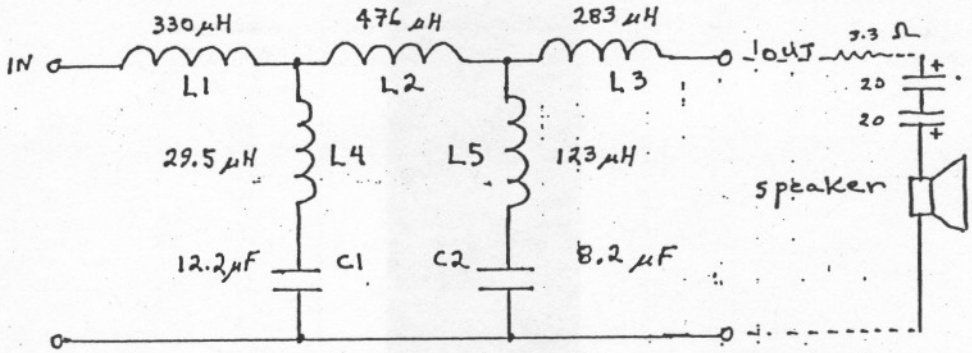
M67-2-1

A Passive Audio Filter For Use With a Speaker

by Al Koppel

Owners of the NRD-525 are aware of the high frequency hiss on its audio output, even while using the NVA88 external speaker. In addition, I found it annoying to hear 5000 Hz hets when listening near powerful SW broadcasters while using the wide IF filter. As there is plenty of room inside the speaker enclosure, I decided to build a low pass filter which would eliminate these problems. In addition, the design would be useable for similar receiver/speaker combinations.

The desired cut-off frequency was 3000 Hz, with minimal ripple in the passband and high attenuation at 5000 Hz. A standard low-pass filter design with steep enough roll-off would involve numerous inductances and capacitances. Instead, I used information contained in the Radio Data Reference Book, 4th edition, from the Radio Society of Great Britain (pages 51-55 Table 1-5 #1). This showed an appropriate filter normalized to 1 Hz cut-off with a 1 ohm input and output impedance. Following the procedure in the book, I developed the following filter with a 3000 Hz cutoff and a 4 ohm impedance suitable for the speaker:



No. of turns: L1--131 L2--151 L3--124
L4--42 L5--82

Figure 1

The coils were home wound, and are 1" inside diameter by 1 1/2" long. All coils were multilayer to accomodate the number of turns required. I used #19 D.C.C. (double cotton covered) copper wire to wind the coils; this has approximately the same diameter as #17 enamelled copper wire. The capacitors should be polyester or of a similar high grade; I found that electrolytics caused poor roll-off characteristics due to their low parallel resistance. The 12.2 uF capacitor is made up of a 10 and a 2.2 uF capacitor in parallel.

If sharp 5000 Hz rejection is important to your listening, L5's turns could be adjusted to give exact 5 kHz resonance with your 8.2 uF capacitor. A piece of ferrite placed partially in the middle of the coil will increase inductance, a piece of copper pipe will decrease it. I was able to obtain over 50 dB rejection at 5000 Hz using this method.

The test circuit below can measure inductances of home wound coils (especially useful if you can't wind ones similar to mine). Adjust the audio oscillator for the largest voltage indication on a scope (or FET VOM) and use the formula shown to give coil inductance. The capacitance value should be accurately known (check it on a capacitance meter if possible) for best results.

MBT-2-2

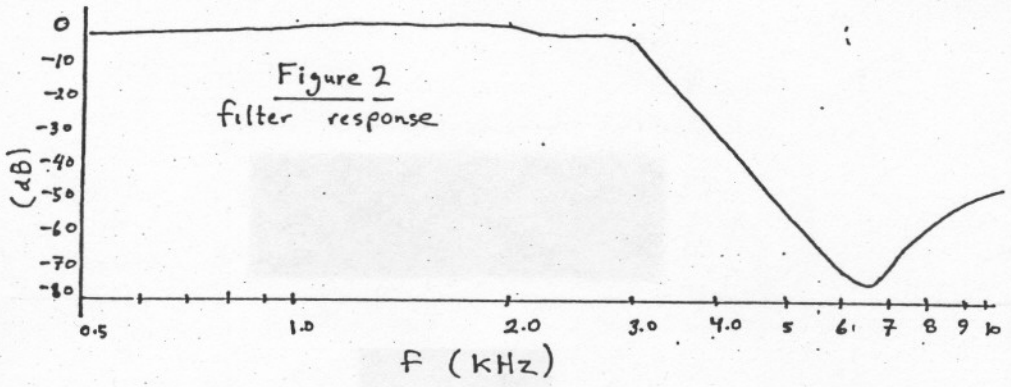


Figure 2
filter response

Incidentally, the NVA88 cabinet is poorly designed and has a resonant point of 160 Hz. When I mounted my circuit in the cabinet, I placed foam rubber in there as well to dampen this resonance. My cabinet has another resonant point at around 9 kHz, and the die-hard experimenter may want to design his filter to reject this frequency as well, because filter rejection tends to deteriorate again as the frequency goes higher. I tried a 3.3 ohm resistor in series with two 20 uF electrolytic capacitors placed back to back (see figure 1) between the output of the filter and the speaker, and noticed several dB further reduction at 9 kHz with little change to the overall filter passband.

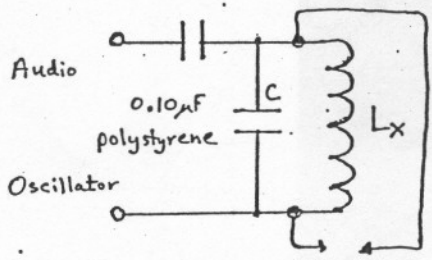


Figure 3

$$L(mH) = \frac{25.33}{C(\mu F) \times [f(KHz)]^2}$$

∴ using C of 0.10μF

$$Lx = \frac{253.3}{[f(kHz)]^2}$$

(ed note: Although Al is not an IRCA member, I thought that this would be of use to readers of this column. I tried this modified speaker with my Drake SPR-4 and found that even music sounded much better on the NVA-88 than with the filter bypassed. This certainly took the ragged edge off the otherwise unimpressive SPR-4 audio. I agree, however, that at least some of the audio problems must be due to this speaker's poor design.)