

## INTRODUCTION TO EMC

### What is EMC?

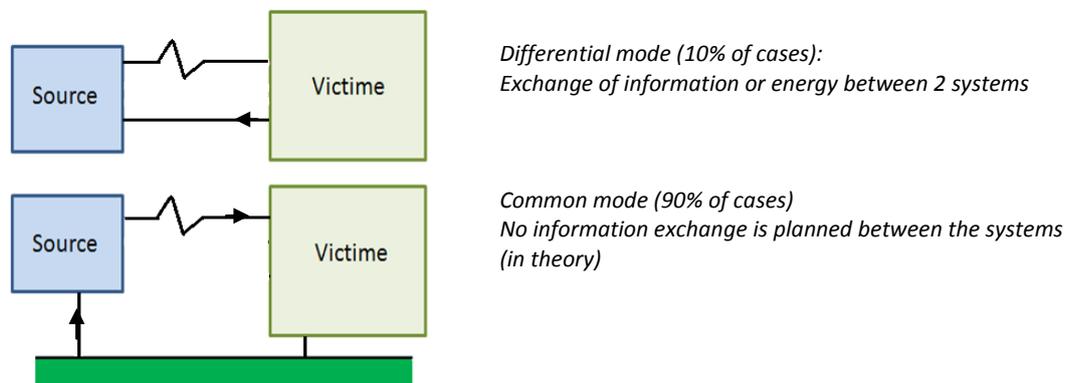
EMC is the ability of electrical or electronic equipment to operate without interfering with or without being interfered with by an electromagnetic field.

### Where does the interference come from?

- Lightning
- Electrostatic discharge (ESD)
- Current switch
- Radio/ radar/Wi-Fi/ 3G transmitters, etc.
- Internal clocks in components
- IEMN (Nuclear Electromagnetic Pulse)
- Electromagnetic weapons
- Jammers/decoys
- Chopping converters
- Arc welding
- Vehicle ignition systems

### How does this interference propagate?

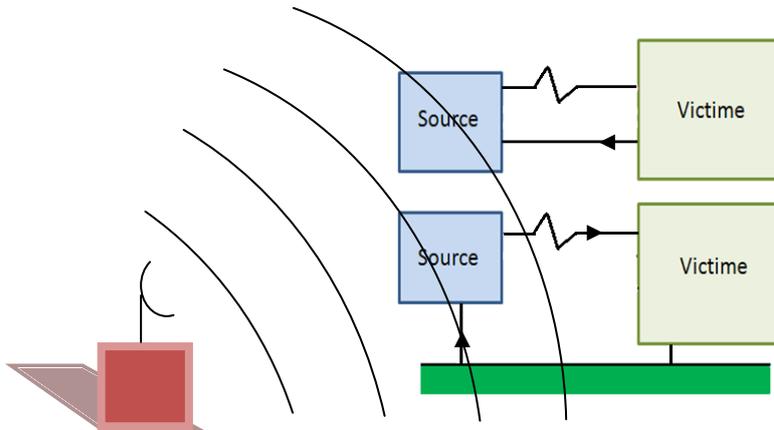
Case 1: the interference is conducted (frequencies generally  $\leq 150\text{MHz}$ )



Types of coupling (means by which the interfering energy reaches its victim):

- Inductive coupling: Conductor/Cable conveying a current which generates a magnetic field around it
- Capacitive coupling: Voltage transmitted between two isolated conductors, one which having a difference in potential
- By common impedance
- By ground plane

Case 2: radiated interference (frequencies generally  $\geq 150\text{MHz}$ )



Couplings:

- Radiated interference is conveyed through the air and is eventually conducted!

### Definition of shielding effectiveness

It is the attenuation of the electromagnetic field (in dB) transmitted in shielded equipment as compared with the same equipment that does not have shielding.

It is defined by the expression:

$$EB \text{ (dB)} = 20 \log \frac{\text{Electric field measured without shielding (V/m)}}{\text{Electric field measured with shielding (V/m)}}$$

$$EB \text{ (dB)} = 20 \log \frac{\text{Electric field measured without shielding (I/m)}}{\text{Electric field measured with shielding (I/m)}}$$

Shielding effectiveness depends on the source and the distance between the source and the receiver, on the field frequency, on the presence or absence of openings, on the conductivity and permeability of the materials serving as shielding.

**How to protect our equipment?**

- By limiting the internal pollution in our equipment
- By increasing the immunity of the sensitive circuit. To do so, we must act for example upon:
  - The routing of PCBs
  - The positioning of cables
  - The equipotentiality of earths
  - The filtering of inputs/outputs
  - The sizing of aeration vents according to wavelength
  - The use of openings with baffles whenever possible

Despite all these precautions, some very sensitive components and/or polluting components must be protected by a shielding screen which is done mentioned according to the field of use. The shielding must be composed of a plate/metalwork, machine part, etc. and joining parts.

**Applicable standards**

Fundamental standards (international)	
Electromagnetic compatibility	IEC 61000
Harmonised European Standards (based on fundamental standards)	
Industrial and scientific equipment	EN 55011
Data processing equipment	EN 55022
Electrical medical equipment	EN 60601
Specific standards for certain products	
US military	MIL STD461 C-D MIL STD704 C-D
NATO military	STANAG
France military	GAM EG13 (86, 89, ...)
Civil aeronautics	RTCA DO-160E
Low voltage equipment	NF-EN 60947
Etc.	...