IPC-9691B

User Guide for the IPC-TM-650, Method 2.6.25, Conductive Anodic Filament (CAF) Resistance and Other Internal Electrochemical Migration Testing

Developed by the Electrochemical Migration Task Group (5-32e) of the Cleaning and Coating Committee (5-30) of IPC

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Users of this publication are encouraged to participate in the development of future revisions.

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Table of Contents

Figures

Tables

User Guide for the IPC-TM-650, Method 2.6.25, Conductive Anodic Filament (CAF) Resistance and Other Internal Electrochemical Migration Testing

1 SCOPE

This document is the product of the IPC Electrochemical Migration (ECM) Task Group. It was drafted to provide guidance regarding implementation of the User Guide for the IPC-TM-650, Method 2.6.25, Conductive Anodic Filament (CAF) Resistance and Other Internal Electrochemical Migration Testing to evaluate the effects of mechanical stress, laminate material fracturing, ionic contamination, moisture content prior to press lamination, and other material processing characteristics on formation of conductive paths within laminate material such as conductive anodic filaments (CAF), one specific type of ECM failure mode. This internal ECM test method provides a proven standard for determining the risk of through-hole bias and other internal conductor orientations that result in significant reduction of insulation resistance internally, rather than on the surface of printed boards.

2 BACKGROUND

In recent years, internal electrochemical migration (ECM) liability concerns in the industry have increased as board designs have advanced in terms of decreasing clearances, dimensions and/or higher voltages. ECM failures describe any phenomena that causes internal drop in insulation resistance, including conductive anodic filament (CAF) formation, weak polymer resin bond, hollow fibers, poor wetting of glass reinforcement fibers with resin, foreign material or contamination, rough hole walls, and excessive copper wicking within plated through holes. Temperature, humidity and bias testing of insulation resistance using test coupons is the methodology used to check for these defects. The user of this document is encouraged to become familiar with IPC-9201, *Surface Insulation Resistance Handbook* to distinguish between internal ECM failures and possible confounding Surface Insulation Resistance (SIR) failures.

3 PURPOSE

This user guide addresses test issues regarding determining pass/fail criteria based on knowledge of three product goals:

a) What are the long term reliability requirements?

b) What is the closest spacing required for a given voltage?

c) Evaluate the internal ECM Failure risk.

4 INTRODUCTION

Internal ECM, including conductive filament growth occurs within a printed board and may or may not be visible under a microscope. It is often associated with adjacent laminate material fracturing or defect (i.e., ‘‘pathway’’) that contributed to its formation. Examples of visible filament growth shown in Figures 4-1, 4-2, 4-3 and 4-4 would fail the temperature, humidity, and bias conditions selected to determine multilayer board reliability between internal features.

The high magnification photo, Figure 4-1 below, shows a printed board with layer 1 (top layer) removed, revealing a near shorting condition between the plated through hole and layer 2 ground plane.

Poor press lamination and/or defective prepreg material may contribute to entrapped contaminants and the formation of conductive pathways which results in early test failure if the resin/reinforcement bonding strength and resistance to mechanical stress is reduced.

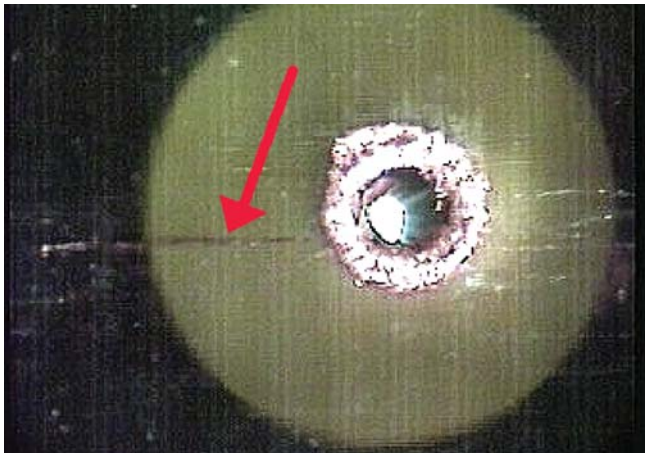

Figure 4-1 Example of an Internal Conductive Filament
[Photo courtesy of Matsushita]

Failure analysis, as seen in two perspectives in Figure 4-2, show a near-shorting condition from the hole barrel to the plane on layer 3.