



Another EMC resource  
from EMC Standards

## Automobile EMC (2 Day Course)

*Helping you solve your EMC problems*

# Automobile EMC

a 2-day training course

- **Automaker's Testing Requirements**
- **European and UN Regulations**
- **Controlling Functional Safety Risks**

**Taught by:**  
**Eurling Keith Armstrong, CEng FIET Senior MIEEE**  
of Cherry Clough Consultants Ltd  
[www.cherryclough.com](http://www.cherryclough.com)



## Synopsis

- 1) The typical EMC tests used by the major US and European automobile manufacturers. (based on material from Dr Uwe Reinhardt, Managing Director of Mercedes-Benz Technology)
  - a. Automakers EMC test specifications for purchased electronic sub-assemblies (ESAs)
  - b. The EMC tests automakers do on their completed vehicles
  - c. AEMCLRP accreditation for automotive EMC testing
- 2) The Regulatory requirements of the European Automotive EMC Directive 2008/104/EC, and UN ECE REG 10 (which is used worldwide)
- 3) Doing EMC to control Functional Safety risks.  
The design, risk assessment, verification and validation techniques that should be done *in addition to the above tests*, for ESAs that can affect vehicle safety, to comply with the Functional Safety requirements of IEC 61508 (and draft ISO 26262).

## Objective

To help reduce financial risks in design and development, reduce time-to-market, achieve EMC at the level of the state of the art world-side, make vehicles more reliable, and reduce exposure to warranty costs and product liability claims.

This is *not* a course that shows EMC test engineers exactly how to do the tests, or shows designers exactly what to do to pass them. These require much longer courses. Instead, this course describes the global state of the art in EMC, for automotive subassemblies, subsystems and complete vehicles, including *overviews* of the correct testing procedures, including important issues that are not mentioned in the test standards themselves.

It also provides an overview of the testing and other verification and validation procedures needed to help control the functional safety risks caused by using electronics (and firmware) in vehicles.

## Who Should Attend

All electronic and safety designers and their managers, involved with automotive products (including subassemblies, subsystems, and complete vehicles).

EMC test engineers should also find the overview of the global state of the art in testing useful.

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### Prerequisites

Some familiarity with the design, assembly and testing of electrical and/or electronic products or equipment.

Plain English is used, with a small amount of very easy mathematics.

### Course Methodology

This course is presented classroom style using a PowerPoint slideshow containing photographs and practical illustrations of the techniques to aid understanding.

Case studies that are relevant to the trainees will be included verbally.

Each attendee will be presented with a bound copy of the PowerPoint slides used during the training, printed at 6 slides per page, with sufficient space is provided for taking notes.

### Course Duration

Two (2) full days, for example: 9:00am – 5:00pm each day.

### Reviews of this course

Delegates have always awarded this course an overall score of at least 80%.

### Venue and Date

**To be decided.**

The course can be provided as a public course, or “in-house” for a specific organisation.

As an in-house course, it has the added value of allowing confidential discussions on how best to apply the material to particular projects or products. We will be happy to sign a non-disclosure agreement if this is necessary.

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### COURSE OUTLINE

#### Part 1: Automaker's typical EMC requirements and test methods

*Note:* Part 1 contains material provided to Cherry Clough Consultants by Dr Uwe Reinhardt, the Managing Director of Mercedes-Benz Technology, Germany

- Basics of EMC and automobiles
- Automaker's EMC testing requirements for components
  - Conducted RF emissions
  - Conducted transient emissions
  - Radiated RF emissions
  - Radiated electric, magnetic and EM field immunity
    - ISO 11452-2: Absorber-Lined Shielded Enclosure (ALSE)
    - ISO 11452-3: Transverse ElectroMagnetic (TEM) cell
    - ISO 11452-4: Bulk Current Injection (BCI)
    - ISO 11452-5: Stripline
    - ISO 11452-6: Parallel plate antenna
    - ISO 11452-7: Direct RF Power Injection (DPI)
    - ISO 11452-8: Magnetic fields
    - ISO 11452-9 (draft): Portable transmitters
  - Conducted transient immunity of DC power supplies
  - Coupled transient immunity of signal lines
  - Electrostatic discharge immunity (ESD)
  - Other / special
- Automaker's EMC testing requirements for complete vehicles
  - Radiated Emissions: both "On Board" and "Off Board"
  - Radiated Immunity: both "On Board" and "Off Board".
  - ESD
- Special requirements for testing networked systems
- Gaining AEMCLRP accreditation for automotive EMC testing

#### Part 2: European and United Nations EMC regulations for automobiles

- The European Union's Automotive EMC Directive: Applicability and exceptions
- The European Union's Automotive EMC Directive: Technical requirements
- UN ECE Reg10

#### Part 3: Using good EMC design to help control functional safety risks

*Note:* This Part is based upon the IET's 2008 Guide on EMC for Functional Safety

- Why EMC testing is insufficient for controlling safety risks, whatever the immunity test levels, and what is necessary
- Some relevant quotations and statistics
- IEC TS 61000-1-2 and the IET's 2008 Guide on using it
- A Brief Overview of the Whole Functional Safety Lifecycle
- EM Planning
- Assessing the Lifecycle Environment (EM and physical)
- Risk Assessment, creating the Safety Requirement Specification
- EM-Safety Design and System Integration
- Methods for EM-Safety Verification and final safety system Validation, including testing
- Maintenance; Repairs; Refurbishments; Modifications, Upgrades

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### Course Instructor

#### Academic Qualifications

BSc (Elec.Eng), Upper 2<sup>nd</sup> Class with Honours, Imperial College of Science & Technology, London, UK, 1972

#### Professional Qualifications

Fellow IET (Institution of Engineering and Technology, formerly the Institution of Electrical Engineers, IEE), London, UK (Member since 1977) 2010  
Senior Member IEEE (Institute of Electrical and Electronic Engineers Inc.) USA, member of its EMC, Product Safety Engineering Societies since 1998 2010  
Associate of the City and Guilds Institute, London, UK 1972  
UK Chartered Engineer, Engineering Council, London, UK 1978  
Group 1 European Engineer (EurIng), FEANI, Paris, France 1988



#### Professional Activities

Chair of IET's Working Group on EMC and Functional Safety 1997-date  
Reviewer, IEEE Transactions on Electromagnetic Compatibility 2007-date  
UK expert appointed (by invitation) to IEC maintenance team MT23 for IEC 60601-1-2 (Medical Equipment/Systems EMC) 2006-date  
UK expert appointed (by invitation) to IEC maintenance team MT15 for IEC 61000-1-2 (EMC & Functional Safety) 2003-date  
UK expert appointed to IEC 61000-6-7 (EMC & Functional Safety, Generic) 2010-date  
Member EMC Industries Association (EMCIA) 2003-date  
Member EMC Test Labs Association (EMCTLA) and its Working Group B 2001-date  
Technical Panel, IET Functional Safety Professional Network 2003-date  
Technical Panel, IET EMC Professional Network 2001-date  
Editor, Inside Functional Safety magazine 2010-date  
Editorial Advisory board member, Interference Technology magazine 2007-date  
Editorial Advisory board member, Compliance Engineering magazine 1998-date  
EMCIA representative to BSI GEL 210/12 EMC committee 2009-date  
President of the EMC Industries Association (EMCIA) 2008-2010  
Vice-President of the EMC Industries Association (EMCIA) 2010-date  
Chair of IEE's EMC Professional Group (E2) 1997-1999



#### Recent EMC experience (1990-present)

Started Cherry Clough Consultants in 1990.

External lecturer for the Sensors and Electronic Instrumentation MSc course at the University of Manchester, teaching an IET-accredited module on practical EMC design techniques.

The services that Keith provides for Cherry Clough Consultants include:

- Product, system, and installation EMC and safety good practices for reliability and cost-effective regulatory compliance
- Assessment of electromagnetic environments
- Control plans, test plans, etc., for effective management of EMC and safety in projects of all sizes
- Company procedures for EMC and safety, for financial benefits and/or regulatory compliance
- Production / QA procedures for maintaining regulatory compliance in volume manufacture and custom engineering

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- Testing and remedial work to meet EMC and safety standards
- Creation of EMC Directive Technical Construction Files and other compliance documentation
- Assessment of EMC Directive Technical Construction Files for a number of EMC Competent Bodies
- Education and training for designers and managers on cost-effective EMC and Safety techniques; and on “EMC for Functional Safety, high-reliability and legal metrology”
- Education and training for executives in EU compliance; liability; financial benefits of using good EMC techniques; and related marketing issues

The above services have been applied in the following areas (so far) – please note this is not a complete listing:

### Systems and installations:

Machinery and manufacturing/process plant of all sizes

Robotics

Air traffic control towers

Computer and telecommunication rooms

Administration centres

Financial dealer rooms

Professional audio systems and installations (e.g. theatres, opera houses, recording studios)

Steel rolling mills

Hospitals

Hotels

Chemical and pharmaceutical processing plant

Nuclear processing plant

Bottling and canning lines

Road tunnel lighting schemes

Broadband-Over-Power-Line (BPL) systems

Synchrotrons (e.g. the Diamond Light Source, Harwell, UK; Australian Synchrotron, Melbourne)

Railway systems

Mobile X-ray systems for shipping containers

Tokamaks (fusion power generators)

### Products and items of equipment:

Industrial instrumentation, control, and machinery of all sizes

Variable speed AC and DC motor drives from very small to 10MW

Automotive engine control units (ECUs) and other electronic subassemblies (ESAs)

Information technology equipment (ITE) e.g. computers, servers, RAID arrays

Personal Digital Assistants (PDAs) and other hand-held wireless-enabled computing devices

Marine equipment

Computers

Photocopiers

Digital Signal Processing

Datacommunications devices

Professional audio consoles and other equipment

Professional video projectors

Lighting

Telephones and telecommunications

Consumer electronics (TV, Hi-Fi, etc.)

Radiocommunications, cellphones and pagers

Lifts (elevators)

Domestic (household) appliances

Gambling machines

Gas boilers

Electricity meters

Electrical power generators (small scale)

Building electrical services equipment

Subsea oil and gas production equipment

Robots

Solar power converters

Military avionics

Medical equipment (various)

Microscope manipulators

Coin mechanisms

Security equipment

Mains-borne communications

Induction heating

Laser welding

Digital microwave radio

Variable-speed winch for a military submarine

### Previous professional experience (1982-1990)

Keith was mostly involved with the design and development of state-of-the-art capital equipment during the period 1968 to 1990. He has wide experience in electronic product design and project management in the UK, South Africa and France, after finishing graduate apprenticeship with Thorn Automation in 1973.

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Technically, he started in analogue design in 1968; adding digital control of analogue circuits in 1978, and A/D and D/A conversion in 1980. Gained project and departmental management experience from 1983, including teams of more than 20 engineers and scientists (this was for the Microwave division of Marconi Instruments Ltd, Stevenage, UK, 1983-1988).

### Books, publications and papers

#### ***EMC Design Techniques for Electronic Engineers***

Keith Armstrong, Armstrong/Nutwood UK November 2010, ISBN: 978-0-9555118-4-4  
Order from [www.emcacademy.org/books.asp](http://www.emcacademy.org/books.asp). Full colour graphics throughout.

#### ***The Physical Basis of EMC***

Keith Armstrong, Armstrong/Nutwood UK October 2010, ISBN: 978-0-9555118-3-7.  
Order from [www.emcacademy.org/books.asp](http://www.emcacademy.org/books.asp). Full colour graphics throughout.

#### ***EMC for Systems and Installations***

Tim Williams and Keith Armstrong, Newnes, 2000, ISBN: 0-7506-4167-3,  
[www.bh.com/newnes](http://www.bh.com/newnes), RS Components part number: 377-6463.

#### ***EMC for Printed Circuit Boards – Basic and Advanced Design and Layout Techniques,***

Keith Armstrong, Armstrong/Nutwood UK February 2007. ISBN 978-0-9555118-5-1  
Full colour graphics throughout. Order from [www.emcacademy.org/books.asp](http://www.emcacademy.org/books.asp).

#### ***The First 500 'Banana Skins',***

Nutwood UK, 2007, 500 reports and anecdotes concerning EMI. Edited by Keith Armstrong.

Very useful for have a laugh at other's mistakes, or frightening yourself with what could go wrong. A useful present for a boss that doesn't believe EMC can cause very real engineering and financial problems. Read it at [www.theemcjournal.com](http://www.theemcjournal.com), or buy from [www.emcacademy.org/books.asp](http://www.emcacademy.org/books.asp).

#### ***The IET's new (2008) Guide on EMC for Functional Safety***

Written by the IET Working Group chaired by Keith Armstrong. ISBN 978-0-9555118-2-0.

Colour graphics throughout, buy a printed copy from [www.emcacademy.org/books.asp](http://www.emcacademy.org/books.asp) or download from [www.theiet.org/factfiles/emc/index.cfm](http://www.theiet.org/factfiles/emc/index.cfm).

Keith has written and presented a great many papers for a wide range of symposia, conferences, colloquia, and seminars worldwide, including ERA, IEE, IET, IEEE EMC Society and IEEE Product Safety Engineering Society events. Too many to list here, please ask for further details.

He has also published a great many articles on EMC for publication in professional journals and trade magazines worldwide, including the following five annual series for the EMC Compliance Journal (visit [http://www.compliance-club.com/keith\\_armstrong.asp](http://www.compliance-club.com/keith_armstrong.asp)):

- "Designing for EMC" (6 parts 2006-8, updating the 1999 series)
- "EMC for Systems and Installations" (6 parts, 2000)
- "EMC Testing" (7 parts, 2001-2)
- "Advanced PCB Design for EMC" (8 parts, 2004-5)

Keith has written 17 informative guidebooks on electromagnetic phenomena, what they are, what causes them, how they cause interference, and how to test for them using IEC and EN standard methods, plus 5 booklets (so far) on EMC issues in Installations, including: Power Quality, Good EMC Engineering Practices, Variable-Speed Drives, etc. They can all be downloaded for free from [www.reo.co.uk/knowledgebase](http://www.reo.co.uk/knowledgebase).

Please visit [www.cherryclough.com](http://www.cherryclough.com) for more information.

