Insertion Loss

FACTORS AFFECTING INSERTION LOSS

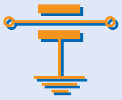
Insertion loss varies with frequency. It is determined by the electrical configuration, source/load impedances and component values. As a result of the nature of ceramic dielectric materials, capacitance change (and therefore insertion loss) may be affected by applied voltage, temperature and the age 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.

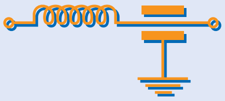
C Filter

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.



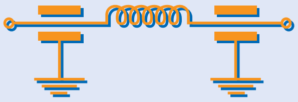
L-C Filter

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.



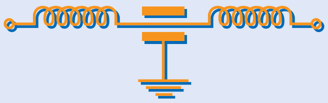
Pi-Filter

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

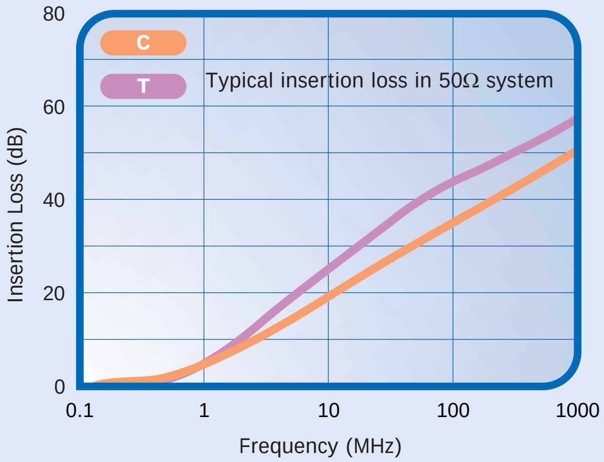
This is a feedthrough filter with 2 series inductive elements separated by one feedthrough capacitor. It is suitable for use where both source and load impedances are low.

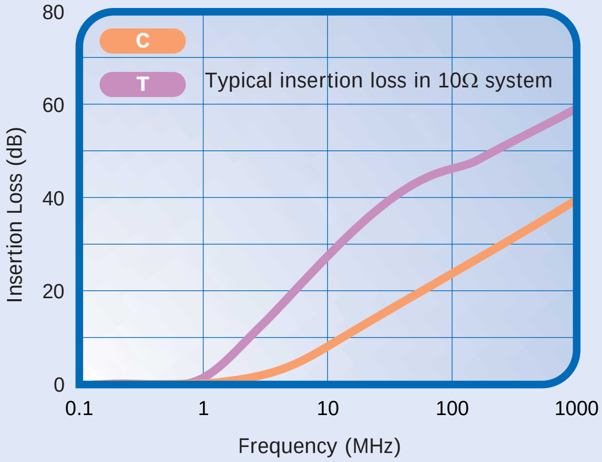


Insertion loss figures are normally published for a 50Ω source and 50Ω load circuit. In practise the impedance values will probably be very different, which could result in either an increase or reduction in insertion loss. The electrical configuration of the filter (the capacitor/inductor combination)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



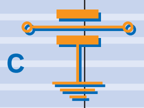


Load current

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.

Insertion Loss Information - Solder and Screw Mount

Chart A - Typical Insertion Loss (dB), No Load. 50 ohm system

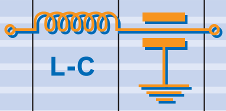


Capacitance	0.01MHz	0.1MHz	1MHz	10MHz	100MHz	1GHz
10pF						4
15pF						7
22pF						10
33pF						12
47pF					1	15
68pF					2	18
100pF					4	22
150pF					7	25
220pF					10	29
330pF					13	33
470pF				1	16	35
680pF				2	19	39
1nF				4	23	41
1.5nF				7	26	45
2.2nF				10	30	50
3.3nF				13	33	52
4.7nF			1	16	36	55
6.8nF			2	19	39	57
10nF			4	22	41	60
15nF			7	25	44	62
22nF			10	29	46	65
33nF			13	33	48	68
47nF		1	16	35	50	70
68nF		2	19	39	54	70
100nF		4	22	41	57	70
150nF		7	25	45	60	70
220nF		10	29	49	62	70
330nF		13	33	52	66	70
470nF	1	16	35	55	68	70
680nF	2	19	38	58	70	70
1µF	4	22	41	61	70	70
1.5µF	7	25	45	64	70	70
2.2µF	10	29	48	66	70	70

C - Section Filters

SFAAC SFABC SFAJC SFAKC SFBCC SFBDC SFBLC SFBMC
SFCDC SFCIC SFCMC SFJEB SFJEC SFJNC SFKBC SFKKC
SFLMC SFNOC SFSRC SFSSC SFSTC SFSUC SFTMC SFUMC

Chart B - Typical Insertion Loss (dB), No Load. 50 ohm system

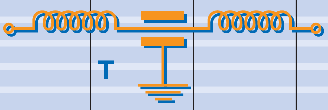


Capacitance	0.01MHz	0.1MHz	1MHz	10MHz	100MHz	1GHz
10pF						6
15pF						9
22pF						12
33pF					1	15
47pF					2	19
68pF					4	20
100pF					7	24
150pF					10	27
220pF					12	30
330pF				1	16	34
470pF				2	19	38
680pF				3	22	41
1nF				6	25	44
1.5nF				9	29	48
2.2nF				12	31	51
3.3nF				15	35	54
4.7nF			1	18	39	57
6.8nF			2	21	41	60
10nF			4	23	43	63
15nF			7	27	46	66
22nF			10	30	48	68
33nF			13	34	50	70
47nF		1	17	37	51	70
68nF		2	20	40	55	70
100nF		4	22	44	60	70
150nF		7	25	47	62	70
220nF		10	29	49	66	70
330nF		13	33	53	68	70
470nF	1	16	35	56	70	70
680nF	2	19	38	58	70	70
1µF	4	22	41	61	70	70
1.5µF	7	25	45	64	70	70
2.2µF	10	29	49	66	70	70

L-C Section Filters

SFABL SFAJL SFAKL SFBCL SFBDL SFBLL SFBML SFCDL
SFCIL SFCML SFJEL SFJNL SFKBL SFKKL SFLML

Chart C - Typical Insertion Loss (dB), No Load. 50 ohm system

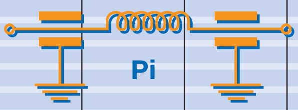


Capacitance	0.1MHz	1MHz	10MHz	100MHz	1GHz
10pF					9
15pF					11
22pF				1	14
33pF				2	18
47pF				4	20
68pF				6	23
100pF				9	27
150pF				12	30
220pF				15	33
330pF			1	19	36
470pF			2	21	40
680pF			4	24	43
1nF			7	28	47
1.5nF			10	30	50
2.2nF			13	34	53
3.3nF			17	38	57
4.7nF			19	40	59
6.8nF		1	23	43	63
10nF		4	26	45	66
15nF		7	29	47	68
22nF		10	33	49	70
33nF		14	36	50	70
47nF	1	17	39	52	70

T - Section Filters

SFBDT SFBMT SFLMT

Chart D - Typical Insertion Loss (dB), No Load. 50 ohm system



Capacitance	0.1MHz	1MHz	10MHz	100MHz	1GHz
20pF				1	11
30pF				2	15
44pF				3	19
66pF				4	23
94pF				6	29
136pF				8	35
200pF				11	41
300pF			1	15	50
440pF			2	20	57
660pF			3	25	65
940pF			5	31	68
1.36nF			7	37	70
2nF			10	44	70
3nF			13	51	70
4.4nF		1	17	59	70
6.6nF		2	21	64	70
9.4nF		4	27	68	70
13.6nF		6	34	70	70
20nF		9	40	70	70
30nF		12	48	70	70
44nF	1	14	54	70	70
66nF	2	17	63	70	70
94nF	4	18	68	70	70

Pi - Section Filters

SFBCP SFBDP SFBLP SFBMP SFCDP SFLMP