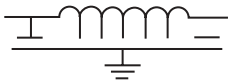
Filter Selection Data

Amphenol® EMI Connectors are produced with several types of filters. They are all low band pass filters with the following configurations:

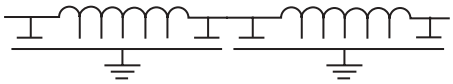
Pi -

Typical of the VHF, UHF and MF filter



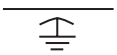
Cascaded Pi -

Typical of the HF filter. It consists of two VHF Pi filters on a common pin and is available in tubular designs only.



Capacitor *-

Consists of a feed-through capacitor without any ferrite. It can be 50pf to 1µf and carry the MF, HF and VHF designation depending on its typical 50dB performance.



L-C *-

Typical of HF, VHF and UHF filter. Low source / high load impedance.

C-L *-

Typical of HF, VHF and UHF filter. High load impedance / low source.

T *-

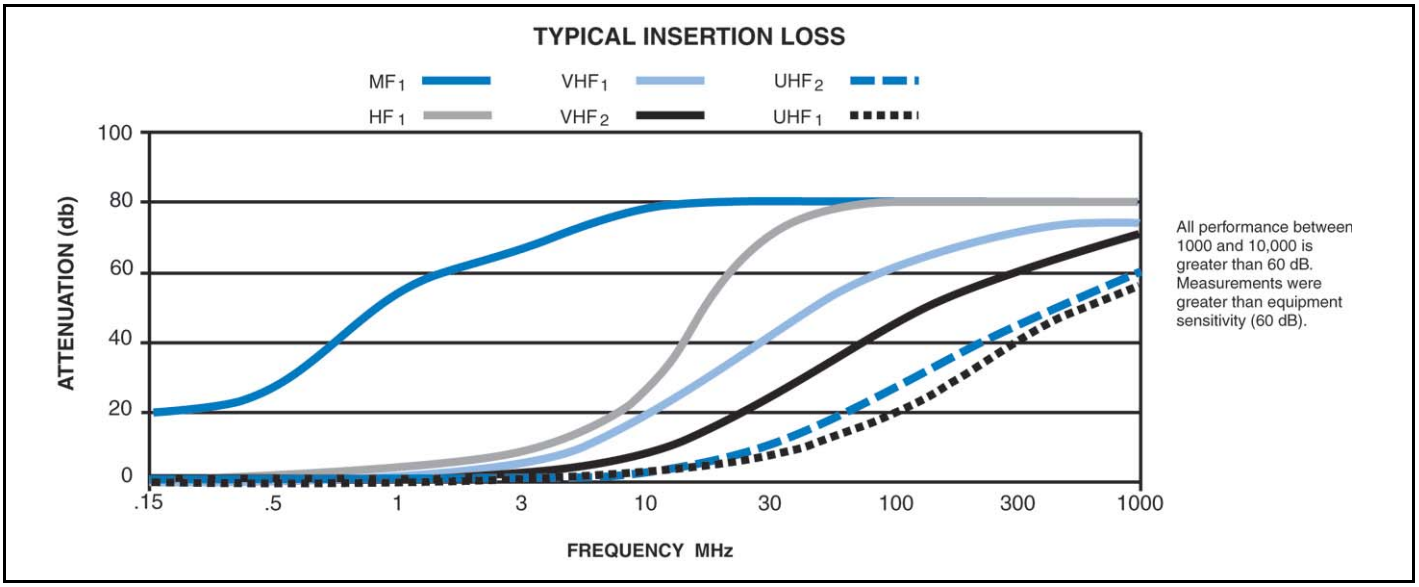
Typical of HF, VHF and UHF filter. Low source / low load impedance.

* Consult factory for attenuation performance values.

Parameters		Medium Frequency Filter◆	High Frequency Filter◆	Very High Frequency Filter		Ultra High Frequency Filter	
		MF1 (Pi)	HF1 (Cascaded Pi)	VHF1 (Pi)	VHF2† (Pi)	UHF1† (Pi)	UHF2† (Pi)
Minimum Attenuation (Test Points)*	150kHz	20dB	–	–	–	–	–
	15MHz	–	50dB	–	–	–	–
	50MHz	–	80dB	–	–	–	–
	100MHz	80dB	–	62dB	46dB	18dB	28dB
Maximum Working Voltage (User must specify DC or AC)††††	DC†††	50VDC	200VDC	200VDC	200VDC	200VDC	200VDC
Dielectric Withstanding Voltage Capability (for 5 sec. with 10 milliamperes max. charging current)◆◆		100 volts DC	500 volts DC	500 volts DC	500 volts DC	500 volts DC	500 volts DC
Maximum Feed-thru Current (DC and/or Audio Frequency R.M.S.)	Size 16 contacts	13.0 amps	13.0 amps	13.0 amps	13.0 amps	13.0 amps	13.0 amps
	Size 20 contacts	7.5 amps	7.5 amps	7.5 amps	7.5 amps	7.5 amps	7.5 amps
	Size 22 contacts	not available	not available	5.0 amps	5.0 amps	5.0 amps	5.0 amps
Maximum RF Current		3.0 amps	3.0 amps	3.0 amps	3.0 amps	3.0 amps	3.0 amps
Minimum Insulation Resistance**		250 megohms	10 gigaohms	10 gigaohms	10 gigaohms	10 gigaohms	10 gigaohms
Typical Capacitance***		1.0 microfarad	16 nanofarads	7 nanofarads	2.5 nanofarads	375 picofarads	710 picofarads
Air Leakage††		4.6×10^{-3} cc/sec					
Operating Temperature Range		–55°C to +125°C					

* When tested at 25°C per MIL-STD-220.
** After 2 minutes at working DC voltage through a protective resistance of 1 megohm when measured between contact and ground at +25°C.
*** When measured at a frequency of 1 ±.1kHz and a voltage not exceeding 1.0 V.A.C.R.M.S. at +25°C.
† Consult Amphenol, Sidney, NY or your Amphenol representative for part number.
†† Lower leakage rates are available upon request.
††† Summation of the DC and low level AC super-imposed peak voltage.
†††† Consult Amphenol, Sidney, NY whenever AC voltage is present.
◆ Consult Amphenol, Sidney, NY or your Amphenol representative for availability.
◆◆ Higher DWV ratings are available upon request. Consult Amphenol, Sidney, NY.

Effect of Temperature on EMI Filter Attenuation



TYPICAL INSERTION LOSS (dB)
PER MIL-STD-220, 5 ADC, 25°C

Capacitance	1MHz	3MHz	10MHz	30MHz	100MHz	300MHz	1000MHz
375 pf UHF_1	0	0	1	8	16	–	–
750 pf UHF_2	0	0	3	10	19	–	–
2500 pf VHF_2	0	2	8	20	28	–	–
7000 pf VHF_1	5	9	17	23	40	–	–
16000 pf HF_1	6	14	20	24	80	–	–

Most filter attenuation curves and capacitance values are expressed at 25°C. However, temperature can affect the capacitance of a titanate filter element, affecting the insertion loss that the element will cause.

In order to assist the user in anticipating the effect of various temperatures, the following charts applicable to Amphenol® filter connectors utilizing MF_1, HF_1, VHF_1, VHF_2, UHF_1 and UHF_2 filters are provided. Please note that all insertion loss (attenuation) values given were measured with no load applied. The band designations refer to MIL-STD-2120.

MF_1*
Typical Capacitance = 1,000,000 pf Min. 800,000 pf Max. 1,600,000 pf
Type Pi

Temp.	F_{CO}	1MHz	3MHz	10MHz	30MHz	100MHz	300MHz	1000MHz
–55°C	–	18	–	64	80	80	80	80
Room	7.94K	55	–	80	80	80	80	80
+125°C	–	22	–	70	80	80	80	80

HF_1*
Typical Capacitance = 16,000 pf Min. 9,800 pf Max. 24,000 pf
Type Cascaded Pi

Temp.	F_{CO}	1MHz	3MHz	15MHz	50MHz	100MHz	300MHz	1000MHz
–55°C	–	2	6	24	62	80	80	80
Room	648K	3	9	50	80	80	80	80
+125°C	–	0	6	30	62	80	80	80

VHF_1
Typical Capacitance = 7,000 pf Min. 4,900 pf Max. 12,000 pf
Band G, Type Pi

Temp.	F_{CO}	1MHz	3MHz	10MHz	30MHz	100MHz	300MHz	1000MHz
–55°C	–	1	2	8	21	44	61	65
Room	1.27M	1	6	18	42	62	72	75
+125°C	–	0	2	9	24	45	62	64

VHF_2
Typical Capacitance = 2,500 pf Min. 1,900 pf Max. 4,000 pf
Band E, Type Pi

Temp.	F_{CO}	1MHz	3MHz	10MHz	30MHz	100MHz	300MHz	1000MHz
–55°C	–	0	2	7	17	40	58	71
Room	3.3M	0	2	8	24	46	61	71
+125°C	–	0	3	10	26	46	63	69

UHF_2
Typical Capacitance = 750 pf Min. 500 pf Max. 1,100 pf
Band C, Type Pi

Temp.	F_{CO}	1MHz	3MHz	10MHz	30MHz	100MHz	300MHz	1000MHz
–55°C	–	0	0	3	9	25	46	61
Room	12.7M	0	0	3	10	28	46	61
+125°C	–	0	0	3	10	24	42	60

UHF_1
Typical Capacitance = 375 pf Min. 290 pf Max. 450 pf
Band B, Type Pi

Temp.	F_{CO}	1MHz	3MHz	10MHz	30MHz	100MHz	300MHz	1000MHz
–55°C	–	0	0	1	6	21	43	58
Room	21.9M	0	0	1	8	18	42	56
+125°C	–	0	0	1	8	17	38	50

Note: F_{CO} = Cut-off Frequency
* Consult Amphenol, Sidney, NY for availability.

Impedance Matching Formula
(your system to a 50 ohm system)

The following formula and example are offered in order to determine the expected filter performance in an impedance system other than 50 ohms.

With the attenuation expressed in 50 ohms and the transfer impedance curve shown in Figure 1 below, a designer can relate the expressed attenuation to the input and output impedance of his circuit.

Example:

(1) Noise is 40dB above specification level at 100 MHz

(2) Input and output impedance are 10 and 100 ohms respectively

(3) Amphenol® VHF 7000 pf filter has a 65 dB minimum attenuation at 100 MHz and +25°C

Formula (Taken from Figure 1):

$1.4 \times 10^2\ \Omega$ = transfer impedance
for 65 dB in a 50 ohm system

$$\text{Atten (dB)} = 20 \log_{10}\left[1 + \frac{Z_S Z_L}{Z_{12}(Z_S + Z_L)}\right]$$

Z_S = source impedance

Z_L = load impedance

Z_{12} = transfer impedance

Atten = filter performance in a system other than 50 ohms

$$\text{Atten (dB)} = 20 \log_{10}\left[1 + \frac{10(100)}{1.4 \times 10^{-2}\ (10 + 100)}\right]$$

Attenuation = 56.3dB

In this case, the 7000 pf VHF filter will give 56.3 dB which is 16.3dB below the desired reduction in noise (40dB) as stated in the above problem.

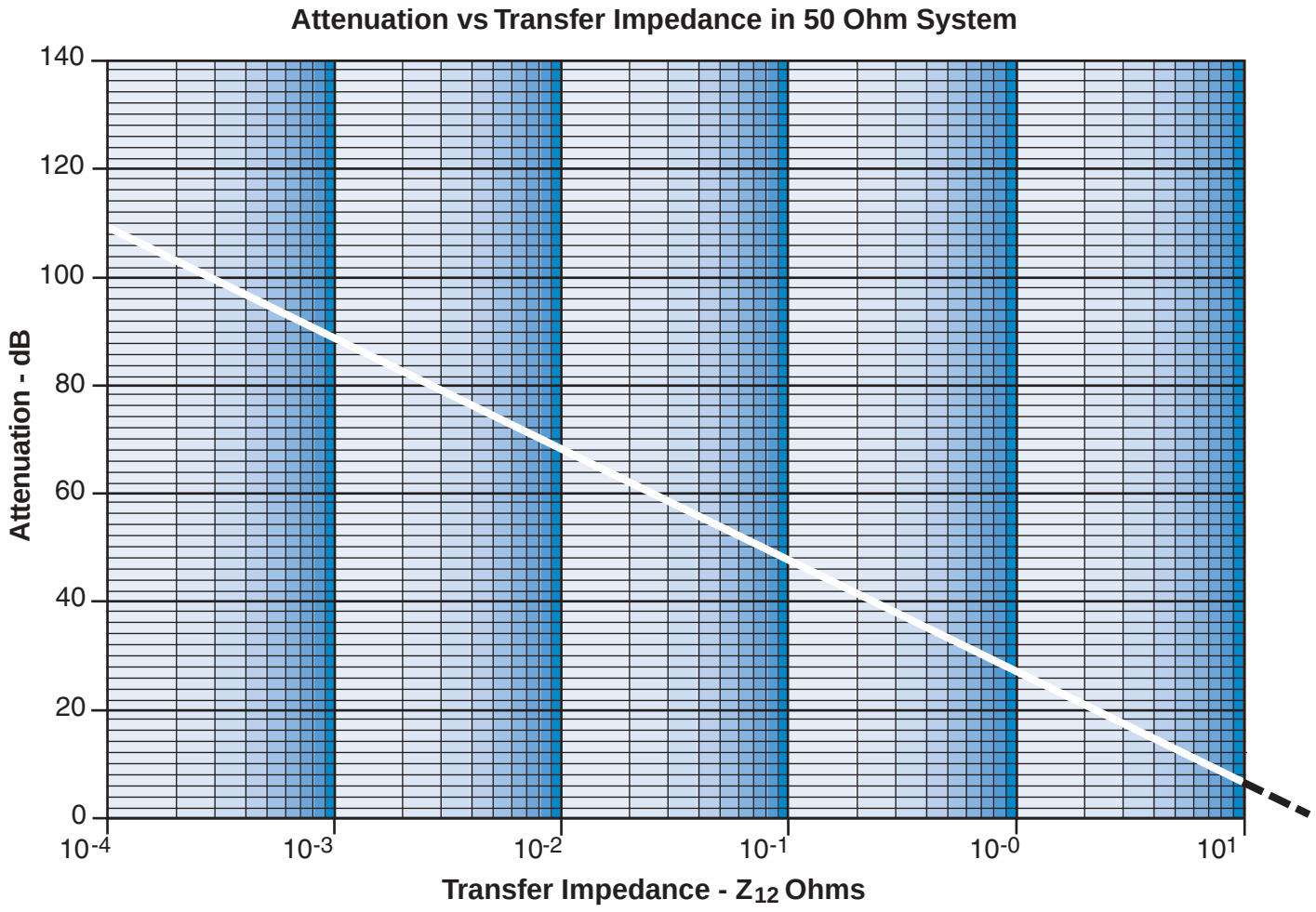


Figure 1