High Voltage Temperature Humidity Bias (THB-HV) Ad-hoc Measurement system for Reliability Assessment of Power Semiconductor devices in harsh environment applications for energy conversion

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Reliability performances have become a key factor in modern power electronic systems, especially in the field of energy conversion. This is particularly true for renewable energies and automotive applications, where the circuitry is usually exposed to harsh environmental conditions of high humidity, as in the case of off-shore wind turbines [1] or on-board conversion circuits for the recharge of electric vehicles. In these systems, the combined effects of high humidity and high voltage can trigger failure mechanisms usually not manifesting at low voltages, leading to electrical and physical degradation of the devices composing the power conversion circuitry.

At the moment, the most indicated testing approach is the High Humidity, High Temperature Reverse Bias Test (THBHV-DC) reliability test [2, 3, 4], which gives the possibility to highlight several failure modes linked to moisture penetration, like electromigration and corrosion phenomena [5,6].

In this work, a customized measurement system has been implemented in order to perform THBHV-DC tests with active monitoring of the devices under test (DUTs).

In addition, several software and hardware implementations have been developed in order to perform advanced test control and evaluate methodological variations on the test, giving the user a higher freedom of choice in controlling and studying various test conditions. Each implementation in the system setup has been then complemented by further electrical testing and failure analysis methods for extended validation of the system. Thanks to this approach it was possible to create a versatile and stable setup, able to provide good insights on test methodologies and design improvements.

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