



Another EMC resource
from EMC Standards

PCB Design and Layout Techniques for cost-effective
SI, PI and EMC, in 2015 (2-day course)

Helping you solve your EMC problems

PCB Design and Layout Techniques for cost-effective SI, PI and EMC, in 2015

***The design techniques now generally required
for all PCBs, plus Advanced techniques***

A Two-day Training Course

by

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Synopsis

For design engineers and their managers interested in the cost-effective design, layout, manufacturing and assembly practices for printed circuit boards (PCBs) needed in 2015 to help control financial risks.

Every two years, on average, every type of semiconductor that is available on the market goes through a die-shrink, which makes their emissions and immunity worse. This applies to older device types, like 74-series TTL and HCMOS, as well as to the latest microprocessors and memories, so designing with the same old parts does not protect us from this problem.

So PCB technology must continually advance, to design PCBs in a way that doesn't create problems for Signal Integrity (SI), Power Integrity (PI) and electromagnetic compatibility (EMC).

Advanced PCB EMC techniques are generally needed when resonances in PCB structures are excited by the frequencies present in the analogue, digital or power supply current waveforms.

This course is kept up-to-date as technology advances, so is never the same from one 6 months to the next. It is much more up-to-date than any textbook can ever be.

Objective

After the appropriate choice of semiconductors (or designing your own ASICs), the most cost-effective SI, PI and EMC techniques are those applied at the PCB level.

This course provides a practical grounding in PCB EMC design and layout techniques that have been proven over many years in real life to help companies quickly improve their commercial and financial performance by:

- Bringing products to market more quickly
- Improving functional performance
- Reducing overall unit manufacturing costs
- Easily complying with legal EMC requirements
- Reducing warranty costs and improving customer perception of the brand
- Reducing financial risks
- Improving Return On Investment

Who Should Attend

All electronic and PCB/PWB designers, and their managers, in all industry areas, including:

Automotive	Medical and healthcare	Consumer
Household (domestic) appliances	Information Technology (IT)	Railway
Industrial instrumentation/control	Marine	Aerospace
Telecommunications	Radiocommunications	Military

Prerequisites

Familiarity with circuit (hardware) design and/or the layout of PCBs.

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. 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. The spaces around the slides suffice for taking extra notes.

Copies of the textbooks listed on page 6 can be provided at extra cost.

Course Duration

Two (2) days: For example: 9:00am – 5:00pm (other timings may be used)

This is an 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.

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

Over the last 20 years, delegates world-wide have always awarded earlier versions of this course an overall score of *at least* 80%.

COURSE OUTLINE

DAY 1

The PCB design/layout techniques generally required for good SI, PI, EMC in 2015

- The scope of these layout techniques
- Saving time and money
- Segregation
- Interface analysis, filtering, and suppression
- 0V and power planes
- PCB-chassis bonding
- Power supply decoupling
- Switch-mode power converter layout (AC-DC, DC-DC, etc.)
- Transmission line techniques
- Layer stacking
- Devices with BGA packages and/or multiple DC rails
- Some useful references and sources

DAY 2

Advanced PCB design/layout techniques for good SI, PI and EMC in 2015

- When should we use advanced PCB techniques?
- Future trends and their implications
- Rules of thumb, approximations, simulations
- Virtual design for SI, PI and EMC
- Advanced segregation techniques
- PCB-level shielding up to GHz
- Advanced interface filtering and suppression
- Advanced PCB-chassis bonding
- Advanced PCB planes
- The totally shielded PCB assembly
- Advanced PCB decoupling
- Buried capacitance
- Advanced transmission lines
- Differential transmission lines up to 10Gb/s
- Microvia (high density interconnect) technology
- Advanced crosstalk
- Some useful 'tricks'
- Electromagnetic Band Gap & High-Impedance Surfaces
- Some useful contacts, sources, references

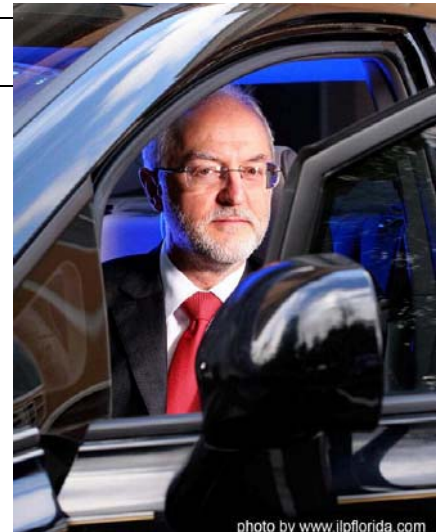
Course Instructor

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-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
Editorial board member, 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) 2010-2012
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 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
- 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 (visit 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 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.reo.co.uk/technical_resources.

Please visit www.cherryclough.com for more information.