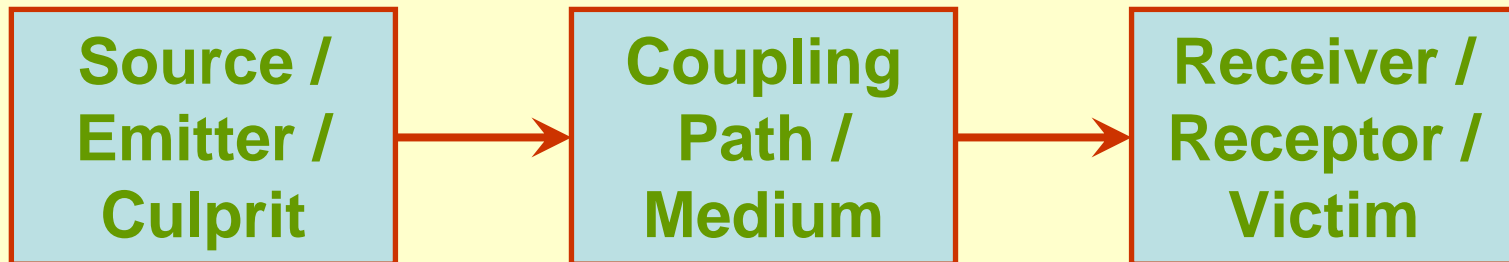


# Overview of EMI / EMC

# What is EMI and EMC ?

- ❖ An electromagnetic disturbance which may degrade the performance of an equipment (device, system or sub-system) or causes malfunction of the equipment, is called electromagnetic interference (EMI).
- ❖ Electromagnetic compatibility (EMC) is a near perfect state in which a receptor ( device , system or subsystem) functions satisfactorily in common electromagnetic environment, without introducing intolerable electromagnetic disturbance to any other devices / equipments / system in that environment.

# Basic elements of EMI situations



- ❖ Interference occurs if the received energy causes the receptor to function in unwanted manner.
- ❖ Whether the receiver is functioning in wanted or unwanted manner, depends on the coupling path as well as the source and victim.
- ❖ The coupling path is to be made as inefficient as possible.

# Causes of EMI

## ❖ Sources

- ❖ Refrigerator, washing machine, electric motors.
- ❖ Arc welding machine.
- ❖ Electric shavers, AC, computers.
- ❖ Fast switching digital devices, ICs.
- ❖ Power cords of computers, UPS etc.
- ❖ Air craft navigation and military equipments

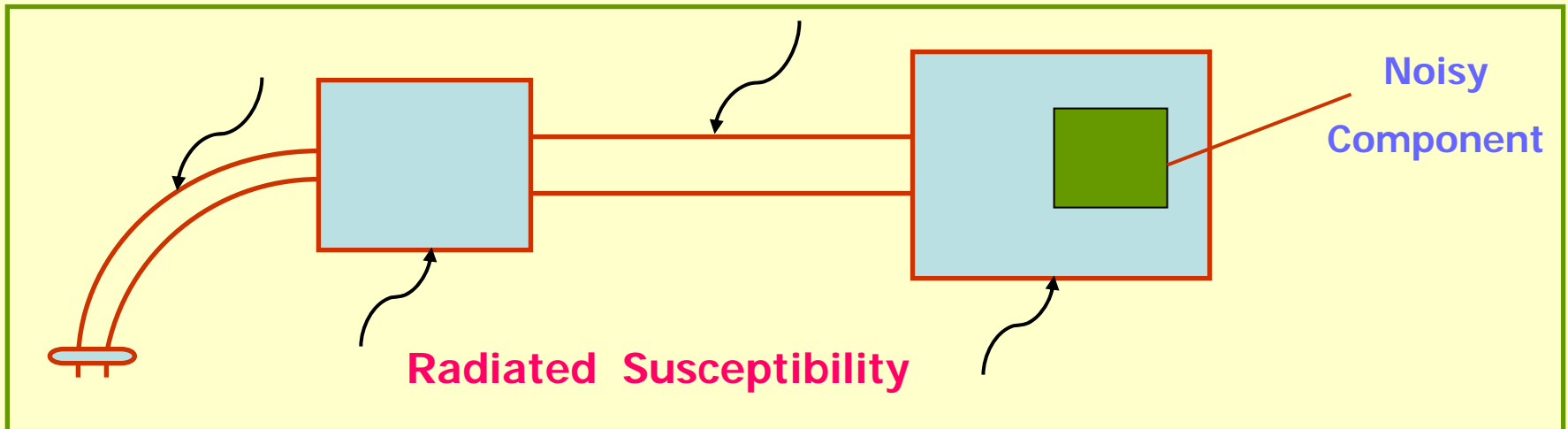
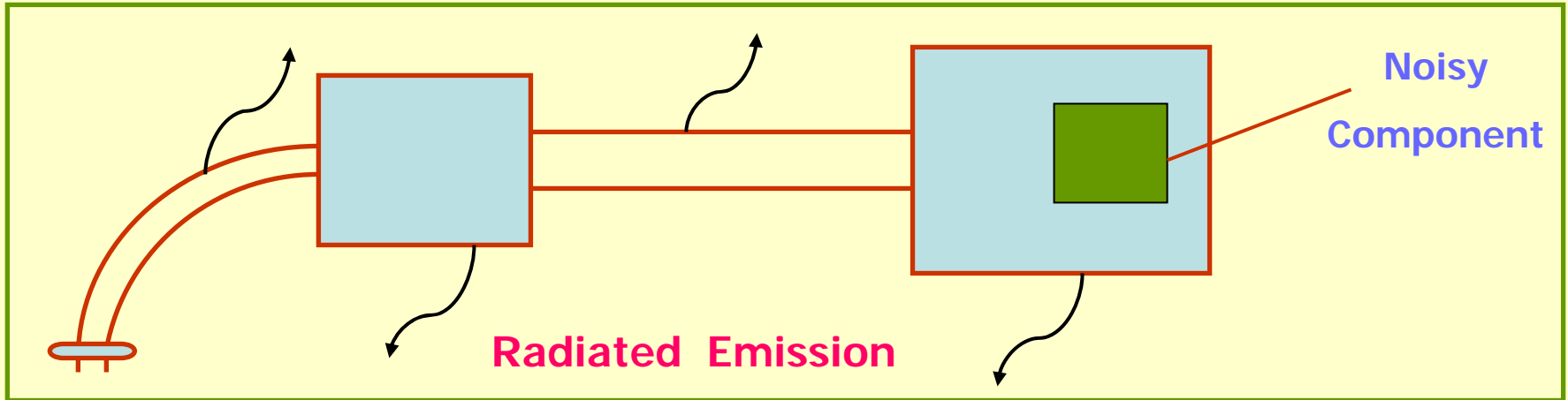
## ❖ Victims

- ❖ Communication receivers.
- ❖ Microprocessors, computers.
- ❖ Industrial controls.
- ❖ Medical devices.
- ❖ House hold appliances.
- ❖ Living beings.

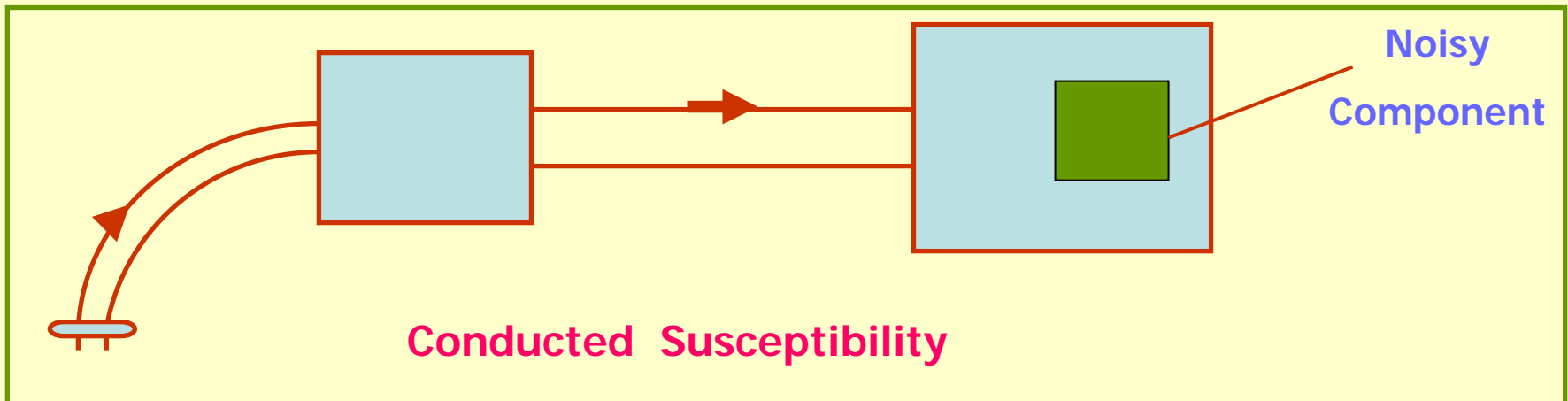
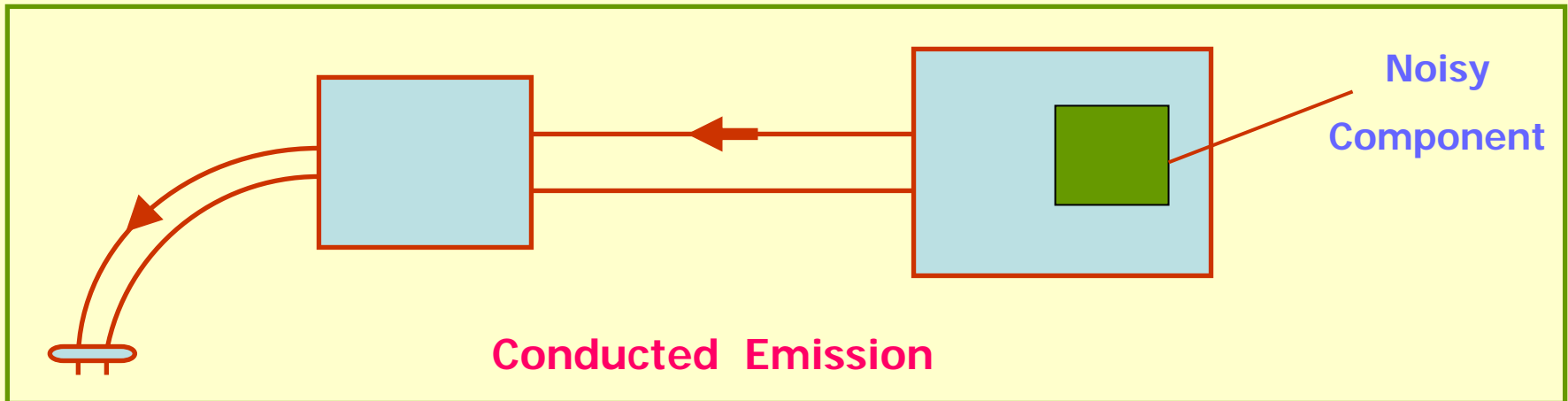
# Effects of EMI

- Momentary disturbance in TV and radio reception due to operation of mixer-grinder / electric shavers / a passing vehicle etc.
- Reset of computers and loss of data.
- Burn out of sensitive cells / components.
- Change of setting of status of control equipments.
- Failure of pace maker implanted in a patient due to a 'walkie talkie'.
- False initiation of electro explosive detonator.
- Malfunctioning of flight controlling system due to use of laptop by passenger.
- Biological hazards.

# Radiated Emission and Susceptibility



# Conducted Emission and Susceptibility



# Purpose and Methodology for EMC System

*A system is said to be electro magnetically compatible if :-*

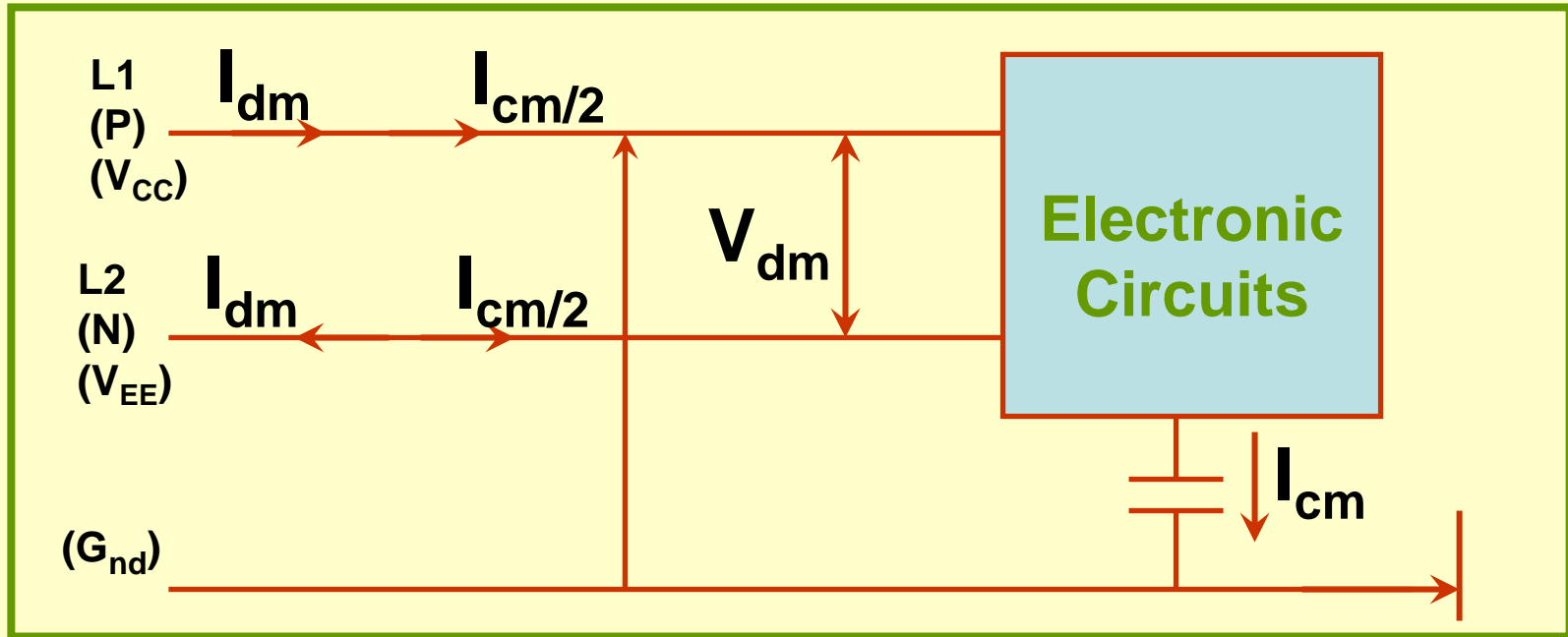
- ❖ It doesn't cause interference with other system .
- ❖ It is not susceptible to emissions from other systems.
- ❖ It doesn't cause interference with itself.

The methodologies to prevent EMI are

- ❖ Suppress the emissions at source point, *best method to control EMI* .
- ❖ Make the coupling path as inefficient as possible.
- ❖ Make the receiver less susceptible to emission.



# Common and Differential Mode Noise



- ❖ CM : Interference signal in two lines are unidirectional and return through ground.
- ❖ DM : Interference signal in two lines are oppositely directed and thus no ground current path is required.

# EMI control techniques at source

Important techniques to control EMI at source point are

- ❑ **Proper Grounding** – single point, multi point or hybrid grounding depending upon the frequency of operation.
- ❑ **Shielding** – *Metal barrier is used to suppress coupling of radiated EM energy into the equipment.*
- ❑ **EMI Filtering** - *used to suppress conducted interference on power, signal and control lines.*
- ❑ **PCB layout** – *Proper PCB design from the early design stage is required.*

# Method of noise coupling

Typical modes of noise coupling are

- Conductive coupling through cables.
- Coupling through common impedance.
- Coupling by radiated E and H field.
- Ground loop coupling.

# Objectives of EMC Standards

- ❖ EM spectrum protection.
- ❖ Adequate power quality.
- ❖ Compatibility between collocated electrical and electronic systems for trouble free operation .

# Standards setting Institutions

- ❖ DOD - *Department of Defence (USA) -- Immunity and Emission MIL standards*
- ❖ IEC - *International Electrotechnical Commission (EU) Immunity standards*
- ❖ CISPR - *International Special Committee on Radio Interference Operating under IEC. -- Emission Standards.*
- ❖ FCC - *Federal Communication Commission (EU) --- Emission standards.*
- ❖ BSI - *British Standard Institution (UK) -- Emission standards.*
- ❖ VDE - *Verband Deutscher Electrotechniker (Germany) - Emission standards.*

# Important Immunity Standards

- ❖ IEC 61000-4-2 : Electrostatic Discharge immunity test
- ❖ IEC 61000-4-3 : Radiated radio frequency EM field immunity test
- ❖ IEC 61000-4-4 : Electrical fast transient / Burst immunity test
- ❖ IEC 61000-4-5 : Surge immunity test
- ❖ IEC 61000-4-6 : Conducted radio frequency EM field immunity test
- ❖ IEC 61000-4-8 : Power frequency magnetic field immunity test
- ❖ IEC 61000-4-11 : Voltage Dips, short interruptions and voltage variations immunity test

# Important Emission Standards

- ❖ CISPR 11 : Industrial, Scientific and Medical equipments
- ❖ CISPR 12 : Automobiles
- ❖ CISPR 13 : Audio visual and similar apparatus
- ❖ CISPR 14 : Household and similar electrical appliances
- ❖ CISPR 15 : Electrical Lighting and similar equipments
- ❖ CISPR 22 : Information Technology equipments
- ❖ FCC Part 15 : Radio Frequency Devices
- ❖ FCC Part 18 : Industrial, Scientific and Medical equipments
- ❖ IEC 61000-3-2 : Limits of harmonic current emission (< 16A per phase)