

Frozen Light Soak Test: “Simulating the Dawn Effect”

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Purpose

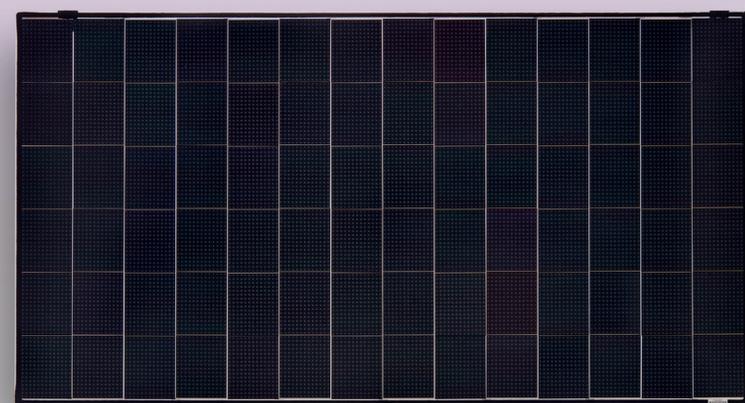
Based on customer experience and input from Beck Energy, Nanosolar sought to simulate the effect of freezing temperatures combined with rapidly-increasing sunlight on panel performance.

Nanosolar's Frozen Light Soak Test combines a baseline of freezing cold temperature with concurrent light exposure to simulate the real-world, outdoor conditions of a frozen yet sunny dawn, such as a solar panel might experience in Germany or Canada.

The combination of thermal and light stress in a panel that is actively producing power causes panel temperature to increase far more rapidly than in the IEC 61646 Humidity Freeze test, while also providing insight into a panel's long-term durability and performance.



Image of Frozen Modules at Dawn



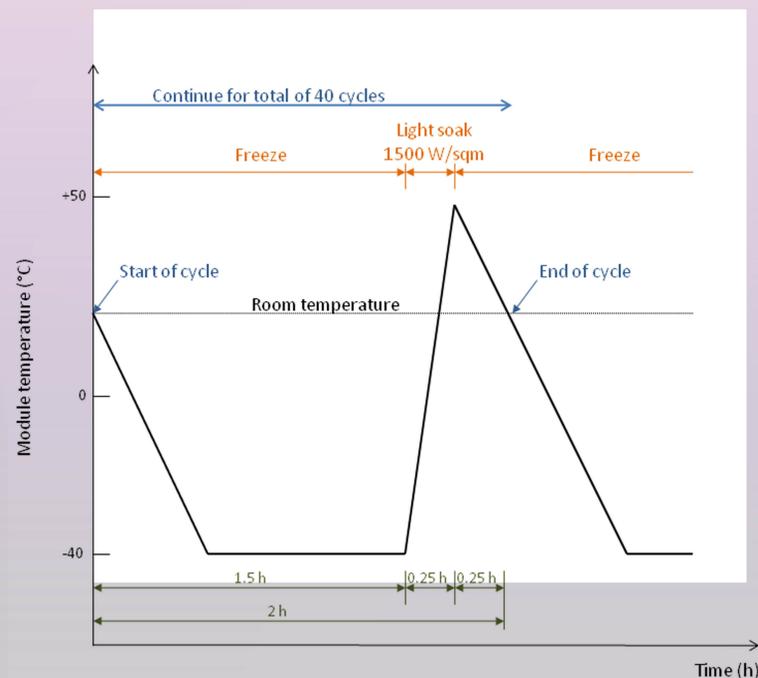
The Nanosolar Utility Panel

Test Process

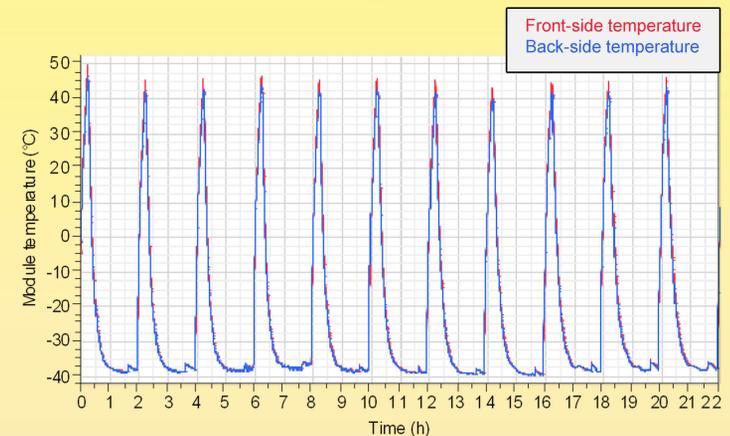
Highly Accelerated Lifetime Test Process

- Freeze the module to -40°C
- Light soak the module at $1500\text{W}/\text{sqm}$ for 15 minutes with lamps placed directly on top of the module
- Run the module at maximum power point with an electrical variable load
- Measure module temperature with two thermocouples (one placed on the front side of the module in the middle and the other on the back side of the module in the middle)
- Run this cycle 40x or until failure

Schematic of Test Process



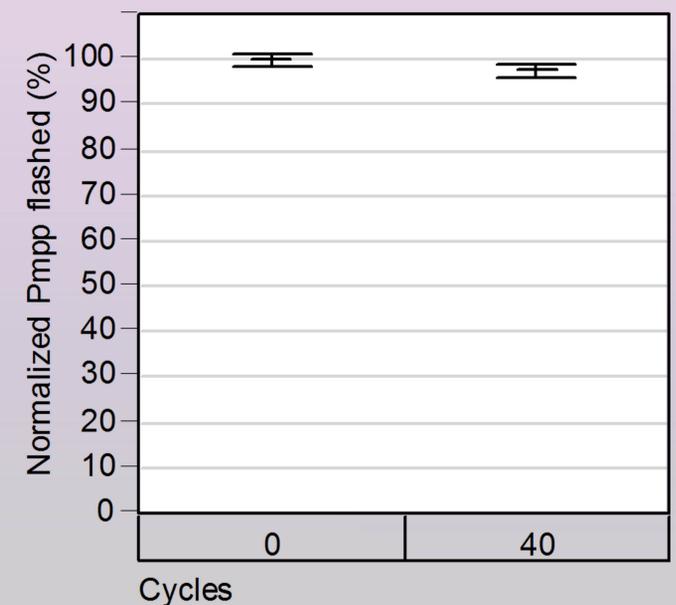
Measured Temperature



Results

After 40 cycles:

- 3% Pmax decrease at the end of the test, as measured from the start of the test
- No visual degradation, such as delamination, edge seal bubbles, edge seal or encapsulant color change
- Wet leakage current test: passed



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