ELECTROMAGNETIC INTERFERENCE (EMI) AND SHIELDING

Radiation and immunity have to be taken into account in early stages of the development of new products. In many cases EMI problems cannot be solved at the PCB level alone and instead, enclosures and cables have to be shielded as well.

Shielding is typically used in enclosures in order to isolate the electrical devices inside them from external influences and for cables in order to isolate wires from the environment through which the cable runs.
Shieldings can be used for appliances with high radiation or sensitivity levels, or for products where these levels are not known in advance, like modular enclosures. Shieldings are used when dealing with sensitive measurements that can be affected by ambient fields as well. Shielding is evidently a wide-spread phenomenon and necessity in the electronics industry to meet today's emission standards.

What is Electromagnetic Interference?

Electromagnetic interference (EMI) **also called radio-frequency interference (RFI) when in the radio frequency spectrum** is a disruption that affects an electrical circuit because of either electromagnetic induction or externally emitted electromagnetic radiation. EMI is the interference from one electrical or electronic system to another caused by the electromagnetic fields generated by its operation.
EMI can easily affect the functioning of an electronic device. In general, since there is a flow of electricity through the circuits in electronic devices, it tends to create some amount of electromagnetic radiation. The energy created from device 1 gets propagated through the air as radiation or to gets coupled into cables of device 2. This results in the malfunctioning of device 2. The energy from device 1 that interferes with device 2 operation is known as Electromagnetic interference

There are **two types of EMI**:

- conducted interference and
- radiated interference.

Conducted interference refers to the coupling (interference) of signals on one electrical network to another electrical network through a conductive medium.

Radiated interference refers to the interference source coupling its signal to another electrical network through space.

How To Reduce Electromagnetic Interference?

All electronic circuits may be subject to EMI, which affects the normal operation of electronic equipment widely. Therefore, electromagnetic compatibility is a problem that must be considered in the design of electronic equipment. There are three commonly used methods to suppress EMI, including grounding, shielding and filtering.

1. Grounding and shielding are relatively easy. Make a standard grounding for the interference source. Sometimes, even a single-point grounding is required, depending on the nature of the interference source.
2. Shielding means to make a metal case for the interference source to isolate the interference source.
3. As for filtering, you can choose reactors, filters, filtering magnetic loops, zero-phase reactors, neutral line reactors, common mode chokes and other components. Installing it on the power supply of the interference source or output end, different interference frequency and the applicable filter components are different.

1. What is EMI /RFI shielding?

Electromagnetic interference (EMI) also called radio-frequency interference (RFI)/RFI shielding is the process of reducing electronic malfunction susceptibility by blocking unwanted external electromagnetic waves or preventing internal electromagnetic waves from emitting and interfering other circuits or devices.

2. Why is EMI shielding important?

The main purpose of effective EMI shielding is to prevent electromagnetic

interference (EMI) or radio frequency interference (RFI) from impacting sensitive electronics. This is achieved by using a metallic screen to absorb the electromagnetic interference that is being transmitted through the air.

3. Is EMI dangerous?

One of the most prevalent dangers of EMI is the harm it can cause to health care equipment. The electromagnetic waves that radiate from our cell phones can easily interfere with medical equipment, and if this equipment stops working as a result, the consequences can be fatal.

GROUNDING

1.What is Safety Ground?

A safety ground is a conductive path to earth that is designed to protect persons from electrical shock by shunting away any dangerous currents that might occur due to malfunction or accident. Electricity by nature seeks a pathway to the ground and always takes one with the least resistance. If the grounding system of an installation is weak or faulty, either due to wrong or poor connections or a circuit fault, the electricity will try to find the easiest path to the ground. This can be a person touching the exposed metallic part of the object, or the nearest object. The path provided by the safety ground connection to the ground mass is therefore designed to have the least resistance so as to allow the fault electricity to flow easily.

The safety ground provides electricity with a pathway from the source to the circuit and then back to the ground.

https://www.sunpower-uk.com/glossary/what-does-safety-ground-mean/

Different methods of Grounding

The process of grounding can be done in several ways depending upon the appliances in use. Below given are the various grounding methods:

1.Plate Grounding

In this type of grounding, a plate made of either galvanised iron or copper is buried vertically at a depth of at least 3m/10ft from ground level.The earth pit is then filled with alternate layers of charcoal and salt to remove the chances of shock. Charcoal is an excellent conductor which can retain moisture for a long duration and salt increases conductivity. Together, both salt and charcoal ensure that any current leakage is passed to the earth as early as possible, thus, avoiding possibilities of electrical accidents

2. Pipe Grounding

In this type of grounding, a galvanised steel pipe of 75 mm diameter, 10 feet long is welded with 75 mm diameter galvanised flange with 6 holes for earth wire connection and is buried vertically into the earth. The depth of the pipe is determined by soil conditions, but usually it should be 4.75m (15.5ft). This pipe must be electrically tied to the main service panel to provide a ground connection. When compared to other grounding procedures, pipe grounding is the most cost-effective.

3. Rod Grounding

Rod grounding is largely similar to pipe earthing. Instead of a pipe a galvanised iron or steel rod is buried upright into the earth manually or hammered inside the ground. This rod must be electrically tied to the main service panel to provide a ground

connection. Ground rods are simple, inexpensive and crucial to protecting the electrical system and its appliances.

4. **Wire Grounding**

In this type of grounding, strip electrodes with a cross-section of no less than 25mm x 1.6mm (1in x 0.06in) are buried in horizontal holes with a minimum depth of 0.5m. If copper is used, the cross-section should be 25mm x 4mm (1in x 0.15in) and the size should be 3.0mm2 if it is galvanised iron or steel.

https://www.cag.org.in/blogs/electrical-grounding

ELECTROSTATIC SHIELDING

What is a FARADAY CAGE

A Faraday cage or Faraday shield is an enclosure used to block electromagnetic fields. A Faraday shield may be formed by a continuous covering of conductive material, or in the case of a Faraday cage, by a mesh of such materials.

A Faraday cage operates because an external electrical field causes the electric charges within the cage's conducting material to be distributed so that they cancel the field's effect in the cage's interior. This phenomenon is used to protect sensitive electronic equipment (for example RF receivers) from external radio frequency interference (RFI) often during testing or alignment of the device. They are also used to protect people and equipment against actual electric currents such as lightning strikes and electrostatic

discharges, since the enclosing cage conducts current around the outside of the enclosed space and none passes through the interior.

What is electrostatic shielding?

Electrostatic shielding is a phenomenon seen when a Faraday cage is used to block the effects of an electric field. The effects of external fields on the internal contents are blocked using the cage.

Electrostatic shielding applications

- During a lightning thunderstorm, it is advised to stay inside the car and not under trees or in the open ground because the outer metallic body of the car acts as an electromagnetic shield from the lightning.
- In a coaxial cable, the central conductor is protected by an electrostatic shield by connecting the outer conductor to the ground.