


Chapter 9

EMI and EMC

ACMA Foundation Syllabus 7

Contents

Introduction

Electromagnetic (**EM**) immunity is the ability of a piece of equipment to operate correctly in the presence of electromagnetic disturbances or interference (**EMI**) from other equipment. Electromagnet Immunity is a key aspect of Electromagnetic Compatibility (**EMC**).

Electromagnetic Compatibility (EMC)

It is rare for electronics devices to operate in isolation as they are usually engineered to function in the presence of some form of EMI. This is particularly important in military-grade, medical and avionics equipment.

EMC is a measure of a device's ability to operate as intended in its shared operating environment while not affecting the ability of other equipment within the same environment. They must all play together.

Testing how a device will react when exposed to electromagnetic energy is known as immunity (or susceptibility) testing. Measuring the amount of EMI generated by the device's internal electrical systems is known as emissions testing.

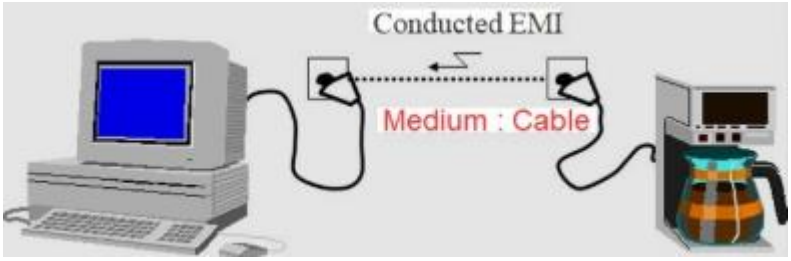
Electromagnetic Interference (EMI)

EMI can be defined as interference that impacts the functioning of an electronic device. Sources of EMI can sometimes be environmental events but more often the EMI source is another electronic device or electrical system. Common electronic sources are transmitters, cellphones, welders, motors, switch mode power supplies, inverters and LED screens.

EMI is also called **RFI** (Radio Frequency Interference) however EMI is any frequency of electrical noise, whereas RFI is a subset of noise on the EMI spectrum.

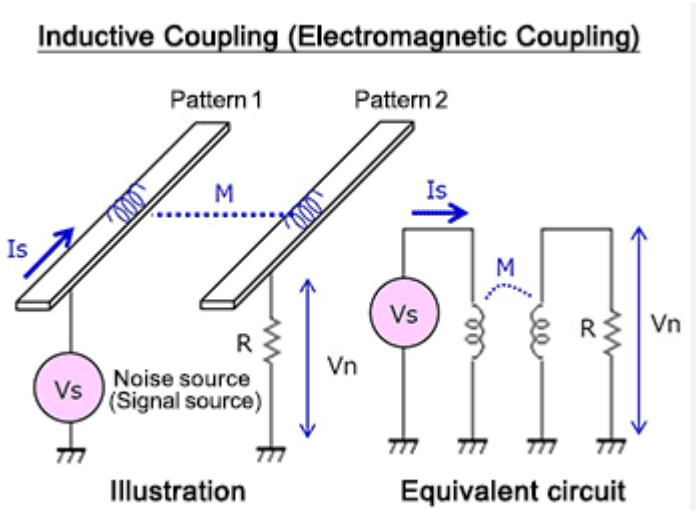
There are four methods for RFI coupling to a device.

Conductive (direct contact) - Occurs when EMI travels through physical connections like wires, cables, or shared ground planes. This is dominant at lower frequencies (typically < 30 MHz).

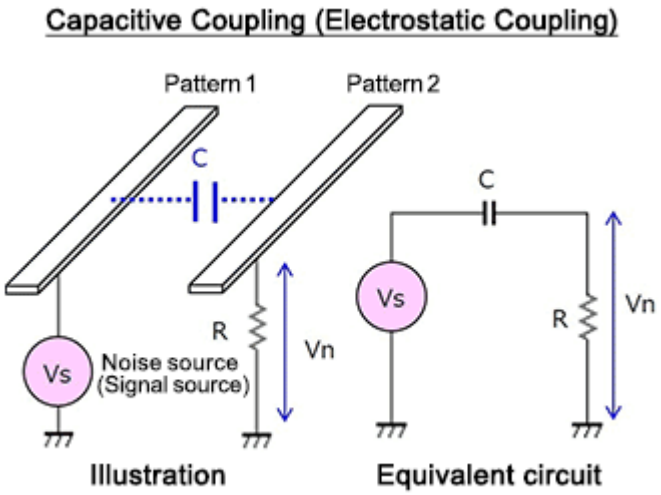


Radiated (electromagnetic). - Electromagnetic fields impacting a device typically when the source and victim are separated by more than one wavelength.

Inductive (magnetic field) - EMI can be induced in a cable or device. The magnetic field in one conductor can induce a voltage in a nearby conductor, often known as magnetic crosstalk.



Capacitive (electric field) – Just like a capacitor, two separated cables can impact each other when a change in voltage induces a current in a nearby the non-connected conductor (high impedance circuits).



Inductive and capacitive coupling mitigation are considered in the initial stages of the equipment design and mitigations are included in the equipment build. This reduces the susceptibility of the device to be affected by these forms of coupling.

The impacts of radiated and conductive EMI can be reduced or eliminated by prescribed methods.

Eliminating EMI Influence

EMI works both ways. You need to ensure that our equipment, amateur radio transmitter, does not interfere with other users and you can take steps to ensure their signals do not interfere with you.

There are three primary methods to reduce or eliminate EMI:

Filtering - *EMI filters can suppress electromagnetic noise transmitted through conduction. These filters extract any unwanted signals while allowing desirable signals to pass. A choke is*

an example of a Low Pass Filter removing EMI. Decoupling and bypass capacitors near ICs to shunt high-frequency noise to ground is also a good method.

Grounding **–** Ensure Proper grounding of devices to provide a low impedance path for EMI to dissipate. Avoid Ground Loops by using single-point grounding for low frequencies and avoid multiple paths to ground.

Shielding or Blocking - EMI shielding is the practice of blocking the electromagnetic field from impacting the device. These barriers are made of conductive or magnetic materials. You will find EMI shielding in your cell phones, in the microwave oven door, as well as your computers and keyboards.

A Faraday shield is a good example of blocking EMI.

Addressing EMI Complaints

If a neighbour complains of EMI, take them seriously and investigate.

Actions You Can Take

- Stop regular transmission until the issue is resolved.
- Keep a log of transmissions and compare these with reported EMI.
- Use only the permitted power from your transmitter.
- Locate your antennas away from other users' equipment. A directional antenna pointing at a neighbour's TV antenna may cause interference.
- Some transmitted frequencies are more likely to cause interference. Try and avoid these frequencies.
- Baluns on antennas provide a better match than straight coax. This match may reduce the likelihood of EMI.
- Install chokes on equipment affected by EMI. A choke is a simple inductor that eliminates high frequency spikes. In essence it is a low pass filter. A simple choke can be made by winding wire around a ferrite core.
- Use a mains filter to prevent any conducted EMI reaching other power circuits,
- Check your signal earth to ensure a low impedance to earth for rogue signals.
- But best of all, use diplomacy with neighbors when dealing with EMI issues.
- The ACMA may need to be involved if the issue cannot be resolved.

Go to Chapter 9 Questions.

Have fun and stay safe.

