EMC Technologies

EMC-EMF-Safety Approvals

EMC: Designing for Compliance

Practical Techniques | Plain English | Immediate Project & Financial Benefits

2024 Design Courses

www.emctech.com.au/keith-armstrong-design-compliance-emc-safety-2024

Melbourne	Sydney	Christchurch (NZ)
Feb 12 - 16	Feb 19 - 23	Feb 26 - March 1

UPDATED: Keith's EMC courses have been significantly updated to keep pace with technical progress, and improved.

His updated Safety Design course covers the LVD and the Radio Equipment Directive (RED) – which now often replaces the LVD, UK Approvals since Brexit, IEC 62368-1 (which now replaces IEC 60950-1 and IEC 60065)

These courses have been very popular worldwide for 30 years because they teach well-proven practical and usable techniques for quick, cost-effective design for safety, functionality (i.e., Signal Integrity, SI, and Power Integrity, PI) and Electromagnetic Compatibility (EMC)

CHERRY CLOUGH CONSULTANTS LTD

emc STANDARDS

Presented by Keith Armstrong, a practising EMC & electronic design consultant, well-known author and articulate and lively presenter. His very popular visits to Australia & New Zealand have excellent approval rates, and here are some comments received:

'You have the most comprehensive work in my opinion for a practical EMC engineer or tech instead of academic based information with no relationship to practice.'

'By the way – just had XXXX in with their latest project. Their design chap was extolling your virtues – It passed first time – no remedial action required – virtually noise floor emissions – and it included Ethernet, PoE, USB and DSP! What more can I say!'

'The courseware is so fine and easy to study. Thank you very much!'

'We enjoyed the talk, and I thought it was one of the most common-sense ones I've heard.'

'I would also like to thank you for the interesting and informative course that you presented. I have already begun to implement some design changes in an ongoing project.'

'I attended a couple of EMC courses in Auckland some years back and like to let you know that your course has been the best and most useful course I ever attended!'

'All participants were very experienced yet I'm sure that the others found it as valuable as I did.'

" There's no question my time was well spent, I have learned things that I need to act upon immediately."

2024 EMC: Design Consultancy and Training

Keith Armstrong and his Associates below will all be visiting Australia/NZ in February/March 2024. They are independent consultants who help designers, manufacturers, system integrators, installers, users deal quickly and cost-effectively with real-life interference (EMI), or compliance with EMC and Safety Directives and similar regulations worldwide. All applications, all industries, all sizes/scales. If you need design consultancy or training during February/March 2024, please contact keith.armstrong@cherryclough.com or https://www.cherryclough.com

Andy Degraeve

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

From 2014 till 2018, he was a Research Assistant at the KU Leuven Campus Bruges, Research group ReMI, Reliability in Mechatronics & ICT.

His main research interests included electromagnetic compatibility, immunity and functional safety in life or mission critical situations.

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.

Dr. Min Zhang

EMC & SIPI expertise

- Specialized in electrically powered vehicles and chargers, home appliance, industrial,professional and medical sectors
- Advanced insight on product research and development
- Background in electronics design, motor control for high-tech volume production business
- In-depth knowledge and experience in electromagnetic design

Chris Nicholas

EMC & RF Design expertise, covering:

- Automotive
- Space
- Military & commercial communications
- Retail market electronics
- Product R&D, Design For Manufacture
- RF comms links, conventional and covert antenna design, HF & VHF propagation studies
- EMC Laboratory Setting-up
- Electrical & RF equipment rack design and implementation
- EMC Installation

Recent Experience

- Military EMI Shelters
- Commercial Power Supply Units
- Screened Rooms
- Clean Room Equipment Racks

Global Markets

- All integrated circuits and opamps have been 'die-shrunk' according to Moore's Law every two years since the 1970s, with the result that they now all emit or are susceptible to microwave frequencies or higher, with the result that their EMC is generally worse every two years on average.
- Switching power devices are also becoming at least ten times nastier for EMC by using SiC and GaN technologies to switch faster, creating much more noise in FM, television and LTE frequency bands.
- Wireless Power Transfer is proving to create unique EMC problems.

  So, we update these courses so they provide regular and practical up-skilling, allowing you to gain competitive advantages in all electronic technologies, in any applications, at any size/scale/volume, regardless of which test standards apply (consumer, commercial, ITE, industrial, medical, automotive, military, aerospace, rail, etc.)
- Design techniques for compliance with national and international EMC standards e.g. RCM, CE, FCC, VCCI, CCC (China), MIL-STDs.
- EMC for Wi-Fi, GSM, GPRS, 3G/UMTS, 4G/LTE, Bluetooth, ZigBee, WLAN, RLAN, etc., and for preventing interference with co-located GNSS receivers.

Participants will receive:

- A PDF copy of the presented course material in full colour, for the courses they attend. Colour-printed and bound course materials are available at extra cost, when registering.
- A certificate of attendance, signed by Keith
- A USB stick containing a very great deal of useful EMC information on design, PCB layout, systems and installations, testing, Functional Safety risk management of EMI, risk management for medical device EMI, complying with the EMC Directive, CE + CE ≠ CE, nearly 1,000 'Banana Skins', and much more.

Sponsored by EMC Technologies Pty Ltd

EMC Technologies has been operating since 1992 and is the largest and most accredited EMC, EMR & Safety test house in Aus/NZ with four fully accredited laboratories in Melbourne, Sydney, and Auckland.

EMC Technologies reports are accepted in most countries including Europe (CE marking), USA (FCC), Japan (VCCI), Canada (ISED), Taiwan (BSMI), Singapore (IMDA), VCA(UK) to name a few. No other test house in Australia/NZ offers such a wide scope of international recognition.

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Course contents

Essential & Advanced SI, PI and EMC design for cost-effective PCBs in 2024

2 full days.
Melb: *Monday February 12th & Tuesday February 13th*
Syd: *Monday February 19th & Tuesday February 20th*
Christchurch (NZ): *Monday February 26th & Tuesday February 27th*

Relevant for: *All electronic, mechanical, and PCB designers and their managers, in all industry areas worldwide including: medical, consumer, household, IT, data/tele/radiocoms, instrumentation/ control, pro-audio/video and broadcasting, industrial, automotive, railway, marine, aerospace, military, security, power conversion, etc.*

Day 1: Essential SI, PI & EMC design for cost-effective PCBs in 2024

- Using these slides to help 'De-Risk' any project's SI, PI and EMC
- Saving time and cost
- EM Zoning techniques (i.e., circuit segregation)
- Interface analysis, filtering, and suppression
- Planes for 0V(GND) and other power rails (PWR)
- RF-bonding PCB Reference Planes at EMZ boundaries
- Power supply decoupling
- Switching power converters (AC/DC, DC/DC, DC/AC, etc.)
- Wireless Power Transfer
- Matched transmission line techniques
- Layer stacking and trace routing
- Devices with BGA packages and/or multiple DC rails
- Some useful references, sources, and webinars

Day 2: Advanced SI, PI & EMC design for cost-effective PCBs in 2024

- When should we use advanced PCB techniques?
- Future trends and their implications
- Guidelines, approximations, simulations, and virtual design for SI, PI and EMC
- Advanced EM Zoning techniques
- Advanced interface filtering and suppression, including using BLS (board-level shielding) and Metamaterials to 60+ GHz
- Advanced RF-bonding for PCB RF Reference Planes at EM Zone boundaries
- Advanced PCB planes, and co-locating wireless antennas
- The totally shielded board assembly
- Damping the resonances in parallel metal structures, including Metamaterial methods such as: Virtual Ground Fence; EBG (Electromagnetic Band Gap); HIS (High Impedance Surface), Split-Ring Resonators, etc.
- Advanced PCB power supply decoupling
- Buried components, especially buried capacitance decoupling
- Advanced transmission lines, including differential signalling up to at least 32Gb/s per lane
- Microvia board design and manufacturing (i.e., High DensityInterconnect, HDI)
- 3-D Moulded, Printed, or Additively Manufactured PCBs
- Advanced crosstalk
- Some final tips and tricks
- Some useful contacts, sources, and references

'I attended a couple of EMC courses in Auckland some years back and like to let you know that your course has been the best and most useful course I ever attended!'

Design for EMC in 2024

1.5 days.
Melb: *Full day on Wednesday 14th February plus the morning of Thursday 15th February*
Syd: *Full day on Wednesday 21st February plus the morning of Thursday 22nd February*
Christchurch (NZ): *Full day on Wednesday 28th February plus the morning of Thursday 29th February*

(Modules 5, 7, 8 not presented, but provided as course notes anyway)

Module 2: EMC techniques for cables and connectors
Accidental antenna behaviour of all conductors. Using fibre- optics, and other alternatives to conductors. The "RF Reference". Cable classification and segregation. Good practices for shielded and unshielded interconnections: DM & CM paths. Shielding techniques for cables. Terminating cable shields. Interconnecting shielded enclosures. Dealing with 'ground loops'. Transmission-line interconnections. Some useful references.

Module 3: EMC filtering
Filtering is not 'black magic'. How filters work. The advantages of soft ferrites. CM filtering. Specifying filters. Real-life problems with resonances, inductors, and capacitors. Earth leakage currents and safety. Filter construction, mounting, and cabling. The synergy of filtering and shielding. Some useful references.

Module 4: EMC shielding (DC to over 50 GHz)
Economic issues for shielding. Shielding with metal plates (image planes). How shielded enclosures work. DC and low frequency shielding. The problems caused by apertures. The problems caused by box resonances. The problems caused by conductor penetrations. Shields in the near field of a source. RF-bonding with multiple metal bonds or conductive gaskets. Waveguides-below-cutoff. Shielding of displays. Shielding of ventilation. Shielding of plastic enclosures. Preventing corrosion at shielding joints. D-I-Y testing SE before hardware or software is ready. Shielding with 'clamshell' enclosures. Some free SE calculators and useful references.

Module 11: Suppressing electrostatic discharge (ESD)
ESD threats. Insulation techniques. Shielding techniques. Suppressing signal, data and power connector pins and conductors. PCB layout for ESD suppressors. Earth lift problems in systems. Protecting control, data and signals from errors. Some useful references, including "software techniques for ESD suppression".

Module 12: Suppressing surge transients on AC & DC supplies; signals, and data
What transients are, and how they cause damage. Using galvanic isolation. Using filters. Using surge protection components (SPCs) – types. Rating SPCs. Protecting and maintaining SPCs. Lead inductance and "let-through" voltage. Avoiding the effects of SPC capacitance on signals. Types of surge protection devices (SPDs). Electronic transient protection for DC power supplies. "Earth/ground lift" problems in systems. Data needs error correction. Dealing with long-duration overvoltages. Some useful references.

For many more details on these courses, *background information on why they are so necessary and valuable, and information on Keith Armstrong, visit: www.emctech.com.au/keith-arm-strong-design- compliance-emc-safety-2024*

Live EMC demonstrations

0.5 day
Melb: *The afternoon of Thursday 15th February*
Syd: *The afternoon of Thursday 22nd February*
Christchurch (NZ): *The afternoon of Thursday 29th February*

Live EMC demonstrations
Several demonstrations that show how we can easily use low-cost and even home-made EMC test gear, on plain (unshielded) testbenches or in the field, to quickly and practically:

i. Help learn the principles of good SI, PI, and EMC design and construction, for circuits, PCB's, enclosures, cabling, systems and installation
ii. Determine the most cost-effective EMC options to be used in design and construction
iii. Help decide which competing components, ICs, boards, modules, power converters, displays, subsystems, etc., to design-in, including their 2nd and 3rd sources
iv. Help avoid financial losses caused by substandard, faulty or counterfeit components, modules, converters, displays, etc., in the supply chain
v. Decide when a new design is ready for 'proper" EMC testing, to help avoid the delays and costs of having to modify and retest
vi. Diagnose, troubleshoot, and help fix EMC problems:
a) during development; b) during serial manufacture, and c) in operation, even in the field
vii. Help avoid financial losses caused by semiconductor manufacturers' automatic (and unavoidable) die-shrinking during serial manufacture
viii. Predict the effects on EMC compliance of component substitutions, bug-fixes, modifications, overhauls, refurbishments, hardware and software upgrades, etc.;
and whether EMC retesting would be necessary
ix. Check that repairs, overhauls, refurbishment, upgrades, etc., to items of equipment in the field, have not harmed their EMC characteristics (and help fix the problems if they have).

Note: you will be able to handle the test gear yourself.

The Safe Design of Electrical Equipment in 2024, and compliance with the LVD or RED– and their equivalent UK Regulations

1 day.
Melb*: Full day on Friday February 16th*
Syd: *Full day on Friday February 23rd*
Christchurch (NZ): *Full day on Friday March 1st*

(Sections A and F below not presented, but provided as course notes anyway)

A Basic Safety Principles, including doing Hazard and Risk Assessments (not presented due to time restrictions)

B Non-CE Marking Safety Directives

C Complying with the Low Voltage Directive (LVD), 2014/35/EU
The New Legislative Framework, and the new 'Blue Guide'. NLF changes between 2006/95/EC and 2014/35/EU. What the LVD applies to, and what it doesn't apply to. Relationships between the LVD and other safety Directives. The requirements of the LVD. The Technical Documentation. The Conformity Assessment procedure. EM Fields and human health. It can be dangerous to rely solely on LVD-listed standards. A single Declaration of Conformity for all Directives. Affixing the CE marking. Enforcement (in England). Management of LVD compliance. Compliance of assemblies of COTS items.

D Complying with the safety requirements of the Radio Equipment Directive (RED) 2014/53/EU (instead of the LVD)

E Design and Validation for INHERENT Safety

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. Wiring, supply and construction. Markings and manuals. Type testing. Routine production tests. Special national conditions. Special safety techniques.

F Design/Validation for FUNCTIONAL Safety
(not presented due to time restrictions)

2024 Program Registration Form

Melbourne: *176 Harrick Road, Keilor Park, VIC 3042*
Sydney: *Unit 3, 87 Station Road, Seven Hills, NSW, 2047*
Christchurch (NZ): *Waimakariri Room, Trimble, 11 Birmingham Drive, Middleton, Christchurch, 8024, New Zealand*

Venue	Monday **February 12th**	Tuesday **February 13th**	Wednesday **February 14th**	Thursday **February 15th**	Friday **February 16th**
Melbourne EMCT Keilor Park	Essential SI, PI and EMC design for cost-effective PCBs in 2024 **AM & PM**	Advanced SI, PI and EMC design for cost-effective PCBs in 2024 **AM & PM**	Design for EMC in 2024 **AM & PM**	**AM** Design for EMC in 2024 (Continued) **PM (1.30)** Half day of live EMC demonstrations	The Safe Design of Electrical Equipment in 2024 **AM & PM**
Venue	Monday **February 19th**	Tuesday **February 20th**	Wednesday **February 21st**	Thursday **February 22nd**	Friday **February 23rd**
Sydney EMCT Seven Hills	Essential SI, PI and EMC design for cost-effective PCBs in 2024 **AM & PM**	Advanced SI, PI and EMC design for cost-effective PCBs in 2024 **AM & PM**	Design for EMC in 2024 **AM & PM**	**AM** Design for EMC in 2024 (Continued) **PM (1.30)** Half day of live EMC demonstrations	The Safe Design of Electrical Equipment in 2024 **AM & PM**
Venue	Monday **February 26th**	Tuesday **February 27th**	Wednesday **February 28th**	Thursday **February 29th**	Friday **March 1st**
Christchurch (NZ) EMCT Trimble	Essential SI, PI and EMC design for cost-effective PCBs in 2024 **AM & PM**	Advanced SI, PI and EMC design for cost-effective PCBs in 2024 **AM & PM**	Design for EMC in 2024 **AM & PM**	**AM** Design for EMC in 2024 (Continued) **PM (1.30)** Half day of live EMC demonstrations	The Safe Design of Electrical Equipment in 2024 **AM & PM**

Electronic copies of course notes are supplied and included in the price. No hardcopies provided. Live streaming is available for registered attendees. All electronic course notes and Certificates (as PDFs) will be provided via email.

Session	Price	City	Sub-total
Essential SI, PI and EMC design for cost-effective PCBs in 2024 (1 day)	$1,050	MEL, SYD, Christchurch	
Advanced SI, PI and EMC design for cost-effective PCBs in 2024 (1 day)	$1,050	MEL, SYD, Christchurch	
Design for EMC in 2024 (1.5 days) (does not cover PCBs)	$1,550	MEL, SYD, Christchurch	
Half day of live EMC demonstrations (0.5 day – afternoon)	$550	MEL, SYD, Christchurch	
The Safe Design of Electrical Equipment in 2024 (1 day)	$1,050	MEL, SYD, Christchurch	
Lunch is at 12.30pm, complimentary with all courses		**Sub-total**	
		Plus 10% GST	
		Total cost of sessions selected (including GST)	

Name		Phone:	
Email			
Company			
Invoice address			
Location	☐ **Melbourne** 176 Harrick Road, Keilor Park, VIC, 3042	☐ On-site ☐ Online	
	☐ **Sydney** Unit 3, 87 Station Road, Seven Hills, NSW, 2147	☐ On-site ☐ Online	
	☐ **Christchurch NZ** Trimble, 11 Birmingham Drive, Middleton, Christchurch, 8024,	☐ On-site ☐ Online	
Dietary/other needs and any allergies			
Payment	Visa ☐ M'card ☐ (Please note 1.5% surcharge for all credit card payments)	EFT ☐ **EMC Technologies Pty Ltd** NAB BSB: 083 865 Account 51835 7100	
Card Number:		Expiry	
Cardholder:			
Email for receipt			

Please return completed Registration form to: sales@emctech.com.au

NOTE: No refunds will apply if less than 7 days' notice is given