



Sunny Island 3324/4248 User Manual



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1 Notes on this Manual

This installation manual is intended solely for qualified electricians. Its aim is to help install and set up a Sunny Island 3324/4248 quickly and correctly.

For further operating information, please consult the Sunny Island 3324/4248 user manual.

1.1 Validity

This installation manual for the Sunny Island 3324/4248 is valid for all firmware versions up to and including 1.84/1.94.

You can call up the firmware version of your inverter by entering the "31-2 FWVers" parameter in the Sunny Island 3324/4248 display (see section 10.4 "System and Fault Messages" (page 53)).

This product may only be used in the intended area of application, i.e. it is only approved for use in 50 Hz grids.

Do not use the Sunny Island 3324/4248 for purposes other than those indicated in this installation manual. Use of the inverter for inappropriate purposes voids the warranty.

For further questions, you can call the Sunny Island hotline at +49 561 95 22 399.

1.2 Symbols Used

To ensure optimum use of these instructions, please note the following explanations of symbols used.

The symbol "Warning" indicates a danger that, if ignored, can lead to serious injury or death and can also damage the inverter.



This symbol indicates a notice.

Failure to observe the advice can cause difficulties in the current working step and can possibly also hinder optimum operation of the inverter.



This symbol identifies an example.

Here you will find further details on the operation and behavior of the inverter.

2 The Sunny Island 3324/4248

2.1 General Description

The Sunny Island 3324/4248 is a bidirectional battery power converter (battery inverter and charger), ideally suited for use in stand-alone grid operation. This inverter allows you to charge lead acid batteries, using power sources provided on the AC side (e.g. generator, public grid, Sunny Boy). The Sunny Island 3324/4248 creates a 230 V AC stand-alone grid using the energy stored in the batteries, allowing stable operation of connected loads and power generation devices (e.g. PV inverters).

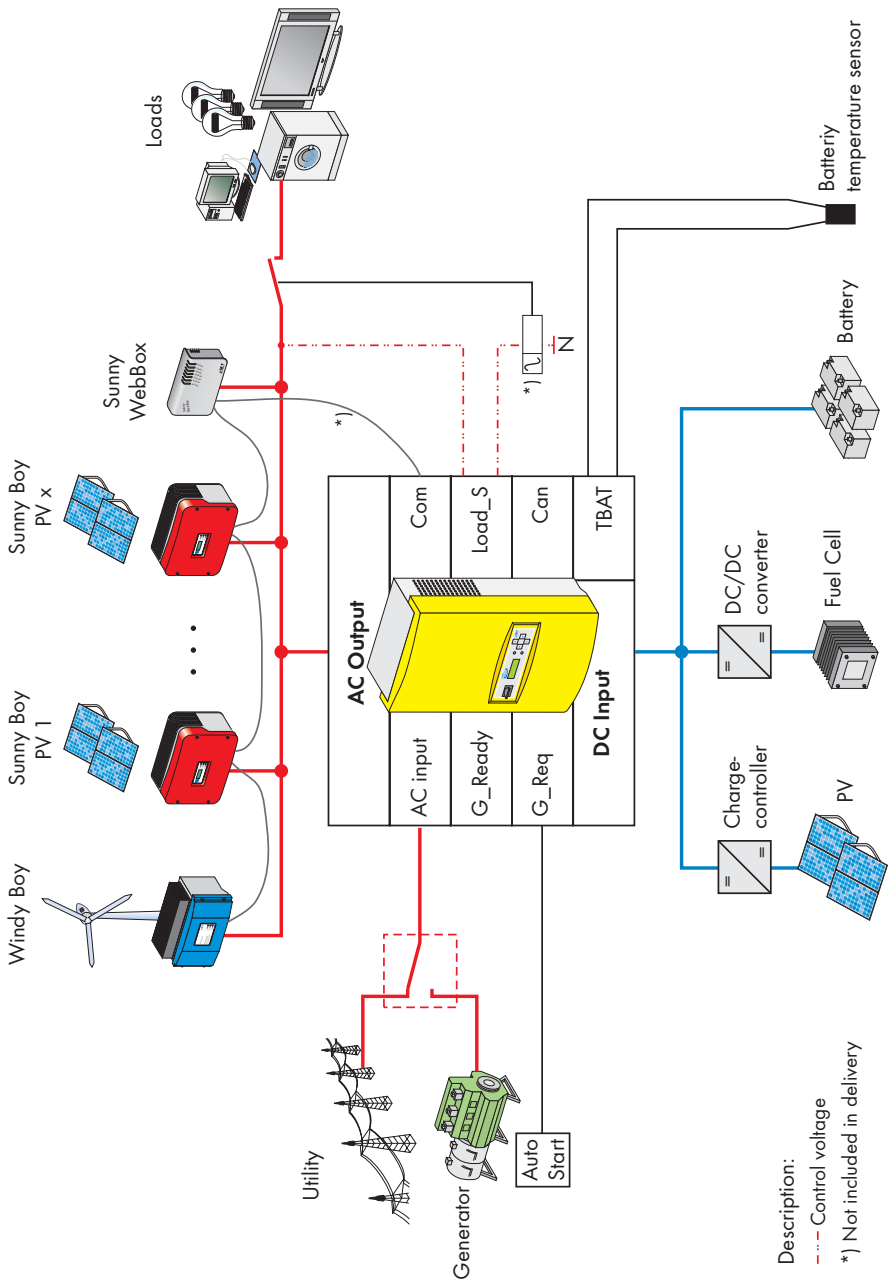
Energy sources can also be connected on the DC side, as long as the specified limits are not exceeded (see section 12 "Technical Data" (page 61)).

The Sunny Island 3324/4248 is able to control a starter contact for a generator and automatically connect or disconnect it to an AC-grid (see section 5 "Generator Settings" (page 29)).

The Sunny Island 3324/4248 can also switch off particular loads if the batteries do not have sufficient electrical energy available.

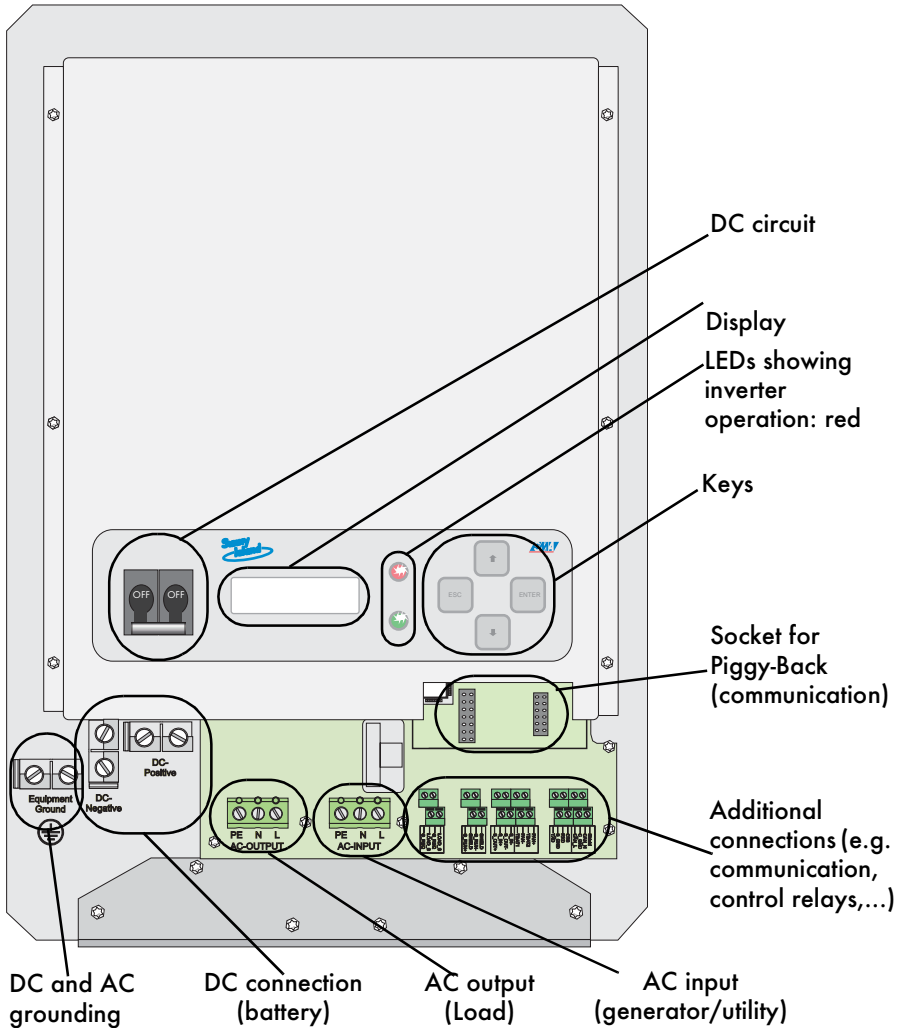
The Sunny Island 3324/4248 can be used in different system configurations. Detailed information on the different stand-alone systems can be found in the installation manual.

The following figure provides an overview of possible system configurations:



2.2 At a Glance

The following figure provides an overview of all control elements and connections of the Sunny Island 3324/4248 (shown with cover removed).



2.3 Accessories (optional)

The following accessories are not essential for operating a Sunny Island 3324/4248, however they extend the range of possible applications in a stand-alone grid:

- 1 GenMan (generator manager) (SMA order number: "SI-GenMan-TFH-230")
Allows the Sunny Island 3324/4248 to control generators requiring more than a simple start/stop (2-wire) signal for remote control.
- 1 separate load disconnecting switch for the batteries (SMA order number: "SI-BattCase.01-200" for SI4248; "SI-BattCase.01-250" for SI3324)
Allows rapid, safe isolation of the Sunny Island 3324/4248 from the connected batteries and also provides cable protection.
- 1 service cable for data transfer (SMA order number: "USBPBS-11"-USB-Service-Interface). You also require the free "Sunny Data" software (see below).
Allows connection of a PC/laptop for communicating with the Sunny Island 3324/4248 in order to set parameters and for data read-outs.

SMA Technologie AG also offers an extensive range of products allowing you to communicate with the Sunny Island 3324/4248, for data read-outs and much more. Among these devices are:

- Sunny Boy Control
- Sunny Boy Control Plus
- WebBox

The "Sunny Data" and "Sunny Data Control" software, which you can use to make settings in and read/analyze data from your inverter, can be downloaded for free from the **SMA** Technologie AG website at www.SMA.de (see section 14 "Contact" (page 65)).

2.4 SMA Products (Optional)

A stand-alone system using the Sunny Island 3324/4248 as the grid controller can also be fed with other alternative energy sources. **SMA** Technologie AG offers the following inverter products (see figure page 10):

- Sunny Boy inverters (for feeding in from PV systems): SB 700/SB 1100/SB 1100LV/SB 1700/SB 2500/SB 2800i/SB 3000/SB 3300/SB 3800/SMC 5000/SMC 6000/SMC 6000TL/SMC 7000TL/SMC 8000TL

- Windy Boy inverters (for feeding in from wind turbines or hydropower systems):
WB 1100/WB 1700/WB 2500/WB 2800i/WB 3000/WB 3300/WB 3800/
WB 6000
- Hydro-Boy inverters (for feeding in from fuel cell systems)

2.5 Type Plate/Firmware Version

You can identify the Sunny Island 3324/4248 from the type plate and the firmware version.

The type plate is located on the left side of the housing (when the Sunny Island 3324/4248 hangs vertically on the wall bracket).

You can call up the firmware version of your Sunny Island 3324/4248 under the "31-2 FWVers" parameter (see section 10.4 "System and Fault Messages" (page 53)).

3 Safety Instructions

3.1 Important Notes Regarding Operation

Please follow all operating and safety instructions in this manual. Failure to follow these instructions could result in damage to the inverter and cause personal injury. Carefully read through the safety instructions **before** installing and commissioning the inverter.

Ensure that the safety instructions and manual are stored in an easily accessible location.

Opening the inverter, and any

- **electrical installation**
- **repair, maintenance, or**
- **modification**



of the Sunny Island 3324/4248 may only be performed by a qualified electrician.

Only qualified personnel may alter the settings of the Sunny Island 3324/4248. The settings are protected by the installer password. All of the instructions in the installation manual must be observed.

Before commissioning the Sunny Island 3324/4248, read the instructions in the relevant sections of this operating manual regarding the Sunny Island 3324/4248 and the batteries.

When touching the inverter, please note that some parts of the Sunny Island 3324/4248 housing heat up during operation. These temperatures may exceed 60°C. There is a danger of burn injury.



This inverter was NOT developed to power life-sustaining medical devices. The Sunny Island 3324/4248 may not be used in systems where a power outage could result in personal injury.





Life-threatening voltages and currents occur within the Sunny Island 3324/4248. Protection against accidental contact is only guaranteed if the following points are followed according to the installation manual:

- the inverter is mounted correctly
- all connections to the inverter are made correctly
- the inverter is properly grounded
- the housing cover is subsequently securely closed

If you believe that any of these requirements are not fulfilled, contact your installer immediately, as ignoring any of these points may cause life-threatening personal injuries due to the voltages present (electric shock) or may cause damage to parts of the system.



Only qualified personnel may mount and install the battery and the Sunny Island 3324/4248. Handling batteries is dangerous, e.g. batteries can produce very high currents if they are short-circuited. All of the safety instructions and general instructions in the installation manual must be observed.

Use only rechargeable lead acid batteries. The use of other types of battery can lead to personal injury and material damage.

Open flame or smoking in the vicinity of the battery is NOT permitted under ANY CIRCUMSTANCES.

Take care to ensure that no metal parts fall onto the battery. This could short-circuit the battery or other electrical components, which could cause a fire or an explosion.

Ensure that the battery room is sufficiently ventilated.



The own consumption of the Sunny Island 3324/4248 discharges the batteries, in standby mode (inverter DC disconnect is on, inverter is in STOP mode and must be started manually) this load is about 4 W and in idle mode (inverter is on, in invert mode, no AC loads are present) it is about 22 W. You should take note of this when operating the Sunny Island 3324/4248 for longer times without recharge possibilities (e.g. in winter with snow on your modules).

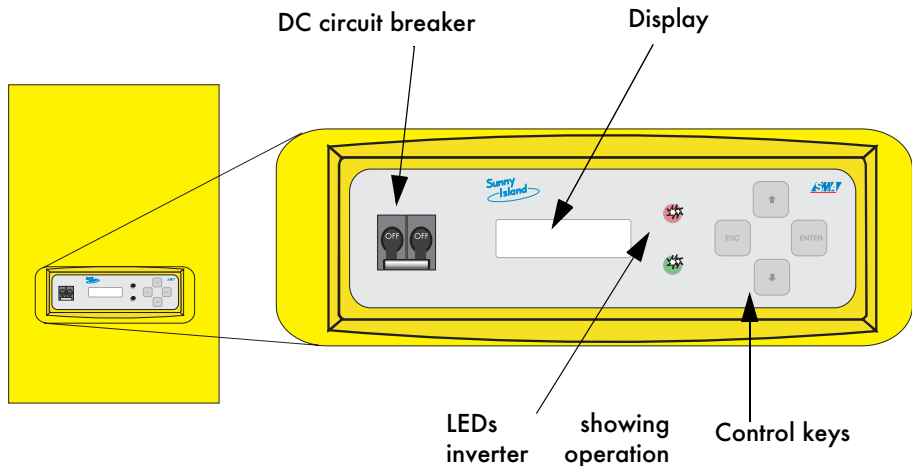
In these cases, you should set the Sunny Island 3324/4248 to Stop mode (see section 9.3 "Switching Off" (S. 83)) and disconnect it from the batteries via the DC circuit breaker.

4 Operation / Commissioning

Before the first commissioning of the Sunny Island 3324/4248, read this "Operation" section and become familiar with the inverter.

4.1 Control Elements

Functions, operating modes, parameters, data and fault messages are all displayed in the two-line display of the Sunny Island 3324/4248. Use the arrow keys (↑↓), the ESC key, and the ENTER key for navigation. The individual control elements can be seen in the figure below.



The following table shows the key functions:

Key	Function
ESC	cancel, NO response, leave current menu, stop the inverter (hold)
↑	navigate up one menu level, increase data value
↓	navigate down one menu level, decrease data value
ENTER	select a function, select a value, confirm changes, YES response

The DC circuit breaker switches the Sunny Island 3324/4248 on and off. Note that all voltage sources (batteries, (stand-alone) grid, generator) must be disconnected from the Sunny Island 3324/4248 before the inverter is free of voltage (see section 4.2 "Activation and Deactivation" (page 20)).

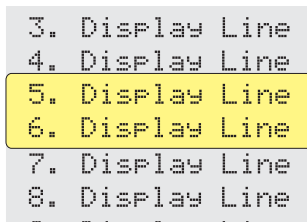
4.1.1 Explanation of the Light-emitting Diodes (LEDs)

A red LED and a green LED are located on the front side of the Sunny Island 3324/4248. The following table explains their meaning:

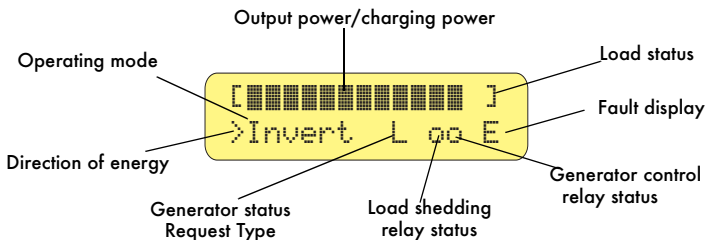
Green LED	Red LED	Operating mode
ON	ON	INIT (initialization phase)
–	–	Standby
ON	–	Operation
BLINKING	–	Derating (power reduction)
–	ON	Fault

4.1.2 Display

Information about the Sunny Island 3324/4248 is shown on the two-line LCD display. Two lines are always shown when navigating up and down the menus.



During normal operation, the Sunny Island 3324/4248 shows the relative output power, the operating mode of the inverter, the generator status (e.g. "L" see section 4.6 "Generator Request" (page 26)), fault messages and the status of the load shedding and generator control relay.



Explanation of the energy flow direction display:

">" = DC to AC (discharging mode)

"<" = AC to DC (charging mode)



Explanation of the load status display:

"J" = Normal

">" = Overload



4.1.3 Power Display

The output power and the battery charging power of the inverter are displayed by means of the number of boxes which appear in the upper row of the display. This is a relative indication of the inverter's output, i.e. if the boxes extend to the middle of the scale, this shows that the Sunny Island 3324/4248 is operating at half of its nominal output.

4.1.4 Relay Status

In the lower right-hand corner of the green display screen appear two "O"s.

Load shedding: the left "O" indicates the status of the load shedding relay of the Sunny Island 3324/4248. "O" stands for "Off" or "Open". If the relay closes, the "O" is filled.

Generator Start: the "O" on the right-hand side indicates the status of the generator control relay in the same manner. It is closed if the Sunny Island 3324/4248 intends to start the generator.

4.2 Activation and Deactivation

4.2.1 Activation and Startup



This step assumes that the Sunny Island 3324/4248 has been checked for

- **correct connections,**
- **voltages and**
- **polarities**

by your electrician, and that it has already been commissioned. If this is not the case, have this checked by a qualified electrician!

Proceed as follows:

1. Switch on the Sunny Island 3324/4248 by switching the DC circuit breaker to the "ON" position.
2. The Sunny Island 3324/4248 begins the initialization phase (INIT), during which it performs a number of self-tests to check that there are no faults in the system.

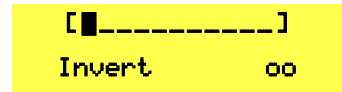
SMA SMA SMA SMA
3. You must wait for this to finish.
4. As soon as the initialization phase is finished, the message "To start press <ENTER>" is displayed.

To start
press <ENTER>
5. Now press <ENTER> and the Sunny Island 3324/4248 starts up.
6. A single beep is heard. The green LED on the control panel of the Sunny Island 3324/4248 illuminates.



If the inverter does not display the "To start press <ENTER>" message but displays an error message instead, this error must be corrected before the inverter can be put into operation. For this purpose, refer to section 11 "Troubleshooting/Problem Solving" (page 55). Once all corrective measures have been taken, switch off the Sunny Island 3324/4248, then wait for 30 seconds before starting again from point 1.

After a successful startup, a status overview appears in the display, showing the present operating mode and the output power (see also figure to the right):



Waiting

You can now call up the various menus using the control elements (see section 4.1 "Control Elements" (page 17)) in order to view the measurement values and the parameter settings.

4.2.2 Stopping

Proceed as follows to set the Sunny Island 3324/4248 to standby mode:

Note that all connected loads are no longer provided with electrical energy once you have stopped the Sunny Island 3324/4248.



1. Switch off all loads, as far as this is possible.
2. Press and hold the "ESC" key until the "To stop press ENTER" message appears.
3. Press "ENTER".
4. The Sunny Island 3324/4248 stops and enters standby mode.
5. The message "To start press <ENTER>" is displayed. The green LED on the control panel of the Sunny Island 3324/4248 goes out.

To stop
press <ENTER>

To start
press <ENTER>

Note that in standby mode there is still voltage present in the inverter (DC, AC input).



Even in standby mode, the Sunny Island 3324/4248 still requires about 4 W of power from the battery.



4.2.3 Deactivation

To switch off the Sunny Island 3324/4248, proceed as follows:

1. Set the Sunny Island 3324/4248 to standby mode (see section 4.2.2 "Stopping" (page 21)).
2. Switch the DC circuit breaker of the Sunny Island 3324/4248 to the "OFF" position.

If anything is still shown on the display several seconds after switching the DC circuit breaker, other voltage sources are active on the AC side.



Note that the Sunny Island 3324/4248 is securely deactivated only once it has also been disconnected from all voltage sources on the AC side. Otherwise, the inverter is NOT securely voltage-free. The housing is not to be opened under any circumstances. For repair work or maintenance, contact qualified electrician. Further instructions can be found in the installation manual of the Sunny Island 3324/4248.



To prevent possible errors, wait at least 30 seconds before switching the inverter on again..

4.2.4 Restarting the Automatic Shutdown

To restart the Sunny Island 3324/4248 after it has switched off due to batteries that are too deeply discharged, proceed as follows:



A complete shutdown indicates that one or more of the system components have failed or are not working properly. Check the components of the system for possible faults or incorrect parameter settings before attempting to restart the system.

- Switch off the DC circuit breaker.



You must wait at least five minutes to allow the capacitors to completely discharge before switching the DC circuit breaker on again.

- After waiting 5 minutes switch the DC circuit breaker on again. The Sunny Island 3324/4248 runs through the INIT phase.
- Once the INIT phase is finished, the message "To start press ENTER" is displayed. Press the "ENTER" key.

Once the inverter is switched on again, it is important that the batteries are charged. If an autostart generator exists in the system, the Sunny Island 3324/4248 will start the generator after a few minutes.



- Monitor the generator start and check that the Sunny Island 3324/4248 switches to "CHARGE" operating mode (battery charging mode).
- Check that all other energy generators in your system are also working correctly.

If the Sunny Island 3324/4248 immediately switches off with the fault "VBatLow" (low battery voltage) after restarting, switch off all loads connected to the AC output. The loads can be reconnected once the Sunny Island 3324/4248 enters the "CHARGE" operating mode. (Provided that a generator capable of providing the required power is connected to the system.)



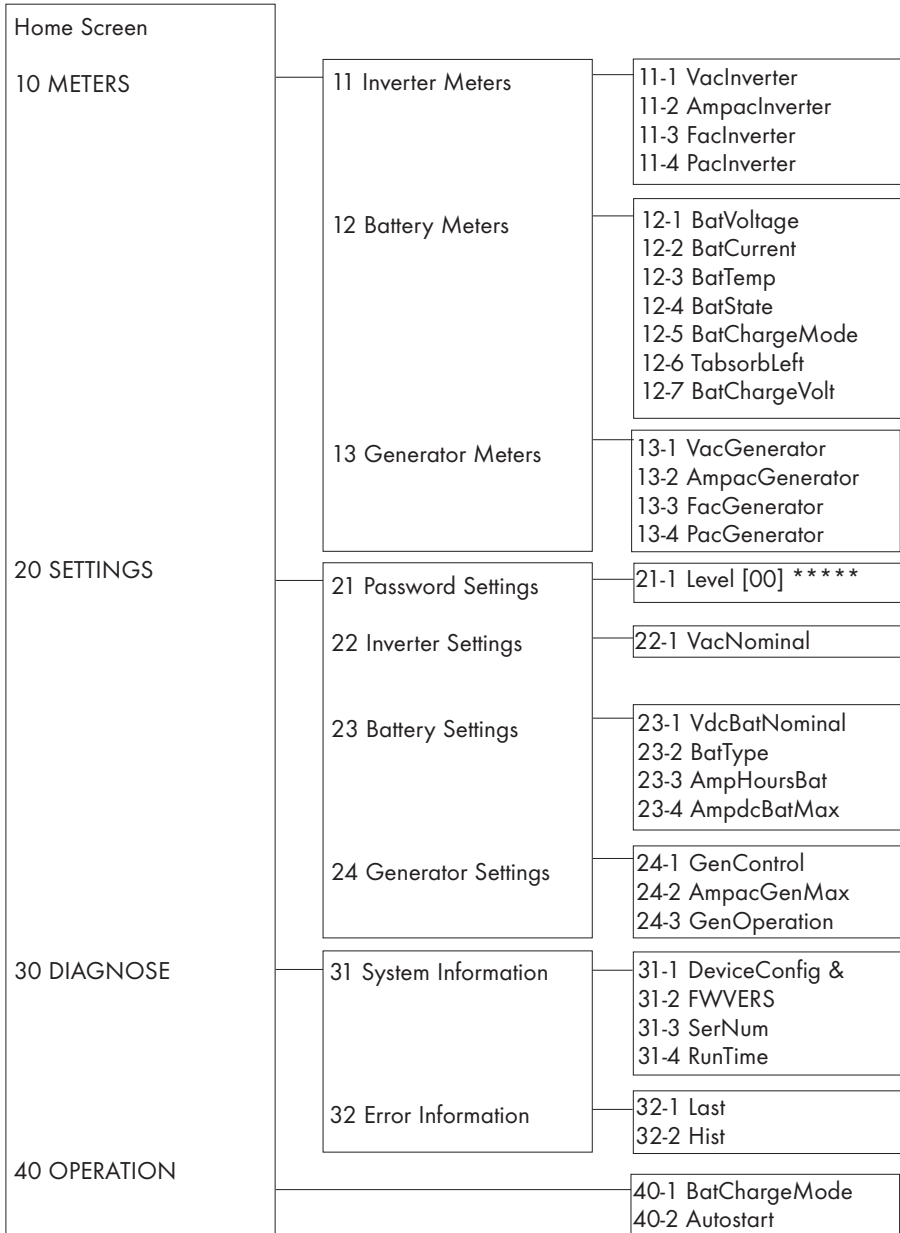
4.3 Menu Structure Overview

The main menu structure is divided into four different groups, each of which having two subsequent submenus.

1. **Meters:** The "10-Meters" main menu has the following submenus: Sunny Island 3324/4248 measurements ("11-Inverter Meters"), battery measurements ("12-Battery Meters") and generator measurements ("13-Generator Meters"). Individual measurement values can be seen in the next two menu levels.
2. **Settings:** Under the main menu "20-Settings" are four different submenus allowing various system parameters to be viewed and changed. This affects password entry ("21-Password Settings") and all system parameters relating to the Sunny Island 3324/4248 ("22-Inverter Settings"), the batteries ("23-Battery Settings") and the generator ("24-Generator Settings").
3. **Diagnose:** Under the main menu "30-Diagnose" are two different submenus allowing various diagnostic parameters to be viewed. These are system data ("31-System Information"), and fault messages ("32-Error Information").
4. **Operation:** The main menu "40-Operation" allows viewing and changing of the operating parameters (e.g. "40-8 SunnyBoys").

Please consult section 4.1.1 "Explanation of the Light-emitting Diodes (LEDs)" (page 18) for information describing how to set the individual parameters.

You will find a tabular list of all parameters in section 10 "Parameter Lists" (page 47).

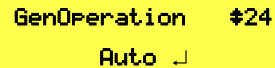


4.4 Viewing and Altering Parameters

Use the <ENTER> key to open a menu. Use the ↑ (upwards) or ↓ (downwards) keys to navigate through the selected menu (see the "Menu structure" diagramm in section 4.3 "Menu Structure Overview" (page 23)) in order to view or change parameter values. As soon as the desired parameter appears in the display, you can read the current parameter value.

The display always shows the first two digits of a parameter. The menu structure and the assignment of parameters are explained in section 4.3 "Menu Structure Overview" (page 23).

On-screen display of e.g. parameter "24-3 GenOperation":



```
GenOperation  #24
              Auto →
```

An "Enter" arrow is displayed next to parameters which you are able to alter ↓ .

Note that some parameters can only be changed when the inverter is in standby mode (see section 4.2.3 "Deactivation" (page 21)). You can find the parameters for which this applies in the tables in section 10.3 "Adjustable System Parameters" (page 51) and section 10.5 "Operation (Operation)" (page 54).

If you press the <ENTER> key, the "Enter" arrow begins to blink and you can then use the arrow keys (↑ or ↓) to change the current parameter value.

As soon as the desired value appears in the display, press the <ENTER> key to save the new value, or press the <ESC> key to discard the changes and exit the menu.

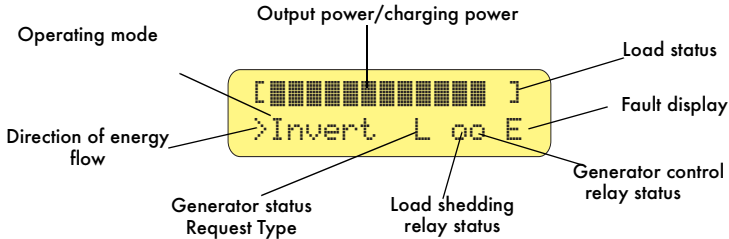
If you wish to exit the current menu level (e.g. "24-3 GenOperation" parameter) then press the <ESC> key. In this example, the cursor then jumps back to the "23-Battery Settings" menu level.

4.5 Operating Modes

The operating modes are shown on the left-hand side of the display. The operating modes are:

- **Invert:** Inverter operation (no generator or public grid present)
- **Charge:** Charging (batteries are being charged by the generator or the public grid)
- **DerInvert:** Inverter operation with reduced power due to voltage reduction
- **DerCharge:** Charging with reduced power due to current reduction
- **Silent:** Energy-saving mode

4.6 Generator Request



In the Sunny Island 3324/4248 display, it is possible to read whether and why the generator is working. Some of the generator menu parameters mentioned here can only be viewed or altered after entering the installer password.

More detailed descriptions regarding the generator can be found in section 5 "Generator Settings" (page 29) of this user manual, or in the installation guide of the Sunny Island 3324/4248.

The following table describes the status of the generator voltage and generator frequency, as they are shown in the display:

Display	Description
*	The generator voltage and frequency lie within the defined limits (see Generator Settings: parameters 24-4 to 24-8, installer level).
?	The generator voltage and/or frequency lie outside the defined limits (see Generator Settings: parameters 24-4 to 24-8, installer level). The Sunny Island 3324/4248 will not connect the generator to the stand-alone grid while this situation exists.
!	The maximum permissible generator reverse power ("24-11 PGenReverse" parameter, installer level) has been exceeded. The Sunny Island 3324/4248 has removed the generator from the stand-alone grid. The generator cannot be reconnected to the stand-alone grid for a period of 20 minutes. This lockout can be removed by setting the "24-3 GenOperation" parameter to "Release".

The following table provides information as to the reasons why the generator is being requested. One of the following six letters will appear in the display:

Display	Description
B(attery)	The generator has been requested as a result of the battery management system.
H(eat)	The generator has been started as a result of a temperature dependent request.
L(oad)	The generator has been started as a result of a load dependent request.
R(emote)	<p>The generator was started for one of the following reasons:</p> <ul style="list-style-type: none"> • The user directly started the generator. • The user switched the (optional) GenMan switch to "ON". • The GenMan automatically started the generator due to a too low starter battery voltage. • The Sunny Island 3324/4248 automatically switches to an external voltage source (displayed in backup systems, as long as the public grid is present). <p>In all three situations the Sunny Island 3324/4248 CANNOT start or stop the generator but may charge the batteries if required.</p>
S(tart)	The generator is requested by the user manually setting the generator request in the Sunny Island 3324/4248 from "Auto" to "Start". The generator is then NO LONGER controlled or switched off by the Sunny Island 3324/4248.
T(ime)	The generator was started for one hour using the "Run 1 h" setting in the Sunny Island 3324/4248. Once this time has passed, the Sunny Island 3324/4248 automatically switches off the generator.

The generator status and the reason for the request are shown (alternating) in the "Generator status" in the display.

If (e.g.) the display changes every 2 seconds from "*" to "B" then this means that the generator voltage and frequency lie within the specified limits and that the generator was requested by the battery management system.



If the generator has been manually set to "Stop" then no generator status information is shown in the display. The field remains empty.

4.7 Fault Detection

If the Sunny Island 3324/4248 detects a fault, it displays the corresponding error code in the display for ten seconds. The error is added to the list in the error menu, and an "E" (for error) is displayed in the lower right-hand corner of the green display screen. The "E" is displayed until the user has checked the error in the error menu. Once the error has been checked, the "E" disappears from the screen.

The list of errors comprises ten errors, and remains intact even if the Sunny Island 3324/4248 is deactivated. If more errors occur, the oldest error in the list is overwritten. The error which was added most recently is marked with an arrow.

5 Generator Settings

5.1 Generator Types

In stand-alone grid systems, (diesel) generators are often used. Choosing the right generator is heavily dependent on the system's operating conditions. There are two basic generator categories:

- those which can be started and stopped via electrical contacts - autostart generators
- those which can only be operated manually - "manual-start" generators

5.1.1 Autostart Generators

The basic function of an autostart generator is to start up and run without intervention from the system operator. To achieve this, the generator, in addition to executing the startup process independently, must also arrange warm-up times, cool-down times, minimum run times and minimum stop times.

This type of generator is recommended for use in conjunction with a Sunny Island 3324/4248. Please contact your installer or system manufacturer for recommendations regarding a specific generator.

5.1.2 Manual-Start Generators

Generators which are activated manually need to be started by the user by means of a button or other activation procedure. These generators are structured more simply, and generally cost less.

Both types of generators can produce electricity. Select your generator carefully. If in doubt, please contact appropriate qualified personnel.



5.2 Generator Parameters

If you wish to use a generator with the system, then you must set the generator type, the type of generator connection and the maximum output current delivered by the generator. To reach the generator menu, start in the main menu (Home Screen) and use the arrow keys to scroll to **Settings (20)**, then press **Enter** and scroll to the **Generator Settings (24)** menu. In this menu, you can change all parameter values relating to a connected generator.

You require the installer password in order to set parameters "24-4 to 24-16".



The following section describes the settings for the following particularly important commissioning parameters in detail:

- "24-1 GenControl" - Selection of the generator type
- "24-2 AmpacGenMax" - Max. generator output current
- "24-3 GenOperation" - Generator request

All adjustable parameters of the **Generator Settings** are listed in tabular form in section 10.3 "Adjustable System Parameters" (page 51).

5.2.1 Selection of Generator Control Method

Use "24-1 GenControl" parameter to select the type of generator to be used in your system. Three settings are possible:

1. "Manual" Setting (Factory Setting)

"Manual" should be selected when

- no generator is installed in the system or
- the connected generator can only be manually started (directly at the generator).

As soon as a voltage at the AC input terminals (generator connection) of the Sunny Island 3324/4248 is within the parameter limits (see parameter 24-2 and 24-4 to 24-7), the Sunny Island 3324/4248 connects to the generator.

The parameter settings are intended for generators that **cannot** be automatically started. Since in these cases the Sunny Island 3324/4248 GenRequest relay is not used for directly starting the generator, it can here provide a signal transmitter for the stand-alone grid user.



A signal light can be connected to the "GenRequest" contact that signals the stand-alone grid user to start the generator when this is required. The signal light is then switched off again via the "GenRequest" contact when the generator is no longer needed. Note that, with these settings, although the signal light has gone out the Sunny Island 3324/4248 will not automatically disconnect from the generator. You must stop the generator manually.

Possible reasons for a generator request are:

- A request by the battery management (low battery voltage)
- A request by the load-dependent generator management (to handle generator peak loads)
- A request by the temperature-dependent generator management (to protect the Sunny Island 3324/4248 against overload)

2. "Direct" Setting

If the system uses a generator that can be automatically started using a contact (two-wire autostart generator directly connected to the Sunny Island 3324/4248), set this parameter to the "Direct" setting. The closing of the GenRequest relay (see the installation manual for connection information) provides the start command to the generator from the Sunny Island 3324/4248. When the generator is no longer required, the start contact opens and the start command is revoked.

Possible reasons for a generator start command are:

- A request by the battery management (low battery voltage)
- A request by the load-dependent generator management (to handle generator peak loads)
- A request by the temperature-dependent generator management (to protect the Sunny Island 3324/4248 against overload)
- Manual start of the generator by the user via setting the "24-3 GenOperation" parameter to the value "Start" or "Run1h"

Note that in this configuration the Sunny Island 3324/4248 will only connect the generator when it requested the generator by closing the "GenRequest" contact.



If you wish to start the generator manually, activate the generator using the "24-3 GenOperation" parameter.

3. "GenMan" Setting

The "GenMan" setting must be used for all generators that require more than a single contact for starting. In addition to setting the parameter, the generator must also be integrated into the system using the (optional) GenMan device - SMA order number 'SI GenMan' . Information on installation and parameter settings can be found in the GenMan handbook.

The reasons for a generator request from the Sunny Island 3324/4248 are the same as those listed under "Direct" with these two exceptions:

- The Sunny Island 3324/4248 will only connect the generator when the "GenRun" signal from the GenMan unit is received indicating that the generator is ready.
- With this setting it is not absolutely necessary that the inverter itself has set the "GenRequest" relay before it connects the generator. In normal operation, the inverter will usually set the "GenRequest" relay to request the generator and then connect the generator once the "GenRun" signal has been received from the GenMan. The decisive signal for connecting the generator is however the "GenRun" signal. This allows the generator to be manually started at the GenMan.

5.2.2 Setting the Output Current Limit

The "24-2 AmpacGenMax" parameter helps to prevent the generator from overloading or stalling. The Sunny Island 3324/4248 will (e.g.) reduce the battery charging current in charging mode ("Charge" mode) so that the total generator load does not exceed the value defined in this parameter. In inverter mode ("Invert" mode) the Sunny Island 3324/4248 will only connect the generator when the load lies below the value defined here, even if the generator was requested.

To make the best use of the run time and service life of the generator, the value here should be set to about 85 % of the nominal generator current. Please refer to the generator manufacturer's recommendations.

5.2.3 Generator Request

The user can use the "24-3 GenOperation" parameter to start the generator directly. Only use the settings 1 – 4 when you have set the "24-1 GenControl" parameter (see section 5.2.3 "Generator Request" (page 32)) to "Direct" or "GenMan". Setting 5 ("Release") is also useful under the "Manual" setting.

Five different settings are possible for the "24-3 GenOperation" parameter. Take note of the messages in the display (see section 4.6 "Generator Request" (page 26)):

1. "Auto" Setting (Factory Setting)

In this configuration, the Sunny Island 3324/4248 will automatically control the generator and start and stop it as needed.

2. "Start" Setting

This setting causes an immediate generator request. The "Start" setting is indicated by an "S" in the display (see section 4.6 "Generator Request" (page 26)).



The Sunny Island 3324/4248 can not automatically stop the generator when you have started it using the "Start" setting.

Do not forget to stop the generator when you no longer need it. To do this, set the "24-3 GenOperation" parameter to "Stop" or "Auto".

3. "Stop" Setting

This setting immediately stops the generator, as long as the "24-1 GenControl" parameter is set to "Direct" or "GenMan".

The Sunny Island 3324/4248 can not start the generator and will not connect an externally started generator if you have switched it off using the "Stop" setting.



Remember to reset the "24-3 GenOperation" parameter back to "Auto" if the Sunny Island 3324/4248 should assume control of the generator.

Please also note that a generator stopped using the "Stop" setting can also be started by other components in the stand-alone system. For example, the GenMan independently starts the generator as soon as the generator starter battery voltage sinks below a particular value.

4. "Run1h" Setting

This parameter setting can be useful when the batteries should be relieved by the generator for a foreseeable period of time. As soon as the "24-3 GenOperation" parameter is set to "Run1h", the generator is requested for a period of one hour. The "Run1h" setting is indicated by a "T" in the display (see section 4.6 "Generator Request" (page 26)).

After one hour has passed, the Sunny Island 3324/4248 automatically sets the "24-3 GenOperation" parameter back to "Auto".

Exception:

If "Run1h" was selected from the "Stop" mode, after one hour the Sunny Island 3324/4248 returns to this mode (see also 3. "Stop" Setting).



5. "Release" Setting

The "Release" setting releases the 20 minute lockout time triggered when the reverse power limits are exceeded.

The "24-11 PGenReverse" parameter limits the power that may be fed back into the generator for up to five seconds.

If the reverse power exceeds this value then the generator/grid is disconnected and the Sunny Island 3324/4248 switches to stand-alone grid operation. The generator or grid cannot now be reconnected for a period of 20 minutes. Setting the "24-3 GenOperation" parameter to "Release" removes this lockout. After "Release" has

been activated, the "24-3 GenOperation" parameter is automatically reset to the "Auto" value and the Sunny Island 3324/4248 can again synchronize to the public grid or the generator.

6 Battery Management

The service life of batteries in off-grid applications can vary greatly. With proper handling the batteries can last as long as 15 years. The main causes of premature aging are incorrect charging and frequent deep discharge. For these reasons, the Sunny Island 3324/4248 has an intelligent charge control and reliable deep discharge protection. When these features are properly used, the battery service life can be greatly extended in comparison with simpler devices.

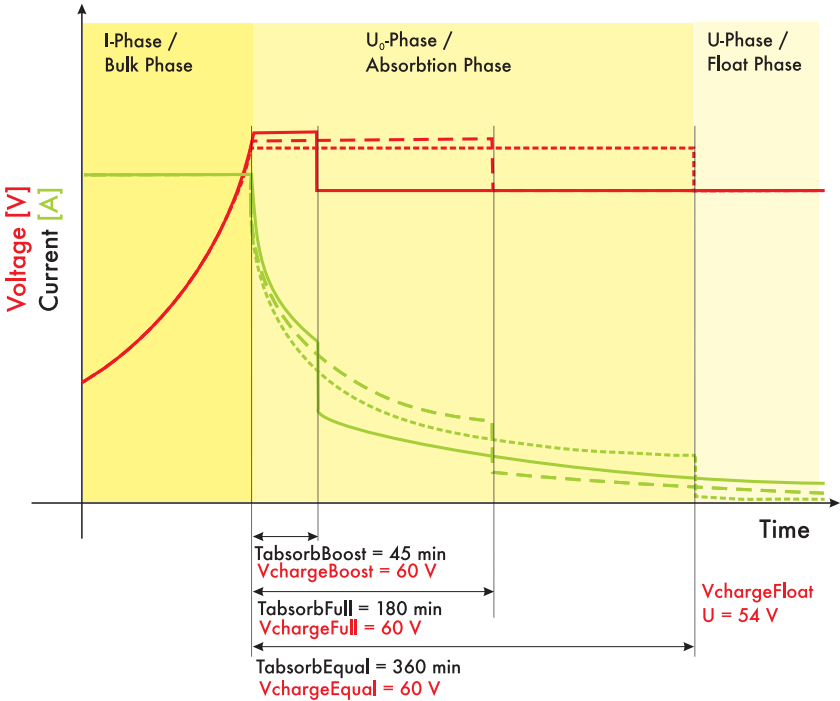
All types of lead acid batteries are supported. The battery management system draws a distinction between sealed lead acid batteries with liquid electrolyte (FLA, **Flooded Lead Acid**) and the sealed lead acid batteries with semi-solid electrolyte (VRLA, **Valve Regulated Lead Acid**). All Gel and Absorbed Glass Mat batteries belong to the last group (AGM, **Absorbent Glass MateSeparator**).

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

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

6.1 Charge Control

The Sunny Island 3324/4248 has a 3-level charge control using the IV₀V process.

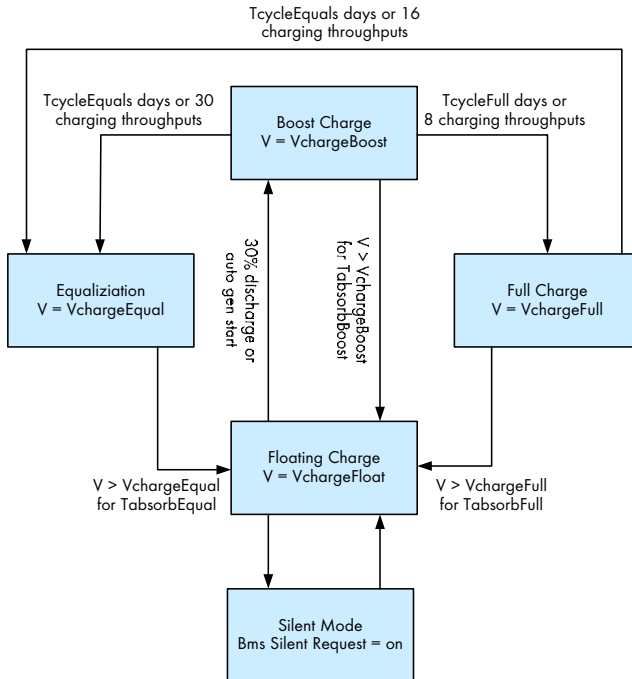


The I stands for the bulk phase. At this level, the charging is only limited by the defined maximum battery current ("23-4 AmpdcBatMax" parameter) or by the maximum generator current ("24-2 AmpacGenMax" parameter). During this phase the battery voltage increases as the batteries are charged.

Once the battery voltage has reached the value defined for the second phase V₀, then the constant voltage charging (absorption phase) begins. At this level, the battery voltage is maintained at a constant level, resulting in a continually decreasing battery current. The Sunny Island 3324/4248 remains in this phase for the period of time defined for this phase (parameters "12-6 TabsorbLeft").

Once this phase is finished, the Sunny Island 3324/4248 enters the float charge that again provides constant current charging but at a greatly reduced charging voltage. If charging is done from a generator, then this is stopped on entry to this phase, thus ending charging of the batteries at this point. The Sunny Island 3324/4248 remains in this phase until either more than 30 % of the nominal capacity has been used (all discharges are summed) or the generator is automatically restarted (see section 5.2 "Generator Parameters" (page 29)).

For the second charging level V_0 , the constant voltage charging (absorption phase) for a limited period of time, the Sunny Island 3324/4248 automatically chooses between three different voltages and charging times. These are the boost charge, full charge and equalizing charge. The following figure shows a process diagram of the charging process.



The Sunny Island 3324/4248 most often chooses the boost charge in order to bring the batteries to a reasonable level in a short period of time. This process is optimized to keep the generator run times as short as possible.

The Sunny Island 3324/4248 initiates a full charge every 14 days or after every eight charging throughputs, with the aim of fully recharging the batteries to remove any negative effects caused by insufficient charging. Various studies have shown that regular full charging every two to four weeks can double the battery service life in off-grid systems.

A battery bank consists of many series-connected individual battery cells (2 V each), each of which having a slightly different behavior. Over time, this results in different charge levels of the individual cells. This can lead to premature failure of first single cells and then failure of the entire bank.

For this reason, the Sunny Island 3324/4248 automatically performs regular equalization charging every 60 days or after every 30 charging throughputs. The equalization charging uses controlled overcharging of the battery bank to ensure that even the weak cells are fully charged. Equalization charging leads to a further significant increase of battery service life by a factor of up to 50 %.

The charging capability of lead acid batteries is heavily dependent on the battery temperature. For temperatures below 20°C the charging voltage must be slightly increased, and for temperatures above 20°C it must be slightly reduced. This is necessary to avoid overcharging and insufficient charging at all battery temperatures. For this reason, the Sunny Island 3324/4248 is equipped with automatic temperature compensation of the charging voltage. At temperatures below 20°C, the charging voltage is raised by 4 mV/°C and cell (96 mV/°C for a 48 V battery) and reduced by the same amount at temperatures above 20°C. The maximum permissible battery temperature is also monitored and the system switches off with a fault if the limit is exceeded ("23-18 T BatMax" parameter).

6.2 Silent Mode

When operating with the public grid, in addition to the float charge a silent mode exists. The main purpose of the silent mode is to save energy in backup systems, where the Sunny Island 3324/4248 spends most of the time in the float charge mode by switching from charging mode to silent mode.

Silent mode is automatically activated when the float charge charging power drawn from the grid and flowing into the batteries is less than 40 W. In this case, one can assume that the batteries are 100 % charged and that further charging is not required in the next few hours.

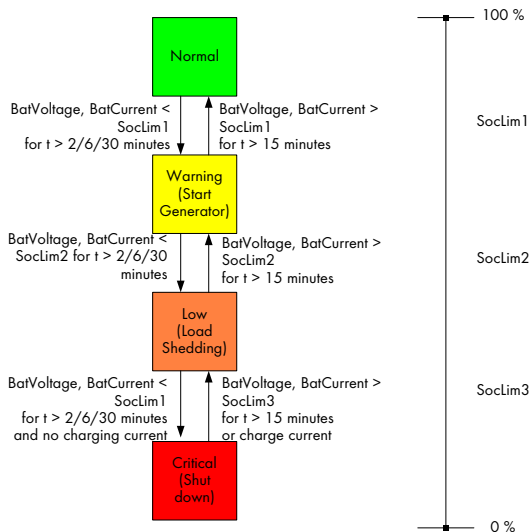
The float charging is automatically reactivated either after twelve hours or when the battery voltage sinks below 50.2 V. This ensures that the batteries are always fully charged, even in silent mode. If a power failure occurs during silent mode, the Sunny Island 3324/4248 switches to invert mode within a few milliseconds. The loads are supplied almost without interruption.

6.3 Deep Discharge Protection / Battery State

When deeply discharged, lead acid batteries age 100 times more quickly than when fully charged. Depending on the battery type, one speaks of deep discharge at charge levels of less than 40 %. Reliable protection from deep discharge is essential for a long battery service life. The Sunny Island 3324/4248 uses current-compensated voltage thresholds combined with time delays for deep discharge protection. The different levels, which can be easily set, are used to define the four state of the batteries (BatState):

- Normal operation (BatState = Normal)
- 1st level (BatState = Warning)
- 2nd level (BatState = Low)
- 3rd level (BatState = Critical)

The following figure shows the four battery states:



As long as the Sunny Island 3324/4248 has not detected a deep discharge then it is in the battery state (BatState) Normal.

As soon as the first level of deep discharge is reached, the Sunny Island 3324/4248 switches to the Warning state. This can be used to start a generator.

If the batteries are further discharged despite the warning, then the battery state now jumps to the next deep discharge level Low. If desired, this level can be used to trigger the Sunny Island 3324/4248 relay contact to switch off all or some of the loads.

If this is not done and the batteries are still further discharged then the battery state reaches the last level Critical.

If no charging current flows into the batteries within five minutes of entering this state, then the Sunny Island 3324/4248 automatically switches to standby mode to avoid any further deep discharge.

If the battery voltage does not recover within 30 minutes, then the Sunny Island 3324/4248 switches completely off. A complete switch-off can be recognized by the fact that the DC circuit breaker is switched on but the display remains dark and no voltage is present at the AC output terminals.

Once fully switched off, the Sunny Island 3324/4248 can only be manually restarted (see section 4.2.4 "Restarting the Automatic Shutdown" (page 22)).

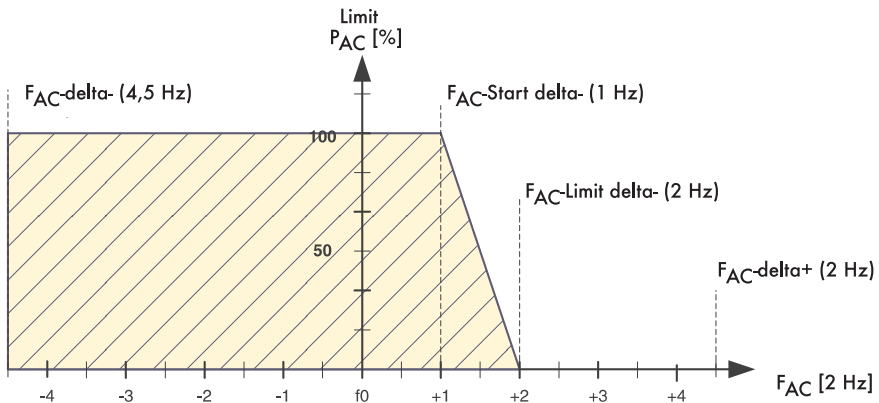
7 Frequency Shift Power Control (FSPC)

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

If Sunny Boy inverters are connected to the AC output side of a stand-alone grid, the Sunny Island 3324/4248 must be able to limit their output power. This situation can occur when (e.g.) the Sunny Island 3324/4248 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 3324/4248 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 frequency increase is 5 Hz maximum, starting at the nominal frequency f_0 .

When FSPC is activated and the generator is operating in the stand-alone grid, the generator determines the frequency and the Sunny Boys react to changes in the generator frequency. Generators normally operate at 50 Hz under load. For this reason, in most cases the Sunny Boys will deliver their entire power to the stand-alone grid, even when the generator is running.

8 Automatic Frequency Adjustment

Clocks that depend on the stability of the grid frequency for their accuracy, become increasingly inaccurate when subjected to constant frequency deviations. Frequency fluctuations, i.e. deviations from the nominal frequency (50 Hz) often occur in (e.g.) stand-alone grids that work with a generator.

The "**A**utomatic **F**requency **A**justment (AFRA)" function of the Sunny Island 3324/4248 allows the use of grid-coupled clocks in these types of stand-alone systems.

By counting all positive zero-crossing points (full waves) at the inverter output of the Sunny Island 3324/4248, in both battery charging operation and inverter operation, the inverter constantly measures the actual frequency. These values are compared with the desired frequency values every twelve hours. If a time difference of five seconds or more exists then a frequency increase or -decrease is activated. This frequency adjustment remains active if the time difference is more than one second.

9 Maintenance and Care

The Sunny Island 3324/4248 has been constructed for low maintenance. Thus, the necessary work is limited to only a few points:

9.1 Housing

Check that the Sunny Island 3324/4248 housing is mechanically sound. If damage (e.g. cracks, holes, missing covers) endangers the operating safety, the Sunny Island 3324/4248 must be deactivated immediately.

Larger particles of dirt should be removed from the inverter 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!

9.2 Cleaning the Fans

The cleaning intervals depend on the ambient conditions. We recommend inspecting the filters at least once a month.

If the fans are covered with loose dust, you can clean them with the aid of a vacuum cleaner (recommended) or a soft brush. Clean the fans only when at a standstill. If it is necessary to replace the fans, please contact your installer.

9.3 Display

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

Take care not to accidentally press the membrane keys during cleaning. Either clean the membrane keypad when the inverter is deactivated, or make sure that the password protection is active.



9.4 Functioning

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 a qualified electrician. To ensure optimal operation, the operator should regularly check the entries in the Sunny Island 3324/4248 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.

9.5 Battery



The battery must be checked and maintained regularly. In this regard, observe the battery manufacturer's specifications.

10 Parameter Lists

The following tables contain information regarding all menu items to which the Sunny Island 3324/4248 user has access.

There are other measurement values and parameters additional to those shown here, but which are to be set by qualified personnel. Only once the installer password has been entered, can these measurement values and parameters be viewed and altered. This is described in the Sunny Island 3324/4248 installation manual.

Please proceed carefully when changing parameter settings, because incorrect settings can lead to faulty operation of the inverter.

Take note of the previous value of each parameter **before** you change it!



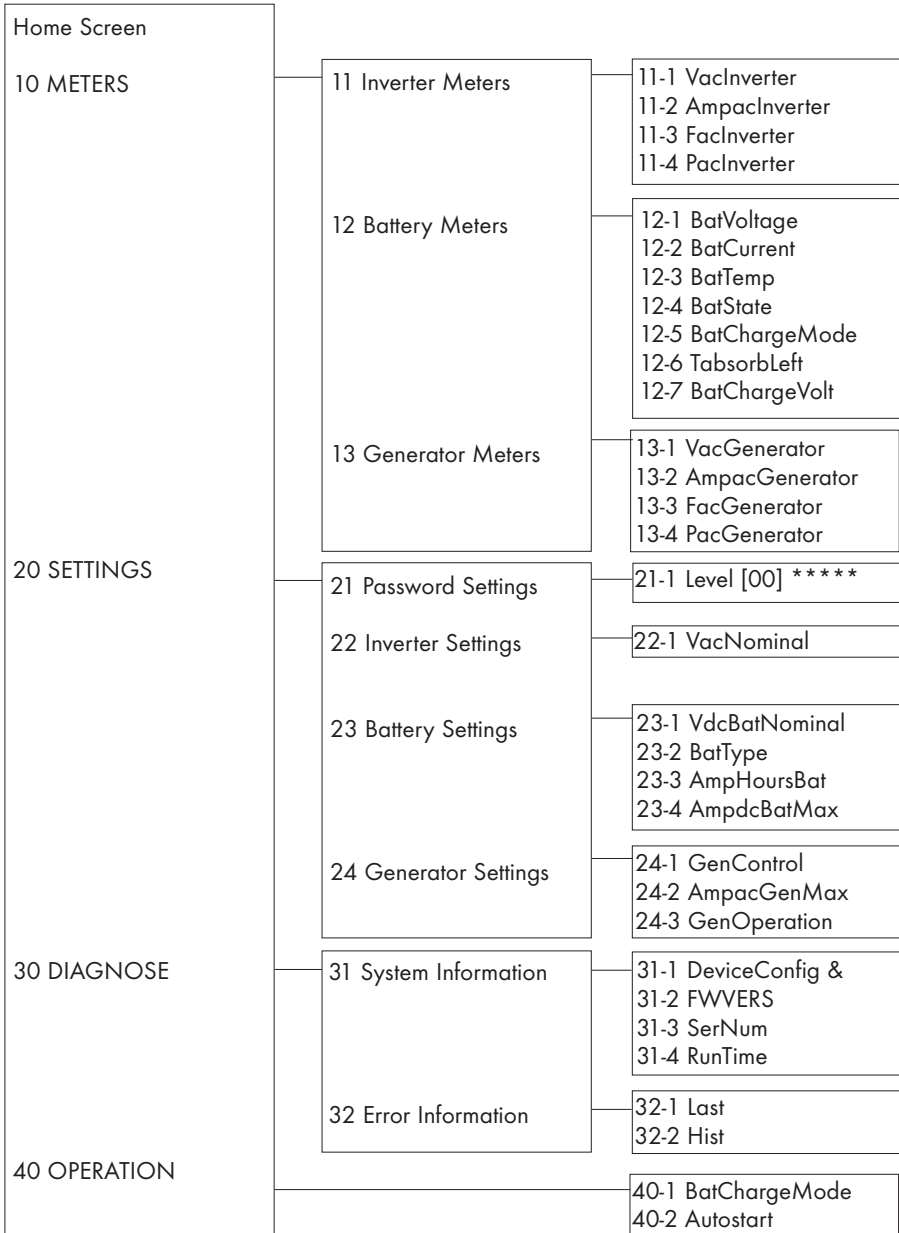
10.1 Menu Structure Overview

The main menu structure is divided into four different groups, each of which having two subsequent submenus.

1. **Meters:** The "10-Meters" main menu has the following submenus: Sunny Island 3324/4248 measurements ("11-Inverter Meters"), battery measurements ("12-Battery Meters") and generator measurements ("13-Generator Meters"). Individual measurement values can be seen in the next two menu levels.
2. **Settings:** Under the main menu "20-Settings" are four different submenus allowing various system parameters to be viewed and changed. This affects password entry ("21-Password Settings") and all system parameters relating to the Sunny Island 3324/4248 ("22-Inverter Settings"), the batteries ("23-Battery Settings") and the generator ("24-Generator Settings").
3. **Diagnose:** Under the main menu "30-Diagnose" are two different submenus allowing various diagnostic parameters to be viewed. These are system data ("31-System Information"), and fault messages ("32-Error Information").
4. **Operation:** The main menu "40-Operation" allows viewing and changing of the operating parameters (e.g. "40-8 SunnyBoys").

Please consult section 4.1.1 "Explanation of the Light-emitting Diodes (LEDs)" (page 18) for information describing how to set the individual parameters.

You will find a tabular list of all parameters in section 10 "Parameter Lists" (page 47).



10.2 Displayed Measurement Values

Inverter Meters

No.	Name	Range/unit	Default	Description
11-1	VacInverter	0 to 300 VAC	N/A	Inverter output voltage
11-2	AmpaInverter	-70 to +70 AAC	N/A	Inverter output current
11-3	FacInverter	0 to 70 Hz	N/A	Inverter frequency
11-4	PaInverter	-10,000 to +10,000 W	N/A	Inverter AC output power


Battery Meters

No.	Name	Range/unit	Default	Description
12-1	BatVoltage	0 to 80 VDC	N/A	Battery voltage
12-2	BatCurrent	-200 to +200 ADC	N/A	Battery current
12-3	BatTemp	-40 to +200 °C	N/A	Battery temperature
12-4	BatState	Normal Warning Low Critical	N/A	Battery state
12-5	BatChargeMode	Boost Full Float Equalize	N/A	Battery charging process
12-6	TabsorbLeft	0 to max min	N/A	An absorption period is assigned to every charging process. The Sunny Island 3324/4248 must keep the generator running during this time, even when this is only partially loaded. The value of "TabsorbLeft" shows the time remaining for the absorption phase.
12-7	BatChargeVolt	SI 4248 44 to 62.4 VDC		Desired value of the battery charging voltage
		SI 3324 27 to 31.2 VDC		

Generator Meters

No.	Name	Range/ unit	Default	Description
13-1	VacGenerator	0 to 260 VAC	N/A	Inverter input voltage (AC input)
13-2	AmpacGenerat	-60 to +60 AAC	N/A	Inverter input current (AC input)
13-3	FacGenerator	0 to 70 Hz	N/A	Inverter input frequency (AC input)
13-4	PacGenerator	-20 to +20 kWAC	N/A	Inverter input power (AC input)

10.3 Adjustable System Parameters

Only change parameters marked with **(Stby)**, when the Sunny Island 3324/4248 is in standby mode. Appropriately set operational data can take effect as soon as the "Enter" key is pressed. Incorrect values in these parameters can probably not be corrected quickly enough to avoid potential damage to your system. 

All parameters marked with a **(B)** can be set while the system is running.

All parameters can be set using a connected PC/laptop with the Sunny Data Control software, a Sunny WebBox or a Sunny Boy Control.

Inverter Settings

No.	Name	Range/unit	Default	Description
22-1	VacNominal (B)	200 to 253 VAC	230	Setting of the inverter nominal output voltage

Battery Settings

No.	Name	Range/unit	Default	Description
23-1	VdcBatNominal (see section 11.4)	SI4248 42 to 48 VDC	48	Nominal battery voltage
		SI3324 20 to 24 VDC	24	
23-2	BatType (see section 11.4)	VRLA FLA	VRLA	The type of battery used in the system. VRLA = Gel/Absorbed Glass Mat battery FLA = battery with liquid electrolyte These parameters must be set when first commissioning the system. After this, the value can only be changed after you have set the "23-5 New Battery" parameter to the value "Reset". The Sunny Island 3324/4248 will then again run through the INIT phase.
23-3	AmpHoursBat (see section 11.4)	100 to 6000 Ah	100	Battery capacity. These parameters must be set when first commissioning the system. After this, the value can only be changed after you have set the "23-5 New Battery" parameter to the value "Reset". The Sunny Island 3324/4248 will then again run through the INIT phase.
23-4	AmpdcBatMax (B)	SI4248 0 to 100 ADC	10	Maximum battery charging current
		SI3324 0 to 140 ADC	10	

Generator Settings

No.	Name	Range/ unit	Default	Description
24-1	GenControl (B)	Manual Direct GenMan	Manual	<p>The generator start option to be used in your system (see section 5.2.1 "Selection of Generator Control Method" (page 30)).</p> <p>Manual: Manual start or no generator connected</p> <p>Direct: Generator start using the Sunny Island 3324/4248 "GenRequest" control relay</p> <p>GenMan: Generator start using the (optional) GenMan</p>
24-2	AmpacGenMax (B)	2 to 56 AAC	10	<p>Max. generator current that the Sunny Island 3324/4248 will demand from the generator (see section 5.2.2 "Setting the Output Current Limit" (page 32)).</p> <p>Note: If the system load exceeds this value, the Sunny Island 3324/4248 will not switch to the generator, to avoid overloading it. Ensure that a sensible value is entered here!</p>
24-3	GenOperation (B)	Auto Start Stop Run1h Release	Auto	<p>Auto: Automatic start of the generator is activated.</p> <p>Start: The generator is immediately started (the display shows "S"). Remember to stop the generator again when you no longer require it (by selecting either "Stop" or "Auto").</p> <p>Stop: The generator is immediately stopped. Remember to set the generator back to "Auto" if you want the Sunny Island 3324/4248 to once more assume control.</p> <p>Run1h: The generator is immediately started and will run for one hour (the display shows "T"). After this, the Sunny Island 3324/4248 returns to the previously active mode.</p> <p>Release: Interrupts the lockout time (20 min) for the generator after a "ReversePower" fault has occurred.</p>

10.4 System and Fault Messages


System Messages

No.	Name	Range/ unit	Default	Description
31-1	DeviceConfig	N/A	N/A	Name of the inverter
31-2	FWVers	N/A	N/A	Version number of the firmware installed in the inverter
31-3	SerNum	N/A	N/A	Inverter's serial number
31-4	RunTime	Hours	N/A	Inverter's operational hours

Fault messages

No.	Name	Range/ unit	Default	Description
32-1	Last	N/A	N/A	The last fault that occurred in the system
32-2	Hist	N/A	N/A	The last ten faults that occurred in the system

10.5 Operation (Operation)

Only change parameters marked with **(Stby)**, when the Sunny Island 3324/4248 is in standby mode. Appropriately set operational data can take effect as soon as the "Enter" key is pressed. Incorrect values in these parameters can probably not be corrected quickly enough to avoid potential damage to your system. 

All parameters marked with a **(B)** can be set while the system is running.

All parameters can be set using a connected PC/laptop with the Sunny Data Control software, a Sunny WebBox or a Sunny Boy Control.

No.	Name	Range/ unit	Default	Description
40-1	BatChargeMode (B)	Auto Boost Full Equalize	Auto	Direct triggering of a battery charging process. Auto: The inverter automatically triggers the different battery charging processes. The selection of any other mode causes the inverter to start the selected charging process. Automatic operation is then resumed after this.
40-2	Autostart (B)	Off On	Off	Autostart allows the inverter to automatically restart (e.g. after a fault). If AutoStart is set to "Off", then the inverter must always be manually started.

11 Troubleshooting/Problem Solving

11.1 List of Fault Displays

The meaning of fault messages displayed by the Sunny Island 3324/4248 are explained in the following table:

Fault display	Cause	Fault correction
CBT-Open	The battery temperature sensor is missing or not correctly connected.	Please contact your installer.
	The battery temperature sensor cable is defective.	Please contact your installer.
CBT-Short	Short-circuit in the battery temperature sensor.	Please contact your installer.
	The battery temperature sensor cable is defective.	Please contact your installer.
ChargeLow	This fault occurs when the battery state remains in the critical area for an extended period of time ("Critical"), i.e. the batteries have not been charged in time (see section 6.3 "Deep Discharge Protection / Battery State" (page 39)). Possible causes:	The Sunny Island 3324/4248 can be started to charge the batteries after the fault has been confirmed. Requirements: The system has enough energy available for charging the batteries from a generator or the public grid.
	The generator does not start when requested by the Sunny Island 3324/4248.	Check the generator fuses. Check the fuel supply (diesel).
	Energy consumption is higher than that provided by the power generator (e.g. PV generator).	Switch off the energy consumers/loads.
CHS-Open	Device fault	Please contact your instller or the SMA hotline (see section 14 "Contact" (page 65)).
CHS-Short	Device fault	Please contact your instller or the SMA hotline (see section 14 "Contact" (page 65)).
CTR-Open	Device fault	Please contact your instller or the SMA hotline (see section 14 "Contact" (page 65)).
CTR-Short	Device fault	Please contact your instller or the SMA hotline (see section 14 "Contact" (page 65)).
FailSet	Device fault	Please contact your instller or the SMA hotline (see section 14 "Contact" (page 65)).
HotACout	The Sunny Island 3324/4248 will not start because voltage already exists on the AC output terminals.	Please contact your installer.

Fault display	Cause	Fault correction
HS-TempOV	Excessive heatsink temperature: The Sunny Island 3324/4248 has been operated under overload conditions for an extended period of time. The ambient temperature is very high while the Sunny Island 3324/4248 is being operated with a heavy load.	The Sunny Island 3324/4248 can only restart when the heatsink has cooled by a minimum of 5 °C. Place the Sunny Island 3324/4248 in standby mode for a few minutes to allow the fans to cool the inverter. Switch off some of the connected loads in the stand-alone grid to avoid immediately overloading the Sunny Island 3324/4248 after a restart. If the "40-2 Autostart" parameter is set to "On", the Sunny Island 3324/4248 automatically starts once the heatsink temperature has sunk by 5 °C.
INTERNAL01	Device fault	Please contact your installer or the SMA hotline (see section 14 "Contact" (page 65)).
INTERNAL02	Device fault	Please contact your installer or the SMA hotline (see section 14 "Contact" (page 65)).
INTERNAL03	Device fault	Please contact your installer or the SMA hotline (see section 14 "Contact" (page 65)).
INTERNAL04	Device fault	Please contact your installer or the SMA hotline (see section 14 "Contact" (page 65)).
INTERNAL05	Automatic confirmation. Restart	If this fault frequently occurs please contact the SMA hotline (see section 14 "Contact" (page 65)).
INTERNAL06	Device fault	Please contact your installer or the SMA hotline (see section 14 "Contact" (page 65)).
PRevOver	Generator or grid reverse power has exceeded the defined limits ("24-11 PGenRevers" parameter). A "!" appears in the display under 'Generator Run'.	Remove the 20 minute generator/grid lockout by setting the "24-3 GenOperation" parameter to "Release" or wait 20 minutes for the lockout to be automatically released (see also page 33 under 5. "Release" Setting).
RelayFail	Device fault	If this fault frequently occurs please contact your installer or the SMA hotline (see section 14 "Contact" (page 65)).

Fault display	Cause	Fault correction
TBatHigh	The battery temperature is too high. Cause:	The Sunny Island 3324/4248 can only restart when the batteries have cooled by a minimum of 2 °C. If the "40-2 Autostart" parameter is set to "On", the Sunny Island 3324/4248 automatically starts once the temperature has sunk sufficiently.
	poor battery ventilation	Check the room fan for correct operation.
	high ambient temperatures	Avoid high ambient temperatures in the battery environment. Provide adequate ventilation.
	excessive battery charging current	Reduce the value of the "23-4 AmpdcBatMax" parameter (see section 4.4 "Viewing and Altering Parameters" (page 25) and section 10.3 "Adjustable System Parameters" (page 51)).
TR-TempOV	Excessive transformer temperature: The Sunny Island 3324/4248 has been operated under overload conditions for an extended period of time. The ambient temperature is very high while the Sunny Island 3324/4248 is being operated with a heavy load.	The Sunny Island 3324/4248 can only restart when the transformer has cooled by a minimum of 5 °C. Place the Sunny Island 3324/4248 in standby mode for a few minutes to allow the fans to cool the inverter. Switch off some of the connected loads in the stand-alone grid to avoid immediately overloading the Sunny Island 3324/4248 after a restart. If the "40-2 Autostart" parameter is set to "On", the Sunny Island 3324/4248 automatically starts once the transformer temperature has sunk by 5 °C.
VAC-High	Output voltage too high	Check the value of the "22-1 VacNominal" parameter setting (see section 10.3 "Adjustable System Parameters" (page 51)).
VAC-Low	Output voltage too low	Check the value of the "22-1 VacNominal" parameter setting (see section 10.3 "Adjustable System Parameters" (page 51)). For an explanation, refer to point 7 of section 11.2 "Troubleshooting FAQs" (p 58).
	Short-circuit in the system	Check the system for a possible short-circuit.
VBatHigh	Battery voltage too high:	Check the battery connections.
	External charger with excessive charging voltage	Check the external charger.
	One or more defective batteries with high internal resistance	Check the batteries.

Fault display	Cause	Fault correction
VBatLow	Battery voltage too low: wrong parameter setting	Check the value of the "23-1 VdcBatNominal" parameter setting (see section 10.3 "Adjustable System Parameters" (page 51)).
	Deeply discharged batteries	Recharge the batteries as soon as possible.
	One or more defective batteries	Check the batteries.
Watchdog	Automatic reset	If this fault frequently occurs please contact your installer or the SMA hotline (see section 14 "Contact" (page 65)).

11.2 Troubleshooting FAQs

Here you will find answers to frequently asked questions (FAQs):

1. The Sunny Island 3324/4248 does not switch to the running generator, even though the generator control relay has closed (Gen_Request) (the "24-1 GenControl" parameter is set to "Direct", see page 30).
 - Check the generator fuses.
 - The stand-alone grid load current ("11-2 AmpacInverter" parameter) is greater than the maximum generator current ("24-2 AmpacGenMax" parameter). Reduce the stand-alone grid load until the stand-alone grid load current is smaller than the maximum generator current. The Sunny Island 3324/4248 can now switch to the generator.
 - The reverse power that can be fed back into the generator for up to five seconds has been exceeded. A "!" is shown in the display. The generator cannot be connected for a period of 20 minutes. Set the "24-3 GenOperation" parameter to "Release" (see page 33).

2. The Sunny Island 3324/4248 does not switch to the running generator, the generator control relay (Gen_Request) is open .
 - The generator was manually started, even though the "24-1 GenControl" parameter is set to "Direct" (see page 30) or "GenMan" (see page 31).
 - Set the "24-3 GenOperation" parameter to "Run1h" (see page 33). The Sunny Island 3324/4248 switches to the generator for a period of one hour. After one hour, the generator is automatically switched off by the Sunny Island 3324/4248 and the "24-3 GenOperation" parameter is set to the previous state.
 - You can also set the "24-3 GenOperation" parameter to "Start" (see page 32). The Sunny Island 3324/4248 will immediately switch to the generator. You must note that the Sunny Island 3324/4248 will no longer switch off the generator. Only when you manually reset the "24-3 GenOperation" parameter back to "Auto" can the Sunny Island 3324/4248 again assume control of the generator.

- The generator reverse power has been exceeded. A "!" is shown in the display. Set the "24-3 GenOperation" parameter to "Release" (see page 33), the Sunny Island 3324/4248 will switch to the generator.
3. The DC circuit breaker on the Sunny Island 3324/4248 is set to "On" but the display remains dark.
 - The inverter has switched off to protect the batteries from deep discharge (see also section 6.3 "Deep Discharge Protection / Battery State" (page 39)). To restart the Sunny Island 3324/4248, see section 4.2.4 "Restarting the Automatic Shutdown" (page 22).
4. The Sunny Island 3324/4248 only briefly switches to the generator and constantly changes from battery charging mode (Charge mode) to inverter mode (Invert mode).
 - The "24-2 AmpacGenMax" parameter (see section 5.2.2 "Setting the Output Current Limit" (page 32)) is too high. Set the "24-2 AmpacGenMax" parameter to a value that is 85 % of the nominal generator current.
 - The limits for the maximum permissible AC voltage or the minimum permissible frequency of the generator are too strict. Increase the limits for voltage and/or frequency according to the technical data of your generator.
5. The stand-alone grid frequency is not 50 Hz.
 - The Sunny Boy inverter is controlled via the frequency (see section 7 "Frequency Shift Power Control (FSPC)" (page 41)).
 - The "AFRA" function of the Sunny Island 3324/4248 is activated (see the Sunny Island 3324/4248 user manual, section "Automatic Frequency Adjustment").
6. The "VAC-Low" fault (output voltage too low) occurs when the Sunny Island 3324/4248 is started.
 - A short-circuit exists in the stand-alone grid. Check the AC output connections of the stand-alone grid.
 - The loads connected to the stand-alone grid are too heavy. The power/ electrical energy of the Sunny Island 3324/4248 is not sufficient to supply the loads. Switch of some of the loads and restart the Sunny Island 3324/4248.

12 Technical Data

	SI 3324	SI 4248
Output data:		
Nominal AC voltage ($V_{AC, nom}$) (adjustable)	230 V (202 to 253 V)	230 V (202 to 253 V)
Nominal frequency (f_{nom})	50 Hz	50 Hz
Continuous AC output (P_{nom}) at 25 °C	3300 W	4200 W
Continuous AC output (P_{nom}) at 45 °C	2300 W	3400 W
AC output for 30 min at 25 °C	4200 W	5400 W
AC output for 5 min at 25 °C	4400 W	6200 W
AC output for 1 min at 25 °C	5000 W	7000 W
Nominal AC current ($I_{AC, nom}$)	14.5 A	18 A
Max. current (peak value) for 100 ms	100 A (100 ms)	100 A (100 ms)
Harmonic distortion of output voltage (K_{VAC})	< 3 %	< 3 %
Phase shift factor $\cos\varphi$	-1 to +1	-1 to +1
Input data		
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 60 Hz)	50 Hz (40 to 60 Hz)
Max. AC input current ($I_{AC, ext}$) (adjustable)	56 A (2 to 56 A)	56 A (2 to 56 A)
Max. input power ($P_{AC, ext}$)	12.8 kW	12.8 kW
Battery data		
Battery voltage ($V_{Bat, nom}$) (adjustable)	24 V _{DC} (21 to 32 V _{DC})	48 V _{DC} (41 to 63 V _{DC})
Max. battery charging current ($I_{Bat, max}$)	140 A _{DC}	100 A _{DC}
Continuous charging current ($I_{Bat, nom}$)	104 A _{DC}	80 A _{DC}
Battery capacity	100 to 6000 Ah	100 to 6000 Ah
Charge control	IV ₀ V process with automatic full and equalization charge	IV ₀ V process with automatic full and equalization charge
Efficiency/power consumption		
Max. efficiency (typical)	94,5 %	95 %
Own consumption (no load/standby)	22 W (< 4 W)	22 W (< 4 W)
German standards		
	DIN EN 50178, DIN EN 61000-3-2 (when charging), DIN EN 61000-6-1, DIN EN 61000-6-2, DIN EN 61000-6-3, DIN EN 61000-6-4	DIN EN 50178, DIN EN 61000-3-2 (when charging), DIN EN 61000-6-1, DIN EN 61000-6-2, DIN EN 61000-6-3, DIN EN 61000-6-4

	SI 3324	SI 4248
Certification		
	CE	CE
Protection degree		
Per DIN EN 60529:	IP 30	IP 30
USA	NEMA1 (indoor)	NEMA1 (indoor)
inverter protection		
	Short-circuit, overload, overtemperature	Short-circuit, overload, overtemperature
Interfaces		
	2 LEDs 4 buttons two-line display 1 relay for load shedding 1 relay for controlling a diesel generator RS485/RS232 galvanically isolated (optional)	2 LEDs 4 buttons two-line display 1 relay for load shedding 1 relay for controlling a diesel generator RS485/RS232 galvanically isolated (optional)
Mechanical data		
Width x height x depth	(390 x 590 x 245) mm	(390 x 590 x 245) mm
Weight	39 kg (approx.)	39 kg (approx.)
Ambient conditions		
Ambient temperature	from -25°C to +50°C	from -25°C to +50°C
Miscellaneous		
Guarantee (EU)	2 years	2 years
Accessories		
Ext. battery temperature sensor	included	included
Generator management (GenMan)	optional	optional

13 CE Declaration of Conformity

CE Declaration of Conformity



for off-grid inverters

Product: Sunny Island
Type: SI 3324, SI 4248

We declare that the above specified device is compliant with the regulations of the European Community, in terms of the design and the version fabricated by SMA. This especially applies for the EMC Regulation defined in 89/336/EWG and the low voltage regulation defined in 73/23/EWG.

The device is compliant with the following standards:

DIN EN 50178 (04.98) (VDE 0160)
DIN EN 61000-3-2: 2001-12 (in charging operation)
DIN EN 61000-6-1: 2002-08
DIN EN 61000-6-2: 2002-08
DIN EN 61000-6-3: 2002-08
DIN EN 61000-6-4: 2002-08

The above mentioned device is therefore marked with a CE sign.

Note:

This declaration of conformity becomes invalid in case

- the product is modified, complemented or changed,
 - and/or components, other than those belonging to the SMA accessories, are installed in the product,
 - as well as in case of incorrect connection or improper usage
- without explicit written confirmation by SMA.

Niestetal, 13.03.2006

SMA Technologie AG

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SI3324/4248-14:BE1106

14 Contact

If you have any questions or queries, please contact us. A team of qualified engineers and technicians is at your disposal.

Help us to help you by having the following information ready when you call us:

- Type of inverter
- Serial number of the Sunny Island 3324/4248
- Firmware version
- Fault message shown in the display
- Battery size and battery type
- Type and size of additional energy sources (generators, PV systems, PV inverters)
- Communications products used



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21 Glossary

Absorption phase

Constant Voltage phase: A charging phase using constant charging voltage. The charging current constantly decreases in this phase.

AC

Abbreviation for "Alternating Current"

AC coupling

The AC side connection between loads, generators and storage devices.

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 glass fiber mat. This is a type of a sealed lead acid battery. A gas mixture (hydrogen and oxygen) is always generated when lead-acid batteries are charged and in normal operation this internally recombines 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.

Backup system

Backup systems are power supply systems that provide an extra level of security for standard power supply systems. The public grid is usually the standard power supply system and the backup system is provided by an additional stand-alone grid in the 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 for the public grid.

Battery

A battery is an electrochemical storage device that can release previously stored chemical energy as electrical energy. A distinction is made between non-rechargeable primary elements (often used in consumer markets) and rechargeable secondary elements (accumulators). In stand-alone grid systems, lead acid batteries are almost always used and, very rarely, Nickel/Cadmium batteries are used as secondary rechargeable elements.

Battery bank

See Battery system

Battery charge mode

An operating mode of a battery inverter in which the inverter takes energy from the AC grid to charge the batteries in a controlled fashion. In this mode of operation, the battery inverter is responsible for correctly charging the batteries and acts like an independent battery charger.

Battery inverter

See Battery power converter

Battery management

The battery management is responsible for the optimum charging of the battery bank and for 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 that can regulate voltage and frequency in a stand-alone grid as well as correctly charging the batteries.

Battery system

Serial 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

Rapid charging: Allows the batteries to be charged to a level of approx. 85 – 90 % in the shortest time and the most efficient manner.

Bulk phase

I-Phase: The charging phase in which charging can be done using the maximum allowable 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 mains supply grid. The low cost of the inverter is usually offset by the much higher installation efforts required and possible yield losses due to variations in shadowing of different solar modules.

Charge level

Describes the current amount of charge that can be drawn from the battery, in percent of the nominal capacity (100 % = battery full, 0 % = battery empty).

Charge mode

See Battery charging mode

C-rate

The nominal capacity specification is always provided 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 , that passes between commencement of discharging the fully charged battery until the final discharge voltage V_S is reached. In permanently on-site batteries, the C10 capacity is usually specified. i.e. a battery with $C_{10} = 200$ Ah can be discharged for 10 hours at a nominal current of $0.1 \times C_{10} = I_{10} = 20$ A.

DC

Abbreviation for "Direct Current"

Derating

A controlled reduction in performance, usually dependent on component temperatures. Derating is used instead of performing a complete shutdown of the system.

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 lead acid batteries, 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

Equalize charge: Allows multiple series-connected battery cells to be charged to a unified charge level of 95 - 100 %. Without regular equalization charging, the charge states of the various cells slowly drift apart, which can lead to premature battery bank failure.

Firmware

Firmware is software that is stored in a chip in various electronic devices, such as Sunny Island, hard disk recorders, DVD burners and players, newer television sets, household appliances and computers - in contrast to software that is stored on a hard drive, CD-ROM or other media. These days, firmware is usually stored in Flash memory or an EEPROM.

FLA

Flooded Lead Acid battery: A lead acid battery with liquid electrolyte, also often described as a sealed lead acid battery.

Flash EEPROM

The abbreviation EEPROM stands for Electrically Erasable Programmable Read-Only Memory. Flash memory is a digital storage chip, the exact designation is Flash EEPROM. In contrast to "normal" EEPROM storage, individual bytes (the smallest addressable storage units) cannot be deleted.

EEPROM is a non-volatile, electronic storage component that is used in the Sunny Island, the computer industry (among others) and usually 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

Maintenance charge: Allows the batteries 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

Recharging of the batteries to a level of approx. 95 % on a regular basis (at least once a month). This efficiently avoids premature aging of the batteries caused by inadequate charging.

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 sealed lead acid battery. A gas mixture (hydrogen and oxygen) is always generated when lead acid batteries are charged, and in normal operation this internally recombines 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 batteries). 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.

Grid-coupled system

PV system that is connected to the power supply grid of an external energy supplier.

Independent disconnection device

The "Independent 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 that is accessible to the distribution grid operator at any time. This is a mandatory safety

device that prevents power 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 assumed by the "SMA grid guard Version 2".

Inverters

A device for converting the direct current (DC) from the PV generator into alternating current (AC), which is used by most normal household devices and especially for feeding energy into an existing supply grid. Inverters for PV systems usually include one or more MPP trackers, store operating data and monitor the grid connections of the PV system (see also MSD).

Inverter 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.

Maximum Power Point "MPP"

The working point (current/voltage characteristic curve) of a PV generator where the maximum power can be drawn. The actual MPP changes constantly depending (e.g.) on the level of solar irradiation and the ambient temperature.

MPP tracker

Regulation of the power drawn so that a PV generator remains as close as possible to the MPP. This working point varies with the solar irradiation and the temperature conditions of the modules. MPP tracking optimizes the extraction of electrical power and is a feature of inverters and charge controllers.

MSD

See Independent disconnection device

Multi-string inverter

An inverter that combines the advantages of several string inverters (separate MPP tracking of individual strings) and a central inverter (lower performance specific costs).

NiCd

Nickel/Cadmium battery, contains Nickel, Cadmium, and potassium hydroxide as the electrolyte. They require a significantly higher charging voltage, have a lower level of efficiency and are significantly more expensive than lead acid batteries. Their robustness, cycle resistance and low-temperature capabilities allow them to be used in certain special applications.

Overload capability

The overload capability of an inverter describes the ability of the inverter to supply short-term (seconds or minutes) excessive loads, that can be significantly higher than the nominal capacity in battery inverters. The overload capability is important to allow electrical machines with a nominal power output close to the nominal power output of the stand-alone grid inverter to be started, since these machines typically require six times the nominal current when starting.

Parallel connection

Parallel connection of the batteries (all positive poles together and all negative poles together) increases the capacity of the battery bank while keeping the voltage constant. Example: Two 24 V/100 Ah batteries connected in parallel still have a voltage of 24 V, but have a capacity of 100 Ah + 100 Ah = 200 Ah.

Piggy-Back (Board)

A printed circuit board that is plugged into another board to increase performance or expand capabilities. A piggy-back board can also replace a single 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 supply cables. The PLC power module is used to amplify the signal and is connected in Multi-String and Sunny Mini Central inverters. Powerline communication is not suitable for Sunny Island inverters.

PV

Photovoltaics (PV) is the conversion of solar irradiation into electrical energy using special semiconductors called solar cells.

PV array

See PV generator.

PV generator

Technical device for the conversion of light energy into electrical energy. All the series and parallel mounted and electrically connected solar modules in a PV system are known as the PV generator.

PV module

See Solar module.

PV array

See PV generator.

PV system

Describes a solar power system for generating electrical power. Describes the complete collection of components needed for the acquisition and utilization of solar energy. As well as the PV generator, this includes the Sunny Boy or Sunny Mini Central, for example, in the case of grid-coupled systems.

Self discharge

Loss of battery charge 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 four 12 V batteries with a capacity of 100 Ah each are connected in series, the total voltage is $4 \times 12 \text{ V} = 48 \text{ V}$, while the total capacity remains at 100 Ah.

SOC

State of Charge: The charge level of the batteries, see Charge level. If (e.g) 25 Ah is taken from a 100-Ah battery, the charge level (SOC) is then 75 %.

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 effects.

Solar cell

An electronic component that generates electrical energy when irradiated with sunlight. Since the voltage produced by a 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 different mechanical variations, that 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.)

Stand-alone grid system

An energy generation system that is completely independent of any external power sources.

String

Describes a group of solar modules connected in series. A PV system usually consists of a number of strings, which avoids yield losses due to variations in shading over different modules.

String inverter

An inverter concept that avoids the disadvantages of the central inverter concept. The PV is split into individual strings, each of which is connected to the external mains supply with its own string inverter. This greatly simplifies installation and greatly reduces the yield losses caused by manufacturing deviations or variations in shadowing of the solar modules.

VRLA

Valve Regulated Lead Acid battery: Lead-acid battery with semi-solid electrolyte or sealed lead acid battery. Examples of this type of battery are Gel batteries and AGM batteries (Absorbent Glass Mat).

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