FIMER

FIMER PowerGain
Scanning algorithm

Contents

Scope and field of application

The purpose of this document is to describe how the FIMER PowerGain scanning algorithm optimizes the yield of any PV system even under shading conditions, hence boosting the return on your investment. Such innovative technology is compared to the standard MPPT algorithm and to DC optimizers, showing how FIMER PowerGain allows to overcome the limits of less advanced technologies.

FIMER PowerGain is a built-in feature of **all FIMER string inverters** and does not require any additional external devices.

Overview

Photovoltaic systems are generally designed and placed to guarantee a constant sun irradiation. However, it is not possible to completely avoid shading situations (clouds, leaves, fixed poles, and so on), which mainly end up reducing the power production from the PV system.

FIMER has developed an algorithm - **FIMER PowerGain** - applying to the whole string inverter portfolio, which is able to mitigate the effects of shading and to increase the power production of the PV system. Such result is achieved without additional devices and, therefore, with a considerably lower number of system components compared to power optimizer solutions.

Standard MPPT algorithm

In standard operating conditions, with no shading effect, the power curve is like the one in the picture below (see Figure 1), and a standard inverter is able to detect and to convert the maximum quantity of power.
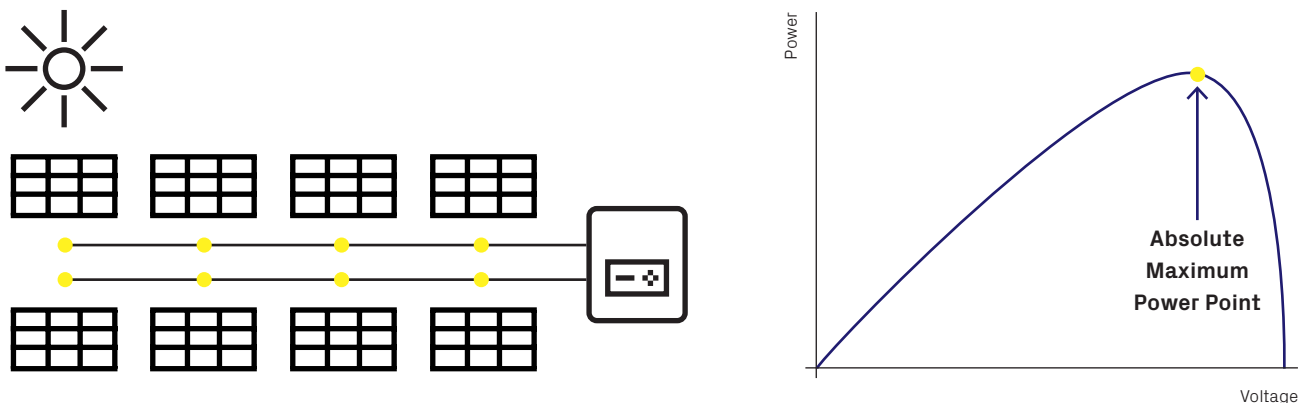

Figure 1

In shading conditions, when some panels or portions of the same do not receive the same irradiation as the others, the power curve changes and a standard inverter could continue to track the previous power point, meaning that it is not providing the maximum power (See Figure 2)
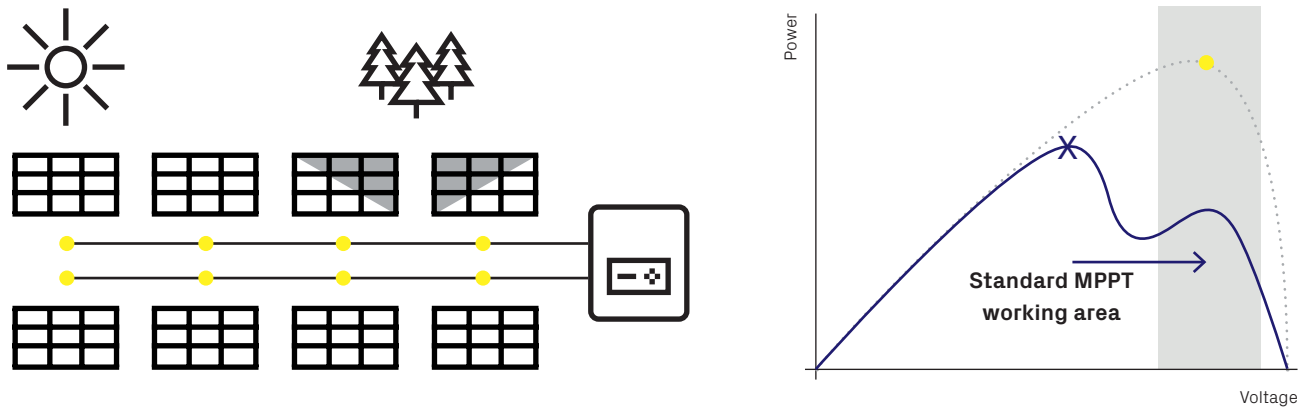

Figure 2

FIMER PowerGain scanning algorithm

To solve the issue described above, FIMER developed a smart function that periodically checks if the PV system is able to produce more energy.
Indeed, with the FIMER PowerGain function, the inverter rapidly scans the input voltage and, **within milliseconds**, it is able to identify the absolute maximum power point, so as to avoid chasing relative maximum power points – i.e. – lower peaks in the curve, which would result in less power produced. Thanks to FIMER PowerGain, the working point is moved on the curve, allowing the system to handle the maximum available power even in shading conditions (see Figure 3).
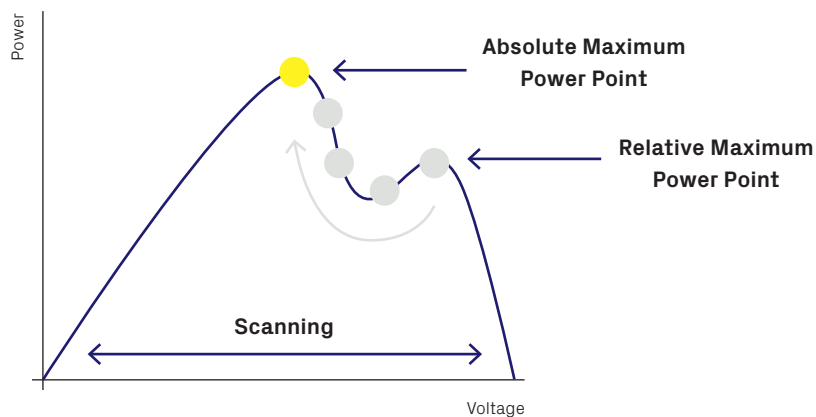

Figure 3

FIMER PowerGain is able to provide the same mitigation of the shading condition as panel optimizer solutions but without additional components. With FIMER PowerGain it is also possible to **schedule the interval between scans.** Allowing up to 60 scans an hour, based on the project requirements, the solution fully meets customer needs in any situation.

Field test comparison

In order to mitigate the negative impact of shading, another option consists in installing additional devices (optimizers) at module level to enhance the energy production of that specific PV module when it is shaded.
Such approach requires several additional components which are installed underneath the panels, being exposed to humidity and temperature changes, increasing both the possibility of failure and installation costs.
A comparative study has been carried out, monitoring power production using FIMER inverters with built-in FIMER PowerGain solution versus, on the one hand, standard inverters installed in PV systems without DC optimizers at module level and, on the other hand, versus PV systems with DC optimizers.

Results show that:
• FIMER PowerGain allows **up to 10% higher yields** compared to PV systems applying traditional inverters
• FIMER PowerGain performs significantly better than optimizers in unshaded circumstances.
• FIMER PowerGain performs significantly better than optimizers in slightly shaded conditions.
• Optimizers perform slightly better than FIMER PowerGain in a temporary and moderate shaded environment (like clouds)
• Over a long-period observation (included some days of slightly shaded conditions) FIMER PowerGain performs better than the traditional optimizers.

It is important to remark that traditional optimizers have a higher risk of failure as a consequence of the higher number of components (optimizers themselves) which are usually installed in tight enclosures underneath the PV modules, exposed to moisture and thermal cycling.

The fire hazard related to photovoltaic systems has been assessed in a research carried out by the international safety certification body TÜV Rheinland in cooperation with the research institute Fraunhofer Institute for Solar Energy Systems and published by the U.S. Department of Energy ("Assessing Fire Risks in Photovoltaic Systems and Developing Safety Concepts for Risk Minimization"). Results showed that each additional component involves a higher risk of causing faults and, potentially, a higher risk of fire. For each optimizer which is added to a PV system, four connectors are also added. This exponentially increases the numbers of elements such as cables and contacts which can cause faults and even fire emergencies.

Conclusions

We can summarise the main advantages of using the FIMER PowerGain function in the list here below:
• Built-in for any FIMER string inverter model and size
• Highest energy production over a long period
• Lower risk of component failures
• Easier and quicker installation
• Scanning interval can be set based on the customer's preference
• One of the fastest curve scanning algorithms on the market
• Less initial investment for the system
• FIMER PowerGain optimizes the Return on Investment of the system

The main disadvantages using optimizers:
• More connectors enhance the risk of bad connections
• Additional components with a higher risk of fire
• Adding complexity to the systems
• Higher costs
• Higher on-site maintenance

FIMER PowerGain is an important smart function, included by default in the whole string inverter portfolio, that enables FIMER inverters to capture the most energy available from solar panels under any shading conditions.
With no additional components – no further expenses, no additional failure points - the inverter itself maximizes the energy production over its entire lifetime, hence boosting the Return on Investment.