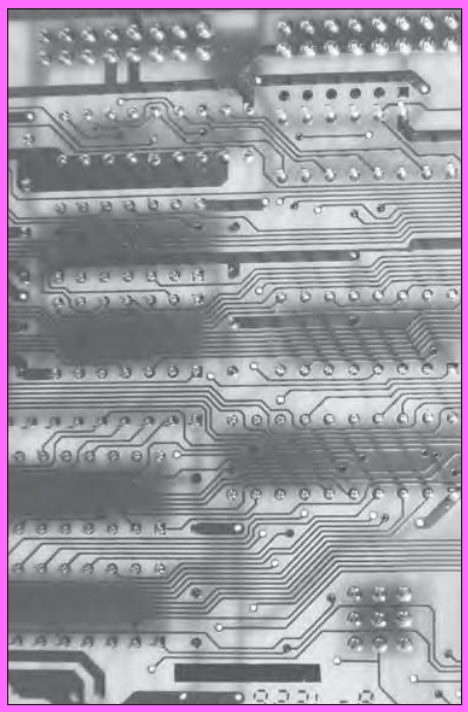
PRACTICAL
SHIELDING, EMC/EMI, NOISE REDUCTION, EARTHING AND CIRCUIT BOARD LAYOUT



YOU WILL LEARN HOW TO:

- Know why and how to earth a circuit effectively
- Efficiently diagnose noise problems
- Identify, design, manufacture and fix EMI/EMC problems
- Effectively design to filter at MHz frequencies
- Understand the four noise coupling mechanisms and minimise them
- Understand the function of the signal earth versus the signal return
- Earth a cable shield correctly
- Reduce DC power bus noise
- Select cables appropriately
- Know when to shield and when to filter
- Effectively earth mixed analog and digital signals
- Minimise pulse ringing and rounding problems
- Reduce earth loop noise
- Reduce emission and susceptibility problems
- Create a check list of items to ensure CE approval

WHO SHOULD ATTEND:

- Instrumentation and control engineers
- Electronics and systems engineers and technicians
- Consulting engineers
- Electrical engineers
- Project engineers
- Maintenance engineers
- Electrical contractors
- Safety professionals
- Consulting engineers
- Electricians
- Electrical inspectors
- Power system protection and control engineers
- Building service designers
- Data systems planners and managers
- Electrical and instrumentation technicians
- Mechanical engineers
- Printed circuit board designers
- Logic designers
- Signal integrity specialists
- CAD managers
- EMC specialists
- Design engineers
- Test engineers
- Technical managers

The Workshop

Any training class is a considerable investment in terms of cost and your time. You can't afford to waste any of your precious time and you need to attend something that is useful and improves your productivity. After five years of presentation throughout the world, this workshop is well polished, practical and relevant.

The aim of this workshop is to help you identify, design, prevent and fix common EMI/EMC problems with a focus on earthing and shielding techniques. Learning how to fix earthing and shielding problems on the job can be very expensive and frustrating. Although it must be noted that most of the principles involved are simple, this course will give you the tools to approach earthing and shielding issues in a logical and systematic way.

This course focuses on the issues of interest to you if you are working in design, operation or maintenance of analog or digital systems involving sensors, data acquisition, process control, cables, signal processing, programmable logic controllers, power distribution, high speed logic etc.

The circuit board layout section concentrates on design and layout of circuits and components on a printed circuit board. The overall focus is on useful design and systems issues; not about regulations and standards. The idea is that you will take this material back with you to your work and apply the key principles immediately to your design and troubleshooting challenges.

Pre-requisites

Some working knowledge of basic electrical engineering principles is required, although there will be a revision at the beginning of the workshop. No prior EMC or electrical noise knowledge is necessary.

The Program

INTRODUCTION
- Fundamentals
- Interference sources
- EMI/EMC regulations

BASIC PRINCIPLES OF NOISE REDUCTION
- Importance of wiring inductance
- Bandwidth of pulse waveforms
- Noise coupling examples
- Common and differential modes
- Balanced circuits and common mode rejection

PRINCIPLES OF EARTHING
- What is "electrical earthing"?
- Function of an earth
- Safety and EMI
- Analog/digital earthing
- Single point, multipoint, and hybrid earths
- Earth grid technique
- Isolated earthing technique
- Earth loops
- Earth loop noise reduction

DIAGNOSIS OF NOISE PROBLEMS
- Relating symptoms to causes
- Ringing, rounding and reflections
- Practical methods of diagnosis
- Noise coupling examples

NOISE REDUCTION TECHNIQUES
- Minimisation of bandwidth
- Best place to earth cable shield
- Reducing mutual inductance

POWER CIRCUITS AND POWER SUPPLIES
- Power quality and EMI
- Filters and transient protection
- Switch mode power supply design

INDUCTIVE AND CAPACTIVE SHIELDING
- Materials and limitations
- Openings and penetrations
- Enclosure design techniques
- Shielded racks and shielded rooms
- Magnetic fields
- Shielding design guidelines

REDUCTION OF ELECTROMAGNETIC COUPLING
- Requirements of EM containment
- EM shielding of cables
- Seams and apertures
- Shielding for ESD and RF
- To shield or to filter?

SELECTION OF THE RIGHT CABLE AND CONNECTOR
- Cable earthing
- Cable crosstalk
- Cable shielding and connectors

SIGNAL ROUTING AND LEAST IMPEDANCE
- Controlling layout inductance
- Signal integrity and EMC at the PCB level
- Hidden "transmitters" and "receivers" and "antennae"
- Trace routing
- Transmission line effects
- Termination

NOISE COUPLING MECHANISMS
- Magnetic causes of common mode current
- Capacitive causes of common mode current
- Identification of unintentional antennas
- Controlling of kHz current paths

CIRCUIT BOARD EARTHING ISSUES
- Identification of critical circuits
- Clock and reset circuits
- Embedded controllers and EMC
- On board power regulators
- Component placement
- I/O treatments
- Clock dithering

FILTERING CONDUCTED NOISE
- Series blocking and shunt diverting
- Filtering clock harmonics
- Reduction of filter mutual inductance
- Ferrite bead applications

DC POWER DISTRIBUTION AND DECOUPLING
- Ideal DC power bus
- Plane resonances and field containment
- Reduction of capacitor inductance
- Isolation of split power planes

COMPONENT PLACEMENT AND LAYER STACKUP
- Optimal connector location and pin assignments
- Lateral segregation by DC voltage
- Layer stack up alternatives

CHASSIS, CABLE AND SYSTEM ISSUES
- HF design at connection/chassis interface
- Reduction of chassis and cable resonances

SUMMARY, OPEN FORUM AND CLOSING