

Audio Amplifiers

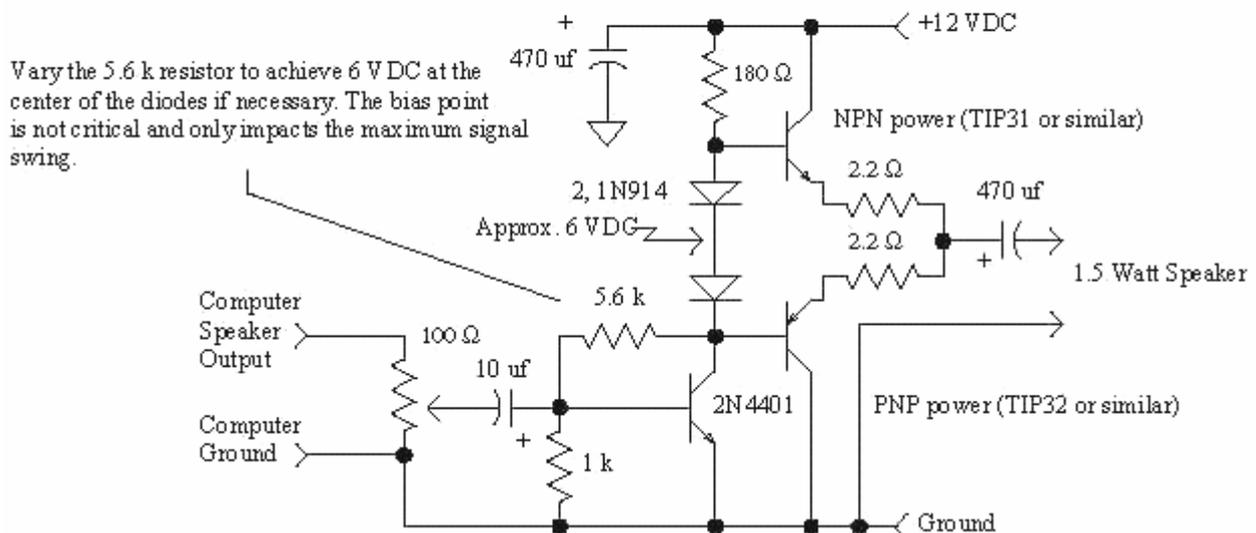
Modest power audio amplifiers for driving small speakers or other light loads can be constructed in a number of ways. The first choice is usually an integrated circuit designed for the purpose. A typical assortment can be seen on this [National Semiconductor](#) page. Discrete designs can also be built with readily available transistors or op-amps and many designs are featured in manufacturers' application notes. Older designs employed audio interstage and output transformers but the cost and size of these parts has made them all but disappear. (Actually, when the power source is a 9 volt battery, a push-pull output stage using a 500 ohm to 8 ohm transformer is more efficient than non-transformer designs when providing 100 milliwatts of audio.) As a general rule, transformerless low power speaker projects will work better with 4.5 or 6 volt battery packs of AA, C, or even D cells than 9 volt rectangulars.

Here are a few easy-to-build audio amplifier circuits for a variety of hobby applications.

Computer Audio Booster

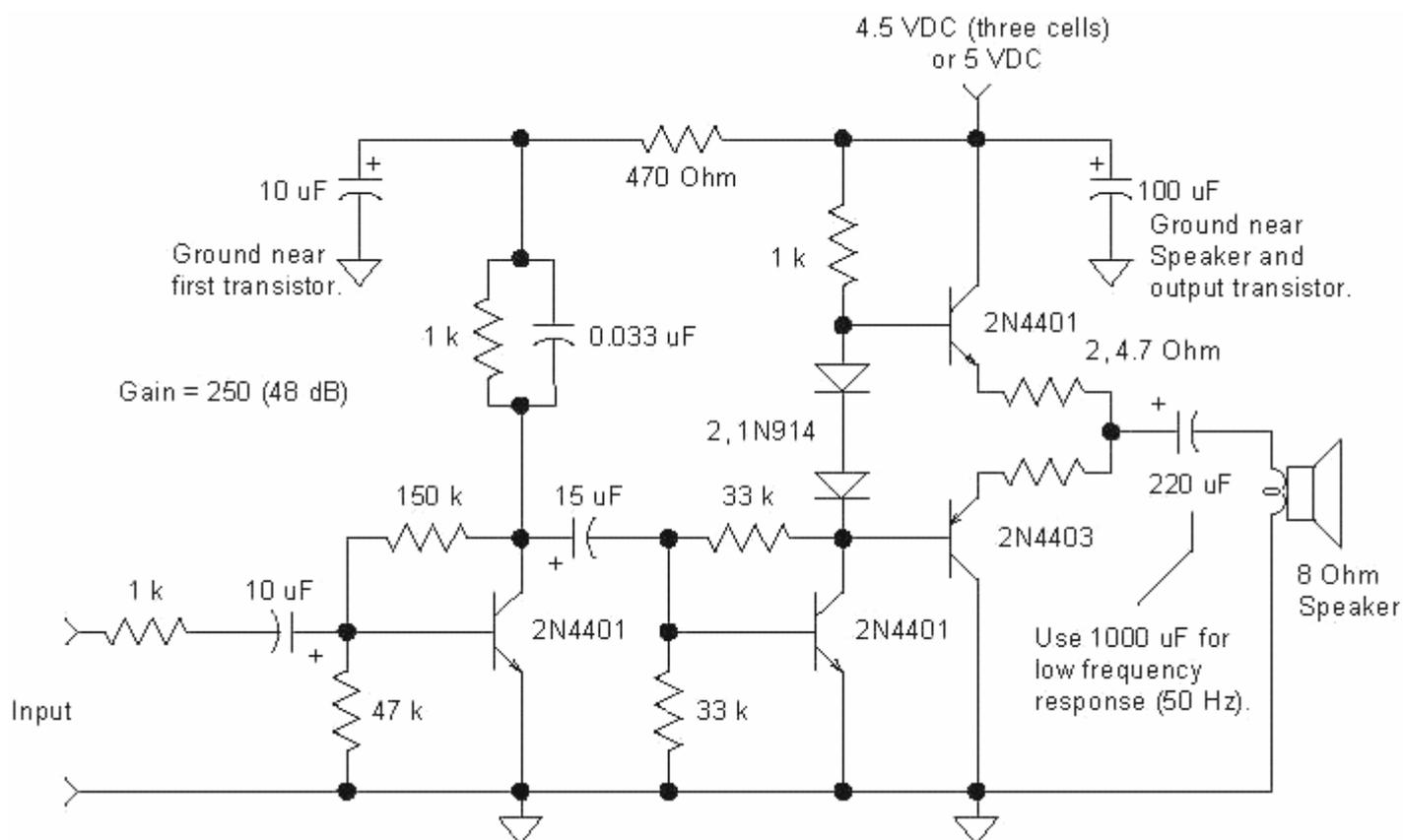
Here is a simple amplifier for boosting the audio level from low-power sound cards or other audio sources driving small speakers like toys or small transistor radios. The circuit will deliver about 2 watts as shown. The parts are not critical and substitutions will usually work.

Audio Power Booster



A lower power version of this circuit is used in the next circuit which also has an additional preamplifier for more gain.

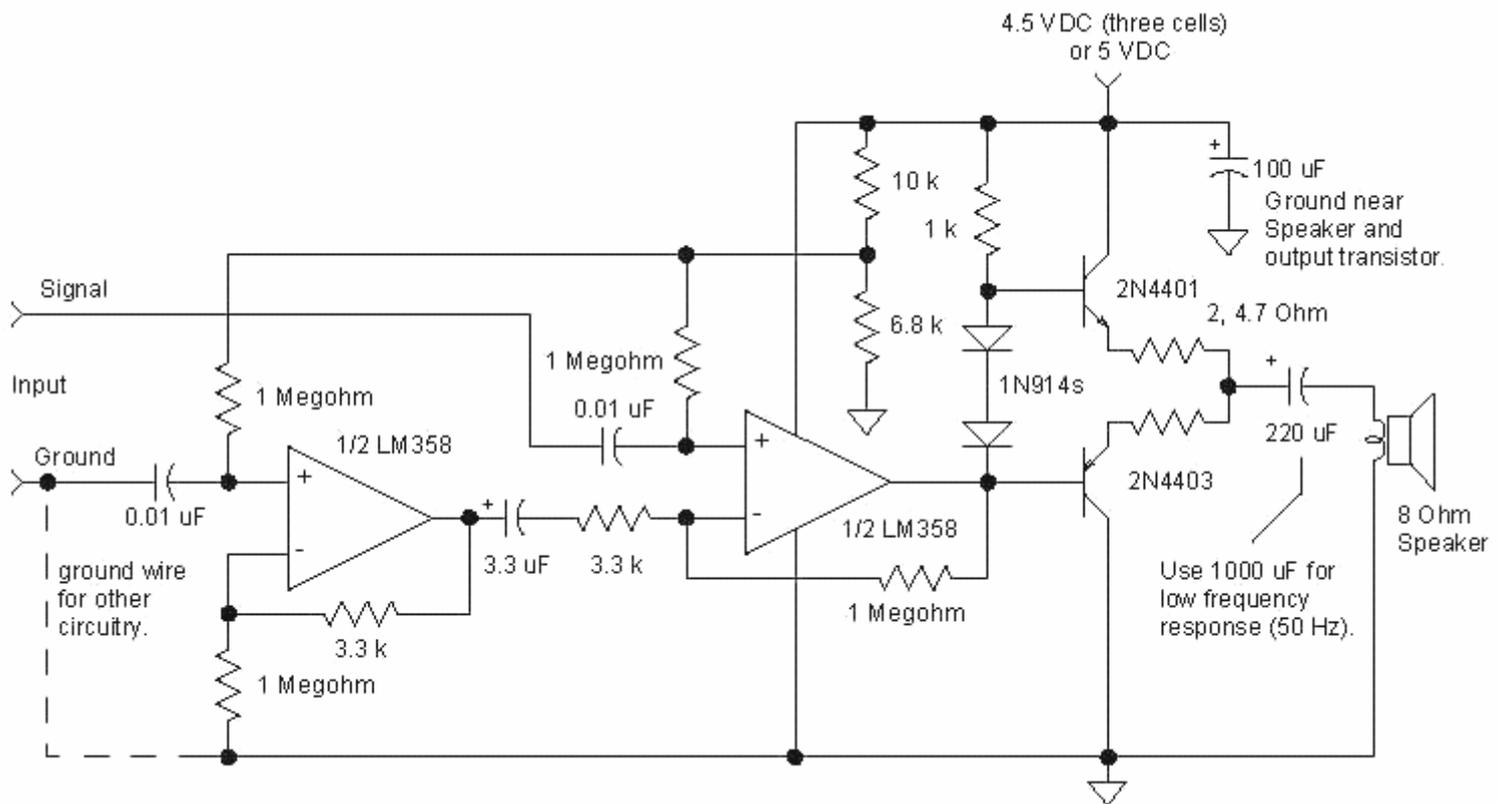
Audio Amplifiers for Small Speaker Applications



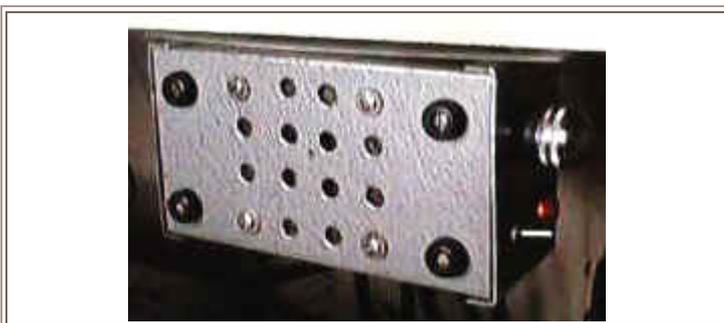
The circuit above shows a 4-transistor utility amplifier suitable for a variety of projects including receivers, intercoms, microphones, telephone pick-up coils, and general audio monitoring. The amplifier has a power isolation circuit and bandwidth limiting to reduce oscillations and "motorboating". The values are not particularly critical and modest deviations from the indicated values will not significantly degrade the performance.

Three cell battery packs giving about 4.5 volts are recommended for most transformerless audio amplifiers driving small 8 ohm speakers. The battery life will be considerably longer than a 9 volt rectangular battery and the cell resistance will remain lower over the life of the battery resulting in less distortion and stability problems.

The amplifier may be modified to work with a 9 volt battery if desired by moving the output transistors' bias point. Lowering the 33k resistor connected from the second transistor's base to ground to about 10k will move the voltage on the output electrolytic capacitor to about 1/2 the supply voltage. This bias change gives more signal swing before clipping occurs and this change is not necessary if the volume is adequate.



The above circuit is a versatile audio amplifier employing a low cost LM358 op-amp. The differential inputs give the amplifier excellent immunity to common-mode signals which are a common cause of amplifier instability. The dotted ground connection represents the wiring in a typical project illustrating how the ground sensing input can be connected to the ground at the source of the audio instead of at the amplifier where high currents are present. If the source is a power supply referenced signal then one of the amplifier inputs is connected to the positive supply. For example, an NPN common-emitter preamplifier may be added for very high gain and by connecting the differential inputs across the collector resistor instead of from collector to ground, destabilizing feedback via the power supply is greatly reduced.



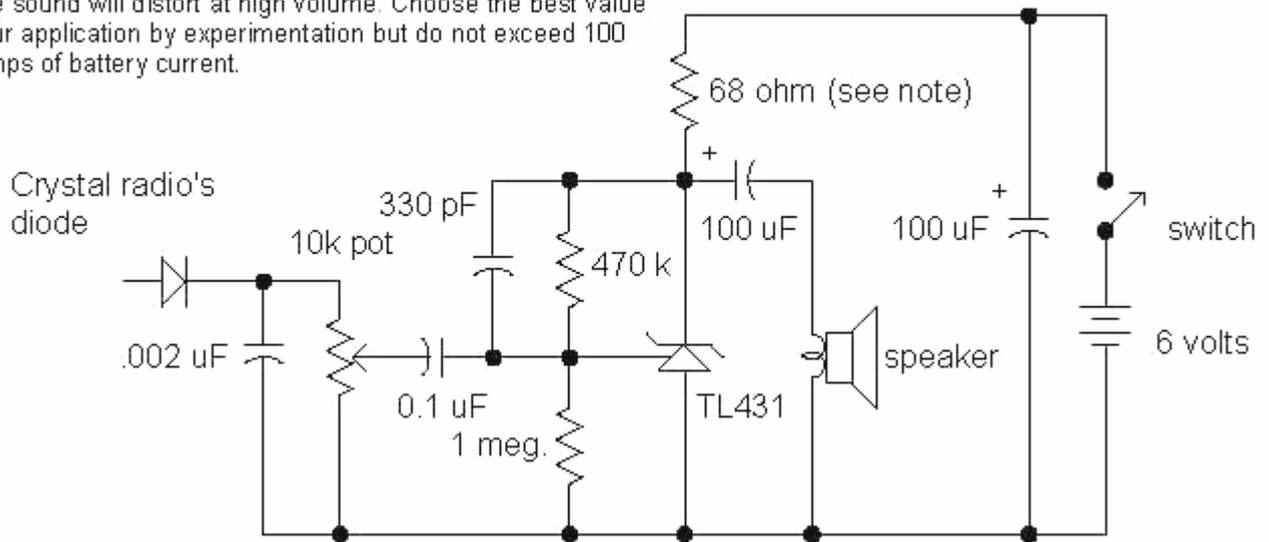
My utility amplifier was built into an aluminum Bud box and eventually ended up bolted to the bottom of a shelf as shown. The well-behaved and ready-to-go amplifier is really handy.

As is often the case, the circuit values are not critical. Other op-amps will usually work but a bit of experience may be necessary if problems develop.

Crystal Radio (and other purpose) Audio Amplifier

Here is a simple audio amplifier using a TL431 shunt regulator. The amplifier will provide room-filling volume from an ordinary crystal radio outfitted with a long-wire antenna and good ground. The circuitry is similar in complexity to a simple one-transistor radio but the performance is far superior. The TL431 is available in a TO-92 package and it looks like an ordinary transistor so your hobbyist friends will be impressed by the volume you are getting with only one transistor! The amplifier may be used for other projects, too. Higher impedance headphones and speakers may also be used. An earphone from an old telephone will give ear-splitting volume and great sensitivity! The 68 ohm resistor may be increased to several hundred ohms when using high impedance earphones to save battery power.

Note: the 68 ohm gives good volume with a 6 volt battery. Use 180 ohm for 9 volts. Higher values will give longer battery life but the sound will distort at high volume. Choose the best value for your application by experimentation but do not exceed 100 milliamps of battery current.



Here is the amplifier used to boost the output from a simple crystal radio. The volume control is at the bottom left and the other components are on the terminal strip at the bottom of the picture. This is a really quick and easy audio amplifier!

