ASK THE EXPERTS: Transformerless Inverters and PV Degradation

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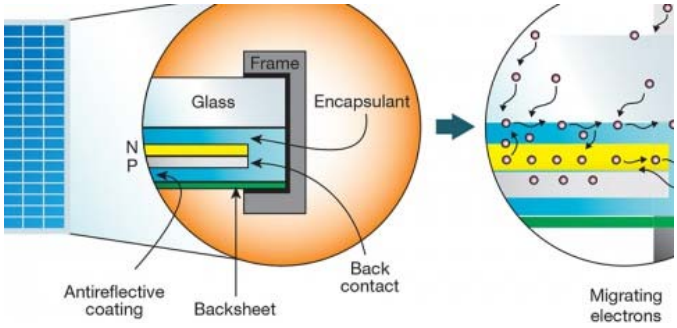
Issue Date Last Updated: 10/26/13

I read that potential-induced degradation (PID), the reduction of a solar-electric module's efficiency over its lifetime, is sped up by the use of transformerless grid-tied inverters, which allow the modules to cycle electrons at the grid's AC frequency. Module manufacturers are advertising PID-free modules, which supposedly counteract this problem.



Reduction of a Solar-Electric Module's Efficiency Over Time

Transformer-based inverters don't cycle and **have a constant flow of electrons. So would using one allow my modules to last longer? Does anyone have real experience in this area, or is it all theoretical at this point?**

Zachary Strassman • via email

PID is the result of PV modules being held at a high potential (voltage), which causes them to temporarily decrease power output. With high-voltage arrays, ungrounded inverters, and increasing module efficiency with antireflective coatings; PID is showing up in the field—not just the lab.

PID is due to leakage of electrons out of the silicon cells. These migrating electrons accumulate on the surface of the silicon cell, where they affect the ability of the P-N junction in the cell to convert sunlight. This power reduction can occur over days or weeks. It is seen at higher array voltages, higher temperatures, and, especially, under higher humidity conditions. Estimates of power losses due to PID range from 10% to 60%, although the most I've seen (on a negatively grounded SunPower array) is about 25%.

The type of encapsulant and backsheet used on the modules are factors that can influence PID. Some compounds are more prone to leaking current than others, and some are more affected by moisture than others.

Another factor is the antireflective coating—some types, while improving efficiency, also make modules more prone to PID. How the silicon's cells are layered (for example, back-contact cells in which the P and N layers are flipped) also affect the module's PID propensity.

The third major factor affecting PID is the array's polarization and voltage. Most negatively grounded arrays are not affected by PID. Historically, however, negatively grounded SunPower arrays could suffer PID. PID is generally only seen on high-voltage (100+ volts) arrays as well. Whether modules are PID-prone is largely dependent on the antireflective coating and encapsulant.

The good news is that, in crystalline silicon modules, PID is mostly reversible. By properly grounding the array, the extra electrons that have leaked to places they shouldn't are sent back, restoring the module to its normal state. By holding the cells at the proper high voltage for a few days (48 to 96 hours) with an external source of voltage, PID can be almost completely reversed. Properly grounding the array so it gets a few hours of the proper voltage every day will also reverse the effects of PID.

Electrical standards organizations are developing tests and standards to rate whether a particular module is susceptible to PID. Look for these certifications on modules in the future. If you do not have PID-prone modules, the type of inverter you use may not matter. But if you do have PID-prone modules, use an inverter that grounds the modules in the proper

direction to avoid PID for those particular modules.

Zeke Yewdall • Mile Hi Solar

Marsha Robison

What are the testing procedures and is there a fix for this in an existing system. I have had an untraceable loss in power from my array which happened about 2 years after I installed it. I was told by someone that I bought a battery bank off of to change my 9 panel, 160watt each, 1k pv array configuration from 3 panels 480 each to 2 panels 320 each. No one could figure out how my system went from putting out 960watt to max 720.....

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