Fraunhofer IWES

HiPE LAB

Application-Specific Reliability Testing of Power-Electronic Systems

Power converters are designed to withstand their typical operating conditions. But in the field, they are exposed to a wide variety of influences giving rise to failures.

In wind energy for instance, the failure rate of power converters is as high as 0.5 damage-related failures per wind turbine and year. Independent analyses of more than 20,000 wind-turbine operating years have revealed: Fatigue or aging failures are rarely found here. Instead, the converters show pronounced early-failure behavior and susceptibility to environmental influences. Strong parallels can be observed in PV inverters. These findings make clear: Improved testing is key to enhancing converter reliability and robustness.

While testing of modules, components and converter systems is carried out, current test procedures (e.g. IEC 60068 / IEC 60749) cover the environment in a standardized, thus simplified way. In contrast in the field, the environment varies considerably with the application, e.g. wind power, PV, traction, power transmission etc.

As humidity is found to be one major driver of failures, we set up a laboratory to validate clients' products from power modules to entire converter systems under real site scenarios and harsh conditions. Fraunhofer joined forces with the University of Bremen to run the HiPE-LAB – a unique facility for testing converters up to 10 MVA under a superposition of application-specific climatic and electrical loads.

Our competences at a glance

- Derivation of test procedures from comprehensive field measurements
- Identification of relevant test cycles and parameters
- Analysis of field data from converters of more than 10,000 wind turbines and many climates (see map, p. 2)
- Experience with a wide variety of converter systems and their components
- Independent advisor / laboratory

| Analyse field data | Derive test profiles | Accelerate reality |
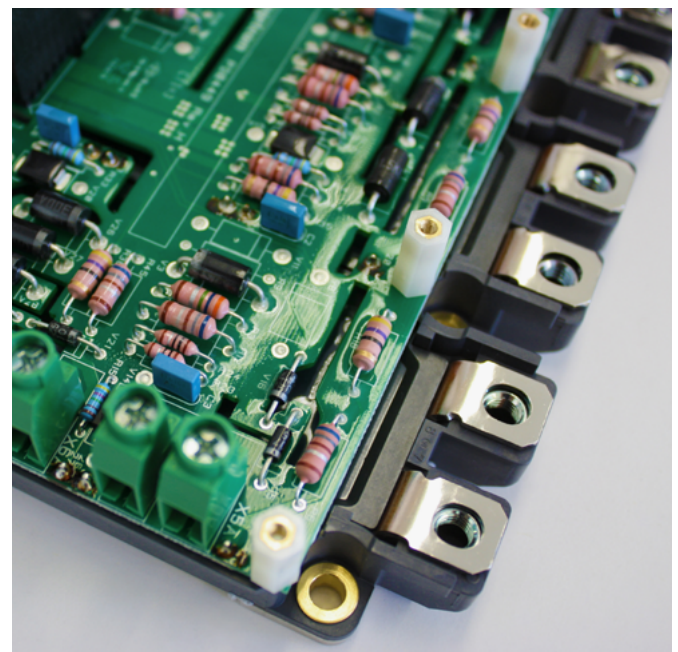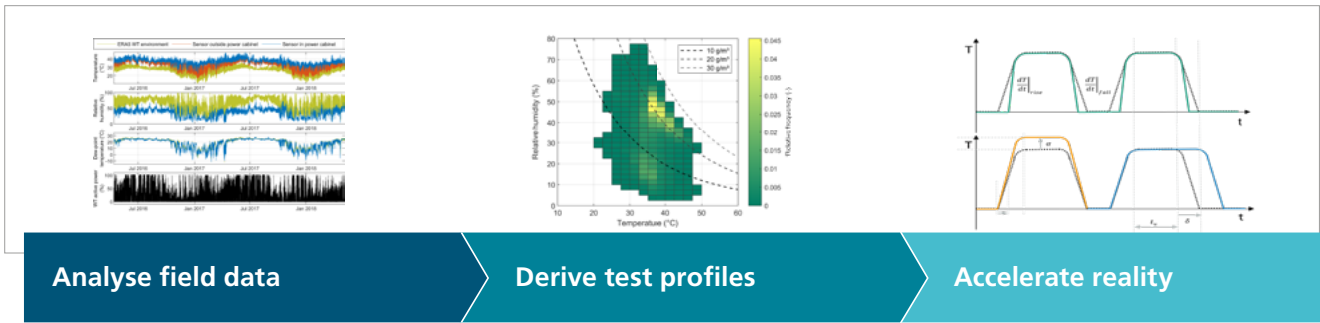
Derivation of realistic profiles from field data and extraction of individual challenges for multi-modal testing

Get specific

- Testing of power converters as a complete unit – existing systems or prototypes
- Combined electrical and climatic loads – defined and reproduceable
- Real-world load scenarios based on field measurements – upon request region or site specific, e.g.
  - Site-specific weathering
  - Day-night cycles
  - Start-stop cycles
  - Cold start-up
- Emulation of extreme situations
- Identify weak points of the system and understand the failure mechanisms
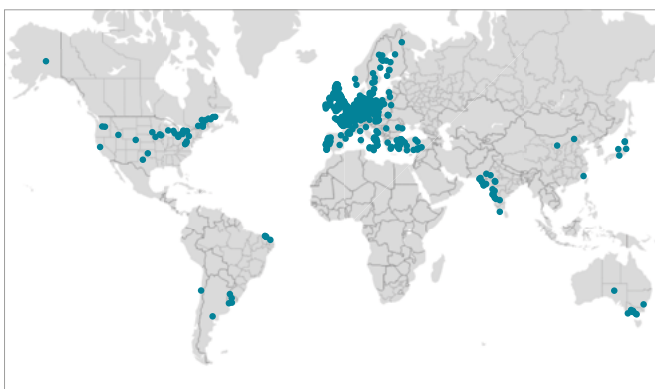- Key step to make converters more reliable

*Operating sites (onshore and offshore)
of evaluated wind-turbine fleet*

Technical data test stand

Universität Bremen

iALB

- Climate room
  - Dimensions: 7.5 m x 5.3 m x 4.3 m
  - Temperature range from -40°C to +120°C
  - Humidity from 10 % to 95 % rH at 10°C to 95°C
- Electrical load system
  - Power up to 10 MW
  - Voltages up to 1,000 V AC
  - Currents up to 9,000 A AC
- Cooling water for the DUT from +16°C up to 60°C

About us

Fraunhofer IWES secures investments in technological developments through validation, shortens innovation cycles, accelerates certification procedures, and increases planning accuracy in the wind energy and hydrogen technology sectors. At present, more than 300 scientists and employees together with about 100 students are committed to driving forward the energy transition. Comprehensive experience in converter-reliability research and the operation of large-scale test facilities form the basis of all services offered in the HiPE-LAB.

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