DH test of a Femtogrid power optimizer and microinverter under operation

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Introduction
The market share of Module Level Power Electronics (MLPE) such as Power Optimizers (PO) and Micro-inverters (MI) is growing fast. Advantages of MLPE compared with string inverter systems are the freedom in installation of systems and the higher yield, especially in case of shadow and/or different orientation of the PV modules.

A disadvantage is that the MLPE have to be connected close to the PV module, by which it suffers from high temperatures and/or high humidity. High temperatures and high humidity can limit the lifetime of the MLPE. A second disadvantage is the high number of connections needed for this "add-on" product. To simplify the system installation, reduction of the cost and improvement of the reliability, it is expected that newer generations of MLPE will be integrated in for instance the junction box.

So far there is no IEC standard for certifying PV modules with integrated MLPE. In the future it is likely that PV modules with integrated MLPE have to be tested at the same conditions as PV modules, such as DH (85/85) and TC in accordance with IEC 61215. For this reason, we tested a PO and MI in DH of which the results will be shown.

Purpose of the work
The first aim of the work is to determine whether the PO and MI will survive the DH conditions following the IEC61215 test protocol for PV modules. In this test the MLPE is not powered. Since the effect of the DH conditions on electronic parts under operation can be completely different, the second aim is to determine the performance and degradation of the MLPE under operation in the DH environment.

Approach
Prior to the DH test, the MLPE (PO supplied by Femtogrid, commercially available MI) was characterised at various power levels in a system consisting of a PV simulator as power source and grid simulator as load. After the characterisation measurements, the MLPE was placed unpowered in the DH for 2 subsequent periods of 500 hours (total 1000 hours), followed by a period of 500 hours under operation. After each DH test period, the MLPE was characterised again. In the DH period under operation, the MLPE was operated continuously at 5% load and daily characterised at 5-100% of the maximum power. Additionally, the performance of the PO was measured at 50% of the nominal power during heating-up and cooling down of the DH.

Scientific innovation and relevance
The maximum temperature operating window of MLPE is commonly between -40° and 65°C. In this test the MLPE unit is tested unpowered during 1000 hours and 500 hours under operation up to 85°C at a relative humidity of 85%. The extended maximum temperature, humidity and the operation under power gives more insight in the reliability of MLPE units under real life conditions.

Results and conclusion
The PO310 unit of Femtogrid¹ and MI passed the DH test sequence at 85°C and 85% relative humidity during a period of 1000 hours unpowered and 500 hours under operation.