JEDEC STANDARD

Method for Developing Acceleration Models for Electronic Device Failure Mechanisms

JESD91B

(Revision of JESD91A, August 2003)

JEDEC SOLID STATE TECHNOLOGY ASSOCIATION

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Published by
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3103 North 10th Street
Suite 240 South
Arlington, VA 22201-2107

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METHOD FOR DEVELOPING ACCELERATION MODELS FOR ELECTRONIC DEVICE FAILURE MECHANISMS

Introduction

The electronics industry often conducts testing at accelerated conditions to predict failure mechanism behavior at customer use conditions. As a consequence, the development of acceleration models for individual failure mechanisms in electronic devices has become a crucial element in defining appropriate accelerated stress conditions and sequences for known mechanisms and establishing their rate of occurrence, with the goal of accurately predicting customer field performance.

Failure mechanisms generally fall into two broad categories: defect-based mechanisms, which typically exhibit a decreasing failure rate and usually affect a small fraction of the product population throughout field use; and wear-out mechanisms, which produce an increasing failure rate and generally involve a substantial portion of the product population.

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(From JEDEC Board Ballot JCB-22-03, formulated under the cognizance of the JC-14.3 Subcommittee on Silicon Devices Reliability Qualification and Monitoring.)

1 Scope

The method described in this document applies to all reliability mechanisms associated with electronic devices.

The purpose of this standard is to provide a reference for developing acceleration models for defect-related and wear-out mechanisms in electronic devices.

2 Terms and definitions

For the purposes of this standard, the following terms and definitions apply.

acceleration factor (A): For a given failure mechanism, the ratio of the time it takes for a certain fraction of the population to fail, following application of one stress or use condition, to the corresponding time at a more severe stress or use condition.

NOTE Times are generally derived from modeled time-to-fail distributions (lognormal, Weibull, exponential, etc.).

activation energy (E_A): The excess free energy over the ground state that must be acquired by an atomic or molecular system in order that a particular process can occur.

apparent activation energy (E_{aa}): An equivalent activation energy on the basis of which the time-to-failure distribution of a complex structure, e.g., a transistor or integrated circuit, can be estimated. Apparent activation energy refers to the apparent shift in the time-to-failure distribution of some product as a function of temperature. The apparent activation energy is associated with a distribution of the time to failure for a given mechanism. The summation of the actual physical processes, with various possible thermal activation energies to create the mechanism, is reflected in the distribution.