Subject: SE 300B Project, Part 10 - The Power Supply some more
Posted by Damir on Sun, 19 Mar 2006 09:17:50 GMT
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We`ve had a Power Supply «chapter» in Part 3 – here`re a few more things, and the final schematic.On the Fig. 1 we can see two filter topologies after the rectifier – first resistor (200 Ohms) is actually a series resistance of the transformer windings and resistance of our tube rectifier. We (simplified) modeled it here like a series resistor between the «perfect» PT/rectifier and the filter.Fig 1: Two filter versionsThe first version is RC-LC-LC-LC filter, the most of the listening tests are done with it – however, second, simplified version with last RC filter instead of LC is investigated and tried in numerous A/B tests. The RC version has a little lower filtering, larger series resistance and lower B1+ voltage for the driver, 400-410V instead of 430-440V in LC version. But, our driver stage is CCS-loaded, it has large PS isolation, and I really can`t hear any difference in the sound between two filter versions. However, if someone chooses resistive load for the driver (27k/5W), then he/she must use lower Ra=22k/5W, or (prefferable) a small choke for the last filter section – LC version.Fig 2: Simulated «frequency responses» of RC-LC-LC-RC filterThe second picture shows a simulated «frequency response» of the second filter, in the points A, B, C, D. I modeled inductors like 10H inductance in a series with resistance (100 and 140 Ohms), and in a parallel with 300pF winding capacitance. I added 1µH inductances in a series with capacitors – it is inductance of the straight wire, 0,8 mm diameter and 70 cm in length. Those are «estimated» values, simulation is simplified, but can show us the «trend». (For detailed explanations/formulas see «Valve Amplifiers 3» by M. Jones.)We`ll concentrate on blue wire, filter response in point «C», it is our B+ supply (about 430-440V) for the output stage. After ~10Hz, filter has smooth attenuation of about 30dB/octave, (RC+LC+LC or 6+12+12 dB / octave), up to about 2kHz or a little more, where self resonance of the chokes takes effect – their inductance + winding capacitance. Then we have another resonance point (~23kHz) where series inductance of the cap(s) wiring takes place, and high frequency «response» of the filter now rises, 30dB/octave. Minimizing the wire length, using a thicker wire, and chokes with lower Cw is a good idea here. After two LC filters, even the low frequencies are attenuated «enough», and the main (rectification) harmonic of 100Hz (120Hz US) is about 110dB «down».Another RC filter for the driver (point D, B1+) adds another 6dB/octave attenuation, 36dB/octave totally.Fig. 3: Power Supply SchematicNow, we have the final Power Supply Schematic – directly heated double diodes are shown. We have two double diodes on the same HV winding, one for each channel, each tube has CLCLCRC filter after it. Output voltage is from the center tap of our filament supply (5V/3A). We need B+=432V after filtering, and about B1+=400V, and with 760Vct (380-0-380V) we can use 5U4 or (half) indirect GZ37 here. 5R4 needs about 780Vct (or a little more), and GZ32/5V4 less, about 740Vct.I actually used old European Mullard/Philips rectifier, AZ50 (CV1264). It isn`t widely used, `cos of «strange» base (B4 or Eu8) and 4V/3A heating. But, new ceramic sockets can be found, and 4V supply is easy, see the picture 4c. I choose this tube by listening test, other solutions are possible, for example 5R4GYB (Sylvania) is a good, standard, and not expensive solution. It sounds brighter than AZ50 (fuller). Sound of the rectifier? Yes – although not directly in the signal path, it is indirectly in it, and sound changes can be heard.PS can be built in many ways, and a little changes (not «centre tapped» filament/heater 5V winding, then «not centre tapped» 6,3V driver heater supply is shown in Fig. 4 b & c.Tube bases (octals and B4/Eu8) are shown on Fig. 4a. F1 is a fuse, «slow-blow» type, `cos of larger turn-on current (magnetization and cold heaters/filaments). It`s value is 3A for 115V mains voltage, or 1,5A for 230V mains.C2 & C6 are

200µF/600V electrolitic – this working voltage isn`t easy to find, and two solutions are possible – use series connection of 350V caps, Fig. 4d ; or use the «standard» 500/550V capacitor. I used the later without problems, although «working» voltage on these capacitors is about 450V, and can be up to 550V with unloaded supply.S2 is a «standby» switch, it must be robust, a few A type. The switch-on/off procedure is as follows:-first switch on S1, wait about one minute, then switch on the S2 – now HV is present on the (warmed) tubes, wait a little more and now – the music! J-for switching off, first switch off the S2 (disconnect the HV), wait a little (for caps dried out) and then switch off the mains voltage by S1-S2 can be used for short «standby» (say a couple of minutes) It is not really advisable to use standby switch in this position in L-input PS (very high voltage pulse is possible), it is probably better to just use indirect, slow heating rectifier like GZ34.Capacitors/chokes values can be a little different, and experiments are welcome. My experience is that PS with a larger cap in C2/C6 position «sounds» better than smaller, 50µF type.Fig. 4: Some PS detailsWe can use the «more economic» way to build our PS, especially when we don`t have two 5V recifier windings.Fig. 5: PS filtering scheme with one rectifier for both channelsFig. 5 showed one rectifier filter scheme, «split» system for L & R. With GZ34 (we can enlarge C1 up to 47µF) we can use 380-0-380V winding, but 5U4 and GZ37 need about 420-0-420V, and 5R4 about 440-0-440V.I like two rectifier scheme (Fig. 3) more – two independent rectifiers on the same HV winding. Of course, the «ultimate» PS is two «monobloc» supplies… Each channel «draws» about 93mA, 11mA for the driver, 80mA for the output stage, and 2mA for the «bleeder» resistor R1/R3.DISCLAIMER: Tube power supply has high AC and DC voltages that are potentially lethal, be very carefull! (Good bye...)

Subject: Re: SE 300B Project, Part 10 - The Power Supply some more
Posted by Wayne Parham on Mon, 20 Mar 2006 15:46:42 GMT
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That's a pretty serious power supply study, great work! Thanks!