FUZZ HEAD

Here's a look at a design I used to call the Differential Fuzz, now it's the FUZZ HEAD. While the stages may look familiar, I tried to piece together parts that I knew to sound good to my ears or were beneficial to guitar players and their effects chain. The first stage is very similar to a treble booster. It does have one small improvement to the bias stability of the transistor and then a larger change to the way the gain or distortion is controlled. Taking some advanced measures that I saw in the ROSS compressor I added some capacitance and stability to the amplifier design by splitting one of the base resistors into two and adding R9 and R2. See Figure 1. You can see that a 10uF capacitor, C10, is added to the midpoint. This added measure was more for fun than anything, but I have noticed that circuit displays better temperature stability when under a heat gun. Why a heat gun? Well, strong stage lights and especially outdoor summer concerts can wreak havoc on simple germanium circuits and a heat gun will help you identify problems before they cause you problems at during a gig. Every little bit helps; I usually try to design for maximum performance even if it is overkill. R1 and C2 are kind of trivial in matter. R1 is for reducing the popping sound when you employ true-bypass switching and C2 to reduce stray noise or radio station interference on the input. R7, R8 and C1 provide a voltage divider so that we can have a stable 4.5 volts where need in the circuit.

The next point of interest is C3, a 0.027uF capacitor (marked 273 on the case), was chosen to provide full range frequency response, some folks might like increasing this value all the way to 0.1uF (marked 104 on the case). I think it sounds good with either. By using a 0.1uF you're adding just a touch more low end and some distortion because of the increased amount of signal amplified. The particular part I use for this is a Panasonic ECQ-P series capacitor available from www.digikey.com part number P3273-ND. It is a Polypropylene capacitor and I consider it to be about the highest quality needed for guitar effects. I don't know of any other manufacturer using this quality of parts regularly. Give them a try; your ears will thank you! By the way, if you wanted to get just a touch more bass and install a 0.033uF cap, you can guess at the part number, it is P3333-ND. Can you guess what the 0.1uF would be? Well, it's P3104-ND, not too bad huh? It's a good idea to socket this capacitor by simply cutting apart a IC socket and soldering it to the board. Then you can plug and play all day.

This is where it gets really interesting. The resistor marked R4 and RGAIN (10k ohm linear) are usually compiled into one thing, a potentiometer only. This is how the gain is controlled by guitarists on typical treble boosters. The problem with this type of control over the gain is that it leads to a static or "bad pot" sound when you try to adjust it. Most guitar players just don't feel comfortable when they twist a control and it makes a noisy sound. I made this an internal trimmer. This pot can control a broad gain range. My thought was that a large amount of capacitance in the emitter circuit reduces the emitter resistance for AC signals and creates more gain. Why not make that adjustable? So with a little math and a lot of trial and error I came up with the configuration you see in Figure 1. Now the user can control the gain without a scratchy sound by adjusting the

emitter branch of the circuit. There is a minimum resistance set by R5, 220 ohms just to be safe. Then a range of gain is created by R6, the pot labeled Gain, the 2.5k-ohm audio taper and the 47uF capacitor. What I tried to do was "blend in" the capacitor for more gain. What is the significant result? No scratchy sound when you cranked the Fuzz up! Try it! You'll like it! There is an amazing amount of difference in tone possible just by the selection of Q0. Although NTE and generic types might sound okay, they will pale and sound harsh compared to certain vintage types of repute. The AC187 sounds pretty darn good in this location. Note that this circuit is set up for a NPN germanium transistor.

Now I needed voltage gain (and maybe a little distortion) from a second stage so I could have a volume control later on down stream. I chose a differential amplifier for a couple reasons. First they provide lots of gain and the allowed my to "tweak" the way the wave was distorted. I wanted a fuzz shape, the one that sounds good to us guitar players, to be created in this stage. This configuration is setup as a single ended differential amplifier, generally not used this way, but it works well and was fun for me. Using oscilloscopes, computer simulations, and ears the design was tweaked so that a pleasing distortion was produced here. Please feel to experiment with R12 and R13, even short them out with a wire jumper! You may or may not find the changes that dramatic but I unbalanced them to get the result I wanted. Essentially those two resistors along with R14 control the gain of this stage. Lowering R14 creates more distortion, increasing it cleans up the signal. The transistors Q1, Q2, and Q3 are MPSA18 high gain low noise types.

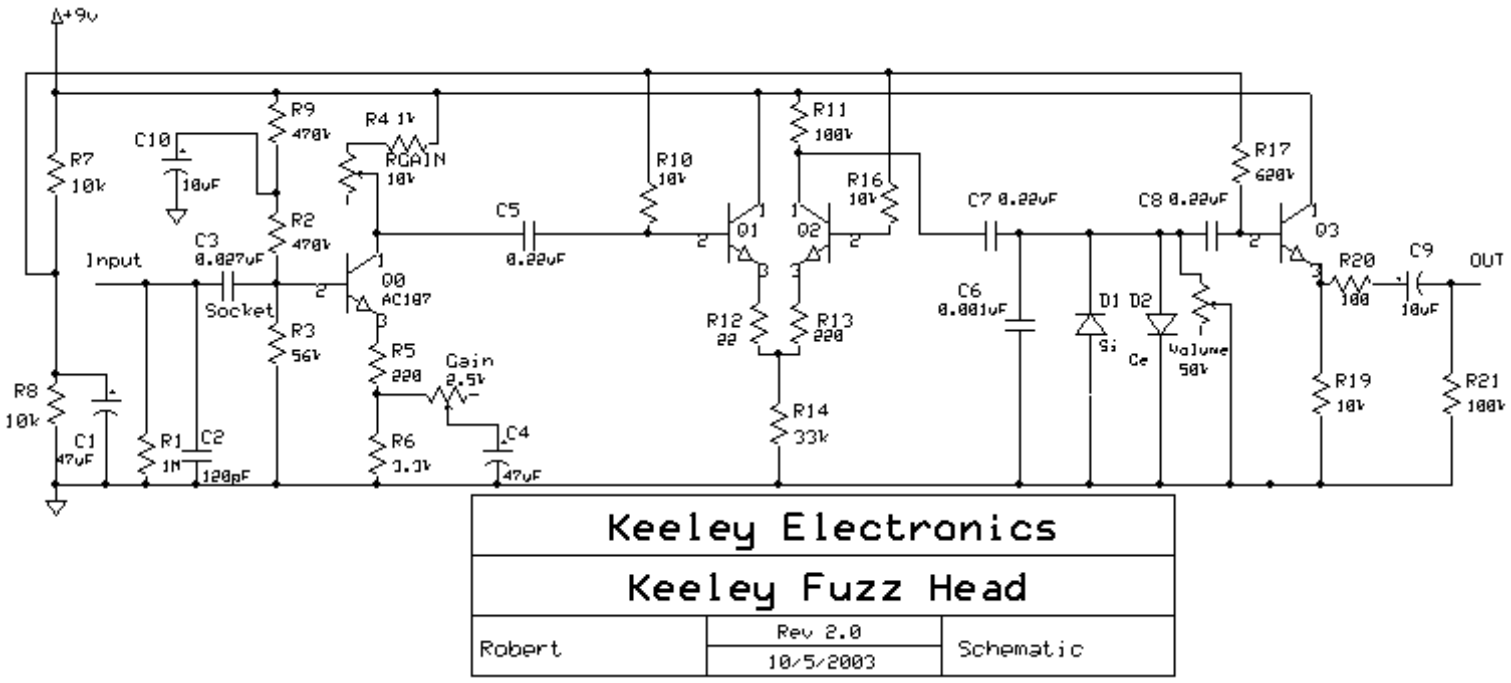
By the way, all of the coupling capacitors, C5, C7, C8 were chosen to be large to make sure there was no bass loss throughout the circuit. It wouldn't hurt to use even larger values, say 1uF even. At some point you get so much low frequency that you hear a "thud" as notes are played. Not really musical, so watch for that when experimenting with this circuit. The capacitor C6 was chosen to lessen the brightness and some of the harshness of the distortion. We use a 0.001uF but you can remove it for a crisper, more open sound. Increase it for a warmer, more midrange type of output.

The clipping diodes marked D1 and D2 are on a toggle switch in my circuit. They are connected to the circuit by switching the anode of D1 and the cathode of D2 to ground at the same time through a simple SPST switch. Switching in these diodes at the same time gives you greater distortion, saturation and sustain. It also slightly lowers the volume output. Note that D1 and D2 are different types of diodes, one is silicon and one is germanium so that there would be some asymmetrical clipping. The volume pot after the diodes was chosen to be 50k ohm. That actually limits what the output of the can be by a significant amount. Feel free to try a 100k pot if you like to have lots of volume to drive a tube amp.

The last stage is just a simple buffer. This is very similar to what you would find in Ibanez 9 series pedals or BOSS pedals. My only wish is that I could find a 10uF film cap that would fit in a pedal box nicely so I could improve C9 and the sound quality.

Final thoughts are that you should use metal film resistors and capacitors in all stages to reduce noise as much as possible. I would even recommend using 1/8-watt resistors because the noise level is theoretically less as the size of the resistor decreases.

This design offers you classic guitar tones I find really well suited for lead work. It allows you to get those sounds at lower volumes rather than cranking your amp and simply having the first amplifier stage (treble booster) create all the distortion. The buffer on the output lets the pedal interact with its following neighbors really well. Your chorus, flanger, or delay will thank you! Have fun building and let me know by email fx@robertkeeley.com if you come up with any tweaks or twists that sound good to you.



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