Area 2 Seminars: Advanced Program for Technical Designers, System Integrators and Test Lab Personnel.

EMC Compliant Digital-Analog Circuit Design and Modifications for Equipment

Issues addressed in this course:

This advanced course is divided into 2 parts, digital (3 day, about 300 screens) and analog (1 day).

- Product designers should always try to design EMC from the beginning into Printed Circuit Boards (PCB) and equipment (boxes). A test lab offering modification or fixing services after discovering that the product failed an EMC test, is limited in its scope of activity.
- Both groups will be addressed and offered state of the art EMC technology solutions. EMC measures for different industries will be shown ranging from DC to 100 GHz.
- There are profound differences between analog and digital EMI occurrence. While the emphasis is on PCB design for large numbers of multi-layers, it is important to understand how EMI leaks in and out of PCBs, interconnects, cables and even metallic equipment chassis.
- Technical economy of design methods and limitations regarding choices of retrofits are explained. What to do with an incorrectly designed chip with uncontrolled internal EMI-coupling since positioning would not be of help.
- How to fight emissions from digital prints. Can a scientific pocket calculator help? The efficiency of conducted versus radiated EMI counter measures.
- How would one predict and measure in design and test labs. Issues such as immunity and susceptibility. How do filters and screens work. Coupling effects in PCB and equipment boxes, what to look for first.
- Design of transient protection EMI? Can modern data cable help EMI? Surface transfer impedance shielding effects for critical video signals. Digital design case studies up to 20 GHz. Stopping emission testing at 1GHz will not do if computer clock fundamentals hit 4 GHz. But there are also simpler products that need less sophisticated care. What to do for low cost cases.
- Critical elements in product compliance, CE marking tests per IEC/CISPR/EN/ETSI standards. When a test fails, designers and retrofitters need information on where to locate the failure. Since this is not supplied by overall test house compliance tests, EMC tools for development tests are discussed, including first order error budgets estimates and limits for correlations to final acceptance testing. Both Frequency and Time Domain testing have certain limitations.
- Layout, mechanical engineering , electronic design and EMI control /EMC interaction in typical projects are highlighted. Wherever appropriate, without overly simplifying, design rules are given. By general understanding of effects based on typical case studies and some classroom 'what if' computer simulation tool demonstrations, big mathematical formulae and algorithms can be avoided. Most of these internet based tools are available as free downloads from various URLs. Java based applets and Calculator tools further help the client self-manage EMIs in their organization.

- Depending on a specified time frame and availability of equipment, specific onsite product consultation would be possible.
- Effective teaching times for such intensive classes would typically not exceed 3 hours before and 3 hours after lunch. Floor discussions are an integral aspect. The optimal number of participants can range anywhere from less than 10 to a maximum of 25 persons.

What you gain from this course:
For this 4 day course comprising Digital 3 days and Analog 1 day, the overall gain would be complete understanding of Advanced EMI control and EMC protection measures. Design Engineers, Technicians, and to a certain degree Mechanical Engineers will gain a deep insight to systematic control of EMI and EMC in Electronics in major industries. Handouts (copyrighted, single user license) and useful links to free internet based simulation tools will enable participants to self manage most of their EMI work environment problems. A prerequisite of this course is an understanding of EMC Basics.

Content-Keyareas:
Introduction and basic EMC philosophy, real world EMI, digital logic truth tables, occurrence of EMI effects, EMI frequency spectra, coupling of EMI, systematic protection by zoning against upset and damage in linear and digital design, systematic project management in all design phases, EMI and counter measures, conducted and radiated emissions from digital circuits, immunity issues, coupling path and testing, hidden RF component specs not stated in spec sheets, digital/analog circuit design, packaging, in-outputs, buses, clock, filters, surge protection, shielding, preferred PCB layouts, controlling PCB ground resonance, zoning, component positioning, power, signal traces and integrity, decoupling of noise, design procedures, layout and rules, various design case studies. Digital focus is mostly on emissions, while analog focuses on immunity. Typical Compliance/Pre-Compliance tests.

EMC Experts interested in the full scientific background with detailed mathematical formula analysis should indicate this requirement before ordering the course as a 3 day event. While EES would welcome this approach, you could however consider a customized course, which we would be more than happy to prepare for you. Our initial focus would be electromagnetic fields in this domain.

EMC Compliance by Design and Modification in Systems and Installations

Issues addressed in this Course:

- This specialized course is designed as a 2 day Seminar. In contrast to Digital-Analog, the focus here is not on PCB design, but rather that which follows namely System-Box Integration.
- How to design electronic racks and wide spread cable systems?
- Essentials and requirements in various industries. The various aspects of EMI protection touch upon mechanical design issues and maintenance to keep filters and shields working over the system life span. Some specs demand 25 years. Vehicles have different natural body chassis resonance than ground based building installations.

- EMI threats of transients as well as CW sinusoidal EMI is considered.
- Understanding coupling phenomena in wiring and cabling is of prime importance. When do shield aperture coupling effects kick in? What type of protection elements are commercially available. How far can we trust the manufacturer's specs. What are design options based on application or system mission.
- How to manage the financial and technical issues of EMC in systems and installations. Checklists to avoid NO-NO Situations. What to first look for in retrofits with limited weight, space, time or budget cases. Can RF-filters degrade system performance in other areas?
- How about electrical safety of filters, filter types and installation procedures. How good must a shield be? What are fatal shielding effects. What are the minimum margin requirement.
- Do we need commercial racks showing 120 dB shielding effectiveness? What are the standards for testing here. Does the norm apply?

Limitations in comparing different standard test procedures and results are presented. What is written in the contract? Turnkey project responsibility for EMC and how to guarantee this with a large number of subcontractors. Site surveys, specifications, the different EMC plans, acceptance procedures, schedule, test procedures for subs and final acceptance. What is the list of seriously critical elements in system and installation integration EMC? Concessions and penalties that follow.

What you gain from this course:
A systematic approach to EMI critical installation/system design. This is not only limited to electrical engineering but understanding EMI phenomena and the traps in the EMC system management are clearer. Checklists help to support the client to act early and accurately. A better balance between business, technology, engineering and legal decisions is now more likely to happen.

Content-Keyareas:
Introduction to system engineering and integration, EMC zoning and cabling EMC threat assessment, damage analysis, coupling mechanism of EMI, spread of EMI, how do cable shields work, theoretical simulation tools and limits, EMC system methodology and design rules, nested zoning, magnetic, electric effects, counter measures for conducted and radiated EMI, cable entry panel, grounding, bonding, PE, electrical safety vs. EMC, geometrical separation, cable conduits, ground loop control, filtering, shielding integrity, maintenance, case studies from different industries, guide lines, rules, summary and practical recommendations. System testing, the “think EMC” approach in project management.

For an optimal fit to specific needs you may however consider a customized course, which we would be more than happy to prepare for you. Do not hesitate to send a mail, in any case to diethard.hansen@ieee.org