Equalizer for Full Range Speakers

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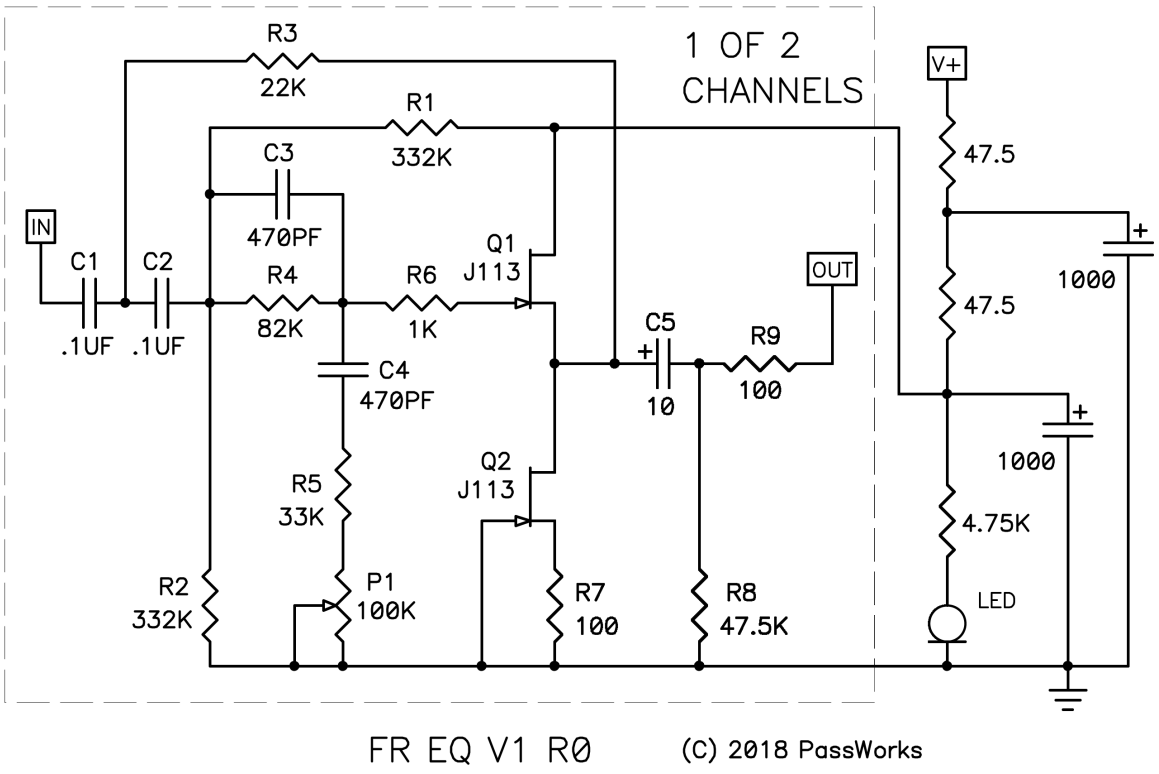
My audio journey began as a teenager when I took my paycheck from pumping gas at the Sonoma County airport and bought a Garrard turntable, Radio Shack 5 watt Germanium amplifier and a pair of *full range* 8 inch loudspeaker drivers. I mounted the drivers in cardboard boxes, later replaced by proper wooden enclosures.

Fifty-seven years later, here are my latest 8 inch full range speakers and 5 watt amplifier:

Full rangers have their flaws - limited response at the highest and lowest frequencies and lesser dynamic range, but usually have qualities that are difficult to achieve with multiple driver systems, one of them being the “articulation” that allows you to discern lyrics in songs that are obscured in many multi-driver systems. I attribute this to relatively flat frequency and phase response in the all important midrange.

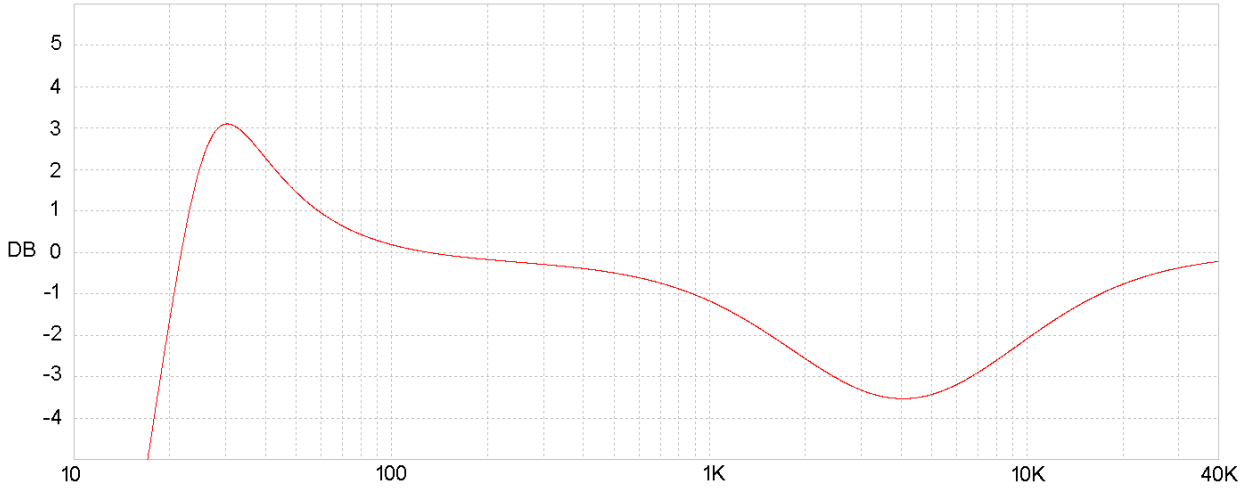
I find it interesting to see what can be accomplished by using a little equalization, and five years ago I worked up a simple filter set to address frequency response flaws in full range drivers that usually works pretty well. Like most full range drivers, the filter circuit is simple and cheap.

Here is the reference circuit schematic:



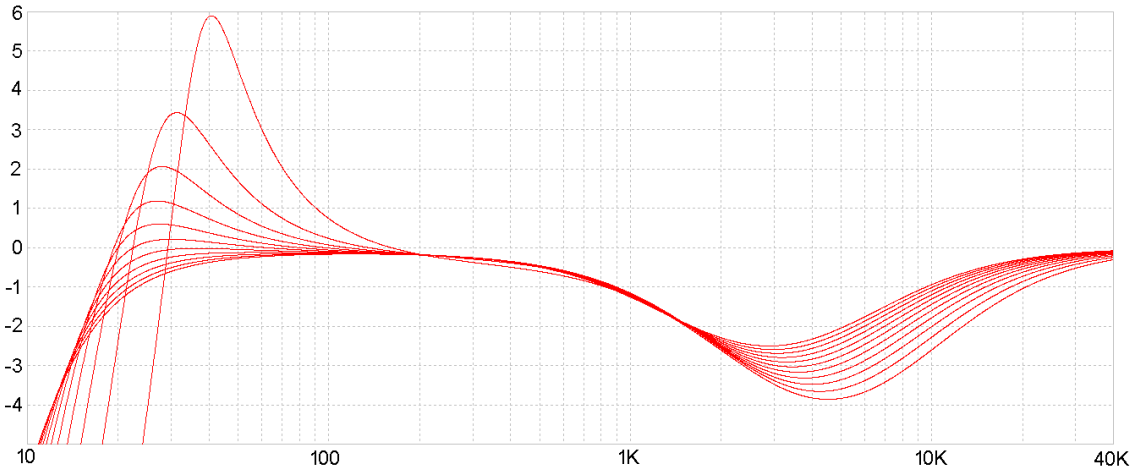
A bass equalization circuit formed by C1-C2 and R1-R3 is followed by the high frequency equalization circuit of C3-C4, R4-R5 and potentiometer P1. Q1 and Q2 form an impedance buffer, and the remaining parts are Fet biasing, output network and power supply filtering.

Here is the response of the reference circuit:



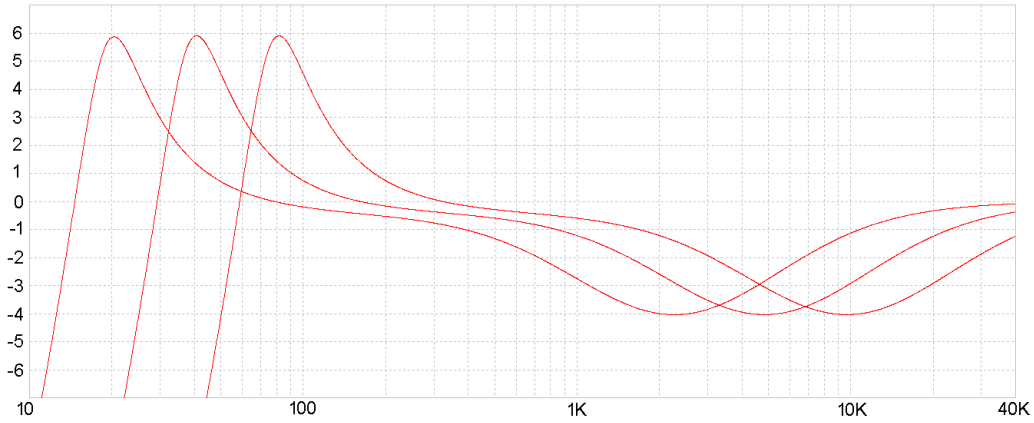
We have a 3 dB peak at 30 Hz and 3.5 dB dip at 4 Khz. I happen to have a pair of speakers which this fits very well. If you have full rangers, there is a good chance that something resembling this curve would be very helpful.

Or not. However, the circuit is quite flexible – you can disable either the low or high frequency filter sections or you can modify them over a wide range to fit your system. Below is the range of responses available by varying R3 from 10K to 100K in 10K steps and also R5 from 33K to 123K in 10K steps.



Lower values of R3 give more boost at the low frequency peak and lower values of R5+P1 in series give more attenuation in the midrange dip.

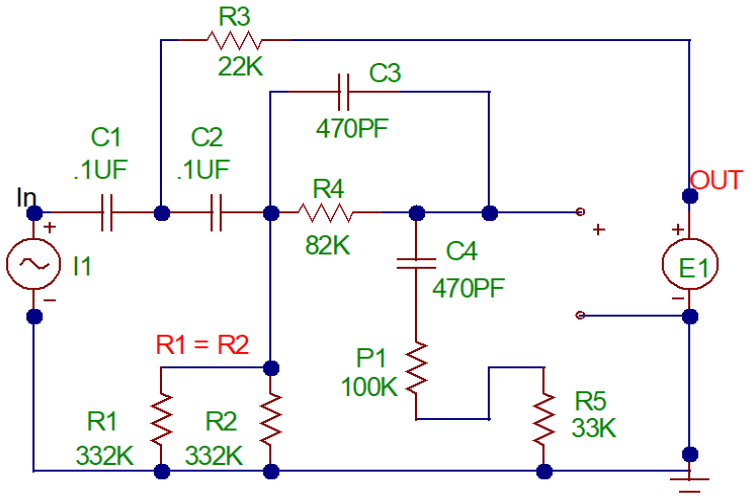
You can also shift the frequencies where the peak and dip occur. Below is for three different values of the filter capacitors:



Here are the variations with C1 and C2 at 50 nF, 100 nF and 150 nF at Bass frequencies and C3 and C4 at 0.5 nF, 1 nF and 1.5 nF at the upper frequencies.

You can model this circuit with simulators such as LTSpice, but I have found that for simple analog circuits it's easier for beginners (and lazy boyz like me) to navigate something like MicroCAP, no longer available commercially, but on the net for free. Last time I looked it was available at https://micro-cap.informer.com/download/ and other sources on the net. I will be posting my copy of this filter circuit simulation on “Full Range EQ” in the Pass Labs forum at www.diyAudio.com for you to play with.

Below is what the circuit look like in MicroCap. An AC voltage source at the input and the circuit buffered by E1, which is a voltage controlled voltage source (VCVS) with a gain of 1.



You can play around with this so as to get close to the set of curves you want, generally using the values and curves provided here. This filter isn't intended to fix the little squiggles you may see on the driver's response curve, but I think most of the time you will find that full range drivers can be broadly tweaked into a more satisfying sound, and the values I have shown here are in the range of what generally works. At this point I have a small library of filter settings, which include the EQ settings for the Lxmini bi-amp, the SLOBs from Speaker Camp and some others.

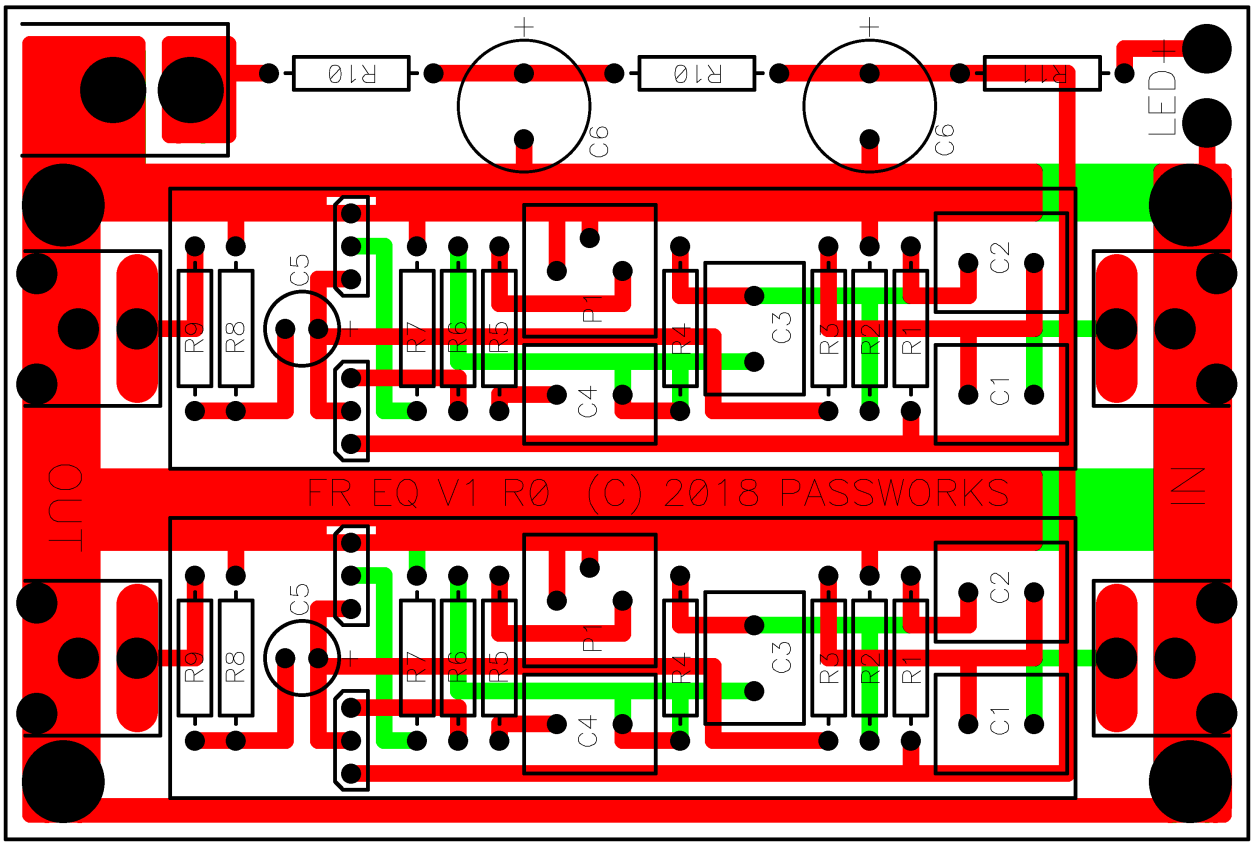
Most of the time full range drivers need a little help on the bottom end, and the bass filter is pretty good at giving them a bump without creating overdrive at frequencies below that. It is also very common to see an upper midrange elevation in full rangers with a decline at the top end, so an adjustable dip in this band is useful. P1 will give you some control of the dip.

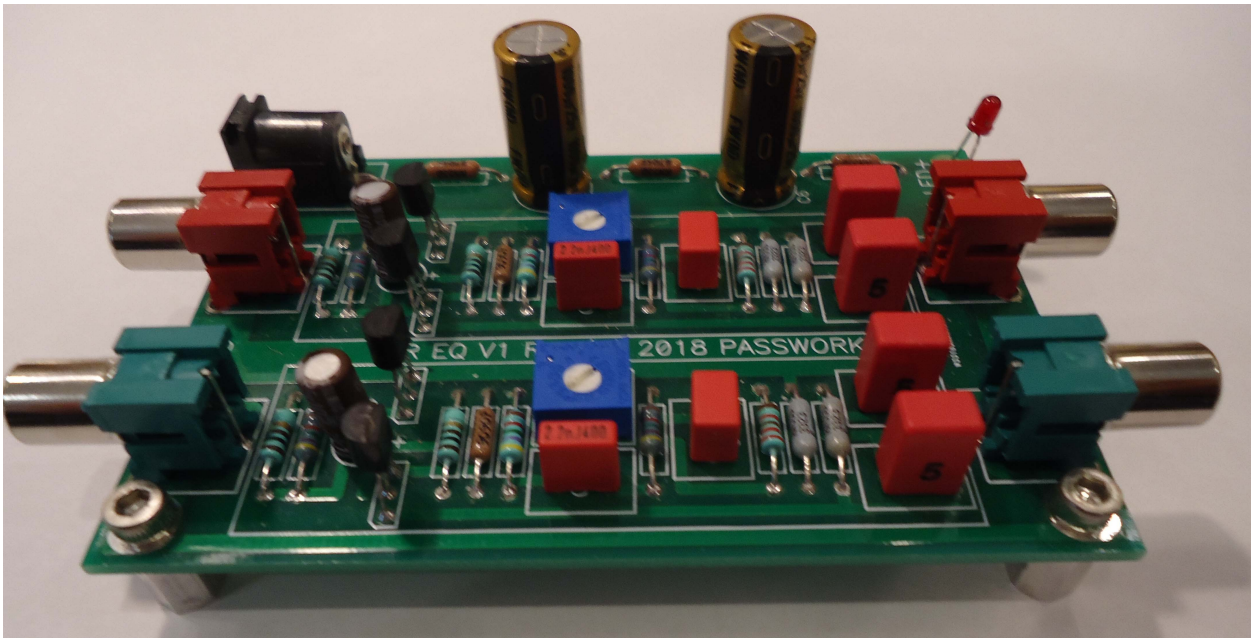
If you have a sense of where your speaker rolls off on the bottom and the band where the midrange peak occurs (if at all) then you can use the above curves to guesstimate the filter values and try it. If you have the data or can measure the response of the speaker, then it is not very difficult to run the simulator a create the RC values for an approximate correction.

It could be that you will try lots of values and the pc board of the filter will become unattractive by the all the part swapping, but I will note that the kit is fairly inexpensive, so you could use a new one once you have settled into the values (and re-use the power supply).

Keep in mind that we are not trying for the accuracy of a 24 band equalizer with tons of active elements and/or digital filters. To my mind full range drivers are part of an aesthetic of simplicity that is at odds with complicated electronics. We just are looking for modest improvements that bring out the best in the full range drivers.

Following is an image of the printed circuit board, with the top layer in red and the bottom layer in green, as well as a photo of the finished project. The kit is provided as the “Essential” version of pc board and matched Jfets in the store at diyAudio . Also offered is a “Completion” kit with the rest of the parts and a 24V switching supply.





Additional support will be found at www.diyAudio.com / Pass Labs Forum / Full Range EQ.