WAVE FILTERS: LOW PASS, HIGH PASS, BANDPASS, BAND REJECT

TYPICAL INSERTION LOSS
HIGH PASS FILTER, 50 OHM CIRCUIT
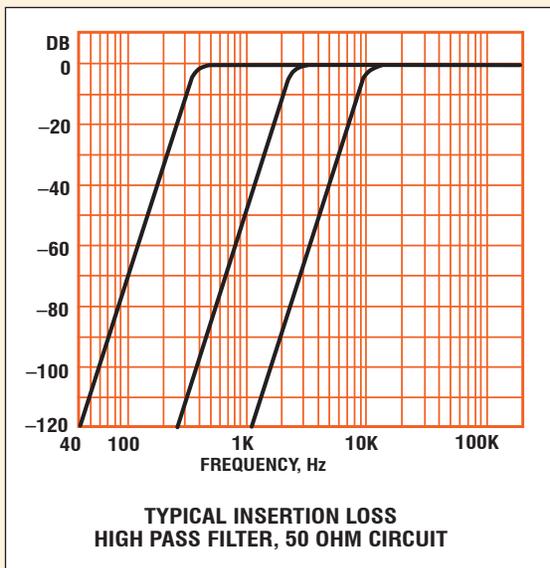
DESCRIPTION

All kinds of wave filters are useful in audio, r.f. and EMI programs to isolate selected portions of the frequency spectrum.

Custom designed wave filters are readily available in different impedance values and with different response slopes outside the pass or reject bands. The slope of response outside of the passband depends on the number of poles (circuit elements). Butterworth style filters are usually preferred since the ripple in the passband is negligible. For Butterworth designs, the frequency slope outside the passband is:

7 pole, approximately 42 dB per frequency octave
9 pole, approximately 54 dB per frequency octave
11 pole, approximately 66 dB per frequency octave

When any kind of wave filter is ordered, the number of poles or the steepness of the skirts of the response curve must be specified. It is also necessary to specify the impedance of the circuit where the filter will be inserted.

The cutoff frequency (fc) must be stipulated. This is the -3 dB point on the response curve which establishes the frequency limit of the pass or reject band. In Butterworth designs, the "knee" of the curve is rounded as it merges into the pass or reject band.

Most of the filters listed on the other side of this page were designed using the Butterworth method due to the absence of ripple in the passband. The Chebycheff design is also available, and usually can be held to less than 1.0 dB ripple in the passband. The Chebycheff design provides much steeper slopes. It is sometimes preferred when a sharper demarcation is needed between the frequencies of the passband and the frequencies which lie outside the band **and** when some ripple is tolerable. Fifteen poles is a practical limit.

LOW PASS FILTERS

Low pass filters are needed in test setups for Methods CS03, CS04, CS05, CS08 and RS04 of MIL-STD-462. To eliminate spurious harmonics and other frequencies above the range of interest, use Solar Electronics Low Pass Filters which provide more than 100 dB of insertion loss at three times the cutoff frequency. Eleven reactive components. Ripple in passband less than 0.5 dB. Use in 50 ohm circuits.

HIGH PASS FILTERS

When applied to a.c. powered equipment. Test Methods CE01 and CE03 of MIL-STD-462 require the elimination of the fundamental power frequency and the second, third and fourth harmonics. Notch filters have too much insertion loss in the passband and you need four of them. A high pass filter is the only practical answer. Used at the input to EMI meter, Solar Electronics High Pass Filters provide more than 100 dB insertion loss at the power line frequency and a very steep response.

BANDPASS FILTERS

Bandpass filters are useful for selecting a mid-range portion of the frequency spectrum with rejection slopes above and below the selected range. The low frequency cutoff can be as low as 300 Hz. The high frequency cutoff can be as high as 50 MHz.

BAND REJECT FILTERS

The inverse of bandpass filters, these units provide rejection of frequencies between two selected points in the spectrum. The sloping response between the low and high cutoff frequencies is as steep as the number of poles permits. For eleven pole filters, the slope is approximately 66 dB per frequency octave.

Bandpass and band reject filters use two reactive elements for each pole. This makes them physically larger and more costly.

For F.C.C., V.D.E., C.I.S.P.R., or the U.S. Army NOTICE 3 version of MIL-STD-462, where LISNs are used for conducted emission tests, a portion of the a.c. line voltage to the EUT is present at the r.f. jack of the LISN.

To prevent damage to the EMI meter or spectrum analyzer used for these tests, it is recommended that a high pass filter be connected between the LISN and the meter.

HIGH PASS FILTERS FOR USE WITH LISNs
For 50 Hz power frequency, use 7205-0.30. For 60 Hz power frequency, use 7205-0.35. For 400 Hz power frequency, use 7801-2.4 or 7930-2.4. For Army Notice 3, MIL-STD-462 or for F.C.C., use 7801-8 or 7930-8.

SIGNAL LINE LOW PASS FILTERS FOR CS03, CS04, CS05, CS08 AND RS04 OF MIL-STD-462 AND OTHER SPECS.

Type No.	-3 dB	-100 dB	Type No.	-3 dB	-100 dB
6623-0.1	0.1 MHz	0.3 MHz	6623-5.0	5.0 MHz	15 MHz
6623-0.2	0.2 MHz	0.6 MHz	6623-10	10.0 MHz	30 MHz
6623-0.5	0.5 MHz	1.5 MHz	6623-20	20.0 MHz	60 MHz
6623-1.0	1.0 MHz	3.0 MHz	6623-30	30.0 MHz	90 MHz
6623-2.0	2.0 MHz	6.0 MHz	6623-50	50.0 MHz	150 MHz

HIGH VOLTAGE 50 OHM HIGH PASS FILTER STYLES

7801-( ) Rated at 125 V.A.C., Type N connectors

7930-( ) Rated at 270 V.A.C., Type N connectors

8130-( ) Rated at 270 V.A.C., Type BNC connectors

8131-( ) Rated at 125 V.A.C., Type BNC connectors

The cutoff frequency in kHz is appended as a dash number to the basic part number. For these four styles (only) the cutoff frequency must be greater than 2.3 kHz. Example: 7801-2.4.

NOTES: When filters will be permanently installed, add dash FL to part number to specify a mounting flange on each end of filter can.

Connectors are Type N unless otherwise noted. Filters rated 50 V.A.C. unless otherwise noted.

Type	FILTERS, 50 OHM LOW PASS
6623-( )	For signal lines. Dash number = fc = MHz, 11 pole Butterworth
7836-( )	For signal lines. Dash number = fc = kHz, 11 pole Butterworth
7907-( )	Isolated from case. Dash number = fc = MHz, Tri-ax connectors
8016-( )	For signal lines. Dash number = fc = kHz, 15 pole Chebycheff, BNC
8304-( )	Same as 7836-( ) except banana jacks each end
8305-( )	7 pole Butterworth. Dash number = fc = MHz, BNC

FILTERS, 50 OHM HIGH PASS
7205-( )	For signal lines. Dash number = fc = kHz, 11 pole Butterworth
7720-( )	For signal lines. Dash number = fc = MHz, 11 pole Butterworth
7801-( )	Rated: 125 V.A.C. Dash number = fc = kHz. (fc must be > 2.3 kHz)
7930-( )	Rated: 270 V.A.C. Dash number = fc = kHz. (fc must be > 2.3 kHz)
8018-( )	Same as 7720-( ) except with BNC connectors
8130-( )	Same as 7930-( ) except with BNC connectors (fc must be > 2.3 kHz)
8131-( )	Same as 7801-( ) except with BNC connectors (fc must be > 2.3 kHz)
8209-( )	15 pole Chebycheff. Dash number = fc = MHz. BNC connectors
8310-( )	Same as 7205-( ) except with BNC connectors

H.P. and L.P. FILTERS WITH IMPEDANCES OTHER THAN 50 OHMS
6824-( )	600 ohm High Pass. Dash number = fc = kHz, 11 pole Butterworth
7914-( )	600 ohm Low Pass. Dash number = fc = kHz, 11 pole Butterworth
8206-( )	75 ohm Low Pass. Dash number = fc = kHz, 15 pole Chebycheff, male BNC on one end, female BNC on the other end

BANDPASS FILTERS (BUTTERWORTH)
7829-*/*	600 ohm Bandpass filter, 7 poles, BNC connectors
7830-*/*	50 ohm Bandpass filter, 7 poles, BNC connectors
7843-*/*	50 ohm Bandpass filter, 9 poles, BNC connectors
7844-*/*	600 ohm Bandpass filter, 9 poles, BNC connectors
7845-*/*	600 ohm Bandpass filter, 11 poles, BNC connectors
8106-*/*	150 ohm Bandpass filter, 7 poles, BNC connectors
8311-*/*	50 ohm Bandpass filter, 11 poles, BNC connectors

BAND REJECT FILTERS (BUTTERWORTH)
8227-*/*	50 ohm Band Reject filter, 7 poles, BNC connectors
8229-*/*	50 ohm Band Reject filter, 9 poles, BNC connectors
8231-*/*	50 ohm Band Reject filter, 11 poles, BNC connectors

/ The dash number appended to the part number of Bandpass and Band Reject filters describes the -3dB points in Hertz. Example: -300/3K = -3 dB points at 300 Hertz and 3 Kilohertz. Dash number can be as low as 300 Hz on the low end and as high as 50 MHz on the high end.

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