



Installation - Quick Reference Guide

SMA FLEXIBLE STORAGE SYSTEM with Battery Backup Function

**Battery backup systems including increased self-consumption with
SUNNY ISLAND 3.0M / 4.4M / 6.0H / 8.0H and SUNNY HOME MANAGER**



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1 Information on this Document

1.1 Validity

This document is valid for the SMA Flexible Storage System with battery backup function with the following SMA products:

- HM-BT-10.GR2 (Sunny Home Manager) from firmware version 1.04
- SI3.0M-11 (Sunny Island 3.0M) from firmware version 3.2
- SI4.4M-11 (Sunny Island 4.4M) from firmware version 3.2
- SI6.0H-11 (Sunny Island 6.0H) from firmware version 3.1
- SI8.0H-11 (Sunny Island 8.0H) from firmware version 3.1

1.2 Content and Structure of This Document

This document summarizes the specific information for the SMA Flexible Storage System with battery backup function (battery backup system). Circuitry overviews provide you with a basis for setting up a battery backup system. The structure of the document specifies the chronological sequence for configuration and commissioning. This document does not replace the documentation of the individual products. You will find details and help in the event of difficulties in the documentation of the respective product.

1.3 Target Group

The tasks described in this document must only be performed by qualified persons. Qualified persons must have the following skills:









- Training in how to deal with the dangers and risks associated with installing and using electrical devices and batteries
- Training in the installation and commissioning of electrical devices
- Knowledge of and adherence to the local standards and directives
- Knowledge of and compliance with this document and all safety precautions

1.4 Additional Information

Links to additional information can be found at www.SMA-Solar.com:

Document title	Document type
SMA Flexible Storage System with Battery Backup Function	Planning guidelines

1.5 Symbols for Information

Symbol	Explanation
	Indicates a hazardous situation which, if not avoided, will result in death or serious injury
	Indicates a hazardous situation which, if not avoided, can result in death or serious injury
	Indicates a hazardous situation which, if not avoided, can result in minor or moderate injury
	Indicates a situation which, if not avoided, can result in property damage
	Information that is important for a specific topic or goal, but is not safety-relevant
	Indicates a requirement for meeting a specific goal
	Desired result
	A problem that might occur

1.6 Typographies

Typography	Use	Example
bold	<ul style="list-style-type: none"> • Display messages • Parameters • Connections • Slots • Elements to be selected • Elements to be entered 	<ul style="list-style-type: none"> • Connect the grounding conductor to AC 2Gen/Grid. • Select the parameter 235.01 GnAutoEna and set to Off.
>	<ul style="list-style-type: none"> • Several elements that are to be selected 	<ul style="list-style-type: none"> • Select 600# Direct Access > Select Number.
[Button/Key]	<ul style="list-style-type: none"> • Button/key on the inverter to be selected or pressed 	<ul style="list-style-type: none"> • Press [ENTER].

1.7 Nomenclature

Complete designation	Designation in this document
SMA Flexible Storage System with battery backup function	Battery backup system
Sunny Boy, Sunny Mini Central, Sunny Tripower	PV inverter
Grid failure or deviation from the country-specific limiting values for voltage and frequency	Grid failure

The term parameter includes parameters with configurable values as well as parameters for displaying values.

2 Safety

2.1 Intended Use

In the event of grid failure, a battery backup system with Sunny Island supplies loads with energy and a grid-tie PV system with voltage. In the event of grid failure, an automatic transfer switch disconnects the battery backup grid from the utility grid. After disconnection, the loads and the PV system have no supply for approximately five seconds, until the battery backup system can provide active and reactive power once more. The battery backup system supplies the loads and the PV system can synchronize with the battery backup grid and feed in.

The battery backup system should only be used in countries for which it is licensed or for which it is released by SMA Solar Technology AG and the grid operator. To fulfill the technical connection requirements of the grid operator and the local standards and directives, you must select one of the following basic structures:

- Battery backup system with all-pole disconnection

In the event of grid failure, a tie switch disconnects all line conductors and the neutral conductor from the utility grid. The tie switch is designed with built-in redundancy. If the technical connection requirements of the grid operator or the local standards and directives call for or allow all-pole disconnection, you must install this basic structure. You must install all-pole disconnection in the following countries:

- Belgium
- Denmark
- Germany
- France
- Austria
- Switzerland

- Battery backup system without all-pole disconnection

In the event of grid failure, a tie switch disconnects all line conductors from the utility grid. The neutral conductor of the battery backup grid remains permanently connected to the utility grid. If the technical connection requirements of the grid operator or the local standards and directives prohibit disconnection of the neutral conductor, you must install this basic structure. In Australia, you must install a battery backup system without all-pole disconnection.

Each basic structure can be designed either as a three-phase battery backup grid or as a single-phase battery backup grid. Single-phase battery backup grids can be connected to three-phase utility grids.

In a three-phase battery backup system, in the event of grid failure, three Sunny Island inverters supply all line conductors with the corresponding line conductor. The three Sunny Island inverters are connected in parallel on the DC side and form one cluster. Only Sunny Island inverters of the same device type may be installed in a cluster. In a three-phase battery backup system, both single-phase and three-phase PV inverters can be connected. Multiple clusters must not be connected together.

In a single-phase battery backup system, in the event of grid failure, one Sunny Island supplies the battery backup grid. A grid failure is only recognized at the line conductor which is connected to the Sunny Island. In the event of grid failure, only single-phase PV inverters can feed in to a single-phase battery backup grid. A phase coupling, in the event of grid failure, enables combination of the line conductors to a single-phase distribution grid. With phase coupling, all the loads in the battery backup grid must be single-phase. No more than one Sunny Island may be connected in a single-phase battery backup system.

A PV system can be connected in the battery backup grid. The PV system must be suitable for use in battery backup systems (see the Planning Guidelines "SMA Flexible Storage System with Battery Backup Function" at www.SMA-Solar.com). The power of the PV system must be appropriate for the system (see Section 3.2 "System Information", page 12).

The automatic transfer switch is not a distribution board for the loads or the PV system. The loads and the PV system must be secured with protective devices in accordance with the local standards and directives. Grid-forming voltage sources (e.g., generators) must not be connected.

The utility grid connected to the automatic transfer switch must be a TN or TT system. The battery backup system is not suitable for supplying life-sustaining medical devices.

In battery backup systems, the Sunny Island uses lead-acid batteries or lithium-ion batteries for energy storage. Ensure that the battery room is sufficiently ventilated when using lead-acid batteries (see battery manufacturer's documentation). If lithium-ion batteries are connected, the battery management of the lithium-ion battery must be compatible with the Sunny Island (see the Planning Guidelines "SMA Flexible Storage System with Battery Backup Function" at www.SMA-Solar.com). The lithium-ion battery must be able to supply enough current at maximum output power of the Sunny Island inverter (for technical data, see the Sunny Island inverter installation manual).

In single-phase battery backup systems, the multifunction relays of the Sunny Island inverter cannot be configured. In three-phase battery backup systems, the slaves can control devices in the system (e.g., load-shedding contactors), each via two multifunction relays. The multifunction relays of the master cannot be configured.

The automatic transfer switch must be wired and connected in accordance with this documentation. The equipment or devices of the automatic transfer switch must satisfy protection class II and be operable without prior knowledge of electrical technology.

In battery backup systems, the following products must not be connected:

- Sunny Island Charger or other DC charge controllers
- DC loads

The battery backup system records the grid feed-in and purchased electricity with an SMA Energy Meter only. An SMA Energy Meter does not replace the energy meter of the electric utility company. The grid feed-in and the purchased electricity are transmitted to one Sunny Island via Speedwire. Therefore, the Sunny Island must be fitted with the Speedwire data module Sunny Island.

The Sunny Home Manager must not be installed in PV systems in which a Sunny WebBox is installed.

The individual products in the battery backup system must be used for their intended purpose (see documentation of each product). Any use of the system other than that described in the Intended Use section does not qualify as appropriate.

The enclosed documentation is an integral part of the products. Keep the documentation in a convenient place for future reference and observe all instructions contained therein.

2.2 Safety Precautions

This section contains safety precautions that must be observed at all times when working on or with the system. To prevent personal injury or property damage and to ensure long-term operation of the system, read this section carefully and follow all safety precautions at all times.

⚠ WARNING

Danger to life from electric shock due to circuit breakers that cannot be tripped

In the battery backup grid, only the circuit breakers that can be tripped by the Sunny Island can be tripped in the event of a grid failure. Circuit breakers with a higher operating current cannot be tripped. Under fault conditions, there may be a voltage that poses a danger to life present on accessible parts for several seconds. This can result in fatal or serious injury.

- Check whether a circuit breaker has a higher trip characteristic than the following circuit breakers which can be tripped:
 - SI3.0M-11 and SI4.4M-11: circuit breaker with trip characteristic B6 (B6A)
 - SI6.0H-11 and SI8.0H-11: circuit breaker with trip characteristic B16 (B16A) or circuit breaker with trip characteristic C6 (C6A)

If a circuit breaker has a higher trip characteristic than the specified circuit breaker which can be tripped, you should also install a residual-current device of type A.

Danger to life from electric shock due to live voltage

High voltages are present in the battery backup system. When covers are removed (e.g., an enclosure lid), live components can be touched. Touching can result in death or serious injury due to electric shock.

- When carrying out any work on the electrical installation, wear suitable personal protective equipment.
- Turn off or disconnect the following devices from voltage sources in the given order:
 - Sunny Island
 - At the grid-connection point, the circuit breaker of the battery backup system
 - In the automatic transfer switch, all circuit breakers
 - Load-break switch of the battery
- Ensure that the battery backup system cannot be reconnected.
- Open the enclosure lid on the Sunny Island inverter and ensure that no voltage is present.
- Ground and short-circuit the AC conductors outside the automatic transfer switch.
- Cover or isolate any adjacent live components.

Danger to life from electric shock due to damaged devices

Operating a damaged device can lead to hazardous situations that can result in death or serious injuries due to electric shock.

- Only use the battery backup system when it is technically faultless and in an operationally safe state.
- Ensure that all safety equipment is freely accessible at all times.
- Make sure that all safety equipment is in good working order.

⚠ WARNING**Danger to life due to incompatible lithium-ion battery**

An incompatible lithium-ion battery can lead to a fire or an explosion. With incompatible lithium-ion batteries, it is not ensured that the battery management is intrinsically safe and will protect the battery.

- Ensure that the battery complies with the locally applicable standards and directives and is intrinsically safe.
- Ensure that the lithium-ion batteries are approved for use with the Sunny Island.

The list of lithium-ion batteries approved for the Sunny Island is updated constantly (see Technical Information "List of Approved Lithium-Ion Batteries" at www.SMA-Solar.com).

- If no lithium-ion batteries approved for Sunny Island inverters can be used, you should use lead-acid batteries.

Danger to life due to explosive gases

Explosive gases may escape from the battery and cause an explosion. This can result in fatal or serious injury.

- Protect the battery environment from open flames, embers, or sparks.
- Install, operate, and maintain the battery in accordance with the manufacturer's specifications.
- Do not heat the battery above the temperature permitted or burn the battery.
- Ensure that the battery room is sufficiently ventilated.

Chemical burns and poisoning due to battery electrolyte

If handled inappropriately, battery electrolyte can cause irritation to the eyes, respiratory system, and skin, and it can be toxic. This may result in blindness and serious chemical burns.

- Protect the battery enclosure against destruction.
- Do not open or deform the battery.
- Whenever working on the battery, wear suitable personal protective equipment such as rubber gloves, apron, rubber boots, and goggles.
- Rinse acid splashes thoroughly with clear water and consult a doctor.
- Install, operate, maintain, and dispose of the battery according to the manufacturer's specifications.

Risk of injury due to short-circuit currents

Short-circuit currents in the battery can cause heat build-up and electric arcs. Burns or eye injuries due to flashes may result.

- Remove watches, rings, and other metal objects.
- Use insulated tools.
- Do not place tools or metal parts on the battery.

⚠ CAUTION**Risk of burns due to short-circuit currents on the disconnected Sunny Island**

The capacitors at the DC connection input area store energy. After the battery is isolated from the Sunny Island, battery voltage is still temporarily present at the DC connection. A short circuit at the DC connection can lead to burns and may damage the Sunny Island inverter.

- Wait 15 minutes before performing any work at the DC connection or on the DC cables. This allows the capacitors to discharge.

NOTICE**Damage to three-phase loads during phase coupling**

If three-phase loads are connected to a single-phase utility grid during phase coupling, SMA Solar Technology AG cannot rule out damage to the three-phase loads.

- Ensure that, during phase coupling, only single-phase loads are connected to the battery backup grid.

Damage to the tie switch due to incorrect design

If the ampacity of the tie switch is not sufficient, the tie switch becomes overloaded and is damaged.

- Adjust the ampacity of the tie switch in accordance with the requirements on site. The tie switch must be designed for at least the operating range of the upstream fuse or the maximum short-circuit current of the PV system.

Damage to the battery due to incorrect settings

Incorrect settings can lead to premature aging of the battery. Settings of the parameters in the menu **220# Battery** influence the charging behavior of the Sunny Island inverter.

- Ensure that the values recommended by the battery manufacturer are set for the battery (for the battery technical data, see the documentation of the battery manufacturer).

Destruction of devices due to electrostatic discharge (ESD)

If enclosure parts are removed, the devices (e.g., Sunny Island or PV inverter) can be damaged or destroyed if electronic components or connections are touched.

- Do not touch any electronic components in open devices.
- Ground yourself before touching any connections.

3 Information and System Description

3.1 Requirements of the "VDE Forum Network Technology / Network Operations (FNN)"

The information only applies for systems for which the following characteristics are all applicable:

- The system stores energy for increased self-consumption.
- Only one Sunny Island is connected in the system.
- The grid operator requires compliance with the Technical Information "Connection and Operation of Storage Units" of the FNN. Currently, only the grid operators in Germany require compliance with the above-mentioned Technical Information (status: June 2014).

In these systems, the Sunny Island must be connected to a line conductor supplied by a single-phase PV inverter. If there are only three-phase PV inverters connected in the system, the Sunny Island can be connected to any line conductor.

The requirements of the Technical Information "Connection and Operation of Storage Units in Low-Voltage Networks" published by the FNN influence the discharge behavior of the Sunny Island inverter. In systems with one Sunny Island and single-phase PV inverters, the SMA Flexible Storage System reduces the maximum discharge power of the Sunny Island inverter if necessary (for examples of correct connection of the PV inverters, see quick reference guide "SMA Flexible Storage System").

3.2 System Information

i Battery backup systems without increased self-consumption

If you are not increasing the self-consumption of PV energy, the following devices are not required:

- SMA Energy Meter
- Sunny Home Manager
- Speedwire data module Sunny Island

i Information on batteries

Lithium-ion batteries in battery backup systems

In order to meet the requirements of battery backup systems in the event of grid failure, the Sunny Island has a high overload capacity. The prerequisite for this overload capacity is that the battery is able to supply sufficient current. With lithium-ion batteries, this capacity cannot be taken for granted.

- Clarify with the battery manufacturer whether the battery is suitable for battery backup systems with Sunny Island. Note especially the capacity if, in the event of grid failure, the battery backup grid is supplied by the Sunny Island.

Recommendations for battery capacity

SMA Solar Technology AG recommends the following minimum battery capacities. The battery capacities apply for a ten-hour electric discharge (C10).

- Single-phase battery backup system with SI3.0M-11: 100 Ah
- Single-phase battery backup system with SI4.4M-11: 100 Ah
- Single-phase battery backup system with SI6.0H-11: 120 Ah
- Single-phase battery backup system with SI8.0H-11: 160 Ah
- Three-phase battery backup system with three SI3.0M-11: 300 Ah
- Three-phase battery backup system with three SI4.4M-11: 300 Ah
- Three-phase battery backup system with three SI6.0H-11: 360 Ah
- Three-phase battery backup system with three SI8.0H-11: 480 Ah

The minimum battery capacity must be observed to ensure stable operation of the system.

i Information on the automatic transfer switch

Wiring and connection of automatic transfer switches

- Do not bridge the neutral conductors of connections **X1** to **X5**. If the neutral conductor connections are bridged, residual-current devices could trip.
- Label the equipment and devices of the automatic transfer switch in accordance with the schematic diagrams. This makes installation and commissioning easier and simplifies the support process in the event of service.
- Only install an SMA Energy Meter if the systems have increased self-consumption.
Install the SMA Energy Meter in such a way that it can measure the total purchased electricity and grid feed-in.

Connection of automatic transfer switches for single-phase battery backup systems

- With single-phase battery backup systems, connect circuit breaker **F1** and the Sunny Island to the same line conductor. Ensure that only this line conductor of the Sunny Island inverter is monitored for grid failure.
- Connect the PV inverter and the Sunny Island to the same line conductor if possible. This way, in the event of grid failure, the PV inverters are supplied with voltage directly and then can feed in even if phase coupling is deactivated.

i Information on the Sunny Island

Connection of the neutral conductor

At connection **AC2**, there are two terminals **N** and **N_{TT}** for the connection of the neutral conductor.

- In battery backup systems, at connection **AC2**, always connect the neutral conductor to terminal **N_{TT}**.

This ensures that the Sunny Island disconnects at all poles.

Device types within a cluster

All Sunny Island inverters must be of the same device type.

i Information on the communication devices

Requirements for the router and network switches for Speedwire devices

An SMA Flexible Storage System has the following requirements for the communication devices:

- All Speedwire devices must be connected to the same router or network switch.
- The router and optionally one or more network switches must fully support Multicast.
- The router must support "Internet Enabled Devices" with the interfaces SIP and STUN.

The most common routers and network switches support Multicast and "Internet Enabled Devices".

Electricity supply of communication devices

During a grid failure, only the devices in the battery backup grid are supplied with current.

- Connect the electricity supply of the Sunny Home Manager, router, and the optional network switches to the battery backup grid.

The Sunny Home Manager does not support wind power inverters or CHP plants

The Sunny Home Manager only supports PV inverters. If your system combines various AC power sources (e.g., PV system and small wind turbine system), the Sunny Home Manager can only detect the PV inverters and limit their power. In the Sunny Home Manager system, no wind power inverters or CHP plants are displayed in Sunny Portal. Since the data from wind power inverters or CHP plants is not taken into account by the Sunny Home Manager, the data calculated in Sunny Portal and the displayed diagrams may be inaccurate. However, you have the option of displaying the wind power inverters via the Sunny Explorer software and configuring them if necessary (see Sunny Explorer documentation).

i Information on the PV system

Maximum PV system power

In battery backup systems, the maximum power of the PV system depends on the total power of the Sunny Island.

- Maximum output power of the PV system per SI3.0M-11: 4,600 W
- Maximum output power of the PV system per SI4.4M-11: 4,600 W
- Maximum output power of the PV system per SI6.0H-11: 9,200 W
- Maximum output power of the PV system per SI8.0H-11: 12,000 W

Observance of the maximum output power of the PV system is a requirement for stable operation of the battery backup system during a grid failure.

Frequency-dependent control of active power feed-in

In battery backup systems, the active power of the PV inverters must be controllable depending on the frequency.

- With existing systems, ensure that the PV inverters are controllable depending on the frequency (see Planning Guidelines "SMA Flexible Storage System with Battery Backup Function").

3.3 Design and Functions of the Battery Backup System

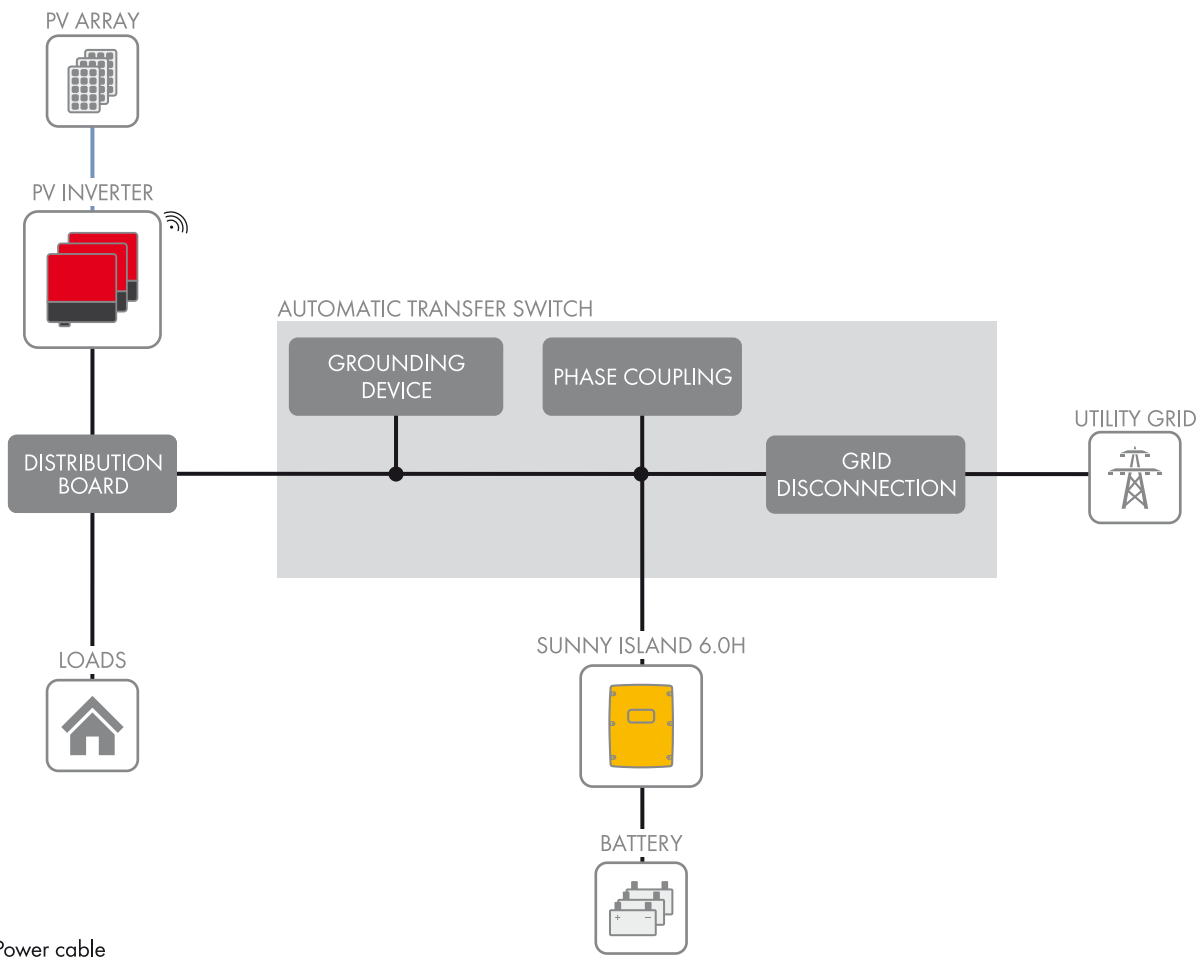


Figure 1: Block circuit diagram of a single-phase battery backup system

In the event of grid failure, a battery backup system with Sunny Island supplies loads with energy and a grid-tie PV system with voltage. In the event of grid failure, an automatic transfer switch disconnects the battery backup grid from the utility grid. After disconnection, the loads and the PV system have no supply for approximately five seconds, until the battery backup system can provide active and reactive power once more. The battery backup system supplies the loads and the PV system can synchronize with the battery backup grid and feed in.

When the utility grid is available again, the battery backup system synchronizes the battery backup grid with the utility grid. Following successful synchronization, the automatic transfer switch connects the battery backup grid to the utility grid. If the automatic transfer switch is connected to the utility grid, the battery backup system uses the battery for increased self-consumption.

You can set up and wire the automatic transfer switch yourself or acquire it pre-wired from another provider (see Planning Guidelines "SMA Flexible Storage System with Battery Backup Function" at www.SMA-Solar.com).

i **Connection of loads and the PV system**

The automatic transfer switch is not a distribution board for the loads or the PV system. You must also install the necessary protective devices for the loads and the PV system.

3.4 Design and Functions of the Automatic Transfer Switch

3.4.1 Devices of the Automatic Transfer Switch

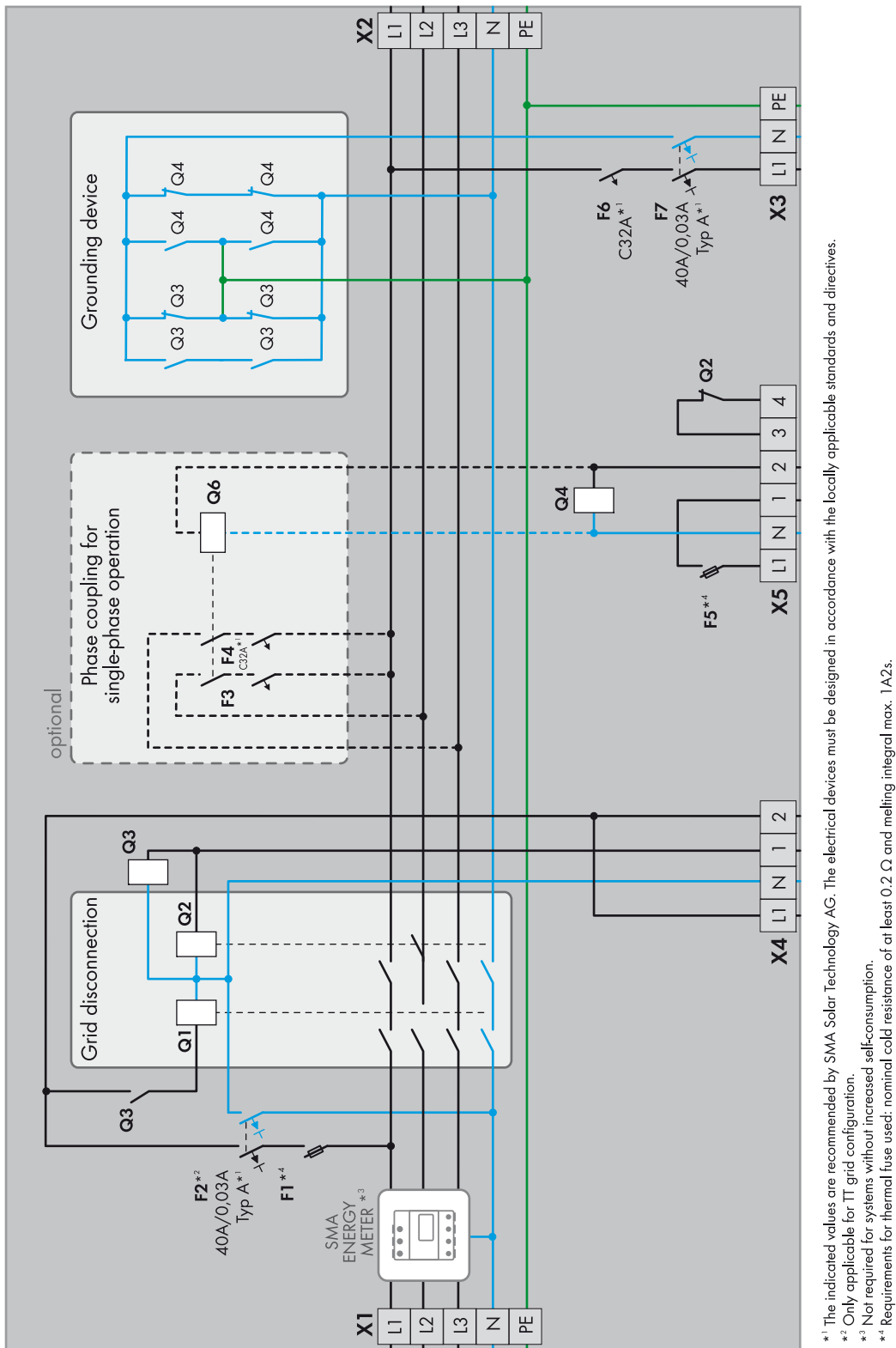


Figure 2: Schematic diagram of a single-phase automatic transfer switch with all-pole disconnection and SMA Energy Meter for increased self-consumption (example)

An automatic transfer switch provides the following functions:

- Grid disconnection isolates the battery backup grid from the utility grid.
- The grounding device grounds the battery backup grid after it has been disconnected from the utility grid.
The grounding device is only required in systems with all-pole disconnection.
- The phase coupling connects the line conductors of the battery backup system to a single-phase distribution grid.
The phase coupling is a function for single-phase battery backup systems if the installation of the battery backup grid is three-phase.
- The SMA Energy Meter measures the grid feed-in and the purchased electricity.
The SMA Energy Meter is only required in systems for increased self-consumption.

3.4.2 Grid Disconnection

Within the automatic transfer switch, a tie switch disconnects the battery backup grid from the utility grid. The conditions at the tie switch differ depending on the installation site. SMA Solar Technology AG offers two basic structures for grid disconnection and these differ as far as the tie switch is concerned:

- Grid disconnection with all-pole disconnection of the battery backup grid from the utility grid
In the event of grid failure, a tie switch disconnects all line conductors and the neutral conductor from the utility grid. If the technical connection requirements of the grid operator or the local standards and directives call for or allow all-pole disconnection, you must install this basic structure. You must install all-pole disconnection in the following countries:
 - Belgium
 - Denmark
 - Germany
 - France
 - Austria
 - Switzerland
- Grid disconnection without all-pole disconnection of the battery backup grid from the utility grid
In the event of grid failure, a tie switch disconnects all line conductors from the utility grid. The neutral conductor of the battery backup grid remains permanently connected to the utility grid. If the technical connection requirements of the grid operator or the local standards and directives prohibit disconnection of the neutral conductor, you must install this basic structure. In Australia, you must install a battery backup system without all-pole disconnection.

Independent of the basic structure, you must adjust the ampacity of the tie switch in accordance with the requirements on site. The tie switch must be designed for at least the operating range of the upstream fuse or the maximum short-circuit current of the PV system.

The circuitry of the automatic transfer switch is designed in such a way that the tie switch disconnects only in the event of a grid failure. If you stop or switch off the Sunny Island, the battery backup grid remains connected to the utility grid. This means that you can carry out maintenance work on the battery without the supply to the loads being interrupted.

Circuit description of the tie switch with all-pole disconnection *

The tie switch with all-pole disconnection consists of contactors **Q1** and **Q2**. The tie switch disconnects the battery backup grid from the utility grid in the event of a grid failure or if the utility grid is outside the limiting values for voltage and frequency.

The control voltage of contactors **Q1**, **Q2**, and **Q3** is equal to the voltage of a line conductor of the utility grid. This means that the tie switch can only be activated when grid voltage is present. An auxiliary contact of contactor **Q3** locks contactor **Q1**. Contactors **Q3** and **Q2** are controlled by the multifunction relay **Relay1** of the Sunny Island inverter. If the multifunction relay **Relay1** is in non-operative mode, contactors **Q2** and **Q3** activate. If contactor **Q3** is in non-operative mode, contactor **Q1** will also go into non-operative mode and be locked.

In the event of a total grid failure, contactors **Q1**, **Q2**, and **Q3** go into non-operative mode due to lack of control voltage and they disconnect the battery backup grid with all poles from the utility grid. The Sunny Island also measures the voltage of the utility grid. For this, the Sunny Island is connected with the same line conductor as the control voltage of contactors **Q1**, **Q2**, and **Q3**. If there is a deviation from country-specific limiting values for voltage and frequency of the utility grid, the multifunction relay **Relay1** is activated. The contactors **Q1**, **Q2**, and **Q3** remain in non-operative mode or go into non-operative mode.

When the utility grid is available again, the Sunny Island detects this. The Sunny Island synchronizes the battery backup grid with the utility grid. Following successful synchronization, the multifunction relay **Relay1** goes into non-operative mode and contactors **Q2** and **Q3** are activated. Contactor **Q3** unlocks contactor **Q1** and **Q1** is activated. The battery backup grid is again connected to the utility grid.

Circuit description of the tie switch without all-pole disconnection **

The tie switch without all-pole disconnection consists of contactor **Q2** (see Section 5.1.1 "Schematic Diagram of the Automatic Transfer Switch", page 30). The tie switch disconnects the battery backup grid from the utility grid in the event of a grid failure or if the utility grid is outside the limiting values for voltage and frequency.

The control voltage of contactor **Q2** is equal to the voltage at the line conductor L1 of the utility grid. This means that the tie switch can only be activated when grid voltage is present. Contactor **Q2** is controlled by the multifunction relay **Relay1** of the Sunny Island inverter. If the multifunction relay **Relay1** is in non-operative mode, contactor **Q2** activates.

In the event of a total grid failure, contactor **Q2** goes into non-operative mode due to lack of control voltage and disconnects the battery backup grid from the line conductors of the utility grid. The Sunny Island also measures the voltage of the utility grid. For this, the Sunny Island is connected to the same line conductor as the control voltage of contactor **Q2**. If there is a deviation from country-specific limiting values for voltage and frequency of the utility grid, the multifunction relay **Relay1** is activated. Contactor **Q2** remains in non-operative mode or goes into non-operative mode.

When the utility grid is available again, the Sunny Island detects this. The Sunny Island synchronizes the battery backup grid with the utility grid. Following successful synchronization, the multifunction relay **Relay1** goes into non-operative mode and contactor **Q2** activates. The battery backup grid is again connected to the utility grid.

3.4.3 Grounding Device for the Battery Backup Grid

With TN and TT systems, the neutral conductor must be grounded for protection in the case of indirect contact with live components. Grounding in the utility grid is usually achieved at the local grid transformer.

In automatic transfer switches with all-pole disconnection, all poles of the battery backup grid are disconnected from the utility grid in the event of grid failure. As a result of the disconnection, the neutral conductor in the battery backup grid is not grounded. Therefore, in automatic transfer switches with all-pole disconnection, a grounding device must ground the neutral conductor in the event of grid failure. The grounding device enables the required protection in the event of indirect contact with live components. The grounding device is set up for fail-safe operation.

If the neutral conductor of the battery backup grid is connected to the utility grid, there must be no further grounding in the battery backup grid. The grounding device therefore disconnects the connection between the neutral conductor and ground if the automatic transfer switch connects the battery backup grid to the utility grid.

* The explanation is based on a single-phase battery backup system with one Sunny Island. Three-phase battery backup systems behave in the same way.

** The explanation is based on a single-phase battery backup system with one Sunny Island. Three-phase battery backup systems behave in the same way.

Circuit Description of the Grounding Device

Contactors **Q3** and **Q4** form the grounding device (see Section 4.1 "Single-Phase Battery Backup System", page 20). Contactors **Q3** and **Q4** are controlled by the two multifunction relays of the Sunny Island inverter. Contactor **Q3** is activated in parallel to contactor **Q2** of the tie switch. If contactor **Q2** deactivates and the tie switch opens, contactor **Q3** connects the neutral conductor in the battery backup grid to the grounding conductor. In addition, the Sunny Island uses the multifunction relay **Relay2** to control contactor **Q4**. If the multifunction relay **Relay2** activates, contactor **Q4** activates and also connects the neutral conductor to the grounding conductor. This arrangement ensures that the neutral conductor of the battery backup grid is always connected to ground.

3.4.4 Phase Coupling for Single-Phase Battery Backup Systems

In single-phase battery backup systems, in the event of grid failure, the battery backup grid is single-phase. If the installation of the battery backup grid is three-phase, only one part of the loads can continue to be supplied.

Phase coupling enables combination of the line conductors in the battery backup grid. As a result, the other two line conductors are also supplied with voltage. This means that, in the event of grid failure, a three-phase battery backup grid becomes a single-phase distribution grid.

Phase coupling can be switched on independently for the other line conductors. Phase coupling is only suitable for battery backup grids with single-phase PV inverters and single-phase loads.

Circuit description of the phase coupling

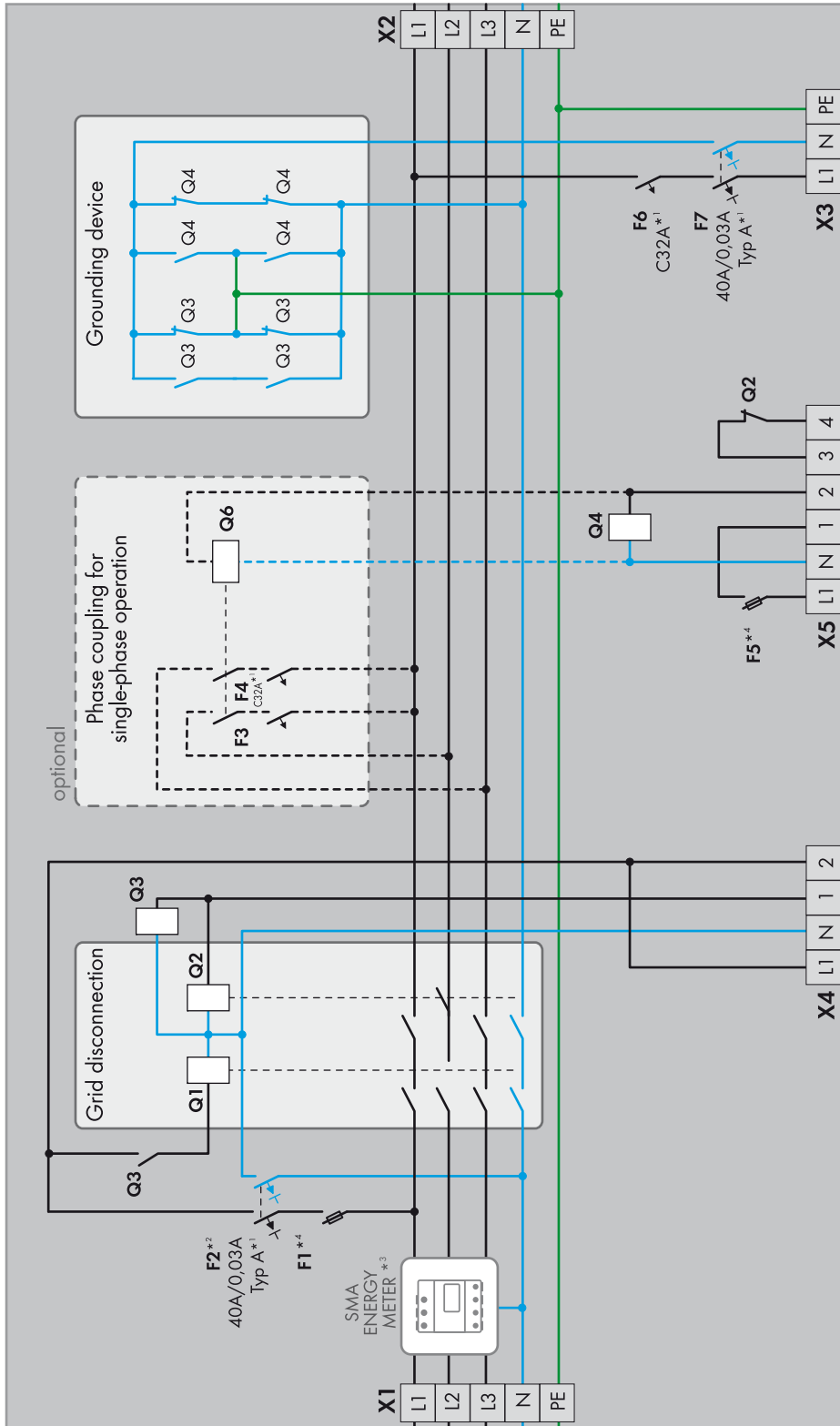
Contactor **Q6** is the phase coupler. If the multifunction relay **Relay2** activates on the Sunny Island, contactor **Q6** activates and connects the unsupplied line conductors via circuit breakers **F3** and **F4** with the supplied line conductor.

In the event of grid failure, the line conductor that is connected with the Sunny Island is supplied with voltage first. Then the phase coupling combines the two other line conductors. When the utility grid is available again, the phase coupling disconnects the combined line conductors. Only the line conductor which is connected to the Sunny Island is not interrupted on connection to the utility grid.

4 Battery Backup Systems With All-Pole Disconnection

4.1 Single-Phase Battery Backup System

4.1.1 Schematic Diagram of the Automatic Transfer Switch



*¹ The indicated values are recommended by SMA Solar Technology AG. The electrical devices must be designed in accordance with the locally applicable standards and directives.

*² Only applicable for TT grid configuration.

*³ Not required for systems without increased self-consumption.

*⁴ Requirements for thermal fuse used: nominal cold resistance of at least 0.2 Ω and melting integral max. 1A2s.

Figure 3: Schematic diagram of the single-phase automatic transfer switch with all-pole disconnection and optional SMA Energy Meter

4.1.2 Circuitry Overview

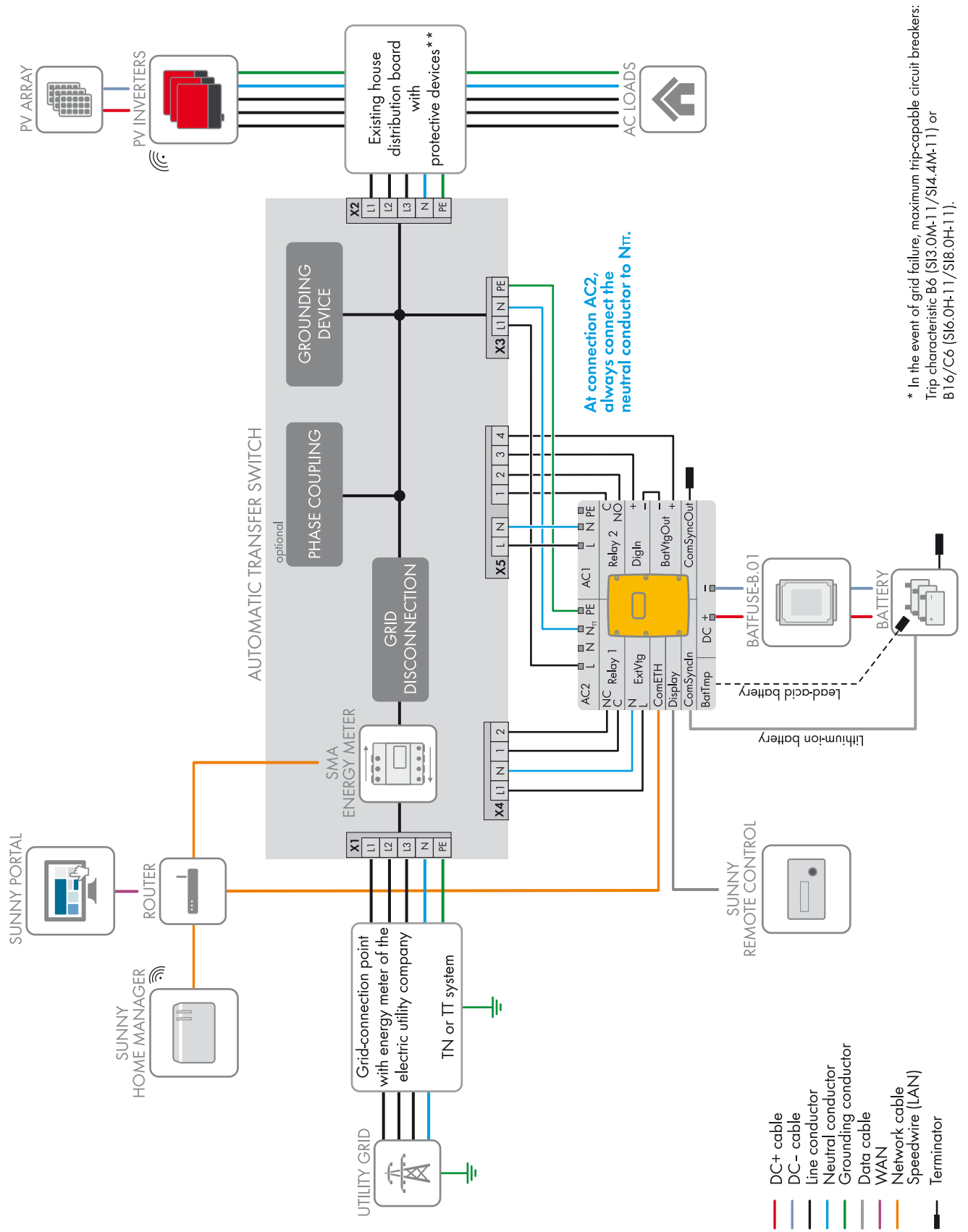


Figure 4: Connection of the automatic transfer switch with all-pole disconnection (e.g., for Germany)

4.1.3 Connecting the Sunny Island Inverter

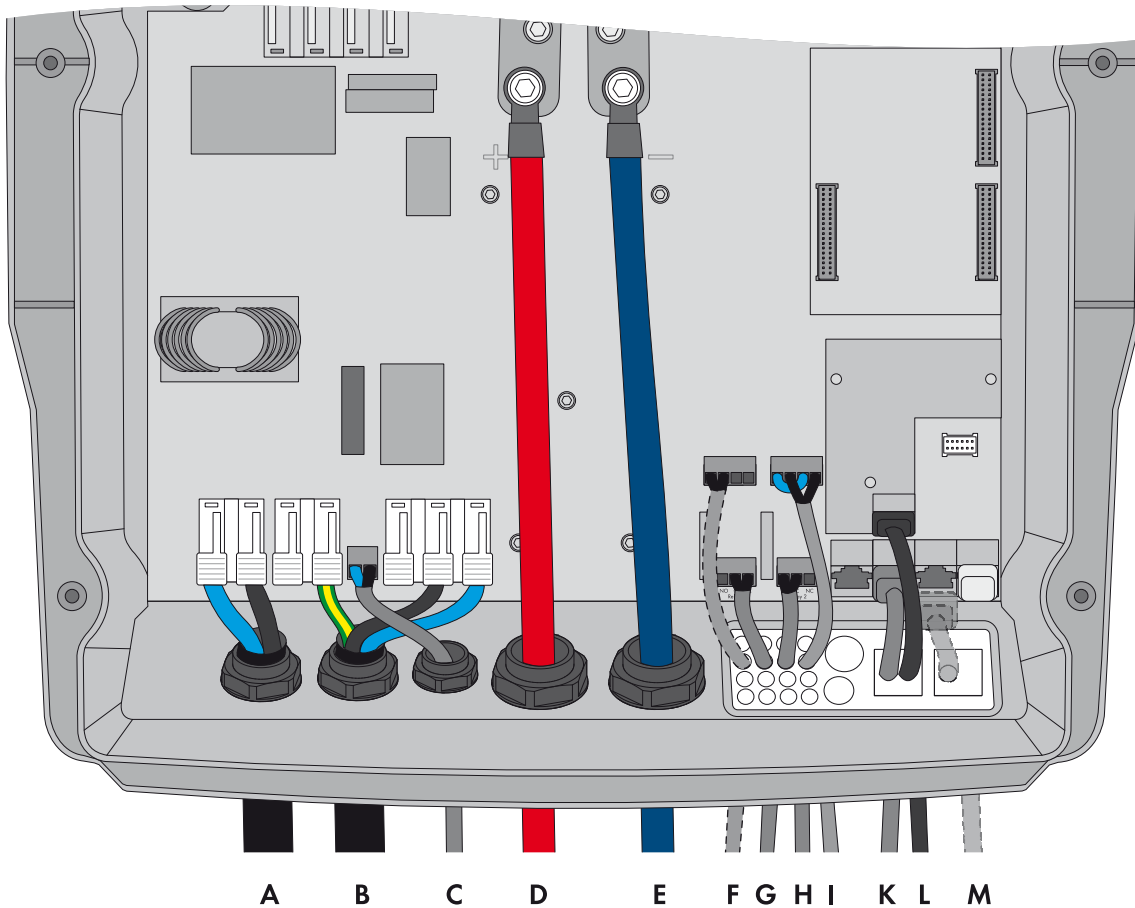


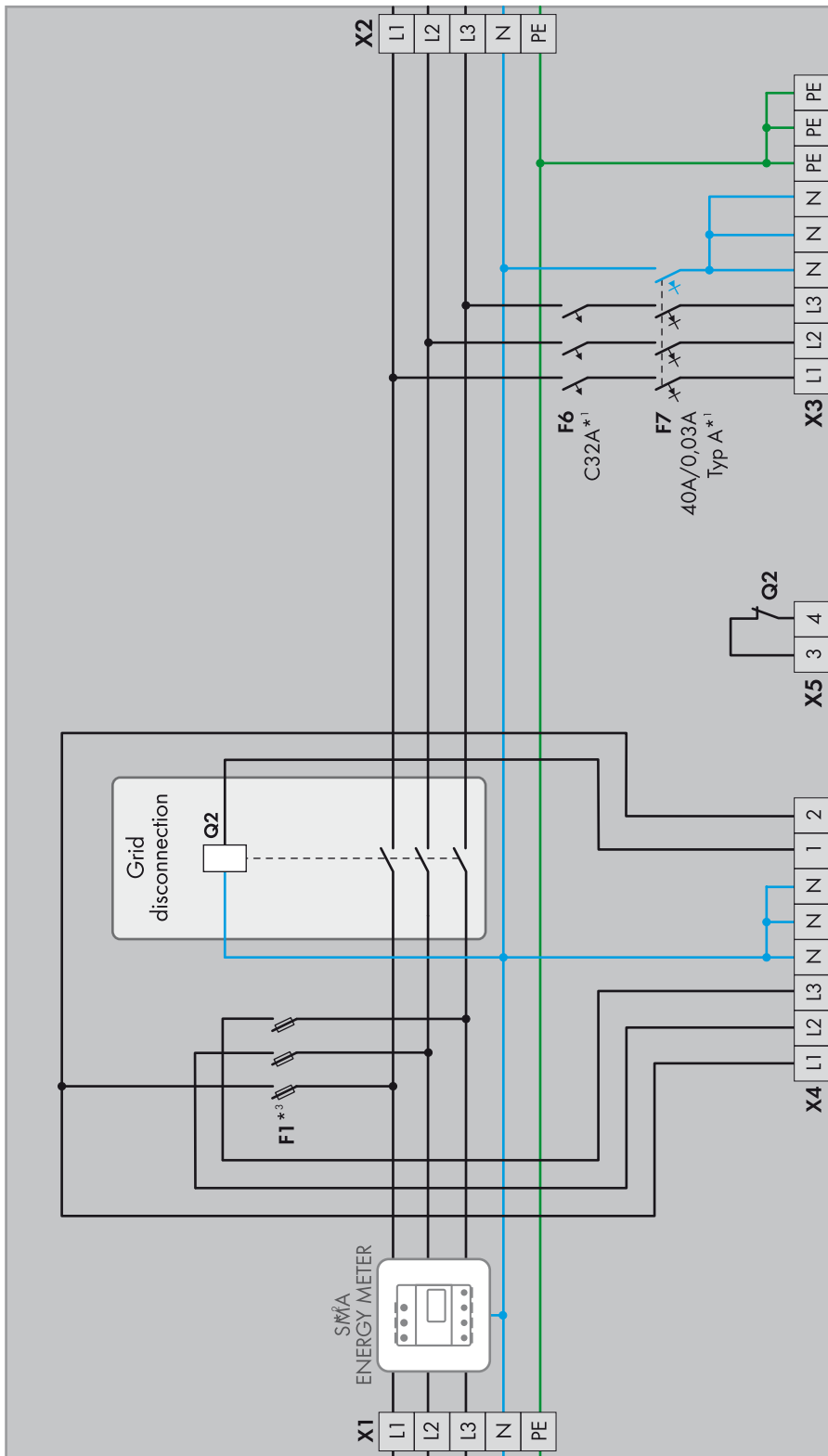
Figure 5: Connecting the Sunny Island inverter

Position	Designation	Description/information
A	Cable for the control voltage	Sunny Island: connection AC1 Loads/SunnyBoys terminals L and N Automatic transfer switch: connection X5 terminals L and N Conductor cross-section: 2.5 mm ² to 16 mm ²
B	AC power cable	Sunny Island: connection AC2 Gen/Grid terminals L , N_{TT} , and PE Automatic transfer switch: connection X3 terminals L1 , N , and PE Conductor cross-section: 10 mm ² to 16 mm ²
C	Measuring cable for voltage measurement	Sunny Island: connection ExtVtg terminals L and N Automatic transfer switch: connection X4 terminals L1 and N Conductor cross-section: 1.5 mm ² to 2.5 mm ²
D	DC+ cable	Battery connection
E	DC – cable	Conductor cross-section: 50 mm ² to 95 mm ² Cable diameter: 14 mm to 25 mm

Position	Designation	Description/information
F	Measuring cable of the battery temperature sensor	Sunny Island: BatTmp connection You only have to connect a battery temperature sensor if lead-acid batteries are used. Mount the battery temperature sensor in the middle of the battery connection, in the upper third of the battery cell.
G	Control cable of the tie switch	Sunny Island: connection Relay1 terminals C and NC Automatic transfer switch: connection X4 terminals 1 and 2 If the multifunction relay activates, the contactors of the tie switch deactivate. Conductor cross-section: 1.5 mm ² to 2.5 mm ²
H	Control cable of contactors Q4 and Q6	Sunny Island: connection Relay2 terminals C and NO Automatic transfer switch: connection X5 terminals 1 and 2 If the multifunction relay activates, the contactors activate. Conductor cross-section: 1.5 mm ² to 2.5 mm ²
I	Measuring cable for monitoring the tie switch	Sunny Island: connections DigIn+ and BatVtgOut+ Automatic transfer switch: connection X5 terminals 3 and 4 Inside the Sunny Island inverter, connect connections DigIn – and BatVtgOut – . Conductor cross-section: 0.2 mm ² to 2.5 mm ²
K	Data cable to Sunny Remote Control	Sunny Island: Display connection
L	Speedwire network cable	Sunny Island: ComETH connection In order to connect the router/network switch, the Speedwire data module Sunny Island must be mounted in the Sunny Island (see Sunny Island Speedwire data module installation manual). The ComETH connection is on the data module.
M	Data cable for battery management	Sunny Island: ComSync In connection You only have to connect a data cable to the battery if lithium-ion batteries are used. The communication bus must be equipped with a terminator on both ends.

4.2 Three-Phase Battery Backup System

4.2.1 Schematic Diagram of the Automatic Transfer Switch



*1 The indicated values are recommended by SMA Solar Technology AG. The electrical devices must be designed in accordance with the locally applicable standards and directives.
 *2 Not required for systems without increased self-consumption.
 *3 Requirements for thermal fuse used: nominal cold resistance of at least 0.2 Ω and melting integral max. 1 A2s...

Figure 6: Schematic diagram of the three-phase automatic transfer switch with all-pole disconnection and optional SMA Energy Meter

4.2.2 Circuitry Overview

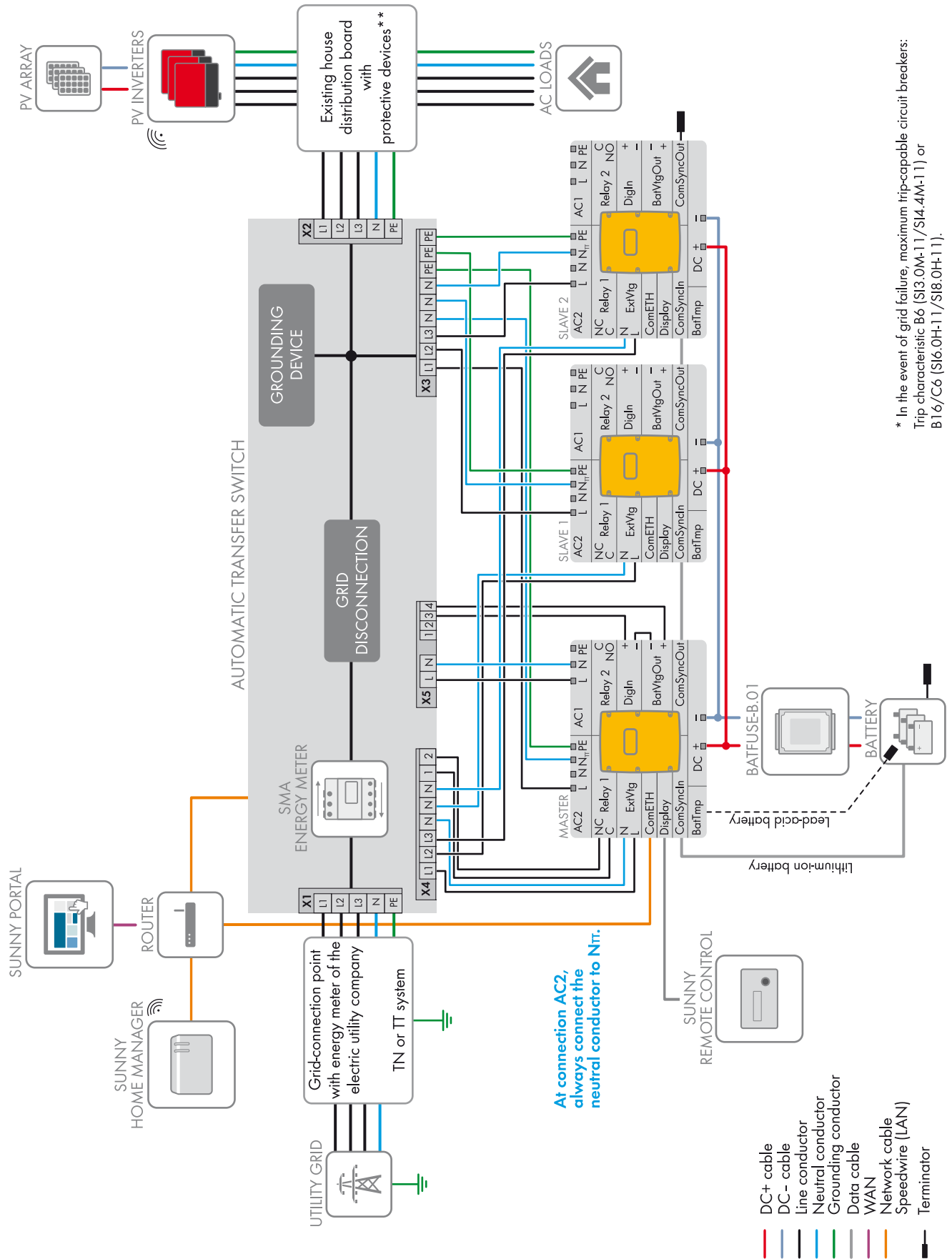


Figure 7: Connection of the automatic transfer switch with all-pole disconnection (e.g., for Germany)

4.2.3 Connecting the Master

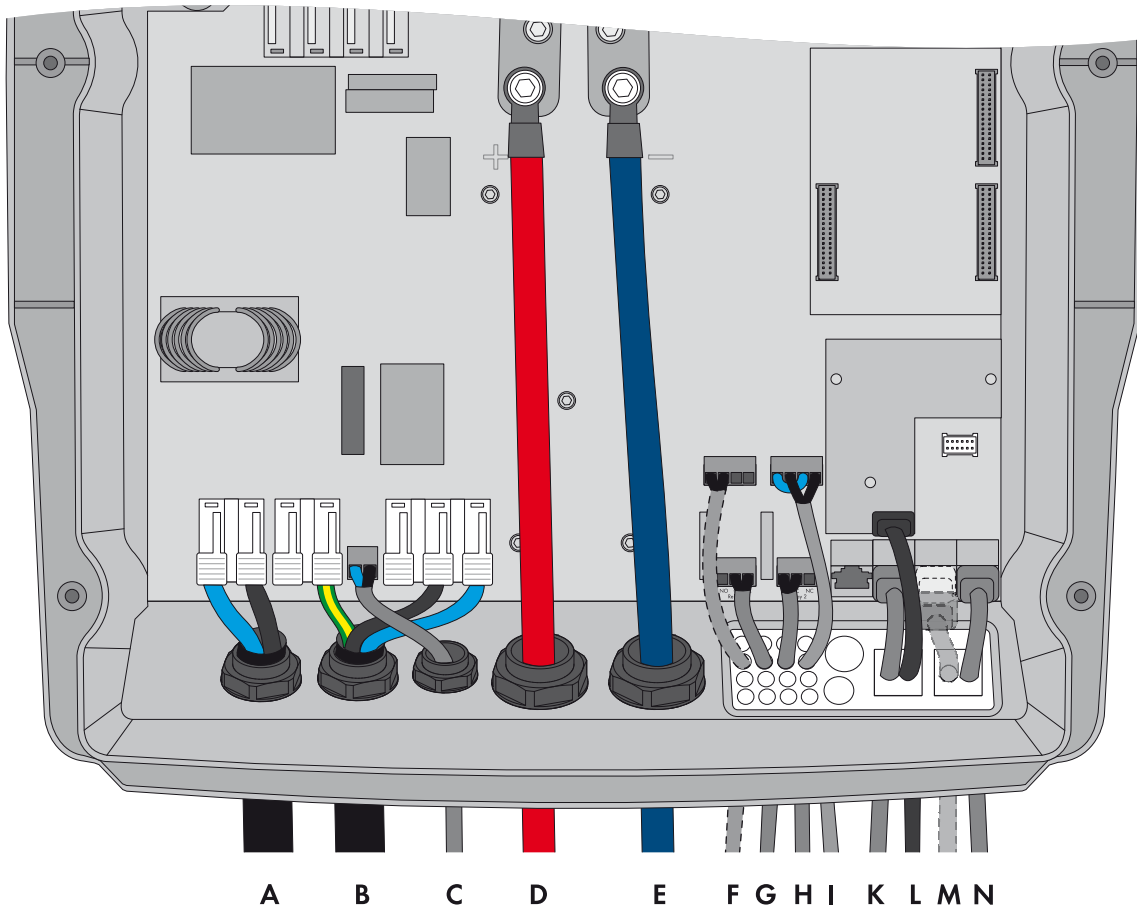


Figure 8: Connecting the master

Position	Designation	Description/information
A	Cable for the control voltage	Sunny Island: connection AC1 Loads/SunnyBoys terminals L and N Automatic transfer switch: connection X5 terminals L and N Conductor cross-section: 2.5 mm ² to 16 mm ²
B	AC power cable	Sunny Island: connection AC2 Gen/Grid terminals L , N_{TT} , and PE Automatic transfer switch: connection X3 terminals L1 , N , and PE Conductor cross-section: 10 mm ² to 16 mm ²
C	Measuring cable for voltage measurement	Sunny Island: connection ExtVtg terminals L and N Automatic transfer switch: connection X4 terminals L1 and N Conductor cross-section: 1.5 mm ² to 2.5 mm ²
D	DC+ cable	Battery connection
E	DC – cable	Conductor cross-section: 50 mm ² to 95 mm ² Cable diameter: 14 mm to 25 mm
F	Measuring cable of the battery temperature sensor	Sunny Island: BatTmp connection You only have to connect a battery temperature sensor if lead-acid batteries are used. Mount the battery temperature sensor in the middle of the battery connection, in the upper third of the battery cell.

Position	Designation	Description/information
G	Control cable of the tie switch	Sunny Island: connection Relay1 terminals C and NC Automatic transfer switch: connection X4 terminals 1 and 2 If the multifunction relay activates, the contactors of the tie switch deactivate. Conductor cross-section: 1.5 mm ² to 2.5 mm ²
H	Control cable of contactor Q4	Sunny Island: connection Relay2 terminals C and NO Automatic transfer switch: connection X5 terminals 1 and 2 If the multifunction relay activates, contactor Q4 activates. Conductor cross-section: 1.5 mm ² to 2.5 mm ²
I	Measuring cable for monitoring the tie switch	Sunny Island: connections DigIn+ and BatVtgOut+ Automatic transfer switch: connection X5 terminals 3 and 4 Inside the Sunny Island inverter, connect connections DigIn - and BatVtgOut - . Conductor cross-section: 0.2 mm ² to 2.5 mm ²
K	Data cable to Sunny Remote Control	Sunny Island: Display connection
L	Speedwire network cable	Sunny Island: ComETH connection In order to connect the router/network switch, the Speedwire data module Sunny Island must be mounted in the Sunny Island (see Sunny Island Speedwire data module installation manual). The ComETH connection is on the data module.
M	Data cable for battery management	Sunny Island: ComSync In connection You only have to connect a data cable to the battery if lithium-ion batteries are used. The communication bus must be equipped with a terminator on both ends.
N	Data cable for the internal communication in the cluster	Sunny Island: ComSync Out connection Connection of internal communication bus of slave 1

4.2.4 Connecting the Slaves

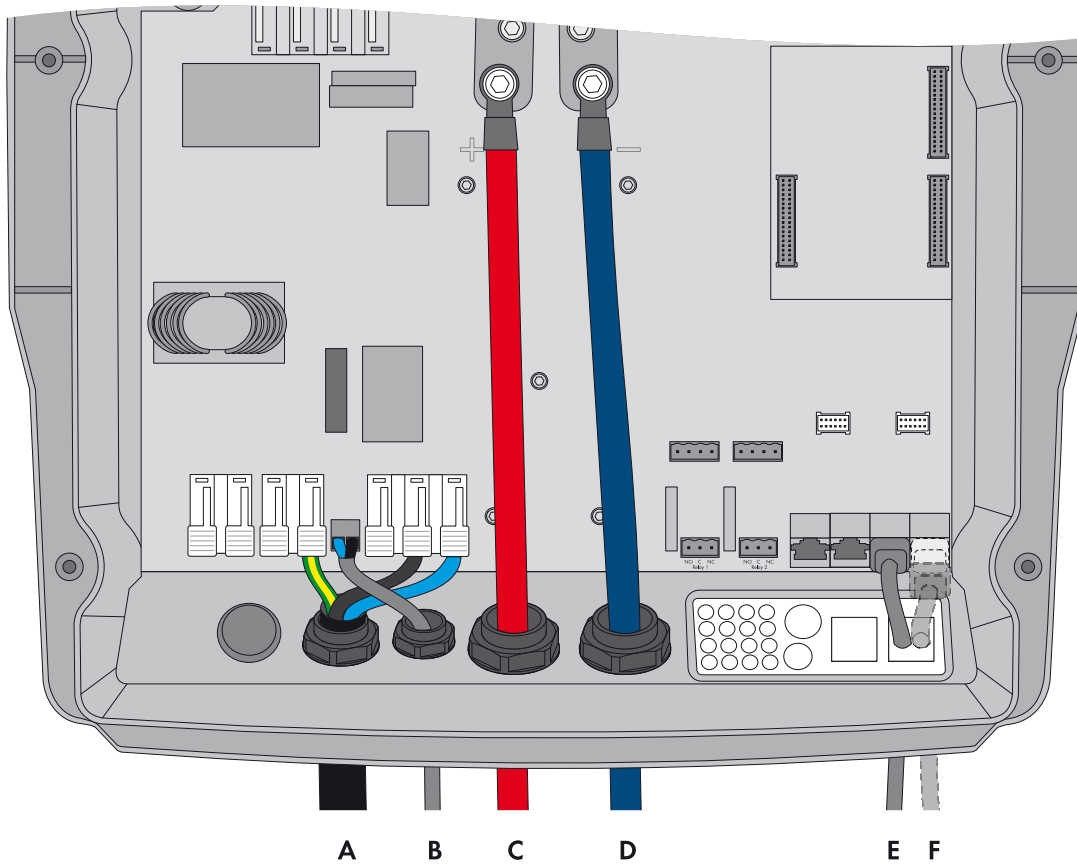


Figure 9: Connecting the slaves

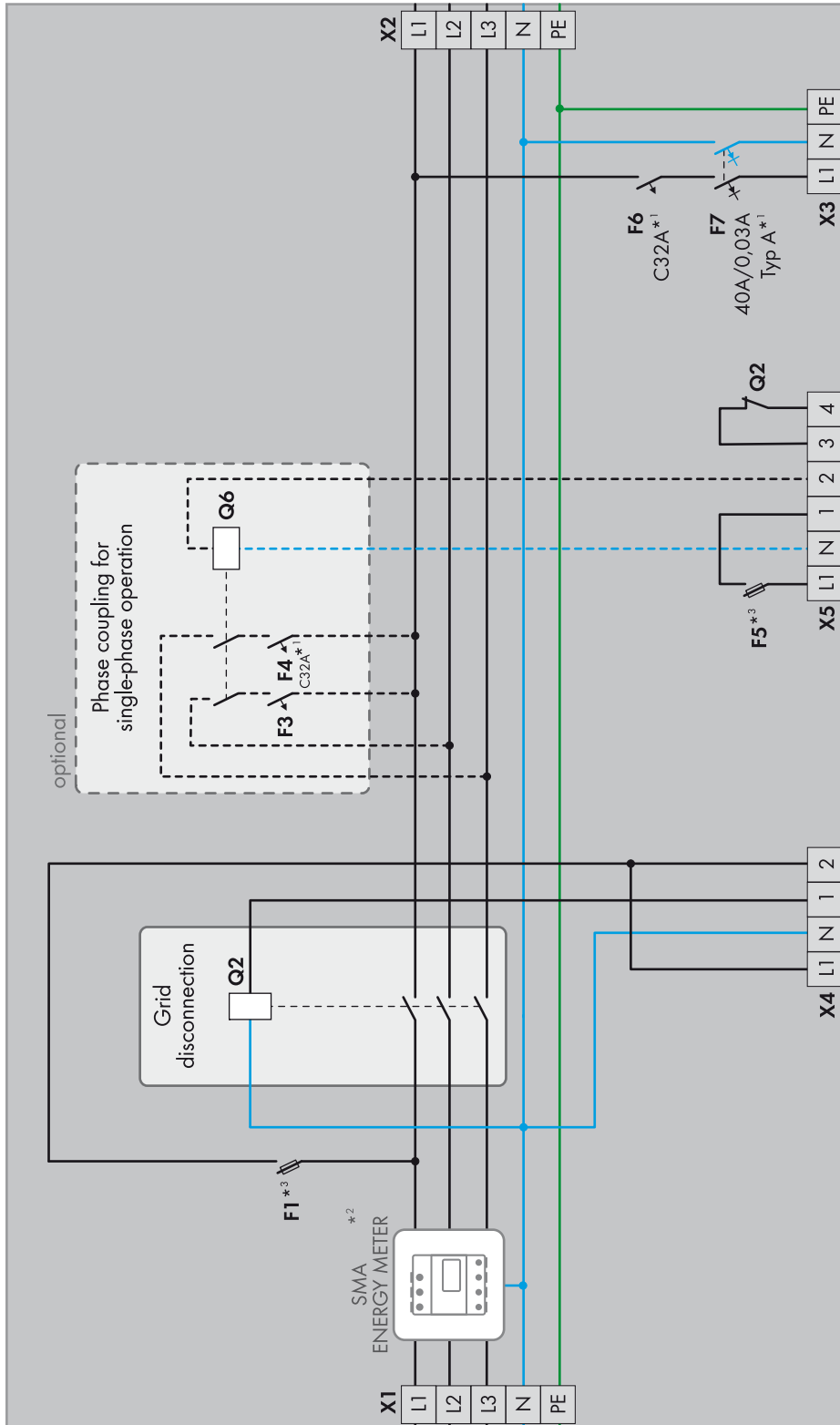
Position	Designation	Description/information
A	AC power cable	Sunny Island: connection AC2 Gen/Grid terminals L , N_{TT} , and PE Automatic transfer switch: Connect slave 1 to X3 terminals L2 , N , and PE . Connect slave 2 to X3 , terminals L3 , N , and PE . Conductor cross-section: 10 mm ² to 16 mm ²
B	Measuring cable for voltage measurement	Sunny Island: connection ExtVtg terminals L and N Automatic transfer switch: Connect slave 1 to X4 terminals L2 and N . Connect slave 2 to X4 terminals L3 and N . Conductor cross-section: 1.5 mm ² to 2.5 mm ²
C	DC+ cable	Battery connection
D	DC – cable	Conductor cross-section: 50 mm ² to 95 mm ² Cable diameter: 14 mm to 25 mm
E	Data cable for the internal communication in the cluster	Sunny Island: ComSync In connection With slave 1: connection of internal communication bus of master With slave 2: connection of internal communication bus of slave 1

Position	Designation	Description/information
F	Data cable for the internal communication in the cluster	Sunny Island: ComSync Out connection With slave 1: connection of internal communication bus after slave 2 With slave 2: leave terminator plugged in. Slave 2 is connected to slave 1 only.

5 Battery Backup Systems Without All-Pole Disconnection

5.1 Single-Phase Battery Backup System

5.1.1 Schematic Diagram of the Automatic Transfer Switch



*¹ The indicated values are recommended by SMA Solar Technology AG. The electrical devices must be designed in accordance with the locally applicable standards and directives.
 *² Not required for systems without increased self-consumption.
 *³ Requirements for thermal fuse used: nominal cold resistance of at least 0.2 Ω and melting integral max. 1A2s.

Figure 10: Schematic diagram of the single-phase automatic transfer switch without all-pole disconnection and optional SMA Energy Meter

5.1.2 Circuitry Overview

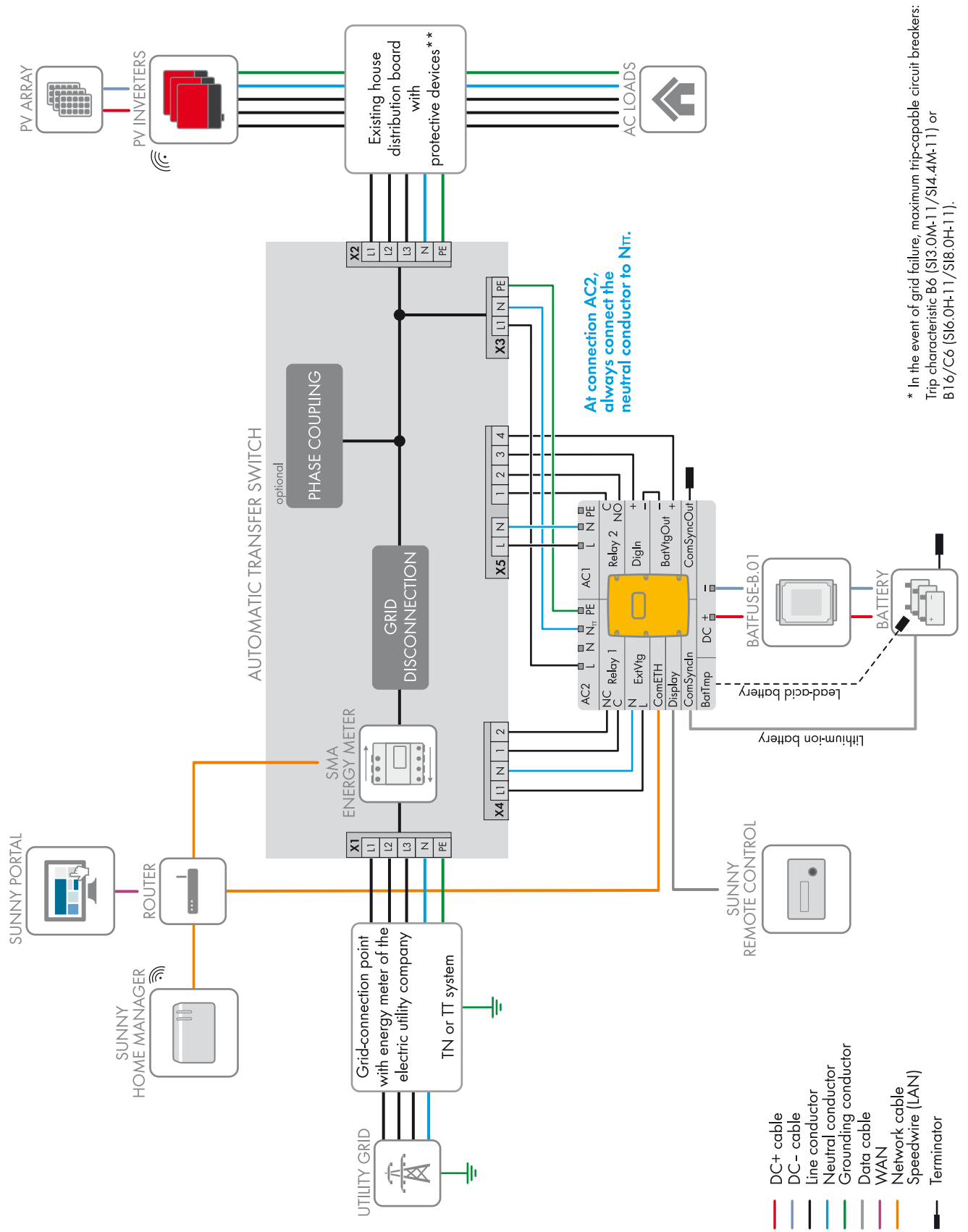


Figure 11: Connection of the automatic transfer switch without all-pole disconnection (e.g., for Australia)

5.1.3 Connecting the Sunny Island Inverter

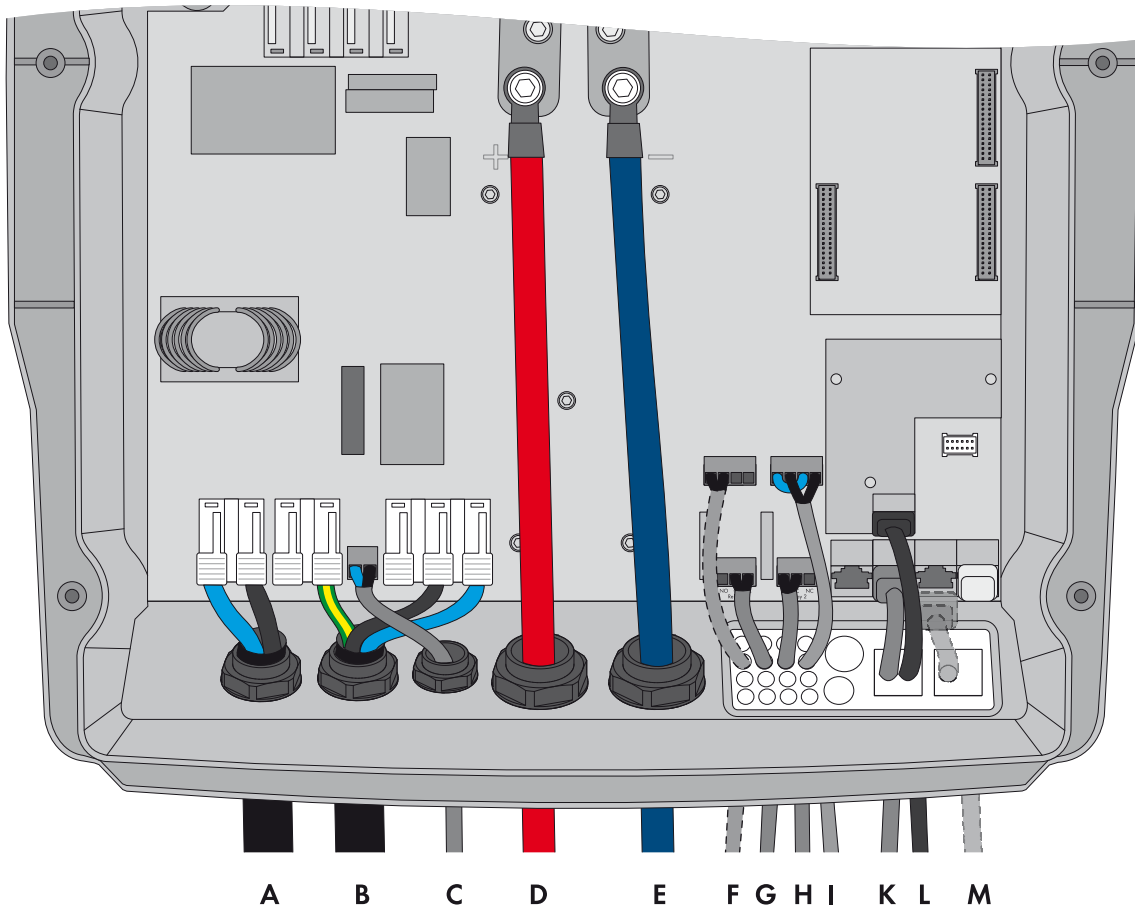


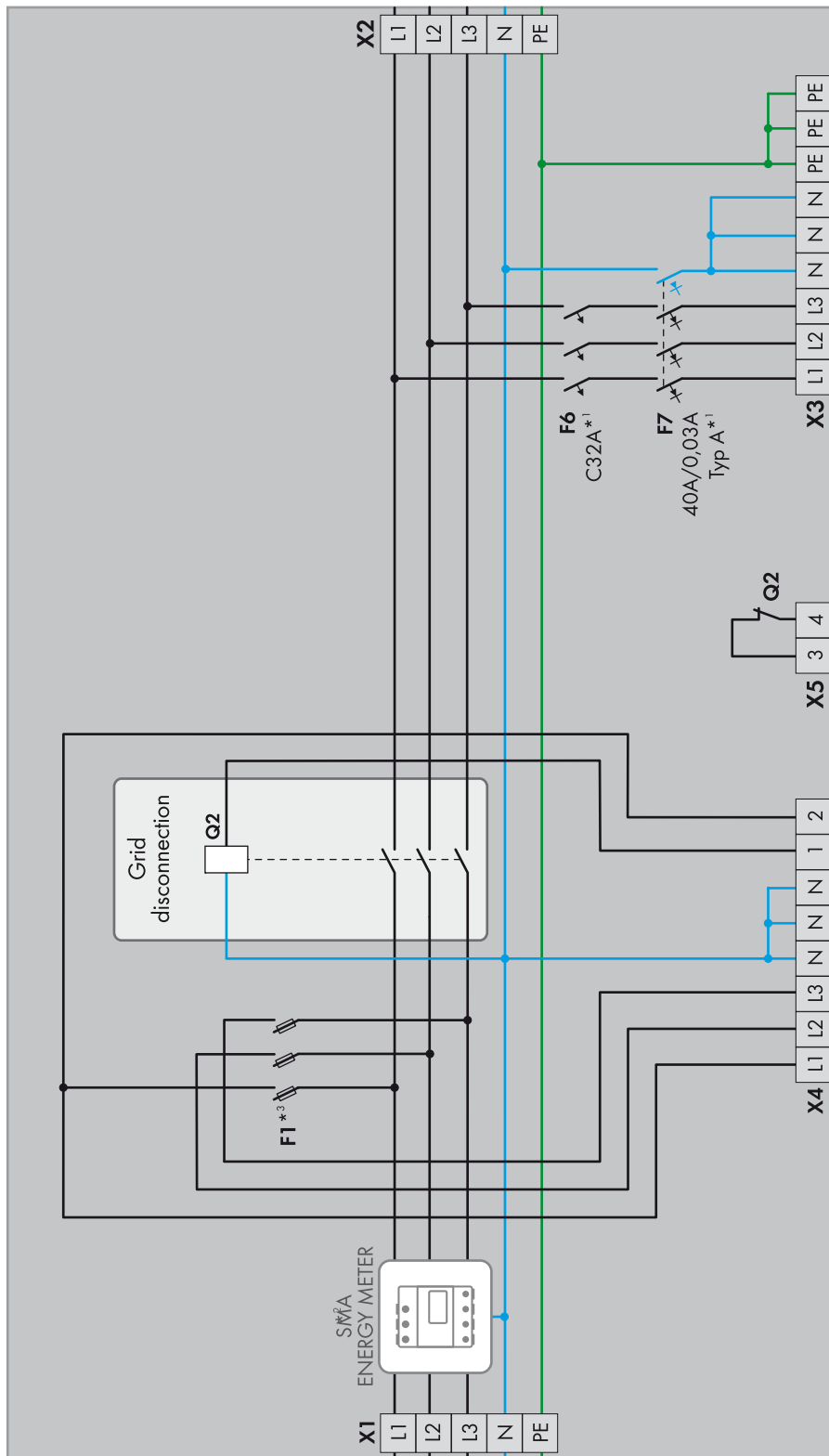
Figure 12: Connecting the Sunny Island inverter

Position	Designation	Description/information
A	Cable for the control voltage	Sunny Island: connection AC1 Loads/SunnyBoys terminals L and N Automatic transfer switch: connection X5 terminals L and N This cable is only required for phase coupling. Conductor cross-section: 2.5 mm ² to 16 mm ²
B	AC power cable	Sunny Island: connection AC2 Gen/Grid terminals L , N_{TT} , and PE Automatic transfer switch: connection X3 terminals L1 , N , and PE Conductor cross-section: 10 mm ² to 16 mm ²
C	Measuring cable for voltage measurement	Sunny Island: connection ExtVtg terminals L and N Automatic transfer switch: connection X4 terminals L1 and N Conductor cross-section: 1.5 mm ² to 2.5 mm ²
D	DC+ cable	Battery connection
E	DC – cable	Conductor cross-section: 50 mm ² to 95 mm ² Cable diameter: 14 mm to 25 mm
F	Measuring cable of the battery temperature sensor	Sunny Island: BatTmp connection You only have to connect a battery temperature sensor if lead-acid batteries are used. Mount the battery temperature sensor in the middle of the battery connection, in the upper third of the battery cell.

Position	Designation	Description/information
G	Control cable of the tie switch	Sunny Island: connection Relay1 terminals C and NC Automatic transfer switch: connection X4 terminals 1 and 2 If the multifunction relay activates, the contactor of the tie switch deactivates. Conductor cross-section: 1.5 mm ² to 2.5 mm ²
H	Control cable of contactor Q6	Sunny Island: connection Relay2 terminals C and NO Automatic transfer switch: connection X5 terminals 1 and 2 If the multifunction relay activates, the contactor activates. This cable is only required for phase coupling. Conductor cross-section: 1.5 mm ² to 2.5 mm ²
I	Measuring cable for monitoring the tie switch	Sunny Island: connections DigIn+ and BatVtgOut+ Automatic transfer switch: connection X5 terminals 3 and 4 Inside the Sunny Island inverter, connect connections DigIn – and BatVtgOut – . Conductor cross-section: 0.2 mm ² to 2.5 mm ²
K	Data cable to Sunny Remote Control	Sunny Island: Display connection
L	Speedwire network cable	Sunny Island: ComETH connection In order to connect the router/network switch, the Speedwire data module Sunny Island must be mounted in the Sunny Island (see Sunny Island Speedwire data module installation manual). The ComETH connection is on the data module.
M	Data cable for battery management	Sunny Island: ComSync In connection You only have to connect a data cable to the battery if lithium-ion batteries are used. The communication bus must be equipped with a terminator on both ends.

5.2 Three-Phase Battery Backup System

5.2.1 Schematic Diagram of the Automatic Transfer Switch



*¹ The indicated values are recommended by SMA Solar Technology AG. The electrical devices must be designed in accordance with the locally applicable standards and directives.
 *² Not required for systems without increased self-consumption.
 *³ Requirements for thermal fuse used: nominal cold resistance of at least 0.2 Ω and melting integral max. 1A2s.

Figure 13: Schematic diagram of the three-phase automatic transfer switch without all-pole disconnection and optional SMA Energy Meter

5.2.2 Circuitry Overview

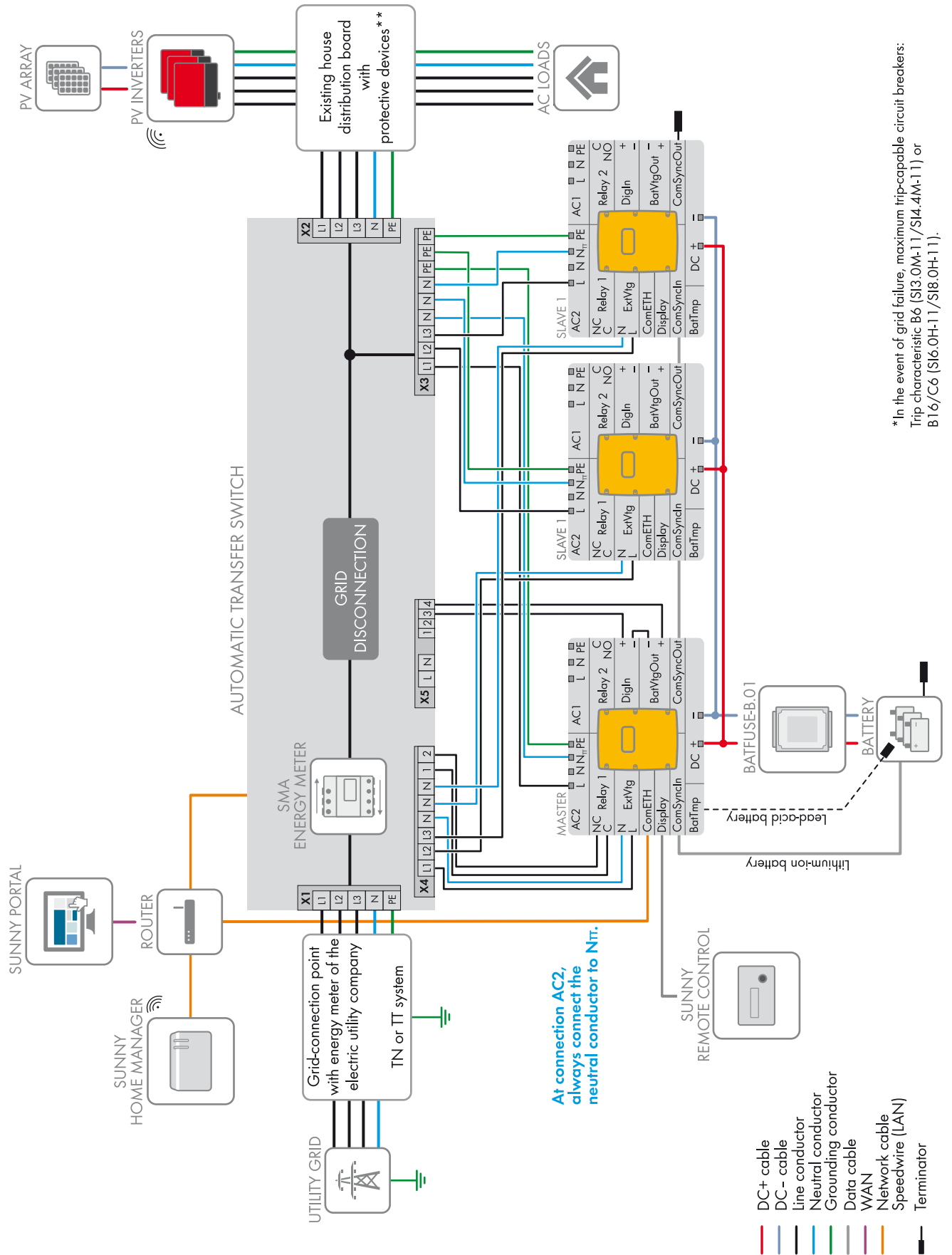


Figure 14: Connection of the automatic transfer switch (e.g., for Australia)

5.2.3 Connecting the Master

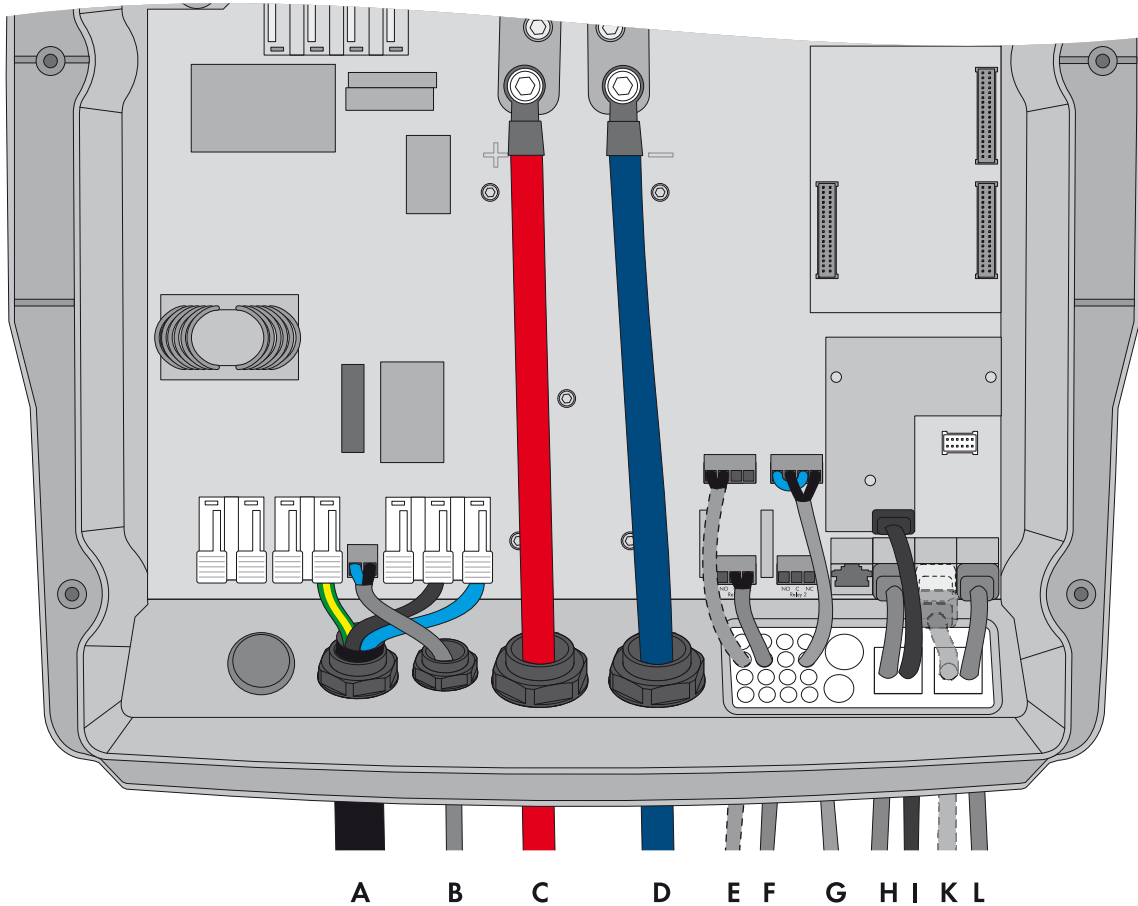


Figure 15: Connecting the master

Position	Designation	Description/information
A	AC power cable	Sunny Island: connection AC2 Gen/Grid terminals L , N_{TT} , and PE Automatic transfer switch: connection X3 terminals L1 , N , and PE Conductor cross-section: 10 mm ² to 16 mm ²
B	Measuring cable for voltage measurement	Sunny Island: connection ExtVtg terminals L and N Automatic transfer switch: connection X4 terminals L1 and N Conductor cross-section: 1.5 mm ² to 2.5 mm ²
C	DC+ cable	Battery connection
D	DC – cable	Conductor cross-section: 50 mm ² to 95 mm ² Cable diameter: 14 mm to 25 mm
E	Measuring cable of the battery temperature sensor	Sunny Island: BatTmp connection You only have to connect a battery temperature sensor if lead-acid batteries are used. Mount the battery temperature sensor in the middle of the battery connection, in the upper third of the battery cell.

Position	Designation	Description/information
F	Control cable of the tie switch	Sunny Island: connection Relay1 terminals C and NC Automatic transfer switch: connection X4 terminals 1 and 2 If the multifunction relay activates, the contactor of the tie switch deactivates. Conductor cross-section: 1.5 mm ² to 2.5 mm ²
G	Measuring cable for monitoring the tie switch	Sunny Island: connections DigIn+ and BatVtgOut+ Automatic transfer switch: connection X5 terminals 3 and 4 Inside the Sunny Island inverter, connect connections DigIn – and BatVtgOut – . Conductor cross-section: 0.2 mm ² to 2.5 mm ²
I	Data cable to Sunny Remote Control	Sunny Island: Display connection
K	Speedwire network cable	Sunny Island: ComETH connection In order to connect the router/network switch, the Speedwire data module Sunny Island must be mounted in the Sunny Island (see Sunny Island Speedwire data module installation manual). The ComETH connection is on the data module.
L	Data cable for battery management	Sunny Island: ComSync In connection You only have to connect a data cable to the battery if lithium-ion batteries are used. The communication bus must be equipped with a terminator on both ends. If no data cable is plugged in, plug the terminator into ComSync In .
M	Data cable for the internal communication in the cluster	Sunny Island: ComSync Out connection

5.2.4 Connecting the Slaves

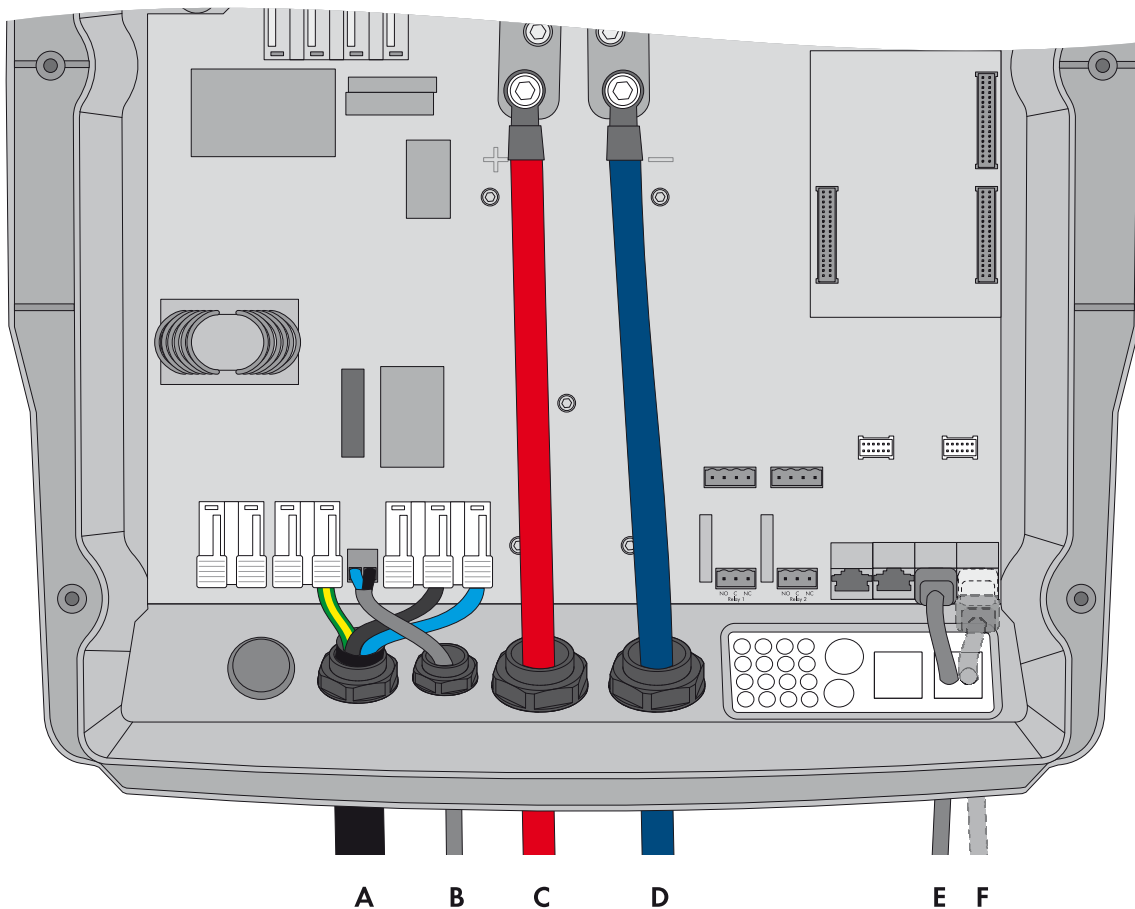


Figure 16: Connecting the slaves

Position	Designation	Description/information
A	AC power cable	<p>Sunny Island: connection AC2 Gen/Grid terminals L, N_{TT}, and PE</p> <p>Automatic transfer switch:</p> <p>Connect slave 1 to X3 terminals L2, N, and PE.</p> <p>Connect slave 2 to X3, terminals L3, N, and PE.</p> <p>Conductor cross-section: 10 mm² to 16 mm²</p>
B	Measuring cable for voltage measurement	<p>Sunny Island: connection ExtVtg terminals L and N</p> <p>Automatic transfer switch:</p> <p>Connect slave 1 to X4 terminals L2 and N.</p> <p>Connect slave 2 to X4 terminals L3 and N.</p> <p>Conductor cross-section: 1.5 mm² to 2.5 mm²</p>
C	DC+ cable	Battery connection
D	DC – cable	<p>Conductor cross-section: 50 mm² to 95 mm²</p> <p>Cable diameter: 14 mm to 25 mm</p>
E	Data cable for the internal communication in the cluster	Sunny Island: ComSync In connection
F	Data cable for the internal communication in the cluster	<p>Sunny Island: ComSync Out connection</p> <p>With slave 2, leave terminator plugged in.</p> <p>Slave 2 is connected to slave 1 only.</p>

6 Connecting the Sunny Home Manager

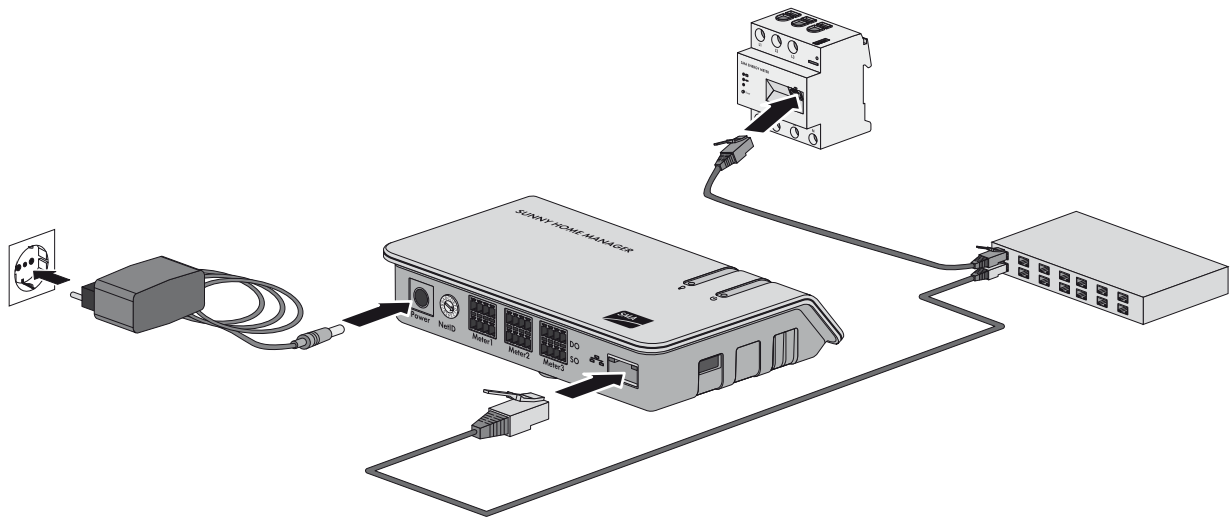


Figure 17: Connection of the Sunny Home Manager in systems with an SMA Energy Meter

Requirements:

- All Speedwire devices must be connected to the same router or network switch.
- The router and optionally the network switch must fully support Multicast.
- The router must support "Internet Enabled Devices" with the interfaces SIP and STUN.

The most common routers and network switches support Multicast and "Internet Enabled Devices".

7 Commissioning

7.1 Basic Configuration of the Sunny Island Inverter

NOTICE

Damage to the battery due to incorrect settings

Aging of the battery will be accelerated by incorrect settings of the parameters for battery type, nominal voltage, and battery capacity. The battery parameters influence the charging behavior of the Sunny Island inverter.

- During the basic configuration, ensure that you configure the battery values recommended by the battery manufacturer (for the battery technical data, see the documentation of the battery manufacturer).
- In the basic configuration, configure the battery capacity for a ten-hour electric discharge (C10). The battery manufacturer specifies the battery capacity in relation to discharge time.

Requirements:

- With a three-phase system, the Sunny Remote Control must be connected to the master. The master is thus defined during basic configuration.
- In the automatic transfer switch, all circuit breakers must be open. This means that the Sunny Island is not connected to any PV inverter.

Procedure:

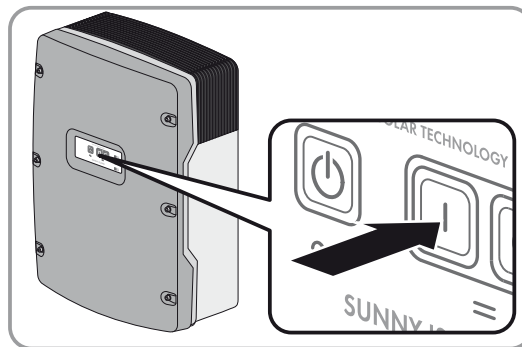
Check the wiring
(see the Sunny Island inverter installation manual).



Close all devices except the BatFuse.
This protects all live components from being touched.



Close the BatFuse and switch on all Sunny Island inverters:
In systems with one Sunny Island, press the "On" button.
In systems with three Sunny Island inverters, press and hold the "On" button on the master until an acoustic signal sounds.



↓

When the Sunny Remote Control shows **<Init System>**, press and hold the button on the Sunny Remote Control.

```

Boot          xxxxxxx-xx
              <Init System>#
xxxxxxxxxxxx  xx!xx!xx
    
```

An acoustic signal sounds three times and the Sunny Remote Control displays the Quick Configuration Guide.

```

Select option
001#01 [#####]
          StartMenu
          Start System#
    
```

↓

Turn the button on the Sunny Remote Control and select **New System**.

```

Select option
001#01 [#####]
          StartMenu
          New System#
    
```

↓

Press the button. This confirms your selection of **New System**.

An entry confirmation prompt appears.

```

Select option
001#01 <accept Y/N>
          StartMenu
          New System#
    
```

↓

Set **Y** and press the button.

↓

Set the date.

```

Setup new device
003#04          <Set>#
                Dt
02.01.2014 [d.m.y.]
    
```

↓

Set the time.

```

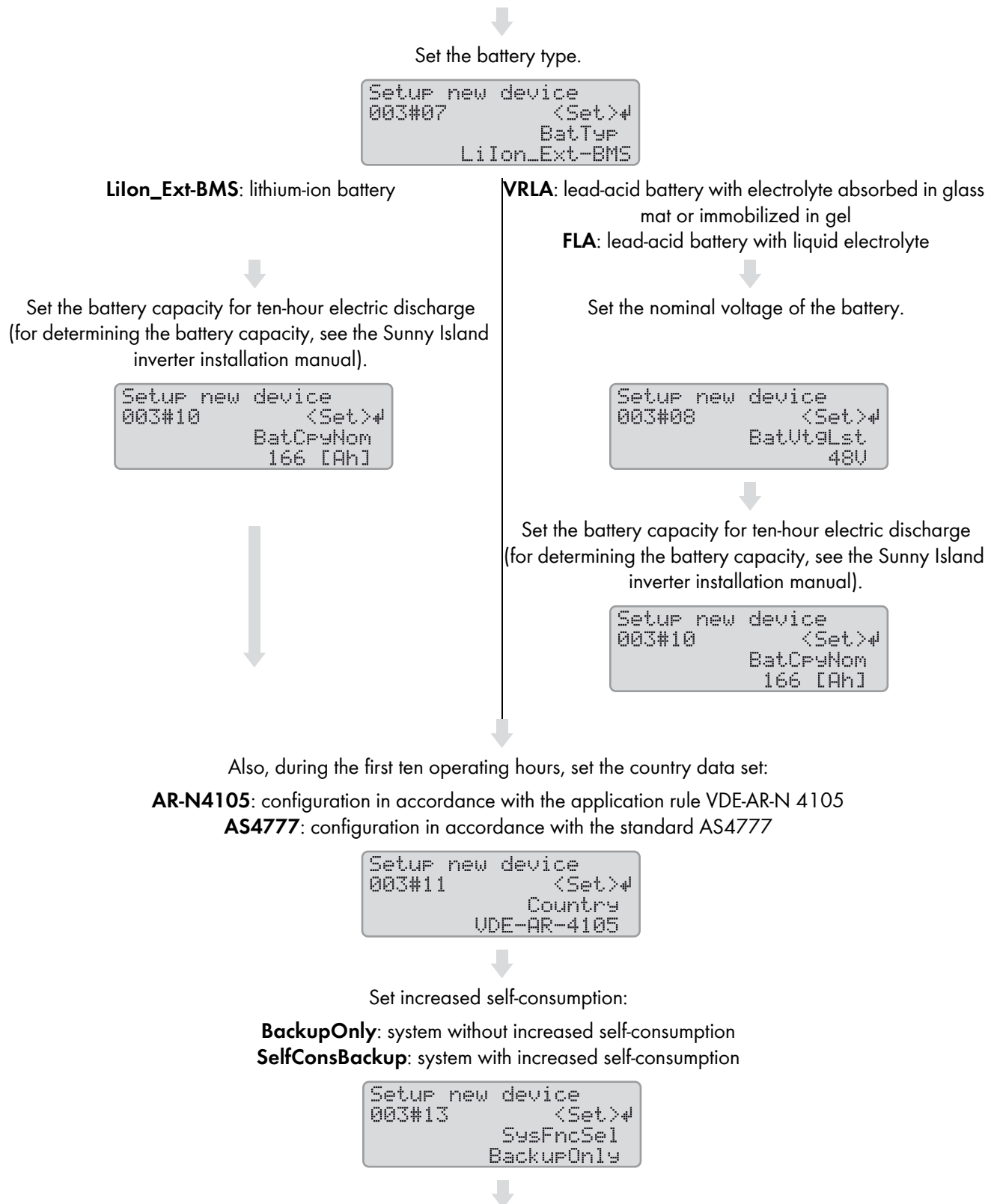
Setup new device
003#05          <Set>#
                Tm
06:24:24 [hhmmss]
    
```

↓

Set **OnGrid**.

```

Setup new device
003#06          <Set>#
                ApplSel
                OnGrid
    
```



Set the number of Sunny Island inverters in the system:

```
Setup new device
003#14      <Set>#
           ClstType
           1Phs
```

1Phase: system with one Sunny Island inverter

If the country data set of the Sunny Island inverter is **VDE-AR-4105** and the system increases self-consumption (**SelfConsBackup**), set the type of feed-in of the PV system (see Section 3.1, page 12).

```
Setup new system
003#15      <Set>#
           EZAType
           Asymmetric
```

Asymmetric: The installation site is located in Germany and at least one PV inverter feeds in asymmetrically on a single line conductor.

Symmetric: The installation site is either located outside of Germany or all PV inverters feed in symmetrically on three line conductors.

Set the line conductor to which the Sunny Island is connected:

```
Setup new system
003#16      <Set>#
           MsPHSel
           L1
```

- L1:** connection to line conductor L1
- L2:** connection to line conductor L2
- L3:** connection to line conductor L3

Confirm the basic configuration with **Y**.

```
Setup new system
Done ? <accept Y/N>
```

If the system does not increase self-consumption (**BackupOnly**) or the country data set of the Sunny Island inverter is **AS4777**, confirm the basic configuration with **Y**.

```
Setup new system
Done ? <accept Y/N>
```

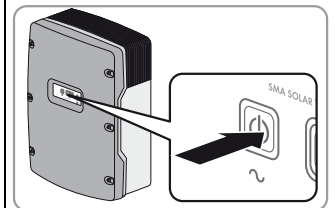
3Phase: system with three Sunny Island inverters

Confirm the basic configuration with **Y**.

```
Setup new system
Done ? <accept Y/N>
```

Wait until the upper LED (inverter LED) on slave 1 is flashing and the Sunny Remote Control is displaying **To identify Slave 1, press Tss on the Slv.**

Press the start-stop button on slave 1.



Wait until the upper LED (inverter LED) on slave 2 is flashing and the Sunny Remote Control is displaying **To identify Slave2, press Tss on the Slv.**



☑ The basic configuration is complete.

If an SD memory card is inserted in the Sunny Remote Control, the message
Do not remove MMC/SD memory card ... appears.



Close the circuit breaker **F1** and the residual-current device **F2** in the distribution board and leave the Sunny Island switched on, but do not start it.

7.2 Testing the Automatic Transfer Switch Function

⚠ WARNING

Danger to life from electric shock due to live voltage

During the test, high voltages are present in the automatic transfer switch. Touching live components can result in death or serious injury.

- Ensure that you do not touch any live components while measuring and testing.
- Disconnect the automatic transfer switch from voltage sources while you are eliminating any faults.

The sequence of the test applies to all types of automatic transfer switches and is independent of the automatic transfer switch installed. Ignore tests for non-existent devices.

Requirements:

- In the automatic transfer switch, all circuit breakers **F1**, **F3**, ..., **F6** must be open.
- The residual-current devices **F2** and **F7** must be closed.
- All Sunny Island inverters must be switched on but not operational.
- PV system and all loads at connection **X2** must be disconnected from voltage sources.

Procedure:

1. Open the automatic transfer switch and ensure that at connection **X1**, there is voltage present and a right-hand rotating magnetic field.
2. Measure whether the individual terminals are voltage-free:

Check point	Task
Connection X2	If AC voltage is present, correctly wire contactors Q1 and Q2 .
Connection X3	If AC voltage is present, stop the Sunny Island.
Connection X4	If AC voltage is present, correctly wire circuit breaker F1 .
Connection X5 , terminals L1 , N , 1 , and 2	If AC voltage is present, stop the Sunny Island.
Connection X5 , terminals 3 and 4	If DC voltage is present, correctly wire contactor or auxiliary contact Q2 .

3. Check whether the grounding device is correctly wired:

Check point	Task
Contactors Q3 and Q4	Ensure that the wiring is correct.
Connection X2 , terminals N and PE	Ensure that no voltage is present between the terminals and that conductivity can be measured.

4. Close circuit breaker **F1** and check the following:

Check point	Task
Contactors Q1 , Q2 , and Q3 Connection X2	Check whether the contactors activate and whether there is voltage present and a right-hand rotating magnetic field at connection X2 . If the contactors do not activate or no voltage is present at connection X2 , ensure the following: <ul style="list-style-type: none"> • At the master, ensure that the control cable is correctly connected to connections Relay1 C and Relay1 NC. • Ensure that, in the automatic transfer switch, contactors Q1, Q2, and Q3 are correctly wired.

5. Close circuit breaker **F6**.

Voltages are present at connection **X3**.

6. Check whether the residual-current devices trip correctly and are correctly wired:

Check point	Task
Residual-current device F7	Press the test button and measure whether there is voltage present at connection X3 . If voltage is present, correctly wire residual-current device F7 . <hr/> Switch on residual-current device F7 again.
Residual-current device F2	Press the test button and check if contactors Q1 , Q2 , and Q3 go into non-operative mode. If the contactors do not deactivate, wire the residual-current device F2 correctly. <hr/> Switch on residual-current device F2 again.

7. Start the Sunny Island. Press and hold the button on the Sunny Remote Control until you hear an acoustic signal.

8. Check whether error messages are displayed on the Sunny Remote Control.

If the error message **F365 VAcExtPhsFail** is displayed, correctly connect connection **ExtVtg** on the Sunny Island.

9. Close circuit breaker **F5** and check whether contactors **Q4** and **Q6** remain in non-operative mode.

If the contactors activate, correctly wire connections **Relay2 C** and **Relay2 NO** on the Sunny Island.

10. Simulate a grid failure. To do this, open circuit breaker **F1**. As a result, contactors **Q1**, **Q2**, and **Q3** deactivate.

If the error message **F367 ExtCtcNotOpen** is displayed, correctly connect connections **DigIn** and **BatVtgOut** to the Sunny Island.

11. Check whether contactors **Q4** and **Q6** activate approximately five seconds after circuit breaker **F1** is opened.

If the contactors do not activate, correctly wire the control cables of the contactors and correctly connect connections **Relay2 C** and **Relay2 NO** to the master.

12. Check whether the grounding device switches correctly.

- Ensure that no voltage is present at connection **X2** between terminals **N** and **PE** and that conductivity can be measured.
- Open circuit breaker **F5**.
- Ensure that no voltage is present at connection **X2** between terminals **N** and **PE** and that conductivity can be measured.
- Close circuit breaker **F5**.

13. Check whether the phase coupling switches correctly. To do this, close circuit breakers **F3** and **F4** and check the following:

Check point	Task
Connection X2	<p>Measure if there is voltage present between the line conductors and the neutral conductor.</p> <p>If no voltage is present, correctly wire contactor Q6.</p> <hr/> <p>Ensure that no voltage is present between the line conductors.</p>

14. Switch on circuit breaker **F1**.

- Contactors **Q4** and **Q6** deactivate within five minutes and the tie switch then connects the battery backup grid to the utility grid.

7.3 Adjusting the Configuration of the Sunny Island Inverter

7.3.1 Countries in Which the Configuration Must Be Adjusted

In the SMA Flexible Storage System, the Sunny Island inverters are connected to the utility grid and must meet the requirements of the grid operators. Depending on the settings, the Sunny Island inverters satisfy the requirements of the application rule VDE-AR-N 4105:2011-08 or the standard AS4777. The application rule is stored in the Sunny Island as the standard country data set **VDE-AR-4105** or **AS4777**.

The configuration must be adjusted for the following countries (status: July 2014):

- Denmark (see Section 7.3.2, page 47)
- France (see Section 7.3.3, page 47)
- Austria (see Section 7.3.4, page 47)
- Switzerland (see Section 7.3.5, page 48)

The configuration may only be adjusted on request or with permission of the grid operator in the following countries (status: July 2014):

- Australia
Country data set: AS4777
- Belgium
Country data set: VDE-AR-4105
- Germany
Country data set: VDE-AR-4105

Use in other countries is possible with the agreement of the grid operator. Consult the grid operator on whether adjustment is necessary.

7.3.2 Adjusting the Configuration for Denmark

When using the Sunny Island 6.0H / 8.0H in Denmark, you must reduce the discharge/charging current (default setting: max. 20.0 A).

When using the Sunny Island 3.0M / 4.4M in Denmark, you can retain the default setting of the discharge/charging current (default setting: max. 16.0 A).

Requirement:

- The extended configuration must be performed within the first ten operating hours of the Sunny Island inverter, otherwise an SMA Grid Guard code is required in order to change grid-relevant parameters (application form for the SMA Grid Guard code available at www.SMA-Solar.com).
- The country data set of the Sunny Island inverter must be set to **VDE-AR-4105** (see Section 7.1 "Basic Configuration of the Sunny Island Inverter", page 40).

Procedure:

1. Switch to expert mode on the Sunny Remote Control (see the Sunny Island inverter operating manual).
2. Set the parameter **210.03 InvChrgCurMax** to **16.0 A**.

7.3.3 Adjusting the Configuration for France

The following limiting values must be adjusted in order to meet the requirements of the Union technique de l'électricité (UTE):

- Maximum power frequency
- The upper frequency difference for valid grid connection
- Minimum observation time for grid voltage and frequency before grid connection

Requirement:

- The extended configuration must be performed within the first ten operating hours of the Sunny Island inverter, otherwise an SMA Grid Guard code is required in order to change grid-relevant parameters (application form for the SMA Grid Guard code available at www.SMA-Solar.com).
- The country data set of the Sunny Island inverter must be set to **VDE-AR-4105** (see Section 7.1 "Basic Configuration of the Sunny Island Inverter", page 40).

Procedure:

1. Switch to expert mode on the Sunny Remote Control (see the Sunny Island inverter operating manual).
2. Set the parameter **232.07 GdFrqMax** to **50.6 Hz**.
3. Set the parameter **232.15 GdFrqMaxDel** to **0.05 Hz**.
4. Set the parameter **232.08 GdVldTm** to **30 s**.

7.3.4 Adjusting the Configuration for Austria

If your grid operator does not permit frequency-dependent control of active power feed-in in the case of overfrequency, you must switch off this function (see VDE-AR-N 4105 item 5.7.3.3).

If your grid operator specifies a maximum grid feed-in per line conductor, you must reduce the discharge/charging current (default setting in the Sunny Island is 20.0 A).

Requirement:

- The extended configuration must be performed within the first ten operating hours of the Sunny Island inverter, otherwise an SMA Grid Guard code is required in order to change grid-relevant parameters (application form for the SMA Grid Guard code available at www.SMA-Solar.com).
- The country data set of the Sunny Island inverter must be set to **VDE-AR-4105** (see Section 7.1 "Basic Configuration of the Sunny Island Inverter", page 40).

Procedure:

1. Switch to expert mode on the Sunny Remote Control (see the Sunny Island inverter operating manual).
2. If frequency-dependent control of active power feed-in is not permitted, set the parameter **232.41 P-WCtLHzMod** to **Off**.
3. If your grid operator specifies a maximum grid feed-in per line conductor, set the parameter **210.03 InvChrgCurMax** to the value specified by the grid operator.

7.3.5 Adjusting the Configuration for Switzerland

The following limiting values must be adjusted in order to meet the requirements of the grid operators in Switzerland:

- Maximum power frequency
- The upper frequency difference for valid grid connection
- Minimum observation time for grid voltage and frequency before grid connection

If your grid operator specifies a maximum grid feed-in per line conductor, you must reduce the discharge/charging current (default setting in the Sunny Island is 20.0 A).

Requirement:

- The extended configuration must be performed within the first ten operating hours of the Sunny Island inverter, otherwise an SMA Grid Guard code is required in order to change grid-relevant parameters (application form for the SMA Grid Guard code available at www.SMA-Solar.com).
- The country data set of the Sunny Island inverter must be set to **VDE-AR-4105** (see Section 7.1 "Basic Configuration of the Sunny Island Inverter", page 40).

Procedure:

1. Switch to expert mode on the Sunny Remote Control (see Sunny Island inverter operating manual).
2. Set the parameter **232.07 GdFrqMax** to **50.2 Hz**.
3. Set the parameter **232.15 GdFrqMaxDel** to **0.05 Hz**.
4. Set the parameter **232.08 GdVldTm** to **30 s**.
5. If your grid operator specifies a maximum grid feed-in per line conductor, set the parameter **210.03 InvChrgCurMax** to the value specified by the grid operator.

7.4 Adjusting the Configuration of the PV Inverters**Countries in which the configuration should be adjusted**

In battery backup systems, the active power of the PV inverters should be controllable depending on the frequency (see Planning Guidelines "SMA Flexible Storage System with Battery Backup Function"). If your grid operator prohibits control of active power feed-in in the case of overfrequency, you can also use the PV inverters without changing the configuration. SMA Solar Technology AG recommends activating the frequency-dependent control of the PV inverters.

Country	Does the current country data set valid for the site include frequency-dependent control?
Australia	no
Belgium	yes
Denmark	yes
Germany	yes
France	no
Austria	no
Switzerland	no

Activating frequency-dependent control of active power

Requirements:

- The PV inverters are part of a battery backup system and the automatic transfer switch can disconnect the PV inverters from the utility grid.
- Adjustment must be coordinated with the grid operator.
- You must be authorized to change Grid Guard parameters. You can find the application form at www.SMA-Solar.com in the download area of the relevant PV inverter.
- The firmware version of the PV inverter must support the frequency-dependent control of active power (for "PV inverters", see Planning Guidelines "SMA Flexible Storage System with Battery Backup Function" at www.SMA-Solar.com).

Procedure:

1. With existing PV systems, make sure that the firmware of the installed PV inverters supports frequency-dependent active power control (see the Planning Guidelines "SMA Flexible Storage System with Battery Backup Function" at www.SMA-Solar.com).
2. Set the following parameters of the PV inverters to the specified value (see the documentation of the communication product).

Parameters	Values for the relevant country	
	France ^{**} Austria ^{**} Switzerland ^{**}	Australia ^{***}
P-WCtHzMod Operating mode of active power limitation in the case of overfrequency P(f) [*]	On or WCtHz	On or WCtHz
P-WGra Active power gradient, linear instantaneous power gradient configuration [*]	40	77
P-HzStr Difference between starting frequency and power frequency, linear instantaneous power gradient configuration [*]	0.2	0.2
P-HzStop Difference between reset frequency and power frequency, linear instantaneous power gradient configuration [*]	0.2	0.05
P-HzStopWGra Active power gradient after reset frequency, linear instantaneous power gradient configuration [*]	10	10

^{*} Menu **Equipment & device control system**

^{**} The adjustments are based on the requirements for PV inverters from the application rule "VDE-AR-N 4105:2011-08".

^{***} The adjustments are based on the requirements for PV inverters from the product standard "AS 4777 2014".

7.5 Attaching the Labels

The warning label for battery backup systems is included in the scope of delivery of the Sunny Island inverter.

- Attach the warning label "Battery Backup System" to the AC main distributor from the outside.

7.6 Activating Phase Coupling in Single-Phase Battery Backup Systems

With phase coupling it is possible, in the event of utility grid failure, to supply loads which are not connected to the line conductor of the Sunny Island inverter (see Section 3.4.4 "Phase Coupling for Single-Phase Battery Backup Systems", page 19). As soon as the utility grid returns, the contactor disconnects the coupled line conductors again. The switchover times for the loads to the coupled line conductors are longer than to the line conductor of the Sunny Island. The switchover times are a matter of seconds.

Disconnection of the Sunny Island inverter as a result of overload:

The Sunny Island switches itself off when overloaded. Only activate phase coupling for line conductors whose loads do not exceed the maximum AC power of the Sunny Island inverter (for technical data, see the Sunny Island inverter installation manual).

NOTICE

Damage to three-phase loads during phase coupling

If three-phase loads are connected to a single-phase utility grid during phase coupling, SMA Solar Technology AG cannot rule out damage to the three-phase loads.

- Ensure that, during phase coupling, only single-phase loads are connected to the battery backup grid.

Procedure:

- In the automatic transfer switch, switch on circuit breaker **F3** or **F4** or both.

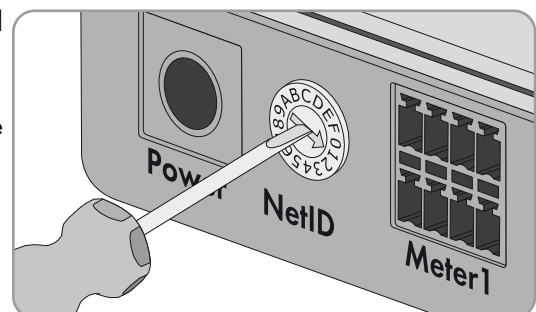
7.7 Commissioning System With Increased Self-Consumption

7.7.1 Preparing BLUETOOTH Communication

To allow SMA BLUETOOTH devices in the battery backup system to communicate with each other, all devices must be set to the same NetID. The NetID is used to distinguish between systems with SMA BLUETOOTH operating in close proximity to one another.

Procedure:

1. For PV inverters with integrated BLUETOOTH interface that communicate via Speedwire, set NetID **0** (see PV inverter installation manual). This deactivates communication via BLUETOOTH.
2. Determine the NetID of the BLUETOOTH system.
 - Install Sunny Explorer on a computer. Either run the installation file on the CD provided or download free of charge at www.SMA-Solar.com.
 - Determine a free NetID for the BLUETOOTH system using Sunny Explorer (see Sunny Explorer user manual).
 - Quit Sunny Explorer. This will ensure that the BLUETOOTH network is set up via the Sunny Home Manager.
3. Set the determined NetID on the Sunny Home Manager and on all devices with active BLUETOOTH interface (see documentation of the BLUETOOTH devices). Note that the NetID must not be set to **1** if the Sunny Home Manager is intended to communicate with more than one BLUETOOTH node.



7.7.2 Commissioning a System With Increased Self-Consumption

i Deactivation of the intermediate storage of PV energy during certain charging procedures

To increase the service life of the battery, the system regularly carries out full charges and equalization charges (see Technical Information "Battery Management" at www.SMA-Solar.com). During this charging process, the intermediate storage of PV energy is deactivated and electricity may have to be purchased to perform the full and equalization charges.

Required data for registration in Sunny Portal:

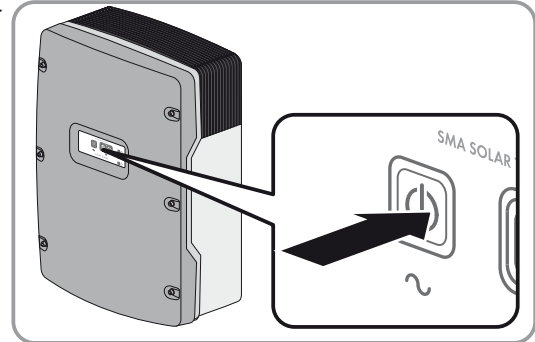
Device/customer data	Required data and explanation
Sunny Home Manager	<ul style="list-style-type: none"> Serial number (PIC) and registration ID (RID) <p>Register the new system in Sunny Portal using the PIC and RID.</p>
SMA Energy Meter	<ul style="list-style-type: none"> Only when two SMA Energy Meters are installed, note down the serial number and purpose (e.g., PV production meter) in each case. This way you can identify the energy meters in the Sunny Portal.
PV inverter	<ul style="list-style-type: none"> PV system password <p>The PV system password is the same as the device password for the user group "Installer". All devices in a PV system must be set to the same password (for user groups and security concept, see the Sunny Explorer user manual).</p> <p>The default password is 1111.</p> <ul style="list-style-type: none"> Serial number of the PV inverters <p>You can uniquely identify the PV inverters in the Sunny Portal using the serial number.</p> <ul style="list-style-type: none"> PV array power in kWp
SMA radio-controlled socket	<ul style="list-style-type: none"> The serial number and connected load of each SMA radio-controlled socket <p>In Sunny Portal, configure the SMA radio-controlled socket in accordance with the requirements of the connected load. To do so, you require the serial number of the SMA radio-controlled socket.</p>
Customer data	<ul style="list-style-type: none"> E-mail address Password for Sunny Portal access Address of the PV system Electricity tariff data <ul style="list-style-type: none"> Electricity price for purchased electricity Tariff times, if applicable (e.g., for tariffs with peak and off-peak tariff) Feed-in tariff Self-consumption tariff, if applicable

Requirements:

- The basic configuration of the Sunny Island inverter must have been performed (see Section 7.1, page 40).
- The functionality of the automatic transfer switch must be checked (see Section 7.2, page 44).
- The Sunny Home Manager, the Sunny Island and all other Speedwire devices must be connected to the same router.
- DHCP must be enabled for the router of the system.
- The router of the system must have an Internet connection.

Procedure:

1. In the distribution board, switch on circuit breaker **F1** and residual-current device **F2**.
2. Commission the PV system (see PV inverter documentation).
3. On the Sunny Island, press and hold the "On" button until you hear an acoustic signal. This starts the system.



4. Only when two SMA Energy Meters are installed in the local network, assign the grid feed-in meter and purchased electricity meter to the Sunny Island using Sunny Explorer. To do this, enter the serial number of the grid feed-in meter and purchased electricity meter (see the Sunny Explorer user manual).
5. Open Sunny Portal via www.SunnyPortal.com/Register and run the PV System Setup Assistant. The required data for registration in Sunny Portal must be at hand.

i **Representation of the Sunny Island inverters in Sunny Portal**

In Sunny Portal, the Sunny Island inverters are always displayed as one device, even if the system consists of three Sunny Island inverters. If there are three Sunny Island inverters, the data is added together.

6. Activate the automatic update of the Sunny Home Manager and the PV system in Sunny Portal.
7. Only in systems with active power limitation, ensure that the limitation of the active power feed-in is configured and functioning in Sunny Portal ("Configuring Active Power Feed-In Limitation", see the User Manual "Sunny Home Manager in Sunny Portal" at www.SunnyPortal.com).

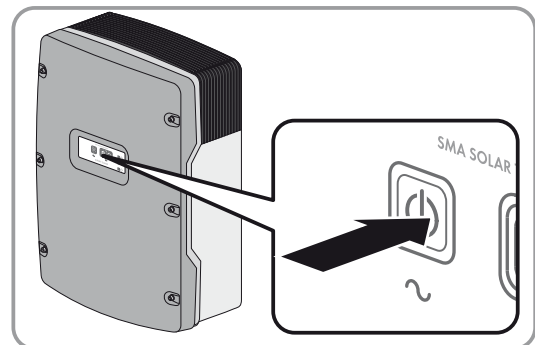
7.8 Commissioning a System Without Increased Self-Consumption

Requirement:

- The functionality of the automatic transfer switch must be checked (see Section 7.2, page 44).

Procedure:

- Commission the PV system (see PV inverter documentation).
- To start the system, press and hold the "On" button on the Sunny Island until an acoustic signal sounds.



8 Contact

If you have technical problems with our products, contact the SMA Service Line. We need the following information in order to provide you with the necessary assistance:

- Sunny Island inverter type
- Sunny Island inverter serial number
- Sunny Island inverter firmware version
- Displayed error message
- Type of battery connected
- Nominal battery capacity
- Nominal battery voltage
- Type of the communication products connected
- Type and size of additional energy sources

Australia	SMA Australia Pty Ltd. Sydney	Toll free for Australia:	1800 SMA AUS (1800 762 287)
		International:	+61 2 9491 4200
Belgien/ Belgique/ België	SMA Benelux BVBA/SPRL Mechelen	+32 15 286 730	
Brasil	Vide España (Espanha)		
Česko	SMA Central & Eastern Europe s.r.o. Praha	+420 235 010 417	
Chile	Ver España		
Danmark	Se Deutschland (Tyskland)		
Deutschland	SMA Solar Technology AG Niestetal	Medium Power Solutions Wechselrichter: Kommunikation: SMA Online Service Center:	+49 561 9522-1499 +49 561 9522-2499 www.SMA.de/Service
		Hybrid Energy Solutions Sunny Island: PV-Diesel Hybridsysteme:	+49 561 9522-399 +49 561 9522-3199
		Power Plant Solutions Sunny Central:	+49 561 9522-299
España	SMA Ibérica Tecnología Solar, S.L.U. Barcelona	Llamada gratuita en España: Internacional:	900 14 22 22 +34 902 14 24 24

France	SMA France S.A.S. Lyon	Medium Power Solutions	
		Onduleurs :	+33 472 09 04 40
		Communication :	+33 472 09 04 41
		Hybrid Energy Solutions	
		Sunny Island :	+33 472 09 04 42
		Power Plant Solutions	
		Sunny Central :	+33 472 09 04 43
India	SMA Solar India Pvt. Ltd. Mumbai	+91 22 61713888	
Italia	SMA Italia S.r.l. Milano	+39 02 8934-7299	
Κύπρος/ Kıbrıs	Βλέπε Ελλάδα/ Bkz. Ελλάδα (Yunanistan)		
Luxemburg/ Luxembourg	Siehe Belgien/ Voir Belgien (Belgique)		
Magyarország	lásd Česko (Csehország)		
Nederland	zie Belgien (België)		
Österreich	Siehe Deutschland		
Perú	Ver España		
Polska	Patrz Česko (Czechy)		
Portugal	SMA Solar Technology Portugal, Unipessoal Lda Lisboa	Gratuito em Portugal:	800 20 89 87
		Internacional:	+351 2 12 37 78 60
România	Vezi Česko (Cehia)		
Schweiz	Siehe Deutschland		
Slovensko	pozri Česko (Česká republika)		
South Africa	SMA Solar Technology South Africa Pty Ltd. Centurion (Pretoria)	08600 SUNNY (08600 78669)	
		International:	+27 (12) 643 1785
United Kingdom	SMA Solar UK Ltd. Milton Keynes	+44 1908 304899	
Ελλάδα	SMA Hellas AE Αθήνα	801 222 9 222	
		International:	+30 212 222 9 222
България	Вижте Ελλάδα (Γърция)		
ไทย	SMA Solar (Thailand) Co., Ltd. ปทุมธานี	+66 2 670 6999	
대한민국	SMA Technology Korea Co., Ltd. 서울	+82-2-520-2666	

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