EMC Lab Techniques for Designers
(Practical Methods to Find EMC Problems in the Development Lab)
by Douglas C. Smith

for System, Circuit, and IC Engineers

> **"You don't want to attract the attention of the EMC group/test lab.**
> **It can spoil your whole day."**

About the Course

The course covers techniques for finding design issues that may cause EMC compliance problems early in the design cycle, long before an official EMC test. This can be accomplished in the development lab without a lot of fancy EMC equipment. These techniques are easy to use and can find a wide range of potential EMC problems in a design right on the lab workbench.

This seminar describes each technique in depth, how to apply it, and how to interpret results. A list of recommended equipment is presented. The techniques presented sometimes use test equipment in unusual ways.

Emphasis is placed on delivering practical knowledge that can be used immediately on the job. Some class time is reserved to discuss problems and interests of those attending. Each class delivery is modified to fit the interests of the attending people.

Doug Smith's High Frequency Measurements website, http://emcesd.com, contains a wealth of interesting technical information on related topics.

Instructional Methods

The course includes a combination of teaching methods including lecture, live experiments, live computer simulations, and still pictures of experiments with results. The combination of methods combined with Mr. Smith's enthusiastic presentation style helps the students learn and enjoy the course.

Who is it for?

All circuit designers, system designers, design supervisors, even EMC personnel will find the material useful.

Prerequisites

A college-level course on circuit analysis is desirable although the seminar will be useful to those with two-year technical degrees. Desirable, although not required, is the two day course by Mr. Smith, "High Frequency Measurements and Noise in Electronic Circuits" either before or after taking this course.

> **"You don't need a lot of fancy EMC equipment to find problems early."**

Benefits

- Learn the simple theory behind easy to use development lab tests that can find EMC problems.
- Learn to find and evaluate potential EMC problems with readily available lab equipment.
- Learn to measure the resonant frequency of physical structures like heat sinks or edge connectors.
- Learn the design errors than can cause EMC problems and how to find them in a design.
- Learn to measure EMI currents in systems and recognize when they are a problem.
- Learn to relate the easily measurable relative phase of EMI currents to fixing EMC problems.
- Learn construction techniques for useful laboratory apparatus that can track down problems.
- Learn how to use test equipment you already have in novel ways to find EMC problems in a design.

Course Presenter

Douglas Smith, Author of *High Freqency Measurements and Noise in Electronic Circuits*

Course Content

Technical Background

- Loop theory and resonant frequency of physical structures
- Common mode current relationship to EMC emissions
- Using current probes to find EMC problems
- Design of system cables and connectors and their relationship to EMC
- Differential signals: how much do they help?
- Skin effect

Tools Discussed

- Commercially available equipment
- Simple to build probes
- Scopes and Spectrum Analyzers

Techniques and Methods

- Measuring resonant frequencies in a system and relating them to potential EMC problems.
- Measurement of common mode currents and relative phase to predict EMC problems.
- Evaluation of heat sinks, board edge connectors, and other physical parts of a system.
- Unconventional uses for conventional test apparatus
- Interpreting measurement results.

Hands-On Experiments

- Sources of common mode current and connector design
- Resonant frequency of a circuit board mounted over sheet metal (by class attendees)
- Shielding effectiveness (by class attendees)

Recommended equipment and sources

- Probes
- Test equipment
- List of sources

"This half day course can help minimize the chance that an EMC issue appears just before product introduction."