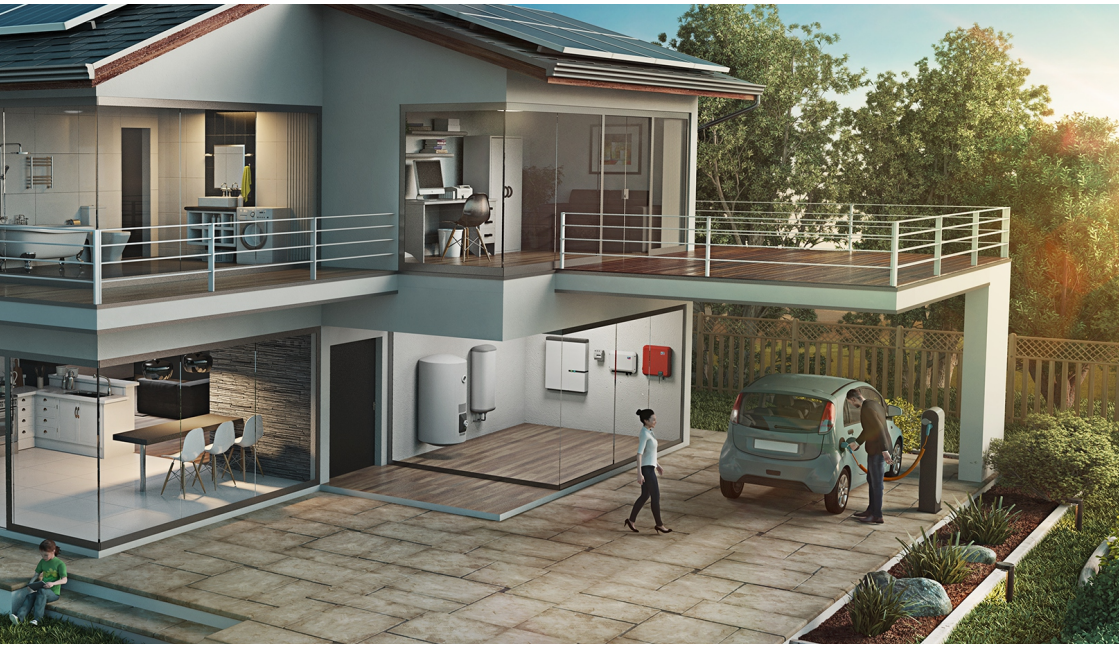
Planning Guidelines



PV Systems with Zero Export

ENGLISH

ZeroFeedIn-PL-en-11 | Version 1.1

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1 Introduction

Zero-export systems are systems that consist of power generation units and, if applicable, battery-storage systems. Such systems are not designed for feeding into the utility grid and they actively prevent this. The zero-export system from SMA maximizes self-consumption and uses 100% of the self-generated solar power. Our system lets customers expand the solar energy without high additional investments in the utility grids. This is necessary if the grid operator does not allow grid feed-in because of a weak infrastructure and possible overload, for example.

SMA offers a variety of solutions especially for PV systems that are no longer allowed or intended to feed solar power into the grid due to restrictions imposed by the grid operator:

- **Solution 1: Direct self-consumption with zero export**

  An intelligent PV inverter is installed in the system. This inverter is configured for zero export and dynamically limits the power if it cannot be consumed in the household at the same time it is generated. Direct self-consumption can cover 30% to 40% of power consumption in a typical household.
- **Solution 2: Self-consumption with a battery-storage system and zero export**

  This system is equipped with a storage system so that a larger proportion of the consumed power can be covered by electric current from the customer's own PV system. It also requires an intelligent PV inverter that can regulate the power. 1 Sunny Island 4.4M / 6.0H / 8.0H or 1 Sunny Boy Storage 2.5 / 3.7 / 5.0 / 6.0 can be installed as the battery inverter. As an alternative to an intelligent PV inverter and an additional battery inverter, an intelligent hybrid inverter may be used. In a typical household, the proportion of self-generated solar power after installing such a storage system is 50% to 70%.
- **Solution 3: Retrofit a battery-storage system for self-consumption with zero export in existing PV systems**

  If a PV inverter from another manufacturer is installed in the existing system or the existing inverter cannot be regulated, the system can be upgraded to a zero-export system by adding a storage system. Any PV inverter can be used in the system in combination with a compatible lithium-ion battery. 1 Sunny Island 4.4M / 6.0H / 8.0H must be installed as the battery inverter. The proportion of self-generated energy in the power consumption is 50% to 70%.

SMA solution	PV inverter	Storage system	Additional components
Solution 1	The inverter must be able to regulate the power.	-	Components for intelligent energy management Optional upgrade by adding components for charging electric vehicles

SMA solution	PV inverter	Storage system	Additional components
Solution 2	The inverter must be able to regulate the power.	1 Sunny Island 4.4M / 6.0H / 8.0H or 1 Sunny Boy Storage 3.7 / 5.0 / 6.0 or 1 Sunny Tripower 5.0 / 6.0 / 8.0 / 10.0 Smart Energy with compatible lithium-ion battery	Components for intelligent energy management: Sunny Home Manager 2.0 Optional upgrade by adding components for charging electric vehicles Optional system upgrade by adding a battery-backup system
Solution 3	Any inverter can be used. Make sure that the AC power of the PV inverter is not greater than the rated power of the battery inverter.	Upgrade of the existing PV system by adding 1 Sunny Island 4.4M / 6.0H / 8.0H and a battery-storage system. A compatible lithium-ion battery can be used for this.	Components for intelligent energy management Additional contactor for disconnecting the PV inverter Optional upgrade by adding components for charging electric vehicles

2 Solution 1: Direct Self-consumption with Zero Export

2.1 System Configuration

Systems can be operated as zero-export systems even if grid feed-in is not possible or desired, as long as 100% of the generated energy is self-consumed. Here, it is important that the PV inverter can regulate the generated power so that only so much energy is generated as is currently consumed and in total no energy is fed into the grid. The amount of self-consumption can be increased by adding controllable loads. For instance, the generated energy can be used to charge an electric vehicle.

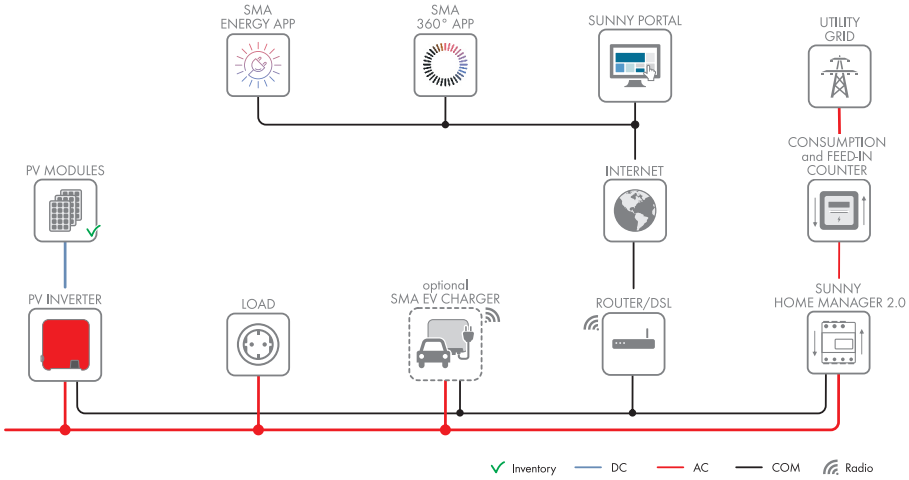

Figure 1: System configuration: Solution 1

If the inverter of your PV system cannot regulate the power, it must be replaced with a new inverter. Alternatively, you can upgrade your PV system by adding a Sunny Island (see Section 4, page 10).

The SMA inverters listed below can regulate the power within the allowed time:

- Sunny Boy 3.0 / 3.6 / 4.0 / 5.0 (SB3.0-1AV-40 / SB3.6-1AV-40 / SB4.0-1AV-40 / SB5.0-1AV-40)
- Sunny Boy 3.0 / 3.6 / 4.0 / 5.0 / 6.0 (SB3.0-1AV-41 / SB3.6-1AV-41 / SB4.0-1AV-41 / SB5.0-1AV-41 / SB6.0-1AV-41)
- Sunny Boy 1.5 / 2.0 / 2.5 (SB1.5-1VL-40 / SB2.0-1VL-40 / SB2.5-1VL-40)
- Sunny Tripower 3.0 / 4.0 / 5.0 / 6.0 / 8.0 / 10 (STP3.0-3AV-40 / STP4.0-3AV-40 / STP5.0-3AV-40 / STP6.0-3AV-40 / STP8.0-3AV-40 / STP10.0-3AV-40)
- Sunny Tripower X 12 / 15 / 20 / 25 (STP12-50 / STP15-50 / STP20-50 / STP25-50)

2.2 System Requirements for Zero Export

If your PV system is equipped with an inverter that can regulate the power, you can basically operate your system as a zero-export system without any upgrades.

For zero export, the hardware components listed below must be included in the PV system:

- ☐ Controllable PV inverter
- ☐ Sunny Home Manager 2.0 (from firmware version 2.6.6.R)

  The Sunny Home Manager 2.0 must provide the measured values from the point of interconnection every 200 ms so that the required control dynamics can be reached. Therefore, the setting in Sunny Portal must be changed after registering the system:
  - On the **Configuration > Device Overview > HomeManager > Characteristics** page, select the [**Process**] button.
  - Select **Extended Configuration**.
  - In the **Counter Configuration** field, set the measuring interval to **200 ms**.
- ☐ Additional components to increase self-consumption, e.g., radio-controlled sockets or a controllable heating rod

To charge an electric vehicle with solar power, you need to upgrade the system by adding the SMA EV Charger.

With this solution, you can always install a storage system at a later time.

3 Solution 2: Self-consumption with a battery-storage system and zero export

3.1 System Configuration

In the case of systems where grid feed-in is not possible or desired, but you want to increase the proportion of self-generated energy in the consumed power, we advise installing a storage system in addition to the smart PV inverter. This reduces grid purchase costs to a minimum. To ensure that the system does not feed into the utility grid, an SMA Home Manager 2.0 must be installed. It measures the power at the point of interconnection, limits the PV inverter as soon as the battery-storage system is fully charged, and prevents the electric current from flowing into the utility grid.

Here, it is important that the PV inverter can regulate the generated power so that only so much energy is generated as is currently consumed. The storage system, consisting of a battery inverter and battery, supplements the power generators. Alternatively, the system can be designed with a hybrid inverter to which further PV inverters may be added. The storage system lets you shift the time of consumption so that your own solar power can be used at night, for example. For instance, the generated energy can be used to charge an electric vehicle. In addition, installing a battery-backup system can provide security if the utility power grid fails.

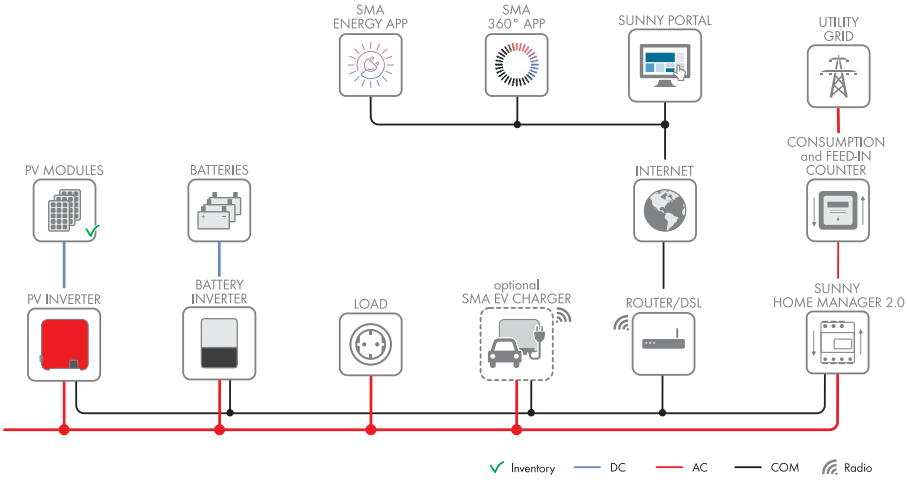

Figure 2: Design of the PV system: solution 2 with PV and battery inverters

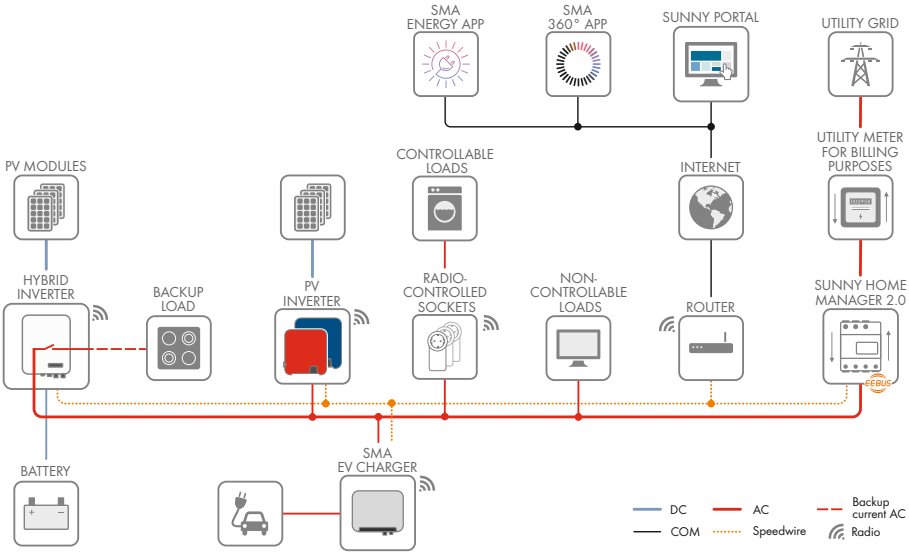

Figure 3: Design of the PV system: solution 2 with hybrid inverter and optional PV inverters

The SMA inverters listed below meet the requirements of Solution 2 and do not need to be replaced:

PV inverter	Battery inverter	Hybrid inverter
Sunny Boy (SB)	**Sunny Boy Storage (SBS)**	**Sunny Tripower Smart Energy (STP SE)**
SB3.0-1AV-40	SBS2.5-1VL-10	STP5.0-3SE-40
SB3.6-1AV-40	SBS3.7-10	STP6.0-3SE-40
SB4.0-1AV-40	SBS5.0-10	STP8.0-3SE-40
SB5.0-1AV-40	SBS6.0-10	STP10.0-3SE-40
SB3.0-1AV-41	**Sunny Island (SI)**	
SB3.6-1AV-41	SI4.4M-12	
SB4.0-1AV-41	SI6.0H-12	
SB5.0-1AV-41	SI8.0H-12	
SB6.0-1AV-41	SI4.4M-13	
SB1.5-1VL-40	SI6.0H-13	
SB2.0-1VL-40	SI8.0H-13	
SB2.5-1VL-40		
Sunny Tripower (STP)		

PV inverter	Battery inverter	Hybrid inverter
STP3.0-3AV-40		
STP4.0-3AV-40		
STP5.0-3AV-40		
STP6.0-3AV-40		
STP8.0-3AV-40		
STP10.0-3AV-40		
STP12-50		
STP15-50		
STP20-50		
STP25-50		

3.2 System Requirements for Zero Export

For zero export, the hardware components listed below must be included in a PV system equipped with a battery-storage system:

- ☐ Controllable PV inverter
- ☐ Sunny Boy Storage 2.5 / 3.7 / 5.0 / 6.0 or Sunny Island 4.4M / 6.0H / 8.0H
- ☐ Compatible battery-storage system
- ☐ Sunny Home Manager 2.0 (from firmware version 2.6.6.R)

  The Sunny Home Manager 2.0 must provide the measured values from the point of interconnection every 200 ms so that the required control dynamics can be reached. Therefore, the setting in Sunny Portal must be changed after registering the system:

  - On the **Configuration > Device Overview > HomeManager > Characteristics** page, select the [**Process**] button.
  - Select **Extended Configuration**.
  - In the **Counter Configuration** field, set the measuring interval to **200 ms**.
- ☐ Additional components to increase self-consumption, e.g., radio-controlled sockets or a controllable heating rod

To charge an electric vehicle with solar power, you need to upgrade the system by adding the SMA EV Charger.

4 Solution 3: Retrofit a Battery-storage System for Self-consumption with Zero Export in Existing PV Systems

4.1 System Configuration

Solution 3 is a zero-export system with a battery-storage system. The system is operated with 1 PV inverter and 1 Sunny Island. This solution is especially useful for PV systems in which the PV inverter is not an SMA product, cannot regulate the energy, and should not be replaced by another product.

In this system, the generated energy is regulated by the battery inverter. If the PV inverter cannot be controlled by communication, an additional contactor controlled by the multifunction relay of the battery inverter must be installed. As soon as a defined state of charge is reached in the battery, the battery inverter opens the contactor and this temporarily disconnects the PV inverter from the system. When the battery falls below a defined state of charge, the battery inverter closes the contactor so that the PV inverter can generate energy again.

Here, it is important that the charging power of the battery inverter is at least equal to the maximum AC power of the PV inverter. This ensures that the energy from the PV system is not fed into the utility grid but is received by the battery-storage system, or the PV system is disconnected by the contactor.

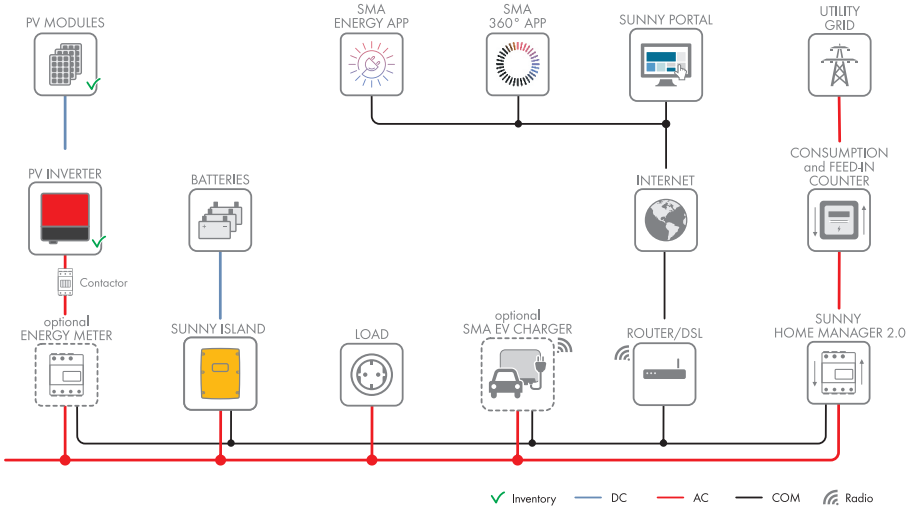

Figure 4: System configuration: Solution 3

The SMA battery inverters listed below can be used in a storage system:

- Sunny Island 4.4M / 6.0H / 8.0H (SI4.4M-12 / SI6.0H-12 / SI8.0H-12)
- Sunny Island 4.4M / 6.0H / 8.0H (SI4.4M-13 / SI6.0H-13 / SI8.0H-13)

Only compatible lithium-ion batteries are suitable for this use case (see "TI Batteries in Sunny Island Systems – List of Approved Batteries" at www.SMA-Solar.com). Lead batteries are not suitable for this use case.

4.2 System Requirements for Zero Export

For zero export, the hardware components listed below must be included in an existing PV system equipped with a battery-storage system:

- ☐ The existing PV inverter is used. Any PV inverter can be used for this.
- ☐ Additional contactor for closed-loop control of the PV inverter
- ☐ Sunny Island 4.4M / 6.0H / 8.0H (from firmware version 3.30.12.R). Make sure that the maximum AC power of the PV inverter is less than or at most equal to the rated power of the battery inverter being used.
- ☐ Compatible lithium-ion battery
- ☐ Sunny Home Manager 2.0 (from firmware version 2.6.6.R)

  The Sunny Home Manager 2.0 must provide the measured values from the point of interconnection every 200 ms so that the required control dynamics can be reached. Therefore, the setting in Sunny Portal must be changed after registering the system:
  - On the **Configuration > Device Overview > HomeManager > Characteristics** page, select the [**Process**] button.
  - Select **Extended Configuration**.
  - In the **Counter Configuration** field, set the measuring interval to **200 ms**.
- ☐ Additional components to increase self-consumption, e.g., radio-controlled sockets or a controllable heating rod

To use e-mobility as well, you need to upgrade the system by adding the SMA EV Charger.

Installing a Contactor for Closed-Loop Control of the PV Inverter

The Sunny Island features an integrated multifunction relay that uses a contactor to switch the PV inverter on and off. The contactor must be installed additionally.

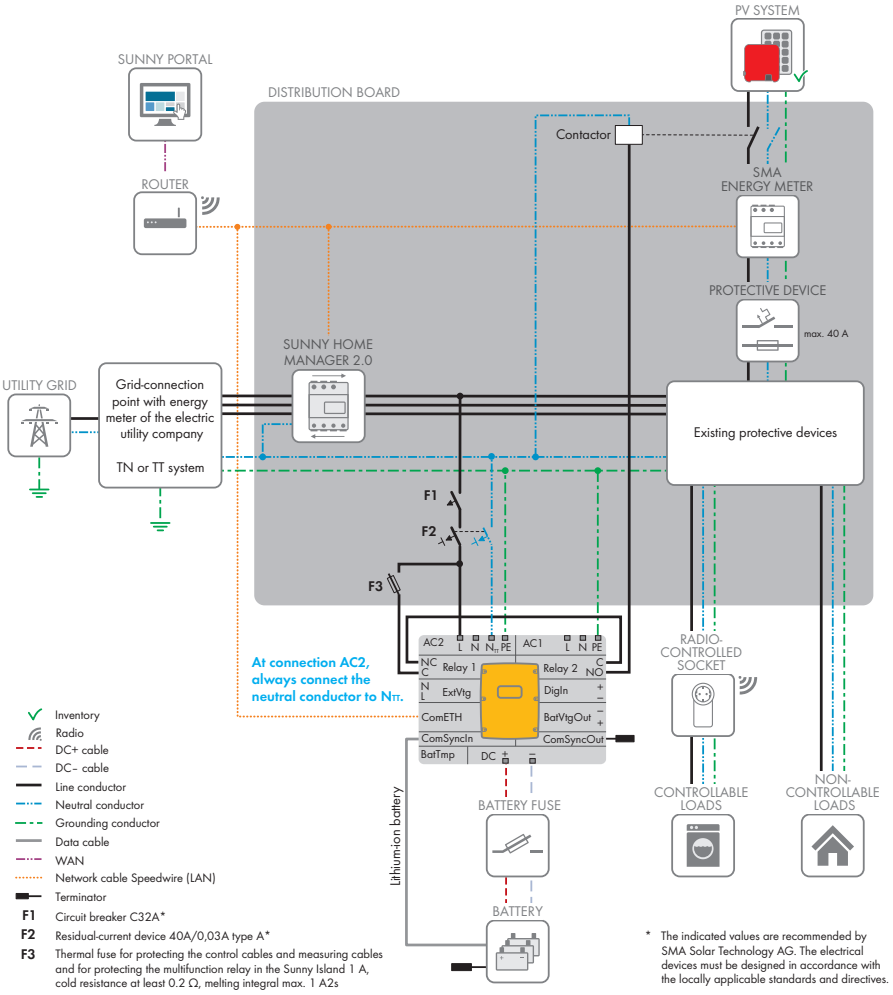

Figure 5: Circuitry overview for a system with Solution 3

Requirements for the Additional Installations:

☐ Contactor with 2 make contacts: 230 VAC, 32 A, 2 x S

☐ The contactor must be connected to the **relay 1** and **relay 2** connections in Sunny Island. The contacts **C** and **NC** as well as **C** and **NO** are used in series connection. For information on cable requirements and the installation procedure for the Sunny Island, refer to the Sunny Island operating manual in the download area of our homepage at www.SMA-Solar.com.

Requirements for a single-phase system with Sunny Island:

- A single-phase system with a Sunny Island is only used for increased self-consumption, not as a battery-backup system.

Adjusting the Parameters via the User Interface of the Battery Inverter

Adjusting the Parameters of the Switching Limits

The following parameters in the parameter group **Device > Load shedding 1** in the Sunny Island must be adjusted via the user interface so that the Sunny Island can control the PV inverter reliably.

- Disconnection of the PV inverter: For relay 1 **Battery state of charge threshold for stop load shedding 1**: 85% of the SOC
- Connection of the PV inverter: For relay 1 **Battery state of charge threshold for start load shedding 1**: 75% of the SOC
- Relay 2 is closed when Sunny Island is in operation.
- Relay 2 is opened when the Sunny Island is switched off, set to stop, or displays a fault.

Adjusting the Country Data Set

The current country data set must be selected for the system. To do this, the system must be configured as an on-grid system with self-consumption.

For information on the procedure for changing the settings on the Sunny Island user interface, refer to the Sunny Island operating manual in the download area of our homepage at www.SMA-Solar.com.

Communication failure between Sunny Island and energy meter or Sunny Home Manager 2.0

If communication between the Sunny Island and the SMA Energy Meter or the Sunny Home Manager 2.0 is interrupted, the Sunny Island stops after a certain time and both multifunction relays switch to the idle state. As a consequence, the PV inverter operation is also stopped.

- The time to detect an interruption in the communication can be set in the parameter group **System and device control** via the device parameter **Communication timeout data logging energy meter at the point of interconnection** (1 to 30 seconds; default setting: 2 seconds).

5 Setting Zero Export

Requirement:

☐ All system requirements of the selected solution have been met.

☐ The system needs to be registered in Sunny Portal.

Procedure:

1. Log in to Sunny Portal and call up the desired system.
2. In the menu **Configuration > System properties > Parameters**, select the button [**Edit**].
3. In the **Limiting of the active power feed-in** field, select the subitem **Max. ## % of the nominal PV system power** and enter **0**.
4. If a battery inverter is present in the system: activate **Including the battery inverter**.
5. Click on [**Save**].
6. Log in to the user interface of the battery inverter as **Installer**.
7. Select **User Settings > SMA Grid Guard Login** and enter the SMA Grid Guard code.
8. Call up the menu **Device parameters**.
9. Click on [**Edit parameters**].
10. Set the parameter **Operating mode active power setting** to **External setting** in the parameter group **System and device control > Inverter > Active power mode**.
11. Click on [**Save all**].

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