



Electromagnetic Interference Filters

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Abstract: In this paper we discuss about the electromagnetic interference which is very well known field in today's life. Electromagnetic interference also called as radio frequency interference. The EMI is a disturbance or unwanted signal that effect the electrical circuit due two electromagnetic radiation that comes from external source. EMI problems has been increasing in mobile electronic system, wireless communication system and also in computer network. For reduction of EMI there are different type of method like grounding and shielding, filtering and power supply method etc. In this paper I describe the EMI filtering method to reduce the effect of EMI including its design step. The type of EMI are also given in this paper. This paper also include the application of EMI filter that used to reduce the factor of EMI in several fields.

Keywords: *Electromagnetic Interference, Types and Sources of EMI, EMI Filter, Application of EMI filter.*

INTRODUCTION

ELECTROMAGNETIC INTERFERENCE

Electromagnetic interference is also known as Radio frequency interference. Electromagnetic interference is a type of electric and electronics emission that can degrade or prevent the electrical circuit performance. Electromagnetic interference emission can arise from many sources like manmade and natural. These two sources produce changing electrical currents and electrical voltages that can cause EMI: automobile ignition systems, mobile phones, thunder storms, the Northern Lights. Electromagnetic interference affects the AM radios, FM radios, and televisions. It can be used for radio jamming.

II. TYPE OF EMI

Based on the source of generation

- **Man-made EMI:** Manmade EMI usually occur from other electronics circuits, although some EMI can arise from switching of large currents, etc.
- **Naturally occurring EMI:** Naturally occurring EMI can occur from natural sources such as cosmic noise, lightning and other atmospheric noises.[7]

Based on the period of interference

- **Continuous interference:** Continuous interference EMI produced in the circuit will be in the form of continuous signal.
- **Impulse noise:** This type of EMI can be produced either man-made or natural causes such as switching action, lightning. This type noise will be in the form of impulse.[1][6]

Based on the bandwidth

- **Narrowband:** The narrowband EMI is occur due to inter modulation and transmitter distortion. The bandwidth of spurious signals frequency is narrow.
- **Broadband:** The broadband EMI can be produced by the manmade actions such as arc welding and natural source of Sun behind the satellite.[1]

III. SOURCES OF EMI

The sources of EMI are classified into eight categories.[8] They are:

- External noise
- Incidental interference
- Intermodulation distortion
- Spurious Emission
- Environmental interference
- Adjacent channel interference
- Intentional interference(jamming)
- Band congestion

IV. REDUCTION OF EMI USING EMI FILTER

To reduce the EMI affects in many applications the EMI filter are used. The passive electronic devices suppresses conducted

EMI emission on any signal line ,but does not suppress radiated emissions in free space, Filter can attached to suppress their EMI output. The EMI filters can be found both on plastic as well as metals housing. EMI filter are also known as RFI filter. Input EMI filters are used to impair conducted susceptibility, and suppress spikes. The specifications for the allowable interference are generally driven by the power circuit specification electromagnetic interference (EMI) filter, Frequency range of EMI noise are

1. 10 kHz to 30MHz by conduction through wires
2. 30 MHz to 1GHz by radiation .

Modes of EMI noise are two type;

- Common mode (CM) -EMI noise present on the line and neutral referenced to safety ground. CM noise is a asymmetrical interference.
- Differential (transverse) mode (DM) - EMI noise present on the phase line reference to the neutral.DM noise is a symmetrical interference.

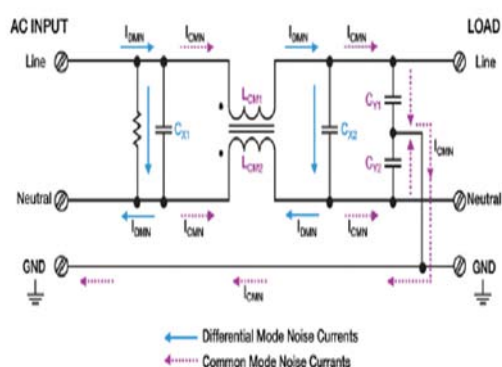


Fig.1 Common mode and Differential mode noise current

Steps to design EMI filter are describe below:

STEP 1:

Separate the CM and DM noise spectrum of the SPC.

STEP 2:

Determine the noise voltage without and with a single filter (example: capacitor).

STEP 3:

Calculate the maximum CM and DM noise source impedances for the frequency range of Interest.

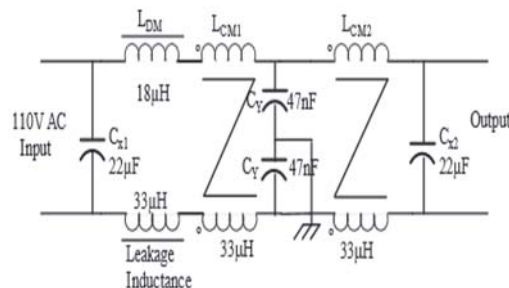
STEP 4:

Design the EMI filter with maximum or minimum value of the noise source impedance which contains the least attenuation.

STEP 5:

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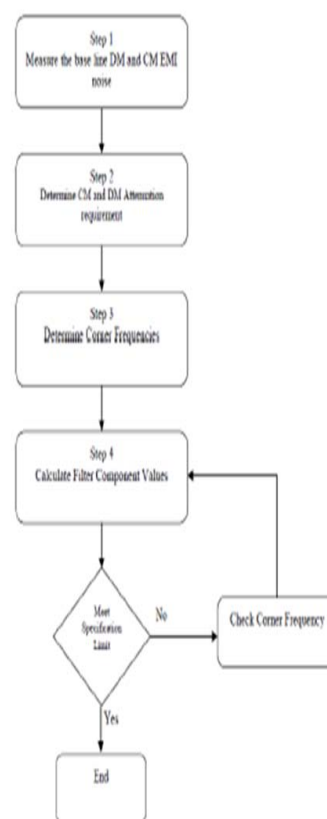
The completed EMI filter is analyzed.



Fig

2. Complete EMI FILTER design

EMI filter design circuit model shows in fig. 2 and flow chart



shows in fig. 3. [6]

Fig.3 Flowchart of EMI FILTER design

VI. TYPE OF EMI FILTER

EMI filter are basically two type

- Passive EMI filter
- Active EMI filter

Passive EMI Filter: Passive EMI filter design with passive components including capacitors and inductors that form the LC circuits. The unwanted EMI noise frequencies are higher as compare than the normal signals frequencies. In EMI filter the inductive part used to block the high frequency and pass the low frequency. And in the EMI filter the capacitive part is

used to bypass or shunt unwanted high frequency noise. Thus the EMI filter attenuates all unwanted internally and externally noise signals.[4]

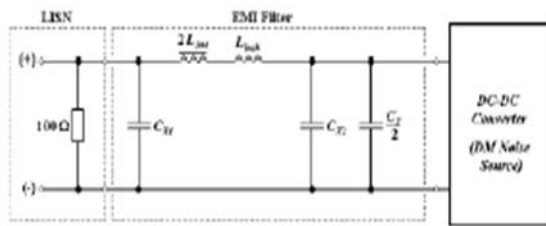


Fig.4 The common mode equivalent circuit

A Passive EMI filters are bulk in size. It require multi stage LC circuits to achieve high frequency noise reduction. This causes higher cost and larger size. A passive EMI filter designed for the suppression of Common Mode and Differential Mode that shown in the fig. 4 and fig. 5. [1]

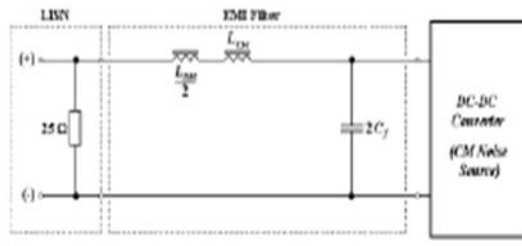


Fig.5 The differential mode equivalent circuit

Where,

LCM - Common-mode inductor

LDM- Differential-mode inductor

Cx1, Cx2 – differential mode capacitors

Cy – common mode capacitor

For design the inductor filter LCM and LDM inductor and capacitor are used and LISN is the line impedance stabilization network.[2]

Active EMI Filter: Active EMI filter are those that are design with active components in addition with passive components to overcome the low frequency attenuation. The main functionality of Active EMI filter is principled on sensing the noise current from the current transformer that amplifying the same and then injecting back it as the compensation current through an RC branch connected to an operational Amplifier circuit. The active EMI filter are shown in fig 6. [5]

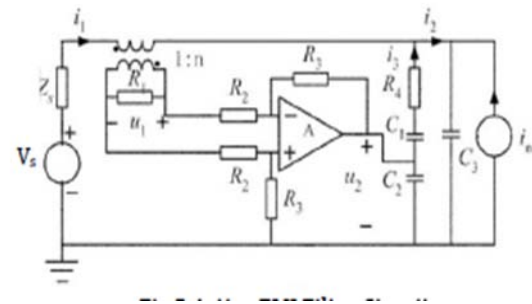


Fig.6 active EMI filter

VII. APPLICATION OF EMI FILTER

• Electronics

There are several variety of application for EMI filter in electronics including industry

• Space/Aero electronics

Space and Aero Vehicles contains EMI filtering in communication equipment to protect from data loss and corruption.

• Energy Management

We can use EMI filter in energy management to keep emission from damaging sensitive equipment that are used as smart homes.

• Communication

Communication system such as telephones, data lines, PA systems and others general communications required EMI filter to dismiss

• Shielded rooms

Shielded rooms are used in many applications like in hospitals for MRI, for secure data or server rooms , for military applications etc.

• In military application removal of interference from navigation and detection EMI filter are best in use.

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