Another EMC resource
from EMC Standards

The Safe Design of Electrical/Electronic Equipment for compliance with the new LVD, 2014/35/EU, or the new RED, 2014/53/EU (A One-day Training Course)

Helping you solve your EMC problems

9 Bracken View, Brocton, Stafford ST17 0TF T:+44 (0) 1785 660247 E:info@emcstandards.co.uk

The Safe Design of Electrical/Electronic Equipment

for compliance with the new LVD, 2014/35/EU, or the new RED, 2014/53/EU

A One-day Training Course

by

EurIng Keith Armstrong
Cherry Clough Consultants Ltd, U.K.

Synopsis

This course describes practical design engineering and testing techniques for achieving safe operation of electrical and electronic equipment operating from up to 1000VAC RMS, and also to assist in achieving regulatory compliance with the European Union's Low Voltage (safety) Directive.

Objective

To provide a practical understanding of the equipment and product design and test techniques that are necessary for safety of users and third parties, and regulatory compliance.

These techniques will also help reduce financial risks in design and development, and limit exposure to liability claims.

Who Should Attend

All electronic designers and their managers, in all industry areas, concerned with equipment that operates from up to 1000VAC RMS, including:

Automotive	Medical and healthcare	Consumer
Information Technology (IT)	Industrial instrumentation or control	Railway
Aerospace	Military	Telecommunications
Radiocommunications	Scientific instrumentation	

Mechanical designers will also find much of the course material very valuable, and the order of delivery of the material can be arranged to make it easy for them to attend part-time. Alternatively, we can offer a version of this course aimed solely at mechanical designers.

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 practical illustrations of the techniques to aid understanding. The material is based upon a number of safety standards, including IEC/EN/UL 60950, IEC/EN/UL 61010-1, IEC/EN 60204-1, IEC/EN 60335-1 and IEC 61508, and deals with the principles of safe design rather than go into any one standard in detail.

Special medical issues, e.g. 'patient connected equipment', are *not* covered in this course, but the safety principles described are of course applicable to medical equipment.

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

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

Course Duration

One (1) full day, for example: 9:00am – 5:00pm.

This is a very intensive course with a very large amount of practical detail. If presented as an in-house course it can be very usefully combined with individual consultancy for each engineer or manager, to help him or her apply the material to his or her current projects.

In countries where English is not the first language, a longer duration may be preferred.

Venue and Date

To be decided.

The course could be provided as a public course, or as an in-house course. 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.

Reviews of this course

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

COURSE OUTLINE

1 Complying with the Low Voltage Directive 2014/35/EU or the Radio Equipment Directive 2014/53/EU

The requirements of the LVD
What the LVD applies to
Exclusions to the LVD
When the RED applies instead
Relationships between the LVD and other safety Directives
Declarations of conformity
The LVD's 'safety objectives'
Principal elements of the safety objectives
The LVD's definition of 'safe'
Conformity assessment procedure
Creating the Technical Documentation
Presumption of conformity
It can be dangerous to rely solely on LVD-listed standards
Affixing the CE marking
New supply chain compliance requirements in 2014/35/EU and 2014/53/EU
Enforcement (in England)
Management of LVD / RED safety compliance

2 Design and Test for 'Inherent' Safety (shock, fire, etc.)

Using the most relevant safety standards
Single-fault safety
Electrical shock hazards
Energy hazards
Fire hazards
Heat related hazards
Mechanical hazards
Other hazards
Choosing and using components
Issues with incorporating COTS (Commercial Off The Shelf) items
Wiring, supply and construction
Markings and manuals
Type testing
Routine production tests
Special national conditions
Special safety techniques

5 Some safety resources

Course Instructor

Academic Qualifications

BSc (Elec.Eng), Upper 2nd 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 IEE/IET's Working Group on EMC and Functional Safety	1997-date
Chair of IEEE EMC Soc. Special Committee on Risk Management of EMC	2012-2016
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
Editorial board member, Inside Functional Safety magazine	2010-date
Editorial Advisory board member, Interference Technology magazine	2007-date
Editorial Advisory board member, In Compliance magazine	2005-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)	2010-2012
Chair of IEE's EMC Professional Group (E2)	1997-1999

RECENT RELEVANT EXPERIENCE (1990-PRESENT)

Started Cherry Clough Consultants in 1990, Director of the Limited Company since 2010.

External lecturer, Sensors and Electronic Instrumentation MSc course, University of Manchester, teaching an IET-accredited module on practical EMC design techniques, 2002/3 – 2007/8.

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
- 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 (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, Oxfordshire)
Railway systems — Mobile X-ray systems for shipping containers

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.

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. Project and departmental management experience

was gained from 1983 onwards, 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
Nutwood UK November 2010, ISBN: 978-0-9555118-4-4, full colour graphics throughout.
Order from www.emcacademy.org/books.asp. Covers all electronic applications, with a very practical approach to good design practices that will save time and cost, reduce time-to-market, and reduce warranty costs and financial risks.
(Chapter 2 of this book is the complete text of "The Physical Basis of EMC" (below), so don't buy both!)

The Physical Basis of EMC
Nutwood UK October 2010, ISBN: 978-0-9555118-3-7, full colour graphics throughout.
Order from www.emcacademy.org/books.asp. Provides an understanding of electromagnetic phenomena, in a way that can be easily understood by practising electronic engineers.
(Chapter 2 in "EMC Design Techniques for electronic engineers" is the same text, so don't buy both!)

EMC for Printed Circuit Boards – Basic and Advanced Design and Layout Techniques
Nutwood UK December 2010, ISBN 978-0-9555118-5-1, full colour graphics throughout. (2nd Edition, identical to 1st Edition except for format.) From www.emcacademy.org/books.asp
Practical good-practice EMC design techniques for printed circuit board (PCB) design and layout, for designers of electronic circuits and PCB designers themselves. All application areas are covered, from household appliances, commercial and industrial equipment, through automotive to aerospace and military. This book is used by some University courses.

The First 500 'Banana Skins'
Nutwood UK, 2007, 500 reports and anecdotes concerning electromagnetic interference (EMI), collected and edited by Keith Armstrong. Read it at www.theemcjournal.com, or buy from www.emcacademy.org/books.asp. More 'Banana Skins' are published 6 times a year in 'The EMC Journal', available free at www.theemcjournal.com or www.compliance-club.com

EMC for Systems and Installations
By Tim Williams and Keith Armstrong, Newnes, 2000, ISBN: 0-7506-4167-3,
www.bh.com/newnes, RS Components part number: 377-6463

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 (now available from www.emcstandards.co.uk):

- "EMC design of Switching Power Converters" (14 parts, 2011-2013)
- "Designing for EMC" (6 parts 2006-8)
- "Advanced PCB Design for EMC" (8 parts, 2004-5)
- "EMC Testing" (7 parts, 2001-2)
- "EMC for Systems and Installations" (6 parts, 2000)

Keith has written 17 informative booklets 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 another 5 booklets on EMC issues in systems and installations, for example: Power Quality, Good EMC Engineering Practices, Variable-Speed Drives, etc. They can all be downloaded for free from www.emcstandards.co.uk.

Please visit www.cherryclough.com for more information.