Real-Cases of Electromagnetic Immunity and Reliability in Embedded Electronics Architectures

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Abstract—**this papers concerns works about electromagnetic immunity and reliability investigations on electronics devices, combined with different physical impacts as temperature.**

Keywords-couplings; aggression; reliabilility; device; temperature;

I. INTRODUCTION

New complex electromagnetic environment have to be taken into account to prevent real critical electromagnetic compliances [1]. We try to estimate the realistic impact of external temperature on Electromagnetic Interferences (EMI) and compliances (EMC) for couplings in electronic structures [2]. Some cases of instantaneous failures (susceptibility, immunity) and long-time failures (reliability) of these configurations are presented, both by technical (characterization) and virtual (simulation) investigations.

II. THE METHODOLOGY OF VIRTUAL EXPERIMENT

The aim is to identify the electromagnetic contributions in a 3D complex physical architecture. The modeling approach is based on the optimized use of electromagnetic numerical tools, as Finite Elements Method (FEM) and Partial Electric Equivalent Circuit (PEEC). Wide-band Electrical equivalent models of a Hybrid Printed Circuit Board(PCB) can be used to investigate the thermal influences on EM characteristics. The temperature as an influent parameter is the new key for good simulation's results and EMC couplings prevention.

III. RESULTS AND DISCUSSIONS

Some parts of an embedded architecture studied to investigate the modeling way and the effects of temperature on electromagnetic noise, immunity behavior and reliability.

A. EM noise and reliabilty

The electromagnetic noise with chips on PCB is due to supply, input-output network, and device packaging pins, which acts as parasitic elementary antennas excited by fast signals transitions. Application on an active power PCB using IGBT (Insulated Gate Bipolar Transistor) has been driven (fig. 1). The results on electromagnetic radiation frequency confirm the trends: with high-temperature aggression, devices are emitting electromagnetic noise peak at lower frequency and levels.

B. EM immunity with temperature agression

Immunity is driven by aggressing integrated circuit and connexions with a combination of power-frequency levels. A default is validated for when the criteria has been reached. The figures 2 and 3 show the difference of susceptibility/reliability on the parts of the devices, with the impact of T°

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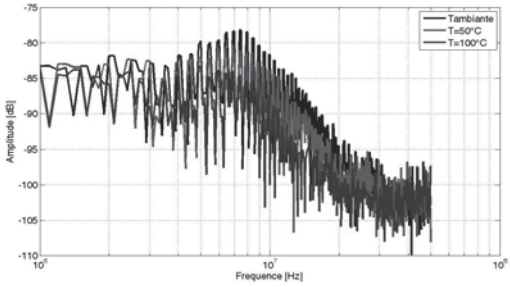

Fig.1: Spectrum of radiated field over an IGBT module for different aggression temperature

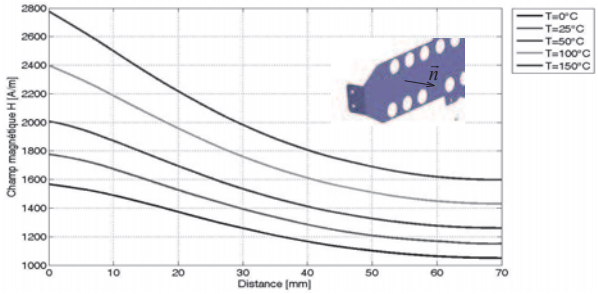

Fig. 2: Simulation of radiated magnetic field(normal component) of a bus bar for different distances and aggression temperature.

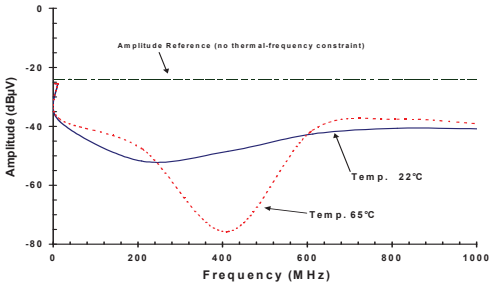

Fig. 3: Comparison of electromagnetic aggression over a digital PCB at different temperature (22°C, 65°C)