4th Order Filter

2016-01-26

6th Order Filter

Cascaded RC low pass filters for a 3400Hz telephone filter.
Calculation: −3dbFreq = 1 / (2*PI*R*C)
When cascading multiple RC filters, the −3db frequency point will shift lower with each filter.
This may affect the desired frequencies to keep. If so, increase the frequency point. This is not
a perfect brick wall filter. Even with the frequency point shifted, there will be some roll off
before the −3db point.
When creating filters, you will need precise resistors and capacitors. It is recommended to
measure each before soldering them down. Most capacitors are rated for 10−20%. Most will be
towards the lower end since manufacturers can sell the next level up at a lower end.
When cascading multiple RC filters, the difference between each needs to be R*10 and C/10 to
avoid impedance loading problems.
The usual minimum for R is around 470 and the max is 100k.
The usual minimum for C is 1nF. The max isn't really limited but most will stay below 10uF.
Take careful note of your op−amp's input impedance. JFET's are usually >1meg and can take the
100k resistor at the input. BJT's are usually around 20k and cannot accept anything over 10k.
That should really be around 2k (1/10th input impedance), but most people will push it.

The U1 op−amp is used to not put a heavy load on the signal source. If the signal source is
capable of delivering a high current, some people will skip the U1 op−amp and connect Rf1a
directly to it. In that case, make sure Rf1a is greater than 1k.
Each R−C pair is 1 order, so a 2nd order filter is 2 R−C pairs. The top circuit is 4th order. The
bottom circuit is 6th order and must use an op−amp with JFET inputs. Each order will drop the
signal 3db. A 2nd order is −6db. A 6th order is −18db. Most people won't do anything over a
4th order filter since any higher orders have significantly reduced advantages.
U3 adds gain to counteract some of the losses in the filters. The other op−amps could add
gain as needed, but it is normally the last to save part counts and space.