

# Troubleshooting, Verification, and High Frequency Measurements in SI, Design, and EMC

## for Digital and Analog Designers

This course covers techniques applicable to design and verification of high-speed digital and analog circuits.

## About the Course

The course delivers practical knowledge for SI design troubleshooting and verification that can be used immediately on the job. The course material contains design tips and troubleshooting techniques developed by Mr Smith, many of which are unpublished and have solved engineering problems in less than a day that were not solved by published methods with weeks or months of effort. Electronic engineers from all fields will find this course useful.

This seminar describes in depth how to measure signal and noise in high speed digital and analog circuits. These measurements are then used to characterize high speed effects in electronic circuits including design verification and troubleshooting. Sources of measurement error are discussed. The measurement techniques are related to design issues to improve signal integrity, equipment EMC performance, and improve the overall reliability of electronic systems.

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

[www.emcesd.com](http://www.emcesd.com) - Doug Smith's High Frequency Measurements website, which contains a wealth of interesting technical information

## Instructional Methods

The course includes a combination of teaching methods including lecture, live experiments, live computer simulations, still pictures of experiments with results, and video. 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 (especially those involved with signal integrity issues), design supervisors, and manufacturing test engineers.

## Prerequisites

A college-level course on circuit analysis is desirable although the seminar will be useful to those with two-year technical degrees.

## Benefits

- Understand the subtleties and effects of high frequency measurement techniques and their application to signal integrity and system performance
- Learn to locate and fix difficult signal quality or noise problems in a design
- Understand and apply techniques for measurement verification to insure accurate signal measurements
- Learn about noise related reliability problems in system and board design
- Apply high frequency measurement techniques to signal integrity, operational, and EMC problems to improve the reliability of a design
- Learn good circuit design and signal integrity/EMC principles and to avoid common and *unusual* design problems
- Learn construction techniques for useful laboratory probes that often outperform expensive commercial probes.

- Develop the ability to spot limitations of measurement apparatus from the "fine print" in measurement apparatus and probe specifications

## Course Presenter

[Douglas Smith](#), Author of *High Frequency Measurements and Noise in Electronic Circuits*

## Course Content

### Technical Background

- Shielded cable operation
- Skin effect
- di/dt and dv/dt effects in circuit and measurements
- Null experiments to verify measurement results
- Circuit board and system level design issues
- Effects of transmission lines and system cables on signal transmission and noise

### Probes

- Single ended and differential
- Sources of measurement error and how probe design can be a major contributor to error
- Useful home built probes

### Current and Magnetic Field Measurements

- Magnetic loop operation and application to signal integrity and noise problems (quite distinct from EMC uses of these probes)
- Current probe operation and application to signal integrity and noise problems
- Utilizing phase information between two probes to debug noise problems
- Sources of error
- Useful home built probes

### Troubleshooting Techniques

- Intermittent board and system level problems
- Signal integrity
- EMC problems and their relationship to signal integrity
- ESD problems and their relationship to signal integrity and system operation.
- Switching power supply induced corruption of signals far removed from the supply that result in intermittent problems
- Methods for determining if an IC package, with its accompanying parasitics, will robustly support the edge rates and clock speed of the chip inside.

***'Excellent demonstrations, much easier to understand than lots of equations'***

Tony Shaw, Principal Engineer, Sony Semiconductors

#### ***Additional comments from people recently taking the course***

- One of the best classes I've ever attended. Very practical information that can be easily applied to all designs.
- Great!! Very useful!!
- I appreciate the practical examples and "war stories" The book of slides was very effective. The industry contacts and tool suppliers was good, too.