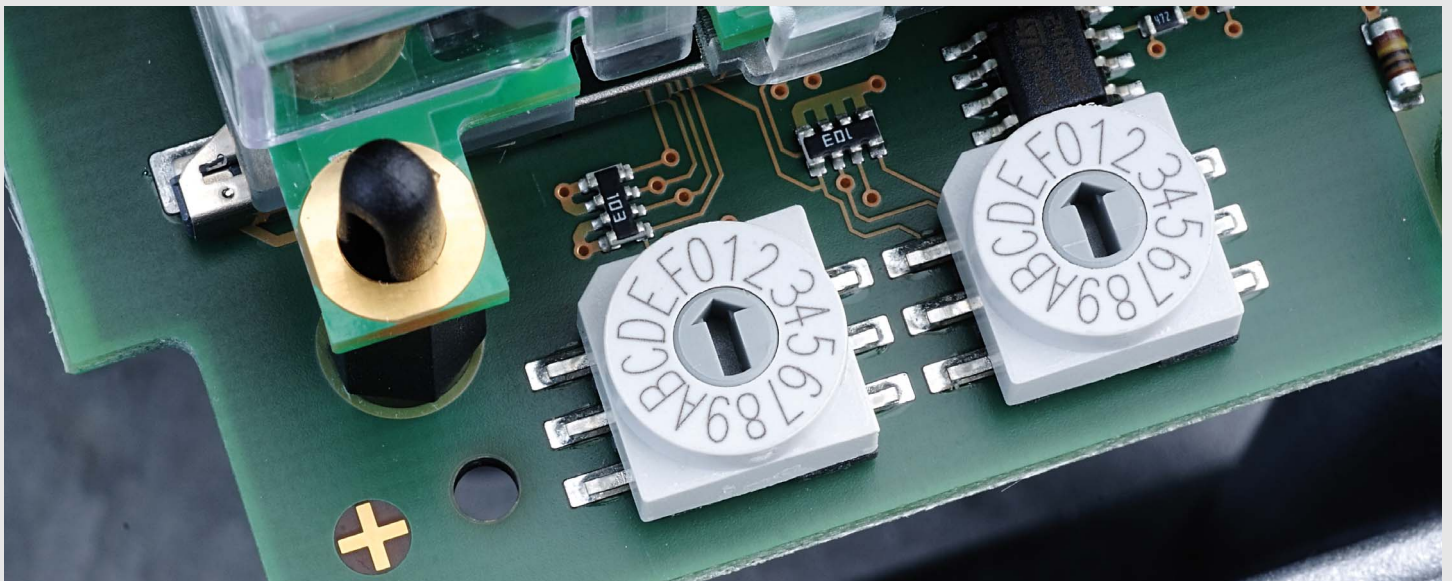


PV inverter

Usage and settings of PV inverters in island grids and backup systems



Contents

Deviations from the nominal voltage and frequency are possible in island grids and in backup systems during grid failures. Despite these variations in the island grid, all components of these systems must work together smoothly.

- Find the right SMA PV inverter type that is suitable for usage in an island/backup system (see page 2 ff).
- Set the PV inverter parameters to island/backup so that you can achieve optimal operation (see page 4 ff).
- The PV inverter can reduce its output power with these island/backup parameter settings if required by the battery charge state or the consumer power demands. This task is assumed by the Frequency Shift Power Control (FSPC) integrated in the PV inverter (see page 8 ff).

1 Choosing the PV inverter

The following SMP PV inverters can be used in island grids or backup systems:

Inverter	Island system	Backup system
SB 700	x	x
SB 1100 / 1700	x	x
SB 1100LV	x	x
SB 2100TL		x
SB 2400	x	x
SB 2500	x	x*
SB 2800i	x	x*
SB 3000	x	x*
SB 3000TL-20 / 4000TL-20 / SB 5000TL-20	x	x
SB 3300	x	x
SB 3300TL		x
SB 3300TL HC		x
SB 3800	x	x
SB 4200TL Multi-String / 5000TL Multi-String		x
SB 4200TL HC / SB 5000TL HC		x
SB 5000TLW Multi-String		x
SMC 4600A / 5000A / 6000A	x	x
SMC 5000 / 6000	x	x
SMC 7000HV	x	x
SMC 6000TL / 7000TL / 8000TL	x	x
SMC 9000TL / 10000TL / 11000TL	x	x
SWR 700 / 850(E) / 1100E		x
SWR 1100LV		x
SWR 1500		x
SWR 1700(E)		x
SWR 2000		x
SWR 2500 / 3000		x

* In the backup system S, SI 2012/2224: Usage from model series May 2005

Sizing procedure:

In an **island system**, the nominal AC power of the PV inverter may only be twice as large as the nominal AC power of the island grid inverter.

In a **backup system**, the maximum AC power of the PV inverter is limited by the Automatic Switch Box (AS-Box).

The following table shows the nominal PV inverter power that you can connect to a suitable AS-Box:

Automatic Switch Box – Type	nominal AC power of PV inverter
AS-Box S	4.6 kW
AS-Box M	5.7 kW
AS-Box L	30 kW
AS-Box XL	110 kW

SUNNY BACKUP SET S

Connect a maximum of 2 PV inverters to an AS-Box S!

SUNNY BACKUP SET XL

In a Sunny Backup system XL, the nominal AC power of the PV inverter may only be twice as large as the sum of the nominal AC power of the backup inverters.

2 Setting the island grid/backup parameters

Note when configuring the SMA PV inverters for operation in island grids or backup systems:

DEFAULT SETTINGS

You can order all PV inverters with default island grid or backup parameters from SMA Solar Technology.

WARNING!

As soon as you set a PV inverter to island grid/backup parameters, the device no longer complies with certain standards and guidelines (e.g. in Germany the DIN VDE 0126-1-1). Danger of feedback if the public grid is down.

- **Never directly** operate the PV inverter on the public grid with these settings.

ACCESS PERMISSION

For changing the grid relevant parameters in the PV inverter you need a special access code, the installer code. To obtain your personal code, contact the Sunny Island Hotline by calling +49 561 9522 399 or sending an e-mail to SunnyIsland.Service@SMA.de.

You need one of the following communication devices to set the PV inverter parameters:

- Sunny Boy Control
- Sunny WebBox
- PC/laptop with Sunny Data /Sunny Data Control software and a service cable for data transfer (SMA order number: "USBPBS-1 1" USB service interface)

Change the parameter settings as described in the user manual for the device or the software.

2.1 Setting the parameters for PV inverter Sunny Boy SB 3000TL-20 / 4000TL-20 / SB 5000TL-20

Setting parameters with the internal rotary code switch

In the first 10 operational hours you can set the inverter types SB 3000TL-20 / 4000TL-20 / SB 5000TL-20 using the rotary code switch to island grid/backup operation ("off-grid"). In this time period you do not require access permission to change the grid parameters.

Turn the rotary code switch to the position "E1". "E" stands for off-grid and "1" stands for German.

Setting parameters with the software Sunny Data/Sunny Data Control

After the first 10 operational hours you can only set the island grid/backup parameters using the communication devices. For this you need access permission.

Set the parameter "GridGuard.CntrySet" to "None".

Operation of the inverters in 60 Hz grids

NO GRID FREQUENCY DETECTION

The inverters SB 3000TL-20 / 4000TL-20 / SB 5000TL-20 do not perform automatic grid frequency detection (50 Hz or 60 Hz).

Setting the parameters to island grid/backup operation using the rotary code switch does not change the frequency. The device continues to operate with a frequency of 50 Hz. Manually change the frequency from 50 Hz to 60 Hz if you wish to use this inverter in 60 Hz grids.

Parameter settings for operation in 60 Hz grids:

- "GridGuard.FrqCtl.hLim" = 65 Hz
- "GridGuard.FrqCtl.Max" = 65 Hz
- "GridGuard.FrqCtl.lLim" = 55 Hz
- "GridGuard.FrqCtl.Min" = 55 Hz

2.2 Setting parameters for the PV inverters Sunny Boy SB 2100TL / SB 3300TL / SB 3300TL HC / SB 4200TL Multi-String / SB 4200TL HC / 5000TL Multi-String / SB 5000TL HC / SB 5000TLW Multi-String for backup operations

The inverter types SB 2100TL / SB 3300TL / SB 3300TL HC / SB 4200TL Multi-String / SB4200TL HC / 5000TL Multi-String / SB 5000TL HC / SB 5000TLW Multi-String are set up manually for backup operation. For this you need access permission.

Set the parameters in the following table with the values provided.

No.	Parameter	Unit	Value
1	I-NiTest	mA	Off (MSD = 0)
4	Fac-delta- lower range in which the Sunny Boy is active relative to f_0	Hz	-4.5 (starting from base frequency f_0)
5	Fac-delta+ upper range in which the Sunny Boy is active relative to f_0	Hz	+1.5 (starting from base frequency f_0)
6	dFac-Max Max. Rate of change	Hz/s	4

2.3 Setting parameters for other PV inverter types

This chapter describes the settings for the following PV inverter types:

- SB 700
- SB 1100 / 1700
- SB 1100LV
- SB 2400
- SB 2500
- SB 2800i
- SB 3000
- SB 3300
- SB 3800
- SMC 4600A / 5000A / 6000A
- SMC 5000 / 6000
- SMC 7000HV
- SMC 6000TL / 7000TL / 8000TL
- SMC 9000TL / 10000TL / 11000TL

- SWR 700 / 850(E) / 1100E
- SWR 1100LV
- SWR 1500
- SWR 1700(E)
- SWR 2000
- SWR 2500 / 3000

Set these inverter types to island grid/backup operation by setting the parameter "Default" to "Offgrid". For this you need access permission.

The parameter setting "Offgrid" sets the parameters of the Sunny Boy automatically to the values listed in the following table.

No.	Parameter	Unit	Value
1	I-NiTest	mA	Off (MSD = 0)
2	Uac-Min	V	180
3	Uac-Max	V	260
4	Fac-delta- lower range in which the Sunny Boy is active relative to f_0	Hz	-4.5 (starting from base frequency f_0)
5	Fac-delta+ upper range in which the Sunny Boy is active relative to f_0	Hz	+4.5 (starting from base frequency f_0)
6	dFac-Max Max. Rate of change	Hz/s	4
7	Fac-start delta refers to the frequency increase relative to f_0 , at which point the power adjustment via frequency begins.	Hz	1 (starting from base frequency f_0)
8	Fac-Limit delta refers to the frequency increase relative to f_0 , at which point the power adjustment via frequency ends. The output of the Sunny Boy at this point is 0 W.	Hz	2 (starting from base frequency f_0)

3 Frequency Shift Power Control (FSPC)

If Sunny Boy inverters are connected to the AC side of an island grid/backup operation, the island grid/backup inverter must be able to limit their output power. This kind of situation arises, for example, when the island grid/backup inverter battery is fully charged and the (solar) power available from the PV system exceeds the power required by the connected loads.

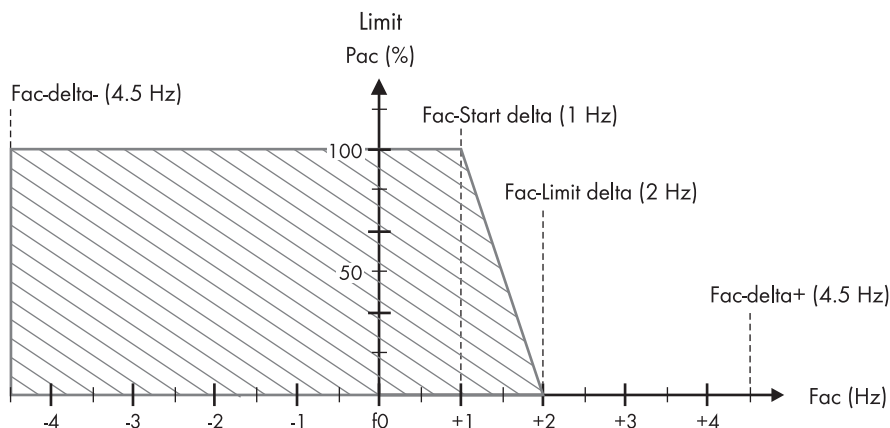
To prevent the excess energy from overcharging the battery, the island grid/backup inverter recognizes this situation and changes the frequency at the AC output. This frequency adjustment is analyzed by the Sunny Boy. As soon as the grid frequency increases beyond the value specified by "Fac-Start delta"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

NO FREQUENCY SHUTDOWN

From the inverter types SB 2100TL / SB 3300TL / SB 3300TL HC / SB 4200TL Multi-String / SB 4200TL HC / 5000TL Multi-String / SB 5000TL HC / SB 5000TLW Multi-String as well as from the older models of the SWR model series, Frequency Shift Power Control is **not supported**.

If the actual battery voltage (V_{Batt}) is greater than the nominal battery voltage ($V_{\text{Batt soll}}$), these Sunny Boys disconnect from the present island grid/backup grid. They can only connect again after the battery has discharged at least 5 %.

This function is shown in the following figure:



The data in the above figure have the following meanings:

- f_0 refers to the base frequency of the island grid (50 Hz in this example).
- Fac-delta- and Fac-delta+ refer to the maximum range in which the Sunny Boy is active relative to f_0
- Fac-start delta refers to the frequency increase relative to f_0 , at which point the power adjustment via frequency begins.
- Fac-Limit delta refers to the frequency increase relative to f_0 , at which point the power adjustment via frequency ends. The output of the Sunny Boy at this point is 0 W.

If the value is below the Fac-delta- limit or exceeds the Fac-delta+ limit, the Sunny Boys disconnect from the island grid or backup system.

FREQUENCY SHUTDOWN OF THE SUNNY BOY

The island grid/backup inverter increases the frequency short-term when it needs to synchronize itself to the public grid and the actual battery voltage (V_{Batt}) is greater than the nominal battery voltage ($V_{Batt\,soll}$).

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

The Sunny Boys automatically switch back on once the grid frequency returns to within the limit values.

When Frequency Shift Power Control is activated and the diesel generator in the island grid/backup grid is operating, the diesel generator determines the frequency, and the Sunny Boys react to certain changes in the diesel generator frequency. As a rule, diesel generators operate at 50 Hz when under load. For this reason, in most cases the Sunny Boys will deliver their entire power to the island grid/backup grid, even when the generator is running.