IEEE EMC Society Sponsored Workshop

Session I: EMC Aspects in the Analysis and Design of Printed Circuit Boards (PCBs)

EMC Aspects of PCB Grounding Design

SPEAKER: DR. ALEX AXELROD, ISRAEL

Abstract: Grounding, in general, and the design of the Grounding system in PCBs in particular, are probably among the most important, yet less understood topics of electronic design, often considered as "black magic". This presentation is intended to shed some light on the concepts and pitfalls of the grounding system design, with particular emphasis on its implementation in PCBs.

The presentation will begin in a discussion of Ground categories and design considerations for each category, leading to the advantages of using ground planes versus ground traces, for instance – the Shielding provided by ground PCB layers. Discussion of rules for correct allocation of ground PCB layers and the pitfalls and effects of Irregularities in ground planes and their effects on EMI and signal integrity will also be discussed. Ground bounce, as a source of radiated EMI on the one hand, and techniques for improving ground performance (e.g., chassis ground stitches) will also be covered. The presentation will be embedded with practical design problems and examples.

Decoupling, Bypassing and Embedded Capacitance for Enhanced PCB Performance

SPEAKER: MARK MONTROSE, USA

Abstract: With advances in semiconductor manufacturing, larger pin count devices, greater power consumption and higher clock speeds, power distribution to digital systems on a printed circuit board is becoming a primary concern for design engineers. Signal integrity must be ensured while maintaining electromagnetic compatibility for the intended operational environment.

Power plane resonances and lack of energy charge to digital components operating a high frequencies cause problems that are now magnitudes greater than several years ago. Understanding how to incorporate capacitive structures in power distribution networks is now a mandatory part of digital engineering. Use of discrete capacitors and embedded capacitance will be examined for enhanced performance of printed circuit boards.

Signal Traces as Transmission Lines on PCBs – Why, and What does that Imply?

SPEAKER: ELYA B. JOFFE, ISRAEL

Abstract: As signal speed increase on printed circuit boards, traces can no longer be treated simply as lossless (or even lossy/resistive) conductors. As propagation delays along the traces become a significant portion of the signal (very fast) rise time) and especially when it exceeds the rise time, transmission line effects such as reflections, leading to "ringing" and hence significant degradation of high speed propagation will result.

This presentation is intended to present the concept of transmission lines and the motivation for treating high speed signal conductors (what IS "high speed" – that will also be discussed) as transmission lines. Concepts of reflection and ringing, termination and signal distribution will be presented and pitfalls in transmission line implementations on PCBs will be presented.

Methods of the Analysis of PCB of High-Speed Devices

SPEAKER: PROF. LEONID N. KECHIEV, RUSSIA

Abstract: The main numerical analyses of PCB of high-speed devices are considered. The low speeds of overfalls of powers in digital systems, broad spectrum of transmitted signals require careful improvement of PCB in its physical properties, estimation of the directed powers and definition of signal distortions. The electrodynamics substantiation of analyzed models of PCB and their classification will be carried out, the classification of methods of the analysis and condition of their implementation will be carried out. The generalized algorithm of definition of PCB physical properties is considered on the fundamentals of the base parameter - capacitance.

The methods of Isogonal Transformations, Method of Boundary Units, Method of the Moments and the Finite Element Method are considered. For these methods the main steps of implementation, possibility, and limitation are given. The items of information on application of the numerical methods for an estimate of integrity of signals are listed.

Session II: Techniques and Facilities for EMC Measurements

Radiated and Injected Measurements - When are they Equivalent?

SPEAKER: PROF. JOSE PERINI, USA

Abstract: The performance of radiated tests requires very expensive equipment such as Shielded, Mode Stir, or Anechoic Chambers, and high power amplifiers. It is intellectually satisfying that perhaps the same result could be obtained by injecting current and or voltage sources, of much less power, in strategically selected places of the equipment under test (EUT). The question is then where to place these injection sources, and with what amplitudes and phases, so that the two tests are equivalent? This presentation derives exactly under what conditions, and with what sources these two tests can be made equivalent. However the equivalence can only be established at specified ports and only for linear and reciprocal EUTs. It is shown, by way of numerical simulation, that the internal excitation of the EUT can be drastically different for both tests, even when the ports currents and voltages are the same.

Extending the Operation of Mode Stirred Chambers to Low Frequencies

SPEAKER: PROF. JOSE PERINI, USA

Abstract: In this presentation the nature of the modes normally excited in a rectangular cavity will be discussed. This will lead to the concept of propagating and evanescent modes and how they behave inside the cavity. From this it becomes obvious why the Mode Stirred Chamber cannot operate at low frequencies when excited in the way they are today. If a wire parallel to any one of the three axis of the cavity, and extending to the two opposing walls perpendicular to the wire, is introduced in the cavity, then a structure capable of supporting a Transverse Electric Magnetic Field (TEM) is established. This is the same mode that exists in a coaxial line or in any transmission line. This mode is frequency independent and exists from DC to any frequency. Therefore this new structure can produce a field that can fill the whole cavity for any frequency. Instead of using the paddle wheels to stir the fields, another wire parallel to the first can be introduced and fed with a voltage whose phase and or amplitude can be electronically changed, in a sequential fashion, such that the fields can go through its maxima and minima. This will eliminate the bulky paddle wheels leaving much more space for testing or reducing the size of the chamber. There are several other more efficient options to electronically stirring the fields that will be discussed. Simulation results for the two parallel wires will be presented to support the claims.