

Ph262

Multi-stage filter parameters, based on H&H 2ed. (with 1 tiny correction), and Q values calculated to provide a more general prescription.

For implementation with Sallen-Key or other 2-pole stages. The transfer function for each stage is:

$$G = \frac{k}{1 + \frac{j}{Q} \frac{\omega}{\omega_0} - \left(\frac{\omega}{\omega_0}\right)^2} = \frac{k}{1 + \frac{j}{Q} \frac{f}{f_0} - \left(\frac{f}{f_0}\right)^2}$$

The above is for low pass. For high pass, multiply by $-(f/f_0)^2$.

legend: K Gain for a Sallen-Key stage, with equal component values, to attain the desired Q for the stage.
 Q Quality factor, for the denominator of the response function. Inferred from H&H K values.
 fn Low pass frequency conversion factor: $\omega_0 = fn \cdot \omega_c = fn \cdot fc \cdot 2\pi$, where fc or ω_c is the desired critical frequency.
 These values are for low pass filters. Use 1/fn for high pass!
 Note that critical frequency for Butterworth and Bessel are at -3dB compared to DC, whereas for Chebyshev it's when the response leaves the specified passband ripple.

#poles	Butterworth (flat response in passband)			Bessel (flat time delay in passband)			Chebyshev, 0.5dB ripple (sharp roll-off)			Chebyshev, 2dB ripple (sharp roll-off)		
	K	Q	fn	K	Q	fn	K	Q	fn	K	Q	fn
2	1.586	0.707	1.000	1.268	0.577	1.273	1.842	0.864	1.231	2.114	1.129	0.907
4	1.152	0.541	1.000	1.084	0.522	1.432	1.582	0.705	0.597	1.924	0.929	0.471
	2.235	1.307	1.000	1.759	0.806	1.606	2.660	2.941	1.031	2.782	4.587	0.964
6	1.068	0.518	1.000	1.040	0.510	1.607	1.537	0.684	0.396	1.891	0.902	0.316
	1.586	0.707	1.000	1.364	0.611	1.692	2.448	1.812	0.768	2.648	2.841	0.730
	2.483	1.934	1.000	2.023	1.024	1.908	2.846	6.494	1.011	2.904	10.417	0.983
8	1.038	0.510	1.000	1.024	0.506	1.781	1.522	0.677	0.297	1.879	0.892	0.238
	1.337	0.601	1.000	1.213	0.560	1.835	2.379	1.610	0.599	2.605	2.532	0.572
	1.889	0.900	1.000	1.593	0.711	1.956	2.711	3.460	0.861	2.821	5.587	0.842
	2.610	2.564	1.000	2.184	1.225	2.192	2.913	11.494	1.006	2.946	18.519	0.990