

WORLD-DESIGNS HD3S DEDICATED HEADPHONE AMPLIFIER

For headphone enthusiasts out there and for those hi-fi family guys who lack the benefits of a dedicated hi-fi room, may I introduce to you the HD3S valve headphone amplifier.

THE DESIGN

The heart of the HD3S is a single ECL83 in each channel. Enclosed in this old timer's envelope is a triode alongside a pentode, the latter making up the output stage in what is an elegantly, single-ended circuit. However, this mode of operation can't fulfil its potential without a quality power supply, so we specify a toroidal mains transformer and high capacitance smoothing capacitors to keep any ripple voltage on the high tension line to an absolute minimum. Rest assured, you will find the HD3S is as quiet as the proverbial mouse. The final stage utilises E/I core output transformers of a very high grade. As headphones can have a nominal impedance of anything from 16ohms to over 300ohms, our designer has come up with a clever way to cope with this large range. The secondary of the output transformer has been built up of four equal but independent windings with their own leads. Depending on which way you wire them up, you can match the HD3S to any headphone. There are four range options: 16-50ohms, 50-125ohms, 125-250ohms and over 300ohms. Where your headphones are borderline between two ranges, try both and compare, and stick with the optimal setting. We also found that the Mullard original valve was the best performer, which is why we only supply this type in the kit. IN THE FLESH The HD3S is housed in a U-style aluminium chassis, 220mm(w) by 310mm(l) by 85mm(h), finished in black powder coat with white screen-printed labelling. The valves themselves are housed internally. Never fear though - each valve is ventilated by a pattern of elongated holes on the chassis top, so they can be viewed easily. On the rear panel you will find two pairs of phono sockets for the left and right channel inputs so that the link from the Tape Out to pre-amplifier can be interrupted easily. On the front panel you will find a power LED, a 1/4in. stereo jack socket for your headphones and a chromed volume knob connecting to an ALPS Blue Velvet potentiometer.

HD3S Circuit Description by Gary Devon

The HD3S headphone amplifier is extremely simple. It uses a pair of ECL83 triode/output pentode valves, one per channel. In each envelope is a signal triode and a small power pentode, originally designed for economy as you only needed one valve, plus a rectifier, to make an amplifier - mono of course! The triode/output pentode valve was very popular in TV sets, radios and record players in the 50s and 60s; the Dansette had one inside. The HD3S circuit is extraordinarily simple, with only one amplification stage before the output stage. In our application the pentode section is connected as a triode, with its screen grid connected to its anode via a 100 ohm resistor. This was done because we do not need the extra power output which the straight pentode can achieve, and we wanted the sonic purity of the triode output stage. The triode connection still allows around 1 watt of power, which gives enormous headroom on headphones. The input stage is the triode section of the ECL83; this is used conventionally apart from the feedback arrangement which uses the bass compensation scheme where overall feedback is increased with decreasing frequency by virtue of the capacitor, C4 and C7 in the triode cathode - this gives a very tactile and solid bass quality. The output transformer and the derivation of overall feedback are a little different to the norm. Here a special tertiary (techspeak for third) winding is incorporated into the output transformer.

The most obvious reason for this is the various connections which are possible with the four separate secondary windings. There are four combinations of these windings making it possible to match headphones from 16 ohm to over 300 ohm. If the feedback were taken directly from the secondary this would mean changing feedback components each time, but with the tertiary winding there is no need. The coupling of the tertiary to the secondaries is very good but not perfect, this shows itself as a leakage inductance which here is very useful. It helps filter RF, stopping it from entering the amp's feedback loop, and in a similar way to the essential inductor on the output of solid state amplifiers it helps keep stability with reactive especially capacitive loads. The power supply is again very straight forward with solid state rectifiers and capacitor input filters, with RC decoupling.

MEASURED PERFORMANCE

To give you an idea of what the HD3S is capable of, the frequency response spanned 17Hz to 87kHz. Distortion at 1mW into a 30ohm load amounted to 0.04%. In addition, driving a 30ohm load with a 30mV input gave 180mV output; 750mV will providing an output of around 1 watt, no mean feat for a headphone amp!

As the usual power rating of headphones is around 200mW, you can see that the HD3S will give you plenty of headroom direct from a line level source.

THE KIT

The kit contains everything you will need, bar tools of the trade and headphones. The HD3S is relatively easy to build thanks to clear, simple instructions illustrated with lots of informative diagrams and tables. As long as you have a good soldering technique, some understanding of electronics and a multimeter, and you're aware of important safety procedure, you are unlikely to encounter problems.

ADDENDUM

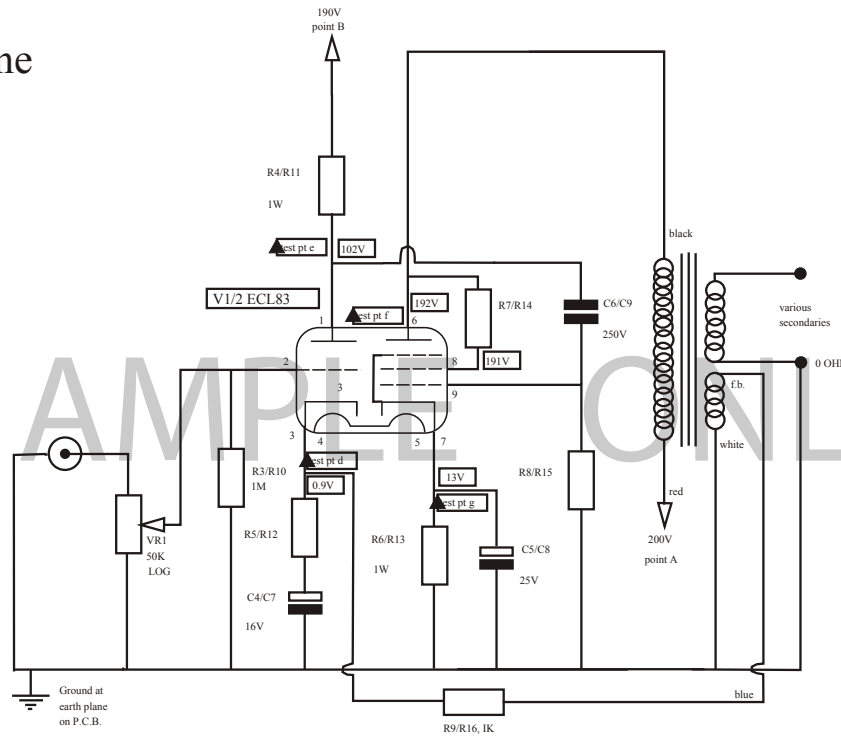
This kit was originally introduced as a Hi-Fi World DIY Supplement kit with the product code HD83. The enclosure was originally steel and the pcb allowed secondary impedance selection via solder pins.

HD3S is a complete upgrade of the original circuit, still retaining the main circuit design, originally by master valve chef Andy Grove, but now featuring an aluminium chassis to remove magnetic eddy currents induced by the transformers, a new internal layout for optimum component placement, a new pcb design for optimum signal path and star earth grounding and switchable output impedance.

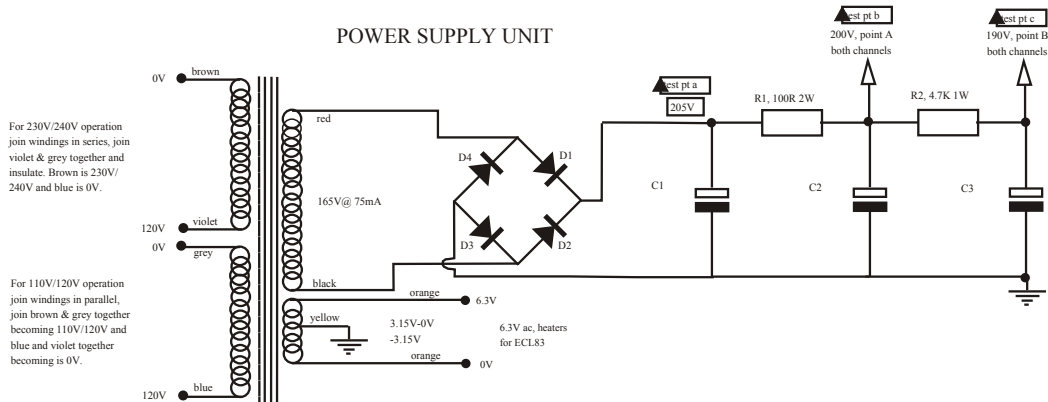
Output impedance is now selected by removing the cover and flipping a selection of DIP switches. This makes it easy to try different impedance selections where your headphones border on two impedance bands, or just to change headphones without the need to resolder the secondary links.

SIGNAL CIRCUIT (ONE CHANNEL)

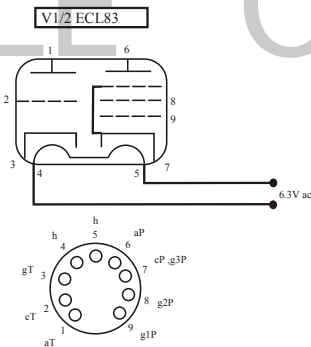
HD3S headphone amplifier



POWER SUPPLY UNIT



VALVE PIN LAYOUT



Views are from underneath valve or valve holder
 h = heater hct = heater centre tap c = cathode a = anode nc = no connection T=triode P=pentode