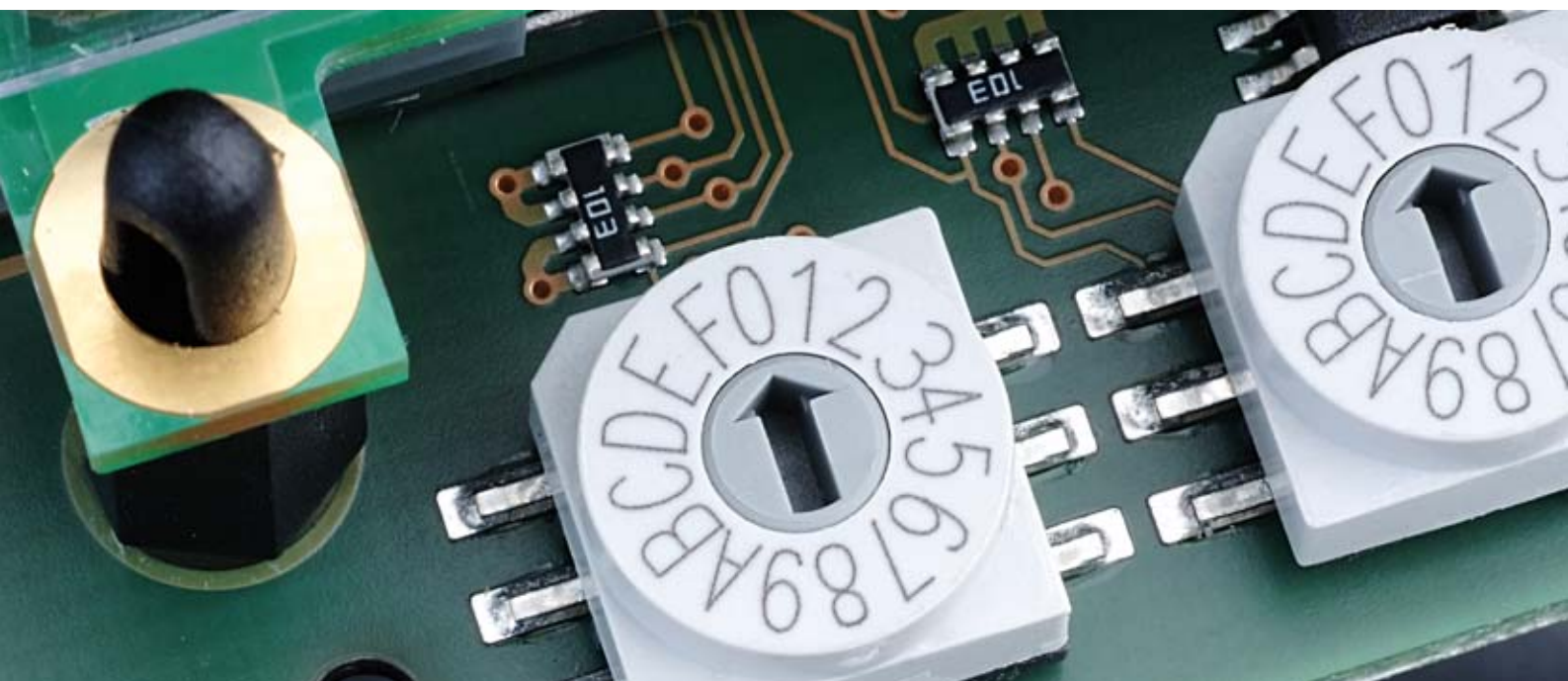


Technical Information

PV Inverters

Use and Settings of PV Inverters in Off-Grid Systems



Content

This technical information includes the following points:

- How to identify the SMA PV inverter best suited for use in an off-grid system
- How to set the PV inverters to stand-alone mode to achieve optimum operation
- The PV inverter can be set to stand-alone mode and reduce its feed-in power if this is required by the battery state of charge or the energy demand of the connected loads. To do this, use the integrated frequency-shift power control (FSPC).

1 Selecting the PV Inverter

You can use the following PV inverters in off-grid systems. You can order all the listed PV inverters with preset off-grid parameters from SMA Solar Technology AG. The PV inverters must be equipped with at least the firmware version given in the table, or a higher version. If this is not the case, perform a firmware update (see PV inverter documentation).

PV inverter	Firmware version
SB 1300TL-10	4.22
SB 1600TL-10	4.22
SB 2100TL	4.22
SB 3000TL-21	2.60.03.R
SB 3600TL-21	2.60.03.R
SB 4000TL-21	2.60.03.R
SB 5000TL-21	2.60.03.R
STP 5000TL-20*	2.50.01.R
STP 6000TL-20*	2.50.01.R
STP 7000TL-20*	2.50.01.R
STP 8000TL-20*	2.50.01.R
STP 9000TL-20*	2.50.01.R
SMC 9000TLRP-10	All versions
SMC 10000TLRP-10	All versions
SMC 11000TLRP-10	All versions
STP 10000TL-10*	02.22.17
STP 12000TL-10*	02.22.17
STP 15000TL-10*	02.22.17
STP 15000TLEE-10*	2.10.11.R
STP 17000TL-10*	02.22.17
STP 20000TLEE-10*	2.10.11.R

* Can only be used in three-phase off-grid systems

Notes on design:

- In off-grid systems, the nominal AC power of the PV system must not be more than double the nominal AC power of the Sunny Island inverters.
- The battery capacity per installed kWp of the PV array must be at least 100 Ah.
Example: In a PV array with 5 kWp, the battery capacity must be at least 500 Ah.

2 Setting a PV Inverter to Stand-Alone Mode

To change grid-relevant parameters in the PV inverter after the first ten operating hours, you will need a special access code, the SMA Grid Guard code. The application form for this personal access code is available in the download area at www.SMA-Solar.com, in the "Certificate" category of the respective PV inverter.

If the SMA PV inverter is not configured for off-grid operation ex works, you will need to configure the country data set of the PV inverter to stand-alone mode (see the PV inverter documentation).

Prior to commissioning, you can set the following PV inverters to stand-alone mode by means of rotary switches (see Technical Information "Overview of Rotary Switch Positions for PV Inverters" at www.SMA-Solar.com):

- SB 3000TL-21 / 3600TL-21 / 4000TL-21 / 5000TL-21
- STP 5000TL-20 / 6000TL-20 / 7000TL-20 / 8000TL-20 / 9000TL-20
- STP 10000TL-10 / 12000TL-10 / 15000TL-10 / 17000TL-10
- STP 15000TLEE-10 / 20000TLEE-10

With all other PV inverters you must set the parameter **Default** to **OFF-Grid** using a communication product (see PV inverter documentation).

Required Communication Products

To enter the SMA Grid Guard code or to configure a PV inverter without using rotary switches, you will need one of the following communication products:

- Sunny Boy Control
- Sunny WebBox
- Computer with the Sunny Data/Sunny Data Control software and a service cable for data transmission (SMA order number: "USBPBS-11" – USB service interface)
- Computer with SMA *Bluetooth*[®] Wireless Technology and Sunny Explorer software for PV inverters with a *Bluetooth* interface
- Computer with Sunny Explorer software for PV inverters with a Speedwire interface

Change due to Configuration of Stand-Alone Mode

The setting for stand-alone mode automatically sets the Sunny Boy parameters to the values listed in the following table:

Parameter	Value
I-NiTest	Off (ENS = 0)
Uac-Min	180 V
Uac-Max	260 V
Fac-delta – Lower range in which the Sunny Boy is active, relative to f_{AC}	-4.5 Hz (starting from the base frequency f_{AC})
Fac-delta+ Upper range in which the Sunny Boy is active, relative to f_{AC}	+4.5 Hz (starting from the base frequency f_{AC})
dFac-Max Max. rate of change	4 Hz/s
Fac-start delta Frequency increase relative to f_{AC} , at which the power control via frequency begins	1 Hz (starting from the base frequency f_{AC})
Fac-Limit delta Frequency increase based on f_{AC} , at which the power control via frequency ends. The power of the Sunny Boy at this point is 0 W.	2 Hz (starting from the base frequency f_{AC})

3 Frequency-Shift Power Control (FSPC)

In off-grid operation, the Sunny Island inverters must be able to limit their output power, if PV inverters are connected on the AC side. This situation can occur when, for example, the battery of the Sunny Island is fully charged and the PV power available from the PV system exceeds the power requirement of the connected loads.

To prevent the excess energy from overcharging the battery, the Sunny Island recognizes this situation and changes the frequency at the AC output. This frequency change is monitored by the PV inverter. As soon as the power frequency increases beyond the value specified in **f_{AC} Start Delta**, the PV inverter limits its output power accordingly.

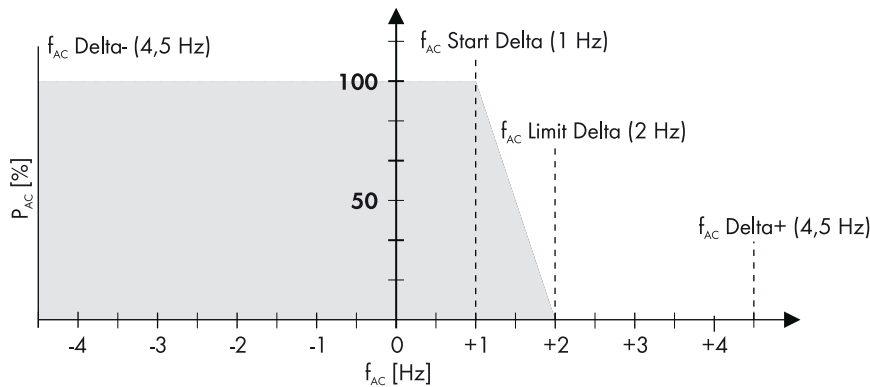


Figure 1: Operating principle of the FSPC

The terms used have the following meanings:

- **f_{AC}** refers to the base frequency of the stand-alone grid (here 50 Hz).
- **f_{AC} Delta-** and **f_{AC} Delta+** refer to the maximum range relative to **f_{AC}** in which the PV inverter is active.
- **f_{AC} Start Delta** is the frequency increase relative to **f_{AC}**, at which the frequency-based power control begins.
- **f_{AC} Limit Delta** is the frequency increase relative to **f_{AC}**, at which the frequency-based power control ends. The output power of the PV inverter at this point is 0 W.

If the value is below the **f_{AC} Delta-** limit or above the **f_{AC} Delta+** limit, the PV inverters disconnect from the stand-alone grid.

If a diesel generator is operating in the stand-alone grid, the diesel generator determines the frequency, and the PV inverters react to certain changes in the diesel generator frequency.

With diesel generators, the frequency of the output voltage under load is 50 Hz. For this reason, the PV inverters will in most cases supply their entire power to the stand-alone grid, even when the diesel generator is in operation.

If the current battery voltage is greater than the rated battery voltage and is also to be synchronized with a diesel generator, the Sunny Island will temporarily increase the frequency and the PV inverters will disconnect from the stand-alone grid via frequency shutdown (overfrequency). Afterwards, the Sunny Island synchronizes with the diesel generator.