Contribution ID: **154** Type: **Oral**

Designing Printed Circuit Boards Not To Fail (1)

Friday 19 September 2008 14:15 (1h 30m)

1) Circuit boards fail primarily for mechanical and electro-chemical reasons.
2) Failure mechanisms in circuit boards.
a) Vibration (mechanical fatigue).
b) Mechanical shock (high stress).
c) Thermal fatigue (thermally induced fatigue).
d) Humidity effects (diffusion of water vapor).
e) Condensing moisture effects (electromigration and dendritic growth).
3) These failure mechanisms represent stresses that produce cumulative damage effects that lead to loss of product life over time.
4) "Time-to-failure as a function of the stress"can be modeled as a stress-life relationship on log-log paper. This will later allow us to produce equivalent damage accelerated tests.
5) What is design margin?
a) Stress-Strength interference.
b) Design margin is also easily portrayed on the life-stress relationship graph.
6) We need design margin for each failure mechanism relative to the damage it will see in its intended lifetime.
a) The intended lifetime is defined as the severe use application.
7) How much margin is enough?
a) Where does the 3X concept come from?
8) What is "Damage in its intended lifetime"and how do we quantify this damage.
a) The severe use situation as a function of the normal use –the other 3X concept.
9) Design process to insure that we have adequate margin against a lifetime of damage for the severe use situation.
a) Design equations for thermal fatigue. (example worked in class)
b) Design equations for vibration. (example worked in class)
c) Design equations for humidity. (example worked in class)
d) Design solutions for condensing moisture. (examples shown)
10) Summary of test methods for weakness discovery and design margin evaluation

Summary

Understanding the physics of how circuit boards fail provides the ideal starting point for failure prevention. This half day tutorial will begin with a comprehensive explanation of the "physics of failure"for electronic circuit boards, and then provide design solutions relative to each failure mechanism discussed. Empirical design equations along with test methodology will be explained through examples. "Quick Learning Cycle"test methods that help in the design for reliability will be explained through video examples.
Quantitative reliability planning and evaluation for circuit boards will be explained through the concepts of Stress-Life models and Stress-Strength Interference. Design margins needed for the severe use situation will be explained as well as how to quantify the severe use condition. The class will culminate with an explanation of test flow design that includes the best reliability test methods including acceleration factors resulting from increased stress testing.

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Session Classification: TUTORIAL - Designing Printed Circuit Boards Not To Fail