Artificial intelligence from SunSniffer changes the PV industry!

Starting at Intersolar 2019, a new technology will make the invisible visible: degradations, soilings and shadings of each individual module will be displayed with SunSniffer.

Previous PV monitoring portals are practical and show, among other things, how much power a system produces. But if one or more modules produce less, you see only little except a reduced total output. Finding the reason for the power reduction and its exact location is difficult.

SunSniffer now has implemented a **Digital Twin technology** in the PV sector originally developed by **NASA**. **Artificial intelligence** evaluates the **measurement data** from high-precision, small sensors in each module. Through this combination of module-specific measurement data and their evaluation with artificial intelligence, it is possible to show exactly **where which losses exist and why**.

Everything in view: Degradation, soiling, shading

The losses are divided into classes and you can immediately see where the most losses occur. These losses, in turn, are broken down more precisely: the degraded modules, for example, are divided into power classes; in the case of dirty modules, you first see the loss for the entire system, then the loss for each individual module, just as with shading.

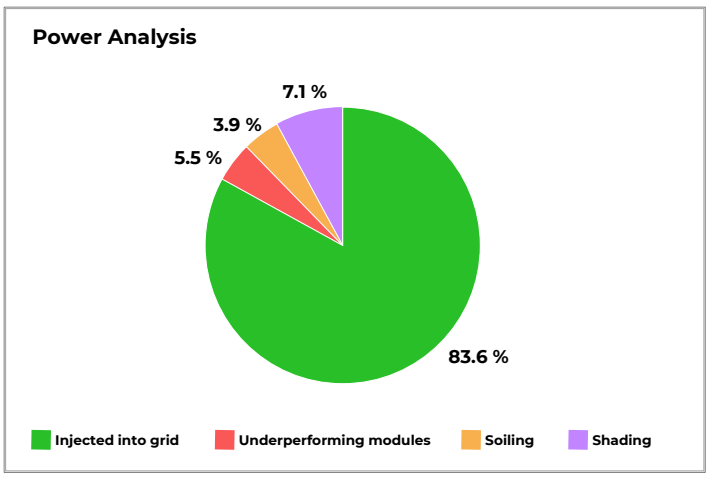


Figure 1: Overview performance analysis - here you can see exactly in percent how many losses arise for which reason.

The three most important power reducers thus become transparent and can be remedied in a **targeted**, **timely** and **cost-efficient** manner: degraded modules, soiling, shading..

- The **degradation** of each individual module is displayed. This ensures that proof of warranty is provided quickly and unambiguously. By the recognizable trend one can see, which module will become a warranty case in all probability and when.
- The degree of **soiling** or the resulting loss is measured; this allows cleaning to be carried out as required. You can see how good the last cleaning was and when the next one should be.
- **Shading** losses are shown in euros. The system distinguishes between unavoidable shading and eliminable shading. In this way measures can be taken - or the unavoidable losses that change the result can be removed from the analysis.

From the overview to the concrete action

1. Overview of poorly performing modules:

   The overview first shows how many modules (in %) perform how much less and why. If you want to know more, e.g. which modules perform considerably less and which are still under warranty, just click on them.

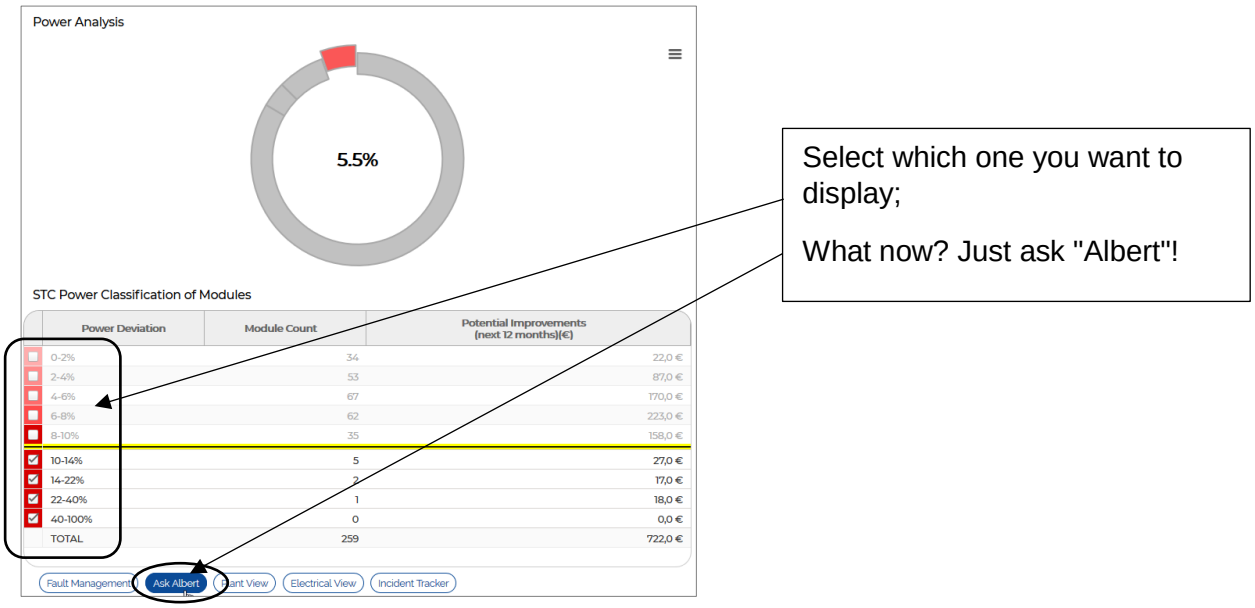


Figure 2: Losses are divided into classes which can be displayed individually. The yellow line indicates the warranty limit; all modules under this line are warranty cases.

2. „Ask Albert“: Know at a glance how much the repair process of the modules would cost and how much additional revenue would be generated by it:

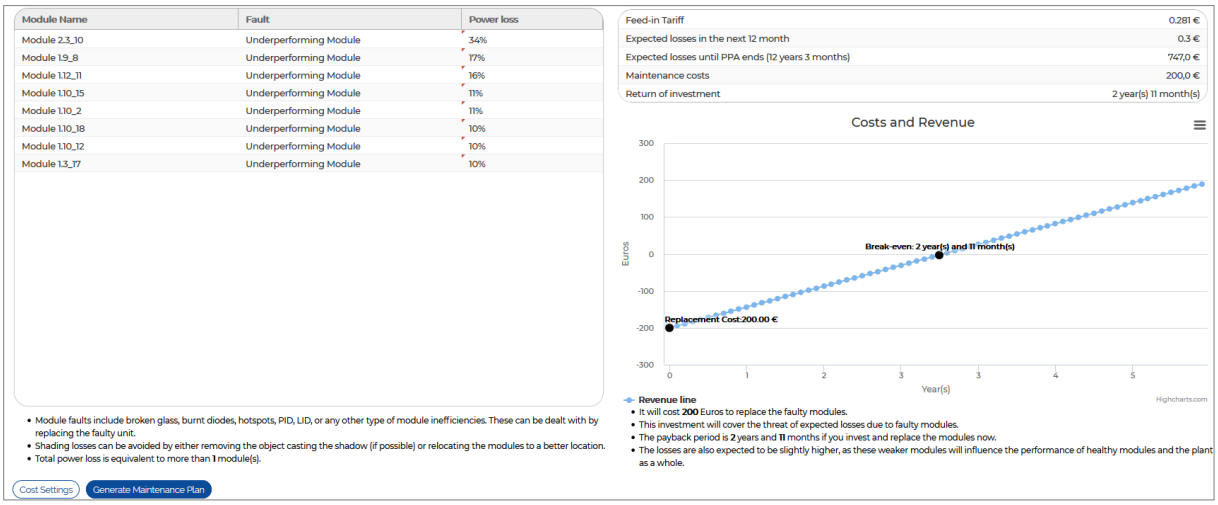
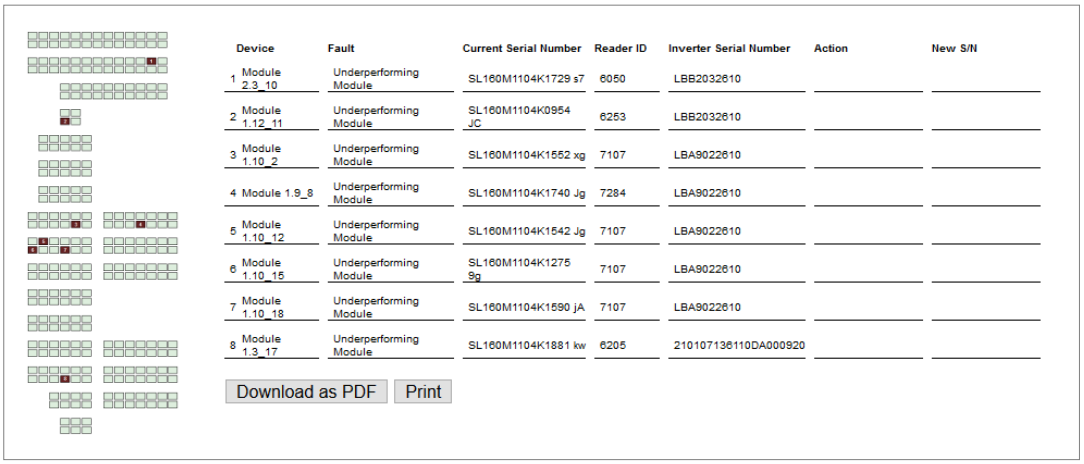


Figure 3: Ask Albert - cost-benefit calculations

3. **The selected modules are to be replaced; how does the installer know which modules? At the push of a button!**



	Device	Fault	Current Serial Number	Reader ID	Inverter Serial Number	Action	New S/N
1	Module 2.3_10	Underperforming Module	SL160M1104K1729 s7	6050	LBB2032610		
2	Module 1.12_11	Underperforming Module	SL160M1104K0954 JC	6253	LBB2032610		
3	Module 1.10_2	Underperforming Module	SL160M1104K1552 xg	7107	LBA9022610		
4	Module 1.9_8	Underperforming Module	SL160M1104K1740 Jg	7284	LBA9022610		
5	Module 1.10_12	Underperforming Module	SL160M1104K1542 Jg	7107	LBA9022610		
6	Module 1.10_15	Underperforming Module	SL160M1104K1275 9g	7107	LBA9022610		
7	Module 1.10_18	Underperforming Module	SL160M1104K1590 jA	7107	LBA9022610		
8	Module 1.3_17	Underperforming Module	SL160M1104K1881 kw	6205	210107136110DA000920		

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Figure 4: Maintenance plan for the installer on site - here you can see where the modules to be replaced or handled are located and what the problem is, together with the serial numbers.

For small and large plants

For owners of small plants, there are naturally other questions here than for owners or operators of large plants. In the case of smaller systems, the **costs** of an on-site inspection are often **disproportionate**, with the result that many people do not carry out an inspection at all and live with the losses - grudgingly. The problem with large plants is the sheer **number of modules** that have to be examined. After all, what do you do if it turns out that 11,500 of 200,000 strings, for example, perform less - but you don't know which modules have to be replaced?

Enforcing warranty claims is also usually very time-consuming; not with SunSniffer: it's just a **push of a button** here.

Automatic measurement and evaluation

The SunSniffer solution is as simple as it is elegant: each module is measured **automatically at any time during normal operation**. The sensor integrated in the junction box provides the data during operation. No additional cables are required. The artificial intelligence evaluates this data. The SunSniffer portal thus not only shows how much the system produces, but above all also where exactly which problem lies and how large the losses are or what potential for improvement exists - in euros. Transparency doesn't have to be expensive: the SunSniffer system is available **from 1 cent/Wp**.

The advantages are obvious: defective modules can be **quickly replaced** before losses accumulate. **Guarantee cases** can be dealt with quickly and clearly. Expensive drone overflights are no longer necessary. The operational management is **quick and easy on a computer, tablet or smartphone**..

Fully digitised PV systems perform better, cost less and live longer.

For technically interested people:

SunSniffer has achieved a **world first**: to record the **actual status of a module during operation** and to present it in a comprehensible and meaningful form. This was made possible by the use of software developed and applied for the first time by NASA to repair and maintain remote equipment.

At the core of this development is a **two-diode model** that simulates all the modules in the system. The measurement data of modules are linked with all other available data such as **irradiation sensors**, **string measurements** and **inverters**. Measurement errors are sorted out. All **irradiation situations and behaviours** of the modules for at least one **week** are included in this calculation. The aim is to obtain meaningful information on the individual modules. The results are somewhat less precise in some points than a laboratory test, but better in others. Thus, not only snapshots of modules like a flasher are included in the calculation, but also longer time series from days to weeks. This enables us, for example, to detect the **extent of thermal degradations of any kind**. LID and LeTID can not only be detected with this method, but their complete scope can also be determined.

Thus, for example, the **STC conversion of the MPP values per module** is obtained. This information corresponds to the evaluation of a laboratory report and, in addition to **IV characteristics**, also contains **MPP values with different irradiations**. Thus, the user is fully informed about the actual, current status of a module and can act accordingly: **notify a warranty claim**, **replace the module**, **schedule cleaning** of the system, **remove specific shadows**, etc. This software functionality **will be made available to SunSniffer users in "beta mode" from Intersolar in Munich 2019**.

The SunSniffer technology is available for **new systems** and can also be **retrofitted**.

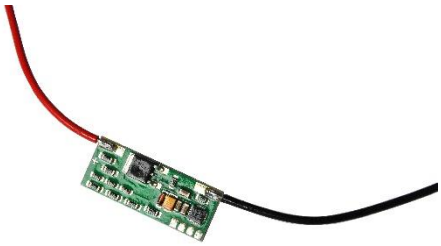

Figure 5: SunSniffer sensor

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