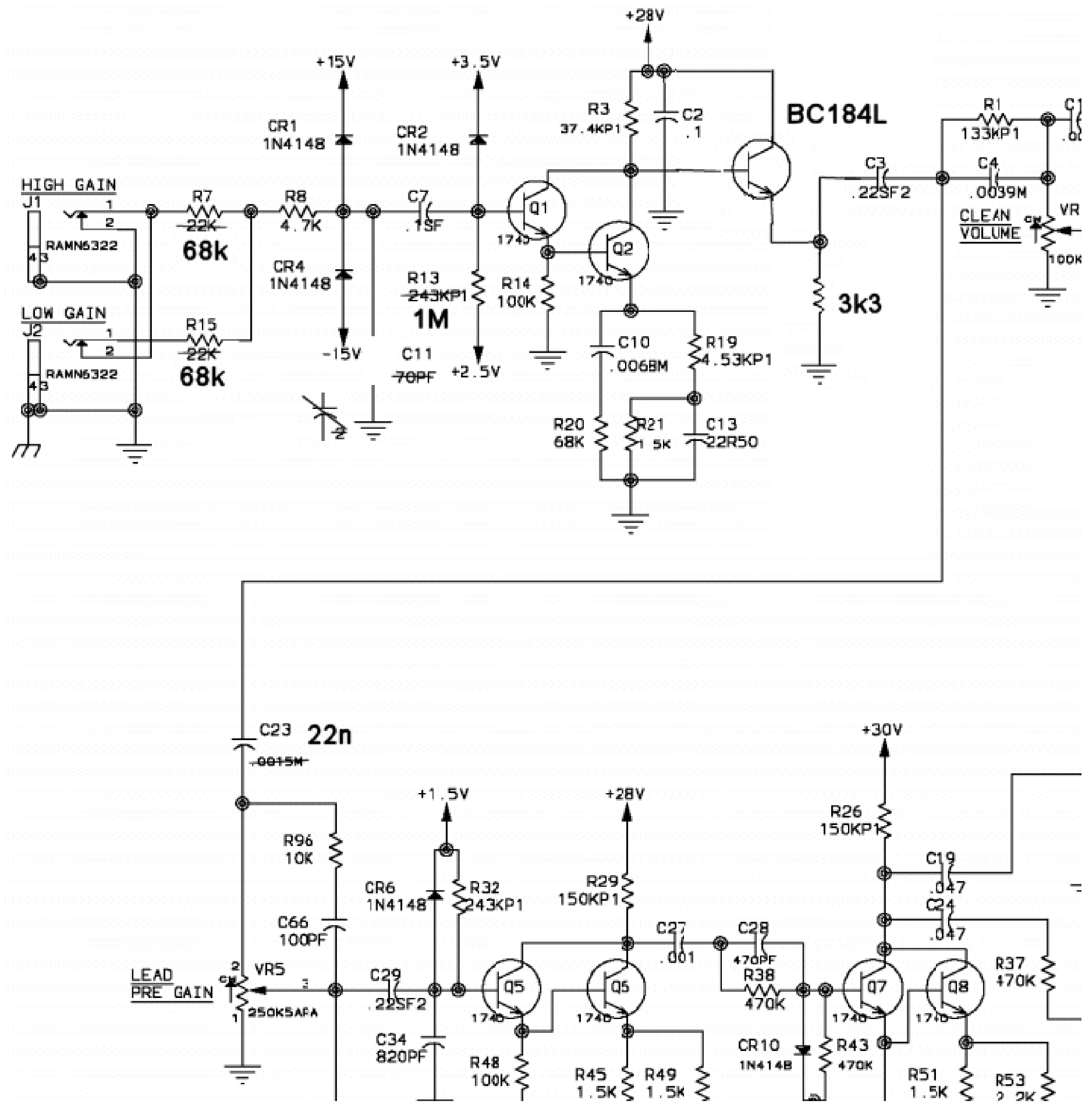
Peavey Studio Pro 112 Modifications

This information is in support of the YouTube video https://youtu.be/EpgSDhzcVCU

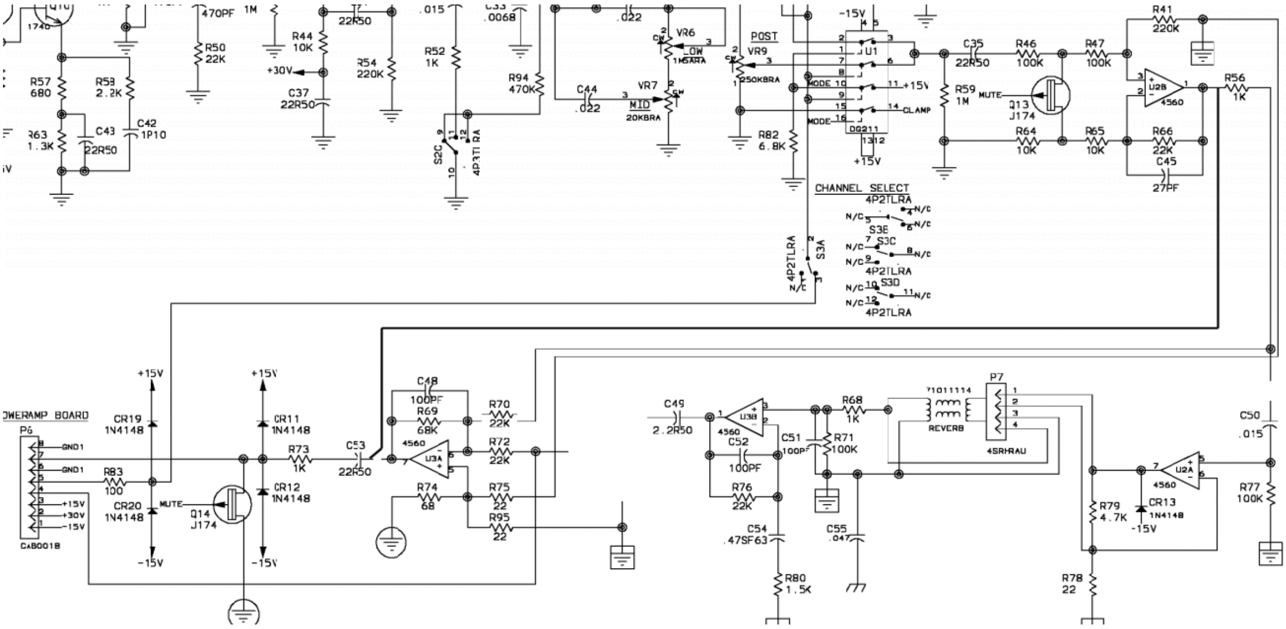
Preamp Mods



The idea here was to have a high impedance input for single coil pick-ups, the impedance is now similar to the standard Fender input. I also removed C11. Changing R13 does move the bias point of Q2 but it was found to be ok. The HF response really improved by the addition of the emitter follower after Q2. I used a BC184L as I had some on hand but any similar will do the job. If you wish to experiment, increase the 3k3 in value and the HF should reduce (but reducing it further is unlikely to make much difference).

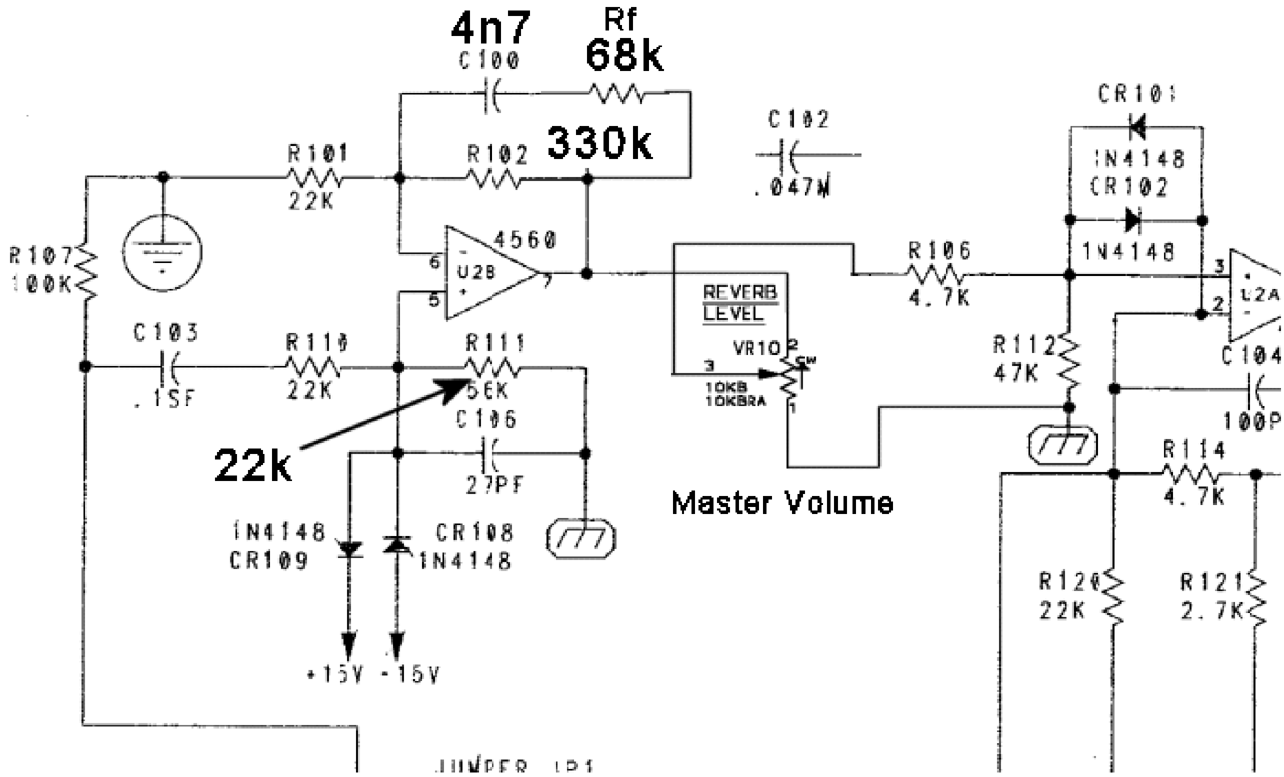
I also increased C23 to where the bass tones were thicker in the distortion channel. This is a value you will probably need to adjust to suit your pickups and desired tone.

Reverb Circuit Bypass



I decided to not use the spring reverb so freeing up the front panel knob as use as Master Volume. The three opamps were no longer needed. I removed a few components and put a wire link from U2B pin 1 to C53. Note, there is now no connection between U3a pin 7 and C53.

Bass Boost Voicing



This is where it all gets interesting and where you can voice the amp to your taste. Notice here is where I added the Master Volume control, also note where the track is connected (pin 1 on the VR10), it needs to be connected to a ground shown in a rectangular box, others will cause instability at high volumes.

My primary objective was to get more bass so I set this opamp up as a bass boost. There are many circuit configurations available and as many technical websites with all the explanations, maths and formulas. I will leave all that to them, I will simply go for the "I want to do it now" rather than spend time with theory and maths.

The basics are, R110 and R111 form a divider (attenuator), I use this to adjust the gain after getting the tone to my liking. Reduce R111 for more attenuation.

Attenuation is: $\frac{R111}{R110 + R111}$

In my set up attenuation is 0.5

Now it gets interesting, to keep things simple:-

C100 and Rf set the breakpoint frequency where the bass starts to rise, in basic maths it goes like this:

$$\frac{1}{(6.28 \times Rf \times 4n7)} = 498Hz$$

I find it simpler to use the same capacitor value and change the resistors as there are many more values to use.

If you want to start with the frequency and get a resistor value…

$$\text{Resistor value} = \frac{1}{(6.28 \times \text{Frequency} \times 4n7)}$$

(4n7 = 4.7nF on your calculator press buttons: 4.7 Exp -9)

It's all a bit hit and miss, capacitor tolerance are usually about +/- 10% so 4n7 will be in the range of 5.17nF to 4.23nF which gives different frequencies.

My best method was to start with a value and then go by ear, plug in and play the amp, use the tone controls over their full range and use every pickup to see if it sounds good. Check the maths every now an again just to make sure everything is as expected, to avoid that "wow that sounds great" but upon checking the values, it's total rubbish!

The ratio of Rf to R102 sets how much gain increase there is at very low frequencies. The original value is 56k so consider that as the starting point, so at high frequencies aim to get close to that value, in my example:

330k in parallel with 68k gives 56k so that should be the normal gain value, and then at low freq the value is 330k, from opamp theory that gives a gain of about:-

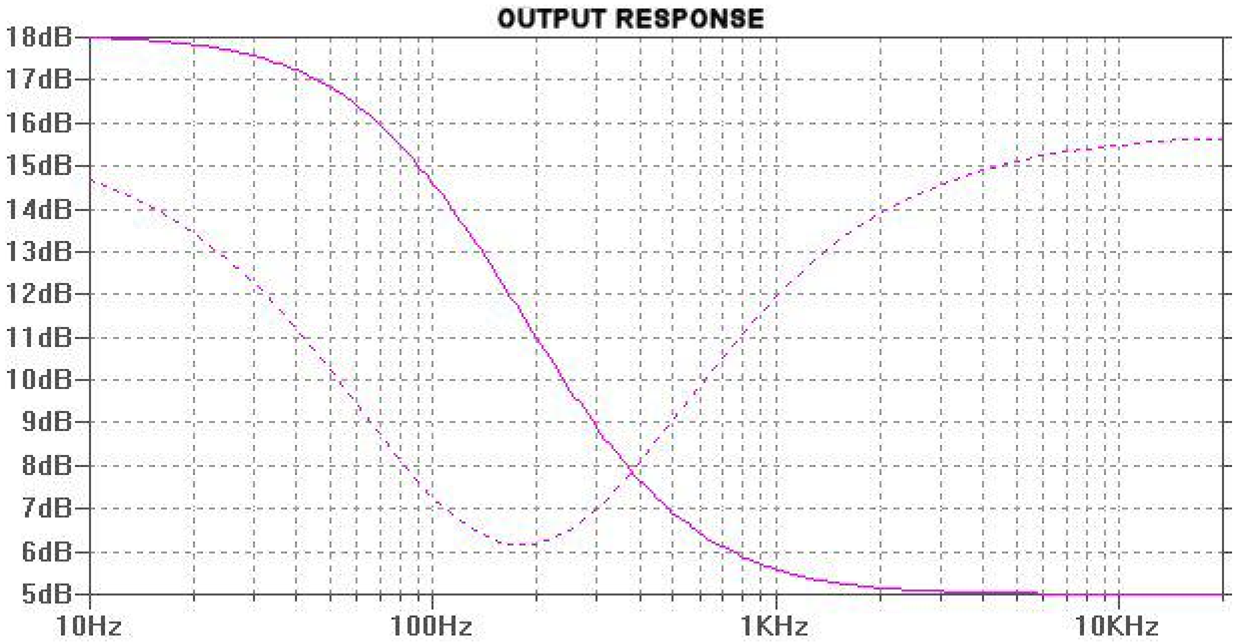
$$\frac{330k}{56k} = 5.9 \text{ which is 15dB}$$

(the 22k is R101 which we don't need to change)

In my case I liked the low boost, but if anything it was a little too much so I could have gone for 270k. (It also moves the LF breakpoint up to 100Hz, not that it matters much)

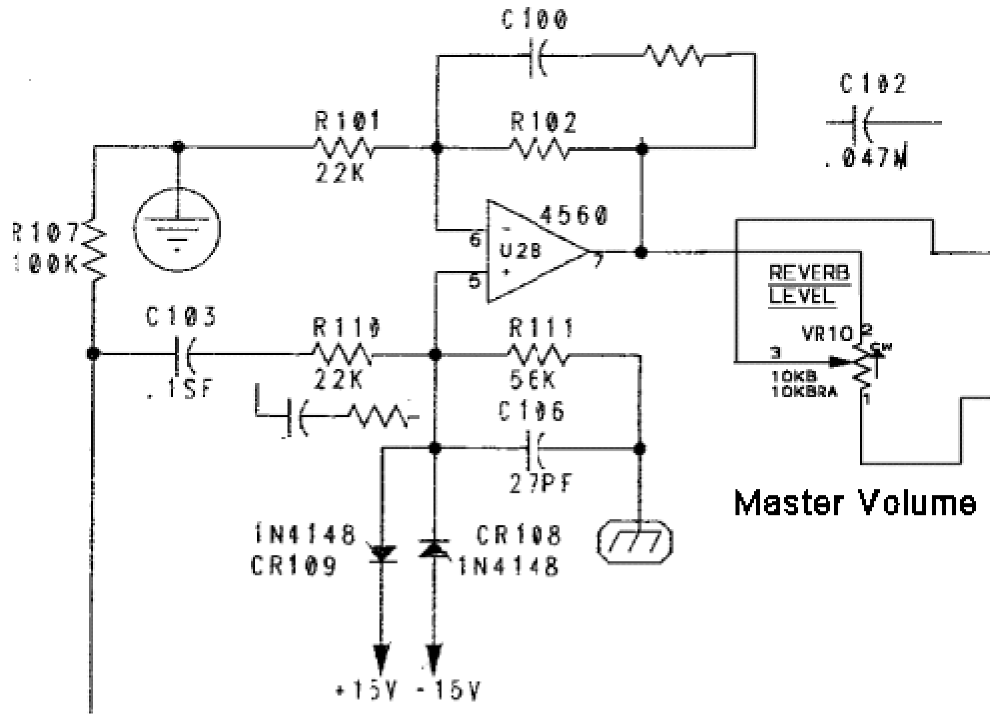
I find that selecting filter components like R102, C100 and Rf is best done by ear. We can calculate anything we want, just use that as your starting point then experiment. It can take many iterations to find a circuit that suits your style, that's part of the fun. In fact having now played with my set up, I need to increase the tops a little.

The response of this circuit is as shown in the solid magenta line. My guitar tone will mostly be in the 100Hz to 3kHz ranges anyway so the curve will boost the lows just fine.



HF Boost

After some experiments playing my guitar through this modified amp, I find I now might like a little more top. U2B is still a good place to add some tone shaping. Again it's all just standard opamp filter circuits, there are a number of ways to get the desired result, details of which are on the many websites.



My first attempts would be to add a simple R+C across R110, select values in a similar way as for the low boost circuit. An alternative could be to add a top bleed capacitor between points 2 and 3 on the Master Volume. Or even copy what Peavey has done on the existing volume controls. It's all there for you to experiment with.

Tone Controls

The Studio Pro 112 amp is not a bad design, not at all, it's more a case of, not what I was expecting or found useful. One of the circuits I would expect Peavey designers to get right is the passive tone stack. From experience I've leant because each component interacts with another, it can be really time consuming changing values in the belief of "better tone". So I didn't make any changes here, indeed once the amp has been voiced, the true range of the tone controls do actually seem to be very good.

For those needing more info, the generally accepted computer design app is from Duncan pickups. www.duncanamps.com/tsc

Circuit Design

There are now many free electronic circuit simulator programs, the plot above was generated by LTspice. They can be useful mostly to confirm expectations, although for some circuits they do need correct source/load impedances added. For opamps filters this simulation works just fine.

Loudspeaker Choice

My Studio Pro came with the Peavey voiced Blue Marvel 8 ohm speaker, I did a swap for a Celestion G12 which did sound very different. The Blue Marvel seems to have a strong output at the higher tones making it rather cutting. The Celestion gave a more mellow tone. This is another area where this amp combo is good for modding, speaker swaps are easy.

The Power Amp Fix

It seems this amp may suffer from failing power output IC U3, the LM3886, mine did. Upon investigation it was noted it suffered from that age old manufacturing problem of the chip's internal heatsink interface was not in full proper contact with the sizable external finned heatsink. I would suggest everyone to at least check this mechanical interface fit.

The source of this problem, is where the mechanical strength of the chip's pins/PCB is strong enough to keep the chip from being flat against the heatsink, especially where the pins enter the chip. Usually the chip's heatsink tab gets bent at the screw hole.

The fix is to slacken off the brackets that hold the heatsink to the PCB, make it all very loose, make sure the chip/heatsink interface surface is clean and flat, loosen and try to ensure fully body contact between the two items. Then retighten the heatsink/PCB brackets. Adding heatsink compound should not be necessary as long as the existing is still soft. It's not a case of more is better, just a small amount in the right place works best. The trick is, the chip to heatsink contact area should be a perfect flat fit without the screw.

A common mistake is to think tightening the screw will make a better connection by pulling the two together, it doesn't, it just makes matters worse.

Note: it was found this Studio Pro uses a virtual ground to keep hum to a minimum. A clever idea, it's at the junction of R74/R95/R75 and U3A+
I mention this because some of my experiments produced very strange results, it turned out it was because during development I'd left off the two screws holding the heatsink to chassis, so always make sure you have at least one installed.

Finally

I've left out a lot of circuit theory and alternative designs, mostly as it's all readily available on the internet, besides we all have different technical abilities, I prefer just to give a guide for those wanting to get stuck in developing their own sounds rather than wrestle with endless technical discussions and derivations.

Just be aware, the power amp PCB does have exposed mains voltage and some voltages that can give shocks, so do be careful. Electrical safety procedures are essential.

Have fun.

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26th October 2017
England

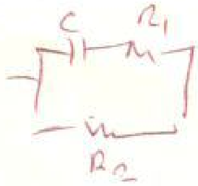
References

Circuit diagram: Peavey Studio Pro/Envoy, Dwg Number 81500254 Rev A

Appendix

1) My hand calcs as seen in the video.

Shown on the following page, so to make the image as large as possible. The calcs are all basic standard opamp stuff.



$$\frac{\left(R_1 - j\frac{1}{\omega C}\right) R_2}{R_1 + R_2 - j\frac{1}{\omega C}} = \frac{R_1 R_2 - j\frac{R_2}{\omega C}}{R_1 + R_2 - j\frac{1}{\omega C}}$$

$\omega \to \infty$ (HF) $Z \to \frac{R_1 R_2}{R_1 + R_2} = \frac{68 \cdot 330}{68 + 330} = \underline{56.3k}$

$\omega \to 0$ (LF) $Z \to R_2 = \underline{330k}$

Pole @ $\frac{1}{R_1 + R_2 - j\frac{1}{\omega C}}$ $R_1 + R_2 = \frac{1}{2\pi f C}$

$f = \frac{1}{(R_1 + R_2) 2\pi C} = \underline{85\text{Hz}}$

Zero: $R_1 . R_2 = \frac{R_2}{\omega C}$ $f = \frac{R_2}{R_1 . R_2 . 2\pi . 4n7}$

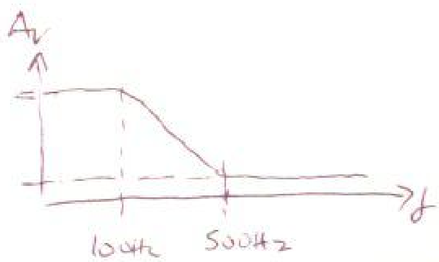
$= \underline{497\text{Hz}}$

Gain $= 1 + \frac{R_f}{R_i}$

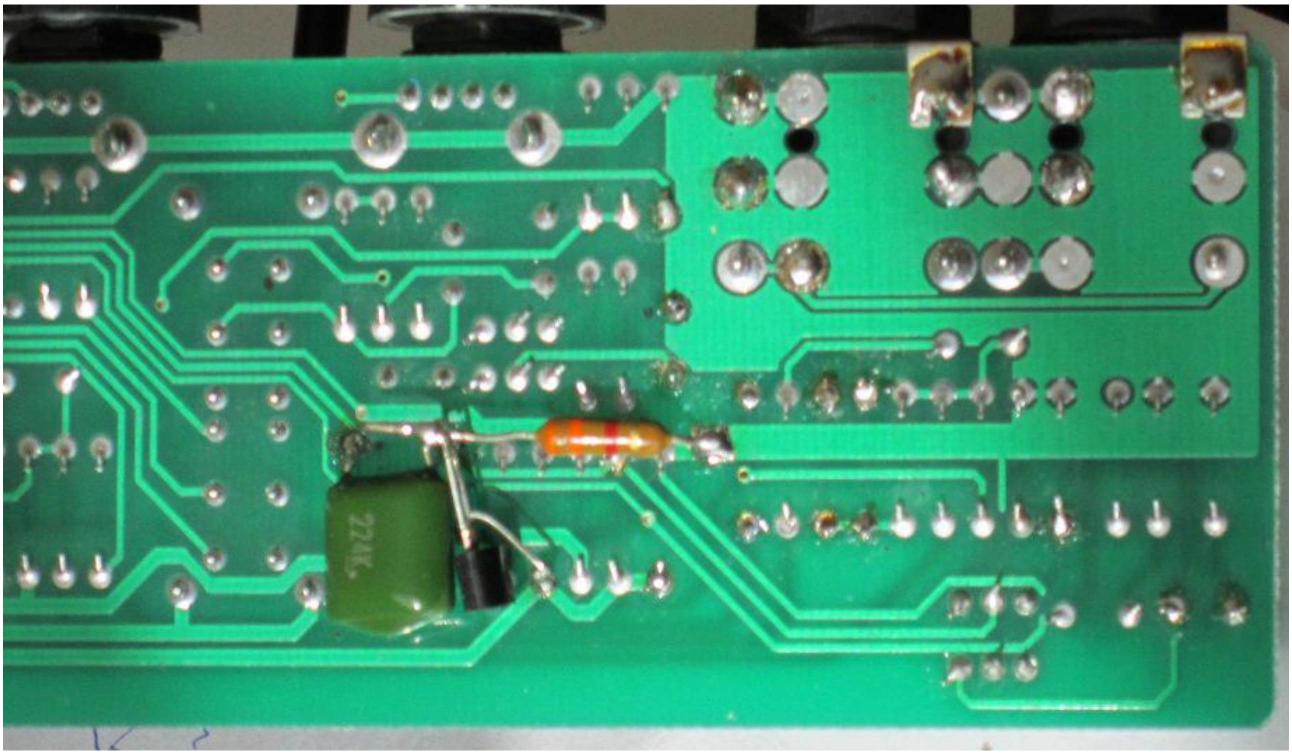
@HF $= \left(1 + \frac{56.3}{22}\right) 0.5 = 1.7$: ~~[illegible] dB~~ 5dB

@LF $= \left(1 + \frac{330k}{22k}\right) \frac{1}{2} = 8$ = 18dB

Gain $18 - 5 = \underline{13dB}$



2) How I patched on the BC184



3) The “voicing” opamp during development. The knob is Master Volume.