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The 4-30 Amplifier Revisited

After correspondence with a lot of people around the world who have built the 4-30 amplifier I described in the year 2000 at the Lundahl web-site, some slight corrections and addenda seem appropriate.

The most important observation made, is that the chain of two 220uF e-lyts in the rectifier for the anode voltage, C53 and 54 in the diagram on page 20 should be increased to 470uF/350 Volts or even 680uF. If the PCBs are used it may prove difficult to get those only 30mm in diameter, but 470uF 400Volts are to be found on the market. 680uF 250 Volts are also used by some and they work well too, as the voltage during operation never exceeds 450 Volts when the Lundahl LL1669A is used as the mains transformer. But I use myself 470uF and have no plans or desire to increase their size. Today I would have designed the PCB so that 35mm types could have been used, but alas, it is too late for that. All PCBs are now sold and I have no plans for having another batch made. Many have made their amplifiers point-to-point wired which is straightforward and in this case the physical size of the condensers is of less importance.

Also in the power supply the zener diode D55 can be omitted as the 100kOhm resistor R53 is more than adequate to protect C57 and if you are in doubt, use a 450Volt type instead.

The two foil condensers C51 and 52, both 470nF can of course be substituted by one 1uF condenser, 630 Volts.

There is a small fault on the amplifier PCB. I have corrected it on all PCBs sold by me. A small track on the side where the tube sockets and the trim potentiometers are mounted must be disconnected because it can short-circuit the negative grid supply with disastrous consequences for the output valves, if a fuse in the anode supply does not blow. Every danger is avoided when the track is cut at both ends.
As already mentioned, I have done so on all PCBs.

To facilitate adjustment of DC balance the potentiometer P2 could be lowered to 10kOhms.

As the PCBs allow the original Mullard 5-20 amp to be made as well, it has the possibility to incorporate the RC combination R4-C2, 4.7kOhm-47pF across the anode load of the EF86, compare diagram p16 to diagram p19 and diagram p20 in the appendix. These two components should ***not*** be mounted as they are not used in the 4-30. Some builders have not observed this and mounting them is a little damaging to the transient response and may also require a change in the value of C5 in the feedback line. The value, 560pF, is right when the Lundahl output transformer is used. There is no guarantee that it will be the same if other transformers are used and the measurements in the appendix are also only valid for the transformers indicated. I warn against output transformers where only a part of the secondary is used like those with taps for 4, 8 and maybe 16 Ohms. Using only a part of the secondary invariably leads to increased leakage induction and increased capacity i.e. lower quality than could otherwise be achieved.

The same applies to the electrolytic across the cathode resistor of the EF86. 50uF is used in the original 5-20 diagram on p16. The PCB also allows for the inclusion of such a component, called C4 on the diagram p20 in the appendix, here 220uF. It should ***not*** be mounted. Read p 14 and 17 once again, please. The diagram of the revised amplifier is found on p19 where you will see that the above mentioned components are not included. Today I regret that I made the PCB so that also the original 5-20 could be made on it as well. Nobody has done so as far as I know.

Some readers have commented on my claim at p25 where I write that odd harmonic distortion is cancelled by perfectly balanced push-pull operation. The normal approach to this is that only even harmonic distortion is cancelled but odd harmonic distortion is summed! Yes, this is in many cases what happens but not necessarily in all. The result depends very much on how the working lines of the power valves behave at their ends, and it is a fact that both 2cond and 3rd harmonic distortion have distinct minimums when both AC and DC balance is correct. Both measurements and listening reveals that.

Finally on p30 I write that the only thing that happens when the output valves are connected as triodes is that the available power halves. I should also have mentioned that output resistance drops and most significantly so if no negative feedback is used. I still think however that triode connection is overkill, but at least, now it is mentioned.

Some EL34 valves of current production have proven less reliable and difficult to adjust for the desired anode current and in particular to maintain that current over time. The problem is that some contamination of the grid with material from the cathode are to be found in some samples. When a contaminated grid becomes hot, it can begin to emit electrons itself thereby loosing part of its negative potential if the lost electrons are not immediately replaced. This can only happen through the grid resistor, and if that is of too high a value, the missing electrons are not replaced fast enough and as a consequence the anode current will rise and the grid becomes even hotter, the problem continues and

worst case scenario is that thermal run-away takes place and the valve is destroyed if the fuse is not mounted to protect the valves.

You will invariably find that there is a maximum allowable value of the grid resistor for most valves and this value is lower for use with fixed bias as in this design, than it is for use with cathode bias. When cathode bias is used, the rising anode current will increase the cathode voltage and thereby increase the electromotive force that replaces missing electrons on the grid thus stabilizing the current. For the EL34 the maximum value is 470kOhm for use with fixed bias and 1Mohm for cathode bias. To be on the safe side I have used 390kOhm but it has turned out not to solve the problem in all cases. Using an even lower value will load the phase-splitter too heavily.

There are many different brands to choose from, some good and some of more dubious quality. I have heard that for instance the SOVTEK valves that I have used myself are not always from the same factory and that SOVTEK just buys valve from other suppliers and mark them as their own. Others may do the same and consequently the quality can not be expected to be consistent. I have myself had some good valves and also some completely unusable and not long ago I bought 10 EL34 of the brand TAD. Four of them were prone to thermal run-away and could not be used. They may function with cathode bias but they were simply too unstable for fixed bias.

We never had this problem in the old days and none of my old SIEMENS or TELEFUNKEN valve ever showed any tendencies toward unstable current and proneness to run-away, so I was simply not aware of the seriousness of this problem until a few years ago.

The two brands I have found of fine and stable quality are the Chinese SHUGÙANG and the Russian TUNG-SOL. But there are more reliable brands. The SVETLANA valves are well spoken off and that also goes for the JJ valves. And I am sure that there are more good brands. I only can pass my own experiences on.

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