



**EMC & Compliance International,
Newbury, UK, 22 & 23 May 2024**
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Essential EMC Training Course for Product Design Engineers

Agenda Version 1.1

Course Overview

This course empowers product design engineers with the skills to effectively identify, troubleshoot, and prevent complex Electromagnetic Interference (EMI) issues. The course also introduces essential design skills to engineers, enabling them to apply these skills effectively and ensure that their products pass EMC tests successfully on the first attempt.

This course is appropriate for circuit and system design engineers, EMC engineers, as well as those who are new to EMI problem-solving.

The course draws upon an extensive collective experience of over 100 man-years in troubleshooting and design. It is jointly presented by renowned EMC experts Keith Armstrong, Ken Wyatt, Andy Degraeve, and Rod Macpherson. The course is delivered in a "hybrid" fashion, with Keith and his associates providing in-person instruction, while Ken's modules are delivered through online sessions. Following the online sessions, there will be dedicated Q&A sessions and discussions facilitated by Dr. Min Zhang. This format ensures a comprehensive learning experience, combining the expertise of multiple experts and providing ample opportunity for interaction and knowledge exchange.

As part of the course, during the lunchtime break, there will be live demonstrations to illustrate key concepts. These will cover various topics, such as radiated emissions, accidental RF antennas, filtering and shielding. If interested, trainees can also have a hands-on experience with the equipment in the designated exhibition area. This interactive element adds a practical dimension to the learning process, allowing participants to directly engage with the hardware and deepen their understanding of EMC principles.

Certification

Participants who attend the full course will receive an *EMC Academy* certificate of attendance (see <https://www.emcstandards.co.uk/emcacademy>). This will be presented to you at the end of the course. The certificate will show your name, the course title and the dates of the course you attended.

Table 1 Essential EMC Training Course Programme

Time	Day 1 (22/05/2024)	Day 2 (23/05/2024)
09:00 – 10:30	Section 1: The Physical Basis of SI, PI and EMC – Andy Degraeve	Section 4: Essential EMC Design Techniques for PCB Layout – Rod Macpherson
Morning Break	Demo & Hands-on	Demo & Hands-on
11:00 – 12:30	Section 2: Essential EMC Design of Switching Power Converters – Keith Armstrong	Section 5: Essential Circuit Design for EMC – Keith Armstrong
Lunch Break	Keynote presentation + Demo & Hands-on	Keynote presentation + Demo & Hands-on
14:00 – 15:00	Section 3: Radiated emissions (RE) bench top characterization, troubleshooting and mitigation – Ken Wyatt	Section 6: Radiated immunity and ESD bench top characterization, troubleshooting and mitigation – Ken Wyatt
15:00 – 15:30	Discussions & Ask the experts – Ken Wyatt & Min Zhang	Discussions & Ask the experts – Ken Wyatt & Min Zhang
16:00 – 18:00	IEEE Distinguished Lecturer talk & Social	Panel discussion & Social

Day 1, Wednesday, 22nd of May, 2024

Section 1 (09:00 – 10:30) The Physical Basis of SI, PI and EMC

Andy Degraeve

This course module is effectively the “Maxwells Equations without maths”, It helps ordinary engineers to visualise EMC, so as to help understand the practical design techniques described in the remainder of the course modules. Key points include:

- *Electromagnetic fields, waves, & importance of the return current path*
- *Field theory, permittivity, permeability, wave impedance and velocity*
- *Near-field and Far-field*
- *Coupling mechanisms*
- *Differential mode (DM) and common mode (CM)*
- *Overview of RF emissions*
- *And more*

Morning Break (10:30 – 11:00)

Why not visit stands 7 and 12, where free demonstrations are going on all day, and you may control the test gear!

Section 2 (11:00 – 12:30) Essential EMC Design of Switching Power Converters

Keith Armstrong

Switching power converters of all sorts present extreme difficulties in containing generated interference. Typical switching frequencies of 30kHz–3MHz and their harmonics can be emitted by both differential and common mode conducted

and radiated mechanisms. The introduction of wideband gap devices such as SiC and GaN devices brings new challenges. This session discusses topics that include:

- *Applications of switched-mode power conversion*
- *EMC design of switchers and choppers*
- *EMC design of high-frequency isolating transformers*
- *Suppressing RF emissions from converter inputs and outputs*
- *And more*

Lunch Break (12:30 – 14:00) in the Exhibition Hall

Why not visit stands 7 and 12, where free demonstrations are going on all day, and you may control the test gear! An important highlight of our Conference is our Keynote presentation, free to all on the Exhibition floor, from 13:15 to 13:45.

Section 3 (14:00 – 15:00) Radiated emissions (RE) bench top characterization, troubleshooting and mitigation

Ken Wyatt

Most product designers know how to use a near-field probe to assess harmonic content on their boards or system cabling. However, they often don't know how to proceed next to resolve the actual issue. I developed a simple three-step process for evaluating a product and drilling down to the root cause. We'll also discuss the major causes of RE and how to mitigate them.

Section 3 Q&A and discussion (15:00 – 15:30)

With Ken Wyatt & Min Zhang

During this session, engineers will have the opportunity to engage in a detailed discussion with our EMC experts Ken and Min. They will delve into the essential EMC troubleshooting tools and skills necessary for effective problem-solving. This interactive discussion will provide a platform for engineers to ask questions, share experiences, and gain valuable insights from these experienced EMC professionals.

Social and IEEE Talk Section (16:00 – 19:00)

Our free EMC demos on Stand 7 will continue until 16:00, when a one-hour seminar provided by the IEEE EMC Society will start on the upper floor. This seminar is free to everyone at EMC+CI, not just those attending the conference and training sessions.

A delightful arrangement of free drinks and snacks will be provided on the upper floor from 16:00 to 18:00. This is also free to everyone at EMC+CI.

Day 2, Thursday, 23rd of May, 2024

Section 4 (09:00 – 10:30) Essential EMC Design Techniques for PCB Layout

Rod Macpherson

The way in which you design a printed circuit board makes a big difference to the overall EMC performance of the product which incorporates it. The principles outlined above must be carried through onto the PCB, particularly with regard to partitioning, interface layout and ground layout. This section gives the engineers the necessary guidance which include:

- *Physical partitioning of sub-systems on board*
- *Positioning of components and I/O ports*
- *Ground design on multi-layer PCBs*
- *Critical power and signal tracks routing*
- *And more*

Morning Break (10:30 – 11:00)

Why not visit stands 7 and 12, where free demonstrations are going on all day, and you may control the test gear!

Section 5 (11:00 – 12:30) Essential Circuit Design for EMC

Keith Armstrong

Good EMC design is cost-effective SI, PI and EMC engineering. This Module contains many EM Engineering guidelines that should also be used as an initial design checklist. The subjects include:

- *EMC design for digital circuits*
- *EMC design for analogue circuits*
- *EMC design for communication circuits*

Lunch Break: (12:30 – 14:00) in the Exhibition Hall

Why not visit stands 7 and 12, where free demonstrations are going on all day, and you may control the test gear! An important highlight of our Conference is our Keynote presentation, free to all on the Exhibition floor, from 13:15 to 13:45.

Section 6 (14:00 – 15:30) Radiated immunity and ESD bench top characterization, troubleshooting and mitigation

Ken Wyatt

Many of the more challenging EMC issues tend to cycle endlessly between in-house trying of “fixes” and then failing again at the 3rd-party compliance test lab. This wastes time and money. Learn easy ways to analyze and mitigate the top two EMC immunity issues and lower the risk of test failures during compliance testing. We’ll discuss how to simulate radiated immunity failures and trace the path of ESD current, so intelligent mitigations can be applied - all on your own workbench!

Section 6 Q&A and discussion (15:00 – 15:30)

With Ken Wyatt & Min Zhang

During this session, engineers will have the opportunity to engage in a detailed discussion with our EMC experts Ken and Min. They will delve into the essential EMC troubleshooting tools and skills necessary for effective problem-solving.

This interactive discussion will provide a platform for engineers to ask questions, share experiences, and gain valuable insights from these experienced EMC professionals.

Final Summary & Panel Discussion (16:00 –)

Join conference delegates and EMC experts for a panel discussion, which marks the culmination of this two-day event. Discuss any issues with the panellists, and chat with them afterwards whilst enjoying a delightful arrangement of free drinks and snacks. This is all free to everyone attending the conference or training sessions."

Bio for Keith Armstrong

Keith graduated from Imperial College, London, UK, in 1972 with an Honours Degree in Electrical Engineering. He has been a member of the IEE/IET since 1977 and a member of the IEEE since 1997. Appointed both IET Fellow and IEEE Senior Member in 2010.

After working as an electronic designer, project manager then design department manager, Keith started Cherry Clough Consultants in 1990 to help companies reduce project costs and timescales, warranty costs and other financial risks, through the use of well-proven signal integrity, power integrity and EMC engineering design and manufacturing techniques. By 2022 he had well-over 900 satisfied customers worldwide.

Keith has published several books and a great many articles, and taught many training courses worldwide. In 2018 he was first person to receive the new IEEE award: '*Excellence in Continuing EMC Engineering Education, for continuing education in EMC, signal integrity, and power integrity from a practically based point of view*'.



Bio for Ken Wyatt

Kenneth Wyatt is principal consultant of Wyatt Technical Services LLC and served three years as the senior technical editor for Interference Technology magazine from 2016 through 2018. He has worked in the field of EMC engineering for over 30 years with a specialty in EMI troubleshooting and pre-compliance testing.

He is a co-author of the popular EMC Pocket Guide and RFI Radio Frequency Interference Pocket Guide. He also co-authored the book with Patrick André, EMI Troubleshooting Cookbook for Product Designers, with forward by Henry Ott. He recently completed and released a three-volume "EMC Troubleshooting Trilogy", which is now available through Amazon.



He is widely published and authors a monthly column for the Signal Integrity Journal, has blogged for www.EDN.com for many years and continues to write for Interference Technology Magazine. Ken is a senior life member of the IEEE and a longtime member of the EMC Society. To contact Ken or for more information on technical articles, training schedules and links, check out his web site: <http://www.emc-seminars.com>.

Bio for Rod Macpherson

Rod is a Chartered Engineer having 32 years of industry experience, with special interests in RF/Microwave development. Since 2015 he has been active in defence electronic systems development and Functional Safety (EN 61508, TÜV certified).

After graduating from the University of Strathclyde in 1990 with a 1st Class Honours Degree in Electronics and Electrical Engineering, he has worked as an electronic engineer in the semiconductor and consumer electronics industries with diverse activities from Digital Audio, RF and Microwave development (including 3D/EM modelling) to university research collaboration.

In 2009, he set up Radiosmith to provide independent design consultancy services and has been involved in radiometric imaging, automotive exterior lighting, medical electronics and capacitive sensing where he has applied his expertise in RF design & test, embedded software (Microchip PIC/AVR), 3D mechanical modelling and PCB layout (experienced Altium user).

Rod became an associate of Cherry Clough Consultants Ltd in 2021 to also provide EMC consultancy services and has enjoyed drawing from his wide electronics and RF design experience when troubleshooting EMI-related problems in products, equipment and systems.



Bio for Andy Degraeve

Andy Degraeve (IEEE Member) was born in Ghent, Belgium, on June 6, 1980.

He received the M.S. degree in electronics and computer engineering from the KU Leuven, Technology Campus Ostend, Belgium, in 2014.

In June 2014 he received a nomination for the best master thesis, by the 'ie-net' engineering association. From 2014 till 2018, he was a Research Assistant at the KU Leuven Campus Bruges, Research group ReMI, Reliability in Mechatronics & ICT (now called "M-Group" standing for "Mechatronics Group"). His main research interests included electromagnetic compatibility, immunity and functional safety in life or mission critical situations.



In May 2018 he was a Technical Session chair at the joint IEEE EMC and APEMC symposium in Singapore, Singapore. From 2019 till 2020 he was the Technical and Product Manager at Schlegel Electronic Materials, a member of eMei group, in Belgium, with a focus on shielding, absorbing and thermal management materials.

From 2020, he is focussing on EMC education and diagnostics using low-cost test equipment, and joined Cherry Clough Consultants Ltd as an Associate to provide independent expertise in good, cost-effective EMC design, worldwide.

Bio for Min Zhang

Dr. Min Zhang received his PhD within Newcastle University's Electrical & Electronics Engineering department in 2013.

His research was in novel power switching schemes to reduce EMI emissions, and his research papers have received many citations.

Since then, he has worked as an EMC specialist on milestone projects with Dyson Technology, UK.

With a proven track record designing state-of-the-art electronics and electric machines with minimal EMC issues, Min then established the EMC capability for the Dyson Electric Vehicle project.

Following the closure of that project, he started Mach One Design, and became associated with Cherry Clough Consultants Ltd, to provide independent expertise in good, cost-effective EMC design, worldwide.

Min's in-depth knowledge in power electronics, digital electronics, electronic machines and product design is sure to benefit your product's design, helping you win the race against time and cost.

