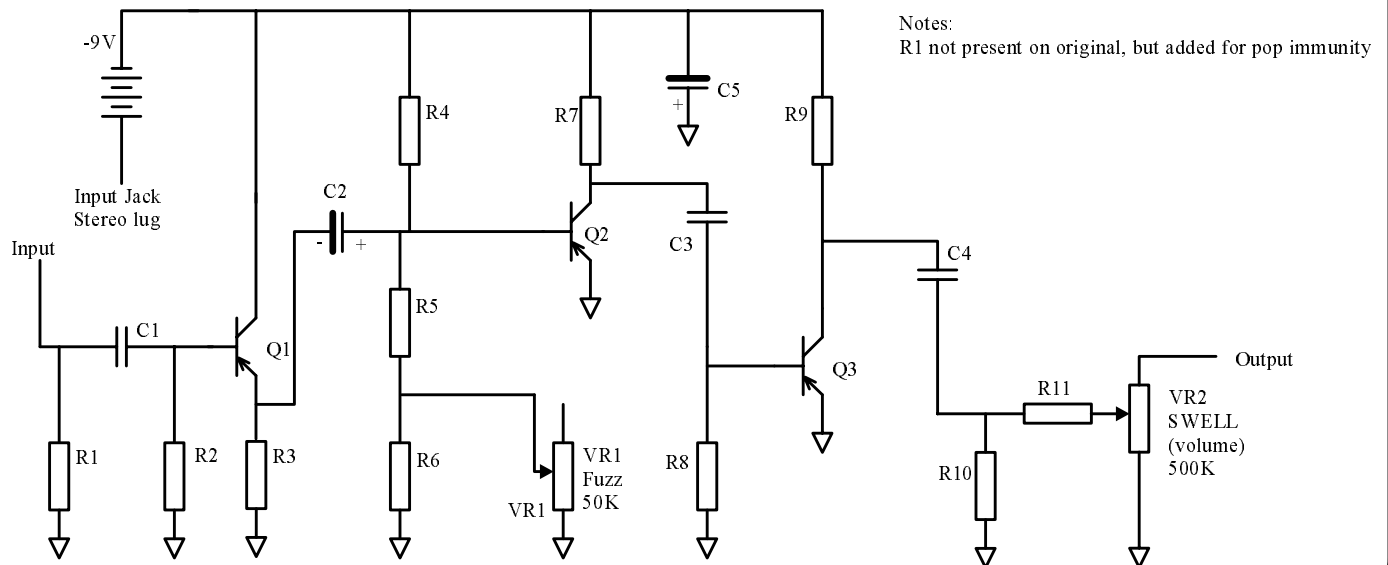


# Zonk Machine and Treble Booster

Thanks to A. Coleman for lending his original Hornby-Skewes Zonk Machine for tracing. This is another of those obscure distortions that were designed in the early years of electronic distortion for guitars. It's not YAFF (Yet Another Fuzz Face) circuit, and it's probably more interesting for that. Thanks also to "amscray" for providing the schemo for the Hornby-Skewes Treble Booster, which is purportedly the preferred front end for this.

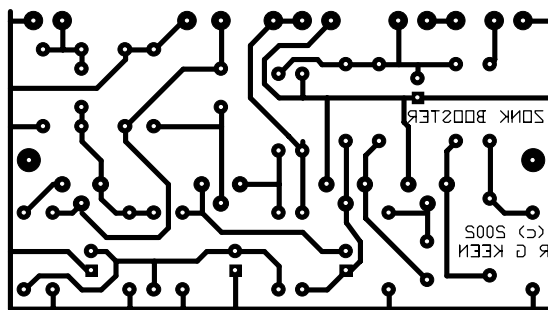
## Zonk Machine - Schematic



Traced from a board graciously loaned by A. Coleman. Layout and schematic copyright 2002 R.G. Keen

This is the schematic of the whole circuit, less the input/output jacks and bypass switching arrangements, which have been left out for clarity about the circuitry. The jacks, controls, and bypass switching are all shown in the wiring diagrams that follow.

Here's a full-size layout of a board to do the Zonk Machine - plus a little extra.



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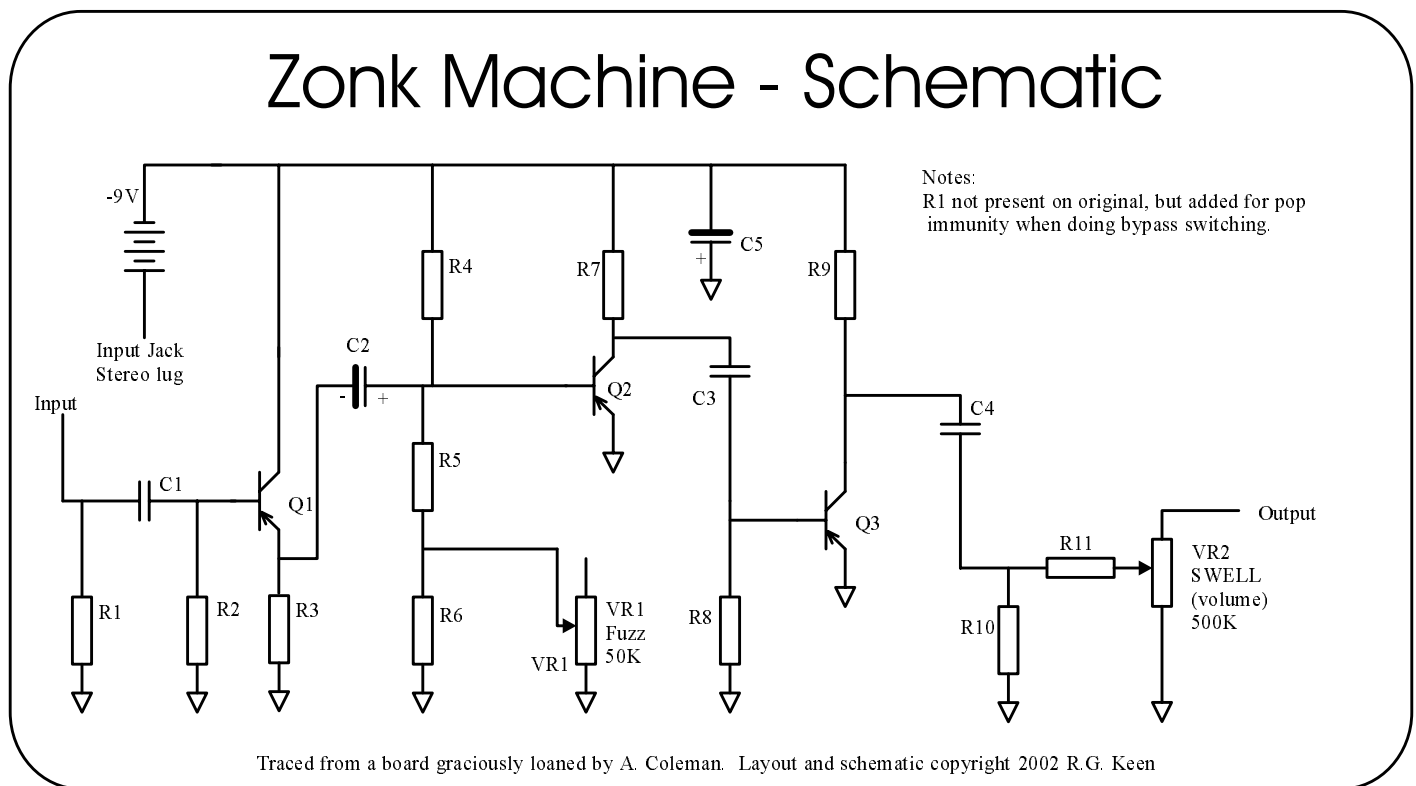
# How it works

Looking at the schematic from an EE's perspective, the view is a little odd. We have two of the transistors, Q1 and Q3, biased with their bases pulled to ground like a JFET. That's distinctly odd in a world where every transistor that's used as a linear amplifier has to be turned slightly on by a bit of base current to get it to conduct.

The key here is that these are GERMANIUM transistors. Q1 and Q3 both leak through their collector base junctions at around a thousand times as much as if they were silicon. Current from the collector into the base region acts just like current from the wire leading into the base - it makes collector current flow. Ohm's law still applies, though. The leakage current raises the base voltage with respect to the emitter, and that give us an opening for controlling things. The leakage into the base can go two places: through the emitter, where it lets more collector current flow, or out the base. With a resistor to ground outside the base, some of the leakage gets pulled out of the base, and this lessens the amount that can cause collector current to flow.

The trick is that by changing the value of the base-ground resistor, we can change the effective bias and therefore the operating point of the transistor. The 1 megohm resistor from Q1 to ground soaks up very little of the leakage, so the base (and emitter) floats relatively high. In my proto board, various transistors showed emitter voltage of -1.5 to -8Vdc. In all cases I could make this be anything I wanted by varying the value of the resistor from the base to ground (R2 on this schematic).

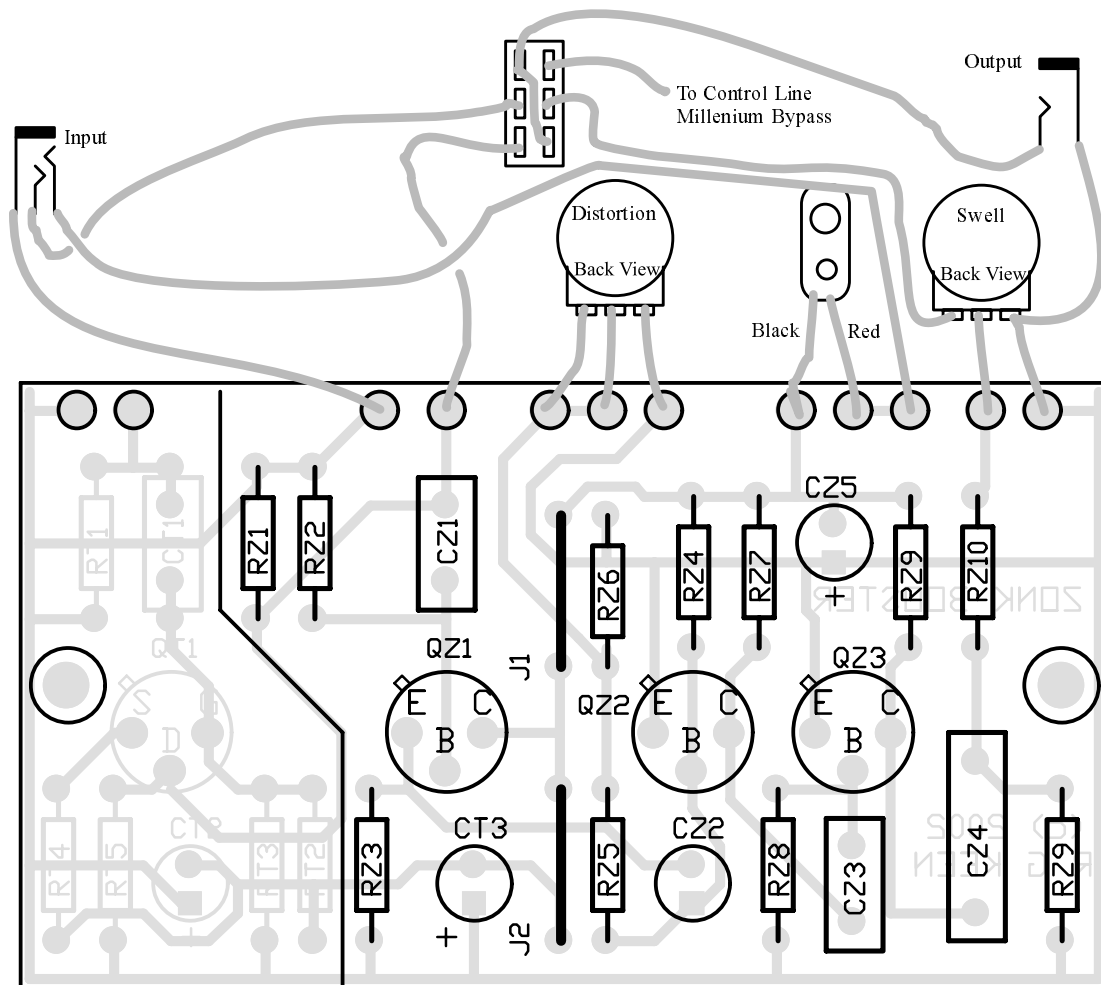
On Q3 we see a much lower value of base resistor, 15K. This turns the transistor much more "off" than Q1. It's effectively riding at the edge of cutoff.



This has a couple of consequences. First, even modest signals at the base will turn Q3 off entirely, making for hard clipping. Second, like the Dallas Rangemaster, the characteristic curves for germanium near cutoff are distinctly nonlinear, providing some soft distortion. All from changing the value of the bias resistor.

Q2 is where a lot of the gain and some of the distortion happens. It's biased with a pullup resistor and a pull-down resistor, making the actual bias condition depend much less on the transistor itself and its leakage. The low value of R4 and R5 together (5.5K) forms a pretty stiff turn-off anti-leakage network. But that's countered by R3 (470K) trickling current into R4 and R5. Overall, Q2 is biased well into conduction. VR1, the Fuzz control provides a means of varying the bias point, and thus the amount and positioning of clipping in the signal waveform.

# Zonk Machine - Layout and Wiring



## Zonk Machine Parts List

QTY	Value	Part Number
1	- 2.2M	RZ10
4	- 1M	RZ1,RZ2
1	- 470K	RZ4
1	- 56K	RZ9
1	- 15K	RZ8
1	- 10K	RZ9
2	- 4.7K	RZ3
2	- 3.3K	RZ6,RZ7
1	- 2.2K	RZ5
4	- 22uF	CZ2,CZ5
1	- 0.47uF	CZ4
1	- 0.1 uF	CZ3
1	- 0.001uF	CZ1
1	- 50K linear pot (Fuzz)	
1	- 500K Log pot (Swell)	

This is the basic population for the Zonk Machine PCB. Notice that **ONLY THE PARTS SHOWN IN BLACK ARE PART OF THE ZONK MACHINE!!** If you put only these parts on the board, and wire it this way, you have a working complete Zonk Machine.

But what's that other stuff, shown in gray?

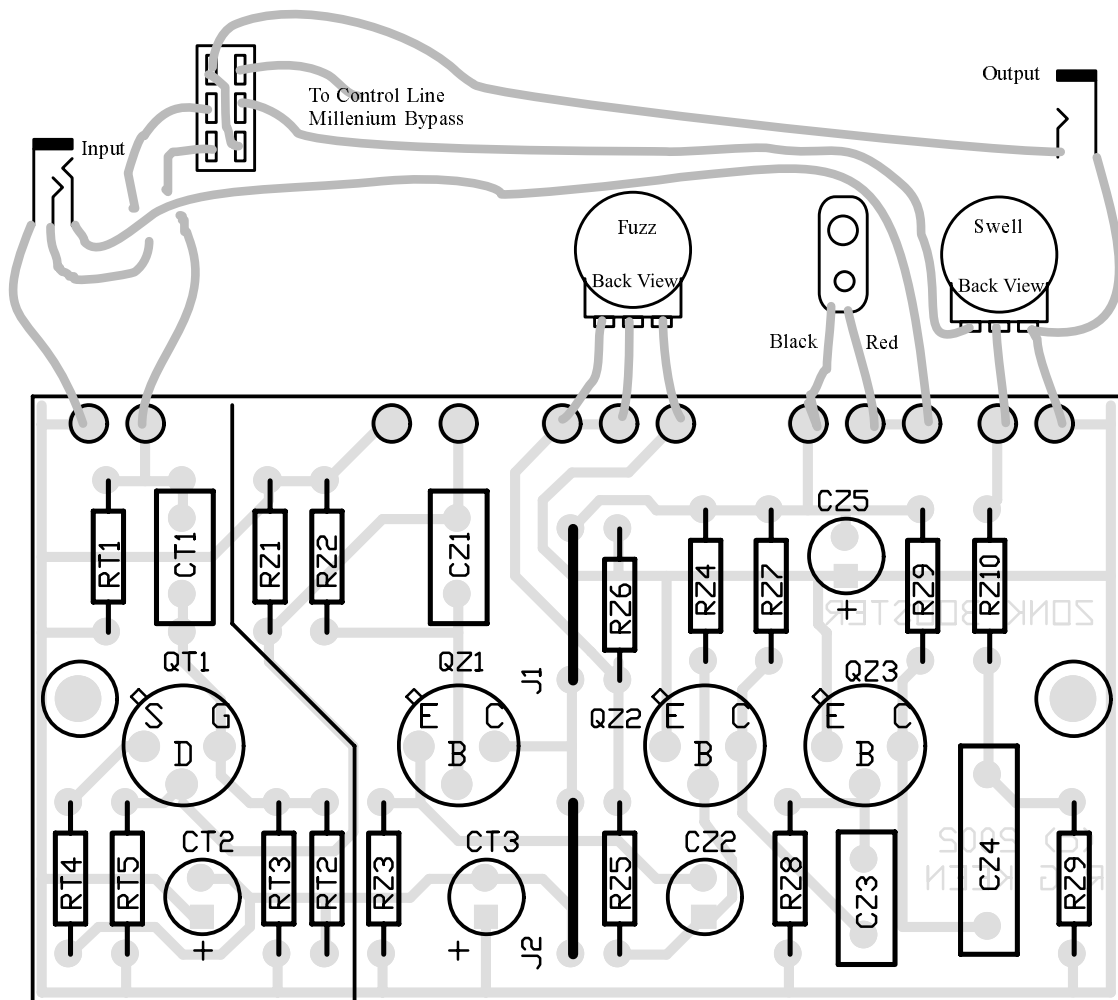
It's the Hornby-Skewes treble booster. The original Zonk Machine reputedly was best when coupled with this booster for a front end. Leave it off if you like. Put it on if you like that.

In any case, if you want only the Zonk Machine, this is your baby.

The parts list at left is just for the Zonk Machine. All the part names except the pots have a "Z" in them to help you remember. These reference numbers are not the same as the numbers in the schematic.

The emitter, base and collector pins are marked; the positive lead of electrolytic caps is marked with a "+" (and are all turned the same way on the board - a free PCB layout tip!). The pots are all shown back view - that is, with the shaft away from you.

# Zonk + Treble Booster -Layout and Wiring



## Parts List For Treble Boost

QTY	Value	Part Number
1	* see text	CT1
2	100uF	CT2, 3
1	1M	RT1
1	10K	RT2
1	62K	RT3
1	1K	Rt4
1	3.9K	RT5

If you want, to add the treble booster, his version shows how to populate the treble booster part of the board. The parts list for just the treble booster section shown at left.

There were some surprises in the "treble booster". If the circuit is correct, and there is no reason to think it's not, then there is no input capacitor to block the bias DC from the guitar and bypass switching. This will make for some major pops when you bypass the thing. I think most modern guitarists will demand quiet switching, and so I have added some parts to make this possible. Rt1 is a pull-down resistor, and Ct1 is a DC blocking capacitor to keep the DC off the bypass switch. You can pick Ct1 to your taste. If it's big - maybe 47uF - then it will not limit bass response by itself, and the performance should be the same as with the DC coupled input. If you pick smaller, there will come a point where the input capacitor limits bass response making it even more of a treble booster (see the article on the Dallas Rangemaster at GEO for some more discussion of this effect).

It's not clear to me why the "treble booster" contains nothing to boost treble. Maybe it's just a gain booster, misnamed. More distortion does add the effect of more treble with the distortion harmonics. Maybe that's it.

# Zonk -Tuning and Tips

You'll probably have to tune things to get a good sound. Like all germanium-transistor effects, this effect will have varied results depending on what transistors you get, their gains and leakages. If you have a stock of unused Mullard OC44's and OC70's, you might be able to just pop them in.

Then again, you might not. Germanium transistors vary - a lot! - and always have. If you're serious about building effects out of germanium transistors, you should probably learn to select them for yourself. If you do this, you can buy surplus devices for US\$0.25 to US\$1.00 each and pick out the ones that work. If you don't, count on paying US\$5.00 and up for someone to have done this for you. To learn how, read the information at GEOFEX (<http://www.geofex.com>) on determining the leakage of germanium transistors. It's in the FX skills section.

The transistors are all marked "Ge PNP". What kind of transistors are used, really?

What you need here is your ordinary gain-of-100 type germanium. Low leakage is a real plus. A transistor otherwise used for a Fuzz Face would work well. However, you can tune in many transistors.

The tuning is largely a matter of getting the bias right. As I noted earlier, germanium leaks into the base, and we can either add to or subtract from that leakage with external resistors connected to the base. The Zonk Machine has two transistors biased solely by a resistor from the base to ground. Varying those resistors varies the bias.

On Qz1 (the zonk input transistor) you need to get a few volts on the emitter. So to tune that one, put your voltmeter from ground to the emitter, and adjust the resistor from base to ground until you get between -3V and -5V on the emitter. Anywhere in there is OK. The original value, 1M, has a fair chance of doing this all by itself.

I would tune Qz3 by meter first, then by ear. put your voltmeter between ground and the collector of the transistor, and adjust the nominally 15K resistor to get about -7V on the collector. Then play through it, and further tinker the value for the sound you like best.

Qz2 should not need tuning - that's what the "Fuzz" pot does.