A Transistor Audio Amp

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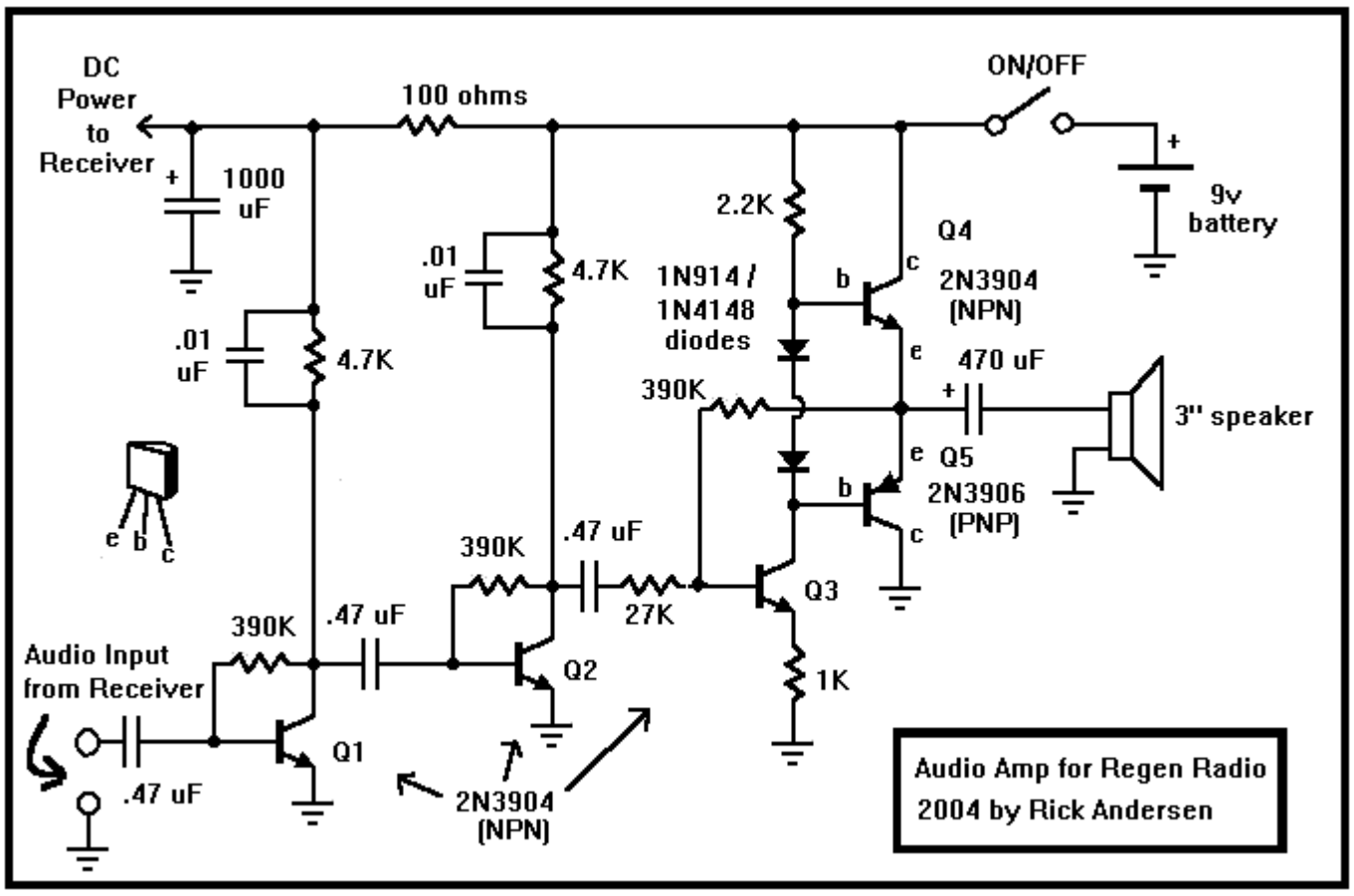
A Simple Audio Amplifier for your radio projects

Nov. 23, 2004 by Rick Andersen

The schematics here in my radio projects page all show a diagram of a Radio Shack amplified speaker, used to boost the weak output of the receivers up to speaker-level. But maybe you don't want to use that particular amplifier, or maybe there isn't a Radio Shack near you, or maybe they'll discontinue that model (like they've discontinued so much over the years, turning a hobbyist builder's paradise into another freaking cell-phone store! -- editorial). And maybe you don't want to copy everybody else who have been promoting audio amps based on the LM386 IC, which also could be discontinued at any time, the way things are changing.

Maybe you just want to roll your own audio amp from the most common, generic, all-purpose, "popcorn" transistors ever known to electronics hobbyists: the venerable 2N3904 (NPN) and his wife, the 2N3906 (PNP) small signal silicon transistor.

Here's the schematic for a transistor amplifier I use in my "universal" regenerative receiver built for the AM broadcast band:



Looks complicated? No, it's not. Notice that the first two transistor stages, starting at left (Q1 and Q2), are identical. They're preamps, and you can knock one of them off if you want. I wanted a lot of audio voltage gain; you may find two preamp stages to be somewhat of an overkill.

Please note the 1000 uF electrolytic capacitor and the 100 ohm resistor in the 9v Vcc line: They form a "decoupling network" which counteracts the tendency for multistage amplifiers to oscillate ("motorboat", "putt-putt", or "squeal"), a very common problem.

Also note the .01 uF ceramic or mylar caps across each 4.7k collector resistor: these act as simple low-pass filters, cutting the highs and mellowing the sound a bit, for more comfortable listening. Their value of .01 uF is approximate, and may be varied to taste.

The 4.7k collector load resistors, likewise, can vary from around 2.2k up to 10k or so.

Ditto for the base bias resistors (390k); they can range from about 220k to 1 MegOhm with little variation in performance.

I used rather small coupling caps between stages - non-polarized .47 uF's rather than the more usual 10 uF electrolytics, because we're driving a mere 3" speaker and don't expect (in fact, don't *want*) any bass notes passing through the amp.

The class AB power amp section is made up of the 2N3904/2N3906 (Q4/Q5) output pair, along with the 2N3904 (Q3) driver that precedes them. This section humps a little current to drive the 8 ohm speaker, but doesn't have much voltage gain; that's why you need at least ONE of the two preamps left in-circuit. But feel free to lop the first preamp stage off if you find that it's overkill.

If you build this circuit right into one of the other receivers described in these pages, you can feed DC power to those receivers via the path shown in the upper left of the schematic, off the top of the 1000 uF decoupling cap. The 9 volt battery, interrupted by the power switch, then supplies the audio amp directly, and the receiver front end indirectly, through the decoupling network. As mentioned before, this helps prevent unwanted oscillation.

What's the power output available from this little amplifier? Who knows? These are not power transistors. Max power is probably under 100 milliwatts. What's important is to be able to get volume at least as loud as a cheap transistor radio. And, by the way, if you "breadboard" your circuits and connect a 2" or 3" speaker, bare and open, just sitting by itself on the breadboard, you're going to conclude that there's not enough volume, and think you need watts instead of milliwatts.... listen to me; I've had years of experience with this: Mount your little speaker in a cardboard or wooden box, or even a decent plastic one (or even in a styrofoam coffee cup!), and you'll immediately hear a tremendous difference in both volume and sound quality-- it never fails to surprise first-time builders when they experience this for themselves. Acoustic resonance via a speaker box really does boost the sound and takes some of the "tinniness" away, letting you get away with using cheap transistors for the output stage.

CAUTION! Having been a lab instructor at an electronics technical school, I know that invariably somebody will either get their output transistors swapped, or connect them the wrong way. *[In fact, a friend in the UK who has been corresponding with me, pointed out that I myself had had a brain fart; in the first upload of my schematic, I HAD Q4 AND Q5 SWAPPED! Nothing like a good dose of humility administered by someone when you least expect it. Thanks, Cyril!]* Pay close attention to the schematic, where I've labeled the pinout (E-B-C) for both the schematic itself, and the pictorial diagram of the transistor(s). If either output transistor gets hot when you first power up the circuit (and they *can*, even with a dinky 9v battery!), turn the power off and find out where you messed up your wiring. If you overheated them too long, you may need to replace them.

Good luck!

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