

FACTORS AFFECTING INSERTION LOSS

Insertion loss varies with frequency. It is determined by the electrical configuration, source/load impedances and component values. As a result of the nature of ceramic dielectric materials,

capacitance change (and therefore insertion loss) may be affected by applied voltage, temperature and the age of the part. Insertion loss can also be affected by load current due to ferrite saturation.

Electrical Configuration

A number of different electrical configurations are available in feedthrough filters, including the common types shown below. A single element filter (a capacitor or an inductor) theoretically provides an insertion loss characteristic of 20dB per decade, a dual element filter (capacitor/inductor) 40dB per decade whilst a triple element filter (Pi or T configuration) theoretically yields 60dB per

decade. In practise, the insertion loss curves do not exactly match the predictions, and the datasheets should be consulted for the realistic figure. The choice of electrical configuration is made primarily on the source and load impedances and may also be influenced by the level of attenuation required at various frequencies.

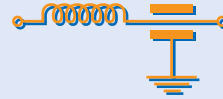
C Filter

This is a feedthrough capacitor with low self inductance. It shunts high frequency noise to ground and is suitable for use with a high impedance source and load.



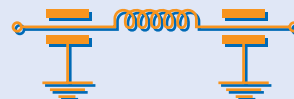
L-C Filter

This is a feedthrough filter with an inductive element in combination with a capacitor. It is commonly used in a circuit with a low impedance source and a high impedance load (or vice versa). The inductive element should face the low impedance.



Pi-Filter

This is a feedthrough filter with 2 capacitors and an inductive element between them. Ideally, it should be used where both source and load impedances are high.



T Filter

This is a feedthrough filter with 2 series inductive elements separated by one feedthrough capacitor. It is suitable for use where both source and load impedances are low.



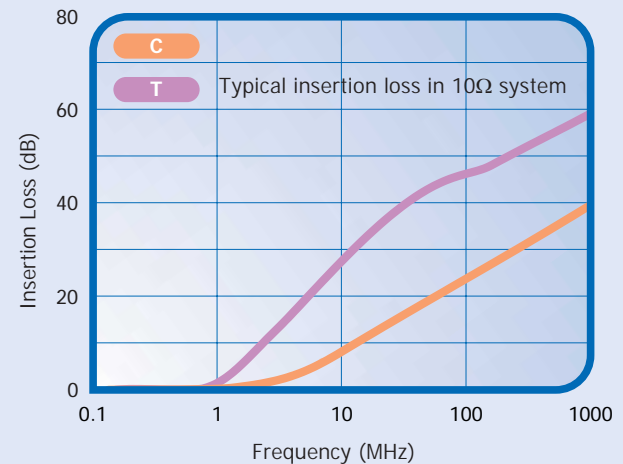
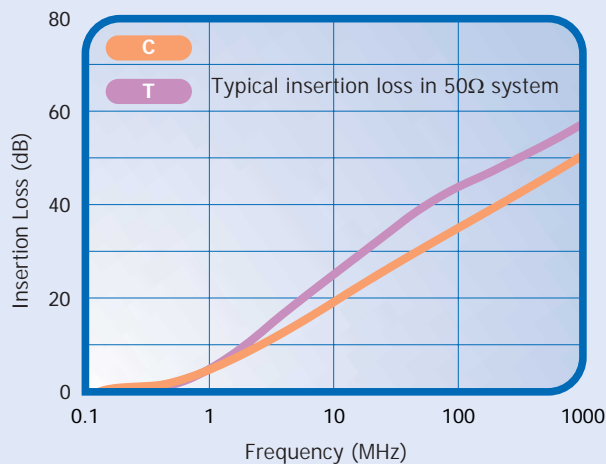
Insertion loss figures are normally published for a 50Ω source and 50Ω load circuit. In practise the impedance values will probably be very different, which could result in either an increase or reduction in insertion loss. The electrical configuration of the filter (the capacitor/inductor combination)

should be chosen to optimise the filter performance for that particular source/load impedance situation (see section above on electrical configuration). An estimate of insertion loss for source and load impedances other than 50Ω can be supplied. Please contact our Sales Office.

Example of effect of different source and load impedances

The 2 graphs below show typical attenuation curves for C and T filters in a) a 50Ω source load situation and b) a 10Ω source load circuit. It can be seen that the C filter shows a reduction in

performance in a 10Ω system. In contrast, the T filter which has an inductive element at each end shows an improvement in performance.



Load current

For filters which include ferrite inductors, the insertion loss under load current may be less than that with no load. This is because the ferrite material saturates with current. The reduction in insertion loss depends on the current and the characteristics of

the particular ferrite material. In extreme cases the ferrite will become ineffective and insertion loss will appear to be the same as for a C filter.

Effects of mounting method on Insertion Loss

Whilst SBSG, SBSM and SBSP filters can be mounted conventionally on pcbs, they are also suitable for mounting in a wall or partition on a board. This greatly improves the screening between filter input and output, thereby enhancing the high frequency response.

The following insertion loss curves, based on actual measurements, show the effect. It can be seen that the filters conventionally mounted (Fig. 1) exhibit a drop in attenuation at higher frequencies. The types mounted in a partition, however (Fig. 2), maintain excellent suppression characteristics to 1GHz and above.

Figure 1. Filters mounted on open pcb

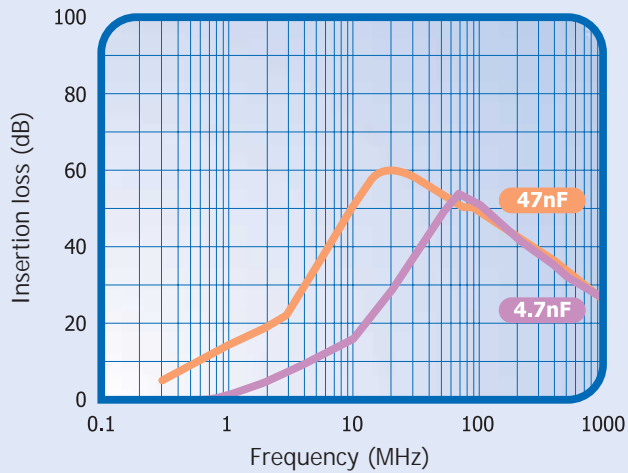
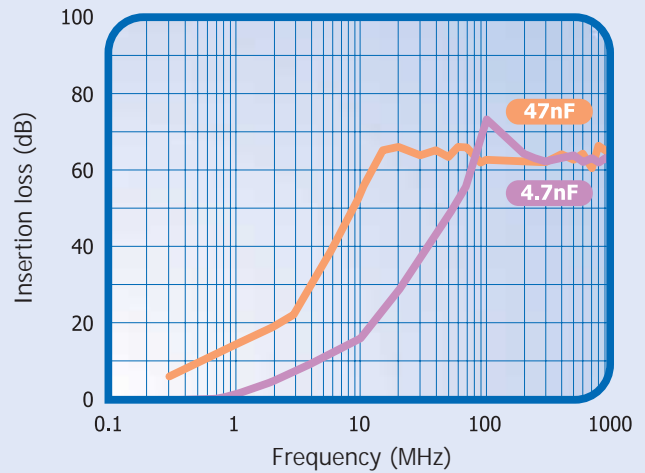


Figure 2. Filters mounted in wall or partition



Comparison of insertion loss curves for SBSP, SBSG, SBSM Pi Filters