Fundamental Concepts of Printed Circuit Board Design for Signal Integrity & EMC Compliance (Two Day Seminar)

Fundamentals of Signal Integrity
- What is Signal Integrity
- Signal Integrity Concerns
- LosslessTransmission Line Equivalent Circuit
- LossyTransmission Line Equivalent Circuit
- Relative Permittivity (Dielectric Constant)
- Propagation Delay Within Various Materials
- Ringing and Reflections
- Typical Transmission Line System
- Identification of Signal Distortion
- Crosstalk
- Terminator Noise and Crosstalk
- Design Techniques to Prevent Crosstalk
- Power and/or Ground Bounce
- Typical Bounce Waveform

Fundamentals of EMC
- Definition of EMC Terms
- The Decibel, Variations and Pitfalls
- Basic Aspects of EMC
- The EMC Environment
- Component Characteristics at RF Frequencies
- How Printed Circuit Boards Create EMI
- Right Hand Rule
- Maxwell's Equations
- Electric and Magnetic Field Components
- Closed Loop Circuit
- Time and Frequency Representation
- Radiated Emissions from a Closed Loop Circuit
- Loop Area Between Components
- Common-Mode and Differential-Mode Currents
- Basic Concept for EMC Suppression
- Different Grounding Methodologies

Basic EMC Suppression Concepts
- Image Planes
- RF Current Retrun Path and Distance Spacing
- RF Current Density Distribution
- Ground Loop Control
- Three Main Grounding Methods
- Resonance in a Multi-Point Ground
- Aspect Ratio
- Ground Slots and Through-Hole Components
- Partitioning
- Logic Families and Components

Bypassing and Decoupling
- Defining Capacitor Usage
- Capacitors and Resonance
- Using Capacitors in Parallel
- Effects of Capacitors in Parallel
- Power and Ground Plane Capacitance
- Equivalent Circuit of a PCB
- Capacitive Loops Created by Capacitors
- Placement Recommendations

Clocks, Impedance Control and Trace Routing
- Calculating Clock Frequency Range
- Microstrip and StriplineTopology
- Impedance Control Equations
- Capacitive Loading
- Calculating Maximum Trace Length for Routing
- Trace Separation and the 3-W Rule
- Routing Differential Pairs
- Trace Routing
- Routing Layers
- Layer Jumping - Use of Vias
- Guard and Shunt Traces

Layer Stackup Assignments
- Single and Double Sided Recommended Layout
- Multi-Layer Stackup Assignments
- Film and Manufacturing Concerns

Terminations (Signal Integrity Concerns)
- Fundamental Concepts of Trace Termination
- Transmission Line Effects
- Termination Methodologies
- Branched Terminations
- Correct Method to Implement Termination
- What Happens When One Cannot Terminate

Interconnects and I/O
- Partitioning
- Isolation (Moating) and Bridging
- Image Plane or Moat Violation
- Digital and Analog Partitioning
- Filtering and Grounding
- Common-Mode and Differential-Mode Currents
- Multi-Point Grounding (I/O Connectors)
- Video and Audio Circuits

Electrostatic Discharge (ESD) Protection

Backplanes and Daughter Cards
- Design Basics - Five Areas of Concern
- Construction, Mechanicals, Interconnects
- Signal Routing and Terminations
- Crosstalk
- Ground Loop Control
- Ground Slots in Backplanes

Miscellaneous Design Techniques/Concepts
- Localized Planes
- Trace Routing for Corners
- The *20-H Rule*
- How to Select a Ferrite Device
- Grounded Heatsinks
- BNC Conectors
- Lithium Battery Circuits
- Creepage and Clearance Distances