



## **Mini Cube** (Accelerated Life Testing Lab)

# Testing the performance of photovoltaic modules at low temperatures

### The test in a nutshell



Cooling capacity

### **terraXcube**

terraXcube is Eurac Research's extreme climate simulation centre at the NOI Techpark in Bolzano, South Tyrol, Italy. Within its chambers, even the most extreme of all our Planet's environmental conditions can be created. By combining hypobaric and altitude technology with state-of-the-art environmental simulation, we aim to investigate the effects of extreme climate conditions on humans, ecological processes and industrial products.

The climate chambers differ in size and equipment and can accommodate people, plants and other living organisms for up to extended periods and have the space to accommodate large machines and products.

Each day our team breaks new ground with scientists and industry partners and prepares the path to gain discoveries.

### **Test description**

The test investigates the electrical performance of a photovoltaic module when subjected to extreme winter temperatures typical of certain climate zones.

In a photovoltaic system, the inverter converts the direct current generated by the photovoltaic modules into alternating current before feeding it into the grid. When designing the system, it is important to choose a suitable inverter that can withstand the voltage and current peaks generated by the photovoltaic modules - irrespective of the season. In winter, the cold temperatures force the photovoltaic modules to work at voltage values much higher than those defined on the data sheet (referring to a standard temperature of 25°C). If the inverter is not correctly sized, there is a risk of inverter malfunction or disconnection from the grid, with consequent loss of electricity production.

With this performance test it is therefore possible to quantify the actual voltage generated by a photovoltaic module at sub-zero temperatures.

The photovoltaic modules are delivered to the technicians and prepared for conditioning in the Mini Cube (Accelerated Life Testing Lab) climate chamber managed by the Eurac Research Institute for Renewable Energy. They are placed in an insulating enclosure that leaves only the front (active) part of the photovoltaic modules visible. The temperature sensors are then installed, and the data acquisition system is configured. The modules are brought to a sub-zero temperature that is defined with the customer. After several hours and once they have reached thermal equilibrium, they are individually extracted and transferred to the adjacent ISO 17025 accredited "Solare-PV" (Accredia, LAB N° 1785L) laboratory, within the Eurac Research Institute for Renewable Energies solar simulator. Next, the characteristic curve is measured using an irradiance of 1000 W/m<sup>2</sup>, and the temperature is monitored throughout the process. From the characteristic curve, the open circuit voltage and the voltage at the maximum power point are extrapolated.

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### Mini Cube (Accelerated Life Testing Lab) - General Characteristics and Environment Control

Internal dimensions	1.30 m x 1.52 m x 2.20 m (L x W x H)
Load Capacity	Photovoltaic modules with a total weight of up to 240 kg
Temperature Range <small>According to IEC 60068-3-5</small>	-40...+90°C (variability $\pm 1^\circ\text{C}$ in time $\pm 2^\circ\text{C}$ in space)
Temperature Rate of Change <small>According to IEC 60068-3-5</small>	1.7°C/min (-40...+85°C), 1.7°C/min (+85...-0°C), 1°C/min (+0...-40°C)

### Other Features

Data-acquisition equipment	
Network connection	Gigabit-Ethernet (1000BaseT) PoE, Wi-Fi