

EMCT Module #1:
“Propagation From Devices, Circuit Boards, and Chassis”

In this first of three EMCT learning modules we're introduced to the primary mechanisms that create EMI from active circuit boards. Using a layered teaching approach, we first learn about the fields that are created by a single device. Then, building on those concepts, we can understand the more complex fields that emanate from several devices, including how circuit boards couple EMI currents to attached wires or cables and form radiating antenna structures. Along the way, we learn the Fourier approach—that digital waveforms are comprised of many higher frequency sine waves.

By a careful progression through important EMC design concepts, we're brought to the heart of Module 1: Circuit Board Layout Considerations. In this all-important section, with over 250 screens, we learn how circuit boards create distributed transmission lines with respect to chassis structures and surface planes. We learn how to control EMI propagation using the reflection losses and null formations that form within the distributed transmission lines that are setup between the boards and the chassis. Then, we learn how to minimize losses by flux and inductive cancellation using transmission-line methods in the stack-up of circuit boards and individual traces. Finally, we study the techniques we'll need to reduce EMI coupling by partitioning the circuitry.

By the time you've completed studying this module, you won't need the "hand-me-down" lists of "do's and don'ts" in PC Board design. You'll be able to create your own—specific to your particular products. Then, you'll be the local expert.

MODULE CONTENT:**Introduction to EMC (43 screens)**

- Blocked and Lumped Equivalent Models
- Chassis Structures
- Interface Connections
- Conductive Case / Packaging Containment
- Susceptibility Coupling
- ESD Application
- Interface Connections
- Exit Currents
- Antenna Structures

Module 1 Details (370 screens)**Logic Devices and Circuit Boards**

- Output Drivers and Cross-Conduction
- Spectral EMI Characteristics of Waveforms
- Common-Mode Structures
- Propagation of Current Through a Plane
- Peak Currents Impulse Surges
- Heat Sinks
- Spectral Resonance
- Storage Capacitors
- Multiple Circuit Devices
- Wire and Cable as Antennas

Field Transfers to Structures from Circuit Boards

- Distributed Transmission Lines
- Chassis Planes
- Modes of Fields and Transfers
- Image Plane Mode
- Surface Patch Mode
- Spectral Level Alterations
- Common-Mode Field Displacements
- Cable Connections
- Conductive Structures
- Multi-Mode Arrays
- Antenna Propagation
- Ground Stitches
- Isolation Moats
- Impedance Considerations

Circuit Board Layout Considerations

- Detailed Transmission Line Review
- Flux Linkage
- Flux and Inductance Cancellation
- Transmission Line Breaks
- Return Images
- Micro-Stripline Schematic Description
- Transmission Line – Stripline
- Transmission Line – Micro-Stripline
- Transmission Line – Embedded Micro-Stripline
- Transmission Line – Asymmetrical Stripline
- Transmission Line – Edge Coupled Differential Line
- Transmission Line – Broadside Coupled Differential Line
- Circuit Board Transmission Line Impedance Characteristics
- Flux Linkage Patterns
- Power Planes and Impedance
- Stack-up Considerations
- Flux Termination Concepts
- Power Planes and Impedance Termination
- Undercut Planes
- Improving EMC Performance and Signal Quality
- Multiple Dielectric Separations
- Reducing Power Flux Coupling
- Skin Effect
- "3W Rule" for Signal Isolation in Traces
- Signal Imaging
- 8-Layer Board Example
- Image Phase Return Skew
- Skew Route Patch
- Imaging on Voltage Planes
- Signal Impedance Matching
- Terminations
- Circuit Board Partitioning
- Blind Vias
- Buried Vias
- Faraday Fences
- Circuit Board Shield Structures
- Isolation "Picket" Fences
- 3-D Partitions
- Via Patterns
- Analog Partitioning
- Common-Mode Inductor Valuation
- Susceptibility Partitioning
- Topology of Circuit Boards with EMC Architecture

What is the EMCT?

Brought to you by Elliott Laboratories and the IEEE Standards Information Network, the Electromagnetic Compatibility Tutorial is an EMC education on a CD-ROM. It combines the best qualities of a classroom instructor, a seminar, and a book into one extremely convenient and very powerful teaching medium. The EMCT is easy to carry around. It's more compact than a book or seminar notes—and it's interactive.

Learn from W. Michael King – Reap the benefits of a lifetime of learning and applying EMC in more situations than most EMC engineers would ever hope to encounter. William Michael King is one of the acknowledged pioneers and masters of EMC. He has been in the EMC field for over 40 years and has worked on more than 1000 designs for more than 400 clients worldwide.

Want more? EMCT has successfully completed the IEEE Peer review process so you know it meets the highest professional standards!

Benefits of the EMC Tutorial

EMCT presents over 1,200 images in dazzling color using mixed media. There are 3-D animated graphics, photographs, plots, schematics, and block diagrams. All the images are in vivid color. Some of EMCT's images are even animated, 3-Dimensional graphics depicting radiating fields (books can't show movies). And, remember the old saying "a picture is worth a thousand words?" You'll learn EMC faster because you'll remember the images you've seen—they cement the concepts in your mind.

EMC is a complex subject. In the tutorial, the author masterfully weaves the concepts of EMC into a powerful understanding of complex systems—one simple layer at a time. The teaching method is both conceptual and intuitive. Throughout the tutorial, you're provided with numerous design examples and the design rules. And, what's most important—you're not just blindly learning a bunch of rules. Always, you're learning the concepts, so you'll know when and where to apply the design rules.

Would you like more information? Many topics in the EMCT provide additional screens to clarify and further explain the concepts at hand—the additional information is a path off the main stream of slides.

Another major benefit of the EMCT is that it's self-paced. You learn on your time, when it is convenient for you! Seminars and instructors move at a predetermined pace, not according to your busy schedule. You often miss important concepts because you're too busy taking notes or the topic has been fully explained to your satisfaction. And of course, instructors can run out of time but the EMCT is there for you as long as you need it.

Then there's the ability to administer a self-test to validate your understanding of the subject matter. At any time you choose you can take the EMCT self-test and gauge your progress on the course curriculum. Take it over and over – the questions change every time. And when you're done you'll be directed to the correct screens for each incorrect answer.

To Purchase the EMCT CD-ROM

For more information or to purchase the EMCT, please visit our website at www.elliottlabs.com, send an email to emctinfo@elliottlabs.com, or call us at +1.408.245.7800 or +1.877.245.7800.