

# Electrical Resonances in Physical Structures

## (A New Approach to Solving EMC Emissions and Immunity Problems)

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Many system design problems result from electrical resonances in the physical structures of the system, such as PCB construction and mounting, heat sink construction and mounting, chassis construction, unintended resonances of system antennas, and system cables both internal and external. If these problems are thought of in terms of resonances (LC and transmission lines), the problems are often more easily found and solved. Techniques for finding, characterizing, determining if a specific resonance is a problem or is harmless, and fixing those resonances that are causing problems are presented.

The presentation is practical (as opposed to theoretical) and no head scratching math is needed or presented in the seminar. Results are presented from various types of systems. This short seminar is composed of 75 slides and can be presented over GoToMeeting, WebEx, or Skype. Attendees will receive a pdf copy of the slides. Length of the presentation is up to two hours.

### Seminar Outline

1. How to measure resonances
  - Direct measurements
  - Measurements using magnetic probes and a spectrum analyzer/network analyzer
2. Examples of measurements and implications
  - PCB plane resonance
  - Simple BNC connector
  - PCB mounted over metal/another board
    - Time domain
    - Frequency domain
  - Chassis resonance and ESD performance
  - RFID antenna (~10 MHz) spurious resonances @200 MHz and emissions
  - Resonance on a PCB path on development PCB
  - Heat sink resonance - EMC examples
  - Resonance in a system cable
3. Methods to kill the Q of resonances
4. Effect of system resonances on emissions and radiated immunity
5. Effect of system resonances on ESD performance
6. Testing resonances to see if they are a problem
7. Equipment recommendations
  - Spectrum Analyzer/Network Analyzer
  - Directional Coupler
  - 2 Watt power amplifier
8. Summary