

# Triode Dick's Page

## Cleo 6

The new pre-amplifier

Update:16-8-2006



## Cleo 6, a simpler brother of the Cleo V?

The goal was to achieve a 'simpler' version of the Cleo-V, built with easy to find components. The result should be a device that is reliable and predictable to build, without doing too much concessions to the audible qualities. That needs some adjustments. The Ba and AZ1 are harder to find these last years and the prices are going sky high. In addition to that, I see more and more not guaranteed and untested AZ1 tubes for sale, which seems to be straight pulls from old radios.. The change to buy a worn out tube is huge. Don't trust a (used) tube seller without a descent tube tester. Reason enough to look out for other

possibilities. A replacement for an AZ1 is not that hard, I previously discovered the little giant 6X4 and used it in the PhonoDude pre-amp. They are easy to obtain for reasonable prices. Real NOS quality. They



are Long Life tubes giving a slow start after pulling the power switch.. These tubes are made by many manufacturers, in the USA as well in Europe and to be particular in England. That gives us the opportunity to tweak as we please. Just like the old AZ1, there are audible differences between the different tubes.. The Tungsol is said to have legendary capabilities. I have to say that this tube scores high, but there are more jewels: The GEC is beautiful, the Mullard, Haltron, Sylvania..... They all produce a somewhat different sound.. Try it for yourself and determine your favorite(s). But keep in mind that different is not equal to better or worse. Even with the 'worst' 6X4 tube I can be happy ...

## Ba exit... what? More heroes expelled?

The Ba is another concern... a tube that sounds incredible well, and not easy to replace. An ECC99 perhaps? A nice tube, powerful but with a silky character, mmmm, when you listen somewhat longer it is somewhat too smooth and too gallant. The character of the ECC99 must be compensated somewhere in the line with a more brutal tube. The classic tube 6SN7? A nice tube, but in no means a tube that comes close to the Ba. It somewhat more harsh, less transparent, less... less... next candidate. Wait.., should a collaboration of the 6SN7 and the ECC99 perhaps?... Yes, that will work fine. The combination seems to be stronger than every tube on its own, what is nicely displayed in the integrated Bill amplifier. The ECC82? Njet, ECC83? Too much gain and too flat in this application. ECC88, could be an option... I'm cured from my earlier '88 phobia', but I rather look for other possibilities. The gain of the ECC88 is also too high for this application. The strong 5687, that seems to be especially made for the Cleo 6! No, not even this tube. The 5687 is indeed strong as a horse, but has an (even more than the 6SN7) brute character. A 5687 irritates me in the long run. We can go on this way for a long time, but I already stumbled on a Russian tube, the 6N30P, also labeled as a 6H30. The by the Russians used Cyrillic 'H' is in our Latin language an 'N'. Could that be a good replacement for the Ba? That was not hard to find out. I had these tubes already on a shelf for a period of time. When you just go for the looks it is a comparison between the 'beauty and the nerd'. The 6N30 is a though looking tube, but measured by it looks it fades away next to a SIF Ba triode.

## Perestroika after a somewhat limited glasnost....

I liked it more and more to use the Russian. But to build a complete amplifier just to try it out? The Cleo is build without any compromise. Double mono. Black Gate WKZ, amorphous chokes... When you make a test setup with some budget components, to what are you listening then? The comparison will tell less about the tube itself. So, we are going to apply the 6N30 tube in the existing Cleo V. The low buffer tube (ECC88) will make place for the 6N30. The circuit can be modified really easy. And by doing that the Cleo has apparently unchanged doing its job in my audio rack.. Sneaky as I am, I didn't tell anything to friends who came to visit me. The only thing I told them that I was thinking about a new pre amplifier.



The reaction was often 'If you want to reach the same level of quality with a simpler tube?....' 'O well', I said, 'we shall see...' And I have to admit that the sound surprised me as well. It's not like the Ba is beaten when you focus on the sound. The 6N30 has its own qualities. The first becomes immediately clear: the amplifier is much quieter. I'm telling you: Very quiet ....ssssttt...listen, no nothing to hear ..... The Ba is the sensitive diva which must be handled whit care. The gain adjustment on the power amplifiers must really be right. To much amplifying on the power amps also amplifies all the negative characteristics from the Ba: the noise and microphonics. The over sensitivity we wouldn't even discuss here. With the 6N30 on the Cleo V you will get a pre-stage that is so quiet, that it almost meets a solid state design.. The music is coming from a pitch black background. Next to the silent operation, the sound itself leaves not much room for criticism. The 6N30 tube has a character from flesh and blood, much power, especially the low frequencies are deep, but also subtle. Voices become very plastic placed in the listening space ... and I can go on and on about it. It tastes like more. Maestro music! A lot of music!

## More simple and not less, even better?

Yes, so it seems to be. The complete circuit will be less complex because of the skipping of the Ba current source. The 6N30 is happy with just a voltage regulator. The tube will use some higher current (0,9 ampere), but that is no problem for a LM317 or a 7806 regulator.

The rest of the changes are limited to some other values for the bootstrap resistor and the cathode resistor. The 6N30 needs a higher anode current as the Ba needed. But I will use the tube far from its maximum 20 mA specs, where other people are debating about. Whit this tube it is not much different as for

others pre-amp tubes. When you are close to the maximum dissipation, the sound seems to gain power, but is it true? Is it necessary to push the pre-amp tubes to their limits? I don't think so; the music is gaining on rest and ease when the tubes are not squeezed. You can find the 'sweet point' of the 6N30 around the 8 a 9 mA. More anode current presents with a much heater glass envelop and not a better sound. Yes... but isn't it a fact that more anode current should result in less distortion? Not noticeable here. Cleo with the 6N30 as voltage amplifying tube has very outstanding distortion figures and a lot of driving power to spare. At 1% THD+n (Total distortion plus noise) there will be 117 volt in 100 kOhm produced from this amplifier. At 1 volt output voltage we measure a THD+n that's below the 0,01% what for almost for 100% on account of the first harmonic, harmless..... What makes me very happy is the fact that the power supply is as clean as it is. The 100 Hz leftovers from the rectified voltage are measured on the noise floor at -100 dB. The 50 Hz peak (often caused by emitting of transformers on sensitive tubes or electronics) which was evidently there with the Ba, is now on -76 dB, in relation to 1 volt. So, it's not that strange that there are no more hums and noise to be heard with this new Cleo setup.

## Other clothes for the mistress of the emperor

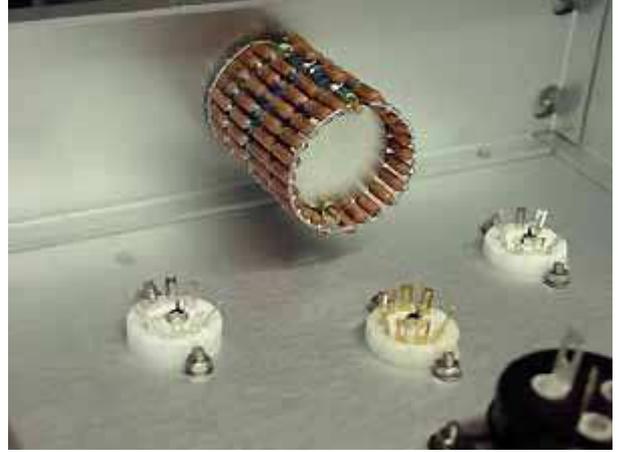
Okay, now its time to build a 'real' *Cleo 6*. Due to the innovations, it will be a



relative easy pre amplifier to build. I will use a complete aluminum chassis this time, in which I only have to drill the holes in. That may seem a big job, but the aluminum is an easy to handle metal. Because of its high quality, the drilling and punching leaves us with nice and clean holes. To drill holes with a manual

drill is no problem at all. The result is a pre amp that could be build by an audio manufacturing. DIY didn't need to be less good as expensive ready to buy devices, in contrary... I know only a few manufactured amplifiers in which you can find a stepped attenuator, amorphous chokes or *Black Gate WKZ* PSU capacitors. Manufacturers often advertising proud and loud even when a brandless standard MKP coupling capacitor is used. The hobbyist has the possibility to apply the best component there is, at his own insight and flavor.. Do you like the wooden cabinet nicer? No problem, just use that. The setup of the C6 is not really different from the Cleo V. The transformer set is identical, the PSU capacitors also. The volume attenuator is this time a *24-step ladder*,

built with *Dale* resistors. With thanks to the Far East you can buy this stuff now for reasonable prices. Where you, not so long ago, had to pay hundreds of dollars for a stepped ladder attenuator, you are now ready to go for just \$50 on average.



The aluminum chassis makes the mechanical work a really nice thing to do. Not that this is the reason we are doing it, but these are really nice cabinets, from which we dreamed of, a couple of years ago. When you wanted to buy a ready to go chassis you were stuck with an ugly black 19" thing made from thin iron plate. That time is passed by now.. there are really nice cabinets for sale nowadays, made from strong and nice finished aluminum and still affordable too. The appearance of the end result didn't have to be less than a manufactured amplifier of many thousands of dollars. When you also take the super quality of the applied components in respect (which you hardly find in production devices) than we DIY-ers are doing well ann. 2006.

## The PSU capacitors...



... don't leave much room for questions, is my personal opinion. Direct after the rectifier we use a 10 uF MKP in oil capacitor, an amorphous choke, a 47 uF *Black Gate WKZ*, the second amorphous choke and a 100 uF *BeeGee WKZ*. You can't find better PSU for this amplifier, exclamation mark. Yes but... eh...what about the *non-polar Black Gate NX*? That's also a nice one? Yes it is! But not for the high

voltages that *Cleo 6* needs to operate.... Other brands or types? *BC Components*, *JJ*, *Nichicon*, are all very useful, but everything is depending on the level you want to reach. You can also use a series of *Solen MKP's* to make a nice PS, but they are not cheap also in the higher capacitance values. I want to make the best pre amplifier possible and in that respect I don't hesitate to spend an extra \$200 for a couple of *BG WKZ* caps. It gives you listening pleasure for the years to come.

## Coupling capacitors...

A lot is possible because of the huge offering of quality capacitors. That also brings a lot of confusion, because it is a huge task to test all possible capacitors and to pick the one and only capacitor... not even mentioning the costs of such a task.... Happy for us, there is no such thing as "The one and only" capacitor. I can live well with a lot of brands and types, but there are definitely big and small differences, which can give you just the "click" you are looking for. I have a

large bin full of capacitors, old and new ones. Its very fascinating to exchange these and filter out the favorites.

My personal experience? Do you want a sound as if it came thru a straight wire? Take the *Auricap*, an honest capacitor which leaves and adds almost nothing. A big favorite of me for a couple of years. But not everybody's cup of tea. Sometimes you have to flavor things a little bit with a color or an taste. There's nothing against it, in contrary, that is part of the real tweaking. If you find the soup not spicy enough, you add salt and pepper, in spite of the opinion of the cook....

A little bit smoother is the highly appreciated *Audio Note copper-foil* in oil capacitor of the last generation, in the copper housing. Those are, in spite of the different design, still made by *Jensen* in Denmark.

The old *Sprague Vitamin Q* is an option. I received 4 of these caps from the *Major* a couple of days ago. A man who is, in my opinion, dedicated to find all old audio jewels on earth.... (when he is promoted in the mean time, I will hear it soon.. ☺). Those VQ's are going in the amp for a while. Do you also have some of those caps laying around? Give them enough time to their full prosperity. *Mundorf* makes beautiful *silver/oil* and *gold/silver/oil* caps. Very expensive, but also very nice stuff. Give the silver/oil enough time..... it takes several days of continuous operation to work at their best. In the time between you get very agitated by the several stages of the presentation... swinging between dead flat and okay with a sharp edge. And then it stabilizes and the sound balances. The silver/gold *Mundorf* doesn't have this kind of behavior, probably because of the different composition. I will come back to it later, because it is time for a nice shoot out. Several new stars are rising.

Don't want to spend too much money on coupling capacitors? The well known black *Solen*, *SCR* or *Intertechnik Audyn MKP's*, are okay in a speaker filter or PSU, but less optimal as a coupling cap. But surely they are not bad at all. The *Audyn* is next to the standard series also available as a better *Audyn Plus* cap, but I have experience with that cap (so far). The *Solen* or *Audyn tinfoil* caps are sounding too dark for me, with a loss on detail. Remarkable, those things are doing a nice job in speaker filters. *Solen* also makes *Teflon* caps nowadays, but I didn't used them in my amps yet. An alternative is the well known red *Wima* MKP. It also has its own character, but always stays friendly. This capacitor is found in many, many manufactured amplifiers. Just firm quality for reasonable prices. The *Russian military Teflon caps* that are being sold at eBay are also getting good critics. They are very cheap and built super firm, but are (or were?) never made in the higher capacitance values (0,1 uF max.) That is a shame.... I have 2 of these on the shelf, but could never bring them in action. But as said earlier, we come to that later... There are also a lot of US made capacitors like *Multicap*, *Sonicap*, *Dynamicap* (from the well known *Wondercap* stable) and even moer. TherOs enough to try-out if that pleases you ...

## Resistors..

The differences between resistors are less dramatic as between capacitors. But differences are noticeable between the different types. But a difference is not always bad or better, keep that always in mind.. The improvement is often a question of personal taste. But it also can go terribly wrong with the wrong resistor at the wrong place.. Built for the fun of it (how audio masochistic can you be?) a 24 step series regulator using old carbon resistors. You can find them now and then, those nice small 1/8 watt Alan Bradley resistors. So, if you want to remove all the dynamics from your amplifier, you are on the right track. And that when you are convinced that you did something fantastic ... it just doesn't work. At particular places in the circuitry it can add the flavor you are looking for, but watch out... applied as a grid stopper, you can harm the signal/noise ratio of the circuitry. I experienced it several times. It is just like if these things get broken and change in a noise source. The first time everything is well, the next time it can be sh\*t. Better use a modern *carbon resistor*, which are very stable and within the specs. The noise properties are better than expected. Even a 5 % carbon resistor is often within 1 % of its specified value. Is that important? Yes, it makes that you can make both your stereo channel levels much closer to each other, what is at least as important as the type of the resistor itself. If all the settings are steady as a rock, your stereo image will do the same. In a phono stage, carbon resistors are misplaced anyway, you have to use metal film resistors, unless you like a very noisy background ... Next to that the RIAA correction in a phono stage is a tight timed filter that only will function properly if all the components are stabile.

If there is noise and hum in a line stage, it will be magnified by the power amp. The volume regulator is placed on the start of the circuit and won't damp the noise that is created behind the regulator.

## Which resistors should I use?

Always good are the well known blue *Beyslag* 1-watt resistors, a metal film resistor which is sounding unexpected smooth and for many years a good choice to pick. The Beyslag has its own sound character, but it will never irritate you. On the other side of the spectrum you have the *Bulk Foil Metal* resistors. Those will be tried out very soon. I'm very curious about them. Expensive stuff, but happily, you don't need a lot of them in a single ended amplifier or pre-amplifier.

*Kiwame* built itself a good brand name with their resistors. In addition to that, you can buy them in 2W and 5W versions.

For myself, I had good experiences with the purple carbon resistors which are displayed in the pictures. My good audio friend Jan D. pointed them out to me, he bought them from the local electronics shop. For a nickel on the first row? Almost. Before this find, I always used the expensive *Riken Ohm* resistors, still

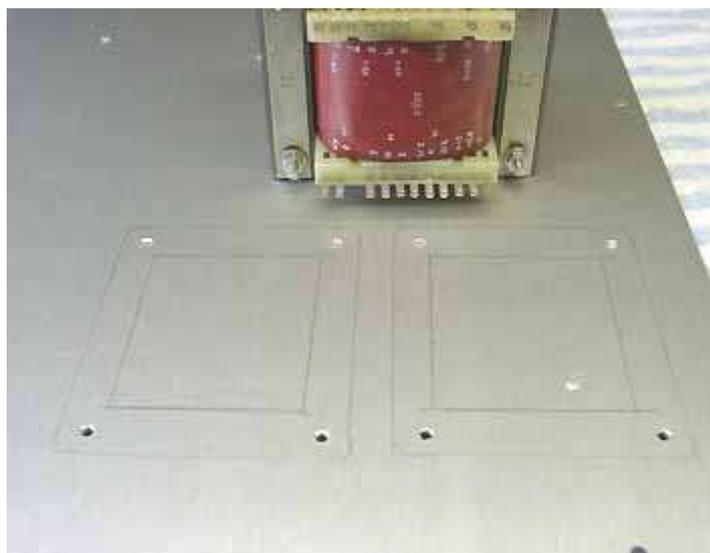
beautiful stuff, but 6, 7 times as expensive. And the quality is really not 6 or 7 times less, in contrary.

## The built from start to end...



The parts are placed with a lot of fitting, measuring and moving their definite position on the chassis. I keep the same lay-out as I previous used on the Cleo-V, what results in a logical wiring method for this amplifier....

Sawing the holes for the power transformers seems to be the trickiest job of the build, but it much easier as you expect. A few holes in the corners and the sawing machine goes from hole to hole as if it was butter. Take your time and be cautious to not damage the plate. The brushed aluminum is not easy to damage, but with a metal tool the risk is great it will..... To be clear, I marked the down side of the plate.

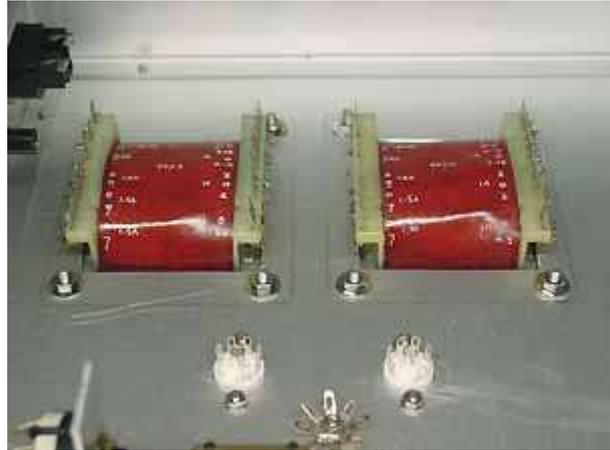




Let the saw doing its job...

After that make the holes the correct size and make the edges smooth..

...and this is what it should look like when the hard labor is done...



These are the largest holes in the chassis. I use a 37mm metal sheet punch. The holes of the capacitor clamp are marked with the clamp mounted on the capacitor..



The holes for the volume pot- and input selection switch axles getting their axle sockets....



The tube socket for the 6X4 rectifier tubes...

The power supply capacitors and the tube sockets for the amplifying stage...



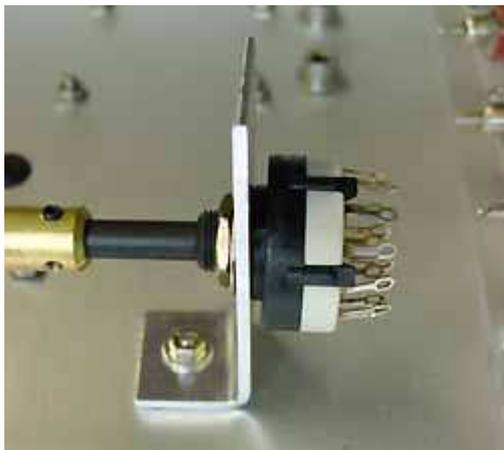
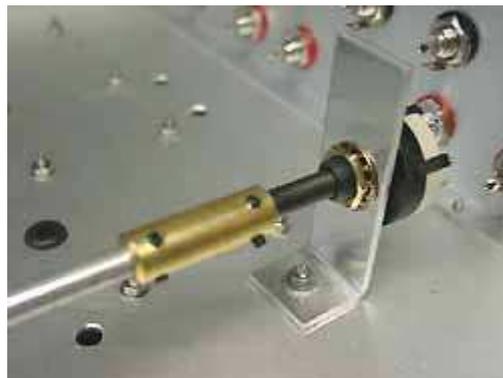
The holes for the cinch busses. Pre-drill with 3 mm, than drill up to 9,5 mm. Clean the edges for a nice result.



The cinch busses mounted....



The central mass terminal is made by using several solder connectors and a small bolt. Mount it very tight, a clean good contact is a must. I always use wrinkled washers, which are digged in the aluminum.



The clamp for the axle of the selection switch is made using a small aluminum strip and provided with a hole for a stress free mounting of the long axle. You don't have to apply any kind of force when you turn the knob. Don't forget to set the switch to the proper amount of inputs, otherwise you have to dismantle everything, whoops.... I provided the amp with 5 inputs and 2 parallel outputs. That makes bi-amping or driving a subwoofer really easy.

It begins to look like something nice...



The inlet for the power cable and of course the necessary circuit breaker.

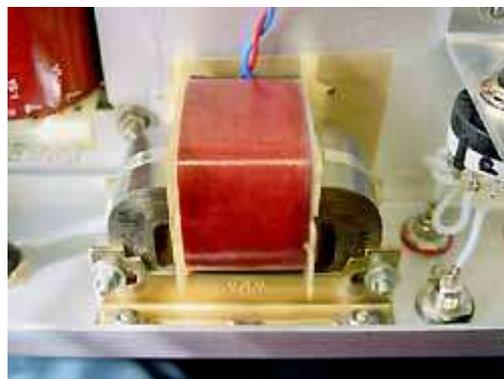
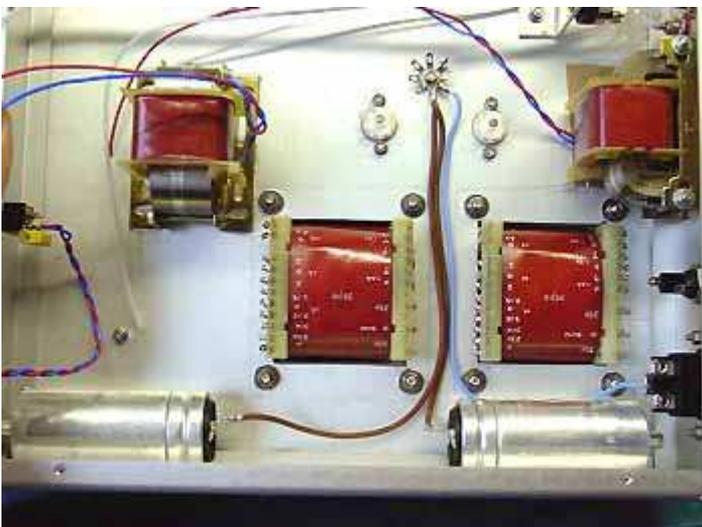
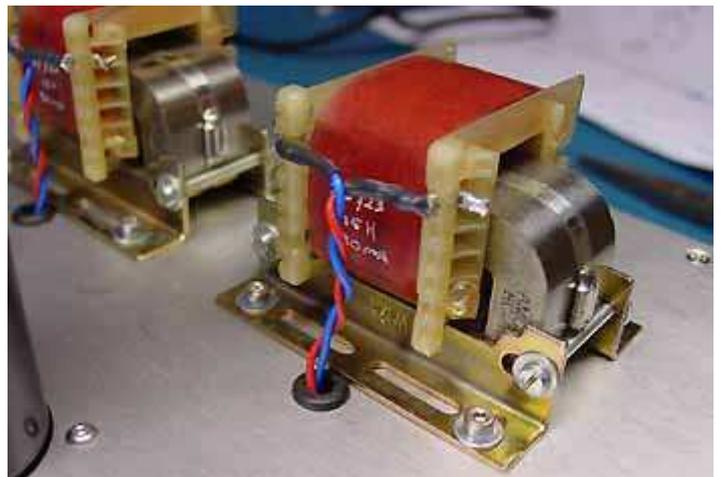


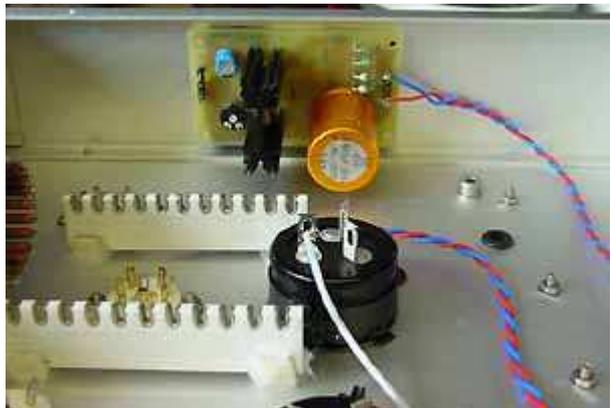
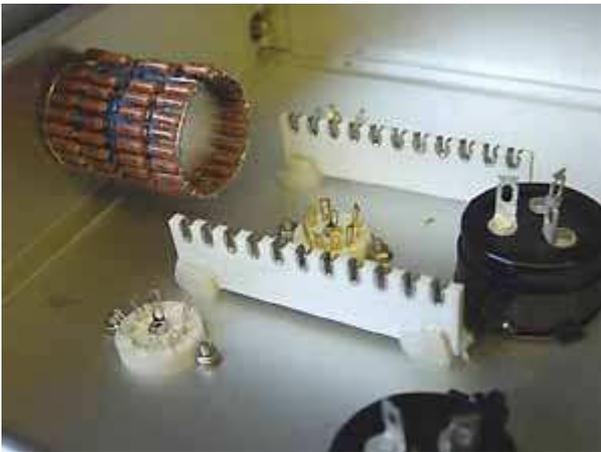
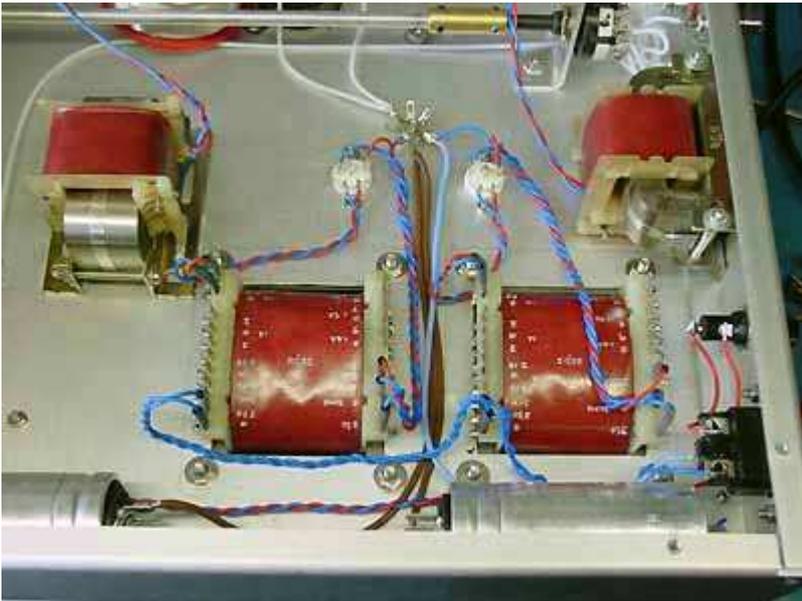
It's all looking nice and clean



Two of the four chokes (the 15 Henry) are mounted on top of the chassis. The two inside the cabinet are the 10 Henry chokes which are placed direct behind the first PSU capacitor. On the picture below here, you can see the Icar MKP capacitors which are glued tot the chassis with some silicon kit.

The picture down left is the choke which is bolted on the backside of the chassis. Don't forget to solder the connections...

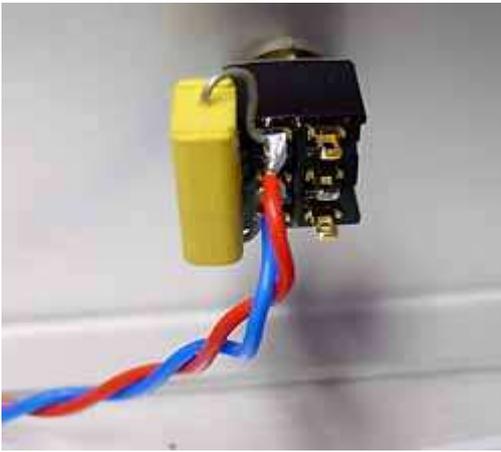




The wire stands next to the tube sockets are glued using silicon kit.. On the right picture you can see that the filament supply board for the 6N30 is placed near the tube.



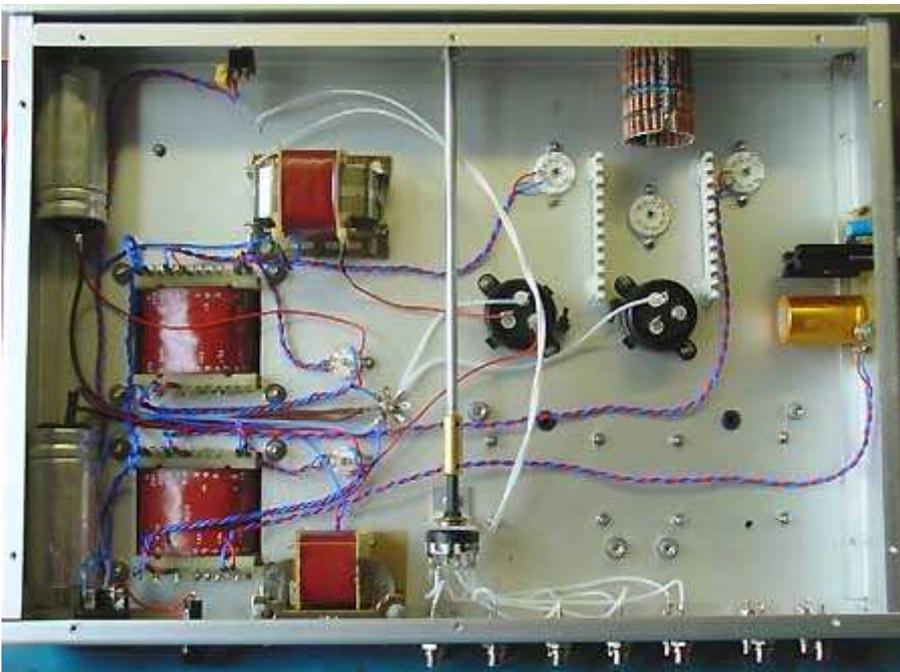
The input selection switch is wired.....and the 4 output cinch busses for double signal output.



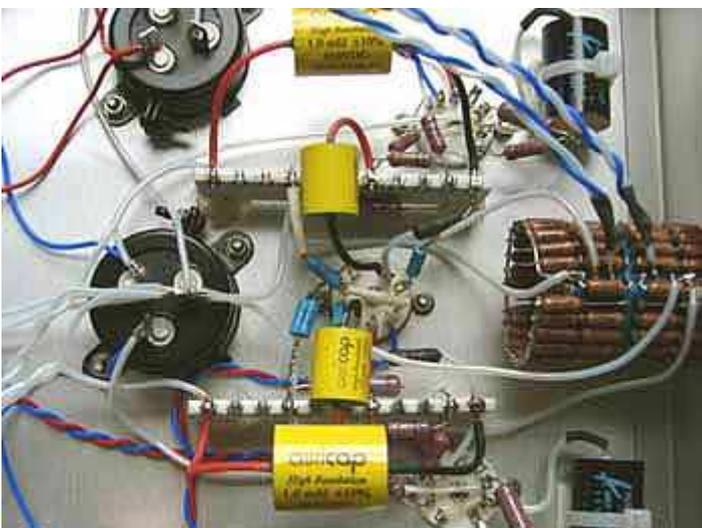
The power switch.....

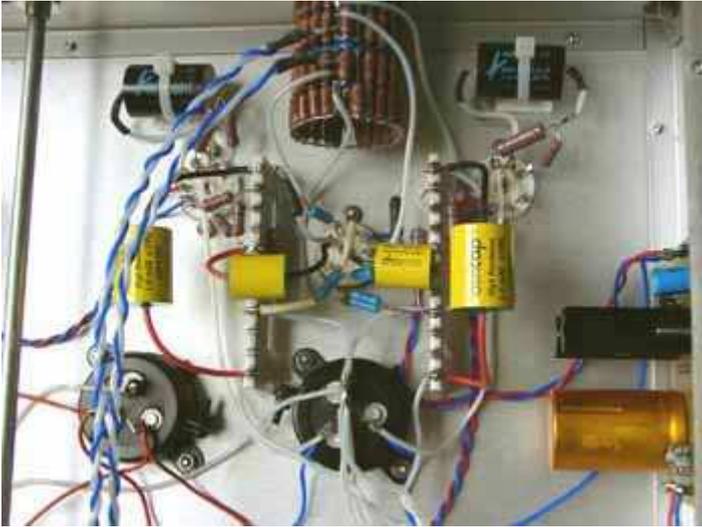


...and IEC inlet plus circuit breaker.

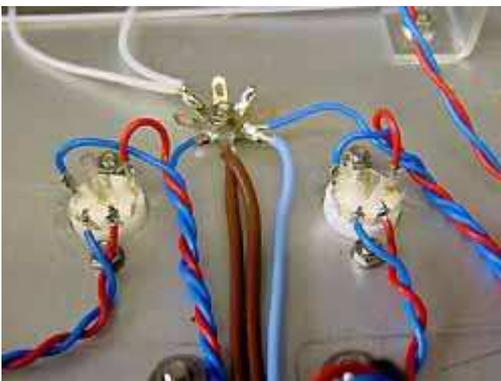


A go between...

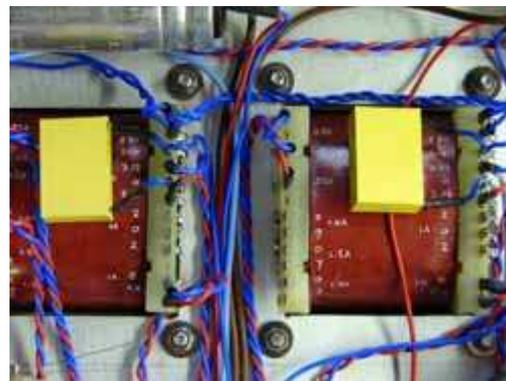




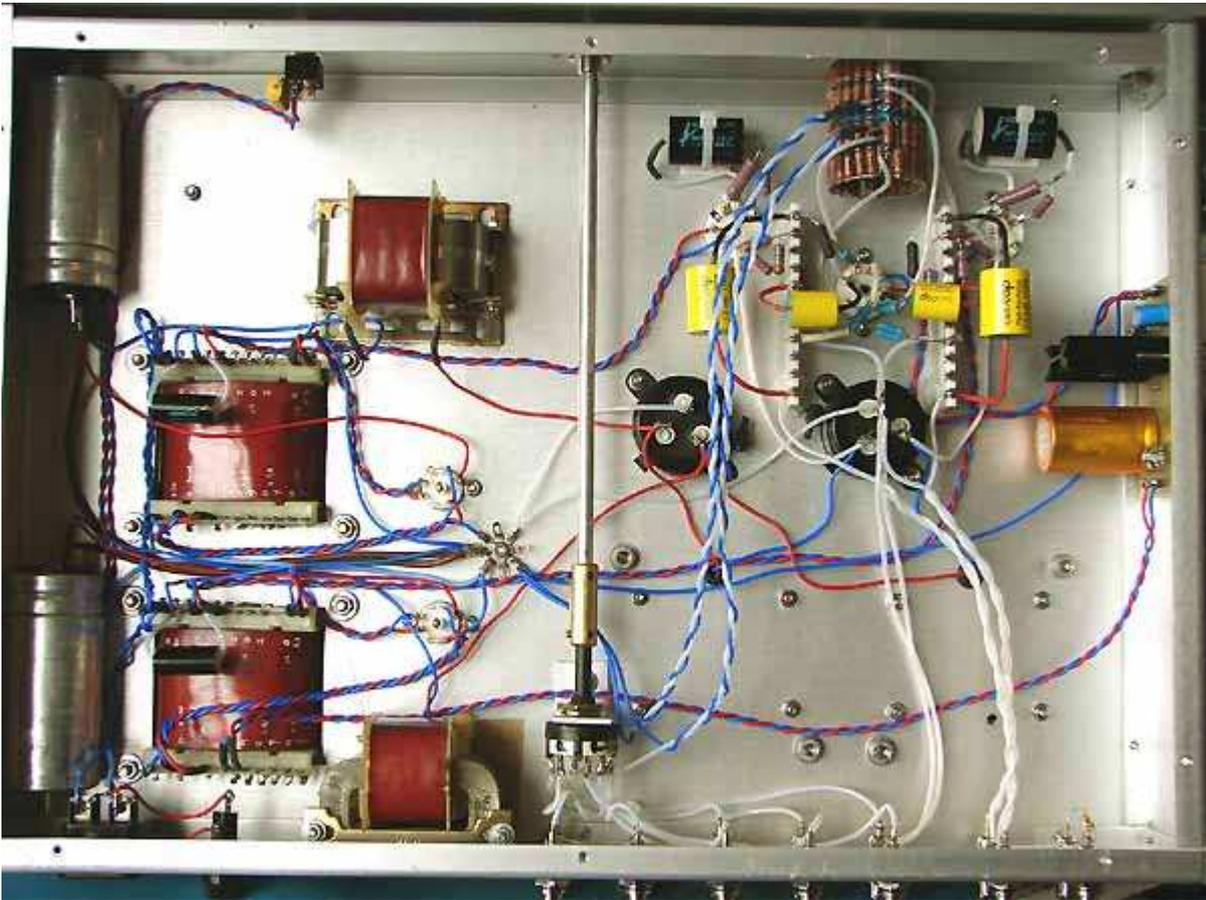
The rest of the pre stage is wired and resistors and capacitors are applied....



A detailed picture of the central mass connector.. Around the Mu-stage amplifying stage, all the mass connections are gathered on sub terminals, like the negative pole of the capacitor, which is directly connected to the central mass terminal. Don't produce long wire loops between the connections. It only lengthens the signal path. We don't need that....



The capacitors which virtually connects the filament of the D3a penthode to mass. Don't forget this one...



All the wiring is in place... and it stays very straight forward.....





So, the amplifier is ready and can be hooked up.... *Maestro, music!*