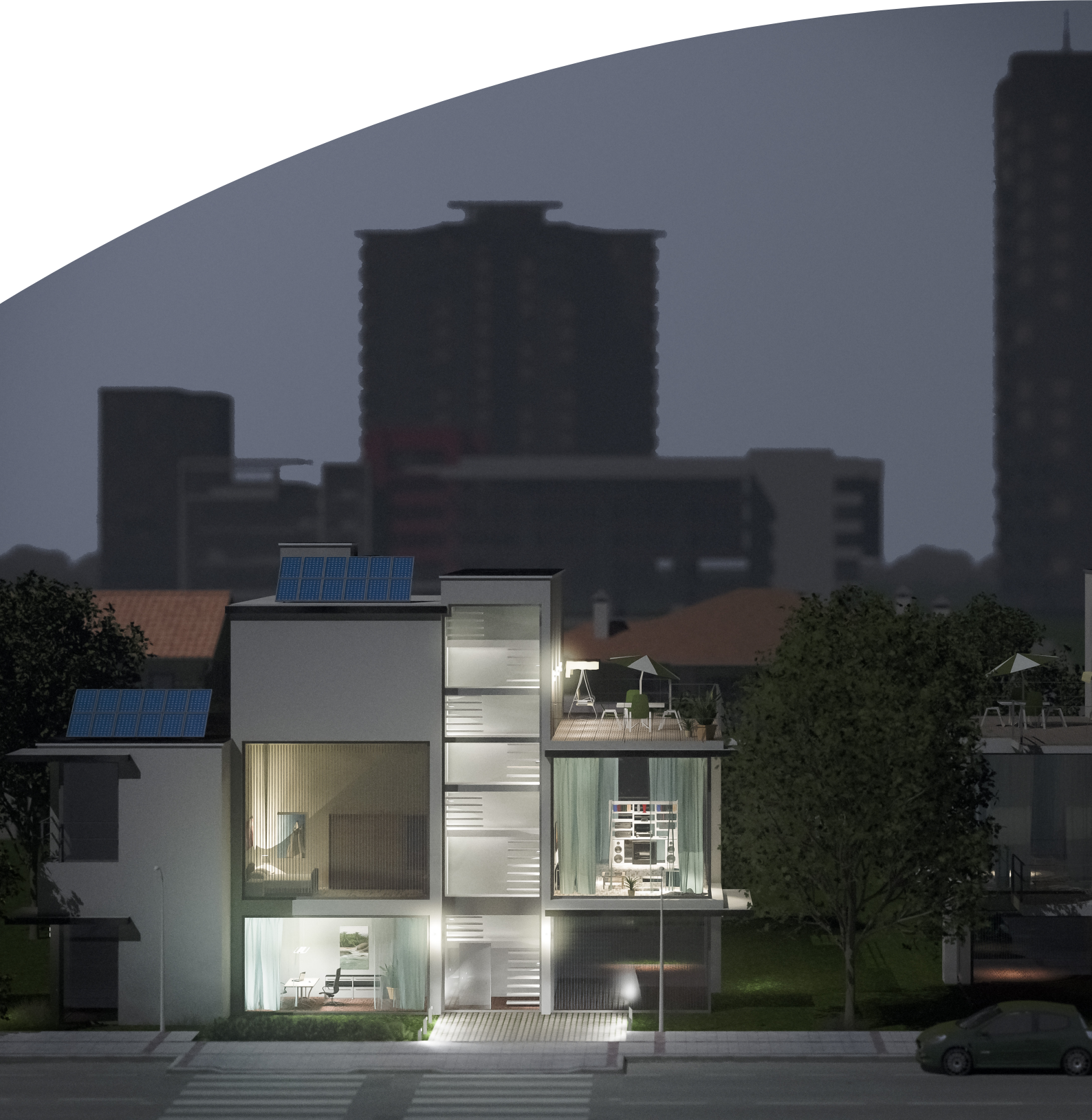


System Description



SMA FLEXIBLE STORAGE SYSTEM with Battery-Backup Function

Battery-Backup Systems including Increased Self-Consumption with SUNNY ISLAND 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-20 (Sunny Home Manager 2.0) from firmware version 2.00.00.R
- SI4.4M-12 (Sunny Island 4.4M) from firmware version 1.00.xx.R
- SI6.0H-12 (Sunny Island 6.0H) from firmware version 1.00.xx.R
- SI8.0H-12 (Sunny Island 8.0H) from firmware version 1.00.xx.R

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 the basic principle of how an system must be connected. 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:





- Knowledge of how an inverter works and is operated
- Knowledge of how batteries work and are operated
- Training in the installation and commissioning of electrical devices and installations
- Knowledge of the applicable standards and directives
- Knowledge of and compliance with this document and all safety information
- Knowledge of and compliance with the documents of the battery manufacturer with all safety information





1.4 Additional Information

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

Document title and content	Document type
"SMA Smart Home"	Planning guidelines
"SMA Flexible Storage System with Battery Backup Function"	Planning guidelines

1.5 Symbols

Symbol	Explanation
 DANGER	Indicates a hazardous situation which, if not avoided, will result in death or serious injury
 WARNING	Indicates a hazardous situation which, if not avoided, can result in death or serious injury
 CAUTION	Indicates a hazardous situation which, if not avoided, can result in minor or moderate injury
 NOTICE	Indicates a situation which, if not avoided, can result in property damage

Symbol	Explanation
	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"> Terminals Slots Parameters Elements on the user interface Elements to be selected Elements to be entered 	<ul style="list-style-type: none"> The value can be found in the field Energy. Select Settings. Enter 10 in the field Minutes.
>	<ul style="list-style-type: none"> Connects several elements to be selected 	<ul style="list-style-type: none"> Select Settings > Date.
[Button]	<ul style="list-style-type: none"> Button to be selected or pressed 	<ul style="list-style-type: none"> Select [Next].

1.7 Nomenclature

Complete designation	Designation in this document
SMA Flexible Storage System with Battery-Backup Function	Battery-backup system
Grid failure or deviation from the country-specific thresholds for voltage and frequency	Grid failure
Automatic transfer switch with battery-backup function	Automatic transfer switch
Sunny Boy, Sunny Mini Central, Sunny Tripower	PV inverter
Sunny Places, Sunny Portal, Sunny Home Manager	Communication product
SMA Speedwire	Speedwire

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 PV system disconnected from the utility grid 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 are not supplied for approximately five to seven seconds. The battery-backup system can then provide active power and reactive power again. The battery-backup system supplies the loads, and the PV system can synchronize with the battery-backup grid and feed in.

The product is not suitable for supplying life-sustaining medical devices. A power outage must not lead to personal injury.

Loads connected to the Sunny Island must have an CE, RCM or UL identification label.

The battery-backup system must 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. In order to meet the technical connection requirements of the grid operator and the locally applicable standards and directives, you must install the battery-backup system either with or without all-pole disconnection:

- 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. 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, e.g. in Belgium, Denmark, Germany, Austria and 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.

Single-phase clusters are not permitted. Only Sunny Island inverters of the same device type may be installed in a three-phase cluster. Several clusters may only be interconnected if the Multicluster-Box 12 (MC-BOX-12.3-20) is used for it.

Single-phase battery-backup grids can be connected to three-phase utility grids. In a single-phase battery-backup system, a grid failure is only recognized at the line conductor that is connected to the Sunny Island. In the event of grid failure, only single-phase PV inverters can feed into a single-phase battery-backup grid.

Only applies in Belgium: If the utility grid functions as an IT system that is grounded to the neutral point of the source, the connected battery-backup system must be single-phase.

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.

The battery-backup system must be equipped with an automatic transfer switch (see planning guidelines "SMA Flexible Storage System with Battery Backup Function" at www.SMA-Solar.com). This automatic transfer switch is not part of the Sunny Island scope of delivery.

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 to the battery-backup system. The equipment or devices of the automatic transfer switch must satisfy protection class II and be operable without prior knowledge of electrical engineering.

The tie switch in the automatic transfer switch must have an ampacity that is designed for at least the operating range of the upstream fuse.

The connected PV inverters must be suitable for use in battery-backup systems. In addition, the power of the PV system must be appropriate for the system (see planning guidelines "SMA Flexible Storage System with Battery Backup Function" at www.SMA-Solar.com).

In a three-phase battery-backup system, both single-phase and three-phase PV inverters can be connected.

The entire battery voltage range must be completely within the permissible DC input voltage range of the Sunny Island. The maximum permissible DC input voltage of the Sunny Island must not be exceeded. A battery fuse must be installed between the battery and the Sunny Island.

With lead-acid batteries, the battery room must be ventilated in accordance with the requirements of the battery manufacturer and with the locally applicable standards and directives (see documentation of the battery manufacturer).

The following conditions must be satisfied for lithium-ion batteries:

- The lithium-ion battery must comply with the locally applicable standards and directives and must be intrinsically safe.
- The battery management of the lithium-ion battery used must be compatible with the Sunny Island (see the technical information at "List of Approved Batteries").
- The lithium-ion battery must be able to supply enough current at maximum output power of the Sunny Island (for technical data see the Sunny Island operating manual).

An DC supply grid may not be established with the Sunny Island.

Grid feed-in and purchased electricity are recorded with an SMA Energy Meter only. An SMA Energy Meter does not replace the energy meter of the electric utility company.

Use this product only in accordance with the information provided in the enclosed documentation and with the locally applicable standards and directives. Any other application may cause personal injury or property damage.

Alterations to the product, e.g. changes or modifications, are only permitted with the express written permission of SMA Solar Technology AG. Unauthorized alterations will void guarantee and warranty claims and in most cases terminate the operating license. SMA Solar Technology AG shall not be held liable for any damage caused by such changes.

Any use of the product other than that described in the Intended Use section does not qualify as the intended use.

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

2.2 Safety Information

This section contains safety information that must be observed at all times when working on or with the product.

To prevent personal injury and property damage and to ensure long-term operation of the product, read this section carefully and observe all safety information at all times.

⚠ DANGER**Danger to life from electric shock due to live voltage**

High voltages are present in the live components of the inverter when in operation. Touching live components results in death or serious injury due to electric shock.

- Wear suitable personal protective equipment for all work on the product.
- Do not touch any live components.
- Observe all warning messages on the inverter and in the documentation.
- Observe all safety information of the battery manufacturer.
- Switch off or disconnect the following components from voltage sources in the following order before carrying out any work:
 - Sunny Island
 - The circuit breakers of the Sunny Island, the control and measurement voltages
 - All circuit breakers and load-break switches of the connected AC sources
 - Load-break switch of the battery fuse
- Ensure that no disconnected devices can be reconnected.
- After disconnecting the Sunny Island from voltage sources, wait at least 15 minutes for the capacitors to discharge completely before opening the doors.
- Before carrying out any work make sure that all devices are completely voltage-free.
- Cover or isolate any adjacent live components.

⚠ DANGER**Danger to life due to electric shock**

Overvoltages (e. g. in the case of a flash of lightning) can be further conducted into the building and to other connected devices in the same network via network cables or other data cables if there is no overvoltage protection.

- Ensure that all devices in the same network and the battery are integrated in the existing overvoltage protection.
- When laying the network cables or other data cables outdoors, attention must be given to suitable overvoltage protection at the cable transition from the inverter or the battery outdoors to the inside of a building.

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

In an off-grid system and battery-backup system, 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, a voltage that poses a danger to life may be present on accessible parts for several seconds.

- Check if a circuit breaker has a higher trip characteristic than the following circuit breakers which can be tripped:
 - SI4.4M-12: circuit breaker with trip characteristic B6 (B6A)
 - SI6.0H-12 and SI8.0H-12: 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 breakers that can be tripped, you should also install a residual-current device of type A.

⚠ WARNING**Danger to life from electric shock due to overvoltages**

Overvoltages of up to 1500 V can occur in the stand-alone grid and in the battery-backup grid. If the connected loads have not been designed for these overvoltages, a voltage that poses a danger to life may be present on accessible parts for several seconds.

- Only connect loads that have a CE, RCM or UL designation. Loads with a CE, RCM or UL designation are designed for overvoltages of up to 1500 V.
- Operate the loads only when they are technically faultless and in an operationally safe state.
- Check the loads regularly for visible damage.

⚠ WARNING**Danger to life from electric shock due to damaged inverter**

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

- Only use the inverter when it is technically faultless and in an operationally safe state.
- Check the inverter regularly for visible damage.
- Make sure that all external safety equipment is freely accessible at all times.
- Make sure that all safety equipment is in good working order at any time.

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

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

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

⚠ CAUTION**Risk of burns due to hot enclosure parts**

Some parts of the enclosure can get hot during operation.

- Mount the inverter in such a way that it cannot be touched inadvertently during operation.

NOTICE**Damage to the product due to sand, dust or moisture penetration**

Sand, dust or moisture penetration can damage the inverter or impair its functionality.

- Do not open the inverter during a sandstorm, precipitation or when humidity exceeds 95%.
- Only perform maintenance work on the inverter when the environment is dry and free of dust.

NOTICE**Damage to the inverter due to electrostatic discharge**

Touching electronic components can cause damage to or destroy the inverter through electrostatic discharge.

- Ground yourself before touching any component.

NOTICE**Damage to seals on the enclosure lids in subfreezing conditions**

If you open the enclosure lid when temperatures are below freezing, the enclosure lid seal could be damaged. This can lead to moisture entering the inverter.

- Only open the enclosure lid if the ambient temperature is not below -5°C
- If a layer of ice has formed on the seal of the lid when temperatures are below freezing, remove it prior to opening the enclosure lid (e.g. by melting the ice with warm air). Observe the applicable safety regulations.

2.3 Battery Safety Information

This section contains safety information that must be observed at all times when working on or with batteries.

To prevent personal injury or property damage and to ensure long-term operation of the batteries, read this section carefully and observe all safety information at all times.

⚠ 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 battery management is intrinsically safe and will protect the battery.

- Ensure that the lithium-ion batteries are approved for use with the Sunny Island (see technical information "List of Approved Batteries" at www.SMA-Solar.com).
- If no lithium-ion batteries approved for the inverter can be used, lead-acid batteries can be used.
- Verify that the battery complies with locally applicable standards and directives and is intrinsically safe.

⚠ WARNING**Danger to life due to explosive gases**

Explosive gases may escape from the battery and cause an explosion.

- Protect the battery environment from open flames, embers and sparks.
- Install, operate and maintain the battery in accordance with the manufacturer's specifications.
- Do not burn the battery and do not heat it beyond the permitted temperature.
- Additional measures for lead-acid batteries: Ensure that the battery room is sufficiently ventilated.

⚠ WARNING**Chemical burns due to battery electrolyte**

If handled inappropriately, battery electrolyte can leak from the battery and cause irritation to the eyes, respiratory system and skin.

- Install, operate, maintain and dispose of the battery according to the manufacturer's specifications.
- Whenever working on the battery, wear suitable personal protective equipment such as rubber gloves, an apron, rubber boots and goggles.
- Rinse acid splashes thoroughly for a long time with clear water, and consult a doctor immediately.
- If acid fumes have been inhaled, consult a doctor immediately.

⚠ WARNING**Risk of burns due to flashes**

Short-circuit currents in the battery can cause heat build-up and flashes.

- Remove watches, rings and other metal objects prior to carrying out any work on the battery.
- Use insulated tools for all work on the battery.
- Do not place tools or metal parts on the battery.

⚠ CAUTION**Risk of burns due to hot battery components**

Improper battery connection may result in excessively high transition resistances. Excessive transition resistances give rise to localized heat build-up.

- Ensure that all pole connectors are connected with the connecting torque specified by the battery manufacturer.
- Ensure that all DC cables are connected with the connecting torque specified by the battery manufacturer.

NOTICE**Damage to the battery due to incorrect settings**

The set battery parameters influence the charging behavior of the inverter. The battery can be damaged by incorrect settings of the battery type, nominal voltage and capacity parameters.

- Set the correct battery type as well as the correct values for nominal voltage and battery capacity when configuring.
- Ensure that the values recommended by the manufacturer are set for the battery (refer to the technical data of the battery in the manufacturer documentation).

NOTICE**Permanent damage to the battery due to improper handling**

Improper set-up and maintenance of the battery can cause it to become permanently damaged. Logs can help to determine the cause.

- Comply with all requirements of the battery manufacturer with regard to mounting location.
- Check and log the status of the battery before performing maintenance work.
Useful hint: Many battery manufacturers provide suitable logs.
 - Check the battery for visible damage and log.
 - Measure and log the fill level and acid density of FLA batteries.
 - In the case of lead-acid batteries, measure and log the voltages of the individual cells.
 - Perform and log the test routines required by the battery manufacturer.

2.4 Battery-Backup System Safety Information

i Wiring and connection of automatic transfer switches for single-phase or three-phase battery-backup systems

- Do not bridge the neutral conductors of connections **X1** to **X5** in the automatic transfer switch. If the neutral conductor connections are bridged, residual-current devices could trip accidentally.
- Label the equipment and devices of the automatic transfer switch in accordance with the schematic diagrams. This will facilitate installation, commissioning and assistance in case servicing is required.

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

In single-phase battery-backup systems, only the line conductor of the Sunny Island that is connected to the circuit breaker **F1** of the automatic transfer switch is monitored for grid failure. If terminal **AC2 Gen/Grid L** is connected to another line conductor, the battery-backup system is not able to synchronize with the utility grid following a grid failure.

- With single-phase battery-backup systems, connect circuit breaker **F1** and terminal **AC2 Gen/Grid L** of the Sunny Island to the same line conductor, e.g. to L1 (for a single-phase battery-backup system with an all-pole disconnection function).
- 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.

3 Functions and Design

3.1 Design and Functions of the Battery-Backup System

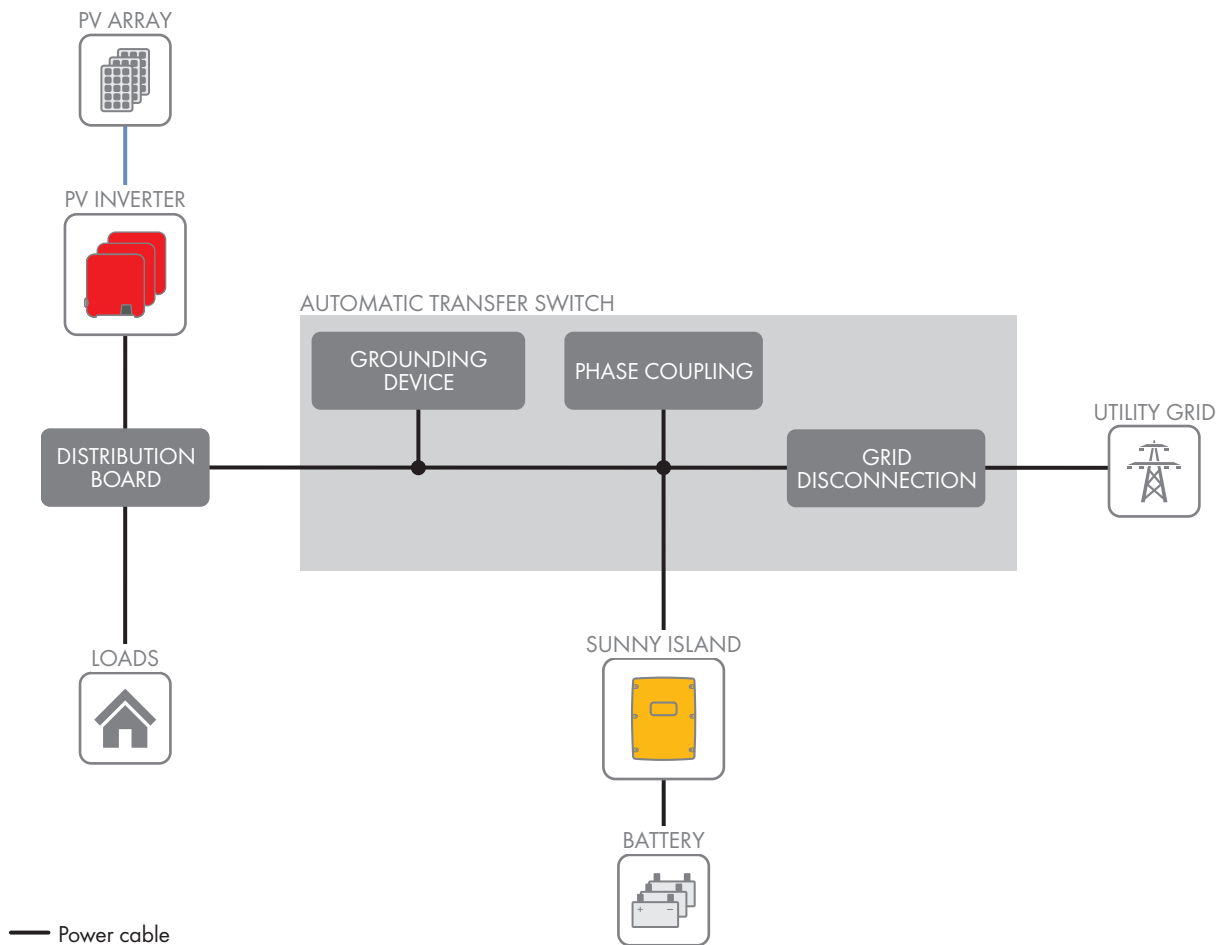


Figure 1: Overview of a single-phase battery-backup system

In the event of grid failure, a battery-backup system with Sunny Island supplies loads with energy and a PV system disconnected from the utility grid 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 are not supplied for approximately five to seven seconds. The battery-backup system can then provide active power and reactive power again. 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.

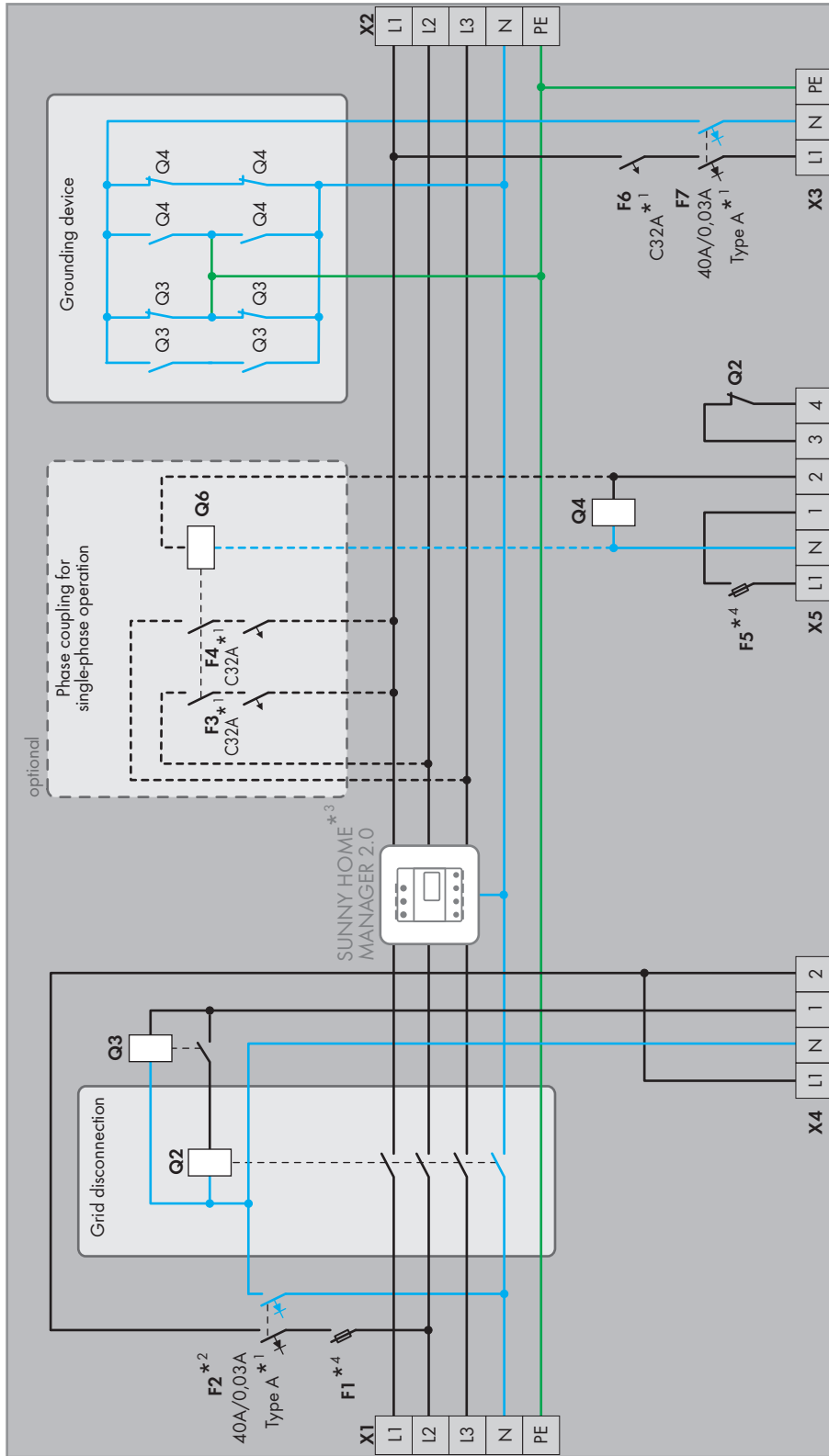
You can set up and wire the automatic transfer switch yourself or acquire it pre-wired from another provider (see Planning Guidelines "SMA Flexible Storage System with Battery Backup Function" at <http://www.SMA-Solar.com>).

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.

3.2 Design and Functions of the Automatic Transfer Switch

3.2.1 Devices 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: 1A, nominal cold resistance of at least 0.2 Ω and melting integral max. 1A²s.

Figure 2: Schematic diagram of a single-phase automatic transfer switch with all-pole disconnection (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 Sunny Home Manager 2.0 measures the grid feed-in and purchased electricity.
The Sunny Home Manager 2.0 is only required in systems for increased self-consumption.

3.2.2 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, which 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
 - 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.

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 comprises the contactor **Q2** (see Section 3.2.1, page 15). The tie switch disconnects the battery-backup grid from the utility grid in the event of grid failure or if the utility grid has breached the thresholds for voltage and frequency.

The control voltage of contactors **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 **Q2**. Contactors **Q3** and **Q2** are controlled by multifunction relay **Relay1** of the Sunny Island inverter. If multifunction relay **Relay1** is in non-operative mode, contactors **Q2** and **Q3** activate. If contactor **Q3** is in non-operative mode, contactor **Q2** will also go into non-operative mode and be locked.

In the event of a total grid failure, contactors **Q2** and **Q3** go into non-operative mode due to the 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 **Q2** and **Q3**. When a deviation from country-specific voltage and frequency thresholds of the utility grid occurs, multifunction relay **Relay 1** is activated. Contactors **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, multifunction relay **Relay 1** goes into non-operative mode and contactors **Q2** and **Q3** are 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 "Automatic Transfer Switch of a Single-Phase Battery-Backup System without All-Pole Disconnection", page 30). The tie switch disconnects the battery-backup grid from the utility grid in the event of grid failure or if the utility grid has breached the thresholds for voltage and frequency.

The control voltage of contactor **Q2** is the voltage at 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 **Relay 1** of the Sunny Island. If multifunction relay **Relay 1** 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 the 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 with the same line conductor as the control voltage of contactor **Q2**. When a deviation from the country-specific voltage and frequency thresholds of the utility grid occurs, multifunction relay **Relay 1** 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, multifunction relay **Relay 1** goes into non-operative mode and contactor **Q2** activates. The battery-backup grid is again connected to the utility grid.

3.2.3 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.

Circuit description of the grounding device

Contactors **Q3** and **Q4** form the grounding device (see Section 3.2.1, page 15). Contactors **Q3** and **Q4** are controlled by both multifunction relays of the Sunny Island. Triggering of contactor **Q3** occurs simultaneously with 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 multifunction relay **Relay 2** to control contactor **Q4**. When multifunction relay **Relay 2** is activated, contactor **Q4** is activated 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.

3.3 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

Contactors **Q6** is the phase coupler (see Section 3.2.1, page 15). If 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 that is connected to the Sunny Island is not interrupted on connection to the utility grid.

3.4 Requirements of VDE Application Guide 2510-2

The requirements below apply only for systems for which the following properties are all applicable:

- The system is a system with increased self-consumption (SMA Flexible Storage System) or a system with increased self-consumption and battery-backup function (battery-backup system).
- The grid operator or the locally applicable standards and guidelines require compliance with the above-mentioned Application Guide.

Currently, only the grid operators in Germany require compliance with the above-mentioned Application Guide.

In accordance with the scope of VDE application guide 2510-2, a manufacturer's system is regarded as a complete energy storage system only if products are used that have been approved by the manufacturer (see the technical information "List of Approved Batteries"; for a battery-backup system also refer to the planning guidelines "SMA Flexible Storage System with Battery Backup Function", and for the SMA Flexible Storage System to the planning guidelines "SMA Smart Home"). If products are used that have not been approved by SMA Solar Technology AG, the installer is deemed to be the manufacturer of the system.

The requirements of VDE application guide 2510-2 are fulfilled if the installation is carried out in accordance with the technical documentation of the Sunny Island inverter.

3.5 Requirements for Communication

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 router and the optional network switches to the battery-backup grid.

Requirements for the Speedwire network

The Sunny Island and the Sunny Home Manager 2.0 can be directly interconnected via Speedwire. If more than two devices are to communicate via Speedwire or the Sunny Home Manager 2.0 is to establish an internet connection to the Sunny Portal, a Speedwire network is required.

Requirements:

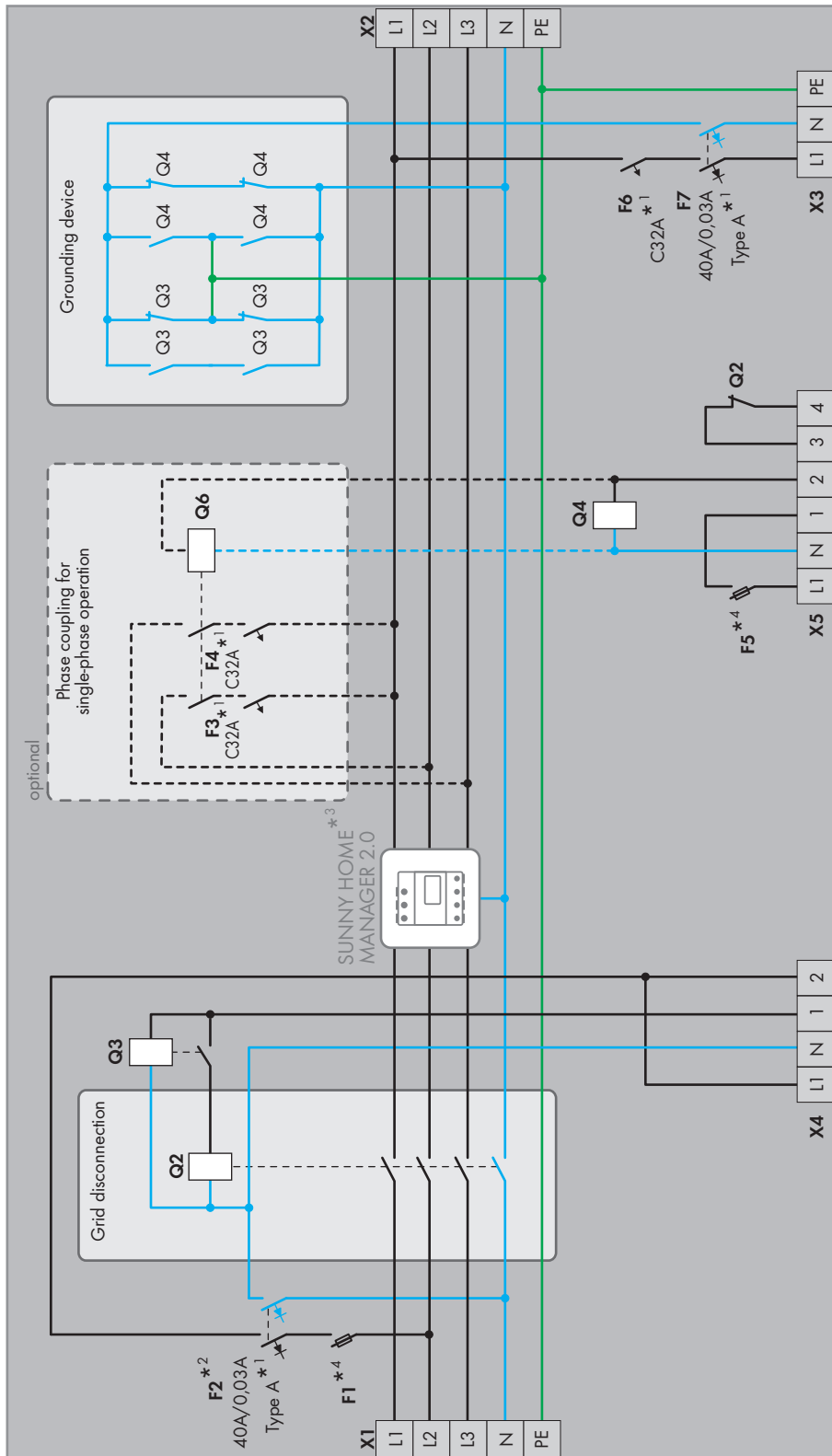
- All Speedwire devices must be connected to the same router.
- The router and the optional network switch must fully support Multicast.

The router must support "Internet Enabled Devices" with the SIP and STUN interfaces.
Most common routers and network switches support Multicast and "Internet Enabled Devices".

4 Battery-Backup Systems With All-Pole Disconnection

4.1 Single-phase battery-backup system with all-pole disconnection

4.1.1 Automatic Transfer Switch of a Single-Phase Battery-Backup System with All-Pole Disconnection



*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 IT grid configuration.

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

*4 Requirements for thermal fuse used: 1A, 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

4.1.2 Circuitry overview of a single-phase battery-backup system with all-pole disconnection

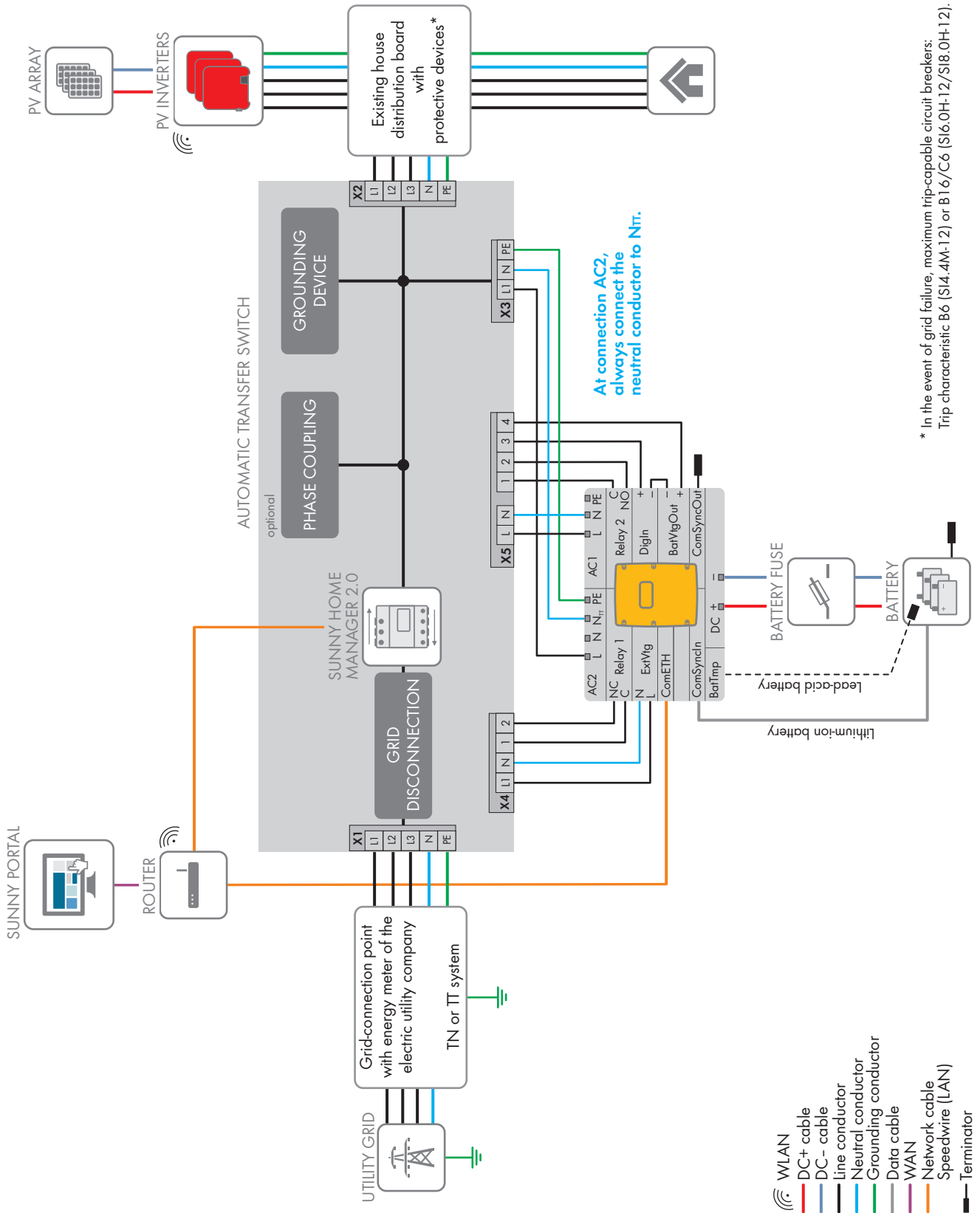


Figure 4: Connection of the automatic transfer switch with all-pole disconnection (e.g. for Germany)

4.1.3 Connection of the Sunny Island

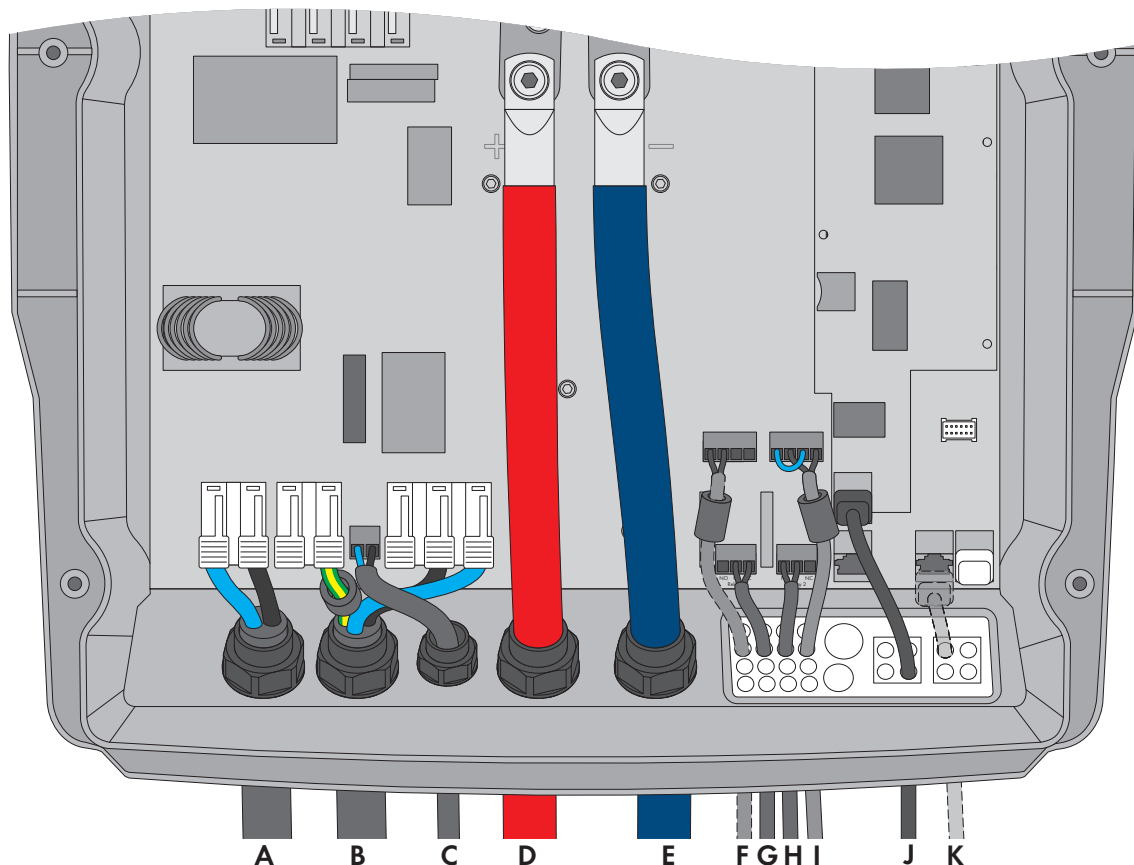


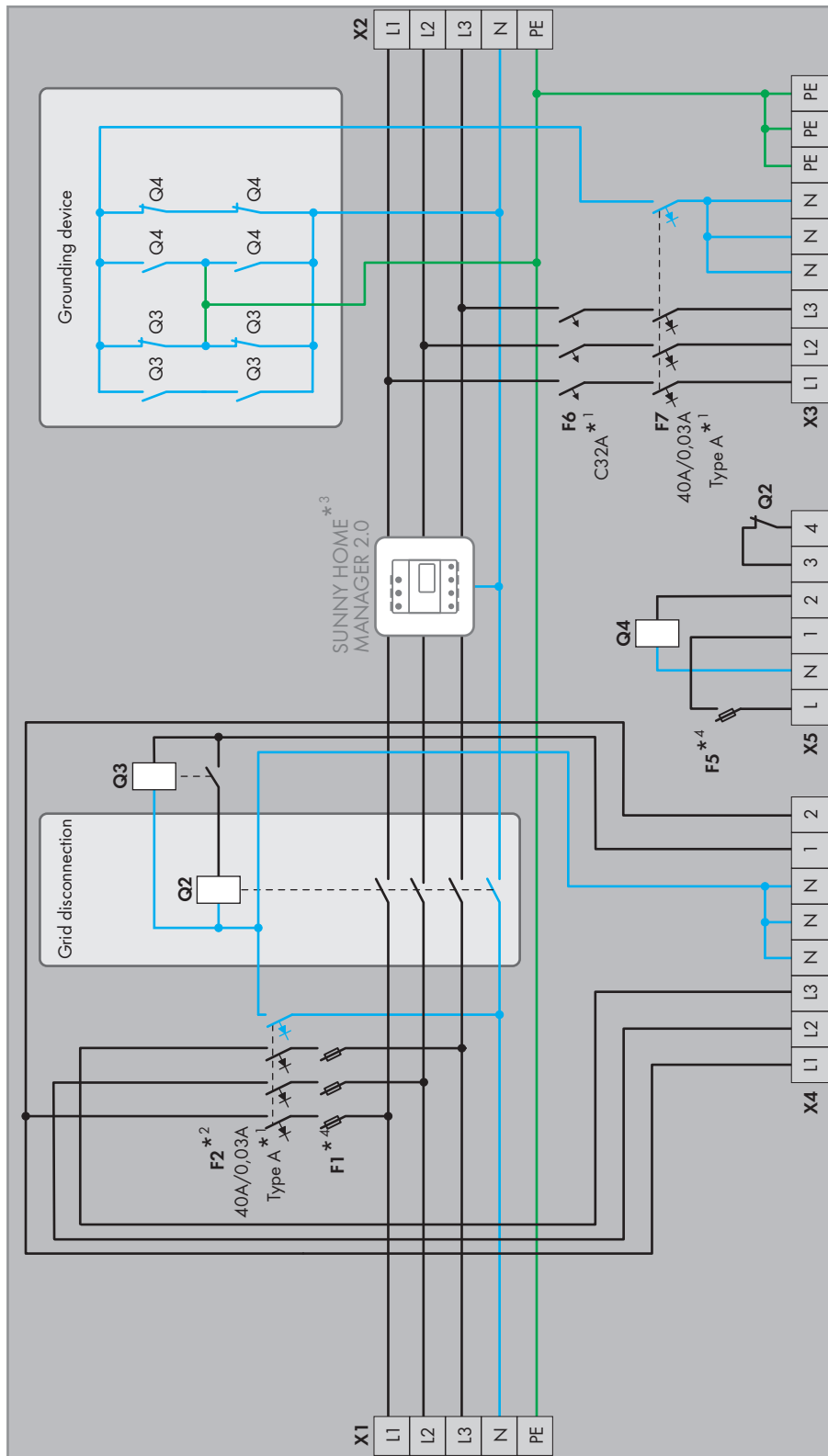
Figure 5: Connection of the Sunny Island

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: from 6 mm ² to 16 mm ²
B	AC power cable	Sunny Island: connection to AC2 Gen/Grid terminals L , N_{TT} and PE Automatic transfer switch: connection X3 terminals L1 , N , and PE Conductor cross-section: from 10 mm ² to 16 mm ² Use the ferrite included in the delivery for the PE .
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: from 1.5 mm ² to 2.5 mm ²
D	DC+ cable	Battery connection
E	DC- cable	Conductor cross-section: from 50 mm ² to 95 mm ² Cable diameters 14 mm to 25 mm Torque: 12 Nm

Position	Designation	Description / information
F	Measuring cable of the battery temperature sensor	<p>Sunny Island: connection BatTmp</p> <p>You only have to connect a battery temperature sensor if lead-acid batteries are used.</p> <p>Mount the battery temperature sensor in the middle of the battery-storage system, in the upper third of the battery cell.</p> <p>Use the ferrite included in the delivery.</p>
G	Control cable of the tie switch	<p>Sunny Island: connection Relay1 terminals C and NC</p> <p>Automatic transfer switch: connection X4 terminals 1 and 2</p> <p>If the multifunction relay activates, the contactors of the tie switch deactivate.</p> <p>Conductor cross-section: from 1.5 mm² to 2.5 mm²</p>
H	Control cable of contactors Q6	<p>Sunny Island: connection Relay2 terminals C and NO</p> <p>Automatic transfer switch: connection X5 terminals 1 and 2</p> <p>If the multifunction relay activates, the contactors activate. This cable is only required for phase coupling.</p> <p>Conductor cross-section: from 1.5 mm² to 2.5 mm²</p>
I	Measuring cable for monitoring the tie switch	<p>Sunny Island: connections DigIn+ und BatVtgOut+</p> <p>Automatic transfer switch: connection X5 terminals 3 and 4</p> <p>Use a separate cable as a measuring cable for monitoring the tie switch. This will help prevent disturbances during the transmission of signals. Use the ferrite included in the delivery.</p> <p>Conductor cross-section: from 0.2 mm² to 2.5 mm²</p> <p>Inside the Sunny Island, connect terminals DigIn- and BatVtgOut-.</p> <p>The entire DC voltage range is displayed at the BatVtgOut terminal. The terminal BatVtgOut is current-limited and protected against short circuits.</p>
J	Speedwire network cable	Sunny Island: connection ComETH
K	Data cable for battery management	<p>Sunny Island: terminal ComSync In</p> <p>A data cable must be connected to the battery only when lithium-ion batteries are used. The communication bus must be equipped with a terminator on both ends.</p>

4.2 Three-Phase Battery-Backup System with All-Pole Disconnection

4.2.1 Automatic Transfer Switch of a Three-Phase Battery-Backup System with All-Pole Disconnection



*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: 1A, nominal cold resistance of at least 0.2 Ω and melting integral max. 1A² s.

Figure 6: Automatic transfer switch of a three-phase battery-backup system with all-pole disconnection

4.2.2 Circuitry Overview of a Three-Phase Battery-Backup System with All-Pole Disconnection

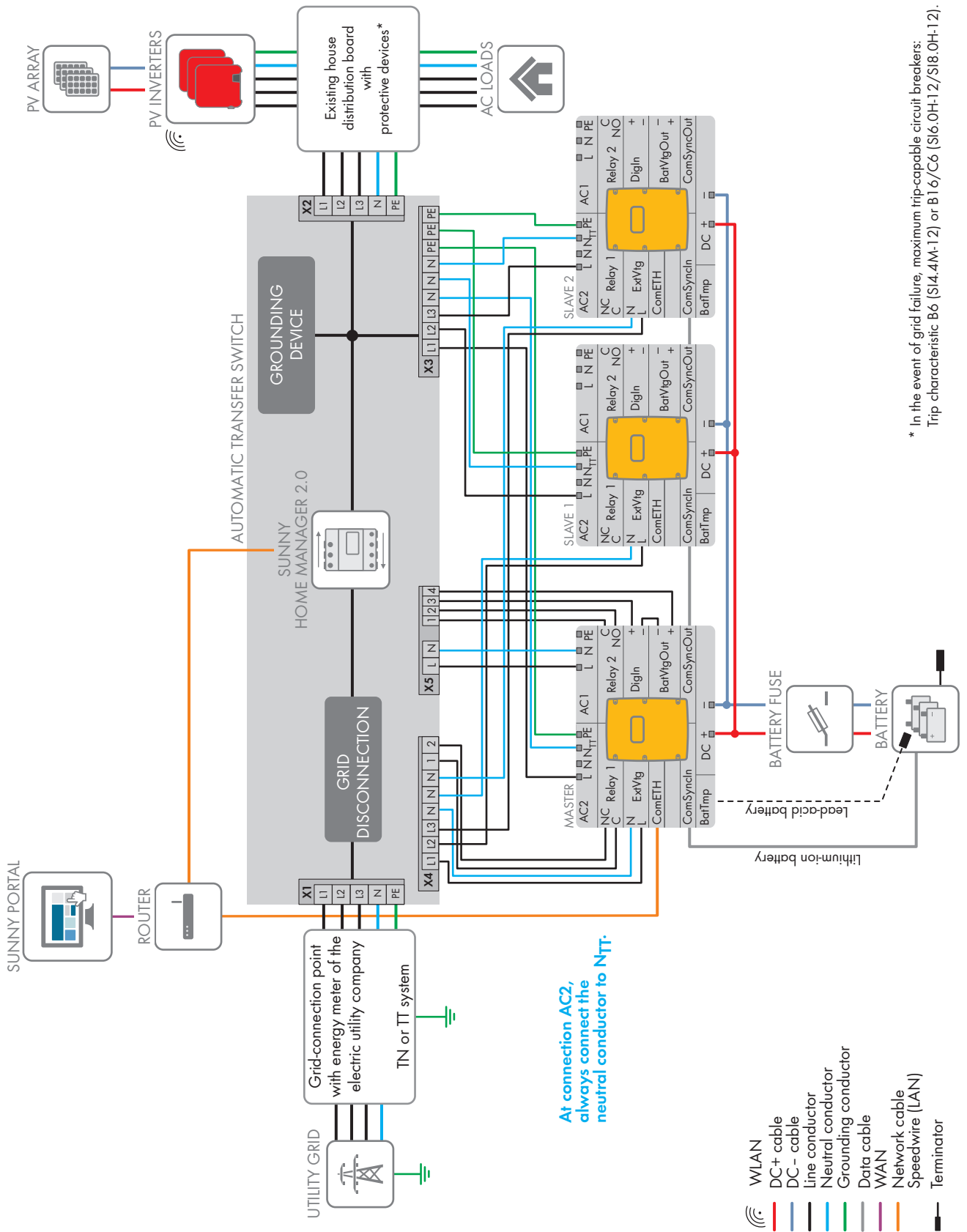


Figure 7: Circuitry overview of a three-phase battery-backup system with all-pole disconnection

4.2.3 Connecting the Master with All-Pole Disconnection

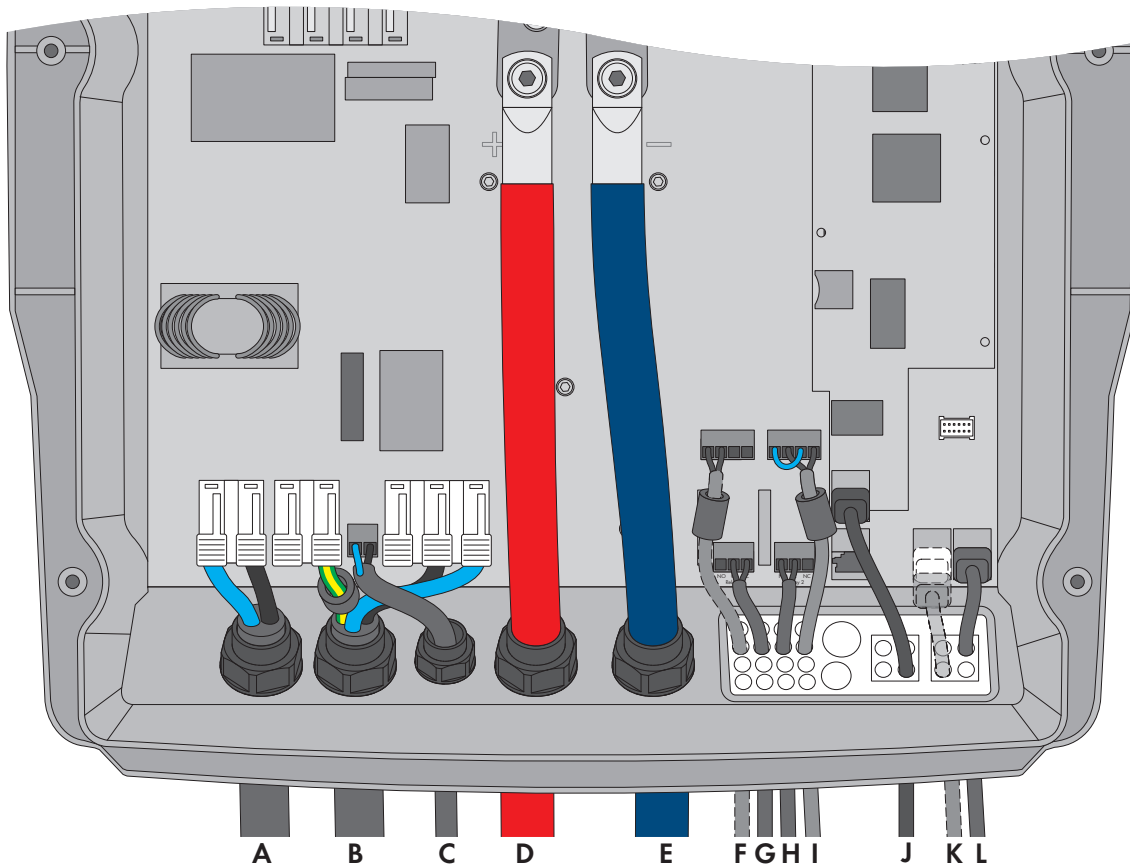


Figure 8: Connecting the master with all-pole disconnection

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: from 6 mm ² to 16 mm ²
B	AC power cable	Sunny Island: connection to AC2 Gen/Grid terminals L , N_{TT} and PE Automatic transfer switch: connection X3 terminals L1 , N , and PE Conductor cross-section: from 10 mm ² to 16 mm ² Use the ferrite included in the delivery for the PE .
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: from 1.5 mm ² to 2.5 mm ²
D	DC+ cable	Battery connection
E	DC- cable	Conductor cross-section: from 50 mm ² to 90 mm ² Cable diameters: 14 mm to 25 mm Torque: 12 Nm

Position	Designation	Description / information
F	Measuring cable of the battery temperature sensor	<p>Sunny Island: connection BatTmp</p> <p>You only have to connect a battery temperature sensor if lead-acid batteries are used.</p> <p>Mount the battery temperature sensor in the middle of the battery-storage system, in the upper third of the battery cell.</p> <p>Use the ferrite included in the delivery.</p>
G	Control cable of the tie switch	<p>Sunny Island: connection Relay1 terminals C and NC</p> <p>Automatic transfer switch: connection X4 terminals 1 and 2</p> <p>If the multifunction relay activates, the contactors of the tie switch deactivate.</p> <p>Conductor cross-section: from 1.5 mm² to 2.5 mm²</p>
H	Control cable of contactor Q4	<p>Sunny Island: connection Relay2 terminals C and NO</p> <p>Automatic transfer switch: connection X5 terminals 1 and 2</p> <p>If the multifunction relay activates, contactor Q4 activates.</p> <p>Conductor cross-section: from 1.5 mm² to 2.5 mm²</p>
I	Measuring cable for monitoring the tie switch	<p>Sunny Island: connections DigIn+ und BatVtgOut+</p> <p>Automatic transfer switch: connection X5 terminals 3 and 4</p> <p>Use a separate cable as a measuring cable for monitoring the tie switch. This will help prevent disturbances during the transmission of signals. Use the ferrite included in the delivery.</p> <p>Conductor cross-section: from 0.2 mm² to 2.5 mm²</p> <p>Inside the Sunny Island, connect terminals DigIn- and BatVtgOut-.</p> <p>The entire DC voltage range is displayed at the BatVtgOut terminal. The terminal BatVtgOut is current-limited and protected against short circuits.</p>
J	Speedwire network cable	Sunny Island: connection ComETH
K	Data cable for battery management	<p>Sunny Island: terminal ComSync In</p> <p>A data cable must be connected to the battery only when lithium-ion batteries are used. The communication bus must be equipped with a terminator on both ends.</p>
L	Data cable for the internal communication in the cluster	<p>Sunny Island: terminal ComSync Out</p> <p>Connection of internal communication bus of slave 1</p>

4.2.4 Connecting the Slaves

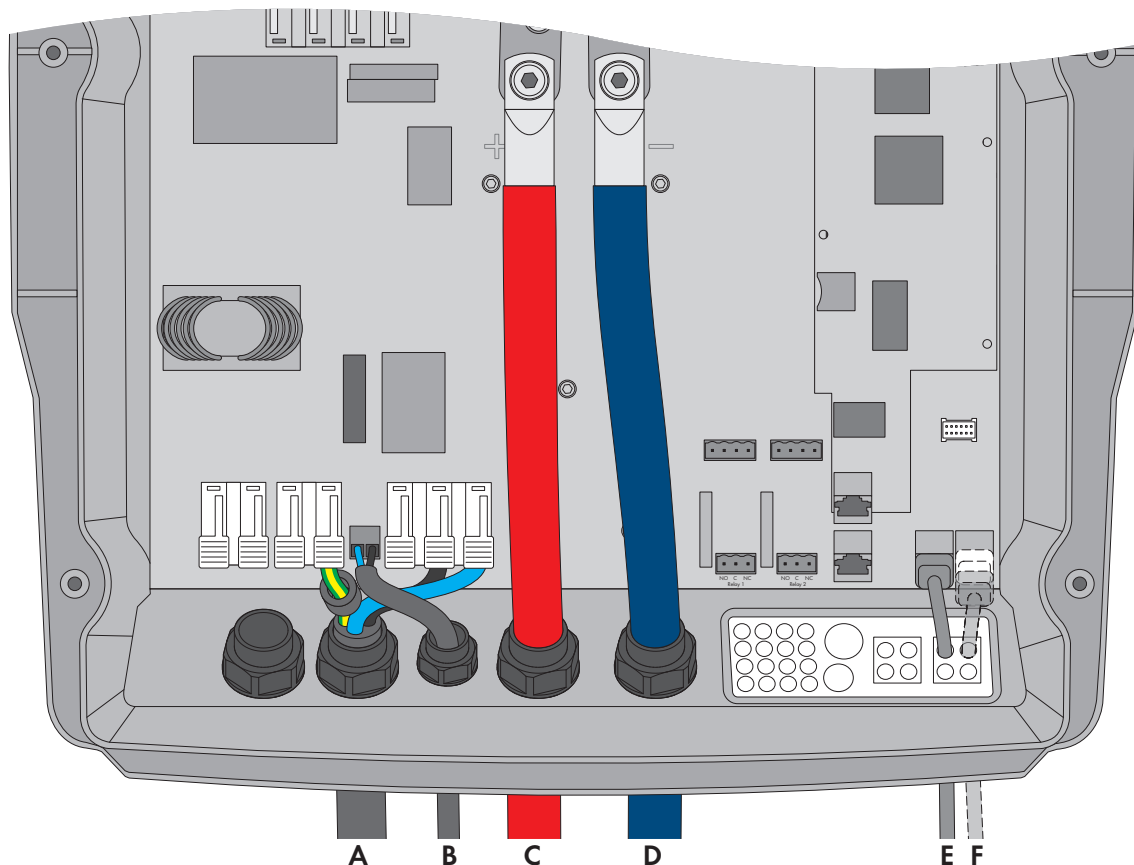


Figure 9: Connecting the slaves

Position	Designation	Description / information
A	AC power cable	<p>Sunny Island: connection to AC2 Gen/Grid terminals L, N_{IT} and PE</p> <p>Automatic transfer switch:</p> <ul style="list-style-type: none"> • Connect slave 1 to X3 terminals L2, N and PE. • Connect slave 2 to X3 terminals L3, N and PE. <p>Conductor cross-section: from 10 mm² to 16 mm²</p> <p>Use the ferrite included in the delivery for the PE.</p>
B	Measuring cable for voltage measurement	<p>Sunny Island: connection ExtVtg terminals L and N</p> <p>Automatic transfer switch:</p> <ul style="list-style-type: none"> • Connect slave 1 to X4 terminals L2 and N. • Connect slave 2 to X4 terminals L3 and N. <p>Conductor cross-section: from 1.5 mm² to 2.5 mm²</p>
C	DC+ cable	Battery connection
D	DC- cable	<p>Conductor cross-section: from 50 mm² to 95 mm²</p> <p>Cable diameters: 14 mm to 25 mm</p> <p>Torque: 12 Nm</p>

Position	Designation	Description / information
E	Data cable for the internal communication in the cluster	Sunny Island: terminal ComSync In With slave 1: connection of internal communication bus of the master With slave 2: connection of internal communication bus of slave 1
F	Data cable for the internal communication in the cluster	Sunny Island: terminal ComSync Out 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.

5.1.2 Circuitry overview of a single-phase battery-backup system without all-pole disconnection

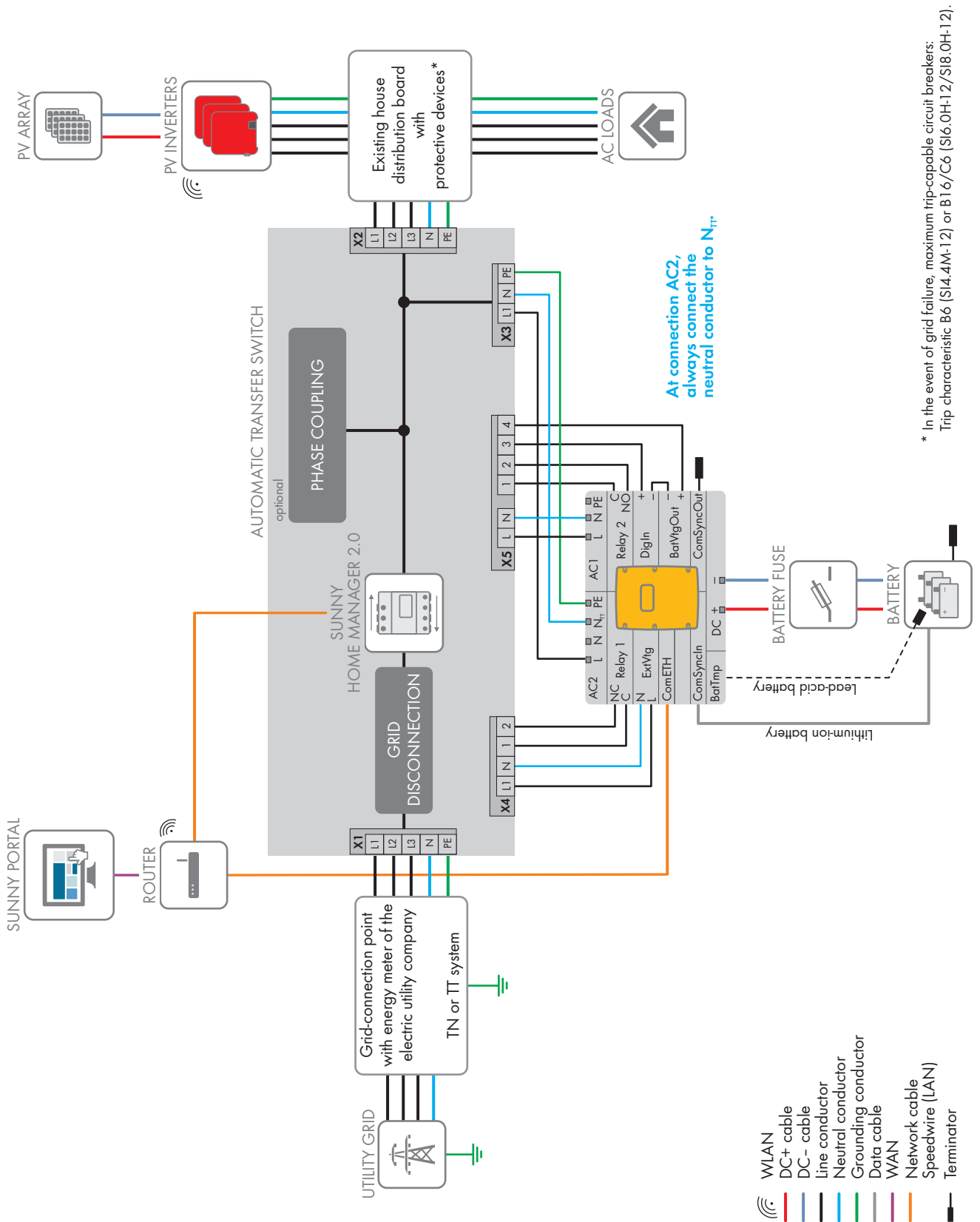


Figure 11: Connection of the automatic transfer switch without all-pole disconnection

5.1.3 Connection of the Sunny Island

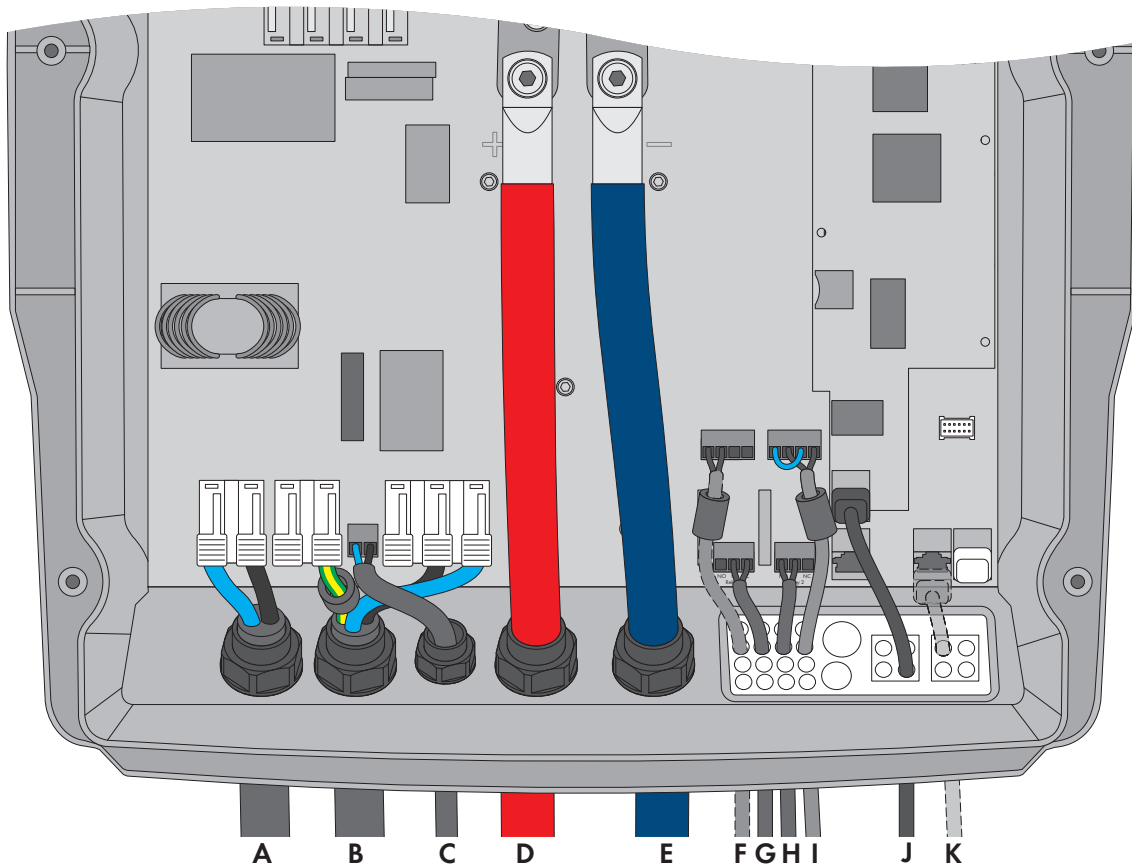


Figure 12: Connection of the Sunny Island

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: from 6 mm ² to 16 mm ²
B	AC power cable	Sunny Island: connection to AC2 Gen/Grid terminals L , N_{TT} and PE Automatic transfer switch: connection X3 terminals L1 , N , and PE Conductor cross-section: from 10 mm ² to 16 mm ² Use the ferrite included in the delivery for the PE .
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: from 1.5 mm ² to 2.5 mm ²
D	DC+ cable	Battery connection
E	DC- cable	Conductor cross-section: from 50 mm ² to 95 mm ² Cable diameters 14 mm to 25 mm Torque: 12 Nm

Position	Designation	Description / information
F	Measuring cable of the battery temperature sensor	<p>Sunny Island: connection BatTmp</p> <p>You only have to connect a battery temperature sensor if lead-acid batteries are used.</p> <p>Mount the battery temperature sensor in the middle of the battery-storage system, in the upper third of the battery cell.</p> <p>Use the ferrite included in the delivery.</p>
G	Control cable of the tie switch	<p>Sunny Island: connection Relay1 terminals C and NC</p> <p>Automatic transfer switch: connection X4 terminals 1 and 2</p> <p>If the multifunction relay activates, the contactors of the tie switch deactivate.</p> <p>Conductor cross-section: from 1.5 mm² to 2.5 mm²</p>
H	Control cable of contactors Q6	<p>Sunny Island: connection Relay2 terminals C and NO</p> <p>Automatic transfer switch: connection X5 terminals 1 and 2</p> <p>If the multifunction relay activates, the contactors activate. This cable is only required for phase coupling.</p> <p>Conductor cross-section: from 1.5 mm² to 2.5 mm²</p>
I	Measuring cable for monitoring the tie switch	<p>Sunny Island: connections DigIn+ und BatVtgOut+</p> <p>Automatic transfer switch: connection X5 terminals 3 and 4</p> <p>Use a separate cable as a measuring cable for monitoring the tie switch. This will help prevent disturbances during the transmission of signals. Use the ferrite included in the delivery.</p> <p>Conductor cross-section: from 0.2 mm² to 2.5 mm²</p> <p>Inside the Sunny Island, connect terminals DigIn- and BatVtgOut-.</p> <p>The entire DC voltage range is displayed at the BatVtgOut terminal. The terminal BatVtgOut is current-limited and protected against short circuits.</p>
J	Speedwire network cable	Sunny Island: connection ComETH
K	Data cable for battery management	<p>Sunny Island: terminal ComSync In</p> <p>A data cable must be connected to the battery only when lithium-ion batteries are used. The communication bus must be equipped with a terminator on both ends.</p>

5.2.3 Connecting the Master without All-Pole Disconnection

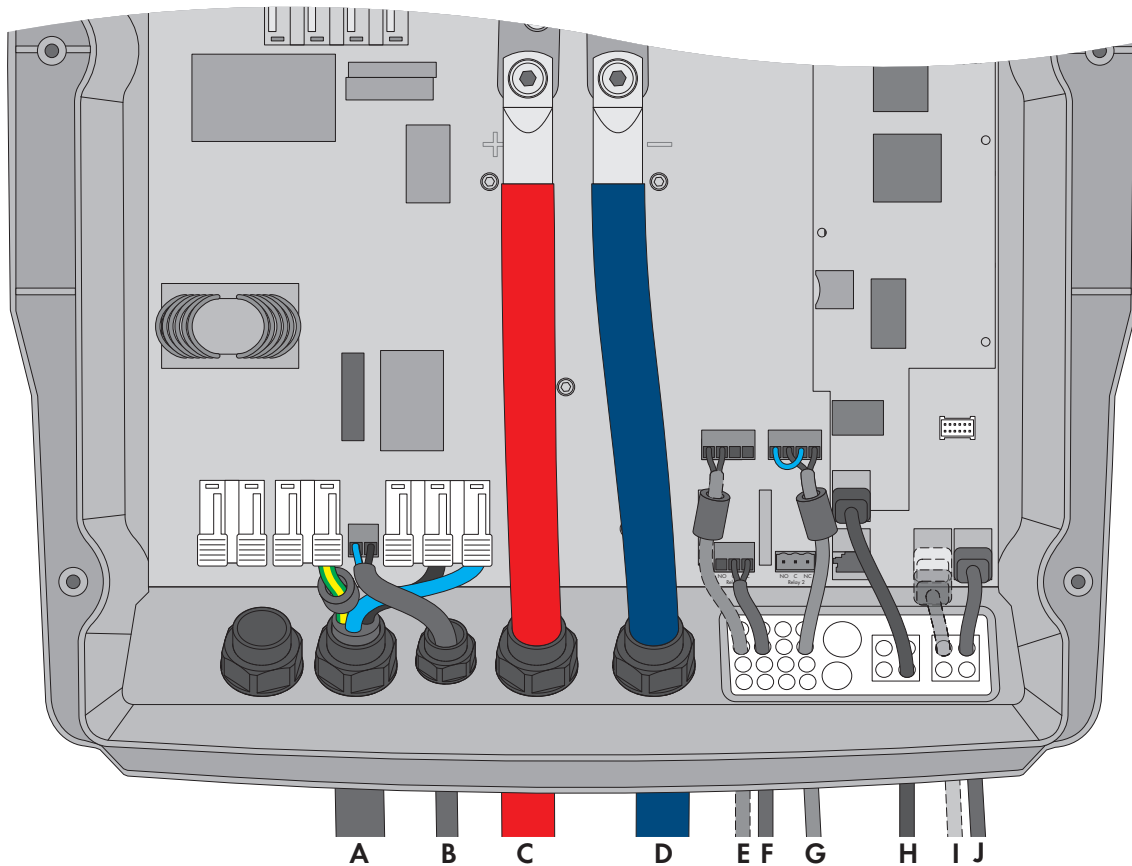


Figure 15: Connecting the master

Position	Designation	Description / information
A	AC power cable	Sunny Island: connection to AC2 Gen/Grid terminals L , N_{IT} and PE Automatic transfer switch: connection X3 terminals L1 , N , and PE Conductor cross-section: from 10 mm ² to 16 mm ² Use the ferrite included in the delivery for the PE .
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: from 1.5 mm ² to 2.5 mm ²
C	DC+ cable	Battery connection
D	DC- cable	Conductor cross-section: from 50 mm ² to 95 mm ² Cable diameters 14 mm to 25 mm Torque: 12 Nm
E	Measuring cable of the battery temperature sensor	Sunny Island: connection BatTmp 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-storage system, in the upper third of the battery cell. Use the ferrite included in the delivery.

Position	Designation	Description / information
F	Control cable of the tie switch	<p>Sunny Island: connection Relay1 terminals C and NC</p> <p>Automatic transfer switch: connection X4 terminals 1 and 2</p> <p>If the multifunction relay activates, the contactor of the tie switch deactivates.</p> <p>Conductor cross-section: from 1.5 mm² to 2.5 mm²</p>
G	Measuring cable for monitoring the tie switch	<p>Sunny Island: connections DigIn+ und BatVtgOut+</p> <p>Automatic transfer switch: connection X5 terminals 3 and 4</p> <p>Use a separate cable as a measuring cable for monitoring the tie switch. This will help prevent disturbances during the transmission of signals. Use the ferrite included in the delivery.</p> <p>Conductor cross-section: from 0.2 mm² to 2.5 mm²</p> <p>Inside the Sunny Island, connect terminals DigIn- and BatVtgOut-.</p> <p>The entire DC voltage range is displayed at the BatVtgOut terminal. The terminal BatVtgOut is current-limited and protected against short circuits.</p>
H	Speedwire network cable	Sunny Island: connection ComETH
I	Data cable for battery management	<p>Sunny Island: terminal ComSync</p> <p>A data cable must be connected to the battery only when lithium-ion batteries are used. The communication bus must be equipped with a terminator on both ends.</p> <p>If no data cable is plugged in, plug the terminator into ComSync In.</p>
J	Data cable for the internal communication in the cluster	Sunny Island: terminal ComSync Out

5.2.4 Connecting the Slaves

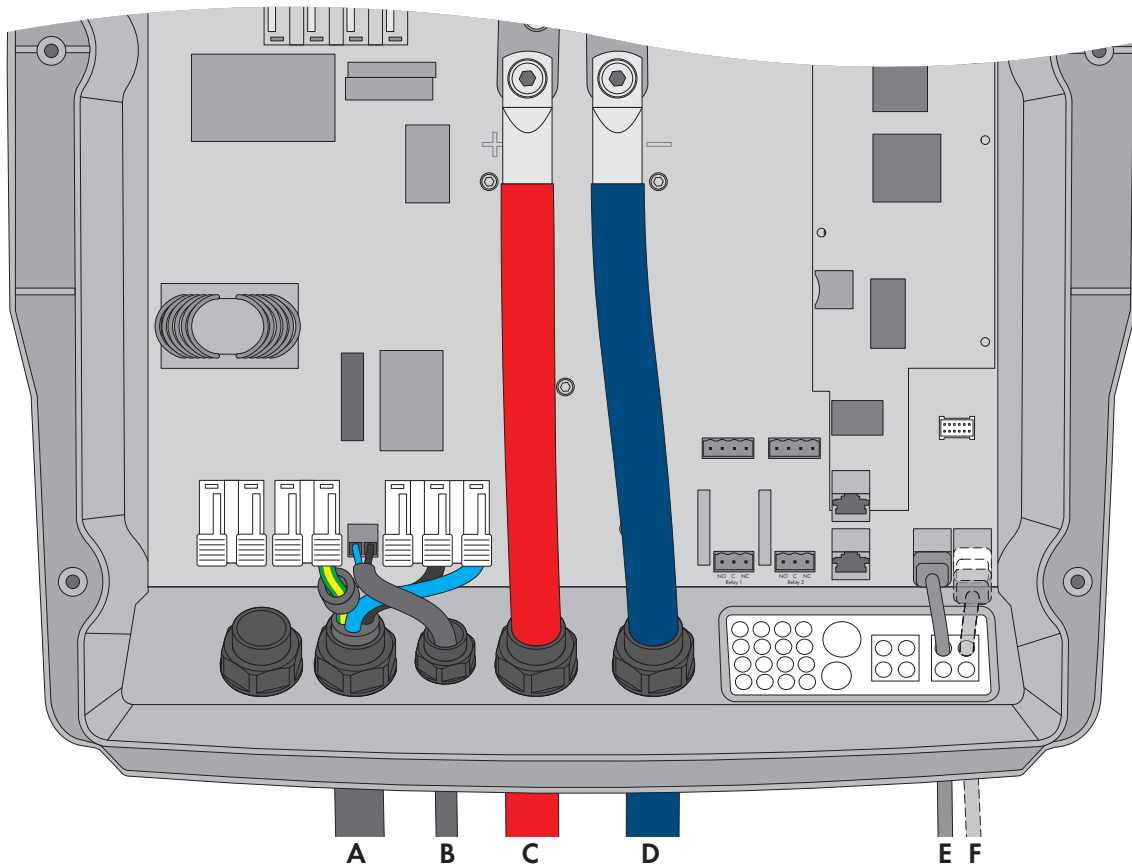


Figure 16: Connecting the slaves

Position	Designation	Description / information
A	AC power cable	<p>Sunny Island: connection to AC2 Gen/Grid terminals L, N_{IT} and PE</p> <p>Automatic transfer switch:</p> <ul style="list-style-type: none"> • Connect slave 1 to X3 terminals L2, N and PE. • Connect slave 2 to X3 terminals L3, N and PE. <p>Conductor cross-section: from 10 mm² to 16 mm²</p> <p>Use the ferrite included in the delivery for the PE.</p>
B	Measuring cable for voltage measurement	<p>Sunny Island: connection ExtVtg terminals L and N</p> <p>Automatic transfer switch:</p> <ul style="list-style-type: none"> • Connect slave 1 to X4 terminals L2 and N. • Connect slave 2 to X4 terminals L3 and N. <p>Conductor cross-section: from 1.5 mm² to 2.5 mm²</p>
C	DC+ cable	Battery connection
D	DC- cable	<p>Conductor cross-section: from 50 mm² to 95 mm²</p> <p>Cable diameters: 14 mm to 25 mm</p> <p>Torque: 12 Nm</p>

Position	Designation	Description / information
E	Data cable for the internal communication in the cluster	Sunny Island: terminal ComSync In With slave 1: connection of internal communication bus of the master With slave 2: connection of internal communication bus of slave 1
F	Data cable for the internal communication in the cluster	Sunny Island: terminal ComSync Out 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.

6 Commissioning

6.1 Commissioning Procedure

Before commissioning the system, you must make various settings. This section describes the procedure and gives an overview of the steps, which must always be performed in the prescribed sequence.

Procedure	See
1. Commission the inverter.	Sunny Island operating manual
2. Establish a connection to the user interface of the inverter. There are the following connection options available to choose from: <ul style="list-style-type: none"> • Direct connection via WLAN • Direct connection via Ethernet • Connection via Ethernet in the local network 	Sunny Island operating manual
3. Log into the user interface.	Sunny Island operating manual
4. Carry out the basic configuration via the Installation Assistant: <ul style="list-style-type: none"> • Single system (system with one Sunny Island) • Single-cluster system (system with three Sunny Island) Please note that the personal SMA Grid Guard code for changing the grid-relevant parameters must be available after completion of the first ten operating hours (see "Application for SMA Grid Guard code" available at www.SMA-Solar.com).	Sunny Island operating manual
5. Testing the automatic transfer switch function	Section 6.2, page 40
6. Adjusting the configuration of the Sunny Island inverter	Section 6.3, page 43
7. Adjusting the configuration of the PV inverters	Section 6.4, page 44
8. Activating phase coupling in single-phase battery-backup systems	Section 6.5, page 45
9. Commissioning a system with increased self-consumption	Section 6.6, page 46
10. Commissioning a system without increased self-consumption	Section 6.7, page 47

6.2 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**, **F4**, **F5**, and **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 there is voltage present and a right-hand rotating magnetic field at connection **X1**.
2. Measure whether the individual terminals are voltage-free:

Test point	Task
Connection X2	If AC voltage is present, correctly wire contactor 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:

Test 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:

Test point	Task
Contactors Q2 and Q3	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 Q2 and Q3 are correctly wired.
Connection X2	

5. Close circuit breaker **F6**.

Voltages are present at connection **X3**.

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

Test 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 . Switch on residual-current device F7 again.

Test point	Task
Residual-current device F2	<p>Press the test button and check if contactors Q2 and Q3 go into non-operative mode.</p> <p>If the contactors do not deactivate, wire the residual-current device F2 correctly.</p> <hr/> <p>Switch on residual-current device F2 again.</p>

7. Start the Sunny Island (see operating manual of the Sunny Island).
8. Check whether error messages are displayed on the user interface.

If the error message **Phasing of measured AC voltage at Vext and VAC2 does not correspond at phase L1**, **Phasing of measured AC voltage at Vext and VAC2 does not correspond at phase L2** or **Phasing of measured AC voltage at Vext and VAC2 does not correspond at phase L3** is displayed, connect the **ExtVtg** connection correctly to 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 **Q2** and **Q3** deactivate.

If the error message **Section switch does not open** is displayed on the user interface, 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:

Test 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.

6.3 Adjusting the Configuration of the Sunny Island

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. The Sunny Island inverters fulfill the requirements of application guide VDE-AR-N 4105:2011-08. In the Sunny Island, this application guide is defined as standard country data set **VDE-AR-4105**.

The configuration must be adjusted as follows for Denmark, Austria and Switzerland (status as of June 2017):

Country	Operating condition	Parameters	Set value
Denmark	When using the Sunny Island 6.0H / 8.0H, the discharge/charging current must be reduced.	Maximum AC battery charging current	16.0 A
	When using the Sunny Island 4.4M, you can retain the default setting of the discharge/charging current.	-	-
Austria	If your grid operator does not permit frequency-dependent control of active power feed-in in the case of overfrequency, this function must be deactivated (see VDE-AR-N 4105 item 5.7.3.3).	Operating mode of active power limitation in the case of overfrequency P(f)	Off
	If your grid operator specifies a maximum grid feed-in per line conductor, the electric discharge/charging current must be reduced.	Maximum AC battery charging current	Grid operator specifications
Switzerland	The maximum grid frequency must be observed.	Frequency monitoring upper maximum threshold	50.2 Hz
	The upper frequency difference for valid grid connection must be observed.	Frequency monitoring hysteresis maximum threshold	0.05 Hz
	The minimum observation time for grid voltage and frequency before grid connection must be observed.	Grid monitoring time	30 s
	If your grid operator specifies a maximum grid feed-in per line conductor, the electric discharge/charging current must be reduced.	Maximum AC battery charging current	Grid operator specifications

In Belgium and Germany, the configuration may only be adjusted upon request or with permission of the grid operator (status: June 2017):

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

Requirements:

- The grid-relevant parameters must be changed within the first ten operating hours of the inverter, otherwise the SMA Grid Guard code must be available (see "Application for SMA Grid Guard Code" at <http://www.SMA-Solar.com>).
- The parameter **Set country standard** must be set to **VDE-AR-N4105**.

Procedure:

1. Activate the user interface of the inverter (see the inverter operating manual).
2. Log in as Installer.
3. Adjust the parameters for Denmark, Austria or Switzerland (see the Sunny Island operating manual).
4. When installing in Switzerland, attach the label "VDE 0126-1-1" next to the type label of the Sunny Island inverter.

6.4 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 the 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?
Belgium	Yes
Denmark	Yes
Germany	Yes
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 <http://www.SMA-Solar.com> in the download area of the relevant PV inverter.
- The firmware version of the PV inverters must support the frequency-dependent control of active power (for "PV inverters", see the planning guidelines "SMA Flexible Storage System with Battery Backup Function" at <http://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 <http://www.SMA-Solar.com>).
2. The following parameters of the PV inverter must be set to the indicated value. For this, use the user interface of the PV inverter or of a communication product (for the procedure, refer to the documentation of the PV inverter or communication product).

Parameters	Values for the application guide VDE-AR-N 4105:2011-08*
P-WCtHzMod Operating mode of active power limitation in the case of overfrequency P(f)**	On or WCtHz
P-WGra Active power gradient, linear instantaneous power gradient configuration**	40
P-HzStr Difference between starting frequency and power frequency, linear instantaneous power gradient configuration**	0.2
P-HzStop Difference between reset frequency and power frequency, linear instantaneous power gradient configuration**	0.2
P-HzStopWGra Active power gradient after reset frequency, linear instantaneous power gradient configuration**	10

* The adjustments are based on the requirements for PV inverters in Austria and Switzerland.

** Menu **Device parameters > Equipment and device control system**

6.5 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 that 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 operating manual).

NOTICE

Damage to three-phase loads during phase coupling

If three-phase loads are connected to a single-phase utility grid with 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.

6.6 Commissioning a System With Increased Self-Consumption

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

When using lead-acid batteries, the SMA Flexible Storage System carries out full and equalization charges on a regular basis (see technical information "Battery Management" at www.SMA-Solar.com). During this charging process, the increased self-consumption function is deactivated and electricity may have to be purchased to perform the full and equalization charges.

The battery life of lead-acid batteries increases with full and equalization charges.

i Representation of Sunny Island in Sunny Portal

The Sunny Island inverters of a three-phase cluster will be displayed as one device in Sunny Portal. The data is either added up via the three phases or displayed for each Sunny Island as a phase-specific single value.

Required data for registration in Sunny Portal:

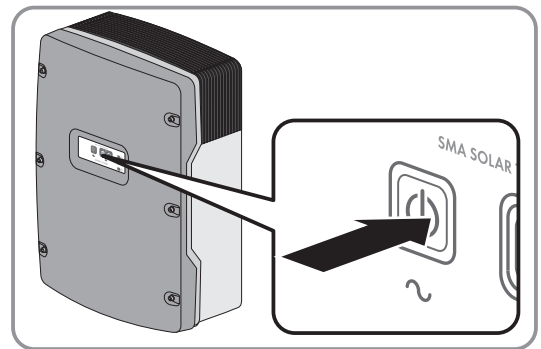
Device / customer data	Required data and explanation
Sunny Home Manager 2.0	<ul style="list-style-type: none"> • Serial number (PIC) and registration ID (RID) Register the new system in Sunny Portal using the PIC and RID. • Only when two SMA Energy Meters are installed, note down the serial number and 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"> • System Password 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 operating manual). The default password is 1111. • Serial number of the PV inverters You can uniquely identify the PV inverters in Sunny Portal using the serial number. • PV array power in kWp
Radio-controlled socket	<ul style="list-style-type: none"> • The serial number and connected load of each SMA radio-controlled socket 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.
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 must have been performed (see the Sunny Island operating manual).
- The functionality of the automatic transfer switch must be checked (see Section 6.2, page 40).
- All other Speedwire devices must be connected to the same router.
- The router must meet the requirements for the design of a Speedwire communication network (see Section 3.5, page 18).

Procedure:

1. Attach a clearly visible indication of the installed battery-backup system to the AC main distributor.
2. In the automatic transfer switch, switch on circuit breaker **F1** and residual-current device **F2**.
3. Commission the PV system (see PV inverter documentation).
4. Press the start-stop button on the Sunny Island and hold it until an acoustic signal sounds. This starts the system.



5. Only when one Sunny Home Manager 2.0 and one SMA Energy Meter are installed in the local network, assign the grid feed-in meter and purchased electricity meter to the Sunny Island via the user interface. To do this, enter the serial number of the grid feed-in meter and purchased electricity meter (see the Sunny Explorer operating manual).
6. Open Sunny Portal via <http://www.SunnyPortal.com/Register> and run the PV System Setup Assistant. The required data for registration in Sunny Portal must be at hand.
7. Activate the automatic update of the Sunny Home Manager and the PV system in Sunny Portal.
8. In order to activate the forecast-based charging function, call up the device properties of the Sunny Home Manager in Sunny Portal and activate the **Forecast-based battery charging** checkbox. For further information on the forecast-based battery charging, see planning guidelines "SMA Smart Home".
9. 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 operating manual "Sunny Home Manager in Sunny Portal" at <http://www.SunnyPortal.com>).

6.7 Commissioning a System without Increased Self-Consumption

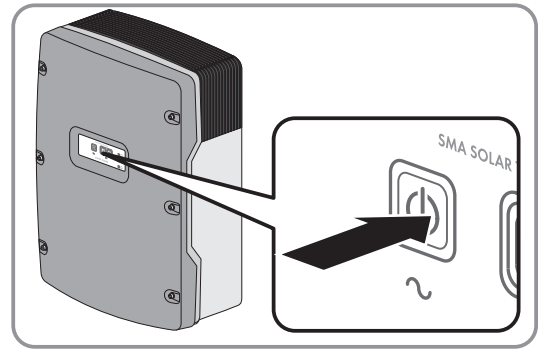
Requirement:

- The functionality of the automatic transfer switch must be checked (see Section 6.2, page 40).

Procedure:

1. Attach a clearly visible indication of the installed battery-backup system to the AC main distributor.
2. Commission the PV system (see PV inverter documentation).

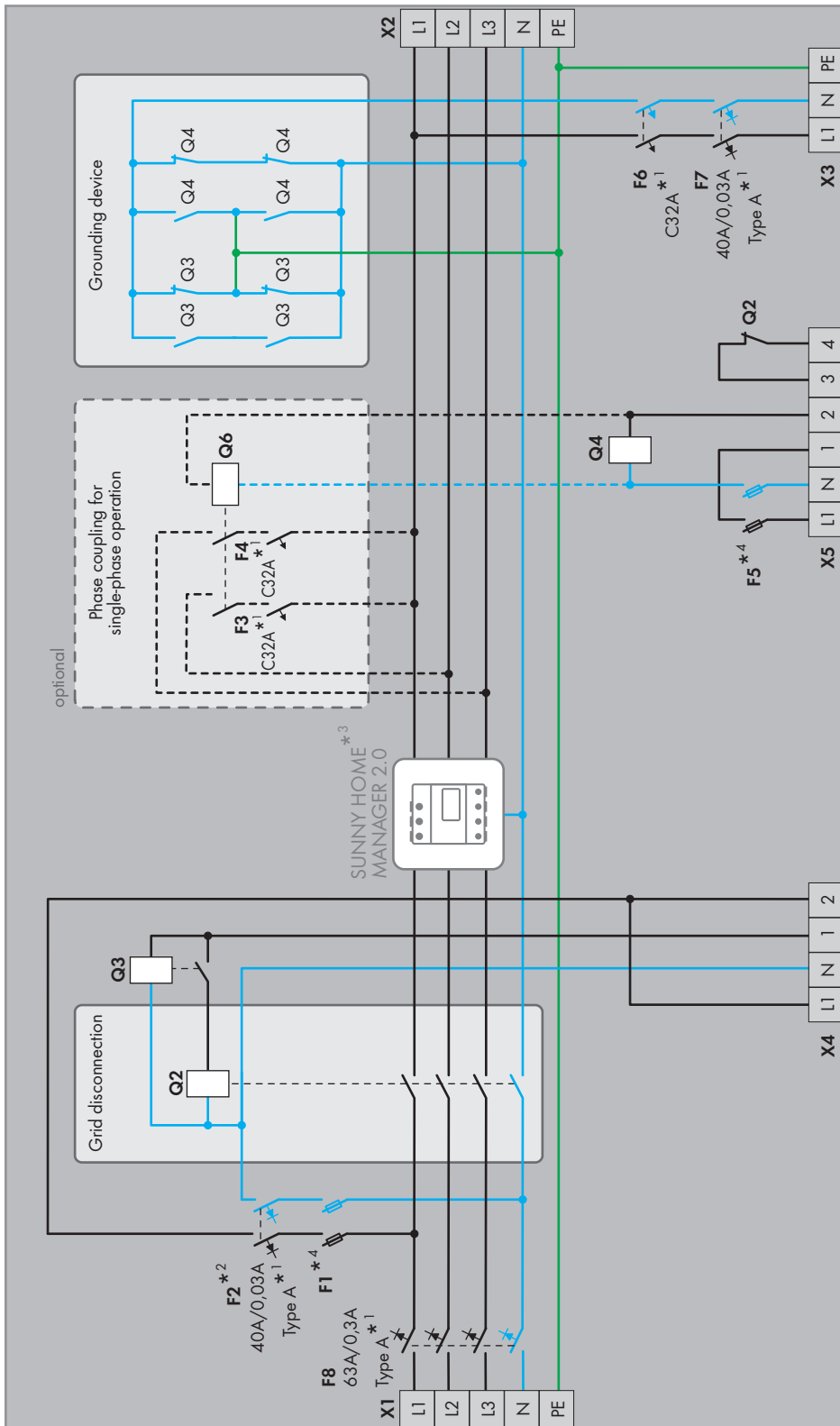
3. To start the system, press and hold the start-stop button on the Sunny Island until an acoustic signal sounds.



7 Appendix

7.1 Single-Phase Battery-Backup System in Belgium

7.1.1 Automatic Transfer Switch of a Single-Phase Battery-Backup System in Belgium



*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: 1A, nominal cold resistance of at least 0.2 Ω and melting integral max. 1A² s.

Figure 17: Schematic diagram of the single-phase automatic transfer switch for Belgium

7.1.2 Circuitry Overview of a Single-Phase Battery-Backup System in Belgium

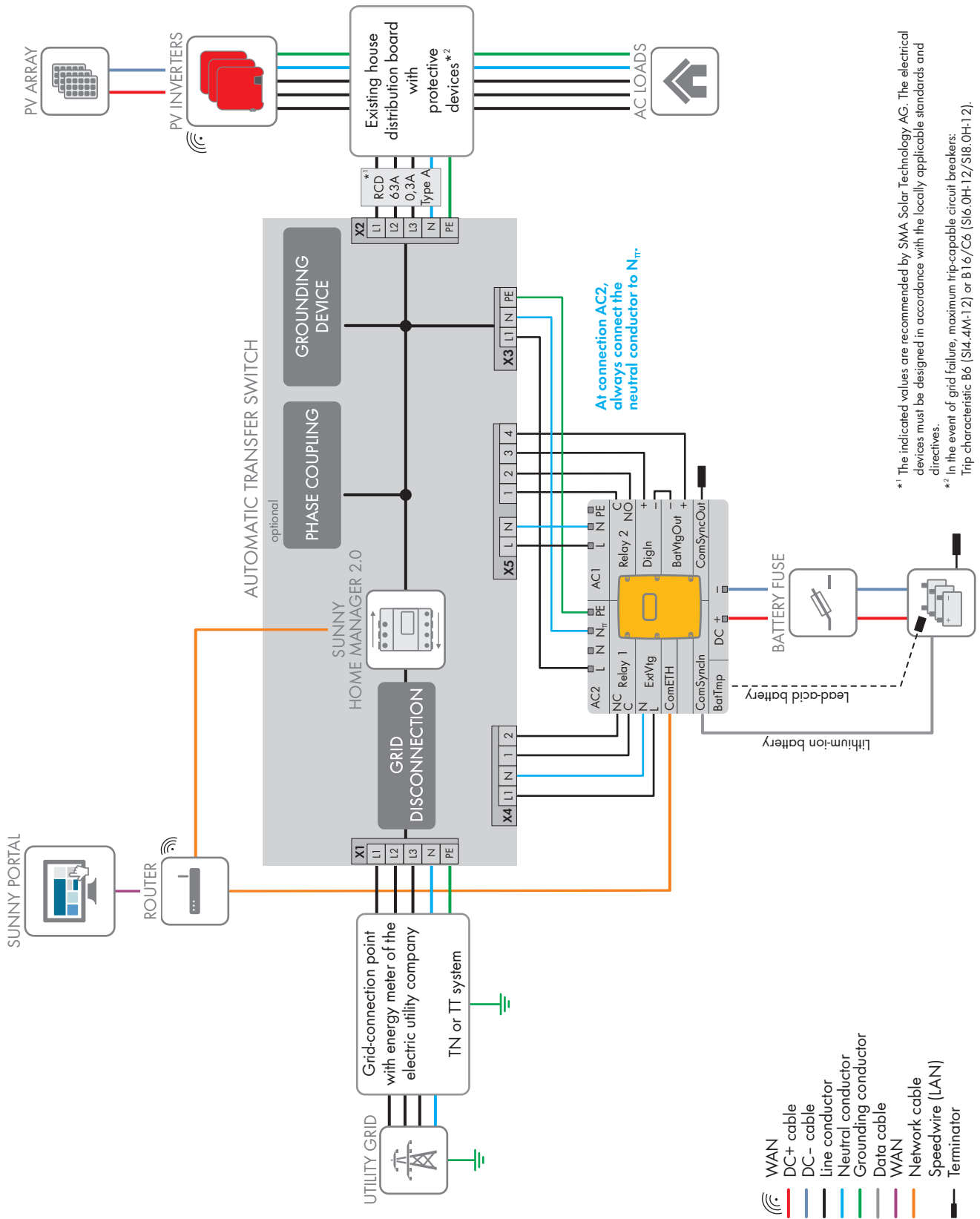
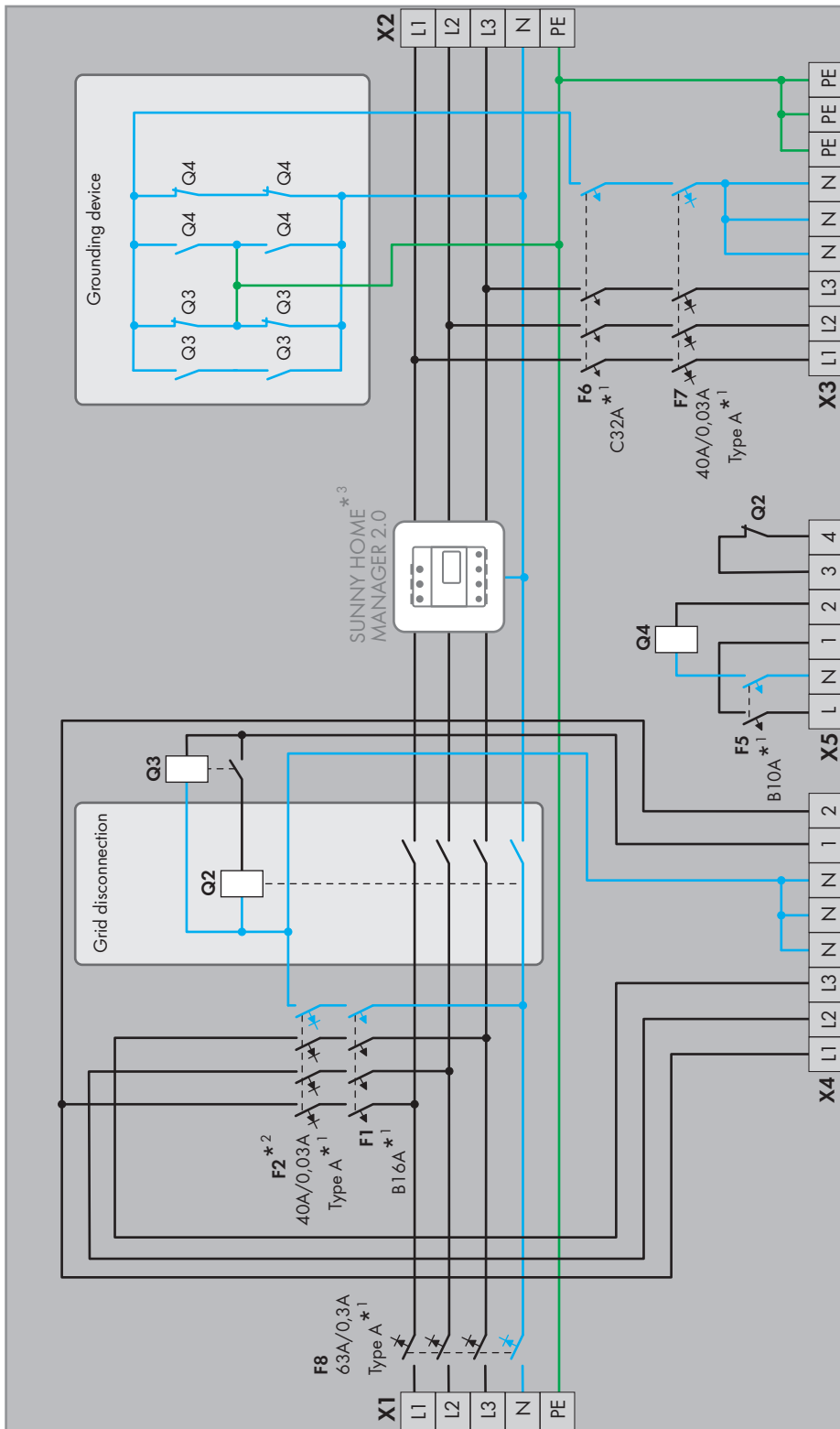


Figure 18: Connection of the automatic transfer switch with all-pole disconnection for Belgium (see Section 5.1.3 "Connection of the Sunny Island", page 32)

7.2 Three-Phase Battery-Backup System in Belgium

7.2.1 Automatic Transfer Switch of a Three-Phase Battery-Backup System in Belgium



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

Figure 19: Schematic diagram of the three-phase automatic transfer switch for Belgium

7.2.2 Circuitry Overview of a Three-Phase Battery-Backup System in Belgium

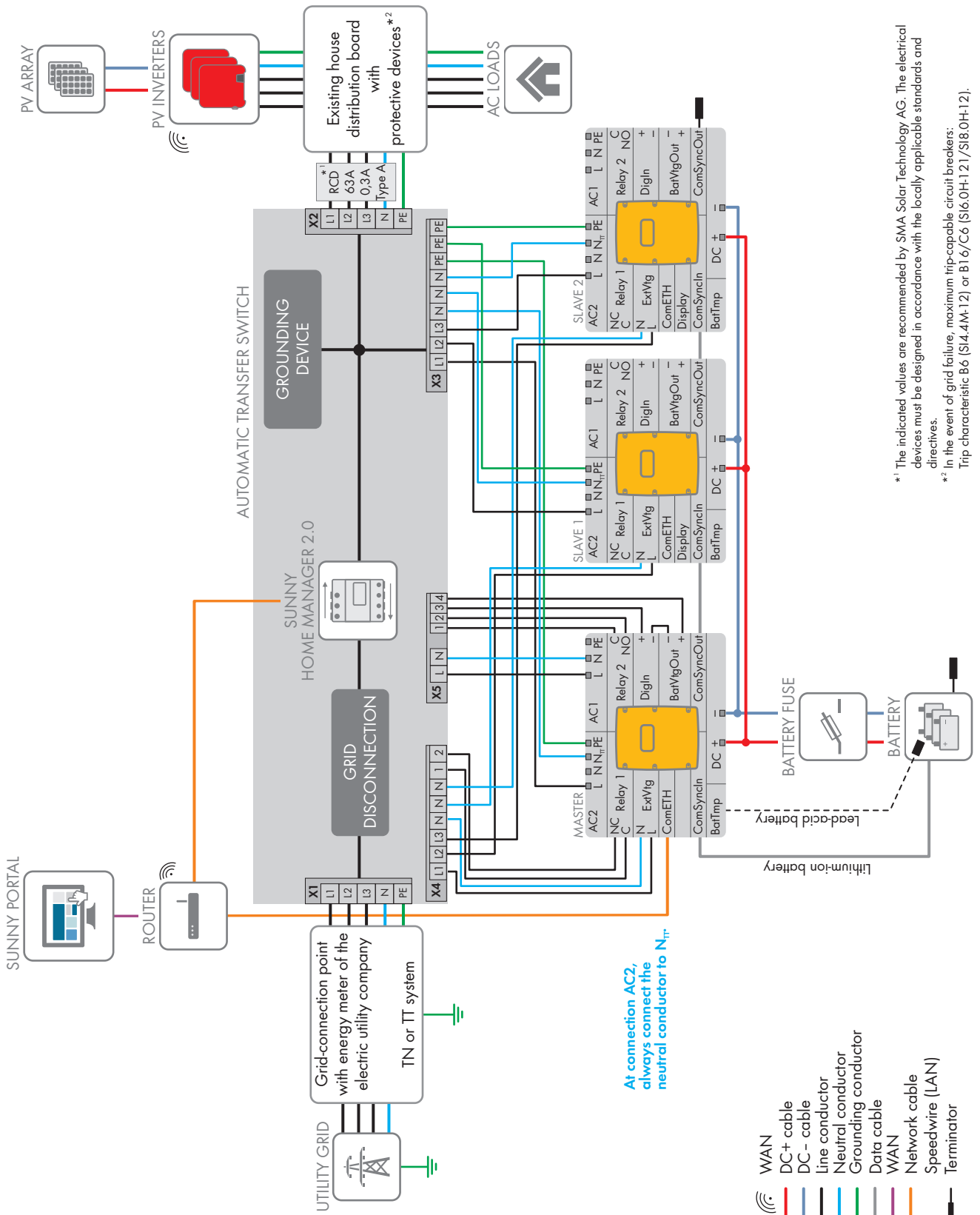


Figure 20: Connection of the automatic transfer switch with all-pole disconnection for Belgium (see Section 4.2.3, page 26) and (see Section 5.2.4, page 38)

8 Contact

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

- Type of system installed (e.g., three-phase single-cluster system)
- Number and type of the Sunny Island inverters
- Serial number of the Sunny Island inverters
- Firmware version of the Sunny Island inverters
- Error message displayed
- Type of battery connected
- Nominal battery capacity
- Nominal battery voltage
- Type of the communication products connected
- Type and size of additional energy sources
- If a generator is connected:
 - Type
 - Power
 - Maximum current
- If a Multicluster-Box is connected, device type of the Multicluster-Box

In order to receive service assignments for the Sunny Island system, all system data must be recorded in the information sheet for Sunny Island systems during commissioning and made available to Service (for information sheet see www.SMA-Solar.com).

Deutschland	SMA Solar Technology AG	Belgien	SMA Benelux BVBA/SPRL
Österreich	Niestetal	Belgique	Mechelen
Schweiz	Sunny Boy, Sunny Mini Central, Sunny Tripower: +49 561 9522-1499	België	+32 15 286 730
	Monitoring Systems (Kommunikationsprodukte): +49 561 9522-2499	Luxemburg	SMA Online Service Center: www.SMA-Service.com
	Fuel Save Controller (PV-Diesel-Hybridsysteme): +49 561 9522-3199	Luxembourg	
	Sunny Island, Sunny Boy Storage, Sunny Backup: +49 561 9522-399	Nederland	
	Sunny Central, Sunny Central Storage: +49 561 9522-299	Česko	SMA Service Partner TERMS a.s.
	SMA Online Service Center: www.SMA-Service.com	Magyarország	+420 387 6 85 111
		Slovensko	SMA Online Service Center: www.SMA-Service.com
		Türkiye	SMA Service Partner DEKOM Ltd. Şti. +90 24 22430605
			SMA Online Service Center: www.SMA-Service.com
France	SMA France S.A.S.	Ελλάδα	SMA Service Partner AKTOR FM.
	Lyon	Κύπρος	Αθήνα
	+33 472 22 97 00		+30 210 8184550
	SMA Online Service Center : www.SMA-Service.com		SMA Online Service Center: www.SMA-Service.com

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Italia	SMA Italia S.r.l. Milano +39 02 8934-7299 SMA Online Service Center: www.SMA-Service.com	Australia	SMA Australia Pty Ltd. Sydney Toll free for Australia: 1800 SMA AUS (1800 762 287) International: +61 2 9491 4200
United Arab Emirates	SMA Middle East LLC Abu Dhabi +971 2234 6177 SMA Online Service Center: www.SMA-Service.com	India	SMA Solar India Pvt. Ltd. Mumbai +91 22 61713888
ไทย	SMA Solar (Thailand) Co., Ltd. กรุงเทพฯ +66 2 670 6999	대한민국	SMA Technology Korea Co., Ltd. 서울 +82-2-520-2666
South Africa	SMA Solar Technology South Africa Pty Ltd. Cape Town 08600SUNNY (08600 78669) International: +27 (0)21 826 0600 SMA Online Service Center: www.SMA-Service.com	Argentina Brasil Chile Perú	SMA South America SPA Santiago de Chile +562 2820 2101
Other coun- tries	International SMA Service Line Niestetal 00800 SMA SERVICE (+800 762 7378423) SMA Online Service Center: www.SMA-Service.com		

