

Electronic Product Design and Retrofit for EMC

This two-day class gives engineering professionals the ability to successfully recognize, solve and avoid common 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.

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 - electrical schematic and the purpose of LISNs
5. Function and purpose of immunity tests with simplified schematics

Section 2: Lumped and Parasitic Capacitance, Inductance, and Current Paths

1. Capacitance - in ESD, PC 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

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

Section 6: Modern Power Decoupling Theory and Applications

1. The need for and function of decoupling capacitors - time and frequency domain
2. Understanding two-sided and multilayer PCB decoupling networks
3. Interplane capacitance. Power plane resonance. Latest research