufacturer: Eltako, item designation: ER12-110-UC
Earth line	Earth connection for main earth bar	• Cable cross-section: 10 mm^2 (CU cross-section)
Plastic-sheathed cable	Connection of electrical generators (e.g. PV inverters) *(for AC microgrid only)*	• Observe the manufacturer's specifications.

Designation	Use	Specification
Connection option 2 (backup power supplied to separate backup circuits)		
Residual current device (RCD)	Personal protection	• Fuse protection for backup circuits during backup operation. • Nominal differential current: max. 300 mA • Type: depends on local grid conditions.
Miniature circuit breaker (MCB)	Fault protection for sonnenProtect	• Tripping characteristic: B • Nominal current: max. 20 A
Miniature circuit breaker (MCB)	Fault protection for electrical generators (e.g. PV inverters) *(for AC microgrid only)*	• Observe the manufacturer's specifications.
Relay	Implements PV reduction when output > 3.4 kW *(for sB10/5.5 with AC microgrid only)*	• Coil voltage: 230 V • 1 break contact. • e.g. manufacturer: Eltako, item designation: ER12-110-UC
Earth line	Earth connection for main earth bar	• Cable cross-section: 10 mm² (CU cross-section)
Plastic-sheathed cable	Connection of electrical generators (e.g. PV inverters) *(for AC microgrid only)*	• Observe the manufacturer's specifications.
Additional electrical lines, circuit breakers and other components (e.g. distributor housing)	Creation of backup circuit(s)	• Depends on local conditions and the planned execution of the backup circuits.

Material

Quantity	Designation	Use
4	Screws	• For securing the sonnenProtect to the wall. • Type and length adapted to the weight of the sonnenProtect and the properties of the wall.
4	Washers	• For establishing contact between the screws and sonnenProtect.
4	Wall plugs	• For anchoring the screws to the wall. Type and length adapted to suit the screws used.
	Cable duct	• For routing lines into the sonnenProtect. • Size: 60 × 40 mm; length individual.

9.5 Installing the sonnenProtect

- The sonnenProtect can be mounted to the left or right of the storage system or extension cabinet (if any).

Requirements for the installation location

▶ Observe the required ambient conditions (see Technical data [P. 105]).

Observing minimum and maximum distances

▶ Install the sonnenProtect at the same level as the top edge of the storage system, if possible.

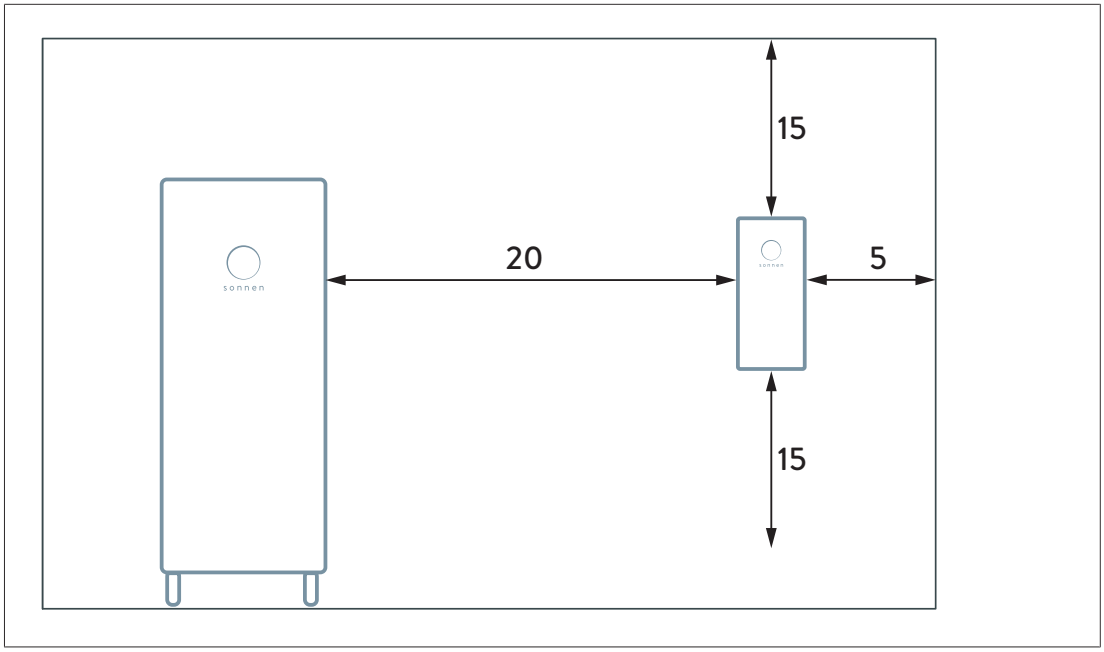


Illustration 31: Minimum distances (figure not true to scale - all measurements in centimetres)

- Observe the **minimum distances** to the storage system and to neighbouring objects, walls and ceilings.
- Ensure that there is not too great a distance between the sonnenProtect and storage system so that the length of the pre-mounted lines is sufficient (approx. 5 m). In doing so, also observe the required line lengths for routing the lines in a cable duct.

Removing the cover

- Remove the cover of the sonnenProtect.

Drilling the holes

- Mark out the four holes on the back of the sonnenProtect on the wall.
- Drill the holes with a suitable diameter for the selected mounting material.
- Insert suitable wall plugs in the holes.

Mounting the sonnenProtect

- Use suitable screws and washers to secure the sonnenProtect to the wall.

9.6 Connecting the sonnenProtect

⚠ DANGER **Electrical work on the storage system and electrical distributor**

Danger to life due to electrocution!

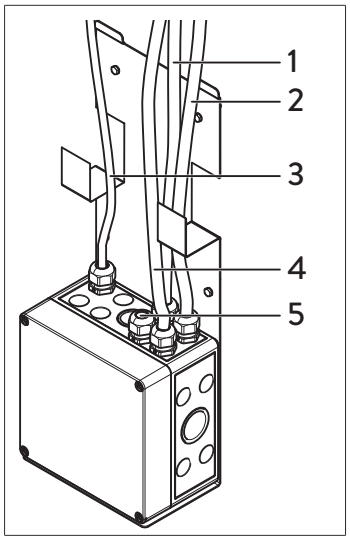
- Switch off the storage system to electrically isolate it.
- Disconnect the relevant electrical circuits.
- Secure against anyone switching on the device again.
- Wait five minutes so the capacitors can discharge.
- Check that the device is disconnected from the power supply.
- Only authorized electricians are permitted to carry out electrical work.

⚠ DANGER **Touch voltage in the event of a fault during backup operation**

Danger to life due to electrocution!

- A selective *residual current device (RCD)* with a nominal differential current of 300 mA must be installed downstream of the sonnenProtect output. Nominal differential currents of 100 mA or 30 mA are also possible. The type of RCD must be selected depending upon the local conditions of the network.

Observe the sealing area for pre-mounted cable glands on the sonnenProtect when connecting the lines (sealing area: 16–28 mm).



1 AC line from storage system (AC Protect)
2 AC line from building mains (AC grid)
3 Signal line from storage system (Protect)
4 AC line to backup circuit or building mains (AC load)
5 Reserve cable entry point

Recommended order for the electrical installation

- Carry out the steps in the following order to ensure the smooth electrical installation of the sonnenProtect. Note that there are different procedures depending on the connection option used.

1. **For connection option 1:** Note section consumers in backup operation [P. 77] before starting to install the sonnenProtect.
2. **For connection option 2:** Read sections consumers in backup operation [P. 77] and Implementing the backup circuit(s) [P. 78] and, together with the operator, define how the backup circuit or circuits are to be set up. The on-site circumstances must always be taken into account during this process, because with electrical installations where there are few separate circuits, it can be difficult to integrate all of the desired electrical consumers in the backup circuit or to integrate only the consumers which should be supplied with backup power.

3. Carry out the necessary revision work on the distributor in the building. It is essential to ensure that all electrical lines meet local and national regulations in terms of their dimensioning and that they are suitably fuse-protected (e.g. with a *miniature circuit breaker (MCB)*.
4. If the circuits are installed accordingly, the sonnenProtect can be connected and the necessary additions can be made to the storage system (see the following sections).
5. When all steps have been implemented and the electrical installation is complete, continue with section Commissioning the sonnenProtect [P. 85].

9.6.1 Electrical consumers in backup operation

Prior to installation, the following points must be explained to or clarified with the operator by the electrician performing the installation:

- Backup operation does not offer the same output as grid operation.
- Electrical consumers can sometimes not be operated in backup operation (e.g. due to high switch-on currents).
- **How much capacity of the storage system should be reserved as an backup buffer?** The following example, in which a utility room and other important functions within a single-family home are to be supplied with power, can be used to determine this. This example is based on a grid outage lasting one hour (the individual power consumption values are estimated values).

Electrical consumer	Power consumption [kW]	Active during grid outage [h]	Electrical work [kWh]
Lighting	0.5	1	0.5
Freezer	0.6	0.25	0.15
Heating	0.7	0.25	0.175
Router, telephone	0.01	1	0.01
Refrigerator	0.6	0.25	0.15
Alarm system, grid-connected smoke detector	0.05	1	0.05
		Total	**1.04**

In this example, the total power requirement for a grid outage lasting one hour is approx. 1.1 kWh, which must be covered in order to maintain the function of all of the listed consumers.

▶ Use this calculation to determine with the operator which emergency buffer should be set, taking the total capacity of the storage system and other requirements (e.g. from sonnenFlat contract) into account (see Setting the backup buffer [P. 85]).

- If connection option 2 is used, not all electrical consumers are supplied with power in backup operation. **Which electrical consumers should be supplied with power in backup operation?** The current paths in the building network must be installed in such a way that the consumers which are relevant in the event of a grid outage are connected to an independent circuit (backup circuit). The electrical consumers which are crucial for the electrical supply to the building in backup operation are relevant here.

9.6.2 Implementing the backup circuit(s)

This section refers to the installation of backup circuits for **connection option 2**.

Basics for the formation of the backup circuits:

- For systems with backup power capability, the power distribution must be separated into backup power authorised and not backup power authorised parts.
- All components within the backup power authorised part must be clearly identified by lettering (or graphic symbols).

▶ **At any time observe further local and national requirements and guidelines regarding backup power supply!**

When undertaking electrical work on the distributor in the building, the following must be taken into account, among other things:

1. How is the wiring set up to the desired backup consumers?
   - Is independent wiring already in place?
   - Do the existing circuits include electrical consumers that should not be supplied with power in backup operation?
   - Can the existing wiring be split?
   - If the circuits cannot be split, the connected wattage of the consumers which should not be supplied with backup power needs to be taken into account. If loads are too high, the circuit breaker for the sonnenProtect will trip, and then none of the electrical consumers in the backup circuit will be supplied with power.
2. Can the electrical distributor in the building be adapted to suit the new circumstances?
   - Is there enough space to install the necessary circuit breakers and other components in the distributor?

9.6.3 Positioning components in the electrical distributor

The following components must be installed in the electrical distributor for the sonnenProtect:

- **Miniature circuit breaker (MCB) | type B | 20 A**

A miniature circuit breaker with type B tripping characteristics and a nominal current of 20 A must be installed *at the input line* (Mains line for sonnenProtect, see Overview lines [P. 76]) of the sonnenProtect.

- **Residual current device (RCD)**

A *residual current device (RCD)* must be installed *at the output* of the sonnenProtect. This RCD protects against electric shock in the backup circuit. The *residual current device (RCD)* must meet the relevant country-specific regulations and local grid conditions.

9.6.4 Wiring the sonnenProtect

▶ Connect the sonnenProtect and other components in the electrical distributor as shown in the following circuit diagram overviews (based on selected connection option and type of power measurement).

- The overview circuit diagrams each show the installation of a sonnenBatterie 10 with a **sonnenProtect 4000 without AC microgrid** in **single-phase mains.** The storage system can also be installed in three-phase mains, but only a single-phase backup power system can be formed using the sonnenProtect 4000.

▶ For installation with **AC microgrid**, see section Connecting an AC microgrid [P. 87].

- The grey areas each mark the **installation of the sonnenProtect**.

Measuring power when using a storage system with sonnenProtect:

- The set-up shown in the circuit diagram overview for **connection option 1** follows the **consumption measurement** concept (standard measurement concept).

There are two ways of measuring power when implementing **connection option 2**:

- If **one power meter** (included in scope of delivery) is installed, the building consumption is not explicitly recorded as consumption and shown on the online portal during backup operation. The function of the sonnenProtect is not affected by this.
  - The set-up in the circuit diagram overview follows the **consumption measurement** concept.
- If **two power meters** (one additional power meter to the one already included in the scope of delivery) are installed, the consumption is precisely recorded and shown on the online portal even during backup operation. The second power meter and the associated clamp-on current transformer can be purchased from sonnen; see Optional accessories [P. 20].
  - The set-up in the circuit diagram overview follows the **consumption measurement** concept.

NOTICE! In the circuit diagram overviews, pay special attention to the connection for the voltage measurement of the power meters and the position of the clamp-on current transformer.

Further information on power measurement and the power meter can be found in the power meter instructions[8]. These instructions explain, among other things, the different measurement concepts and how to use multiple power meters.

[8] Document number: 401

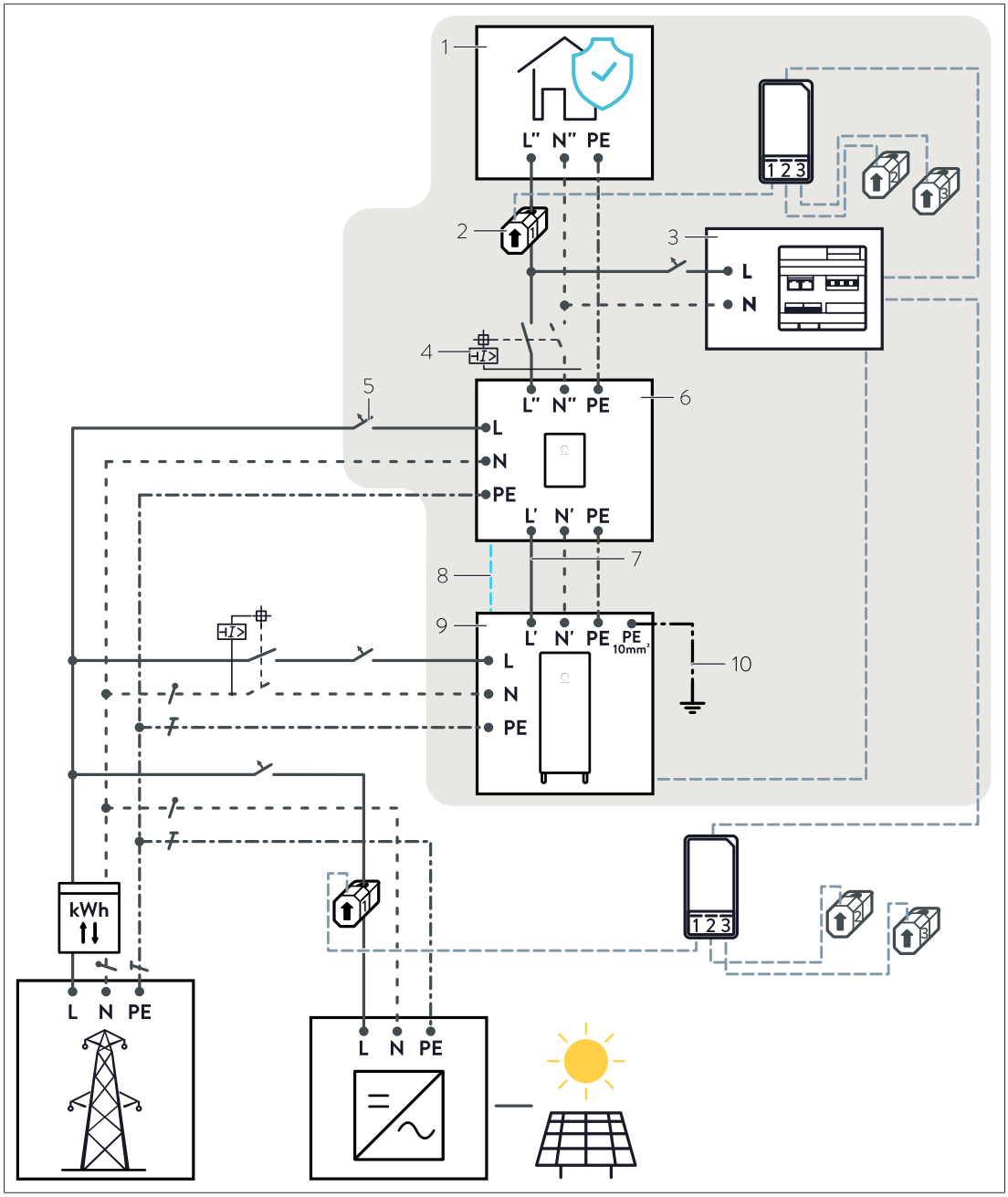


Illustration 32: Circuit diagram overview - sonnenBatterie 10 with sonnenProtect 4000 - Connection option 1

1	Consumers in building	6	sonnenProtect
2	*CT* Consumption	7	AC line from storage system (**AC Protect**)
3	Power meter WM271	8	Signal line from storage system (**Protect**)
4	*Residual current device (RCD)*	9	Storage system
5	*Miniature circuit breaker (MCB)* | max. 20 A	10	Earthing connection

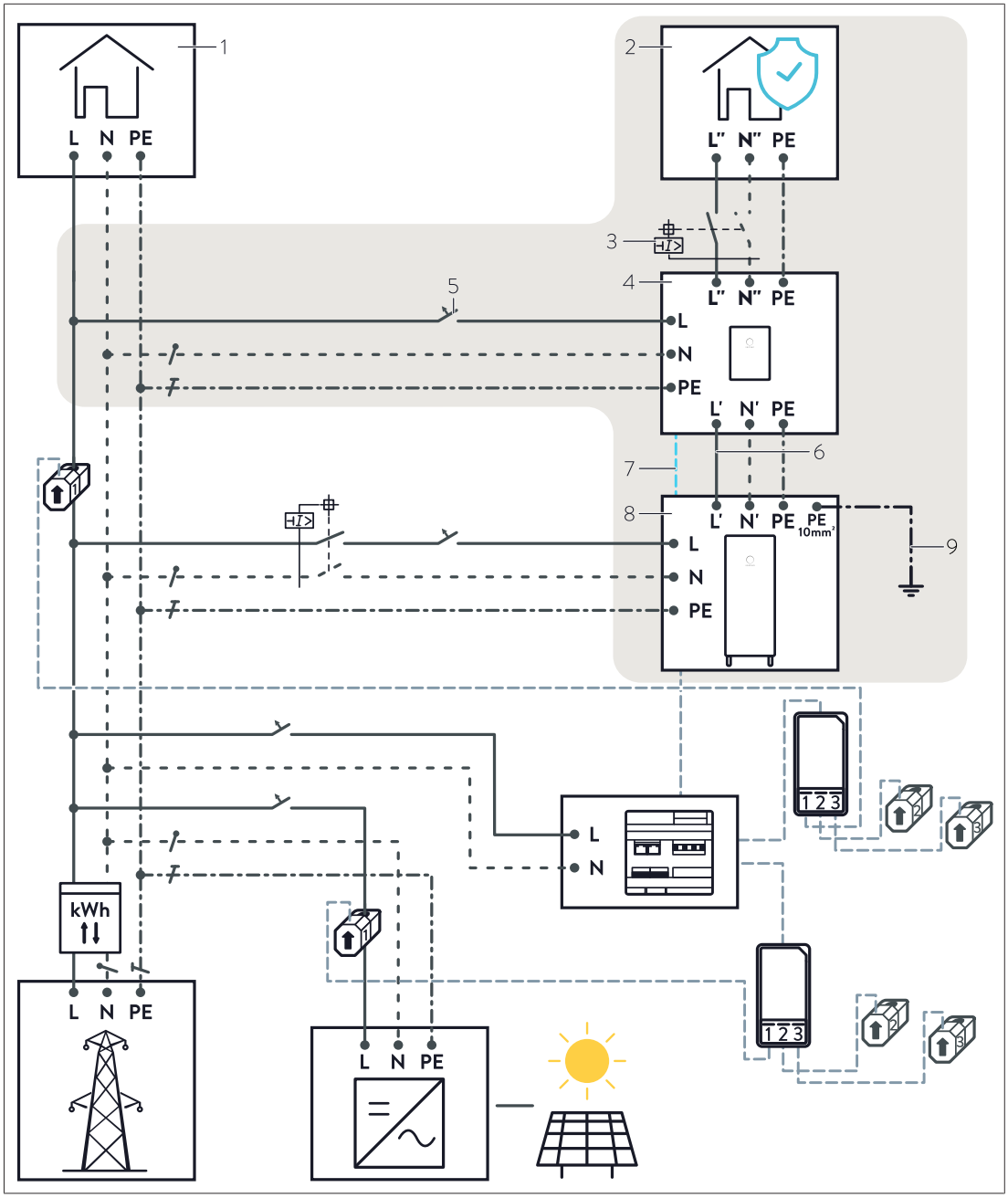


Illustration 33: Circuit diagram overview - sonnenBatterie 10 with sonnenProtect 4000 - Connection option 2 with one power meter (Standard scope of delivery)

1 Consumers in building
2 Consumers in backup circuit
3 *Residual current device (RCD)*
4 sonnenProtect
5 *Miniature circuit breaker (MCB)*
6 AC line from storage system (**AC Protect**)
7 Signal line from storage system (**Protect**)
8 Storage system
9 Earthing connection

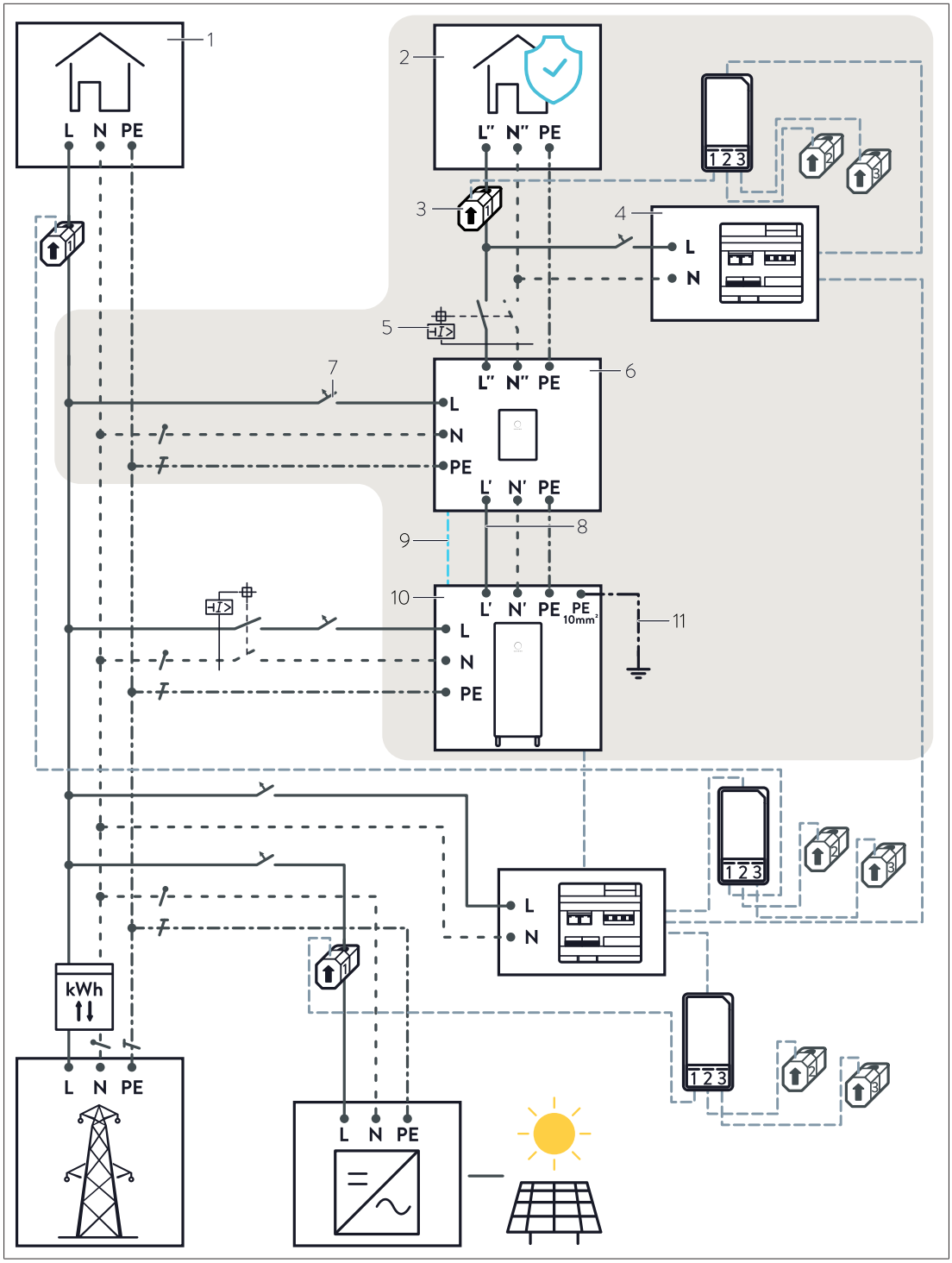
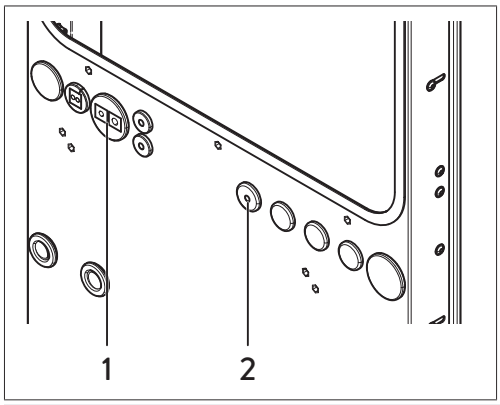


Illustration 34: Circuit diagram overview - sonnenBatterie 10 with sonnenProtect 4000 - Connection option 2 with two power meters

1	Consumers in building	7	sonnenProtect
2	Consumers in backup circuit	8	AC line from storage system (**AC Protect**)
3	*CT* Consumption	9	Signal line from storage system (**Protect**)
4	Power meter WM271	10	Storage system
5	*Residual current device (RCD)*	11	Earthing connection
6	*Miniature circuit breaker (MCB)*		

9.6.4.1 Connecting the lines to the storage system

Routing lines on the storage system

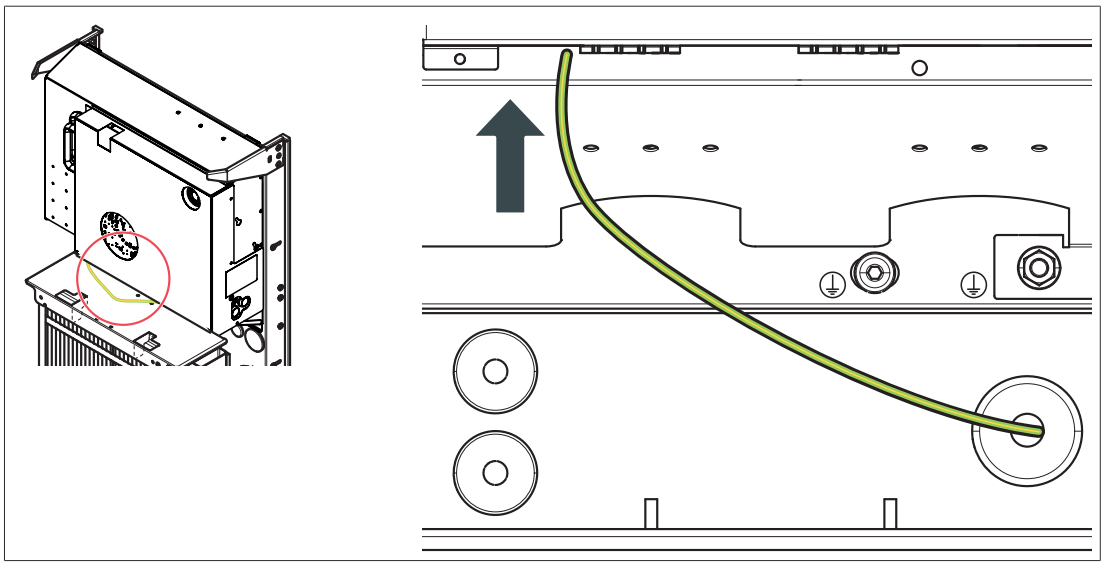


No.	Type	Use
1	Cable entry plate ∅ 50 (from scope of delivery for sonnenProtect 4000)	**Left:** sonnenProtect signal line **Right:** sonnenProtect AC line
2	Dummy plug ∅ 27.8 (already mounted; from storage system accessory kit)	Earthing line 10 mm²

Correct assembly must be observed when inserting the grommets into the cable entry plates. The flat side of the grommet must always be facing the flat side in the cutout of the cable entry plate.

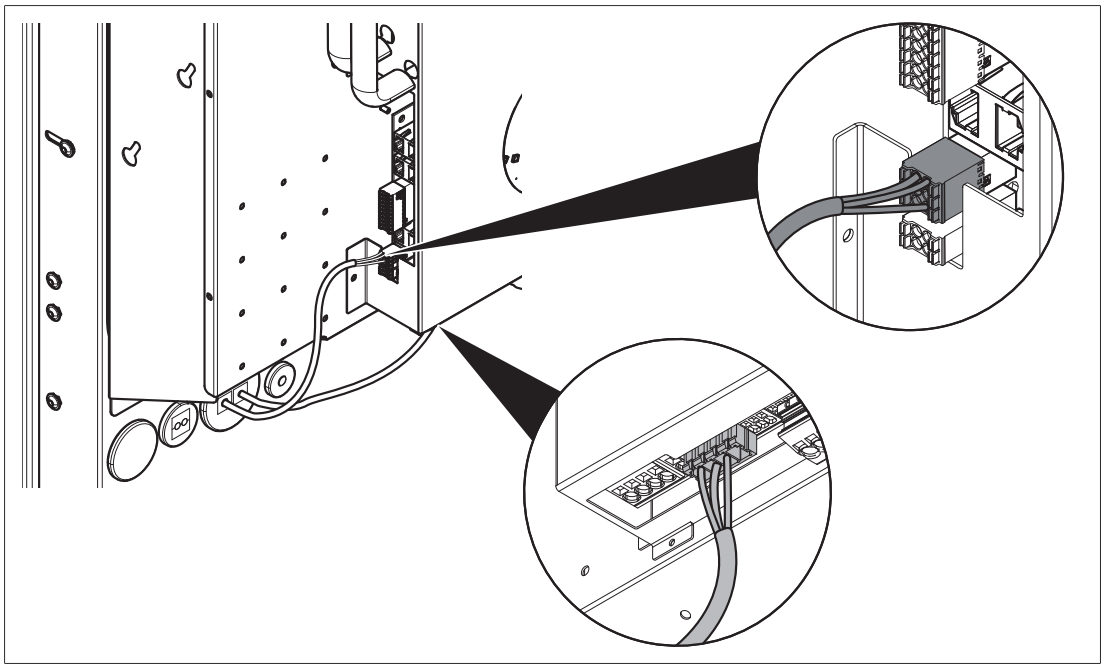
Connecting the earthing line

- An earthing conductor with a cross-section of 10 mm² (CU cross-section) must be installed between the storage system and the main earthing terminal.



- ▶ Connect the earthing line to the central unit of the storage system (**PE 10 mm²**).
- ▶ Connect the earthing line to the main earthing terminal of the building.

Connecting the signal line and AC line



- ▶ Connect the signal line to the central unit of the storage system (**Protect**) using the pre-assembled plug.
- ▶ Connect the AC line to the central unit (**AC Protect**) using the pre-assembled plug.

9.6.5 Attaching safety label to the distributor

⚠ DANGER

Electrical installation remains live in event of grid outage

Danger to life due to electrocution!

To warn electricians:

- ▶ Attach the safety label shown below (included in scope of delivery) to the relevant electrical distributor.

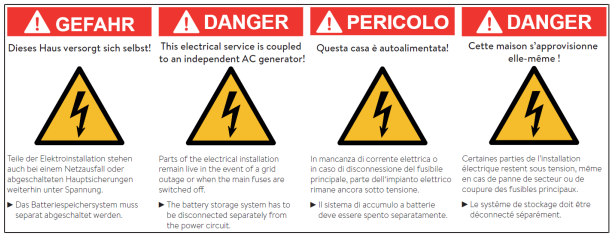


Illustration 35: Label for attachment to the electrical distributor

9.6.6 Attaching type label to storage system

As the sonnenProtect 4000 constitutes an add-on to the storage system, a duplicate of the type plate for the sonnenProtect must be affixed to the storage system.

- ▶ Affix the type plate for the sonnenProtect 4000, which is included in the scope of delivery, to the cover of the storage system above the inspection window.

9.7 Commissioning the sonnenProtect

Closing the sonnenProtect

▶ Attach the cover to the sonnenProtect. To do so, hang the cover on the top side of the sonnenProtect.

Switching on the sonnenProtect

▶ Switch on the grid voltage to the sonnenProtect.

- The sonnenProtect becomes active as soon as the storage system is properly commissioned (see Carrying out first-time commissioning [P. 97]) and switched on (see Switching the storage system on [P. 97]).

Setting up the sonnenProtect

- The sonnenProtect is activated using the commissioning assistant.

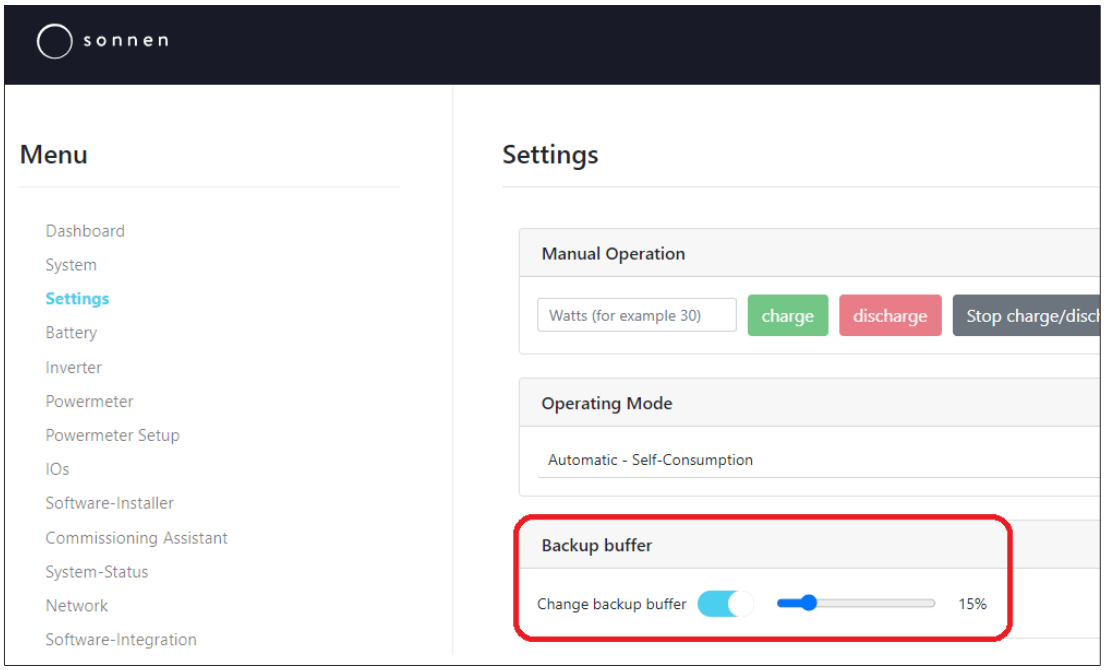
▶ Run through the *CA* (see Commissioning assistant [P. 97]) and activate the sonnenProtect 4000 at the appropriate point. The backup buffer can also be set.

9.7.1 Setting the backup buffer

Proceed as follows to set what percentage of the capacity of the storage system should be available for the sonnenProtect in the event of a grid outage.

▶ On the web interface of the storage system, navigate to the Settings page.

▶ Change the percentage for Backup buffer to a desired value.



9.7.2 Testing backup/standalone operation

Backup operation cannot be tested if the storage system performs a full charge after initial commissioning. The full charge can be stopped to perform the test and postponed to a later time (on the Dashboard page of the storage system web interface).

1. Simulate a grid outage

- ▶ Switch the main fuses in the building off, so that the sonnenProtect and storage system are no longer connected to the public electricity grid. The storage system switches to backup operation after switching off the fuses.

2. Activate a consumer

- ▶ Activate an electrical consumer connected to the building mains (for connection option 1) or to the backup circuit (for connection option 2).

3. Switch on the PV inverter (with AC microgrid)

- ▶ Check whether the PV inverter switches on after a short time.

4. Test the backup supply

Backup/standalone operation (with AC microgrid) is working properly when the activated consumers are supplied with electrical power.

If the backup operation does not work:

1. Check the electrical wiring (see Connecting the sonnenProtect [P. 75]).
2. Check if there is a malfunction which is mentioned in the Troubleshooting [P. 102] section and follow the suggestions for rectification.
3. Contact the sonnen service team if the problem cannot be resolved.

9.8 Decommissioning the sonnenProtect

Switching off the sonnenProtect

To switch off the sonnenProtect manually, proceed as follows: In order to be able to work on the sonnenProtect safely it must be disconnected from the power supply (see next section).

- ▶ Disconnect the storage system from the power supply [P. 100].

Disconnecting the sonnenProtect from the power supply

1. Disconnect the storage system from the power supply [P. 100].
2. Switch off the miniature circuit breaker in the mains line for the sonnenProtect and in the PV inverter supply line (with AC microgrid).
3. Take steps to ensure that these switches cannot be switched on again.
4. Carefully check that there is no voltage inside the sonnenProtect.

9.9 Connecting AC microgrid (optional)

When certain prerequisites are met, the **storage system with sonnenProtect** can form an 'off-the-grid' standalone power system together with an external electrical generator. The PV inverter of a PV system is used in the following example as the external electrical generator.

In standalone operation, electrical power can be produced by the PV inverter off the grid, then stored in the battery modules of the storage system and provided to the building via sonnenProtect. The batteries are charged and discharged based on the requirements of the connected electrical consumers.

Automatic stop and start of standalone operation

The storage system continues to provide electrical power to the consumers via sonnenProtect until a minimum battery charging status is reached and there is no (or no sufficient) PV generation. From this point on, no further discharge is allowed, and the backup operation stops completely.

The storage system tries to restore standalone operation at predefined restart times by checking whether there is sufficient PV production to supply the active electrical consumers with power.

To increase the possibility of standalone operation restarting, there should be as few electrical consumers in the building at the restart time(s) as possible. Therefore:

- ▶ Do not switch on any electrical consumers with high power consumption (e.g. heating, lighting, pumps, compressors).

Overload protection through frequency shift

To ensure that the battery modules are not overloaded by the PV system power production in standalone operation, the storage system inverter increases the frequency from 50 Hz to 52.2 Hz when the state of charge (*SOC*) reaches a level greater than or equal to 91 %.

The PV inverter detects this frequency increase and stops production and therefore charging of the storage system battery modules. The electrical consumers in the building are supplied with power from the storage system battery modules from this point in time.

The frequency is reset to 50 Hz and production starts up again when the state of charge of the battery modules drops below 85 % and standalone operation is active again.

9.9.1 PV system as an electrical generator

9.9.1.1 Requirements for the PV inverter

The PV inverter must have a maximum output of 4.6 kW. With the sonnenBatterie 10/5.5, if the output is higher than 3.4 kW, a power limit must be implemented, e.g. using a relay; see Power reduction for PV inverter with output > 3.4 kW (for sB10/5.5) [P. 88].

- Single-phase PV inverter with max. 4.6 kW AC output.
- Compliance with currently applicable grid codes.
- Mains connection detection via mains frequency shift.
- Meter concept: sonnenProtect sits between PV production meter and feed-in point.
- Digital inputs for power reduction (only necessary for sB10/5.5 and PV inverter with output greater than 3.4 kW).

9.9.1.2 Connecting the PV inverter

The PV inverter is connected as an electrical generator in the building's network (with connection option 1) or in the backup circuit (with connection option 2); see Wiring an AC microgrid [P. 88].

- ▶ Connect the PV inverter and a *MCB* (if required, also a *RCD*) according to the specifications of the PV inverter manufacturer. Country-specific requirements must be observed at all times.

9.9.1.3 Power reduction for PV inverter with output > 3.4 kW (for sB10/5.5)

If the output power of the PV inverter for a sB10/5.5 storage system is greater than 3.4 kW, the output power of the PV inverter must be statically reduced to a maximum of 3.4 kW during standalone operation. A switch relay with a break contact is used for this purpose. The PV inverter must also have a suitable interface for power control.

Tools:

- 1× relay, e.g. manufacturer: Eltako, item designation: ER12-110-UC

Function

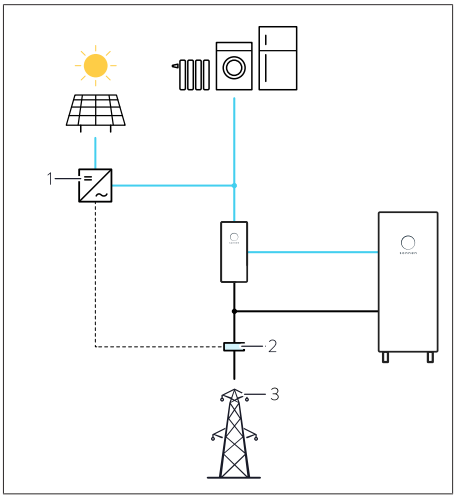


Illustration 36: AC microgrid concept with power reduction (for sonnenProtect with connection option 1)

In grid operation there is 230 V on the relay (2), the break contact opens and there is no signal to reduce power on the PV inverter (1).

If the public electricity grid (3) fails, the 230 V drops off on the relay and the break contact closes the connection to the PV inverter (1). This limits the PV inverter to the set power output.

Important note: When the relay taps the grid voltage, it must be ensured that the potential from the grid connection point is there. The voltage must not be tapped from the distribution board or backup circuits.

PV power reduction with freely programmable reduction levels

If the PV inverter has a free reduction contact and this contact is freely programmable, this contact can be used for PV reduction. To this end the potential-free break contacts of the relay are connected to the free input on the PV inverter. Any power value can then be set as a percentage on the PV inverter.

Example

If the PV inverter has a power output of 4.2 kW, the reduction contact can be set to 80 %. The PV inverter then feeds in a maximum of 3,360 W in standalone operation.

9.9.2 Wiring an AC microgrid

- ▶ Connect the sonnenProtect and other components in the electrical distributor as shown in the following circuit diagram overviews (based on selected connection option and type of power measurement).

- The overview circuit diagrams each show the installation of a sonnenBatterie 10 with a **sonnenProtect 4000 with AC microgrid** in **single-phase mains.** The storage system can also be installed in three-phase mains, but only a single-phase standalone power system can be formed using the sonnenProtect 4000 with AC microgrid.
- The power measurement follows the **consumption measurement** concept. In the circuit diagram overview for connection option 1, only **one electrical generator** (PV system) is connected. In the circuit diagram overview for connection option 2, production is measured for **two electrical generators** (PV systems) using **two power meters**.

Measuring power when using a storage system with sonnenProtect and AC microgrid:

- The connection for the voltage measurement on the power meter, which measures the energy flows in standalone operation, must be connected so that it is supplied with voltage even in the event of a grid outage.
- If there are multiple generator or consumer paths, another power meter must be installed for measuring the power, as no more than two inverter interfaces (and therefore measurement points) can be recorded per power meter.
- The consumption measurement concept is recommended as standard for measuring power with a sonnenProtect with AC microgrid.

Further information on power measurement and the power meter can be found in the power meter instructions[9]. These instructions explain, among other things, the different measurement concepts and how to use multiple power meters.

[9] Document number: 401

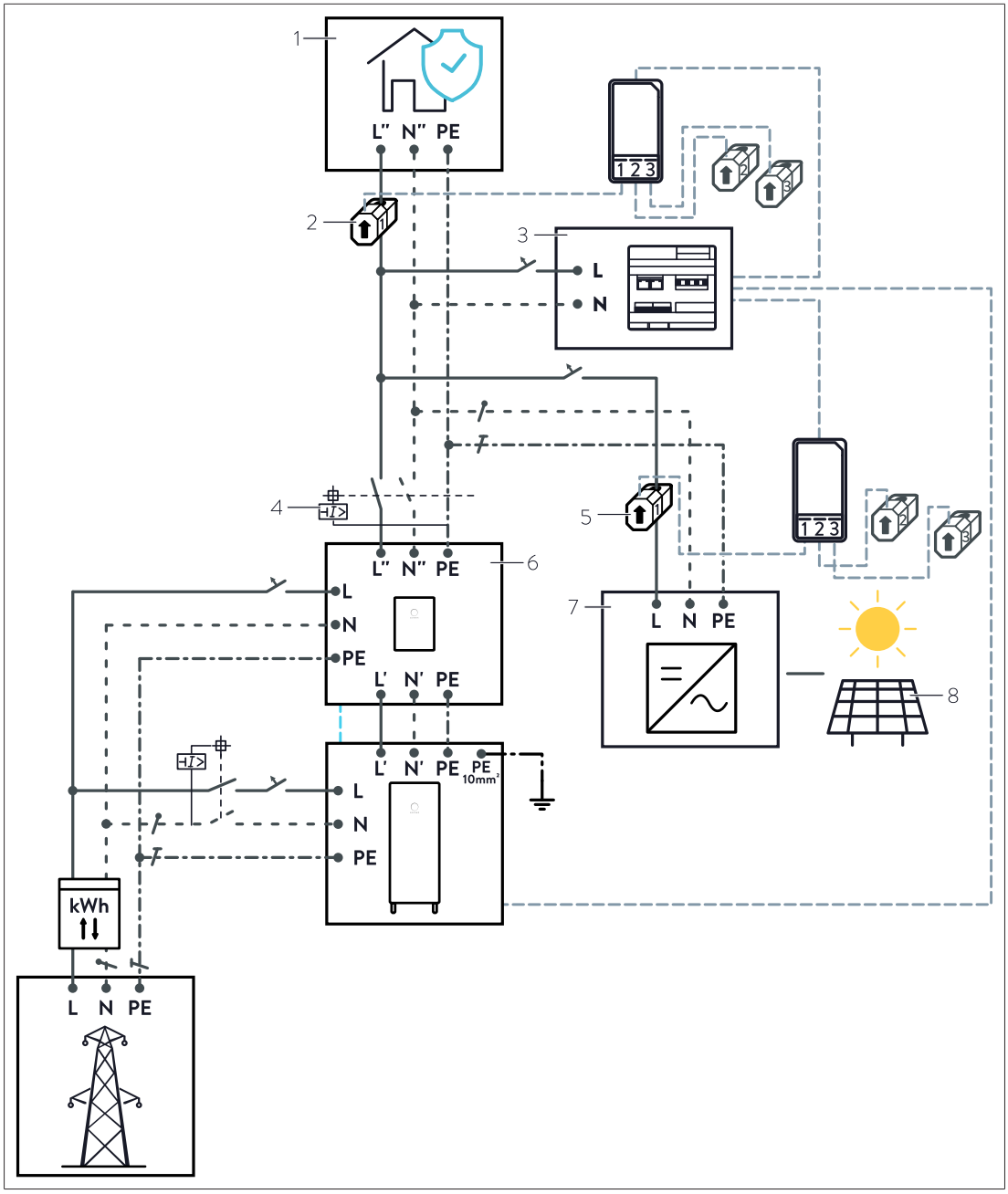


Illustration 37: Circuit diagram overview - sonnenBatterie 10 with sonnenProtect 4000 - Connection option 1 with AC microgrid

1 Consumers in building
2 *CT* for consumption
3 Power meter WM271
4 *RCD*
5 *CT* for production
6 sonnenProtect
7 PV inverter (1-phase, max. 4.6 kW)
8 PV system

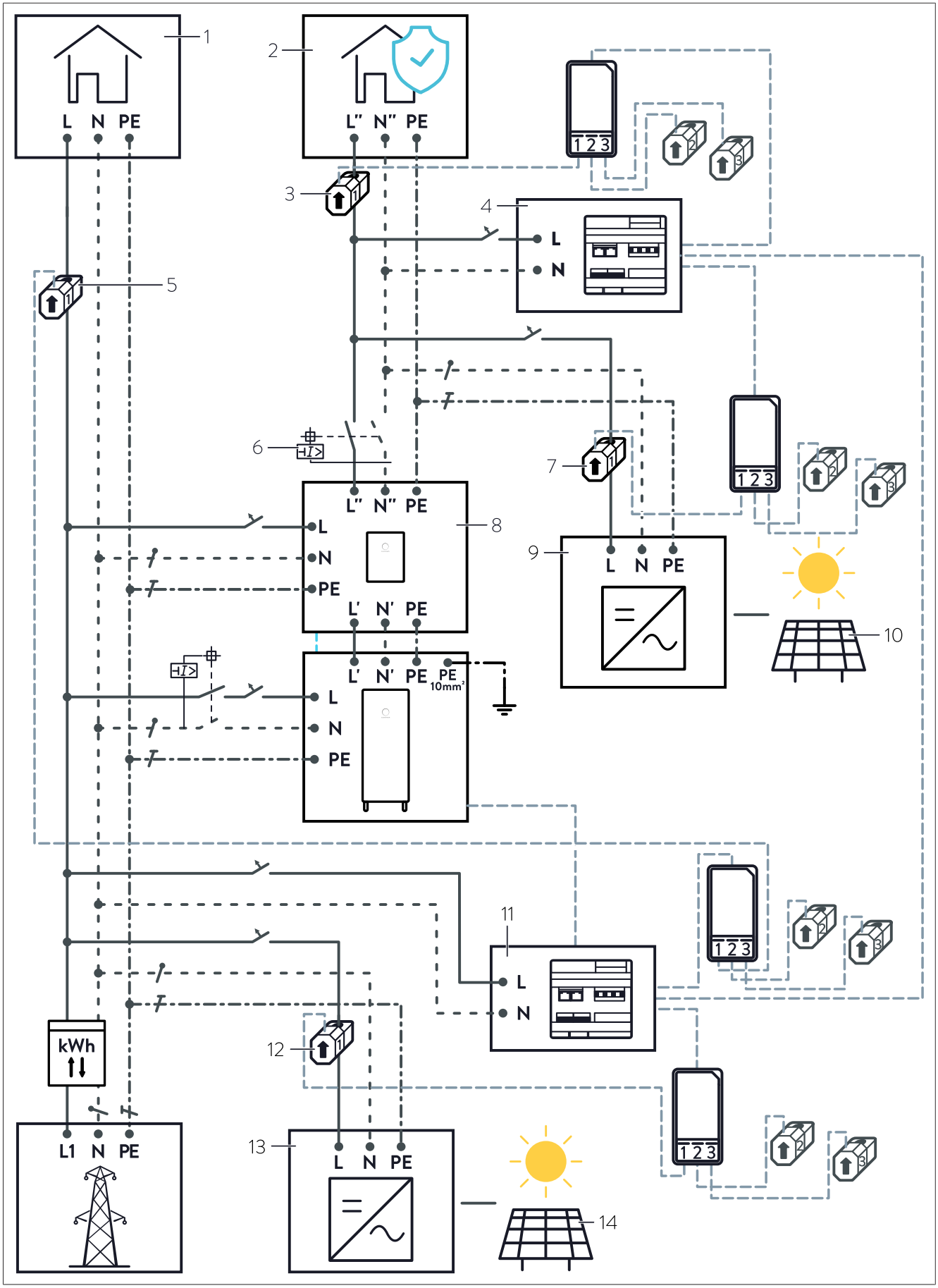


Illustration 38: Circuit diagram overview - sonnenBatterie 10 with sonnenProtect 4000 - Connection option 2 with AC microgrid

1 Consumers in building
2 Consumers in backup circuit
3 *CT* for consumption in backup circuit
4 Power meter AC microgrid
5 *CT* for consumption
6 *RCD*
7 *CT* for production AC microgrid
8 sonnenProtect
9 PV inverter AC microgrid (1-phase, max. 4.6 kW)
10 PV system AC microgrid
11 Power meter WM271
12 *CT* for production
13 PV inverter
14 Additional PV system (optional)

9.9.3 Setting up an AC microgrid

- Standalone operation can be activated when setting up the sonnenProtect (see Commissioning the sonnenProtect [P. 85]).

▶ Activate the Microgrid.

The Reenabling time determines the times at which the storage system tries to restore standalone operation using PV system production after standalone operation has been stopped because there was no PV production and the batteries had reached their minimum state of charge.

▶ Define the Reenabling time. In doing so, consider the PV system setup (e.g. its orientation, shading, etc.) and the PV production to be expected as a result.

9.9.4 Testing standalone operation

▶ Perform the steps described in section Testing backup/standalone operation [P. 85] to test backup operation with AC microgrid.

10 Completing installation

10.1 Filling in the type plate

Tools:

- Permanent marker

The energy capacity marked on the type plate always refers to the total energy installed in the storage system and extension cabinet, if any.

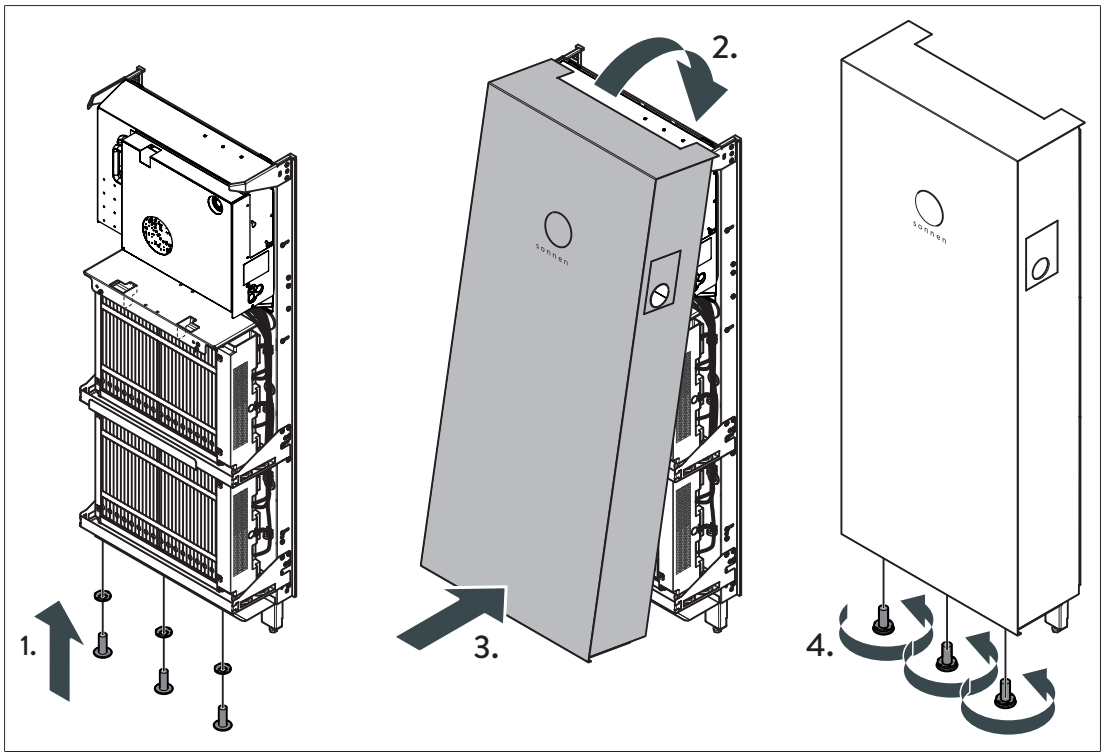
The possible battery capacities with the associated nominal power values can be found in section Technical data [P. 105].

▶ Mark the installed battery capacity on the type plate, which is affixed to the switch panel of the storage system.

10.2 Attaching and earthing the cover

- The earth connection between the cover and mounting frame is established via the screw connection.
- The inspection window and sonnen Eclipse have protective film on the inside and outside.

▶ Remove all protective film before mounting the cover.



▶ Use three screws with contact discs from the installation equipment pack to secure and earth the cover.

▶ Tilt the cover forward when lifting it, so it can be hung on the mounting frame.

▶ Centre and then hang the cover on the mounting frame. **WARNING! Do not kink or crush any cables between the cover and the mounting frame.**

▶ Tighten the screws with a torque of **8 Nm**.

10.3 Attaching the switch cover

The specified degree of protection for the storage system and therefore touch protection and protection against the ingress of foreign bodies is only achieved when the switch cover of the storage system is mounted.

- Mount the switch cover from the accessory kit onto the inspection window on the cover.

10.4 Checking the installation

- Use the following criteria to check whether the installation has been performed correctly and is complete.
- Only commission the storage system for the first time after first ensuring that the criteria have been successfully met.

1. **Component earthing:**
   - The feet (if mounted) are secured to the mounting frame using contact discs. All screws have been tightened with the correct torque.
   - The individual components are mounted correctly on the mounting frame. All screws have been tightened with the correct torque.
2. **Line routing:**
   - All of the lines going into the storage system have been routed through the appropriate cable entry points.
   - All other openings have been sealed with the corresponding dummy plugs.
3. **Cover mounting:**
   - The cover is form-fitted to the mounting frame.
   - The earth connection for the cover has been correctly established using screws and contact discs.
   - The switch cover has been correctly attached to the inspection window.
4. **Electrical connections:**
   - The mains line is properly connected and the necessary safety devices (miniature circuit breakers and residual current devices) are installed.
   - The battery lines and communication lines for the battery modules are connected correctly.
   - The connection to the power meter and the connection to the internet have been correctly established. The electrical connection of the power meter is protected with a miniature circuit breaker according to specifications.
5. **Completed type plate:**
   - The required information is marked on the type plate.
6. **sonnenProtect 4000 installation (optional):**
   - The sonnenProtect is mounted in a suitable installation location.
   - All lines are completely and correctly connected.
   - A miniature circuit breaker (type B - 20 A) is installed in the mains line of the sonnenProtect.
   - The electrical consumers in the backup circuit are protected by a corresponding *residual current device (RCD)*.
   - The electrical lines meet the requirements of all local and national guidelines for line dimensions.

• The additional earth connection between the storage system and the main earthing terminal is in place and has a cross-section of 10 mm² (CU cross-section or equivalent).

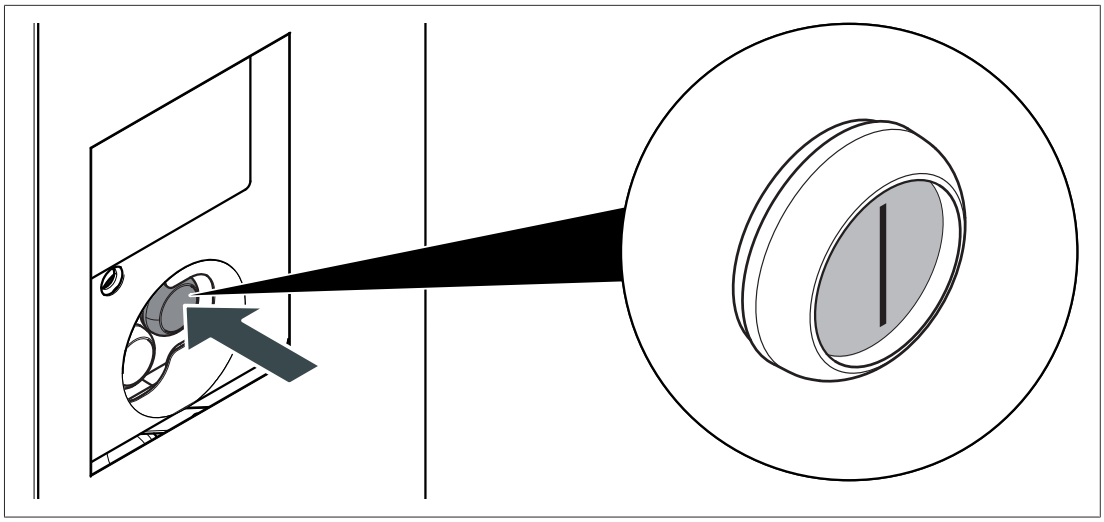
Table 6: Installation checklist

11 Commissioning

11.1 Switching the storage system on

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

1. Switch on the grid voltage using the miniature circuit breaker for the mains line.
2. Remove the switch cover on the inspection window of the switch panel.



3. Press the ON/OFF switch so it clicks into the **ON (I)** position.
4. Reattach the switch cover to the inspection window.

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

When the storage system is in normal operation, the sonnen Eclipse pulses white. The other operating statuses and the associated indications of the sonnen Eclipse are described in section Troubleshooting [P. 102].

11.2 Carrying out first-time commissioning

First-time commissioning must be carried out when the storage system has been installed, set up and connected for the first time.

11.2.1 Commissioning assistant

The storage system is only ready for operation if the commissioning assistant is fully completed.

Conditions:

✓ Storage system installation is complete.

✓ The storage system is switched on (see Switching the storage system on [P. 97]).

▶ The commissioning assistant is used to set up the storage system, whereby the following data is recorded and settings configured:

- Check the installed software version and update if necessary.
- Record the operator's customer information.
- Configure the notifications.

- Select the country code for the inverter.
- Provide details on the PV system.
- Select the power measurement concept and configure power measurement.
- Select and configure Features (use of digital inputs and outputs, activation of sonnenProtect, etc.).
- Perform a system test.
- Confirmation of the information by the installing electrician and the operator. Subsequent sending of a confirmation to the operator by e-mail.

11.2.1.1 Establishing connection to the storage system

▶ Connect your laptop/PC to the router of the home network to which the storage system is also connected.

11.2.1.2 Running the commissioning assistant

▶ Navigate to the following internet address: **https://find-my.sonnen-batterie.com**

The following window appears:

▶ Select the storage system to be configured and click on the ***Configure Assistent*** button.

▶ Log in as the **Installer**.

Use the initial password the first time you log in. This password can be found on the type plate of the storage system.

▶ Assign an individual password for the storage system after you have logged in successfully using the initial password.

Contact the sonnen service team if you have forgotten the individually assigned password or need to reset the password for another reason.

▶ Run the commissioning assistant until it is fully completed.

If the storage system is not displayed:

▶ Follow the instructions in section Troubleshooting [P. 102].

12 Decommissioning

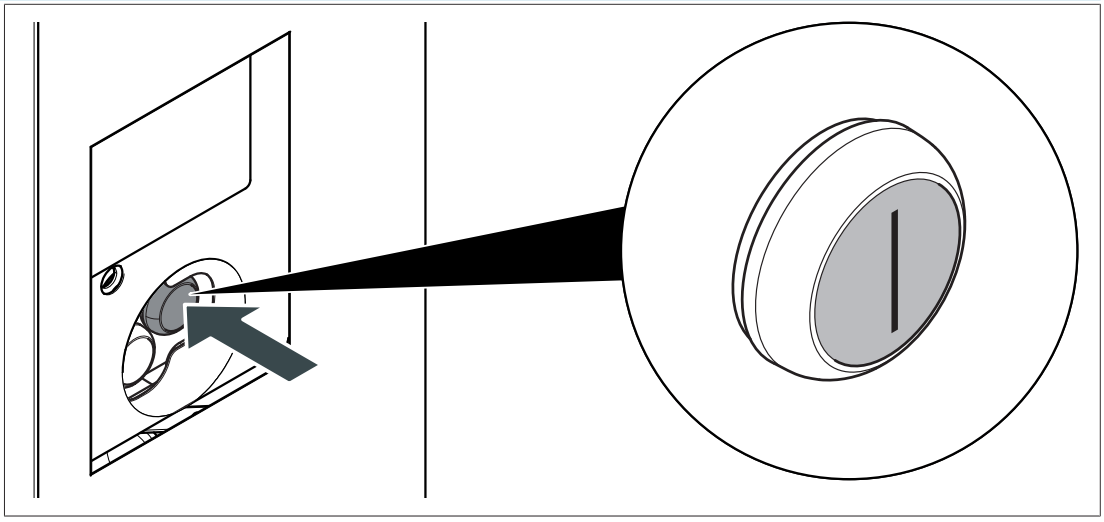
12.1 Switching the storage system off

NOTICE

Deep-discharge of the battery modules

Destruction of the battery modules!

- ▶ Do not disconnect the storage system from the public electricity grid for long periods of time (see Storing the battery modules [P. 12]).
- ▶ Never continue to operate battery modules which have been deep-discharged.



1. Remove the switch cover on the inspection window of the switch panel.
2. Press the ON/OFF switch. The sonnen Eclipse switches off.
3. Switch off the grid voltage using the miniature circuit breaker for the mains line.
4. Reattach the switch cover to the inspection window.

The storage system must be disconnected from the power [P. 100] before any work is carried out!

12.2 Switching the storage system off to electrically isolate it

⚠ DANGER

High battery voltage (> 200 V)

Danger to life due to electrocution!

When battery lines are connected, the central unit always carries the voltage of the battery modules, even if the storage system and mains voltage are switched off.

To disconnect the battery voltage from the central unit:

▶ Unplug the battery lines from **all** battery modules.

Before **working on the storage system** it must be completely switched off to be electrically isolated.

1. Remove the switch cover on the inspection window of the switch panel.
2. Press the ON/OFF switch. The sonnen Eclipse switches off.
3. Reattach the switch cover to the inspection window.
4. Switch off the grid voltage using the miniature circuit breaker for the mains line.
5. Take steps to ensure that these switches cannot be switched on again.
6. Wait at least five minutes until the internally stored energy in the inverter has fully discharged.

DANGER! If a sonnenProtect is installed, this must be switched off separately. Please note section Decommissioning the sonnenProtect [P. 86] in this case.

13 Uninstallation and disposal

13.1 Uninstallation

⚠ DANGER

Improper uninstallation of the storage system

Danger to life due to electrocution!

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

⚠ DANGER

Improper uninstallation of the sonnenProtect

Danger to life due to electrocution!

- ▶ The sonnenProtect must only be uninstalled by authorised electricians.

13.2 Disposal

⚠ CAUTION

Improper transport of battery modules

Fire outbreak at battery modules or emission of toxic substances!

- ▶ Only transport battery modules in packaging that meets applicable regulations.
- ▶ Never transport damaged battery modules.

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

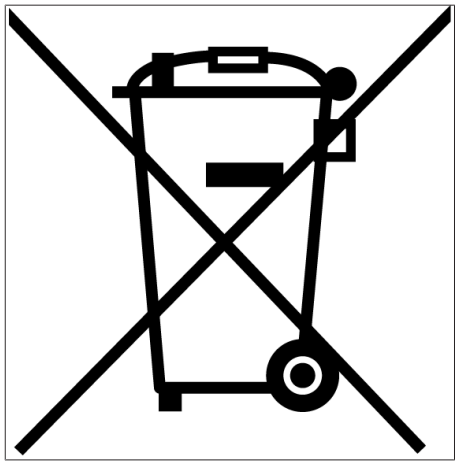


Illustration 39: WEEE symbol

- ▶ Dispose of the storage system, the batteries it contains and the sonnenProtect 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.

14 Troubleshooting

14.1 sonnenBatterie 10

Fault	Possible cause(s)	Solution
The sonnen Eclipse of the storage system pulses white.	The storage system is in normal operation.	No troubleshooting necessary.
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.	▶ Check that the circuit breaker in the supply line of the storage system is switched on. If so: The public electricity grid does not provide any electrical energy (grid outage). ▶ It can only be waited until the public electricity grid supplies energy again. Thereafter, the storage systems resumes normal operation.
	Storage system with backup power function only[10]: The storage system is not connected to the public electricity grid and is in backup operation.	No troubleshooting necessary.
The sonnen Eclipse of the storage system pulses orange.	The internet connection to the storage system has been interrupted.	▶ Check whether the home network router is able to establish an internet connection. If so: ▶ Ensure that the network line for the storage system is connected to the home network router.
The sonnen Eclipse of the storage system lights up red.	The storage system has detected a problem that is preventing normal operation or may cause damage to the storage system.	▶ Check the connection of the storage system and the battery modules in line with the installation instructions. ▶ Ensure that the correct temperature conditions are observed at the installation location. If none of the specified errors apply: ▶ Contact the sonnen service team to get help resolving the problem.
No online connection to the storage system.	No connection between the storage system and the server.	▶ Make sure that the Ethernet line between the storage system and the Router of the home network is correctly connected. ▶ Make sure that the Router of the home network allows connections on the following ports: **TCP ports:** 443 (https); 18883 (MQTT-TLS) **UDP ports:** 123 (NTP); 1196 (VPN)

[10] Optional accessories sonnenProtect.

14.2 sonnenProtect 4000 (optional)

Fault	Possible cause(s)	Solution
Grid operation (no grid outage)		
The electrical consumers in the backup circuit are not supplied with energy in grid operation.	The backup circuit lines have not been correctly connected.	▶ Check the electrical wiring of the backup circuit.
	The *miniature circuit breaker (MCB)* in the supply line to the sonnenProtect is switched off.	▶ Switch on the *miniature circuit breaker (MCB)*.
	The *residual current device (RCD)* or another circuit breaker in the backup circuit is switched off.	▶ Switch on all circuit breakers in the backup circuit.
	The *residual current device (RCD)* or another circuit breaker in the backup circuit has tripped.	▶ Check the electrical wiring and the connected electrical consumers for faults. ▶ Switch on the affected circuit breaker once any faults are corrected.
Backup operation (grid outage) – backup operation does not start		
Backup operation does not start. The Eclipse on the storage system pulses **green** and goes **off** after several minutes. The illuminated switch on the sonnenProtect **does not light up**.	No backup buffer is set. The batteries of the storage system have discharged so much that further discharging would lead to a deep discharge state and therefore damage the batteries. ***With AC Microgrid:*** The PV system produces no or insufficient electrical energy to start the backup operation.	When the grid outage is over and the public electricity grid once again begins supplying electrical energy, the sonnenProtect automatically switches to grid operation. ***With AC Microgrid:*** If the PV system produces sufficient electrical energy at one of the defined reenabling times and the grid outage continues, the backup operation starts again.
	The storage system is switched off.	▶ Switch on the storage system.
Backup operation does not start. The Eclipse on the storage system pulses **green**. The illuminated switch on the sonnenProtect **does not light up**.	The *residual current device (RCD)* or another circuit breaker in the backup circuit is switched off.	▶ Switch on all circuit breakers in the backup circuit.
	The *residual current device (RCD)* or another circuit breaker in the backup circuit has tripped.	▶ Check the electrical wiring and the connected electrical consumers for faults. ▶ Switch on the affected circuit breaker once any faults are corrected.
Backup operation does not start. The Eclipse on the storage system pulses **orange**. The illuminated switch on the sonnenProtect **lights up**.	Electrical consumers with too high of a power consumption are connected to the backup circuit.	▶ Switch off electrical consumers in the backup circuit or reduce their power consumption. ▶ Press the illuminated switch on the sonnenProtect for approx. 2 seconds. Backup operation restarts.

		▶ Only connect electrical consumers to the backup circuit when they have a power consumption that does not exceed the maximum power (see Technical data [P. 105]).
Backup operation (grid outage) – backup operation stops		
Backup operation stops. The *miniature circuit breaker (MCB)* in the supply line to the sonnenProtect and the circuit breakers in the circuit have not tripped. The Eclipse on the storage system pulses **green** and goes **off** after several minutes. The illuminated switch on the sonnenProtect **does not light up**.	The backup buffer of the storage system batteries is depleted. The batteries have discharged so much that further discharging would lead to a deep discharge state and therefore damage the batteries ***With AC Microgrid:*** The PV production of the PV system has stopped or has decreased to such an extent that there is not enough electrical energy available for backup operation.	When the grid outage is over and the public electricity grid once again begins supplying electrical energy, the sonnenProtect automatically switches to grid operation. ***With AC Microgrid:*** If the PV system produces sufficient electrical energy at one of the defined reenabling times and the grid outage continues, the backup operation starts again.
Backup operation stops. The *miniature circuit breaker (MCB)* in the supply line to the sonnenProtect or a circuit breaker in the backup circuit has switched off. The Eclipse on the storage system pulses **green**. The illuminated switch on the sonnenProtect **does not light up**.	The *residual current device (RCD)* or another circuit breaker in the backup circuit has tripped.	▶ Check the electrical wiring and the connected electrical consumers for faults. ▶ Switch on the circuit breaker once any faults are corrected.
Backup operation stops. The *miniature circuit breaker (MCB)* in the supply line to the sonnenProtect and the circuit breakers in the backup circuit have not tripped. The Eclipse on the storage system pulses **orange**. The illuminated switch on the sonnenProtect **lights up**.	Electrical consumers with too high of a power consumption are connected to the backup circuit.	▶ Switch off electrical consumers in the backup circuit or reduce their power consumption. ▶ Press the illuminated switch on the sonnenProtect for approx. 2 seconds. Backup operation restarts. ▶ Only connect electrical consumers to the backup circuit when they have a power consumption that does not exceed the maximum power (see Technical data [P. 105]).

15 Technical data

15.1 sonnenBatterie 10

System data (AC)		**sonnenBatterie 10**				
General	Nominal voltage	230 V				
	Nominal frequency	50 Hz				
	Nominal power[11]	4,600 W				
	Apparent power	4,600 VA				
	Nominal current	20 A				
	Max. inverter efficiency	95,4 %				
	Power factor range	0.9 capacitive ... 0.9 inductive				
	Max. THD	4 %				
	Network Impedance (Z_{max})	R: 0.35 Ω; X: 0.22 Ω				
	Max. continous current	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 connection fuse	Miniature circuit breaker | Type B | 20 - 25 A				
Depends on capacity[12]	**sonnenBatterie**	**10/5,5**	**10/11**	**10/16,5**	**10/22**	**10/27,5**
	Nominal capacity	5.5 kWh	11 kWh	-	22 kWh	-
	Usable capacity	5 kWh	10 kWh	-	20 kWh	-
	Charging/discharging power[13]	3,400 W	4,600 W	-	4,600 W	-
	Charging/discharging current	14.8 A	20 A	-	20 A	-
Battery data (DC)	Cell technology	lithium iron phosphate (LiFePO4)				
	Nominal voltage	102.4 V				
	Operating voltage	204.8 V				
	Current (Max. continous)	40 A				
	Short-circuit current (I_{SC})	80 A				
	Max. battery efficiency	95,9 %				
	Min. / max. number of battery modules	1 / 4				
Safety	Protection class	I / PE conductor				
	Required fault current monitoring	In TT networks: Residual current device (RCD) with a rated differential current of 300 mA; requirements on site must be observed.				
	Degree of Protection	IP30				
	Overvoltage category	2				
	Rated short-withstand current	10 kA				

[11] at power factor cos phi = 1

[12] from 16.5 kWh: storage system with extension

[13] at power factor cos phi = 1

	Separation principle	no galvanic isolation, transformer-less				
	Fulfilled standards and directives	CEI 0-21; EMC Directive 2014/30/EU; G98/99; IEC 61000-6-1; IEC 61000-6-3; IEC 62040-1; IEC 62109-1; IEC 62619; Low Voltage Directive 2014/35/EU; UN 38.3; VDE-AR-E 2510-2; VDE-AR-N 2510-50; VDE-AR-N 4105				
Power measurement with WM271	Voltage measurement inputs	Nominal voltage (AC): 230 V (L-N), 400 V (L-L) | max. connectible conductor cross-section: 1.5 mm²				
	Clamp-on current transformer	Max. measurable current: 60 A (standard), optional up to 400 A				
Power measurement with EM357	Voltage measurement inputs	Nominal voltage (AC): 230 V (L-N), 400 V (L-L) | connectible conductor cross-section: 1.5 mm²				
	Measurable current	Max. 100 A				
Dimensions/weight[14]	**sonnenBatterie**	**10/5,5**	**10/11**	**10/16,5**	**10/22**	**10/27,5**
	Dimensions (H/W/D)	172-184/69/27 cm		2 x 172-184/69/27 cm		
	Height without feet	161 cm				
	Weight	98 kg	138 kg	-	257 kg	-
Ambient conditions	Environment	Indoor (conditional)				
	Operating temperature range	-5 °C ... 45 °C[15]				
	Storage temperature range	0 °C ... 40 °C				
	Transport temperature range	-15 °C ... 50 °C				
	Max. rel. humidity	85 %, non-condensing				
	Permissible installation altitude	2,000 m above sea level				
	Pollution degree	2				

Requirements for the installation location

- No direct sunlight.
- No danger due to flooding.
- No corrosive and explosive gases. The maximum permissible ammonia content is 20 ppm.
- No dust, especially flour dust or sawdust.
- No vibrations.
- Ventilation possible.
- Easy access.
- Floor is suitable for heavy loads.
- Observe all fire safety guidelines and regulations.
- Observe applicable local building codes.
- Smoke detectors must be installed both at the installation location and in bedrooms.

[14] From 16.5 kWh: storage system with extension

[15] Optimal: 5 °C ... 30 °C | Derating possible below 5 °C / from 30 °C.

15.2 sonnenProtect 4000 (optional)

		sonnenProtect 4000	
System data (AC)	**with sonnenBatterie**	**10/5.5**	**10/11 - 10/27.5**
	Nominal power[16]	3 kW	4 kW
	Apparent power	3 kVA	4 kVA
	Max. possible generator output in standalone operation (AC microgrid)	3.4 kW	4.6 kW
	Nominal frequency	50 Hz	
	Output voltage	230 VAC +/- 10 %	
	Overload (30 min)	max. 3.4 kVA	max. 4.6 kVA
	Power factor range	0 capacitive ... 0 inductive	
	Max. output current (continuous / 100 ms)	20 A / 23 A	
	Short-circuit current	40 A	
	Network configuration in emergency operation	TN-S	
	Mains connection	single-phase, L / N / PE	
	Mains connection fuse	Miniature circuit breaker | Type B | 20 A	
	Operating concept	Single-phase power supply via emergency circuit(s). The switch to emergency operation takes place automatically through the storage system.	
	Switchover time	approx. 5 s	
	Switchback time	approx. 3 s[17]	
	Threshold power	none (starting from 0 W)	
Dimensions/weight	Dimension (H/W/D)	52/23/12 cm	
	Weight	approx. 10 kg	
Safety/protective devices	Protection class	II	
	Degree of Protection	IP65	
	Overvoltage category	2	
	Required fault current monitoring	Residual current device (RCD) with a rated differential current of max. 300 mA; requirements on site must be observed.	
Ambient conditions	Environment	Indoor/Outdoor	
	Pollution degree	3	
	Operating temperature range	-5 °C ... 45 °C	
	Max. rel. humidity	100 %, condensing	
	Permissible installation altitude	2,000 m above sea level	
	Additional ambient conditions	The ambient conditions prescribed for the storage system apply.	

[16] at power factor cos phi = 1

[17] After grid return the waiting time before switch back can be up to 5.5 minutes due to country-specific regulation.

Glossary

AC

Alternating current

ADR

Accord européen relatif au transport international des marchandises Dangereuses par Route [fr] – European Agreement concerning the International Carriage of Dangerous Goods by Road

BMS

Battery management system

CA

Commissioning assistant

CHP

Combined heat and power station

CT

Clamp-on current transformers. These are connected to the transformer interface of the power meter and are clamped over the electrical line in question.

DC

Direct current

DI

Digital input

DNO

Distribution network operator

DO

Digital output

DOD

Depth of discharge

ESD

Electrostatic discharge

EVU

Energieversorgungsunternehmen [de] - energy supply company

GND

Ground

Grid and system protection

Protective measures for ensuring the safety of the grid and systems installed

IP

International protection – degree of protection using to classify systems in terms of their suitable for different ambient environments

LED

Light-emitting diode

MCB

Miniature circuit breaker. Overcurrent safety device that protects the lines from damage caused by overheating as a result of excessive current.

MW

Module width. A unit of measurement used to describe the width of components in the electrical installation. One module width is equal to 18 mm.

PV

Photovoltaics

PV reduction

Reduction of the power output by the PV system through communication with the inverter

RCD

Residual current device

SELV

Safety extra low voltage

SMCB

Selective miniature circuit breaker or main miniature circuit breaker. This special circuit breaker meets selectivity requirements for upstream and downstream overcurrent protective devices and is used upstream of the electricity meter.

SOC

State of charge

Technical connection conditions

The technical connection conditions govern the connection to the electricity grid of the distribution network operators in Germany.

USB

Universal serial bus

VPN

Virtual private network

sonnen

energy is yours

sonnen GmbH
Am Riedbach 1
D-87499 Wildpoldsried