

# LINEAR AUDIO T-REG TUBE/MOSFET REGULATORBOARDS

## CONSTRUCTION GUIDE



**SAFETY WARNING:** THIS SUPPLY CONTAINS POINTS WITH LETHAL VOLTAGES AND CURRENTS, INCLUDING THE HEAT SINKS FOR THE MOSFETS IF YOU USE THOSE! YOU ARE RESPONSIBLE FOR YOUR OWN SAFETY, NOT ME, NOR THE FOLKS AT ELEKTOR OR AX WHO PUBLISHED THE DESIGN. DOUBLE CHECK THAT THE HIGH-VOLTAGE INPUT IS DISCONNECTED OR TURNED OFF BEFORE DOING ANYTHING ON THE BOARD. DISCHARGE THE HIGH-VOLTAGE CAPACITORS WITH A 1 K RESISTOR. MAKE IT A PRACTICE TO KEEP ONE HAND IN YOUR POCKET WHEN TOUCHING LIVE BOARDS WITH A METER PROBE OR ANYTHING AT ALL TO AVOID BODY CURRENTS. EVEN WHEN SWITCHED OFF, THE HIGH-VOLTAGE CAPACITORS MAY STILL HAVE A DANGEROUS CHARGE.

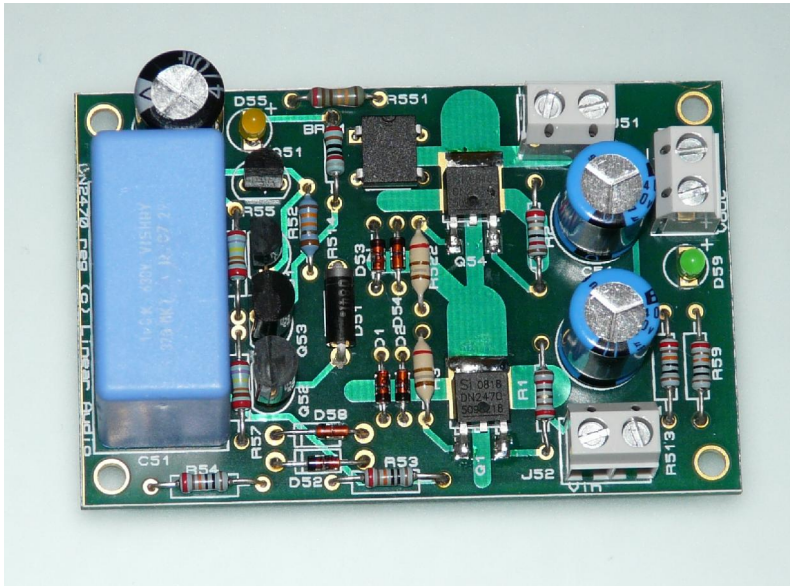
**Technical warning:** the heater supply for the pass tube is also used for the reference and control circuits, and floats on the regulated high-voltage. Do NOT use this heater winding for any other tubes in the equipment. If you use the DN2540 or DN2470 as pass device, you don't need a heater per se but you still need a separate floating supply for the reference and control circuits. In that case, you could also use a small separate 5 or 6 V<sub>AC</sub> transformer, provided it has enough secondary insulation to allow it to float to up to the maximum V<sub>out</sub>.

**Construction.** The following gives some general info for assembling a T-reg high voltage regulator. This guide addresses ONLY the regulator-only boards, NOT the mother board/plug-in set as published in Elektor and AudioXpress (although the general process would be the same). Since there are several different configuration boards with different tubes and MOSFET devices, I will not mention specific parts references but functional blocks. It will be obvious for your particular configuration which parts are meant and you should also read one of the mentioned articles for a concept and description of the circuitry.

The best is to start with the reference circuit, the small-signal transistor and the current source and current source LED, associated resistors and (zener) diodes. Also mount the control supply rectifier and the supply capacitor, as well as all terminal blocks. Do not yet mount the two transistors in the error amplifier nor the pass device. You can then test the reference circuits before proceeding so if there is an error it is much easier to isolate and correct it.

Calculate the total reference resistor value from the required V<sub>out</sub> and assuming a reference current of about 1mA. So, for instance, if you want 300V V<sub>out</sub>, the total reference resistor should be 300k. You can split that evenly between the two resistors on the board (two resistors are used to half the voltage on each one for reliability). Solder these resistors in the board but in such a way that you can easily remove them if you need to adjust them later on.

Now connect the heater (or auxiliary AC source if you use a separate transformer) to the 'heater' terminal block. This should either be the correct heater voltage (and current capacity) for the tube you are using, or, if you use the MOSFET version, 4-6VAC at 100mA or so. For the MOSFET case, a separate xformer of just a few watts is enough. Check that the rectified DC across the control supply cap is about 1.2 \* the V<sub>ac</sub> input. This is not critical though.



Next connect your high voltage source to the input terminal block. This should be a DC voltage source a little higher than your wanted  $V_{out}$ . If you will use tube pass devices, start with an input DC of about 50V higher than the design  $V_{out}$ . If you use MOSFET series devices, a 20V extra input DC is enough. The LED in the reference current source should now be lit. Carefully measure across the reference capacitor to see if the voltage is what you have calculated above. If it is too high or too low, adjust the reference resistors (with the power OFF and high-voltage caps discharged!). Be aware that the reference voltage can never be higher than the high-voltage DC input!

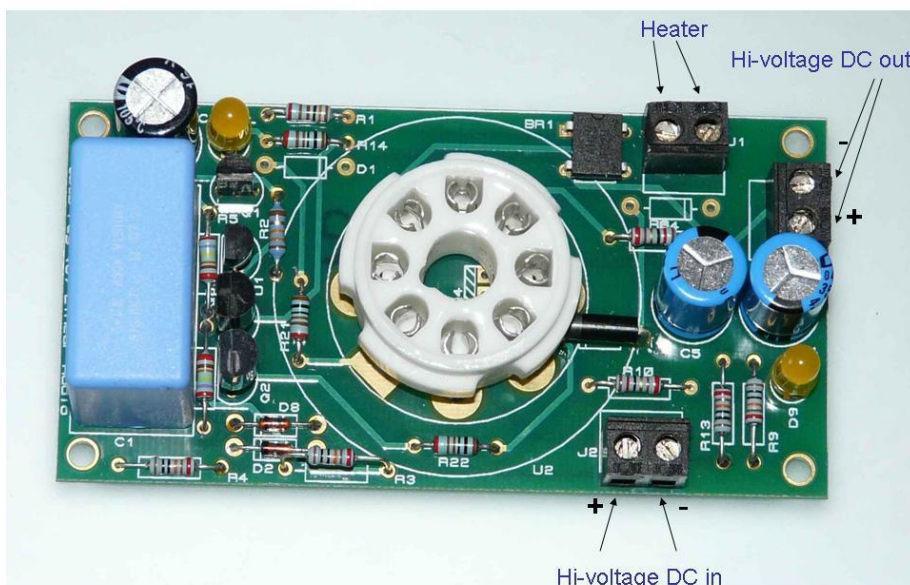
DN2470 regulator board assembled

With the reference voltage dialed in, you can mount the remaining components. Then again connect the 'heater' AC input as well as the DC high voltage input, and measure  $V_{out}$ . It should be about 1.2V less than  $V_{ref}$ . Verify again that the DC  $V_{in}$  has some headroom above  $V_{out}$ . You can then check regulation by temporary connecting a load to the output and verify that  $V_{out}$  remains steady. If the output drops when you load it, you may not have enough DC input headroom, or too much ripple on it. Be aware that if you measure say 50V DC input headroom, but there is 30V peak-to-peak ripple on it under load, your headroom drops in the valleys while at the same time the pass element needs more headroom under load.

Finally, if there are tips for or issues with these regulators I will post them on [www.linearaudio.nl](http://www.linearaudio.nl). And if you really get stuck you can email me.

Happy building and happy listening!

Jan Didden  
Linear Audio



6080-type tube regulator board assembled