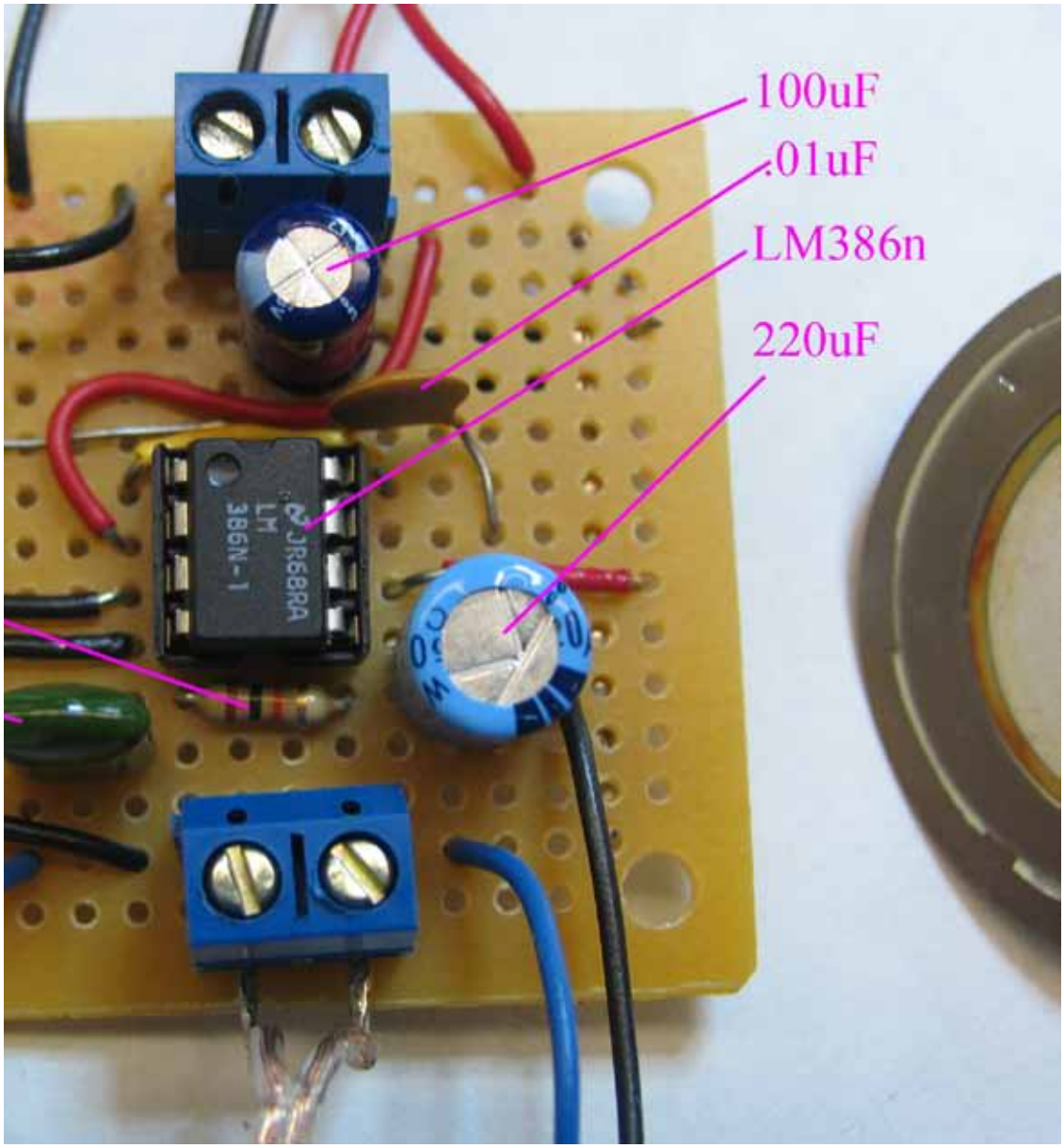
Making an Audio Amplifier ...so easy!

with Lesley Flanigan



Soldering Tips

When heated, solder becomes a liquid. And like water, it has a surface tension and can behave unexpectedly. It flows well over surfaces that are evenly heated, so the goal is to heat the target surface properly so that the solder covers it smoothly.

The general idea behind soldering is to have the soldering iron be the first and last thing against the part to be soldered. Try not to let the solder touch the iron itself. Only apply solder to a part that is already hot.

1. hold the soldering iron against the surface to be heated
2. apply some solder
3. remove the solder
4. remove the soldering iron

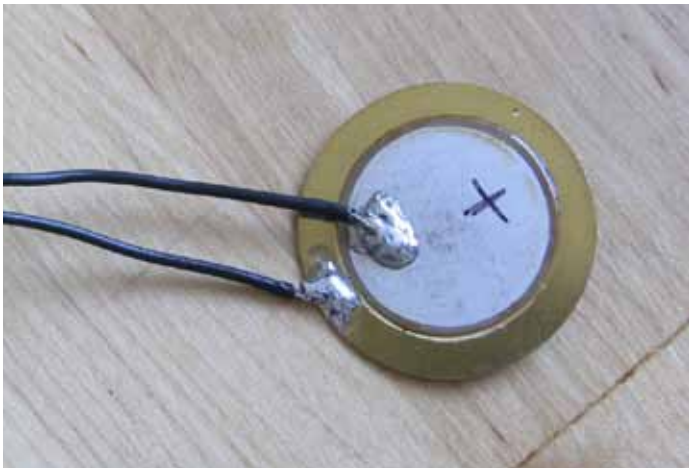
There are three basic kinds of soldering depending on what you want to connect. We'll do the first two while we make the noise toy. Most people overcomplicate the process, which is actually quite simple if you know how to do it correctly.

Wire / Part:
- "pre-tin" both the wire and the part by adding a little solder to each individually
- hold the pre-tinned wire and part together and briefly heat them with the soldering iron
- they will merge together quickly and cleanly

Wire / Wire:
- twist the wires together before soldering
- apply solder and make sure it covers them evenly

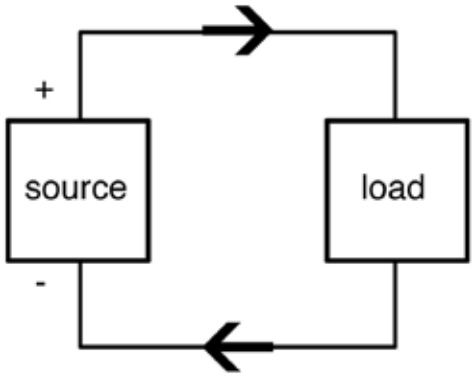
Part / Circuitboard:
- insert the part
- heat both the part and the metal on the circuitboard
- apply solder

soldered wires on a pizeo and a potentiometer:



Some basic electronics

The figure below shows the basic type of electrical circuit, in the form of a block diagram. It consists of a source of electrical energy, some sort of load to make use of that energy, and electrical conductors connecting the source and the load.



The electricity provided by the source has two basic characteristics, called voltage and current. **Voltage** is the electrical “pressure” that causes free electrons to travel through an electrical circuit. Also known as electromotive force (emf). It is measured in volts. **Current** is the amount of electrical charge (the number of free electrons) moving past a given point in an electrical circuit per unit of time. Current is measured in amperes. The load, in turn, has a characteristic called resistance, a medium which opposes the flow of electrical current through itself. Resistance is measured in ohms.

Every electrical device needs electricity. Power can come from different kinds of sources, from a battery to a wall outlet. We encounter electricity of two kinds: DC and AC. In this circuit we will be working with DC power.

DC (or direct current) is electricity in its pure form. Batteries and solar panels give us DC power, and most electronics require DC power to run. The battery in this circuit is 9 volts. DC electricity always has two sides: + and -, known as power and ground. These are labeled on a battery and also on power cables if you look closely. An electrical circuit needs to be connected to both ends to work. A circuit gives electricity a path to follow, and the flow of electricity from + to - powers the device. Simply hooking a circuit to the + end of a battery doesn’t actually give it power until the - end is also connected.

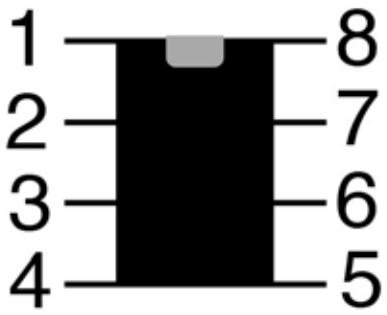
Resistors resist, but do not totally block, the flow of electricity. They are used to control the flow of current. Current can move either way through a resistor, so it doesn’t matter which way they’re connected in a circuit.

Capacitors store up electricity while current is flowing into them, then release the energy when the incoming current is removed. Sometimes they are polarized, meaning current can only flow through them in a specific direction, and sometimes they are not. If a capacitor is polarized, it will be marked as such on the diagram. Don’t wire a polarized capacitor backwards; it might explode!

LM 386

An **amplifier** is a device that changes (usually increases) the amplitude of a signal. In audio applications, amplifiers drive the loudspeaker used in PA systems to make instruments louder or play recorded music. The relationship between the input to the output of an amplifier is referred to as gain.

The **LM386** microchip is an operational amplifier (op-amp) integrated circuit (IC). It consists of a low voltage audio power amplifier. Designed for low voltage consumer applications, it can be powered by a 9V battery and used with radios, guitar amplifiers, and hobby projects.



Pins 1 to 8 on the LM386

Pins 2 and 3 are inputs.
Pin 5 is output
Pin 4 is ground
Pin 6 is power
Pin 7 is bypassed (not used)
Pins 1 and 8 are connected to increase gain

The gain is internally set to 20 to keep external part count low, but the addition of an external resistor and capacitor between pins 1 and 8 will increase the gain to any value from 20 to 200.

With pins 1 and 8 open, the internal resistor sets the gain at 20 (26 dB). If a capacitor is placed between pins 1-8, bypassing the built-in resistor, the gain will go up to 200. If a resistor is placed in series with the capacitor, the gain can be set to any value from 20 to 200.

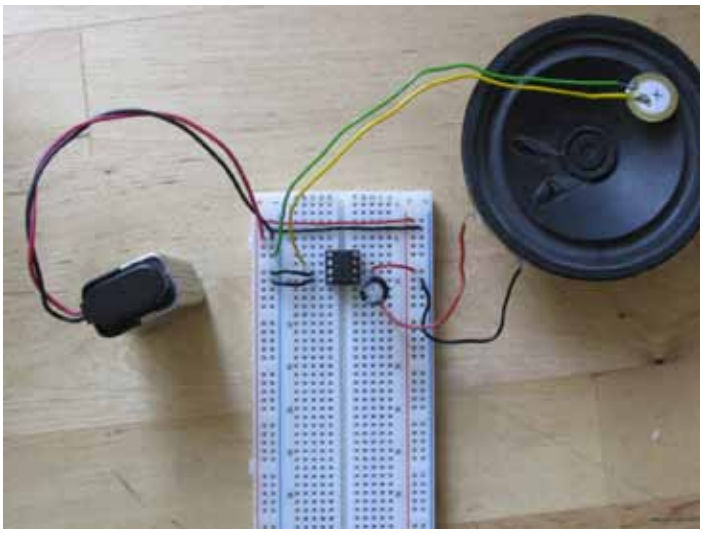
All of this information and much more comes from reading a **data sheet**, a PDF which you can easily find online and download for any microchip you want to work with.

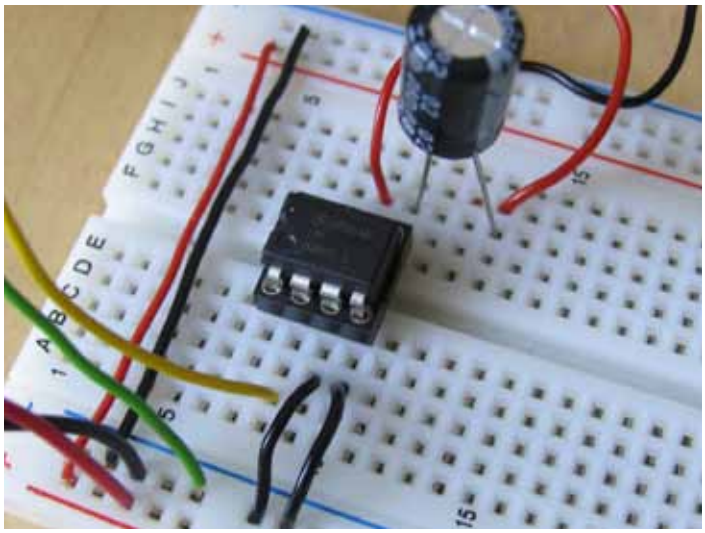
Now let's make some noise!

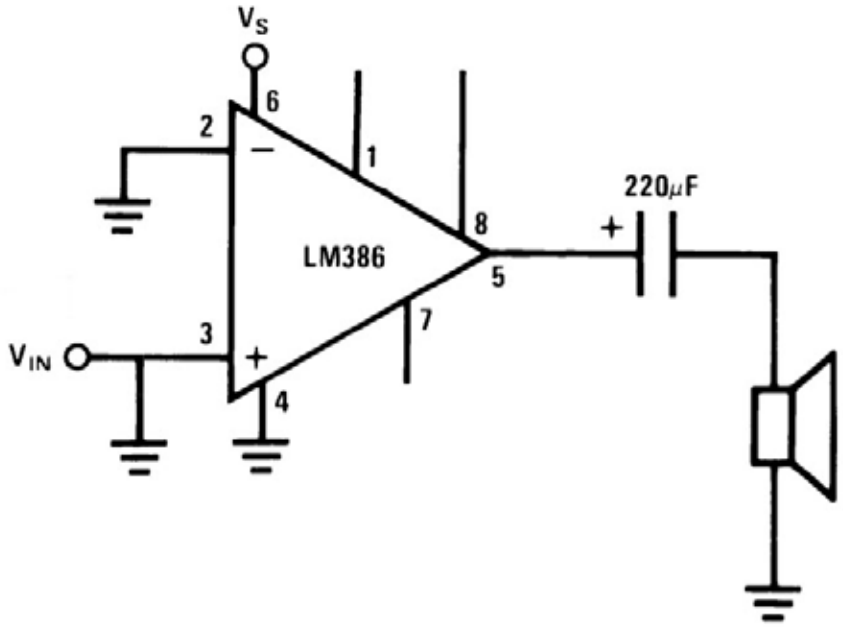
as simple as it gets...

The schematics and parts for this circuit vary. You can build it to be as simple or as complex as you want. For now, we are just going to work with the most basic elements to give you sound. Then you can go as crazy as you want!

1. breadboard
2. LM 386
3. 220 uF capacitor
4. 9V battery 3. Potentiometer (variable resistor)
5. speaker
6. piezo (to induce sound, place it on your speaker to create a feedback loop)



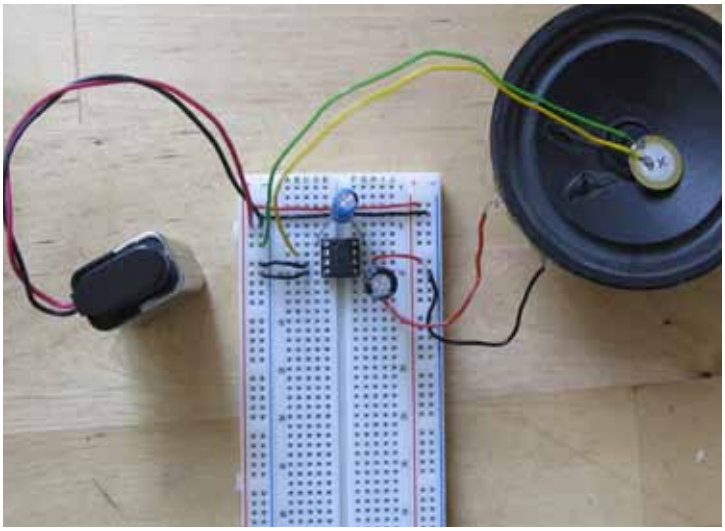


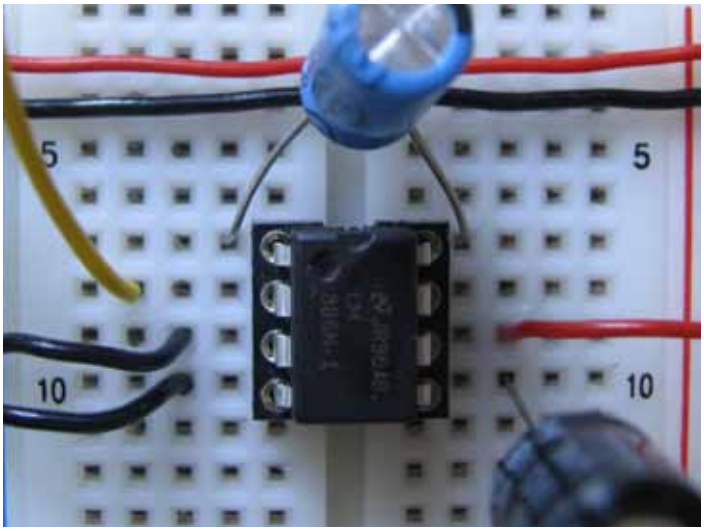


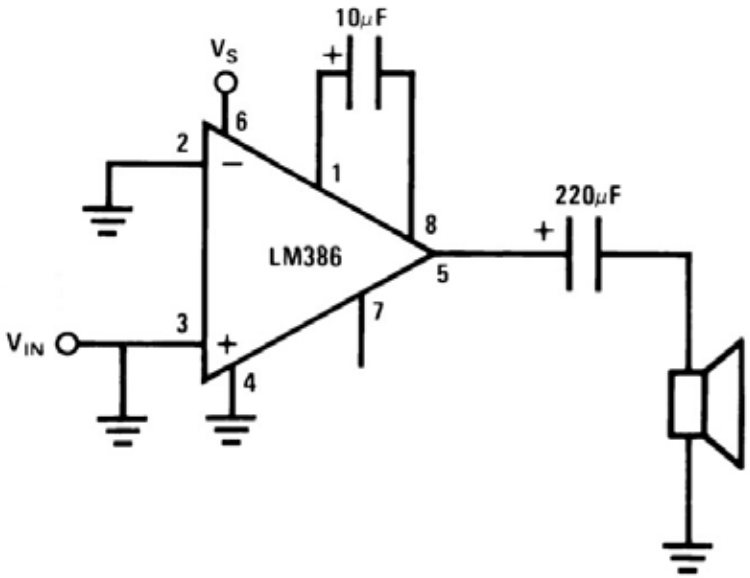
now lets add more...

Now add a capacitor between pins 1 and 8. You should hear that your circuit has more gain and the sound is louder!

1. breadboard
2. LM 386
3. 220 uF capacitor
4. 9V battery 3. Potentiometer (variable resistor)
5. speaker
6. piezo (to induce sound, place it on your speaker to create a feedback loop)
7. 10 uF capacitor



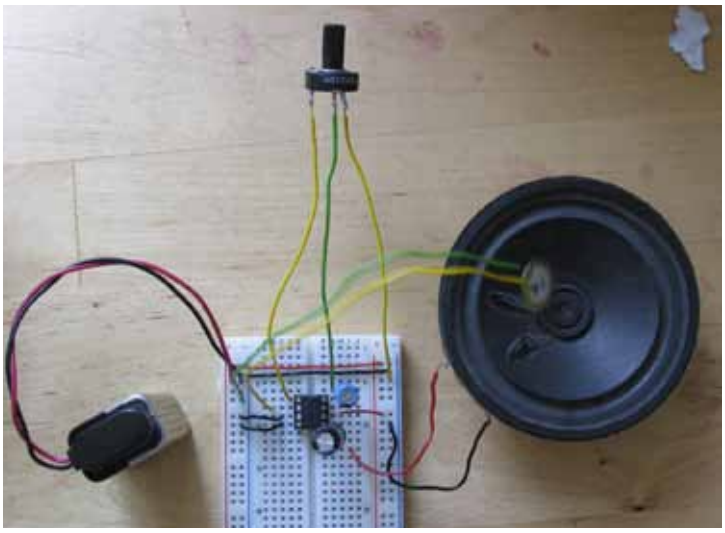


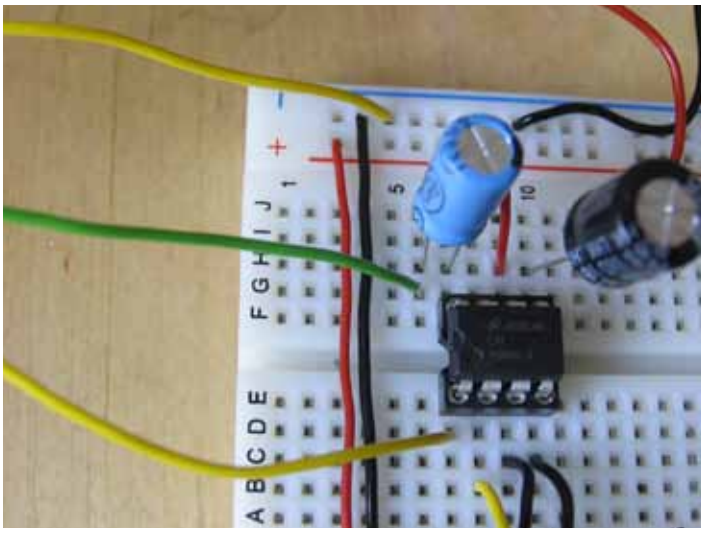


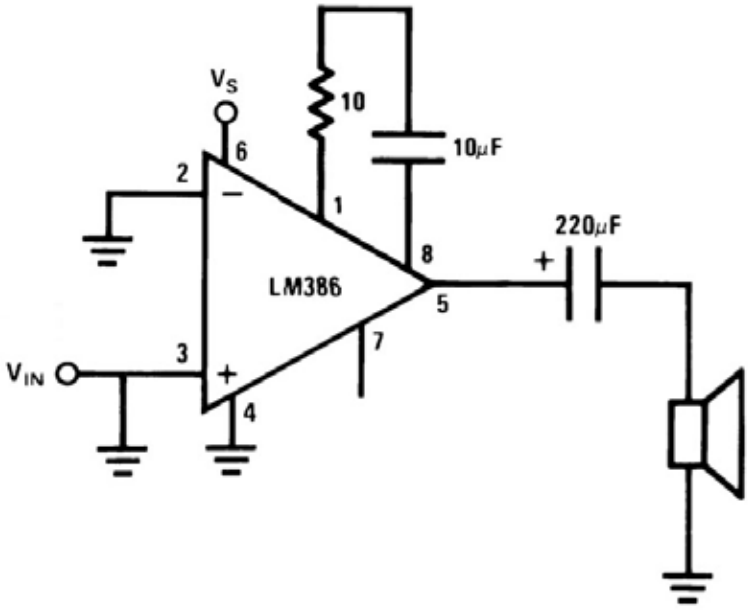
...and more...

Now let's hear what happens when you add a potentiometer, which is a variable resistor. Hear what happens when you add it between pins 1 and 8, and when you add it to the output signal line (from pin 5). It may sound a little jumpy right now, but with the right combination of resistors and capacitor, you can use this part to regulate both the gain and the output volume of your amplifier.

1. breadboard
2. LM 386
3. 220 uF capacitor
4. 9V battery 3. Potentiometer (variable resistor)
5. speaker
6. piezo (to induce sound, place it on your speaker to create a feedback loop)
7. 10 uF capacitor
8. 10K potentiometer



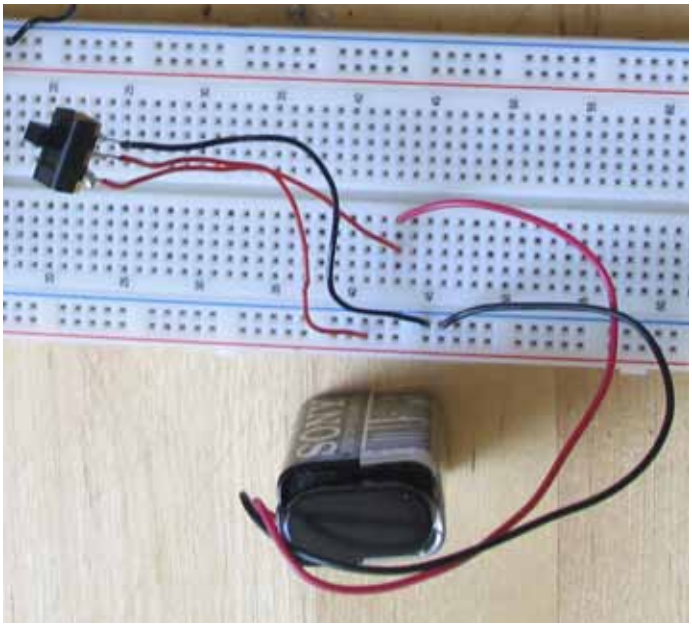


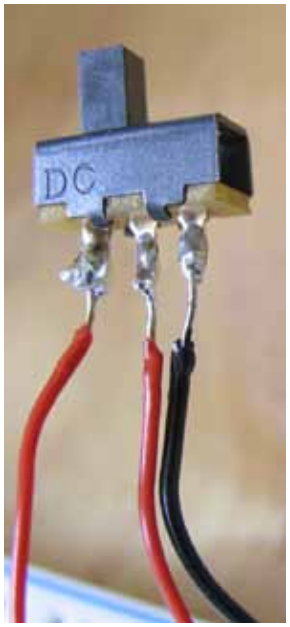


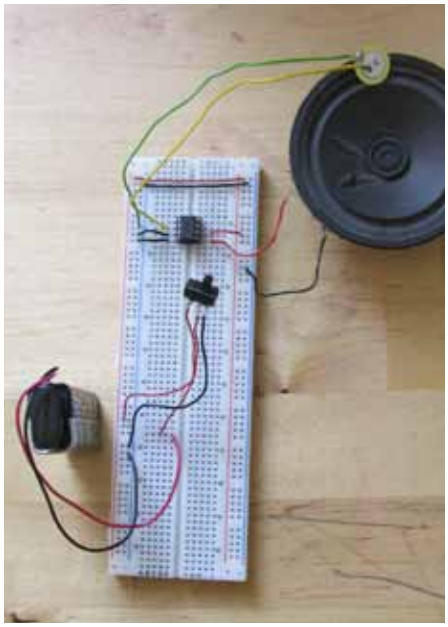
keep going!

There are many other fun electronic parts to play with such as switches and different kinds of connectors to plug in other input sources such as mp3 players, radios and even guitars! Use your data sheet to guide you through different schematics that will tailor your amplifier to the sound output you desire. You can also go online to see what other people have done. The most important thing is to just have fun with it! The great thing about the LM396 is that it is cheap and easy to get at your local electronics shop, so if you break it, don't worry!

Use a switch to turn your battery on and off







Plug in your ipod with an 1/8" audio jack