EMI/EMC

Ferrite beads and **cores** are used in equipment design to **suppress** and dissipate high frequency **noise** levels caused by electromagnetic devices. **Ferrite** components are used to attenuate **EMI** and can be extremely effective. Of course, using properly installed and grounded shielded cables helps **suppress** EMIs.

Ferrite beads prevent **electromagnetic interference** (**EMI**) in two directions: from a device or to a device. A conductive cable acts as an antenna – if the device produces radio-frequency energy, this can be transmitted through the cable, which acts as an unintentional radiator.

In electronics, a **ferrite core** is a type of magnetic **core** made of **ferrite** on which the windings of electric transformers and other wound components such as inductors are formed. It is **used for** its properties of high magnetic permeability coupled with low electrical conductivity (which helps prevent eddy currents).

In signal processing when a signal is changed from analog to digital (step pulse edges,ringing,overshoot,etc) and in case when clock frequency is increased.

In SMPS for high frequency switching and harmonics.

Type of ferrite core used in EMI/EMC:-

- Ring Core or U core in input filter.
- Wideband chokes or rod inductor.

Electromagnetic propagation can be of two types via mains:-

Common-mode :
Phase and null interference voltagesare equal. This is likely to occur ifphase and null are close together and interference is coupling in froman external field (radiation or crosstalk).

Differential-mode :
Differential EMI has a wider spectrum going into MHz.
These generally require Ni-Zn ferrites with low permeability. These designs rely largely on capacitors and is done by Filter manufacturers who just buy the Ni-Zn ring cores from ferrite makers by specifying the AL value at frequencies typically 20 MHz to 100 MHz.

Selecting the ferrite for EMI/EMC:-

i) **Material:** Select core material as per interference frequencies.

ii) **Core Size:-**Select core size and turns for the required impedance.

$$Z=Z_N N^2 A_e/l_e$$

where N =Number of turns;
Ae = Core effective area
le = Core Effective length

iii) **Bias Current.**
Core can saturate when current passing through inductor due to high field strength.

$$H=n.I/l_e$$

Impedance at high frequency decreases less due to current field.