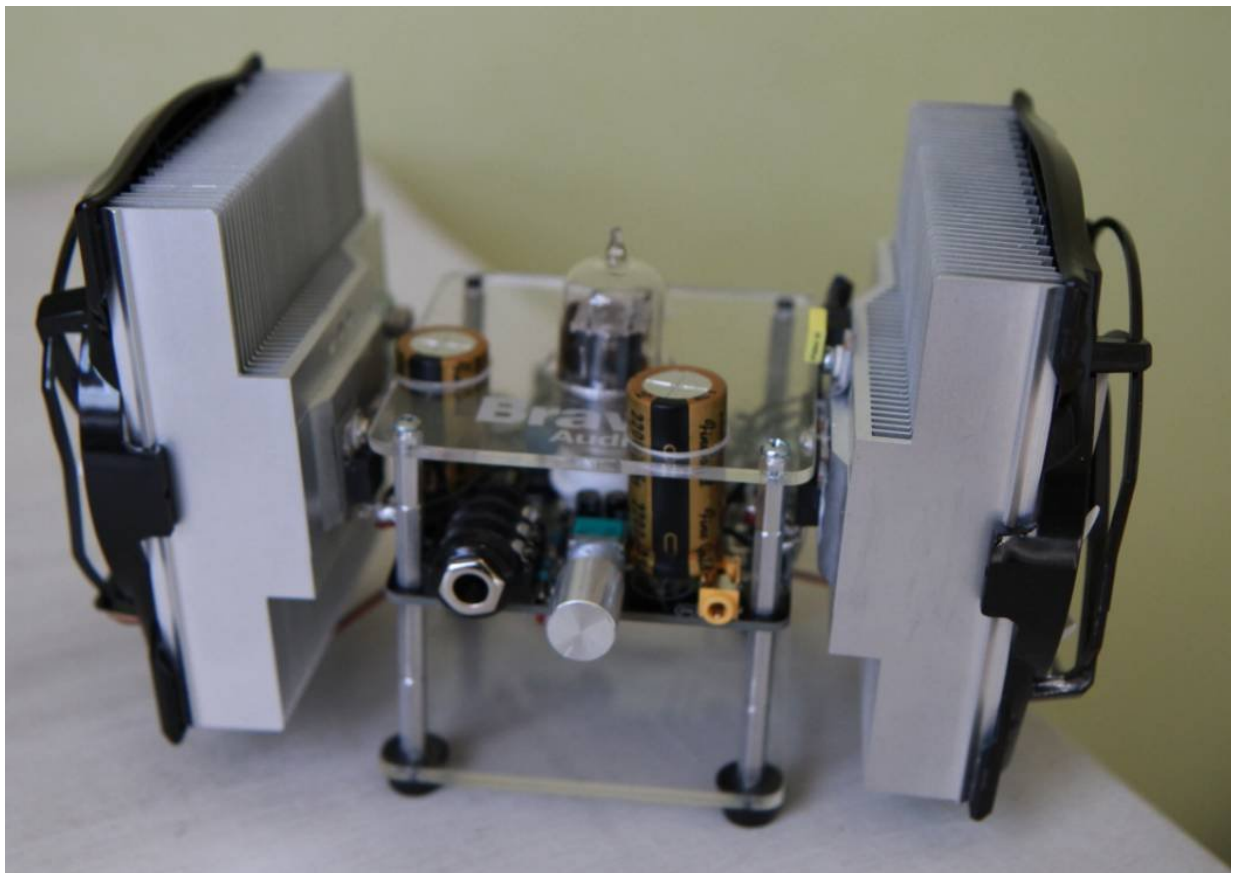
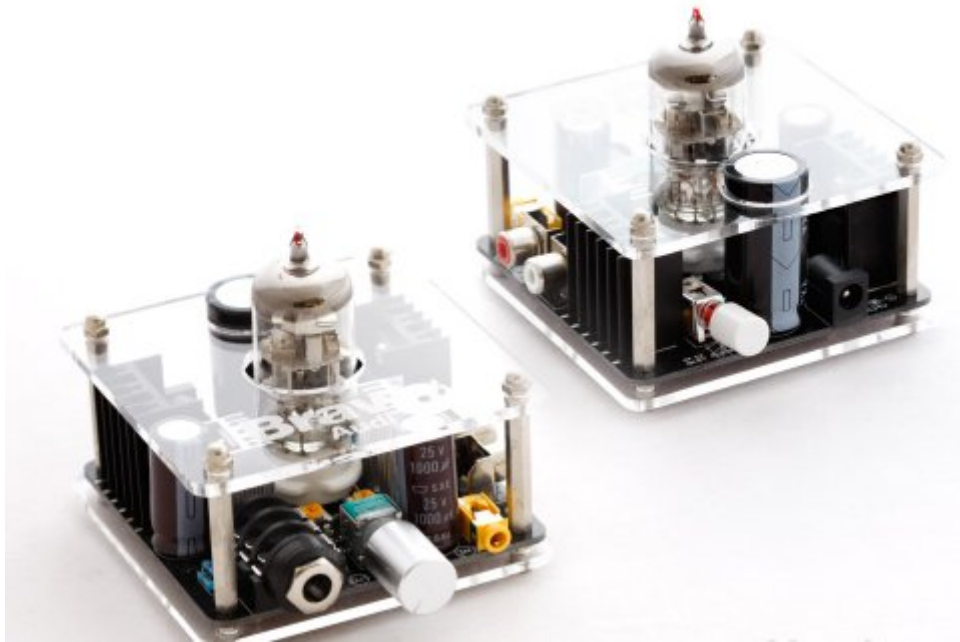


## Modifying the BRAVO V2 12AU7 hybrid headphone amplifier



# Modifying the BRAVO V2 12AU7 hybrid headphone amplifier

Here is some tips to mod this small amp to get the best of this hybrid amp. Most of the mods have been done with the help of SOLDERDUDE from the ROCKGROTTO PROBOARDS forum and with the help of Oohms for the crosstalk mod. This small design is quite cheap and can be bought on ebay. It can be used factory made but this amplifier, however, can be improved on some points.

Here is a list of the mods:

the power decoupling capacitor is rated at a too low voltage (25V)

the LM317's have an undersized/rated cooling fin

the frequency range is too limited (makes it sound 'warm' though) and can be expanded

distortion can be decreased

output power can be increased

crosstalk can be eliminated

temperatures in the amp can be lowered

300mA/365mA tube rolling made better

output disable function improved

A couple of different mods can be done to achieve these goals.

Here it comes, after buying all the parts from MOUSER (for the NICHICON FINEGOLD caps) and from FARNELL France, below are the needed parts.



## **Mod1: Replacing the IRL510 to IRL510**

The aim of this mod is to increase the frequency response. You can actually tailor the frequency range by choosing the MOSFET:

- ➔ -0.5 dB point to shift to 20kHz use an IRx530
- ➔ -0.5 dB point to shift well above 30kHz use an IRx510.

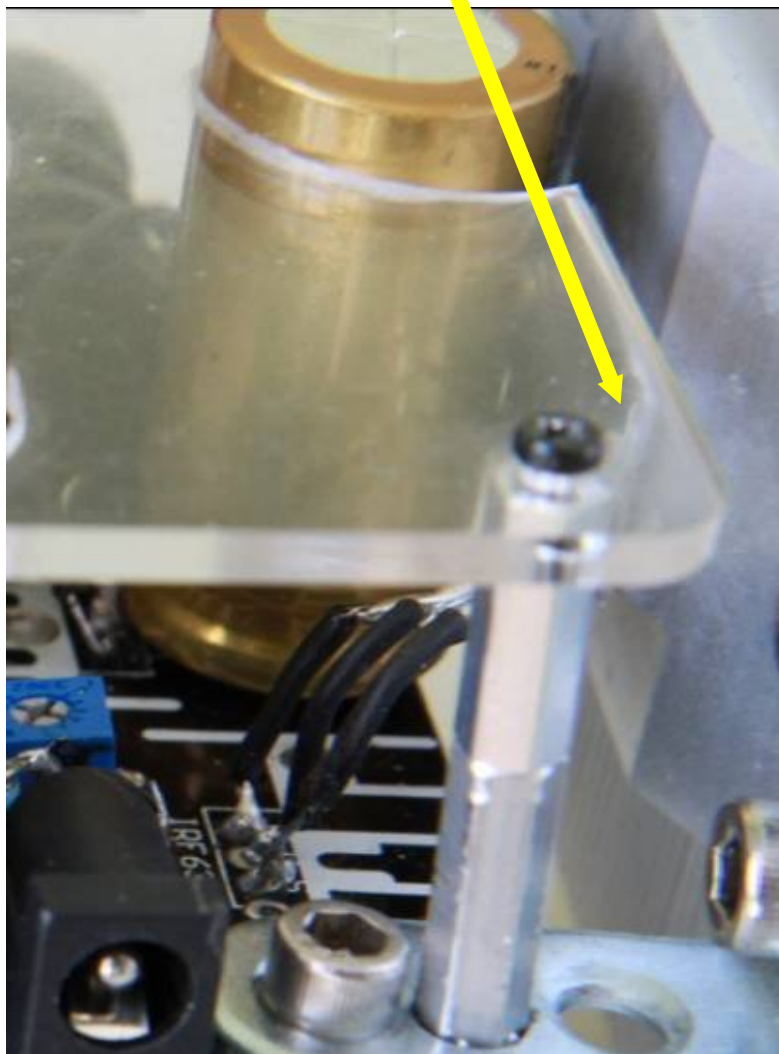
It is better to opt for **IRL** type MOSFETs instead of **IRF**.

For the mod of my amp I have changed the heat-sink of the IRL510 and placed the new IRL510 on by heat sink on each side of the amp:



No more heat-sink on the PCB

Here you can see the MOSFET moved to the heat-sink on the right side.

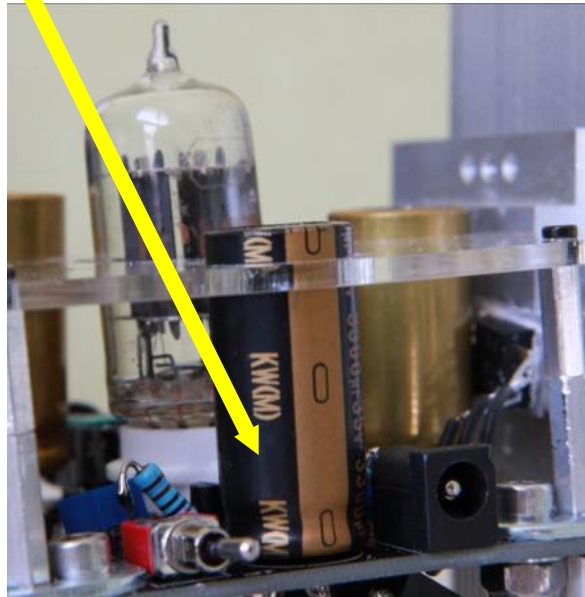


The new MOSFET have lower voltage drop in Source follower mode. With IRL types this is **4V** and IRL types this is **2V**. So when replacing the MOSFETs with IRL types there will be more voltage across the LM317's and because of this reason they will become much **hotter then before easily reaching 60°C or 70°C**.



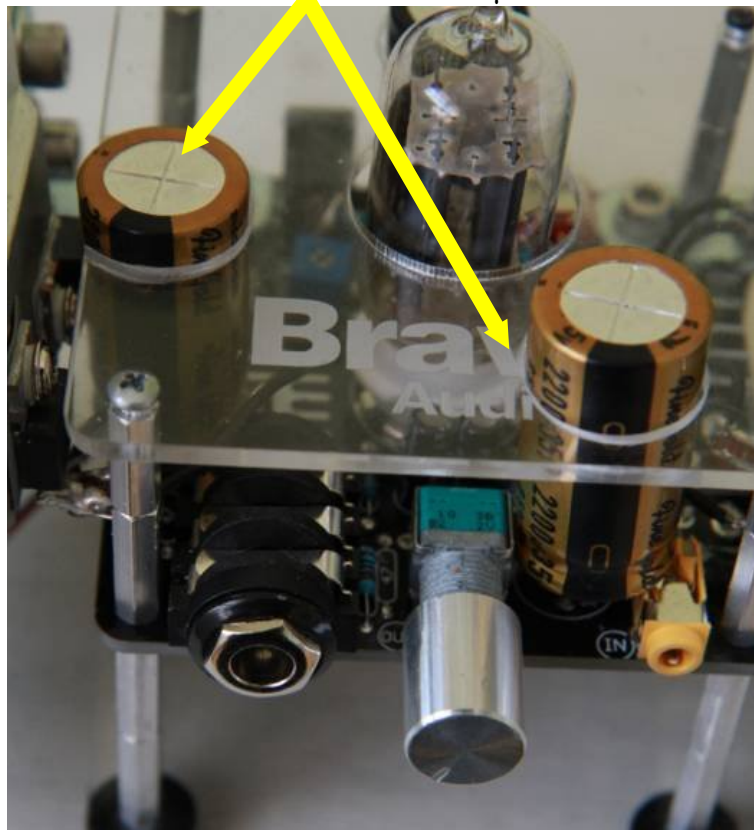
### **Mod2: Replacing the input cap:**

The power decoupling capacitor is rated at a too low voltage (25V) as the amp uses a 24V PSU voltage ! You will have to replace the 6,800 $\mu$ F/25V for a 35V capacitor. To get the same size it will be 3,300 $\mu$ F/35V type. I chose a NICHICON KW 3300 $\mu$ F/35V from MOUSER.



### **Mod3: Replacing the output caps:**

To expand the low frequency limit you can replace the 2 output caps (1,000 $\mu$ F/25V) with larger ones. 2,200 $\mu$ F/25V will lower the frequency range to half that of the original frequency. This is not needed but it can't hurt. The least that can be done is replacing the output caps to 2,200 $\mu$ F/25V/105°C types. These will last longer because they are near very hot components. For these caps I chose the NICHICON FINE GOLD 2200 $\mu$ F/35V 85°C:

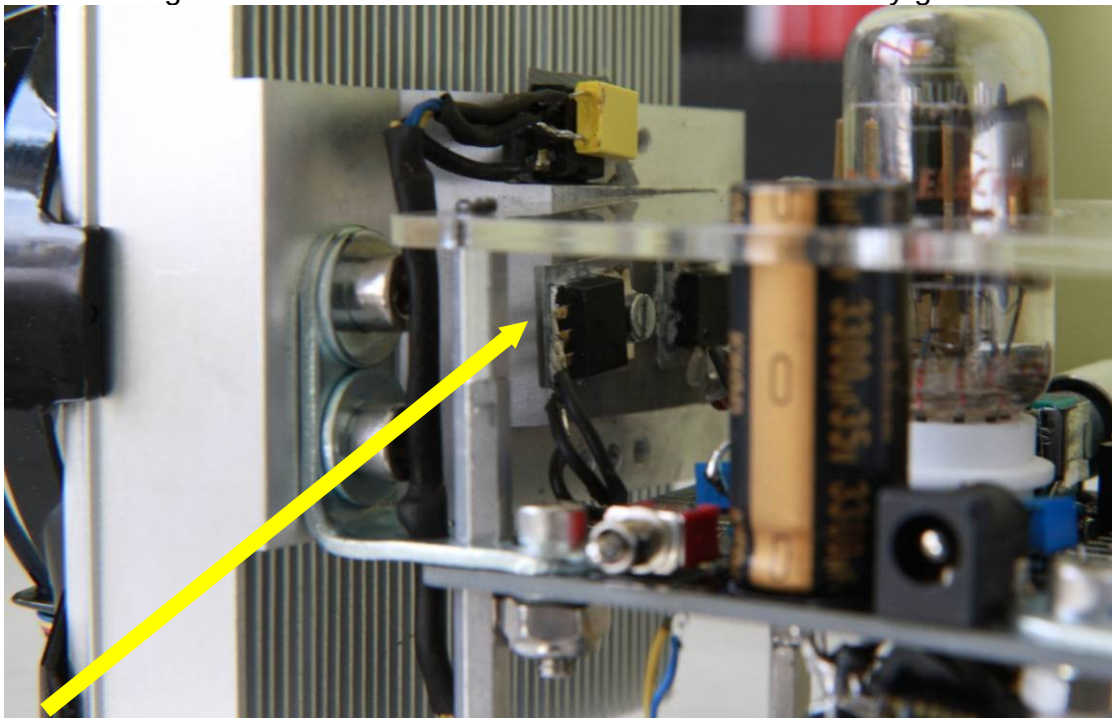




This picture shows the differences in size between the original output caps (brown) and the new Nichicons ones...;-) But be careful, the cap just near the volume pot does not fit directly on the PCB because of its size! So perhaps the KW series of Nichicon, which are smaller in size, could help to get better alignment on the PCB....As I don't really care for the looks of the design I used the bigger Nichicon caps.

#### **Mod4: Replacing the LM317 with high grade AND change the class A current:**

You can replace the LM317 for a higher grade LM317A. Won't make any audible differences so you might want to leave it in place. I chose to get LM317AT from National Semiconductor. To get a higher class A current I used a 2.2Ω resistor between the ADJ pin and the output PIN. The original resistors were 7,5Ω. So current will change from 165mA to 600mA with this mod. BE CAREFUL the LMs and MOSFET become much hotter with this current, you will NEED big heatsinks to dissipate the heat produced by the LM's and IRL's. My heat-sink is 110x95x35mm and it did reach 60°C on the aluminum without forced cooling! I couldn't touch the LM directly with the finger. I mounted a fan running at 5V instead of the 12V rated and now works very good!



LM317AT mounted of the big heat-sink



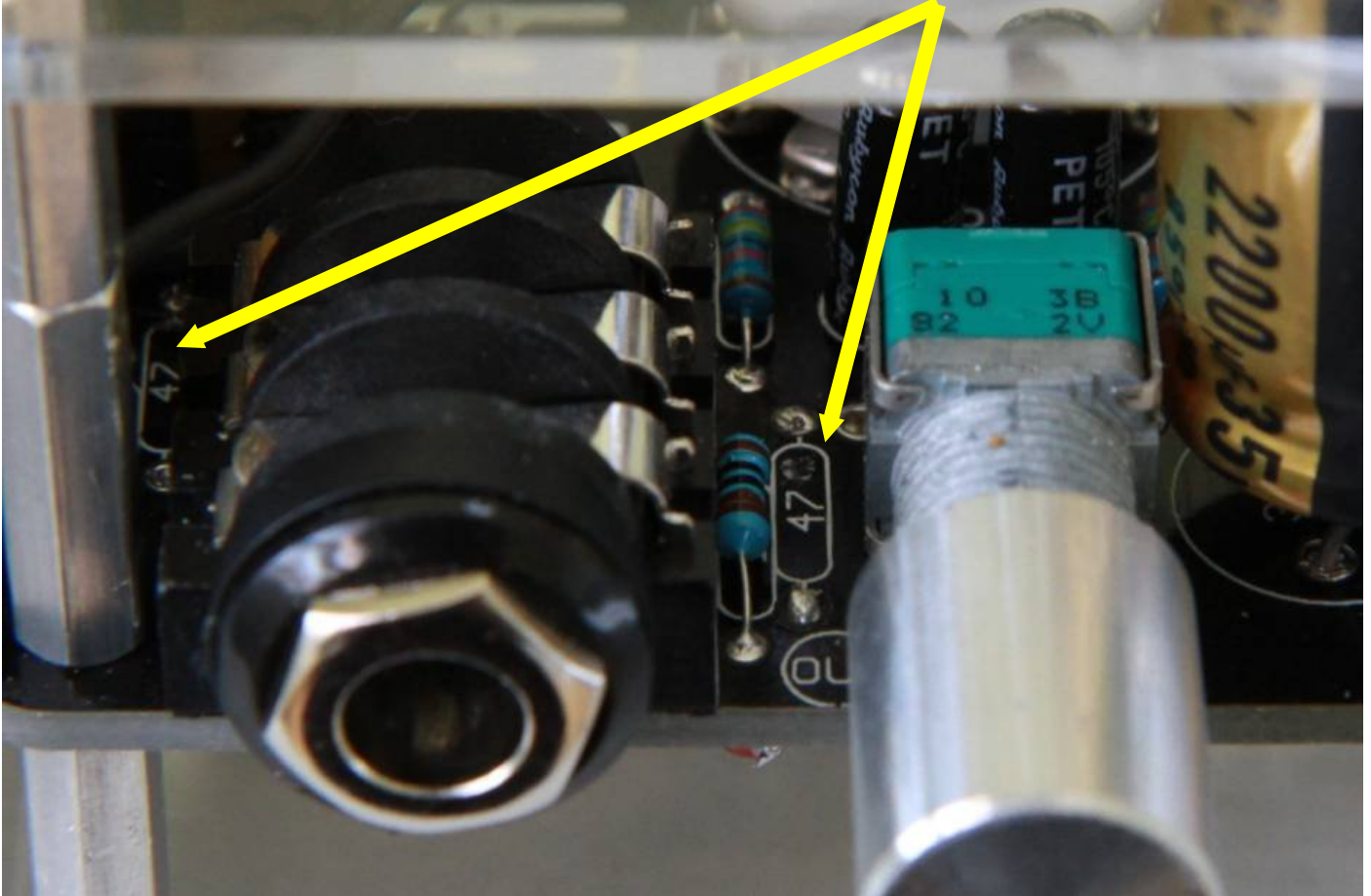
### **Mod5: Replacing the output resistors**

This is a very simple way to change the sound of this (actually any) headphone amp. The output resistance has an influence on the sound in conjunction with the used headphone. This depends on the impedance characteristic of the used headphone as well as its nominal impedance. To make it sound like the later G2 model replace the 47  $\Omega$  with a 30  $\Omega$  resistor. You can also make the resistors 120  $\Omega$  which is a standard for some headphones. The output power will be considerably lower in this case.

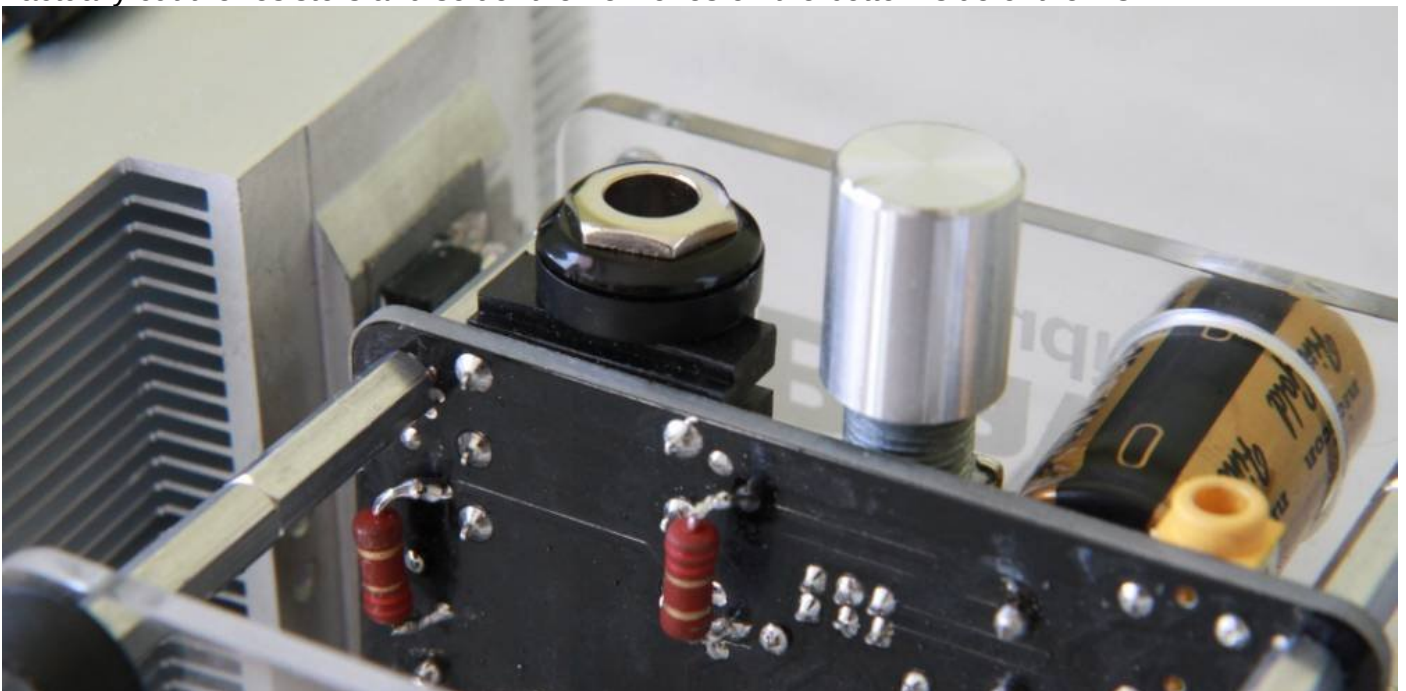
Info on this subject:

<http://www.mediafire.com/?jdpaj1r17x1sos5> and <http://www.mediafire.com/?82kf0r5kdckdcer>

➔ For my Sennheiser HD650 (300  $\Omega$ ) I replaced the original 47  $\Omega$  to 2.2  $\Omega$  resistors:

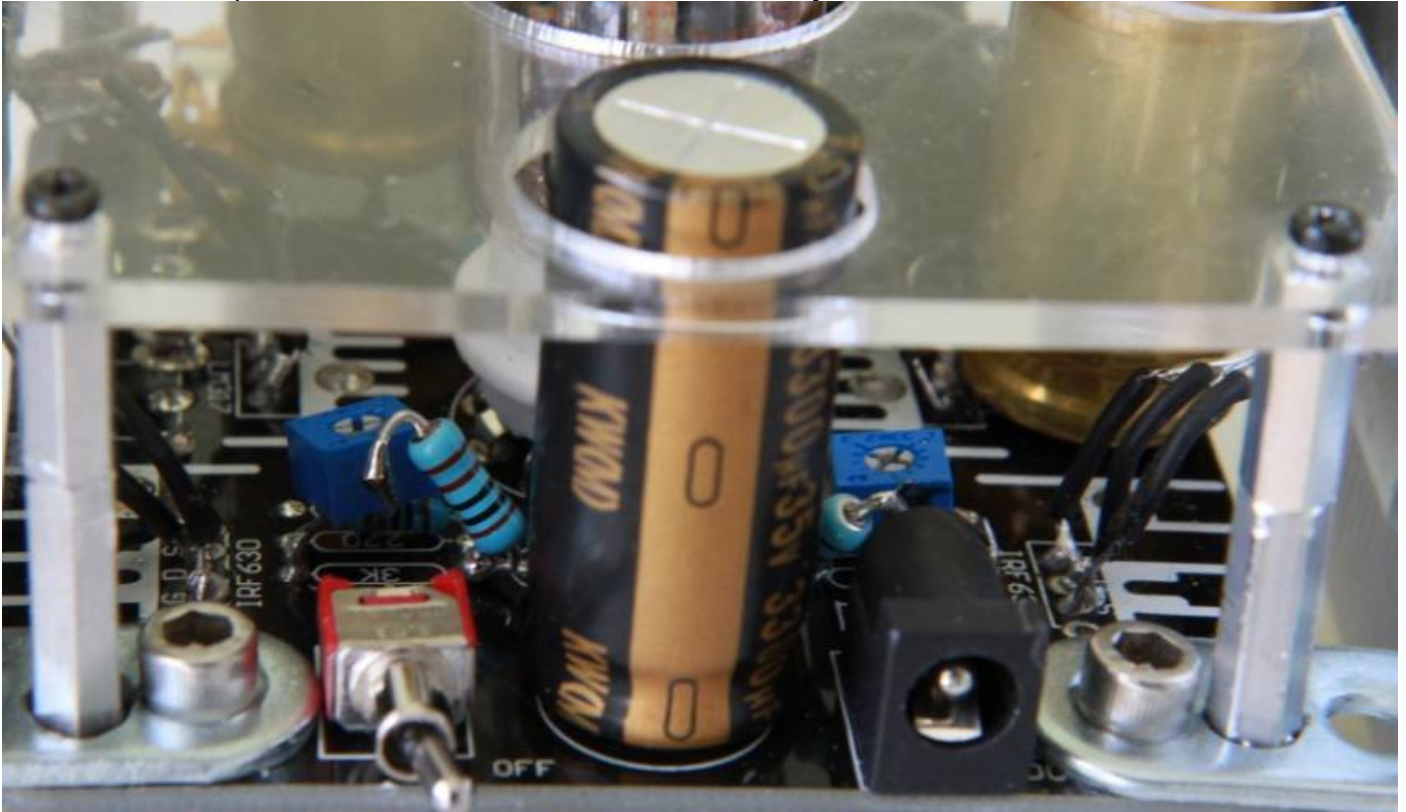


I actually cut the resistors and solder the new ones on the bottom side of the PCB:



### **Mod6: Replacing the bias resistors**

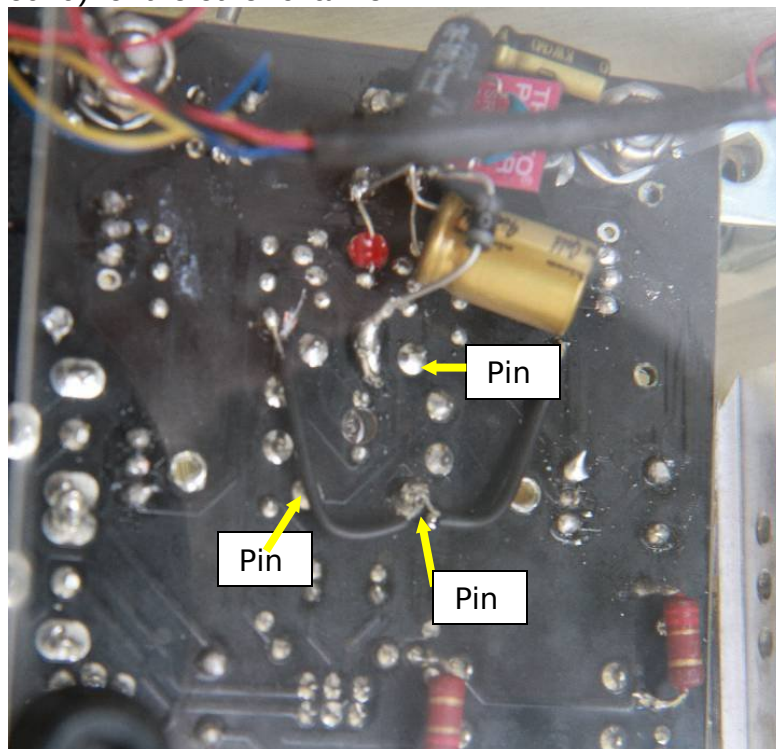
All triodes tubes 12AU7 will have a small differences between it's two halves and also each tube has different characteristic. To be able to adjust the bias voltage for tube rolling purpose, you will have to desolder the 3k $\Omega$  resistors on each side of the amp, and solder a 5k $\Omega$  pot + 1k $\Omega$  resistor in series in it's place. Set the pot in the 2k $\Omega$  region to start bias setting within the "normal" region. The stock tube gave me 2Volts difference between right and left channel. Now it's quite easy to set the anode voltage to 13.5Volts. Also when I changed the tube for the clear top tube seen on these pics, the voltages where 21V and 18V instead of 13.5V due to the spread in tube characteristics ;- ) So this is a recommended mod for everyone !



To measure the bias voltage you will have to measure at 2 different spots:

PIN1(+) and PIN9 (Ground) for one channel

PIN6(+) and PIN9 (Ground) for the other channel

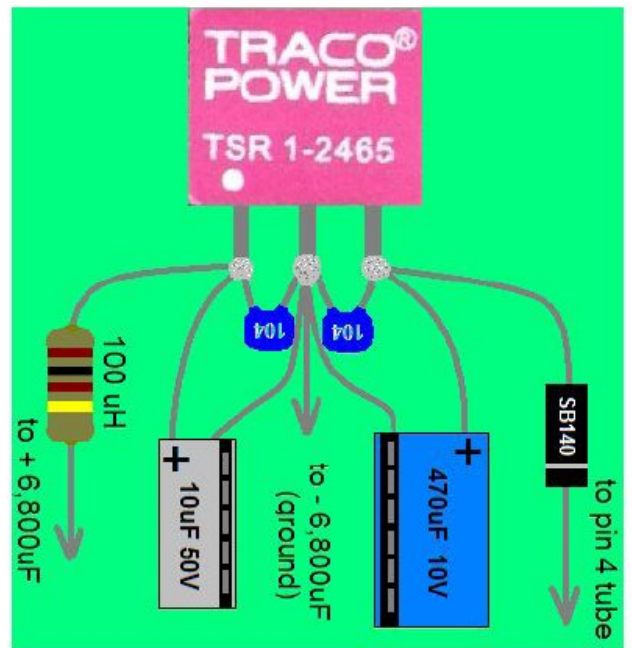
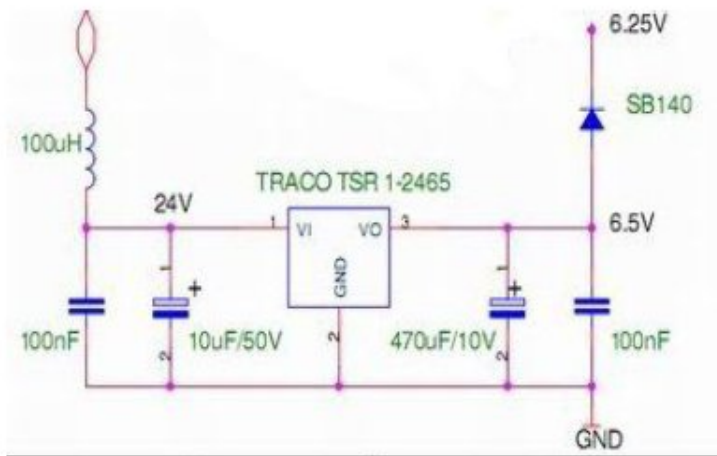




## Mod7: Heaters mod using an independent 6.3V power supply

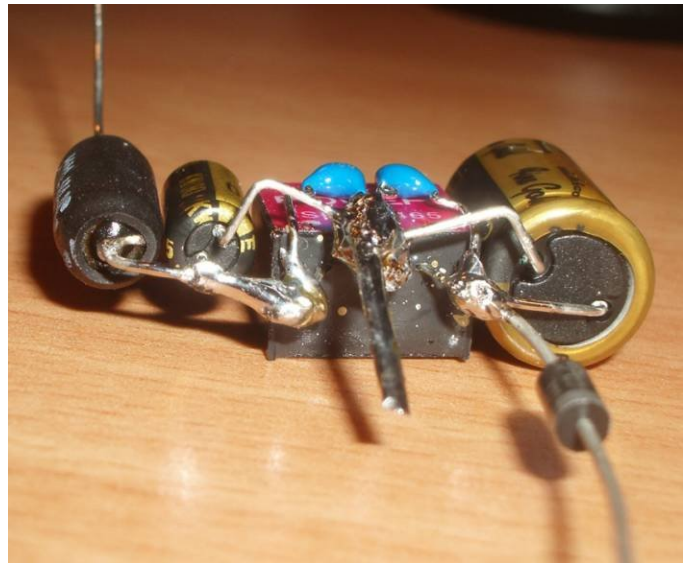
Build a power supply for the heaters using a switch-mode regulator. I chose the TRACO POWER TRS 1-2465 (6.5V output). It has a similar pin-out as a standard 3 pin regulator. A NON-switching (normal linear regulator) can **NOT** be used as this would get extremely hot and would need a huge cooling fin, the switch-mode regulator will stay cool... and needs no cooling fin. (Farnell order code: 169-6321 ).

illustrations came from Solderdude's G2 tutorial.  
<http://www.mediafire.com/?ccw7g2f8u97elpd>



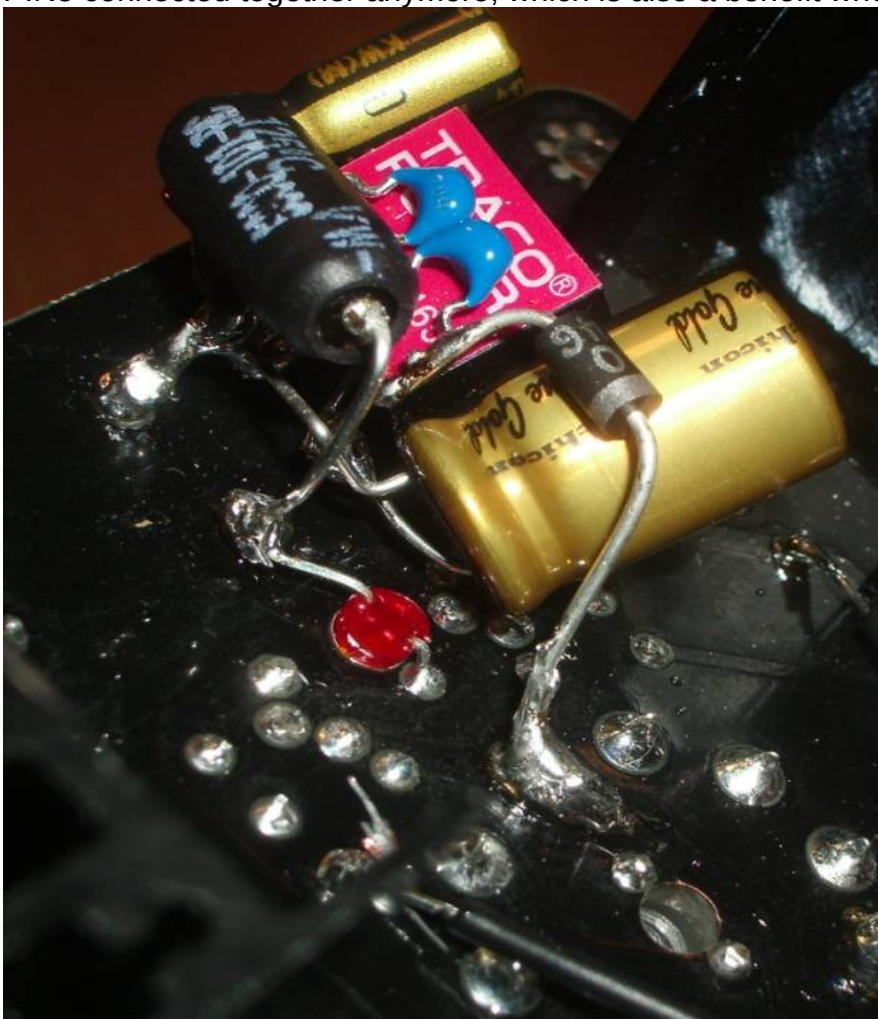


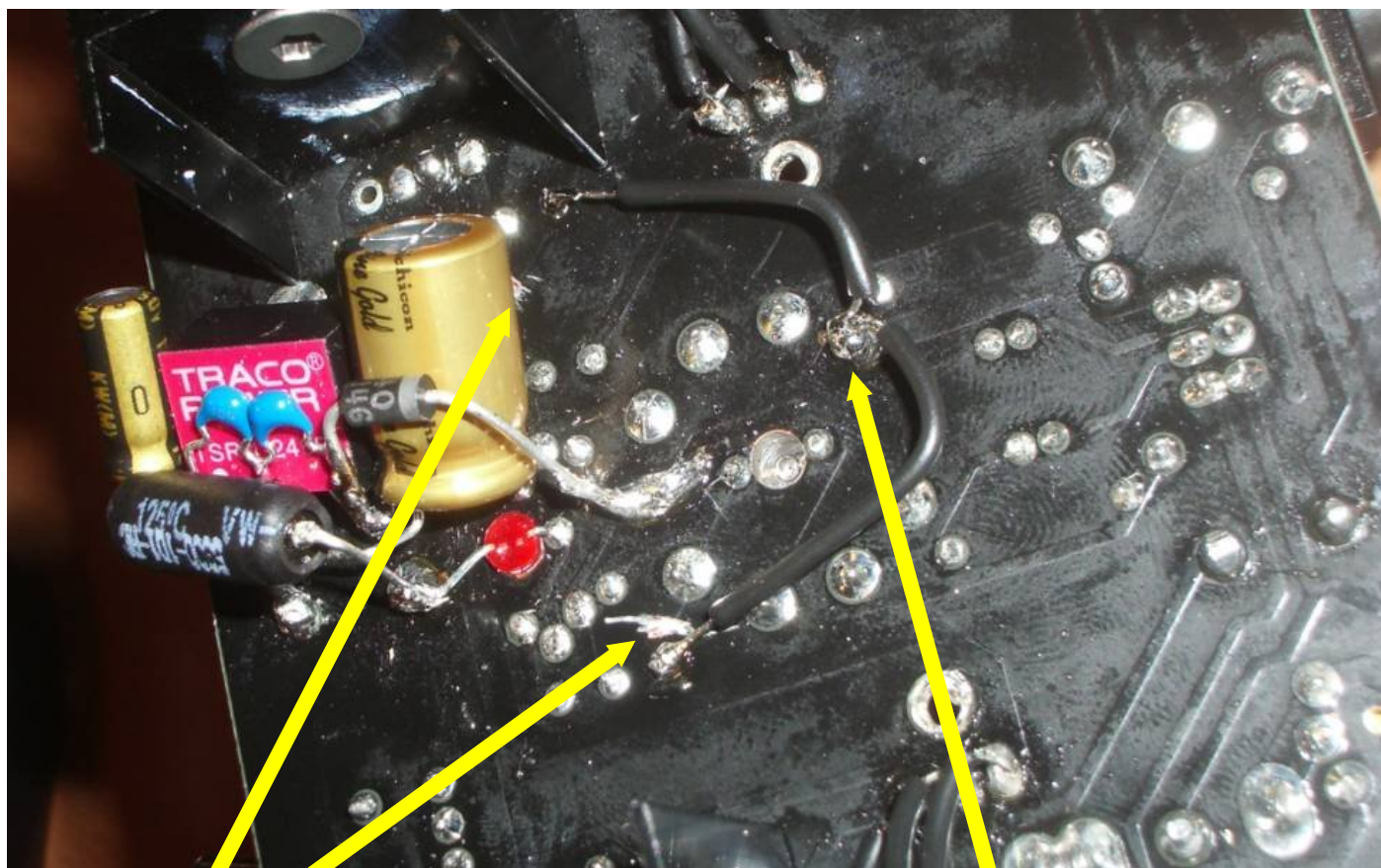
When you finally get all the parts soldered as shown:



To make the mods on the PCB, you will have **TO SOLDER THE LM317s OUTPUT PINS TO GROUND**, and also the **line just after the ADJ RESISTORS**. See the pics below for the cut and line connected to ground...

This mod will eliminate the crosstalk and distortion. The LM317s won't feed the heaters PIN4 and PIN5 connected together anymore, which is also a benefit when tube rolling.





Cut the PCB here and the output of the LM's won't feed the PIN5 and PIN4 of the tube (heaters). Then use small cable to ground the outputs of the LM's to PIN9 (ground)

Because the traces had already been cut to do the crosstalk mod in this amp the additional wiring is different from working with a standard board. For a non modded board the traces are marked on page 8.

### **Conclusion:**

This amp just sounds amazing and can easily drive my HD650 ! You will have to give it a very good source and that's a very great deal for the price ! I'm using a FIIO E10 (79\$) DAC and the line out to feed the BRAVO V2 MODDED amp result is surprising ;-) Just to make a test I also plugged in my LITTLE DOT DAC 1 ( 350\$ DAC) and the Bravo gave me a very wide sound stage, better highs, more details! That's a very great deal for this kind of small amp. Try it.

Much thanks for solderdude who help me during this modding week ;-)



I'll now build the 24V PSU linear based LT1083 to supply this small amp and replace the SMPS PSU supplied with the amp here are some pics of the start of the PS build:

