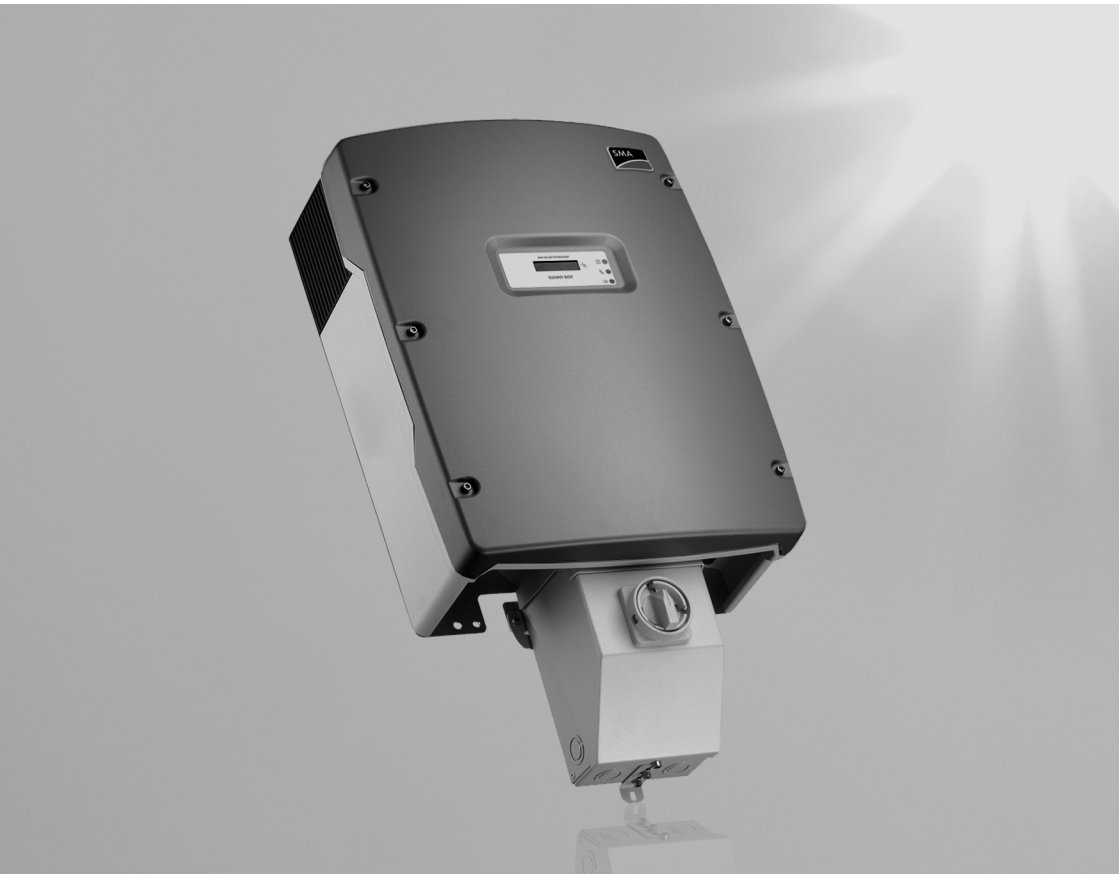
PV Inverter

SUNNY BOY US

User Manual



SB_CL_US-BUS094410 | TBUS-SBUS | Version 1.0

US

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SMA America, LLC
3801 N. Havana Street
Denver, CO 80239 U.S.A.

IMPORTANT SAFETY INSTRUCTIONS

SAVE THESE INSTRUCTIONS

This manual contains important instructions for Sunny Boy inverter, that must be followed during installation and maintenance of the inverter.

The Sunny Boy is designed and tested according to international safety requirements, but as with all electrical and electronic equipment, certain precautions must be observed when installing and/or operating the Sunny Boy. To reduce the risk of personal injury and to ensure the safe installation and operation of the Sunny Boy, you must carefully read and follow all instructions, cautions and warnings in this user manual.

Warnings in this document

A warning describes a hazard to equipment or personnel. It calls attention to a procedure or practice, which, if not correctly performed or adhered to, could result in damage to or destruction of part or all of the SMA equipment and/or other equipment connected to the SMA equipment or personal injury.

DANGER

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

WARNING

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

CAUTION

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

NOTICE

NOTICE is used to address practices not related to personal injury.

Other Symbols in this document

In addition to the safety and hazard symbols described on the previous pages, the following symbol is also used in this User Manual:

Information

This symbol accompanies notes that call attention to supplementary information that you must know and use to ensure optimal operation of the system.

Markings on this product

The following symbols are used as product markings with the following meanings.

Warning regarding dangerous voltage

The product works with high voltages. All work on the product must only be performed as described in it's documentation.

Electric arc hazards

The product has large electrical potential differences between its conductors. Arc flashes can occur through air when high-voltage current flows. Do not work on the product during operation.

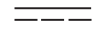
Beware of hot surface

The product can become hot during operation. Do not touch the product during operation.

Observe the operating instructions

Read the product's documentation before working on it. Follow all safety precautions and instructions as described in the documentation.

AC current



DC current

Transformerless

Earth Ground

UL1741 is the standard applied by Underwriters Laboratories to the Sunny Boy to certify that it meets the requirements of the *National Electrical Code*® and IEEE-929-2000. IEEE 929-2000 provides recommendations regarding the proper equipment and functionality necessary to ensure compatible operation when power generation is connected to the utility grid.

General Warnings

General Warnings

All electrical installations must be done in accordance with the local and *National Electrical Code*® ANSI/NFPA 70. For installation in Canada the installations must be done in accordance with applicable Canadian standards.

The Sunny Boy contains no user-serviceable parts except for the fans on the bottom of the enclosure and the filters behind the fans as well as the handle covers on the sides of the unit. For all repair and maintenance, always return the unit to an authorized SMA Service Center.

Before installing or using the Sunny Boy, read all of the instructions, cautions, and warnings on the Sunny Boy in this User Manual.

Before connecting the Sunny Boy to the electrical utility grid, contact the local utility company. This connection must be made only by qualified personnel.

Wiring of the Sunny Boy must be made by qualified personnel only.

Table of Contents

1 Notes on this manual

1.1 Validity

This manual describes how to operate the following SMA inverters:

- Sunny Boy 8000TL-US (SB 8000TLUS-10)
- Sunny Boy 9000TL-US (SB 9000TLUS-10)
- Sunny Boy 10000TL-US (SB 10000TLUS-10)

This manual does not cover any details concerning equipment connected to the Sunny Boy (e. g. PV modules). Information concerning the connected equipment is available from the manufacturer of the equipment.

1.2 Target group

This manual is for qualified personnel an for the operator.

- Qualified personnel have received training and have demonstrated skills and knowledge in the construction and operation of this device. Qualified personnel are trained to deal with the dangers and hazards involved in installing electric devices.
- The operator has been adequately supervised by qualified personnel to ensure a save use of the Sunny Boy.

1.3 Storage of the manuals

Keep all Sunny Boy manuals in a convenient place for future reference.

1.4 Additional information

You will find further information on special topics in the download area at www.SMA-America.com.

1.5 Nomenclature

In this document SMA America Production, LLC is referred to in the following as SMA.

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

2 Safety

2.1 Appropriate usage

The Sunny Boy is a PV inverter which converts the DC current of the PV array to AC current and feeds it into the grid.

More precise information on this subject and on your device can be found in the installation guide. The operational limits specified in the installation guide for the particular inverter must be observed.

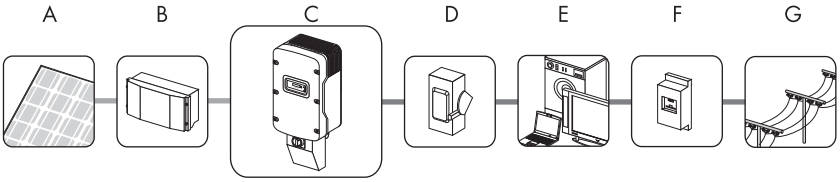
All inverters may only be operated with PV generators (modules and cabling) with protective insulation. Do not connect any sources of energy other than PV modules to the inverter.

Do not use the inverter for purposes other than those described here. Alternative uses, modifications to the inverter or the installation of components not expressly recommended or sold by the manufacturer void the warranty claims and operating permission. If you have questions regarding the proper usage of the inverters, contact the SMA Serviceline.

Principle of the string inverter

The string inverter is used to connect a number of series-connected PV modules (strings) to the public supply grid. This way, even a large PV generator can be constructed from a large number of individual strings, each having its own string inverter. The energy is then combined on the AC side.

Principle of a PV plant with a Sunny Boy



Position	Description
A	PV modules
B	Sunny Boy Combiner Box
C	Sunny Boy with SMA DC Disconnect
D	AC load circuit breaker
E	Load
F	Energy meter
G	Utility grid

2.2 Safety precautions

DANGER

During operation, high voltages are present in the Sunny Boy.

Death or serious injury due to electric shock.

The following work on the inverter must be carried out by qualified personnel only.

- Electrical installation
- Repairs
- Modifications

Even when no external voltage is applied, high voltages can still be present in the device. These high voltages can result in death or serious injury.

WARNING

The Sunny Boy becomes hot during operation.

Risk of burn.

- Do not touch the enclosure during operation.
- Only touch the lid during operation.

NOTICE

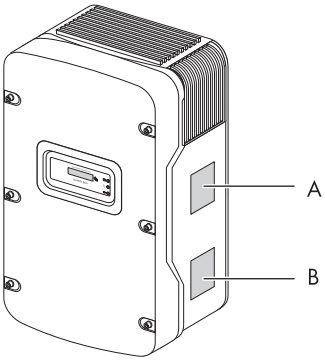
Overvoltages in the inverter.
Destruction of the inverter will result.

- Contact your installer whenever the inverter reports an error.

2.3 Identifying the Sunny Boy

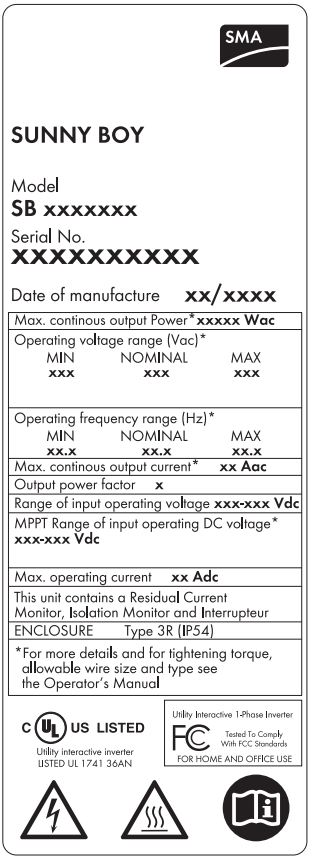
You can identify the Sunny Boy by the type label. It is on the right side of the enclosure.

Position	Description
A	Type label
B	General warning label



The type label shows:

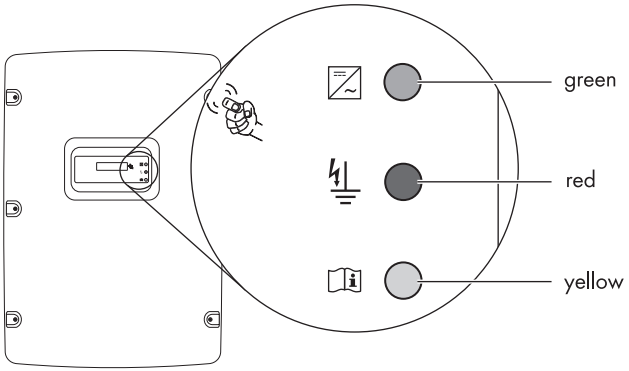
- The serial number (Serial No.).
- The type of product (Type/Model).
- Device-specific characteristics.



3 Operating modes

The different operating modes are indicated by 3 light-emitting diodes (LEDs) on the inverter lid, and also via the integrated display (see section 4 "Information on the display" (page 21)). To allow the device to signal its operating mode via the 3 integrated LEDs, the inverter must be connected to the DC side of the system. The level of solar irradiation must be high enough to supply the inverter with sufficient DC voltage.

The following diagram shows the 3 LEDs, as exemplified by the Sunny Boy 10000TLUS.



LED	Meaning
Green	The green LED indicates normal operation of the inverter.
Red	The red LED indicates an earth fault.
Yellow	The yellow LED indicates that there is a fault of some kind, either inside the inverter or somewhere in the PV system. The inverter will not operate until the fault has been corrected. The different error codes and possible causes are addressed later in this section and in chapter 6 "Measurement channels and messages" (page 26).

LED Display

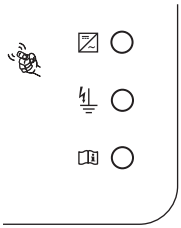
If you do not have any means of plant communication, it is advisable, particularly during the first year of operation, to keep a close eye on this display at different times of day and under varying solar irradiation conditions. This will enable you to recognize errors at an early stage.

A detailed description of the possible LED signals and blink codes is given in the following section.

3.1 LED operation indicators

3.1.1 All LEDs are off

Overnight shutdown

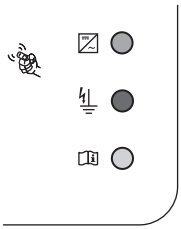


The inverter is in standby mode because the input voltage is too low for operation.

If this operating mode occurs during a sunny day with good irradiation, have the PV voltage checked by your installer.

3.1.2 All LEDs are on

Initialization



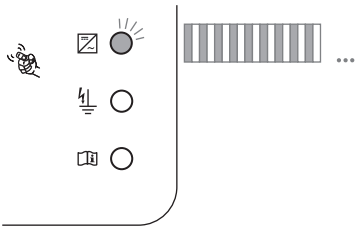
The inverter is initializing. The power from the array is sufficient to initialize control power, but not yet powerful enough to begin normal operation. Data transmission is not possible during initialization.

Occasionally, during inclement weather or low irradiation, the LEDs may all turn on at once and then go off again. This indicates that the inverter is trying to initialize but the power available from the array is not sufficient for normal operation. This is not a malfunction.

If no LED, or only the green LED is on or blinking, the inverter is operating normally. If all 3 LEDs are lit up simultaneously, this is also an indication of normal operation ("initialization"). All other signals are a sign of faulty operation.

3.1.3 The green LED is blinking rapidly

Starting



The inverter has sufficient PV power to calibrate its internal systems, but not enough to begin normal operation. Typically, the calibration lasts less than 10 sec. and then the inverter resumes normal operation. PV voltage must remain > PV Start Voltage setting for the period of the P-Start parameter setting. The inverter will also show this status if it has been manually set to STOP mode.

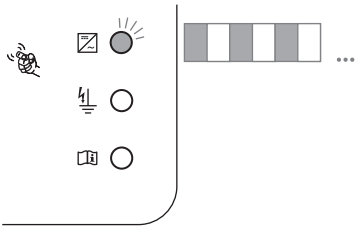
3.1.4 The green LED is blinking slowly

Waiting, Grid Monitoring

The inverter has determined that there is enough voltage from the array to operate and is checking the condition of the grid prior to connecting to it.

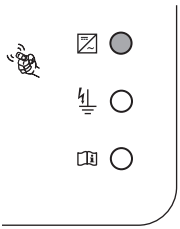
If the inverter fails to connect to the utility grid 3 times in a row, it will wait 10 min. before the next attempt.

In case of a grid failure, the Sunny Boy waits 5 min. before it tries to reconnect to the grid.



3.1.5 The green LED is continuously on

Feeding operation



The inverter is feeding the utility grid in either "MPP" or "Constant Voltage" mode.

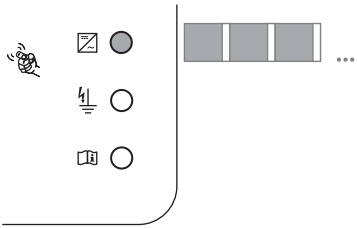
"MPP" Mode: The Sunny Boy adjusts the voltage and current from the PV array to obtain the greatest PV output power.

"Constant Voltage" Mode: The voltage from the PV array has been set to a fixed value. This value is set by using the Sunny Boy Control or the Sunny Data software (the parameter name is "V-Const"). This mode is typically used for fuel cell or micro-hydro applications.

3.1.6 The green LED goes out briefly

Derating

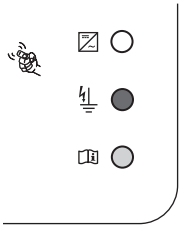
The Sunny Boy is designed to operate at full rated power up to 113 °F (45 °C) ambient temperature. The inverter will continue to operate beyond 113 °C (45 °C) and will derate as required to maintain a safe internal component temperature. Unnecessary derating can be caused by blocked fan intakes. For this reason the fan intakes must be inspected in regular intervals and cleaned if necessary.



3.2 LED fault indicators

3.2.1 Red and Yellow LEDs are on

The inverter has detected a ground fault in the PV system and has disconnected from the grid. The ground fault must be located and fixed before the inverter will resume normal operation. Refer to the installation guide for information on solving PV array ground faults (the inverter will not restart automatically).

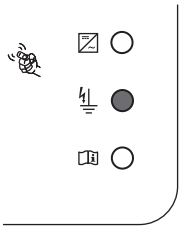


3.2.2 The Red LED is continously on

Ground fault

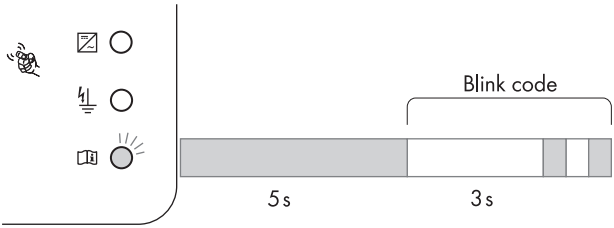
The red LED on the Sunny Boy is permanently on. With this blink code it is irrelevant whether the green or yellow LEDs are on or blinking. When the red LED lights up continuously, the inverter has detected a ground fault.

Contact your installer to have the error corrected. Instructions on correction errors can be found in the inverter installation guide.



3.2.3 The yellow LED blinks twice

Grid failure



The yellow LED is on for 5 sec., out for 3 sec. and then blinks twice. The code is repeated 3 times. This code sequence will repeat as long as there is a grid fault condition.

This code can be caused by any of the following conditions:

- Low Grid Voltage (<Vac Min)
- High Grid Voltage (>Vac Max)
- Low Grid Frequency (< fac Min)
- High Grid Frequency (>fac Max)
- Rapid change in grid frequency or voltage

Check the condition of the grid at the AC terminal blocks within the Sunny Boy. Also inspect the AC disconnect between the Sunny Boy and the grid.

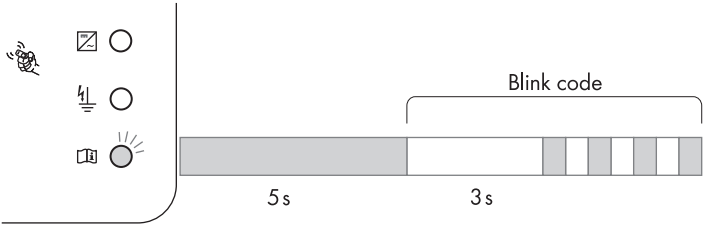
WARNING

During operation, high voltages are present in the Sunny Boy.

Death or serious injury due to electric shock.

- The grid connection to the Sunny Boy must be checked by qualified personnel.

3.2.4 The yellow LED blinks 4 times



The yellow LED is on for 5 sec., remains off for 3 sec. and then blinks 4 times. The code is repeated 3 times. If the condition remains the code will continue to be sent.

The inverter has detected a DC input voltage that is too high for safe operation.

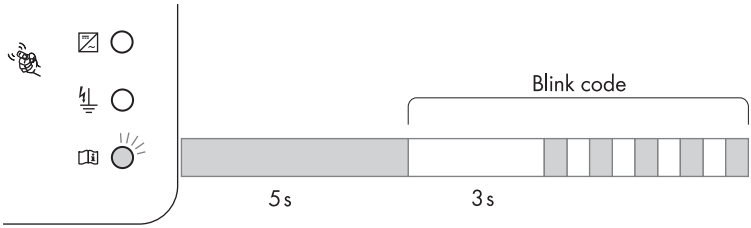
NOTICE

Destruction of the inverter caused by high DC input voltage.

- Contact your installer, who will immediately disconnect the PV generator from the inverter and check the DC voltage, as described in the inverter installation guide.
- Always test the DC voltage at the DC disconnect switch before energizing the Sunny Boy.

3.2.5 The yellow LED blinks 5 times

Device fault



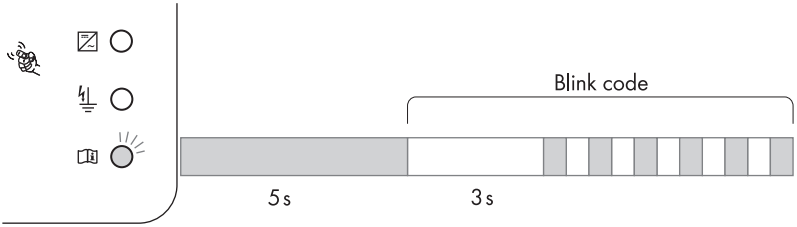
The yellow LED is on for 5 sec., remains off for 3 sec. and then blinks 5 times. The code is repeated 3 times. If the condition remains the code will continue to be sent.

The inverter has encountered an internal fault that prohibits normal operation and will most likely require servicing.

Contact SMA for assistance.

3.2.6 The yellow LED blinks 6 times

Discharge current too high



Discharge current

The fault "Discharge current too high" can only occur in transformerless inverters. Transformerless inverters can be identified by their device designation. The "TL" in the name stands for transformerless, e.g. Sunny Boy 10000TL-US.

The yellow fault LED lights up for 5 sec. when the fault occurs, and then starts emitting the following blink code. 3 sec. off and then 6 brief consecutive blinks. This code is emitted 3 times in succession. If this fault is still present, the fault signal starts over again.

The discharge current from the inverter and the PV generator is too high. The Sunny Boy interrupts grid feeding immediately after exceeding a threshold value and switches back onto the grid automatically after testing. If necessary, testing will be repeated several times.

Discharge current is dependent on the capacity of the PV generator relative to ground and also depends on the type of modules and manner of installation as well as the weather conditions. Therefore, it is quite normal for this value to vary over time.

However, if the inverter frequently displays this fault, please notify the installer who installed your PV system and clarify the reasons for the high level of discharge current.

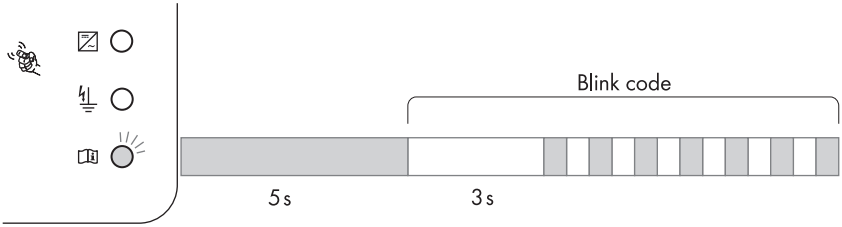
This fault message can also be triggered by a PE connection which is not connected to the inverter.

Correction of error by installer

Contact your installer to deal with the fault or get in touch with the SMA Serviceline.

3.2.7 The yellow LED blinks 7 times

Drastic change in differential current



Differential current

The fault "Drastic change in differential current" can only occur in transformerless inverters. Transformerless inverters can be identified by their device designation. The "TL" in the name stands for transformerless, e.g. Sunny Boy 10000TL-US.

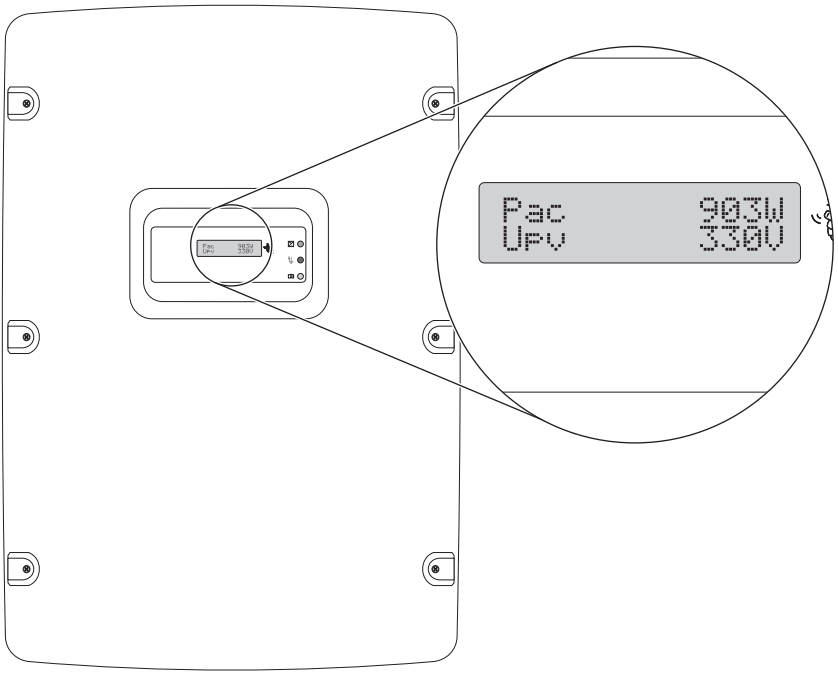
The yellow fault LED lights up for 5 sec. when the fault occurs, and then starts emitting the following blink code. 3 sec. off and then 7 brief consecutive blinks. This code is emitted 3 times in succession.

If this fault is still present, the fault signal starts over again.

The Sunny Boy has detected a drastic change in differential current and immediately stopped feeding into the grid. The integrated all-pole-sensitive residual current monitoring unit monitors the differential current relative to ground from the inverter supply connection right through to the PV generator. This additional personal protection system reacts to a drastic change in differential current of IDN > 30 mA and disconnects the Sunny Boy from the grid within 0.2 sec.

4 Information on the display

Sunny Boy inverters are equipped with a LC display in the lid.



Display Messages

Detailed explanations of the individual error and fault messages can be found in section 6 "Measurement channels and messages" (page 26).

4.1 Activating the backlight

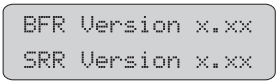
The backlight is switched on by knocking on the lid. Additional knocks switch the display on to the next message.

The backlight shuts off automatically after 2 min.

4.2 Display messages in the startup phase

- After startup of the inverter, the display first shows the device type.

- After 6 sec., the display shows the firmware versions of the operation control unit (BFR) and the current control unit (SRR).



4.3 Display messages during operation

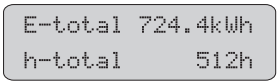
The LCD continuously scrolls through all relevant operating data. Each message is displayed for 5 sec., after all messages have been displayed the LCD repeats from the beginning.

- Message 1: Energy generated that day and the current operating mode:

- Message 2: Nominal grid voltage configuration and actual line-to-neutral voltage measurements:

- Message 3: Current feed-in power and the voltage of the PV generator:

- Message 4: Accumulated energy yield of the device since installation and the total operating hours:



The screens may also be scrolled through manually by repeatedly knocking on the lid of the inverter. Each knock advances the screen to the next message.

4.4 Fault messages

In case of a fault condition the LCD switches to "Fault" mode and the backlight is activated.

Each fault message is displayed for 5 sec. After 5 sec., the LCD will once again scroll through its normal operating screens. The fault condition will be included in the series of screens until the condition is cleared.

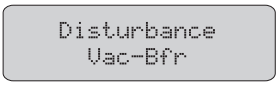
The upper display line indicates one of the three following failure types:

- Disturbance
- Warning
- Error

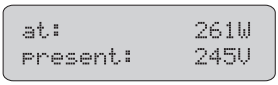
4.4.1 Disturbance

If an operational failure occurs, the display immediately switches to "Disturbance" and the background illumination lights up. In this case the inverter stops feeding into the grid. The following illustrations give examples of possible failure scenarios.

- For example, this Disturbance message would be displayed if the Sunny Boy detected a problem with the voltage of the utility grid. The message would clear automatically once the condition was corrected. Disturbances are typically caused by a measured value exceeding a predetermined limit.



- The display will show the value of the error (at:) as well as the present value for the particular parameter (present:).

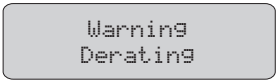


- After another 5 sec. the normal operating data appear. If the fault is still present, the fault display cycle starts over again. An overview of the status and error messages can be found in section 6 "Measurement channels and messages" (page 26) of this documentation.

4.4.2 Warning

If a fault warning occurs, the display immediately switches to "Warning" and the background illumination lights up. When warnings occur, the inverter continues feeding into the grid.

This warning appears after the inverter has been in "Derating" mode for 10 min.



4.4.3 Error

If an operational failure occurs, the display immediately switches to "Error" and the background illumination lights up. An Error condition will prevent the inverter from restarting until the condition is cleared.

- "Error ROM" indicates that the inverter has recognized an error in the EEPROM firmware. Contact SMA to have the error corrected.

4.4.4 Rapid Blinking of background illumination

DC Overvoltage

If an excessive DC input voltage is present at the Sunny Boy, this is indicated by rapid blinking of the background illumination and the message shown on the right.

NOTICE

DC input voltage too high. Destruction of the inverter.

- Contact your installer, who will immediately disconnect the PV generator from the inverter and check the DC voltage, as described in the inverter installation guide.

5 Maintenance and cleaning

Check the correct operation of the inverter at regular intervals. Impurities such as dust or pollen can cause heat accumulation that can lead to yield losses. Also check the inverters and the cables for visible external damage. Have repairs carried out if necessary.

5.1 Checking heat dissipation

5.1.1 Cleaning the fans

If the fan guards are only covered with loose dust, they can be cleaned with a vacuum cleaner. If vacuum cleaning does not produce a satisfactory result, contact your installer, who will dismantle the fans for cleaning.

- The fan cleaning procedure is described in the respective installation guide and must be carried out by qualified personnel.

5.2 Cleaning the display

If the display or the status LEDs are so soiled that they can no longer be read, they should be cleaned with a damp cloth.

- Never use solvents, abrasives or corrosive materials for cleaning.

6 Measurement channels and messages

If your inverter is equipped with a communication component, then numerous measurement channels and messages to aid diagnosis can be transmitted.

The following abbreviations apply:

BFR: Operation control unit

SRR: Current control unit

The BFR and SRR are redundant processor control systems for the utility protection functions.

6.1 Measuring channels

Measuring channel	Description
Balancer	Displays the currently active operating mode of the Sunny Boy, which has been set via the operating parameter "PowerBalancer".
CO2 saved	Amount CO2 saved in operation time
E-total	Total amount of energy fed into the grid
Error	Identification of the current disturbance / error.
Event-Cnt	Counter of events which have occurred
Fac	Grid frequency
Grid Type	Type of grid the inverter is connected to
h-On	h-on indicates how long sufficient DC voltage has been applied to the Sunny Boy and the Sunny Boy has been active including the time it was not able to feed to the utility with respect to low DC voltage or operation in stop mode.
h-total	Total number of grid-feeding operational hours
I-dif	Differential current of the PV system (inverter and PV generator)
Iac	Grid current (active current)
Inv.TmpVal	Temperature measured at IGBT module
Ipv	PV current
Max Vpv	Maximum PV input voltage
Mode	Display of the current operating mode
Pac	Generated AC power
Pcb.Tmp.Val	Temperature measured at PCB board
Power On	Total system start-up counter
Riso	Insulation resistance of the PV system before grid connection
Serial Number	Serial number of inverter
Vac	Grid voltage L1 - L2
Vac L1	Grid voltage L1 - N
Vac L2	Grid voltage L2 - N

Measuring channel	Description
Vfan	Fan supply voltage
Vpv	PV input voltage
Vpv-Setpoint	PV target voltage

6.2 Status Messages

The inverters can be in various operating modes. These are displayed as status messages which can vary according to the method of communication.

Message	Description and corrective measure
Balanced	The Sunny BoyBoy has disconnected from the grid, or is limiting its output to 6 kW (adustable with parameter PowerBalMax) over a 10-minute average. The Sunny Boy is part of a three-phase system equipped with two further Sunny Boys and the SMA Power Balancer to avoid unbalanced load. The "Balanced" message is displayed for the following reasons: **Case 1:** The operating parameter "PowerBalancer" is set to "PhaseGuard". One of the three Sunny Boy inverters in this system has indicated a grid fault and disconnected from the grid. Consequently, the other two Sunny Boy inverters also disconnect from the grid to avoid an unbalanced load, and send the message "Balanced". **Case 2:** The operating parameter "PowerBalancer" is set to "PowerGuard". One of the 3 Sunny Boys in this system has detected a device or grid fault and disconnected from the grid. The two remaining Sunny Boys reduce their output over a 10-minute average to 6 kW (adustable with parameter PowerBalMax) in order to prevent an unbalanced load. **Case 3:** The operating parameter "PowerBalancer" is set to "FaultGuard". One of the 3 Sunny Boys in this system has indicated a device or grid fault and disconnected from the grid. When grid failure occurs, the other two Sunny Boys also disconnect from the grid to prevent an unbalanced load, and send the message "Balanced". In the event of a device fault, the fault message is sent to the other two devices with a time lapse of 5 min. After the 5 min. have passed, the other two devices disconnect from the grid and send the message "Balanced".

Message	Description and corrective measure
Derating	Overtemperature in the inverter. The inverter reduces its output to prevent the device from overheating.
	Corrective measures • In the case of fan devices check heat dissipation, as described in section 5.1 "Checking heat dissipation" (page 25). • To avoid unnecessary yield losses, your installer must check the configuration and string size. • The installer should also check whether the inverter could be installed in a better position with better ventilation and adequate heat dissipation.
Disturbance	Disturbance. This error is generated for safety reasons and prevents the Sunny Boy from connecting to the grid.
	Corrective measures • Contact your installer or SMA.
Error	An error has been detected.
	Corrective measures • Contact your installer or SMA.
Grid Monitoring	Testing the grid status, relay test etc. This message occurs during the startup phase before the Sunny Boy has connected to the grid. The message usually appears in the morning and evening when there is little solar irradiation. Grid monitoring is also carried out after a fault has occurred.
MPP	The Sunny Boy is operating in MPP mode. It extracts the highest possible power output from the PV generator. MPP is the standard display message when operating under normal irradiation conditions.
MPP-Search	The inverter is calculating the MPP (Maximum Power Point)
Offset	Offset calibration of the electronics (at start-up).
Riso	Measurement of the insulation resistance of the PV system.
Stop	Interruption of operation after a disturbance. This status can also be set manually.
V-Const	Constant-voltage operation ("Const. Volt.") The input voltage of the PV array is set at a given nominal value and the inverter is not operating in MPP mode. In some cases this mode can be set as the operating mode.
Waiting	PV voltage is not high enough to start.
Warning	System warning advising further investigation.

6.3 Error messages

If an error occurs, the Sunny Boy generate a message which depends on the operating mode and the error detected.

Message	Description and corrective measure
!PV-Overvoltage! !DISCONNECT DC!	Overvoltage at DC input.
	Corrective measures • Contact your installer who will immediately disconnect the PV generator from the inverter! Otherwise, the inverter may be damaged. • Your installer must check the DC voltage, as described in the inverter installation guide.
CAN	Internal communication fault.
	Corrective measures • Contact your installer or the SMA Serviceline if this problem recurs.
Check L-N-PE	L and N are swapped on the AC connection or PE is not connected.
	Corrective measures • Contact your installer to check the AC connection.
DC link	The internal hardware monitoring system has detected a fault in the power electronics.
	Corrective measures • Contact your installer or the SMA Serviceline.
Derating	The inverter reduces the output power due to high internal temperature.
	Corrective measures • See Section 3.1.6 "The green LED goes out briefly" (page 15) for more information on this warning.
dI-Bfr dI-Srr	The inverter has detected a drastic change in the differential current. This fault only occurs in transformerless inverters that have no galvanic isolation from the grid. The integrated differential current monitoring system plays an important part in ensuring personal safety. A drastic change in the differential current can be caused by a sudden grounding fault, residual current or an actual fault in the device. The inverter disconnects from the grid.
	Corrective measures • If the message „dI-Bfr“ or „dI-Srr“ appears for no obvious reason, contact your installer to verify whether the plant insulation might have a ground fault, as described in the inverter installation guide.

Message	Description and corrective measure
dI-Meas-Srr dI-Meas	Deviation in the differential current measurement / differential current
	Corrective measures • If this fault message is displayed repeatedly, it means that inverter operation is permanently disabled. If the inverter is equipped with a communication interface, the installer can try to rectify the fault with the help of a communication product. • Should this be unsuccessful, contact the SMA Serviceline.
EEPROM	Transition disturbance during reading or writing of EEPROM data. This data is not essential for safe operation. • The disturbance has no effect on the performance of the inverter.
EEPROM p	Data EEPROM defective, device is set to permanent disable due to the fact that the data loss affects important functions of the inverter.
	Corrective measures • Contact SMA.
EeRestore	One of the duplicate data sets in the EEPROM is defective and has been reconstructed without loss of data. • This error message is for information purposes only and has no effect on the performance of the inverter.
Fac-Bfr Fac-Srr	The grid frequency is no longer within the permissible range ("Bfr" or "Srr" is an internal message with no relevance for the user). The Sunny Boy assumes that the public grid is down and disconnects from the grid in order to avoid islanding.
	Corrective measures • Contact your installer to deal with the fault. • If the grid frequency is within the tolerance range, yet "Fac-Bfr" or "Fac-Srr" faults are still being displayed, contact SMA.
HW-Signal	Internal measurement fault or hardware defect.
	Corrective measures • Contact your installer or the SMA Serviceline if this problem recurs.
Iac-DC_Offs-Srr	The DC component of the electricity being fed into the grid has exceeded the permissible range. For safety reasons, the inverter disconnects itself from the grid.
	Corrective measures • If the grid current is outside the permissible range due to local grid conditions, contact the local utility operator for assistance. • If the grid current is within the tolerance range, yet the "Iac-DC_Offs-Srr" fault is still being displayed, contact the SMA Serviceline.

Message	Description and corrective measure
IGBTs	The internal hardware monitoring system has detected a fault in the power electronics.
	Corrective measures • Contact your installer or the SMA Serviceline.
MSD-FAC	Internal measurement comparison fault or hardware defect.
	Corrective measures • Contact your installer or SMA if this problem recurs.
MSD-Idif	Internal measurement comparison fault or hardware defect.
	Corrective measures • Contact your installer or SMA if this problem recurs.
MSD-VAC	Internal measurement comparison fault or hardware defect.
	Corrective measures • Contact your installer or SMA if this problem recurs.
MSD-Timeout	Internal measurement comparison fault or hardware defect.
	Corrective measures • Contact your installer or the SMA Serviceline if this problem recurs.
Offset	Fault in the acquisition of measurement data.
	Corrective measures • Contact your installer or SMA if this problem recurs.
PowerBalancer	The Sunny Boy is part of a three-phase system with two further Sunny Boys. This is equipped with the SMA Power Balancer for preventing unbalanced loads. The operating parameter "PowerBalancer" is set to "PhaseGuard" or "FaultGuard".
	Corrective measures • For more detailed descriptions of the operation modes „PhaseGuard“ and „FaultGuard“ refer to section 6.2 "Status Messages" (page 25) under „Balanced“.
REL_INV_CLOSE REL_GRID_CLOSE	A grid relay does not close. The inverter checks the relays connecting it to the grid before feeding power into the grid. If the grid relays do not function properly, the inverter does not connect to the grid for safety reasons.
	Corrective measures • If this fault message is displayed repeatedly, it means that inverter operation is permanently disabled. If the inverter is equipped with a communication interface, the installer can try to rectify the fault with the help of a communication product. • Should this be unsuccessful, contact the SMA Serviceline.

Message	Description and corrective measure
REL_INV_OPEN REL_GRID_OPEN	A grid relay does not open. The inverter checks the relays connecting it to the grid before feeding power into the grid. If the grid relays do not function properly, the inverter does not connect to the grid for safety reasons.
	Corrective measures • If this fault message is displayed repeatedly, it means that inverter operation is permanently disabled. If the inverter is equipped with a communication interface, the installer can try to rectify the fault with the help of a communication product. • Should this be unsuccessful, contact the SMA Serviceline.
Riso	The electrical insulation of the PV system to ground is faulty. The resistance between the DC plus and/or DC minus connection and ground is outside the defined limit range.
	Corrective measures • Contact your installer to check whether your system is properly insulated or a ground fault has occurred. Further information is to be found in the inverter installation guide.
Riso-Sense	The insulation measurement has failed.
	Corrective measures • Contact your installer or the SMA Serviceline if this problem recurs.
ROM	The inverter firmware is faulty.
	Corrective measures • Contact your installer or SMA if this problem recurs.
SD-DI-Conv	The inverter has detected an insulation fault on the DC side.
	Corrective measures • Contact your installer to check whether the plant is properly insulated or a ground fault has occurred. Further information is to be found in the inverter installation guide.
SD-Imax	The inverter has detected an overcurrent on the AC side. It disconnects from the grid for safety reasons and then attempts to reconnect to the grid.
	Corrective measures • Contact your installer or the SMA Serviceline if this problem recurs.
SD-INV-Bridge	The inverter has detected a fault in the power electronics. It disconnects from the grid and then attempts to reconnect to the grid.
	Corrective measures • Contact your installer or the SMA Serviceline if this problem recurs.
Shutdown	Temporary inverter fault.
	Corrective measures • Contact your installer or SMA.

Message	Description and corrective measure
STM-Timeout	Internal program run fault.
	Corrective measures • Please contact your installer or the SMA Serviceline if this problem recurs.
Vac-Bfr Vac-Srr	The grid voltage is no longer within the permissible range ("Bfr" or "Srr" is an internal message that has no meaning for the user). This can be caused by any of the following: • Grid disconnected (line circuit breaker, fuse), • AC cable is broken or • AC cable is highly resistive For safety reasons, the inverter disconnects itself from the grid.
	Corrective measures • Contact your installer to check the grid voltage and the grid connection at the inverter. • If the grid voltage is outside the acceptable range due to local grid conditions, your installer should ask the utility operator whether the voltage can be adjusted at the feed-in point or whether they would agree to modifications in the monitored operational limits (operating parameters: Vac-Min and Vac-Max). • If the grid frequency is within the tolerable range, yet "Vac-Bfr," or "Vac-Srr" faults are still being displayed, contact SMA.
VacL1-Bfr VacL1-Srr	The grid voltage on line 1 is no longer within the permissible range ("Bfr" or "Srr" is an internal message that has no meaning for the user). This can be caused by any of the following: • Grid disconnected (line circuit breaker, fuse), • AC cable is broken or • AC cable is highly resistive For safety reasons, the inverter disconnects itself from the grid.
	Corrective measures • Contact your installer to check the grid voltage and the grid connection at the inverter. • If the grid voltage is outside the acceptable range due to local grid conditions, your installer must ask the utility operator whether the voltage can be adjusted at the feed-in point or whether they would agree to modifications in the monitored operational limits (operating parameters: Vac-Min and Vac-Max). • If the grid frequency is within the tolerable range, yet "Vac-Bfr," or "Vac-Srr" faults are still being displayed, contact SMA.

Message	Description and corrective measure
VacL2-Bfr VacL2-Srr	The grid voltage on line 2 is no longer within the permissible range ("Bfr" or "Srr" is an internal message that has no meaning for the user). This can be caused by any of the following: • Grid disconnected (line circuit breaker, fuse), • AC cable is broken or • AC cable is highly resistive For safety reasons, the inverter disconnects itself from the grid.
	Corrective measures • Contact your installer to check the grid voltage and the grid connection at the inverter. • If the grid voltage is outside the acceptable range due to local grid conditions, your installer must ask the utility operator whether the voltage can be adjusted at the feed-in point or whether they would agree to modifications in the monitored operational limits (operating parameters: Vac-Min and Vac-Max). • If the grid frequency is within the tolerable range, yet "Vac-Bfr," or "Vac-Srr" faults are still being displayed, contact SMA.
VdclinkMax	The internal hardware monitor has detected an overvoltage condition in the intermediate circuit of the inverter.
	Corrective measures • Contact your installer or the SMA Serviceline if this problem recurs.
VpvMax	Overvoltage at DC input.
	Corrective measures • Contact your installer who will immediately disconnect the PV generator from the inverter! Otherwise, the inverter may be damaged. • Your installer must check the DC voltage, as described in the inverter installation guide.
Watchdog Watchdog Srr	Internal program run fault.
	Corrective measures • Contact your installer or the SMA Serviceline if this problem recurs.

7 Glossary

AC

Abbreviation for "Alternating Current"

DC

Abbreviation for "Direct Current"

Derating

A controlled reduction in performance, usually dependent on component temperatures. Compared with the (also common) practice of completely shutting down the device, derating has a less drastic effect on the external grid.

Grid-connected system

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

Grid impedance

The grid impedance is a characteristic grid specification, which is determined both by the grid infrastructure, and by the number of power suppliers and power consumers. If supply to the grid section drops due to a grid shutdown on the part of the adjacent energy suppliers (medium-voltage transformers), the grid impedance changes abruptly. In order to detect this occurrence, and to prevent the formation of an unwanted stand-alone grid, SMA Grid Guard monitors the grid impedance and disconnects the inverter from the grid in the event of a sudden impedance variation.

Inverter

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.

Maximum Power Point "MPP"

The operating point (current / voltage) of the PV generator at which the highest possible performance under the prevailing conditions is achieved. The actual MPP changes constantly, depending on the level of solar irradiation, cell temperature, etc.

MPP tracker

A device that adjusts the voltage and current of a PV generator so that it operates at its "Maximum Power Point".

PV

Abbreviation for "photovoltaic" describing the conversion of solar energy into electrical energy.

PV generator

Technical device for the conversion of solar energy into electrical energy. This normally refers to all installed and electrically connected PV modules in a PV system.

PV module

A collection of solar cells in an enclosure that protects the sensitive cells from mechanical stress and allows easy installation.

SMA Grid Guard

The SMA Grid Guard concept monitors, for instance, the voltage and frequency of the connected AC grid according to predefined parameters. This serves to prevent the formation of a stand-alone grid in the event of grid disconnection.

SMA Power Balancer

The SMA Power Balancer is a serial feature of the Sunny Boy. The SMA Power Balancer prevents the formation of an unbalanced load during three-phase grid feeding. To this effect, a group made up of 3 Sunny Boys are each connected via a control line to a 3-phase feeding unit.

Solar cell

An electronic component which generates electrical energy when irradiated with sunlight. Since the voltage produced by a single solar cell is very small (approx. 0.5 V), several solar cells are combined to form a PV module.

Solar energy

"Sun energy", i.e. energy from sunlight (solar irradiation).

PV power plant

Describes the totality of components required for the exploitation and utilization of solar energy. In grid-connected systems this includes not only the PV generator, but also the inverter, e.g. Sunny Boy.

String

Describes a group of series-connected PV modules.

String inverter

In string technology, the PV generator is subdivided into individual module surfaces, or "strings", each of which has an assigned string inverter. This technology reduces system costs while at the same time making installation a lot simpler and increasing the energy yield and system availability.

Unbalanced load

The difference between the power fed into the grid at the individual phase conductors.

8 Contact

If you have technical problems concerning our products, contact your installer or the SMA Serviceline. We require the following information in order to provide you with the necessary assistance:

- Inverter type
- Type and number of modules connected
- Communication method
- Serial number of the Sunny Boy
- Failure or warning number of the Sunny Boy
- Display of the Sunny Boy

SMA Solar Technology America, LLC

4031 Alvis Court

Rocklin, CA 95677

Tel. +1 916 625 0870

Tel. +1 877-MY SMA TECH

Tel. +1 877 697 6283 (Toll free, available for USA, Canada and Puerto Rico)

Fax +1 916 625 0871

Service@SMA-America.com

www.SMA-America.com

SMA America, LLC

www.SMA-America.com