Effect of Environments on Parametric Degradation in Polymer Tantalum Capacitors

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Chip polymer tantalum capacitors (CPTCs) are more sensitive to environments compared to conventional, MnO2 cathode capacitors. Contrary to MnO2 capacitors, CPTCs can degrade with time of storage even in dry conditions, that might limit their use for space applications. Performance of CPTCs depends on the amount of moisture in the slug, and varies with time of storage after manufacturing. For this reason, characteristics of the parts and qualification testing should be carried out after preconditioning to stabilize moisture content. This work analyzes kinetics of moisture sorption and desorption in different types of CPTCs from three manufacturers. Variations of capacitance, dissipation factor, leakage currents and breakdown voltages caused by exposure to humid, dry, and radiation environments are discussed. Characteristics of 13 types of CPTCs and 5 types of MnO2 capacitors have been measured with time of exposure to gamma radiation from Co-60 at a rate of 40 rad per sec up to 5 Mrad TID. Examples of the effects of long-term exposure to vacuum, humid environments at 85%RH, and dry air at temperatures from 100 ºC to 175 ºC are presented and mechanisms of degradation discussed. Temperature dependencies of the characteristic times of moisture diffusion allow for assessments of the bake-out times that are necessary to avoid pop-corning failures after soldering and to precondition parts before testing.