Low Power All Valve Headphone Amplifier

With No Coupling Capacitors and No Negative Feedback

GENERAL

This is a project that has roots back about 2 years or so ago. I wanted a quality headphone amplifier to be an addition to my system. I was to be something to use when I didn't want to disturb everyone else in the house. I prototyped a few, but never got around to doing a finished version. One version used 6J5 miniature twin triodes that share a common cathode. As a note all versions were push pull in nature. It worked fine, but didn't seem to have as much dynamic range as I wanted. Other versions used 12AU7s and 6CG7s. For various reasons none seemed to come up to the standards I wanted. So finally I designed and built one using E88CC/6DJ8 dual triodes that I liked. It is designed along the lines of the Oddwatt power amplifiers, except it has no driver stage. All the gain is in the single output stage. Once again I used a solid stage constant current source in the cathodes but since only low power levels were needed there is no provision for balancing the load between the two triode sections. None was needed either as the output is quite symmetrical to levels way above anything you could use with headphones. I wanted simplicity in the circuit. It has neither coupling capacitors nor any feedback loop. In fact there are a total of only 7 components including the tube in each channel. The power supply, alas, has many more components. This is common in many of my designs. I find that very clean power is essential to high quality performance.

CAUTION: This project uses moderately high voltages in the 250 to 270 volt range. Contact with voltages of this magnitude can cause serious injury or possibly be fatal. If you do not know how to build projects that have these potentials or are not comfortable in with projects have these voltage levels I strongly recommend you do not built this amplifier.

DETAILS

The layout and construction is not critical as the gain is relatively low. Approximately 100 millivolts input will result in about 50 milliwatts output. This is much more than is needed for really excessive sound levels with most headphones. The output transformers are Edcor XSM-10K-150. They are designed for inter stage matching and have a center tapped primary impedance of 10K and a center tapped secondary of 150 ohms. These values lend themselves for use with many phones. While there is some loss of efficiency in using phones below 32 ohms on the 75 ohm tap there was minimal effect on the quality of the sound. Besides anyone wanting efficiency should not be building headphone amplifiers that use tubes. Power consumption is approximately 20 watts. The power supply provides DC for the heaters and well filtered B+. I believe that AC on the heaters would be just fine but since I have the PCBs and components to get the DC, it is what I used. The PCB and chassis are from left over Forewatt line stage preamp prototypes. Being somewhat frugal, I tend to use things that are available. The 1.0uf and

0.1 uf capacitors in the circuit should be “poly” types. The ones across the tube heaters can be low voltage ceramics. For best performance the 1.0 uf capacitor shown on the main amplifier section near the output transformer should be close to the actual B+ connection on the transformer. You can use the standard size of LM317 in place of the TO72 size low power ones if you wish. The actual dissipation is rather small at about 75 milliwatts. The LM7806 should have a small heat sink or tab as it will be dissipating a little over a watt if you use the Edcor transformer shown in the schematic. I recommend against using standard rectifiers in the B+ power supply. The UF400X series work far better and generate considerably less noise than the 1N400X ones do and are nearly as cheap. The bridge rectifier in the heater circuit can however, be a generic one. As always, be careful not to create ground loops.

PERFORMANCE

The amplifier will deliver over 100 milliwatts of output into pretty much anything from about 32 ohms to 300 ohms. The optimum match is at 75 and 150 ohms. If you go below 32 ohms the performance will be less as the load on the tubes will be below the best range. Above 300 ohms it will also be less than the best match, but many phones in that range seem to be more sensitive than those with lower impedances and it may not matter. The frequency response at the 50 mw level is from 20 HZ to 28K HZ within 0.5db and the wide band signal to noise is at -84 db. I didn't run a full distortion series on the amplifier as the output levels are rather low (voltage wise) and the ambient EMI in my shop would tend to confuse the results. On a spectrum analyzer I was able to get as much as 2 volts output before there were obvious harmonics appearing on the display. At more typical listening levels (about 0.1 to 0.2 volts into 100 ohms) there was no sign of any harmonics above the noise floor. I would conclude from this that the actual distortion levels at such levels are well below 1%.

HOW DOES IT SOUND

The sound in short, was excellent. With my phones (Koss Pro4AAT and Sennheiser HD280S) there was no audible noise or hum and the response was rich and clean. I won't give up my electrostatic speakers and other gear to swap for phones and the headphone amp but it sure is nice for those occasions when private listening is needed.

Good listening Bruce

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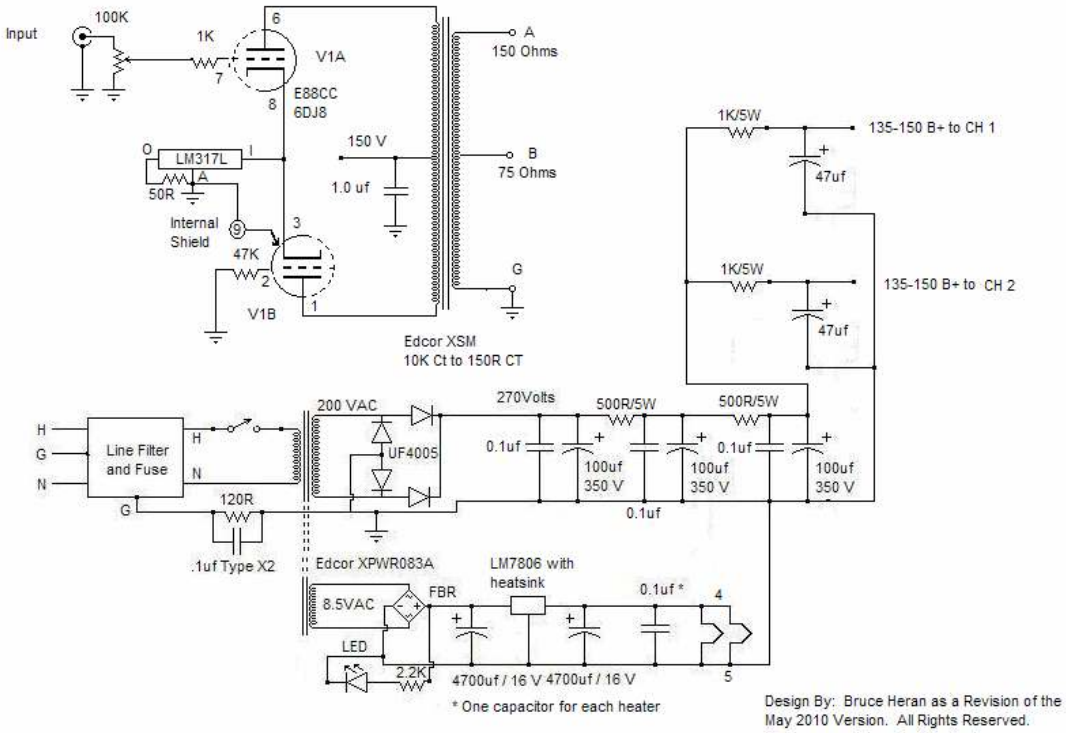
Only one Channel Shown



* One capacitor for each heater

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