

Building A Vacuum Tube Guitar Amplifier

By Andy Robb

Dec 10, 2000

My one and only project for physics 398EMI was to build a Vacuum Tube Guitar Amplifier. My goals were to build a tube amp that sounded nice and that could be put together for a reasonable cost. I chose to try to build a Fender Bassman amplifier (AA864) a version produced in 1964. Fortunately a great deal of the parts I needed I was able to scrounge up for free. I acquired many, many, vacuum tubes from junked Lab equipment. And I also came across an old Tektronix signal amplifier that was being junked it turned out to be the perfect chassis for the amp and it also had a very beefy power transformer that I could use and a fan that I figured would work wonders keeping the tubes cool. I also bought a 50-watt Fender output transformer.

The circuit

The next step was to modify the heck out of the Bassman circuit. If you look on the circuit diagram you'll notice that it's been changed quite a bit from the original. The input for the bass instrument was dropped altogether. The 2nd stage 12AT7 has been replaced with a 12AX7 for greater pre-amp amplification. The filters and sound controls were changed, and I dropped in a potentiometer to control the presence. I also have it so that I can use either vacuum tubes or solid-state diodes for rectification of the High Voltage power.

Building the amp

Building the amp was the hard part. I grabbed some ceramic component holders from some junked o-scopes and crammed them into the chassis. I ran filament power to the tube sockets and then proceeded to drop in the components. I was somewhat worried about problems with hum as I built this and tried my best to keep AC lines away from signal lines and I used very thin coax cable for long signal lines. At every opportunity I had I chose to use very high precision parts. The lab equipment I ripped apart yielded a ton of resistors and capacitors with tolerances of 5% and under.

It took me over a month to finally get it to the point where I could first test it out. I then entered the stage of troubleshooting. The power supply I am using gives out a voltage that is about 402 volts this is about 20V lower than the power supplies used in the Bassman AA864. The power tubes contain a grid that can be biased to limit the current flowing through them and thus the total power they produce. I originally had my tubes biased at -53 volts and this seriously cut back the amount of power it produced. I then dropped in 1-OHM resistors between the cathode of the power tubes (pin8) and ground. This allowed me to measure the cathode current and then to calculate the total power dissipated in the tubes. I then turned them up to an appropriate level of 42 mA (corresponding to a 6L6 grid bias voltage of -40 volts).

The next interesting situation I encountered was an instability when the amp is turned up all the way. I'm somewhat unsure what caused this but I dropped the resistance between the cathode of the second 12AX7 and ground and replaced the wire wound presence pot with a normal single turn pot and the instability vanished.

The cabinet and speakers were the last thing I threw together for the amp. I used a pioneer 12-inch hi-fi subwoofer, a soundteller 8-inch guitar speaker, and a 10-inch guitar speaker. They were enclosed in an open back 26"*26"*16" plywood box. I put it into an 8-ohm configuration and hooked it up to the amp.

The end result

What I ended up with wasn't a Fender Bassman. It's by all means it's a very unique amplifier. It has a beautiful warm sound. It distorts nicely and sounds great when you crank it and would make a wonderful lead guitar amp. Although at 50 watts max it's not the most powerful amplifier it is very loud, the speakers must be pretty efficient. It is hard to describe the sound that's put out by it but I will be recording some sound samples for the course web page. For those of you who haven't gotten to hear the amp do try to check it out.

I have been thinking what may have led to the uniqueness of the amp and I've come up with a few reasons why it sound the way it does. I believe that the lower plate voltages give rise to greater distortion. The circuit was modified quite a bit from the original. The precision resistors I used have non-negligible inductances. And finally the speaker combination and cabinet is somewhat unusual and I believe helps the low frequencies ring through much clearer.

In the future I will be trying it out with a pair of 6550's in place of the 6L6's to see how different it sounds I may also make some recordings of that. Another thing I plan to do is to measure the frequency response of this amplifier. I haven't had a chance to do so due yet but it will be interesting to see.

And finally, a big thanks to Steve Errede for all the help with this project.