F5X-P, an All-FET, Pure Class A Preamplifier (iii)

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Passive Components

The only key components on the amplifier board other than the active devices are the resistors. Same as in the F5X power amplifier, multiple PRP audio grade resistors are used in parallel to reduce noise and inductance. However, for the 2W source resistors at the second stage, resistor values between 1R and 10R are required, and there are no real audio-grade devices available. Thus PR02 from BC components or Panasonic 2W metal film resistors are used at those positions.

Power Supply

Even though we are known for our affinity to batteries for line level applications, we thought that we should start off a public project with transformer supplies, and present battery operation as an option. Most DIY'ers appear to prefer transformer supplies, even though they can be just as costly as batteries, if not more.

For a no-compromise, line-level power supply, the best transformers one can use are R-Core transformers. In particular, they allow very low inter-winding capacitance between primary and secondary windings. The power requirements of the preamp itself is +/-24V 250mA per channel, so that a 35VA transformer would be sufficient. However, as the volume and price of transformers between 35VA and 80VA do not differ so much, we ordered a pair of 80VA R-Core transformers ourselves from the Japanese audio transformer manufacturer Phoenix. As in the F5X, we chose to use two separate bridge rectifiers per channel, so that the Gnd connection of the positive and negative power supplies is only made at the star point at the centre of the preamp PCB. As current consumption is much lower than the F5X, MUR860 or MSR860 rectifiers are more than sufficient for the purpose. A bank of 4 capacitors in parallel follows the rectifier immediately, before any voltage regulation.

Mountings are provided for the same capacitor multiplier / regulator as in the F5X, as this provides a low enough output impedance without the use of feedback. However, if one chose to use any of the popular regulators around, shunt or otherwise, the PSU case provides sufficient space as well as heat dissipating capacity. Only a small capacitor should be included immediately at the output of the regulator to ensure stability (in case of feedback type regulators). The actual power supply capacitors for the preamp are placed immediately next to the preamp PCB itself, as they should be.

The relay power for source selector and attenuators is taken from the power supply of one channel after a series of LC filters, before being regulated to 24V. Further LC filters and a voltage regulator follow to create the low voltage supply for the MCU. The multi-stage passive filtering makes sure that very little HF disturbance of the MCU will ever get through to the preamp itself.

Source selector, Attenuator, and User Interface

Had we done this project for our own use alone, we might have used a Seiden switch for source selector and attenuator, very much like the Ayre top-of-the-line preamp. As we are presenting this as a public project, however, relay-controlled source selector and attenuator provide more flexibility.

The source selector consists of 6 Omron G6S miniature signal relays for each channel to accommodate 3 single-ended and 3 balanced sources. An additional relay is used to connect the negative input of the F5X-P to Gnd whenever a single-ended source is selected.

For the attenuator, we have deliberately not chosen to use the well-known constant impedance circuit, as the attenuated signal would have to go through multiple solder joints and relay contacts in series. We believe that most modern signal sources would have low enough output impedance to drive a load of 10k or higher, and thus there is no need for such constant-impedance attenuator network. We have therefore chosen to use a balanced attenuator with 2x 10k series resistors connected to the positive and negative source inputs respectively. The inputs to the F5X-P are in turn connected to the shunt resistor sandwiched between the 2x 10k series resistors. The shunt resistor itself consists of 8 relay-switched resistors in parallel, with the values of 20k, 10k, 5k, 2.5k, 1.25k, 618R, 300R and 160R, providing an attenuation between 0dB and -48dB. Each of the 8 resistors is controlled to open or close to the attenuator network by an Omron G6S relay. As such, all the resistors and their relay contacts are in parallel, this minimising contact resistance, stray inductance, and noise. We consider these benefits to far outweigh that of constant input impedance.

In case a single-ended source is chosen, the series resistor at the negative input is effectively shorted, thus reducing the attenuation by 6dB. As such, a single ended source will sound just as loud as a balanced one at the balanced output of the F5X-P.

The attenuator PCB has resistor mounting holes at 3.8mm and 5mm pitch to suit all popular top-of-the-line audio grade bulk foil resistors (Texas Components, naked Vishay, Caddock MK132, etc.).

The source selector and attenuator relays are controlled by a microprocessor based controller board. We have chosen to use a MCU instead of pure logic circuit, as the former will allow more functionality to be implemented with more flexibility, among them IR remote control.

For manual operation, the MCU board is also equipped with 5 push buttons for Mute, Mode, Select, <, > respectively. A small 1x16 VFD display completes the user interface.