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

ENGLISH

SI44M-80H-13-BBF-IA-en-10 | Version 1.0

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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 device types:

- SI4.4M-13 (Sunny Island 4.4M) from firmware version 3.01.xx.R
- SI6.0H-13 (Sunny Island 6.0H) from firmware version 3.01.xx.R
- SI8.0H-13 (Sunny Island 8.0H) from firmware version 3.01.xx.R
- HM-20 (Sunny Home Manager 2.0) from firmware version 2.00.00.R

1.2 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 all applicable laws, 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

1.3 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 this document specifies the chronological sequence for configuration and commissioning.

This document supplements the documents that are enclosed with each product and does not replace any locally applicable codes or standards. Read and observe all documents supplied with the product.

Illustrations in this document are reduced to the essential information and may deviate from the real product.

1.4 Levels of Warning Messages

The following levels of warning messages may occur when handling the product.

⚠ 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, could result in death or serious injury.

⚠ CAUTION
Indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.

NOTICE
Indicates a situation which, if not avoided, can result in property damage.

1.5 Symbols in the Document

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
	Example
	This information is relevant for systems which are to be operated in parallel with utility grid. (e.g. SMA Flexible Storage System).
	Content is relevant for off-grid systems.

1.6 Typographies in the Document

Typography	Use	Example
bold	• Messages • Terminals • Elements on a user interface • Elements to be selected • Elements to be entered	• Connect the insulated conductors to the terminals **X703:1** to **X703:6**. • Enter **10** in the field **Minutes**.
>	• Connects several elements to be selected	• Select **Settings > Date**.
[**Button**] [**Key**]	• Button or key to be selected or pressed	• Select [**Enter**].
#	• Placeholder for variable components (e.g., parameter names)	• Parameter **WCtlHz.Hz#**

1.7 Designation in the document

Complete designation	Designation in this document
SMA Flexible Storage System with Battery-Backup Function	Battery-backup system
SMA Speedwire	Speedwire
Sunny Boy, Sunny Tripower	PV inverter
Sunny Places, Sunny Portal, Sunny Home Manager	Communication product

1.8 Explanation of Used Terms

Term	Explanation
Grid failure	Utility grid failure or deviation from the country-specific thresholds for voltage and frequency
Automatic transfer switch with battery-backup function	disconnects the battery-backup grid from the utility grid in the event of grid failure.

1.9 Additional Information

For more information, please go to www.SMA-Solar.com.

Title and information content	Type of information
Mounting, installation, commissioning, operation, configuration, troubleshooting and decommissioning of the inverter	Operating manual
"Parameters and Measured Values" Overview of all inverter operating parameters and their configuration options	Technical Information
"SMA Smart Home" The System Solution for Greater Independence	Planning Guidelines
"SMA Flexible Storage System with Battery Backup Function"	Planning Guidelines
SUNNY ISLAND 4.0M / 6.0H / 8.0H	Operating manual

2 Safety

2.1 Intended Use

An SMA Flexible Storage System with battery-backup function (battery-backup system) takes care of the uninterrupted supply of the loads with electricity during a grid failure. An automatic transfer switching device disconnects the household grid with the PV system from the utility grid. When this happens, a battery inverter forms a battery-backup grid and the PV system can supply the loads. When the energy demand of the active loads exceeds the current power of the PV system, the battery will provide the energy shortfall.

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

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

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.

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. In a three-phase cluster, only device types with the same output power may be installed. This means that the device types, such as SI6.0H-12 and SI6.0H-13, may be combined within a cluster. In contrast, device types with different outputs (e.g. SI6.0H-13 and SI8.0H-13) may not be combined. The cluster master must always be an SI4.4M-13 / SI6.0H-13 / SI8.0H-13. It must be equipped with the latest firmware version.

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.

Use SMA products only in accordance with the information provided in the enclosed documentation and with the locally applicable laws, regulations, standards and directives. Any other application may cause personal injury or property damage.

Alterations to the SMA products, 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, dry place for future reference and observe all instructions contained therein.

This document does not replace and is not intended to replace any local, state, provincial, federal or national laws, regulations or codes applicable to the installation, electrical safety and use of the product. SMA Solar Technology AG assumes no responsibility for the compliance or non-compliance with such laws or codes in connection with the installation of the product.

2.2 IMPORTANT SAFETY INSTRUCTIONS

SAVE THESE INSTRUCTIONS

This section contains safety information that must be observed at all times when working.

The product has been designed and tested in accordance with international safety requirements. As with all electrical or electronical devices, there are residual risks despite careful construction. 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 due to electric shock when live components or cables are touched

High voltages are present in the conductive components or cables of the product. Touching live parts and cables results in death or lethal injuries due to electric shock.

- Do not touch non-insulated parts or cables.
- Disconnect the system from voltage sources and make sure it cannot be reconnected before working on the device.
- Observe all safety information on components associated with the product.
- Wear suitable personal protective equipment for all work on the product.

⚠ DANGER

Danger to life due to electric shock in case of overvoltages and if surge protection is missing

Overvoltages (e. g. in the event of a flash of lightning) can be further conducted into the building and to other connected devices in the same network via the network cables or other data cables if there is no surge protection. Touching live parts and cables results in death or lethal injuries due to electric shock.

- Ensure that all devices in the same network and the battery are integrated into the existing surge protection.
- When laying the network cables or other data cables outdoors, it must be ensured that a suitable surge protection device is provided at the transition point of the cable from the product or the battery outdoors to the inside of a building.

⚠ DANGER

Danger to life due to electric shock in case of overvoltages and unsuitable loads

Overvoltages of up to 1500 V can occur in the stand-alone grid and in the battery-backup grid. If the loads are not suitable for these overvoltages or are not safe to operate, a voltage that poses a danger to life may be present on accessible parts or cables. Touching live parts and cables results in death or lethal injuries due to electric shock.

- Only connect loads that have a CE, RCM or UL designation. These loads are suitable 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.

⚠ DANGER

Danger to life due to electric shock when operating a damaged product

Operating a damaged product can lead to hazardous situations since high voltages can be present on accessible product parts. Touching live parts and cables results in death or lethal injuries due to electric shock.

- Only operate the system when it is in a flawless technical condition and safe to operate.
- Check the system 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.
- Wear suitable personal protective equipment for all work on the product.

⚠ WARNING

Danger to life due to fire or explosion

In rare cases, an explosive gas mixture can be generated inside the inverter under fault conditions. In this state, switching operations can cause a fire inside the inverter or explosion. Death or lethal injuries due to hot or flying debris can result.

- In the event of a fault, do not perform any direct actions on the inverter.
- Ensure that unauthorized persons have no access to the inverter.
- Disconnect the battery from the product via an external disconnection device.
- Disconnect the AC circuit breaker, or keep it disconnected in case it has already tripped, and secure it against reconnection.
- Only perform work on the inverter (e.g., troubleshooting, repair work) when wearing personal protective equipment for handling of hazardous substances (e.g., safety gloves, eye and face protection, respiratory protection).

⚠ WARNING

Risk of injury due to toxic substances, gases and dusts.

In rare cases, damages to electronic components can result in the formation of toxic substances, gases or dusts inside the inverter. Touching toxic substances and inhaling toxic gases and dusts can cause skin irritation, burns or poisoning, trouble breathing and nausea.

- Only perform work on the inverter (e.g., troubleshooting, repair work) when wearing personal protective equipment for handling of hazardous substances (e.g., safety gloves, eye and face protection, respiratory protection).
- Ensure that unauthorized persons have no access to the inverter.

⚠ WARNING

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

In off-grid systems and battery-backup systems, the Sunny Island can only trip circuit breakers up to a certain tripping characteristic. 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. Touching live components can result in death or serious injury due to electric shock.

- SI4.4M-13: Check whether a circuit breaker has a higher trip characteristic than B6 (B6A).
- SI6.0H-13 and SI8.0H-13: Check whether a circuit breaker has a higher trip characteristic than B16 (B16A) or 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.

⚠ 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 system due to sand, dust and moisture ingress

Sand, dust and moisture penetration can damage the system and impair its functionality.

- Only open the product if the humidity is within the thresholds and the environment is free of sand and dust.
- Do not open the product during a dust storm or precipitation.

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 the enclosure seal in subfreezing conditions

If you open the product when temperatures are below freezing, the enclosure seals can be damaged. Moisture can penetrate the product and damage it.

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

NOTICE

High costs due to inappropriate Internet tariff

Depending on use, the data volume of the product transferred via the Internet may vary in size. The data volume depends, for example, on the number of inverters in the system, the frequency of device updates, the frequency of data transfer to Sunny Portal or the use of FTP push. High costs for the Internet connection can be the result.

- SMA Solar Technology AG recommends using an Internet flat rate.

The inverter supports different firmware versions that are suitable for different systems.

Inverters using firmware version ≤ 2.99.99.R are suitable for off-grid systems and systems that are not subject to the European grid connection conditions in accordance with Regulation (EU) 2016/631 for establishing a network code (also known as RfG). In addition, inverters with firmware version ≤ 2.99.99.R may be used in systems that have been commissioned before April 27, 2019, and that are subject to the grid connection conditions of VDE-AR-N 4105:2011-08.

Inverters using a firmware version ≥ 3.00.00.R are only suitable for systems that are operated in parallel with the utility grid (e.g. SMA Flexible Storage System). The firmware version ≥ 3.00.00.R complies with VDE-AR-N 4105-11:2018, EN50549-1:2018, C10/11:2018 and EREC G98:2018 / G99:2018 of the European grid connection conditions in accordance with Regulation (EU) 2016/631 for establishing a network code (also known as RfG), valid from April 27, 2019 within the EU.

Inverters with a firmware version ≤ 2.99.99.R can be identified by the imprint **2:Off-Grid** on the box label. Invertes with a firmware version ≥ 3.00.00.R can be identified by the imprint **1:On-Grid** on the box label.

- Ensure that the inverter is equipped with a firmware version that are suitable for the respective system.

Change to the names and units of grid parameters to comply with the grid-connection requirements in accordance with Regulation (EU) 2016/631 (valid from April 27, 2019)

To comply with the EU grid-connection requirements (valid from April 27, 2019) the names and units of grid parameters were changed. The change is valid from firmware version ≥ 3.00.00.R. Names and units of grid parameters for inverters with firmware version ≤ 2.99.99.R are not affected by this change and remain valid.

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

Danger to life due to burns caused by electric arcs through short-circuit currents

Short-circuit currents in the battery can cause heat build-up and electric arcs. Heat build-up and electric arcs may result in lethal injuries due to burns.

- 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.
- Observe all safety information of the battery manufacturer.

⚠ 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).

3 Functions and Design

3.1 Information on Battery-Backup Systems

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.

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.

3.2 Design and Functions of the Battery-Backup System

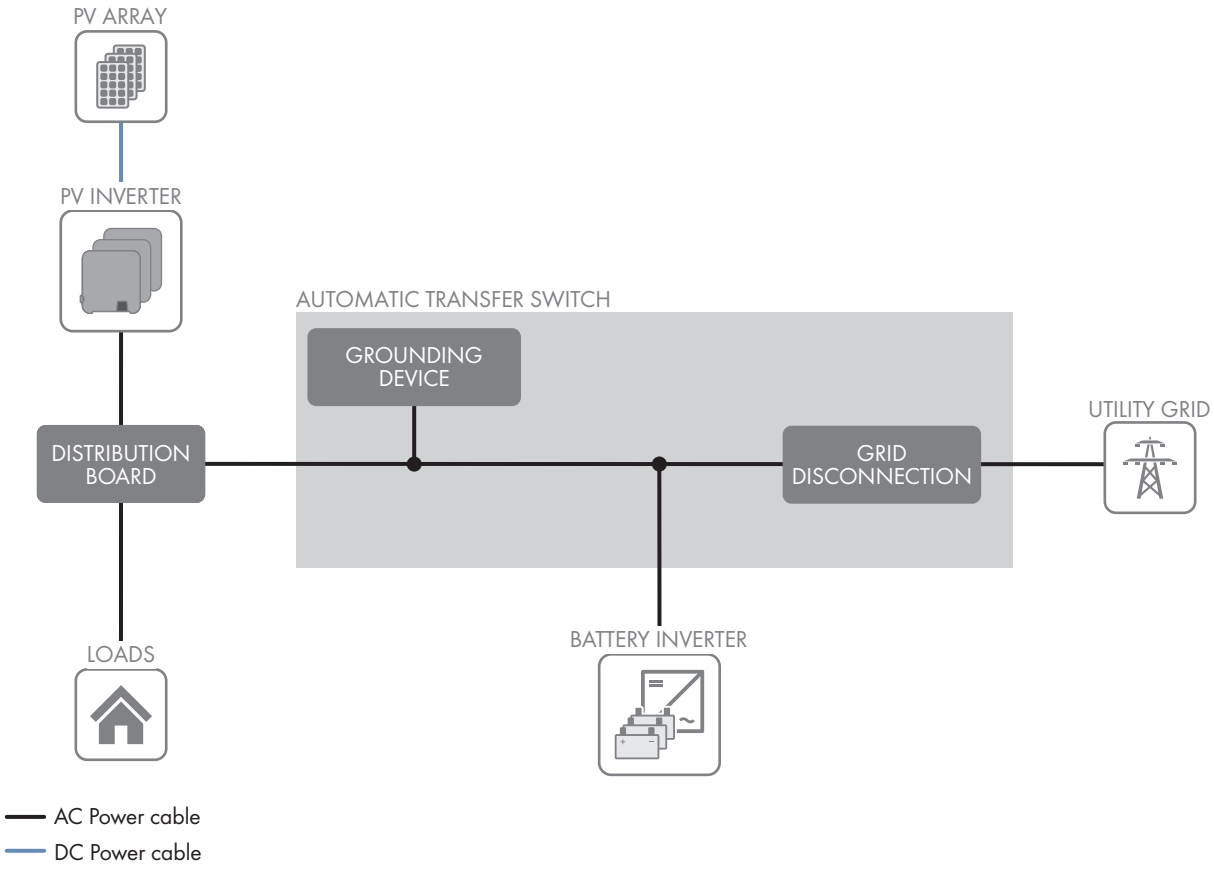


Figure 1: Overview of a single-phase battery-backup system

An SMA Flexible Storage System with battery-backup function (battery-backup system) takes care of the uninterrupted supply of the loads with electricity during a grid failure. An automatic transfer switching device disconnects the household grid with the PV system from the utility grid. When this happens, a battery inverter forms a battery-backup grid and the PV system can supply the loads. When the energy demand of the active loads exceeds the current power of the PV system, the battery will provide the energy shortfall.

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.

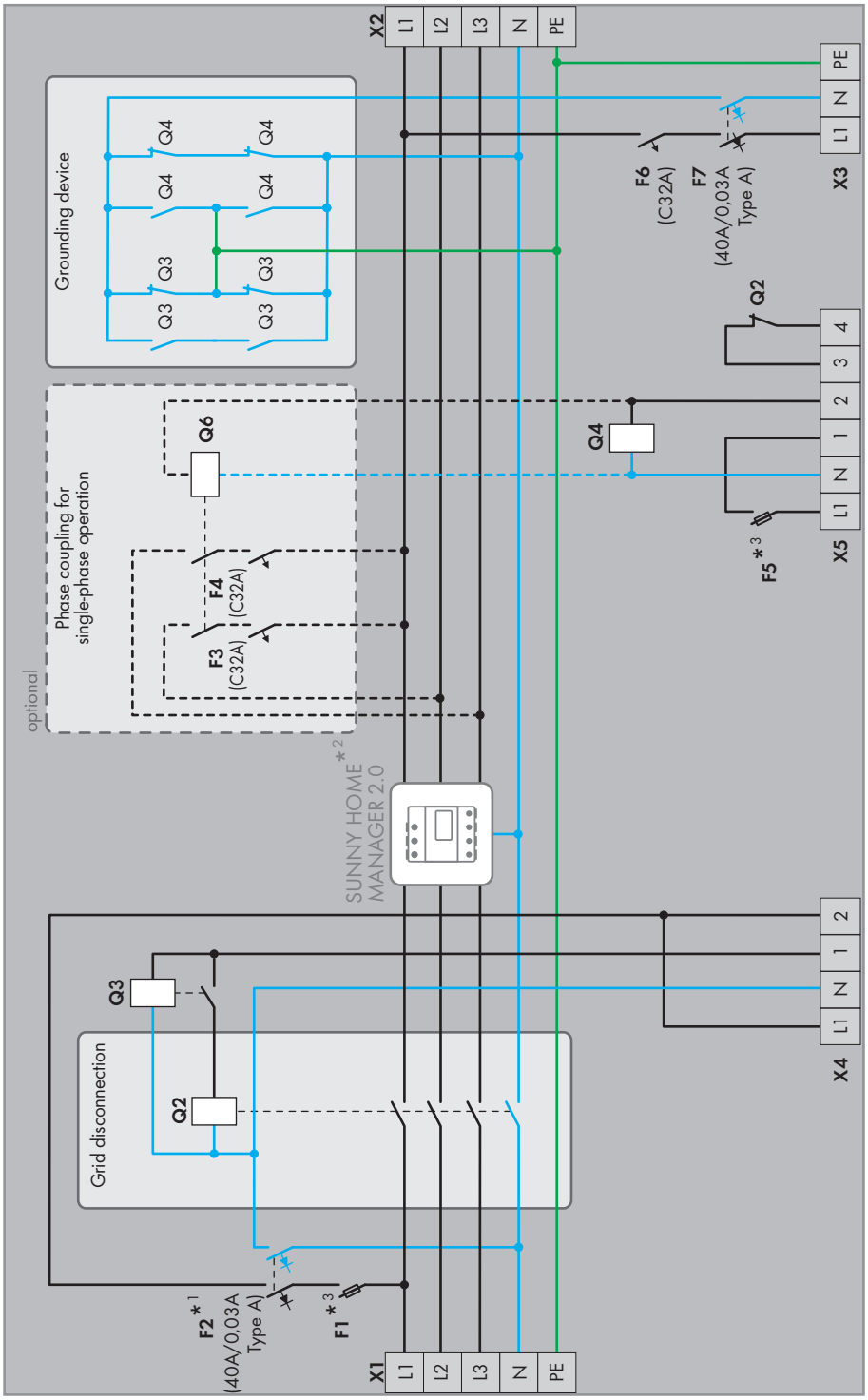
You can set up and wire the automatic transfer switch yourself or acquire it pre-wired from another provider (see Planning Guidelines "SMA Flexible Storage System with Battery Backup Function" at www.SMA-Solar.com).

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.

3.3 Design and Functions of the Automatic Transfer Switch

3.3.1 Devices of the Automatic Transfer Switch



*1 Only when connecting to a TT grid, the line conductor and the neutral conductor must be fused.
*2 Not required for systems without increased self-consumption.
*3 Requirements for thermal fuse used: 1 A, nominal cold resistance of at least 0.2 Ω and melting integral max. 1A2s. The indicated values in brackets are recommended by SMA Solar Technology AG. The electrical devices must be designed in accordance with the locally applicable standards and directives.

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.

3.3.2 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.

Operating principle of the tie switch with all-pole disconnection

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 contactor **Q2** is the tie switch with all-pole disconnection.

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 Relay1 goes into non-operative mode and contactors **Q2** and **Q3** are activated. The battery-backup grid is again connected to the utility grid.

Operating principle of the tie switch without all-pole disconnection

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 contactor **Q2** is the tie switch without all-pole disconnection.

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 **Relay1** of the Sunny Island. If 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 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 **Relay1** goes into non-operative mode and contactor **Q2** activates. The battery-backup grid is again connected to the utility grid.

3.3.3 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.

Operating principle of the grounding device

Contactors **Q3** and **Q4** form the grounding device. 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 in battery-backup operation is always connected to ground.

3.4 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.

Operating principle of phase coupling

Contactor **Q6** is the phase coupler (see Section 3.3.1, page 17). 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.

3.5 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 at hand (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 the accordance with the technical documentation of the battery inverter.

3.6 Communication

Electricity supply of communication devices

During a grid failure, only the devices in the battery-backup grid are supplied with current. If the router, the optional switch or other communication devices are not supplied with electricity, many of the inverters' capabilities in the battery-backup system are limited or unavailable.

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

Requirements for the Speedwire network

The battery inverter 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.

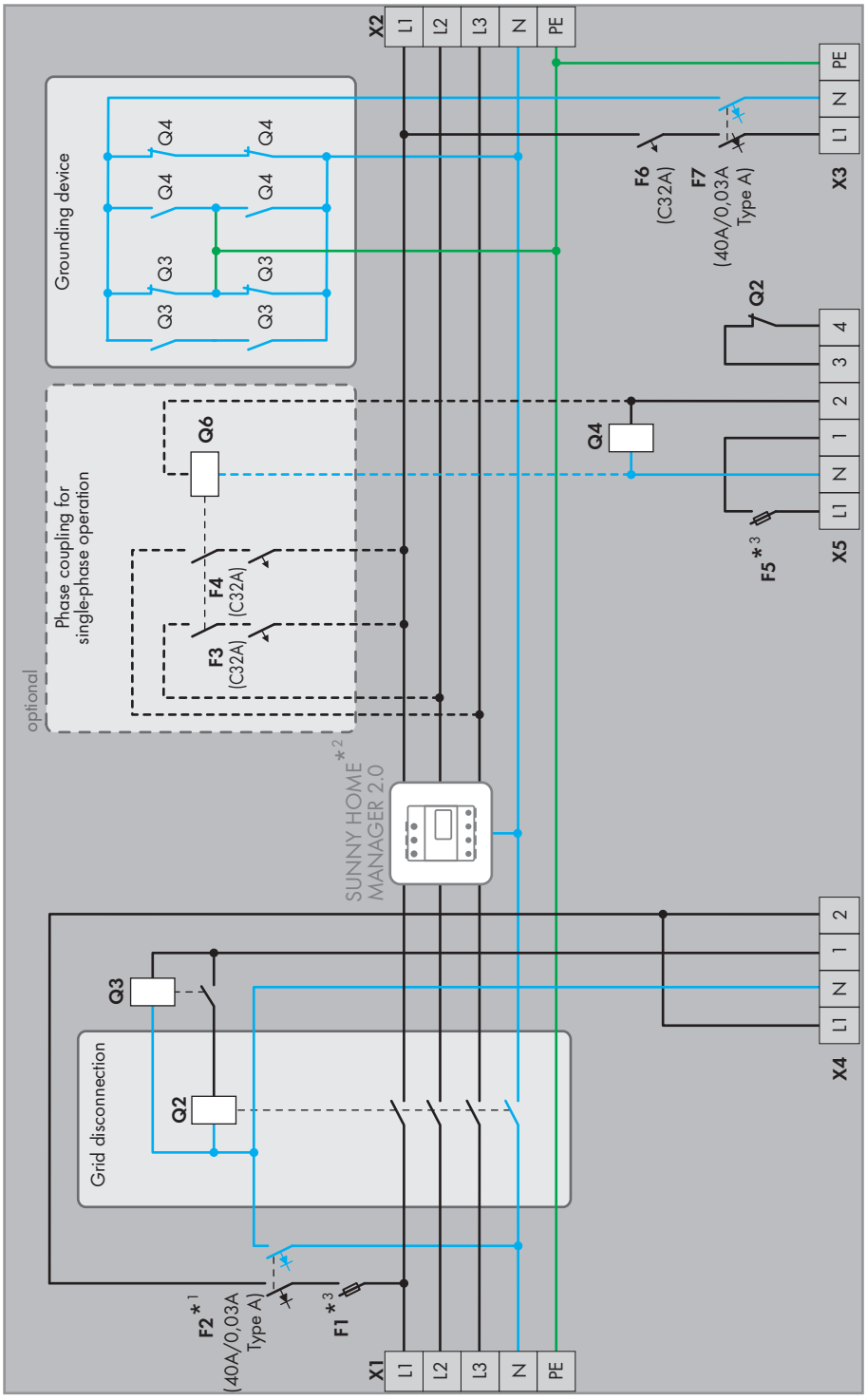
☐ The router must support "Internet Enabled Devices" with the SIP and STUN interfaces.

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

4 Battery-Backup Systems With All-Pole Disconnection

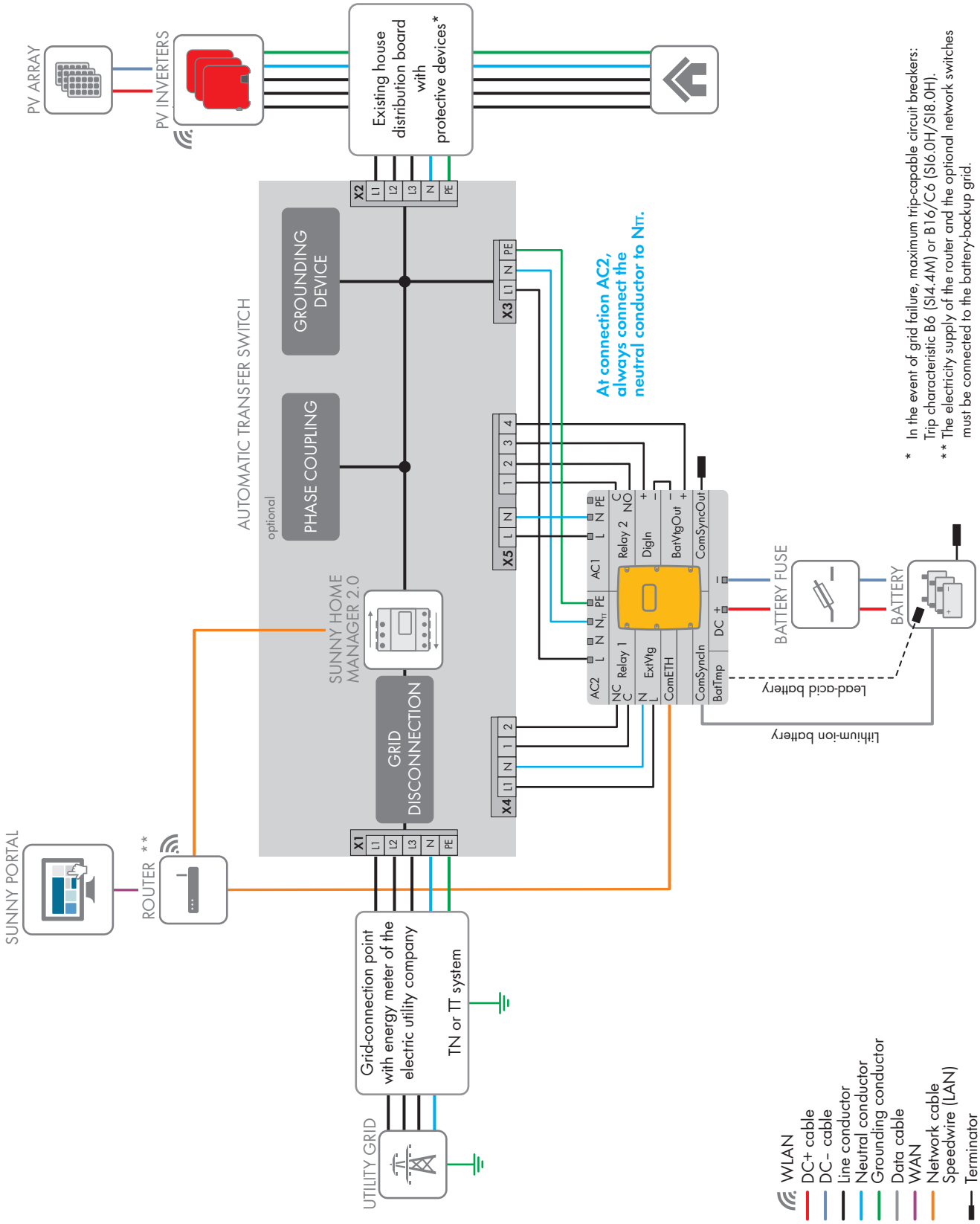
4.1 Single-phase battery-backup system with all-pole disconnection

4.1.1 Automatic Transfer Switching Device for Single-Phase Battery-Backup System with All-Pole Disconnection



*1 Only when connecting to a TT grid, the line conductor and the neutral conductor must be fused.
*2 Not required for systems without increased self-consumption.
*3 Requirements for thermal fuse used: 1 A, nominal cold resistance of at least 0.2 Ω and melting integral max. 1A2s. The indicated values in brackets are recommended by SMA Solar Technology AG. The electrical devices must be designed in accordance with the locally applicable standards and directives.

4.1.2 Circuitry Overview for single-Phase Battery-Backup System with All-Pole Disconnection



4.1.3 Connection of the Sunny Island

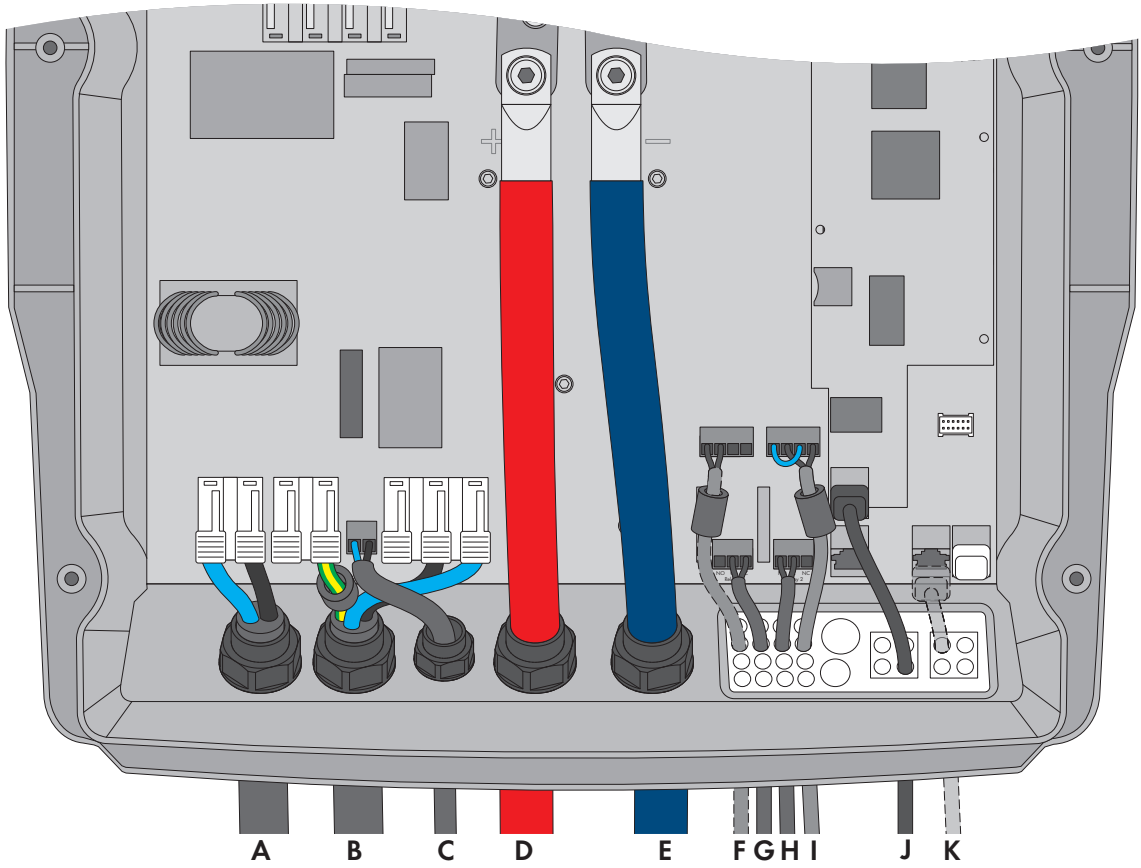


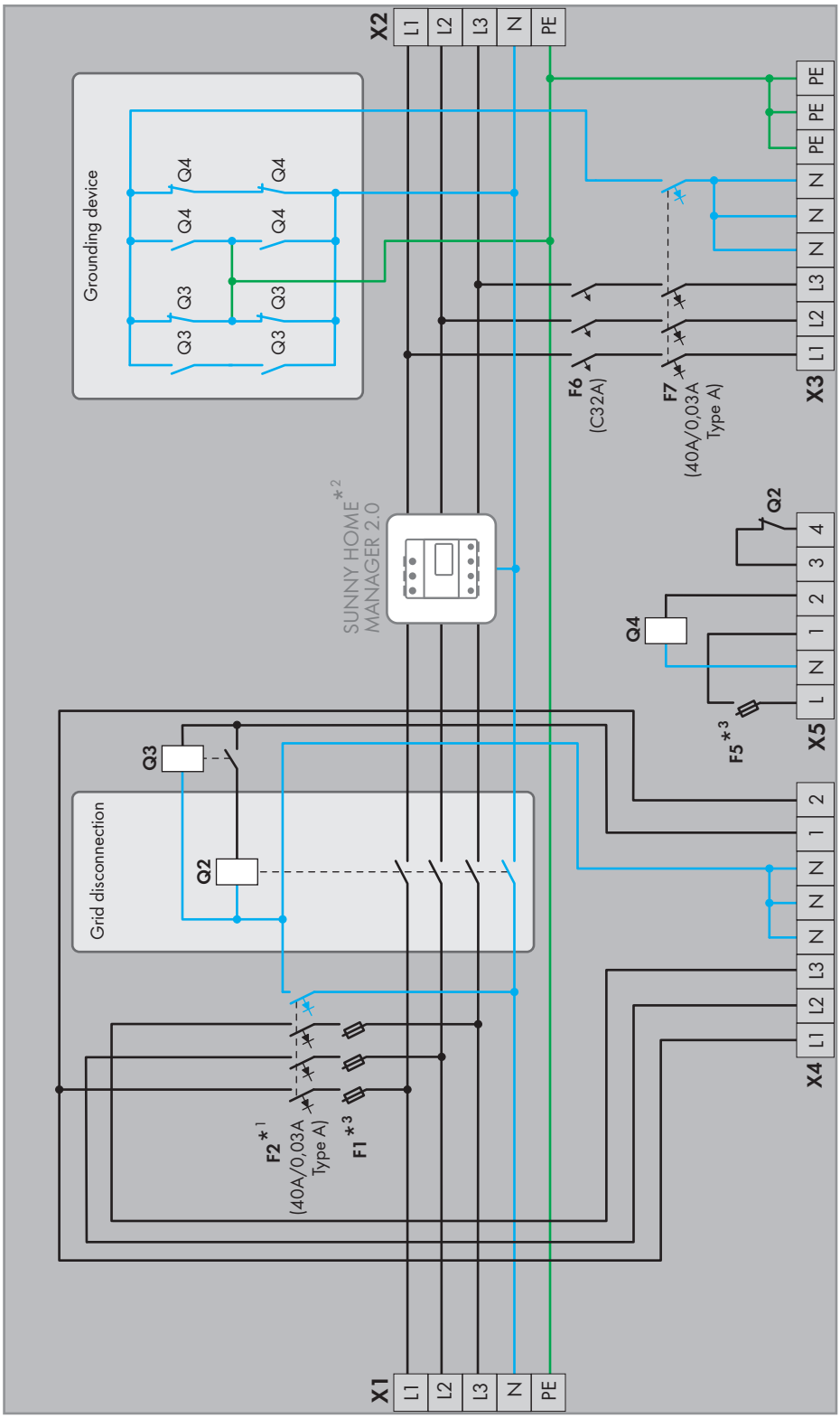
Figure 3: Connection of the Sunny Island

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 Conductor cross-section: from 50 mm^2 to 95 mm^2 Cable diameters 14 mm to 25 mm Torque: 12 Nm
E	DC- cable	

Position	Designation	Description / information
F	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.
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 de-activate. Conductor cross-section: from 1.5 mm^2 to 2.5 mm^2
H	Control cable of contactors **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. This cable is only required for phase coupling. Conductor cross-section: from 1.5 mm^2 to 2.5 mm^2
I	Measuring cable for monitoring the tie switch	Sunny Island: connections **DigIn+** und **BatVtgOut+** Automatic transfer switch: connection **X5** terminals **3** and **4** 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. Conductor cross-section: from 0.2 mm^2 to 2.5 mm^2 Inside the Sunny Island, connect terminals **DigIn-** and **BatVtgOut-**. The entire DC voltage range is displayed at the **BatVtgOut** terminal. The terminal **BatVtgOut** is current-limited and protected against short circuits.
J	Speedwire network cable	Sunny Island: connection **ComETH**
K	Data cable for battery management	Sunny Island: terminal **ComSync In** 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.

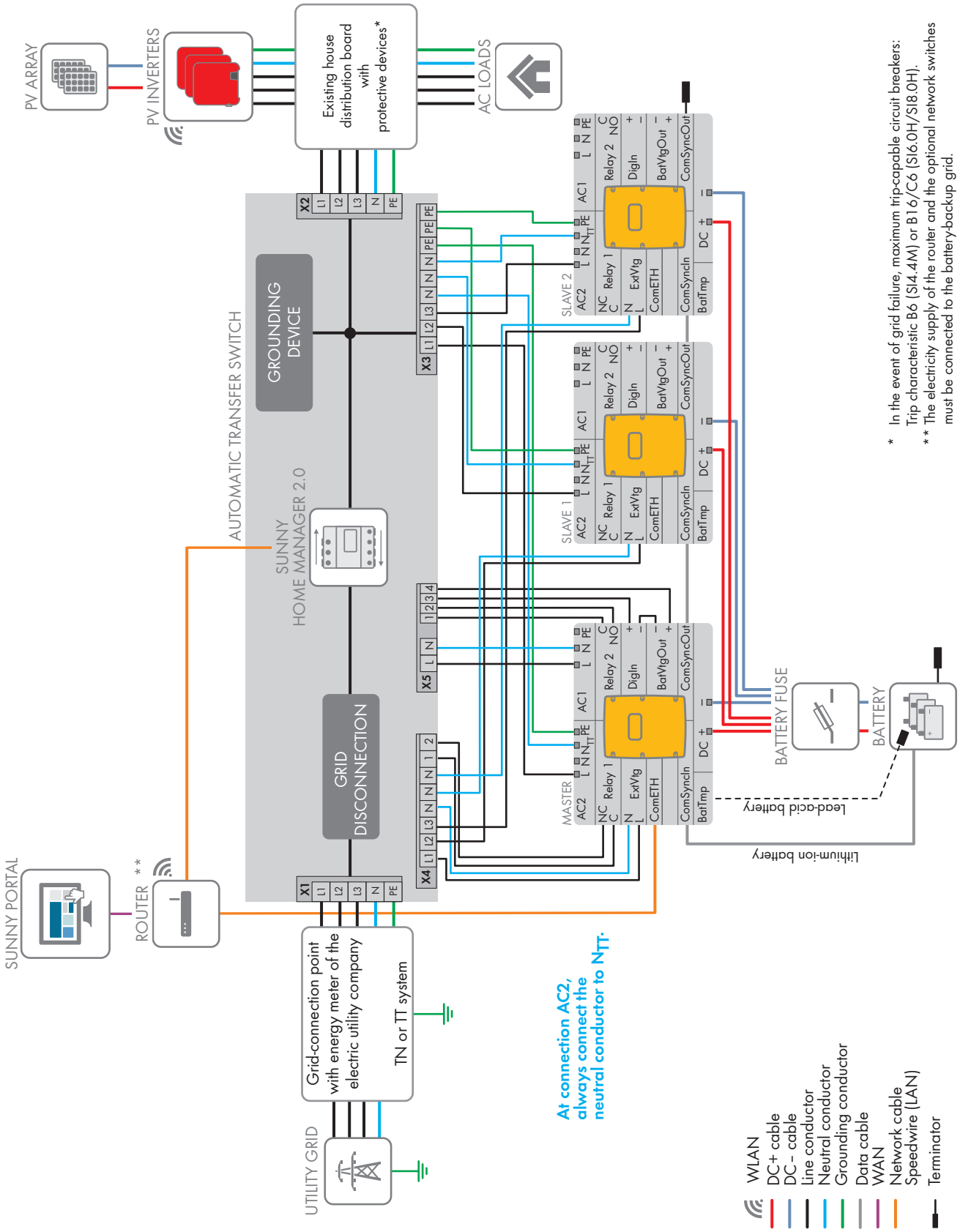
4.2 Three-Phase Battery-Backup System with All-Pole Disconnection

4.2.1 Automatic Transfer Switching Device for Three-Phase Battery-Backup System with All-Pole Disconnection



*1 Only when connecting to a TT grid, the line conductor and the neutral conductor must be fused.
*2 Not required for systems without increased self-consumption.
*3 Requirements for thermal fuse used: 1 A, nominal cold resistance of at least 0.2 Ω and melting integral max. 1A2s. The indicated values in brackets are recommended by SMA Solar Technology AG. The electrical devices must be designed in accordance with the locally applicable standards and directives.

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



4.2.3 Connecting the Master with All-Pole Disconnection

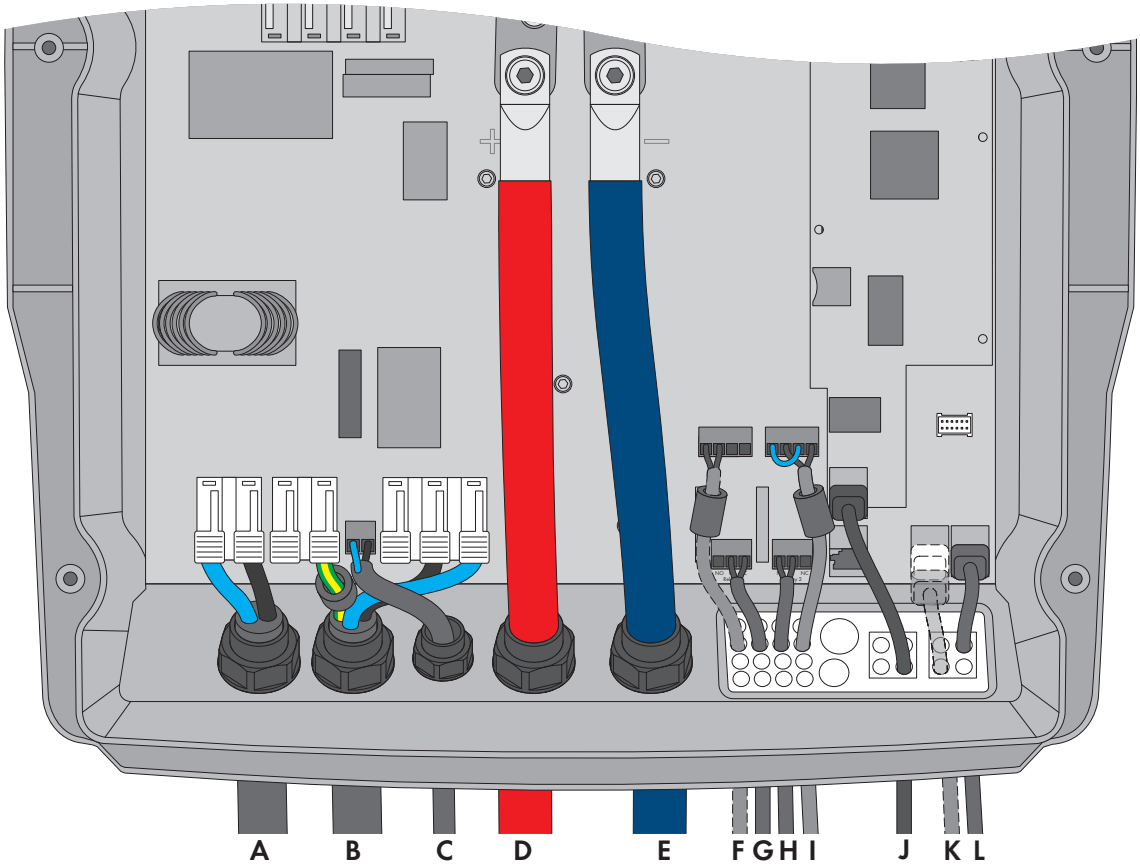


Figure 4: Connecting the master with all-pole disconnection

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 Conductor cross-section: from 50 mm^2 to 90 mm^2 Cable diameters: 14 mm to 25 mm Torque: 12 Nm
E	DC- cable	

Position	Designation	Description / information
F	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.
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: from 1.5 mm^2 to 2.5 mm2
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: from 1.5 mm^2 to 2.5 mm^2
I	Measuring cable for monitoring the tie switch	Sunny Island: connections **DigIn+** und **BatVtgOut+** Automatic transfer switch: connection **X5** terminals **3** and **4** 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. Conductor cross-section: from 0.2 mm^2 to 2.5 mm^2 Inside the Sunny Island, connect terminals **DigIn-** and **BatVtgOut-**. The entire DC voltage range is displayed at the **BatVtgOut** terminal. The terminal **BatVtgOut** is current-limited and protected against short circuits.
J	Speedwire network cable	Sunny Island: connection **ComETH**
K	Data cable for battery management	Sunny Island: terminal **ComSync In** 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.
L	Data cable for the internal communication in the cluster	Sunny Island: terminal **ComSync Out** Connection of internal communication bus of slave 1

4.2.4 Connecting the Slaves

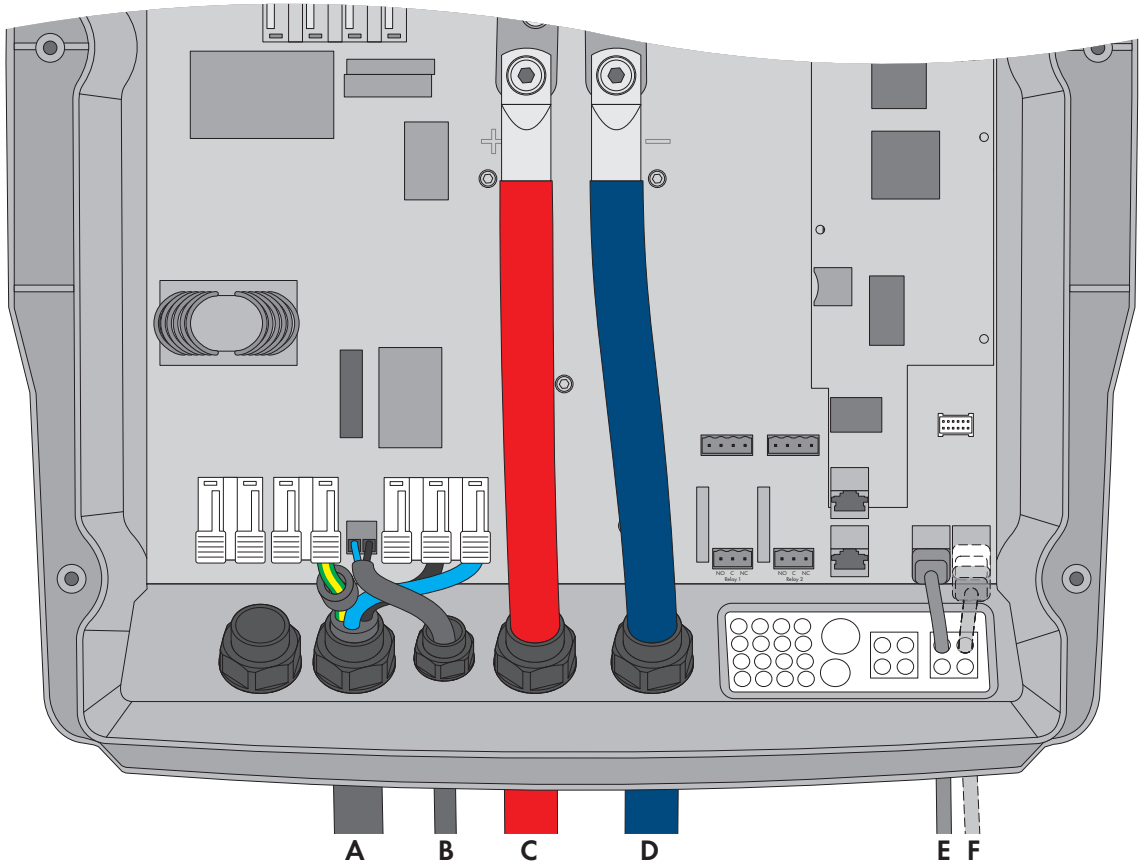


Figure 5: Connecting the slaves

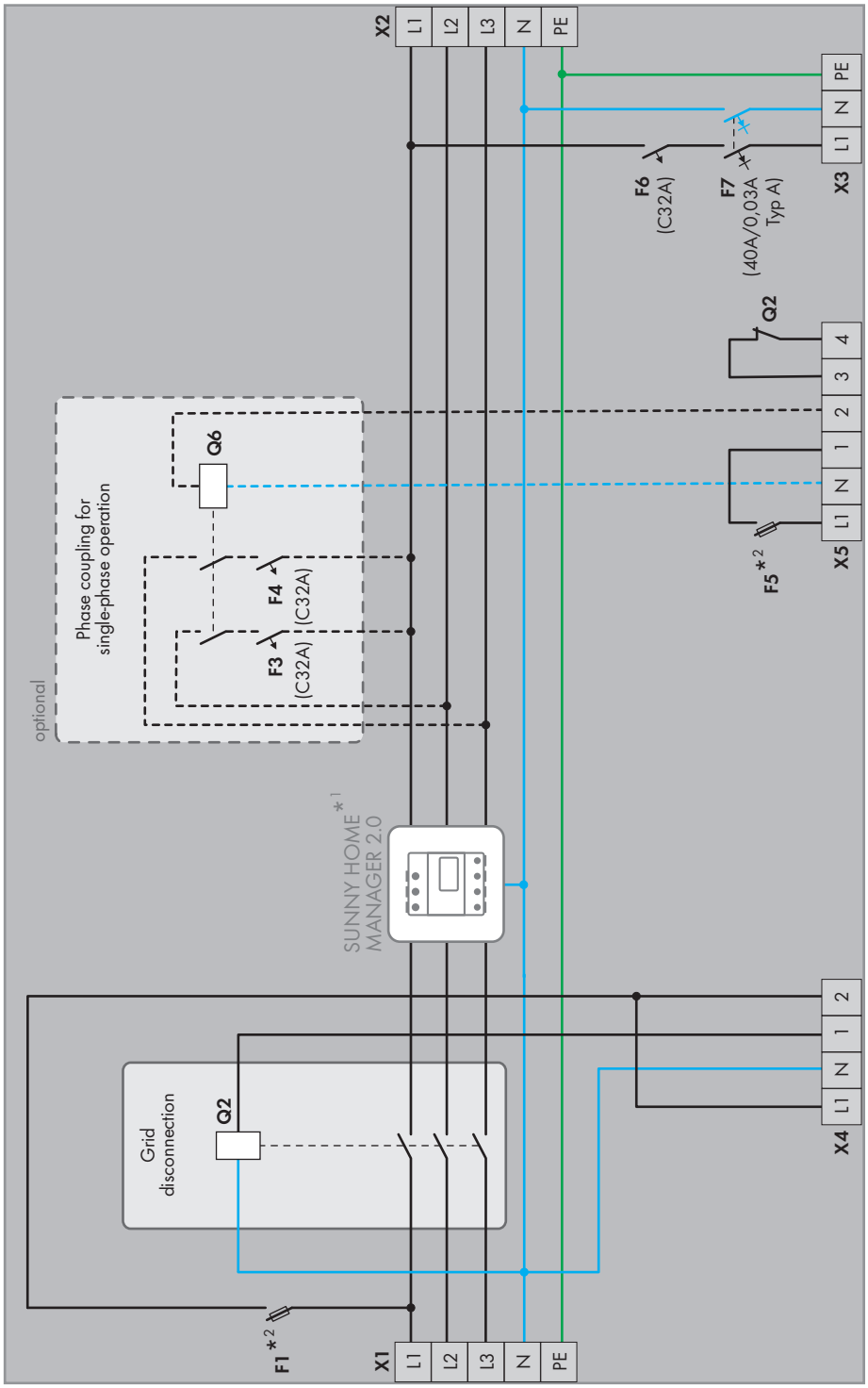
Position	Designation	Description / information
A	AC power cable	Sunny Island: connection to **AC2 Gen/Grid** terminals **L**, $\mathbf{N}_{TT}$ and **PE** Automatic transfer switch: • Connect slave 1 to **X3** terminals **L2**, **N** and **PE**. • Connect slave 2 to**X3** terminals **L3**, **N** and **PE**. Conductor cross-section: 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: • Connect slave 1 to **X4** terminals **L2** and **N**. • Connect slave 2 to **X4** terminals **L3** and **N**. Conductor cross-section: from 1.5 mm^2 to 2.5 mm^2
C	DC+ cable	Battery connection Conductor cross-section: from 50 mm^2 to 95 mm^2 Cable diameters: 14 mm to 25 mm Torque: 12 Nm
D	DC- cable	

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 Battery-Backup Systems Without All-Pole Disconnection

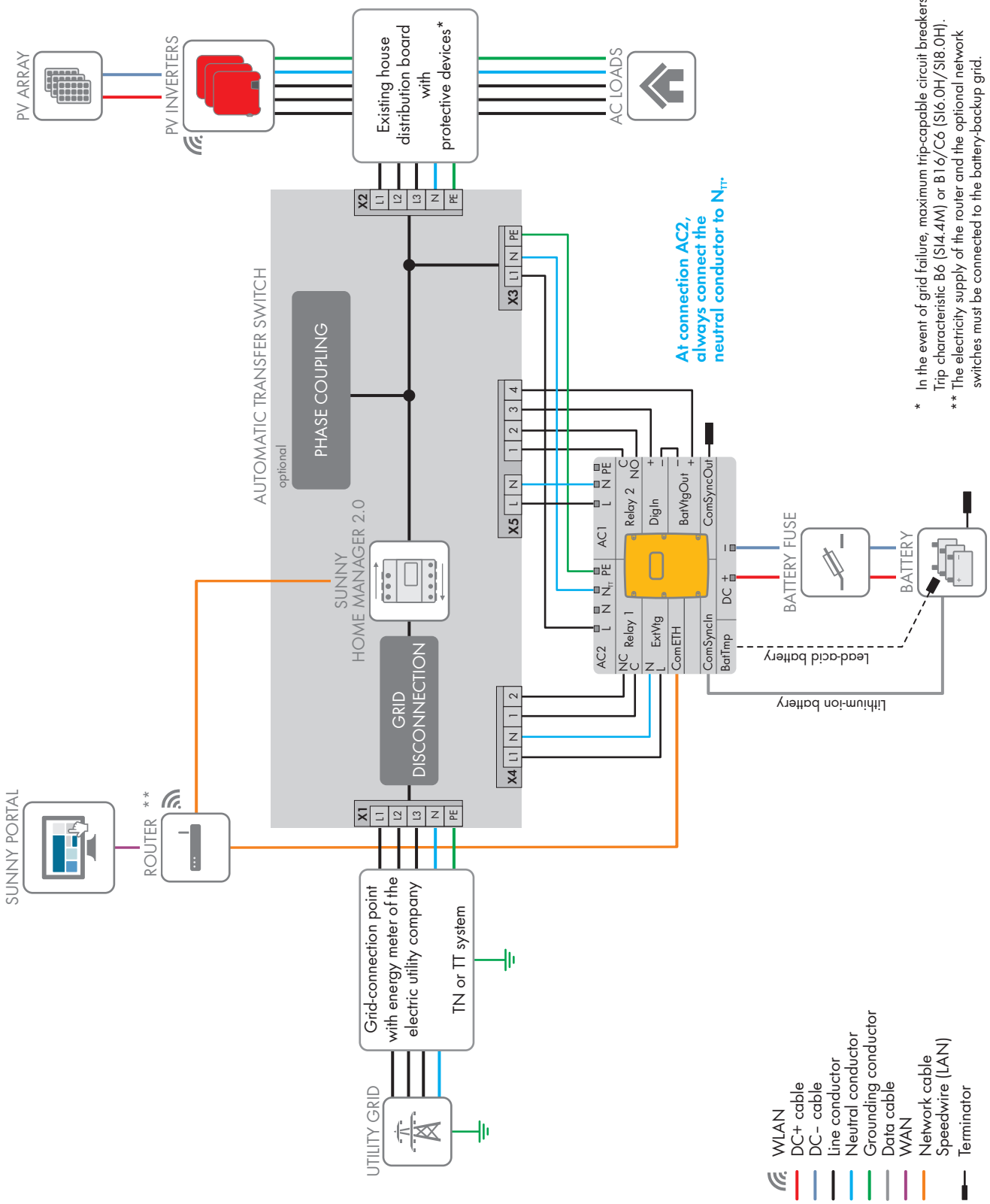
5.1 Single-Phase Battery-Backup System without All-Pole Disconnection

5.1.1 Automatic Transfer Switching Device for Single-Phase Battery-Backup System without All-Pole Disconnection



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

5.1.2 Circuitry Overview for Single-Phase Battery-Backup System without All-Pole Disconnection



5.1.3 Connection of the Sunny Island

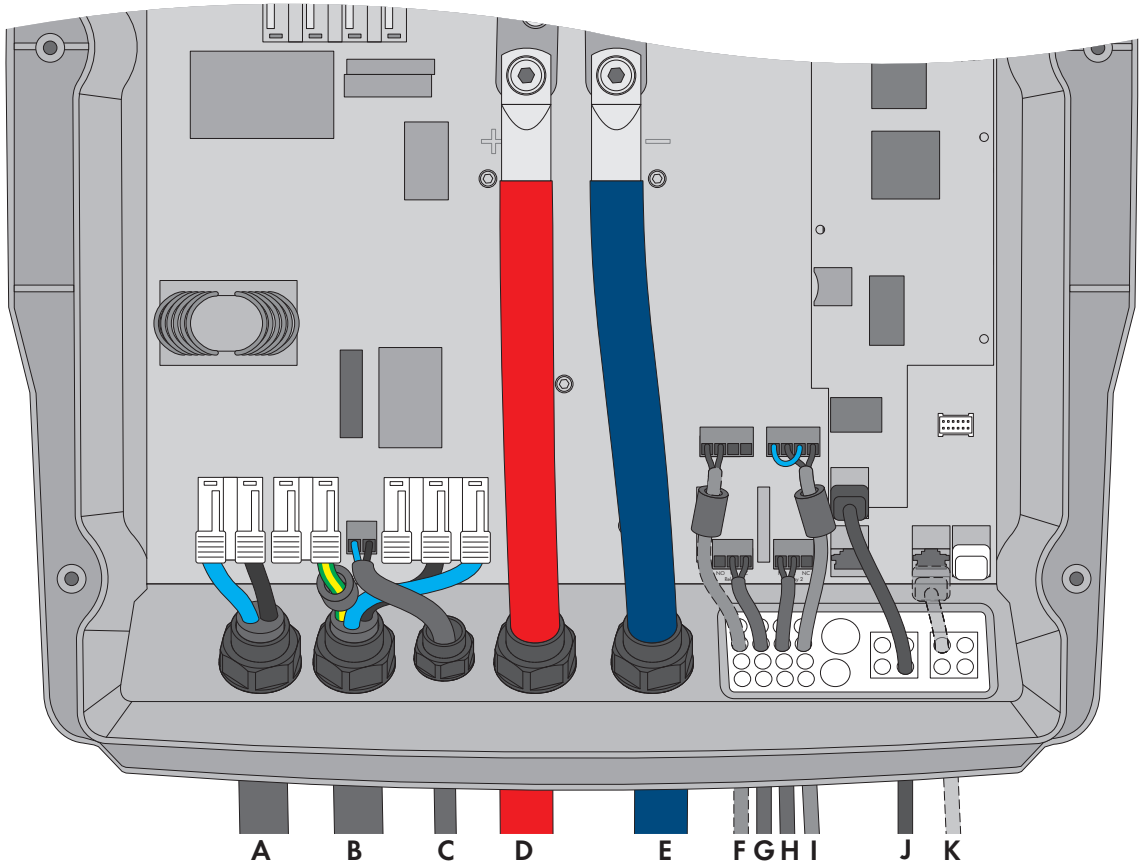


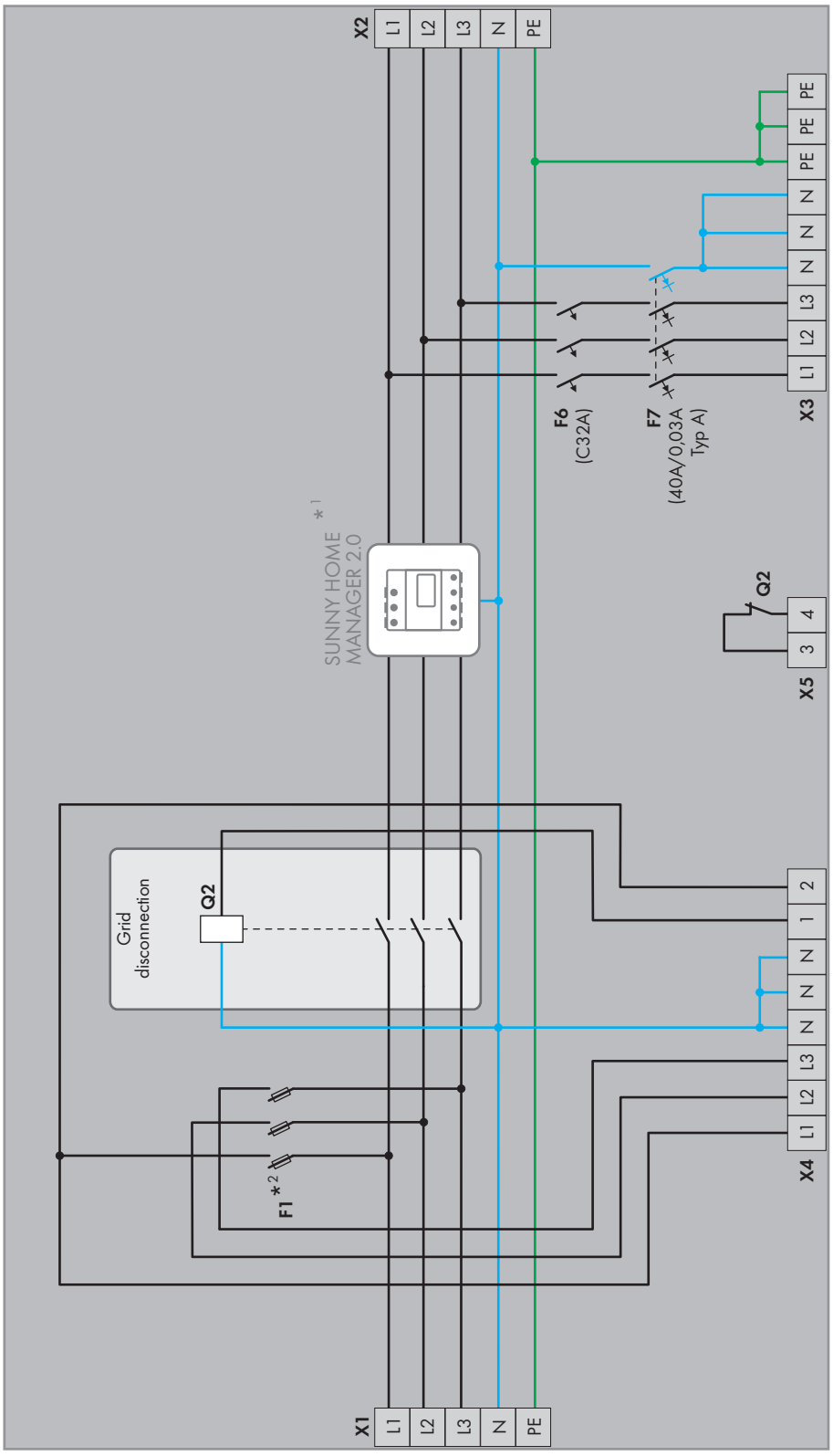
Figure 6: Connection of the Sunny Island

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 Conductor cross-section: from 50 mm^2 to 95 mm^2 Cable diameters 14 mm to 25 mm Torque: 12 Nm
E	DC- cable	

Position	Designation	Description / information
F	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.
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 de-activate. Conductor cross-section: from 1.5 mm^2 to 2.5 mm^2
H	Control cable of contactors **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. This cable is only required for phase coupling. Conductor cross-section: from 1.5 mm^2 to 2.5 mm^2
I	Measuring cable for monitoring the tie switch	Sunny Island: connections **DigIn+** und **BatVtgOut+** Automatic transfer switch: connection **X5** terminals **3** and **4** 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. Conductor cross-section: from 0.2 mm^2 to 2.5 mm^2 Inside the Sunny Island, connect terminals **DigIn-** and **BatVtgOut-**. The entire DC voltage range is displayed at the **BatVtgOut** terminal. The terminal **BatVtgOut** is current-limited and protected against short circuits.
J	Speedwire network cable	Sunny Island: connection **ComETH**
K	Data cable for battery management	Sunny Island: terminal **ComSync In** 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.

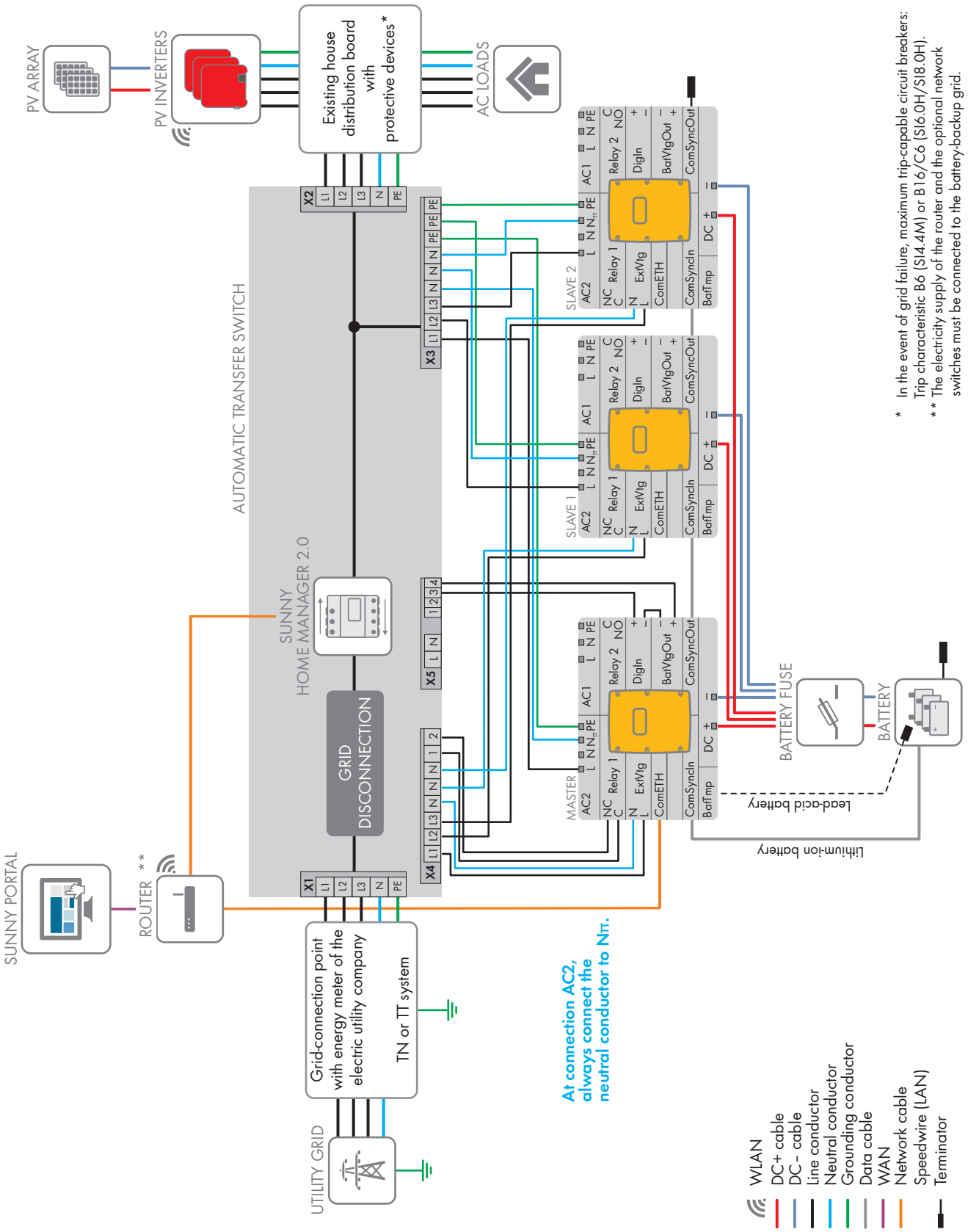
5.2 Three-Phase Battery-Backup System without All-Pole Disconnection

5.2.1 Automatic Transfer Switching Device for Three-Phase Battery-Backup System without All-Pole Disconnection



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

5.2.2 Circuitry Overview for Three-Phase Battery-Backup System without All-Pole Disconnection



5.2.3 Connecting the Master without All-Pole Disconnection

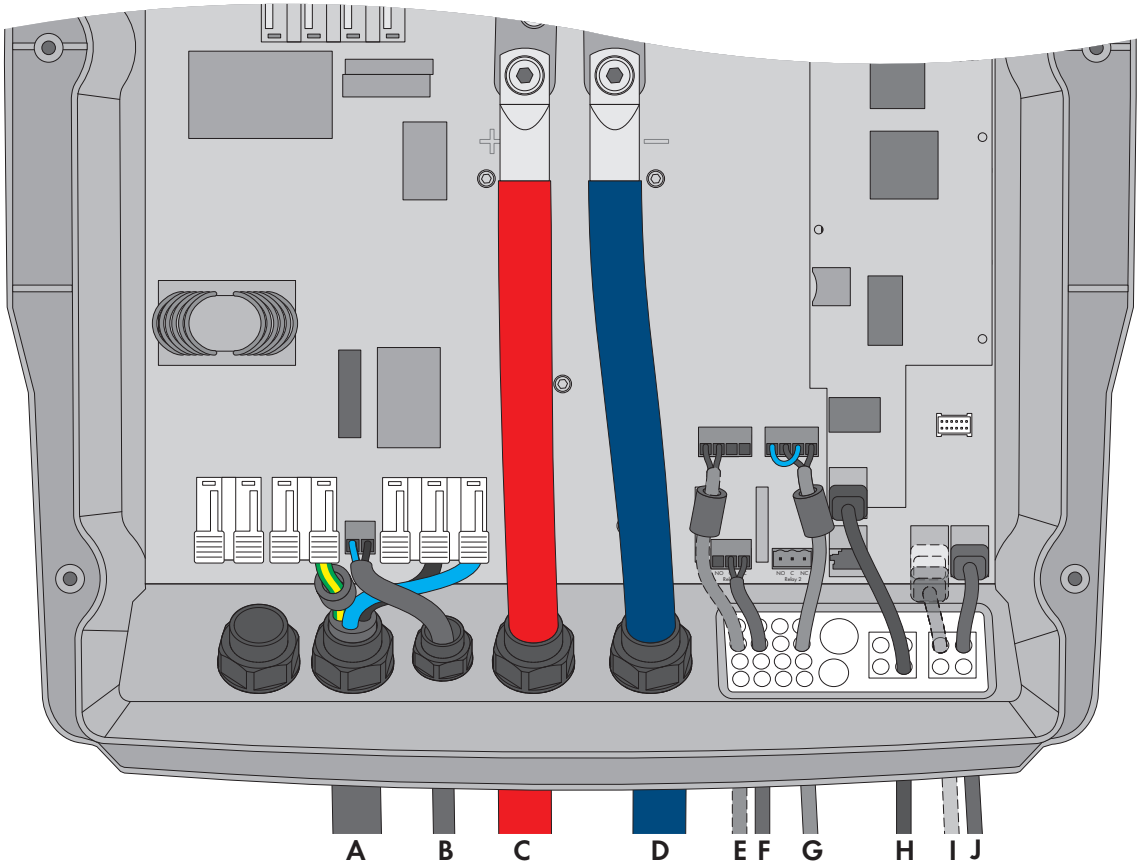


Figure 7: Connecting the master

Position	Designation	Description / information
A	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**.
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 Conductor cross-section: from 50 mm^2 to 95 mm^2 Cable diameters 14 mm to 25 mm Torque: 12 Nm
D	DC- cable	
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	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: from 1.5 mm^2 to 2.5 mm^2
G	Measuring cable for monitoring the tie switch	Sunny Island: connections **DigIn+** und **BatVtgOut+** Automatic transfer switch: connection **X5** terminals **3** and **4** 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. Conductor cross-section: from 0.2 mm^2 to 2.5 mm^2 Inside the Sunny Island, connect terminals **DigIn-** and **BatVtgOut-**. The entire DC voltage range is displayed at the **BatVtgOut** terminal. The terminal **BatVtgOut** is current-limited and protected against short circuits.
H	Speedwire network cable	Sunny Island: connection **ComETH**
I	Data cable for battery management	Sunny Island: terminal **ComSync** 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. If no data cable is plugged in, plug the terminator into **ComSync In**.
J	Data cable for the internal communication in the cluster	Sunny Island: terminal **ComSync Out**

5.2.4 Connecting the Slaves

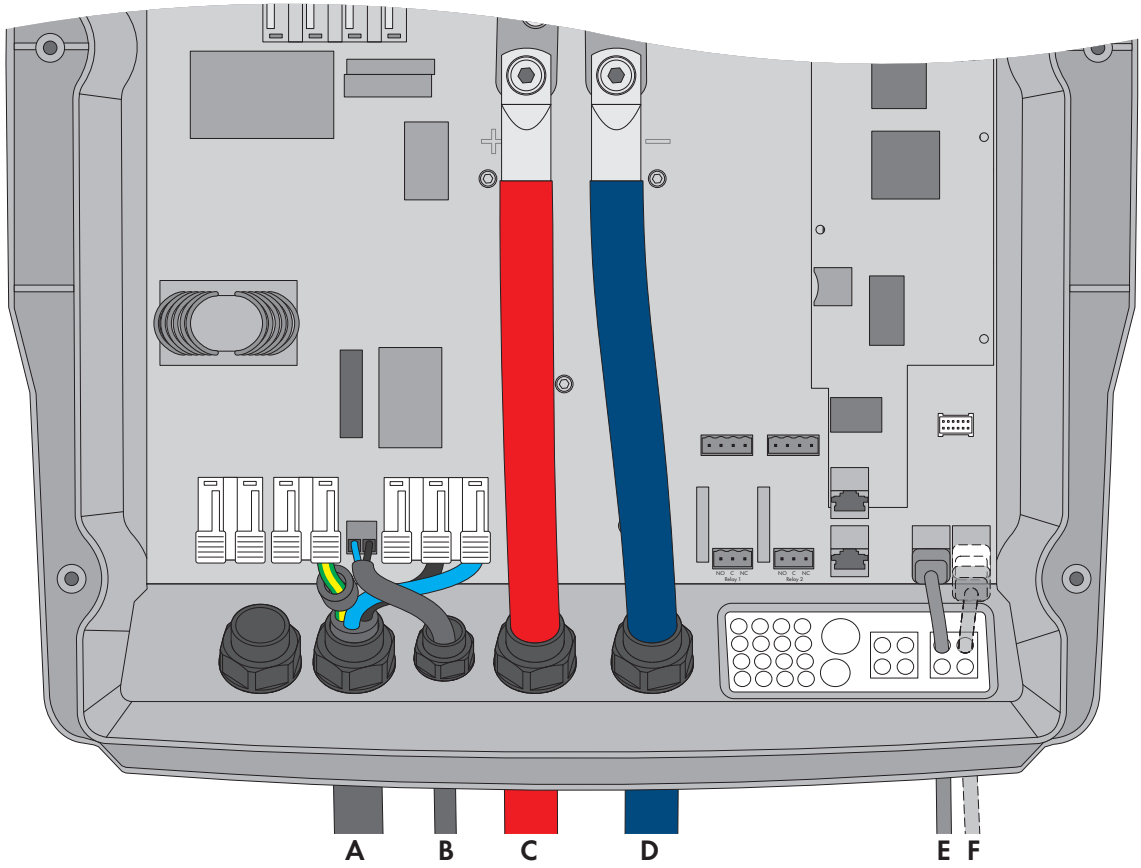


Figure 8: Connecting the slaves

Position	Designation	Description / information
A	AC power cable	Sunny Island: connection to **AC2 Gen/Grid** terminals **L**, $\mathbf{N}_{TT}$ 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: 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: • Connect slave 1 to **X4** terminals **L2** and **N**. • Connect slave 2 to **X4** terminals **L3** and **N**. Conductor cross-section: from 1.5 mm^2 to 2.5 mm^2
C	DC+ cable	Battery connection Conductor cross-section: from 50 mm^2 to 95 mm^2 Cable diameters: 14 mm to 25 mm Torque: 12 Nm
D	DC- cable	

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: • 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: • 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 41
6.	Adjusting the configuration of the Sunny Island inverter	Section 6.3, page 44
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 45
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: • 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.
Residual-current device **F2**	Press the test button and check if contactors **Q2** and **Q3** go into non-operative mode. If the contactors do not deactivate, wire the residual-current device **F2** correctly.
	Switch on residual-current device **F2** again.

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 the miniature circuit breaker **F5**.
    - Ensure that no voltage is present at connection **X2** between terminals **N** and **PE** and that conductivity can be measured.
    - Close miniature 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**	Measure if there is voltage present between the line conductors and the neutral conductor. If no voltage is present, correctly wire contactor **Q6**.
	Ensure that no voltage is present between the line conductors.

14. Switch on the miniature 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. With the firmware version ≥ 3.00.00.R, the Sunny Island complies with VDE-AR-N 4105-11:2018, EN50549-1:2018, C10/11:2018 and EREC G98:2018 / G99:2018 of the European grid connection conditions in accordance with regulation (EU) 2016/631. These requirements are included in the country data sets of the Sunny Island.

In case of Switzerland, the country data set **DE VDE-AR-N4105** must be selected and the configuration adjusted according to the specifications of the grid operator.

Use in other countries is possible with the agreement of the grid operator. Consult with the grid operator which country data set must be selected and whether an 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 www.SMA-Solar.com).

Procedure:

1. Activate the user interface of the inverter (see the inverter operating manual).
2. Log in as Installer.
3. For installation in Switzerland, carry out the following steps:
   - In the parameter group Grid monitoring > Grid monitoring, select the parameter Set country standard.
   - Set the country data set **DE VDE-AR-N4105**.
   - Attach the label “VDE 0126-1-1” next to the type label of the Sunny Island.

6.4 Adjusting the Configuration of the PV Inverters

If PV inverters are to be used in an SMA Flexible Storage System with battery-backup function, they must limit their active power as a function of frequency. The manner of the frequency-dependent active power limitation complies with the locally applicable standards and directives (for further information see Technical information "SMA GRID GUARD 10.0 - Grid management services through SMA Inverter").

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 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 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 technical information "SMA GRID GUARD 10.0 - Grid management services through SMA Inverter").
2. In case of Switzerland: Set the PV inverter to the country data set valid for VDE-AR-N 4105:2011-08. 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).

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.

Regular full and equalization charges increase the service life of lead-acid batteries.

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	• 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	• System Password The PV system password is the same as the device password for the user group "Installer." All devices of a system must be set to a uniform installer password. • 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	• 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	• E-mail address • Password for Sunny Portal access • Address of the PV system • Electricity tariff data – 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).

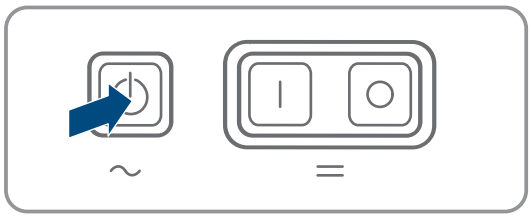
☐ The functionality of the automatic transfer switch must be checked (see Section 6.2, page 41).

☐ 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 3.6, page 20).

Procedure:

1. Attach a clearly visible information about the installed battery-backup system to the AC main distribution board.
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 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 of the Sunny Home Manager at www.SunnyPortal.com).

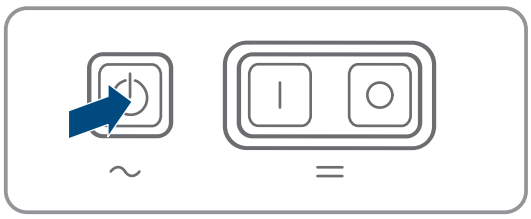
6.7 Commissioning a System without Increased Self-Consumption

Requirements:

- The functionality of the automatic transfer switch must be checked (see Section 6.2, page 41).

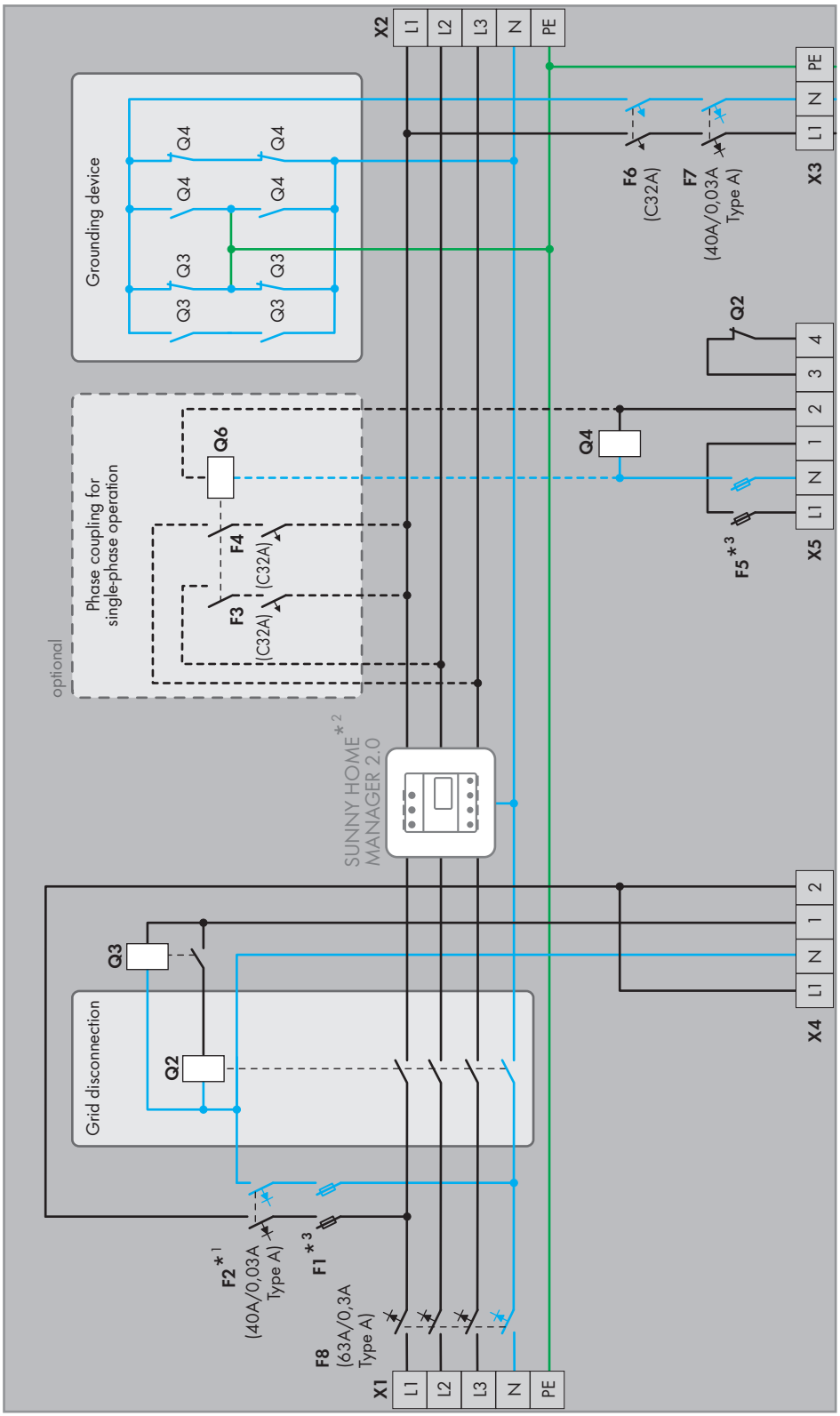
Procedure:

1. Attach a clearly visible information about the installed battery-backup system to the AC main distribution board.
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 Only for Belgium: connection of battery-backup systems with Sunny Island

7.1 Automatic Transfer Switching Device for Single-Phase Battery-Backup System in Belgium



*1 Only when connecting to a TT grid, the line conductor and the neutral conductor must be fused.
*2 Not required for systems without increased self-consumption.
*3 Requirements for thermal fuse used: 1 A, nominal cold resistance of at least 0.2 Ω and melting integral max. 1A2s. The indicated values in brackets are recommended by SMA Solar Technology AG. The electrical devices must be designed in accordance with the locally applicable standards and directives.

Figure 9: Schematic diagram of the single-phase automatic transfer switch for Belgium

7.2 Circuitry Overview for Single-Phase Battery-Backup System in Belgium

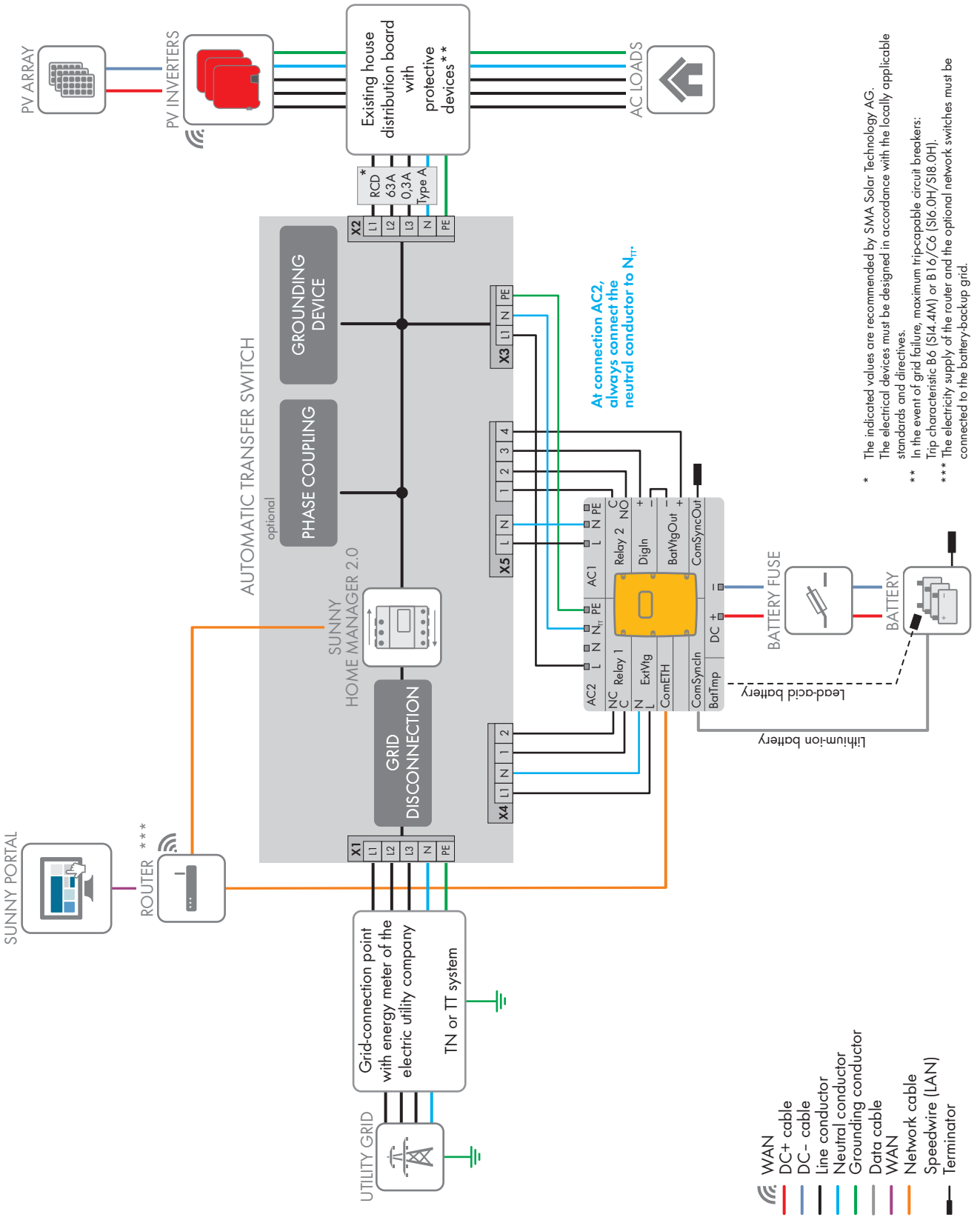


Figure 10: Connection of the automatic transfer switching device with all-pole disconnection for Belgium

7.3 Automatic Transfer Switching Device for Three-Phase Battery-Backup System in Belgium

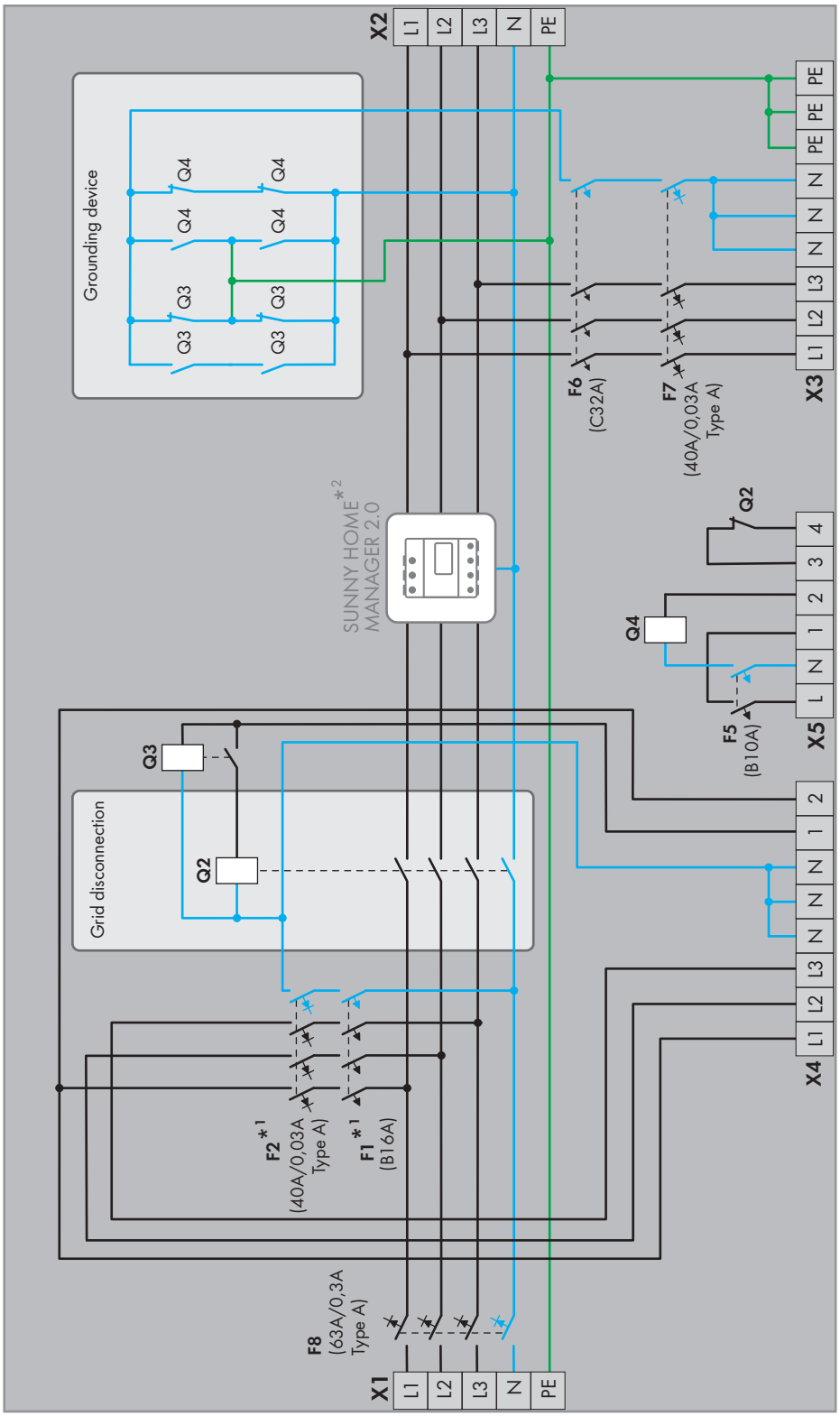


Figure 11: Schematic diagram of the three-phase automatic transfer switch for Belgium

7.4 Circuitry Overview for Three-Phase Battery-Backup System in Belgium

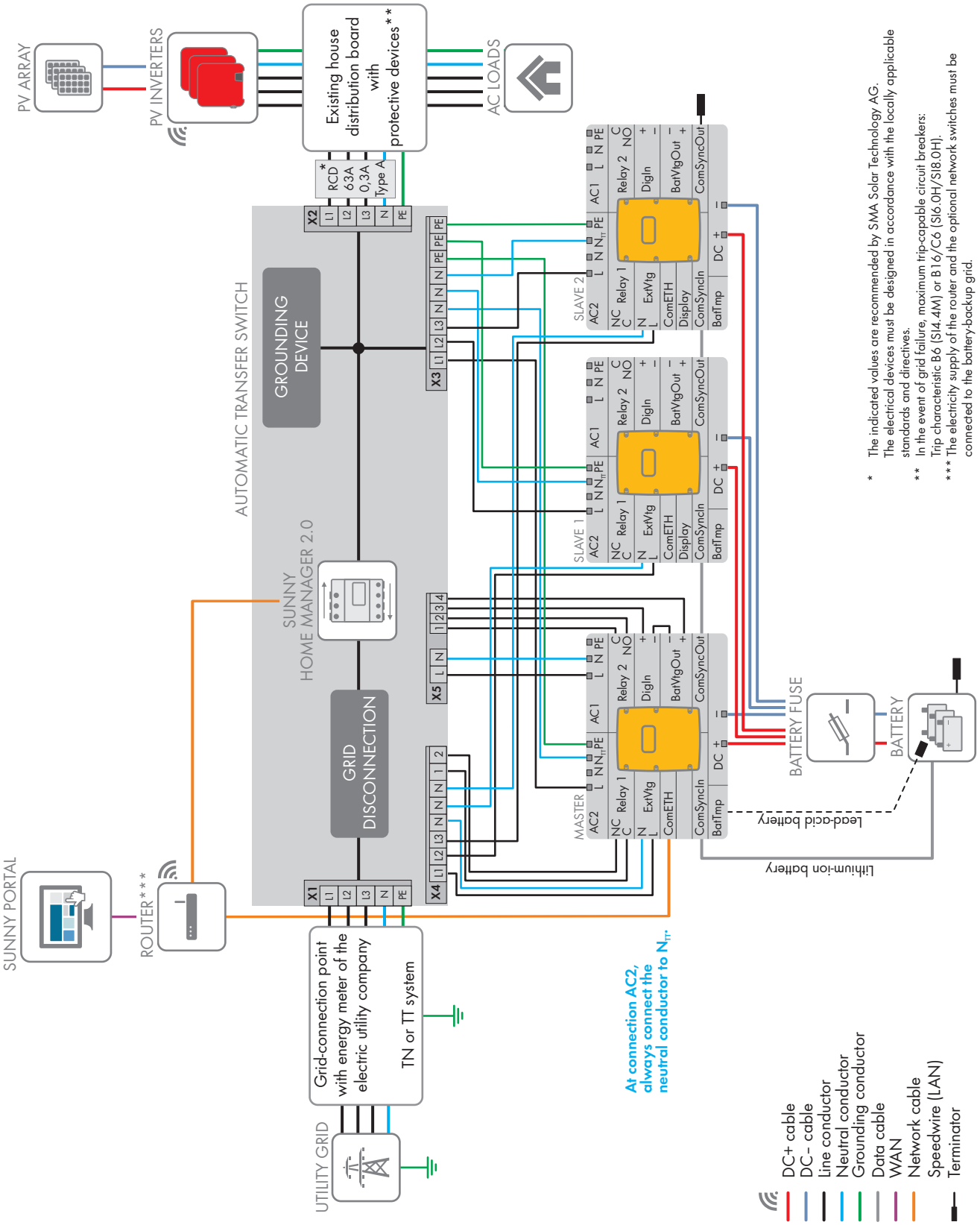


Figure 12: Connection of the automatic transfer switching device with all-pole disconnection for Belgium

8 Contact

If you have technical problems with our products, please contact the SMA Service Line. The following data is required in order to provide you with the necessary assistance:

- Type of system installed (e.g. three-phase single-cluster system)
- Battery inverter:
  - Device type
  - Quantity
  - Serial numbers
  - Firmware version
  - Event message
  - File with event messages for troubleshooting
  - Service files for troubleshooting
- Type of the communication products connected
- Type, power and maximum current for the generator (if present)
- Batteries:
  - Type
  - Nominal capacity and nominal voltage (with lead-acid batteries)

Deutschland Österreich Schweiz	SMA Solar Technology AG Niestetal Sunny Boy, Sunny Mini Central, Sunny Tripower, Sunny Highpower: +49 561 9522-1499 Monitoring Systems (Kommunikationsprodukte): +49 561 9522-2499 Hybrid Controller: +49 561 9522-3199 Sunny Island, Sunny Boy Storage, Sunny Backup: +49 561 9522-399 Sunny Central, Sunny Central Storage: +49 561 9522-299 SMA Online Service Center: www.SMA-Service.com	Belgien Belgique België Luxemburg Luxembourg Nederland	SMA Benelux BVBA/SPRL Mechelen +32 15 286 730 for Netherlands: +31 30 2492 000 SMA Online Service Center: www.SMA-Service.com
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