Build a 9 volt battery torch

Every year, millions of 9 volt batteries are discarded when people change the batteries in their smoke detectors. Having accumulated several only slightly discharged batteries from my own detectors, I thought it time to make a kit that could make good use of these.

Most 9 volt batteries removed from smoke detectors are only slightly discharged—often they have 80% or more capacity still left in them. These batteries are small, and being alkaline or lithium (you don't use the zinc-carbon cheapies in your smoke detectors, now do you!), they are ideal as the basis for a pocket torch or emergency flasher.

The 9 volt battery kit is a very simple kit that consists of two LEDs, a resistor and a tiny switch, all mounted on a 15mm x 25mm PCB, along with two battery terminals. You can use any 3mm or 5mm LEDs you like, and so can build the unit up as a torch with a narrow beam, or a lantern with a wide beam, or even as a flasher with a combination of flashing LED and normal LED.

The circuit will discharge the battery down to between 3 and 5 volts, depending on the type of LEDs used, before they become too dim to use. This represents a much larger portion of the usable battery capacity than a smoke detector will use while still working reliably.

How it works

The circuit is quite simple. When the switch is turned on, current flows from the battery through the resistor and through the two LEDs, back to the battery. And that's it! The 120 ohm resistor limits the current through the LEDs to around 20mA, depending on the LEDs used and the state of charge of the battery. If you are using LEDs with a relatively high voltage drop, such as white, blue or green LEDs, then you should use the 120 ohm resistor supplied. If using red or amber LEDs, you should use a higher value, say around 220 ohm, unless one of the LEDs is a flashing LED. These have some current control of their own, so use a 120 ohm resistor in this case. Note that the resistor position on the PCB is marked as 220 ohm, but this is just a nominal value. Use the values suggested for each LED type.

Building it

There isn't much to building this kit, just put the components into the board at their appropriate places and solder them in place. However, you must start with the battery terminals.

The female terminal (the larger one) goes at the +ve position on the board (closest to the resistor), and the smaller one goes at the –ve position, next to the switch. The terminals mount underneath the board, not on the component side.

Fitting the terminals is a little tricky, but the female terminal is easiest, so start with that. Firstly, place one of the rivets through the terminal, from the front (the side that mates to the battery) to the back. Now position the terminal and rivet so that the shaft of the rivet is aligned with the +ve hole in the board, and press it in until it grips the inside of the hole. The rivets are a press fit, so you now need to place the board over some form of support—the slightly open jaws of a vice, or a block of wood with a small hole, a bit larger than the rivet shaft, drilled into it.

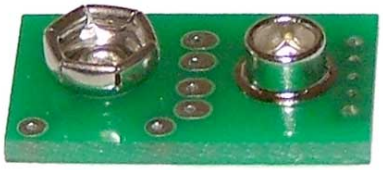
Once the board is supported, press the rivet all the way through the hole until the terminal is seated tightly against the PCB—you should not be able to spin the terminal around—it must be tight to maintain good electrical contact. The ideal tool for this task is a #0 or #1 phillips head screwdriver.

Now you must do the same with the male terminal. However, as the rivets were designed to be used in the opposite direction to what we are using them (ie, inserted through a board, then the terminal, and crimped in place), you need to trim the head of the second rivet so that it will fit inside the male terminal. This sounds difficult, but in fact will only take a few seconds with a pair of sharp side cutters. I found the best way was to trim the rivet head to a square shape, cutting most of each side off almost down to the shaft. The rivets are thin brass, so won't damage cutters designed to cut electronic component leads.

Anyway, once the rivet head is trimmed, use it to fit the male terminal to the PCB at the –ve position, once again making sure the terminal is tight against the PCB.

Once the terminals are in place, solder them on the component side of the board—this will take a bit of heat, and make sure the solder sticks to the rivet. There should be around 2mm of rivet shaft protruding through the board, which is more than enough to solder to.

The rest of the board is simple. Fit and solder the LEDs (make sure they are around the right way!) and the resistor. The switch is the last item, and can be mounted upright or lying on its side. If mounting it upright, don't try and push the switch all the way into the board as there are no solder pads on the terminal side of the board, and you need to solder the switch on the component side no matter which way you orient it.



At left you can see the component side of the board with the terminal rivets before they are soldered. At right is the terminal side of the board. Note how the rivet heads are pressed all the way down inside the terminals.