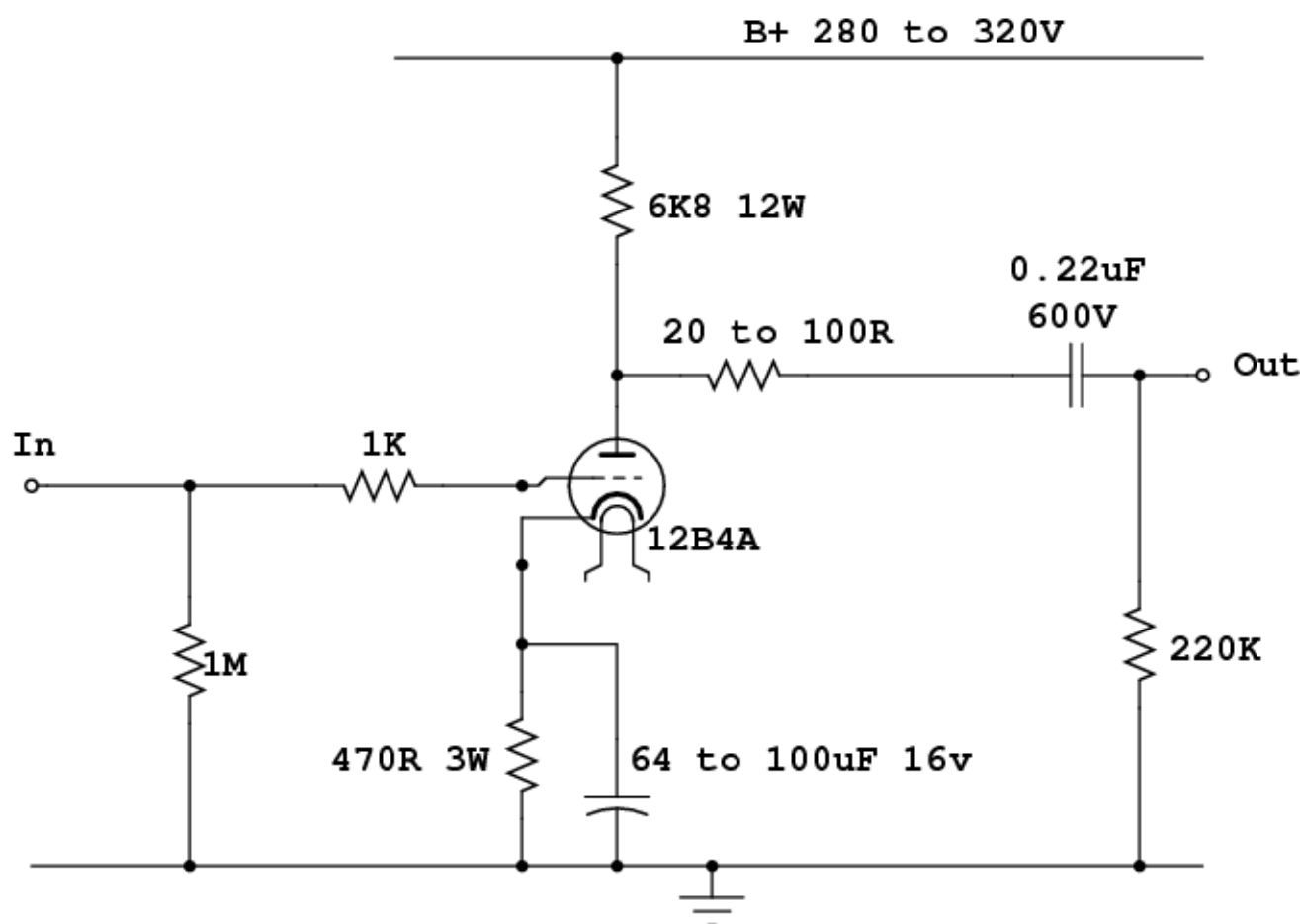


12B4A DIY Pre-Amplifier

Introduction

Recently going through the diyaudio forums I came across an old thread that was once very active. It was all around building a 12B4A based pre-amplifier. The circuit given used a regulator in the cathode for a constant current type design but a resistor could be substituted in its place. The circuit was very simple, easy to make which I always like. It was also getting quite favorable reviews from those that had built it so I decided to have a go myself. I really needed another pre-amp to test with the Mr Liang 845, which although is an integrated, really needs a good pre for some more gain especially if using 6SJ7 type driver tubes.

Before I started I put the circuit values in an old version of tubecad software and everything seemed ok. In-fact the resistor values can be adjusted somewhat with no odd results. I have re-drawn the circuit in xCircuit as shown below.



I had many of the parts already and I really needed to make use of some of them so this was a good opportunity. A friend gave me an old case which I primed and sprayed satin black. I managed to scrounge a nice choke for the PSU although some have built the PSU without a choke.

The 12B4A is really a small power tube capable of dissipating 5.5W on its plate. It should also be possible to drive a pair of high impedance headphones directly or a pair of speakers via an output tx with some circuit changes.

The 1K grid stopper is optional but I would use one at least 100R. The 0.22uF output cap is a minimum value and it really depends on the load it is driving and can be increased to what you have. Again use common sense, value is not critical so just use what you have to hand as long as it is not too low a value.

Removing the cathode by-pass capacitor across the 470R 3W resistor creates some local negative feedback and will lower the gain of the stage from 5 to about 3 and also roll off the bass so take care and experiment with matching your power amp and speakers to hear the effect.

GENERAL

ELECTRICAL

	Series	Parallel
Cathode—Coated Unipotential		
Heater Voltage, AC or DC	12.6	6.3 Volts
Heater Current	0.3	0.6 Amperes
Heater Warm-up Time*	—	11 Seconds
Direct Interelectrode Capacitances, approximate†		
Grid to Plate	4.8	μμf
Input	5.0	μμf
Output	1.5	μμf

MECHANICAL

Mounting Position—Any
 Envelope—T-6½, Glass
 Base—E9-I, Small Button 9-Pin

MAXIMUM RATINGS

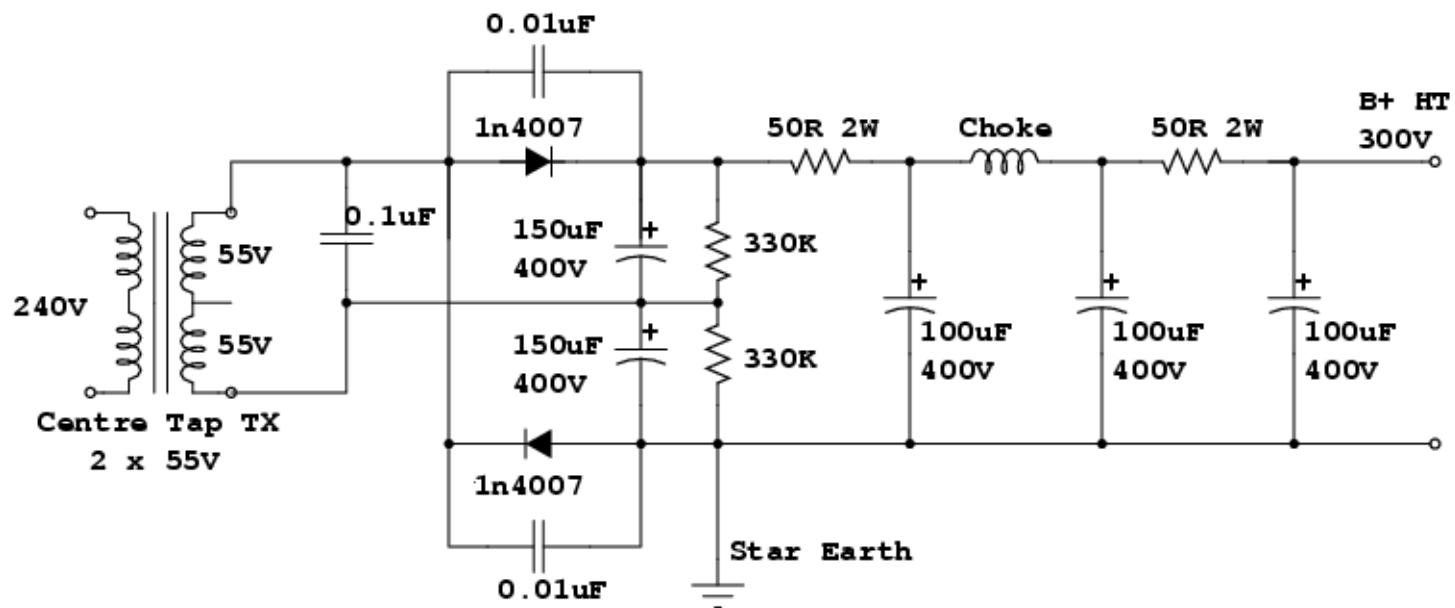
	Class A ₁ Amplifier	Vertical- Deflection Amplifier‡
DC Plate Voltage	550	550 Volts
Peak Positive Pulse Plate Voltage	—	1000§ Volts
Peak Negative Grid Voltage	—	250 Volts
Plate Dissipation	5.5	5.5π Watts
DC Cathode Current	—	30 Milliampères
Peak Cathode Current	—	105 Milliampères
Heater-Cathode Voltage		
Heater Positive with Respect to Cathode		
DC Component	100	100 Volts
Total DC and Peak	200	200 Volts
Heater Negative with Respect to Cathode		
Total DC and Peak	200	200 Volts
Grid Circuit Resistance		
With Fixed Bias	0.47	— Megohms
With Cathode Bias	2.2	2.2 Megohms

The Power Supply

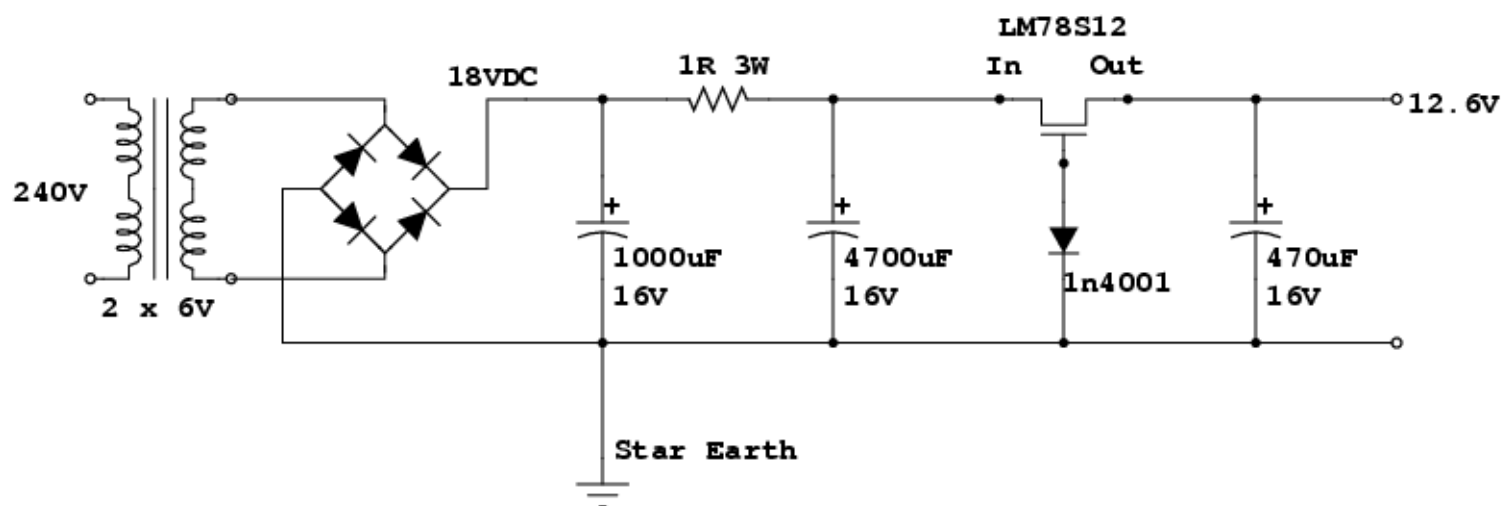
The power supply for most tube gear is always a problem. Getting hold of high voltage tube transformers at low cost is not easy in the UK and most sites that sell suitable transformers are not only costly but are usually based in the USA or Hong Kong so shipping greatly adds to those costs. This was meant to be a scratch project as cheap as possible. I already had a 12V potted transformer in my parts box so the heaters were not a problem. The HT needed to be around 280V. I also had a RS 50VA transformer with 2 x 55V secondary windings which can be placed in series. It actually outputs around 120V off load but bridge rectified and smoothed would only give me 1.41 x DC ~ 170V. Not enough for this design according to tubecad. The solution was to use a voltage doubler. When the voltage is doubled the current is halved but at 50VA this is not an issue for the HT. These transformers can be bought from RS and Farnell for about £12 so are not too badly priced for a small 110V (2 x 55V) toroidal and you can reach up to 300V with them which is ideal for many tube projects.

The HT and heater supply I used is shown below. The 50R resistors can be adjusted to get the HT you need in the range 280 to 320V. A LM78S12 should be used for the heaters if you want to go the regulated heater route. This is a 2A version of the standard LM7812 which is only 1A. The regulator must be bolted to a heatsink or the chassis. If it is bolted to the chassis then the heaters cannot be floated but it does not seem to be a problem if they are referenced to ground and not lifted.

HT SUPPLY



HEATER SUPPLY



Capacitor values in both the HT and Heater supply are not critical, choose sensible values close to these. The choke can be what you have spare. I used a 10H 200R choke but anything a few Henry or more will be fine. It may be possible to omit the choke and use another wire wound resistor if cost is a problem. If you have a suitable HT transformer then obviously you will not need the voltage doubling method in the circuit above.

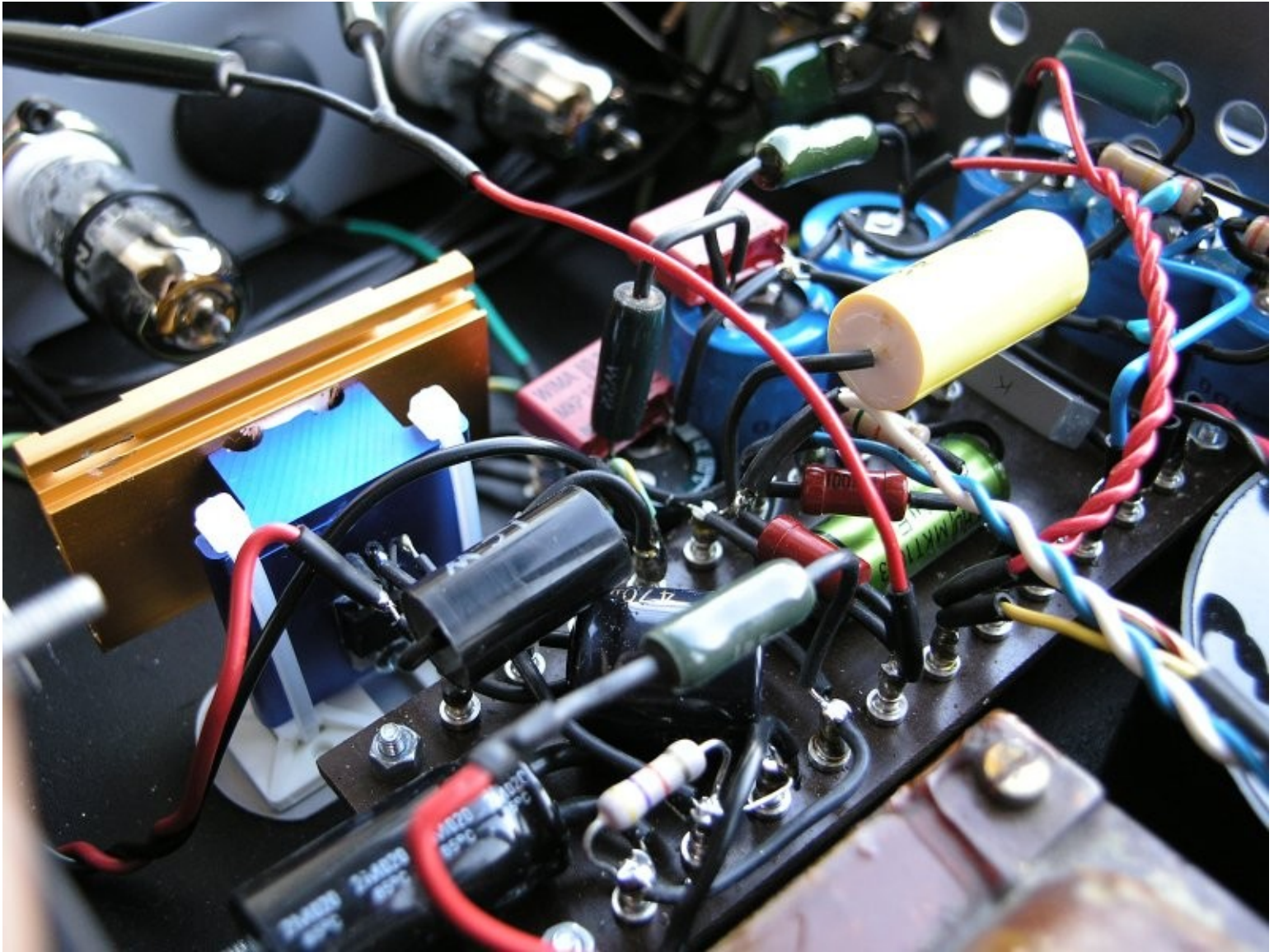
Warm-up Delay

I also used a small toggle switch in line with the HT such that at switch-on the tubes can warm up first and the HT switched later after the heaters have been on a few seconds. A small timer circuit switching a relay could be used for more elegance solution but a mains rated mini toggle on the AC side of the HT supply is cheaper, takes less space and simpler. Below shows the PSU assembled along with all sockets and switches. I also used a mini DPDT toggle switch for the input selector since I only wanted 2 pairs of inputs for a CD Player and Aux / Tuner.

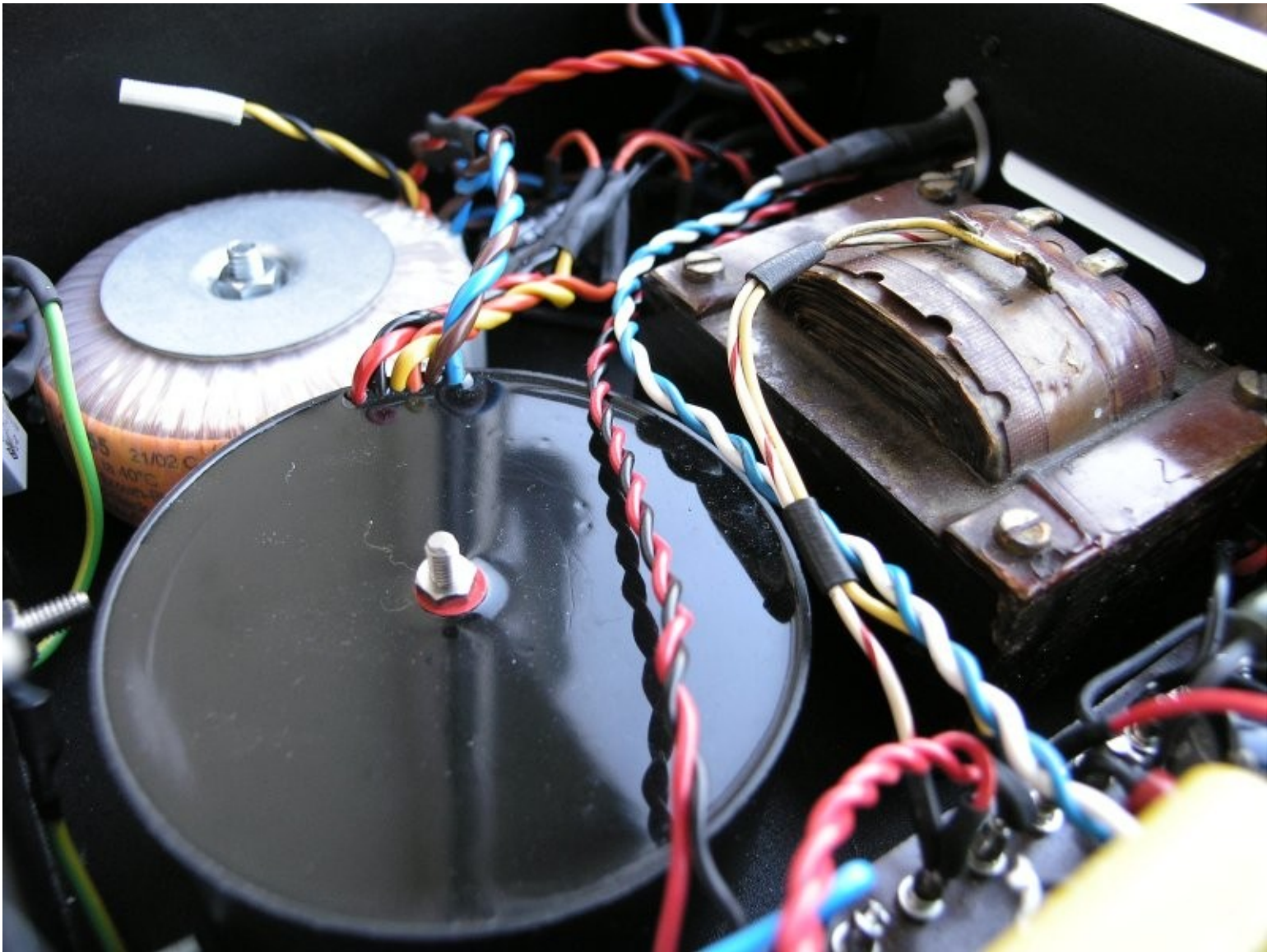


Assembly

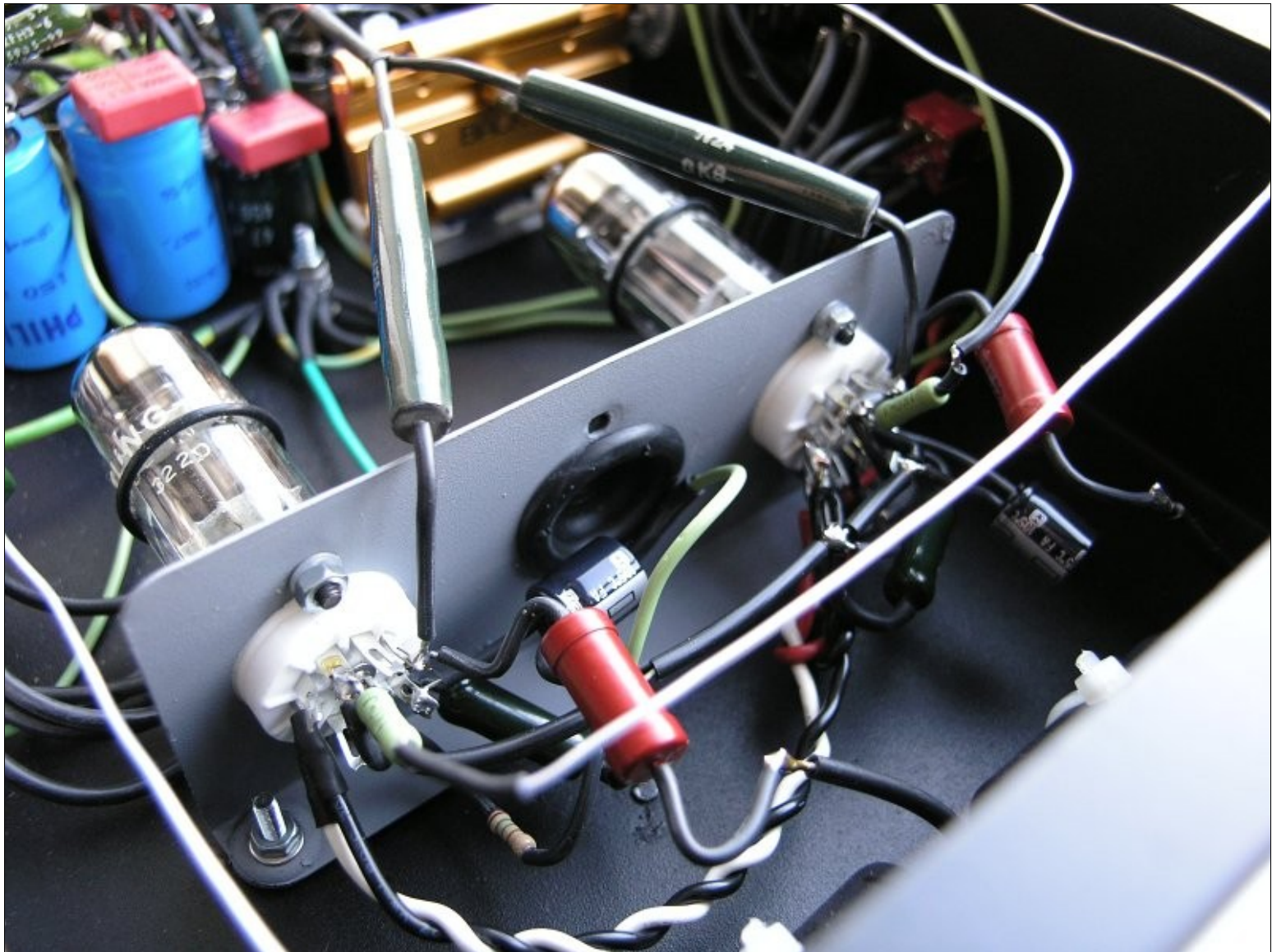
The power supply was assembled on tag strip as shown below and I used an old PC video card headsink aluminium block for the regulator sink. The larger HT caps where just glued to the case with a glue gun I borrowed.



Closeup of the RS transformers. The potted transformer is the 12V heater supply and the frame unit is the choke.



The main circuit itself was assembled on a piece of right angle aluminium which had holes punched to take the 9-pin chassis mount tube sockets as shown below. This can then be bolted to the case and it keeps the unit compact height wise since the tubes sit horizontal.



The long vitreous enamel wire-wound 6K8 12W resistors get very hot. They are best fixed in free space away from other components. If you plan on building this circuit for yourself and you have space in the chassis it would be better to purchase some metal body type wire-wounds and bolt them to the metal chassis for cooling. Just make sure they are bolted in a clear area not too close to other parts. These resistors get hotter than the tubes !! Having said that each tube takes about 25mA on the HT when measured so the resistors are well within spec at 12W.

$$P = I^2 * R$$

$$P = (0.025)^2 * 6800$$

$$P = 4.25W$$

So each of those 6K8 are only just running over 1/3rd of their rating.

Low Output Noise

The output noise level of this pre-amp is very low (0.2mV). Bare in mind that it only has a gain of about 5 so it is not huge but is enough for most systems and the output can swing 70V. Noise level is so low I can use it on my Korsun v6i in pure power amp mode, bypassing its internal pre-amp. The Korsun is a transistor amp with a very sensitive input on its power amp stage, normally needing a transistor pre-amp to maintain its low noise floor. It will amplify any hum or noise further back up the chain on any source or pre-amp so I was very pleased with the 12B4A design considering this had been built from odd spare parts.



Sound

Sound quality is good. It is easily on Par with a Consonance Basie Mk2 I built sometime back. Testing it with some Tronix or Raytheon tubes keeps the sound close to neutral with no overly warm sound. It can sound clean and transparent if not as fast and dynamic as the Aikido Pre-amp. The Aikido is one of the fastest most dynamic sounding pre-amplifiers I have used when partnered with a suitable power-amp. It does not sound nasal or pinched as some simple cathode follower tube pre-amps can do. Nor does it sound analytical and sterile like some SRPP pre-amps. It does the job with no warts and minimum of fuss. Changing the tube type to some TungSol added some tube lushness, warmth and bloom which helps when using with a transistor power amplifier like the Korsun / Dussun but it did sound a little slower with these tubes. Overall it is a great little pre-amp and worth the effort. It makes a good scratch tube project due to its simple circuit and with low gain and careful layout noise and hum will not be an issue.

David