

10 Northern Blvd, Suite 1, Amherst, NH 03031-2328 USA

T: +1 (603) 578-1842 www.silent-solutions.com

Applying Practical EMI Design and Troubleshooting Techniques

This two-day course gives engineering professionals the ability to successfully recognize, solve and avoid challenging EMI problems. Demonstrations using working hardware illustrate concepts such as radiated emissions, high frequency antennas, radiated and conducted immunity and crosstalk in connectors, cables and IC packages. Integrating over 30 years of hands-on troubleshooting experience and the latest EMC research, this class is appropriate for experienced circuit and system design engineers, EMC engineers, as well as those who are new to EMI problem solving.

After Attending This Class, You Will Be Able To:

- Systematically analyze and solve noise problems by using the noise model to create and analyze a noise circuit schematic
- Minimize radiated EMI by designing low inductance signal interconnects
- Understand ground loops, how to represent them in an equivalent circuit, and how to eliminate them
- Clearly identify and manage the three different types of "ground" in schematics and physical circuits
- Identify "accidental antennas" in new designs
- Understand and measure common-mode current in emissions and immunity problems
- Improve the quality of sensor and instrumentation signals in the presence of noise

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Day 1

Section 1: **Measuring and Inducing Noise**

- 1) Electromagnetic Compatibility
- 2) Radiated emissions & associated measurements + DEMONSTRATION
- 3) Uncertainty in measurements. Underlying problems in predicting results
- 4) Conducted emissions—mode separation, LISNs, troubleshooting
- 5) Function and purpose of immunity tests with simplified schematics

Section 2: **Predicting and Solving Noise Problems**

- 1) Capacitance—in ESD, PD boards, decoupling networks, filter networks, cables + DEMONSTRATION
- 2) Inductance—in PC boards, connectors, ICs, high speed signal paths, decoupling networks, filter networks
- 3) Behavior of current paths at low and high frequencies + DEMONSTRATION
- 4) Develop a customized source/victim/coupling-factor list of your company's designs
- 5) Improving your skills – additional topics

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Day 2

Section 3: The Four Noise Coupling Paths, Functions of “Ground” and “Ground” Loops

- 1) Common impedance - in PCB power planes, ground planes, cables
- 2) Capacitive - in PCB power filtering, transformers, heatsinks, connectors +DEMONSTRATION
- 3) Inductive - in PCB ground planes, connectors, and IC packages
- 4) Radiative - from small electronic products +DEMONSTRATION
- 5) Ground - the three distinct functions, ground loop problems, +DEMONSTRATION

Section 4: Optimum Use of EMI Control Components

- 1) Control components: capacitors, inductors, ferrite beads, common-mode filters
+DEMONSTRATION
- 2) Coping with and improving non-ideal characteristics such as interconnect inductance, DC bias

Section 5: Measuring and Diagnosing Effects of Common and Differential-Mode Sources and Filters

- 1) Differential-mode current, voltages
- 2) Common-mode currents, voltages, +DEMONSTRATION
- 3) Understanding the common-mode current and antenna path for emissions and immunity
- 4) Antenna currents and relevance to filter networks and troubleshooting
- 5) Common and differential-mode filtering. Filter network topology and function
- 6) Inherent difficulties in EMC filter design. Effects of filters on intended and unintended signals
- 7) Where to use common-mode filters—application circuits
- 8) Where to use differential-mode filters—application circuits