



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 two-day Training Course)

Helping you solve your EMC problems

The Safe Design of Electrical/Electronic Equipment

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

A two-day Training Course

by

Eurlng 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 (for example, with the European Union's Low Voltage (safety) Directive).

Objective

To provide a practical understanding of the equipment and product design, verification and validation techniques 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 focussing on 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 colour-printed PDF copy of the PowerPoint slides used during the training, printed at 6 slides per page. Printed/bound versions can also be provided, by agreement.

Course Duration

Two full days, for example: 9:00am – 5:00pm on both days, allowing for breaks and lunches.

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

For the past 20 years, delegates have always awarded this course – which is always kept up-to-date – an overall score of at least 80%.

COURSE OUTLINE

1 Basic Safety Principles

What do we mean by 'safe'?

Good practices in safety engineering

Example of project safety flowchart

The hierarchy of safety design techniques

Hazards and risks assessments

Doing hazard/risk assessments (properly)

Taking EMI into account in risk assessments

Overall safety documentation

Qualifying and quantifying hazards and risks

Keeping up to date with safety standards

National safety laws

Marketing and Sales and safety

Making equipment for in-house use

Competency

Some examples of useless legal arguments

It isn't enough to simply apply the more relevant published standard

HALT and HASS

2 Non-CE Marking Safety Directives

Product Liability (PLD): 85/374/EEC & 99/34/EC

General Product Safety (GPSD): 92/59/EEC

Health and Safety Directives

3 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

4 Design, verification, validation 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 Design, verification and validation for Functional Safety

EN 60204-1

Other functional safety standards

IEC 61508

6 Some useful 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.