

A Novel RoHS Compliant K~4000 X7R Dielectric Compatible with 80%Ag/20%Pd Internal Electrodes for High Reliability PME MLCC Applications

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X7R-type dielectrics with high reliability and $K \geq 3000$ are the workhorse for specialty precious metal electrode (PME) Class II multilayer ceramic capacitor (MLCC) manufacturing. Due to the high price of palladium (Pd), ~\$973/troy ounce, and silver (Ag), ~\$17/troy ounce (prices as of October 25th, 2017), the PME capacitor industry constantly demands new dielectrics with higher dielectric constant and lower sintering temperature for product range extension and cost reduction. For the same volumetric efficiency of PME MLCC chips, it is possible to reduce the cost of PME internal electrodes by about 50% by increasing the dielectric constant of the ceramic dielectric from 3000 to 4000, with the simultaneous reduction of Pd content in Ag/Pd electrodes from 70% Ag/30% Pd to 80% Ag/20% Pd. As of today, there are only a few RoHS compliant X7R-type PME dielectrics commercially available, which offer both K~3000 and compatibility with 80% Ag/20% Ag electrodes. This paper describes a newly developed highly reliable RoHS compliant X7R-type dielectric, which is not only compatible with 80% Ag/20% Pd electrode systems, but also offering enhanced dielectric constant of 4000 ± 300 . Basic electrical properties of the new dielectric were evaluated based on the performance of .0805-size MLCC chips with varied number of dielectric layers and thicknesses. The results of these evaluations are presented in detail and illustrate the robust behavior of the new material system.