Mini Block Ultra Linear Class A Push-Pull Valve Power Amplifier

Precaution: This project uses potentially lethal voltages and should not be undertaken by anyone who is not familiar with working with such voltages or may not be comfortable with projects that entail such voltages.

A Pair of Mini Blocks (the bigger transformer is the power one)

General

It has been a while since I did anything really crazy in DIY and had it work out far above my expectations. Such is the case for the Mini Blocks. I had a lot of extra parts lying around (really a huge amount of them) and tried to figure out what I could build. Two small chassis about 5 inches by 9 inches by 2 inches (12.5 X 22.5 X 5 cm) were just begging for a project. They are just the right size for lots of things. I first thought of a pair of SET amps. But since I didn't have any suitable single ended output transformers I nixed that idea. A preamp perhaps could be built on one of the chassis. Since I have many preamps now that didn't really get the nod either. A pair of small push pull amplifiers was next on the list. Maybe, but I have so many amps now that it doesn't make sense either. Since this hobby doesn't always have to make sense, that is what I built. Clever observers will note that each of the mini blocks is a whole lot like half of a Poddwatt. This is true, but there were a number of what seemed like small differences that caused some surprising end results. The mini blocks are more powerful than the

Poddwatts and seem to have more detail while retaining all the good characteristics of the Poddwatts. The biggest differences from the original project is in the output and power transformers. This is especially true in the case of the output transformer. They are custom designed to my specifications by Edcor and while OEM to Oddwatt Audio, I asked Edcor to permit sales to individual customers. The part number is EMO-750. In a push-pull class A ultra linear amplifier using EL84s they excel. The other change is to use the power transformer from the bigger amps (EMO-719). This transformer is now also available to individuals from Edcor. It is serious overkill for power. It doesn't even get warm in use. Other changes include the use of AC heaters and revised component values and voltages on the SRPP driver. The net result is a small mono block that will deliver 5.8 watts RMS from just below 10HZ to 44KHZ within 0.2db. Distortion is quite small at under 0.25% through 1 watt RMS and gradually goes to 2% at full power. Signal to noise on the prototypes was -89dbv. Better yet than all the specifications, they sound a lot more powerful than they measure and are for want of a better term extremely articulate in reproducing music. They are now my main amplifiers. They drive my Martin Logan Vista ESLs just fine. Like I said, they sound more like 15-25 watt amplifiers than 6 watt ones. To have a more complete explanation of the various operational and design features of the Oddwatt type amplifiers please see some of my earlier posted projects.

The Build

Construction is straight forward and un-complicated. I didn't show a photo of the insides as the layout is non-critical. I used a perf board for the power supply and point to point wiring for the remainder of the circuit. I mounted the LM317 directly to the chassis with an insulator. I used a three pin ribbon connector to connect the LM317 to the circuitry. The grounding system I used was a main signal ground buss running down the length of the chassis. The actual buss was made from a strip of self adhesive copper tape that was used in window breakage alarm systems. The power supply board had buss wires down each edge that tied together in the center of the board. From there I ran a single wire to the junction of the signal buss and the input and output terminals. I have found that this type of arrangement works well to prevent ground loops. The chassis is connected to the same ground location by a 0.1uf type X2 capacitor with a parallel 120 ohm resistor. The chassis is also directly connected to the AC mains ground at the IEC power entry filter. The level control at the amplifier input can be deleted and replaced with a 100K resistor to the ground if you are going to use them as mono blocks. With the level control in place the amplifiers can be used as stand alone monaural amplifiers. The cases are made out of bamboo kitchen bins with one end cut off. The bottom of the bins slide out and make it easy to access the interior of the chassis.

Side View of Mini Blocks

Specific Build Concepts

As always, I recommend a few things so that you can get the best performance from a project:

Keep wires and components that carry signals away from ones that carry power.

Use shielded wiring from the input jacks to the volume control and if more than an inch or so from the volume control to the tubes.

Ground only one end of the shielded wiring.

If signal and power wires must cross, separate them as much as possible and do so at right angles.

Tightly twist AC carrying wires together (such as to tube filaments).

Use terminal strips, lug strips or other methods of fastening components in place so they will not shift over time and possibly short out.

Be sure to observe the color codes on the transformers. If you get the output transformer wiring wrong (blue vs brown) the amplifier will have positive feedback instead of negative feedback and will not perform properly.

Use quality components. Cheap parts, especially the coupling capacitors will seriously degrade the performance of the amplifier. The Russian K40Y9 paper in oil capacitors work well as the coupling capacitors in this amplifier. I used audio grade capacitors for bypassing the filter capacitors. You do not need to use the brands specified on the schematic, I left them there to show what I had used.

Do not use carbon composition resistors. Use either metal or carbon film ones. One half watt size is sufficient except for the 100 ohm one in the power supply. It should be a 2 watt or larger and can be a wire wound type. Use 5 percent tolerance resistors for best results (except the 100 ohm power resistor which can be 10 or even 20%).

Filter capacitors may be larger, but avoid using smaller ones. I recommend 300-350 volt rating on the capacitors as the power supply can deliver slightly over 250 volts with no load at 120VAC input. If you AC mains are above 120 volts the value will be correspondingly larger.

Be careful using the LR8 IC regulators. They will fail if you wire them wrong, short them out or abruptly apply a different load. If they fail, they usually will act just like a low value resistor and pass all the voltage to the load. They also have internal sensors for temperature and excessive dissipation. If they sense either condition they will shut down and not restart until you remove the power and correct the condition. The first time this happened to me, I thought the regulator had failed. The “K” series LR8s are the most robust but the “N” series that look like TO92 transistors may be easier to use.

Be careful using the LM317. They are robust, but can be cooked. If you wire them wrong they will not act as constant current sources and the amplifier will not work.

In amplifiers like this one, be sure that no part of the heater circuit is connected directly to the ground. It will defeat the reference voltage (about 70-80 VDC) that is applied to the heater circuit. The reference voltage protects the driver tube from heater to cathode failure and helps reduce the overall noise level in the amplifier.

Place the driver tube away from the power transformer. It isn’t particularly sensitive to hum pick up, but every little bit helps to improve the signal to noise ratio.

Space the tubes at least one diameter (of the tube) apart for good heat dissipation.

Check your wiring before you first apply power to the amplifier. See the recommended start up procedures at the beginning of the forum for tube projects.

Amplifier Operation and Final Checks

This amplifier is identical in operation to all the other "Oddwatts". It uses a constant current source to establish tube operation instead of a more conventional cathode bias resistor or fixed bias arrangement. The use of the CCS forces the amplifier to always stay in class A mode. To insure that both output tubes share equally in the power output a balancing control is placed in the cathode circuit. It is important to proper operation of the amplifier that the tubes be balanced at idle. This should be done on initial power up and checked after a few minutes to allow for initial tube variances. After that it should be checked occasionally and reset as needed. The reading ought to be about 41 milli-volts on each set of test points (82 milli-volts total of both sets). If you can not obtain satisfactory balance, check for wiring errors. If you don't find any, then try swapping the tubes and see if the problem follows the tube or remains with the socket. If it follows the tube, then one or the other is out of tolerance and needs to be replaced. I find that with well matched tubes the deviation is quite small even after many months of use. An unbalance up to10% will reduce the output power but otherwise not be a problem. Above that level it is possible to have the tube passing the greater current to approach maximum thermal dissipation and in extreme cases fail. When you do the balance measurements you are actually measuring milli-volts across the one ohm resistors. This translates directly into the number of milli-amps that particular tube is passing. I highly recommend matched pairs of output tubes from quality manufacturers. Others may work, but performance can not be assumed to be good.

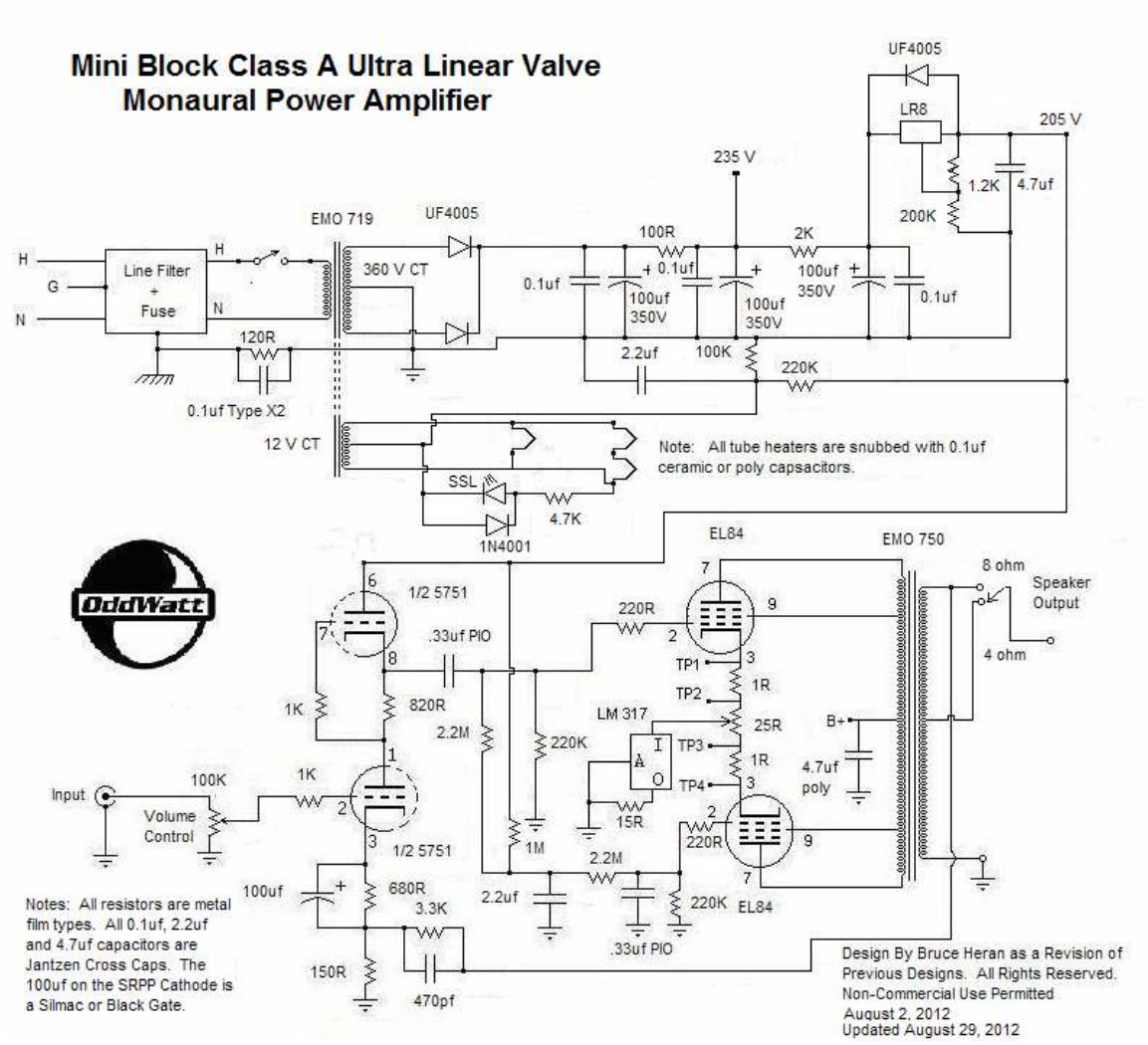
Trouble Shooting

As noted above if the tubes won't balance there is either a wiring error (including cold solder joints) or a tube out of tolerance. If the tubes balance and you get no sound then you need to go through the wiring to find the problem. In the event the amplifier seems to have no bass or sounds excessively detailed you probably have the output transformer wired incorrectly. Temporarily disconnect the negative feedback wire and see what happens. If the sound level goes up then it was correct, if it goes down then it is backwards. You will then need to swap the anode and screen leads from the transformer from one tube to the other. If there is excess hum you will first need to determine the type. Is it at the mains frequency or a multiple of it? If it is at the mains frequency it is either due to lack of shielding on the input signal wiring, or a ground loop. If it is at a multiple of the mains frequency then it is power supply related and most often indicates a problem with a filter capacitor.

Use and Listening

The amplifiers require virtually no care and should work well for a very long time. I estimate tube life of around 5-8000 hours depending on the brand. The original tubes from the Poddwatt project are now in the mini blocks and have somewhere in excess of 6000 hours and are still fine. There is no time delay / warm up circuit in these amplifiers and based on my prior experience none is needed. They will produce quality sound within about a minute from turn on. The sound should be clean, detailed and full range. Tube rolling is possible and encouraged with these amplifiers. I find that JJ and EH EL84s sound fairly similar and have a very detailed and clean sound. New production

Mullard ones are warmer and slightly sweeter in sound. For the driver, the new production Sovtek 5751 is very nice with a detailed and ever so slightly bright sound. The NOS Phillips used in several of my projects is a little warmer and laid back. It is a good choice for systems that on the bright side. The new production JJ 5751 is not recommended. It does not seem to perform like the other 5751s and has an inferior sound in these amplifiers. You can also use many 12AX7/ECC83/ECC803 series tubes. They will work satisfactorily but I was not able to find any I liked better than the 5751. My preferred combination is the Sovtek 5751 and JJ EL84s.



Final Thoughts

While it didn't make any sense to design and build these amplifiers, I am really glad I did as they are stellar performers. I hope you enjoy this project as much as I am and I welcome comments and questions regarding it. I will have a thread on the forum for it so we can all share experiences. Finally while many of my projects find their way into kits, it is unlikely that this one will. So if you want one, you will need to build it. I made the task a bit easier by permitting Edcor to sell the transformers directly to individuals.

Good listening
Bruce