Filter Buying Considerations

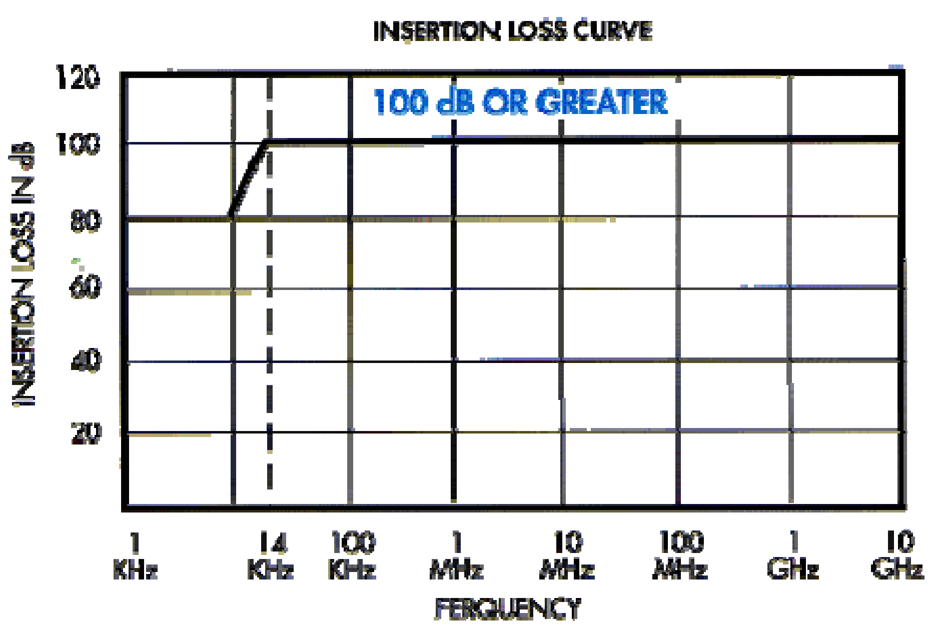
Passive EMI/RFI Filters consist of inductors, capacitors and in some cases resistors in selected combinations, designed to pass or reject selected frequencies.

Low Pass Filters	Passes all frequencies below the cutoff frequency.
High-Pass Filters	Passes all frequencies above a selected cutoff frequency.
Band-Pass Filters	Passes a selected band of frequencies while rejecting those above and below the band.
Band-Stop or Band - Reject Filters	Passes all frequencies except those within a selected band.

To filter commercial utility power entering a shielded room, a low-pass filter, such as Genisco's GFP58201 series, would be used to pass the power line frequencies while rejecting the higher frequencies. This filter is designed to also keep conducted high frequency noise from exiting the shielded room via the power lines.

Within an instrumentation package, a custom-designed filter may be used to filter out powerline or primary switching power supply frequencies from sensitive signal circuits.

The above examples are just two of the many types of applications of EMI/RFI filters. Others may include such diverse applications and specialized designs as telephone, fire alarm, data line and TEMPEST filters. The choice of what filter to use includes mechanical considerations, cutoff frequency, passband, insertion loss, voltage rating, current, capability plus many applicable military and regulatory agency requirements.



1. Voltage and Current

The first, and most obvious, consideration is to determine the voltage (both line-to-line and line-to-ground) of the system and the current that will pass through the filter. For a power line filter, the voltage will normally be 120/208 VAC or 277/480 VAC, but it may also be DC voltage. Current may be less than 1 amp to well over 1000 amperes.

2. Frequency

Both the passband and the stopband must be specified. The passband must be large enough to insure that the filter will allow the system in which it is installed to operate properly. Obviously, for powerline filters, the power frequency must be given.

The stopband should also be specified so that the filter will adequately reject all undesired frequencies. If the power frequency is 400 Hz, a power factor correction coil capable of carrying large reactive currents maybe required.

3. Insertion Loss

Insertion loss, measured in dB, is the ratio between the power received at a specified load before and after the insertion of the filter at a give frequency. This measurement is an indication of the degree of attenuation provided by the filter at that frequency.

In determining or specifying Insertion Loss, a number of key factors must be considered. For any filter design, Insertion Loss can be increased with a commensurate increase in size and weigh as additional components (or stages) are added. Even seemingly small increases (e.g. from 94 dB to 100 dB) can significantly increase the size and weight.

Because early test equipment had only a 50 Ohm Characteristic impedance, it became the convention to specify Insertion Loss with a 50 Ohm source and load impedance. In actual operation the source and load impedance's will normally be different and the Insertion Loss in a system will thus be different as well.

4. Passband Impedance

For data and signal line filters, the passband impedance of the load must be specified to insure that the filter is properly matched for data transmission.

5. Circuits

Each phase of a power line should have its own filter. In addition, the neutral line, if included, should be filtered as well.

It should be noted that the latest revision of the National Electrical Code requires that the neutral line in many systems be the same size as the phase line. Instrumentation packages, because of size constraints, usually require that a number of custom filters be contained in a single can with multiple-pin input and output connectors. The circuit layout in these multiple circuit filters is a critical factor in achieving the desired filter performance.

6. Reactive Current

The reactive current allowed is normally defined by a regulatory agency or military specification for safety purposes. Limiting reactive current may increase the size of a filter with given attenuation requirements. Decreasing the line-to-ground capacitance in order to decrease reactive current will tend to require the in-line inductance to increase. This may increase the DC Resistance, voltage drop, size and weight.

7. Capacitive vs. Inductive Input and Output

A filter may be designed with either capacitive or inductive input. An inductive input will normally cost more than one with a capacitive input. The advantage of an inductive input is the ability of the input inductor to limit the effect of transients or spikes on the line as well as some EMP pulses.

8. Size and Weight

The size of a filter may be restricted by the space available in the application and may be further constrained by the dimensions of mounting surfaces that also serve as ground planes.

Weight constraints are regularly imposed for portable or aircraft instrument applications. These constraints should not be imposed lightly as their imposition may restrict more important characteristics of a filter such as Insertion Loss and Leakage Current.

9. Special Considerations

There is an almost unlimited list of possible special considerations in selection of a filter. Regulatory Agencies such as UL,FCC,CSA,TUV and VDE, as well as a long list of military specifications, such as MIL-F-15733, MIL-I-45208, MIL-STD-202, MIL-STD-220, MIL-STD-461. In addition, special requirements such as EMP and TEMPEST must be given careful consideration.

A discussion with Genisco's Engineering staff will be helpful in determining the applicability of these requirements and their effects on the design of a specific filter to meet a given application.