

The DAO SE, an All-FET, Zero- Global-Feedback, Pure Class A Headphone Amplifier (Part 4)

XEN Audio
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Case Design

Following the XEN tradition, we set out the same design objects in the case design as our F5X power amplifier :

1. Same elegant, minimalistic design with minimum number of non-protruding screws visible.
2. High intrinsic rigidity by the use of extrusions rather than plates.
3. Vibration damping between transformer (if any) and the main case structure.

The main shell of the case is a single piece of German aluminium extrusion of 200x80mm cross section and 4mm thickness. A cut-out is CNC milled on one side to allow access for mounting the entire electronics, including the power supply boards, with the exception of the mains transformer. This is later on closed by the heat sink extrusion of 200x40x250mm, resulting in an extremely rigid box structure and ample heat dissipating capability.

The DAO power buffer, the HAGS modules, as well as the CRC PSU boards are all mounted onto a heat spread as one sub-module, with the input and output connectors prewired. This can then be placed inside the main shell as one unit, and access from the top allow easy access for connector fixing. The cross-feed buffer is then placed from the top on the rear wall of the main shell, right above the input RCA connectors.

The top plate is a 3mm 6061 AL plate with a milled periphery to ensure proper centring in the main shell, to which it is bolted with 6 M2 countersink stainless steel screws. Slots are provided for proper ventilation for the enclosed volume in the shell.

Although we ourselves prefer the more costly variant of LiFePo4 battery power supply, we expect others to prefer the use of transformers. Sufficient space is provided to allow both versions to be implemented.

To provide some degree of damping of transformer vibration transmitted to the main shell, a number of Additional features are included in the transformer mounting. A first level of damping is provided by rubber washer between the transformer mounting screw and the transformer brackets. The mounting screw itself is made of Tufnol, a reinforced thermal plastic with inherent damping properties. The transformer brackets are then mounted on an 18mm.thick base plate made from oil-impregnated, solid acacia wood which also fits into the bottom cavity of the main shell. The battery version is, without saying, a much better solution with lower mechanical as well as electrical noise. A single 3-pin power connector allows easy connection of the transformer / battery to the rest of the circuitry.



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Adapting to varying Load Impedance

Although the basic circuit of the DAO follower is open loop, it does have some excessive gain at high frequencies due to interaction between the cascode and gain devices. Testing as well as simulations show that it performs best with a resistive load of about 65 ohm or below, with which the square wave response is clean with no overshoot at all. This makes the DAO ideal for such hungry headphones as the AKG K701.

Some of these phones however show an inductive behaviour above 10kHz. Therefore, it is recommended to incorporate a compensating Zobel network. For the K701, a simple R-C network of 65R/100n in parallel with the phone will give a flat impedance over frequency.

For high impedance phones over 100 ohm, such as the Sennheiser HD650, there are two simple solutions. One is simply to load the DAO with a 75R power resistor at the output (e.g. Caddock MP930). This then provide a pure resistive load for the DAO and swamp the impedance of the headphone itself. The other solution is to use a low impedance Zobel to load the follower at high frequencies. Recommended starting value is 27R/10n, which should give a clean, flat frequency response for all conditions between 70R load and open circuit. This might vary somewhat between amplifiers. So the best is to test with a 1kHz square wave and adjust those values to get the best waveform.