Competitive Exams EMC Filter Designs

In order that an item of electronics equipment can pass its EMC testing and gain its EMC compliance, it is necessary to incorporate various elements into the design. By designing the circuit to meet the electromagnetic compatibility, EMC requirements it is possible to significantly reduce the levels of unwanted signals entering and leaving the unit. One of the major ways in which this can be done is to use an EMC filter or a series of filters.

There are many ways in which EMC filters can be incorporated into a unit from a mechanical viewpoint. They may exist as stand alone EMC filters to be fixed near to the extremities of the unit. They may be mounted on the edge of the electronics board. However one popular method of incorporating an EMC filter into a unit is to incorporate the filter into the connector itself. This has many advantages in terms of convenience and performance. However whatever the method used, a filter is often necessary if the electromagnetic compatibility, EMC requirements are to be met.

EMC filter methodology

Although circuits may be well screened to prevent any signal radiated or being picked up by the circuit itself, there are always interconnections to and from the electronics circuit. These wires themselves can conduct unwanted signals into and out of the unit. If the unit is to be able to meet its electromagnetic compatibility, EMC requirements and pass its EMC testing, it is necessary to reduce the levels of unwanted signals that can enter or leave the unit via its interconnections.

In order to enable the unwanted signals to be removed, EMC filters need to be placed in the various lines. The idea is that the interfering signals generally have a frequency above that of the signals normally travelling along the wire or line. By having what is termed a low pass filter as the EMC filter, only the low frequency signals are allowed to pass, and the high frequency interference signals are removed.

These EMC filters can be in one of a variety of formats. Often they may be as simple as a resistor or a ferrite placed around a wire or cable. For more exacting requirements, these EMC filters may need to be made up from a number of components.

The EMC filters may categorised into two main types. One is where the unwanted energy is absorbed by the EMC filter. The other type of filter rejects the unwanted signal

and in this case it is reflected back along the line. For EMC filtering applications, the absorptive type is preferred.

EMC filter application

When developing filters for use in electromagnetic compatibility, EMC applications, the EMC filters are nearly always low pass filters, although on occasions bandpass filters may be used. The reason for using low pass filters is that typically interfering signals, i.e.. . Ones that are easier to pick up or radiate tend to be at higher frequencies. These can be filtered by allowing the low frequencies through and rejecting the high frequencies.

The cut-off point for the low pass filter used as the EMC filter has to be chosen so that it rejects the unwanted frequencies, but does not have any undue effect on the wanted signal. Unfortunately this choice is not always easy and it may require some degradation of the wanted signal.

The EMC filter placing is of importance. EMC filtering can be placed at any or every level of assembly between segregated areas of circuitry. EMC filters may be placed between segregated areas of a printed circuit board. They may be placed between different boards within a module or sub-assembly, and an EMC filter may be placed between different modules or subassemblies. However a particularly important place for EMC filters is between the equipment and its external environment. An EMC filter placed here is particularly effective as it will prevent unwanted signals even entering the equipment. Once they enter they are more difficult to contain.

EMC filter design

The EMC filter design is critical to the electromagnetic compatibility, EMC performance. The EMC filter must be capable of providing the required level of attenuation of the unwanted signals while allowing through the wanted signals. In addition to this the EMC filter design must match both the source and load impedances.

Typically for a high impedance circuit, a capacitor connected between the line and ground provides better results, while for low impedance circuits a series inductor placed within the line provides the best results. Often a single component like this designed to have a reactance with little effect at frequencies appropriate to the wanted signals, but a much higher effect at the higher frequencies of the unwanted signal can provide levels of attenuation of up to 30 dB or 40dB in some cases. To improve the performance of one of these basic filters, further components can be added to make multi-component EMC filters. However to give the required performance they must be configured correctly. One precaution to ensure that inductors face a low impedance sink or source and capacitors face a high impedance.