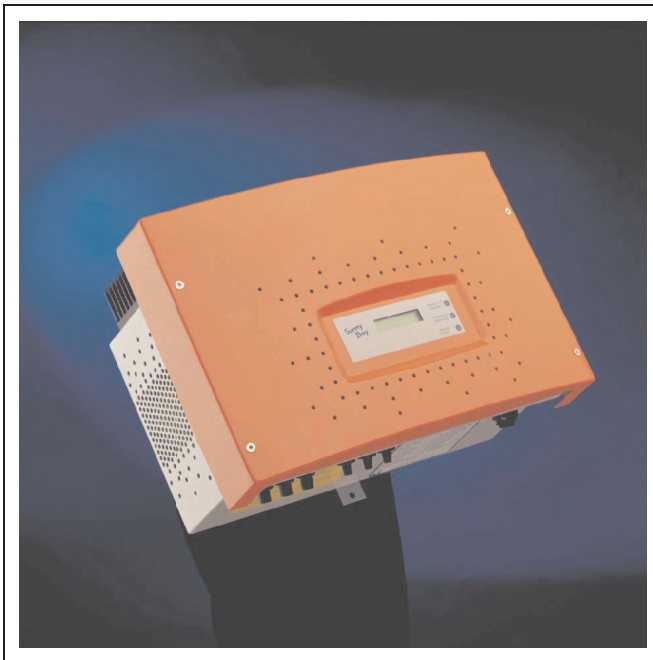


Sunny Boy 2800i

**String Inverter Sunny Boy 2800i
The New Generation of PV System Technology**



Operating Instruction

1	Introduction	3
2	Safety Instructions	5
3	Device Description	7
	3.1 Normal use	7
	3.2 Device Design	8
	3.3 Operating States	10
	3.4 Status Messages on the Optional Display	23
	3.5 Configuration of the Display Language . .	26
4	Servicing and Maintenance	27
5	Upgrading your Sunny Boy	29
	5.1 User Interface under Windows	30
6	Technical Documentation	31
	6.1 Data PV Generator Connection	31
	6.2 Data Grid Connection	31
	6.3 General Data	32
	6.4 Measurement Channels and Messages . .	34
	6.5 Declaration of Conformity (CE)	40
	6.6 Unbedenklichkeitsbescheinigung	41
7	Glossary	43
8	Contact	45

Revision History

Document number	Changes	Author
SB2800i-11:FE0504	First Issue	Siebert

1 Introduction

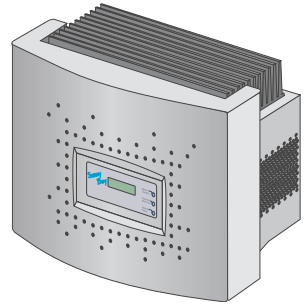
You have decided to use one of the most advanced devices for modular PV system technology by purchasing a Sunny Boy 2800i. The Sunny Boy 2800i convinces with its outstanding qualities concerning efficiency and reliability.

The Sunny Boys comply with all regulations from the VDEW (Association of German Electricity Producers) for supplementary grid feeding to the low voltage electricity grid of the utility. This includes the regulations of the employee association (Berufsgenossenschaft für Feinmechanik und Elektrotechnik) concerning the „Independent Disconnection Device“ known as MSD (Mains monitoring device with allocated Switching Devices) and the regulations of the DIN VDE 0126. Furthermore the Sunny Boy complies with the according harmonized standards and the low voltage regulations as certified in the CE declaration (see chapter 6.5 „Declaration of Conformity (CE)“ (page 40)).

This document contains the „Operating Instructions“ of the Sunny Boy 2800i. They are meant as guidelines on how to use all functions of the Sunny Boy 2800i optimally and how you can extend your existing PV-plant.

This part of device documentation especially deals with those topics that are relevant to the operation of the Sunny Boy 2800i. For the installation of the Sunny Boy 2800i please have a look at the „Installation Guide“.

The Sunny Boy 2800i is especially designed for indoor usage. It is equipped with an internal fan for active cooling.



Sunny Boy 2800i



2 Safety Instructions

Opening the device and by that

- the electrical installation,
- the repair or
- the modification



of the Sunny Boy 2800i may only be done by a qualified technician. Even if there are no external voltages on the device there may be high voltages that are hazardous to touch.

The temperature of individual parts of the enclosure of the Sunny Boy 2800i – especially the heat sinks – can reach 85 °C even in normal operation. There is a danger of burning yourself when touching the Sunny Boy.



The Sunny Boy 2800i is equipped with the anti-islanding unit „SMA grid guard“. The Sunny Boy 2800i therefore complies with the VDEW guidelines for grid interactive inverters and the DIN VDE 0126 (4.99) specified in this regulation.



3 Device Description

3.1 Application of the Sunny Boy

The Sunny Boy 2800i is used in order to convert DC power from photovoltaic modules to AC voltage and subsequently feed this to the grid. The technical data is specified in chapter 6 „Technical Documentation“ (page 31) of this document.

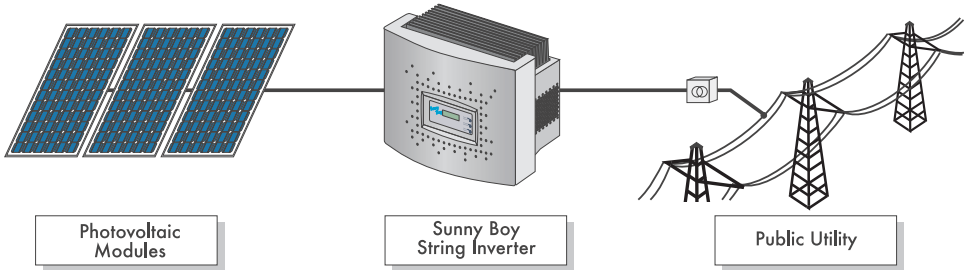


Fig. 3.1: Basic Principle of an Utility Interactive PV Plant

Usage of the Sunny Boy 2800i in any applications different from this will void the warranty.

3.2 Device Design

We have focused on a simple functional design when we developed the Sunny Boy string inverters. In its basic design the Sunny Boy 2800i does not need more than three LEDs for status display. A display unit is available. The display can be already installed when your Sunny Boy is delivered as well as it can be additionally installed later.

The Sunny Boy 2800i will operate fully automatically without any modification or configuration as long as it is installed and commissioned according to the technical specifications. It can nevertheless be modified in terms of operating parameters if necessary. An additional communication interface is required for this, which also can be used in order to acquire operating data for performance evaluation. Please have a look at chapter 5 „Upgrading your Sunny Boy“ (page 29) for details.

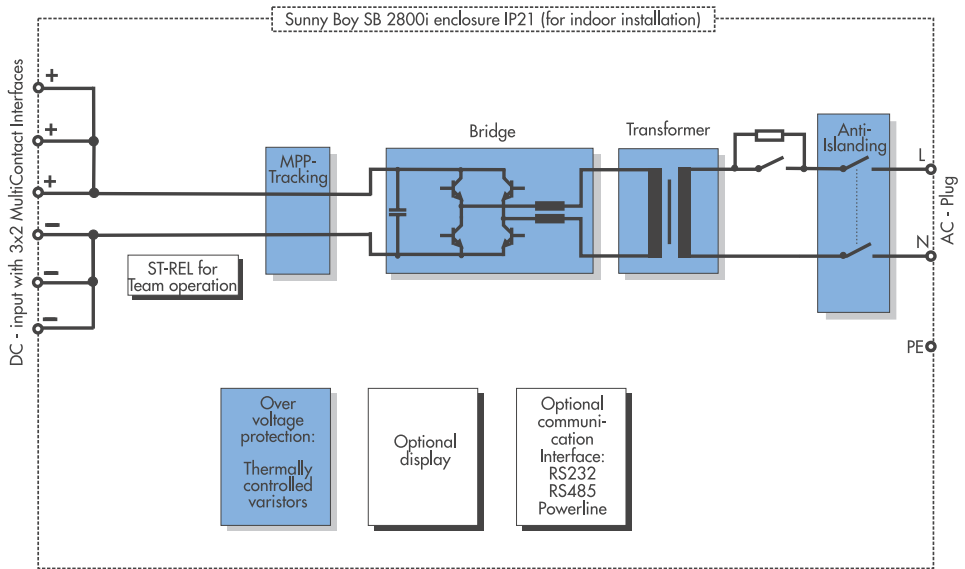


Fig. 3.1: Block circuit diagram of the Sunny Boy 2800i

Due to this design the specific costs are kept low and system management can be optimized.

All connections to the PV strings and the public grid as well as the optional communication cables are on the bottom of the Sunny Boy 2800i.

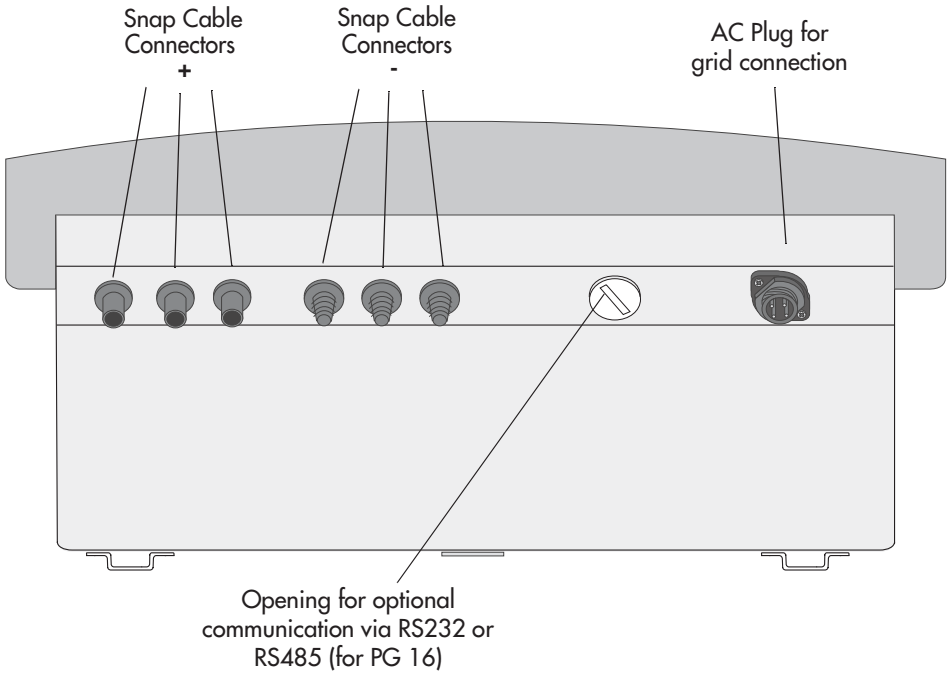
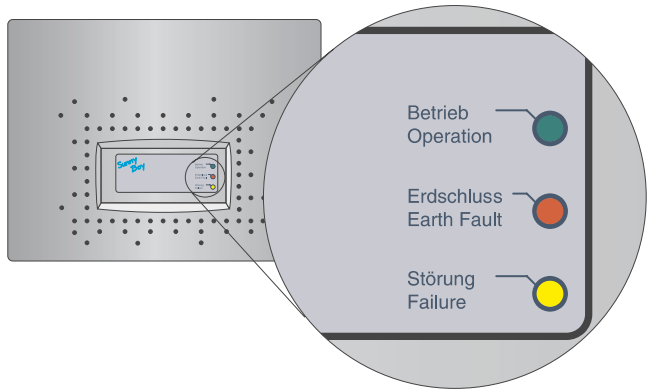


Fig. 3.2: Bottom view of the Sunny Boy 2800i

3.3 Operating States

The different operating states are displayed with three LEDs in the lid of the Sunny Boy 2800i.



Especially in the first year after installation the operator of the plant should regularly have a look at this display at different times of the day and with different irradiation.

You will find a complete description of all signal codes in chapter 3.3.4 „Description of Operating States“ (page 14). The operating states can be divided into three categories:

3.3.1 Normal Operating States

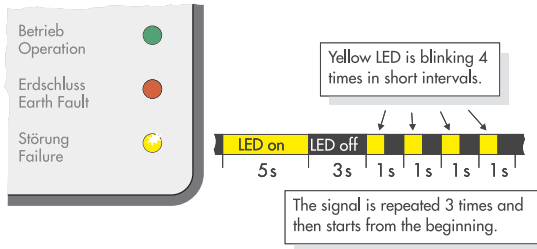
As long as no LEDs or only the green LED is on blinking, the Sunny Boy 2800i is in one of its normal operating states. If all three LEDs are on, the inverter is in its initialization phase which is a normal operating state as well. All other signals indicate a disturbed operating state.

3.3.2 Critical Failure States

Due to a comprehensive safety concept, the number of critical operating states could be reduced to one:

Input voltage exceeding specification

This is shown with the following blinking code of the yellow LED:



When failure occurs, the yellow failure LED is on for five seconds and then starts to send the blinking code by remaining off for three seconds and blinking four times in short intervals. The code is sent three times. If the failure persists the code is repeated.



Immediately disconnect the PV generator from the inverter! The Sunny Boy can otherwise be severely damaged.

3.3.3 Uncritical Failure States

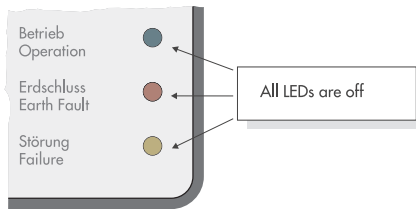
All other signaling codes show uncritical operating states. These normally do not mean any high danger of people or device, but their cause must be found and removed immediately in order to avoid yield losses.

Despite all the necessary precaution it is possible that there are additional faults which can not be signaled (e. g. failure of the status display). To be able to detect such failures as well, the operator should check the display of normal operating states for plausibility based on the explanations given in chapter 3.3.4 „Description of Operating States“ (page 14). For example if the green LED is on in the middle of the night, this means as much a failure as if no LED is on in full sunlight.

You can diagnose the states in much more detail with one of the communication interfaces described in chapter 5 „Upgrading your Sunny Boy“ (page 29).

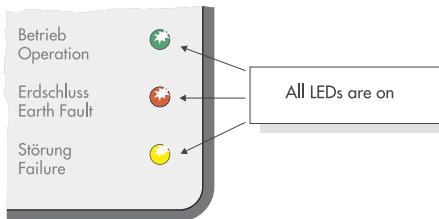
3.3.4 Description of Operating States

Stand-by at Night



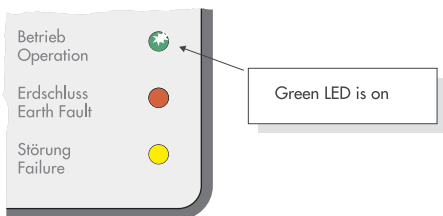
The Sunny Boy 2800i is in so-called stand-by operation. This state is reached if the input power at the inverter is too low for feeding operation ($U_{PV} < \text{ca. } 80 \text{ V}$) and not sufficient for normal operation)

Initialization



The on-board computer of the Sunny Boy 2800i is in the initialization phase. At least one of the string voltages on the inverter is between approx. 80 V and approx. 220 V. Power is already supplied to the internal board, but is not yet sufficient for grid feeding. Data transmission is not possible yet.

Feeding Operation



The Sunny Boy 2800i has successfully completed the self-test of the measurement electronics and the MSD and starts feeding to the grid.

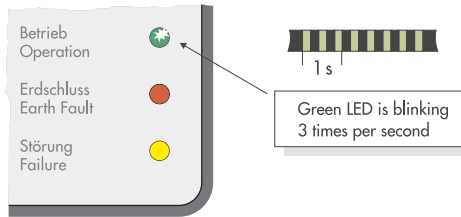
MPP operation (default):

The Sunny Boy 2800i automatically determines the MPP voltage of the PV generator.

Constant voltage operation:

The operating state „U-Konst“ can be manually defined by the plant operator with Sunny Boy Control or the PC programs Sunny Data or Sunny Data Control. In the „U-Konst“ operating mode, the Sunny Boy 2800i uses this externally defined PV setpoint voltage for its internal control.

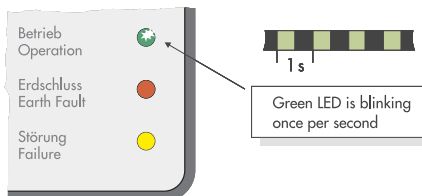
Stop



The Sunny Boy 2800i is in stop state. This is to calibrate the measurement electronics, subsequently the inverter switches into „Waiting“ state.

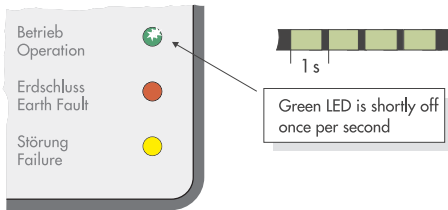
The „Stop“ state can also be set manually by the plant operator using the Sunny Boy Control or the PC program Sunny Data or Sunny Data Control. In this case, the Sunny Boy 2800i remains in „Stop“ state until a new operating state is defined („MPP operation“ or „Constant voltage operation“).

Waiting, Grid Monitoring



The Sunny Boy 2800i is testing whether start-up conditions for feeding operation are fulfilled (starting voltage, starting time) and then starts to monitor the grid.

Derating

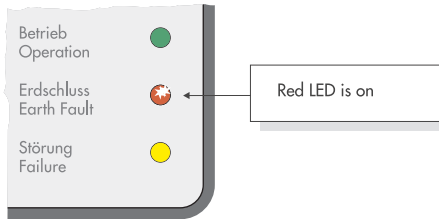


The temperature monitoring of the Sunny Boy 2800i has reduced the output power to prevent the device from overheating. If this happens often, heat dissipation might be insufficient.

To avoid unnecessary yield losses,

- check if the ambient temperature is too high.
- check the heat dissipation (air flow of the heatsink disabled).
- check the fan.

Insulation Failure



The red LED on the Sunny Boy 2800i is on, which indicates an earth fault.

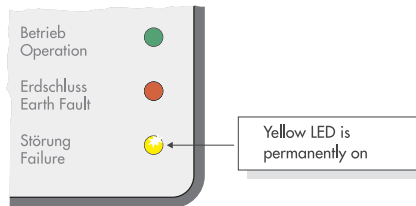
The earth fault could have two different reasons:

- it could be an insulation failure at the connection of the PV generator.
- one of the two thermally monitored varistors on the DC input side is defective.



Please contact a qualified electrician who will remove the failure following the instructions in the „Installation Guide“.

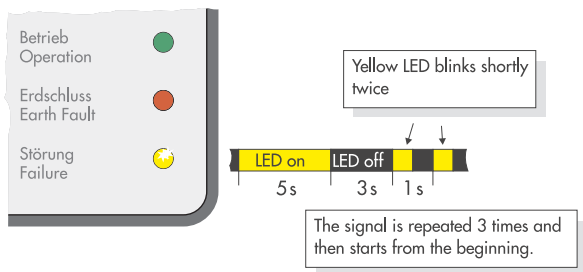
Permanent Device Disable



This signal appears if there is a failure of the grid monitoring / the independent disconnection device (MSD). During the internal test, the inverter has detected a malfunction of the MSD and has stopped feeding to the grid.

Normally this is a failure which cannot be removed on site. Please contact the manufacturer (see chapter 8 „Contact“ (page 45)) to discuss further proceedings.

Grid Failure



When a grid failure occurs, the yellow failure LED is on for five seconds and then starts the blinking code by staying off for three seconds and then blinking shortly twice. The code is repeated three times.

If the failure persists, the signal starts from the beginning.

With the above signal the Sunny Boy 2800i indicates a grid failure which can be caused by:

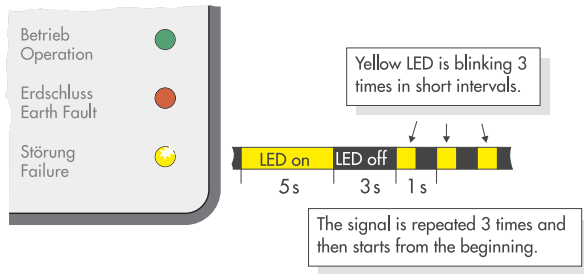
- Grid undervoltage ($U_{AC} < „U_{ac-Min}“$)
- Grid overvoltage ($U_{AC} > „U_{ac-Max}“$)
- Grid underfrequency ($f_{AC} < „f_{ac-Min}“$)
- Grid overfrequency ($f_{AC} > „f_{ac-Max}“$).
- Grid frequency change („|dFac|“)
- Defective grid connection
(e. g. if N and L are not connected)

First find out whether there is a general power shutdown (by checking the function of other consumers) and whether the fuse of the inverter feeding cable is OK.

If you do not find any failure, the grid connection of the inverter has to be checked by a qualified electrician.



Grid Impedance too High

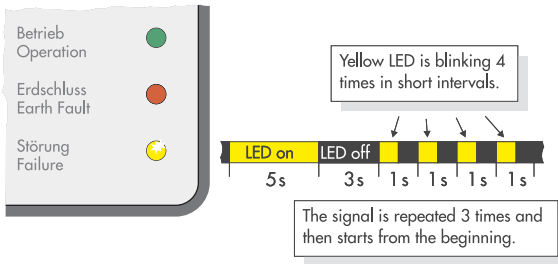


When this failure occurs, the yellow failure LED is on for five seconds and then starts the blinking code by staying off for three seconds and then blinking three times in short intervals. The code is sent three times.

If the failure persists, the signal starts from the beginning.

The Sunny Boy has detected a failure as the grid impedance values are out of permissible range. If the inverter switches off frequently during grid monitoring because of the above failure, the reason might be that grid impedance is too high. A qualified electrician can normally solve this problem by increasing the cross-section of the grid cable. Other actions are possible as well. Any modifications of the operating parameters require the explicit permission of the public utility company.

Input Voltage (PV Generator) too High



When failure occurs, the yellow failure LED is on for five seconds and then starts the blinking code by staying off for three seconds and then blinking four times in short intervals. The code is sent three times.

The Sunny Boy indicates that the input voltage is too high. The voltage of the PV generator exceeds the respectively admissible voltage!

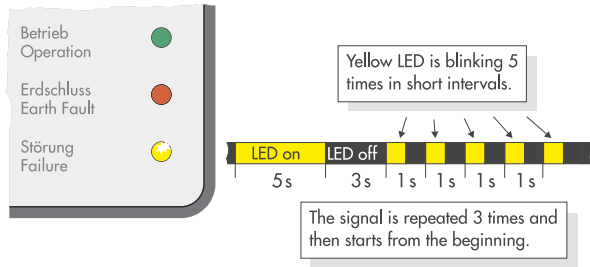
Immediately disconnect the PV generator from the Sunny Boy 2800i. Too high voltage may lead to irreparable damages!

Have your installer examine your plant configuration.



Please have a look at chapter 6 „Technical Documentation“ (page 31) for the permissible PV input voltage of the Sunny Boy 2800i.

Device Failure



When the failure occurs, the yellow LED is on for five seconds and then starts the blinking code by staying off for three seconds and then blinking five times in short intervals. The code is sent three times.

If the failure persists, the signal starts from the beginning.

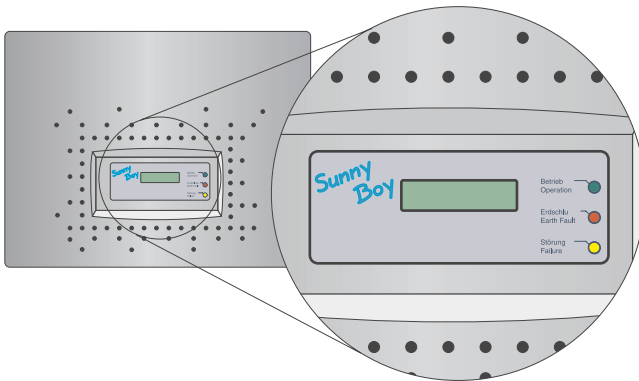
The Sunny Boy is in a state it cannot leave for normal operation. Presumably there is an internal failure in the device.



A qualified electrician has to examine the device.

3.4 Status Messages on the Optional Display

The Sunny Boy 2800i can be optionally equipped with the „Sunny Display“ LCD in the lid.



A Sunny Boy 2800i without the „Sunny Display“ can be upgraded and equipped with the Sunny Display lid.
(SMA order code, „SB-Display“, please specify the lid color and the language setting together with your order.)

Activation of the background illumination

The background illumination is activated by slightly knocking on the lid. Knocking once more activates the next message on the display.

The background illumination is automatically deactivated after 2 minutes.

```
SunnyBoy 2800i
WRxxx-xx
```

Initialization of the display on the
Sunny Boy 2800i

Messages of the Sunny Display during initialization

The following messages are displayed during initialization of the Sunny Boy 2800i.

```
BFR Version 2.00
SRR Version 2.00
```

Initialization of the display on the
Sunny Boy 2800i

The installed firmware versions of the control system (BFR) and the current control processor (SRR) are displayed after 6 seconds.

Messages of the Sunny Display during operation

The Sunny Display presents all relevant operating data one screen after the other. The images on the side indicate the messages. Each message is displayed for 5 seconds, after all messages have been displayed the display starts from the beginning again.

```
E-today 3.86kWh
Mode MPP
```

Energy produced today
and current operating status

First the „E-Today“ (total energy produced on this day) is displayed together with the current operating status.

```
Pac 903W
Uac 195V
```

Current AC Power
and AC voltage

The message is followed by the current power and the current grid voltage.

```
E-Total 724.4kWh
h-Total 512h
```

Total energy yield and
total operating hours

Finally the accumulated yield of the device since installation is displayed together with the total operating hours:

Messages of the Sunny Display in case of a failure

In case of a failure the Sunny Display switches to „Failure“ and the background illumination is activated.

The bottom line indicates the type of failure for 5 seconds.

```
Error
Vac-Bfr
Indication of a failure
and failure type
```

Failures that result from a specific value that e.g. exceeds a limiting are specified with the value that caused the failure as well as the current value.

The normal operating data is displayed after 5 seconds.

The display starts from the beginning again in case the failure is still present. Chapter 6.4 „Measurement Channels and Messages“ (page 34) gives more detailed information concerning the failure messages.

```
at:      261V
Present: 245V
Display of the value that caused the
failure and the current value
```

“Failure ROM” indicates that the Sunny Boy has detected a defective firmware in the EPROM. Contact SMA in order to remove this failure.

```
Error
ROM
Indication of defective firmware
```

Indication of DC Overvoltage

A too high voltage on the input (DC) side is indicated with a blinking background illumination and the display shown on the side.

```
!PV-Overvoltage!
!DISCONNECT DC !
Indication of an overvoltage on one
of the DC input connectors
```

Disconnect the Sunny Boy from the supply voltage immediately. The Sunny Boy can otherwise be severely damaged.

Check the input voltage and your module configuration before you reconnect the DC voltage to the Sunny Boy again!

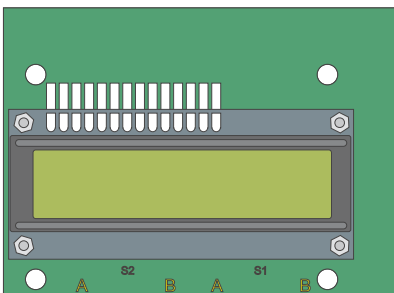
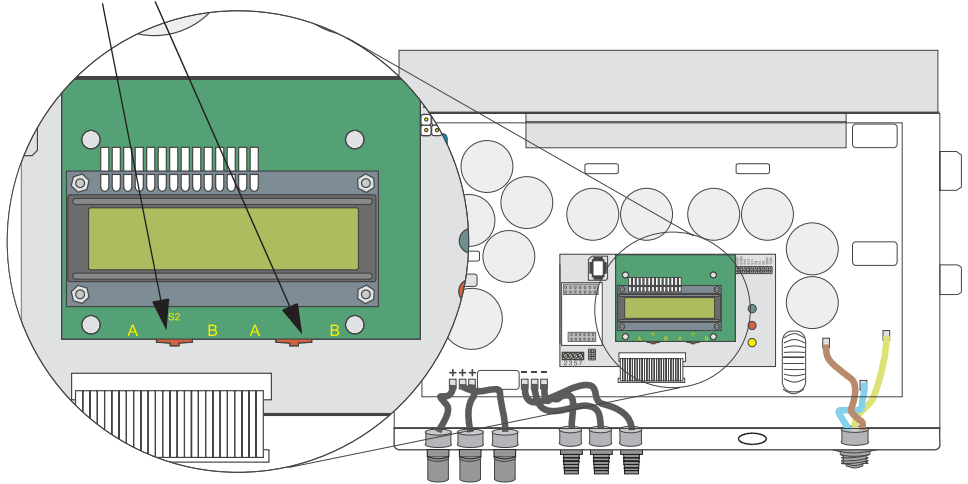


3.5 Configuration of the Display Language

The language of the Sunny Display is configured with the switches on the bottom of the display unit.

Disconnect both DC and AC from the Sunny Boy as described in the „Installation Guide“ and remove the lid.

Position of the switches for configuration of the Sunny Display language



A ↔ B A ↔ B
 Switch S2 Switch S1

Language	Switch S2	Switch S1
German	B	B
English	B	A
French	A	B
Spanish	A	A

4 Service and Maintenance

To obtain optimum yield the plant operator should examine the performance with respect to different insolation whether the LEDs of the Sunny Boy 2800i signals plausible normal operation (see chapter 3.3.4 „Description of Operating States“ (page 14). Of course you can also check this with one of the optional communication devices.

It is only necessary to clean the Sunny Boy if heat dissipation is disturbed by dirt particles on the fins of the heatsink or in the space between the inverter and the wall. Carefully remove the dirt with an appropriate soft brush.

If the status LEDs are dirty and no longer clearly visible, remove the dirt with a moist cloth. Solving agents, abrasives or corrosives may not be used for cleaning!

5 Upgrading your Sunny Boy

Like all inverters of the Sunny Boy family, the Sunny Boy 2800i can be equipped with different communication interfaces. The operator can see operating values and failure messages in detail and can process them on a PC with the software tools provided by SMA free of charge.

In addition the installer can easily adjust the Sunny Boy 2800i to specific conditions (e. g. too high grid impedance or PV modules not based on silicon cells).

Currently there are three ways to transmit data:

- via the grid cable (PLC = Power-Line-Communication)
- via a separate cable with RS485 signals
- via a separate cable with RS232 signals

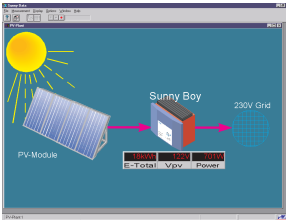
For continuous data acquisition SMA Regelsysteme GmbH developed the data logger Sunny Boy Control. All values recorded can be visualized on a four-line LCD. A convenient and complete data acquisition system can be established by coupling Sunny Boy Control to a PC that you only need to switch on occasionally.

At the moment there are three different versions of the Sunny Boy Control:

- **Sunny Boy Control Light**
Simple data acquisition and reduced measurement data storage with PV plants consisting of up to 20 Sunny Boys
- **Sunny Boy Control**
Data acquisition for plants with up to 50 Sunny Boys, long term data storage
- **Sunny Boy Control Plus**
Fully compatible with Sunny Boy Control with analog and digital ports for enhanced data acquisition with external sensors

5.1 PC User Interface under Windows

Sunny Data

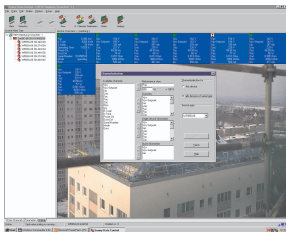


Graphic user interface
Sunny Data

The Windows program Sunny Data offers you a graphic user interface and all its well-known positive functions for communication with the Sunny Boy 2800i.

The available measurement channels (see chapter 6.4 „Measurement Channels and Messages“ (page 34)) of the Sunny Boy 2800i can be displayed online. Data of measurement channels can be recorded manually or automatically. Measured values are saved in files on any storage medium. An implemented special function for the installer enables to adjust system parameters to optimize the PV plant. For additional information on Sunny Data please see the Operating Instructions „Sunny Data“.

Sunny Data Control



Graphic user interface
Sunny Data Control

In PV plants where many inverters of the Sunny Boy family are used we recommend to use a Sunny Boy Control for communication. The Sunny Boy Control is a central data logger for up to 50 Sunny Boys. It supports commissioning of the PV plant and offers remote diagnosis by fax and email. Larger plants with more than 50 Sunny Boys are monitored by coupling several Sunny Boy Control.

To visualize the PV plant data SMA offers the PC program Sunny Data Control under Windows. This program can e. g. display the output power of the entire large-scale PV plant in a matrix.

Please see the Operating Instructions of Sunny Boy Control for the multiple possibilities to establish a monitoring system.

6 Technical Documentation

6.1 Data PV Generator Connection

Max. input open-circuit voltage	U_{PV0}	600 V (at -10 °C Module Temperature)
Input voltage, MPP operation	U_{PV}	224 V ... 600 V DC
Max. input current	I_{PVmax}	13,5 A
Max. input power	DC_{max}	3000 W
Recommended P_{PV} max. generator power		3750 Wp
All-pole disconnecter on DC input side		Multi-Contact® plug connector (standard - other snap cable connectors optional)
Surge voltage protection		thermally monitored varistors
Voltage ripple	U_{PP}	< 10 % of input voltage
Personnel protection		Ground Fault monitoring (Riso > 1 MΩ)
Internal consumption in operation		< 7 W
Pole confusion prevention		by short-circuit diode

6.2 Data grid connection

Nominal output power	P_{ACnom}	2500 W
Peak output power	P_{ACmax}	2800 W
Nominal output current	I_{ACnom}	11 A
Harmonic distortion of output (with $K_{U_{nom}} < 2\%$, $P_{AC} > 0,5 P_{ACnom}$)	THD_{IAC}	< 4 %
Operating range, grid voltage	U_{AC}	190 ... 260 V AC
Operating range, grid frequency	f_{AC}	49.8 ... 50.2 Hz
All-pole disconnecter on grid side		independent disconnection device (MSD), (2 independant systems)
Phase difference (related to basic wave of current)	φ	0°
Overvoltage category		III
Test voltage (50 Hz)		1.4 kV (1/5 s unit / type test)
Surge voltage test		4 kV (1.2/50 ms) (serial interface: 6 kV)
Internal consumption in stand-by		0.25 W

Input current as a function of the input voltage

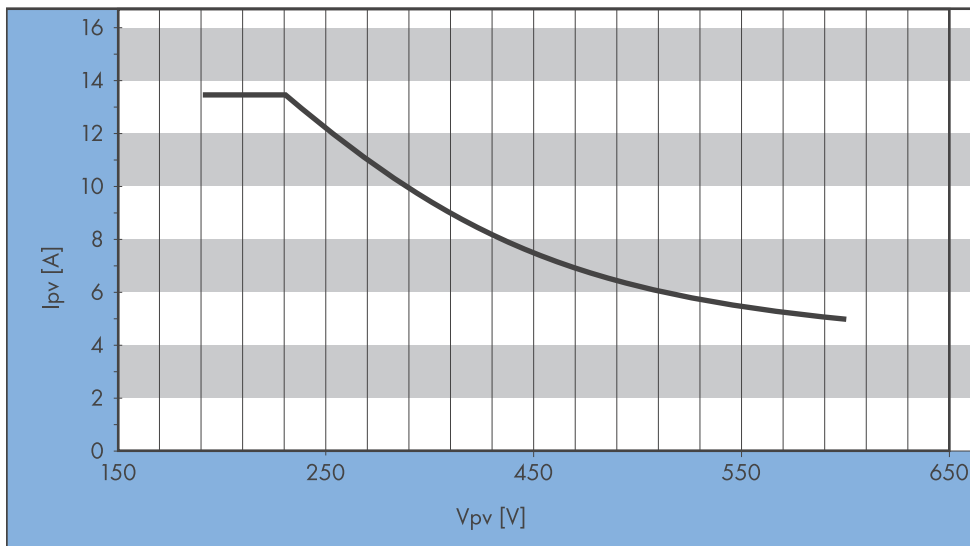


Fig. 6.1: Input current I_{pv} as a function of the input voltage U_{pv}

6.3 General Data

You will find a detailed device description in chapter 3 "Device Description" (page 7) of these Operating Instructions.

General Data

Protection Degree according to DIN EN 60529	IP21 (inside installation)
Dimensions (width x height x depth)	approx. 440 mm x 305 mm x 226 mm
Weight	approx. 31 kg

External interfaces

Data transmission via Powerline	optional
Data transmission via separate data cable	optional, RS232 / RS485, electrically separated

Efficiency

Max. Efficiency	η_{max}	> 94 %
European Weighted Efficiency	η_{euro}	> 93 %

The efficiency of the Sunny Boy 2800i depends on the input DC power coming from the PV modules.

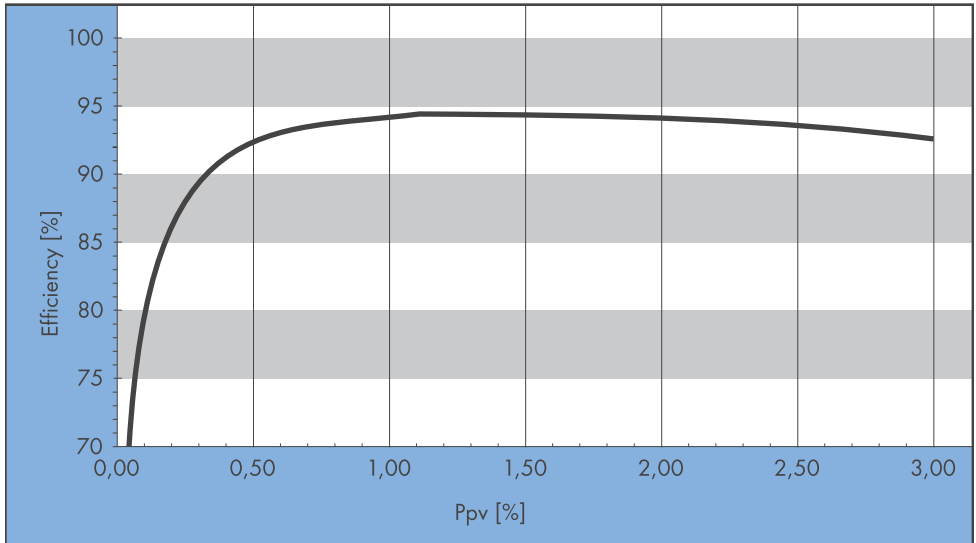


Fig. 6.1: Efficiency of the Sunny Boy 2800i with respect to the input voltage

6.4 Measurement Channels and Messages

If your Sunny Boy 2800i has been equipped with a communication interface, numerous measurement channels and messages can be acquired. These can help improve the performance as well as eliminate failures of your plant.

BFR: System control

SRR: Current control

6.4.1 Measurement Channels

E-Total	Total power fed to the grid accumulated from the day of installation
Fac	Grid frequency
Störung/Failure	Display of failure type in „Failure“ state
h-Total	Total sum of operating hours in feeding operation
Iac-Ist	Current fed to the grid
I _{pv}	Current from PV-panels
Netz-Ein/Power ON	Total number of connections to the grid
Pac	Present output power
Riso	Insulation resistance of PV plant before the connection to the grid
Seriennummer/Serial number	Serial number of the Sunny Boy
Status/Mode	Display of current operating state
Uac/Vac	Grid voltage
U _{pv-Ist} /V _{pv} DC	PV input voltage
U _{pv-Soll} / Vconst-Setpoint	PV setpoint voltage
Zac	Grid impedance

6.4.2 Status Messages

The Sunny Boy 2800i generates a number of status messages according to the mode it currently operates in. The status messages that you see can differ depending on the type of communication you are currently using (Sunny Display, Sunny Data, Sunny Boy Control, Sunny Data Control)

MPP	The Sunny Boy 2800i is operating in MPP mode. The input voltage setpoint is constantly adjusted in order to obtain the maximum energy from the different strings. This is the default operating mode in normal operation with normal radiation.
U-Konst	Constant voltage operation. (The input voltage from the PV modules is fixed to a defined setpoint. The Sunny Boy 2800i is not operating in MPP mode.) This mode can be defined as operating mode in special applications.
Derating	PV generator power is higher than the amount the Sunny Boy 2800i can process
Netzueb. / grid. mon.	Test of grid status for subsequent connection (grid impedance), relay test etc. This mode only occurs during startup, before the Sunny Boy connects to the grid. This status can occur often during the morning and evening with varying insolation.
Offset	Offset adjustment of measurement electronics
Stoer./disturb.	Failure (see following table „Failure messages“)
Stop	A safety relevant failure or similar occurred preventing that the Sunny Boy connects to the grid. This status can also be set manually.
Warten/waiting	Conditions for connection have not (yet) been fulfilled.
Zuschalt	Electronics are connecting to grid
MPP-Such	PV voltage is determined and set
MPP-Peak	AC current is higher than the nominal current of the Sunny Boy

6.4.3 Sunny Boy 2800i Operating Parameters



Any unauthorized modifications of the operating parameters can

- 1. Result in serious injuries or casualties due to altered internal safety precautions within the Sunny Boy**
- 2. Void the operating permission of the Sunny Boy**
- 3. Void the warranty of the Sunny Boy**

Never change the operating parameters without explicit permission and instructions!

Name	Unit	Range	Default	Description
E_Total	kWh	0 ... 200000		Total energy yield (E_Total) and total operating hours (h_Total) of the inverter. Changing the value can be necessary when a Sunny Boy is exchanged and you wish to match the previously acquired data
h_Total	h	0 ... 200000		
Usoll-Konst	V	250 ... 600	600	PV setpoint voltage for constant voltage operation. The parameter is only important in case the parameter „Betriebsart“ is set to „U-konst“
I-NiTest/ impedance test	mA	0 ... 15000	9000	Activates (9000) and deactivates (0) the automatic impedance measurement. This parameter only takes effect when the Sunny Boy was deactivated (by disconnecting from the AC utility) or set to operating mode „Stop“
Uac-Min/Vac-Min	V	180 ... 300	198	Lower (Uac-Min) and upper (Uac-Max) limit of permissible AC voltage (Anti-Islanding)
Uac-Max/Vac-Max	V	180 ... 300	260	
Fac-Delta-	Hz	0 ... 4.5	0.19	Maximal frequency above (Fac-Delta+) and below (Fac-Delta-) 50 Hz grid frequency before anti-islanding trips
Fac-Delta+	Hz	0 ... 4.5	0.19	
dFac-MAX	Hz/s	0.005 ... 4.0	0.25	Maximal „rate of change of frequency“ before anti-islanding trips
dZac	mOhm	0 ... 2000	350	Maximal „rate of change of grid impedance“ before anti-islanding trips
Upv-Start	V	250 ... 600	300	Minimum voltage the Sunny Boy needs in order to initiate normal operation.
T-Start	s	5 ... 300	10	Parameter relevant for start time. Counts seconds after minimum PV voltage is exceeded
T-Stop	s	1 ... 1800	2	Parameter relevant for the MPP-tracking. Do not change.
Betriebsart/ Operating Mode		MPP/lkonst/ UKonst/Stop	MPP	Operating Mode of the Sunny Boy: MPP: Maximum Power Point Ukonst: Constant Voltage Mode (Setpoint defined in „Usoll-Konst“) lKonst: Experimental mode / special applications Stop: Disconnection from utility, no operation
Speichertfunktion/ Memory Function			none	Default Parameter: Sets all parameters to default Reset Betriebsdaten: Sets all parameters that are visible in user level to default values. Reset Fehler: Resets a permanent device disable (dBh)
Default			GER/ENS	Used for adjusting the parameters country specific settings

Table 6.1: Operating Parameters of the Sunny Boy 2800i (changeable)

Name	Unit	Range	Default	Description
Storage			permanent	permanent: changed parameters are stored in EPROM and are still available after restarting the Sunny Boy volatile: prevents storing the parameters in EPROM, i. e. parameters are only saved until next startup
Inst.-Code				The parameters concerning anti-islanding can only be changed after entering the installers password here.

Table 6.1: Operating Parameters of the Sunny Boy 2800i (changeable)

The following parameters appear in parameter list but cannot be modified:

Name	Unit	Range	Default	Description
Plimit	W	2850		Upper limit of AC output power
SMA-SN				Serial Number of the Sunny Boy
Software-BFR				Firmware version of the operation control unit (BFR)
Software-SRR				Firmware version of the current control unit (SRR)

Table 6.2: Operating Parameters of the Sunny Boy 2800i (fixed)

6.4.4 Precision of Measured Value Acquisition

Acquisition of measured values always is imprecise within a certain margin. The measured values acquired by the Sunny Boy 2800i are required for its system management and control of current to be fed to the grid. This is why measured values of the Sunny Boy 2800i must be reproducible. The maximum error of measured value acquisition is specified for an ambient temperature T_U of 25 °C. A temperature coefficient failure must be accounted for with other ambient temperatures.

Physical variable	Unit	Measurement range	Resolution of display	Resolution of measurement	Max. failure (of final value, $T_U=25^\circ\text{C}$)
Input voltage	U_{PV} [V]	0 ... 659 V	1 V	1.12 V	±2 %
Input current	I_{PV} [mA]	0 ... 13500 mA	1 mA	2.92 mA	±4 %
Grid voltage	U_{AC} [V]	180 ... 300 V	1 V	0.3 V	±1 %
Grid current	I_{AC} [mA]	0 ... 15000 mA	1 mA	7.3 mA	±2 %
Grid frequency	f_{AC} [Hz]	45 ... 55 Hz	0.01 Hz	0.01 Hz	±0.1 %
Power fed to grid	P_{AC} [W]	0 ... 3000 W	1 W	2 W	±3 %
Energy fed to grid	E [kWh]	0 ... $4.29 \cdot 10^9$ Wmin	1 Wmin	20 Wmin	±3 %
Operating hours	h [h]	0 ... $4.29 \cdot 10^9$ s	1 s	375 μ s	±0.1 %

Table 6.3: Measured value acquisition of the Sunny Boy 2800i

6.4.5 Failure Messages

In case of a failure the Sunny Boy 2800i generates the failure code according to the operating mode and the detected failure.

Failure Code	Description
Uac-Bfr/ Uac-Srr	<p>The AC grid voltage is exceeding the permissible range. („Bfr“ or „Srr“ is an internal message and is not important for the user.) Uac can also result from a disconnected grid or a disconnected AC cable. The Sunny Boy assumes that the public grid is down and disconnects from the grid in order to avoid islanding.</p> <p>Check the grid voltage and the grid cable connection in the Sunny Boy enclosure. If the grid voltage is out of range due to your local grid conditions contact the utility company and ask if it is possible to modify the utility conditions. If the grid voltage is within the tolerable range and you still observe the failure message „Uac-Bfr“ or „Uac-Srr“ contact SMA.</p>
Fac-Bfr Fac-Srr	<p>The AC grid frequency is exceeding the permissible range. („Bfr“ or „Srr“ is an internal message and is not important for the user.) The Sunny Boy assumes that the public grid is down and disconnects from the grid in order to avoid islanding.</p> <p>Check the grid frequency and the grid cable connection in the Sunny Boy enclosure. If the grid frequency is out of range due to your local grid conditions contact the utility company and ask if it is permissible to change the grid monitoring parameters of the Sunny Boy. Contact SMA about how to change the grid monitoring parameters of your Sunny Boy. If the grid frequency is within the tolerable range and you still observe the failure message „Fac-Bfr“ or „Fac-Srr“ contact SMA.</p>
Zac-Bfr/ Zac-Srr	<p>The AC grid impedance is exceeding the permissible range. („Bfr“ or „Srr“ is an internal message and is not important for the user.) The Sunny Boy assumes that the public grid is down and disconnects from the grid in order to avoid islanding.</p> <p>The impedance is the sum of the grids internal impedance and the impedance of the AC cable that connects the Sunny Boy to the grid.</p> <p>Check the grid impedance and the grid cable connection in the Sunny Boy enclosure. Use a cable with a higher cross section (=lower impedance) for connection of the Sunny Boy to the grid. If the grid impedance is out of range due to your local grid conditions contact the utility company and ask if it is possible to modify the utility conditions.</p>

Failure Code	Description
dZac-Bfr dZac-Srr	<p>The rate of change of the AC grid impedance is exceeding the permissible range. („Bfr“ or „Srr“ is an internal message and is not important for the user.) The Sunny Boy assumes that the public grid is down and disconnects from the grid in order to avoid islanding.</p> <p>If you therefore often observe „dZac-Bfr“ or „dZac-Srr“ consult the utility company and ask if it is permissible to change the grid monitoring parameters of the Sunny Boy. Contact SMA about how to change the grid monitoring parameters of your Sunny Boy.</p>
Riso	<p>The electric isolation of the PV system to the ground is leaking. The resistance between one of the poles and ground is below a defined threshold.</p> <p>Have the plant checked for ground faults. This can be defective cable crimpings, cracked modules (especially when moist) or similar.</p>
Imax	Overcurrent on the AC side. This failure code is indicated in case the current to the AC grid exceeds the specification. Have your plant configuration checked.
UpvMax	PV input voltage above the tolerable maximum value
NUW-Mess NUW-FAC NUW-UAC NUW-ZAC	Internal measurement comparison error: The Sunny Boy 2800i measured values of BFR and SRR are too different from each other.
K1-Schliess K1-Trenn	Relay test failed
EEPROM	Transition failure during reading or writing of data EPROM, the data is not essential for safe operation - this failure does not effect performance.
EEPROM dBh	Data EPROM defective, device is set to permanent disable due to the fact that the data loss affects important functions of the Sunny Boy. Contact SMA.
Offset	Grid monitoring self-test failed.
Rechner	BFR or SSR controller failure
ROM	The internal test of the Sunny Boy Control system firmware failed. Contact SMA in case you observe this failure often.
Watchdog	Internal Watchdog function triggered
Iac-DC-Offs	DC injection to high
EeRestore	One of the two data records of the EEPROM was defective and has been repaired without losing data.

6.5 Declaration of Conformity (CE)

DECLARATION OF CONFORMITY

for Photovoltaic Inverters



Product : Sunny Boy

**Typ: SB2100TL, SB2500, SB2800i, SB3000,
SB4200TL Multi-String, SB5000TL Multi-String**

We declare that the Photovoltaic Inverter Sunny Boy complies with the VDE regulations for supplementary grid connection, especially to the "regulation for the supplementary grid feeding with photovoltaic electricity producing facilities to the low voltage power supply grid" issued by the VDEW. The Sunny Boy complies with the requirements concerning the redundant grid monitoring with allocated switching devices (German: ENS) issued by the general organization of the professional employee associations, mainly directed by the employee association for precision mechanics and electronic engineering together with the organization of German electricity companies (German: VDEW) on the 7th of June 1994.

The Sunny Boy complies with the according regulations of the European Community, especially the EMC regulation according to 89/336/EWG and the low voltage regulation according to 73/23/EWG.

The device especially complies with

- DIN EN 50081, part 1 (3.93), with
 - DIN EN 61000, part 3-2 (12.01)
 - DIN EN 55014, part 1 (11.01)
 - DIN EN 55011 group 1, class B (5.00)
- DIN EN 50082, part 1 (11.97)
- DIN EN 50178 (04.98) (VDE 0160)
- DIN EN 60146-part 1-1 (03.94) (VDE 0558 part 11)
- E DIN VDE 0126 (04.99)

The Sunny Boy is therefore marked with a CE sign.

Niestetal, 2nd May 2003

SMA Regelsysteme GmbH

i. V. Frank Greizer

i.V. Frank Greizer
(Head of R&D Solar Technology)

INDUSTRIAL COMPUTERS - SOLAR TECHNOLOGY - RAILWAY TECHNOLOGY





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38-CE-11-REG103

6.6 Clean Report of Findings (Grid Guard)

The Sunny Boy 2800i is equipped with the automatic anti-islanding unit „SMA grid guard“. The following „clean report of findings“ applies for this unit:

Fachausschuss Elektrotechnik der Berufsgenossenschaftlichen Zentrale für Sicherheit und Gesundheit – BGZ des Hauptverbandes der gewerblichen Berufsgenossenschaften				BG Federführung: Berufsgenossenschaft der Feinmechanik und Elektrotechnik	
Fachausschuss Elektrotechnik, Postfach 51 05 80, 50941 Köln					
SMA Regelsysteme GmbH Hannoversche Straße 1-5 34266 Niestetal					
Ihre Zeichen/Nachricht vom	Unser Zeichen (Bitte stets angeben)	Bearbeiter	☎ (02 21) 37 78-	Datum	
	UB.010.17	PI/Ow	357	14.12.2001	
Unbedenklichkeitsbescheinigung					
Erzeugnis:	Selbsttätig wirkende Freischaltstelle				
Typ:	SMA grid guard				
Bestimmungsgemäße Verwendung:	Parallelbetrieb von Photovoltaikanlagen am EVU-Niederspannungsnetz				
Prüfgrundlagen:					
E DIN VDE 0126 (04.99)	„Selbsttätige Freischaltstelle für Photovoltaikanlagen einer Nennleistung ≤ 4,6 kVA und einphasiger Paralleleinpeisung über Wechselrichter in das Netz der öffentlichen Versorgung“				
Die elektrische Sicherheit o.g. Erzeugnisse entspricht den zum Zeitpunkt der Ausstellung dieser Bescheinigung geltenden Bestimmungen.					
Die Unbedenklichkeitsbescheinigung gilt befristet bis					
31.12.2004					
 - Peuker - Leiter der Prüf- und Zertifizierungsstelle					
Hausadresse:	Gustav-Heinemann-Ufer 130	50968 Köln	Tel. (02 21) 37 78-365	Fax (02 21) 37 78-366	

7 Glossary

AC

Abbreviation for „Alternating Current“

DC

Abbreviation for „Direct Current“

Derating

Controlled reduction of power, mostly depending on temperatures of certain modules. Compared to a complete shutdown of a device, which is a usual procedure as well, the negative impact on the external grid is lower with derating.

MSD

The „Mains monitoring with allocated Switching Devices“ is an obligatory safety device which interrupts the inverter's feeding of PV power to the grid if the external power generators have shut down.

Stand-alone plant, island plant

Power supply system which is totally independent from external power supply.

Maximum Power Point „MPP“

The operating point (current / voltage) of the PV generator where this generates maximum power under the current conditions. The position of the MPP changes continuously, e. g. depending on insolation and temperature.

MPP tracker

Unit that adjusts current and voltage of the PV generator in a way so as to make the generator operate in its maximum power point.

Grid-tied plant

PV plant connected to a public electricity grid run by an external supplier company.

PLC

Abbreviation for „Power Line Communication“, term for data transmission via the grid cable

PV

Abbreviation for „Photovoltaics“, term for the conversion of light energy into electrical energy.

PV plant

A system consisting of components required for the generation and utilization of solar energy. In the case of grid-tied plants these components include the PV generator and the inverter.

PV generator

Technical facility to convert light energy into electrical energy. Usually the term includes all PV modules of a PV plant that have been mounted and electrically wired.

PV module

See „Solar module“

Solar energy

Energy supplied by the sun, i. E. energy from sunlight or other insolation (heat, UV radiation)

Solar module

Combination of individual solar cells in one enclosure which protects the delicate cells against mechanical strain and guarantees easy installation.

Solar cell

Electronic component which can supply electrical energy when in sunlight. As the electric voltage of one single solar cell is very low (approx. 0.5 V) several cells are combined into solar modules. The material mostly used for solar cells at the moment is silicon. It is upgraded in different ways (mono-crystalline, poly-crystalline, amorph) before use. There are also various ways to increase efficiency mechanically. In addition totally new materials are currently tested (Cadmium-Tellurid, Cadmium-Indium-sulfide, titan dioxide etc.).

String

A group of solar modules switched in series. Usually a PV plant consists of several strings. Thus it is possible to avoid too high yield losses if the modules are shadowed to a different extent.

String inverter

Inverter concept avoiding the disadvantages of a concept with one central inverter. The PV generator is divided into individual strings which are each connected to the external grid with their own string inverter. This considerably simplifies installation and reduces yield losses due to variations in manufacture or a different degree of shading of solar modules.

Inverter

Device to convert the direct current (DC) supplied by the PV generator into alternating current (AC) which is required for the supply of most consumers and especially for feeding into the public grid. Inverters for PV plants usually include one or more MPP trackers.

Central inverter

Inverter concept where all PV modules are wired among each other (switching in series and / or in parallel). One single inverter feeds into the external grid. Costs for a central inverter concept are lower, but installation might be much more complicated and yield losses may occur due to shadowing of individual solar modules.

8 Contact

If you have any questions about or technical problems with the Sunny Boy 2800i our hotline will be happy to assist you. Please keep the following data ready when contacting SMA:

- Type of inverter
- Type of Modules connected
- Communication Interfaces
- Serial number of the Sunny Boy



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