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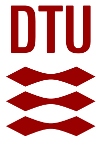

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Parametric study of regional climates on electronics: Understanding local climate effects on corrosion failure mechanisms

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Product reliability under various climatic conditions is one of the key factors for electronic manufacturers. Electronic components can fail in various stages of applications due to design or materials issues, but failures can also be due to environmental conditions during the service life of the products. Temperature, humidity, and presence of hygroscopic contaminations are high feasible causes of intermittent failures in electronic products.

A physical simulation of electronic devices with various parts inside and exposed to different climates from arid to humid regions has been performed. Local internal temperature and humidity have been recorded and related leakage current on surface insulation resistance - printed circuit board (SIR-PCB) comb patterns with different pitch sizes, pre-contaminated with different weak organic acids, with and without the presence of thermal mass have been measured.

The results give an understanding of the average value of failure rate for electronic devices based on climate information and electronic packaging design such as pitch size on SIR pattern, effect of thermal mass and type of contamination. It shows that the diurnal temperature fluctuations of the outdoor climate can lead to the formation of transient conditions inside the device where the dew point (DP) is very close to the air temperature. The presence of hygroscopic contamination and the thermal delay of the thermal mass enhance the possibility of transient water layer build-up on the surface of PCB, resulting in corrosion reliability issues and intermittent failures.

Keywords: Climate, Contamination, Electrolyte solution, Enclosure, Humidity, Leakage current, Printed circuit boards, Temperature, Thermal mass, Water layer formation