HT250 PCB Design and Build

Ian Thompson-Bell

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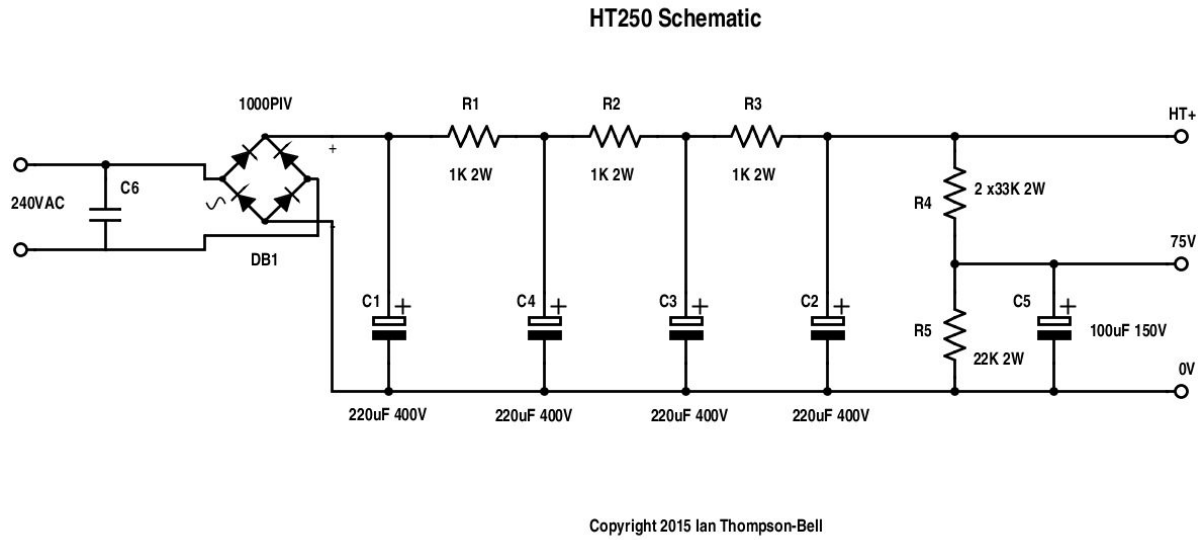
Circuit Description

The HT250 is a simple HT rectifier and CRCRCRC filter PCB designed for use in small tube mixers and preamps. Its schematic is shown below:



AC from a mains transformer secondary winding enters on the left hand side and is rectified by the bridge rectifier DB1. Capacitor C6 suppresses spikes caused when the diodes in the bridge turn off. C1 is the reservoir capacitor which creates raw dc from the rectified waveform. R1, R2, R3, C2, C3 and C4 provide a 3 stage RC filter that reduces the ripple voltage on C1 by up to 120dB. R4 and R5 provide two functions. First they serve to discharge the capacitors when power is removed even if no load is connected to the output. Secondly they act as a potential divider to produce a voltage equal to 25% of the HT voltage for use as a heater elevation voltage. Capacitor C5 ensures the elevation voltage is connected to 0V for audio signals. Heater elevation is required in some types of circuit where the dc voltage on the cathode of a tube might be a hundred or more volts above 0V. If one side of the heater is connected directly to 0V, there is a possibility that the heater to cathode voltage rating of the tube might be exceeded. To avoid this the heaters are elevated. Most of my designs have the cathode of one tube at approximately half the HT supply. Elevating the heaters to 25% of the HT voltage means this cathode is now only 25% of the HT voltage above the heaters. Other tubes with cathodes connected to 0V are 25% below the heater voltage.

BOM

The table below lists the components in the HT250 PCB along with suggested Farnell part numbers.

Reference	Value	Farnell Part No.
R1, R2, R3	1K 2W (see text)	1565434
R4	2 x 33K 2W	9338225
R5	22K 2W	9338179
C1, C2, C3, C4	220uF 400V electrolytic	2610784
C5	100uF 150V electrolytic	2346538
DB1	1000V PIV DIL bridge	2101162
C6	100nF 275VAC film	1198295

The value of R1,R2 and R3 depend on the load current. The unloaded HT voltage is approximately 340V and you typically require the HT output to be in the region of 280V to 300V so you should aim to drop 15V to 20V across each resistor. So for a 15mA load, the value of each resistor would typically be 1K. For a 30mA load the value would be 500 ohms (470 is close enough). This board will provide up to 100mA HT current whilst keeping the ripple low enough to supply a mic preamp. For a 100mA load, 200 ohm resistors will drop approximately 20V each giving an HT of around 280V and the circuit will still attenuate the ripple by over 80dB.

For currents up to 50mA, 2W resistors are sufficient. Above this, 5W types should be used.

R4 consists of two 33K 2W resistors wired in series. This conveniently provides the required 66K and also doubles the total dissipation.

C6 needs to be an X1 or X2 rated suppressor capacitor rated at 275VAC.

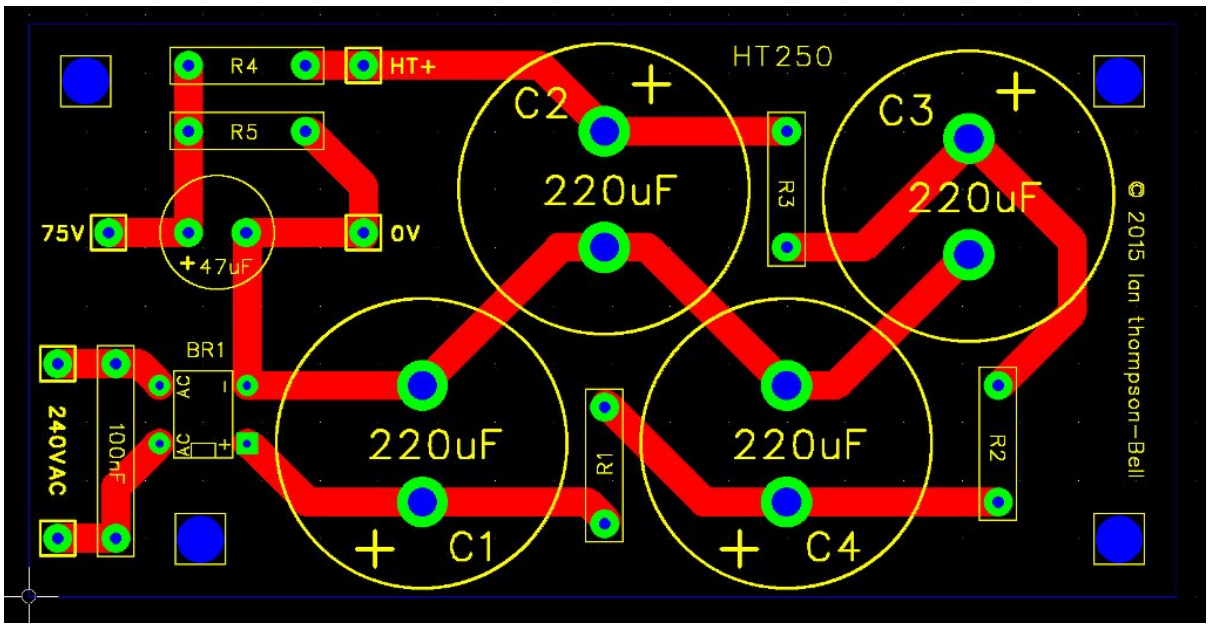
Assembly and Test

The completed PCB is shown below:

Start by fitting the DIL bridge and its suppressor capacitor. Next fit all the resistors. Notice how the resistors are all fitted vertically , to save space, and with the body outermost. Note how the two 33K resistors (top left) are wired in series before inserting into the PCB. Lastly fit the 100uF capacitor and the four large electrolytics. Make sure these are ‘snap-in’ types with 10mm lead spacing. They can be no more than 25mm in diameter. They must be rated at least 400V working types. 450V types can also be used. Be very careful to fit all the electrolytic capacitors the right way round. The PCB layout (shown on the next page) has the positive terminal of each one clearly marked.

To test, connect 240VAC from a transformer secondary to the two pads labelled 240VAC and apply mains power. **Do not under any circumstances connect the mains directly to the PCB**.

Connect a DVM (set to a range of at least 500VDC) across the pads marked 75V and 0V and you should get a reading in the region of 85V. Connect the DVM between the pads labelled HT and 0V and you should get a reading of around 340V. The HT250 is now ready to use. If the board is unloaded, it can take some time for the capacitors to discharge through the heater elevation resistors. After one minute, the voltages across all the capacitors should have reached safe levels. **Always check the HT voltage with a DVM before handling the board**.


HT250
R4
HT+
R5
75V
0V
47uF
C2
220uF
R3
C3
220uF
© 2015 Ian Thompson-Bell
BR1
AC
AC
240VAC
100nF
220uF
C1
R1
220uF
C4
R2

Issue Record

0.1 Initial Issue March 2017