# Electromagnetic Compatibility

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Introduction

Electromagnetic Compatibility is related to the undesired generation, propagation and reception of harmful electromagnetic emissions. The emissions are rich in frequency components and can be picked up by intentional receivers like Radio and Television; or unintentional receivers like digital Computers. This can cause malfunction of the sensitive electronic equipment.

High voltage power distribution lines generate electromagnetic emissions at the power frequency and its harmonics. Much higher frequency components also exist on the ac power cord. These emissions can be harmful for connected electrical and electronic equipment. Conversely, external interference from interconnection cables, lightning, metallic enclosures, electronic devices etc. can be coupled with Distribution lines as well. The power Distribution net is an extensive array of wires that are directly connected. Long cables have the potential for efficiently emitting and picking up electromagnetic energy. Once these external signals are induced on the cables, they will be conducted via ac power cord to the internal components of the connected subsystems. These Intense Electromagnetic Pulses can destroy semiconductor and electronic devices, rendering them nonfunctional.

A Distribution System must produce minimum interference and must not be susceptible to external interference. Such a Distribution System is Electromagnetically compatible with its environment.

The Transfer of Electromagnetic Energy can be broken into four subgroups:

1. Radiated Emissions
2. Radiated Susceptibility
3. Conducted Emissions
4. Conducted Susceptibility

Electromagnetic Compatibility Design encapsulates a wide range of subjects including circuit analysis, electronics, electromagnetics, liner system theory etc. These problems can be modeled accurately using Maxell’s equations which are quite complicated. Of all the possible electromagnetic field problems, relatively few of them can be solved in closed form. Often, these require visualization of the problem in three dimensions and complex mathematical acrobatics. Solutions often require proper choice of coordinate system (rectangular, cylindrical, spherical etc.), exploitation of symmetry, numerical methods (Method of Moments; Method of Images; Finite Difference Method; Finite Element Method) and simplifying assumptions (sinusoidal steady state; modes of propagation; medium homogeneity, isotropy and linearity etc.).

Lumped Circuit Models provide a feasible substitute for Field Models when the largest circuit dimension is electrically small i.e. much smaller than the source excitation signal wavelength. Distributed Electromagnetic parameters like Electrical Resistivity, Permeability and Permittivity can be represented by the linear circuit components of resistors, inductors and capacitors respectively. Virtually all lumped linear circuit problems can be solved using Kirchhoff’s voltage and current laws in closed form. Computer codes and simulation software suffice to solve the most challenging Lumped Circuit problems.

Some models for Transmission lines include Telegrapher’s equation, Taylor’s Model for Transmission Lines.

Broadband EMI is not a discrete frequency. Itoccupies a relatively large part of the electromagneticspectrum. This type of EMI is usually caused by arcingor corona and causes most EMI problems in digital dataequipment. It will be especially noticeable when you arereceiving data on digital data links. It is caused by theworn or improperly installed brushes of motors orgenerators, defective fluorescent lights, arcing ofcontacts in electrical controllers or stepping switches,ignition systems of motor vehicles, igniters for jetengines, and defective power lines or powertransformers.Improperly bonded lifelines, rigging, jackstays,ladders, and stanchions also produce a significantamount of EMI in a shipboard environment. They act asnonlinear mixing devices and antennas. They receive anumber of different transmitted frequencies, mix them,and reradiate them over a broad spectrum.