

The F5 Preamp

XEN Audio

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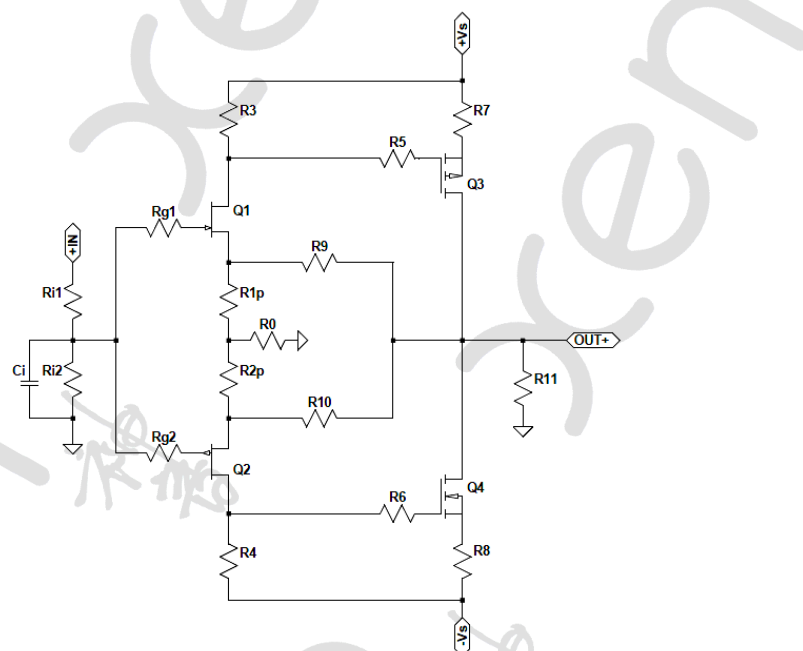


Background

Earlier, we published the F5Pi integrated amplifier with a F5 frontend, a M2OPS, and a Relaxed relay ladder attenuator. With the modular architecture of the F5Pi^[1], all the ingredients are there to make a F5 Preamp as well. All we need to do is leave out the M2OPS, right ?

Not quite. Because 26dB is certainly too much gain for a preamp. Rather, most preamps have a closed-loop gain of 10~13dB. If the same level of negative feedback around 30dB is to be maintained, the open-loop gain would also have to be reduced by ~13dB

This can be done conveniently by using JFET pairs with less transconductance, such as 2SK246 / 2SJ103, or 2N5457 / 2N5460. The resistor values would have to be adjusted, without saying. These not only help to reduce OLG, but also allow the use of higher value resistors in the feedback network, thus avoid loading the output excessively. Of course, you can use the BA3 here as well, but also with reduced gain.



Options for Source Select and Volume Control

The most convenient option for source selection and volume control is the original Relaxed Passive modules as designed by Jos van Eijndhoven^[2]. One has been built as published, and it works faultlessly. However, it is limited to 4 inputs, and has a SMPS powering the relays and the control electronics. So other options have also been explored.

There are quite a few electronic volume control units on offer, such as the Muses 72323 unit from Meldano^[3]. There is also a Chinese 128-step relay-switched-resistor-ladder volume known as W-ONE by Golden Technology^[4]. All of these fit within a 40x40x40mm volume, and encoder driven with remote control and LED display. These allow the control knob to be placed at the front, while the attenuator itself can remain at its optimum position at the rear panel, near the input connectors and the source selector, to minimise signal path length and noise pickup. The W-ONE uses the same Omron small-signal relays as the F5Pi, but it only has separate DGND and one AGND, i.e. the 2 channels share the same AGND. Special 4-layer boards were designed to overcome that, for those who consider it important to have separate AGND's.

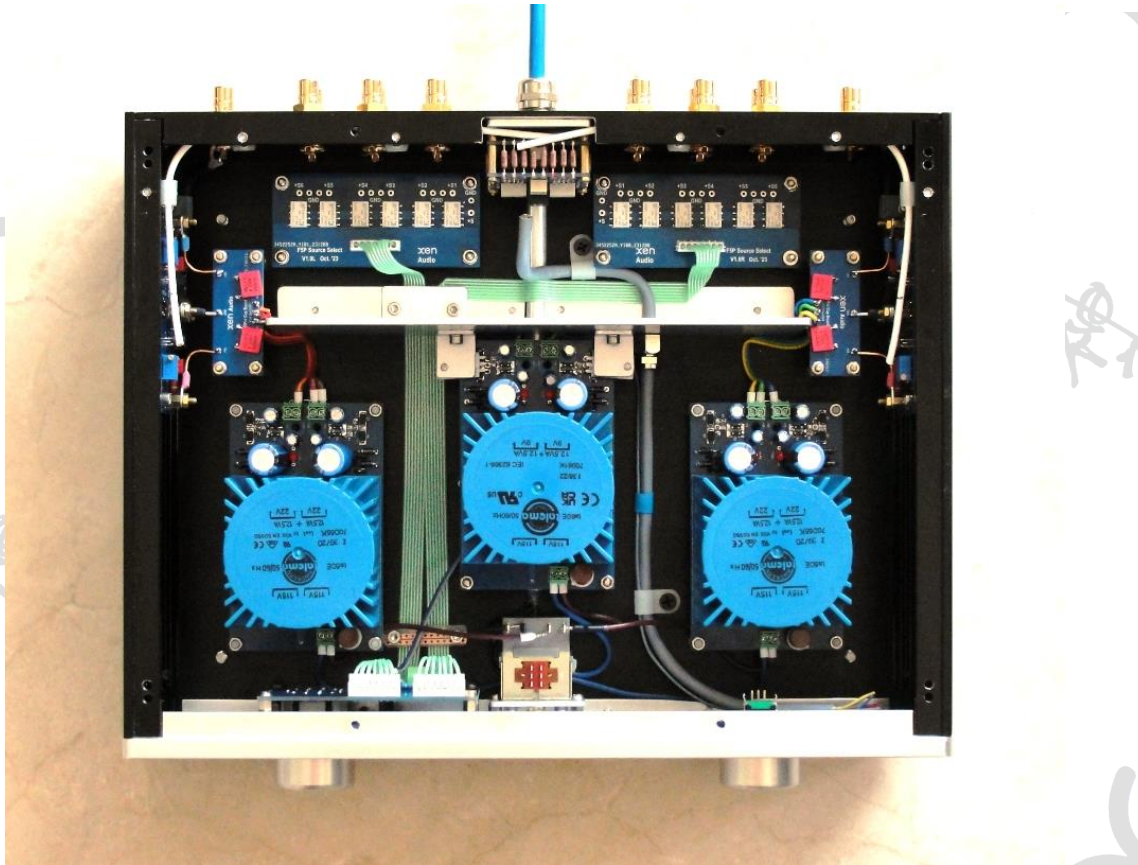
To go together such a volume control unit, additional left & right channel source-selector PCBs were designed to suit. These allow better channel separation, and up to 6 input sources. The same Omron micro-signal relays as in the F5Pi were chosen, and they were selected by a simple rotary switch with no digital circuitry necessary. The quality of the rotary switch is of no importance in terms of distortion. So low-cost units from Lorlin can be used here. The only disadvantage is that only the attenuator has remote control. If this is a must, go for the original Relaxed.

Enclosure Layout

One of the goals set out for this project was to use a case design that everyone can make without access to CNC milling. That means rectangular windows are to be avoided, unless they already come with the case. We have chosen to use a BZ3207 blank case, and develop a special ring LED user interface for the volume attenuator. An STM32 MCU chip is used to receive the display signal from the attenuator MCU board, and uses the decoded attenuator position information to light up one of the 32 LEDs around the knob (dot mode). As you can see from the picture above, one only needs to be able to drill round holes, and still has a decent looking case. And of course it is not restricted to the BZ3207.

There is also a cloned 3207 preamp case from the same OEM supplier which already includes acrylic window for channel and volume display with 7-segment LEDs. We have also made special PCBs to suit, for those who fancy a different look.

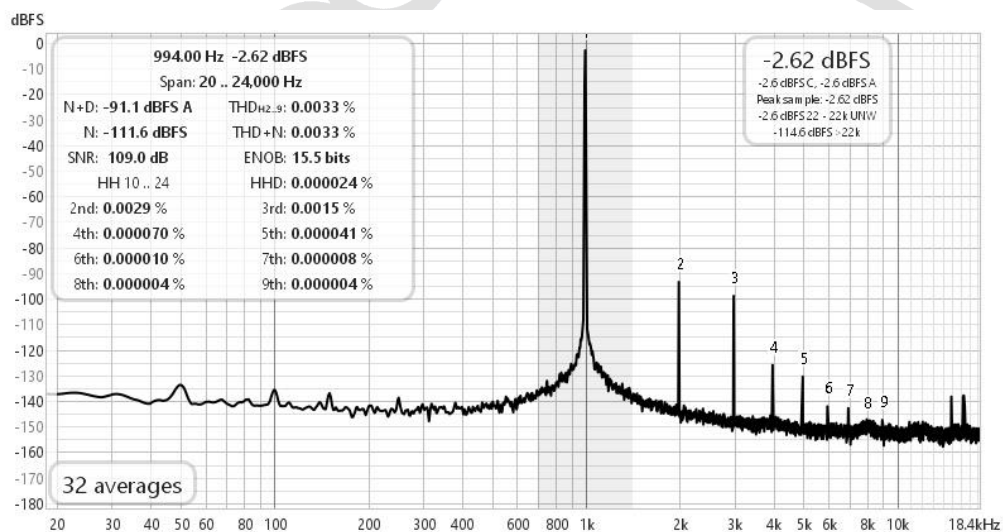
The 3207 case has sufficient height to mount preamp PCB vertically on the side walls, freeing up lots of space for the rest. Because of the space available, separate PSUs can be used for each channel, and an additional one for Source Selection / Volume Control electronics. These are placed towards the front panel, away from the audio signals, together with manual control knobs and LED displays. Each of the supply units has a Talema 25VA PCB toroidal transformer, followed by soft recovery diodes, Nichicon KA caps, and dual LM317 regulators, or any pin-compatible equivalent in TO220 case. Additional local caps are placed right next to the preamp boards.



Measurements

Without any caps in the feedback network, the -3dB frequency bandwidth is ~3MHz. We decided to have some bandwidth limiting to avoid excessive HF noise from digital sources and noisy surroundings. Using a 330p MKP2 cap of suitable value, the bandwidth is reduced to about 500kHz. But one can make an individual choice by using different values.

Distortion at 2Vrms output is about -90dB h2, and -96dB H3. But note the noise level and the 110dB SNR, in case there are any doubts about the input JFET choice.



References

1. <https://www.diyaudio.com/community/threads/the-f5pi-f5p-voltage-gain-stage-m2-output-stage-perfectly-integrated.406024/>
2. <http://www.vaneijndhoven.net/jos/relaixedpassive/index.html>
3. <https://www.diyaudio.com/community/threads/muses-volume.322983/>
4. <https://www.diyaudio.com/community/threads/stepped-attenuator-with-rc-and-display.404695/>