## Power Up and Bias Adjustments

Before starting up the F5 turbo,  a builder should again read what Nelson Pass has written concerning building the F5 and instructions on setting the bias.  A summary document is found in various sources on the web, with the following as an example.

http://www.dms-audio.com/system/files/F5-Nelson.pdf

First, we once again made sure P1 and P2 were set to minimal resistance.  In Nelson's paper, above, he wrote about them being turned down.  This means current is turned down (HIGH resistance).

Second we used a 1 amp fuse for initial start-up, even though we would use larger if the amp works without problems.  The current draw should be minimal on first power-up if P1 and P2 are set to minimal resistance and the circuits are built correctly.

Third, as is frequently discussed on various threads, we performed initial power-up with a 100 watt light bulb in series with the power cable.  We created this simply by taking a bulb socket and power cord and wiring the socket in series.

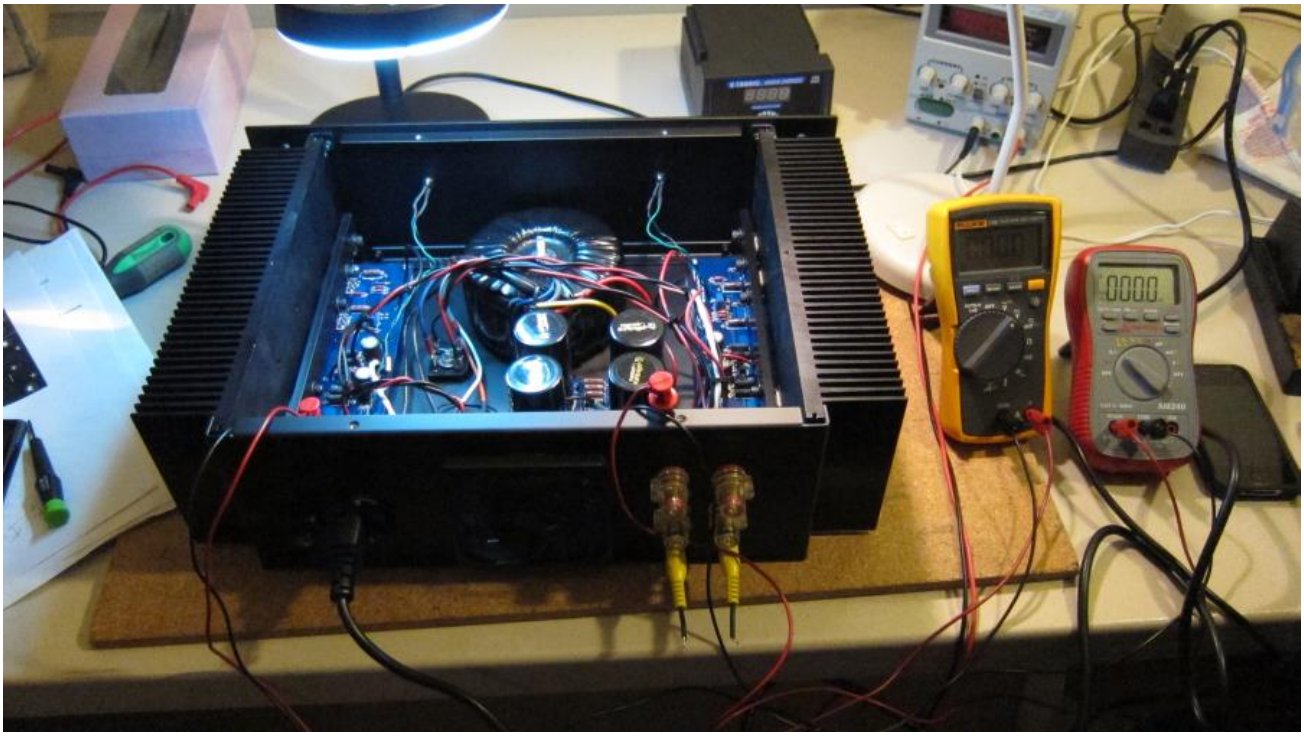
The resistance of the bulb drops voltage to the amp significantly.  On initial start-up using the bulb, if the bulb lights up brightly, too much current is flowing and there is a problem somewhere.  We now have a variac, but still love the light-bulb start up given the immediate warning relayed when the bulb lights brightly.

We cut off the ends of two cables with RCA plugs and shorted the wires to the plugs.  We then plugged these into the signal input RCA jacks in the back panel.  We keep these inputs shorted when setting bias.

We do not attach speakers or other loads to the speaker terminals during startup and bias.

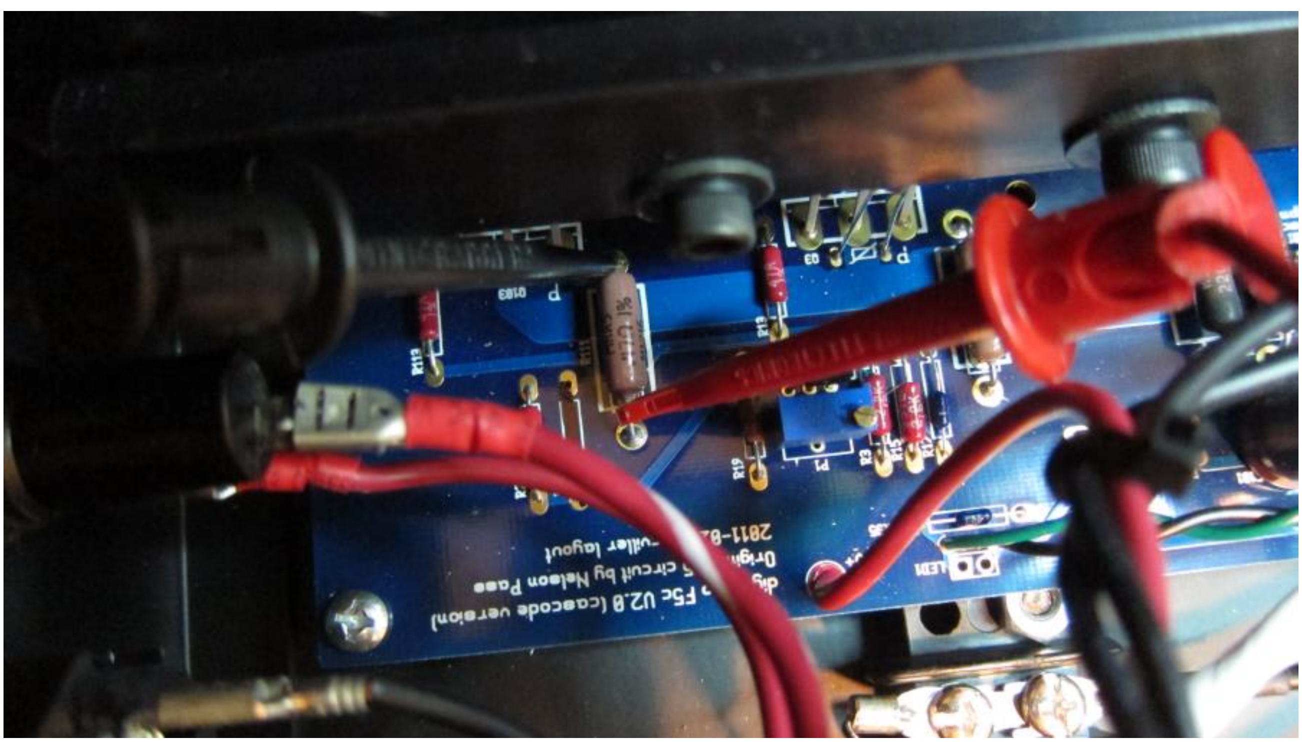
We decided that we would shoot for about 0.8 A across the MOSFET source resistors, with plans to let it sit there for 3-4 weeks while being used, and then go up to about 1 A, if the heat sinks can handle it.  Of course, we want this desired current with speaker offset voltage < 10 mV.  Since we have 0.47 ohm resistors on the sources of the MOSFETs, 0.8A would be a voltage drop of 376 mV across source resistors.

Below is a an overview of the bias setup.



Above, you can see the yellow shorted RCA plugs in the input jacks.  No load on output (no speakers). The yellow volt meter is measuring voltage drop across a source resistor.  The red volt meter is measuring output offset voltage across speaker terminals.

Below, the yellow volt meter leads are across a 0.47 ohm MOSFET source resistor on one of the amp boards.  It doesn’t matter which source resistor you choose on a given board.  Just be sure you are measuring the offset on the speaker terminals from the same board with the second volt meter.



Over to the right are leads from the red volt meter on corresponding speaker output terminals.

We powered up using the light bulb and a 1 A fuse.

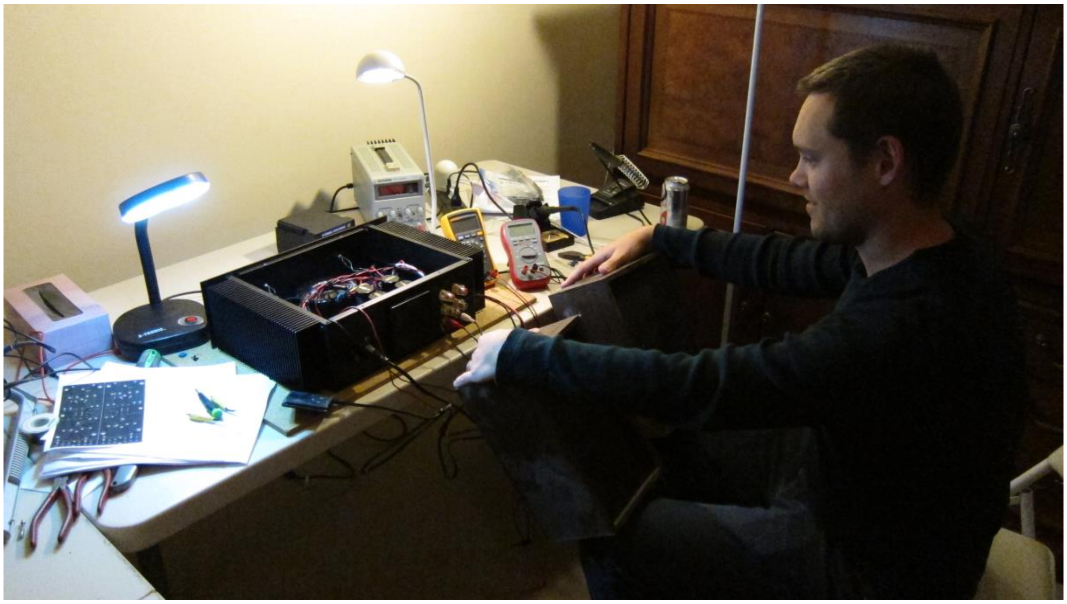
On initial power-up, there was no voltage drop across the resistor and zero or minimal speaker offset voltage, which is good. P1 and P2 were doing their job at minimal resistance.

We turned P1 and P2 until we began seeing voltage drops across a source resistor on each board, with corresponding rises in offset voltage. **<u>We then set P1 and P2 back to minimal resistance on each board.</u>**

Then we took the light bulb out of circuit, changed out to a 3A fuse, and powered up again with an normal power cord.

We then carefully began turning P1 and P2 as described in countless posts on countless threads until we began to see a rise in voltage drop across the resistor while we maintained the lowest voltage on the output. As we did so, of course, the amp began heating up. We initially biased up to about 280 mV across a source resistor on each board with an offset of near zero. After letting it sit for 5 minutes, we put the top on and let it cook for about 30 minutes. We found it was pretty steady, so we took the bias up to our goal, with offsets easily obtained < 10 mV. We let the amp sit with the top on (and fan running) for about an hour and readjusted again. The photo below was taken with 0.372 volts (372 mV) across a source resistor and only -6.7 mV offset voltage. We continued to adjust and ended up getting offset to +/- 1 mV on both boards with source resistor voltage drops of about 375 mV.

We  took the output from an Ipod and sent it into the amp and hooked up a couple old 4 ohm test speakers we keep for just such purposes.  Sounded fine.



The following day, we turned the amp on and let it sit for a couple hours and again recalibrated with shorted inputs and no load on the output.  It was amazingly steady, requiring almost no adjustment.

With a bias of 0.8 A, we could keep our hands on the heat sinks for about 10 seconds before things got a pretty hot.  Of course, when playing music, the amp cooled dramatically, with heat sinks that were only slightly warm to touch, as current was directed to speakers rather than being wasted as heat.  The amp has been in use for about 4 weeks and it is time to rebias it and see if we can take up the bias to 1 A.  That is, whether the heat sinks can handle it. Upon measurement, the amplifier consistently draws about 230 watts (regardless of volume).  I suppose if we blasted the speakers and stayed out of class A, we would see additional power consumption, but 230 watts consumption gives us way more volume than we would ever require out of our speakers.  230 watts with a 400 VA transformer seems fine for what we are using the amplifier for.

When comparing it to the F5, it sounds (by ear) that there is not quite as much bass when connected to 8 ohm speaker columns, but this may be our imagination. We may need to put some 0.5 to 1 ohm power resistors in series with the speakers and see if we don’t increase our low frequency response some.  We also need to measure some frequency response curves using software. There are differences from the F5 beyond the number of MOSFETs.  For example, we have increased rail voltage and have changed the feedback resistors to increase gain coming out of the JFETs.  But the amp does sound incredibly good.

What would we do differently next time?  Now cases are available from the DIYaudio store along with a hardware package for the back panel, and the sinks are pre-tapped for the boards we are using.  Thus, we would (will) buy our next enclosure from DIYaudio along with back panel hardware.  Their enclosure has extremely generous ventilation (without fan). If we do buy the same or similar enclosure we used for this project, we certainly would dramatically increase ventilation below and on the top with or without a fan.  We may still drill additional vent holes and have some more powder coating done. We would also seriously consider spacing the MOSFETs evenly on the sinks and simply run wires to the boards from the MOSFET terminals to allow better heat-sinking.  Or simply use larger heat sinks (probably what we would choose).  Given the discussions on threads concerning difficulties with allegedly matched JFETs, we would measure IDSS on the JFETs ourselves, not trusting the vendor, unless the vendor is a member on the DIYaudio threads with a good reputation, and there certainly are such members.  We would certainly use much,  much cheaper two-pole electrolytics on the

PS board if we didn't have several more Jensens left for our next amplifier.  We also wouldn't bother to score the PS board for 4-pole capacitors.  We also might go up to a 450 or 500 VA transformer.

We hope this thread may have been of some assistance to a first-time builder and would love to get some constructive/destructive feedback and advice on this build and for our own future builds.  Below are photos of the completed amplifier.  Good luck.

Steve and Matt