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Editorial

Boltzmann-Arrhenius-Zhurkov (BAZ) Constitutive Equation Enables Quantifying Reliability Physics in Electronics Engineering

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"Probability theory is nothing but common sense reduced to calculation"

Pierre-Simon Laplace (1749-1827), French mathematician.

Ability to understand the physics of failure and predict-and-prevent failures in electronic materials, devices, packages and systems is of obvious importance, especially for highly demanding applications, such as, aerospace, long-haul communications or military. The multi-parametric Boltzmann–Arrhenius–Zhurkov (BAZ) equation [1,2] introduced about a decade ago enables quantifying the probability of failure and the corresponding lifetime of an electronic or a photonic product by interpreting the results of a specially designed, thoroughly conducted and carefully interpreted highly-cost-effective and highly-focused failure-oriented accelerated testing (FOAT) [3,4]. This type of testing is always conducted at the manufacturing stage, when there is an intent to get rid of the infant-mortality portion of the bathtub curve, but some of the product development tests, such as, e.g., shear-off or temperature cycling tests, are also of the FOAT type. What is less obvious is that there is an incentive to conduct FOAT also at the design stage, when the probabilistic-design-for-reliability (PDfR) [5] effort is pursued. This undertaking is particularly advisable when a new technology is developed or a new design or a new material are introduced, and when the popular today highly-accelerated-life-testing (HALT) has not been developed yet, nor best practices exist. The multi-parametric BAZ can be effectively employed to predict the probability of failure of the test specimens from the FOAT data and the probability of failure in the field from the burn-in tests (BIT) data [6]. It has been shown, particularly, that BAZ might be helpful in answering the critical "to BIT or not to BIT" question, the first question that an electronic product manufacturer asks himself/herself before starting such testing.

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