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LOSSYLINE FILTERS

Filters offer simple means of improving the interference characteristics of electronic equipment, transmitters and receivers. However, low-pass filters of the reactive types can exhibit spurious responses. A simple and effective technique for eliminating or reducing these spurious responses is to add sections of an appropriate lossy transmission line in series with the conventional filter. Combining the lossy element with the conventional reactive elements increases attenuation and allows a significant size reduction of the conventional reactive EMI/RFI filters. Quick fixes of operational equipment can be accomplished, with LOSSY TRANSMISSION LINE FILTERS since they can usually be added without extensive modification of the equipment.

If the interference suppression filters are to be completely effective, the attenuation of the filters must be high and flat in the required rejection band. Unfortunately, many conventional filters exhibit regions of relatively low attenuation which often coincide with spurious responses. In some instances, the inherent reactance versus frequency of conventional interference elimination filters strongly favors the production of multiple resonances since the reactances of these filters are periodic functions of frequency. The periodic frequency behavior of a worst case conventional low-pass filter attenuation function is shown in Figure 1a. For EMI applications multiple spurious passbands of such filters are unacceptable.

A method of avoiding the spurious passbands is to employ a dissipative or absorptive mechanism or approach. The required frequency-sensitive attenuation can be provided by incorporating an absorptive/dissipative element whose attenuation is an increasing function of frequency. Several materials are suitable for use as these lossy elements; the particular material and composition selected are determined by the

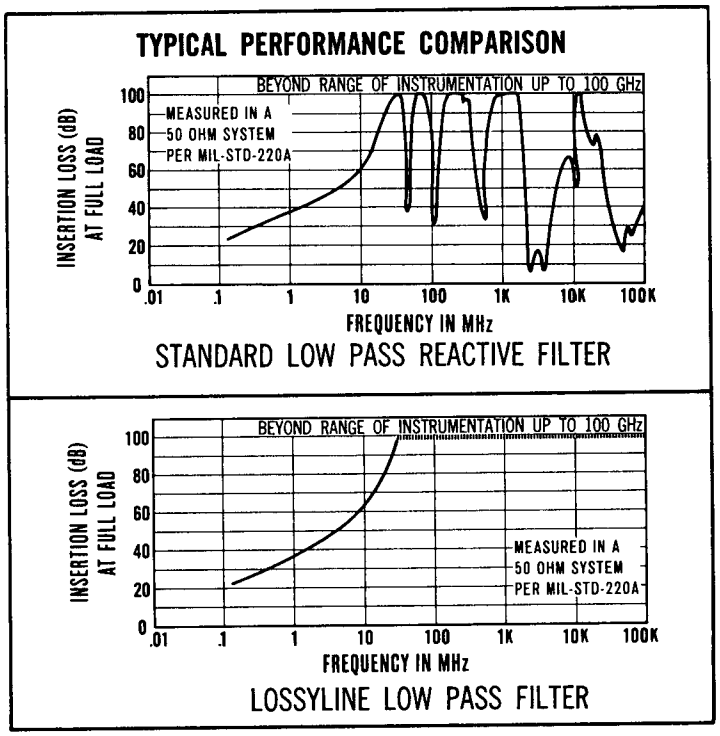

Figure 1 Low-Pass Filter Attenuation Characteristics
(a) Conventional Type EMI Low-Pass Filter Only.
(b) Low-Pass Filter Plus LOSSYLINE Absorptive Dissipative Element.

desired cutoff frequency and the frequency range to be covered. These characteristics vary with the binder selected, the dielectric material employed and the ratios.

A conventional reactive type filter may be used in cascade or series, as applicable, with the LOSSYLINE section to maximize the attenuation characteristics. The combination of the reactive filter and a LOSSY section will provide an overall characteristic which has the rapid cutoff slope of the reactive filter, as well as the high stop-band attenuation of the LOSSY section. An example of the improvement in the stop-band attenuation that can be gained by preceding a reactive filter with a LOSSYLINE section is illustrated. Figure 1a. shows the performance of a typical reactive low-pass filter constructed with lumped constant elements. The rapid cutoff at low frequencies is followed by a high attenuation region, but then the attenuation is reduced greatly with accompanying spurious responses. If the same low-pass filter is preceded by a LOSSYLINE section the attenuation characteristic is altered to that shown on Figure 1b. The LOSSY section has increased the passband attenuation only slightly, but the stop-band attenuation has been increased to as much as 100 dB, without spurious responses.

Dissipative/absorptive filters are an effective means of producing a low-pass transmission function with a uniformly high stop-band attenuation. The combination of these dissipative filters and conventional lumped constant reactive filters can produce units with superior characteristics for use in EMI interference suppression and elimination.

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