

Dielectric Properties in Frequency Domain of Main Insulation System of Printed Circuit Board

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Abstract : Printed Circuit Board (PCB) is a critical component applicable to power electronics systems, especially for high-voltage applications involving several high-voltage and high-frequency SiC/GaN devices. The insulation system of PCB is facing more challenges from high-voltage and high-frequency stress that can alter the dielectric properties. Dielectric properties of the PCB insulation system also determine the electrical field distribution that correlates with intrinsic and extrinsic aging mechanisms. Hence, investigating the dielectric properties in the frequency domain of the PCB insulation system is a must. The paper presents the frequency-dependent, temperature-dependent, and voltage-dependent dielectric properties, permittivity, conductivity, and dielectric loss tangents of PCB insulation systems. The dielectric properties mechanisms associated with frequency, temperature, and voltage are revealed from the design perspective. It can be concluded that the dielectric properties of PCB in the frequency domain show a strong dependence on voltage, frequency, and temperature. The voltage-, frequency-, and temperature-dependent dielectric properties are associated with intrinsic conduction behavior and polarization patterns from the perspective of dielectric theory. The results may provide some reference for the PCB insulation system design in high voltage, high frequency, and high-temperature power electronics applications.

Keywords : electrical insulation system, dielectric properties, high voltage and frequency, printed circuit board

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