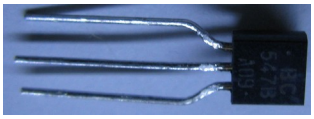
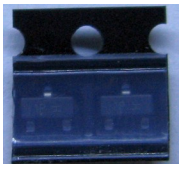
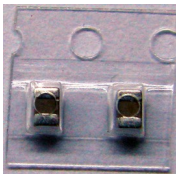
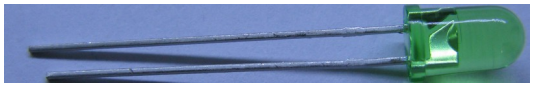
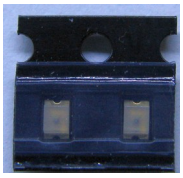
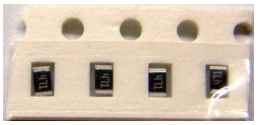
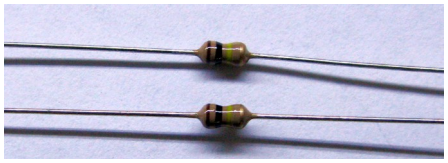
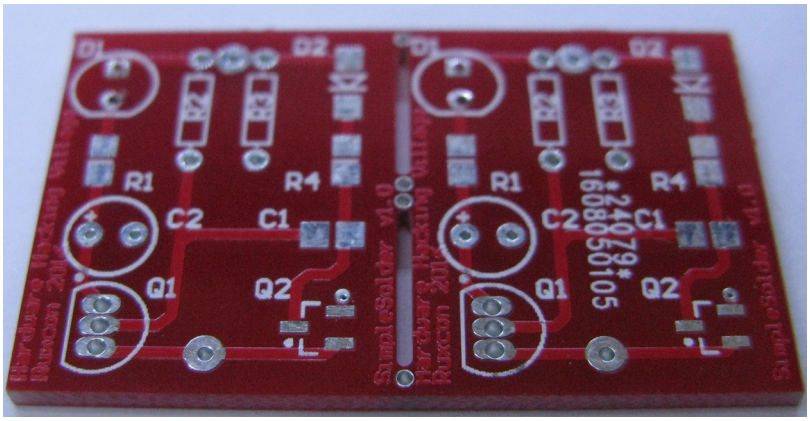
Ruxcon Hardware Hacking Village 2016

SimpleSolder instruction sheet

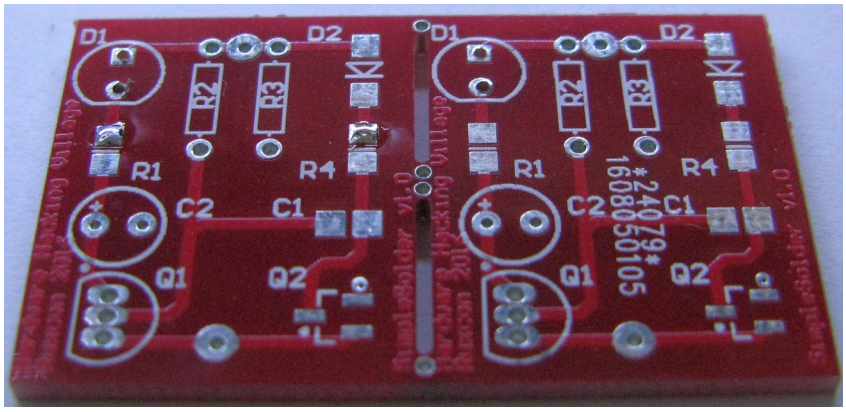
Bill of materials (note that there are two sets of parts in each kit);

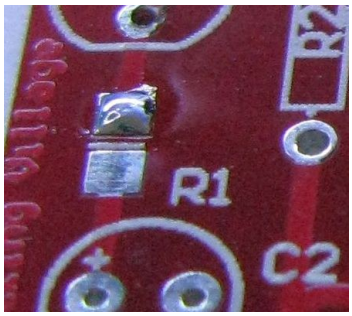
Qty	Description	Designators	Image
1	PN2222 TO-92 NPN Transistor	Q1	
1	MMBT2222 SOT-23 NPN Transistor (SMD)	Q2	
1	10uF Aluminium Electrolytic Capacitor	C2	
1	10uF MLC 0805 Capacitor (SMD)	C1	
1	Green 5mm LED	D1	
1	Red 2512 LED (SMD)	D2	
2	470R 0805 Resistor (SMD)	R1, R4	
2	100k 1/8W Carbon Film Resistor	R2, R3	
1	CR2032 Battery Holder	B1	

NOTE: Some muppet (i.e. yours truly) screwed up the PCB design in serveral places, so read and follow the instructions carefully. This is the peril of going straight to production runs, but we didn't really have time otherwise.

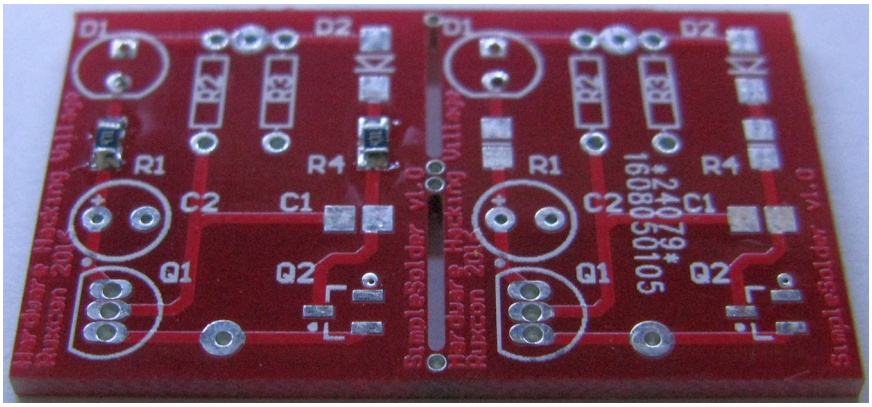


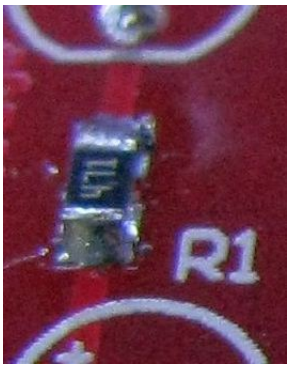
1. Each board is actually two boards. This guide only goes through populating the left hand board; the intention being that you can go and populate the right hand board yourself later (the boards can be snapped down the middle).





2.First we're going to solder the two surface mount resistors R1 and R4. The easiest way to do this manually is to “tin” one of the pads which basically entails applying a small amount of solder to the pad. (It's easiest to use fine solder for surface mount and thicker solder for through-hole parts) In the above image the topmost pads of R1 and R4 have been “tinned”.

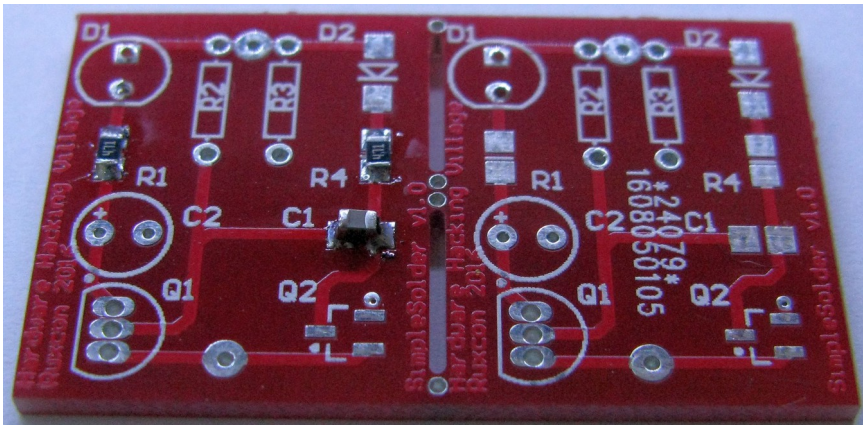




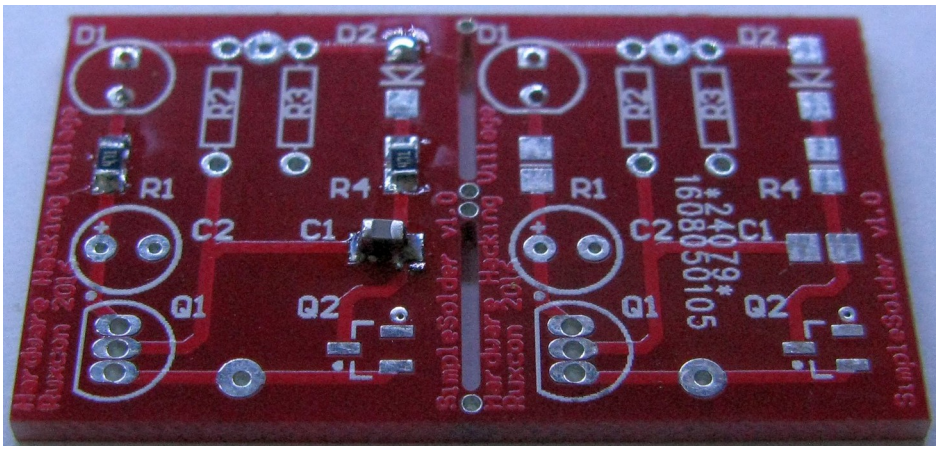
3. Next, place the resistors, positioning them so that one end is sitting on the tinned pad. Hold them in place with tweezers, then touch your soldering iron to the pad and the end of the resistor. The solder should flow onto the end of the resistor. Hold it in place for a moment while the solder freezes. After you've soldered the “tinned” end, apply solder to the other end of the resistor. Just a little dab will be enough; the end result should look similar to the above image.

If you don't hold it down while the solder freezes on the first joint, it's liable to “tombstone” (basically the surface tension of the pool of solder causes it to stand up on-end). If this happens to you, you can just re-heat the pad and use your tweezers to push the resistor flat to the board.

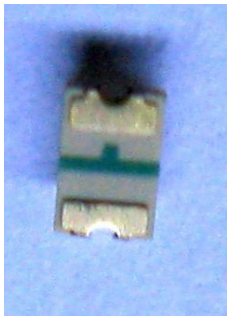
If you plan to do more of this sort of thing in future, this is probably as good a time as any to learn about component “dressing”. It's not as clear from the above image as it could be, but if you look closely, you'll see that the resistors have a marking 471 on them, and that marking is oriented such that it can be read in the same orientation which allows you to read the vertical text on the board. It's just a bit neater and can be a help for troubleshooting and such down the track.

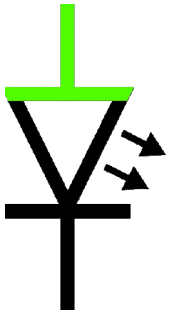


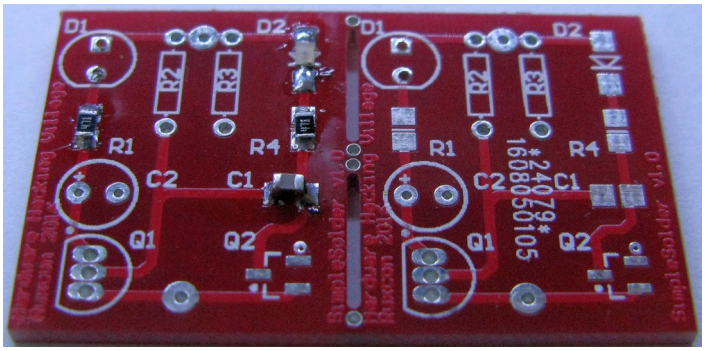
4. Repeat the process for the surface mount capacitor C1. Tin the pad, place the cap, hold it down while you touch the joint with your iron, then solder the other end.



5. Next, we're going to mount the surface mount LED. Once again we're following the same process as the other surface mount parts, but this one is a bit trickier since the board was designed for a 3216 (1206) package and I ordered 2520 (0805, smaller) LEDs... Tin one pad again here but you want a good glob of solder on it this time.





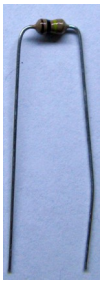


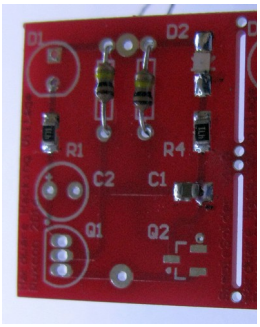
6. Make sure you orient the LED the right way around. If you look at the BACK of the LED you'll see a “T” shaped marking. That “T” shape corresponds to the highlighted “T” shape on the LED symbol next to it, which in turn corresponds with the marking on the PCB (this is the reverse of what it should be, it seems that Osram screwed up the markings on this batch of LEDs).

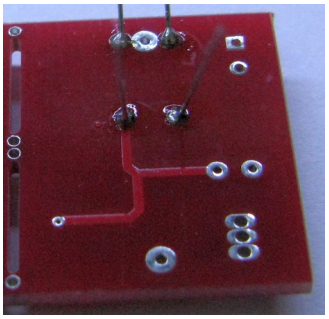
Using your tweezers, position it on the very edge of the pad you put the glob of solder on. Touch your iron to the solder pool and draw it towards the contact on the end of the LED. Once it catches, hold it in place until the solder freezes.

Next apply a good helping of solder to the other pad and once again draw it towards the contact on the LED. When it grabs, pull out your iron and wait for the solder to freeze. It's not entirely clear from the above photo (thanks to my trully l33t photography skillz) but the LED is effectively sitting between the pads with a little “bridge” of solder to each side.

If that's not working for you you can place the LED so the contact is sitting on the pad, flow the solder onto the end of the LED. Then, with your soldering iron still in contact, use your tweezers to drag the LED down until the other contact is on the edge of the bottom pad, then apply solder to the bottom end.

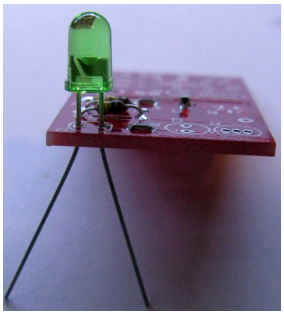






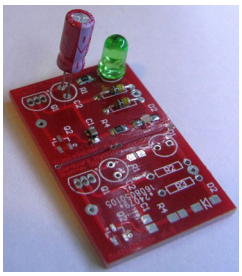
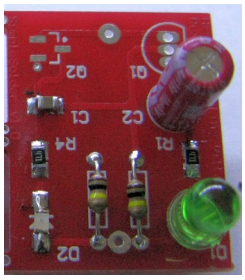
7. Grab two of your resistors and bend the leads at 90 degrees a few millimeters away from the body (left hand photo above), then insert them into the footprints on the board (R2 and R3). Once again, notice that they are installed such that they read (black brown yellow gold 100k 5%) the same way as the other components in this orientation on the board. Then flip the board over and solder the connections. Finally trim the leads off close to the board. Put one of your “pigtails” aside.

Usually this step would have been to mount Q2, as you should generally mount low-profile components first. But in spite of it having been checked three times, the Q2 footprint on the PCB is still the wrong way around and as a result Q2 needs to be installed upside down.

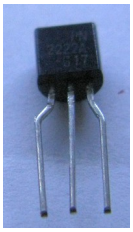
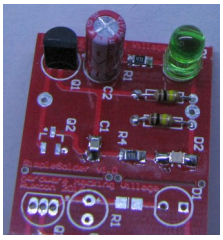


8. Next we're going to mount the through-hole LED. The holes in the design were too small for the leads of the LED so they had to be drilled out. This means that you will need to solder the LED on the TOP side of the board.

The LED is polarity sensitive (i.e. you need to put it around the right way). The easiest way to tell is by the leads on the LED, they're different lengths; the shorter one goes in the hole nearest the “flat” on the PCB overlay (there is also a VERY subtle flat on that side of the LED but it's hard to see). As you push it in you will eventually encounter resistance when the LED is about 5mm from the surface of the board (as in the above photo). Don't push it any further. Bend the leads out a bit then solder the leads on the top of the board.

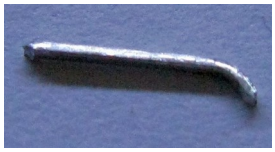
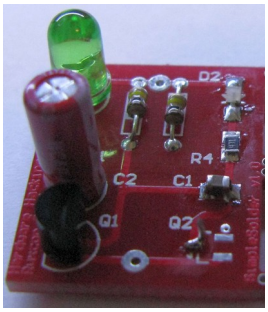




9. Next step is to install the through-hole capacitor (C2). Be careful with the orientation of this one too; the stripe on the can indicates the negative terminal, and it should be positioned in the orientation shown in the left hand photo (i.e. stripe facing “inwards”). Push it all the way down, flip the board over and solder both leads. Trim close to the board.

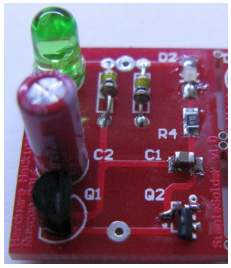
10. Next install the transistor. Note that the transistor should be installed **BACKWARDS** i.e. with the rounded side facing out.

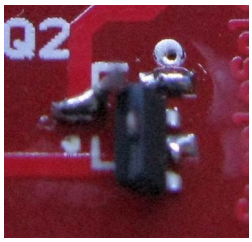
The legs are bent outwards from the factory, but our footprint wants them closer together. The easiest way to handle this is to bend them a bit so they'll go in the holes, then push it down hard. The legs will “snap” through the bend and pull the transistor down flush. Spread the leads out a bit and carefully solder the leads. The pads are very close together so it's easy to bridge them. Once the three leads are soldered, trim them close to the board.

11. Now we get back to Q2. Take one of the “pigtails” you cut off earlier and put a bit of a bend in the end. Now, solder it down to the lefthand pad of Q2 (easiest to tin the pad, tin the wire, bring them together and then just a touch with the soldering iron) so that it's pointing straight up. Don't bend it around too much or you'll lift the pad off the board.

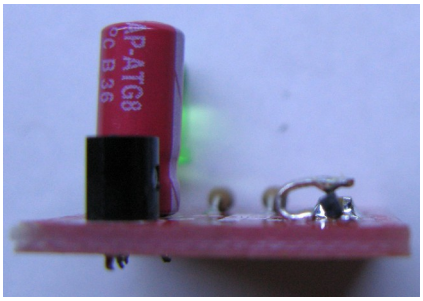
If you do accidentally lift the pad off the board it is not the end of the world, you can connect to the righthand side of C1 with another pigtail.





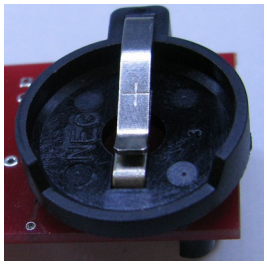
12. Now to actually mount it. First tin one of the two “clean” pads.

Next we need to orient the transistor properly. When it's “right side up” you'll see the legs bend down and sit flat on the table (as in the left hand image). We need to flip it over so the legs are sticking upwards. After you flip it over, you should be able to “tilt” it up so that it rests on the two legs coming out of the right hand side, per the right hand image (which once again thanks to my totally l33t photography skillz is awesomly clear...).



13. With your tweezers, position the transistor so that the two legs are sitting on the pads, then touch the pad you tinned with the soldering iron to flow the solder. Solder the other leg.

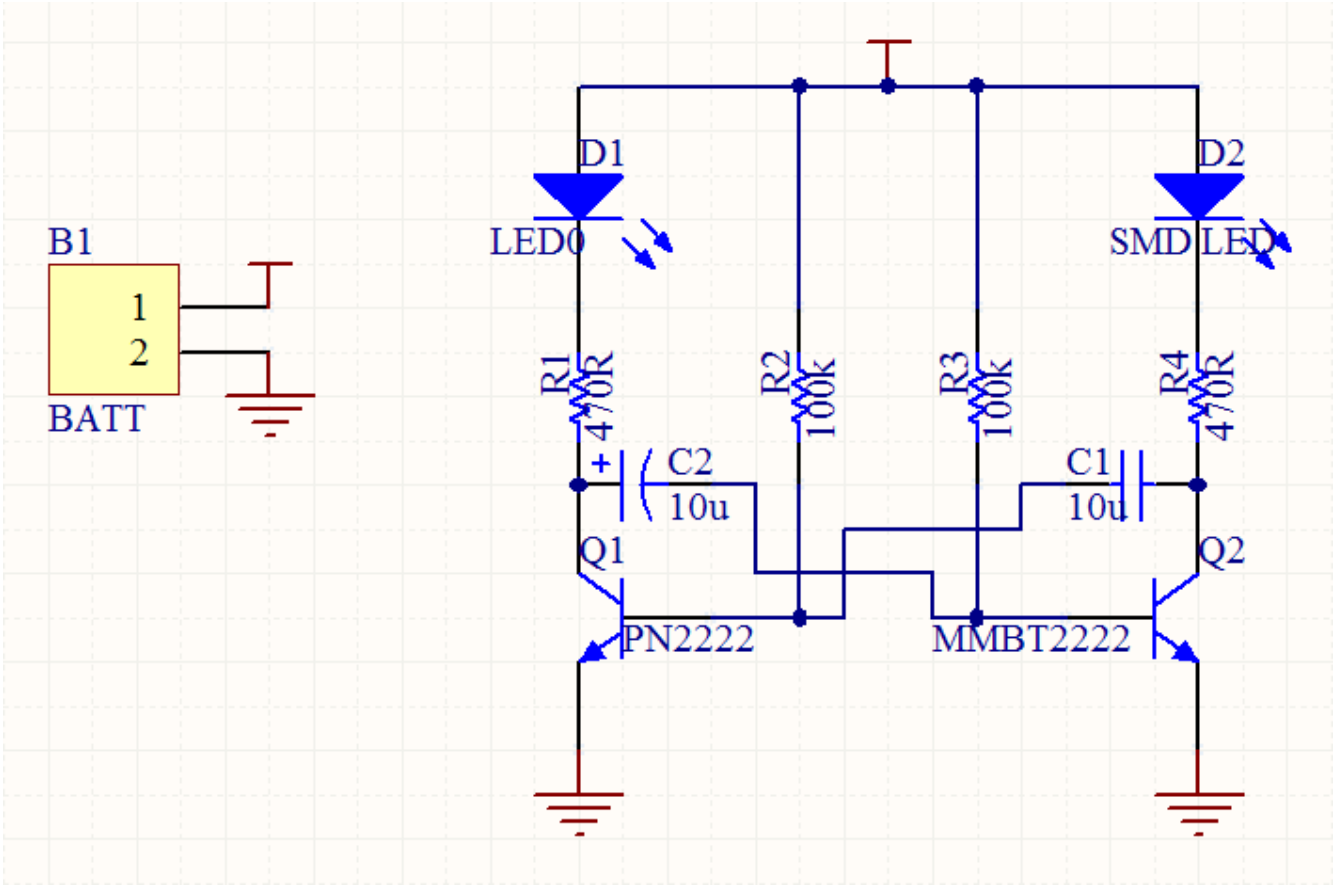
After the two “bottom” legs are done, bend the pigtail so that it makes contact with the third leg (if necessary), then apply solder to the junction. You'll have to be pretty quick otherwise it will come unstuck from the pad.



14. Last, but not least, mount the battery holder on the back of the board. The pin on the “round” end of the battery holder should go to the hole nearest the transistors, and the other pin obviously goes in the hole nearest the LEDs. The holes are a touch small so you will have to “pursuade” the battery holder into the board. You can safely apply a good amount of force to the battery holder. Try to press down on top of the contacts though. Once it's in place solder the two leads on the top side of the board.

Now if all is well, when you put a battery in it, you should get the LEDs flashing back and forth. Congratulations! In spite of my screw ups you've got a working (if somewhat boring) LED flasher.

If this has whet your appetite and piqued your interest, and you think you're up for something a little more challenging, have a chat to our HHV staff about the Ruxcon 2016 Hardware Hacking Village badge. It's a much more advanced (and potentially useful) project, and it's even got less screw ups than this one!


B1
1
2
BATT
D1
LED0
D2
SMD LED
R1
470R
R2
100k
R3
100k
R4
470R
+
C2
10u
C1
10u
Q1
Q2
PN2222
MMBT2222