Stand-alone grid inverter

Sunny Island 2012/2224

Technical Description

SI2012_2224-TEN082311 | 98-2005110 | Version 1.1

EN

Overview of the menu area:

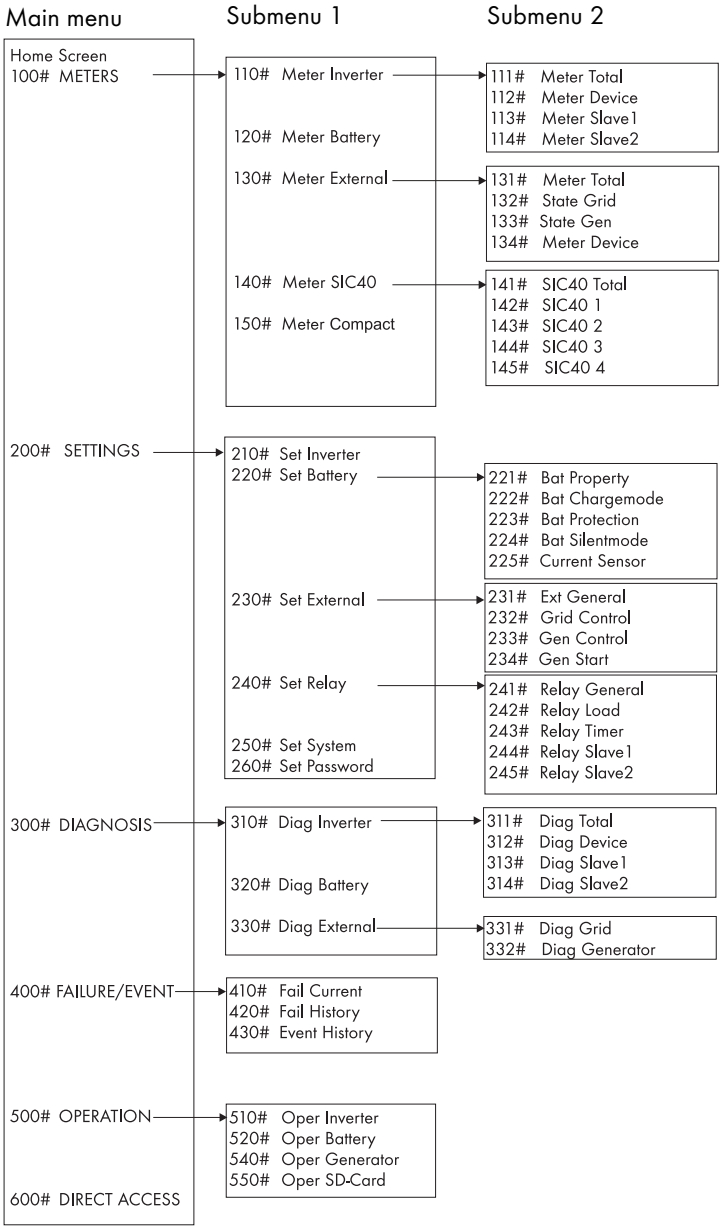


Table of Contents

1 Notes on this Manual

This technical description explains the functioning, correct installation and operation of a stand-alone grid system. It describes the Sunny Island 2012 / 2224 inverter as well as the Sunny Remote Control 1 display.

Information on the following topics can be found in the respectively labeled sections:

- Installation:	Chapter 2 "System Overview" (Page 12)
- Commissioning:	Chapter 8 "Control Elements" (Page 70)
- Functions:	Chapter 11 "Additional Functions" (Page 117)
- Appendix:	Chapter 16 "Maintenance and Care" (Page 158)

1.1 Validity

The technical description applies to the Sunny Island 2012 / 2224 firmware versions 2.0 and later (see chapter 4.2 "Name Plate/Firmware Version" (Page 20)).

You can read the firmware version of your Sunny Island 2012 / 2224 on the display using the "312.02 FwVer" parameter (see section 17.3 "Diagnosis" (Page 178)).

Information

The following applications are only possible with firmware versions 3.0 and above:

- Connection of two or three Sunny Island 2012 / 2224 devices to a 1-phase parallel system
- Connection of two or three Sunny Island 2012 / 2224 devices to a 3-phase parallel system

The stand-alone grid system devices may only be operated within the intended area of application described in this documentation.

- The use of a stand-alone grid system to power life-sustaining medical devices is not permitted.
- The Sunny Reomet Control 1 is suited only for installation in enclosed spaces (protection rating IP20).
- The Sunny Island 2012 / 2224 has been designed for use at elevations of up to 2600 m above sea level. Please contact SMA Solar Technology AG before using the device at elevations above 2600 m.

  A performance loss of 0.5 % per every 100 m is to be expected starting at an elevation of 2000 m above sea level.

Do not use the stand-alone grid system devices for purposes other than those indicated in this technical description. Use of the devices for other purposes can void the warranty as well as damage both the devices and the system.

For further questions, you can call the Sunny Island hotline at

- +49561 95 22 399
- E-Mail: SunnyIsland.Service@SMA.de.

1.2 Target Group

This technical description is meant both for the installer and the operator of the stand-alone grid system. Some of the tasks described in this document must be performed only by qualified electricians and are labeled accordingly with warnings.

1.3 Storage of the Documentation

The manuals for the stand-alone grid system and its installed components must be kept in the immediate vicinity of the Sunny Island so as to be accessible at all times.

1.4 Explanation of the Symbols Used

The following types of safety warnings are used in this document:

DANGER!

"DANGER" indicates a hazardous situation which, if not avoided, will result in death or serious injury.

WARNING!

"WARNING" indicates a hazardous situation which, if not avoided, could result in death or serious injury.

CAUTION!

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

Notice!

"NOTICE!" designates a safety warning about a condition which can lead to property damage if the warning is ignored.

Information

"Notice" designates information which is important for the optimal operation of the product.

1.5 Syntax

The syntax specified here for menus and parameters applies throughout the entire document:

Menu:	Menu number, hash and menu name (150# Meter Compact)
Parameter:	Menu number, dot, parameter number and parameter name (150.01 GdRmgTm)

Information

The parameter names used are based on the international IEC 61850-7-4 and 61400-25 standards.

2 System Overview

The Sunny Island is a bi-directional battery inverter (battery inverter and charger) for off-grid systems. The Sunny Island supplies consumers on the stand-alone grid side and charges battery banks with the energy from grid-feeding units connected on the AC side.

High efficiency

The comfortable support of AC- and DC coupling as well as the expandability of the systems formed with the Sunny Island guarantee highest flexibility. In addition, innovative technology allows the Sunny Island to achieve a maximum efficiency of more than 93 %. Optimized for partial load operation, its low open-circuit and standby consumption are convincing features. Because of its high overload capability and integrated power management, overdimensioning of the Sunny Island is not necessary.

Multiple Phase / Parallel Connection Capabilities

The parallel operation of up to three devices on a single phase of a battery or of three devices on a three-phase system enables the Sunny Island to be used to set up stand-alone power supply systems with outputs of up to 9 kW.

Automatic Generator Control

Thanks to its sophisticated generator management it can control connected diesel generators in a particularly gentle and fuel-saving manner. It can also be integrated into the public grid. The Sunny Island can also deactivate loads automatically if the battery does not provide sufficient electrical energy.

Perfected Battery Management

The stand-alone grid's critical component, the battery, is monitored diligently and utilized optimally. The intelligent battery management registers the battery's state of charge precisely. This makes possible an improved utilization of the battery capacity, which means that smaller and thus more cost-effective batteries can be used without affecting performance.

In order to prevent premature aging caused by incorrect charging and frequent deep discharge, the Sunny Island has an intelligent charge control and reliable deep discharge protection. Because of these functions the battery service life can be largely extended, in comparison with simpler devices.

DC fuse

WARNING!

The Sunny Island 2012 / 2224 has no internal DC fuse.

Install an external DC fuse between the Sunny Island and the battery (see chapter 7.2 "DC connection" (Page 43)).

As an external DC fuse, the BatFuse secures the Sunny Island's battery connection leads.

In addition, the BatFuse allows the disconnection of the inverter on the DC side. You will find more information in the technical description of the BatFuse. You can obtain the BatFuse as an accessory from the SMA Solar Technology AG.

Simple Installation and Configuration

Despite the complex function of this battery inverter, the Sunny Island is easy to install and configure. All the settings required for operation can be quickly and easily programmed in ten steps using the "Quick Configuration Guide". Using the central operation concept referred to as "Single Point of Operation", the system/cluster parameters are only set on the master device; all other devices adopt the configuration automatically.

Menu Navigation and Data Archiving

The easy-to-understand menu navigation allows quick access to all important data, even while the system is running. The Sunny Island can be controlled easily with the Sunny Remote Control 1 (SRC-1) external display. An MMC/SD card provides simple system supervision and thus simplifies any service tasks.

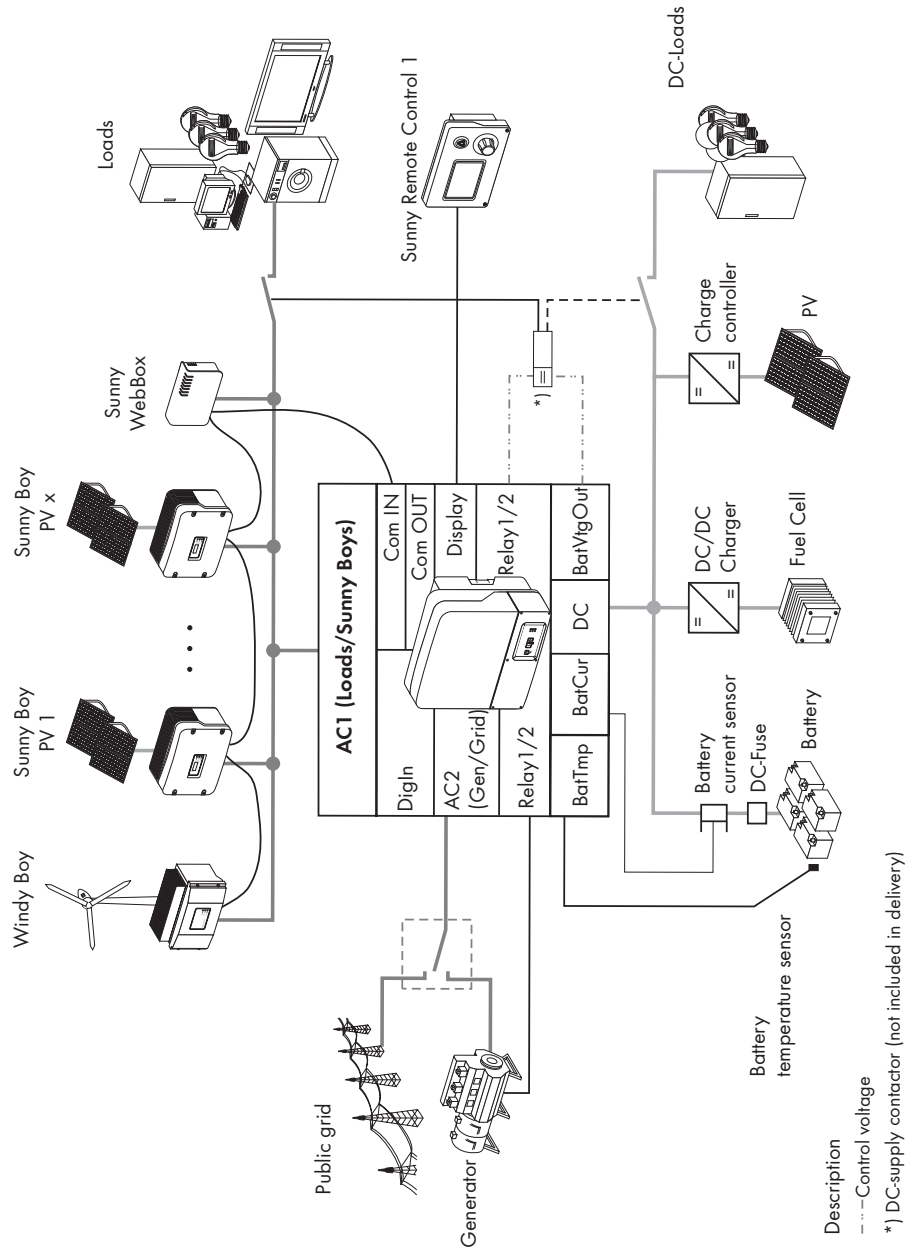
Saving Data

Always use the MMC/SD card for saving data and events. This way, in case of a failure, the SMA Solar Technology AG can help you quickly.

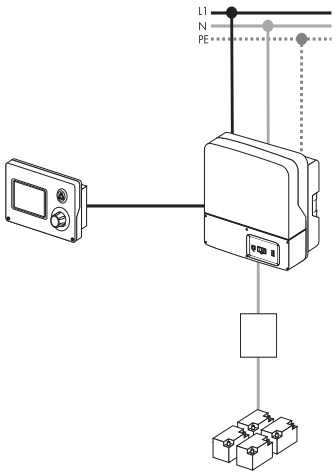
The Sunny Island monitors the set voltage and frequency limits on the grid and generator. If these limits are not observed, it disconnects from the external source without interruption and changes to stand-alone grid operation. The Sunny Island also has an integrated anti-islanding process in order to prevent unintended islanding on the public grid. If this process is triggered, the system will also change to stand-alone mode without any interruption.

You can use the Sunny Island within various system configurations.

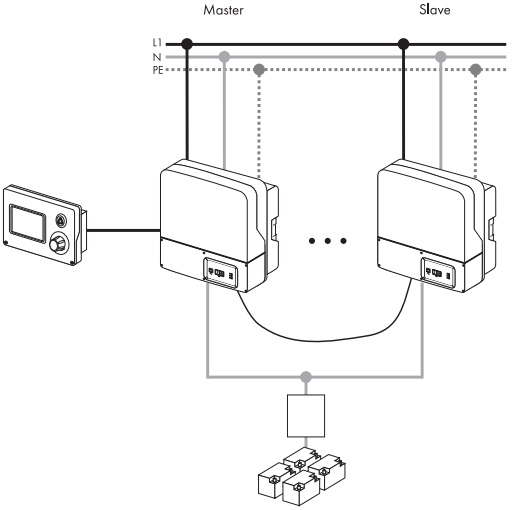
- The graphic on the following page shows which components can be integrated into a stand-alone grid system.
- The graphics on the page after next show the different wiring options (1-phase, 1-phase parallel and 3-phase).


Loads
Sunny Remote Control 1
DC-Loads
Sunny WebBox
Charge controller
PV
Sunny Boy PV x
Sunny Boy PV 1
Windy Boy
AC1 (Loads/Sunny Boys)
Com IN
Com OUT
Display
Relay1/2
BatVtgOut
DigIn
AC2 (Gen/Grid)
Relay1/2
BatTmp
BatCur
DC
*)
DC/DC Charger
Fuel Cell
Battery current sensor
DC-Fuse
Battery
Public grid
Generator
Battery temperature sensor
Description
– ·· – Control voltage
*) DC-supply contactor (not included in delivery)

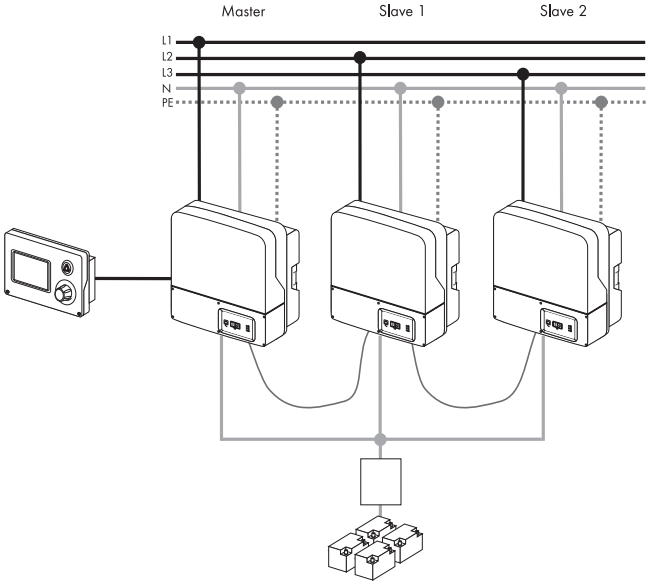
1-phasig



1-phasig parallel

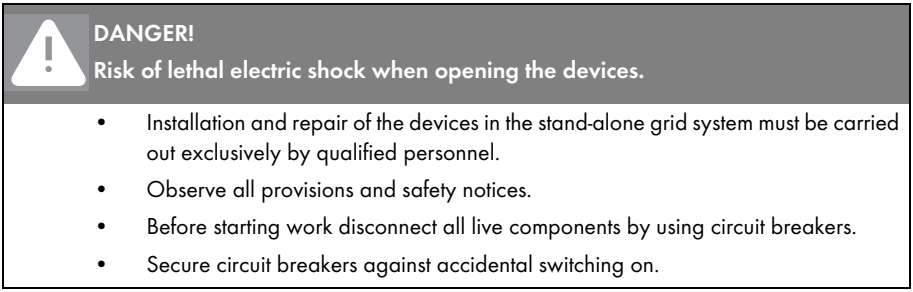


3-phasig



3 Safety Instructions

Please follow all operating and safety instructions in this manual. Failure to follow these instructions could result in damage to the device and personal hazard.



Information

Be sure to observe all applicable regional standards and guidelines.

4 Unpacking

Before installing the Sunny Island and the Sunny Remote Control 1, make sure that all parts are included in the delivery.

- Carefully check the packaging and the devices for any signs of damage.
- Ensure that all parts are included in the delivery (see section 4.1 "Scope of delivery" (Page 18)).

If something is missing or if the devices have been damaged during shipment, contact the SMA Solar Technology AG immediately. Further information is provided in section .21 "Contact" (Page 201).

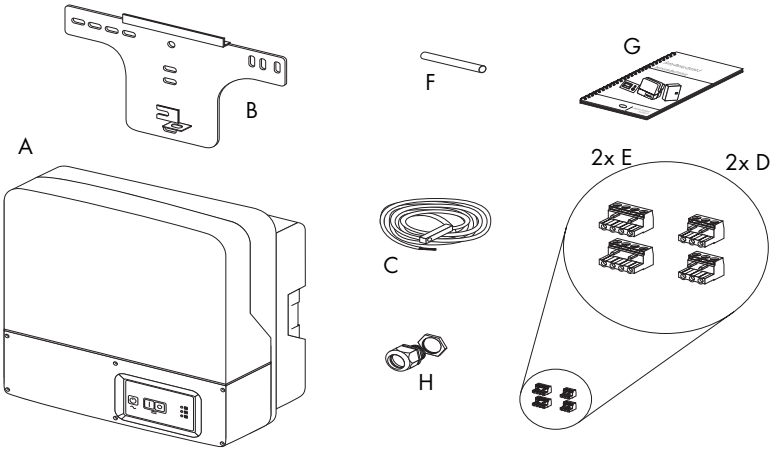
Information

Keep the packaging in case you need to return the Sunny Island, the Sunny Remote Control 1 or their accessories.

4.1 Scope of delivery

4.1.1 Sunny Island 2012/2224

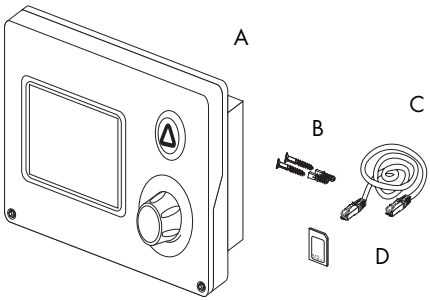
The following elements are included:



A	1	Sunny Island 2012/2224 and lid.
B	1	Wall bracket
C	1	Battery temperature sensor
D	2	3-pin print terminals (for connecting relays 1 & 2)
E	2	4-pole print terminals for connecting battery temperature sensors
F	1	silicone tube 10 mm x 0.5 m
G	1	Technical Description (Manual)
H	1	M25 metric-thread cable screw

4.1.2 Sunny Remote Control 1

The following elements are included:



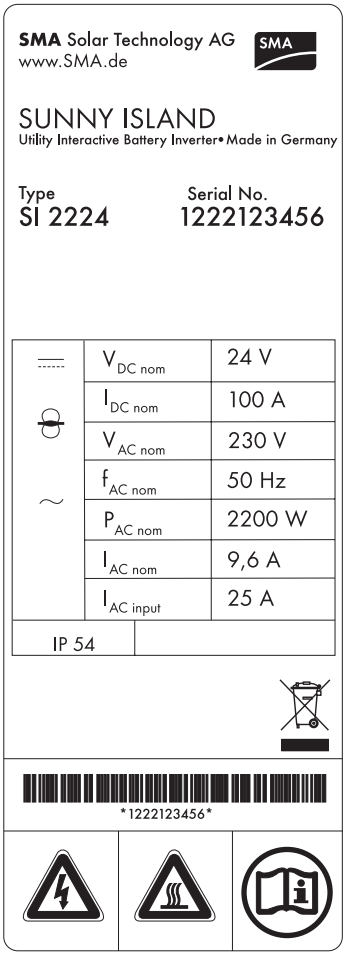
A	1	Sunny Remote Control 1 (SRC-1)
B	2	Screws and dowels
C	1	CAT5e-FTP patch cables (2 x RJ45 plugs, 5 m)
D	1	MMC/SD card

4.2 Name Plate/Firmware Version

4.2.1 Sunny Island 2012/2224

You can identify the Sunny Island by the type plate and firmware version. The following diagram shows the type plate of the Sunny Island 2224.

- The name plate is located outside on the right side of the housing.
- You can read the the firmware version of your device on the display using the "331.02 FwVer" parameter (see section 17.3 "Diagnosis" (Page 178).



4.2.2 Sunny Remote Control 1

You can identify the display by the name plate. The type plate is located on the rear side of the Sunny Remote Control 1.

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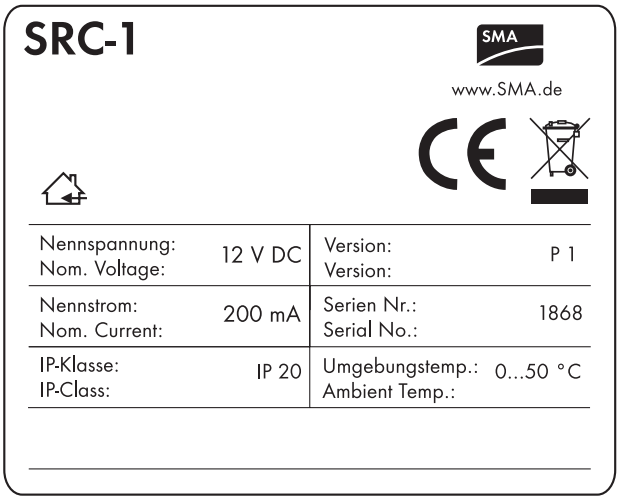


5 Installation

Take note of the required installation conditions specified in the sections **below** before mounting, installing and commissioning the Sunny Island.

5.1 Required Tools and Resources

The following tools and materials are recommended for mounting and installing the island grid system:

Tools (not included in delivery)

- Stripping pliers
- Drill (e.g. stone drill), Ø 6 to 10 mm
- Drill
- Crimping tool for cable lug
- Torque wrench (4 Nm to 10 Nm), 13 mm socket wrench
- 4 mm allen wrench
- Cable knife
- Ratchet (including extension)
- Combination pliers
- 13 mm open end/ring wrench
- Multimeter
- Diagonal cutting pliers
- Phillips screwdriver, PH1and PH2
- Flathead screwdriver, 0.4 x 2.5 mm/1.0 x 10 mm/1.0 x 5.5 mm
- Spirit level

Material (not included in delivery)

- Cable end sleeves
- Wall anchors for the wall bracket (e.g. SX 10)
- Cable ties
- AC cable (3 leads, 2.5 mm² each)
- DC cable (95 mm² max.)
- Cable lug for DC cable
- hexagon bolts, 8x60 mm, washers

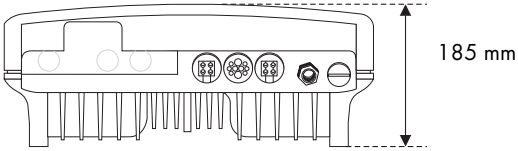
Material (not included in delivery)

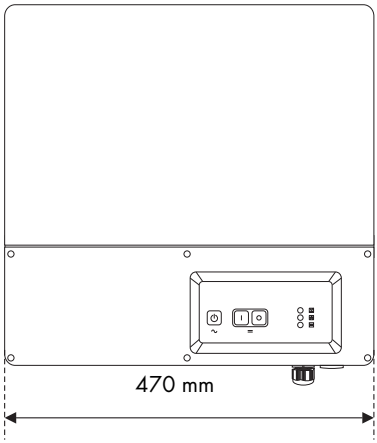
Heat shrink tubing

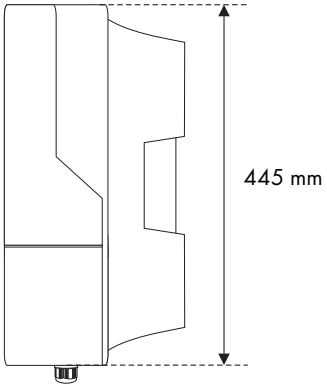
5.2 Sunny Island 2012/2224

5.2.1 Dimensions

Housing:







5.2.2 Choosing a Mounting Location

DANGER!
Death hazard due to fire or explosions

The temperature of the enclosure can reach 60 C during operation.

Do not install the device

- on flammable construction materials,
- in areas where highly flammable materials are stored,
- in potentially explosive areas

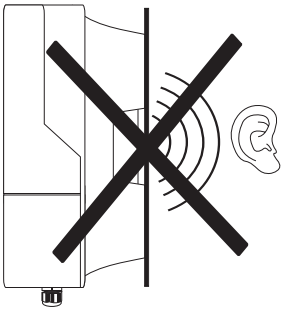
CAUTION!
Touching these parts could result in severe burns.

The temperature of the enclosure can reach 60 C during operation.

- Mount the device in such a way that it cannot be touched inadvertently!

- The location for the installation must be suitable for the weight (ca. 18 kg) and the size.
- Choose a solid fundament for mounting.
- The installation location must be accessible at all times (do not mount in inaccessible places).
- An ambient temperature of between -25 °C to +60 °C guarantees optimal operation.
- Avoid direct solar radiation. Excessive heating could lead to a reduction in performance.
- In domestic installations, the unit should not be mounted on plasterboard walls or similar materials in order to avoid audible vibrations.

  The Sunny Island can make noises when in use that may be irritating in a domestic setting.

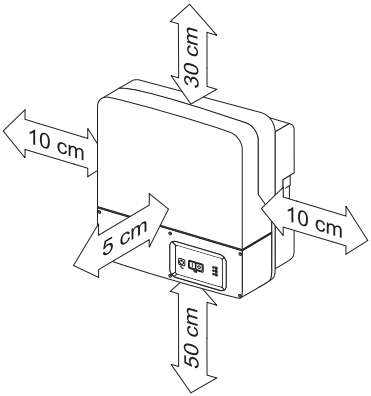


5.2.3 Observe minimum clearances

The following minimum clearances to walls, other devices or objects must be observed to guarantee sufficient heat dissipation.

All external cables are connected through the underside of the housing. This requires a minimum clearance of at least 50 cm.

Direction	Minimum clearance
sides	10 cm
above	30 cm
below	50 cm
in front	5 cm



Sufficient Ventilation

When installing the in smaller rooms, make sure that adequate ventilation is available. During operation the device produces heat which must be dissipated.

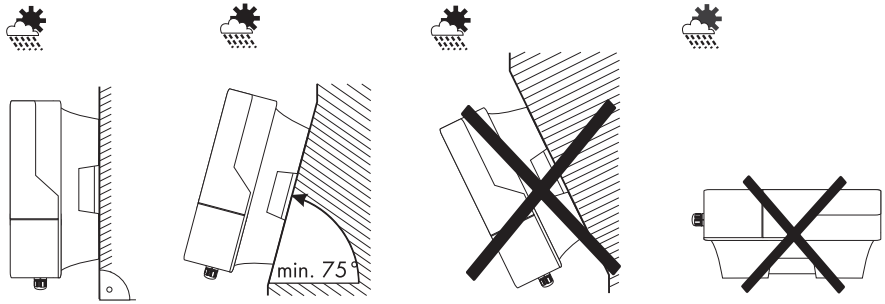
5.2.4 Mounting Position

NOTICE!

Short-circuit due to condensation

If the device is in operation while lying flat, water can accumulate due to condensation.

- Operate the device only while it hangs vertically on a wall.



- Mount the device only vertically or with a backward inclination of at most 15°!
- Do not mount the device with a forward inclination!
- Do not mount the device lying flat on its back!
- Mount the device at eye level.

5.2.5 Mounting the Sunny Island with a Wall Mounting Bracket

1. Use the wall bracket as a drilling template.

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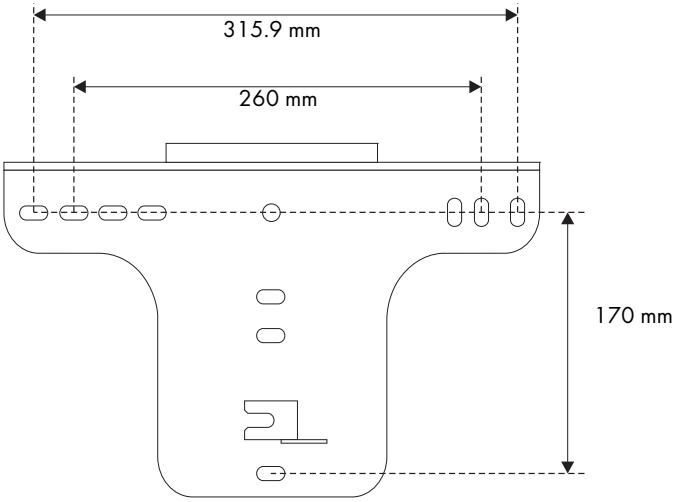


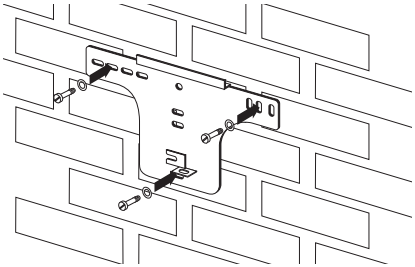
Number of drilled holes used

- When mounting onto a wall, use at least two of the horizontal holes and the lowest one in the middle.
- When mounting onto a post use at least three of the holes in the middle (use the superior one in any case).

Mounting Material

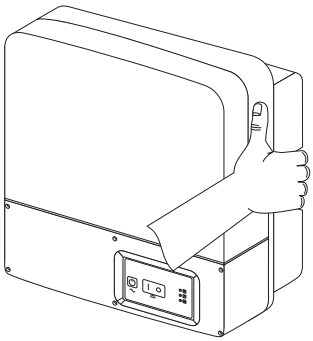
When mounting the wall bracket use mounting material which is suited to the fundament. In doing this, observe that the weight of the Sunny Island is approximately 18 kg.

2. Mount the wall bracket.



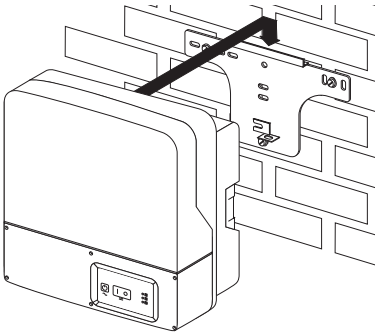
Transporting the Sunny Central

For the transportation and the installation of the Sunny Island use the handles at the sides of its enclosure.

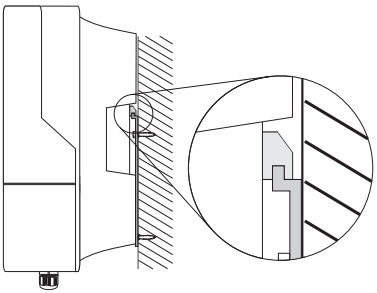


3. Hang the device onto the wall bracket with its attachment plate somewhat displaced to the left.

   The right edge of the back side of the device must be flush with the right edge of the wall bracket.

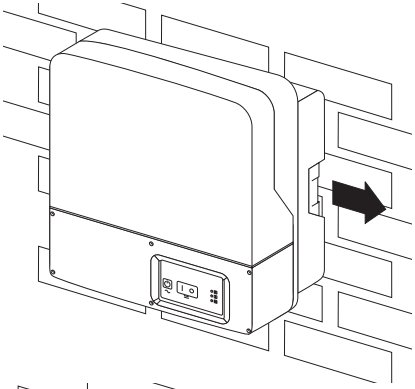


4. Check on both sides to see that the device sits correctly.

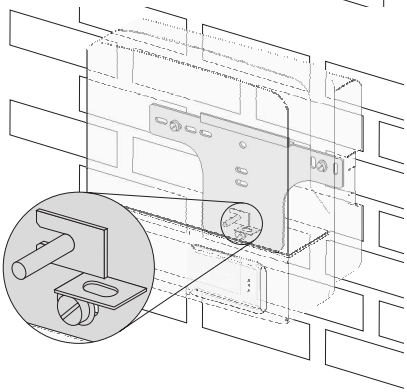


5. Secure the enclosure so it cannot be accidentally lifted up.

   Shove the Sunny Island toward the right on the wall bracket until it snaps into place with the safety stud on its back side.

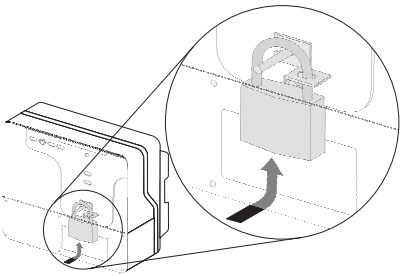


6. Check to see that the device sits correctly.



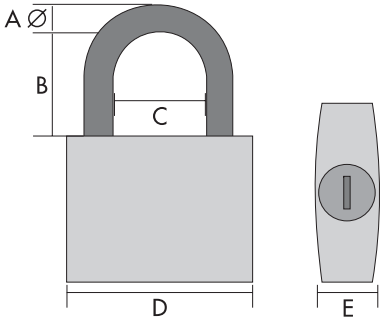
Optional anti-theft protection

Protect the device against theft. Secure the Sunny Island with a lock onto the wall mounting bracket.



The lock must meet the following specifications:

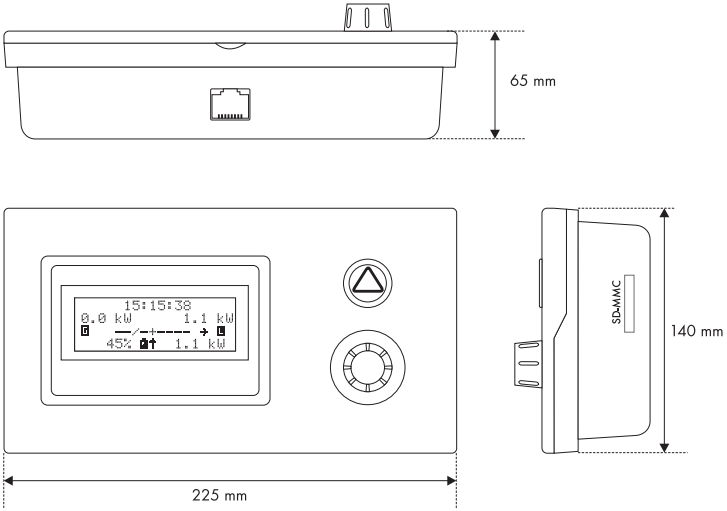
- Size:
  A: 6 mm - 10 mm in diameter
  B: 21 mm - 35 mm
  C: 20 mm – 33 mm
  D: 40 mm – 60 mm
  E: 13 mm – 21 mm
- stainless
- hardened shackle
- secured cylinder lock



5.3 Sunny Remote Control 1

5.3.1 Dimensions

The external display has the following dimensions:



5.3.2 Choosing a Mounting Location

- The installation location must be easily accessible.

  Using the display, you can control the Sunny Island and with it the island grid system.

  Distance between the Sunny Remote Control 1 and the Sunny Island

  The communication cable between the Sunny Island the Sunny Remote Control 1 must not exceed 20 m in length.

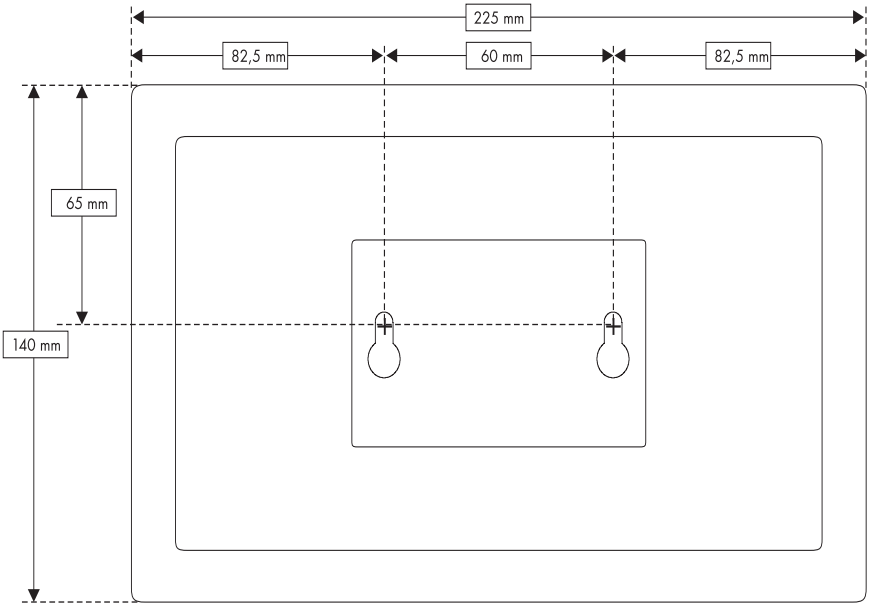
- Choose a solid fundament for mounting.
- Protect the Sunny Remote Control 1 from dust, wet conditions, corrosive substances and vapors.
- An ambient temperature of between 0 °C to 50 °C guarantees optimal operation.
- Avoid direct solar radiation.

5.3.3 Wall Mounting

Mount the Sunny Remote Control 1 on the wall. Proceed as follows:

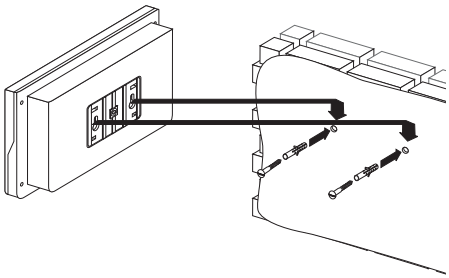
1. Allow enough room for installing a communications cable and a MMC/SD card.
2. Determine the position of the two holes to be drilled using the Sunny Remote Control's mounting plate.

   To do this, unscrew and remove the mounting plate from the back of the Sunny Remote Control.



3. Draw the position of the holes to be drilled.
4. Install the dowels and screws included.
5. Install the dowels and screws included

   Allow for the heads of the screws to protrude about 6 mm from the surface of the wall.
6. Screw the mounting plate onto the Sunny Remote Control enclosure.
7. Hang the Sunny Remote Control onto the screws.
8. Check to see it sits correctly.



5.4 Installing Batteries

Information

Observe the battery manufacturer's installation instructions, as provided with the battery upon delivery, and the applicable standards and directives for installation of batteries (EN 50272-2).

DANGER!

Death hazard due to

1. Explosion and fire
2. short circuit
3. Chemical burns due to leaking electrolytes

1. Smoking prohibited!
   Do not allow open flames, embers, or sparks near the battery.
2. The metal parts of the battery carry voltages.
   Do not place foreign objects or tools on the batteries!
   Work on the battery with insulated tools exclusively!
3. Use protective clothing and eyewear when working on the battery.
4. During normal operation, it is not possible to accidentally touch the electrolyte.
   Do not damage the enclosure of the battery! The electrolyte is extremely corrosive.

Dimensioning for the Battery Capacity

To ensure a faultless operation of the island grid system, the SMA Solar Technology AG recommends a battery capacity of at least:

- 175 Ah per Sunny Island 2224 (24 V) at C_{10}
- 350 Ah per Sunny Island 2012 (12 V) at C_{10}

If an AC-coupled PV plant is to be connected to the system, the SMA Solar Technology AG recommends a battery capacity of at least:

- 200 Ah (C_{10}) per kW of AC nominal power of the Sunny Boy inverter in the case of 24 V systems.
- 400 Ah (C_{10}) per kW of AC nominal power of the Sunny Boy inverter in the case of 12 V systems.

Batteries must be accommodated in protected rooms, and sufficient ventilation of the installation location must be ensured. In the case of batteries which are connected to one Sunny Island exclusively, there is no need for protection against direct or indirect contact, due to the safety low-voltage.

It is not necessary to install such batteries in a separate battery room, or in a self-contained electrical facility.

The necessary air volume flow for ventilation of the room which accommodates the batteries is calculated as per EN 50272-2 as follows:

$$Q = 0{,}05 * n * I_{Gas} * C_{10}/100 \ [m^3/h]$$

Q = required air flow volume

n = Number of cells

I_{Gas} = maximal finishing charge rate

with C_{10} as the 10 hour nominal capacity in [Ah].

The cross-sectional area of the ventilation inlets and outlets (in the case of natural ventilation) is calculated according to the following formula:

$$A = 28 * Q \ [cm^2]$$

Sufficient dissipation of explosive gases is not always ensured in the vicinity of the battery. Therefore, a safety distance must be observed, in the form of an air clearance in which no sparks or smoldering materials are allowed.

The clearance distance is calculated as follows:

$$d = 5{,}76 * (C_{10})^{1/3} \ [cm]$$

Installation of a battery with liquid eletrolyte.

With closed batteries, installation in an acid-resistant collecting tray is to be provided for so that, in the event of a fault, leaking electrolyte cannot cause further damage.

Finally, install the battery bank in accordance with the installation instructions provided by the battery manufacturer.

Refer to the following table for the preferred values for the finishing charge rates and charge voltages for the battery types which may be used in the system, unless the battery manufacturer has determined other values:

Maximal charging voltage in [V/cell]	**maximal finishing charge rate I_{Gas} in [A/100 Ah]**		
Type	**FLA***	**VRLA**	**NiCd**
1.4	-	-	0.5
1.55	-	-	5
1.6	-	-	5
1.65	-	-	5
2.25	0.5	0.1	-
2.4	2	0.8	-
2.5	4	1.5	-
2.6	6	6	-
*These values are valid only for battery types with low antimony content (SB < 3 %)			

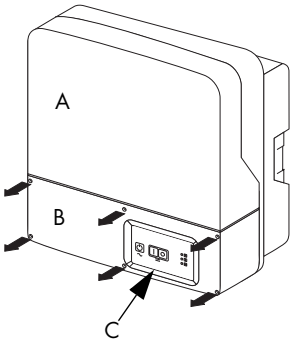
Consult the appropriate battery manufacturer for other battery type values.

6 Opening and Closing

Enclosure lid

Only remove the lower enclosure lid from the Sunny Island when you want to mount, install or maintain it.

- A = upper enclosure cover
- B = lower enclosure cover
- C = control area



DANGER!
Risk of lethal electric shock

High voltages are present in the device!

- Only qualified personnel should open the device!
- Do not open the lower enclosure cover!

  After the system has been disconnected (see chapter 10.1.4 "Disconnecting the Device from Voltage Sources" (Page 87)) there are still dangerous voltages present for up to 15 minutes.
- Follow the instructions!

1. Shut down the Sunny Island.
2. Disconnect the Sunny Island from all voltage sources (battery, generator, grid). (see chapter 10.1.2 "Stopping" (Page 85) and 10.1.3 "Switching Off" (Page 87)).
3. Ensure that the system cannot be accidentally switched on again.

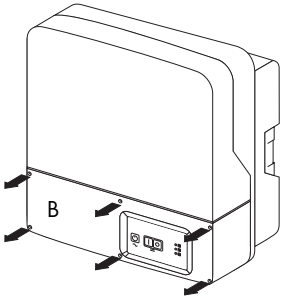
6.1 Opening the Sunny Island

NOTICE!

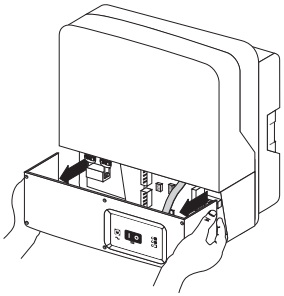
The components in the Sunny Island (e.g., communications interface) can be damaged by an electrostatic discharge!

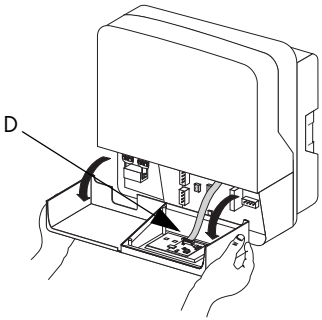
- When working on the Sunny Island and when handling the components observe all ESD safety regulations.
- Eliminate static charge by touching the grounded metal casing.
- Only then should you begin any work.

1. Loosen the six non-removable allen screws on the lower cover (B).



2. Remove the cover carefully.
3. Unplug the control area cable from the inner side of the enclosure cover (in the new devices the cable is not in place).





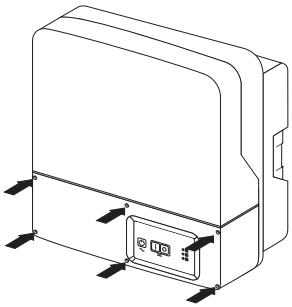
4. Keep the cover in a safe place.

Information

The cover screws can be loosened but not removed, which keeps them from getting lost.

6.2 Closing the Sunny Island

1. Ensure that all cables are properly laid and that all tools have been removed from within the Sunny Island's enclosure (see chapter 7 "Sunny Island Electrical Connection" (Page 39)).
2. Plug the cable for the control area into the lower enclosure cover.
3. Starting from the front, place the cover evenly on the housing.
4. Screw all six screws in sequence and lightly into their threads (one or two turns).
5. Tighten the screws in a crosswise sequence and with 2.5 Nm of torque.



7 Sunny Island Electrical Connection

DANGER!

Risk of lethal electric shock due to wrong connection

- Only qualified personnel should install the devices' connections.
- Install line safety switches (max. 25 A) before the Sunny Island as seen from the grid side.
- Follow every safety notice in this chapter during installation.

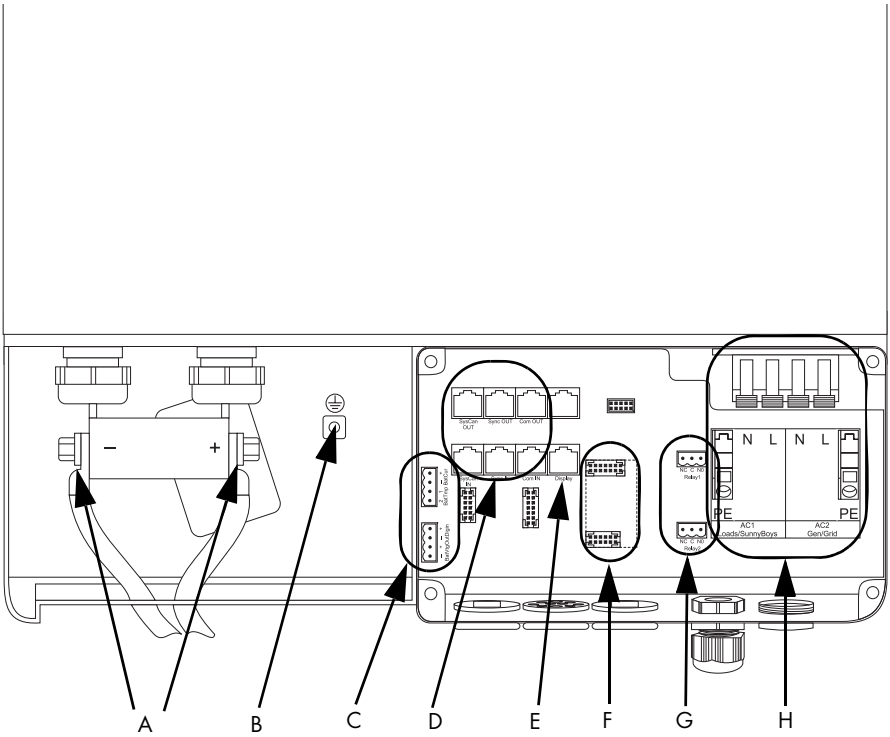
NOTICE!

The components in the Sunny Island (e.g., communications interface) can be damaged by an electrostatic discharge!

- When working on the Sunny Island and when handling the components observe all ESD safety regulations.
- Eliminate static charge by touching the grounded metal casing.
- Only then should you begin any work.

7.1 At a Glance

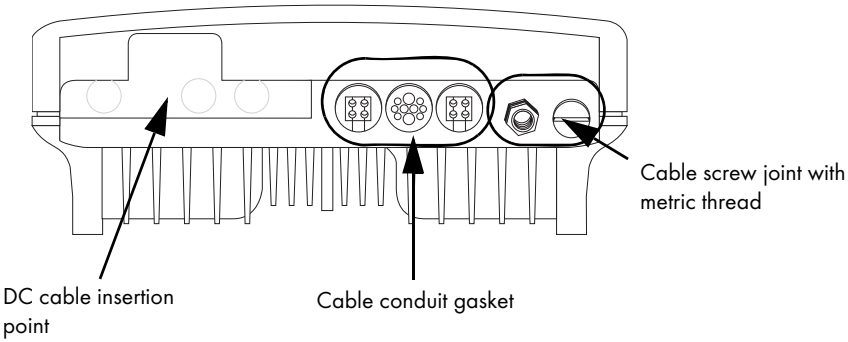
The following figure provides an overview of all connections of the Sunny Island:



A	DC connections
B	Additional protective earth conductor
C	Additional connection terminals (battery current sensor, battery temperature sensor, etc.)
D	Communication connection
E	Sunny Remote Control connection
F	Interface plug (Piggy Back) RS485
G	Multi-function relay connections
H	AC connections

Cable conduits in the enclosure.

All cables are fed through the feed-troughs on the bottom side of the device (see following figure) and connected to the appropriate connection terminals on the Sunny Island.

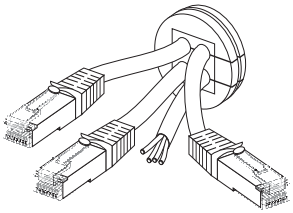


Cable screw joint with metric thread

Use the metric-thread cable screw connections provided to fasten the AC cables inside the Sunny Island housing in a manner conforming to the appropriate norms. The metric-thread cable screw connections guarantee a dust-free and waterproof installation of the cables in the housing and also provide strain relief for the cable connection.

Close all unused openings in the housing using the appropriate dummy plugs.

Cable conduit gasket



The cable conduit gasket allows simple connection of the pre-assembled communication and control cables (with RJ45 plugs).

NOTICE!

Damage to device can be caused by penetrating moisture

- Install screw joints and cable conduit gaskets properly.
- Seal unused conduits.

Properly installed screw joints and cable conduit gaskets guarantee to provide protection rating IP54.

Obtain an overview of the different components and connection areas of the Sunny Island (see section 7.1 "At a Glance" (Page 40)).

Detailed installation descriptions of the connections are provided in the following sections:

- DC connection	Chapter 7.2 "DC connection" (Page 43)
- AC connection	Chapter 7.3 "AC Connection" (Page 46)
- Grounding:	Chapter 7.3.1 "Grounding" (Page 47)
- Sunny Remote Control 1	Chapter 7.4 "Sunny Remote Control 1" (Page 51)
- External communication:	Chapter 7.5 "Communication" (Page 53)
- Battery temperature sensor:	Chapter 7.6.1 "Battery Temperature Sensor" (Page 59)
- Multi-function Relays 1 and 2	Chapter 7.6.3 "Multi-function Relays 1 and 2" (Page 63)

7.2 DC connection

WARNING!

The Sunny Island 2012 / 2224 has no internal DC fuse.

Install an external DC fuse between the Sunny Island and the battery as a protective conductor. Dimension the fuse in proportion to the cable cross-section used.

- Sunny Island 2012: fuse NH01, 250 A (BATFUSE-B.0x)
- Sunny Island 2224: fuse NH00, 125 A (BATFUSE-A.0x)

7.2.1 Grounding

External grounding.

- External grounding of the negative pole of the batteries is possible, because the batteries and the grid side are galvanically isolated within the Sunny Island. In this case, make sure that the high currents that may occur under fault conditions can be adequately diverted.
- If a connection is required, then this must be made separately, external to the Sunny Island, by an installer.
- When grounding the battery, the Sunny Island's enclosure must be additionally grounded, also in the DC area (see chapter 7.3.1 "Grounding" (Page 47)).

Calculating the Required Grounding Conductor Cross-Section

The SMA Solar Technology AG cannot state generally valid values for the cross-section of the conductor required for the external grounding of the battery. The conductor dimensions depend on the type and size of the battery connected, the external fuse (DC side) and the material used for the grounding conductor.

Determining the wire cross-section

Exact calculation of the grounding conductor cross-section must consider the regionally applicable standards and guidelines (e.g., DIN VDE 0100 Part 540).

The required cross-section of a (copper) grounding conductor can be calculated using the following formula. Trigger times, e.g., for the integrated DC circuit breaker and short-circuit currents of between 2000 and 10,000, are typically about 25 ms.

$$S = \frac{\sqrt{I_{sc}^2 * t}}{143}$$

t = disconnection time in seconds
I_{SC} = max. battery current (short circuit) in Amperes
S = cross section of the conductor in mm²

A grounding conductor of 10,000 mm² cross-section is thus adequate for short-circuit currents up to 16 A.

7.2.2 Connecting the Battery

Connect a suitable battery to the DC side (see section 20 "Technical Data" (Page 197)).

WARNING!

Risk of lethal electric shock when the battery is connected!

Connect the NH fuse to the BatFuse-A.01 bracket or close the DC fuse disconnector only after completing all installation work on the island grid system.

The DC connection must be made observing all valid regulations (e.g., DIN EN 50272-2, "Safety requirements for Batteries and Battery Systems - Part 2: Stationary Batteries").

WARNING!

Danger of burns or even death due to arcing and short-circuiting when connecting the battery.

- All safety and maintenance instructions provided by the battery manufacturer must be heeded.
- Use special (insulated) tools to mount and install the battery.
- Please observe the correct cross-section and polarity of the leads connected to the battery.

DC Cables

The DC cables should be as short as possible (in any case < 30 m). Long cables and insufficient cable cross-sections reduce the system efficiency as well as the overload capabilities. Do not lay the battery feed cables under plaster or in armored plastic pipes. High currents flow through the battery cables, so they can become very warm.

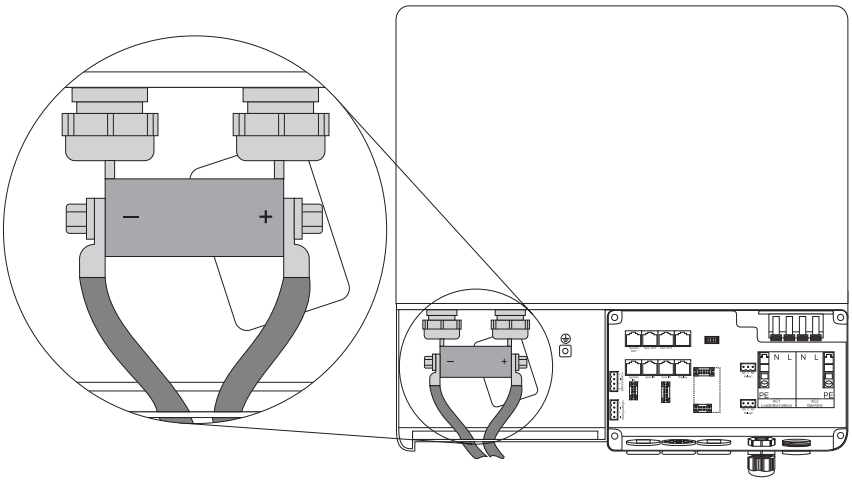
7.2.3 Connecting the Sunny Island

There is a "DC –" and a "DC +" connection provided for each ring cable lug (max. 95 mm²) for the battery feed cables in the Sunny Island.

The following cable cross-sections are recommended for the DC cables:

Sunny Island 2224:	35 mm² min.
	95 mm² max.
Sunny Island 2012:	70 mm² min.
	95 mm² max.

Install the DC connections in the following sequence:



1. Remove the protective insulation from each DC cable.
2. Fit the bare cable ends with ringed cable lugs.
3. Introduce the DC cables into the enclosure from below and to the left.
4. Attach the "DC –" conductor with the ring cable lug to the "DC –" connection and tighten the retaining screw firmly (torque 4.0 Nm to 10 Nm).
5. Then attach the "DC +" conductor with the ring cable lug to the "DC +" connection and tighten the retaining screw firmly (torque 4.0 Nm to 10 Nm).

7.3 AC Connection

Connect the Sunny Island through a sub-distribution to the inland grid (loads, PV generator (Sunny Boy)) and to any other external sources (generator, grid).

Information

The sub-distribution unit must be equipped with appropriate circuit breakers. Be sure to observe all the applicable regional standards and guidelines.

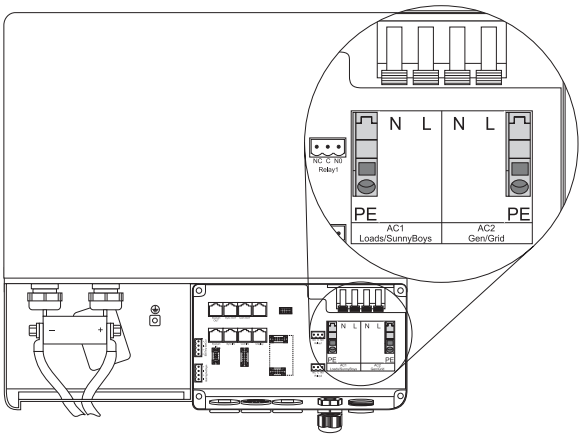
Information

A maximum of 25 A should flow through the Sunny Island's AC input.

Information

The Sunny Island does not disconnect all 3 poles: the neutral conductor (N conductor) is looped through the device; i.e., the AC1 and AC2 N connection terminals are connected inside the device.

Use a maximum cross-section of 6 mm² for the AC installation. The nominal AC current is 9.6 A.



7.3.1 Grounding

Information

In stand-alone configurations, the (protective) ground of the Sunny Island and its individual components must be wired as a TN grid only. All valid standards and guidelines must be taken into account!

CAUTION!
Danger of injury due to leakage current against PE.

The N connection of the Sunny Island has NOT been connected with PE by default.

- Ground the island grid system outside the Sunny Island before commissioning (see chapter 7.3.3 "AC2 (Gen/Grid)" (Page 50)).
- For safety technical reasons (leakage currents of over 3.5 mA),
  - two protective ground wires with 6 mm² (double ground) or
  - one protective ground wire >10 mm².

For the ground connection with two redundant protective leads use the PE connections in the AC connection area of the Sunny Island.

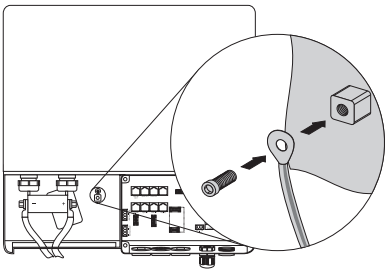
For the ground connection with the protective lead of > 10 mm² use the addtional PE connection (PE crown on the enclosure) in the DC connection area (see following segment).

Additional Grounding of the Housing.

If the Sunny Island is used in a country which prescribes the use of a second protective ground (e.g., Switzerland), you can ground the enclosure additionally by using the PE crown in the DC connection area.

Proceed as follows:

1. Strip the protective conductor.
2. Fit the protective conductor with a ringed cable lug (max. cross-section 50 mm²).
3. Screw the ringed cable lug onto the enclosure's PE crown (screw: M8 x 20 mm).



7.3.2 AC1 (Loads/Sunny Boys)

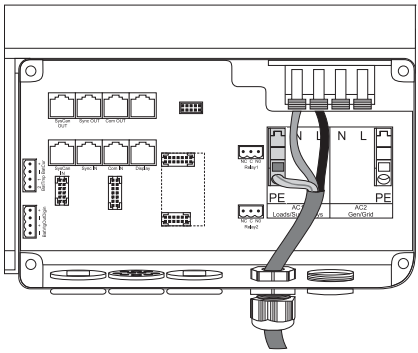
Connect, with three conductors via the subdistribution, for example, loads, PV generators (Sunny Boy) and wind power plants (Windy Boy), to the Sunny Island's AC1 connection.

DANGER!
Death hazard due to residual currents

- Install an RCD circuit breaker between the Sunny Island and the loads.

Connection procedure for the Sunny Island:

1. Loosen the metric-threaded cable screw joint on the right of the enclosure's underside.
2. Insert the 3-conductor cable through the threaded joint.
3. Draw the cable into the enclosure.
4. Flip the AC1's terminal connectors (N and L conductors) all the way up.



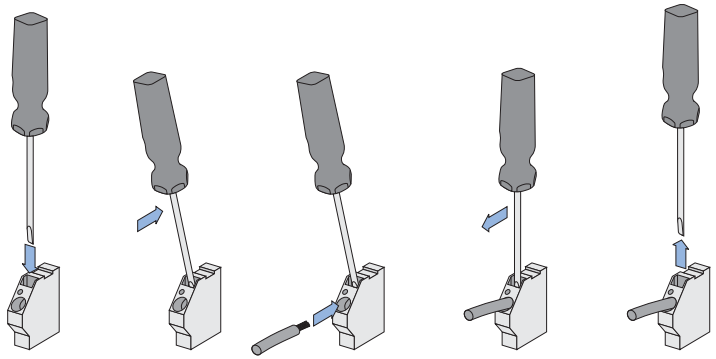
DANGER!
Risk of lethal electric shock

Improperly laid cables can loosen out of the terminal connectors.

- Do not use end wire sleeves when connecting the AC cable.

5. Remove the protective insulation from each of the three wires.

6. Fasten the protective earth (PE) cable onto the spring type terminal. Use a slot screwdriver (see figure below).



- Stick the screwdriver into the spring type terminal's slit.
- Push the screwdriver upward. The spring type terminal is now open.
- Introduce the stripped PE cable into the terminal (round opening).
- Return the screwdriver to its original position. The spring type terminal is closed and the PE cable is installed firmly.

7. Connect the N and L cables according to the labeling on the AC1 terminal connectors
"L" and "N" must not be swapped!

CAUTION!

Danger of crushing due to the terminal connectors snapping shut!

When closing, the terminal connectors snap back very fast and with force.

- Flick the clamps back down with care.
- Press down on the clamps with the thumb, and do not take hold of the whole clamp.
- Keep the fingers away from the range of motion of the clamp as it snaps down!

8. Tighten the cable screw joint's lock nut firmly.

Connection in a Single-Phase Parallel System

In a single phase system, connect all Sunny Boys using the same cable cross-sections and lengths.

Connection in a 3-Phase System

- In a 3-phase system, always connect the master to phase L1, slave 1 to phase L2 and slave 2 to phase L3. This circuitry results in a right rotating field.
- If a phase fails within a three-phase grid, the cluster continues to run. In order to protect your loads, you may require phase monitoring or a motor overload switch.

7.3.3 AC2 (Gen/Grid)

Via the distribution, connect the generator or the public grid using 3 conductors to the Sunny Island's AC2 connector.

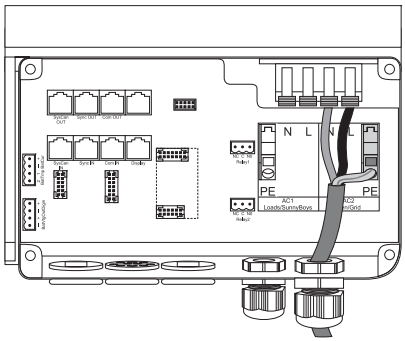
DANGER!
Death hazard due to residual current if the neutral wire is not grounded.

- Do not install an RCD circuit breaker (or similar) onto the island grid system's grid-side supply cable.
- Ground the grid-side PEN conductor within the installation (before or at the separation into N and PE conductors, e.g., the connection from the house's junction box to the equipotential bonding rail).

Proceed as follows:

1. Remove the blank seals from the opening on the underside of the enclosure and to the right.
2. Introduce the metric-threaded cable connection M25 (included in the delivery) into the opening and tighten.

   Do not forget the seal!
3. Wire up the AC2 cable as described in chapter 7.3.2 "AC1 (Loads/Sunny Boys)" (Page 48).



Connection in a Single-Phase Parallel System

- In single-phase parallel systems, connect each of the Sunny Islands via the AC2 terminal to the generator or the public grid.
- The cable cross-sections and cable lengths used must be identical.

Connection in a 3-Phase System

- In a 3-phase system, always connect the master to phase L1, slave 1 to phase L2 and slave 2 to phase L3. This circuitry results in a right rotating field.
- The system does not monitor additional fuses. Check any additional fuses regularly!

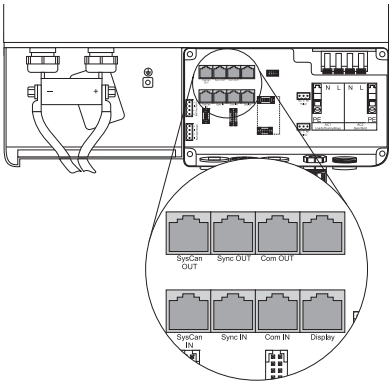
7.4 Sunny Remote Control 1

NOTICE!

The components in the Sunny Island (e.g., communications interface) can be damaged by an electrostatic discharge!

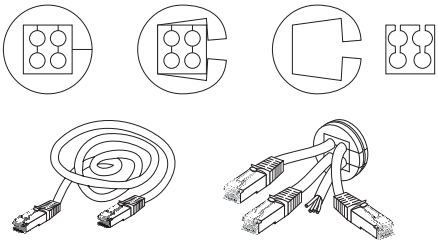
- When working on the Sunny Island and when handling the components observe all ESD safety regulations.
- Eliminate static charge by touching the grounded metal casing.
- Only then should you begin any work.

The Sunny Remote Control 1 is connected to the "Display" terminal in the Sunny Island.



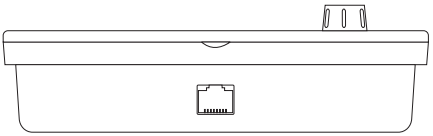
1. Dismantle the preinstalled cable conduit on the enclosure floor.
2. Remove the feed-through element completely from the mounting opening.
3. Lay the cable equipped with RJ45 plugs through one of the openings in the inner rubber element.

   Plan a sufficient lead length from the enclosure openings to the "Display" socket on the conductor board.
4. Install all communication leads (see chapter 7.5 "Communication" (Page 53)), before you reassemble the rubber element and refit it onto the Sunny Island.
5. Fit any unused openings on the enclosure with blind seals.



6. Insert the RJ45 plug into the "Display" socket in the Sunny Island. The plug snaps audibly into place.

7. Connect the second RJ45 plug on the cable (outside the Sunny Island) to the Sunny Remote Control 1 Display socket.



Information

The communication cable can also be plugged into the Sunny Remote Control during operation (hotplug-able).

7.5 Communication

7.5.1 Communication with Sunny Island

The Sunny Island can be connected in parallel or in a 3-phase system with up to two other Sunny Islands in order to increase the overall power. The devices communicate through CATe-FTP patch cables (with two RJ45 plugs each). A patch cable is referred to subsequently as a communication lead.

Notes on the Installation

1. Lay the communication cable separately from the AC cables.
2. DO NOT feed the communication leads through the membranes with their plugs mounted. Feeding the plugs through the membrane would overstretch it, so that there would no longer be a tight seal around the cable itself, which is thinner.
3. If the length of the provided communication cables is insufficient, use commercially available Cat5e FTP cables (single shield) with gold contacts.
4. The maximum cable length is 30 m. The cable cross-section is at least AWG26/7.

Installation in a Single-Phase, Parallel System or in a 3-Phase System

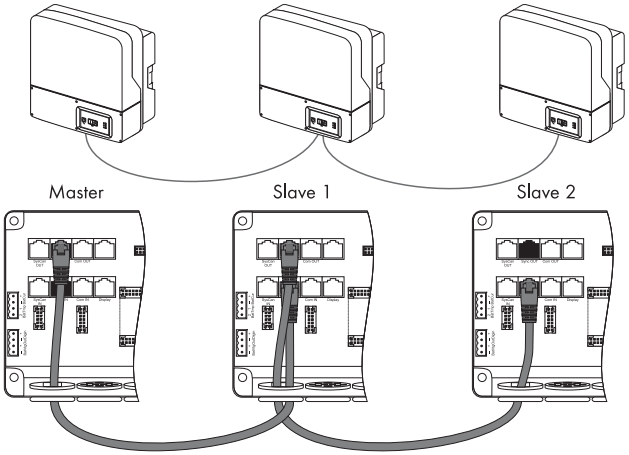
- A communication cable is included with each Sunny Island.

  You need the cable in order to establish an (internal) communication between several Sunny Islands. If you operate only one Sunny Island in the cluster the cable is not required.
- If needed, choose a parallel/multiphase configuration in the Quick Configuration Guide (see chapter 9 "(First) Commissioning" (Page 75)).

Install the communication cable as follows:

1. Lay the cable equipped with RJ45 plugs through one of the four openings in the inner rubber element of the cable conduit seal.

   Plan a sufficient lead length from the enclosure openings to the desired socket on the conductor board.
2. Connect the Sunny Islands as follows:



Upon delivery of a Sunny Island, the "SyncIn" socket is terminated.

- Master (first Sunny Island):
  - A terminator is plugged into the "SyncIn" socket.
  - Insert the communication cable's RJ45 plug in the "SyncOut" socket. The plug snaps audibly into place.
  - Lay the other end of the communication cable in the second Sunny Island.
- Slave 1 (second Sunny Island):
  - Remove the terminator from the "SyncIn" socket.
  - Plug the RJ45 plug of the communication cable from the master device in the "SyncIn" socket of the slave 1. The plug snaps audibly into place.
  - If **no other Sunny Island** (slave 2) is to be installed in the island grid system, plug a terminator in the "SyncOut" socket of the slave 1. The terminator snaps audibly into place.
  - If **a third Sunny Island** (slave 2) is to be installed in the island grid system, plug the RJ45 plug of another communication cable in the slave 1's "SyncOut" socket. The plug snaps audibly into place.
  - Lay the other end of the communication cable in the third Sunny Island.

- Slave 2 (third Sunny Island):
  - Remove the terminator from the "SyncIn" socket.
  - Plug the RJ45 plug of the communication cable from the slave 1 device in the "SyncIn" socket of the slave 2. The plug snaps audibly into place.
  - Plug a terminator in the "SyncOut" socket of the slave 2. The terminator snaps audibly into place.

Please Note

The first and last Sunny Islands in a chain must always be terminated.

3. Install all communication leads before you reassemble the rubber element and conduit and refit them onto the Sunny Island.
4. Fit any unused openings on the enclosure with blind seals.

Information

The "SysCanOut" and "SysCanIn" sockets have no function.

7.5.2 Communication With External Devices

You can connect SMA communication devices (e.g., Sunny Boy Control, Sunny WebBox) or a PC with the appropriate software to a communication interface. A detailed wiring diagram can be found in the communication device manual, the software, or on the Internet at www.SMA.de.

This wiring diagram includes:

- Details on the required cable type
- Which of the Sunny Island's connections are used
- Whether or not the communications cables must be terminated
- Whether the PE needs to be connected to the cable shield

You can incorporate an RS485 communication interface into the Sunny Island.

Information

Communication via Powerline/Powerline modem (NLM) is not possible in an island grid system.

NOTICE!

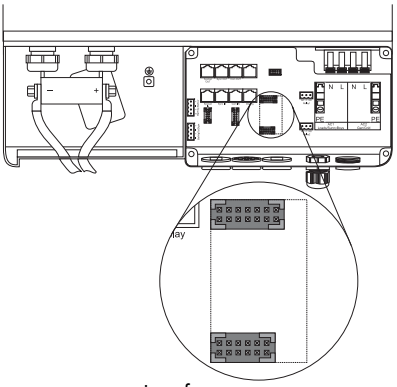
Electrostatic discharges may damage the communications interface.

- When working on the Sunny Island and when handling the components observe all ESD safety regulations.
- Eliminate static charge by touching the grounded metal casing.
- Only then should you begin any work.

When installing the communications interface proceed as follows:

1. Lay the interface's communication cable in one of the free openings of the cable conduit seal's inner rubber element.

   Plan a sufficient lead length from the enclosure opening to the "ComOut" socket on the conductor board in the Sunny Island.
2. Introduce the communication cable into the enclosure from outside.
3. Insert the RJ45 plug into the "ComOut" socket in the Sunny Island. The plug snaps audibly into place.
4. Reassemble the cable conduit unit and reinsert it into the opening on the floor of the Sunny Island.
5. Fit any unused openings on the enclosure with blind seals.
6. Connect the other end of the communication cable to the communication device.



Interface port (Piggy Back) RS485

Find the description of which three pins you should use in the installation instructions of the communication device.

The following table shows the allocation of these pins to the corresponding pins of the RJ45 socket.

WebBox Pin Assignment	**RS485**	**RJ45 Socket**
2	A (Data+)	3
7	B (Data-)	6
5	GND	2

7. Terminating the Sunny Island using RS485.

   The RS485 data bus of Sunny Island is terminated with a plug. This plug is already pre-installed in your Sunny Island. Remove this plug only if you intend to connect another communication device.
8. Plug the communications interface into the board.

The Sunny Island can be operated at different transmission rates (1200 to 19200 bps), to communicate with external devices. The parameter "250.06 ComBaud" must be set correspondingly.

Setting the Baudrate

If Sunny Boys are connected to the communications bus, then the baud rate must be set to 1200 bps (factory setting).

The Sunny Island uses the SMA-Net protocol for communication.

7.6 Additional Connections

7.6.1 Battery Temperature Sensor

The battery temperature sensor measures the temperature of the connected battery. This is necessary since the optimum charging voltage for a battery largely depends on the temperature. Further information is provided in section 12.4 "Charge Control" (Page 122). A battery temperature sensor is provided with the Sunny Island (see the delivery scope description).

Defective Battery Temperature Sensor

If the battery temperature sensor is rendered inoperative, e.g., due to a short circuit or broken cable, the Sunny Island works with a fixed setting which, however, leads to an insufficient charge of the battery in the long run. In this case the Sunny Island's display shows a warning.

- Replace the defective battery temperature sensor promptly.
- Always operate the Sunny Island with the battery temperature sensor (included in the delivery).

NOTICE!

Damage to the battery due to faulty installation

- Always install the battery temperature sensor included in the delivery.
- Do not drill holes into the battery when installing the battery temperature sensor.
  - Fasten the battery temperature sensor to the outside of one of the battery cells.
  - Choose a position in the space between two cells or in the middle area of the battery bank, where the heat generation during operation is greatest.

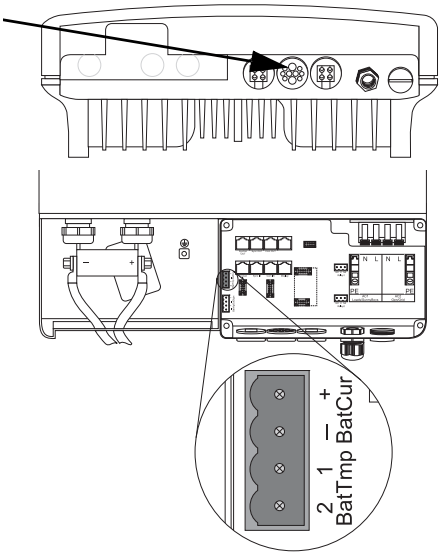
One battery temperature sensor per cluster!

A battery temperature sensor is provided with each Sunny Island.

Only one battery temperature sensor, which is connected to the corresponding master, is required for a cluster.

When connecting the battery temperature sensor proceed as follows:

1. Pierce the rubber plugs with a pointed tool.
2. Fit the cables with wire sleeves.
3. Introduce both cables from the outside through the opening.
4. Plug one wire into each of the "BatTmp" contacts of the 4-pole terminal included.
5. Tighten the screws of the contact.
6. If needed, install a battery current sensor before you insert the plug into the "BatCur BatTmp" socket on the board.



Installation notice

The polarity of the two conductors has no influence on the function of the battery temperature sensor.

7.6.2 Battery Current Sensor

In addition to the internal measurement, the Sunny Island provides the possibility to measure the battery current via a shunt. You need this function if you intend to operate additional DC generators and DC loads in your island grid system.

NOTICE!

Damage to the battery due to the connection of additional DC generators or DC loads to the island grid system.

In this operating situation, the Sunny Island's internal current measurement works imprecisely; the charge state of the battery is not determined exactly.

- Install an external battery current sensor (shunt).

Battery Current Sensor

Install a battery current sensor if there are charge or discharge DC currents of over 200 A.

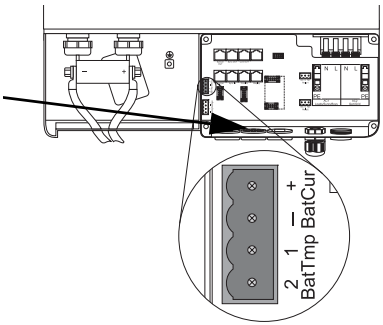
Connect the battery current sensor to the master.

Use cables of intrinsically safe circuits.

Always use cables of intrinsically safe circuits for the connection of battery current sensors. "Intrinsically safe" means here that the cable is double-insulated and that the wire melts but the insulation remains intact in the event of a short circuit. In addition, the cable is not combustible. In order to avoid measuring errors, make sure to use twisted cables (see DIN VDE 0100-430).

When connecting the battery current sensor proceed as follows:

1. Pierce the rubber plugs with a pointed tool.
2. Fit the cables with wire sleeves.
3. Introduce both cables from the outside through the opening.

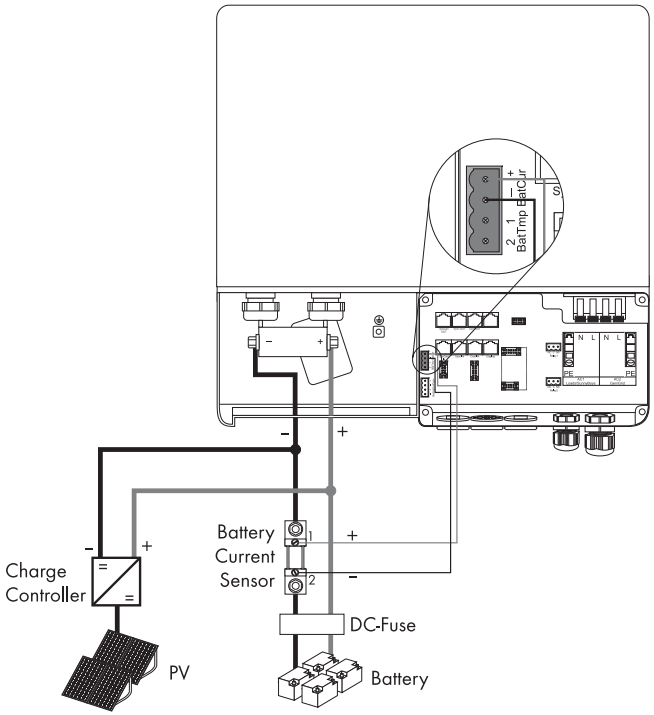


Installation notice

The battery current sensor must be looped around the negative pole of the battery. In addition, the contact of that battery current sensor which is connected to the Sunny Island (1) must be connected to the terminal "BatCur+" (see following diagram).

If the battery current sensor is connected as described above,

- positive battery current means that the battery is discharging (current from the battery)
- negative battery current means that the battery is charging (current into the battery)



Information

Charge controller and PV in the illustration above are only examples.

4. Plug one wire into each of the "BatCur" contacts of the 4-pole terminal included.
5. Tighten the screws of the contact.
   Observe the correct polarity of the leads (see also the installation notice above).
6. Insert the plug into the "BatCur BatTmp" socket on the board.

Commissioning the Battery Temperature Sensor

When connecting the battery temperature sensor, set up the internal offset on the Sunny Island during the first commissioning of the island grid system (see chapter 9.3 "Commissioning the Battery Current Sensor" (Page 81)).

7.6.3 Multi-function Relays 1 and 2

DANGER!
Death hazard due to faulty insulation

Separate the relay cable safely away from the communication area.

- Strip the wires of the relay cable.
- Fit each individual wire with the silicon tube included in the delivery.
- The device should not be operated without the silicon tube.

The Sunny Island offers you several options for the control of internal and external processes. To this end, the device is equipped with two multi-function relays to which you can assign functions with the parameters "241.01 Rly1Op" and "241.02 Rly2Op" (see chapter 14 "Relay" (Page 152)).

Information

The slave devices' relays can also be used and programmed separately.

Information on the switching capacity of the relays is provided in section 20 "Technical Data" (Page 197).

Operating principles of the relays

The relays are changeover contacts; they can be used as normally closed contacts (NCC) or as normally open contacts (NOC).

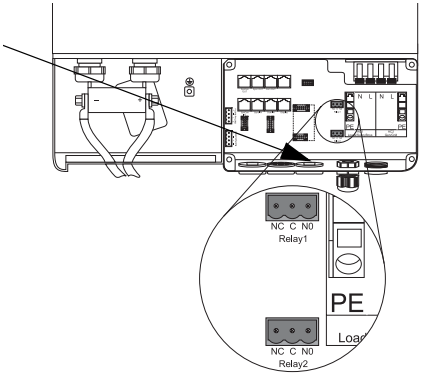
The relay functions are listed as NO contact functions, in other words, the contact is closed if the relay is activated by selecting the function. An exception is "Alm" (alarm), in which case the relay has a break function. This means that the relay is normally activated, opening the contact. Only in case of a failure is it deactivated and closes the contact (activating, for example, a warning light).

Please note:

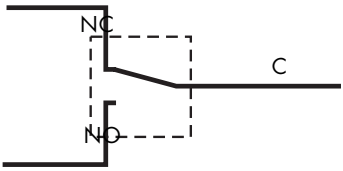
You can only assign one function to the relay.

Proceed as follows when installing the relay connections:

1. Pierce the rubber plugs with a pointed tool.
2. Fit the cables with wire sleeves.
3. Introduce both cables from the outside through the opening.
4. Insert the wires in the "Relay1" or "Relay2" sockets of the 3-pole terminal clamps provided.
5. Tighten the screws on the sockets.



6. Pay attention to the designation of the pins:
   - NC: Normally closed (closed when idle)
   - C: Contact (operation contact)
   - NO: Normally opened (opened in standby)
7. Insert the plug into the appropriate socket on the board.



Load shedding

The Sunny Island can automatically switch off loads to protect the batteries from deep discharge. To do this, an external (AC or DC) power contactor must be installed between the Sunny Island and the loads (see also chapter 19.3 "Accessories (Optional)" (Page 195)).

NOTICE!

If a relay is used for load shedding, the loads connected to the power contactor will no longer be supplied with electricity in the event of a fault in the island grid system, even when the grid is available.

Generator Start

The Sunny Island can control generators. It supports generators that can be started and stopped by a single contact and generators that require more than one contact (in combination with the optionally available generator manager (GenMan)).

Default Setting of the Relays

By default, relay 1 is set to the start generator function "AutoGn" and relay 2 is set to the load shed function "AutoLodSoc".

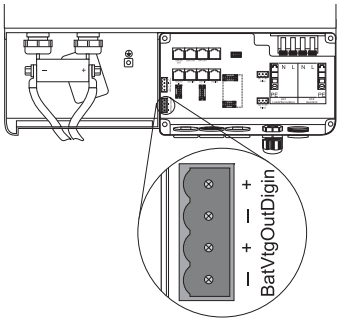
The first figure in section 2 "System Overview" (Page 12) shows the principal connection.

7.6.4 BatVtgOut Power Supply

The battery voltage is conducted to the outside at these terminals. It is fused at both poles by PTC thermistors (max. 0.75 A) and can fluctuate depending on the battery status. This connection can, for example, be used to supply a DC contactor for load shedding.

Proceed as follows when connecting the power supply:

1. Pierce the rubber plugs with a pointed tool.
2. Fit the cables with wire sleeves.
3. Introduce both cables from the outside through the opening.
4. Plug one wire into each of the "BatVtgOut" contacts of the 4-pole terminal included.
5. Tighten the screws of the contact.
6. If needed, install DigIn before you insert the plug into the "DigIn BatVtgOut" socket on the board.



7.6.5 DigIn Digital Input

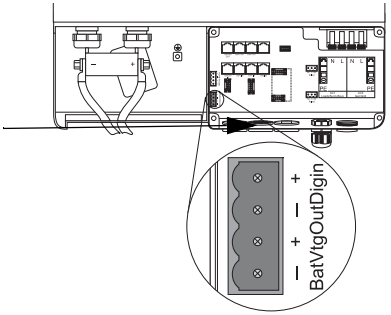
These terminals function as a digital input for external electric sources. For example, the feedback contact for the GenMan (GenRn) is connected here.

Information

If you connect a GenMan, or operate the system with the generator and utility (GenGD) in parallel, use the relays on the master device in order to activate the respective functions.

Proceed as follows when connecting the digital input:

1. Pierce the rubber plugs with a pointed tool.
2. Fit the cables with wire sleeves.
3. Introduce both cables from the outside through the opening.
4. Plug one wire into each of the "DigIn" contacts of the 4-pole terminal included.
5. Tighten the screws of the contact.
6. Insert the plug into the "DigIn BatVtgOut" socket on the board.



Further Information

For further information on connecting and operating the GenMan see the respective product documentation.

7.7 Configuring a System with Several Sunny Islands[1)]

The Sunny Island can be configured for various system combinations:

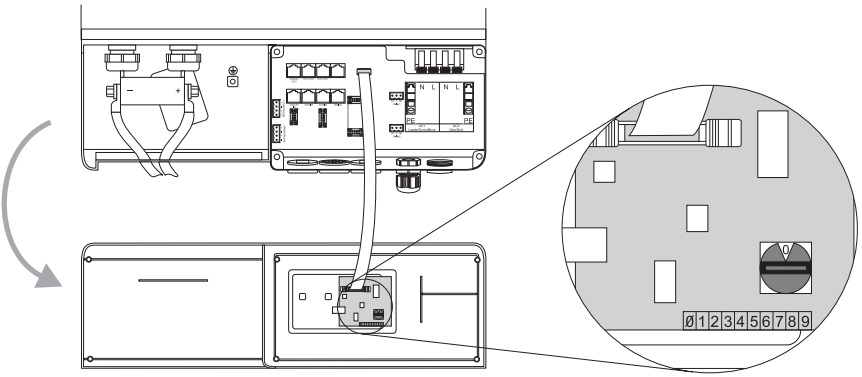
- Single-phase system with one Sunny Island
- Single-phase system witn two or three Sunny Islands connected in parallel
- 3-phase system with three Sunny Islands (one Sunny Island per phase)

Carry out the configuration before the first commissioning of the system. Each Sunny Island must be configured with the aid of the rotary code switch. Upon delivery this rotary code switch is set to "0".

Please note:

The position of the rotary code switch must only be changed if you intend to operate more than one Sunny Island in your system!

The rotary code switch is found on the back of the back of the display, on the inside of the lower enclosure cover of the Sunny Island.



To configure the system proceed as follows:

With a screwdriver (2.5 mm), turn the mark on the rotary code switch to the desired position.

Set the rotary code switch to

- 0 for master
- 1 for slave 1
- 2 for slave 2

1) These applications are only possible with firmware versions 3.0 and above.

The configuration possibilities of the rotary code switch at a glance:

Parameter	Meaning
0	Master
1	Slave 1
2	Slave 2

7.8 Concluding Tasks

1. Remove all tools from the enclosure.
2. Have all cables been laid so as to be strain-relieved?
3. Are there no communication cables inside the Sunny Island which are touching a stripped 230 V wire?
4. Are all cable conduits on the Sunny Island sealed?
5. Have all unused openings been closed with blind seals?
6. Close the lower enclosure cover (see chapter 6.2 "Closing the Sunny Island" (Page 38)).

The installation of the Sunny Island and Sunny Remote Control 1 is complete.

8 Control Elements

Before commissioning the island grid system, familiarize yourself with the operation of the device.

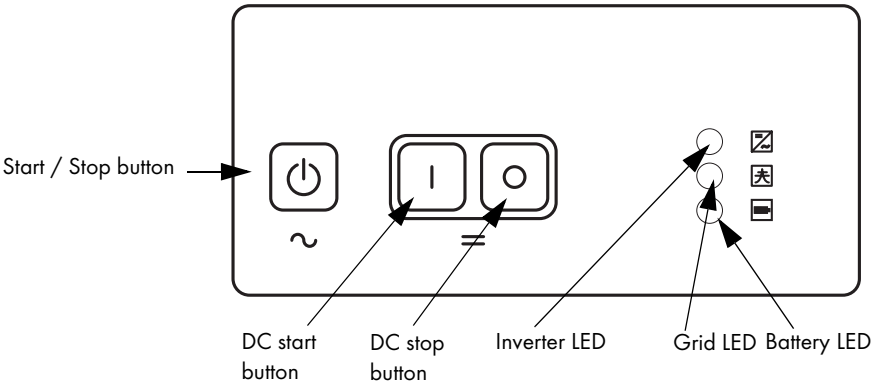
The Sunny Island is operated with the control panel on the enclosure only under the standard setup (for default values see chapter 17.2 "Adjustable System Parameters" (Page 166)).

To change the Sunny Island's parameter setup you need the Sunny Remote Control 1 (SRC-1) external display.

8.1 Sunny Island

8.1.1 Control Panel on the Enclosure

The following diagram describes the elements of the control panel:



8.1.2 Control Panel Buttons

The Sunny Island's control panel has three buttons.

- Start / Stop starts and stops the inverter operation of the Sunny Island (see also chapter 10.1 "Switching On and Off" (Page 83)).
- DC start turns ont the Sunny Island (standby).
- DC stop turns off the Sunny Island

8.1.3 Meaning of the Light-Emitting Diodes (LEDs)

The three LEDs show, from top to bottom, state messages for

- Sunny Island (inverter LED)
- Grid / Generator (grid LED)
- Battery (battery LED)

Depending on the message, the corresponding LED glows red, green, orange, or not at all.

The following table describes the meanings of the color signals from the inverter LED:

Green	**Red**	**Orange**	**Operating mode of the Sunny Island**
–	–	–	Off (device has been switched off)
–	–	ON	Standby (no inverter operation)
ON	–	–	In operation
–	ON	–	Failure or error

The following table describes the meanings of the color signals from the grid LED:

Green	**Red**	**Orange**	**Operating mode grid/generator**
–	–	–	if applicable, no grid/generator (conduction possible)
–	–	ON	Synchronization to the external grid / generator
ON	–	–	Operation with grid / generator
–	ON	–	Failure or error

The following table describes the meanings of the color signals from the battery LED:

Green	**Red**	**Orange**	**Battery charge level**
–	–	–	Off (device has been switched off)
ON	–	–	100 % – 50 %
–	–	ON	50 % – 20 %
–	ON	–	20 % – 0 %

8.2 Sunny Remote Control 1

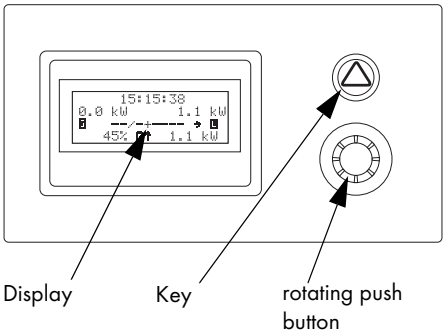
Information

The Sunny Island is controlled via the external display (Sunny Remote Control 1).

You can navigate the Sunny Island's menus with the external display (Sunny Remote Control 1).

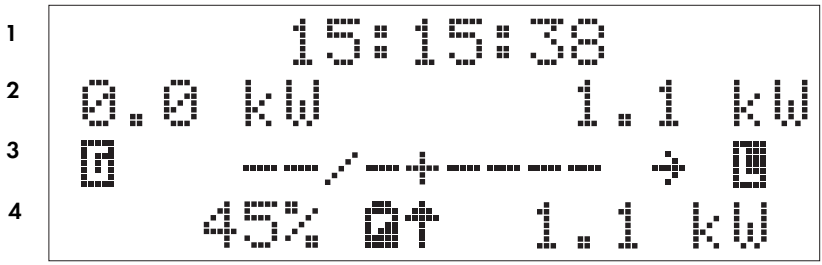
The Sunny Remote Control 1 consists of

- Display
- Key
- rotating pushbutton



8.2.1 Display Messages

The Sunny Remote Control 1 display consists of four lines with 20 characters each. You can find details on the symbols shown in chapter 10.2.1 "Standard View 1" (Page 92).



1 Row: Uhrzeit in [hh:mm:ss]

2 Row: grid or generator power in kW ("TotExtPwrAt")

ggf. Pfeil in Energieflussrichtung (z. B. ↓ = Einspeiseleistung PV-Generator)

Load power in kW ("TotExtPwrAt" + "TotInvPwrAt")

3 Row: Symbols for grid / generator G

Loads L

Generator relay or load shedding relay: On = – Off = /

ggf. Pfeil in Energieflussrichtung (z. B. →)

4 Row: state of charge of battery (SOC)

Symbol for battery

Pfeil in Energieflussrichtung (↑ = Entladen, ↓ = Laden)

Inverter power in kW ("TotInvPwrAt")

- positive value: the battery is discharging/the Sunny Island is feeding the loads
- negative value: the battery is charging

8.2.2 Key

If there is an error during operation, the back of the pushbutton glows red.

If you push the key, you acknowledge the error and the warning light goes off again (see also chapter 18.1 "Error Confirmation" (Page 184)).

8.2.3 Rotating Pushbutton

The Sunny Remote Control 1 is controlled via a rotating pushbutton. This pushbutton allows simple navigation of the Sunny Island menus (see chapter 10.2 "Navigation Area" (Page 89)).

The rotating pushbutton can be pushed or turned.

- Turn:
  - Moves up and down the menu
  - Entering values
- Push:
  - Open/close menu
  - Select/cancel function
  - Select value
  - Confirm entry
  - Answers yes/no
  - Starts the device (hold down the button while on standby)
  - Stops the device (hold down the button during operation)

Operation of the Sunny Island with the Sunny Remote Control 1 using the rotating pushbutton is described in detail in chapter 10 "Operating the Sunny Island" (Page 83).

In the remainder of the manual, the "rotating pushbutton" will only be referred to as "button".

8.2.4 MMC/SD card

The Sunny Remote Control 1 provides an MMC/SD card for firmware updates and as a service interface. For details, refer to section 10.4 "Saving Data onto a MMC/SD Card" (Page 107).

9 (First) Commissioning

9.1 Requirements

Check the connections

Before starting the commissioning process, ensure that all electrical connections have the correct polarity and make sure that everything is connected according to the instructions in chapters 7 "Sunny Island Electrical Connection" (Page 39).

Always save data

Always use the MMC/SD card for saving data and events. This way, in case of a failure, the SMA Solar Technology AG can help you quickly.

The Quick Configuration Guide (QCG) allows you to quickly install and commission your island grid system.

- On the Sunny Island, choose one of the following positions:
  - Start system
  - New system
  - New battery
- Set up the parameters of the desired system specifically.

QCG with Sunny Remote Control 1 only

You can read and set up lists of menus, parameters and errors only with the Sunny Remote Control 1!

You can start up the Sunny Island without an external display as well. In this case the Sunny Island works only with the default parameters
(see chapter 8 "Control Elements" (Page 70)).

9.2 Starting the Quick Configuration Guide (QCG)

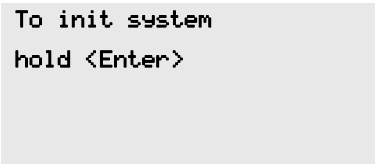
Information

The QCG sets up all parameters values automatically. Reasonable operation is possible this way, with little manipulation.

The QCG is automatically activated when the device is started for the first time. Please continue reading under point *7*, otherwise follow this list.

1. Insert the NH fuse in the BatFuse or close the BatFuse's DC disconnector.
2. Start the Sunny Island.
   Press the DC start key on the Sunny Island
3. The Sunny Island initiates the startup phase. Wait for the following displays to finish.

4. "To init system hold <Enter>" is displayed after the startup phase.



5. Press and hold the pushbutton on the Sunny Control 1.
   During this procedure a bar appears on the display.

6. When the bar on the display disappears and the Sunny Remote control emits a tone signal:

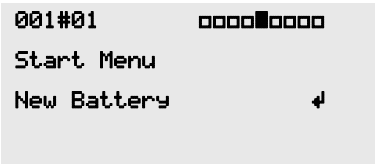
   Let go of the Sunny Remote Control pushbutton.

7. You are now in the Quick Configuration Guide (QCG).

   By turning the pushbutton you can now choose between the following options:

   - "Start System" (if you have accidentally accessed the QCG and would only like to restart the system)

   - "New Battery" (if you would like to change the main battery settings, but retain the system configuration)



   - "New System" (if you would like to start a new system or perform changes to the system configuration)

"New Battery"

When you want to install a new battery in the island grid system, you need the "New Battery" option.

Only specific battery settings are reset and set to new values. The overall system settings are not affected.

The following parameters must be set when **"New Battery"** is selected:

(default setting shown in bold)

- Battery type: 002#05 BatTyp (**VRLA**, FLA, NiCd)
- Battery voltage: 002#06 BatVtgLst (22 V, 24 V in 2 V increments for FLA and VRLA, 21.6 V, 22.8 V, 24 V in 1.2 V increments for NiCd), **24 V** Sunny Island 2224, **12 V** Sunny Island 2012
- Nominal battery capacity: 002#07 BatCpyNom (100 Ah to 10000 Ah, preset **140 Ah** for Sunny Island 2224,)

The following parameters must be set when **"New System"** is selected:

(default setting shown in bold)

- System configuration: 003#01 (selection see "Overview of System Configurations:" (Page 79)), presetting is "**1phase 1SI**"[a)]
- Voltage / Frequency type: 003#02 AcVtgFrqSet (**230V_50Hz**, 220V_60Hz)
- Date: 003#03 Dt (dd.mm.yyyy)
- Time: 003#04 Tm (hh:mm:ss)
- Battery type: 003#05 BatTyp (**VRLA**, FLA, NiCd)
- Battery voltage: 003#06 BatVtgLst (22 V, 24 V in 2 V increments for FLA and VRLA, 21.6 V, 22.8 V, 24 V in 1.2 V increments for NiCd), **24 V** Sunny Island 2224, **12 V** Sunny Island 2012
- Nominal battery capacity: 003#07 BatCpyNom (50 Ah bis 10000 Ah, **140 Ah**)
- External power supply unit: 003#08 ExtSrc (**PvOnly**, Gen, Grid, GenGrid)
- Maximal grid current: 003#09 GdCurNom (0 to 25 A, **16 A**)
- Maximal generator current: 003#10 GnCurNom (0 to 25 A, **16 A**)
- Generator interface: 003#11 GnStrMod (Manual, GenMan, **Autostart**)

a) These applications are only possible with firmware versions 3.0 and above.

Overview of System Configurations:[2)]

The system configuration is described extensively in chapter 7.7 "Configuring a System with Several Sunny Islands" (Page 68).

Displayed Text	Meaning
1phase 1SI	single-phase system, 1 Sunny Island
1phase 2SI	single-phase system, 2 Sunny Islands
1phase 3SI	single-phase system, 3 Sunny Islands
Three 3SI	3-phase system, 3 Sunny Islands

8. After entering the parameters, the following message appears on the display:
   "Init Device OK
   START?"

9. Confirm the question:
   Press and hold the pushbutton on the Sunny Remote Control 1.
10. The following message appears:
    „ST(A)NDBY: To Start INV(erter) hold <Enter>"
    The QCG is complete.
    To start the Sunny Island:

11. Press and hold the pushbutton on the Sunny Remote Control 1.
    During this procedure a bar appears on the display.
12. When the bar on the display disappears and the Sunny Remote control emits a tone signal:
    Let go of the Sunny Remote Control pushbutton.
13. The Sunny Island starts.
    The Sunny Island is in operation.

2) These applications are only possible with firmware versions 3.0 and above.

If there is an error message

If the device displays an error message, this error must be fixed before the device can be put into operation. Use the information in section 18 "Troubleshooting/Problem Solving" (Page 184).

Parameter Lists

Further details concerning the modifiable parameters are found in chapter 17 "Parameter List Overview" (Page 160).

Note that you must first enter the installer password before some parameters can be changed (see section 10.3.2 "Setting the Installer Password" (Page 102)). In addition, some parameters can only be changed in standby mode (see section 10.1.2 "Stopping" (Page 85)).

9.3 Commissioning the Battery Current Sensor

When connecting a battery current sensor to the Sunny Island the internal offset must be calibrated. Proceed as follows:

1. Place the Sunny Island in standby mode (see section 10.1.2 "Stopping" (Page 85)).
2. **NOTICE!**

   System error due to wrong parameter entry

   All parameter settings which could affect the operating safety of the island grid system are protected/locked by the installer password.

   - Only qualified personnel should change and set system parameters.
   - Enter the installer password (see chapter 10.3.2 "Setting the Installer Password" (Page 102)).
3. Remove the "BatCur+" wire from the terminall clamp 1 of the battery current sensor.
4. Connect both the "BatCur+" and the "BatCur-" wires to the terminal clamp 2.
5. Start the Sunny Island
6. Set the following parameters:

   Choose the type of battery current sensor:

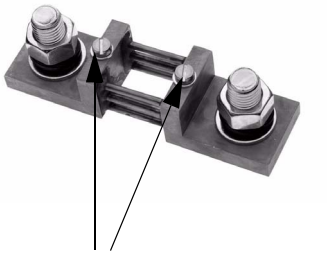
   - "225.01 BatCurSnsTyp" (None / 50 mV / 60 mV). Only after activation of the parameter with 50 mV or 60 mV will other parameters (02, 03 and 04 in the menu "225 Battery Current Sensor") be shown and activated.

   Set the maximal current for the battery current sensor (e.g., 400 A / 60 mV):

   - "225.02 BatCurGain60": (for a 60 mV output (EU-Standard))
   - "225.03 BatCurGain50": (for a 50 mV output (US-Standard))
7. Start the self-calibration:

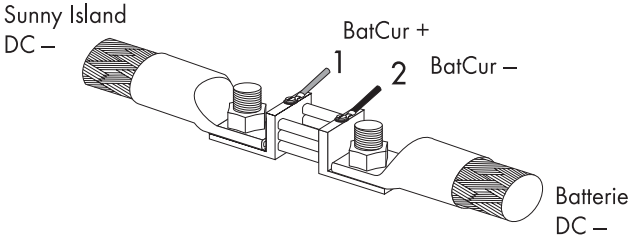
   - "225.04 BatCurAutoCal" to "Start"

   The Sunny Island conducts a self-calibration.



Terminal clamps battery current sensor

8. Subsequently, check the offset error
   "120.06 TotBatCur" should be (close to) zero
9. Switch off the Sunny Island and remove all voltages (see chapter 10.1 "Switching On and Off" (Page 83)).



10. Connect the "BatCur+" wire to the battery current sensor's terminal clamp 2 again.
    Make sure the wires have the correct polarity.
    - BatCur+ to terminal clamp 1
    - BatCur- to terminal clamp 2
11. Start the Sunny Island (see chapter 10.1.1 "Switching On/Starting" (Page 83)).
12. Check the current direction: "120.06 TotBatCur"

Current direction

Battery discharge:

- no generator/grid connected
- Loads are being supplied

The value of the battery current is positive

Charging the battery

- Generator/grid connected
- Loads not being/being marginally supplied
- Battery is being charged

The value of the battery current is positive

10 Operating the Sunny Island

10.1 Switching On and Off

10.1.1 Switching On/Starting

WARNING!

Danger due to incorrect wiring of the island grid system

Only qualified electricians should carry out the first commissioning. Check the island grid system beforehand for

- correct electric cabling and connections
- voltages and polarities

Start the island grid system with the Sunny Island

Information

The island grid system can also be operated without an external display (Sunny Remote Control 1). In this case the Sunny Island works only with the default parameters (see chapter 17.2 "Adjustable System Parameters" (Page 166)).

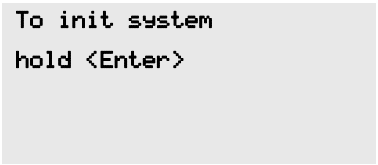
Proceed as follows:

1. Insert the NH fuse in the BatFuse or close the BatFuse's DC disconnector.
2. Press the DC start key on the Sunny Island
   Wait approx. 20 to 30 seconds.
   The Sunny Island is switched on
3. Press and hold the start / stop button on the Sunny Island.
   During the start procedure the inverter LED goes from orange to green.
4. Let go of the start / stop button
   The inverter LED glows green continually.
   The Sunny Island is in operation.

Start the island grid system with the Sunny Remote Control 1

1. Insert the NH fuse in the BatFuse or close the BatFuse's DC disconnector.
2. Press the DC start key on the Sunny Island
   The Sunny Island is switched on
3. The Sunny Island initiates the startup phase.
   Wait for the following displays to finish.

4. "To init system hold <Enter>" is displayed after the startup phase.



5. If you want to go into the QCG, press and hold the Sunny Remote Control 1's pushbutton.
   Instructions on how to proceed further can be found in chapter 9.2 "Starting the Quick Configuration Guide (QCG)" (Page 76).
6. If you do **not** press the pushbutton within 5 seconds, the Sunny Island skips the QCG.
   The following message appears:
   „ST(A)NDBY: To Start INV(erter) hold <Enter>“

7. Press and hold the pushbutton on the Sunny Remote Control 1.
8. The Sunny Remote Control 1 emits a tone.
9. The Sunny Island starts.
10. Let go of the pushbutton.

    The Sunny Island is in operation.

Starting the Sunny Island automatically

Even if the "250.01 AutoStr" parameter is set, the Sunny Island must be manually started for inverter operation after each DC start once, each time the DC circuit breaker is started.

If there is an error message

If the device displays an error message, this error must be fixed before the device can be put into operation. Use the information in section 18 "Troubleshooting/Problem Solving" (Page 184).

10.1.2 Stopping

Stopping the system with the Sunny Island

Set the Sunny Island to standby.

Proceed as follows:

1. Press and hold the start / stop button on the Sunny Island until the inverter LED glows orange continuously.

   During the stop procedure the LED goes from green to orange.
2. Let go of the start / stop button

   The Sunny Island has stopped.

   The device is now in standby mode.

Stopping the system with Sunny Remote Control 1

Set the Sunny Island to standby using the external display.

Proceed as follows:

1. Press and hold the pushbutton on the Sunny Remote Control 1.

   The following display appears:

2. Hold the pushbutton as long as the remaining time for the stop process is shown on the display as bars.
3. The display changes

4. Let go of the pushbutton.
5. The Sunny Island has stopped.

DANGER!
Death hazard due to high voltages

The island grid system is in "standby" operating modus!

- Do not open the device!
- Do not work on the island grid system!

There are still voltages present on the Sunny Island (DC and AC sides).

- Switch off the Sunny Island
- Disconnecting the Sunny Island from Voltage Sources

Consumption in standby mode

In standby mode the Sunny Island still requires about 6 W of power from the batteries.

10.1.3 Switching Off

Switch off the Sunny Island in the following way:

1. Disconnect all loads.
2. Place the in standby mode (see section 10.1.2 "Stopping" (Page 85)).
3. Press the DC stop key on the Sunny Island
   The Sunny Island is switched off

DANGER!
Death hazard due to high voltages

The island grid system is disconnected! There are still voltages present on the Sunny Island (DC and AC sides).

- Disconnecting the Sunny Island from Voltage Sources

Information

You can only ensure that all internal meter readings/values are saved by using this switching sequence.

Ensure that the device cannot be reconnected!

Wait 30 seconds before switching the device on again. Otherwise the smooth operation of the Sunny Island cannot be guaranteed.

10.1.4 Disconnecting the Device from Voltage Sources

1. Switch off the Sunny Island (see chapter 10.1.3 "Switching Off" (Page 87)).
2. Remove the NH fuse from the BatFuse and/or open the BatFuse's DC disconnector.
   The Sunny Island is disconnected from the battery
3. Separate the Sunny Island from all AC voltage sources.
4. Make sure that the Sunny Island has been disconnected securely from all voltage sources.
5. Wait at least 15 minutes.
   The capacitors discharge and allow the voltage inside the device drops to a safe level.
6. The Sunny Island is now completely free of voltage.
7. You can now open the lower enclosure cover of the Sunny Island.

10.1.5 Restarting the System after Automatic Shutdown

NOTICE!

System shutdown due to, for example, wrong device settings

- Before and after recommissioning, inspect the whole island grid system for errors
  - Wrong wiring?
  - Have any components failed?
  - Are there any wrong parameter settings on the Sunny Island?
- If applicable, clear the errors.

If the Sunny Island has swiched itself off due to batteries which are too deeply discharged, proceed as follows to restart:

1. Press the DC stop key on the Sunny Island

Wait!

Wait a minute before you restart the Sunny Island with the DC start key. The capacitors must discharge first.

2. After waiting for a minute, switch on the Sunny Island.
   Press the DC start key on the Sunny Island

Information

If, as in rare cases, it is not possible to restart after one minute, wait a little longer. Try again. A possible cause can be component tolerances.

3. Start the Sunny Island (see chapter 10.1.1 "Switching On/Starting" (Page 83)).

Charging the battery

Once the system is switched on again, it is important that the batteries are charged. If the grid is available again, and/or the generator starts, the grid/generator will recharge the batteries after a few minutes.

4. Monitor the Sunny Island connection in the charging process with the Sunny Remote Control 1.
5. Check that all other energy generators in the island grid system are working correctly.

If Sunny Island begins to operate in battery-preservation mode, disconnect the loads!

If the Sunny Island enters the battery-preservation mode immediately after restarting see chapter 12.5 "Battery Preservation Mode" (Page 127).

- Verify the availability of the grid.
- Reconnect the loads again only after the Sunny Island is operating in charge mode.

10.2 Navigation Area

The navigation area comprises the home screen as well as the main menu items

- 100# Meters (display values)
- 200# Settings
- 300# Diagnosis
- 400# Failure/Event (lists)
- 500# Operation (functions during operation)
- 600# Direct Access

A main menu is subdivided into submenus.

From a submenu you can select another submenu or a parameter.

NOTICE!

Damage to the system due to wrong parameter entry

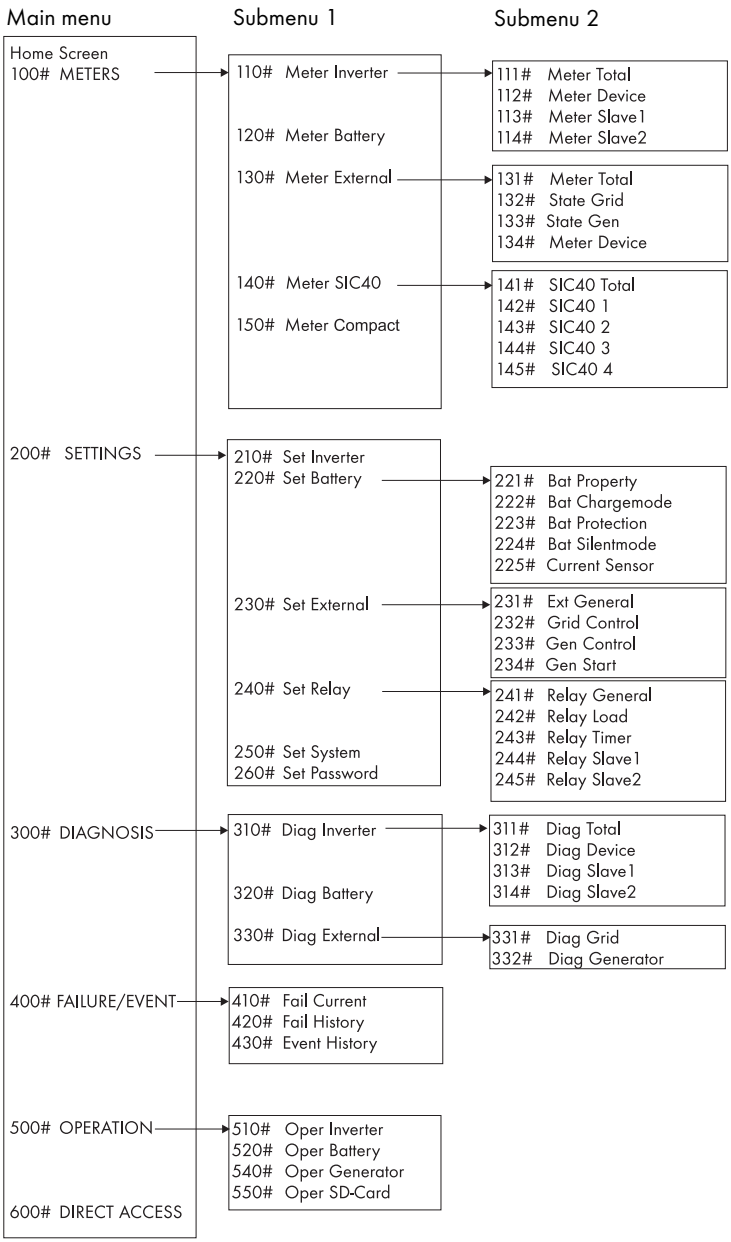
- Only qualified personnel should change and set system parameters.

You can access the navigation area from two access levels:

- User level
- Installer level (only with password)

The menu items and parameters which allow the editing of system parameters are accessible after entering the installer password (see chapter 10.3.2 "Setting the Installer Password" (Page 102)).

Overview of the menu area:



100# Meters (display values): In this main menu you can find the displayed values of the following components of the island grid system:

- 110# Meter Inverter - Sunny Island
- 120# Meter Battery
- 130# Meter External - grid/generator
- 140# Meter SIC40 - battery charge regulator
- 150# Meter Compact - compact display of the commissioning values

By opening the corresponding submenus or the second tier of submenus, you can see the parameters (for example, Parameter "112.03 InvVtg").

200# Settings: In the following submenus you can see and edit the system parameters:

- 210# Set Inverter
- 220# Set Battery
- 230# Set External - grid/generator
- 240# Set Relay
- 250# Set System
- 260# Set Password

300# Diagnosis: In the following submenus you can see the system data:

- 310# Diag Inverter - device data (Sunny Island)
- 320# Diag Battery - battery data
- 330# Diag External - grid/generator

400# History: In the following submenus you can see various error and event lists:

- 410# Fail Current - present errors
- 420# Fail History - warnings and errors to date
- 430# Event History

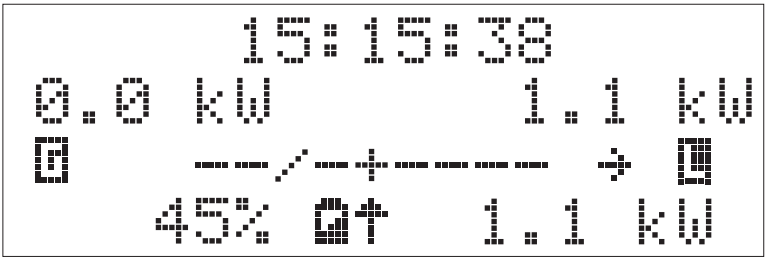
500# Operation - functions during operation: In the following submenus you can see and edit the operating parameters:

- 510# Oper Inverter
- 520# Oper Battery
- 540# Oper Generator
- 550# Oper SD Card - MMC/SD card

600# Direct Access: In this main menu you can access settings and display values directly (see chapter 10.3.3 "Accessing Parameters Directly" (Page 105)).

10.2.1 Standard View 1

The standard view 1 (home screen) shows the operating states of the Sunny Island:



1 Row: Uhrzeit in [hh:mm:ss]

2 Row: grid or generator power in kW ("TotExtPwrAt")

ggf. Pfeil in Energieflussrichtung (z. B. ↓ = Einspeiseleistung PV-Generator)

Load power in kW ("TotExtPwrAt" + "TotInvPwrAt")

3 Row: Symbols for grid / generator

Loads

Generator relay or load shedding relay: On = − Off = /

ggf. Pfeil in Energieflussrichtung (z. B. →)

4 Row: state of charge of battery (SOC)

Symbol for battery

Pfeil in Energieflussrichtung (↑ = Entladen, ↓ = Laden)

Inverter power in kW ("TotInvPwrAt")

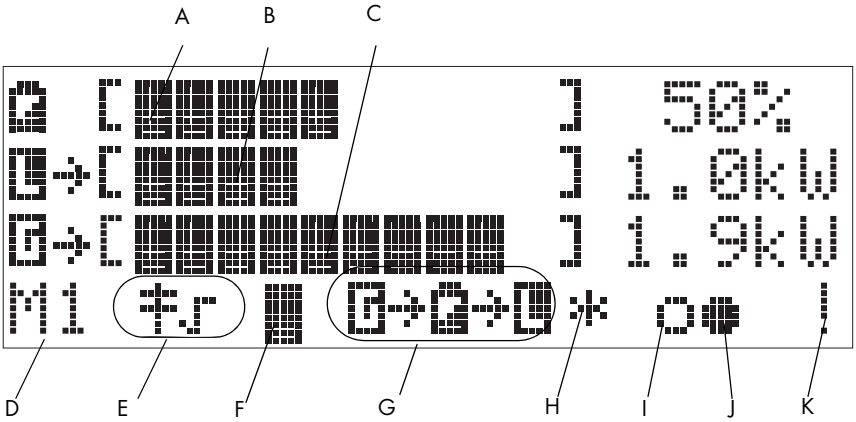
- positive value: the battery is discharging/the Sunny Island is feeding the loads
- negative value: the battery is charging

10.2.2 Standard View 2

The standard view 2 shows the operating states of the Sunny Island:

- Battery charge power
- Output power
- Power from the grid/generator

as well as various information items on the status line.



A	Battery charge level in [%]
B	Output power of consumers in [kW]
C	Power drawn from the grid/generator (AC2) in [kW]
D	Device hierarchy (master, slave 1, slave 2)
E	grid/generator limits
F	MMC/SD card in use
G	Direction of energy flow and system status
H	Status of grid/generator (alternates with GenReq)
I	Relay 1 Status
J	Relay 2 Status
K	Warning message

Row 1

The bar shows the charge state of the battery in [%]

The value of the charge state is also shown digitally on the right.

Row 2

The bar shows the magnitude of the totall output power in [kW] with which the consumers are being supplied.

The arrow to the right, next to the L describes the direction of energy flow:

- → Loads are being supplied
- ← Sunny Boy (PV inverter) feeds into the grid

The magnitude of the total output power [kW] is also shown to the right digitally.

Row 3

The bar shows the magnitude of the power drawn fromt the grid/generator in [kW].

The arrow to the right, next to the G describes the direction of energy flow:

- → The island grid system is being supplied by the grid/generator

The magnitude of the total power [kW] is also shown to the right digitally.

Row 4 (status bar)

The following information is shown in the status bar (from left to right):

1. Device hierarchy
   - M1 = Master
   - S1 = Slave1
   - S2 = Slave2

2. Connection to the public grid/a generator:
   - = the Sunny Island monitors the grid limits (grid operation)
   - = the Sunny Island monitors the generator limits (operation with generator)
3. MMC/SD card (memory card) in the Sunny Remote Control 1:
   - = card inserted
   - = card missing
4. These indicators label the energy flow direction of the
   - = grid/generator
   - = battery
   - = Consumers

   There are four operative states:
   - = the grid/generator charges the battery and supplies the consumers
   - = the grid/generator supplies the consumers
   - = the grid/generator charges the battery, there are no consumers connected
   - = the battery supplies the consumers
5. The state of the external sources are described by the following symbols:
   - * = The grid/generator voltage and frequency are within the set limits
   - ? = Generator voltage and/or frequency are outside of the set limits. The Sunny Island will not connect the generator to the stand-alone grid while this situation exists.
   - ! = The maximal admissible grid/generator reverse power was exceeded, the Sunny Island has disconnected the grid/generator from the stand-alone grid.

   The following characters indicate why the generator was deployed:
   - B = Battery = The generator was deployed due to the battery's state of charge.
   - L = Load = The generator was deployed due to a load-dependent generator requirement.
   - S = Start = The generator was deployed due to the operator's manual switching of the generator activation on the Sunny Island from "Auto" to "Start". The generator is no longer controlled automatically nor switched off by the Sunny Island.
   - T = Time = The generator was run for an hour by the Sunny Island via the parameter setting "Run1h". After this period the Sunny Island switches off the generator automatically.

The display changes

The generator status and the reason for its deployment are shown (alternating) under "Generator-Status" in the display.

- If, for example, the display changes every 3 seconds from "*" to "B", this means that the generator voltage and frequency lie within the specified limits and that the generator was requested as a result of the battery charge level.
- If the generator has been manually set to "Stop", then no generator status information is shown on the display. The field remains empty.

6. Relays
   - ● = relay activated
     ☼ = relay deactivated
7. Warning:

   ! = Warning

   The symbol blinks until you have seen and cleared the warning in menu "410# Fail Current" or "420# Fail History".

   Faults: If there is a fault, the device goes into standby. A fault notice appears on the display. Acknowledge and clear the fault; then the Sunny Island can be restarted.

Change to Standard View 1

The display switches to standard view 1 (home screen) automatically if the Sunny Remote Control 1 has not been used for more than five minutes (inactivity).

Display Illumination

The background illumination is automatically deactivated after a short time of inactivity. Switch the lighting back on by turning the pushbutton slightly. This turning changes no settings; it only reactivates the display illumination.

Message Displays

Messages are displayed at all times during operation, they have priority over the standard view 1 (home screen).

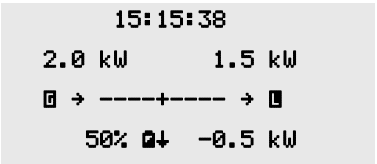
10.2.3 Select menu

You can navigate the Sunny Island's menus with the external display's (Sunny Remote Control 1) pushbutton.

- By pressing the pushbutton, you reach a submenu level.
- By turning the pushbutton you can move within this menu level.
- By selecting the line "back" and pressing the pushbutton, you leave the menu level you are in and move to the next higher level.

Example:

The display shows the standard view 1. Browse through the main menu by turning the pushbutton right or left.



1. Turn the pushbutton to the right.

   The display's background lighting is activated.

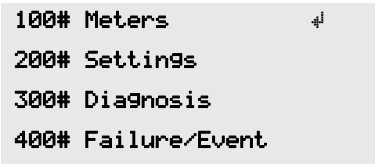
2. Turn the pushbutton further to the right.

   The display shows the standard view 2.

3. Turn the pushbutton further to the right.

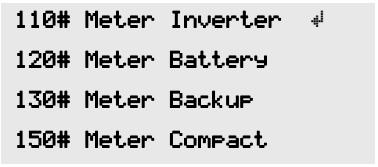
   The following display appears:

   To the left are the menu number and name. That line is active on which, to the far right, the enter arrow ↲ is shown.



4. Depress the knob.

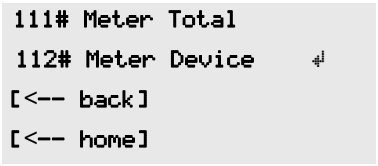
   The arrow jumps to the submenu of the "100# Meters" main menu item.



5. Depress the pushbutton.

   The arrow jumps one menu level further. Now you have three possibilities:

   - Depress the pushbutton. The arrow jumps one level further. You can see parameters which are assigned to this menu.
   - Select the line "back". To do this turn the pushbutton left or right until the "enter" arrow ↵ is on the appropriate line. Then press the pushbutton.
   - Select the line "home". Press the pushbutton. Now you can see the standard view 1.



Sequence of the Menu Items

Menu items can be skipped over, i.e., you do not see all numbered parameters. This is related to the password level which is set. If you are using the device in user level, those parameters which should only be set by the installer do not appear. The menu numbers are fixed, that means they do not change if an entry (or several entries) are skipped.

10.2.4 Selecting Parameters

Parameters are shown on the display as follows:

- To the left are the menu number and the parameter number. To the right, a bar shows the status of the value queried at present.
- To the left is the parameter name and to the right the "enter" arrow ↵. The arrow indicates that this parameter can be adjusted.
- Magnitude and units.

Syntax for this document

The syntax specified here for menus and parameters applies throughout the entire document.

A menu is marked by a hash mark, menu number and menu names (130# Meter Backup).

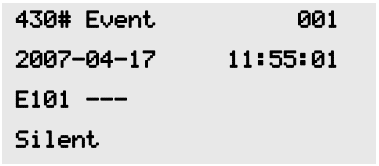
A parameter is marked with a menu number, dot (hash, on the display), parameter number and parameter name (131.01 TotExtPwrAt).

10.2.5 Selecting Events

The event list is found in the main menu, under 400# Failure/Event. Then go to the submenu 1 and activate 430# Event.

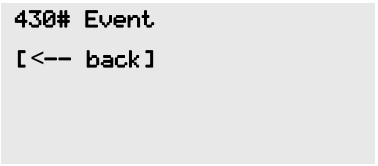
Events are shown on the display as follows:

- To the left are the menu number and name. To the right is the total number of events.
- Date and time of the event.
- Event and number (see chapter 18.5 "Events" (Page 185)).
- Description of the event



Skip back to the previous menu level:

- Turn the pushbutton completely to the left or right until "back" is shown on the display.
- Press the pushbutton



10.2.6 Selecting Warnings and Faults

The warnings and faults list can be found in the main menu under 400# Failure/Event. Then go to the submenu 1.

- List of the current warnings and faults - 410# Fail Current.
- List of all warnings and faults (history) - 420# Fail History

Example:

Warnings and faults are shown on the display as follows:

- To the left are the menu number and name. To the right is the total number of instances for this particular warning or fault, to date.
- Date and time of the warning/fault.
- Warning or Fault and number (see chapter 18.7 "Warnings and Failure messages" (Page 188)). The "enter" arrow shows that the fault must be cleared and confirmed thereafter. Only thereafter can the Sunny Island be restarted.
- Description of the warning/fault.

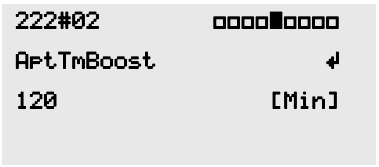
Pending:	The warning/fault is pending. The fault has not yet been cleared.
Arrive:	Time at which the warning/fault appeared.
Clear:	The warning/fault has been cleared.

10.3 Making adjustments

10.3.1 Adjusting parameters

With the pushbutton on the Sunny Remote Control 1 you can move through a menu and select the desired parameter. When the parameter appears on the display, you can read the current value.

The parameter can be adjusted if there is an "enter" arrow ↲ to the right after the parameter name.

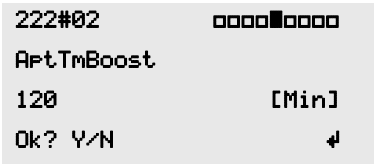


1. Depress the knob.
2. The arrow skips behind the units and blinks.
3. Turn the pushbutton to the right or left. The value increases or decreases.
4. When the desired value appears on the display, save it. Press the pushbutton.

   On the display appear "Ok? Y(es)/N(o)" and the "enter" arrow.

5. Select Y or N. The letter selected blinks.

   With "Y" you can confirm the parameter change. With "N" you can discard the change and the old value remains in memory.



6. Press the pushbutton.

   The parameter is set.

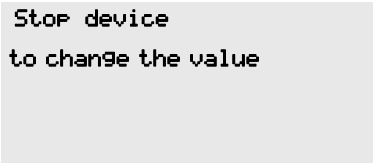
Adjusting parameters in standby

Note that some parameters can only be changed in standby mode. You can find the parameters for which this applies in the tables in chapters 17.2 "Adjustable System Parameters" (Page 166) and 17.5 "Functions During Operation" (Page 182).

In the case of parameters which may only be changed in standby mode or which require a different password, the Sunny Island indicates this with a message.

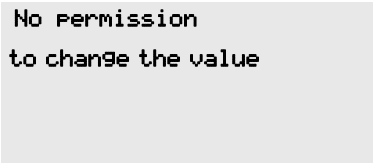
The following message appears on the display:

- This parameter can only be changed in standby mode.
- Stop the Sunny Island (see chapter 10.1.2 "Stopping" (Page 85)).
- Then change the parameter.



The following message appears on the display:

- Wrong user level.
- You cannot make changes in this menu area without entering the installer password.
- Follow the instructions in chapter 10.3.2 "Setting the Installer Password" (Page 102).



10.3.2 Setting the Installer Password

NOTICE!

System error due to wrong parameter entry

All parameter settings which could affect the operating safety of the island grid system are protected/locked by the installer password.

- Only qualified personnel should change and set system parameters.

Do not give out the password to unauthorized persons.

Do not provide the following information for entering the installer password to unauthorized persons. Illegal provision of this information to other persons will lead to invalidation of all guarantees by the SMA Solar Technology AG.

Entering the password

The Sunny Island allows you to enter the password not only in standby, but also during operation.

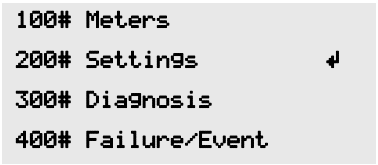
The password is dependent on the operating hours counter. In the installer level there are extended access privileges to all necessary parameters.

Password = Sum of the digits of the number of operating hours.

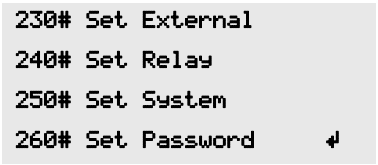
Proceed as follows to enter the installer password:

The display shows the standard view 1.

1. Select the "200# Settings" menu.
2. Depress the knob.



3. Select the "260# Set Password" menu.
4. Depress the knob.



The following message appears:

- Two place holders (**) for the password (PW)
- Level [0] = user level
- Operating hours (OnTmh)
- Sum of all hours in operation
- Units

5. Calculating the password

   Add up all the digits of the number of operating hours. In this case:

   1 +2 + 3 + 4 + 5 + 6 = 21

6. Press the pushbutton. The place holders blink.
7. Enter the password (here: "21").

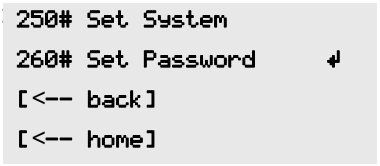
   Turn the pushbutton to the right or left. The value increases or decreases accordingly.

8. Confirm the password. Press the pushbutton.

   The password is confirmed.

   Operating level [1] = installer level has been set.

9. Leave menu.



Changing the operating level

If the password is invalid, the Sunny Island does **not** switch to the installer level. In this case, recalculate and re-enter the installer password as described in this section.

The installer level is reset to the user level if

- the Sunny Island is switched off and on again
- specific parameters are entered (e.g., the "510.01 InvRs" parameter) that cause a restart
- a wrong password is entered
- if no activity takes place within five minutes

10.3.3 Accessing Parameters Directly

Under the menu "600# Direct Access" it is possible to directly access selected parameters via their name or number.

Via the Select Name submenu, you have direct access to the following functions:

- ManChargSel: manual starting of equalization charge (see section 12.4.3 "Equalization Charge" (Page 126))

Under the menu "Select Number" each parameter can be directly accessed by entering the parameter number.

Example

Using the menu 600# Direct Access, you can select the "222.01 BatChrgCurMax" parameter, for example, to set the maximum battery charging current.

The direct access must be entered as a five-digit number, for example, 22201. Here, the first three digits describe the menu number and the last two describe the parameter number.

After the parameter has been set successfully, exit the this menu level.

10.3.4 Meter Compact

The "150# Meter Compact" menu should, above all, facilitate the commissioning for the installer. The display delivers information on the following items at a glance:

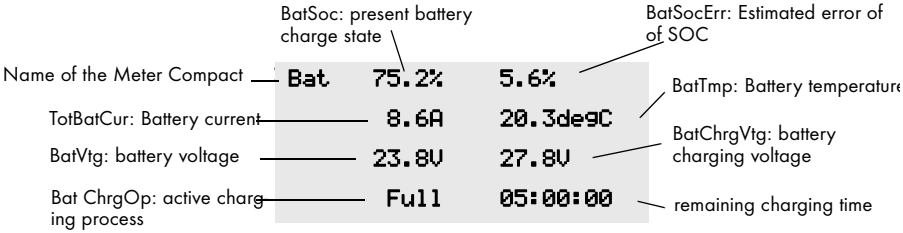
- Battery
- Inverter (AC values)
- grid/generator (external)
- Inverter status

Select item

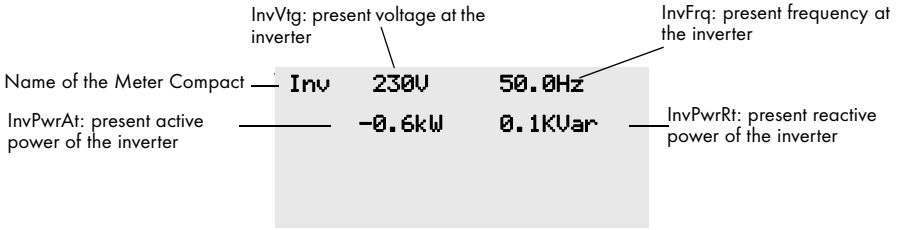
You can select among the various items within the Meter Compact by turning the pushbutton right or left.

Exit the menu by pressing the pushbutton.

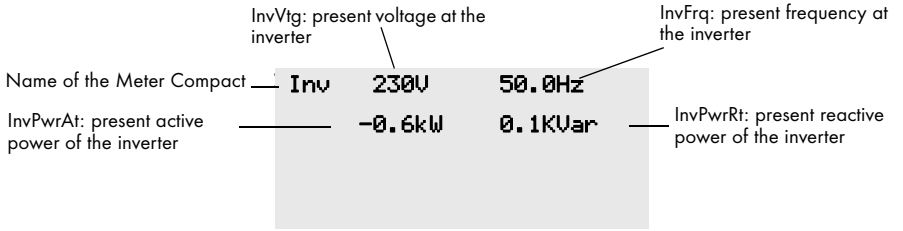
Bat1 (Battery Values 1)



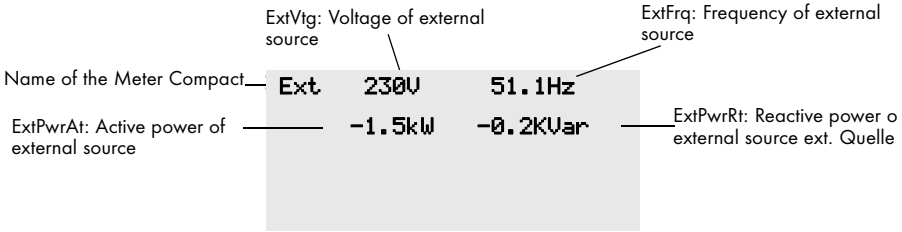
Inv (AC inverter values)



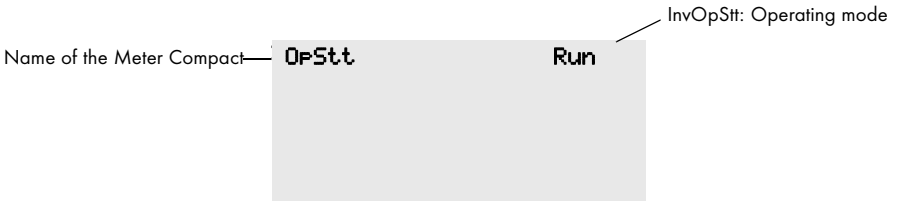
InvTot (total AC values of inverter)



ExtTot (Total AC Values of External Source)



OpStt (Inverter and Generator Status)



10.4 Saving Data onto a MMC/SD Card

The Sunny Remote Control 1 can store firmware, parameters and measured data on a Multimedia-Card (MMC/SD card) which must be FAT-16-formatted, with a max. size of 2 GB (possible memory sizes are 32/64/128/256/512 MB, 1GB and 2 GB). File names are saved in 8.3 format and files with other names are ignored.

Example of a format

A valid 8.3 format is, for example, "M1LOG.DAT".

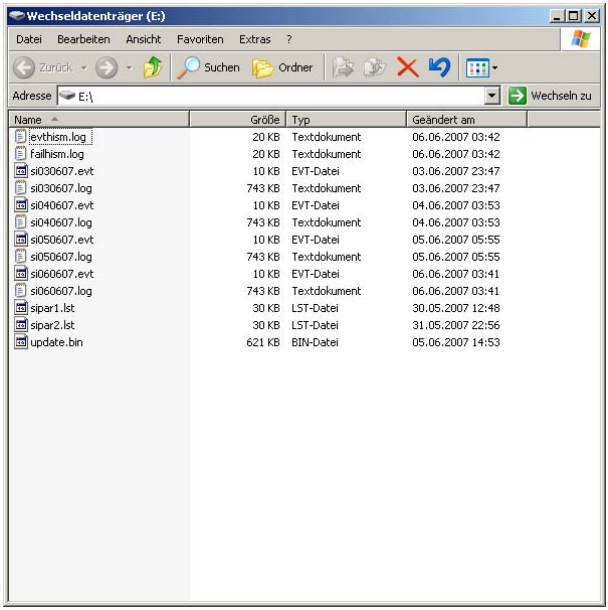
8.3 is the "old" MS-DOS format with a file name that has max. 8 figures before and 3 figures after the dot.

Memory card types

The SMA Solar Technology AG recommends using MMC/SD cards manufactured by Transcend.

If you use a memory card by another manufacturer, check to see that it is a FAT-16-formatted card. If required, format the card. Be aware that, in doing this, data already stored on the card will be lost.

After you have inserted the MMC/SD card into the card reader slot on your PC, you can search for the respective drive in the Explorer (in Microsoft Windows). You can see the following data on this drive (here: E:):



The files saved on the MMC/SD card have the following meaning:

File name	Meaning
evthism.log (evthisN.log for SlaveN)	Event history of the device, saved by means of parameter "550.03 CardFunc", option StoEvtHis

File name	Meaning
failhism.log (failhisN.log for SlaveN)	Failure history of the device, saved by means of parameter "550.03 CardFunc", option StoFailHis
si030607.evt	Event/failure history for the day (format: ddmmyy)
si030607.log	Data recording for the day (format: ddmmyy)
sipar1.lst	Parameter list for the device, created by means of parameter "550.01 ParaSto", option Set1
sipar2.lst	parameter list for the device, created by means of parameter "550.01 ParaSto", option Set2
update.bin	Software for the device

Information

The "BOOTEX.LOG" file is not necessarily on the card. It is created depending on the operating system used (e.g. WindowsXP or Windows2000).

The Sunny Island's firmware expects device-specific data in the root directory of the MMC/SD card. This data consists of a new firmware, parameters and measurement data.

The Sunny Island uses the MMC/SD card in the Sunny Control 1 to store and load device parameters.

In addition, the Sunny Island supports the acquisition of measurement data on the MMC/SD card. It saves these data in a special file. Among other things, the file contains a header, time stamp, date and data type. There are two different types of log data:

- Measurement data (saved cyclically)
- Events and failures (only saved when they occur)

The Sunny Island supports measurement data storage of data from the fields:

- Battery
- Inverter
- System
- External source and
- Loads

Always save data

Always use the MMC/SD card for saving data and events. This way, in case of a failure, the SMA Solar Technology AG can help you quickly.

The data saved on the MMC/SD card can be processed using common table calculation programs.

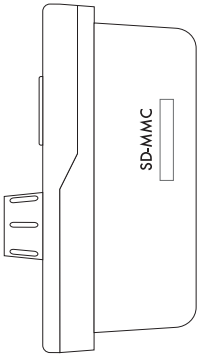
- The first 14 lines of the file are used for information (file header).
- This is followed by two column header lines.
- The data following this are separated by semicolons.
- Decimal places are separated by periods.
- The date format is dd.mm.yyyy
- The time format is hh:mm

Log Data

For further information on processing log data see the instructions of the software used.

10.4.1 Inserting the Card

1. Insert the MMC/SD card with the clipped corner toward the top (the sticker faces forward) into the external display's card slot.



2. After inserting the MMC/SD card, its removal is forbidden via a message on the display:

```
Do not remove
MMC/SD card...
```

3. Initialization of the MMC-/SD card requires a few minutes.

   On the display, three dots move along the bottom line.

4. If there is a fault, the following message appears on the display:

```
MMC operation failed
```

10.4.2 Removing the Card

To ensure that all log data is saved upon deactivation, write all data not yet saved from the buffer to the MMC/SD card by using the parameter "550.03 CardFunc" with the option "ForceWrite".

Data Loss

If you remove the MMC/SD card without first activating the parameter "550.03 CardFunc", you will lose all data not yet saved since the last save process (15 minutes max.).

10.4.3 Loading and Saving Parameters

The "550.01 ParaSto" parameter allows the storage of all the current parameter settings. Parameters already saved can be loaded using the "550.02 ParaLod" parameter.

Saving Optimal Settings

If the system is working optimally, it is a good idea to save these settings. This is especially useful if you try something new and then later wish to reset the inverter back to the previous settings.

When saving the parameters you have the following options:

- Set1 (save parameter set 1)
- Set2 (save parameter set 2)

When loading the parameters you have the following options:

- Set1 (load parameter set 1)
- Set2 (load parameter set 2)
- Factory (load the factory settings (reset))

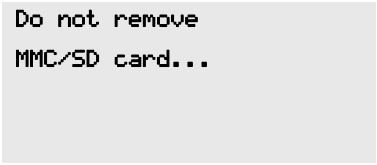
Overwrite protection

The write protection function of SD cards (plastic sliding clip on the left side) is **not** supported by the display. You should take note of this when writing data to your card.

10.4.4 Writing Log Data

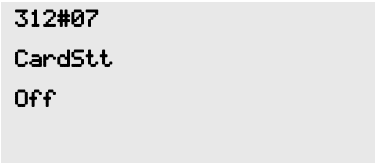
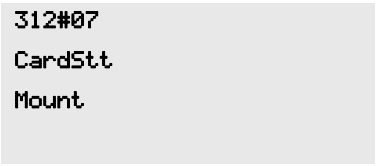
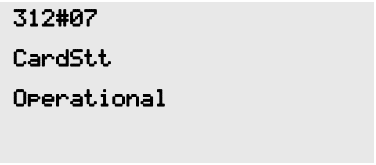
Using the "550.04 DatLogEna" parameter, you can activate the writing of log data onto your MMC/SD card (activated by default).

If the Sunny Remote Control 1 is writing data onto the MMC/SD card, removing the card is forbidden. The following message appears on the display:



10.4.5 Show Status

Using the "312.07 CardStt" parameter, you can request the status of your MMC/SD card:

Meaning	Display
The MMC/SD card is deactivated.	
Initialize the MMC/SD card.	
The MMC/SD card is activated.	

Meaning	Display
The memory capacity of your MMC/SD is full.	312#07 CardStt Out Of Space
The MMC/SD card has an invalid file format.	312#07 CardStt Bad File Sys
The MMC/SD card is incompatible.	312#07 CardStt Incomp

Clearing Errors

For help on troubleshooting see section 18.8 "Troubleshooting" (Page 192).

10.4.6 Updating Firmware

The firmware of the Sunny Island can be updated using the MMC/SD card. When the Sunny Island starts up or when the MMC/SD card is recognized, the Sunny Island searches for special update files on the MMC/SD card. If it detects such update files it conducts an update when it is on standby.

New MMC/SD card

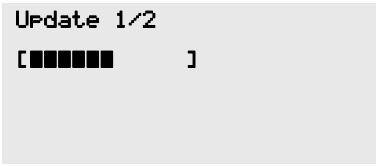
Always save the latest firmware version on the MMC/SD card first. Upon delivery this card is still empty (unwritten).

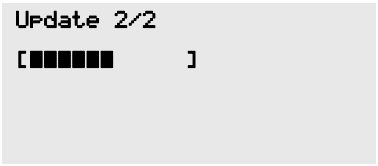
Please note:

- Do not switch off the device during the firmware update!
- Do not remove the MMC/SD card during the firmware update!
- Observe notices regarding the update files.

Updating the Firmware

1. Set the Sunny Island to standby.
2. Insert the MMC/SD card in the Sunny Remote Control 1's card slot.
3. The messages below are displayed while the Sunny Island does the update:





After the Update

- After the update has been successfully completed a reset is enforced in order for the changes to become effective.
- Please Note

4. After the reset, the Sunny Island remains in standby mode.
5. Start the device manually (see chapter 10.1.1 "Switching On/Starting" (Page 83)).

Parameter settings

- Individual parameters and settings are retained during a firmware update.
- When updating, new parameters in the updated firmware are saved with the factory default values automatically.

11 Additional Functions

11.1 Load shedding

The Sunny Island can automatically switch off loads to protect the batteries from deep discharge. To do this, an external (AC or DC) power contactor must be installed between the Sunny Island and the loads (see also chapter 19.3 "Accessories (Optional)" (Page 195)).

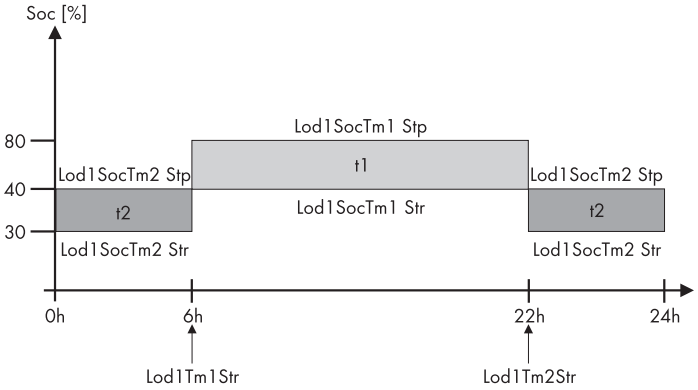
NOTICE!

Faulty system operation due to lack of load shedding.

Install external load-shedding protection in case the island grid system on the AC-generating side is coupled to PV generators or wind generators.

If there is overloading due to low energy production or very high energy consumption, you must be able to switch off loads.

Always switch off the loads, never the energy producers (e.g., Sunny Boy)!



The graphic shows an example for the settings that minimize the load shedding function at night. From 6:00 a.m. to 22:00 p.m. the load shedding is activated for a charge state (SOC) of 40 %, during nighttime (from 22:00 p.m. to 6:00 a.m.), by contrast, the charge state of the battery is allowed to go down to 30 % before the load shedding is activated.

The load shedding function can be assigned twice. In the parameters mentioned above, the "Lod1" part represents the first assigned function and the "Lod2" part represents a second, identical function. These two load shedding functions, which are dependent on the battery's state of charge, allow for tiered load-shedding in which, by using different SOC values, different priorities can be given to various load groups.

Define the time intervals t1 and t2:

- Starting time t1: with the parameter "242.05 Lod1Tm1Str", set the start time for t1 (and with it the end of t2).
- Starting time t2: with the parameter "242.06 Lod1Tm2Str", set the start time for t2 (and with it the ent of t1).
- If the time intervals t1 (Lod1Tm1Str) and t2 (Lod1Tm2Str) are consistent with one another, only t1 will be activated.

Set the battery state of charge at which the time interval t1 or t2 will start/stop:

- The battery state of charge during the t1 interval, the recognition of which will lead to the load-shedding function being started: Parameter "242.01 Lod1SocTm1Str"
- The battery state of charge during the t1 interval, the recognition of which will lead to the load-shedding function being stopped: Parameter "242.02 Lod1SocTm1Stp"
- The battery state of charge during the t2 interval, the recognition of which will lead to the load-shedding function being started: Parameter "242.03 Lod1SocTm2Str"
- The battery state of charge during the t2 interval, the recognition of which will lead to the load-shedding function being stopped: Parameter "242.04 Lod1SocTm2Stp"

11.2 Sleep Mode

Using the "250.10 SleepEna" parameter set to "Enable" allows the sleep mode to be activated in single-phase grids, which the master uses to switch off the slaves when the power value allows this.

Sleep Mode

- The "Sleep Mode" works exclusively in stand-alone grid operation!
- The values for the switching on and off of the Sunny Island are set at the factory and are fixed (and optimized for the efficiency rating).

11.3 Search Mode

The search mode is an energy-saving mode. When the power of the loads is less than 10 W for an definable period of time (Delta T), the Sunny Island switches to the search mode. In the search mode there is still voltage present at the AC1 terminal clamps.

With the parameter "250.26 SearchModTm", you can set the time interval Delta T (0 to 600 seconds).

11.4 Time-controlled Operation

The Sunny Island can be operated in a time-controlled fashion using a timer function (like a clock timer), supplying power at a planned point in time.

To do this, this function must be activated by using the "510.02 InvTmOpEna" parameter. With the "510.03 InvTmOpStrDt" parameter you can specify the starting date, and with the "510.04 InvTmStrTm" you specify the starting time. With the parameter "510.05 InvTmOpRnDur" you set the running time and with the parameter "510.06 InvTmOpCyc" you determine whether this function will be carried out once, or every day or week, at or for the first time at the specified start time (date and time).

11.5 Overload and Short Circuit Behavior

The Sunny Island can be operated under overload conditions temporarily. It can also supply short-circuit currents.

In the case of overload, the Sunny Island can deliver

- An output of 2900 W for 30 minutes at 25 °C
- An output of 3800 W for 5 minutes at 25 °C

In the event of a short circuit, the Sunny Island provides a maximum current of 25 A.

11.6 Device Failure and Autostart

If a critical fault occurs, the Sunny Island automatically shuts down and displays the reason on the display. If the autostart function is activated ("250.01 AutoStr" parameter) the Sunny Island can confirm the failure automatically and restart on its own. If the failure persists the Sunny Island cannot be started.

Information

If the autostart counter has counted down to 0, the Sunny Island waits for 10 minutes before attempting to restart automatically.

Information

Messages can be displayed during operation at any time, they have priority over the display of the "Home Screen".

12 Battery management

The battery management of the Sunny Island supports the following three battery types ("221.01 BatTyp" parameter):

FLA	**- F**looded **L**ead **A**cid:	closed lead acid batteries with liquid electrolyte in all standard designs available on the market (grid plate, tubular plate, small, large, etc.)
VRLA	**- V**alve **R**egulated **L**ead **A**cid:	Closed lead acid batteries with immobilized electrolyte in gel or AGM (**A**bsorbent **G**lass **M**at Separator) in all standard designs available on the market (grid plate, tubular plate, small, large, AGM, Gel, etc.)
NiCd	**- Ni**ckel-**Cd**mium:	Pocket-type plate or fiber plate closed nickel cadmium batteries.

The battery capacity ("221.02 BatCpyNom" parameter) is to be entered as the nominal capacity for a ten hour discharge (C10). If this information is not available from the battery manufacturer's data sheet, it can be calculated from the data for different discharge times (120h, 100h, 20h, 5h, 1h) in the following manner:

C10	C120/1.28	C10	C10
C10	C100/1.25	C10	C5/0.88
C10	C20/1.09	C10	C1/0.61

The Sunny Island is designed and set by default (parameter "221.03 BatVtgNom") for a nominal battery voltage of

- 24 V (12 cells at 2 V each) in the case of lead batteries (FLA and VRLA)
- 22.8 V (19 cells at 1.2 V each) in the case of Nickel-Cadmium batteries

12.1 Battery temperature

The Sunny Island continuously monitors the battery temperature using the battery temperature sensor provided. At 5 °C under the maximal temperature allowed (set using the " 221.04 BatTmpMax" parameter), a warning is displayed. If the maximal value for the battery temperature is exceeded, the Sunny Island switches off.

When lead acid batteries drop –10 °C below the set limit and NiCd batteries drop –20 °C below the set limit, a warning is displayed.

The battery temperature is taken into consideration when the charging voltage is calculated (see section 12.4 "Charge Control" (Page 122)).

NOTICE!

Possible damage to the battery as a result of faulty temperature measurement!

If the battery temperature sensor is defective or missing, the Sunny Island continues to run, assuming a battery temperature of 40 °C. This can result in insufficient charging of the battery in the long run.

- Please observe the corresponding warnings of the Sunny Island.
- Connect the battery temperature sensor.
- Replace the defective battery temperature sensor.

12.2 Start Options

If the battery or individual cells are removed from the battery bank in a system, the battery management must be restarted and configured. This can be done using the "Quick Configuration Guide QCG" (see section 9.2 "Starting the Quick Configuration Guide (QCG)" (Page 76)).

12.3 Charge State/SOC and SOH

The Sunny Island has a very precise internal charge level calculation (display value "120.01 BatSoc"). The operation for calculating the charge level is based on balancing the ampere hours. This means that all currents flowing in and out of the battery are accumulated and referred to the nominal capacity. In order to take into consideration faults caused by self discharge and charging losses caused by gassing, these losses are already internally deducted. Unlike in case of other procedures, a fixed charging factor does not have to be set.

After full charge has been reached, the charge state value is reset to 90 %, 95 % or 100 %, depending on how fully the battery has been really loaded. If default settings are not changed, a state of charge of 90 % after boost charge, 95 % after full charge and 100 % after equalization charge is reached.

Since fully charged states are only rarely achieved, the operation used here can also use the battery voltage during constant discharge phases with low discharge currents to recalibrate the charge state. Due to these recalibrations at regular intervals, the procedure used here exhibits a high level of stability over the long term compared to the ampere hour balancing method.

Both the ampere hour balancing method and the recalibration procedure, which is performed via the voltage, automatically adjust to the connected battery over time (depends on the number of grid failures).

The estimated charge state error (display value "120.11 BatSocErr") will provide you with continuous information on the accuracy of the battery charge state currently calculated. With increasingly better adaptation to the actual battery state of charge, the average error is progressively reduced.

Only when the battery is new does its usable capacity correspond to the capacity specified by the battery manufacturer. As the battery ages and as a result of frequent insufficient charging, the battery's useable capacity may decrease considerably on a permanent or only temporary basis.

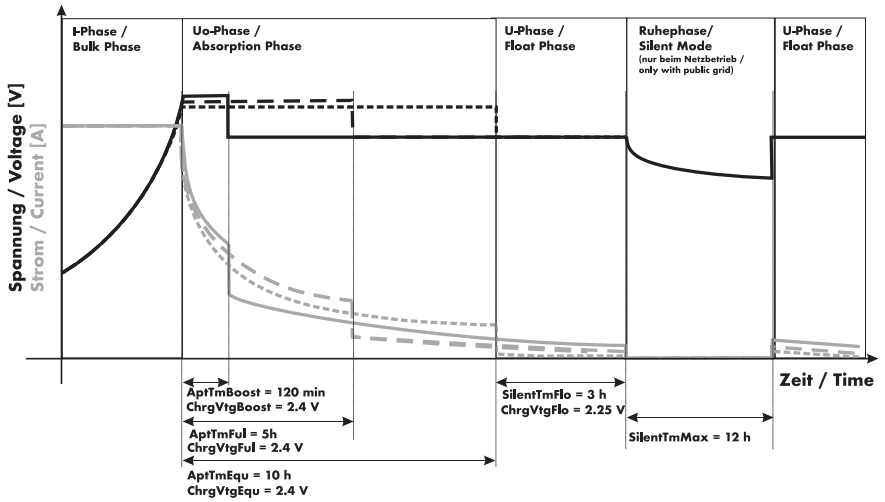
The battery's state of health (display value "320.01 Soh") is a measurement of the present useable capacity expressed as a percentage relative to the nominal capacity. 100 % means that the entire nominal capacity can be used. 50 % means that only half of the original nominal battery capacity can be used. The battery's state of health is also calculated by means of a self-adapting method which, however, can only produce good and exact values after a number of charging cycles.

The present capacity for the Sunny Island is automatically adjusted downwards for temperatures < 20 °C, since the useable capacity of batteries is significantly reduced at temperatures below the nominal temperature.

In the case of lead acid batteries the nominal capacity is adjusted by a fixed factor of –1 %/°C. In the case of NiCd batteries a factor of –0.75 %/°C is used.

12.4 Charge Control

The Sunny Island uses a 3-phase charge control, using the IUoU procedure. When the device operates with the public grid, there is also an optional fourth phase called silent mode.



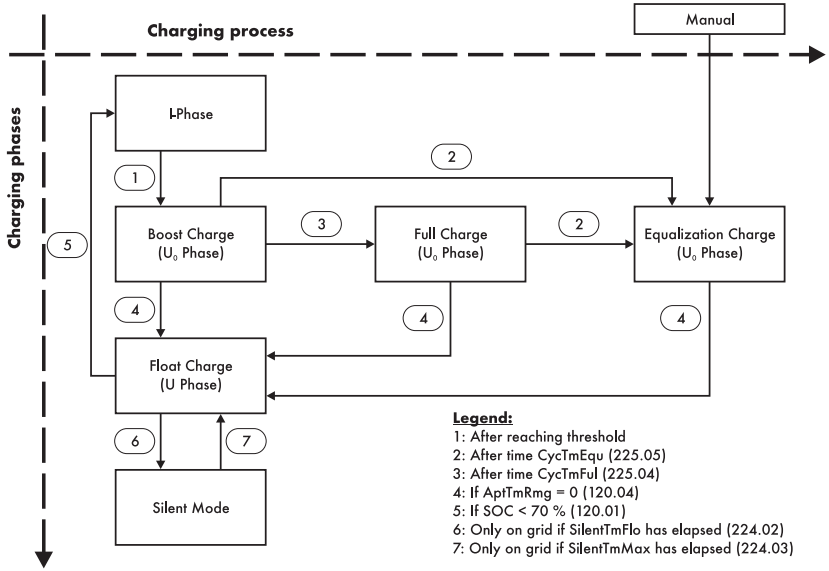
The I stands for the bulk phase (I phase). In this phase, charging is limited by the maximum defined battery current ("222.01 BatChrgCurMax" parameter), the nominal grid current ("232.03 GdCurNom" parameter) or the maximal AC charging current of the Sunny Island ("210.02 InvChrgCurMax" parameter).

In each case, whichever of these values is reached first functions as the limiting value. During this phase, the battery's voltage increases as its state of charge increases.

Once the battery voltage reaches the predefined value for the second phase Uo ("222.07 – 222.09", ChrgVtgBoost or ChrgVtgFul or ChrgVtgEqu parameters), the constant voltage charging (absorption phase) begins.

In this phase, the battery voltage is maintained at a constant level, resulting in a continually decreasing battery current. The Sunny Island remains in this phase for a defined period of time ("222.02 – 222.03", AptTmBoost or AptTmFul or AptTmEqu" parameters). For this charging phase, the Sunny Island automatically selects one of three possible charging methods (boost, full, equalizing) which are described in detail in sections 12.4.1 "Boost Charge" (Page 124) to 12.4.3 "Equalization Charge" (Page 126). The remaining charging time (display value "120.04 AptTmRmg") of this phase and the current process (display value "120.05 BatChrgOp") can be read on the display.

The following figure displays the relationship and the process diagram of the charging phases and charging processes.



Once this constant voltage phase is finished, the Sunny Island switches to float charge which again carries out constant voltage charging but at a greatly reduced charging voltage ("222.10 ChrgVtgFlo" parameter). The purpose of the float charge is to keep the battery in a fully charged state without causing premature aging through overcharging. The Sunny Island remains in this phase until either more than 30 % of the nominal capacity has been used (all discharges are added up) or the state of charge is below 70 %. When the Sunny Island is operating on the public grid, it can also switch from the float charge into silent mode.

Charging voltage change

The charging voltage does not rapidly change, but is slowly adjusted to the new nominal value by approx. 0.5mV/cell*s as the constant voltage phase changes to the float charge. This also takes place if the nominal value is changed manually.

The charging capability of batteries is highly dependent on the battery temperature. For temperatures < 20°C, the charging voltage must be slightly increased, and for temperatures > 20°C it must be slightly decreased. This is necessary to prevent overcharging and insufficient charging reliably and at all battery temperatures. For this reason, the Sunny Island is equipped with automatic temperature compensation of the charging voltage. The charging voltage is adjusted by:

- 4 mV / °C and cell, in the case of VLA and FRLA battery types.
- 0 mV / °C and cell, in the case of NiCd batteries.

The temperature compensation value can be set using the "222.11 BatTmpCps" parameter.

12.4.1 Boost Charge

The boost charge is the most common charging process of the Sunny Island. The boost charge ensures high generator capacity utilization through a high charging voltage over a short period of time. With liquid FLA lead acid batteries, this charge process should be used for gassing and thus homogenizing the electrolytes. The boost charge process can charge the battery up to approx. 85 % to 90 %.

12.4.2 Full Charge

Every 14 days or 8 nominal charge throughputs, the Sunny Island initiates a full charge automatically (parameter "222.05 CycTmFul").

Nominal Charge Throughput

A nominal charge throughput is reached when the sum of the discharge currents corresponds to the rated capacity of the battery.

Example: the battery has a rated capacity of 100 Ah. A nominal charge throughput is reached when the battery has been discharged 10 times for 1 hour by 10A.

The objective is to recharge the battery to a charge level of at least 95 % and to compensate the possible effects of an insufficient charge. A regular full charging every two to four weeks can double the battery service life in off-grid systems.

Information

If the Sunny Island changes to full charge after a boost charge has been running for a specific time, this boost charge time is fully credited toward the full charge.

Information

If more than 1 % of the battery's nominal capacity is discharged during a full charge, 50 % of the time elapsed is credited towards the constant voltage phase.

External Charging Device

If an external charger or charge controller is connected to the battery and the criteria for a full charge are fulfilled due to external charging, the Sunny Island treats this as if it had performed the full charge itself.

Information

Any parallel procedures causing the generator to stop during the full charging process are not taken into account until the charging process is competed.

12.4.3 Equalization Charge

A battery bank consists of many individual battery cells connected in series which all behave slightly differently. Over time, this results in different charge levels in the individual cells. This can lead to premature failure, initially of individual cells, and finally to failure of the entire bank.

The Sunny Island can perform an equalization charge automatically every 180 days ("222.06 CycTmEqu" parameter) or every 30 nominal charge throughputs. During this process, it performs a controlled overcharging of the battery bank to ensure that even the weaker cells are fully recharged. Die Equalization charging extends the battery service life by up to 50 %. The automatic equalization charging function can also be deactivated ("222.12 AutoEquChrgEna" parameter, activated by default) or manually started ("520.01 ManChrgSel" parameter).

Notice

If the Sunny Island changes to equalization charge after boost charging or full charging has been running for a specific time, this time is credited toward the equalization charge completely.

Information

If more than 1 % of the battery's nominal capacity is discharged during an equalization charge, 50 % of the time elapsed credited toward the next constant voltage phase.

Information

If an external charger or charge controller is connected to the battery and the criteria for a full charge are fulfilled due to external charging, the Sunny Island treats this as if it had performed the full charge itself.

12.4.4 Manual Equalization Charge

The parameter "520.01 ManChrgSel" activates the manual equalization charge on the Sunny Island. If a generator is connected to the system, it will be automatically started, and stopped again after the equalization charge is completed.

Information

An equalization charge should be performed at least once a year. After a long period of time without charging, e. g., in the case of systems which are only operated seasonally, manual equalization charges are required at the end or at the beginning of the season.

12.4.5 Silent Mode

In addition to the float charge, the silent mode can be used ("224.01 SilentEna" parameter), only when operating on the public grid.

The main purpose of the silent mode is to save energy by switching from charge mode to standby mode in utility backup systems where the Sunny Island is predominantly in float charge.

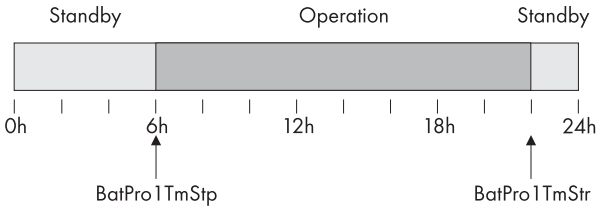
The silent mode is activated after the time set for float charge ("224.02 SilentTmFlo" parameter) has expired. The Sunny Backup system remains in silent mode for a fixed time ("224.03 SilentTmMax" parameter) or until the battery voltage per cell is 0.14 V lower than the set voltage ("222.10 ChrgVtgFlo" parameter). This ensures that the battery is always fully charged, even in silent mode. If a grid outage is detected during silent mode, the Sunny Island makes a stand-alone grid available within a few milliseconds. The loads are supplied with power almost without interruption.

12.5 Battery Preservation Mode

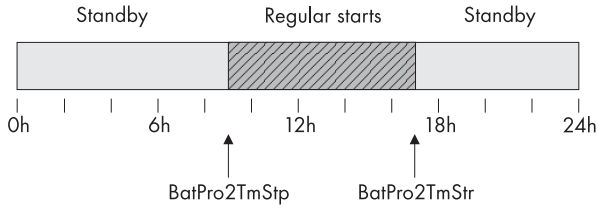
The Sunny Island has a sophisticated battery preservation mode. The battery preservation mode prevents, as far as possible, the battery from being deeply discharged when the energy supply is low, preventing a total system failure as well as damage to the battery.

The battery preservation mode has three levels that are activated as a result of the state of charge (when the charge drops below the respective limit, parameters "223.05 BatPro1Soc", "223.06 BatPro2Soc" and "223.07 BatPro3Soc"):

Level 1: The first level is used to switch the Sunny Island into standby mode at times when the energy is not necessarily required (e.g., at night). You define the start time using the "223.01 BatPro1TmStr" parameter and the stop time using the "223.02 BatPro1TmStp" parameter.



Level 2: The second level of the battery preservation mode ensures that the Sunny Island is started regularly every two hours only in the time period during which energy supply is expected, and that it attempts to charge the battery from the AC side. In case of PV systems this time is during the day. In this case, you define the start time using the "223.03 BatPro2TmStr" parameter and the stop time using the "223.04 BatPro2TmStp" parameter.



Level 3: The third level ensures that the battery is protected from deep discharge and thus against damage. In this case, the Sunny Island is switched off completely. To start the inverter, see section 10.1.5 "Restarting the System after Automatic Shutdown" (Page 88).

At all three levels, the Sunny Island is stopped only if no battery current flows within 5 minutes (limit: 3 A charging current).

The limits for all three levels can be set independently from each other. This allows individual levels to be skipped.

Information

If the BatPro1Soc parameter < BatPro2Soc, level 1 is skipped and only level 2 is conducted.

For level 1 and 2, a hysteresis of 5% of the SOC charge level is designated for exiting this state.

Battery preservation mode is not exited automatically if an external voltage source (grid reconnection) is present.

The battery preservation mode can be quit by manually starting the Sunny Island. If a charging current is detected within 5 minutes (see above) the Sunny Island remains in operation; otherwise, it is disconnected again.

12.6 Battery Diagnostics

In the menu "320 Battery Diagnosis", many values are displayed that provide information on the past operational behavior of the battery. These values are helpful in checking the efficiency of the set parameters and in viewing the typical operating conditions of the battery
(see section 17.3 "Diagnosis" (Page 178)).

13 Connecting External Sources

The Sunny Island supports the integration of external energy sources. A distinction is made between the integration of a generator and the integration of the public grid.

Both the generator ans the public grid are integrated via the Sunny Island's AC2 connection. A single-phase or a three-phase connection is possible. In the case of single-phase operation the transfer relays are operated in parallel, making it possible to use a correspondingly larger current, which in turn allows for a generator or grid connections with a higher capacity.

Connection in a Single-Phase Parallel System

When installing parallel1-phase systems, the connection cables for AC1 and AC2 of all Sunny Islands must have the same cable cross-sections and cable lengths.

The Sunny Island has separate parameters for the grid and generators. It is therefore possible to use both operating modes without additional adjustments. The parameter settings and display values distinguish between settings or values which are generator-specific or grid-specific and settings or values (EXT) common to both grids and generators.

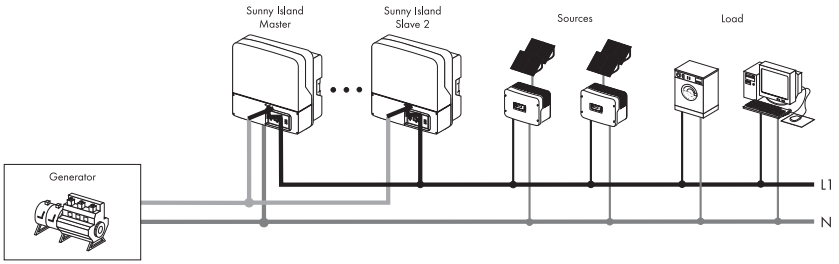
13.1 Generator

The Sunny Island can start or stop a generator depending on consumer power or battery state of charge. In this case, diverse limits and times are taken into consideration (see chapter 13.1.5 "Automatic Generator Operation" (Page 137)).

13.1.1 Connecting Generator Connections in Parallel

In the case of Sunny Islands connected in parallel and which operate on the same phase, the internal transfer relay is activated simultaneously. It is thus possible to multiply the generator current and therefore to connect a larger generator or a higher grid current.

The maximum value of the current depends on the number of transfer relays and therefore on the number of Sunny Islands connected in parallel. One can count on a maximal current of 25 A per Sunny Island.



Information

Use the same cable lengths when installing the Sunny Islands with the generator.

13.1.2 Generator Start Options

The Sunny Island supports the following options for starting the generator which can be set in standby mode with the "233.07 GnStrMod" parameter:

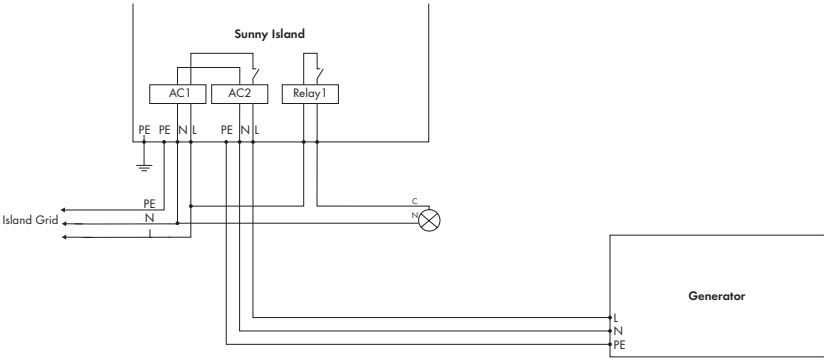
- Manual
- Automatic start
- GenMan

Manual (Manual Generator Start)

This setting is for generators that do not have an electrical remote starting option and are started using cable winches, cranks, or similar methods.

In this case, the Sunny Island has no way of starting the generator. It merely monitors the generator input (AC2). If, in doing this, the device detects that the generator voltage and frequency are within the set limits (see 13.1.6 "Limits and Power Adjustment" (Page 141)), the device is synchronized and switched on after the warm-up time.

The following illustration shows the wiring for a generator that cannot be started remotely:



The generator must always be switched off manually too. The Sunny Island automatically switches to operation without generator.

GnReq Signal

The GnReq signal (see 14 "Relay" (Page 152)) is set to signal the generatordeployment request and can therefore be used as an notification contact. If the generator is no longer required the signal is deactivated.

In case this request occurs when the generator is running the signal is suppressed until the generator has externally been stopped and the stop time has expired (30 seconds).

Disconnecting the generator

A disconnector should be positioned between the Sunny Island and the generator. If the generator is to be stopped, it is first manually disconnected using the disconnector and then it is stopped. This prevents the actuation of the generator when switching off.

Automatic start

So-called autostart generators can be integrated in this manner. These have an internal controller for the start procedure.

The Sunny Island requests the generator via the GnReq signal. If the generator voltage and frequency are within the set limits (see 13.1.6 "Limits and Power Adjustment" (Page 141)), the device is synchronized and switched on after the warm-up time.

The Sunny Island keeps the request signal active until a disconnection is made and the set power-down time has expired.

After-run

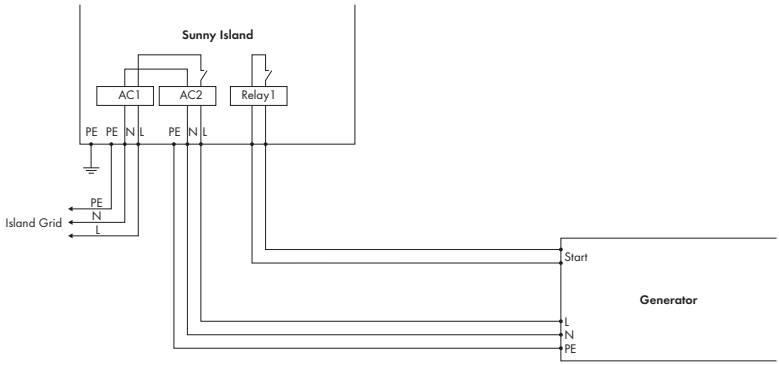
Autostart generators can have an internal after-run which is activated after the request has been disabled. This can extend the power down time accordingly.

Information

Some generator types connect voltage to the output only after the internal warm-up phase has been completed. Therefore the time for the generator activation sequence is internally monitored.

Time for connection = 10 minutes in the case of GenMan and/or 2 x "233.10 GnCoolTm" + 2 minutes for manual and autostart.

The following figure shows the wiring for a generator capable of autostart:



If the generator is started manually in this operating mode, the Sunny Island detects the generator running and connects it after the warm-up time. If you stop the generator externally, this is detected, the generator is disconnected and the stand-alone grid continues to be powered.

Information

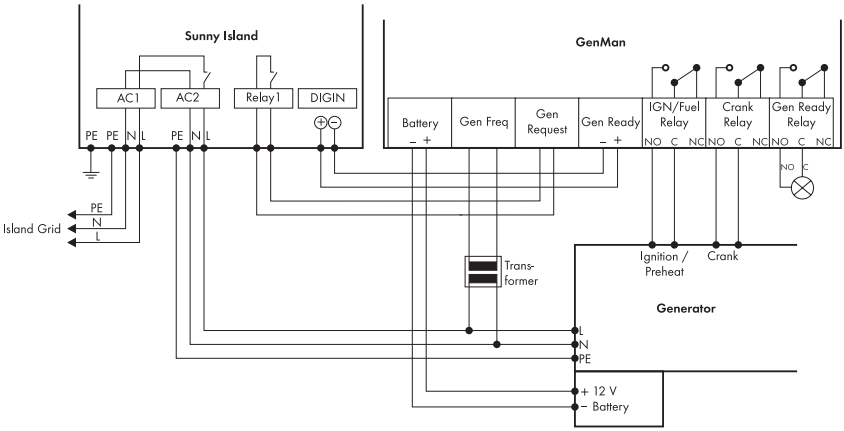
If a generator request is made during the generator operation which was started externally, the GnReq signal is suppressed until the generator is stopped externally again and the stop time has expired.

GenMan

If a GenMan (generator manager) (SMA order number: "SI-GenMan") is integrated into the system, it assumes direct control of the generator. It is connected between the Sunny Island and the generator. The GenMan assumes control of the generator (warm up time, cooling off time and autostart).

The Sunny Island requests the generator from the GenMan via the GnReq signal and keeps the signal active as long as the generator is required. The GenMan returns the GENRDY signal via DigIn when the generator is ready for operation. Then the Sunny Island synchronizes and connects. If the generator is not needed anymore, the Sunny Island disconnects and deactivates the GnReq signal.

The following diagram shows the principle of starting the generator via the "GenMan" generator control:



A manual generator start at the GenMan is notified to the Sunny Island via the GENRDY signal. The Sunny Island synchronizes and switches on.

If the generator is started manually and externally at the GenMan, the Sunny Island blocks the GnReq signal:

- Manual stop and start at the Sunny Island (operation via display and keyboard) are ignored.
- Internal requests (e.g., via the battery's state of charge) are ignored as well.

Information

If the generator was started manually at the GenMan, it must also be stopped there.

The generator is disconnected by the Sunny Island after the GENRDY signal has been withdrawn by the GenMan.

Caution!

A manual start directly at the generator is not possible (see GenMan manual).
Unforseeable operational states could result (see the GenMan manual).

13.1.3 Generator Operation

The Sunny Island allows automatic operation (charge state- or load-dependent) (see 13.1.5 "Automatic Generator Operation" (Page 137)). In addition, manual operation is also possible.

13.1.4 Manual Generator Operation

The manual operating modes for the generator management are triggered using the "540.01 GnManStr" parameter. The following operating modes are distinguished:

Auto: In this operating mode, the generator is automatically started due to the settings. This includes the start via the state of charge or the consumer power or by the request for a manual equalization charge.
("520.01 ManChrgSel" = Start).

Stop: The generator is stopped manually. Cancels the present generator request – immediately disconnects from the generator and transitions into the lockout state. Once the lockout time has ended, the generator switches into automatic operation. The generator can now be started manually.

Start: Manual generator start – the generator runs "continuously" until stopped. The generator can only be stopped manually.

Run1h: Operation for one hour. Once the lockout time has expired, the transition back into automatic mode follows.

An equalization charge can be manually started using the "520.01 ManChrgSel" parameter. The battery management (see section 12 "Battery management" (Page 120)) is set into the equalization charge state and requests the generator. This request persists until equalization charge has been completed.

The following sequence charts provide an overview of the start/stop behavior of the Sunny Island in the case of automatic generator operation:

Generator Interface 233.07 GnSrtMod Manual; Start at the Generator

1 Manual generator start

2 "Generator is running" detected, beginning of warm-up phase

3 Internal generator request is ignored

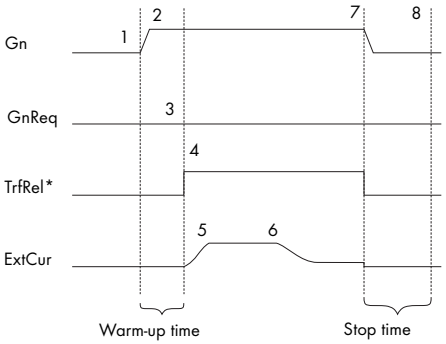
4 Warm-up phase is completed, generator is connected

5 Generator current limiation

6 Current is reduced, battery absorption phase

7 Manual generator stop, disconnection of the generator

8 Minimum generator stop time has expired



Generator Interface 233.07 GnSrtMod Autostart; Start at the Generator

1 Manual generator start

2 "Generator is running" detected, beginning of warm-up phase

3 Warm-up phase is completed

4 Generator is connected

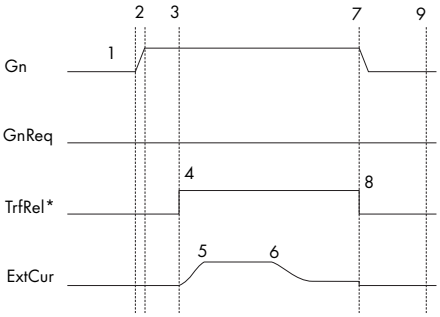
5 Generator current limiation

6 Current is reduced, battery absorption phase

7 Manual generator stop, disconnection of the generator

8 Generator is disconnected, beginning of stop time

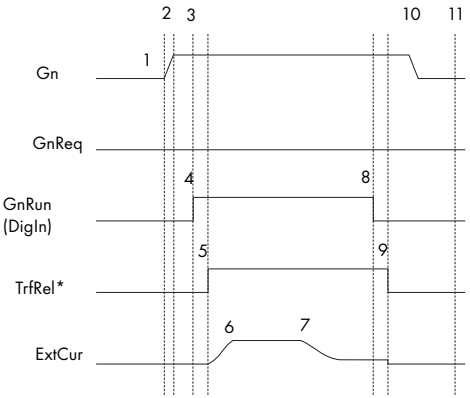
9 End of stop time



* Transfer Relay

Generator Interface 233.07 GnSrtMod GenMan; Start at the Generator

1 Generator start at GenMan
2 Beginning of GenMan generator warm-up phase
3 Generator warm-up time
4 GenMan sends ready for connection signal
5 Generator is connected via Sunny Island
6 Current limitation
7 Current is reduced, battery absorption phase
8 GenMan signals generator stop
9 Generator disconnection via Sunny Island
10 Generator post-run period completed, generator stop
11 Stop time has expired



* Transfer Relay

13.1.5 Automatic Generator Operation

In automatic operating mode ("234.01 GnAutoEna" parameter), the Sunny Island automatically defines the settings (as a function of battery charge state or loads) to determine when the generator starts and how long it runs. The automatic operating mode is enabled via GnAutoEna = On (Default). If GnAutoEna = Off, the automatic operating mode is deactivated.

In addition, the user can also manually start and stop the generator, if required.

State-of-charge dependent start

NOTICE!

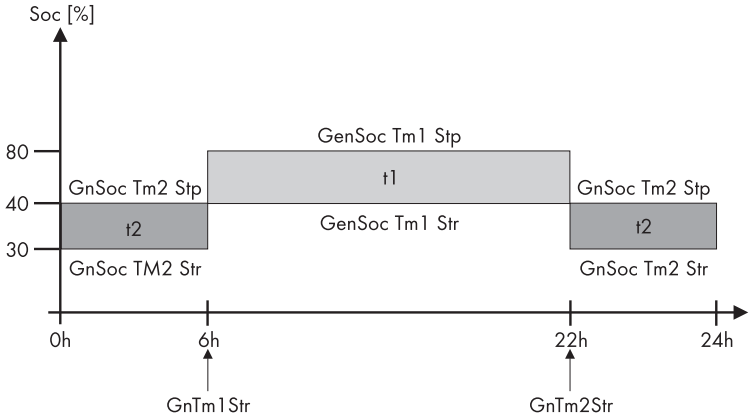
- Manual inputs on the Sunny Island have a higher priority than automatic operation.
- If the Sunny Island is manually stopped while the automatic operating mode is activated it switches to stop/lock operating mode.
- If Generator Automatic Start is activated and the conditions for automatic operation are met, the Sunny Island changes back into the Start operating mode after lock time (or manual acknowledgment with the "540.02 GnAck" parameter).

The time periods t1 and t2 are defined using the "234.07 GnTm1Str" and "234.08 GnTm2Str" parameters respectively. The start time for t1 (and the end of t2) is defined with "GnTm1Str" and the start time for t2 (end of t1) is defined with "GnTm2Str".

Information

If GnTm1Str = GnTm2Str, only t1 is active!

The time intervals t1 and t2 are assigned charge states for start-up and stop with the "234.03 GnSocTm1Str", "234.04 GnSocTm1Stp", "234.05 GnSocTm2Str" and "234.06 GnSocTm2Stp" parameters. GnSocTm1Strt designates the battery charge state at which the generator is started during the t1 time and GnSocTm1Stp designates the charge state at which the generator is switched off during t1. The GnSocTm2Str and GnSocTm2Stp parameters are similarly defined in relation to the time t2.



Example

The figure displays an example of the settings if operation of the generator at night is to be avoided as much as possible. Between 6 a.m. and 6 p.m., the generator is started at a charge state (SOC) of 40 % and by contrast, the battery is discharged to 30 % at night (between 6 p.m. and 6 a.m.) before the diesel generator starts.

Information

If the float charging process (see section 12.4 "Charge Control" (Page 122)) is activated before the cutoff limit (GnSocTm1Stp or GnSocTm2Stp) is reached, the generator request is disabled again. If a full or equalization charge is active, the generator is only stopped after this charge is completed and not when "234.04 GnSocTm1Stp" or "234.06 GnSocTm2Stp" is reached.

Load-dependent Start

The generator can be requested for support in case of increased power consumption. This function can be switched on or off (default) using the "234.09 GnPwrEna" parameter. The function is only effective if the "234.01 GnAutoEna" parameter is simultaneously set to On.

The load limit for the request and the generator stop is configured using the "234.10 GnPwrStr" and "234.11 GnPwrStp" parameters. The averaging time used to calculate an average value for the consumer power can be set using "234.12 GnPwrAvgTm". This prevents temporary power consumption peaks of a few seconds from causing a load-dependent generator start.

If the generator has been started load-dependently, it will run for the generator minimum runtime. If, once this time has expired, the average power is below the cutoff limit, the generator is stopped again.

Multiple-phase system

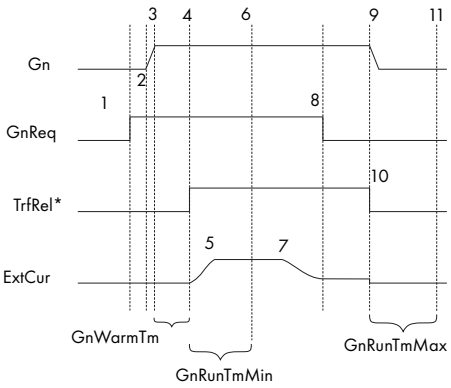
Only the total consumer power of all phases is monitored. Individual phases in a multi-phase system are not monitored.

The consumer power is calculated using the inverter power ("111.01 TotInvPwrAt" parameter) and generator power ("131.01 TotExtPwrAt" parameter).

The following sequence charts provide an overview of the start/stop behavior of the Sunny Island in the case of automatic generator operation:

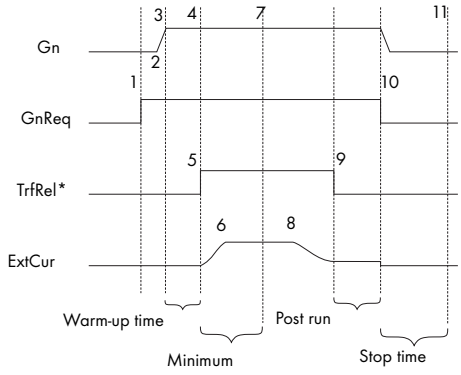
Generator Interface 233.07 GnSrtMod Manual; Generator Request Via Sunny Island

1 Generator is requested via Sunny Island
2 Manual generator start
3 Generator detection on, beginning of warm-up phase
4 Warm-up phase is comleted, generator is connected
5 Generator current limiation
6 Minimum operating time has expired
7 Current is reduced, battery absorption phase
8 Charging process is completed, request signal is disabled
9 Manuel stop of generator
10 Generator is disconnected
11 Stop time has expired



Generator Interface 233.07 GnSrtMod Autostart; Generator Request Via Sunny Island

1 Generator start by Sunny Island
2 Generator Start
3 Beginning of warm-up time
4 Warm-up time has expired
5 Generator is connected
6 Current limitation
7 Minimum operating time has expired
8 Current is reduced, battery absorption phase
9 Charge process complete, generator disconnected
10 Generator post-run period is completed, generator is disconnected
11 Stop time has expired



* Transfer Relay

Generator Interface 233.07 GnSrtMod GenMan; Generator Request Via Sunny Island

1 Generator start by Sunny Island using GenMan

2 Generator start by GenMan

3 Beginning of GenMan warm-up time

4 GenMan warm-up time has expired, connection signaled by GenMan at the Sunny Island

5 Generator is connected via Sunny Island

6 Current limitation

7 Minimum operating time (Sunny Island) has expired

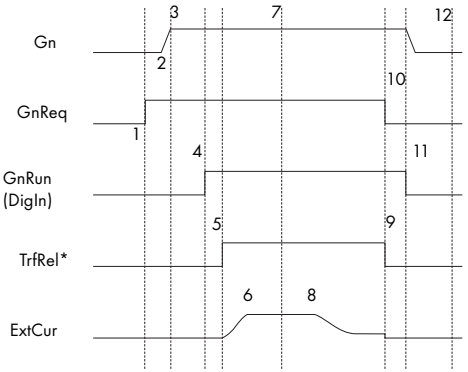
8 Current is reduced, battery absorption phase

9 Charge process complete, generator disconnected by Sunny Island

10 Signal at GenMan

11 GenMan post-run time has expired, generator stopped

11 Stop time has expired



Information

Even in case of a power-dependent generator start, warm-up, minimum run and after-run periods are complied with.

13.1.6 Limits and Power Adjustment

The voltage limits for generator operation can be set using the "233.01 GnVtgMin" and "233.02 GnVtgMax" parameters; the frequency limits for generator operation can be set using the "233.05 GnFrqMin" and "233.06 GnFrqMax" parameters. If the values are beyond these limits the generator is disconnected. Slightly narrower limits apply to generator connection.

Information

The system voltage (AC) depends on the generator voltage when the generator is running.

Voltage and frequency limits are monitored in phases. To connect the generator, at least the phase on the master device must satisfy the defined limits. Slave devices connect and disconnect individually where applicable if the limits are exceeded.

Information

If the master device disconnects the generator, all slave devices are disconnected as well.

Information

If a slave device is disconnected from a generator (and the master continues to be connected to the generator), the slave device can reconnect once the voltage and frequency are within the valid range again.

There is, however, a monitoring period in this case. Only after voltage and frequency are determined to be valid according to the "233.12 GnWarmTm" parameter does reconnection take place.

The Sunny Island burdens the generator at each phase with the current defined in the parameter "233.03 GnCurNom". The power not directly used by the loads flows into the battery for charging. At the same time, the limits for the AC charging current limit ("210.02 InvChrgCurMax" parameter) on the Sunny Island and the DC charging current limit ("222.01 BatChrgCurMax" parameter) are active.

Low values for these limits may be the reason why the defined generator current cannot be adjusted. If the battery voltage reaches the charging voltage nominal value, it is also reduced (absorption phase, see section 12.4 "Charge Control" (Page 122)).

Information

A sensible value for the "233.03 GnCurNom" parameter is approximately 80 % of the maximum generator current for each phase.

If the "233.15 GnCtlMod" parameter is set to CurFrq, the generator is also limited at frequencies lower than the nominal frequency ("233.04 GnFrqNom" parameter). This function can be used if the full generator output is not always available and you want to prevent the generator from being overloaded. The default setting is only intended to control the nominal generator current.

If the current set using the "233.03 GnCurNom" parameter is not sufficient for powering the loads, the battery provides support ("real generator support").

The Sunny Island provides all the required reactive power.

13.1.7 Run Times

If the generator is started (or the Sunny Island detects an external generator start), the warm-up phase starts. If, during this time, the voltage or frequency detected is not within the permissible range, the warm-up phase begins again.

If the generator cannot be connected at the GenMan within twice the time set at "233.12 GnWarmTm" + 2 or 10 minutes, the connection process is cancelled and a new attempt is made. After three attempts, the system changes to error state (Fail).

If the generator has been connected, the minimum run time begins ("233.08 GnOpTmMin" parameter). The generator remains connected during this time, even if in the meantime the generator request is no longer present.

If the minimum run time has ended and a generator request is no longer present, the generator disconnects and enters the power down phase (Cool). If this power down phase is completed after the time specified in "233.10 GnCoolTm", the generator is stopped.

Information

The power-down time ("233.10 GnCoolTm" parameter) defined on the Sunny Island should be set equal to or preferably greater than the power-down time of the GenMan.

If a generator fault (e.g. generator failure) is detected, the generator is also disconnected and then stopped immediately. In doing so, the power-down time is skipped.

Once the stop time (233.09 GnStpTmMin" parameter) has elapsed, the generator is ready for the next request.

Information

An internal generator request is disabled during the power down time and stop time or in error state.

If a generator fault is detected several times and the number of autostarts ("234.02 GnAutoStr" parameter) has been exceeded, the system transitions into the locked error state.

This state lasts for the time period set at "233.11 GnErrStpTm". Once this time has elapsed, the generator is ready for another attempt.

Information

The recording of autostarts is only reset after the generator has been successfully connected and the minimum run time has expired or when the locked error state (FailLock) is disabled.

Information

The error state and the locked error state can be cancelled by confirming the generator fault ("540.02 GnAck" parameter).

The "133.03 GnRmgTm" process value is used to display the remaining time of the generator meter.

Depending on the current request or the phase in which the generator state machine is, the following times are displayed:

- Remaining time of Run1h
- Remaining run time during the warm-up phase (Warm)
- Remaining minimum run time in operation (Run)
- Remaining run time during the power-down time (Cool)
- Remaining stop time after the power down-time has elapsed (Lock)
- Remaining time in the error state (Fail)
- Remaining time in the locked error state (FailLock)

13.1.8 Operation Together With Sunny Boys

NOTICE!

Damage to devices due to improper installation dimensioning.

When dimensioning your installation, please observe:

$P_{AC\ max.,\ Sunny\ Boy} = 2 \times P_{AC\ nom.,\ Sunny\ Island}$

- The maximal AC output of the Sunny Boy inverter connected should not exceed 4.4 kW.

If the battery is fully charged, the frequency limits the power output of the AC feed-in generators (Sunny Boys). If the generator is now manually started, for example, the frequency would be lowered, if required, as the Sunny Island synchronizes with the generator. The AC feed-in generators (Sunny Boys) would then feed additional energy into the system and possibly overload the batteries.

In order to prevent this during such conditions, the stand-alone grid frequency is temporarily increased ("231.04 AcSrcFrqDel" parameter), in line with the synchronization, until the AC feed-in generators (Sunny Boys) are disconnected from the stand-alone grid as a result of the grid limits being exceeded.

13.1.9 Stopping the Generator

If the generator was started via the Sunny Island (automatically or manually), it can be manually stopped at any time using the "540.01 GnManStr" parameter. This disconnects the generator (the minimum run time is not taken into account here), and the power-down time (Cool) is skipped. Afterwards, the system enters the the stop time (Lock).

DANGER!
Death hazard due to high voltages

The power-down time depends on the generator type.

During the power-down time, there is still grid voltage at the consumers.

- Wait until the generator stops.

Information

Generators with the "manual" start option can generally only be started and stopped at the generator.

Information

If the generator start is to be disabled after a manual stop, this must be performed by setting the "234.01 GnAutoEna" parameter to "Off".

13.1.10 Failures

Reverse Power

If the reverse power ("233.13 GnRvPwr" parameter) set for the "233.14 GnRvTm" time is exceeded, the generator is disconnected and stopped. The power down time (Cool, parameter "233.10 GnCoolTm") is skipped and the system transitions into the minimum stop time (Lock). After reverse power, the connection is blocked for at least for the period "231.02 ExtLkTm" or "233.09 GnStpTmMin".

Generator Failure

If a generator failure is detected (failure on the master phase), the generator is disconnected immediately and a stop signal is activated at the generator. The system enters the the stop time (Lock).

Generator Phase Failure

The breakdown of a phase (e.g., blown fuse) at a slave device is treated as a phase breakdown. The slave device then disconnects this phase. If the phase is detected as being available again, it is reconnected after the warm up time "233.12 GnWarmTm" has elapsed.

The phase failure on the master device is treated as a generator failure (see above).

Slave Device Failure

If a slave device fails, the system continues to operate using both the remaining devices of the cluster as well as those on the generator.

13.2 Grid

The Sunny Island supports the operation of grid backup systems on the grid. Here, a distinction is made between two main states: either a main power grid and stand-alone grid are connected or a main power grid and stand-alone grid are disconnected. The operating mode of the Sunny Island is derived from this. If the stand-alone grid is disconnected, the inverter alone is responsible for powering this stand-alone grid. If the main power grid is connected to the stand-alone grid, the stand-alone grid is powered from the main power grid. The voltage and frequency in the stand-alone grid and in the main power grid are identical.

Information

Under specific conditions, the system can also temporarily feed energy from the stand-alone grid into the main power grid in the GridCharge operating mode ("232.08 GdMod" parameter).

13.2.1 Conditions

In order to operate on the grid, very strict limits (for voltage and frequency) must generally be maintained. This strict limits are not sensible for generator operation. The limits are therefore set separately for grid operation and the generator limits are not used.

Information

The default settings for limits during grid operation comply with the following standards:

- For 230V_50Hz: DIN VDE 0126-1-1 (not entirely)

NOTICE!

The Sunny Island does not meet the VDE 0126-1-1 directive required in Germany and, for legal reasons, it must therefore be MSD-certified (e.g. by UfE GmbH) when operated while connected to the public grid.

13.2.2 Stand-Alone Grid Operation

The main power grid and stand-alone grid are disconnected and the Sunny Island powers the stand-alone grid. The system waiting for the grid to reconnect is an indication of this state.

As long as the battery has a sufficient charge level, the loads are powered. In stand-alone operation, the AC feed-in generators (e.g. Sunny Boys) perform a charge operation, if required.

13.2.3 Grid Reconnection

In stand-alone operation, the Sunny Island constantly checks whether the grid has been reconnected (see above). If the voltage and frequency of the main power grid are within the permissible range of the "232.01 GdVtgMin" and "232.02 GdVtgMax" parameters for the time set it "232.07 GdVldTm"; and if the frequency is within the permissible range of the "232.05 GdFrqMin" and "232.06 GdFrqMax" parameters (see also chapter 13.2.1 "Conditions" (Page 147)), the stand-alone grid is synchronized with the main power grid and then connected.

13.2.4 Grid Operation

In grid operation, the stand-alone grid and main power grid are connected. The Sunny Island is connected along with the stand-alone grid to the main power grid. Therefore, the voltage and frequency in both grids are identical.

Information

All grid failures that occur during grid operation affect the stand-alone grid.

In grid operation, the grid monitors whether the permissible limits for voltage and frequency (see Grid Reconnection) are maintained or whether the grid fails to assume powering the stand-alone grid. To do this, the main power grid is disconnected (grid backup operation).

The battery is generally charged or its charge is maintained on the grid.

Charge Mode

Charge mode on the grid is indicated by energy flowing to the battery. The battery is charged until the respective charge process (Boost, Full, Equalize) has been completed and the system transitions into float charge (Float) (see chapter 12.4 "Charge Control" (Page 122)).

Silent Mode

In order to save energy, the silent mode can be activated using the 224.01 SilentEna" parameter set to "enable" (default disable). In this case, the Sunny Island is set to standby mode if the charge has been completed and the battery has been in float charge for some time (see section 12.4.5 "Silent Mode" (Page 127)).

The silent mode is exited regularly to recharge the battery.

Grid feeding

Whether energy is fed from the stand-alone grid into the main power grid is controlled using the "232.08 GdMod" parameter. If GridCharge (Default) is set, no energy is fed into the grid. If GridFeed is set, energy is fed into the grid.

Information

In order to allow electricity to be fed from the battery into the grid, the battery voltage in a charged battery (on the grid) must be increased by external DC chargers above the nominal charging voltage.

AC feed-in generators on the stand-alone grid side (Sunny Boys) can feed their energy into the grid through the internal transfer relay of the Sunny Island; for limitations, see section 13.2.7 "Limits and Power Adjustment" (Page 149).

13.2.5 Grid Failure

A grid fault is characterized by the voltage or frequency being outside of the permissible limits (see section 13.2.3 "Grid Reconnection" (Page 147)) or the main power grid being disconnected. In this case, the time limits are relevant: Smaller deviations are permitted for longer than large deviations (see section 13.2.1 "Conditions" (Page 147)).

In case of a grid fault/failure, the public grid is disconnected and the inverter starts, if it is not already running (silent mode).

Information

If the Sunny Island is in silent mode when there is a public grid failure, there is a short outage in the stand-alone grid (see chapter 12.4.5 "Silent Mode" (Page 127)).

13.2.6 Failures

Reverse Power

If the defined reverse power ("232.09 GdRvPwr" parameter) is exceeded for the time "232.10 GdRvTm", the grid is disconnected. After reverse power, connection is blocked for at least for the amount of time set at "232.07 GdVldTm".

Grid Failure

If a grid failure is detected (failure at the master phase), the grid is disconnected immediately.

Grid Phase Failure

The breakdown of a phase (e.g., blown fuse) at a slave device is treated as a phase breakdown. The slave device then disconnects this phase. If the phase is detected as being available again, it is reconnected.

The phase failure on the master device is treated as a grid failure (see above).

13.2.7 Limits and Power Adjustment

The Sunny Island burdens the generator at each phase with the current defined in the parameter "233.03 GnCurNom". The power not directly used by the loads flows into the battery for charging. At the same time, the limits for the AC charging current limit ("210.02 InvChrgCurMax" parameter) on the Sunny Island and the DC charging current limit ("222.01 BatChrgCurMax" parameter) are active. If the battery voltage reaches the charging voltage nominal value, it is also reduced (see section 12.4 "Charge Control" (Page 122)).

If the current set using the "232.03 GdCurNom" parameter is not sufficient for powering the loads, the battery provides support.

13.2.8 Operation Together With Sunny Boys

Since electricity is fed into the grid through the relay of the Sunny Island, it must be prevented from overloading. For this reason, reverse power monitoring is used which, if required, disconnects the main power grid if the reverse power limit is exceeded or an excessive load is applied to the relay.

NOTICE!

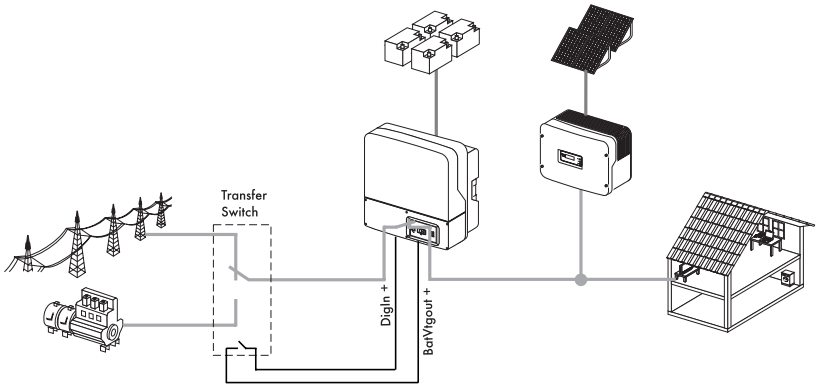
If the current flowing through the relay exceeds the maximum permissible current, the grid is disconnected (relay protection). The quantity of PV output installed in the stand-alone grid must not exceed the maximum quantity allowed by the AC input (see section 20 "Technical Data" (Page 197)).

If the battery is fully charged, the frequency limits the power output of the AC feed-in generators (Sunny Boys) in the stand-alone grid. If the grid is now reconnected, the frequency would be lowered, if required, as the Sunny Island is synchronized with the grid. The AC feed-in generators (Sunny Boys) would then feed additional energy into the system and possibly overload the batteries. In order to prevent this, in this case the stand-alone grid frequency is temporarily increased ("231.04 AcSrcFrqDel" parameter), in line with the synchronization, until the AC feed-in generators (Sunny Boys) are disconnected from the stand-alone grid as a result of the grid limits being exceeded.

13.3 Generator and Grid

In addition to the public grid, a generator can also be integrated into an island grid system as a secondary protective measure. This is particularly useful in case of long-term grid failures, if after some time the battery size no longer suffices either, to bridge the failure.

The standard solution in such cases is to use a transfer switch that can be purchased as a manual or an automatic switch. By using such a switch, theAC2 connection, to which the public grid is normally connected, switches to a connection with a diesel generator, as shown in the figure below:



To use such a switch, proceed with the installation as follows:

1. Connect the negative pole of the DigIn connection on the Sunny Island to the negative pole of the BatVtgOut connection, also located on the Sunny Island.
2. Connect the positive pole of the DigIn connection to a NO connection of an auxiliary contact of the transfer switch.
3. Connect the positive pole of the BatVtgOut connection to the second contact of the same auxiliary contact on the transfer switch.

An auxiliary contact is used because the Sunny Island must “know” whether it is connected to the public grid or whether it must manage a diesel generator.

To enable such operation, the “GenGrid” (GridBackup + Generator) selection is absolutely imperative (see section 9.2 "Starting the Quick Configuration Guide (QCG)" (Page 76)).

Information

All the settings that you have performed for the generator and grid in the submenus also apply to the “GridBackup + Generator” selection.

14 Relay

The Sunny Island offers you several options for the control of internal and external processes. For this purpose, there are two relays integrated into the device to which you can assign functions using the "241.01 Rly1Op" and "241.02 Rly2Op" parameters. Information on connecting the relays is provided in section 7.6.3 "Multi-function Relays 1 and 2" (Page 63). The different settings are explained as follows:

Function/ Settings	Meaning	Function Desctription
Off	Off	relay remains permanently switched off (deactivated)
On	On	Relay is permanently on (e.g., test of relay function when commissioning)
AutoLodExt	Automatic load shedding subject to an external source	Automatic connection / disconnection of loads Connection takes place only if the device is connected to an external source (e.g., generator) or absorption phase is active
AutoLodSoc1	Auto LoadShedding Soc1	Automatic connection / disconnection of loads load is only connected if SOC limit 1 has exceeded the set value again
AutoLodSoc2	Auto LoadShedding Soc2	Automatic disconnection of loads load is only connected if SOC limit 2 has exceeded the set value again
Tm 1	Timer 1 (time-controlled switching of relay1)	Programmable timer 1 (once, daily, weekly) with duty cycle
Tm 2	Timer 2 (time-controlled switching of relay2)	Programmable timer 2 (once, daily, weekly) with duty cycle
Apt-Phs	Absorption phase active	Relay switching when battery charge is in absorption phase
ExtVfOk	External voltage and frequency OK	Extrernal voltage and frequency are in valid range for connection
GdOn	Public grid	Relay is switched if public grid is available and connected
Alm	Alarm	Sunny Island has a fault; contact is open if there is a fault (relay is deactivated)
Rn	Run	Sunny Island is in operation, contact is closed (relay is activated) if the device is running in inverter operation
BatFan	Battery Fan	relay is used for automatic battery room ventilation (switching the fan)
AcdCir	Acid Circulation	relay is used for automatic acid circulation (switching the electrolyte pump)

Relay configuration

You can only assign one function to each relay.

Operating principles of the relays

The relays are changeover contacts. They can be used as normally closed or as normally open contacts.

The relay functions are listed as NO contact functions, in other words, the contact is closed if the relay is activated by selecting the function.

The exception is the "Alm" (Alarm) relay function. Here, the relay is a NOC. Normally, the relay is activated, and the contact is open. In presence of a fault, the relay is deactivated, the contact closes and in so doing switches on, for example, a fault indicator light.

Relays in fault situations

In case of failure the relays change to safe state, i.e., they are deactivated.

15 Sunny Boy in the Island Grid System

The following section provides information for configuring the Sunny Boy inverter in island grid systems. The Sunny Island works with various inverters fromt the SMA Solar Technology AG.

15.1 Setting the Stand-alone Grid Parameters

Sunny Boy with Stand-Alone Grid Parameters

As soon as you set the Sunny Boy to stand-alone grid parameters, the device no longer complies with the DIN VDE 0126-1-1 and it is not allowed to operate connected to the public grid directly.

Controlled battery charging is needed in a stand-alone grid. Sunny Boy inverters can reduce their feed-in power for this reason. This task is performed by an integrated "Power adjustment via frequency" system (see section 15.2 "Frequency Shift Power Control (FSPC)" (Page 156)).

To activate this adjustment, you must configure the Sunny Boy as follows:

Access Permission

For changing the grid relevant parameters in the Sunny Boy inverter you need a special access code, the installer code. Contact the Sunny Island Hotline at the phone number +49 561 9522 399 or by e-mail at SunnyIsland.Service@SMA.de to obtain this personal code.

Required Communication Accessories

To set the parameters, a communication channel to the Sunny Boy is required. Install one of these three variants:

- PC/laptop with Sunny Data software and a service cable for data transfer (SMA order number: "USBPBS-11" USB service interface)
- Sunny Boy Control
- Sunny WebBox

Additional information on communication can be found in section 7.5 "Communication" (Page 53).

1. Establish communication with the Sunny Boy.
2. Go to the parameter settings.
3. Set the parameter "Default" to "Off-Grid" (stand-alone grid).

The "Off-Grid" parameter setting automatically sets the following Sunny Boy parameters to the following values:

No.	Parameter	Unit	Value
1	I-NiTest	mA	Off (MSD = 0)
2	Uac-Min	V	180
3	Uac-Max	V	260
4	Fac-delta- Lower range, where the Sunny Boy is active, based on f_0	Hz	-4.5 (starting from the base frequency f_0)
5	Fac-max+ Upper range, where the Sunny Boy is active, based on f_0	Hz	+1.5 (starting at the base frequency f_0)
6	dFac-Max max. rate of change	Hz/s	4
7	Fac-start delta frequency increase in relation to f_0, at which point the power adjustment via frequency begins	Hz	1 (starting from base frequency f_0)
8	Fac-Limit delta Frequency increase in relation to f_0, at which point the power adjustment via frequency ends. The power of the Sunny Boy here is 0 W.	Hz	2 (starting from base frequency f_0)

This completes the stand-alone grid parameter settings for the Sunny Boy.

WARNING!

Risk of lethal electric shock!

If there is an outage of the public grid there is the danger of feeding back into it

- Never operate your Sunny Backup system directly on the grid with these settings!

Using a Communication Bus

If the Sunny Boy and Sunny Island are operated together on one communication bus, the "250.06 ComBaud" parameter in the Sunny Island must be set to "1200" (default).

The Sunny Island only communicates through the SMA-Net protocol, Sunny-Net is not supported.

Settings in Older SMA Inverters

It may happen that older SMA inverters cannot yet be set to "Offgrid" (stand-alone grid) via the "Default" parameter. In this case, the values 1 - 6 in the table must be set individually.

15.2 Frequency Shift Power Control (FSPC)

This section describes how the power adjustment via frequency "Frequency Shift Power Control (FSPC)" functions.

FSPC

The frequency-based power control works only in stand-alone mode!

Inverters without FSPC

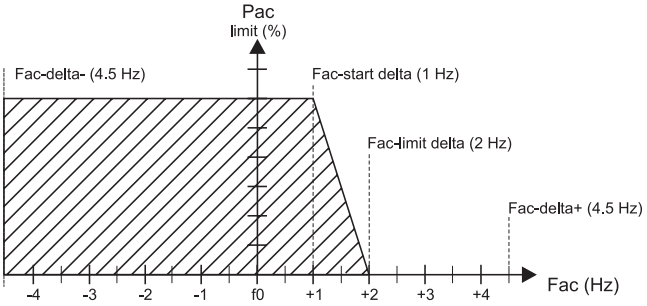
This function is neither supported by the SMA PV inverters SB2100TL, SB3300TL, SB4200TL and SB5000TL, nor by older models in the SWR series. But these Sunny Boys can nevertheless be used in island grid systems.

If the present battery voltage is higher than the nominal battery voltage (VBatt nom), the Sunny Boy inverters mentioned above are disconnected from the stand-alone grid present at that time, and are only reconnected after a battery discharge of at least 5 %.

If Sunny Boy inverters are connected to the AC output side of a stand-alone grid, the Sunny Island must be able to limit their output power. This situation can come about when, for example, the Sunny Island's batteries are fully charged and the (solar) power available from the PV generator exceeds the power required by the connected loads.

To prevent the excess energy from overcharging the batteries, the Sunny Island recognizes this situation and changes the frequency of the AC output. This frequency adjustment is analyzed by the Sunny Boy. As soon as the grid frequency increases beyond the value specified by "Fac-Start delta" the Sunny Boy limits its output power accordingly.

This function is shown in the following figure:



The terms in the figure have the following meaning:

- f_0 refers to the base frequency of the stand-alone grid (here 50 Hz)
- Fac-delta– and Fac-delta+ refer to the max. range in which the Sunny Boy is active, based on f_0
- Fac-start delta refers to the frequency increase relative to f_0, at which point the power adjustment via frequency begins.
- Fac-Limit delta refers to the frequency increase relative to f_0, at which point the power adjustment via frequency ends. The power of the Sunny Boy here is 0 W.

If the value is below the Fac-delta limit and/or above the Fac-delta+ limit, the Sunny Boys are disconnected from the grid.

Sunny Boy Frequency Reduction

The Sunny Island reduces the frequency momentarily when it needs to synchronize itself to the public grid and the present battery voltage (V_{Batt}) is greater than the nominal battery voltage ($V_{Batt\ soll}$).

In this way it disconnects the Sunny Boys via this frequency reduction (excessive frequency) and then synchronizes itself to the external source.

The Sunny Boys switch themselves on again automatically as soon as the grid frequency is within the limit again.

16 Maintenance and Care

16.1 Enclosure

Check to see that every device housing in the island grid system is mechanically sound. If damage (e.g. cracks, holes, missing covers) endangers the operating safety, the Sunny Island must be deactivated immediately.

Larger particles of dirt should be removed from the device with a soft brush, or similar object. Dust can be removed with a damp cloth. Solvents, abrasives or corrosive materials must not be used for cleaning!

16.2 The Sunny Island's Control Panel

NOTICE!

Unintended starting of the Sunny Island while cleaning the membrane keypad.

Only clean the membrane keypad when the device is deactivated.

16.3 Sunny Remote Control 1

It is best to clean the control elements with a soft, damp cloth. Solvents, abrasives or corrosive materials must not be used for cleaning!

NOTICE!

Unintended starting up of the device while cleaning the knob by accidentally depressing or turning it!

1. Switch off the device.
2. Clean the device.

16.4 Functional Test

Check regularly whether error messages are present. If an error message is displayed for which you cannot identify any apparent cause, the stand-alone grid must be inspected by an installer. To ensure optimal operation, the operator should regularly check the Sunny Island's entries in the error list at short intervals (monthly, or even weekly), especially during the first months after commissioning. This can help to discover hidden faults in the installation or errors in the configuration.

Check the ground connection

Once a year, visually inspect the ground connection at the house connection box, or on the meter board between PEN and the equipotential bonding bar!

16.5 Battery

NOTICE!

Possible damage to the battery due to a lack of inspection and maintenance!

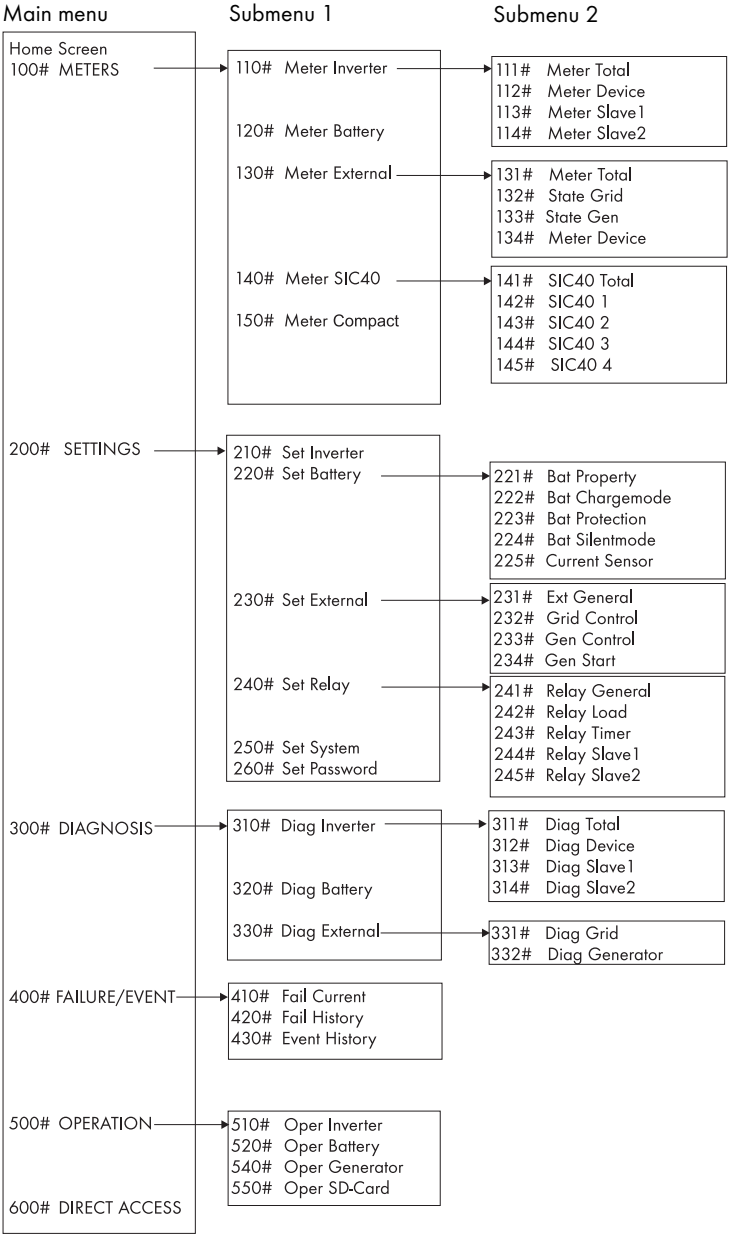
In this regard, observe the battery manufacturer's specifications.

16.6 Disposal

Dispose of the devices at the end of their service life in accordance with the disposal regulations for electronic scrap which apply at the installation site at that time. Alternatively, send them back to the SMA Solar Technology AG with shipping paid by sender and labeled "FOR DISPOSAL" (chapter 21 "Contact" (Page 201)).

17 Parameter List Overview

Overview of the menu area:



Only parameters in the menu branches "200-Settings" and "500-Operation" can be changed. The other values are only shown on the display. The cells with a grey background in the following tables show all menu items that can only be changed after entering the installer password.

Fault-prone operation of the Sunny Island due to wrong parameter settings.

- Proceed carefully when setting parameters!
- Take note of the original values of all parameters that you change.

Saving settings onto the MMC/SD card

Once the system is working optimally, i.e., the selected settings have proven effective, save the selected values on the MMC/SD card using the "510.01 ParaSto" parameter (see chapter 10.4 "Saving Data onto a MMC/SD Card" (Page 107)).

Thereafter you can make new settings. If you choose to reject these settings again, you can restore the system to its previous state using the "510.02 ParaLod" parameter.

Labelling parameters

The parameter names used are based on the international IEC 61850-7-4 and 61400-25 Standards.

17.1 Display Values

110# Meter Inverter

Menu nr.	Parameter Nr.	Parameter Name	Range/Unit	Description
111# Meter Total				
111	01	TotInvPwrAt	kW	Total inverter power (single-phase, parallel, 3-phase)
111	02	TotInvCur	A	Total inverter current (single-phase, parallel, 3-phase)
111	03	TotInvPwrRt	kVAr	Total inverter reactive power (single-phase, parallel, 3-phase)
112# Meter Device				
112	01	InvOpStt	 Init Standby Operate Error	Operating mode = waiting for request (ready) = standby = operation = error
112	02	InvPwrAt	kW	Effective power at the inverter
112	03	InvVtg	V	Voltage at the inverter
112	04	InvCur	A	inverter current
112	05	InvFrq	Hz	Frequency at the inverter
112	06	InvPwrRt	kVAr	Reactive power at the inverter
112	09	Rly1Stt	–,Off,On	state of relay 1
112	10	Rly2Stt	–,Off,On	state of relay 2
113# Meter Slave 1				
113	01	InvOpSttSlv1	 Init Standby Startup RlyTest Operate Error	Operating mode of slave1: = waiting for request (ready) = standby = change standby –> operation = Relay test = operation = error
113	02	InvPwrAtSlv1	kW	active power of inverter at slave1
113	03	InvVtgSlv1	V	inverter voltage at slave1
113	04	InvCurSlv1	A	Inverter current at slave1
113	05	InvPwrRtSlv1	kVAr	reactive power of inverter at slave1
113	06	Rly1SttSlv1	Off On	state of relay 1 at slave1
113	07	Rly2SttSlv1	Off On	state of relay 2 at slave1

Menu nr.	Parameter Nr.	Parameter Name	Range/Unit	Description
114# Meter Slave 2				
114	01	InvOpSttSlv2	Init Standby Startup RlyTest Operate Error	Operating mode of slave2: = waiting for request (ready) = standby = change standby –> operation = Relay test = operation = error
114	02	InvPwrAtSlv2	kW	active power of inverter at slave2
114	03	InvVtgSlv2	V	inverter voltage at slave2
114	04	InvCurSlv2	A	Inverter current at slave2
114	05	InvPwrRtSlv2	kVAr	reactive power of inverter at slave2
114	06	Rly1SttSlv2	Off On	state of relay 1 at slave2
114	07	Rly2SttSlv2	Off On	state of relay 2 at slave2

120# Meter Battery

Menu nr.	Parameter Nr.	Parameter Name	Range/Unit	Description
120	01	BatSoc	%	Momentary state of charge of battery (SOC)
120	02	BatVtg	V	Battery voltage
120	03	BatChrgVtg	V	Battery charging voltage
120	04	AptTmRmg	hhmmss	remaining absorption time (hhmmss)
120	05	BatChrgOp	Boost Full Equalize Float Silent	Active charging process: = boost charge = full charge = equalization charge = maintenance charge = silent mode
120	06	TotBatCur	A	Total battery current
120	07	BatTmp	°C	Battery temperature
120	08	RmgTmFul	d	time remaining until next full charge
120	09	RmgTmEqu	d	Remaining time until next equalizing charge:
120	10	AptPhs	Off On	absorption phase is active
120	11	BatSocErr	%	Estimated error of SOC

130# Meter External

Menu nr.	Parameter.Nr.	Parameter Name	Range/Unit	Description
131# Meter Total				
131	01	TotExtPwrAt	kW	Total effective power of external sources
131	02	TotExtCur	A	Total current of external sources
131	03	TotExtPwrRt	kVAr	Total reactive power of external sources
132# State Grid				
132	01	GdRmgTm	hhmmss	remaining time of GdValTm parameter (valid grid time) (hhmmss)
133# State Gen				
133	01	GnDmdSrc	 None Bat Lod Tim Run1h Start ExtSrcReq	Source or generator request: = no request = dependent on battery state of charge = load-dependent = time-controlled = for 1 hour = started manually = external source request
133	02	GnStt	 Off Init Idle Warm Connect Run Retry Disconnect Cool Lock Fail FailLock Reinit	generator state: = switched off = waiting for request (ready) = warming-up = connecting = operation = restart = disconnecting = cooling down = locked after operation = error = locked after error
133	03	GnRmgTm	hhmmss	remaining operating time of generator (minimum operating time) (hhmmss)
133	04	GnRnStt	Off On	State Generator Response Master (DigIn)
134# Meter Device				
134	01	ExtPwrAt	kW	active power of external source
134	02	ExtVtg	V	voltage of external source
134	03	ExtCur	A	current of external source
134	04	ExtFrq	Hz	frequency of external source

Menu nr.	Parameter.Nr.	Parameter Name	Range/Unit	Description
134	05	ExtPwrRt	kVAr	reactive power of external source
135 # Meter Slave 1				
135	01	ExtPwrAtSlv1	kW	active power of external source at slave1
135	02	ExtVtgSlv1	V	voltage of external source at slave1
135	03	ExtCurSlv1	A	current of external source at slave1
135	04	ExtPwrRtSlv1	kVAr	reactive power of external source at slave1
136# Meter Slave 2				
136	01	ExtPwrAtSlv2	kW	active power of external source at slave2
136	02	ExtVtgSlv2	V	voltage of external source at slave2
136	03	ExtCurSlv2	A	current of external source at slave2
136	04	ExtPwrRtSlv2	kVAr	reactive power of external source at slave2

140# Meter SIC40

If one or more SIC40 charge controller is connected to the island grid communication, the following menus will appear on the display:

Menu nr.	Parameter.Nr.	Parameter Name	Range/Unit	Description
141# SIC40 Total				
141	01	TotSicPvPwr	W	Total power of all SIC40s
141	02	TotSicBatCur	A	Battery current of all SIC40s
142# SIC40 1				
142	01	Sic1PvPwr	W	PV power of first SIC40
142	02	Sic1PvVtg	V	PV voltage of first SIC40
142	03	Sic1BatVtg	V	Battery voltage of first SIC40
142	04	Sic1BatCur	A	Battery current of first SIC40
142	07	Sic1HsTmp	°C	Temperature of first SIC40's heat sink
142	09	Sic1SWVers	–	SW version number SIC-PB
143# SIC40 2				
143	01	Sic2PvPwr	W	PV power of second SIC40
143	02	Sic2PvVtg	V	PV voltage of second SIC40
143	03	Sic2BatVtg	V	Battery voltage of second SIC40
143	04	Sic2BatCur	A	Battery current of second SIC40
143	07	Sic2HsTmp	°C	Temperature of second SIC40's heat sink
143	09	Sic2SWVers	–	SW version number SIC-PB

Menu nr.	Parameter.Nr.	Parameter Name	Range/Unit	Description
144# SIC40 3				
144	01	Sic3PvPwr	W	PV power of third SIC40
144	02	Sic3PvVtg	V	PV voltage of third SIC40
144	03	Sic3BatVtg	V	Battery voltage of third SIC40
144	04	Sic3BatCur	A	Battery current of third SIC40
144	07	Sic3HsTmp	°C	Temperature of third SIC40's heat sink
144	09	Sic3SWVers	–	SW version number SIC-PB
145# SIC40 4				
145	01	Sic4PvPwr	W	PV power of fourth SIC40
145	02	Sic4PvVtg	V	PV voltage of fourth SIC40
145	03	Sic4BatVtg	V	Battery voltage of fourth SIC40
145	04	Sic4BatCur	A	Battery current of fourth SIC40
145	07	Sic4HsTmp	°C	Temperature of fourth SIC40's heat sink
145	09	Sic4SWVers	–	SW version number SIC-PB

For a detailed description of the **"150# Meter Compact"** menu see section 10.3.4 "Meter Compact" (Page 105).

17.2 Adjustable System Parameters

NOTICE!

Damage due to mistakenly entered values.

Directly after pressing the knob, operating values set this way can be changed. It could happen that wrong entries for these parameter values cannot be corrected quickly enough.

- Only qualified personnel should change and set system parameters.
- Parameters marked with **(Stby)** are to be changed only when the Sunny Island is in standby mode.

Changes to parameters

The cells with a grey background in the following tables show all menu items that can only be changed after entering the installer password.

All parameters can be set using a connected PC/laptop with the Sunny Data Control software, a Sunny WebBox or a Sunny Boy Control (see section 7.5 "Communication" (Page 53)).

210# Set Inverter

Menu nr.	Parameter Nr.	Parameter Name	Range/Unit	Default value	Description
210	01	InvVtgNom	V	230	Nominal inverter voltage
210	02	InvChrgCurMax	A	9.6	Maximum AC charging current
210	03	InvFrqNom	Hz	50	Nominal inverter frequency

220# Set Battery

Menu nr.	Parameter.Nr.	Parameter Name	Range/Unit	Default value	Description
221# Bat Property					
221	01	BatTyp	VRLA FLA NiCd	VRLA	Battery type: = valve regulated lead acid = flooded lead acid = nickel cadmium can only be changed in QCG
221	02	BatCpyNom	Ah	140	Nominal battery capacity (E:C10/U:C20) can only be changed in QCG
221	03	BatVtgNom	V	24	Nominal battery voltage can only be changed in QCG
221	04	BatTmpMax	degC	40	Maximum battery temperature
221	05	BatTmpStr	degC	35	battery restart temperature following stop due to overtemperature
221	06	ChrgCtlOp		Auto	Type of DC charging device
222# Bat Chargemode					
222	01	BatChrgCurMax	A	80	Battery charging current limit (depends on nominal battery capacity), 60 % of the nominal battery capacity (221.02)

Menu nr.	Parameter.Nr.	Parameter Name	Range/Unit	Default value	Description
222	02	AptTmBoost	min	120	Absorption time at normal charge 120 = VRLA 90 = FLA 300 = NiCd depending on the setting in QCG
222	03	AptTmFul	h	5	Absorption time at full charge 5 = VRLA 5 = FLA 7 = NiCd depending on the setting in QCG
222	04	AptTmEqu	h	10	Absorption time at equalizing charge 10 = VRLA 10 = FLA 10 = NiCd depending on the setting in QCG
222	05	CycTmFul	d	14	Full charge cycle time
222	06	CycTmEqu	d	180	Cycle time at equalizing charge
222	07	ChrgVtgBoost	V	2.4	Setpoint of cell voltage at normal charge 2.4 = VRLA 2.55 = FLA 1.65 = NiCd depending on the setting in QCG
222	08	ChrgVtgFul	V	2.4	Setpoint of cell voltage at full charge 2.4 = VRLA 2.5 = FLA 1.65 = NiCd depending on the setting in QCG
222	09	ChrgVtgEqu	V	2.4	Setpoint of cell voltage at equalizing charge 2.4 = VRLA 2.5 = FLA 1.65 = NiCd depending on the setting in QCG
222	10	ChrgVtgFlo	V	2.25	Setpoint of cell voltage at floating charge 2.25 = VRLA 2.25 = FLA 1.55 = NiCd depending on the setting in QCG
222	11	BatTmpCps	mV/degC	4.0	Battery temperature compensation 4.0 = VRLA 4.0 = FLA 0.0 = NiCd depending on the setting in QCG

Menu nr.	Parameter.Nr.	Parameter Name	Range/Unit	Default value	Description
222	12	AutoEquChrgEna	Disable Enable	Enable	activates automatic equalization charge
223# Bat Protection					
223	01	BatPro1TmStr	hhmmss	220000	time for starting battery preservation mode level 1
223	02	BatPro1TmStp	hhmmss	060000	time for stopping battery preservation mode level 1
223	03	BatPro2TmStr	hhmmss	170000	time for starting battery preservation mode level 2
223	04	BatPro2TmStp	hhmmss	090000	time for stopping battery preservation mode level 2
223	05	BatPro1Soc	%	20	SOC limit for preservation mode level 1
223	06	BatPro2Soc	%	15	SOC limit for preservation mode level 2
223	07	BatPro3Soc	%	10	SOC limit for preservation mode level 3
224# Bat Silentmode					
224	01	SilentEna	Disable Enable	Disable	Enable Silent mode on the grid
224	02	SilentTmFlo (Stby)	h	3	max. time for float charge until change to silent
224	03	SilentTmMax (Stby)	h	12	max. time for silent mode until transfer into float
225# Battery Current Sensor					
225	01	BatCurSnsTyp	-	None 60mV 50mV	Current sensor type (60mV, 50mV)
225	02	BatCurGain60	A/60mV	3	external battery current sensor 60mV type
225	03	BatCurGain50	A/50mV	12	external battery current sensor 50mV type
225	04	BatCurAutoCal		Start	Automatic calibration of the external battery current sensor

230# Set External

Menu nr.	Parameter.Nr.	Parameter Name	Range/Unit	Default value	Description
231# Ext General					
231	02	PvFeedTmStr	hhmmss	040000	start of PV feed-in
231	03	PvFeedTmStp	hhmmss	220000	stop of PV feed-in
231	04	ExtLkTm	min	20	Locking time after Reverse Power and/or relay protection

Menu nr.	Parameter.Nr.	Parameter Name	Range/Unit	Default value	Description
231	09	ExtSrc	Grid	Grid	Grid Operation
232# Grid Control					
232	01	GdVtgMin	V	189	Minimum grid voltage
232	02	GdVtgMax	V	259.5	Maximum grid voltage
232	03	GdCurNom	A	16	Nominal grid current
232	04	GdFrqNom	Hz	50	Nominal frequency
232	05	GdFrqMin	Hz	47.65	Minimum grid frequency
232	06	GdFrqMax	Hz	50.15	Maximum grid frequency
232	07	GdVldTm	sec	30	minimum time required for grid (voltage and frequency) to be within permissible range for connection
232	08	GdMod	GridCharge GridFeed	GridCharge	Grid interface
232	09	GdRvPwr	W	100	permissible grid reverse power (effective power)
232	10	GdRvTm	sec	5	permissible time for grid reverse power
232	15	GdAISns	Low, Medium standard High	standard	AI sensitivity
233# Gen Control					
233	01	GnVtgMin	V	172.5	Min. generator voltage
233	02	GnVtgMax	V	264.5	Max. generator voltage
233	03	GnCurNom	A	25	Nominal generator current
233	04	GnFrqNom	Hz	50	Nominal generator frequency (at nominal load) 230V_50HZ = 50 220V_60HZ = 60 depending on the setting in QCG
233	05	GnFrqMin	Hz	44.64	Minimum generator frequency 230V_50HZ = 44.64 220V_60HZ = 50 depending on the setting in QCG
233	06	GnFrqMax	Hz	60	Maximum generator frequency 230V_50HZ = 60 220V_60HZ = 70 depending on the setting in QCG

Menu nr.	Parameter.Nr.	Parameter Name	Range/Unit	Default value	Description
233	07	GnStrMod	Manual Automatic start GenMan	Automatic start	Generator interface
233	08	GnOpTmMin	min	15	Minimum generator operating time
233	09	GnStpTmMin	min	15	Minimum generator stop time
233	10	GnCoolTm	min	5	Cooling time for Generator
233	11	GnErrStpTm	h	6	Generator stop time in case of generator failure
233	12	GnWarmTm	sec	60	warm up time (minimum time required for generator voltage and frequency to be within permissible range for connection)
233	13	GnRvPwr	W	100	allowable generator reverse power (active power)
233	14	GnRvTm	sec	30	allowable time for reverse power/ reverse current
233	15	GnCtlMod	Cur CurFrq	Cur	External (Gen/Grid) control (Current or frequency)
233	20	GnAISns	Low, Medium standard High	standard	AI sensitivity
234# Gen Start					
234	01	GnAutoEna	Off On	On	activate generator autostart
234	02	GnAutoStr		3	Number of automatic starts
234	03	GnSocTm1Str	%	40	SOC limit for switching on generator for time 1
234	04	GnSocTm1Stp	%	80	SOC limit for switching off generator for time 1
234	05	GnSocTm2Str	%	40	SOC limit for switching on generator for time 2
234	06	GnSocTm2Stp	%	80	SOC limit for switching off generator for time 2
234	07	GnTm1Str	hhmmss	0	time 1 for generator request (begin time 1, end time 2) (hhmmss)
234	08	GnTm2Str	hhmmss	0	time 2 for generator request (begin time 2, end time 1) (hhmmss)
234	09	GnPwrEna	Off On	Off	activate generator request as a result of power

Menu nr.	Parameter.Nr.	Parameter Name	Range/Unit	Default value	Description
234	10	GnPwrStr	kW	4	Generator request starting capacity
234	11	GnPwrStp	kW	2	Generator request interrupting capacity
234	12	GnPwrAvgTm	sec	60	average time for power-related generator start

240# Set Relay

Menu nr.	Parameter.Nr.	Parameter Name	Range/Unit	Default value	Description
241# Relay General					
241	01	Rly1Op	Off On AutoGn AutoLodExt AutoLod1Soc AutoLod2Soc Tmr1 Tmr2 AptPhs GnRn ExtVfOk GdOn Error Warm Run MSD 1 MSD 2 BatFan AcdCir	AutoGn	Function of relay 1 = switched off = switched on = automatic generator connection = automatic disconnection of loads, connection only if external sources are available = automatic connection/disconnection of loads due to SOC1 = automatic connection/disconnection of loads due to SOC2 = programmable timer1 = programmable timer1 = absorption phase is active = generator is running = ext. voltage and frequency in permissible range = ext. grid is connected = error = warm-up = operation (= currently has no function) (= currently has no function) = battery room fan = electrolyte pump
241	02	Rly2Op	see 241.01	AutoLodExt	Function of relay 2 For details see 241.01
242# Relay Load					
242	01	Lod1SocTm1Str	%	30	SOC limit for load shedding 1 start for t1
242	02	Lod1SocTm1Stp	%	50	SOC limit for load shedding 1 stop for t1
242	03	Lod1SocTm2Str	%	30	SOC limit for load shedding 1 start for t2
242	04	Lod1SocTm2Stp	%	50	SOC limit for load shedding 1 stop for t2

Menu nr.	Parameter.Nr.	Parameter Name	Range/Unit	Default value	Description
242	05	Lod1Tm1Str	hhmmss	0	Loadshed 1 time1 (begin time1, end time2)
242	06	Lod1Tm2Str	hhmmss	0	Loadshed 1 time2 (begin time2, end time1)
242	07	Lod2SocTm1Str	%	30	SOC limit for load shedding 2 start for t1
242	08	Lod2SocTm1Stp	%	50	SOC limit for load shedding 1 stop for t1
242	09	Lod2SocTm2Str	%	30	SOC limit for load shedding 2 start for t2
242	10	Lod2SocTm2Stp	%	50	SOC limit for load shedding 2 stop for t2
242	11	Lod2Tm1Str	hhmmss	0	Loadshed 2 time1 (begin time1, end time2)
242	12	Lod2Tm2Str	hhmmss	0	Loadshed 2 time2 (begin time2, end time1)
243# Relay Timer					
243	01	RlyTmr1StrDt	yyyymmdd	20060101	Starting date timer1
243	02	RlyTmr1StrTm	hhmmss	0	Startzeit für Relaissteuerung Timer1
243	03	RlyTmr1Dur	hhmmss	0	Operating time for relay control timer 1
243	04	RlyTmr1Cyc	Single Dayly Weekly	Single	Repeat cycle time for timer 1
243	05	RlyTmr2StrDt	yyyymmdd	20060101	Starting date timer2
243	06	RlyTmr2StrTm	hhmmss	0	Startzeit für Relaissteuerung Timer2
243	07	RlyTmr2Dur	hhmmss	0	Operating time for relay control timer 2
243	08	RlyTmr2Cyc	Single Dayly Weekly	Single	repeated cycle time for timer 2

Menu nr.	Parameter.Nr.	Parameter Name	Range/Unit	Default value	Description
244# Relay Slave1					
244	01	Rly1OpSlv1		Off	function of relay 1 on slave1
			Off		= switched off
			On		= switched on
			AutoGn		= automatic generator connection
			AutoLodExt		= automatic disconnection of loads, connection only if external sources are available
			AutoLod1Soc		= automatic connection/disconnection of loads due to SOC1
			AutoLod2Soc		= automatic connection/disconnection of loads due to SOC2
			Tmr1		= programmable timer1
			Tmr2		= programmable timer2
			AptPhs		= absorption phase is active
			GnRn		= generator is running
			ExtVfOk		= ext. voltage and frequency in permissible range
			GdOn		= ext. grid is connected
			Error		= error
			Warm		= warm-up
			Run		= operation
			BatFan		Battery room fan
			AcdCir		= electrolyte pump

Menu nr.	Parameter.Nr.	Parameter Name	Range/Unit	Default value	Description
244	02	Rly2OpSlv1		Off	function of relay 2 on slave1
			Off		= switched off
			On		= switched on
			AutoGn		= automatic generator connection
			AutoLodExt		= automatic disconnection of loads, connection only if external sources are available
			AutoLod1Soc		= automatic connection/disconnection of loads due to SOC1
			AutoLod2Soc		= automatic connection/disconnection of loads due to SOC2
			Tmr1		= programmable timer1
			Tmr2		= programmable timer2
			AptPhs		= absorption phase is active
			GnRn		= generator is running
			ExtVfOk		= ext. voltage and frequency in permissible range
			GdOn		= ext. grid is connected
			Error		= error
			Warm		= warm-up
			Run		= operation
			BatFan		Battery room fan
			AcdCir		= electrolyte pump

Menu nr.	Parameter.Nr.	Parameter Name	Range/Unit	Default value	Description
245# Relay Slave2					
245	01	Rly1OpSlv2		Off	function of relay 1 on slave2
			Off		= switched off
			On		= switched on
			AutoGn		= automatic generator connection
			AutoLodExt		= automatic disconnection of loads, connection only if external sources are available
			AutoLod1Soc		= automatic connection/disconnection of loads due to SOC1
			AutoLod2Soc		= automatic connection/disconnection of loads due to SOC2
			Tmr1		= programmable timer1
			Tmr2		= programmable timer2
			AptPhs		= absorption phase is active
			GnRn		= generator is running
			ExtVfOk		= ext. voltage and frequency in permissible range
			GdOn		= ext. grid is connected
			Error		= error
			Warm		= warm-up
			Run		= operation
			BatFan		Battery room fan
			AcdCir		= electrolyte pump

Menu nr.	Parameter.Nr.	Parameter Name	Range/Unit	Default value	Description
245	02	Rly2OpSlv2		Off	function of relay 2 on slave2
			Off		= switched off
			On		= switched on
			AutoGn		= automatic generator connection
			AutoLodExt		= automatic disconnection of loads, connection only if external sources are available
			AutoLod1Soc		= automatic connection/disconnection of loads due to SOC1
			AutoLod2Soc		= automatic connection/disconnection of loads due to SOC2
			Tmr1		= programmable timer1
			Tmr2		= programmable timer2
			AptPhs		= absorption phase is active
			GnRn		= generator is running
			ExtVfOk		= ext. voltage and frequency in permissible range
			GdOn		= ext. grid is connected
			Error		= error
			Warm		= warm-up
			Run		= operation
			BatFan		Battery room fan
			AcdCir		= electrolyte pump

250# Set System

Menu nr.	Parameter.Nr.	Parameter Name	Range/Unit	Default value	Description
250	01	AutoStr **(Stby)**		0	autostart (0=autostart deactivated)
250	02	Dt	yyyymmdd		Date
250	03	Tm	hhmmss		Time
250	06	ComBaud	1200 4800 9600 19200 38400 57600 115000	1200	baud rate interface
250	09	ComAdr			interface address
250	23	BatVtgOut	Auto Off On	Off	Switching on and off of the battery voltage output
250	26	SearchModTm	sec	0	Searchmode timer

For a detailed description of the **"260# Set Password"** menu see section 10.3.2 "Setting the Installer Password" (Page 102).

17.3 Diagnosis

310# Diag Inverter

Menu Nr.	Parameter Nr.	Parameter Name	Range/Unit	Description
311# Diag Total				
311	01	EgyCntIn	kWh	energy absorbed
311	02	EgyCntOut	kWh	energy fed
311	03	EgyCntTm	h	energy metering run time
312# Diag Device				
312	02	FwVer		BFR firmware version
312	03	SN		Serial number
312	04	OnTmh	h	operating hours
312	06	OpStt	Operating Warning Failure	operating mode (device)

Menu Nr.	Parameter Nr.	Parameter Name	Range/Unit	Description
312	07	CardStt	 Off Operational Mount OutOfSpace BadFileSys Incomp Parameter ParamFailed WriteLogData WriteLogFailed	MMC/SD card status message: = no Sunny Island = in operation = card initializing = insufficient memory capacity (on card or in main directory) = incorrect file system = incompatible card = parameter update is active = error during parameter update = writing log data to card = error upon writing log data to card
312	08	FwVer2		DSP firmware version
312	09	FwVer3		Boot loader BFR
312	10	FwVer4		Boot loader DSP
313# Diag Slave 1				
313	01	FwVerSlv1		BFR firmware version on slave1
313	02	SNSlv1		Serial number slave1
313	03	OnTmhSlv1	h	Operating hours slave1
313	04	PhSlv1	L1 L2 L3	Phase angle slave 1
313	05	OpSttSlv1	Operating Warning Failure	Operating state Slave2
313	06	FwVer2Slv1		DSP firmware version on slave1
313	07	FwVer3Slv1		Boot loader BFR slave 1
313	08	FwVer4Slv1		Boot loader DSP slave 1
314# Diag Slave 2				
314	01	FwVerSlv2		BFR firmware version on slave2
314	02	SNSlv2		Serial number slave2
314	03	OnTmhSlv2	h	Operating hours slave2
314	04	PhSlv2	L1 L2 L3	Phase angle slave 2
314	05	OpSttSlv2	Operating Warning Failure	Operating state Slave2

Menu Nr.	Parameter Nr.	Parameter Name	Range/Unit	Description
314	06	FwVer2Slv2		DSP firmware version on slave2
314	07	FwVer3Slv2		Boot loader BFR slave 2
314	08	FwVer4Slv2		Boot loader DSP slave 2

320# Diag Battery

Menu Nr.	Parameter Nr.	Parameter Name	Range/Unit	Description
320	01	Soh	%	state of health (SOH), ratio of current capacity and nominal value
320	02	StatTm	d	statistics counter run time
320	03	ChrgFact		charging factor
320	04	BatEgyCntIn	kWh	energy counter for battery charge
320	05	BatEgyCntOut	kWh	energy counter for battery discharge
320	06	AhCntIn	Ah	counter for battery charging ampere hours
320	07	AhCntOut	Ah	counter for battery discharging ampere hours
320	08	BatTmpPkMin	degC	minimum battery temperature
320	09	BatTmpPkMax	degC	Maximum battery temperature
320	10	EquChrgCnt		equalization charge counter
320	11	FulChrgCnt		full charge counter
320	12	BatCurOfsErr	A	present battery current offset error
320	13	OcvPointCnt		counter for open-circuit voltage points
320	14	Silent Req	Off On	silent mode request
320	15	AhCntFul	Ah/100Ah	counter for battery discharging ampere hours since last full charge
320	16	AhCntEqu	Ah/100Ah	counter for battery discharging ampere hours since last equalization charge
320	17	BatVtgPk	V	Max. battery voltage applied (SMA)
320	18	BatCurPk	A	Max.battery current in charging direction (SMA)
320	19	BatCurPkOut	A	Max battery current in discharging direction (SMA)
320	20	SocHgm100	%	frequency scale of state of charge 100 % > SOC >= 90%
320	21	SocHgm90	%	frequency scale of state of charge 90 % > SOC >= 80%
320	22	SocHgm80	%	frequency scale of state of charge 80 % > SOC >= 70%

Menu Nr.	Parameter Nr.	Parameter Name	Range/Unit	Description
320	23	SocHgm70	%	frequency scale of state of charge 70 % > SOC >= 60%
320	24	SocHgm60	%	frequency scale of state of charge 60 % > SOC >= 50%
320	25	SocHgm50	%	frequency scale of state of charge 50 % > SOC >= 40%
320	26	SocHgm40	%	frequency scale of state of charge 40 % > SOC >= 30%
320	27	SocHgm30	%	frequency scale of state of charge 30 % > SOC >= 20%
320	28	SocHgm20	%	frequency scale of state of charge 20 % > SOC >= 10%
320	29	SocHgm10	%	frequency scale of state of charge 10 % > SOC >= 0%
320	30	SocHgm000	%	frequency scale of state of charge SOC < 0 %
320	31	SocVtgCal	%	re-calibration of state of charge only via open-circuit voltage
320	32	ErrSocVtgCal	%	estimated error of voltage calibrated state of charge
320	33	SocChrgCal	%	re-calibration of state of charge only via full charge
320	34	ErrSocChrgCal	%	estimated error of full-charge calibrated state of charge
320	35	OcvGra	Ah/V	rise of open-circuit voltage characteristic curve
320	36	OcvMax	V	max. open-circuit voltage

330# Diag External

Menu Nr.	Parameter Nr.	Parameter Name	Range/Unit	Description
331# Diag Grid				
331	01	GdEgyCntIn	kWh	energy counter for grid-feed-in
331	02	GdEgyCntOut	kWh	energy meter for power taken from the grid
331	03	GdEgyTmh	h	run time of grid energy counter
331	04	GdOpTmh	h	Operating hour counter for grid operation
331	05	GdCtcCnt		Counter for grid connections
332# Diag Generator				
332	01	GnEgyCnt	kWh	generator energy counter
332	02	GnEgyTm	h	run time of generator energy counter

Menu Nr.	Parameter Nr.	Parameter Name	Range/Unit	Description
332	03	GnOpTmh	h	Counter for generator operating hours
332	04	GnStrCnt	-	Number of generator starts

17.4 Events, Warnings and Failures (History)

Events and failure messages [**410# (Fail Current)**, **420# (Fail History)** and **430# (Event History)**] are described in section 18.4 "Display of Failures and Events" (Page 184).

17.5 Functions During Operation

510# Oper Inverter

Menu nr.	Parameter.Nr.	Parameter Name	Range/Unit	Default value	Description
510	01	InvRs **(Stby)**	Restart	–	triggers inverter reset
510	02	InvTmOpEna	Disable Enable	Disable	activates time-controlled inverter operation
510	03	InvTmOpStrDt	yyyymmdd	20060101	Starting date for time-controlled inverter operation
510	04	InvTmOpStrTm	hhmmss	0	Start time for time-controlled inverter operation
510	05	InvTmOpRnDur	hhmmss	0	Run time for time-controlled inverter operation
510	06	InvTmOpCyc	Single Dayly Weekly	Single	Repeat cycle time for timer 1
510	07	CntRs	Inv Bat Gn Gd All	–	Reset selected energy counter

520# Oper Battery

Menu nr.	Parameter.Nr.	Name	Range/Unit	Default	Description
520	01	ManChrgSel	Idle Start Stop	Idle	triggers equalization charge (manual)

540# Oper Generator

Menu nr.	Parameter.Nr.	Parameter Name	Range/Unit	Default value	Description
540	01	GnManStr	Auto Stop Start Run1h ManEquChrg	Auto	Manual generator start
540	02	GnAck	Ackn		Generator failure acknowledgment

550# Oper SD-Card

Menu nr.	Parameter.Nr.	Name	Range/Unit	Default	Description
550	01	ParaSto	Set1 Set2	Set1	Save parameter settings
550	02	ParaLod	Set1 Set2 Factory	Set1	Load parameter settings
550	03	CardFunc	 ForcedWrite StoEvtHis StoFailHis		functions for MMC/SD card = forces writing of data = writes event list = writes failure list
550	04	DatLogEna	Off On	On	activates automatic data storage

For a detailed description of the 600 „Direct Access“ menu see section 10.3.3 "Accessing Parameters Directly" (Page 105).

18 Troubleshooting/Problem Solving

In general the Sunny Island distinguishes between events and failures. These messages are shown on the Sunny Remote Control 1 display.

- **Events** describe state changes or transient states (e.g. generator connection).
- **Errors** describe impermissible or only limitedly permissible states. This includes, warnings, failures and errors. These normally require user interaction.

18.1 Error Confirmation

If there is an error or fault, the Sunny Island goes into standby.

Proceed as follows to acknowledge and remove an error message:

1. Remove the cause.
2. Acknowledge and confirm the error message by pressing the knob on the Sunny Remote Control 1.
3. Start the Sunny Island again.

18.2 Handling Autostart

The Sunny Island has an autostart counter which counts down by 1 with every automatic start. After 10 minutes of normal operation of the Sunny Island, the autostart counter is set back to its original value.

If another fault occurs when the autostart meter is at 0, the Sunny Island waits for 10 minutes and then attempts to restart. The autostart counter starts again.

The number of autostarts allowed can be set using the "250.01 AutoStr" parameter (in standby mode).

18.3 Handling Failures Present During Startup

During the booting procedure, all pending errors are generally confirmed without an entry being made in the history (see. menu "400 Failure/Event). Any errors still present after that are entered again after booting.

The Sunny Remote Control 1 shows:

- "Arrive" - the Sunny Island has recognized a fault (again) and has entered it in the list.
- "Clear" - the source of the fault has been cleared and the fault is "gone".

18.4 Display of Failures and Events

Every error and every event is labeled distinctively and placed according to the Parameter/ Measured value classification.

The message has four characters and is made up of one letter and three digits.

1. The letter at the beginning corresponds to the message. There are three categories of messages:
   - F = Fault/Error
   - W = Warning
   - E = Event
2. In the second position there is a digit between 1 and 8 which describes the area to which the error, event or warning relates:
   - y1xx - INV = Inverter
   - y2xx - BAT = Battery
   - y3xx - EXT = External
   - y4xx - GEN - Generator
   - y5xx - GRD = Grid
   - y6xx - RLY = Relay
   - y7xx - SYS = System
3. In the third and
4. fourth positions there are two digits.

In addition, the Sunny Remote Control 1 shows whether the message is up-to-date, i.e., whether it is necessary to take corrective action or whether the cause for the message has been taken care of.

- "Arrive" - the Sunny Island has recognized a fault (again) and has entered it in the list.
- "Clear" - the source of the fault has been cleared successfully.

18.5 Events

The meanings of the events displayed by the Sunny Island are described in the following table:

Display number	Description
Category INV	
E101	wait status
E102	startup process
E103	In operation
E104	Operation with generator
E105	Operation with grid
E107	Sleep-Mode (Slave in 1-phase systems)
E108	silent mode on the grid
E110	shutting down due to failure
E118	Automatic start

Display number	Description
E119	manual start (transition from standby to operation)
E120	manual stop (change from operation to standby)
E121	Energy saving mode 1
Category BAT	
E202	(partial) reset of BMS due to new battery (QCG NewBat)
E203	state change, battery charging algorithm for float (maintenance) charge
E204	Status change of battery charge algorithm to Boost (fast) charge
E205	state change, battery charging algorithm for full charge
E206	state change into silent mode (BMS)
E207	state change, battery charging algorithm for equalization charge
Category GEN	
E401	automatic generator start due to user-defined criteria (battery charge state, power, time, etc.)
E402	automatic generator stop due to user-defined criteria (battery charge state, power, time, etc.)
E403	Manual generator start
E404	manual generator stop
E405	Manual generator failure confirmation
Category REL	
E601	relay 1 off
E602	relay 1 on
E603	relay 1 on slave 1 off
E604	relay 1 on slave 1 on
E605	relay 1 on slave 2 off
E606	relay 1 on slave 2 on
E609	Transfer relay open (disconnection from grid)
E610	transfer relay on slave 1 closed (connect to grid)
E611	transfer relay on slave 1 open
E612	transfer relay on slave 1 closed
E613	transfer relay on slave 2 open
E614	transfer relay on slave 2 closed
E617	Relay 2 open
E618	Relay 2 closed
E619	relay 2 on slave 1 open
E620	relay 2 on slave 1 closed

Display number	Description
E621	relay 2 on slave 2 open
E622	relay 2 on slave 2 closed
E625	digital input OFF (low)
E626	digital input ON (high)
E627	Digital Input Slave 1 to OFF (low) (not active)
E628	Digital Input Slave 1 to ON (High) (not active)
E629	Digital Input Slave 2 to OFF (low) (not active)
E630	Digital Input Slave 2 to ON (High) (not active)
Category SYS	
E705	device start
E706	Set Date Time (Recording is done with "old" time)
E707	new system configured in the QCG
E708	Part 1 of the firmware updated (entry of the "old" version)
E709	Part 2 of the firmware updated (entry of the "old" version)
E711	MMC/SD card inserted
E712	Sunny Remote Control 1: parameter update
E715	Sunny Remote Control 1 activated
E851	First SIC40 has been detected
E852	Second SIC40 has been detected
E853	Third SIC40 has been detected
E854	Fourth SIC40 has been detected

18.6 Error Categories

The Sunny Island distinguishes between five different levels of failures, each requiring different user interaction:

Level	Classification	Display	Meaning
1	Warning	Warning	Warning, device continues to run. There is an explicit information on the Home Screen that a warning was recorded.
2	Fault 1	Malfunction	Disturbance that only can be detected in operation, device is deactivated. Restart is possible immediately (Autostart).
3	Fault 2	Malfunction	Disturbance that can be detected in Standby, device is deactivated. Restart (Autostart) is only possible is identified as being gone.
4	Failure	Failure	Device failure, device is deactivated. User interaction required (troubleshooting, confirmation, manual restart).
5	Device defective	Defect	Device is defective, is deactivated and does not restart. Operation permanently blocked. Device must be exchanged.

18.7 Warnings and Failure messages

The meanings of the faults and warnings displayed by the Sunny Island are described in the following table:

Display number	Level	Description
Category INV		
F117	2	AC current limitation (short-circuit control active for too long)
F118	2	AC current limitation (short-circuit control active for too long) on slave 1
F119	2	AC current limitation (short-circuit control active for too long) on slave 2
F121	3	inverter overvoltage
F122	3	inverter overvoltage on slave 1
F123	3	inverter overvoltage on slave 2
F150	3	Overtemperature (inverter)
W151	1	Overheating (inverter) slave 1
W152	1	Overheating (inverter) slave 2
F154	3	Overtemperature (voltage converter)
W155	1	Overheating (voltage converter) slave 1
W156	1	Overheating (voltage converter) slave 2
Category BAT		
F206	3	battery overtemperature
F208	3	battery overvoltage (internal limit for cell voltage)

Display number	Level	Description
W210	1	Warning Battery overvoltage (dependent upon charge voltage setpoint value)
W211	1	insufficient battery temperature warning
W212	1	high battery temperature warning
Category EXT		
W309	1	relay protection
W310	1	relay protection on slave 1
W311	1	relay protection on slave 2
W315	1	Disconnection from grid/generator, external voltage too low
W316	1	Disconnection from grid/generator, external voltage too low slave 1
W317	1	Disconnection from grid/generator, external voltage too low slave 2
W319	1	Disconnection from grid/generator, external voltage too high
W320	1	Disconnection from grid/generator, external voltage too high slave 1
W321	1	Disconnection from grid/generator, external voltage too high slave 2
W323	1	Disconnection from grid/generator, external frequency too low
W324	1	Disconnection from grid/generator, external frequency too low slave 1
W325	1	Disconnection from grid/generator, external frequency too low slave 2
W327	1	Disconnection from grid/generator, external frequency too high
W328	1	Disconnection from grid/generator, external frequency too high slave 1
W329	1	Disconnection from grid/generator, external frequency too high slave 2
W331	1	Disconnection from grid due to anti-islanding (unintended island grid)
W332	1	Disconnection from grid due to anti-islanding (unintended island grid) slave 1
W333	1	Disconnection from grid due to anti-islanding (unintended island grid) slave 2
W335	1	disconnection from grid/generator due to violation of voltage limits
W339	1	Disconnection from grid/generator, voltage rise protection
W340	1	Disconnection from grid/generator, voltage rise protection slave 1
W341	1	Disconnection from grid/generator, voltage rise protection slave 2
W360	1	Disconnection from grid due to excessive current
W361	1	Disconnection from grid due to excessive current slave 1
W362	1	Disconnection from grid due to excessive current slave 2
Categroy RLY		
F605	4	Transfer relay does not open
F606	4	Transfer relay does not open slave 1
F607	4	Transfer relay does not open slave 2

Display number	Level	Description
Category SYS		
W702	1	internal restart
F703	3	Time limit exceeded during internal processing
F704	4	DSP invalid calibration
F705	4	Watchdog DSP triggered
F706	4	watchdog meter has expired (watchdog triggered several times in succession)
F707	4	watchdog meter on slave 1 has expired (watchdog triggered several times in succession)
F708	4	watchdog meter on slave 2 has expired (watchdog triggered several times in succession)
F709	4	watchdog meter on slave 3 has expired (watchdog triggered several times in succession)
F710	4	autostart counter expired (several autostarts in succession)
F711	2	DSP hardware error
F712	2	internal monitoring electronics (HTSS error)
W713	1	watchdog triggered
F714	2	internal overvoltage
F722	3	Short circuit in battery temperature sensor
F723	3	Defective cable in battery temperature sensor
W738	1	Synchronization was not conducted
F739	3	internal device communication BFR-DSP missing
F740	3	internal device communication BFR-DSP missing on slave 1
F741	3	internal device communication BFR-DSP missing on slave 2
F743	3	internal device communication BFR-DSP missing
W753	1	Invalid date (date is set automatically when launched)
W755	1	Battery preservation mode level 1
W756	1	Battery preservation mode level 2
W757	1	Battery preservation mode level 3
F762	4	Short circuit or ruptured cable on transformer temperature
F766	4	Short circuit or ruptured cable on transformer temperature sensor/inverter
W770	1	Short circuit at the 24 V DC-output
W851	1	Battery connection polarity reversed or short-circuit at first SIC40
W852	1	Battery excess voltage (>65 V) at first SIC40
W853	1	PV generator excess voltage at first SIC40
W854	1	PV voltage absent or short-circuit at first SIC40
W855	1	Sensor fault or temperature deficit at first SIC40

Display number	Level	Description
W856	1	Device overheating at first SIC40
W857	1	No communication with first SIC40 for more than 24 h
W861	1	Battery connection polarity reversed or short-circuit at second SIC40
W862	1	Battery excess voltage (>65 V) at second SIC40
W863	1	PV generator excess voltage at second SIC40
W864	1	PV voltage absent or short-circuit at second SIC40
W865	1	Sensor fault or temperature deficit at second SIC40
W866	1	Device overheating at second SIC40
W867	1	No communication with second SIC40 for more than 24 h
W871	1	Battery connection polarity reversed or short-circuit at third SIC40
W872	1	Battery excess voltage (>65 V) at third SIC40
W873	1	PV generator excess voltage at third SIC40
W874	1	PV voltage absent or short-circuit at third SIC40
W875	1	Sensor fault or temperature deficit at third SIC40
W876	1	Device overheating at third SIC40
W877	1	No communication with third SIC40 for more than 24 h
W881	1	Battery connection polarity reversed or short-circuit at fourth SIC40
W882	1	Battery excess voltage (>65 V) at fourth SIC40
W883	1	PV generator excess voltage at fourth SIC40
W884	1	PV voltage absent or short-circuit at fourth SIC40
W885	1	Sensor fault or temperature deficit at fourth SIC40
W886	1	Device overheating at fourth SIC40
W887	1	No communication with fourth SIC40 for more than 24 h

18.8 Troubleshooting

Questions that may be raised in practice are answered below:

Why does the Sunny Island not connect to the running generator?

- Check the generator fuses.
- Has the power allowed to be fed back into the generator during the permissible time been exceeded ("233.14 GnRvTm" parameter)?
  If so, "!" appears in the display. Generator connection is blocked for the time set. Set the "540.02 GnAck" parameter to Ackn.
- If the generator control relay (GnReq) is open:
  Has the generator been started manually ("233.07 GnStrMod" parameter)? Change the setting here to autostart, if required.

Why is the display of the Sunny Remote Control 1 dark and why is nothing displayed?

- Is the communication cable connected, and did both RJ45 plugs snap into their sockets audibly?
- Has the BatFuse (external DC fuse) been actuated?

  The Sunny Island is disconnected from the battery this way and has switched off. Replace the DC fuses.
- Is the BatFuse functional?

  In this case the device has switched off to protect the batteries from deep discharge (see also section 12.3 "Charge State/SOC and SOH" (Page 121)). To restart the Sunny Island, see section 10.1.5 "Restarting the System after Automatic Shutdown" (Page 88).

Why is it not possible to change parameters?

- Has the installer password been entered correctly? Check whether you are actually in "Installer Level" (see section 10.3.2 "Setting the Installer Password" (Page 102)). If necessary, repeat the calculation and entry of the password.
- You are in the "100-Meters" (Measuring data) menu or the "300-Diagnose" (Diagnosis) menu. The data values shown here can only be read.
- Some parameters can only be changed in standby mode or in the QCG (see e.g. the "233.07 GnStrMod" parameter in section 17.2 "Adjustable System Parameters" (Page 166)). Stop the Sunny Island as described in section 10.1.2 "Stopping" (Page 85). Note that this causes a dropout in the stand-alone grid and the loads are no longer supplied.

Why does the Sunny Island connect to the running generator only for a short time?

- The limits for the maximum permissible AC voltage or the minimum permissible frequency of the generator are too strict (parameter in menu "233 Generator Control"). Change voltage and/or frequency limits while observing the technical data for your generator.

What happens if battery cell becomes useless?

- Remove the unusable cell from your battery bank. Start the Sunny Island and change the battery voltage in the QCG under "New Battery".

What can I do if the QCG does not start?

- Switch off the Sunny Island (see section 10.1.3 "Switching Off" (Page 87)) and restart it (see section 10.1.1 "Switching On/Starting" (Page 83)).

What happens when "MMC operation failed" is displayed?

- You wanted to perform an action using the MMC/SD card, but it failed (see section 10.2.6 "Selecting Warnings and Faults" (Page 100)). Check the card (on your PC/laptop) and use a new MMC/SD card, if necessary.
- Format the MMC/SD card using FAT16.

Why is the battery discharging even though the generator is running?

- The power produced by the generator does not reach the Sunny Island. Check the voltage and frequency values. It is possible that the generator fuses have been triggered.
- The energy produced by the generator is not enough to supply the consumers. The generator and the battery supply the consumers.

Why is the deactivation defined by the SOC in case of a full or equalization charge and generator start in the second time zone?

- Equalization charge has a higher priority than silent time.

Why is the SOC not at 100 % even after full charging has been completed?

- Define a longer period of time of absorption.

How is it possible to ensure that the maximum battery charging current is correctly calculated after a reinstallation of the battery current sensor?

- Re-calibrate the battery current sensor using the "225.04 BatCurAutoCal" parameter with the setting "Start" (see chapter9.3 "Commissioning the Battery Current Sensor" (Page 81)).

  This parameter can only be changed by the installer, using the installer password.

What is required if the Sunny Island is continuously switches off after Low Battery Mode (LBM) when restarting the device?

- Start the generator manually, if required (e. g: Run1h). Consider the time for warming up: 5 minutes without charging current in BatProtMode can cause the device to change to standby mode.

How is it possible to change between wintertime and summertime operation e. g. in case of alpine huts?

- Save two differen parameter sets on the MMC/SD card and activate them via the "550.02 ParaLod" parameter (see section 10.4.3 "Loading and Saving Parameters" (Page 112).

What happens if you insert a non-FAT16 card?

- The Sunny Island displays "Incomp".

Why doesn't the generator or grid reconnect, although the voltage/frequency lie within the limits for disconnection?

- The connects with a so-called hysteresis, i.e., the connection value is slightly above the disconnection value. The disconnection values are factory-set.

19 Optional Devices

19.1 External DC fuse

WARNING!

The Sunny Island 2012 / 2224 has no internal DC fuse.

Install an external DC fuse between the Sunny Island and the battery (see chapter 7.2 "DC connection" (Page 43)).

The SMA Solar Technology AG offers the following external DC fuses:

BatFuse-A.01	NH00 battery fuse for a Sunny Island 2224
BatFuse-A.03	NH00 battery fuse for up to three Sunny Island 2224s
BatFuse-B.01	NH01 battery fuse as a fuse switch disconnector for a Sunny Island 2012/2224
BatFuse-B.03	NH01 battery fuse as a fuse switch disconnector for up to three Sunny Island 2012/2224s

19.2 External DC charge controllers (optional)

The SMA Solar Technology AG offers the

- Sunny Island Charger SIC40-MPT

as an external DC charge controller which is ideally adapted to the system.

You can find more detailed information in the technical description of the Sunny Island Charger SIC40-MPT or on the Internet at www.SMA.de.

19.3 Accessories (Optional)

In addition, the SMA Solar Technology AG offers

- a battery rack for two batteries.

Use of communication devices.

The SMA Solar Technology AG also offers an extensive range of products allowing you to communicate with the Sunny Island, for data acquisition and more. The following devices are available:

- Sunny Boy Control
- Sunny WebBox
- Sunny Sensor Box

You cannot use the Sunny Beam and Sunny Matrix communication devices. They do not work together with the Sunny Island.

The software used to make settings in and read/analyze data from your Sunny Island can be downloaded for free from the website of the SMA Solar Technology AG at www.SMA.de (see section 21 "Contact" (Page 201)).

19.4 SMA Products (Optional)

The Sunny Island works with almost all Sunny Boys of the SMA Solar Technology AG.

The following Sunny Boys do **not** work with the Sunny Island 2012/2224:

- Sunny Boy 2100 TL
- Sunny Boy 3300 TL
- Sunny Boy 4200 TL
- Sunny Boy 5000 TL

Layout of the Sunny Boy in the Island Grid System

When laying out your system, observe that total power of the suppliers (e.g., Sunny Boys) should not be greater than the power output of the Sunny Island during one minute (3800 W).

20 Technical Data

20.1 Sunny Island 2012/2224

EC Declaration of Conformity

You can download the CE Declaration of Conformity at www.SMA.de under "Certificates".

	SI 2012*	**SI 2224**
Output Values		
Nominal AC voltage ($U_{AC, nom}$) (adjustable)	230 V (202 to 253 V)	230 V (202 to 253 V)
Nominal frequency (f_{nom})	50 Hz (45 to 65 Hz)	50 Hz (45 to 65 Hz)
Continuous AC output (P_{nom}) at 25°C	2000 W	2200 W
Continuous AC output (P_{nom}) at 45°C	1400 W (-30 %)	1600 W (-27 %)
AC output for 30 min at 25°C	2900 W	2900 W
AC output for 5 min at 25°C	3800 W	3800 W
AC output for 1 min at 25°C	3800 W	3800 W
Nominal AC current ($I_{AC, nom}$)	8,7 A	9,6 A
Max. current (peak value) for 3 s	25 A_{eff} (3 s)	25 A_{eff} (3 s)
Harmonic distortion of output voltage (K_{VAC})	< 4 %	< 4 %
Power Factor cos φ	–1 to +1	–1 to +1
Input Values		
Input voltage ($V_{AC, ext}$) (adjustable)	230 V (172.5 to 250 V)	230 V (172.5 to 250 V)
Input frequency (f_{ext}) (adjustable)	50 Hz (40 to 70 Hz)	50 Hz (40 to 70 Hz)
Max. AC input current ($I_{AC, ext}$) (adjustable)	25 A	25 A
Max. input power (P_{AC}, ext)	5.75 kW	5.75 kW
Battery Data		
Battery voltage ($V_{Bat, nom}$) (adjustable)	12 V (10.2 V to 15.6 V)	24 V (16.8 to 31.5 V)
Max. battery charging current ($I_{Bat, max}$)	180 A	90 A
Continuous charging current ($I_{Bat, nom}$)	150 A	80A
Battery capacity	100 to 10,000 Ah	100 to 10,000 Ah

	SI 2012*	SI 2224
Charge control	IUoU procedure with automatic full and equalization charge	IUoU procedure with automatic full and equalization charge
Battery type	VRLA/FLA/NiCd	VRLA/FLA/NiCd
Efficiency/power consumption		
Max. efficiency	93.0 %	93.6 %
Operating consumption with no load (in standby)	6 W	6 W
Certification		
	CE	CE
Protection rating		
in accordance with DIN EN 60529	IP 54	IP 54
USA	not available	not available
Device protection		
short circuit	Yes	Yes
Overload	Yes	Yes
overtemperature	Yes	Yes
Interfaces		
Display:	3-color LEDs	3-color LEDs
Operating elements:	3 keys,	3 keys,
Electrically separated control contacts:	2 multi-function relays,	2 multi-function relays,
Communication: External display:	RS485/CAN galvanically isolated (opt.),	RS485/CAN galvanically isolated (opt.),
Data storage and firmware update via SRC-1:	Sunny Remote Control 1 (SRC-1)	Sunny Remote Control 1 (SRC-1)
	MMC/SD card	MMC/SD card
Digital input level (Dig-In)	high level starts at 6 V (up to 35 V), low level 0–2 V	high level starts at 6 V (up to 35 V), low level 0–2 V

	SI 2012*	**SI 2224**
Load limits for multi-function relays 1 and 2:		
connection to ohmic loads	AC1: 6.0 A at 250 V~	AC1: 6.0 A at 250 V~
connection to strongly inductive loads	AC15: 1.2 A at 250 V~	AC15: 1.2 A at 250 V~
Interruption time		
Maximal interruption time	50 ms	50 ms
Mechanical data		
Width x height x depth	(470 x 445 x 185) mm	(470 x 445 x 185) mm
Weight	approx. 18 kg	approx. 18 kg
Ambient conditions		
Ambient temperature	from –25 °C to +60 °C	from –25 °C to +60 °C
Miscellaneous		
Guaranty (EU)	5 years	5 years
Accessories		
External battery temperature sensor	included	included
Generator Manager (GenMan)	optional	optional
External DC fuse (BatFuse)	required (not included in delivery)	required (not included in delivery)
External DC charge controllers (SIC40)	optional	optional

* The technical data for the SI 2012 are preliminary

20.2 Sunny Remote Control 1

Interfaces	
DC supply voltage	12 V (from the Sunny Island via communication cable)
nominal current	200 mA
Data archiving and display	128 MB MMC/SD card
Communication	RS422
Communication cable	CAT5e-FTP patch cables (2 x RJ45 plugs)
Maximal cable length	20 m
Display and Operation	
Display	4 x 20 characters
Operation	Rotating push button (knob) Illuminated pushbutton
Mechanical data	
Width x height x depth	(225 x 140 x 65) mm
Weight	approx. 0.4 kg
Ambient conditions	
Ambient temperature	from 0 °C to + 50 °C
Protection rating	
in accordance with DIN EN 60529	IP 20
Certification	
	CE
Accessories Included in Delivery	
SD/MMC card	128 MB
Communication cable	CAT5e-FTP-patch cable, 5 m

21 Contact

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

- Inverter type (Sunny Island 2012/2224, see name plate)
- Type of voltage/frequency
- Serial number (see name plate or parameter "312.03 SN")
- Firmware version (see parameter "312.02 FwVer")
- Error message shown on the display
- Battery type
- Nominal battery capacity
- Nominal battery voltage
- Communication products used
- Type and size of additional energy sources (generator, PV system, Sunny Boy)
- If a generator exists:
  - Generator type
  - Generator capacity
  - Max. generator current
  - Generator interface

Recording of data and events.

Always use the MMC/SD card for saving data and events. This way, in case of a failure, the SMA Solar Technology AG can help you quickly.

To ensure that you have saved the present error list and event list on the MMC/SD card, write all data to the MMC/SD card with the parameter "550.03 CardFunc" and the option "ForceWrite".

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22 Glossary

Absorption Phase

Constant V phase: a charging phase using constant charging voltage. The charging current constantly decreases during this phase.

AC

Abbreviation for "Alternating Current".

AC Coupling

The connection of various loads, generators and storage devices on the AC side.

AGM Battery

Absorbent Glass Mat separator battery. This is a battery where the electrolyte (a mixture of water and sulfuric acid) is bound to a fiberglass mat. This is a type of so-called closed lead acid battery. A gas mixture (hydrogen and oxygen) is always generated when lead acid batteries are charged, and in normal operation this is internally recombined to form water. This removes the need for regularly refilling the battery cells with water, which is why these batteries are often described as “low maintenance” or even “maintenance free”. AGM batteries are available from many different manufacturers for a wide range of applications. They usually have very good high current properties but are not very charge-cycle resistant.

Ah

Abbreviation for “ampere hours”: unit of electrical charge; one ampere hour is the charge provided by a constant current of 1 A over a period of one hour - when two separate charges are connected.

Anti-Islanding

Anti-Islanding is a procedure for preventing unintended islanding on the generator and/or external grid connection point. It is required in order to ensure that, in case of a public grid dropout or generator failure, the Sunny Island reliably prevents possible reverse voltages in these power supply units.

Automatic Disconnection Device

The “automatic disconnection device between a grid-parallel, power-generating system and the public low voltage grid” (DIN VDE 0126-1-1) is an equivalent replacement for a normal public disconnection device with isolation function which is accessible to the distribution grid operator at any time. This is a mandatory safety device which prevents energy from a solar power system being fed into an external power grid when the external power generator is not functioning. In the Sunny Boy / Sunny Mini Central, this function is performed by the "SMA grid guard Version 2". In the case of the Sunny Backup 2200 and Sunny Backup 5000 it is integrated in the Automatic Switch Box.

Automatic Switch Box

Switching unit which switches the Sunny Backup System between grid and off-grid operation. In grid operation, a PV plant in the Sunny Backup System is operated via an automatic disconnection device at its own feed-in counter. If the grid drops out it is switched to the stand-alone grid separated from the public grid. The box can optionally integrate a diesel generator into the Sunny Backup System.

Backup system

So-called backup systems are power supply systems which provide an extra level of security for standard power supply systems. The public grid is usually the standard power supply system, which is backed up by an additional stand-alone grid system in case of a power outage. In addition to the backup systems, diesel generators in PV battery systems are also described as backup generators. Here they perform the same task as a backup system does for the public grid.

Battery

A battery is an electrochemical storage device which can release previously stored chemical energy as electrical energy. A distinction is made between non-rechargeable primary elements (often used in consumer markets, for example) and rechargeable secondary elements (accumulators). In so-called stand-alone grid systems, the batteries used as rechargeable secondary elements are almost exclusively lead acid batteries and, very rarely, nickel/cadmium batteries.

Battery Bank

See Battery System.

Battery Charging Mode

A battery inverter operating mode, in which the inverter takes energy from the AC grid to recharge the battery in a controlled fashion. In this operating mode, the battery inverter is primarily responsible for correctly charging the battery, and acts as an independent battery charger.

Battery Inverter

See Battery Power Converter.

Battery Management

The battery management is responsible for optimal battery charging and reliable protection against deep discharge. This is the only way of ensuring that the battery service life reflects the manufacturer's specifications.

Battery Power Converter

A bidirectional power converter which can regulate voltage and frequency in a stand-alone grid and is also responsible for correct battery charging.

Battery System

Series connection and possibly also parallel connection of several identical batteries. Battery banks of 12 V, 24 V, 48 V and 60 V are typical.

Boost Charge

Quick charge: allows the battery to be charged to a level of approx. 85 – 90 % as quickly and efficiently as possible.

Bulk Phase

I-Phase: the charging phase in which charging can be performed using the maximum charging current.

Capacity

Describes the storage capability of a cell or battery, specified in Ah (ampere hours). The capacity of a battery is heavily dependent on the charging cycle, the amount of current drawn and the temperature.

Central inverter

An inverter concept in which all PV modules are connected to each other (in series and/or parallel) and which uses a single inverter for feeding energy into the external grid. The lower cost of the inverter is usually offset by the much higher installation outlay required and possible yield losses due to variations in shadowing on individual solar modules.

Charge Level

Describes the present amount of charge which can be drawn from the battery, in percent of the nominal capacity (100 % = battery full, 0 % = battery empty).

Charge Mode

See Battery Charging Mode.

Charging Throughput

See Nominal Charging Throughput

Cluster

Several Sunny Island or Sunny Backup inverters which are connected in parallel on the DC side, and which are connected to a shared battery system. On the AC output side, these inverters can also be connected in parallel (single-phase system), or form a multi-phase system. The devices within a cluster must be connected via a communication cable and configured in a way that one device (–> master) leads the cluster and all other devices (–> slaves) communicate with the leading device.

C-Rate

The nominal capacity specification is always provided along with the discharge time on which the capacity is based. The nominal capacity is the product of the constant charging current I_N and the discharge time t_N, which passes between commencement of discharging the fully charged battery and when the final discharge voltage V_S is reached. For permanently on-site batteries, the C_{10} capacity is usually specified. I. e. a battery with C_{10} = 200 Ah can be discharged for 10 hours at a nominal current of 0.1 × C_{10} = I_{10} = 20 A.

DC

Abbreviation for "Direct Current".

Derating

A controlled reduction in performance, usually dependent on component temperatures. Compared with the (also common) practice of completely shutting down the device, the effect on the external grid is smaller with derating.

DSP

Abbreviation for Digital Signal Processor. A DSP is a microprocessor chip especially developed for digital signal processing and control.

Electrolyte

Allows the conduction of ions within a battery.

In a lead acid battery, the electrolyte is diluted sulfuric acid and is also a reactant in the electrochemical reaction.

Nickel/cadmium batteries use an alkaline electrolyte (potassium hydroxide).

EPROM

See Flash EEPROM.

Equalize Charge

Equalization charge: allows different series-connected battery cells to be charged to a unified charge level of 95 – 100 %. Without regular equalization charging, the charge states of the individual cells slowly drift apart, which can lead to premature battery bank failure.

Equalization Charge

See Equalize Charge.

Extension Cluster

see sub-cluster

Firmware

Firmware is software which is embedded in a chip in various electronic devices, such as hard disk recorders, DVD burners and players, newer television sets, household appliances and computers - in contrast to software, which is stored on hard drives, CD-ROMs or other media. These days, firmware is usually stored in a flash memory or an EEPROM.

FLA

Flooded lead acid battery: a lead acid battery with liquid electrolyte, also often described as a closed lead acid battery.

Flash EEPROM

The abbreviation EEPROM stands for Electrically Erasable Programmable Read-Only Memory. Flash memories are digital storage devices (chips). The exact designation is "flash EEPROM". In contrast to "normal" EEPROM memories, in flash EEPROM it is not possible to delete individual bytes (the smallest addressable memory units).

EEPROM is a non-volatile, electronic memory component used (for example) in computer technology, and mainly in embedded systems.

Flash EEPROMs are used where information must be permanently stored in the smallest amount of space, e.g. for storing the firmware.

Float Charge

Allows the battery to be slowly charged to a charge level of 100 % without the negative effects of overcharging. Complete charging to 100% using float charge takes several days. For this reason, float charging is more important for grid backup systems and less important for stand-alone grids.

Full Charge

Full charge: recharging of the battery to a level of approx. 95 % on a regular basis (at least once a month). This efficiently avoids premature battery aging caused by inadequate charging.

Full charge xxx

See Full Charge

Gel Battery

A type of battery in which the electrolyte (a mixture of water and sulfuric acid) is bound into a gel. This is a type of so-called closed lead acid battery. A gas mixture (hydrogen and oxygen) is always generated when lead acid batteries are charged, and in normal operation this is internally recombined to form water. This removes the need for regularly refilling the battery cells with water, which is why these batteries are often described as “low maintenance” or even “maintenance free” (see also AGM battery). Gel batteries are available from many different manufacturers for a wide range of applications. There are gel batteries for high-current applications but also for cycle operation with very high cycle resistance.

Generator

An electrical generator is an electrical machine which converts kinetic or mechanical energy into electrical energy. Here, not only the electrical generator itself, but also the combustion unit (diesel, petrol, or gas motor) necessary for the power unit is combined together with the electrical generator and simplified under the term "generator". This is also described colloquially as a power generator.

Grid-connected system

PV system which is connected to the power supply grid of an external energy supplier.

Inverter

A device for converting the direct current (DC) from the PV generator into alternating current (AC), which is necessary for connection of most normal household devices and especially for feeding solar energy into an existing supply grid. Inverters for PV systems usually include at least one MPP tracker, store operating data, and monitor the grid connection of the PV system (see also MSD).

Invert Mode

See Inverter Operation.

Inverter operation

Operating mode of a battery inverter where it supplies the stand-alone grid from the battery energy. In this operating mode, the battery inverter is especially responsible for the control of frequency and voltage in the stand-alone grid.

Islanding

Islanding is the undesired formation of an island system on the generator and/or external grid connection point. There is a danger that, if there is a public grid outage or generator failure, the Sunny Island may deliver reverse voltages in these power supply units.

Main Cluster

The leading cluster in a multicluster system. The main cluster, for example, has the tasks of voltage and frequency regulation, grid monitoring, generator control, load management, and control of the Automatic Switch Box in a backup system.

Maintenance Charge

see Float Charge

Master

Configuration setting that defines a Sunny Island or backup inverter to be the master within a cluster. This stipulates that centralized control and monitoring tasks, which in a cluster must be performed by just one device (e.g.,frequency regulation, battery management, generator control, and control of the Automatic Switch Box in the Sunny Backup system) are to be performed by this device. All other inverters of the cluster must be configured so as to leave these tasks to the master, and to be led by the master (–> Slave). The master is also the device at which the cluster's configuration, operation, and data recording occurs in a centralized manner.

Maximum Power Point "MPP"

The working point (current/voltage characteristic curve) of a PV generator where the maximum power can be drawn. The actual MMP changes constantly depending on, for example, the level of solar irradiation and the ambient temperature.

MPP tracker

Regulation of the power drawn so that a PV generator is operated for as long as possible at the MPP. This operating point varies with the solar irradiation and temperature conditions of the modules. MPP tracking optimizes the extraction of electrical power and is a feature of inverters and charge controllers.

MSD

See Automatic Disconnection Device.

Multicluster System

Parallel connection of several clusters on the AC output side in a stand-alone grid or backup system. The master devices of the individual clusters must be connected by communication cables, and configured in such a manner that one cluster leads the entire system (see main cluster) and the master devices of all other clusters (see sub-cluster) communicate with the master of the main cluster.

Multi-string inverter

An inverter which to a great extent combines the advantages of several string inverters (separate MPP tracking of individual strings) and a central inverter (low performance-specific costs).

NiCd

Nickel/cadmium battery, contains nickel, cadmium, and potassium hydroxide as the electrolyte. These require a significantly higher charging voltage, have a lower level of efficiency and are significantly more expensive than lead acid batteries. However, their robustness, cycle resistance and low-temperature capabilities mean that they are used in certain special applications.

NLM

Abbreviation for "Netzleitungsmodem" (Powerline modem): communication between SMA inverters and monitoring devices is possible via a cable, a radio link, or a Powerline modem. Powerline modems use a carrier frequency of approx. 132 kHz modulated onto the AC cables, and data is transferred using FSK (Frequency Shift Keying) of this carrier signal. Details on the Powerline modem can be found in the technical description of the SMA-NLM among other places.

Nominal Charge Throughput

The charging throughput is the cumulative total discharge current over time, measured in ampere hours (Ah). These meters are not automatically reset after charging. The nominal charging throughput is the charging throughput with regard to the nominal capacity of the batteries.

Overload Capability

The overload capability of an inverter describes its ability to supply short-term (seconds or minutes) excessive loads that can be significantly higher than the nominal capacity of battery inverters. The overload capability is important to allow startup of electrical machines which have a nominal power output close to the nominal power output of the stand-alone grid inverter, since these machines typically require six times the nominal current when starting.

Parallel connection

Parallel connection of batteries (all positive poles together and all negative poles together) increases the capacity of the battery bank while keeping the voltage constant. For example, two 24V/100Ah batteries connected in parallel still have a voltage of 24 V, but have a capacity of 100 Ah + 100 Ah = 200 Ah.

Photovoltaics

See "PV"

Piggy-Back (Board)

A printed circuit board which is plugged into another board to increase performance or expand capabilities. A piggy-back board can also replace an individual chip. In this case, the chip is removed and the board is plugged into the empty socket.

PLC

Abbreviation for "power line communication": describes the process of data transfer over the grid connection. The PLC power module is used to amplify the signal and is connected in Multi-String and Sunny Mini Central inverters.

PV

Photovoltaics (PV) is the conversion of solar irradiation into electrical energy using special semiconductors, so-called solar cells.

PV-generator

Technical device for the conversion of light energy into electrical energy. This term encompasses all the electrically connected (in series and in parallel) solar modules in a PV system.

PV-module

See "Solar module".

PV system

Describes a solar power system for generating electrical power. This includes the complete collection of components required for the acquisition and utilization of solar energy. As well as the PV generator, this also includes the Sunny Boy or Sunny Mini Central inverter, for example, in the case of grid-connected systems.

Rapid Charge

see Boost Charge

Self Discharge

Capacity loss of a battery cell while it is stored or not used. A higher ambient temperature has a strong influence on self discharge.

Series Connection

In this case the positive pole of each battery is connected to the negative pole of the next battery. There is only one circuit where current can flow. Series connection increases the voltage of the entire battery bank. If two 24 V batteries with a capacity of 100 Ah each are connected in series, the total voltage is 24 V + 24 V = 48 V, while the total capacity remains at 100 Ah.

Slave

A configuration setting which assigns a subordinate role in a cluster to a Sunny Island or Sunny Backup inverter. Thus, this device is relieved of control tasks and monitoring tasks, which must (or may) only be performed by one device in a cluster (–> master). Slave devices accept the configuration settings, present firmware, and start/stop commands from the master, and report these events, as well as warnings and error messages.

SOC

State of Charge: the charge level of the battery, see Charge Level. If, for example, 25 Ah is taken from a 100-Ah battery, the charge level (SOC) is then 75 %.

SOH

State of health: describes the relationship between the present capacity and the battery's nominal value, given as a percentage.

Solar cell

An electronic component which generates electrical energy when irradiated with sunlight. Since the voltage produced by a single solar cell is very small (approx. 0.5 V), several solar cells are combined to form a solar module. The most common semiconductor material presently used for solar cells is silicon, which is manufactured in different forms (monocrystalline, polycrystalline, amorphous). In addition to vastly different mechanical variations, which are usually designed to increase the level of efficiency, completely new materials are currently being tested (cadmium telluride, cadmium indium sulphide, titanium dioxide and many others).

Solar energy

"Sun energy", this means energy from sunlight or other solar irradiation (heat and/or UV radiation).

Solar module

Electrical connection of several solar cells encapsulated in a housing to protect the sensitive cells from mechanical stress and environmental influences.

Stand-alone grid system

An energy generation system which is completely independent of any external power sources.

String

Describes a group of solar modules electrically connected in series. A PV system usually consists of a number of strings, which avoids excessive yield losses caused by variations in shadowing on different modules.

String inverter

An inverter concept which avoids the disadvantages of the central inverter concept. The PV generator is split into individual strings, each of which is connected to the external grid by means of its own string inverter. This greatly simplifies installation and reduces the yield losses which can be caused by manufacturing deviations or variations in shadowing on the solar modules.

Sub-Cluster (Extension Cluster)

Cluster in a multicluster system which is subordinate to the main cluster and is therefore not responsible for the management of the entire system.

VRLA

Valve regulated lead acid battery: lead acid battery with semi-solid electrolyte or closed lead acid battery. Examples of this type of battery are gel batteries and AGM batteries (Absorbent Glass Mat).

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