Introduction to EMC – Fundamental Concepts

Introduction

The field of EMC is considered to be *Black Magic* by those who do not understanding electromagnetics. In reality, one can solve some of the most complex aspects of EMC by understanding fundamental or basic concepts. A brief overview on EMC is presented. Fundamental areas include basic electromagnetic theory, signal development and propagation, grounding methodologies, transmission line theory, printed circuit board basics, and an introduction to system level testing.

Course Objective

This course covers the following topics, which covers most of the field of introductory EMC engineering. Regardless of how many years one has been working within the field of EMC, a fundamental course may provide significant value. A senior engineer tends to solve simple problems using complex analysis. A refresher course in the basics will allow one to visualize problem areas differently and to provide guidance on new approaches toward achieving compliance quickly.

1. Introduction to the Field of Electromagnetic Compatibility
2. Signal Spectra and Waveforms.
3. Basic Electromagnetic Theory
4. Electrostatic Fields (a.k.a. ESD)
5. Grounding and 0V-Referencing
6. Common Impedance Coupling
7. Non-Ideal Behavior of Components
8. Fundamentals of Signal Integrity
9. Printed Circuit Board Basics
10. Simple Test Facilities

Who Should Attend

This course is an introduction to the field of EMC engineering. The target audience is for those responsible for the management of a regulatory compliance department, or supervising engineers working in the field. Mathematical concepts are kept to a bare minimum (simple algebra), where needed. In addition, *practicing* design engineers of all disciplines, regulatory compliance engineers, EMC consultants and PCB designers will benefit from this refresher course. No formal training in electronic theory is required. Concepts, theory and applications are presented in an easy to understand format, *without math*, using practical and real world examples.

Benefits of Attending

- Increased Job Knowledge
- Enhanced Signal Integrity
- Teaches EMC Suppression versus Containment
- Allows First-Time Compliance to EMC Requirements
- Reduce Design Time and Manufacturing Costs
- State-of-the-Art Design and Layout Techniques Presented

Introduction to EMC – Fundamental Concepts
(One Day Seminar)

INTRODUCTION
- Why is this Course Necessary
- Uniqueness of EMC Engineering
- Definition of EMC Terms
- Basis Forms of EMC
- Elements of the EMC Environment
- Basic Aspects of EMC
- Electrical Dimensions
- Logic Families

SIGNAL SPECTRA AND WAVEFORMS
- Signal Spectra - Bandwidth
- Digital vs. Analog Waveforms

BASIC ELECTROMAGNETIC THEORY
- How Circuits Create EMI
- Right Hand Rule
- Maxwell Equations Made Simple
- Electric and Magnetic Field Impedance
- Magnetic and Electric Field Representation
- Closed Loop Circuit
- Common-Mode and Differential-Mode Currents
- What Makes an Efficient Antenna
- Loop Area Between Components

ELECTROSTATIC FIELDS (a.k.a. ESD)
- Description of an ESD Event
- ESD Waveforms and Tribolectric Series
- Failure Modes

GROUNDING AND 0V-REFERENCING
- Inductance – What is It?
- Path of Least Impedance
- Self Inductance
- Current Return Paths
- Defining Ground
- Grounding Methodologies
- Ground Loop Control
- Breaking up Ground Loops

COMMON IMPEDANCE COUPLING
- Methods of Coupling
- Common Impedance Coupling

NON-IDEAL BEHAVIOR OF COMPONENTS
- Component Characteristics at RF Frequencies
- Non-Ideal Behavior of Components
- Circuit Analysis
- Passive Component Analysis
- Hidden Characteristics of Digital Components

FUNDAMENTALS OF SIGNAL INTEGRITY
- Defining Signal Integrity
- Lossy and Lossless Transmission Lines
- Transmission Line Systems
- Identification of Signal Distortion
- Relative Permitivity
- Crosstalk

PRINTED CIRCUIT BOARD BASICS
- Stackup Configurations
- RF Field Distribution
- RF Current Density Distribution
- RF Return Path Configuration
- Image Plane and Moat Violations
- Functional Partitioning
- PCB Layout Guidelines

SIMPLE TEST FACILITIES
- Open Area Test Sites (OATS)
- Chambers
- Screen/Shield Rooms
- LISNs/CDNs
- Shielding