Planning Guidelines

SMA FLEXIBLE STORAGE SYSTEM WITH BATTERY-BACKUP FUNCTION

Circuitry Overviews, Schematic Diagrams and Material Lists

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1 PV Energy Despite Grid Failure

Whenever grid failures occur, the PV system will disconnect from the utility grid to ensure the safety of persons working on the utility grid. For operators of a PV system or an SMA Flexible Storage System, this disconnection means that the loads connected to their household grid are no longer supplied with energy.

We do occasionally experience grid failures as the following examples show:

- On November 4, 2006, the utility grid failed in parts of Germany, France, Belgium, Italy, Spain and Austria. This grid failure was triggered by the disconnection of two high-voltage lines to enable the disembarkation of the cruise liner "Norwegian Pearl". Over ten million people were without electricity for up to 120 minutes.
- On November 11, 2012, the city of Munich experienced the worst grid failure in two decades. This grid failure was triggered by a technical fault in an electrical substation. It lasted for approximately one hour and around 450,000 people were affected.
- A severe storm on October 27, 2014 caused considerable grid failures in the southwest of Great Britain. About 6,000 households were affected.

Long-term grid failures can have serious consequences for those affected: for example, households and companies have to manage without heat, light, telephones and computers, cold chains are interrupted, and in agricultural enterprises barn ventilation and heat lamps go out of service. One possible solution for bridging this supply gap would be to convert existing PV systems into battery backup systems.

Battery-backup systems with PV systems need batteries as intermediate storage units, since PV energy is not available at all times. However, many PV systems have already been converted into energy management systems with intermediate storage to enable optimized self-consumption or internal power supply. These energy management systems are already equipped with batteries which can be additionally used for the battery-backup function. An example of such a battery-backup system is the SMA Flexible Storage System with battery-backup function.

With an SMA Flexible Storage System with battery-backup function, the existing PV system will be able to maintain the electricity supply throughout a grid failure. The battery of the SMA Flexible Storage System not only takes care of the intermediate storage of PV energy, but also supplies the loads during grid failure. The service life of the battery is hardly affected by this dual utilization as long as the utility grid is basically stable.

2 SMA Flexible Storage System with Battery-Backup Function

An SMA Flexible Storage System with battery-backup function takes care of the uninterrupted supply of the loads with electricity during a grid failure. An automatic transfer switch disconnects the household grid with the PV system from the utility grid. When this happens, the battery inverter Sunny Island 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.

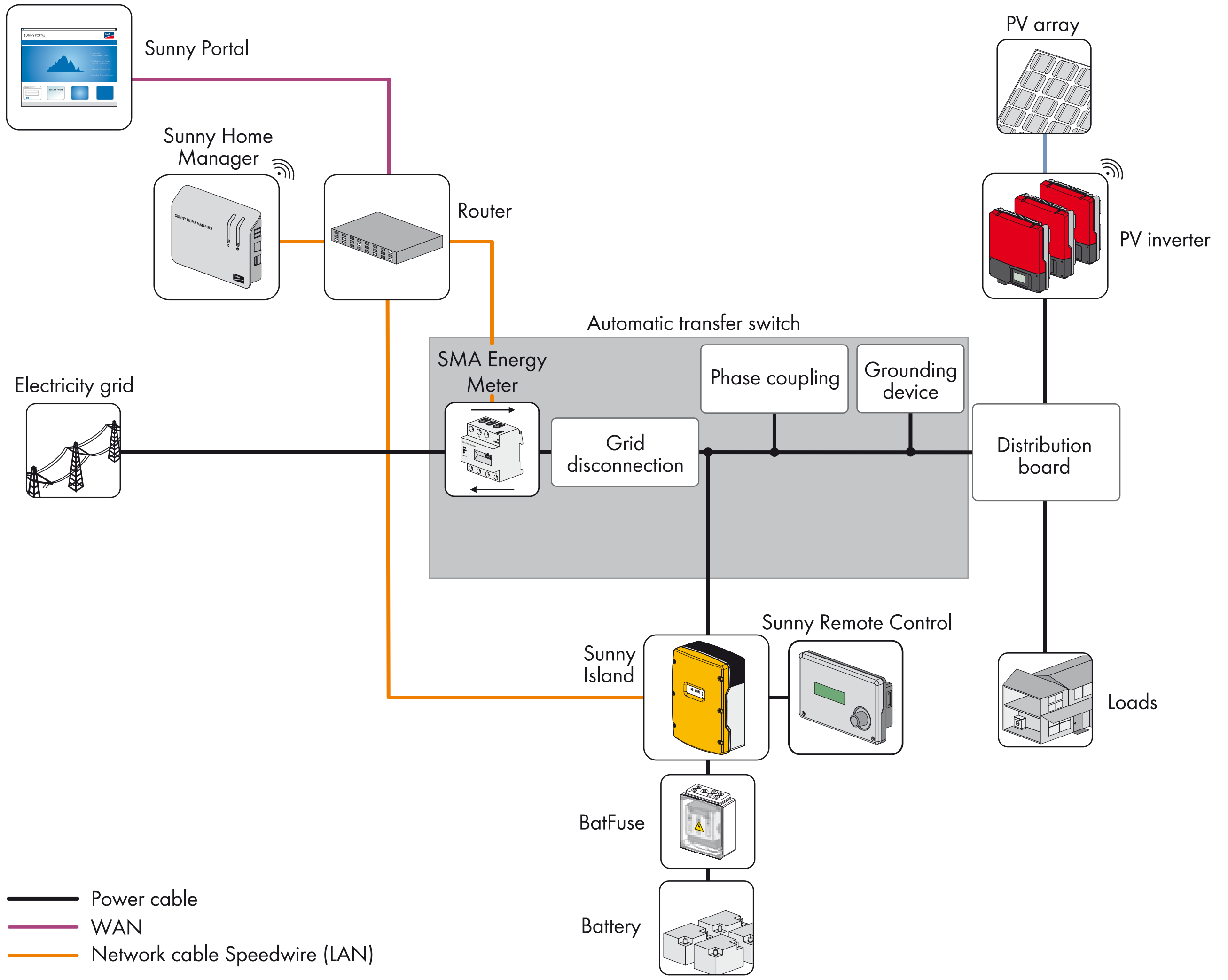


Figure 1: Overview of an SMA Flexible Storage System with battery-backup function

Devices of the SMA Flexible Storage System

Device	Function
Sunny Island 3.0M / 4.4M / 6.0H / 8.0H	The Sunny Island is a battery inverter. In the event of grid failure, the Sunny Island forms a battery-backup grid and regulates the energy distribution in this battery-backup grid. In grid-tie operation, the Sunny Island is responsible for the optimization of self-consumption or internal power supply.
Sunny Remote Control	You can configure and control the Sunny Island via the Sunny Remote Control display.
BatFuse	The battery fuse box BatFuse is an external fuse switch-disconnector which protects the battery connection cables of the Sunny Island inverter. Furthermore, the BatFuse enables DC-side disconnection of the Sunny Island inverter.

Device	Function
Battery	The battery stores excess energy from the PV system. In grid-tie operation, this buffered PV energy is used to optimize self-consumption or internal power supply, and in the event of grid failure, it is used for supplying the loads.
Sunny Home Manager	The Sunny Home Manager is a device for monitoring PV systems and controlling loads in households with PV systems.
SMA Energy Meter	The SMA Energy Meter is a measuring device which detects measured values at the connection point and makes them available via Speedwire, e.g. to the Sunny Home Manager.

Devices of the Automatic Transfer Switch

Device	Function
Grid disconnection	The grid disconnection function is performed by the tie switch. The design of the tie switch depends on whether or not the utility grid is disconnected from the battery-backup grid at all poles (see Section 4.2 "Utility Grid", page 10).
Phase coupling	Phase coupling is an optional function for single-phase battery-backup systems if the utility grid is a three-phase system. With single-phase battery-backup systems, only one Sunny Island is connected to the automatic transfer switch. Therefore, without phase coupling only one line conductor (e.g. L1) is protected against grid failure. In this case, the other two line conductors (e.g. L2 and L3) cannot be protected. Phase coupling enables combined switching of the line conductors. As a result, the other two line conductors are also supplied with voltage in the event of grid failure. This means that in the event of grid failure a three-phase household grid is transformed into a single-phase battery-backup grid. Phase coupling can be switched on independently for the line conductors L2 und L3.
Grounding device	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. This disconnection does not ground the neutral conductor. 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 protects persons working on the system. It is configured for fail-safe operation (see Section 4.2 "Utility Grid", page 10).

3 Bridging Time and Self-Consumption Quota

This section describes a simple method by which you can estimate bridging time and self-consumption quota for an SMA Flexible Storage System with battery-backup function. For the battery capacity, an empirical value of a typical battery-backup system is assumed and verified by means of the estimate.

In the example, the assumed values for the energy demand of the loads in a private household, the peak power of the PV system and the battery capacity are characteristic of a battery-backup system in a four-person single-family household in Germany.

Step 1: Estimation of self-consumption quota for an SMA Flexible Storage System

Input data:

- Peak power of the PV system: 5,000 Wp
- Annual energy demand: 5,000 kWh
- Battery capacity for the SMA Flexible Storage System: 10 kWh

It can be assumed that with lead-acid batteries the Sunny Island utilizes 50% of the battery capacity for intermediate storage of PV energy. Hence, the usable battery capacity would amount to 5,000 Wh.*

$$\frac{\text{Paek power of the PV system}}{\text{Annual energy demand}} = \frac{5.000\ \text{Wp}}{5.000\ \text{kWh}} = 1\ \text{Wp/kWh}$$

$$\frac{\text{Useable battery capacity}}{\text{Annual energy demand}} = \frac{5.000\ \text{Wh}}{5.000\ \text{kWh}} = 1\ \text{Wh/kWh}$$

Transfer the calculated values to the diagram to estimate the self-consumption quota.

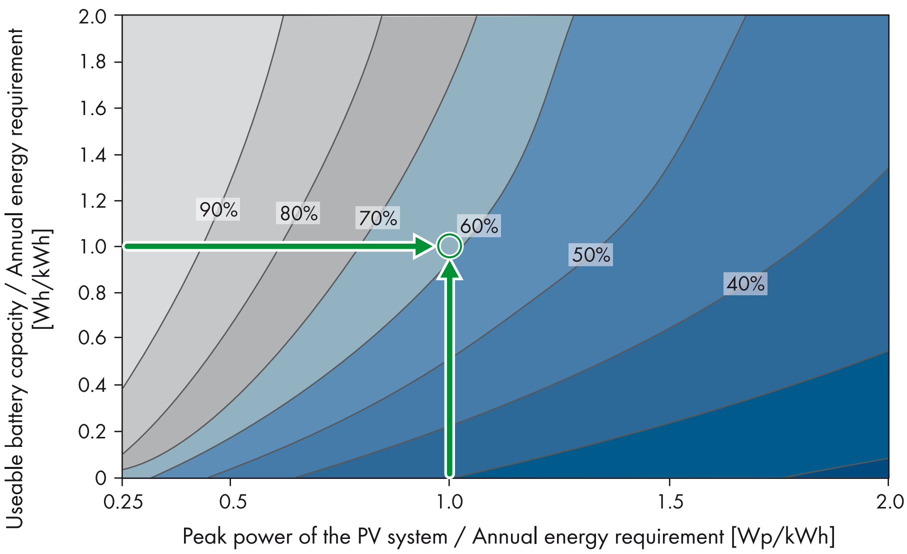


Figure 2: Estimation of self-consumption quota with intermediate storage

The estimate results in a self-consumption quota of approximately 60%.

* Due to the seasonal battery operation, the use of the battery for intermediate storage is limited in winter and extended in summer. Therefore, a usable range of 50% for intermediate storage can continue to serve as the basis for the estimate (see Section 4.6.3 "Capacity of the Battery Utilized by the SMA Flexible Storage System with Battery-Backup Function", page 15).

Step 2: Estimation of energy demand in the event of grid failure

The annual energy demand of the household amounts to 5,000 kWh.

$$\frac{\text{Annual energy demand}}{\text{365 Tage}} = \frac{\text{5.000 kWh}}{\text{365 Tage}} = \text{13,6 kWh/days}$$

It can be assumed that during a grid failure, electrical energy will be used sparingly, e.g. by switching off energy-intensive loads. As a result, the daily energy demand of 13.6 kWh can be reduced by 40%. In this case, the energy demand of this household will be around 8 kWh in the event of a 24-hour grid failure.

Step 3: Estimation of PV generation during a grid failure

The peak power of the PV system is approximately 5 kWp. In Germany in the winter, it can be assumed that 0.7 kWh/kWp will be generated. Hence, an energy yield from PV production of 3.5 kWh between sunrise and sunset is derived.

Step 4: Calculation of battery capacity required for the battery-backup function

Input data:

- Energy demand of the household: 8 kWh
- Energy yield from PV production: 3.5 kWh

Battery capacity = Energy demand – PV generation = 8 kWh – 3.5 kWh = 4.5 kWh

The required battery capacity amounts to 4.5 kWh. In **Step 1**, a battery capacity of 10 kWh was determined.
Thus, in this example 45% of the battery capacity will be needed as energy reserve for grid failure on a winter day.

Result

With lead-acid batteries, a default value of 45% of the Sunny Island battery capacity is reserved for the battery-backup function in winter operation, within the corresponding value range of 15% to 60% (see Section 4.6 "Batteries", page 14). Thus, the battery used for the SMA Flexible Storage System is also adequate for the battery-backup function.

4 Conditions of Use of an SMA Flexible Storage System with Battery-Backup Function

4.1 Certifications and Licenses

The SMA Flexible Storage System with battery-backup function is licensed for use in the following countries:

- Australia
- Belgium
- Denmark
- Germany
- France
- Great Britain and Northern Ireland (see Section 4.8, page 17)
- Austria
- Switzerland

However, its use in other countries is not ruled out. The Sunny Island is certified in accordance with VDE-AR-N 4105 and AS4777. In certain countries, proof of these certifications is sufficient. Please consult the grid operator.

4.2 Utility Grid

Only utility grid permitted as external energy source

The only permitted external energy source connected to the SMA Flexible Storage System with battery-backup function is the utility grid. The SMA Flexible Storage System with battery-backup function does not support operation with a generator (e.g. diesel generator).

Characteristics of the Battery-Backup Grid

Characteristic	Single-phase battery-backup grid	Three-phase battery-backup grid
Utility grid	TN or TT system	
	Single-phase or three-phase	Three-phase
Behavior of the Sunny Island inverters in the event of grid failure	One Sunny Island supplies the battery-backup grid.	Three Sunny Island inverters switched in parallel on the DC side supply each line conductor with the corresponding phase.
Recognition of grid failure	Grid failure is only recognized on the line conductor which is connected to the Sunny Island (e.g. L1).	Grid failure is recognized on all line conductors.
Supply of the loads in the event of grid failure	Only some of the loads are supplied (e.g. the loads connected to L1).	All loads are supplied.
Grid feed-in by the PV inverters in the event of grid failure	Only single-phase PV inverters can feed energy into the grid.	Single-phase and three-phase PV inverters can feed energy into the grid.
Phase coupling in the battery-backup grid	Possible	Not possible
Rotating magnetic field in the battery-backup grid	No: even with phase coupling, the battery-backup grid remains single-phase.	Yes: three Sunny Island inverters form a three-phase battery-backup grid with rotating magnetic field.

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. With phase coupling, single-phase loads only must be connected to the battery-backup grid.

Battery-Backup Grid with or without All-Pole Disconnection

	Battery-backup system with all-pole disconnection	Battery-backup system without all-pole disconnection
Mode of Operation	In the event of grid failure, a tie switch disconnects all line conductors and the neutral conductor of the battery-backup grid from the utility grid. The tie switch is designed with built-in redundancy.	In the event of grid failure, a tie switch disconnects all line conductors of the battery-backup grid from the utility grid. The neutral conductor of the battery-backup grid remains permanently connected to the utility grid. The tie switch is not designed with built-in redundancy.
Criterion for use	If the technical connection requirements of the grid operator or the locally applicable standards and directives call for or allow all-pole disconnection, you must install the battery-backup system with all-pole disconnection.	If the technical connection requirements of the grid operator or the locally applicable standards and directives prohibit disconnection of the neutral conductor, you must install the battery-backup system without all-pole disconnection.
Deployment location	E.g. Germany, Austria, Belgium, Denmark	E.g. Australia

4.3 Circuit Breaker in the Household Distribution

Only the Sunny Island can trip the circuit breakers in the household distribution in case of a grid failure. The circuit breakers in the household distribution must therefore comply with the maximum tripping characteristics listed in the following table. If a circuit breaker in the household distribution has a higher tripping characteristic, an additional residual-current device of type A must be installed.

Sunny Island device type	Maximum tripping characteristics
SI3.0M-11 (Sunny Island 3.0M)	B6 (B6A)
SI4.4M-11 (Sunny Island 4.4M)	B6 (B6A)
SI6.0H-11 (Sunny Island 6.0H)	B16 (B16A)
SI8.0H-11 (Sunny Island 8.0H)	B16 (B16A)

4.4 Switching Times for Loads

The SMA Flexible Storage System with battery-backup function does not fulfill the requirements of an uninterruptible power supply as per IEC 62040. 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, until the battery-backup system can provide active power and reactive power again.

If any single load (e.g. a computer) requires an uninterruptible power supply in compliance with the standard or a switching time shorter than five to seven seconds, this load will need a separate uninterruptible power supply in accordance with IEC 62040.

Longer Switching Periods for Phase Coupling

Loads integrated in the battery-backup grid via phase coupling have a switching time of 15 seconds, as the SMA Flexible Storage System with battery-backup function connects phase coupling with a time delay.

4.5 PV Inverters

4.5.1 Suitable PV Inverters

No three-phase PV inverters in single-phase battery-backup systems

Three-phase PV inverters such as the Sunny Tripower are not suitable for single-phase battery-backup systems, as they cannot feed into the battery-backup grid in the event of grid failure.

Possible solutions:

- Replace the three-phase PV inverter by a combination of single-phase PV inverters, e.g. two Sunny Boy 4000TL inverters instead of one Sunny Tripower 8000TL.
- Select a sufficiently large battery capacity to ensure the supply of the loads from the battery only over the entire bridging time.

Only PV inverters complying with the standards VDE-AR-N 4105 or AS 4777 are suitable for use in an SMA Flexible Storage System with battery-backup function.

In the following PV inverters you can activate frequency-dependent active power limitation as of the indicated firmware version (see Section 4.5.3 "Frequency-Dependent Control of Active Power (Exemplary for Australia)", page 13).

PV inverter	Firmware version*
Sunny Boy (SB)	
• SB 1300TL-10 / 1600TL-10 / 2100TL-10	4.52
• SB 2500TLST-21 / 3000TLST-21	2.50.41.R
• SB 3300-11	4.03
• SB 3800-11	4.02
• SB 2000HF-30 / 2500HF-30 / 3000HF-30	2.30.07.R
• SB 3000TL-21 / 3600TL-21 / 4000TL-21 / 5000TL-21	2.51.02.R
Sunny Mini Central (SMC)	
• SMC 5000A / 6000A	1.50
• SMC 6000TL / 7000TL / 8000TL	3.32
• SMC 7000HV	1.81
• SMC 7000HV-11	2.21
• SMC 9000TLRP-10 / 10000TLRP-10 / 11000TLRP-10	1.40
Sunny Tripower (STP)	
• STP 5000TL-20 / 6000TL-20 / 7000TL-20 / 8000TL-20 / 9000TL-20	2.50.01.R
• STP 8000TL-10 / 10000TL-10 / 12000TL-10 / 15000TL-10 / 17000TL-10	2.51.02.R
• STP15000TLEE-10 / 20000TLEE-10	2.54.03.R

* With older firmware versions, a firmware update is required (see installation manual of the PV inverter).

4.5.2 Maximum AC Power of the PV Inverters

The AC power that PV inverters are permitted to feed into the battery-backup system is limited by the rated power of the Sunny Island inverters.

Type of battery-backup system	Device type of the Sunny Island inverter	Rated power of the Sunny Island inverters	Maximum AC power of the PV inverters
Single-phase	SI3.0M-11 (Sunny Island 3.0M)	2.3 kW	4.6 kW
	SI4.4M-11 (Sunny Island 4.4M)	3.3 kW	4.6 kW
	SI6.0H-11 (Sunny Island 6.0H)	4.6 kW	9.2 kW
	SI8.0H-11 (Sunny Island 8.0H)	6.0 kW	12 kW
Three-phase	SI3.0M-11 (Sunny Island 3.0M)	6.9 kW	13.8 kW
	SI4.4M-11 (Sunny Island 4.4M)	9.9 kW	13.8 kW
	SI6.0H-11 (Sunny Island 6.0H)	13.8 kW	27.6 kW
	SI8.0H-11 (Sunny Island 8.0H)	18.0 kW	36 kW

4.5.3 Frequency-Dependent Control of Active Power (Exemplary for Australia)

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. SMA Solar Technology AG's suggestion for implementing frequency-dependent active power limitation is described in the following diagram.

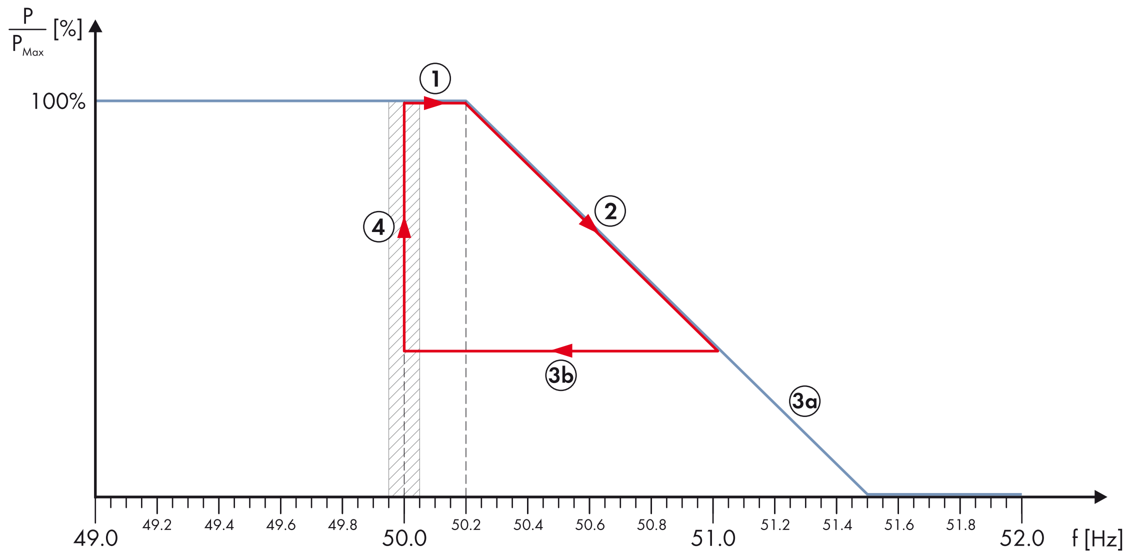


Figure 3: Suggestion for frequency-dependent active power limitation by the PV inverter (exemplary for Australia)

Position	Description
1	As long as power frequency remains at 50 Hz, the PV inverter feeds into the grid at its maximum available power. If power frequency rises to 50.2 Hz, the PV inverter starts to reduce its active power. **Setting on the PV inverter:** • Set the difference **P-HzStr** between starting frequency and power frequency to **0.2 Hz**.*

Position	Description
2	From a power frequency of 50.2 Hz, the PV inverter reduces its active power by 77% of the available maximum power per Hz. The power frequency is monitored by the PV inverter. **Setting on the PV inverter:** • Set active power gradient **P-WGra** to **77%**.*
3a	If the power frequency continues to rise, the PV inverter further reduces its active power, reaching the value zero at 51.5 Hz.
3b	If the power frequency remains constant at a value under 51.5 Hz or continues to fall, the PV inverter stops reducing active power. The PV inverter retains the current active power value and monitors power frequency.
4	Once the power frequency has fallen as far as 50.05 Hz, the PV inverter starts to increase its active power. As long as the power frequency does not start to rise again, the PV inverter increases its active power by 10% of nominal power per minute up to the available maximum power. **Settings on the PV inverter:** • Set the difference **P-HzStop** between the reset frequency and the power frequency to **0.05 Hz**.* • Set the active power gradient depending on reset frequency **P-HzStopWGra** to **10%**.*

* The value is an example valid for Australia.

Adjustment of network-relevant parameters

Since the locally applicable standards and directives do not stipulate frequency-dependent active power limitation everywhere, this control setting is not stored in all country data sets of the PV inverters. If frequency-dependent active power limitation is not stored in the country data set, some parameters of the PV inverter must be adjusted.

- Check at the planned installation site whether parameters of the PV inverter must be adjusted for frequency-dependent active power limitation (see the Quick Reference Guide "SMA Flexible Storage System with Battery-Backup Function" of the Sunny Island inverter).
- Coordinate the parameter adjustment with the grid operator.
- Always have this parameter adjustment carried out by qualified persons (see installation manual of the PV inverter).

4.6 Batteries

4.6.1 Recommendations for Battery Capacity

SMA Solar Technology AG recommends the following minimum battery capacities:

Battery-backup system	Battery capacity for a ten-hour electric discharge (C10)
Single-phase battery-backup system with SI3.0M-11	100 Ah
Single-phase battery-backup system with SI4.4M-11	100 Ah
Single-phase battery-backup system with SI6.0H-11	120 Ah
Single-phase battery-backup system with SI8.0H-11	160 Ah
Three-phase battery-backup system with SI3.0M-11	300 Ah
Three-phase battery-backup system with SI4.4M-11	300 Ah
Three-phase battery-backup system with 3 SI6.0H-11	360 Ah
Three-phase battery-backup system with 3 SI8.0H-11	480 Ah

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

4.6.2 Selection of the Battery Type

Lead-Acid Batteries

The Sunny Island supports lead-acid batteries of types FLA and VRLA as well as various lithium-ion batteries. It is possible to connect batteries with a battery capacity of 100 Ah to 10,000 Ah (C10).

Lithium-Ion Batteries

Lithium-ion batteries are especially suited for intermediate storage of PV energy due to their high cycle stability. Lithium-ion batteries must be compatible with the Sunny Island:

- The battery must comply with the locally applicable standards and directives and be intrinsically safe.
- The battery must be approved for use with the Sunny Island.

  The list of lithium-ion batteries approved for the Sunny Island is updated regularly (see the Technical Information "List of Approved Lithium-Ion Batteries" at www.SMA-Solar.com).
- If no lithium-ion battery approved for the Sunny Island can be used, use a lead-acid battery.

Lithium-ion batteries in battery-backup systems

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

- Check with the battery manufacturer whether the battery is suitable for an SMA Flexible Storage System with battery-backup function. Pay special attention to the ampacity. Ampacity must be especially high if the battery-backup grid is supplied by the Sunny Island in the event of grid failure.

4.6.3 Capacity of the Battery Utilized by the SMA Flexible Storage System with Battery-Backup Function

In many regions, the PV energy available largely depends on the season and the hours of sunshine. The Sunny Island offers the possibility of adjusting the battery management response to the installation site and the time.

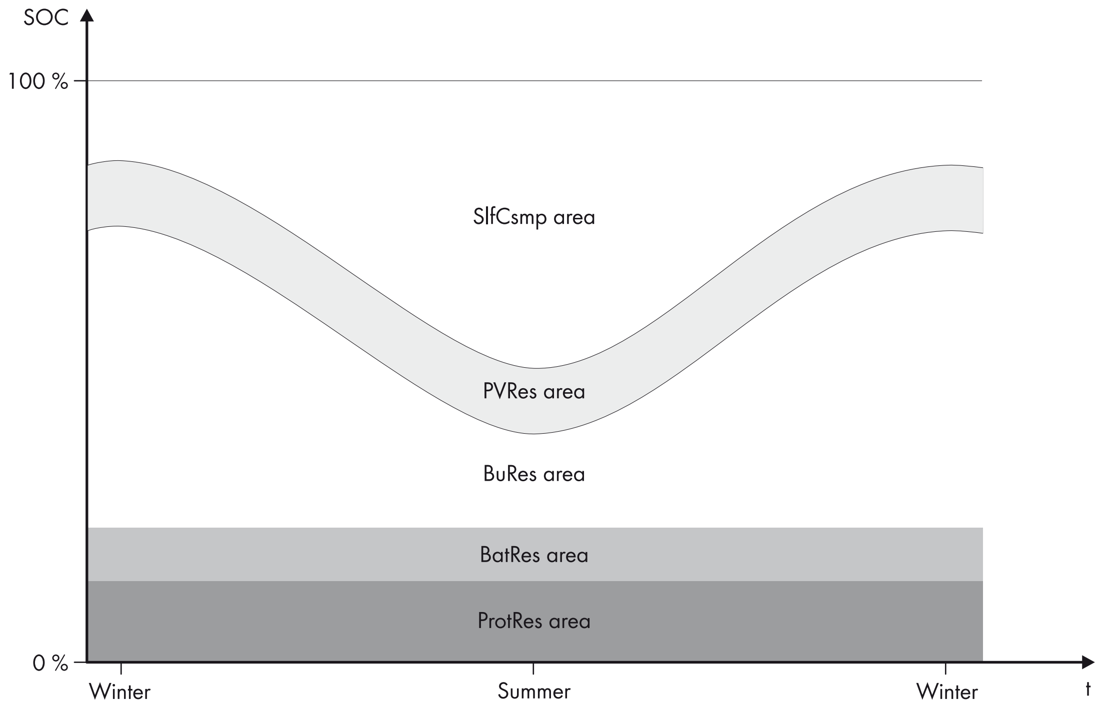


Figure 4: Ranges of the battery state of charge as a function of the season for the northern hemisphere (example)

Range	Explanation
SlfCsmp	Range for intermediate storage
PVRes	Range for the maintenance of the battery state of charge
BURes	Range for battery-backup function
BatRes	Range for protection against deep discharge
ProtRes	Range for protection in the event of deep discharge

Due to the seasonal battery operation of the Sunny Island inverter, a larger range is reserved for the battery-backup function in winter than in summer. This makes sense, as consumption in summer is lower and the PV yield is also much higher. The limits for the ranges of battery state of charge are predetermined for lead-acid batteries and lithium-ion batteries by the following value ranges of the Sunny Island inverter.

Range	Lead-acid battery		Lithium-ion battery*	
	Shortest day	Longest day	Shortest day	Longest day
SlfCsmp	65% to 100%	45% to 100%	30% to 100%	28% to 100%
PVRes	60% to 65%	40% to 45%	25% to 30 %	23% to 28%
BURes	15% to 60%	15% to 40%	13% to 25%	13 % to 23%
BatRes	10% to 15%	10% to 15%	3% to 13%	3% to 13%
ProtRes	0% to 10%	0% to 10%	0% to 3%	0% to 3%

* The value ranges for lithium-ion batteries reserve a smaller proportion of battery capacity for the battery-backup function: 10% of battery capacity in summer and 12% of battery capacity in winter. Therefore, the proportion available for intermediate storage is correspondingly larger.

4.7 Sunny Island

The maximum power consumption of the loads during the day and the type of battery-backup system determine the device type and the number of Sunny Island inverters. In a single-phase battery-backup system, for example, the maximum power consumption of the loads must be less than the maximum power of the Sunny Island inverter for a duration of 30 minutes at 25 °C.

Type of battery-backup system	Maximum power of the Sunny Island inverter for 30 minutes at 25 °C	Device type of the Sunny Island inverter	Number of the Sunny Island inverters
Single-phase	3.0 kW	SI3.0M-11 (Sunny Island 3.0M)	1
	4.4 kW	SI4.4M-11 (Sunny Island 4.4M)	
	6 kW	SI6.0H-11 (Sunny Island 6.0H)	
	8 kW	SI8.0H-11 (Sunny Island 8.0H)	
Three-phase	9.0 kW	SI3.0M-11 (Sunny Island 3.0M)	3
	13.2 kW	SI4.4M-11 (Sunny Island 4.4M)	
	18 kW	SI6.0H-11 (Sunny Island 6.0H)	
	24 kW	SI8.0H-11 (Sunny Island 8.0H)	

Short-Term Overload during Grid Failure

Short-term overload peaks of the loads can be compensated by the Sunny Island within its technical power limits (see installation manual of the Sunny Island inverter at www.SMA-Solar.com). However, the DC cables from the Sunny Island inverter to the battery fuse box and to the battery must be designed to withstand this overload operation.

4.8 Required in Great Britain and Northern Ireland: External Grid and PV System Protection

When using the SMA Flexible Storage System with battery-backup function in Great Britain and Northern Ireland, an external grid and PV system protection must be installed. Contact your grid operator to check which standards are locally applicable for the planned battery-backup system:

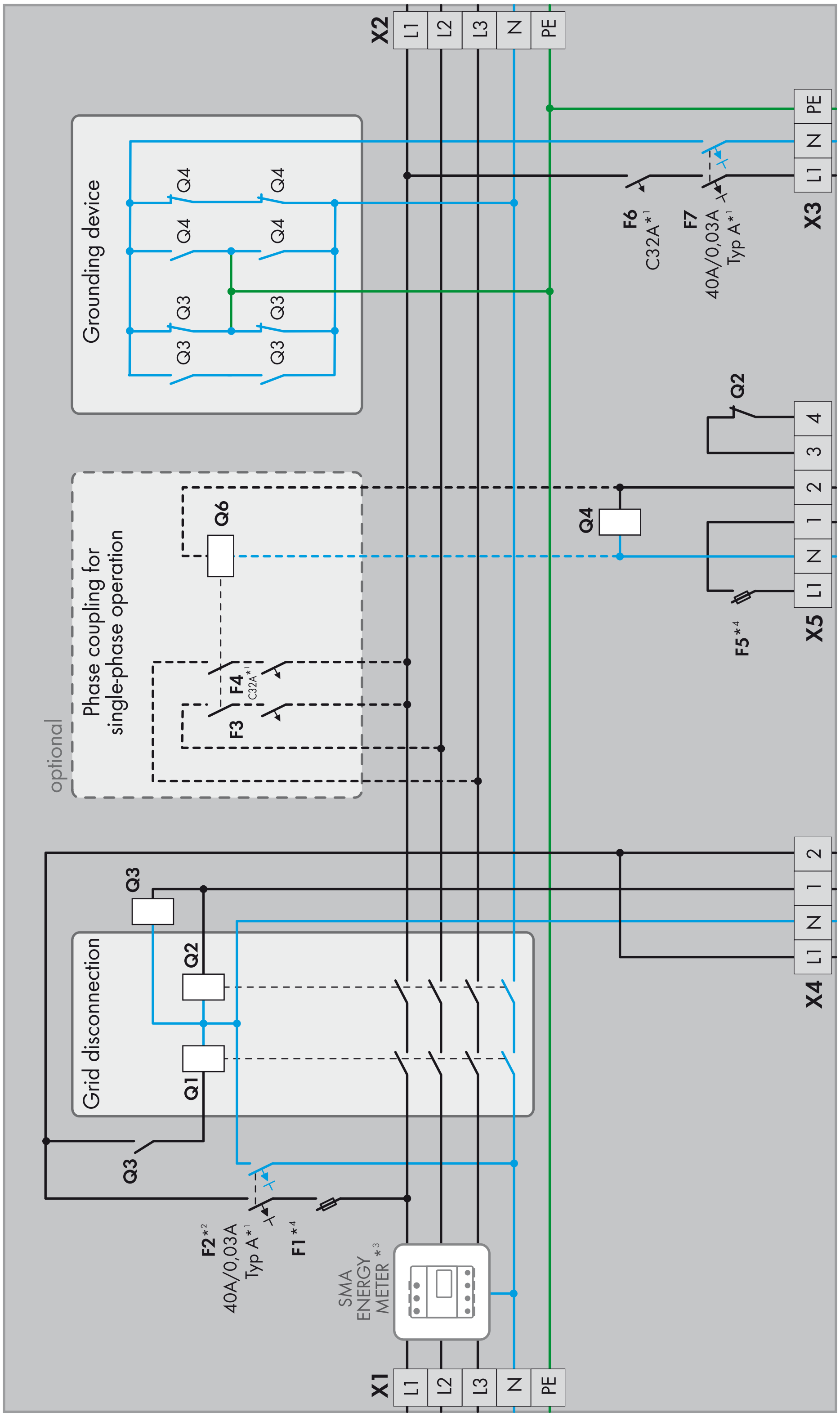
- G83/2: Engineering Recommendation G83, Issue 2
- G59/3: Engineering Recommendation G59, Issue 3

This standard must comply with the external grid and PV system protection.

5 Electrical Connection

5.1 Single-Phase Battery-Backup System with All-Pole Disconnection

Schematic Diagram of the Automatic Transfer Switch



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

*2 Only applicable for TT grid configuration.

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

*4 Requirements for the thermal fuse used: 1A, nominal cold resistance of at least 0.2 Ω and melting integral max. $1 A^2 s$.

Figure 5: Schematic diagram of the single-phase automatic transfer switch with all-pole disconnection (e.g. for Germany)

Circuitry Overview

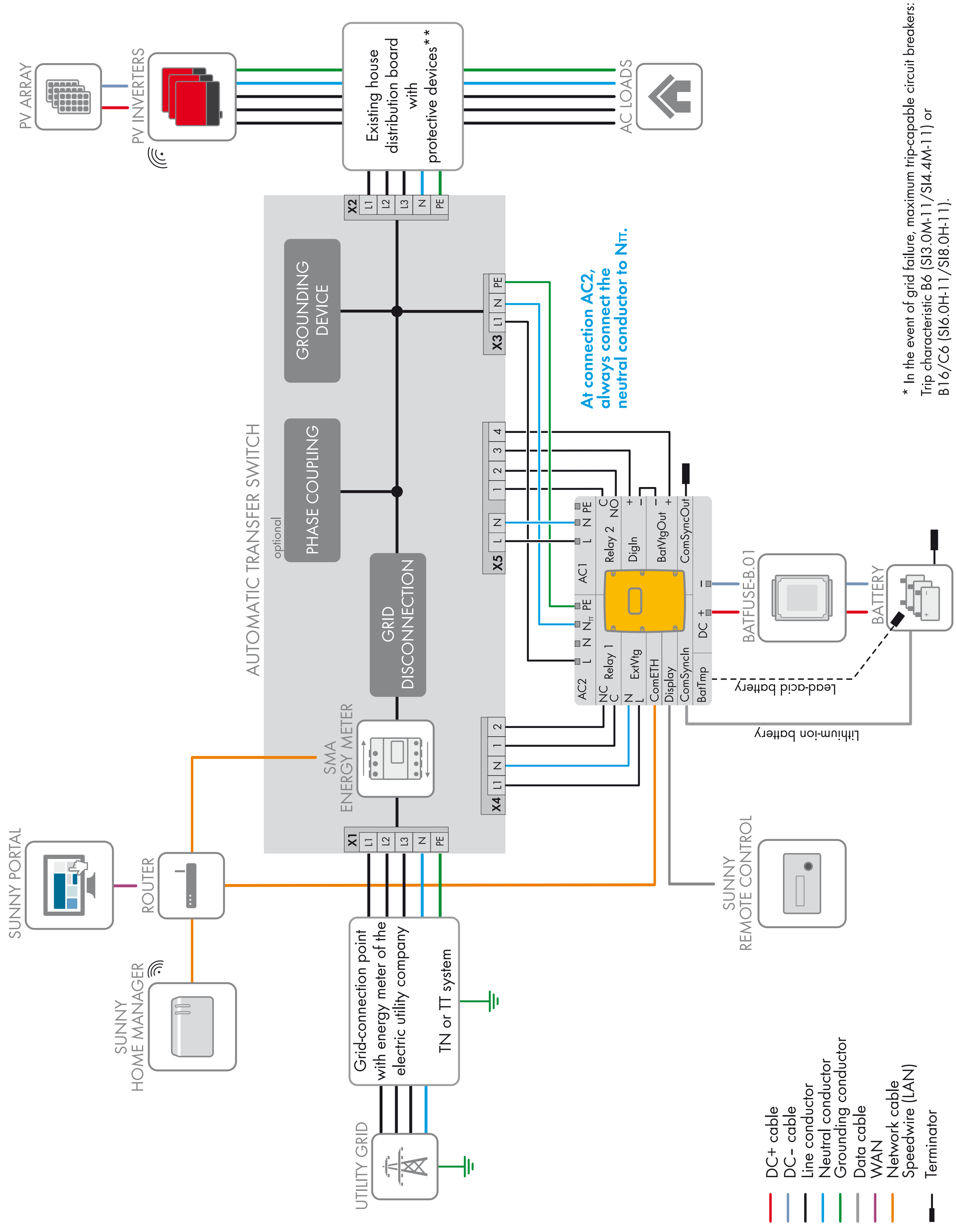
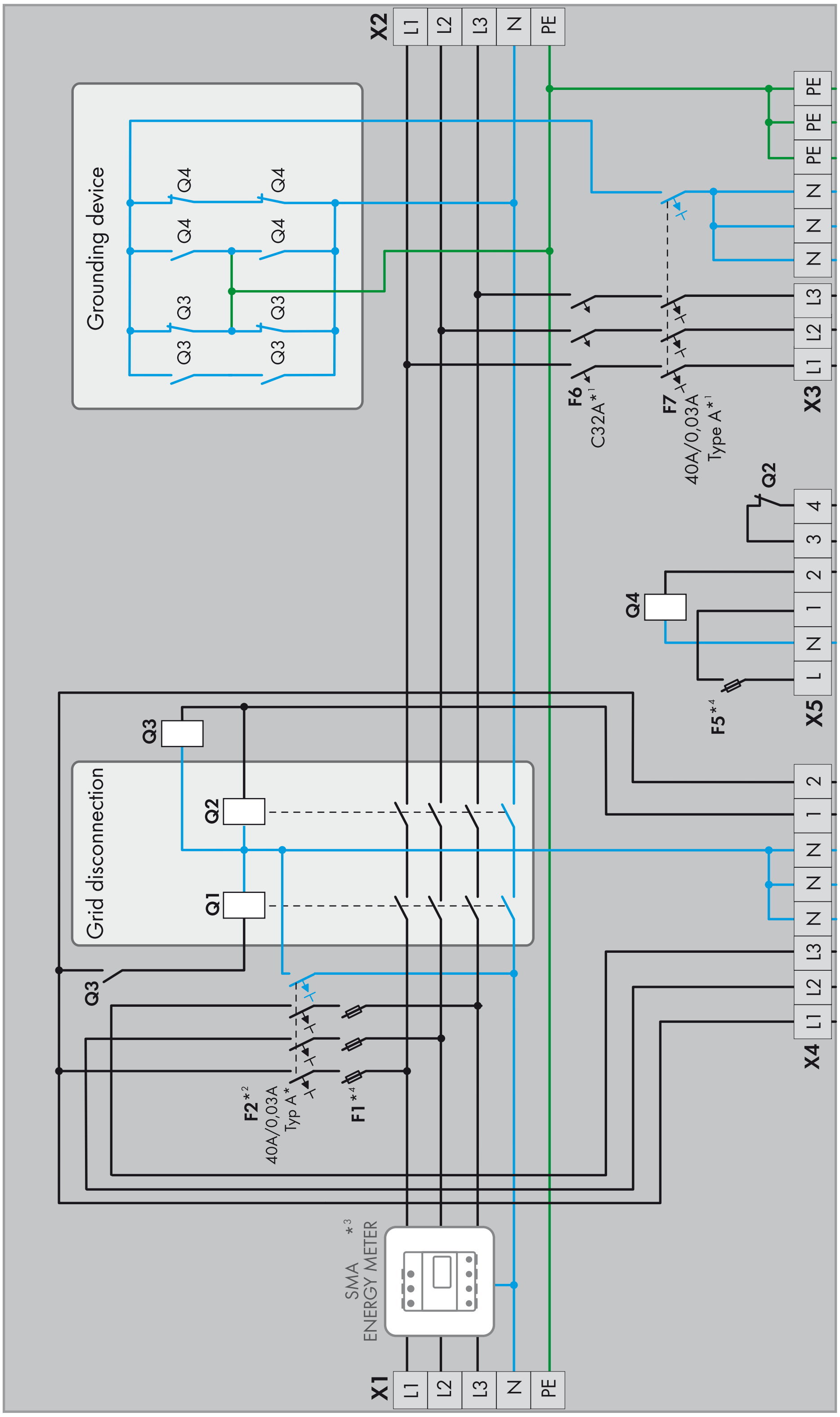


Figure 6: Circuitry overview of a single-phase battery-backup system with all-pole disconnection (e.g. for Germany)

* In the event of grid failure, maximum trip-capable circuit breakers: Trip characteristic B6 (SI3.0M-11/SI4.4M-11) or B16/C6 (SI6.0H-11/SI8.0H-11).

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

Schematic Diagram of the Automatic Transfer Switch



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

Figure 7: Schematic diagram of the three-phase automatic transfer switch with all-pole disconnection (e.g. for Germany)

Circuitry Overview

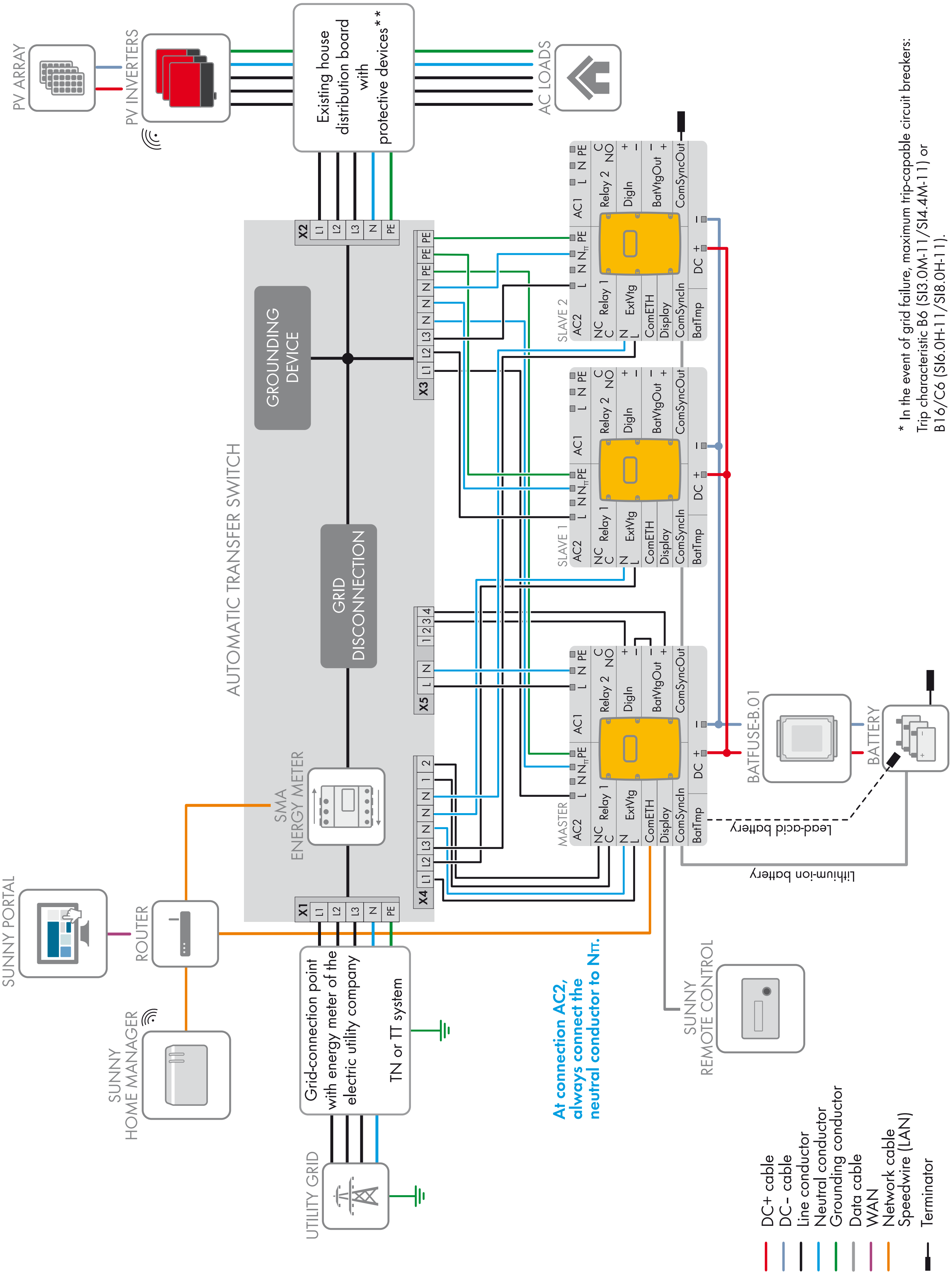
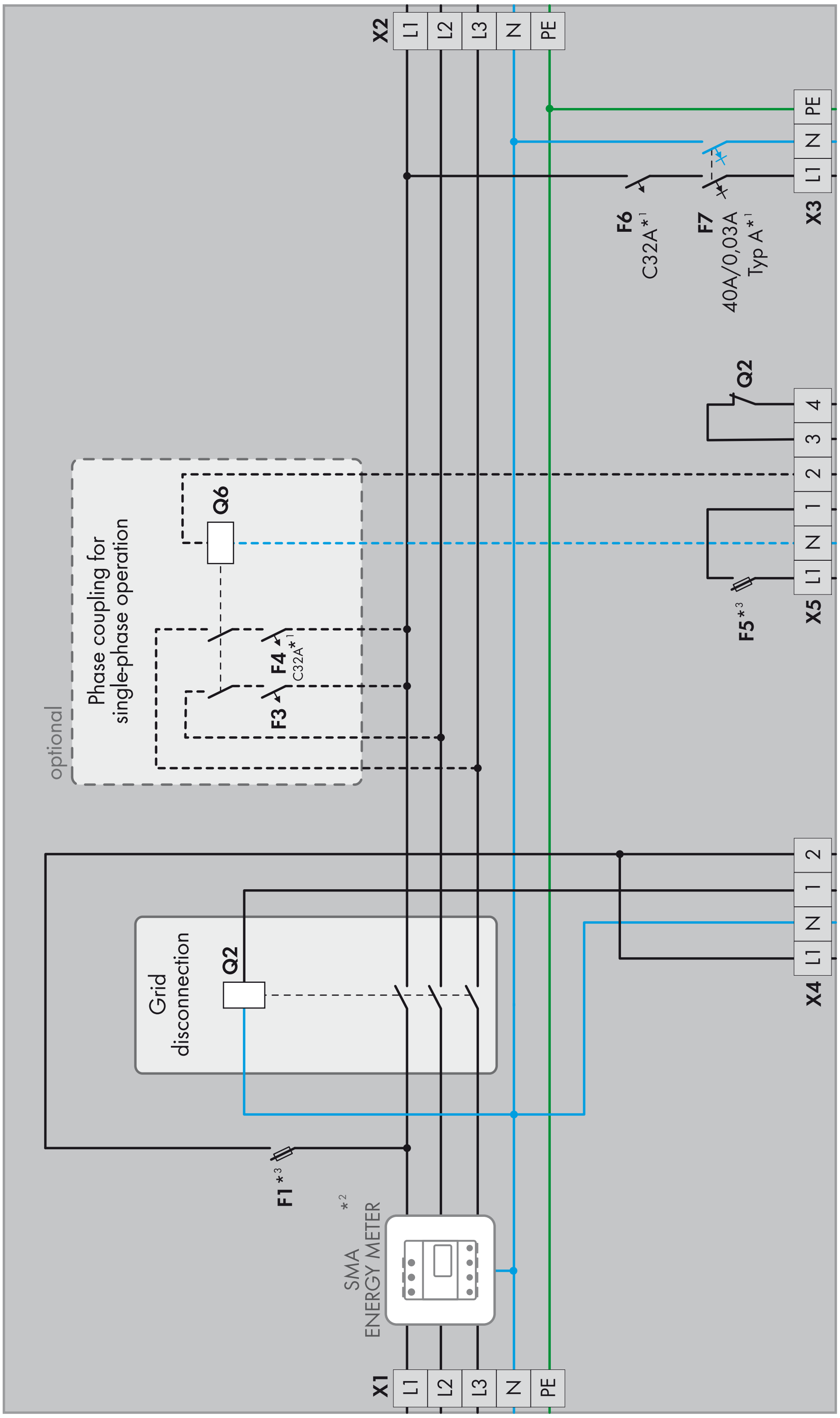


Figure 8: Circuitry overview of a three-phase battery-backup system with all-pole disconnection (e.g. for Germany)

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

Schematic Diagram of the Automatic Transfer Switch



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

Figure 9: Schematic diagram of the single-phase automatic transfer switch without all-pole disconnection (e.g. for Australia)

Circuitry Overview

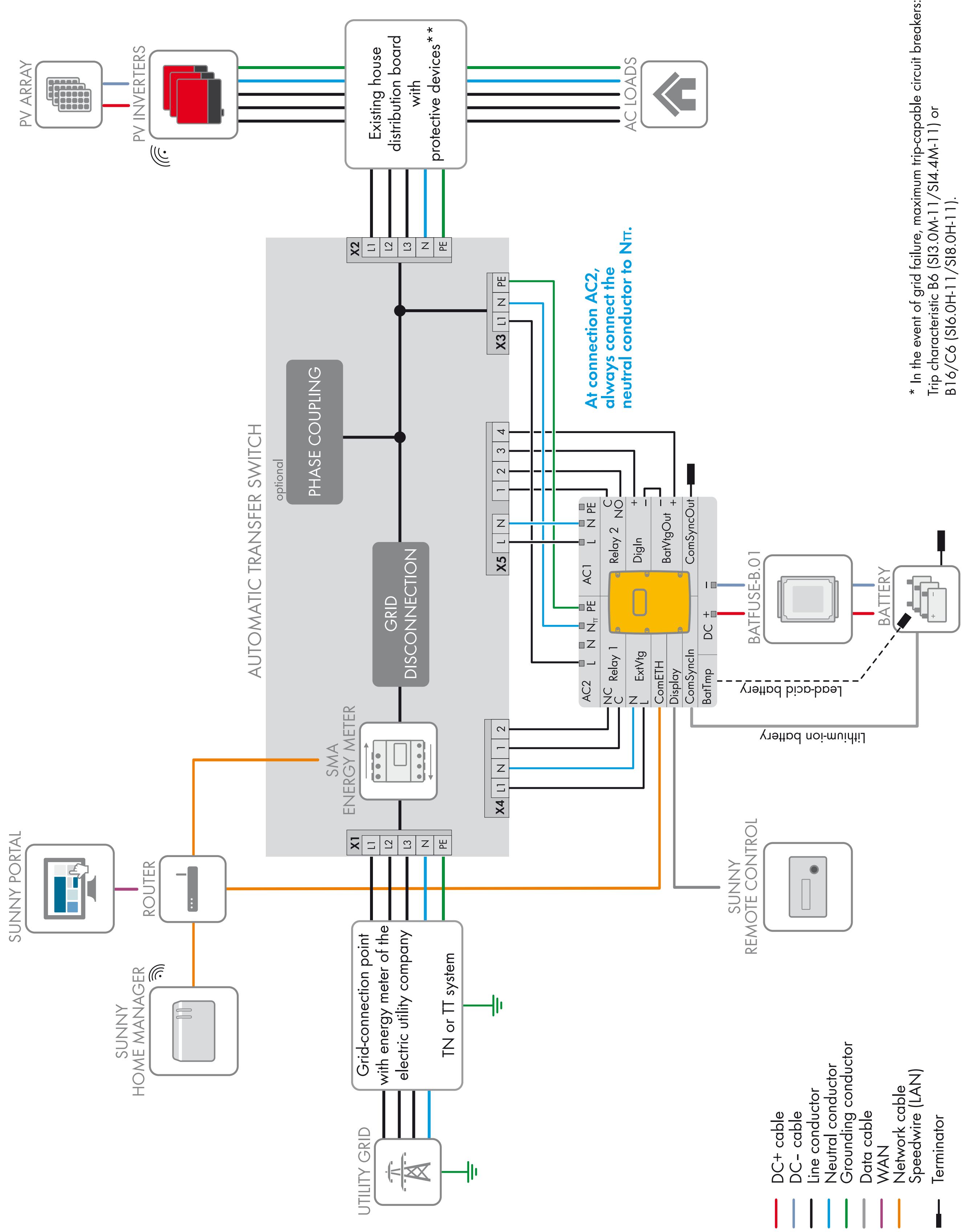
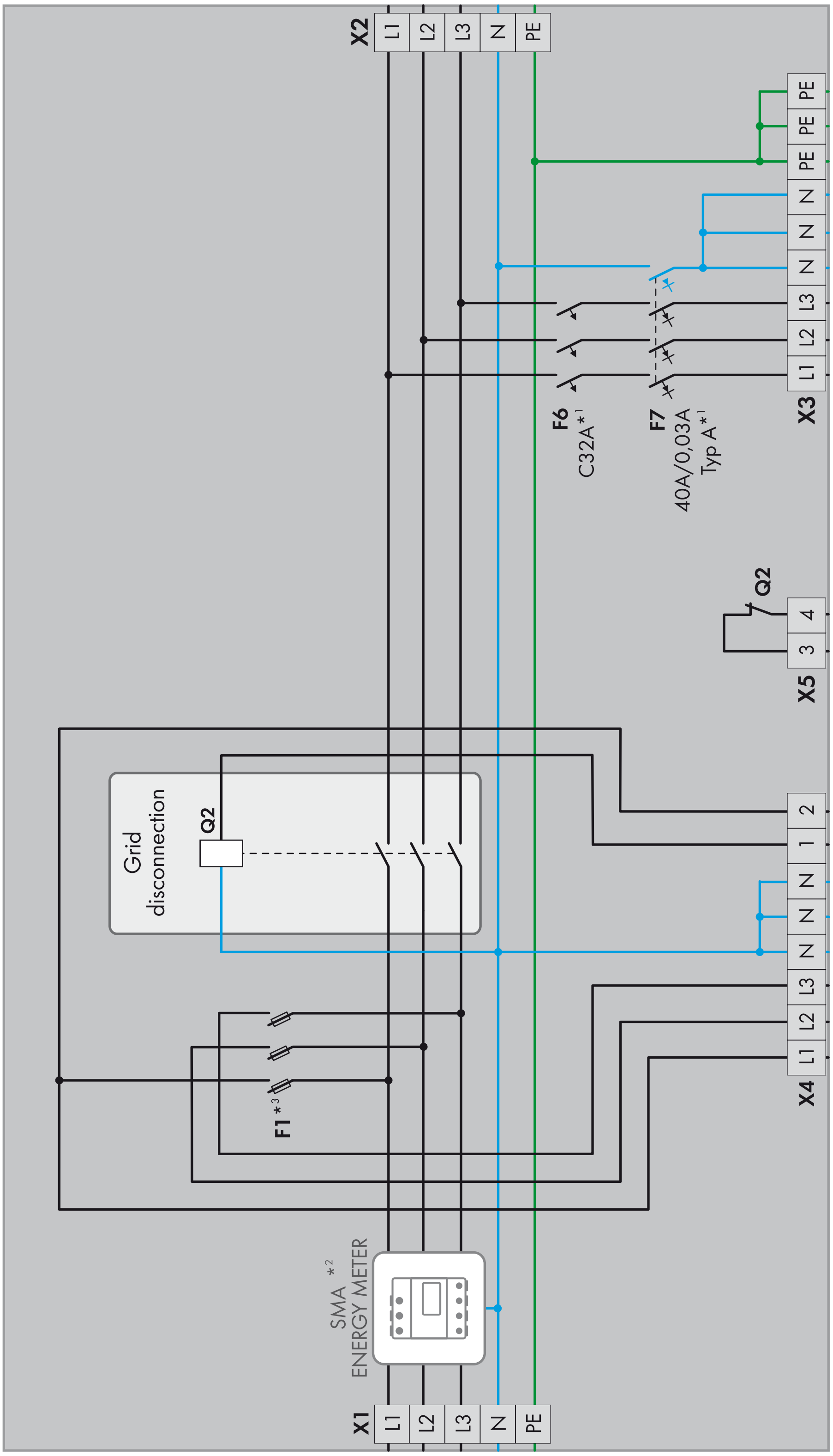


Figure 10: Circuitry overview of a single-phase battery-backup system without all-pole disconnection (e.g. for Australia)

* In the event of grid failure, maximum trip-capable circuit breakers: Trip characteristic B6 (SI3.0M-11/SI4.4M-11) or B16/C6 (SI6.0H-11/SI8.0H-11).

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

Schematic Diagram of the Automatic Transfer Switch



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

Figure 11: Schematic diagram of the three-phase automatic transfer switch without all-pole disconnection (e.g. for Australia)

Circuitry Overview

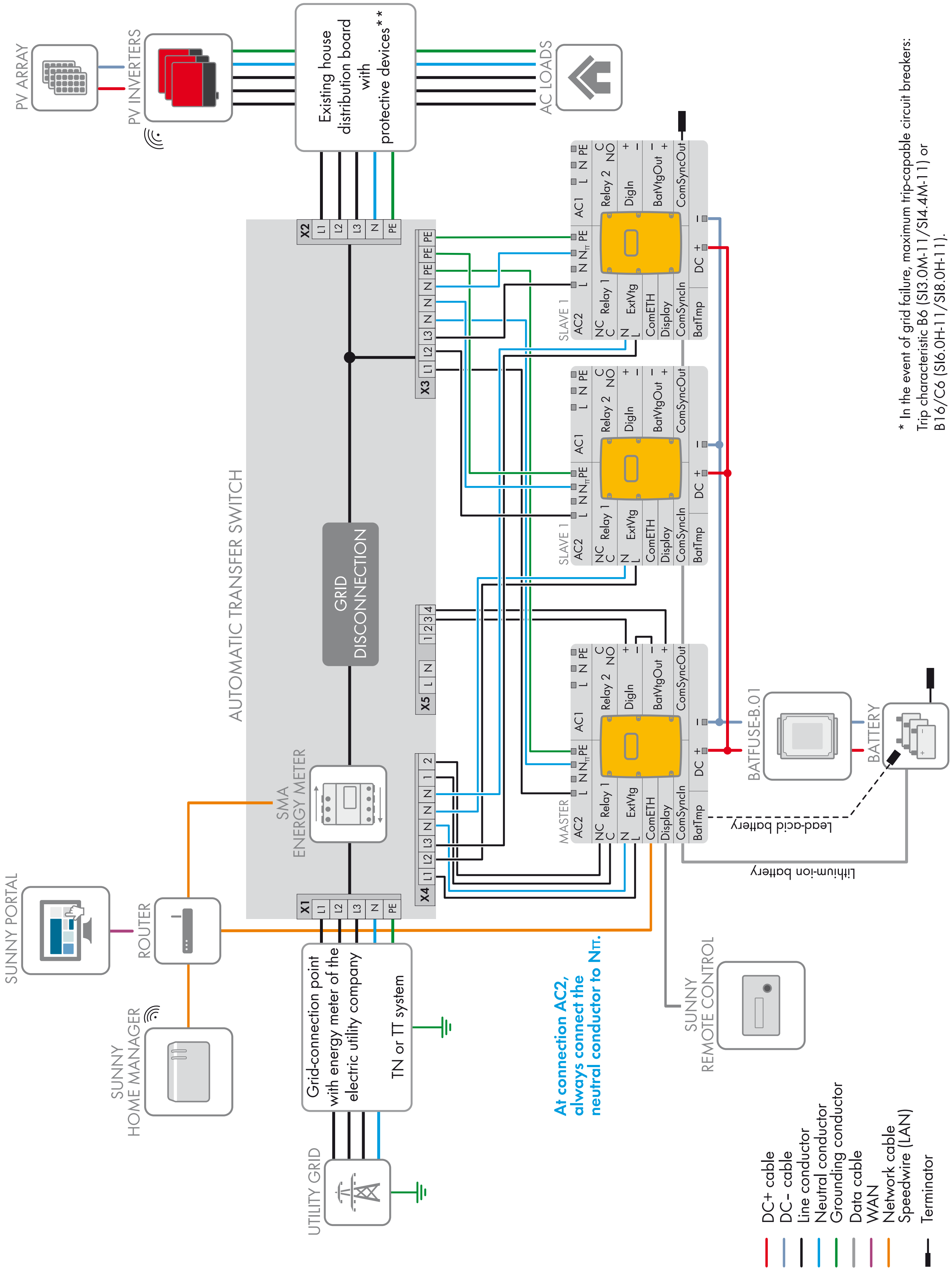


Figure 12: Circuitry overview of a three-phase battery-backup system without all-pole disconnection (e.g. for Australia)

6 Automatic Transfer Switch

6.1 Procurement of the Automatic Transfer Switch

You can order the automatic transfer switch as a complete switch cabinet unit.

Technical characteristics			Procurement	From enwitec electronic GmbH & Co.KG:
Single-phase	Three-phase	With all-pole disconnection		Article number
X	–	X	Order from enwitec electronic GmbH & Co. KG or set up independently.	10010034
–	X	X	Order from enwitec electronic GmbH & Co. KG or set up independently.	10010278
X	–	–	Set up independently	–
–	X	–	Set up independently	–

It is also possible to procure the required devices of the automatic transfer switch from specialist dealers and to build the switch cabinet independently.

No connection of loads or PV system to the automatic transfer switch

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

Dimensioning of the tie switch

Regardless of all-pole or non-all-pole disconnection, you must adjust the ampacity of the tie switch in accordance with the local requirements (see Section 4.1 "Certifications and Licenses", page 10). The tie switch must be designed for at least the tripping range of the upstream fuse or the maximum short-circuit current of the PV system.

Cable route for control cables and measuring cables in the automatic transfer switch

In order to avoid quality losses during the transmission of control signals and measured values, always observe the following rule for the cable route:

- Lay the control and measuring cables at the greatest possible distance from the power cables.

  or

- Use shielded cables for the control and measuring cables.

6.2 Automatic Transfer Switch for Single-Phase Battery-Backup System with All-Pole Disconnection

Material List

The following table summarizes the configuration of the automatic transfer switch as suggested in the schematic diagram for a single-phase battery-backup system with all-pole disconnection (e.g. for Germany). You will need to procure the material from your distributor.

Design of the devices in the automatic transfer switch

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

Position	Material	Number of units	Description
F1	Thermal fuse for protecting the control cables and measuring cables and for protecting the multifunction relay in the Sunny Island	1	1 A, cold resistance of at least 0.2 Ω, melting integral of max. 1 A^2s
F2	Residual-current device for control and measuring cables*	1	40 A/0.03 A, 1-pole + N, type A
F3, F4	Circuit breaker for protection of phase coupling**	2	32 A, C rating, 1-pole
F5	Thermal fuse for protecting the control cables and for protecting the multifunction relay in the Sunny Island	1	1 A, cold resistance of at least 0.2 Ω, melting integral of max. 1 A^2s
F6	Circuit breaker for protection of the Sunny Island	1	32 A, C rating, 1-pole
F7	Residual-current device	1	40 A/0.03 A, 1-pole + N, type A
Q1	Contactor for grid disconnection	1	400 V, 63 A at AC-1, AC-7a, 4 no
Q2	Contactor for grid disconnection	1	400 V, 63 A at AC-1, AC-7a, 4 no
	Auxiliary switch for feedback	1	1 nc
Q3	Contactor for grounding device	1	400 V, 40 A at AC-1, AC-7a, 2 no 2 nc
	Auxiliary switch for Q1 locking mechanism	1	1 no
Q4	Contactor for grounding device	1	400 V, 40 A at AC-1, AC-7a, 2 no 2 nc
Q6	Phase coupling contactor**	1	400 V, 63 A at AC-1, AC-7a, 2 no
X1	3-conductor through terminal	3	16 mm^2, 1-pole, 3 contact points, gray
	3-conductor through terminal	1	16 mm^2, 1-pole, 3 contact points, blue
	3-conductor through terminal	1	16 mm^2, 1-pole, 3 contact points, yellow-green
	End plate for through terminal, 3-conductor	1	–
	Group marker carrier for end clamp	1	–
	End clamp	1	Width: 10 mm

Position	Material	Number of units	Description
X2	3-conductor through terminal	3	16 mm^2, 1-pole, 3 contact points, gray
	3-conductor through terminal	1	16 mm^2, 1-pole, 3 contact points, blue
	3-conductor through terminal	1	16 mm^2, 1-pole, 3 contact points, yellow-green
	End plate for through terminal, 3-conductor	1	–
	Group marker carrier for end clamp	1	–
	End clamp	1	Width: 10 mm
X3	3-conductor through terminal	1	10 mm^2, 1-pole, 3 contact points, gray
	3-conductor through terminal	1	10 mm^2, 1-pole, 3 contact points, blue
	3-conductor through terminal	1	10 mm^2, 1-pole, 3 contact points, yellow-green
	End plate for through terminal, 3-conductor	1	–
	Group marker carrier for end clamp	1	–
	End clamp	1	Width: 10 mm
X4	3-conductor through terminal	3	2.5 mm^2, 1-pole, 3 contact points, gray
	3-conductor through terminal	1	2.5 mm^2, 1-pole, 3 contact points, blue
	End plate for through terminal, 3-conductor	1	–
	Group marker carrier for end clamp	1	–
	End clamp	1	Width: 10 mm
X5	3-conductor through terminal	4	1.5 mm^2, 1-pole, 3 contact points, gray
	3-conductor through terminal (L)	1	6 mm^2, 1-pole, 3 contact points, gray
	3-conductor through terminal (N)	1	6 mm^2, 1-pole, 3 contact points, blue
	End plate for through terminal, 3-conductor	2	–
	Group marker carrier for end clamp	1	–
	End clamp	1	Width: 10 mm

* Required in TT grid configuration only
** Optional

Configuration Suggestion

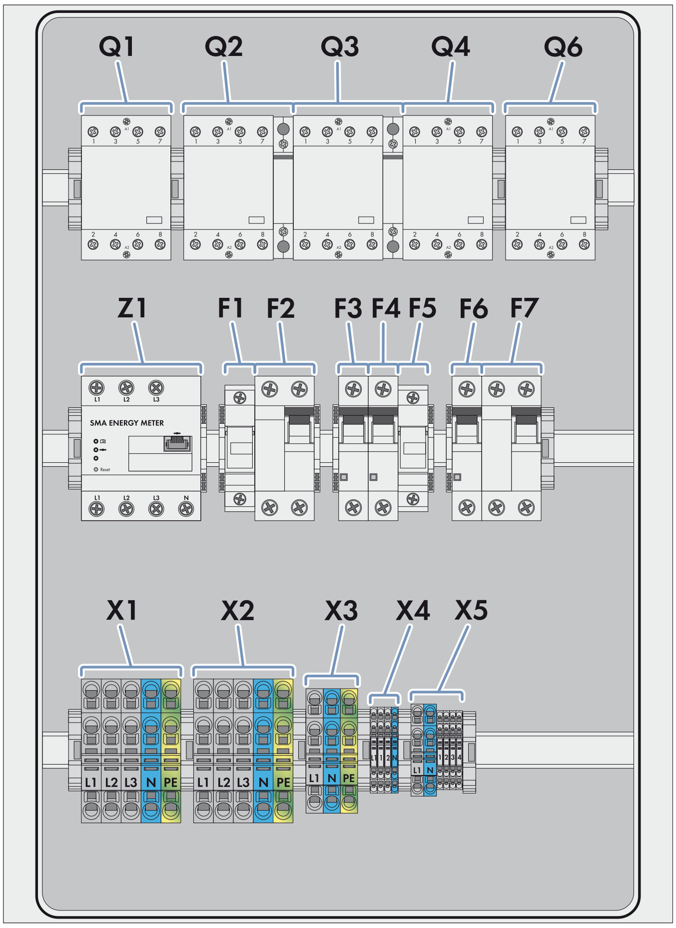


Figure 13: Configuration suggestion for single-phase automatic transfer switch with all-pole disconnection (e.g. for Germany)

6.3 Automatic Transfer Switch for Three-Phase Battery-Backup System with All-Pole Disconnection

Material List

The following table summarizes the configuration of the automatic transfer switch as suggested in the schematic diagram for a three-phase battery-backup system with all-pole disconnection (e.g. for Germany). You will need to procure the material from your distributor.

Design of the devices in the automatic transfer switch

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

Position	Material	Number of units	Description
F1	Thermal fuse for protecting the control cables and measuring cables and for protecting the multifunction relay in the Sunny Island	3	1 A, cold resistance of at least 0.2 Ω, melting integral of max. 1 A^2s
F2	Residual-current device for control and measuring cables*	1	40 A/0.03 A, 3-pole + N, type A

Position	Material	Number of units	Description
F5	Thermal fuse for protecting the control cables and measuring cables and for protecting the multifunction relay in the Sunny Island	1	1 A, cold resistance of at least 0.2 Ω, melting integral of max. 1 A^2s
F6	Circuit breaker for protection of the Sunny Island	3	32 A, C rating, 1-pole
F7	Residual-current device	1	40 A/0.03 A, 3-pole + N, type A
Q1	Contactor for grid disconnection	1	400 V, 63 A at AC-1, AC-7a, 4 no
Q2	Contactor for grid disconnection	1	400 V, 63 A at AC-1, AC-7a, 4 no
	Auxiliary switch for feedback	1	1 nc
Q3	Contactor for grounding device	1	400 V, 40 A at AC-1, AC-7a, 2 no 2 nc
	Auxiliary switch for Q1 locking mechanism	1	1 no
Q4	Contactor for grounding device	1	400 V, 40 A at AC-1, AC-7a, 2 no 2 nc
X1	3-conductor through terminal	3	16 mm^2, 1-pole, 3 contact points, gray
	3-conductor through terminal	1	16 mm^2, 1-pole, 3 contact points, blue
	3-conductor through terminal	1	16 mm^2, 1-pole, 3 contact points, yellow-green
	End plate for through terminal, 3-conductor	1	–
	Group marker carrier for end clamp	1	–
	End clamp	1	Width: 10 mm
X2	3-conductor through terminal	3	16 mm^2, 1-pole, 3 contact points, gray
	3-conductor through terminal	1	16 mm^2, 1-pole, 3 contact points, blue
	3-conductor through terminal	1	16 mm^2, 1-pole, 3 contact points, yellow-green
	End plate for through terminal, 3-conductor	1	–
	Group marker carrier for end clamp	1	–
	End clamp	1	Width: 10 mm
X3	3-conductor through terminal	3	10 mm^2, 1-pole, 3 contact points, gray
	3-conductor through terminal	3	10 mm^2, 1-pole, 3 contact points, blue
	3-conductor through terminal	3	10 mm^2, 1-pole, 3 contact points, yellow-green
	End plate for through terminal, 3-conductor	1	–
	Group marker carrier for end clamp	1	–
	End clamp	1	Width: 10 mm
X4	3-conductor through terminal	5	2.5 mm^2, 1-pole, 3 contact points, gray
	3-conductor through terminal	3	2.5 mm^2, 1-pole, 3 contact points, blue
	End plate for through terminal, 3-conductor	1	–
	Group marker carrier for end clamp	1	–
	End clamp	1	Width: 10 mm

Position	Material	Number of units	Description
X5	3-conductor through terminal	4	1.5 mm², 1-pole, 3 contact points, gray
	3-conductor through terminal (N)	1	6 mm², 1-pole, 3 contact points, gray
	3-conductor through terminal (L)	1	6 mm², 1-pole, 3 contact points, blue
	End plate for through terminal, 3-conductor	2	–
	Group marker carrier for end clamp	1	–
	End clamp	1	Width: 10 mm

* Required in TT grid configuration only

Configuration Suggestion

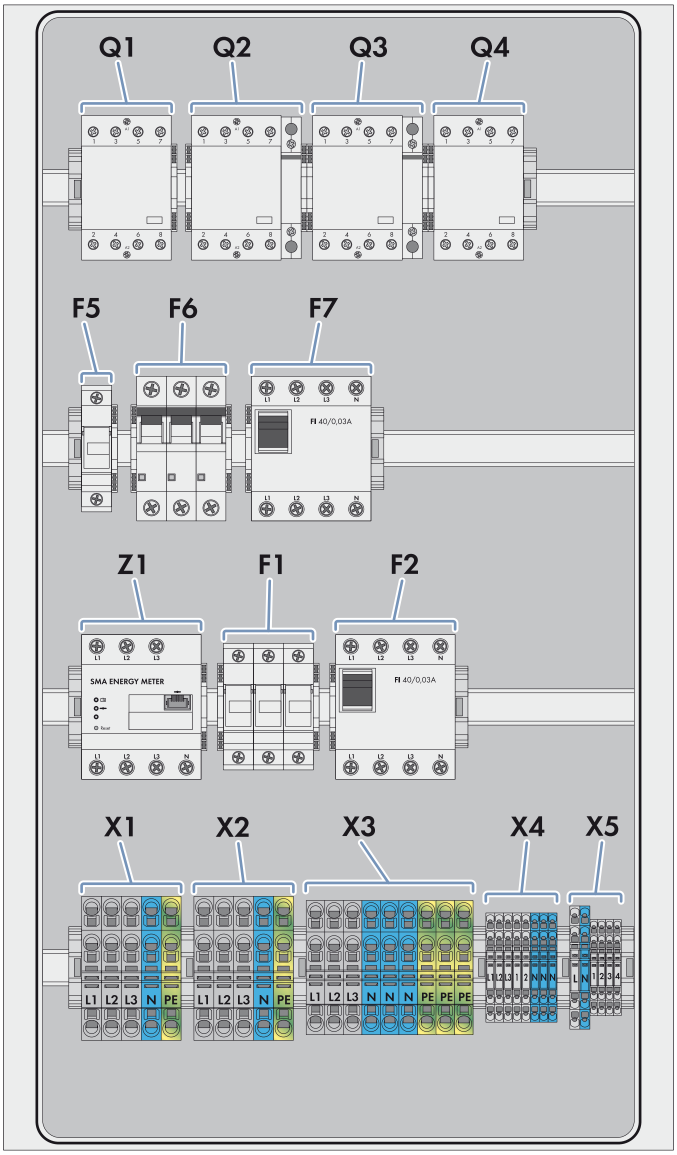


Figure 14: Configuration suggestion for three-phase automatic transfer switch with all-pole disconnection (e. g. for Germany)

6.4 Automatic Transfer Switch for Single-Phase Battery-Backup System without All-Pole Disconnection

Material List

The following table summarizes the configuration of the automatic transfer switch as suggested in the schematic diagram for a single-phase battery-backup system without all-pole disconnection (e.g. for Australia). You will need to procure the material from your distributor.

Design of the devices in the automatic transfer switch

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

Position	Material	Number of units	Description
F1	Thermal fuse for protecting the control cables and measuring cables and for protecting the multifunction relay in the Sunny Island	1	1 A, cold resistance of at least 0.2 Ω, melting integral of max. 1 A^2s
F3, F4	Circuit breaker for protection of phase coupling*	2	32 A, C rating, 1-pole
F5	Thermal fuse for protecting the control cable and for protecting the multifunction relay in the Sunny Island	1	1 A, cold resistance of at least 0.2 Ω, melting integral of max. 1 A^2s
F6	Circuit breaker for protection of the Sunny Island	1	32 A, C rating, 1-pole
F7	Residual-current device	1	40 A/0.03 A, 1-pole + N, type A
Q2	Contactor for grid disconnection	1	400 V, 63 A at AC-1, AC-7a, 4 no
	Auxiliary switch for feedback	1	1 nc
Q6	Phase coupling contactor*	1	400 V, 63 A at AC-1, AC-7a, 2 no
X1	3-conductor through terminal	3	16 mm², 1-pole, 3 contact points, gray
	3-conductor through terminal	1	16 mm², 1-pole, 3 contact points, blue
	3-conductor through terminal	1	16 mm², 1-pole, 3 contact points, yellow-green
	End plate for through terminal, 3-conductor	1	–
	Group marker carrier for end clamp	1	–
	End clamp	1	Width: 10 mm
X2	3-conductor through terminal	3	16 mm², 1-pole, 3 contact points, gray
	3-conductor through terminal	1	16 mm², 1-pole, 3 contact points, blue
	3-conductor through terminal	1	16 mm², 1-pole, 3 contact points, yellow-green
	End plate for through terminal, 3-conductor	1	–
	Group marker carrier for end clamp	1	–
	End clamp	1	Width: 10 mm

Position	Material	Number of units	Description
X3	3-conductor through terminal	1	10 mm², 1-pole, 3 contact points, gray
	3-conductor through terminal	1	10 mm², 1-pole, 3 contact points, blue
	3-conductor through terminal	1	10 mm², 1-pole, 3 contact points, yellow-green
	End plate for through terminal, 3-conductor	1	–
	Group marker carrier for end clamp	1	–
	End clamp	1	Width: 10 mm
X4	3-conductor through terminal	3	2.5 mm², 1-pole, 3 contact points, gray
	3-conductor through terminal	1	2.5 mm², 1-pole, 3 contact points, blue
	End plate for through terminal, 3-conductor	1	–
	Group marker carrier for end clamp	1	–
	End clamp	1	Width: 10 mm
X5	3-conductor through terminal	4	1.5 mm², 1-pole, 3 contact points, gray
	3-conductor through terminal (L)	1	6 mm², 1-pole, 3 contact points, gray
	3-conductor through terminal (N)	1	6 mm², 1-pole, 3 contact points, blue
	End plate for through terminal, 3-conductor	2	–
	Group marker carrier for end clamp	1	–
	End clamp	1	Width: 10 mm

* Optional

6.5 Automatic Transfer Switch for Three-Phase Battery-Backup System without All-Pole Disconnection

Material List

The following table summarizes the configuration of the automatic transfer switch as suggested in the schematic diagram for a three-phase battery-backup system without all-pole disconnection (e.g. for Australia). You will need to procure the material from your distributor.

Design of the devices in the automatic transfer switch

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

Position	Material	Number of units	Description
F1	Thermal fuse for protecting the control cables and measuring cables and for protecting the multifunction relay in the Sunny Island	3	1 A, cold resistance of at least 0.2 Ω, melting integral of max. 1 A²s
F6	Circuit breaker for protection of the Sunny Island	3	32 A, C rating, 1-pole
F7	Residual-current device	1	40 A/0.03 A, 3-pole + N, type A
Q2	Contactor for grid disconnection	1	400 V, 63 A at AC-1, AC-7a, 4 no
	Auxiliary switch for feedback	1	1 nc

Position	Material	Number of units	Description
X1	3-conductor through terminal	3	16 mm², 1-pole, 3 contact points, gray
	3-conductor through terminal	1	16 mm², 1-pole, 3 contact points, blue
	3-conductor through terminal	1	16 mm², 1-pole, 3 contact points, yellow-green
	End plate for through terminal, 3-conductor	1	–
	Group marker carrier for end clamp	1	–
	End clamp	1	Width: 10 mm
X2	3-conductor through terminal	3	16 mm², 1-pole, 3 contact points, gray
	3-conductor through terminal	1	16 mm², 1-pole, 3 contact points, blue
	3-conductor through terminal	1	16 mm², 1-pole, 3 contact points, yellow-green
	End plate for through terminal, 3-conductor	1	–
	Group marker carrier for end clamp	1	–
	End clamp	1	Width: 10 mm
X3	3-conductor through terminal	3	10 mm², 1-pole, 3 contact points, gray
	3-conductor through terminal	3	10 mm², 1-pole, 3 contact points, blue
	3-conductor through terminal	3	10 mm², 1-pole, 3 contact points, yellow-green
	End plate for through terminal, 3-conductor	1	–
	Group marker carrier for end clamp	1	–
	End clamp	1	Width: 10 mm
X4	3-conductor through terminal	5	2.5 mm², 1-pole, 3 contact points, gray
	3-conductor through terminal	3	2.5 mm², 1-pole, 3 contact points, blue
	End plate for through terminal, 3-conductor	1	–
	Group marker carrier for end clamp	1	–
	End clamp	1	Width: 10 mm
X5	3-conductor through terminal	2	1.5 mm², 1-pole, 3 contact points, gray
	End plate for through terminal, 3-conductor	2	–
	Group marker carrier for end clamp	1	–
	End clamp	1	Width: 10 mm

6.6 Operating Principle of the Automatic Transfer Switch

Differences between automatic transfer switches for single-phase and three-phase battery-backup systems

This section describes the operating principle of the automatic transfer switch as exemplified by the single-phase battery-backup system with all-pole disconnection (see Section 5.1, page 18).

- The function of the tie switch and grounding device of a three-phase automatic transfer switch is analogous to that of the single-phase automatic transfer switch.
- In battery-backup systems without all-pole disconnection, no grounding device is required.
- Phase coupling is only suitable for battery-backup grids with single-phase PV inverters and single-phase loads.

Tie Switch with All-Pole Disconnection (e.g. for Germany)

The tie switch with all-pole disconnection comprises the contactors **Q1** and **Q2**. 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 the contactors **Q1**, **Q2** and **Q3** is equal to the voltage at the line conductor L1 of the utility grid. This means that the tie switch can only be activated when grid voltage is present. Contactor **Q3** controls contactor **Q1**. Contactors **Q3** and **Q2** are controlled by the multifunction relay **Relay 1** of the Sunny Island inverter. When the multifunction relay **Relay 1** is in non-operative mode, contactors **Q2** and **Q3** will be activated. If contactor **Q3** is in non-operative mode, contactor **Q1** will also go into non-operative mode and be locked.

In the event of grid failure, contactors **Q1**, **Q2** and **Q3** go into non-operative mode due to lack of control voltage and disconnect the battery-backup grid from the utility grid at all poles. The Sunny Island also measures the voltage of the utility grid. When a deviation from country-specific voltage and frequency thresholds of the utility grid occurs, the multifunction relay **Relay 1** is activated. The contactors **Q1**, **Q2**, and **Q3** remain in non-operative mode or go into non-operative mode.

When the utility grid is restored, this is detected by the Sunny Island. The Sunny Island synchronizes the battery-backup grid with the utility grid. Following successful synchronization, **Relay 1** goes into non-operative mode and the contactors **Q2** and **Q3** are activated. Contactor **Q3** unlocks contactor **Q1** and **Q1** is activated. The battery-backup grid is again connected to the utility grid.

Tie Switch without All-Pole Disconnection (e.g. for Australia)

The tie switch without all-pole disconnection consists of contactor **Q2**. 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 the line conductor L1 of the utility grid. This means that the tie switch can only be activated when grid voltage is present. Contactor **Q2** is controlled by the multifunction relay **Relay1** of the Sunny Island inverter. When **Relay 1** is in non-operative mode, contactor **Q2** is activated.

In the event of grid failure, contactor **Q2** is deactivated due to lack of control voltage and disconnects the battery-backup grid from the line conductors of the utility grid. The Sunny Island also measures the voltage of the utility grid. When a deviation from the country-specific voltage and frequency thresholds of the utility grid occurs, the multifunction relay **Relay 1** is activated. Contactor **Q2** remains in non-operative mode or goes into non-operative mode.

When the utility grid is restored, this is detected by the Sunny Island. The Sunny Island synchronizes the battery-backup grid with the utility grid. Following successful synchronization, **Relay 1** goes into non-operative mode and contactor **Q2** is activated. The battery-backup grid is again connected to the utility grid.

Grounding Device

Contactors **Q3** and **Q4** form the grounding device. Contactors **Q3** and **Q4** are controlled by the two multifunction relays of the Sunny Island inverter. Triggering of contactor **Q3** occurs simultaneously with contactor **Q2** of the tie switch. When the tie switch is closed, contactor **Q3** connects the neutral conductor in the battery-backup grid to the grounding conductor.

In addition, the Sunny Island uses the multifunction relay **Relay 2** to control contactor **Q4**. When the multifunction relay **Relay 2** is activated, the 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.

Phase coupling

Contactor **Q6** is the phase coupler. When the multifunction relay **Relay 2** is activated on the Sunny Island, this activates contactor **Q6** and connects the unsupplied line conductors via circuit breakers **F3** and **F4** with the supplied line conductor.

7 Installation Site

The following products within the SMA Flexible Storage System with battery-backup function impose requirements on the installation site which must be taken into account at the planning stage.

- Sunny Island 3.0M / 4.4M / 6.0H / 8.0H with battery
- Sunny Remote Control
- BatFuse B.01 / B.03
- SMA Energy Meter
- Sunny Home Manager

The requirements made on the installation site of the automatic transfer switch are listed in the manufacturer documentation of the switch cabinet and its components.

With reference to the entire battery-backup system, the following requirements should be taken into account from the initial planning stage:

- ☐ The minimum clearances to walls, objects, SMA products or other technical devices must be complied with.
- ☐ The ambient conditions must meet the requirements of the individual products towards the installation site.
- ☐ The maximum cable routes and radio ranges between the installed SMA products to one another and to other devices must be feasible.
- ☐ The cable cross-sections and the conductor materials of the cables used must meet the requirements of the specified products.
- ☐ The battery room must meet the requirements of the battery manufacturer.

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

Document title	Document type
Sunny Island 3.0M / 4.4M / 6.0H / 8.0H	Installation Manual
Sunny Remote Control	Mounting Instructions
BatFuse	Installation Manual
SMA Energy Meter	Installation Manual
Sunny Home Manager	Installation Manual

8 Glossary

Battery-Backup Grid

A battery-backup grid is that part of a household grid which is supplied by the battery-backup system in the event of grid failure.

Battery-Backup System

A battery-backup system provides an electricity supply for loads in case of grid failure. In this case, the battery-backup system switches automatically from the utility grid to the alternative energy source.

Battery Charging

Battery charging is the power that is currently being charged to the battery.

Battery Discharging

Battery discharging is the power that is currently being drawn from the battery. Battery discharging takes place when the energy demand of the loads exceeds the current power of the PV system.

Bridging Time

The bridging time is the time from the grid failure until restoration of the utility grid which is bridged by the battery-backup system.

Direct Consumption

The direct consumption is the power that the loads draw directly from the PV system. Flexible loads are only switched on at times when their energy demand is completely covered by the PV system.

Grid Failure

A grid failure is an outage of the utility grid. If the utility grid deviates from the country-specific thresholds for voltage and frequency, the Sunny Island will react in the same way as if a utility grid failure has occurred.

Intermediate Storage

Intermediate storage in a battery is a means of energy management. It enables the consumption of PV energy irrespective of the time of generation, e.g. in the evening or during bad weather. This makes it possible even for loads tied to specific time periods to be operated with PV energy.

Internal Power Supply

With internal power supply, the loads in your household cover their energy demand with PV energy generated on site. Internal power supply is made up of direct consumption and battery discharging.

Self-Consumption

Self-consumption is a measure of the amount of PV energy used at the point of generation or in the immediate vicinity. Self-consumption is made up of direct consumption and battery charging.

Self-Consumption Quota

The self-consumption quota is the current ratio of self-consumption to PV generation.

Switching Time

The switching time is the time needed by the battery-backup system to restore the supply of the loads in case of grid failure.

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