The F5Pi
Power Supply Details
XEN Audio
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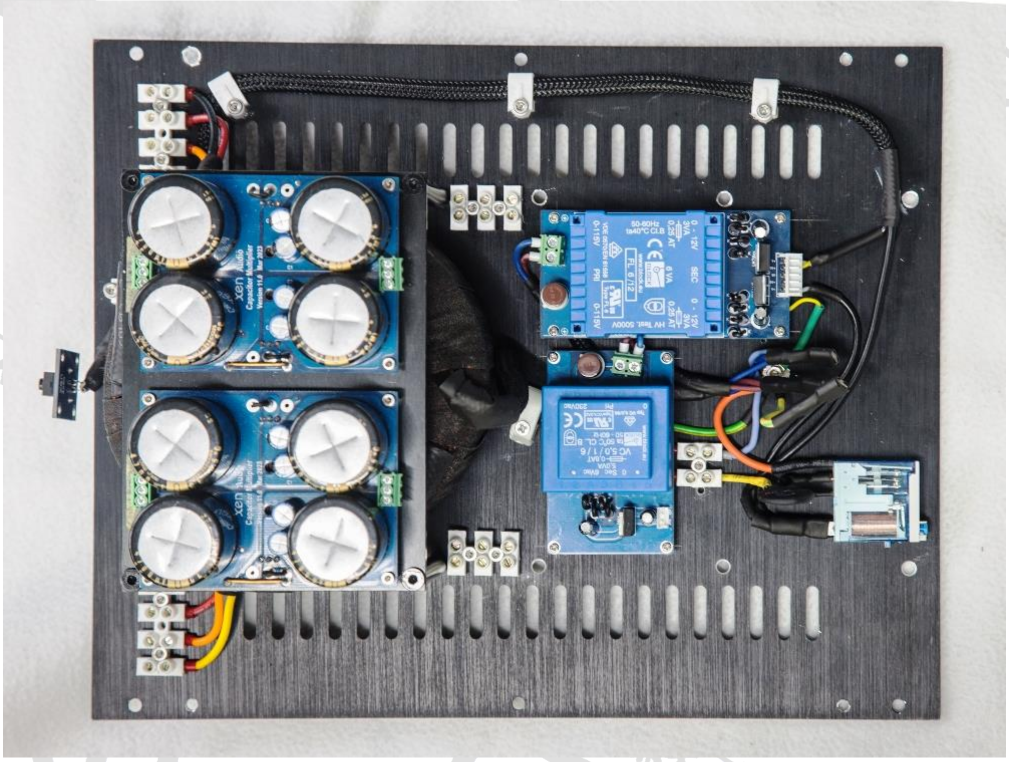

Next topic is power supplies.

The 3213 case has an opening on the rear panel for an IEC socket. But instead of using the cheap one provided, we chose to use the Schurter DD12 Power Entry Modules instead. This has the IEC socket, fuse, toggle switch and line filter all in one.

Once the toggle switch is on, the auxiliary supplies will get power for the source select and volume control. Because some might want to be able to switch off the amp at the front, we included an additional mains relay for the amplifier power. This is activated by a front push button switch. Inrush current for the power transformer is just NTC, a simple and hence reliable solution.

There are 2 auxiliary power supplies, one for +/-12V and another for 5V. Transformers are German Block UI 6VA and EI 5VA. Regulators are just 78xx and 79xx, in TO220. They hardly dissipate much power, so no additional heatsinks are required. And as Fran will tell you, grounding of the AUX PSU's play an important role in the 50Hz pickup noise of the amplifier itself.

The main transformer is one of the key elements to the amplifier. Consumption per channel is 70W, so the minimum is 350VA. The maximum allowable size in our layout is 135mm diameter and 70mm height. This will also fit into 140mm steel cans for housing toroidal transformers. Such steel cans are worth having as they provide additional magnetic shielding.

Even though we were using separate regulators for frontend and output stage, they were still fed from the same bifilar secondaries. The secondaries are separate for each channel, so four in total. If we were to have separate secondaries as well for the frontend, that would mean 8 secondaries. Not only will that add quite a bit of cost, but it will no longer fit the prescribed dimensions.

A special feature of our transformer is that the bifilar secondaries of each channel only occupy 180° of the toroid. This minimises the inter-winding capacitances of the secondaries of one channel to the other channel. Not all toroidal transformer manufacturers want to take that trouble, even if they can technically. We only managed to find one in Europe, not in Poland BTW. Some people might prefer SMPS these days, and 2x 240W should fit in the same space without difficulties.

In our prototype, 4 capacitor multipliers were provided for each channel, separately for the frontend and the output stage. To avoid excessive dropout voltage and wasted power, Japanese MOSFETs were used with Vgs ~2.4V at operating current. Most other devices have Vgs around 5V, i.e. double the dropout and dissipation. One can also consider lateral MOSFETs instead. Their Vgs is a bit low to comfortable cover the ripple voltage at the input side. But that can be overcome in the circuitry. The other alternative is Darlington's with a high hfe, e.g. >5000 at bias.

But we have also developed a simpler and more economical solution – to use generic 3-pin low-dropout regulators. The only one we could find that allows 40V input (to also cover the additional voltage required for Onsemi FETs) and maximum current of 5A is the old faithful LM338. So instead of using a pair of positive and negative LDO's, we are restricted to using 2x LM338's. That also means that 2 separate secondaries with separate bridge rectifiers is now a must. If dual-voltage SMPS is used, then you are restricted to using LT1084 / 1033 instead, which can take maximum 30V 3A.