

Design and testing for EMC

A five day in-house training course for electronic designers and test engineers

Suitable for all electronic manufacturing and related companies, with EMC test facilities

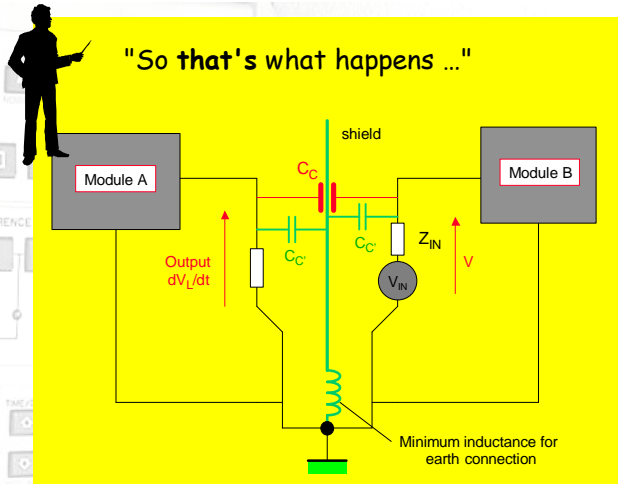
Description

This seminar will cover design and testing to meet the compliance requirements of the European EMC and R&TTE Directives, as well as other commercial and military requirements. Good EMC design gives you a product that is more reliable and better fitted for its environment, as well as complying with legislation, but it doesn't happen by accident; a thorough understanding of the principles of interference generation and coupling is needed. The seminar will also detail all the major tests required to meet the compliance requirements of the Directives via the generic standards, and most product standards. These include conducted and radiated RF emissions, conducted and radiated RF immunity, and transient and power quality immunity. The seminar is structured to achieve the maximum learning potential from a combination of tutorial and case study exercises. It emphasises the underlying physics of interference generation and coupling and how it affects design and test methods, without resorting to complex mathematics.

Who should attend

Electronic product designers, design managers and test engineers: a basic knowledge of electronics is assumed. The course will be of particular interest to design engineers in industrial, medical, transport, telecomms, IT, consumer, marine and military sectors who have to meet EMC requirements as part of their project specification; some prior knowledge of EMC testing is helpful but not essential. It will help them deal with the technical and compliance aspects of EMC, as well as avoiding the costly EMC-related design mistakes that bedevil project timescales and budgets. Both design and test personnel will gain an understanding of the tests that are applied to their products.

Course material: course notes, including all slides used and explanatory text, will be sent before the start for copying and distribution to the delegates.



Cost for the basic course

£4250.00 + VAT (no per-delegate fee)

plus travel and accommodation expenses for the course presenter

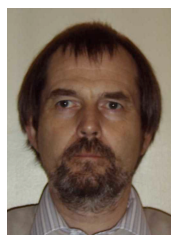
For a firm quote and booking

Contact:
Elmac Services,
Gorseacres, Puddletown Road, Wareham, Dorset
BH20 6AE UK Tel 01929 558279
e-mail courseenquiry@elmac.co.uk
web <http://www.elmac.co.uk>

Payment, admin and cancellations

The course will be invoiced on completion. The client is responsible for administering the seminar. Cancellations less than one month before the agreed start date will incur a charge.

The presenter



Tim Williams, consultant with Elmac Services, is the author of "EMC for Product Designers" (third edition), now regarded as a standard reference for design engineers needing to meet the EMC Directive, and "EMC for Systems and Installations" (with Keith Armstrong). He has written and presented many articles, conference papers and seminars internationally on circuit design and testing for EMC. As well as being an EMC technical assessor for UKAS and SWEDAC, he has conducted EMC design reviews for numerous companies in every industry sector, and considers himself principally as an electronics design engineer who happens to know a fair bit about EMC. He has also contributed to several research projects looking at repeatability and best practice of EMC tests and measurements.

For course contents see over...

Programme

Day 1 – Introduction, theory and basics

Morning

- 09.30-12.30 Introduction to EMC; CISPR and IEC test standards
Why EMC? – the definition of EMC – the various phenomena – the product life cycle and reliability aspects – the EMC and R&TTE Directives – other Directives and requirements
The standards regime – standards generating bodies – the three types of EMC standard – content of the most common test standards

Afternoon

- 13.30-15.00 Principles of interference coupling
The dB – frequency versus time domain – coupling modes – electric, magnetic and electromagnetic fields – transmission lines and VSWR – emissions and immunity control
- 15.15-16.30 System partitioning and grounding
System partitioning – ground as a current return path – control of loop area – current flow in a ground plane and a shield surface – the effect of slots and apertures – conductor impedance and bonding
 Case study: current paths in ESD and EFT events

Day 2 – Mechanical, PCB and cable design

Morning

- 09.30-10.45 PCB layout
Grounding and track impedance – proximity of return path – gridded and ground plane layouts – the optimum ground plane – on-board shielding – interface layout and grounding
- 11.00-12.30 Cables and connectors
Mode of propagation – unscreened cables: twisted pair, ribbon – cable balance and LCL – screened cables: screen operation, transfer impedance – the effect of the connector – cable installation

Afternoon

- 13.30-15.00 Shielding
Theory of reflection and absorption – effect of apertures and seams – conductive gaskets – conductive coatings and shielded windows – partitioning shielded enclosures – using the shield as ground – cable layout and large enclosures
 Exercise and case study – mechanical, PCB and cable design review

Day 3 – Electronics design

Morning:

- 09.30-11.00 Digital and analogue circuit design
Emissions from logic circuits: clocks, transmission line ringing, decoupling, using single chip micros, using complex microprocessors – emissions from analogue circuits: unanticipated oscillations, video signals – logic circuit immunity: timing and logic threshold constraints, transient susceptibility, defensive programming – analogue circuit immunity: bandwidth, linearity and dynamic range, balance, isolation
- 11.15-12.15 Power switching circuits
Emissions from switching circuits – coupling paths – differential and common mode conducted – radiated – construction techniques: screens, transformers

Afternoon:

- 13.15-15.00 Filtering and suppression
Filter configuration and layout – component imperfections – ferrites on cables and within the circuit – I/O filtering – mains filtering – transient and motor suppression
 Exercise and case study: electronic product design review
- 16.00-16.45 The test plan and good lab practice
The tests performed – EUT configuration – ancillary equipment – choice of ports and test points – performance criteria and EUT monitoring – pre-test checks – care of equipment

Day 4 – RF emissions tests

Morning – Conducted emissions measurements

- 09.30-10.30 Instrumentation
The CISPR measuring receiver – the spectrum analyser and preselector – the effects of bandwidths and detectors (peak, quasi-peak, average) – overload responses – sweep rates
- 10.45-12.15 Transducers and the conducted test setup
The LISN – Telecom port ISNs – the ferrite absorbing clamp – current and voltage probes – the test set-up and equivalent circuit
 Exercise – instrumentation, conducted transducers

Afternoon – Radiated emissions measurements

- 13.30-15.00 Test sites and antennas
The CISPR OATS requirement – normalised site attenuation – the problem of ambients – tests in screened rooms – anechoic lining – compliant vs. non-compliant chambers – popular EMC antennas: biconical, log periodic, BiLog, horn, loop – alternative methods: FAR and GTEM
- 15.15-16.30 Procedures and uncertainty
Measurement uncertainty in emissions tests – the radiated test setup – software and procedures: the turntable and height scan, maximising the emission
 Exercise and case study – radiated emissions testing

Day 5 – RF and transient immunity tests

Morning: RF immunity

- 09.30-11.00 Instrumentation and methods
RF fields in the environment – generating the RF test signal: the substitution method – control software for calibration and testing – level setting and field uniformity – step size, sweep rate and modulation
- 11.15-12.45 The test setup and transducers
Immunity antennas – conducted transducers – power and VSWR – radiated and conducted test setups – test procedures – functional checks
 Exercise and case study: the RF immunity system

Afternoon: Transient immunity

- 13.30-15.00 Electrostatic discharge
The generation of electrostatic charge – the discharge event – test method – the ESD generator – test set-up – procedural requirements of the standard
- 15.15-16.45 Electrical fast transients, surge and power quality
Transient generation in the environment – the EFT burst test in IEC 61000-4-4 – the surge test in IEC 61000-4-5 – voltage dips and interrupts in IEC 61000-4-11 – functional checks
- 16.45-17.00 Wrap up and final discussion