

info

Technology-Highlights for 2003

The year 2002 was characterized by a very inhomogeneous progression. While in the first six months of the year the market demand was rather depressive, it increased substantially in the second half and experienced a downright boom in the last months of the year. Thus, the planning for customers and suppliers was very difficult and longer delivery times at the end of the year could not be avoided despite of increased production capacities.

Owing to the good and friendly support of our customers, the dedicated staff of SMA was successful in largely coping with this challenge. As we expect a similar business scheduling - the program "Hundert Tausend Dächer" ("Hundred thousand roofs") will run out at the end of year 2003 - one of our essential tasks in this year is to continue to flexibilize the production in order to be able to react more quickly to larger demand fluctuations.

Our development staff will focus on the consistent enhancements of the approved and well known products concerning ease of use and installation as well as further optimization of the cost/performance ratio. Of course, our top priority is to adapt to the requirements and needs of our customers.

Web Piggy Back – always informed

In the course of the second quarter of 2003 SMA offers a so

called *Web Piggy-Back*, an adequate modem integrated into the Sunny Boy Control in form of a Piggy-Back module. The grid-feeding device can send e-mails via the modem in order to transfer data or error messages to the operator or electrician. Thus, an external modem and the associated time-consuming installation and cabling amount are not necessary any more. The *Web Piggy Back* is available in an analog, ISDN and GSM version and adapts to the requirements of the plant operator. An Ethernet option for the connection of the Sunny Boy Control to a Local Area Network (LAN) will soon be available.

Sunny Beam - The "remote" display for the Sunny Boy

Upon many customer requests, we developed an attractively designed display with wireless technology. The graphic display *Sunny Beam* is connected to the inverters via cable, but can be used independently and remotely. *Sunny Beam* can be used in any place, such as on the table in the living room, at the wall of the utility room or on the table of the conference room. We would like to emphasize that the energy supply is realized by solar cells integrated in the device and is completely independent of the utility.



In addition to the display of the current power of the inverters to be monitored (up to 4 units per device) the course of the day in graphical form, the total power, total energy return of the plant as well as the energy return of the current day and the day before are indicated.

Thus, the *Sunny Beam* provides the plant operator with the maximum amount of information as well as ease and flexibility concerning installation. Furthermore, the upgradeability will offer you an interesting additional business, also in the case of older plants.

Web Piggy Back

Sunny Beam

Sunny Central

Sunny Team

Sunny Island

SB 4200TL

Sunny BIG Boys



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Sunny Central - new!

The inverter of the Sunny Central series designed for large PV plants has also been enhanced consistently.

As from now, the *Sunny Central* is available as

- SC60** (recomm. PV power, 75 kWp),
- SC90** (110 kWp),
- SC150** (180 kWp),
- SC200** (250 kWp),
- SC300** (360 kWp) and
- SC400** (500 kWp)

The new circuit concept *Sunny Team* is a patented enhancement of the Master/Slave principle (MS) avoiding the disadvantages of the MS principle, the static interconnection of the whole generator on the DC rail. Now, this concept can also be used for these central inverters. During periods with lower power the units of the solar generator are wired optimally on the different power units of the inverter. According to the momentary total power of the solar generator, optimal operating states are reached. In addition to a higher energy return of the entire plant, another advantage is a higher lifetime resulting from a more uniform utilization of the power components. In case of malfunction or failure of an inverter unit, the generator fields are switched automatically to other units without energy losses.

The new String monitoring *Sunny String Monitor* is another innovative feature of the new Sunny Central. The String currents are centrally monitored by the inverter's control unit. Thereby, failures of individual Strings shall be safely detected but without obtaining error messages due to fluctuating radiation or similar. The measured values of the Strings are compared with each other via a special algorithm and long-term deviations are detected.

Sunny Island 4500

In 2003, SMA will also introduce new products in the area

of island systems representing essentially consistent enhancements of the successful Sunny Island series. As from now, the Sunny Island 3300 is replaced by the *Sunny Island 4500* with an improved cost/performance ratio.

In order to be able to be more responsive to specific customer needs and the respective requirements of the usage site, we will provide complete energy supply kits consisting of optimally compatible components (for example inverter, battery storage and diesel generators). On the one hand, we can supply these kits as complete plants ready for use. On the other hand, they can serve our customers as orientation and dimensioning guide for the assembly of their own systems for an autarkic energy supply.

Of course, you can continue to rely on the installation and commissioning support by SMA's service staff.

In addition, we will soon offer a special version of the Sunny Boy inverters. In case of a power failure, this version is able of island operation offering a nearly uninterrupted power supply of the most important connected consumers, such as computer or heating controls.

New: SB 4200TL Multi-String - Ideal for 5 kWp plants

Based on the SB 5000TL Multi-String, SMA will be able to provide a transformerless String Inverter with a maximum output power of 4.2 kW (nominal power 4.0 kW) by the end of May 2003.

Due to an outstanding maximum efficiency of 95.5% and a unique local MPP Tracking for each of its two Strings, the *SB 4200TL Multi-String* is distinguished by the best system efficiency of its class. The *SB 4200TL Multi-String*, like his "big brother", is

best prepared for outdoor operation (IP65).

Sunny BIG Boys

After the successful market launch of the SB 5000TL Multi-String there will be another String Inverter in a 3-phase version in the power range of 20 kW.

The specific price (Euro cent/Wp) of this device type will be reduced again in comparison with the SB 5000TL. In case of large PV plants up to the range of 100 kWp, the installation can be simplified substantially when this device version is used.

SMA offers more!

SMA, as trend setter in the photovoltaic system technology, guarantees, that you can always provide your customers with the latest technologies (by far the best efficiencies - provable) and most innovative products at competitive prices, also in the future.

A unique product range covering plants in the range of a few watts up to the megawatt range, accessories meeting the requirements of operators of private small plants and of professional investors as well in the area of monitoring and operation control, components for the supplementary grid feeding as well as the autarkic energy supply - *SMA is a reliable partner by your side.*

Tobias Henne



Finding the Optimal Design of a Utility Interactive PV-Plant

Topics

1. **Inverter / PV generator ratio**
 - 1.1 Power distribution of the energy yield
 - 1.2 Underdimensioning of a PV inverter
 - 1.3 The optimum design
 - 1.4 Sunny Boys among themselves
2. **PV generator voltage**
 - 2.1 Lowest operating voltage
 - 2.2 Highest operating voltage
 - 2.3 MPP voltage and efficiency
3. **Planning instruments**
 - 3.1 Excel table "GenAu"
 - 3.2 Integration of local insolation data
4. **Summary**
5. **Sources**

2.1. Lowest operating voltage

The lowest operating voltage of a PV generator is experienced with the highest temperature of the solar cells. The cells embedded in the module are directly exposed to the full solar radiation and reach temperatures 50°C higher than the ambient temperature depending on the kind of mounting. The MPP voltage decreases by more than 3% for every 10 °C.

If the MPP of a PV generator falls below the input voltage range of the inverter, the plant will not operate at MPP voltage - it will run with the lowest input voltage of the inverter instead (see fig. A). This is no problem for the inverter, but results in a reduced efficiency of the system. As long as basic configuration rules are observed (the MPP voltage at 1000 W/m² and a cell temperature of +70°C are within the input voltage range of the inverter), a possible loss of efficiency can be neglected.

The minimum input voltage of the inverter has major impact on the efficiency of the PV plant. We therefore tried everything in order to keep this operational limit of the Sunny Boy inverters as low as possible.

Technically speaking, the minimum input voltage is defined in such a way that it is also possible to supply a grid with the highest permitted grid voltage (for example 251 V). But as mostly the grid voltage is clearly lower than the permitted maximum value, the lower input voltage limit based on this would be often much too high.

It is much smarter to modify the inverter's lower input voltage limit according to the value of the grid voltage. Figure 2 shows this in a chart based on the Sunny Boy 3000 and indicates which operating range can be reached by a dynamic adjustment of the minimum input voltage.

The slope of the curves in figure 2 corresponds to the transmission ratio of the 50 Hz transformer. It is therefore slightly different for each type of Sunny Boy. The table contains the minimum input voltages of some Sunny Boys for the nominal value and the maximum value of the grid voltage, respectively. The values one experiences on the field are normally between these two values.

Joachim Laschinski

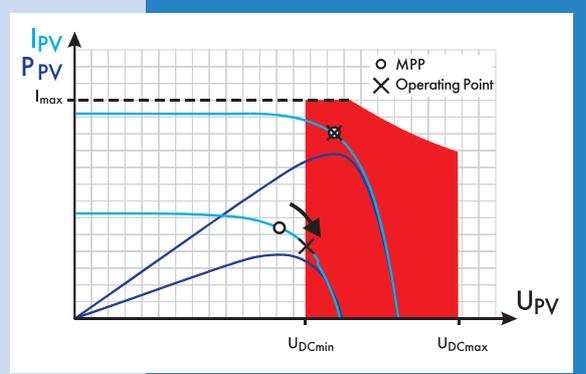


Fig. 1: The MPP voltage of the PV generator is lower than the smallest possible input voltage of inverter.

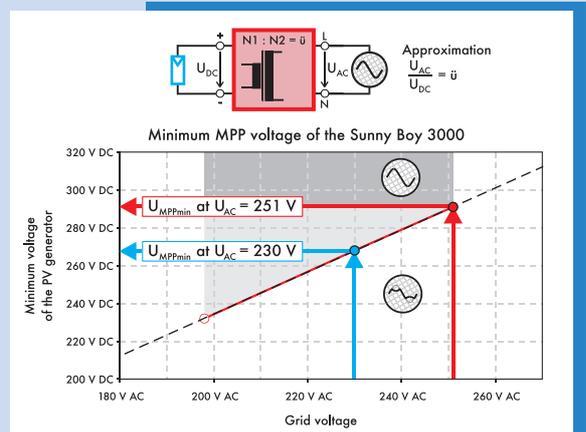


Fig. 2: The flexible lower input voltage limit of the Sunny Boy inverters.

Minimum input voltage	Sunny Boy					
	SWR 700	SWR 850	SWR 1100E	SWR 1700E	SWR 2500	SB 2800i / SB 3000
Grid voltage 230 V	119V	119V	134V	139V	224V	224V / 268V
Grid voltage 251 V	129V	129V	145V	151V	244V	244V / 291V

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Lord of the Rings

... the 4 Sunny Boys on the roof of the Audi Museum in Ingolstadt



Photo: Photon

The PV plant on the roof of the Audi Museum was integrated into the sun shield on the roof.

An interesting solution sun tracking and roof-integrated PV is installed on the roof of the new Audi Museum in Ingolstadt. The four-floor rotunda, approximately 23 m high, has two flexible arched sun shields that provide shade outside the building. The PV plant installed on the roof has a power of 10.8 kWp and is

mechanically linked with the sun shield.

The combination is perfect: Every time when the sun shield realigns, the PV plant is simultaneously driven into the optimum position. Thus, the PV plant is automatically aligned according to the position of the sun resulting in an expected increase of output by appr. 10% in contrast to a plant without tracking system. Thus, a yearly output of 9,200 kWh is expected.

The total of 112 PV modules were custom tailored for the project by the module manufacturer Solon in Berlin. Due to the radial arrangement of the PV modules, two different module sizes with 84 and 109 watt had to be developed. The modules are mounted at a 30° angle.

The energy produced is fed into the grid with 4 Sunny Boy SWR 2500 and partly covers energy demand of the museum. The PV plant with a price of approximately Euro 150,000 has been financed out of a budget arranged in particular for environment-relevant investments by the Audi AG.

Ingo Klute

Description of the plant:

- Total power: 10,8 kWp
- Number of modules: 112
- Module type: Solon, custom tailored modules
- Module power: 84 and 109 watt
- Inverter: 4 Sunny Boy SWR 2500
- Total costs of the plant: Approximately 150,000 Euro
- Expected energy output: 9.200 kWh / year

Communication made easy

As from now, we optionally provide a plug system for RS232 and RS485 for our Sunny Boys to our customers.

For the first time, the wiring of the communication can be prepared before the installation. During installation itself only the plugs are connected with coupling at the Sunny Boy - and the wiring is done! Thus, you save valuable time and possible fail-

ures in the wiring are minimized.

The Sunny Boys can be ordered ex works with built-in socket for RS232 or RS485. Thus, the opening of the Sunny Boys during installation can be omitted. There is no danger any more that during outdoor installation under adverse weather conditions humidity accumulates in the inverters.

The plugs are installed free of cost. (ordering code for installation kit RS232: SB-R232-NR, ordering code for installation kit RS485: SB-RS485-NR)

A plug system is required for each Sunny Boy.

We provide the entire plug system for RS232 / RS485, like all of our plug systems, in the proven protection class IP65 (dust- and waterproof).

Werner Reitze



The complete plug system contains terminal resistor, sealing plug, Y connector, plug, socket, technical description

In case of a device replacement a prolonged time of wiring is not necessary any more: Just rearrange the plugs and ready!

Our service!

We equip your Sunny Boy inverters with the coupling for the communication ex works, if required.