SUPSI University of Applied Sciences and Arts of Southern Switzerland

TESTING

ULTRAVIOLET STRESS TEST

Background and Why the Test Matters

The Ultraviolet Stress Test is designed to identify the susceptibility of photovoltaic (PV) modules to performance loss caused by UV induced degradation (UVID). Although ultraviolet radiation represents only a fraction of the solar spectrum, its high photon energy can initiate material changes leading to measurable power degradation.

UVID is more commonly observed in modern high-efficiency cell architectures – such as PERC, PERT, TOPCon, HJT, and back-contact cells – which rely on precisely engineered passivation structures to achieve superior efficiency. Certain n-type and bifacial technologies have demonstrated increased sensitivity to UV stress due to passivation instability and interface degradation. As of 2026, SUPSI PVLab's experimental observations indicate that a UV dose of 60 kWh/m², which corresponds to roughly one year of exposure in moderate climates, may result in an average power loss of 2–4%.

The UV stress test is not intended to test modules to failure. Instead, it is designed to identify UV-related degradation risks through an accelerated procedure that simulates approximately one to three years of outdoor UV exposure under controlled laboratory conditions. This approach enables comparative evaluation of technology stability against ultraviolet stress.

Test Procedure

The test sequence begins with initial stabilisation in accordance with IEC 61215 to eliminate early light-induced stabilisation effects. Modules are then exposed to a front-side UV dose of 120 kWh/m² at a controlled module temperature of 60°C. After a defined dark storage period in the laboratory, the modules undergo a light soak at 1000 W/m² and 55°C for one hours (1 kWh/m²) to allow temporary, reversible changes to recover.

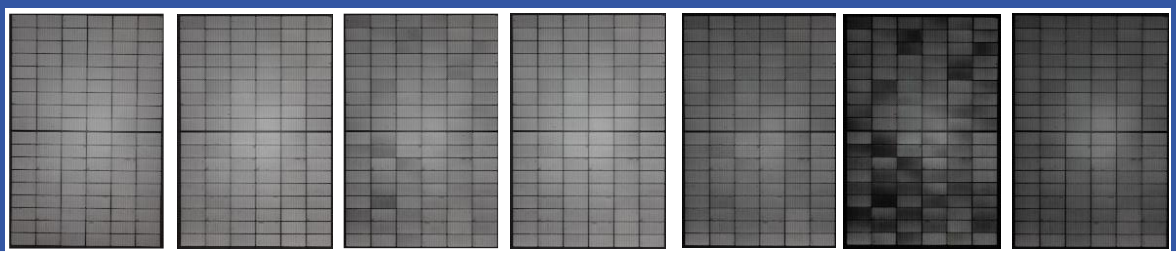
An intermediate measurement after 60 kWh/m² on the front side is optional. If performed, it also requires dark storage and light soaking to ensure realistic and stabilised performance results.

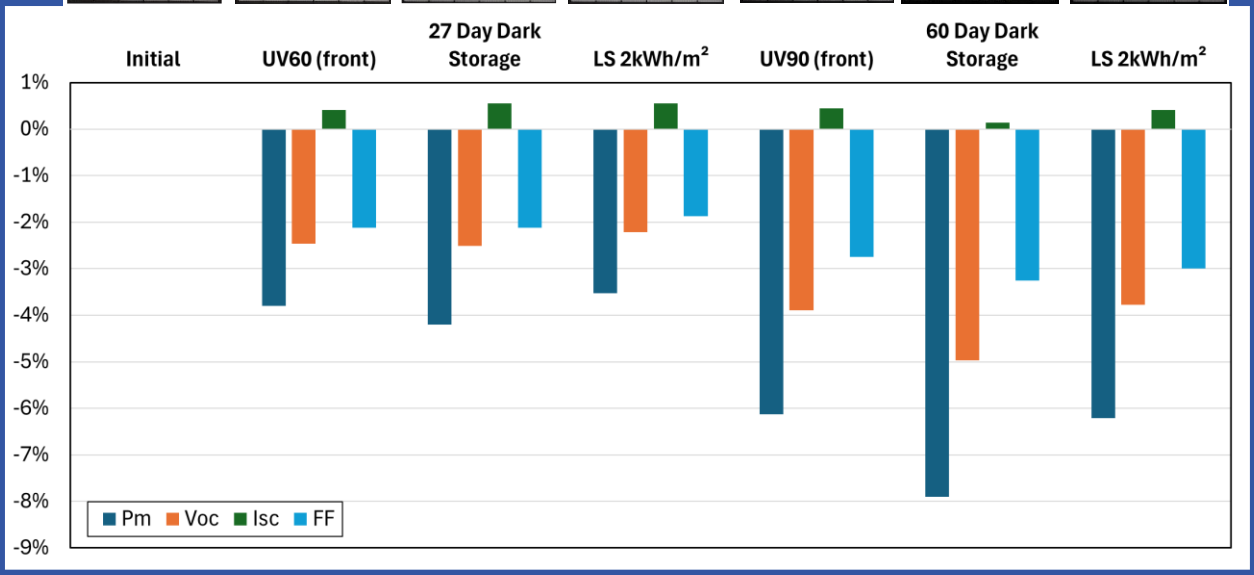
If the module under test is bifacial, the process is then repeated on the rear side with an additional 60 kWh/m² UV dose, again followed by dark storage and a final light soak.

Electrical performance measurements – including current-voltage (I–V) curve testing at standard test conditions (STC) and, optionally, at low-light conditions – as well as electroluminescence imaging are conducted before and after each step to monitor any power loss, changes, or defects.

Example:

EL at 1 Isc





Key Takeaways

- Laboratory testing, such as the work of **ALIENCE project**, shows that many modern high-efficiency c-Si modules (TOPCon, PERC, Back Contact and HJT) experience measurable power loss after UV exposure.
- Field observations confirm similar degradation patterns to indoor UVID testing results. Modules exposed to lower UV dosage typically show reduced degradation impact.
- UV stress testing does not predict exact lifetime performance. However, it provides valuable comparative insights into the robustness of technology.
- Early identification of UV susceptibility helps manufacturers and asset owners mitigate long-term performance risks.