

EMC CONTROL



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What Is EMC?

EMC = ElectroMagnetic Compatibility

IEEE - Institute of Electrical and Electronics Engineers, Inc:

“Origin, control, and measurement of electromagnetic effects on electronic and biologic systems.”

IEC - International Electrotechnical Commission:

“The ability of an equipment or system to function satisfactorily in its electromagnetic environment without introducing intolerable electromagnetic disturbances to anything in that environment.”

Why are we concerned about EMC?

- Radio Frequency emissions are generated by most electronic equipment today.
- These emissions are sometimes useful and sometimes not.
- But, any of these emissions may cause harm to biological and electronic systems.

Who Requires EMC Control?

- **Domestic Commercial:** Regulated by federal Law (CFR) and enforced by the FCC.
- **Domestic Military:** DoD
- **Internationally:** Regulated by CISPR (The International Special Committee on Radio Interference) and enforced by various local agencies.
- **Control of EMC to meet these regulations is called 'Compliance'**

Three Types of EMC Compliance Required Today

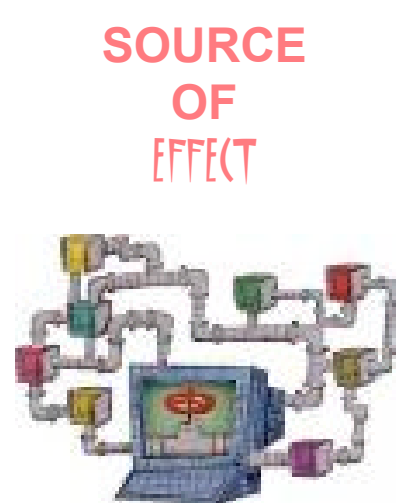
- **INTENDED EMISSIONS** (Conducted & Radiated): Regulation of communications systems and the electromagnetic spectrum.
- **UNINTENDED EMISSIONS** (Conducted & Radiated): Protection of adjacent electronic devices from energy emitted from a *product*. The *product* must not pollute.
- **SUSCEPTIBILITY / IMMUNITY** (Conducted & Radiated): Protection of a *product* from energy emitted by adjacent electronic devices. The *product* must be immune to pollution.

A BRIEF OVERVIEW OF THE PROBLEM OF UNINTENDED EMC

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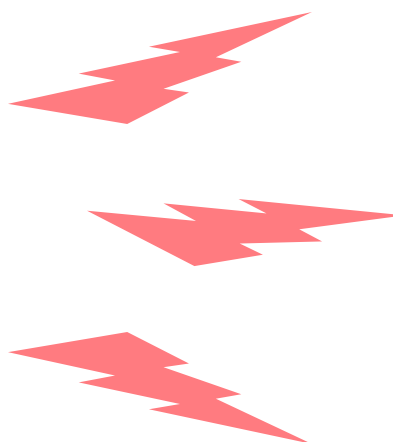
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The Basic EMC Problem



Your product works OK!!

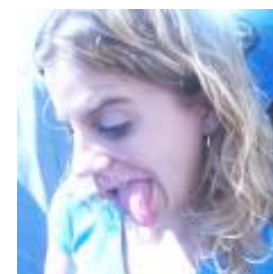
COUPLING PATH OF EFFECT



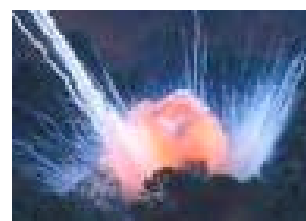
**Wires = Conducted
air = Radiated**



Product is disrupted by EFFECT



Biologic is damaged by EFFECT



Ordnance is activated by EFFECT

Because of this problem, governments world-wide regulate the amount of unintended, emitted energy that is allowed from products.

Notes

- EMI and RFI are general terms used to describe unintended energy emitted from a product.
- EMC design is not a black art; EMC problems should and can be solved during the design and test stages.
- Design techniques used to solve Emissions problems generally solve immunity issues.

The 5 Levels of EMC Control

1. Regulatory requirements for market and country into which a product is sold.
2. Components and circuit design.
3. Printed circuit boards* - i.e. PCBs, including back-planes, dies & flex circuits.
4. Cables, harnesses and connectors.
5. System: Printed Circuit Assembly (PCA), connector and cable environment.

* Most critical: EMC problems on PCB also create EMC problems on cables and at the system level.

Regulatory Requirements

- **Certification of Emissions & Susceptibility:**
 - Compliance required by law in most countries before product can be advertised and sold.
- Design for compliance to loosest level required for the intended market.
- Design for margin (production variances).
- Design and production traceability required.
- Emissions and Susceptibility compliance also required for interfaces to facility power.
- VSI Regulatory Agency Experts will manage the complete certification process.

Component/Circuit EMC Control

- First Line of Defense -

- Select EMC 'hardened' components.
- Control fundamental frequencies and minimize generated frequencies.
- Utilize EMI suppression techniques e.g.:
 - Filtering and Impedance control components.
 - Vendor required component Shielding.
 - Adequate power and grounding paths.
 - Isolation, Balancing and orientation.
- VSI will consult with selection and design then incorporate necessary control.

PCB EMC Control

- Second Line of Defense -

- **Layout design is critical to EMI Control**
 - Trace, power and ground-plane geometries.
 - Signal paths and termination techniques and power and noise filtering.
 - Component placement and orientation.
 - PCB's can resonate at critical frequencies.
- **Differential Mode EMI on Signal Traces**
 - Loop antennae can radiate and pick up noise.
- **Common Mode EMI on Signal Traces**
 - Line antennae can radiate and pick up noise.
 - Ground & power fluctuations can radiate noise.
- **VSI will provide PCB Design expertise and incorporate appropriate solutions**

Cable EMC Control

- Third Line of Defense -

- Cables can resonate at critical frequencies.
- Cables disrupt EMC integrity of enclosures.
- INTRA-BOARD cables:
 - Create antennae to radiate and pick up noise.
- INTER-BOARD cables:
 - Create antennae to radiate and pick up noise.
 - Create ground potential issues, thus inter-system EMC problems.
- VSI will design to meet EMC mandates.

System EMC Control

- Final Line of Defense -

- Solve EMC problems at sub-system levels first.
- New EMC problems can arise when sub-systems are assembled into larger systems.
- Enclosures can resonate at critical frequencies.
- VSI will insure full system compliance.

Conclusions

Provide adequate Design and Protection at each level:

1. Regulatory: Use loosest requirements required for intended market; pre-test often during design.
2. Component/Design: Design expertise + simulation*.
3. PCB: Layout expertise + simulation*.
4. Cables: Design expertise + simulation*.
5. System: System expertise + simulation*.

*Simulation may only get you in the ball park.

What VSI Can do For You

- Step one is expert knowledge and use of good design practices using VSI.
- Step two is incorporating noise suppression technology.
- Step three is Agency Test and Validation using VSI.
- Net result: Breakthrough in achieving EMC Compliance.

The Next Step

- What you need to provide:
 - Authorization to proceed.
 - Access to your engineers.
 - Access to your production people.
- What VSI delivers:
 - A compliant product.
 - All pertinent technical, production and Agency documentation.

- FINI -