Fundamentals of EMC Testing Approaches and Techniques

Introduction

This course illustrates fundamental concepts related to testing products for EMC compliance with a focus on commercial and light-industrial environments. Both emissions and immunity are examined in a manner that permits one to understand what is required and how to perform basic tests. A fundamental understanding on formal conformity assessment is presented for those who have no need to visit a test facility but is responsible for regulatory compliance – in other words, how does one repeat a test back in-house (after failing at a test site) to verify the failure and how does one go about to fix the problem.

Basic theory on the need to comply is presented along with the equipment required to perform testing, either compliance or non-compliance. Troubleshooting techniques are included in the seminar. Instrumentation and support equipment along with specialized diagnostic probes and tools is discussed. Use of the material presented should result in reduced design time, manufacturing costs and improved time-to-market.

Course Objective

This course presents both simplified theory on how RF energy is generated within a system and manner of propagation. Once an RF signal breaks through protection levels related to both EMI and immunity, one must spend time to locate the source of the problem and then apply mitigation using a variety of components, or redesign the unit at considerable expense. Troubleshooting requires knowledge and skill in using the right instrument and transducer (probe or antenna), along with understanding the type of field being measured (electric and/or magnetic). Mathematical and simulation analysis will *not* be presented. Real-world troubleshooting techniques with a proven track record will be presented; both conventional and non-conventional techniques.

Upon completion, one should be able to both test products for EMC compliance, and locate or solve problems quickly. In addition, one will have the knowledge to help design and or develop an in-house EMC test laboratory.

Who Should Attend

The course targets engineers and technicians that are unfamiliar with testing and troubleshooting. Experienced test engineers may find benefit as a refresher course. In addition, this course is especially useful for practicing design engineers of all disciplines, regulatory compliance engineers and EMC consultants.

No formal training in electronic theory is required or experience in EMC testing, as the course is presented at the "fundamental level." The participant, upon completion, should be able to perform in-house testing and analysis at minimal cost, or to be able to locate a problem area that caused failure at a commercial test facility. Solving EMC problems in-house becomes less expensive that spending time and money at a commercial test-house.

Benefits of Attending

- Increased Job Knowledge
- Allows First-Time Compliance to International EMC Requirements
- Reduce Design Time and Manufacturing Costs
- State-of-the-Art Design and Layout Techniques Presented
- Allows One to Perform Testing and Troubleshooting in an Efficient Manner

Fundamentals of EMC Testing - Approaches and Techniques
(Two Day Seminar)

Fundamentals of EMC Testing
- Definition of EMC Terms
- Basic Aspects of EMC

How RF Energy Exists
- Types of Electromagnetic Fields
- How Transmission Lines Create EMI
- Right Hand Rule
- Maxwell's Equations
- Electric and Magnetic Field Components
- Magnetic and Electric Field Representation
- Closed Loop Circuit
- Time and Frequency Representation of a Closed Loop Circuit
- Radiated Emissions From a Closed Loop Circuit
- Loop Area Between Components
- Common-Mode and Differential-Mode Currents
- Differential-Mode and Common-Mode Currents in a Chassis

Instrumentation
- Time Domain Analyzer (Oscilloscope)
- Characteristics to Consider in Choosing an Oscilloscope
- Oscilloscope Probes
- Frequency Domain Analyzers
- Spectrum Analyzers
- Receivers
- Pre-Compliance Versus Compliance Analyzers

Test Facilities
- Open Area Test Site (OATS)
- Chambers
- Screen/Shield Rooms
- Reverberation Chamber
- TEM and Other Specialized Test Cells

Probes, Antennas and Support Equipment
- Need for Transducers (Probes and Antennas)
- Concerns When Using Transducers
- Voltage Probes
- Current Probes
- LISN/AMN (AC Mains)
- Coupling/Decoupling Networks (CDNs)
- Bulk Current Injection (BCI) - Probe and Insertion Clamp
- Near-Field and Closed-Field Probes
- Sniffer Probes
- Far Field Antennas

Emission Testing and Troubleshooting
- Systematic Approach for Emissions Testing
- Systematic Approach for Immunity Testing
- Minimum Requirements for Performing EMC Tests
- Potential Problems During Emission Testing Conducted Testing
- Overview on Performing Conducted Testing
- Common-Mode and Differential-Mode on Wires and Cables
- Determining Coupling Modes
- Coupling Paths for Conducted Emissions

Radiated Testing
- Overivew on Radiated Testing
- Radiated Immunity
- Electrostatic Discharge (ESD)
- Power Frequency Magnetic Field Disturbance

Emission Testing
- Performing Radiated Tests - Beyond Standard Procedures
- Compliance Measurement Procedure
- Typical System Configuration
- Operating Conditions
- Conducted Emissions Setup
- Conducted Emissions Testing (AC Power Mains)
- Radiated Emissions
- Test Report Requirements

Conducted Immunity Testing
- Most Common Tests Performed for Conducted Immunity
- Electrical Fast Transients / Bursts Testing (EFT/B)
- Surge or High Energetic Line Transients
- RF Current Conducted Immunity
- AC Mains Supply Dips, Dropouts and Interruptions

Radiated Immunity Testing
- Concerns Regarding Radiated Immunity Testing
- Commercial Radiated Immunity Testing Techniques

Simplified Testing and Troubleshooting Techniques
- Quick Fixes and Solutions – Conducted Currents
- Quick Fixes and Solutions – Radiated Fields
- Simplified Troubleshooting Techniques
- Simplified Testing and Troubleshooting Concepts Using Probes
- Switching Power Supply Effects on CM Conducted Noise
- Enclosure Resonances and Shielding Effectiveness
- Determining if Emission Noise is Differential or Common-Mode
- Potential Problems When Using Ferrite Clamps
- Measuring Shielding Effectiveness of Materials and Enclosures
- Measuring Noise Voltage Across Seams in Enclosures
- Printed Circuit Board Level Diagnostic Scanners