

EMC Design for Compliance (Immunity) Training Course

Course Description

In this comprehensive course, students will learn how to design, prepare, test and troubleshoot products for a suite of the most common EMC tests including:

- ESD
- EFT
- Surge
- Conducted Immunity
- Radiated Immunity
- Magnetic Field
- Power Quality

Each unit contains narrated Powerpoint presentations, examples, exercises and industry relevant case studies.

Focusing on the PCB and enclosure levels, the course is tailored for electronics engineers, technologists and anyone involved in designing, testing or troubleshooting products for electromagnetic issues.

Course Syllabus

Week 1

Module 1: Introduction

Overview of standards, test plans, monitoring methods, pass/fail criteria. How to create a test plan with case studies for automotive, medical, audio and wireless products. Maximizing the value of an in-house pre-compliance/full compliance lab.

Week 2

Module 2: Electromagnetic coupling mechanisms

Overview of the four electromagnetic coupling mechanisms. Concept of source, coupling path and victim circuits. Examples of typical immunity testing coupling paths. Frequency ranges of tests and how that's related to current paths. Cabling and structures as receiving antennas.

Module 3: Overview of protection methods

Kirchoff's Law. Top level overview of protection classes/options (Cabling, enclosure, board level, grounding, software). Suppression, mitigation and diversion of electromagnetic phenomena. Study of suppressors including passive/active voltage and current limiting devices.

Week 3

Module 4: ESD

Test setup, pulse shapes, energy, human body model. Where discharges are applied to products. Typical failure modes. Field coupling. Simulations. Effective board and enclosure level suppression methods. Metal and plastic enclosures. Battery vs. AC/DC powered. Demonstrations: ground bounce, suppressor implementation, troubleshooting and pre-compliance options.

Week 4

Module 5: EFT

Test setup, pulse shape, frequency content, coupling methods. Typical failure modes. Current paths and solution options. Demonstrations: pre-compliance and troubleshooting.

Module 6: Surge

Test setup, pulse shape, frequency content, coupling methods. Typical failure modes. Specifying adequate surge protection components. Demonstrations: pre-compliance and troubleshooting.

Week 5

Break week

Week 6

Module 7: Power quality

Test setups: 61000-4-11/-29 and automotive pulse shapes. Case study: power supply input filter stability. Power up-down sequences. Demonstration: Using a combination immunity test generator (EM Test UCS500N5).

Week 7

Module 8: Continuous immunity introduction

Modulation and rectification of AM signals. Audio example.

Module 9: Radiated immunity

Test setups and typical failure modes. Shielding effectiveness. Gaskets. Demonstration: current flow on circuit board using 2d near field scanner. Reciprocity. Cavity resonance. Enclosure apertures. Effect of return path discontinuities. Mitigation techniques, shielding, suppression components, cable choice. Biological safety limits. Demonstration: Pre-compliance and troubleshooting (TEM, cable clamp and NF probes).

Week 8

Module 10: Conducted immunity

Test setup. Measuring diverted current. Cable options. Importance of grounding techniques. Demonstrations: Pre-compliance and troubleshooting techniques.

Module 11: Magnetic field

Test setup and applicability. Typical failure modes. Shielding magnetic fields and increasing circuitry robustness. Pre-compliance equipment options.

Week 9

Module 12: RF Desense and analog circuitry immunity

Partitioning/zoning. Methods to minimize analog/digital coupling. PCB grounding techniques. Analog design techniques to increase EM robustness and reduce power supply influence. CMRR. Simulation tools. Troubleshooting analog EMC issues. Demonstration: increasing analog measurement circuit EM immunity.

Assessment Methods

Student progress is tracked on the website to ensure that they have completed each module. They receive a multiple choice quiz (with 5-10 questions) after each module to ensure that key information has been understood and retained.

Once each student has completed the course and successfully completed each quiz with >80% average, they are awarded with a certificate of completion.

Assistance is provided by email.