EMC Technologies
EMC-EMF-Safety Approvals

Cherry Clough Consultants

EMC, SAFETY COMPLIANCE & DESIGN COURSES 2010

Designing for compliance means lower costs and faster time to market. These standalone courses cover the practical techniques you need to maintain or improve performance in any industry that uses electronic technology. **An introduction for new personnel, a refresher and update for those with experience plus NEW courses.**

APRIL 19 – MAY 7
MELBOURNE
SYDNEY

Presented by Keith Armstrong, a practising EMC & electronic design engineer and well-known author of EMC articles and textbooks. Keith is an articulate and lively presenter and his very popular visits to Australia & New Zealand had excellent approval rates.

Developments in electronic technologies and their applications continue to create new challenges to design/development costs, timescales, unit manufacturing costs, reliability, safety; and increase exposure to warranty costs, penalty charges, liability claims, fines or banning from major markets, and other financial risks.

These courses help manufacturers deal with these challenges whilst improving financial performance. They are excellent for those new to EMC or safety engineering, and are good refreshers and updates for experienced personnel.

NEW for 2010

- Motor drives for hybrid and electric vehicles and renewable power AC generators
- Medical EMC – 2nd, 3rd, 4th Editions of IEC 60601-1-2 (AS/NZS 3200.1.2)
- EMC for Functional Safety, high reliability and mission criticality
- Good EMC practices for Systems and Installations
- Close Field probing techniques including a demonstration of emissions suppression.

In addition to new courses, all of the modules have been updated to keep pace with technical progress. High-quality feedback from previous participants has improved these courses to keep pace with changing technologies.

- **Practical methods**
- **Plain English**
- **Immediate financial benefits**

- **Design techniques for compliance with global standards e.g. C-tick, CE, FCC, VCCI, CCC (China)**
- **Complying with human exposure limits – SAR, EMF, EMR etc.**
- **Design techniques for EMC compliance for wireless products – WLAN, RLAN, GSM, GPRS, CDMA, Wi-Fi (IEEE 802.11), EDGE, 3G (UMTS), 4G, Bluetooth, ZigBee, etc.**
- **Design techniques for preventing interference with co-located GPS receivers**
- **All industries, including: medical, consumer, IT, telecommunications, industrial instrumentation & control, professional audio and video, military, etc.**
- **All vehicles and transportation systems including electric vehicles, renewable AC power generators, railway, marine, automotive, aerospace, etc.**
- **Modules, sub-assemblies, products, equipment, machines, etc.**

USE NEW TECHNOLOGIES EFFECTIVELY TO GROW IN GLOBAL MARKETS

Compliance with Electromagnetic Compatibility (EMC) and Electrical safety standards and regulations is of paramount importance in getting your product to market. These courses provide valuable and up-to-date information for electronic, mechanical, PCB and safety engineers; and design, production and QA managers; to help them comply with legal requirements, remain competitive and reduce financial risks as electronic technologies continue to advance.

This series of stand-alone 1/2, 1 and 2-day courses provide proven practical techniques for saving time and cost and reducing non-compliance and financial risks, for new or upgraded products, systems and installations.

SYNOPSIS OF EACH COURSE

EMC design of switch-mode power converters, including PWM motor drives for hybrid and electric vehicles and renewable AC power generators: *1 day - **NEW***

Switch-mode power conversion is an extremely noisy technology, and it is very difficult and costly indeed to suppress its emissions for compliance (and happy customers) unless good EMC design techniques are used from the start.

This course covers EMC design techniques to control emissions from all types of switch-mode power converter, at all power levels (from under 1W to over 10MW), from circuit design and PCB layout to packaging and installation, including:

- DC and AC motor drives for hybrid and electric vehicles
- DC and AC motor drives for domestic appliances, commercial and industrial sites, including steppers and servos
- AC power generation from renewable energy sources (PV, wind, water, tidal, etc) and batteries.
- Mains powered AC-DC power supplies and isolating DC-DC converters
- Non-isolating DC-DC converters
- Class D audio power amplifiers

Relevant for: All electrical, electronic and mechanical designers, and their managers, in all industries including: automotive; oil and gas; mining; renewable energy generation; railway; marine; military; aerospace; HVAC; industrial instrumentation & process control; professional audio, video and broadcasting medical; consumer; household; IT; telecommunications; leisure and entertainment, sports facilities, opera houses, etc.

How to achieve EMC for Functional Safety and high reliability: *1 day **NEW***

Where functional safety or other risks (financial, mission, etc.) need to be controlled, relying solely on EMC immunity testing is TOTALLY INADEQUATE - no matter how high the test levels are cranked up. Conventional EMC tests:

- Ignore foreseeable faults and misuse, wear and ageing
- Overlook the fact that real-life environments have more than one EMI threat at a time
- Fail to consider the effect of the physical environment over the lifetime (shock, vibration, condensation, temperature extremes and cycling, etc.)
- Disregard “emergent” behaviour (the system can be much more susceptible than the items of equipment it is made from)

Many engineers and project managers are unaware of the functional safety risks (or financial or mission risks) they are running by relying solely on EMC testing.

This course is based on the IEE/IET’s new Guide (August 2008) on EMC for Functional Safety, and IEC TS 61000-1-2 Edition 2 (December 2008), the IEC’s basic standard on EMC for Functional Safety.

Relevant for: Everyone in all industries where errors or malfunctions in their electronic or electrical products, equipment, systems or installations could increase the likelihood of a safety hazard arising, or financial loss, including high-reliability and mission-critical applications.

Good EMC Engineering Practices for Systems and Installations: *1 day **NEW***

Because every type of system and installation now relies totally on the correct operation of electronic equipment – good EMC engineering practices are required to be used in all systems and installations to achieve acceptable uptime, product quality, and financial performance.

This applies to all buildings, sites, vehicles & vessels (road, rail, marine, aerospace, etc), infrastructure (water, gas, electricity, transport, radio/telecommunications, internet, etc), energy generation (gas, oil, electricity, etc), commerce, leisure & entertainment, industrial automation and process control, retail, banking, government, military, security, science, healthcare, etc.,

Relevant for: Every engineer who is responsible for the uptime and manufacturing yield/quality of electrical/electronic systems and installations in all of the types of premises, sites, vehicles and vessels mentioned above, and their managers.

EMC, close-field probing, including a demonstration of emissions suppression: *1/2 day **NEW***

Close-field EMC probing is a number of very low-cost, quick and powerful techniques that provide huge amounts of help with controlling emissions and immunity in every stage of a product’s lifecycle, from proof of principle, through design and development, to serial manufacture, site commissioning, maintenance, repair and upgrade.

Once you have learned how to use close-field probing, you will become much more efficient and wonder how you ever managed without it.

This course includes a world-renowned demonstration of emissions suppression techniques, plus the effective use of close-field probes with a very low-cost portable spectrum analyser. Why not bring your own product or prototype for probing as part of this demonstration, if we have time? (Smallish products, please, that only require a 230V mains supply.)

Relevant for: Everyone who has anything to do with electrical or electronic design and/or EMC, and their managers, in any industry or application area.

Medical EMC Requirements & draft 4th Edition of IEC 60601-1-2: *1/2 day **NEW***

The EMC requirements of the current 3rd Edition of the medical EMC standard IEC 60601-1-2, and the very significant developments in its forthcoming 4th Edition. Risk analysis explained.

Relevant for: All electronic designers, EMC testers, and their managers in the medical equipment industry. May also be of interest to people working in healthcare premises.

Designing for cost-effective EMC, and financial benefits: *2 days*

A practical grounding in the EMC design techniques that technology developments have now made essential for the financial success of electronic product manufacturers. Shows how to use well-proven methods to reduce time-to-market, quickly achieve compliance, improve reliability and reduce warranty costs.

Based upon the course that Keith teaches to post-graduate students on the Sensors and Electronic Instrumentation M.Sc. course at the University of Manchester, U.K.

A long-established and very popular course that is constantly being updated to keep pace with developments, and so is never the same from year to year.

Relevant for: All electronic and mechanical designers and their managers, in all industry areas including: automotive, medical, consumer, household, IT, telecommunications, instrumentation & control, professional audio and video, railway, marine, military, aerospace, etc.

Basic and Advanced PCB Design for EMC and Signal Integrity: *1 day*

Inexorable advances in semiconductor technologies make it essential to deal with EMC at PCB-level to achieve signal integrity, low cost, and to get to market quickly. Advanced PCB techniques...

- Reduce size/cost by reducing or eliminating enclosure shielding
- Reduce interference to/from wireless communications (voice or data) and GPS
- Are required for high-speed clocks, Gb/s data and high-power DSP to work at all
- Reduce time to market, compliance costs and warranty costs
- Reduce the financial risks of using new technologies (e.g. 65nm digital ICs)

A long-established and very popular course that is continually updated to keep pace with developments in ICs. PCB design for EMC is constantly changing.

Relevant for: All electronic and PCB designers in all industry areas including: automotive, medical, consumer, household, IT, telecommunications, industrial instrumentation & control, professional audio and video, railway, marine, military, aerospace, etc.

Designing for safety of electrical products and CE LVD compliance: *1 day*

A practical grounding in the safety design, assessment and testing required for compliance with Australian, European and international safety standards such as IEC/EN/AS-NZS 60950, 61010, 60601, 60335, and safety laws such as the EU's Low Voltage Directive (LVD), Product Liability and General Product Safety Directives, and Australian/NZ A-tick and electrical safety regulations.

There are many safety issues associated with the use of 230V mains power, but there are also many other safety issues that are important for products powered from low voltages, such as batteries. The safety standards themselves are not discussed in detail, as the focus is on design techniques.

Relevant for: All electrical/electronic designers and their managers, in all industry areas including: medical, consumer, household, IT, telecommunications, industrial instrumentation & control, professional audio and video, railway, marine, automotive, military, aerospace, etc.

USE NEW ELECTRONIC TECHNOLOGIES TO COMPETE EFFECTIVELY IN GLOBAL MARKETS

There are very powerful economic factors driving us to use ICs with ever-smaller feature sizes, smaller packages and more pins; higher clock and power-switching frequencies, and to add wireless devices for datacommunications and GPS.

One inevitable downside of this is continually worsening signal integrity and degraded EMC performance, for both emissions and immunity, impacting directly on time-to-market, selling price, and warranty costs.

Another consequence, is that EMC emissions at high frequencies are increasing, and are more likely to fail compliance tests and interfere with co-located wireless and GPS receivers.

The present challenge is to use ICs with silicon features of 65 and 42nm, with even smaller devices coming soon. Smaller devices have reduced immunity, and the trend to lower d.c. voltages and co-located wireless transmitters worsens signal integrity (SI) and makes failure to meet immunity tests more likely.

Existing products are affected by shrinking silicon features too, as IC manufacturers convert their existing devices to use the newer silicon technologies, to make more money. This is known as a 'mask shrink' or 'die shrink' and has cost some product manufacturers millions of dollars in re-engineering existing products because of the SI or EMC problems created.

The increased functionality and lower cost of new IC and semiconductor devices creates many exciting new possibilities for products and services. This encourages the use of modern electronic technologies in areas where there is little or no relevant experience, increasing financial risks. The use of wireless communications, DSP, and switch-mode power conversion technologies is particularly fraught with risks.

The increase in risks is especially true as modern electronics penetrate safety-related areas from vehicles and transport infrastructure through industrial automation, medical and healthcare, to household appliances and toys. The risks are further compounded as wireless devices proliferate.

All this has a negative effect on design/development costs, and timescales, regulatory compliance costs, unit manufacturing costs, reliability and safety – hence increased exposure to warranty costs, penalty charges, product liability claims, being fined or banned by major markets due to non-compliance, and other financial risks.

To benefit from modern electronic technologies requires electrical, mechanical and PCB designers and their managers to keep their knowledge and skills up-to-date to control signal integrity, EMC and safety.

These courses describe practical techniques that can be put to work right away to get immediate benefits.

Participants will receive the following documents:

- A bound copy of the presented course material in full colour for the courses they attend
- A certificate of attendance, signed by Keith
- A CD-ROM and downloadable files containing:
  - 22 EMC guides written by Keith for REO (UK) Ltd
  - 23 of Keith's articles on EMC, on:
  - Design techniques for EMC
  - D-I-Y EMC testing techniques
  - EMC for Systems and Installations
  - EMC for Functional Safety
  - How the new EMC Directive applies to 'fixed installations' and equipment supplied to them

KEITH ARMSTRONG

BSc(Elec Eng), Upper Second Class Honours, Imperial College of Science and Technology, London, UK, 1972

Member of IEE (now IET): 1977
UK Chartered Engineer: 1978

Group 1 European Engineer: 1988

- Chair of IET Working Group on EMC and Functional Safety
- Member of IEC 61000-1-2 (EMC & Functional safety) team: MT15
- Member of IEC 60601-1-2 (medical device EMC) team: MT23
- Member EMC Test Labs Association (www.emctla.co.uk)
- Member, Technical Panel, IET EMC Professional Network (PN)
- Member, Technical Panel, IET Functional Safety PN
- Past chair of IEE's EMC Professional Group (E2)
- President, EMC Industries Association (www.emcia.org), 2008

Wide experience in electronic product design and project management. Started Cherry Clough Consultants in 1990.

Has written the following textbooks: "EMC for Printed Circuit Boards - Basic and Advanced Design and Layout Techniques", 2007; "EMC for Systems and Installations" (Newnes, 2000, co-authored with Tim Williams of Elmac Services), and edited "the First 500 Banana Skins" – a compendium of reports and anecdotes of real-life interference.

Keith has written a great many articles on EMC in professional journals and trade magazines, including 6 series for the EMC Journal: "Design for EMC" (1999 and 2006-8), "EMC for Systems and Installations" (2000), "EMC Testing" (2001), "Advanced PCB Design and Layout for EMC" (2004-5), "The Physical Basis of EMC" (2009-10) and is the compiler of the Journal's 'Banana Skins' column.

He is a member of the editorial advisory boards for Compliance Engineering and Interference Technology magazines, and is a reviewer for the EMC Europe Symposia and IEEE Transactions on EMC.

Written 22 practical guides on EMC published by REO (UK) Ltd.

Presented many papers for a wide range of national and international conferences, symposia, etc, including those organised by ERA, IET and the IEEE's EMC and Product Safety Engineering Societies.

You will benefit from Keith's expert consultancy with Cherry Clough:

Systems and installations: machines and manufacturing plant of all sizes; robotics, air traffic control; computer and telecommunication rooms; administration centres; dealer rooms; call centres; professional audio; steel rolling mills; hospitals; hotels; chemical and pharmaceutical processing plant; bottling and canning lines; road tunnel lighting; synchrotrons (e.g. The Diamond Light Source, UK, and Australian Synchrotron, VIC).

Products and equipment: automotive chassis and body electronics; medical devices; marine equipment; computers, DSP, information technology; PDAs; professional audio consoles; professional video projectors; lighting; telephones and telecommunications; consumer electronics; cellphones; set-top boxes; radio-communications and pagers; lifts (elevators); household appliances; gambling machines; gas boilers, medical equipment; coin mechanisms; security equipment; mains-borne communications; laser welding; digital microwave radio; industrial instrumentation, control, and machinery of all sizes; variable speed AC and DC motor drives up to 10MW.

EMC services Keith has provided for Cherry Clough:

- *PCB, product, system, and installation design (and design reviews) for EMC, reliability, functional safety, cost-effective regulatory compliance*
- *Control plans, test plans, etc, for effective management of EMC and EMC for functional safety in projects of all sizes*
- *Production / QA procedures for maintaining compliance in volume manufacture and custom engineering*
- *Testing and remedial work ('fixes') to meet EMC and safety standards*
- *Creation of EMC Directive Technical Construction Files and other compliance documentation*
- *Assessment of complex Technical Construction Files for EMC Directive Competent Bodies*
- *Education and training for designers and managers on cost-effective EMC and Safety techniques*
- *Education and training for executives in EU compliance, financial risks, liability, and related marketing issues*

Sponsored by:

EMC Technologies
EMC-EMF-Safety Approvals

EMC Technologies is the largest and most accredited EMC & Safety test house in Aus/NZ with fully accredited laboratories in Melbourne, Sydney, Brisbane and Auckland. EMC Tech's reports are accepted in most countries including Europe (CE marking), USA (FCC), Japan (VCCI), Canada (IC), Taiwan (BSMI), Singapore (iDT), VCA(UK) to name a few. No other test house in Australia/NZ offers such a wide scope of international recognition.

COURSE CONTENT DETAILS

Medical EMC Requirements and the draft 4th Edition of IEC 60601-1-2 *1/2 day* ***NEW***

- Review of the requirements in the 2nd and 3rd Editions of IEC 60601-1-2
- Review of the risk-based safety assessment required by the new 3rd Edition of IEC 60601-1, requiring the application of ISO 14971
- Why the 4th Edition of 60601-1-2 will be split in two parts: performance, and safety
- Towards the new performance requirements in the 4th Edition:
  - » The huge range of EM environments that some types of medical equipment are exposed to (e.g. homes, shopping, dentists, work in offices and factories, travel by road, rail, air, sea, etc.)
  - » The matrix of possible test requirements for emissions and immunity, depending on the anticipated user environment
- Towards the new risk-based requirements in the 4th Edition:
  - » Why a test-based approach cannot on its own ensure adequate safety over a medical equipment's lifetime
  - » What should be done instead (the state of the art in applying safety engineering to EMC)

Designing for cost-effective EMC, and financial benefits *2 days* ***NEW***

- The physical basis of EMC (at radio frequencies)
- Saving time and money by using good EMC practices
- Digital design for EMC
- Analogue design for EMC
- Switch-mode power conversion design for EMC
- Communications design for EMC
- Choice of components for EMC
- EMC techniques for cables and connectors
- EMC filtering
- EMC shielding (DC to many GHz)
- EMC techniques for heatsinks
- Suppressing surge transients
- Suppressing electrostatic discharge (ESD)
- Suppressing electromechanical devices
- Integrating wireless communication devices (transmitter and receivers, including GPS)
- Some useful references

Based on feedback from previous year's courses, modules on mains harmonics, flicker, and immunity to power quality issues have been omitted and replaced with modules on: The Physical Basis of EMC, Heatsinks, and Integrating Wireless Communications/GPS. Also, PCB EMC techniques have been removed and are now covered only in a separate course

Basic & Advanced PCB design for EMC & Signal Integrity *1 day* ***NEW***

The EMC techniques now generally required for all PCBs:

- Design techniques to save time and money
- Segregation
- Interface analysis, filtering, and suppression
- 0V and power planes
- PCB-chassis bonding
- Power supply decoupling
- Transmission line techniques
- Layer stacking
- Some useful references and sources

Advanced EMC PCB design and layout techniques:

- When do we need to use advanced PCB techniques?
- Silicon trends and their implications
- Rules of thumb, approximations, simulations
- Virtual design for SI and EMC
- Advanced segregation
- PCB-level shielding up to GHz
- Advanced interface filtering and suppression
- Advanced PCB-chassis bonding
- Advanced planes
- The totally shielded PCB assembly
- Advanced decoupling
- Buried capacitance *(continued over page)*
- Advanced transmission lines
- Differential transmission lines up to 10Gb/s
- Advanced layer stacking
- Microvia (high density interconnect) PCB technology
- Some final tricks
- Some useful contacts, sources, references

Designing for Safety of Electrical Products, and for LVD Compliance: *1 day*

- What do we mean by 'safe enough'?
- Doing hazards analysis and risk assessments
- Non-CE marking safety directives
- Complying with the Low Voltage Directive
- The new EMF requirements
- 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 (testing the design)
- Routine tests in serial manufacture
- Special national conditions
- Good safety engineering techniques not yet standardised
- Design and test for functional safety
- EMC for functional safety
- Some useful safety resources

EMC design of switch-mode power converters, including PWM motor drives for hybrid and electric vehicles and renewable AC power generators: *1 day* ***NEW***

This course covers:

- DC and AC motor drives for hybrid and electric vehicles
- DC and AC motor drives for domestic appliances, commerce and industry, inc. steppers and servos
- AC mains generation from green energy sources (PV, wind, water, etc) and from batteries.
- Mains powered AC-DC power supplies and isolating DC-DC converters
- Non-isolating DC-DC converters
- Class D audio power amplifiers
- All types of switch-mode conversion, including AC-DC, DC-DC, DC-AC, AC-AC
- EMC design techniques for circuits, PCBs, mechanical packaging, systems and installations, for converters of less than 1W to greater than 10MW.

CONTENTS:

- EMC design of AC-DC input rectifiers
- EMC design of chopper circuits
- EMC design of converters that use isolating transformers
- EMC design of AC-DC output rectifiers
- EMC design of PWM AC or DC outputs, for motor drive or renewable power generation
- Power Factor Correction – suppressing mains harmonic emissions
- Suppressing emissions of voltage fluctuations and flicker to the mains supply
- Dealing with Insulated Neutral "floating" mains power systems (e.g. ships, offshore, etc.)
- Some useful references and further reading

How to achieve EMC for Functional Safety, high reliability and mission-criticality: *1 day* ***NEW***

- An Update on the Progress in Standardisation of EMC for Functional Safety
- A brief overview of the whole lifecycle and introduction to the IET's new Guide
- Management and planning
- Assessing the lifecycle environments (electromagnetic, physical and climatic, etc.)
- Risk assessment, and creating the EMC Requirement Specification
- Design and Realisation (i.e. manufacture)
- Verification technique (including testing) during Realisation
- Validation techniques (including testing) at the end
- Maintenance, Repairs, Refurbishments, Modifications and Upgrades

Good EMC Engineering Practices for Systems and Installations: *1 day* ***NEW***

- Complying with the Fixed Installation requirements of the new EMC Directive, 2004/108/EC
- Complying with the new Lightning Protection Standard, IEC 62305
- Complying with the 2011 EU and UK Wiring Regulations (Electrical Codes, e.g. BS7671)
- Overview of the overall EMC control procedure
- Good EMC practices for general use
  - » Power distribution systems for EMC
  - » Improving power quality
  - » Galvanic isolation for EMC
  - » Routing send and return current paths together
  - » Segregation (zoning) of apparatus and their supplies
  - » The bonding ring conductor (BRC)
  - » Cable classification, segregation and routing
- EM Mitigation Techniques
  - » EM Zoning
  - » Mesh bonding and creating an RF Reference
  - » What to do if you can't use mesh-bonding
  - » RF bonding techniques
  - » The benefits of 'earth loops' ('ground loops')
  - » Terminating cable shields at both ends
  - » Parallel earth conductors (PECs)
  - » Choosing and using filters
  - » Cable shielding
  - » Shielding for EM Zones
- Surge and Lightning protection
- Preventing corrosion
- Maintaining EM performance over the operational lifecycle
- Some useful references

Close field probing, including a demonstration: *1/2 day* ***NEW***

- Demonstration of emission suppression methods and close-field probing. Why not bring your own product or prototype for probing as part of this demonstration, if we have time? (Smallish products, please, that only require a 230V mains supply.)
- Close Field Probing Techniques (emissions and immunity) for every project stage
  - » The many uses of close-field probing
  - » Making your own close-field probes
  - » Commercially-available close-field probes and similar
  - » Current probes, pin probes, other types of probes
  - » Measuring radiated and conducted RF emissions
  - » Avoiding spectrum analyser input overdrive
  - » Portable analysers and 'noise' probes
  - » Measuring radiated and conducted RF immunity
  - » Identifying structural resonances
  - » Detailed uses for close-field probing at every stage in a product's lifecycle, from proof-of principle through design, development and serial manufacture to maintenance, repair, upgrade and modification
  - » Some useful references

REGISTRATION FORM

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Please circle the venue and dates you wish to attend:

Melbourne	**EMC Technologies Conference Room: 176 Harrick Road, Keilor Park, Vic. 3042**						**19th April – 29th April, 2010**
Cost-effective EMC design for compliance and financial benefits **Two days**	Basic and advanced PCB design for EMC and signal integrity **One day**	Medical EMC: IEC/EN 60601-1-2 (AS/NZS 3200.1.2) editions 2, 3 and draft 4 **Half day**	Close-field probing, including a demonstration **Half day**	Designing for safety of electrical products and LVD compliance **One day**	EMC design of switch-mode power converters, including PWM motor drives for hybrid and electric vehicles **One day**	How to achieve EMC for functional safety reasons **One day**	Good EMC engineering practices for systems and installations **One day**
Mon 19th - Tues 20th April	Wed 21st April	Thurs 22nd April **am**	Thurs 22nd April **pm**	Fri 23rd April	Tues 27th April	Wed 28th April	Thurs 29th April

Sydney	**EMC Technologies Training Room: 3/87 Station Road, Seven Hills, NSW. 2147**				**30th April – 7th May, 2010**
Designing for safety of electrical products and LVD compliance **One day**	Cost-effective EMC design for compliance and financial benefits **Two days**	Basic and advanced PCB design for EMC and signal integrity **One day**	Medical EMC: IEC/EN 60601-1-2 (AS/NZS3200.1.2) editions 2, 3 and draft 4 **Half day**	Close-field probing, including a demonstration **Half day**	EMC design of switch-mode power converters including PWM motor drives for hybrid and electric vehicles **One day**
Fri 30th April	Mon 3rd - Tues 4th May	Wed 5th May	Thurs 6th May **am**	Thurs 6th May **pm**	Fri 7th May

Session	Price	
Cost-effective EMC design (2 days)	$1,380	
Basic and advanced PCB design (1 day)	$840	
Medical EMC (half day)	$680	
Designing for safety of electrical products (1 day)	$840	
EMC design of switch-mode power converters (1 day)	$840	
How to achieve EMC for functional safety reasons (1 day)	$840	
Good EMC engineering practices (1 day)	$840	
Close-field probing (half day)	$680	
Total cost of sessions selected		
Add 10% GST		
TOTAL AMOUNT PAYABLE		

Refreshments provided, lunch provided for full day courses,
please advise any special requirements, dietary, physical etc

METHOD OF PAYMENT Registration will be confirmed on receipt of payment

Payment by credit card: VISA Mastercard Amex OR Cheque payable to EMC Technologies Pty Ltd

Card No: Expiry Date: AMEX ID:

Cardholder Name:

ATTENDEE DETAILS: (Please print clearly)

TITLE: FIRST NAME SURNAME:

ORGANISATION:

ADDRESS:

EMAIL:

TELEPHONE: FAX: