

Mechanical Design for EMC

This two-day class for mechanical engineers provides clear applications, theory and demonstrations for the successful design of mechanical enclosures for good system emissions and immunity performance. Key topics include grounding at the PCB and enclosure, system ground maps, PCB component placement and control drawings, enclosure and cable shielding, PCB device "cans", resonant slots and enclosures, heat sinks, unintentional antennas, as well as connector, screw, and conductive gasket placement.

Day 1: Attend Day 1 of Electronic Product Design & Retrofit

Day 2:

Section 1: Review of Key Concepts and Introduction to Shielding

- 1) The theoretical, perfectly shielded enclosure
- 2) The expensive, practical enclosure
- 3) Review of the four noise paths
- 4) Understanding & visualizing common-mode current + DEMONSTRATION
- 5) Antenna circuits
- 6) Regulatory and functional emissions and immunity tests
- 7) The three properties of electromagnetic shields
- 8) Accidental antennas

Section 2: PCB and Mechanical Control Drawings

- 1) Placement and location of grounds, and connectors
- 2) Effects of heat sinks
- 3) "Ground" / reference maps
- 4) External shielded connector interfaces

Section 3: Shielding

- 1) Why EMC shielding math in textbooks is wrong
- 2) Classical shielding and shielding for EMC
- 3) Problems with the prediction of shielding effectiveness
- 4) Practical aspects of shielding enclosures
- 5) Slot and cavity resonances in shielded enclosures + DEMONSTRATION
- 6) Review: The three properties of electromagnetic shields
- 7) Reflective and absorptive properties of shields
- 8) Low frequency shielding
- 9) Magnetically conductive materials
- 10) Transfer impedance for base materials, connectors, cables and enclosures
- 11) Effects of apertures
- 12) Latest research on apertures and cavities

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Day 2 (cont'd):

- 13) Simple tests to verify performance of enclosures and transfer impedance + DEMONSTRATION
- 14) Overall shielding using enclosures
- 15) PCB level shields + factors that affect performance
- 16) Prevention of "accidental antennas"
- 17) Troubleshooting techniques

Section 4: Shielding of Cables

- 1) Cable shielding and terminations
- 2) Applying transfer impedance concepts to cables, connectors, and system interconnect
- 3) Examples and discussions of common shielded connectors and their defects (ENET, d-sub, video)
- 4) Shield terminations + DEMONSTRATION
- 5) What to ground, where, and why
- 6) Examples of bad cable shielding designs

Section 5: Additional Shielding Topics (if sufficient interest & time permitting)

- 1) Types of EMI gaskets
- 2) Galvanic series and corrosion
- 3) Use of ferrites on cable assemblies