EMCT
Electromagnetic Compatibility Tutorial ®

MODULE 3: Shielding

EMC Shielding Methodologies and Applications (351 screens)

The Shielding Module contains four sections and examines product shielding strategies. We'll learn how shields function with regard to enclosures, localized shields, and cables. In particular, we'll explore the demands placed on shields at increasingly higher frequencies and shorter wavelengths. We'll begin with a look at the broad concepts of how shield structures function in terms of losses (shielding effectiveness). Next, we'll examine the effects of the incident wave impedance on a shield's performance. Then, we'll investigate the effects from gaps, seams, slots, and perforations. We'll learn how to use "waveguide" apertures in a frequency mode below cutoff and study apertures, gaps, and perforations as phased-array structures. Then, we'll learn how to use heat sinks as shield structures (as noted in the Propagation Module). Next, we'll examine circuit partitioning methods using board-mounted shields and, in particular, learn how to use segmented shields to offset the performance required of a perimeter shield. Finally, we'll apply shielding and partition strategies to shields on cables. We'll focus on cable shield characteristics and termination methods as the completion of a perimeter shield structure.

Section A - Product Shielding: Application of Conceptual Theory

- Properties of Electromagnetic Waves
- Concepts of Electromagnetic Wave Impedance Mismatches With Shields
- Transmission Line Analogies of Shielding Processes
- Electromagnetic Wave Impedances:
  - o Near Field;
  - o Transition Region;
  - o Far Field
- Electromagnetic Wave Impingement - Shield Performance Mechanisms
- Reflection Losses From Shield Surfaces
- Initial Reflection Loss Shielding Function of a Boundary
- Skin Effect Boundaries
- Boundary and Inter-boundary Effects:
  - o Thick Shields;
  - o Thin Shields;
  - o Surface Boundary Shields
- Shielding Effectiveness Functions of a Continuous Shield Boundary:
  - o Reflection Losses;
  - o Absorption Losses
- Compilations of Shielding Effectiveness Parameters

Section B - Perimeter Case and Chassis Shielding (Gaps, Seams, Slots, Perforations and Waveguides Operating Below Cutoff)

- Factors Limiting Shield Performance
- Coincidence of Apertures to Circuits and Circuit Boards
- Applications of Seams and Gaps as Shield Apertures
- Induction Flux Equivalence in Shield Gap Formations
- Aperture-Arrayed Shield Structures - Ventilation (Cooling) Applications
- Waveguides in Cutoff - Individual Apertures
- Waveguides in Cutoff - Aperture Arrays
- Ventilation Path - Plenum Shield Indirect Impingement Concepts
- Cavity Resonance in Enclosure Plenums
- Waveguides in Cutoff - Performance Examples
- Perforated Metals and Screen Shield Performance Examples
- Honeycomb Shield Arrays
- Waveguides Performance in Cutoff:
  - o Rectangular
  - o Circular

Section C - Shielded Modules Carried on Circuit Board Partitions

- Device-level Heat Sinks Utilized as Shields
- Completing Shields of Device-level Heat Sinks
- Regional Shield Partitions with Lumped Coupling Approximations
- Regional Shield Partition - Topology Routing Plans
- V-Plane Partitioning in Regional Boundaries
- Inner-Board Shielding Partitions with "Picket Fence" Via Patterned Arrays
- Partition Integration with "Shields" for Externally-Removable Circuit Modules
- Partitions Developed Within Boundaries of Removable Circuit Modules
- Cavity Resonance Effects and "Q-Factor"

Section D - Cable Shielding Applications

- Purpose of Cable Shielding:
  - o Tri-axial Cable Shields;
  - o Twin-axial Cable Shields;
  - o Twisted Pairs;
  - o Unshielded Twisted Pairs
- Cable Shield Construction Details
  - o Braids
  - o Braids with Metallized Polyester Underlay
  - o Description of Weave "Bands & Strands", and Braid-Weave Angle with Respect to Current Flow
- Cable Shields as Boundary Partitions
- Common-mode Cable "Image Return" Functions of Chassis, Structures, and Earth
- Importance of Connector Characteristics
- Shield Categories of Multi-Conductor Shielded Cables
- Twisted and Twisted-Shielded Pairs Within Multi-Conductor Cables
- Significance of Shield Termination Impedance

www.emctutorial.com
info@ emctutorial.com