Two Day EMC Design Seminar Description

Printed Circuit Board Design for Real-World EMI Control

(Electromagnetic Compatibility is ***NOT*** Magic!)

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Course Description

Proper EMC design for printed circuit boards (PCB) can make a significant difference in the final product's performance in the EMC measurement laboratory. Implementing the proper EMC practices during the design phase of the product is critical and can have little or no impact on the product cost when done correctly.

Unfortunately, EMC design is considered to be similar to magic. This seminar focuses on the basic causes of EMC problems, and how to overcome these problems. This seminar is ***not*** just a list of "rules or thumb" but rather it helps the student ***understand why*** EMC problems happen, and what can be done to eliminate them.

This seminar's primary focus is to help working engineers understand the causes of EMC problems so this knowledge can be applied to real world product design immediately. Formulas and equations are not required and are minimized throughout the seminar. Understanding the causes of EMC problems will allow engineers to make difficult design trade-off decisions!

Intended Audience

This course is intended for:

-- Working Board Design engineers and layout engineers who are interested in better understanding the causes of EMC problems, and how to overcome these problems during the design phase without adding cost to the PCB.

-- Working EMI/EMC engineers who are interested in achieving a better understanding of the causes of EMC at the PCB level, and how to control these signals.

-- Managers and engineers who are interested in obtaining a better understanding of EMI/EMC design issues so that they can help make better trade-off decisions and provide proper emphasis to EMC design issues.

Course Materials

All registered participants will receive a copy of all the transparencies used in the presentations.

For More Information Contact

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EMC Design Seminar Outline

Introduction to General EMC

Review of Basic Electromagnetic Principles

Antennas

The Grounding Myth

What is Inductance?

-- *Full Definition*
    -- Requires current flow in a loop
-- *Partial inductance*
    -- Combine to find full inductance
-- *Incomplete Inductance*
-- *Examples, Simple Formulas, Model for Exceptions*

Printed Circuit Board Design

-- *Intentional Signals*
-- *Unintentional Signals*
-- *What is a Critical Signal ?*
-- *Potential Problems*
    -- Intentional Signals
        -- Differential Mode Emissions
        -- Common Mode Emissions
    -- Unintentional Signals
        -- Common Mode Emissions
        -- Crosstalk Coupling
        -- Power/Ground-Reference Plane Noise (Decoupling)
    -- Controlling Emissions at the Source
    -- Intentional Signal Current Spectrum
-- *Direct Radiation from Traces*
    -- Effect of Splits in (Power) Reference Plane
    -- Effects of Stitching Capacitors
-- *Board Edge Effects*
-- *Crosstalk*
    -- Single Level Crosstalk
    -- Multilevel/Cascade Crosstalk
    -- Guard Traces vs. Physical Separation
-- *Power/Ground-Reference Plane Noise (Decoupling)*
-- Decoupling Capacitor Performance
-- Board Resonance
-- Excitation Modes
    -- IC Power draw
    -- Critical Signal through vias

-- *Splits in Ground-Reference Plane in I/O Area*
-- *Effects of Optimum Net Termination on EMC*

-- Using Commercial SI Tools to Help Reduce EMC
-- Voltage is NOT Important, Current IS Important
-- *Critical Net Return Current Flow*
-- Critical Nets through vias
-- Mother/Daughter Card Connectors

-- Above Board Radiating Structures
-- *Grounding Heatsinks to Mother Board*
-- *Mother board and Daughter cards*
-- *Internal Radiation from Wires and Cables*

-- Filter Design
-- Simple Voltage and Current Divider
-- Real Impedance of Capacitors, Ferrite, Zero-ohm Resistors
-- Effect of trace length on component impedance
-- Two Terminal and Three Terminal Filters

-- PCB Reference connection to chassis reference
-- Why do We Care?
-- Impedance of Standoffs and Posts
-- Near I/O Area
-- Common mode voltage between I/O and chassis
-- Away from I/O area
-- Common mode voltage across board radiates into shielded box
-- Radiates directly from unshielded box
-- Impedance of PC Board plane vs. metal plate with some number of standoffs
-- Incomplete inductance?

-- Shielding
-- Cause of Emissions Through Apertures
-- Shielding of Apertures
-- Size/length
-- Thickness
-- Effect of many apertures
-- Seam Shape Effect
-- Gasket Effects
-- Shielding vs. transfer impedance
-- Need to consider metal coatings on chassis
- roughness to cut through coatings
-- Skin Depth Considerations for Ultra-thin Shields

-- What to do When a Product Fails in the Lab?
-- Thought Process for Source Determination
-- Bench Top Testing
-- Local Probing