# INDIA'S PREMIER PRODUCT DESIGN TRAINING WORKSHOP

## PRACTICAL ELECTRONIC DESIGN TECHNIQUES

REGISTER HERE

An Engineering Excellence
For Cost-Effective
**SI, PI and EMC**

Event Organised By :

C-PRAV CERTIFICATIONS

## By Keith Armstrong, UK

Author of hundreds of books and articles which have helped designers, manufacturers, system integrators, installers & users globally

ELECTRONICS INDIA
Billion Needs Million Chips

Ministry of Electronics and Information Technology
Government of India

Supported by:

DoT. TEC.

SEMCE(I)

IEEE EMC SOCIETY

### Webinar Dates:

19 OCT | 20 OCT | 21 OCT | 22 OCT | 23 OCT | 24 OCT 2020

**REGISTRATIONS** : OPEN. on 5th Sept 2020

**ENQUIRES to :** prav@c-prav.com, srinath@c-prav.com

**Call : +91 99000 74728**

**15 Oct Inauguration, Keynote By MEITY & DoT; MTCTE Updates by TEC**

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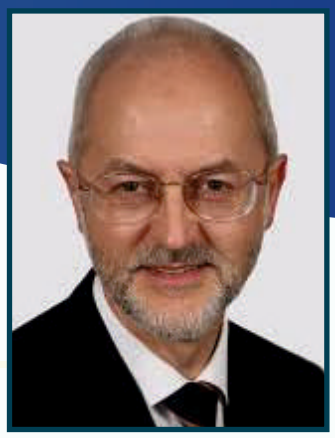
# PRACTICAL ELECTRONIC DESIGN TECHNIQUES FOR COST-EFFECTIVE SI, PI AND EMC

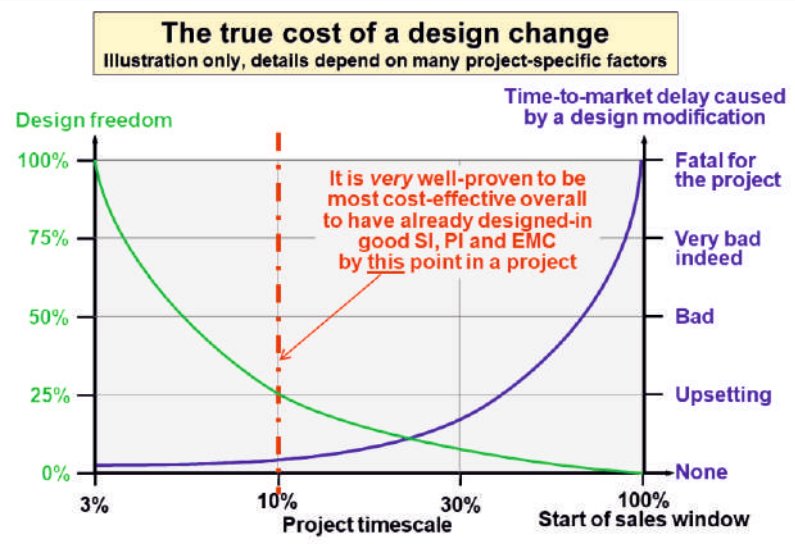


## A Premier Product Design Training Workshop by the Best

**MR KEITH ARMSTRONG**

India's manufacturing boost in all sectors of the electronic, medical and defense industry calls for a robust design strategy to cater for smooth development, manufacturing and regulatory compliance requirements.

**Projects well Begun is half Done!** This is very true when it comes to Product design. Product well designed considering EMC from the start saves a lot of time and money. Risks of Product slippage is often overlooked. Experience has taught many lessons.




Once the product is setup on the test bench in an EMC lab, the money clock starts. If the product fails, costs can multiply exponentially if not handled carefully. Experience of handling EMC is key to get out of the EMC lab quickly with a compliance report. Just handing over the product to the EMC lab and expecting a compliance report in return is a huge underestimation of this compliance process.

Certification is ALL about Time to Market! Manufacturer has spent enormous time, effort and money in developing a product to Sell. If a product falls through during testing or certification stage, this product cannot be legally sold in the market. Losses start multiplying. This is the most crucial stage of a product cycle – Test -> Certify -> Sell for returns. Short-cuts must be avoided at this stage.

Meity's initiatives to promote Indian electronic manufacturing industry – Our contribution to this is bringing the Guru of Electronic Product Design Techniques to the Design houses of India.

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Billion Needs Million Chips

https://www.meity.gov.in/writereaddata/files/Presentation-Electronics_Manufacturing_Schemes.pdf

## India's Electronic Industry : One of the fastest growing in the world

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# PRACTICAL ELECTRONIC DESIGN TECHNIQUES FOR COST-EFFECTIVE SI, PI AND EMC

C-PRAV has organised this event with support from MEITY, DoT, TEC, SEMCE(I) & IEEE EMC Society. This workshop to bring the Best Design of EMC knowledge to India for India's product designers and developers. A series of courses presented by an EMC power house **Mr Keith Armstrong,** a Global veteran who is an EMC Encyclopedia. Keith has published hundreds of articles and books which have helped designers, manufacturers, system integrators, installers and users to quickly and cost-effectively mitigate real-life interference (EMI) problems, or help product compliance with worldwide EMC and Safety standards and Regulations. Some of the popular publications are: EMC Design Techniques, EMC for PCBs.

This is a great opportunity for Indian Designers to interact with Keith. The courses will not just have theory but plenty of case studies, practical references and Q&A sessions. Presenting Keith's 30 years of knowledge & training experience at your door step.

## Webinar Dates:

FREE Introduction Session on 15 October : 2 PM

19 OCT, 20 OCT, 21 OCT, 22 OCT, 23 OCT, 24 OCT 2020

## Webinar Timings:

02 PM – 06 PM IST

***See Topics detail for respective dates and times***

| | INDIA TIME | UK TIME (BST) GMT+1 | AUSTRALIAN EASTERN STANDARD TIME (AEST) | NEW YORK EDT | TAIWAN (GMT + 8) |
|---|---|---|---|---|---|
| START | 02:00 PM | 09:30 AM | 06:30 PM | 04:30 AM | 12. NOON |
| END | 06:00 PM | 01:30 PM | 10:30 PM | 08:30 AM | 4:00 PM |

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# PRACTICAL ELECTRONIC DESIGN TECHNIQUES FOR COST-EFFECTIVE SI, PI AND EMC

## For full details of the workshop & Any Other Enquires, Please Contact


C-PRAV Certifications : www.C-PRAV.com
Srinath Ramaraju : +91 99000 74728; srinath@C-PRAV.com
Sachin Yadav : +91 83101 63120; sachin@C-PRAV.com


**Registrations Open : 05th September 2020**

**Cost For The Event:**

| INDIA | INTERNATIONAL |
|---|---|
| Complete course : INR 20,000 + GST<br>Early Bird Price (Register Before 25th Sept): INR 16,000 +GST | Complete course : USD 500<br>Early Bird Price (Register Before 25th Sept): USD 400 |
| For Each Topic Full Price : INR 5,000 +GST<br>Early Bird Price For Each Topic : INR 4,000 +GST | For Each Topic Full Price : USD 200<br>Early Bird Price For Each Topic : USD 150 |

10% Discount : For All SEMCE(I) Members, IEEE EMC Society Members & Startup's Less than 2 Year's Old.

1. SEMCE(I) Members and IEEE EMC Soceity Members. please share your membership ID to Sachin@c-prav.com
2. If you are a startup company with less than 2 years old please share a copy of Company registration document to Sachin@c-prav.com

### There will Be 5+1 Sessions In Total

A FREE BONUS TOPIC for people who register for ALL 5 sessions: They will be automatically registered for this 6th topic : "Guide to Close-Field Probing"

A complete guide on closed field probes, including making your own probes and using very low-cost test gear to determine whether a product is ready to be sent for EMC compliance testing

Hint: The fee for these workshops is minuscule compared to the value add to your product design and overall costs saved by adopting Keith's methods

### Course Notes (Softcopy) provided to all attendees
### Certificate of Participation endorsed by key stakeholders provided to all attendees

**Register here: www.C-PRAV-Academy.com**

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# PRACTICAL ELECTRONIC DESIGN TECHNIQUES FOR COST-EFFECTIVE SI, PI AND EMC

## A FREE Introductory session : 15th October : 2 pm

- Welcome address by Dr DC Pande, chairman of Society of EMC Engineers India - SEMCE(I)
- Inaugural Keynote 1 address by MEITY : Shri Saurabh Gaur, Joint Secretary, MEITY : Govt's initiatives for Electronics Manufacturing in India
- Inaugural Keynote 2 address by DoT: Shri K. Ramchand, Member (Technology), DoT
  MTCTE Updates by TEC
- Overview of Product development cycle: DESIGN + DEVELOPMENT + TESTING + CERTIFICATIONS by C-PRAV and iAMPS&Hz and Keith Armstrong
- Digital India's role to reduce the proliferation of EMI pollution: Dr. Dipanjan Gope, Chairman of IEEE EMC Society Bangalore Chapter.
- The foundations of Product Design for Indian manufacturing ecosystem by Mr Kishor N Narang, Founder, Mentor and Principal Design Architect at Narnix

Welcome Keith - Setting the stage for Keith's courses. Understanding the entire product development cycle and how vital are these courses for your company, for your careers. Recent developments in India. "TEC's MTCTE- Mandatory EMC Compliance of Telecom Product" What are the support structures available in India ?

## *About the Speaker*

### Keith Armstrong

A renowned and well respected professional with great accolades for his training thousands of professionals globally since 2002. Started his design and development career in 1968 working with various multinational companies. Is a Fellow IET, Senior IEEE member, chaired and chairing several IEE/IETs WGs, MTs since 1997. In 2018, was presented with the IEEE EMC Society's new “Excellence IEEE in Continuing EMC Education Award”. Keith started Cherry Clough Consultants in 1990 and still provides consultancy for Product Design, EMC, functional Safety, installation practices, Technical construction files for EU directive. Member of EMCIA, EMCTLA and Editorial Advisory member of popular magazines like Interference Technology, In Compliance. Author of numerous books and articles, too many popular books to list here.

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# PRACTICAL ELECTRONIC DESIGN TECHNIQUES FOR COST-EFFECTIVE SI, PI AND EMC

**5 sessions/Topics of 4 hours each + 2 hours bonus topic on Probes**

**Day # 1: 2PM to 6PM IST (4 hours) : 19th Oct 2020 (Monday)**

## SESSION # 1 TOPIC: EMC PHYSICS, AND FILTERING

## The Physics of EMC behind Good EMC Design Techniques

1. Electromagnetic fields, waves, & importance of the return current path
2. Field theory, permittivity, permeability, wave impedance and velocity
3. Near-field and Far-field
4. Three types of EMC analysis (includes Skin Effect)
5. Waveforms, spectra, and 'accidental antennas'
6. Three parts to every EMC issue, and four types of EM coupling
7. Differential mode and common mode
8. The EMC benefits of metal planes
9. Overview of RF emissions
10. Safety earthing/grounding does not help EMC at RF
11. Non-linearity, demodulation and intermodulation
12. Three interference mechanisms
13. Overview of RF immunity
14. “Internal EMC” and crosstalk
15. Improving profitability while reducing financial risks
16. Introduction to EM Engineering
17. Controlling return currents with metal planes
18. EM Zoning using guidelines based on the wavelength, at
19. Some useful references and equations

## Designing EMC Filters

1. Filtering is not 'black magic'
2. How filters work
3. The advantages of soft ferrites
4. CM filtering
5. Specifying filters
6. Real-life problems with resonances, inductors, and capacitors
7. Earth leakage currents and safety
8. Filter construction, mounting, and cabling
9. The synergy of filtering and shielding
10. Some useful references

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Day # 2:

**2PM to 6PM IST (4 hours):**

**20th Oct 2020 (Tuesday)**

SESSION # 2

# TOPIC: EMC FOR CABLING AND SHIELDING

## EMC Design for Cables and Connectors

1. Accidental antenna behaviour of all conductors
2. Use fibre optics or alternatives, instead of conductors
3. The “RF Reference”
4. Cable classification and segregation
5. Good practices for both shielded and unshielded interconnections: controlling DM & CM return paths
6. Shielding techniques for cables
7. Terminating cable shields
8. Interconnecting shielded enclosures
9. Dealing with 'ground loops'
10. Transmission-line interconnections
11. Some useful references

## Designing EMC Shielding

1. Economic issues for shielding
2. Shielding with metal plates (image planes)
3. How shielded enclosures work
4. DC and low frequency shielding
5. The problems caused by apertures
6. The problems caused by box resonances
7. The problems caused by conductor penetrations
8. Shields in the near field of a source
9. RF-bonding with multiple metal bonds or conductive gaskets
10. Waveguides-below-cutoff
11. Shielding of displays
12. Shielding of ventilation
13. Shielding of plastic enclosures
14. Preventing corrosion at shielding joints
15. D-I-Y testing SE before hardware or software is ready
16. Some free SE calculators and useful references

Day # 3:

**2PM to 6PM IST (4 hours):**

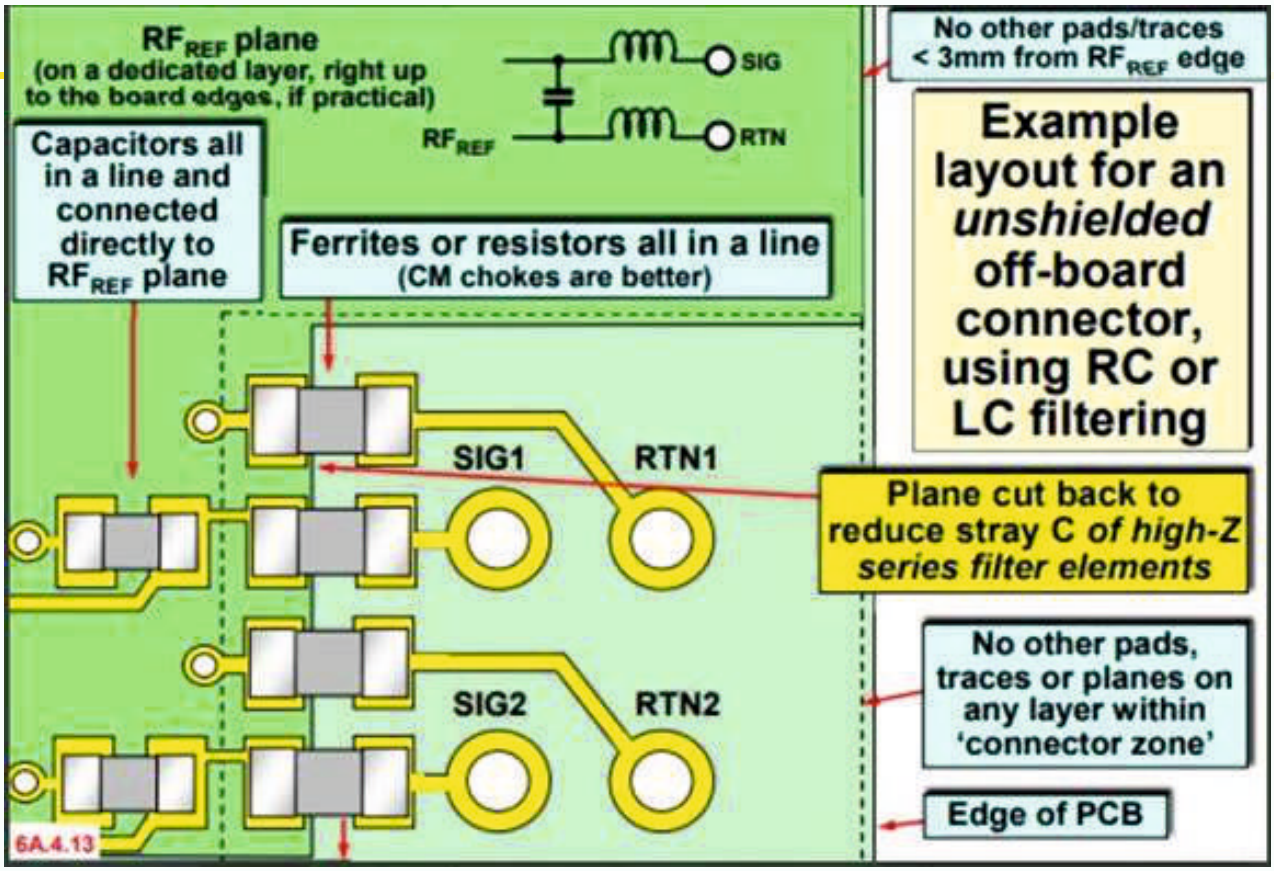
**21st Oct 2020 (Wednesday)**

SESSION # 3

**TOPIC: ESSENTIAL EMC DESIGN / LAYOUT TECHNIQUES FOR ALL PCBS**

# Essential design/layout techniques for SI, PI and EMC for all PCBs – Part 1 of 2

1. The scope of these layout techniques
2. Saving time and money
3. EM Zoning (segregation)
4. Interface analysis, filtering, and suppression
5. 0V(GND) and power (PWR) planes
6. PCB-chassis bonding
7. Power supply decoupling
8. Switching power converter layout (AC-DC, DC-DC, AC-AC)
9. Matched transmission line techniques



Day # 4:

**2PM to 6PM IST (4 hours):**
**22nd Oct 2020 (Thursday)**

SESSION # 4

**TOPIC: PCBS AND CIRCUIT DESIGN**

# Essential design/layout techniques for SI, PI and EMC for all PCBs – Part 2 of 2

10. Layer stacking and trace routing
11. Devices with BGA packages and/or multiple DC rails
12. Some useful references sources, and webinars

# Circuit design for EMC

## Digital circuits

1. Rise/fall times and emissions spectra
2. Numerous digital circuit design techniques
3. Watchdogs and brownout monitors
4. Data scrambling and spread-spectrum clocking

## Analogue circuits

5. Linearity, bandwidth and stability of feedback circuits
6. Numerous analogue circuit design techniques, using hysteresis in Comparators

## Switching power converters

7. "EMC benign" and spread-spectrum techniques
8. Reducing dV/dt and dI/dt with snubbers
9. Heatsinks
10. Use SiC Schottky or soft-switching rectifiers, SiC or GaN switching devices
11. The isolating transformer's interwinding capacitance
12. Don't over-use galvanic isolation!

## Communications circuits

13. Better alternatives to copper cabling
14. How to use copper cabling
15. Common-mode noise reduction techniques
16. Optoisolators and optocouplers
17. Gigabit laser diodes
18. Terminating transmission lines
19. Some useful references

## Component Selection for EMC

1. Active devices Passive components
2. Problems with second sources, counterfeits, and controlling purchasing
3. Some useful references

Day # 5:

**2PM to 6PM IST (4 hours):**

**23rd Oct 2020 (Friday)**

SESSION # 5

# TOPIC: SUPPRESSING TRANSIENTS / SURGES, AND HEATSINKING

## Suppressing Electrostatic Discharge (ESD)

1. ESD threats
2. Insulation techniques
3. Shielding techniques
4. Suppressing signal, data and power connector pins and conductors
5. PCB layout for ESD suppressors
6. Earth lift problems in systems
7. Protecting control, data and signals from errors
8. Some useful references, including “software techniques for ESD suppression

## Suppressing surges/transients on AC & DC power supplies, signals and data

1. What transients are, and how they cause damage
2. Galvanic isolation for transient suppression
3. Transient suppression using filters
4. Types of surge protection component (SPC)
5. Rating SPCs
6. Protecting and maintaining SPCs
7. Lead inductance and “let-through” voltage
8. Avoiding the effects of SPC capacitance on signals
9. Types of surge protection devices (SPDs)
10. Electronic transient protection for DC power supplies
11. "Earth/ground lift” problems in systems
12. Data needs error correction
13. Dealing with long-duration overvoltages
14. Some useful references

## EMC Design for Heatsinks

1. Importance of controlling stray heatsink currents
2. Ceramic and plastic heatsinks have no stray currents
3. Returning stray heatsink currents to their sources
4. Using the PCB's Reference Plane as a heatsink
5. Practical RF-bonding issues
6. Heat sink RF resonances
7. Resonance effects of heat sink shapes, fins, pins, and semiconductor's
8. locations
9. Heat pipes
10. Some techniques that could be useful
11. Low-inductance bonding to control resonances to GHz
12. Combining shielding with heatsinking
13. Some useful references

**Day # 6:**

## 2PM to 4PM IST (2 hours): 24th Oct 2020 (Saturday)

## SESSION # 6

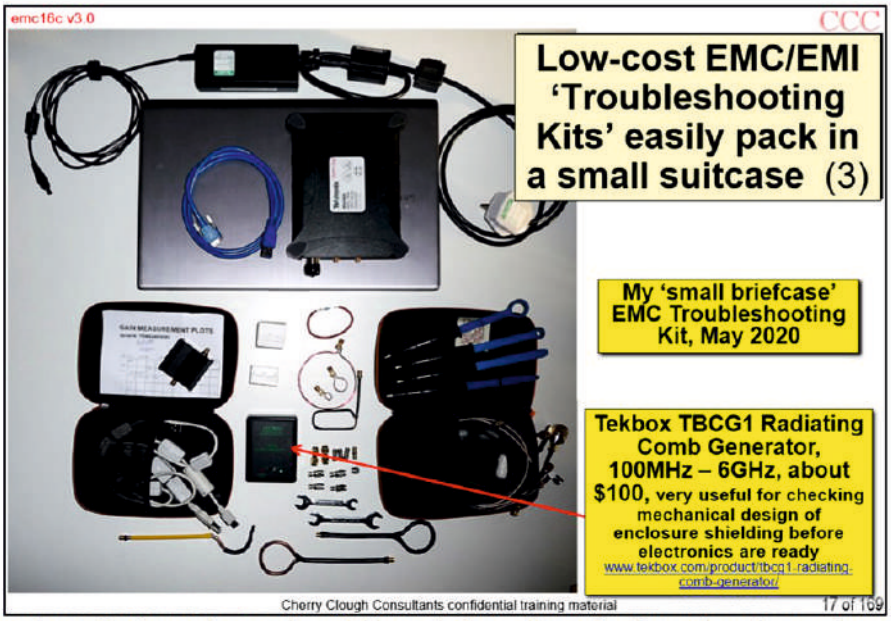
## TOPIC: GUIDE TO CLOSE FIELD PROBING

***This is a FREE BONUS TOPIC for people who register for ALL above 5 topics. They will be automatically registered for this 6th topic***

***Those Who Wish May Register For Just This Topic***

**A complete guide on closed field probes, including making your own probes and using very low-cost test gear to determine whether a product is ready to be sent for emissions testing.**

1. Near-Field Probing
2. Introduction to near-fields and near-field probing (= close-field probing)
3. Making our own near-field probes
4. Buying near-field probes
5. Affordable spectrum analyzers: traditional types and new 'real-time' types
6. Safety: the most important issue !
7. Using near-field probes to check emissions
8. Avoiding overload and intermodulation, including by out-of-band signals
9. Using near-field probes to check immunity
10. Some more uses for near-field probing
11. Using 'Pin Probes' to check emissions or immunity
12. RF Current Monitor Probing
13. Making current monitor probes
14. Buying current monitor probes
15. Using current monitor probes
16. Calibrating current monitor probes
17. Predicting radiated emissions on full-compliance tests
18. Quick and cost-effective uses for probing throughout the life-cycle
19. Some resources on probing, and on pre-compliance testing




Current monitoring probes can be quickly made from clip-on ferrites and use low-cost spectrum analysers to predict radiated emissions test results.

Never send a product for lab tests until you are confident it will pass

** Keith Armstrong (This is the 6th Topic of the Design Workshop on 24 Oct 2020)

## About the Course

**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**
- **Improving customer service 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**
- **Household (Domestic) Appliances**
- **Industrial instrumentation/control**
- **Telecommunications**
- **Medical and healthcare**
- **Information Technology (IT)**
- **Marine**
- **Radiocommunications**
- **Consumer**
- **Railway**
- **Aerospace**
- **Military**

**This webinar is designed for** Product manufacturers, Product Managers, Program Managers, Marketing Executives, Design Engineers, Specialists, Design house leaders, Product Development Managers, System Integrators, Installers, Start-ups, Design enthusiasts, Entrepreneurs, Compliance Engineers, Engineering Service providers, Electronic component vendors, EMI/EMC filter and suppression component vendors, EMC pre-test equipment vendors, in-house lab engineers, Commercial and Defence Test Lab Engineers, Managers, Regulatory Specialists, Technology and Business Decision makers of Electronic and IoT companies, Telecommunications, Medical, Defence, Automotive Industries.....and Educational Institutions nurturing young engineers in any of the above fields.

## Why serious electronic manufacturers and Designers especially Start-ups need attend this workshop

**There is a lot of free information about good EMC design available on the Internet, but it is almost always out of date and can even be incomplete (i.e.insufficient on its own), misleading, or just plain wrong. This workshop is LIVE where Engineers can interact with the expert and get real time answers**

## Prerequisites

- **Familiarity with circuit (hardware) design and/or the layout of PCBs.**
- **Plain English is used, with a small amount of (basic) mathematics**

## Course Methodology

**This course is presented in a live webinar 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 provided with a copy of the course notes and a Participation Certificate**

## Some of the products and items of equipment that Keith has dealt With

- **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 Assistance (PDAs) and other hand-held wireless-enabled computing devices**
- **Marine Equipment**
- **Photocopiers**
- **Data communications Devices**
- **Professional Video Projectors**
- **Telephones and Telecommunications**
- **Radiocommunications, cellphones and pagers**
- **Lifts (elevators)**
- **Gambling machines**
- **Electricity meters**
- **Building electrical services equipment**
- **Robots**
- **Lighting**
- **Gas boilers**
- **Military avionics and land vehicles**
- **Microscope manipulators**
- **Security equipment**
- **Induction heating**
- **Digital microwave radio**
- **Digital signal processing**
- **Professional audio consoles and other equipment**
- **Consumer electronics (TV, Hi-Fi, etc.)**
- **Domestic (household) appliances**
- **Electrical power generators (small scale)**
- **Subsea oil and gas production equipment**
- **Solar power converters**
- **Medical equipment (EEG, EvP, ECG, EMG etc.)**
- **Coin mechanisms**
- **Mains – borne communications**
- **Laser welding**
- **Variable speed winch for a military Submarine**
- **Synchrotrons**
- **Electron microscopes**
- **Nuclear plant**
- **Trams and light rail systems**
- **Air traffic control towers**
- **Tokamaks (nuclear fusion power generation)**

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