Flasher Circuit Assembly Instructions

Assembling the flasher circuit (Figure 1) introduces you to a skill that many physics graduate students must develop, as they must make custom circuits in connection with cutting-edge research: often, the weirdo things they must try cannot be accomplished by off-the-shelf electronic assemblies. This circuit uses a versatile chip, called the "555" timer to generate pulses that flash LEDs (light-emitting diodes). The output of pin 3 on the 555 chip flips back and forth between 3 volts and 0 volts. In either case, one of the two LEDs will have a voltage across it and will light up—but only one LED will be on at a time.

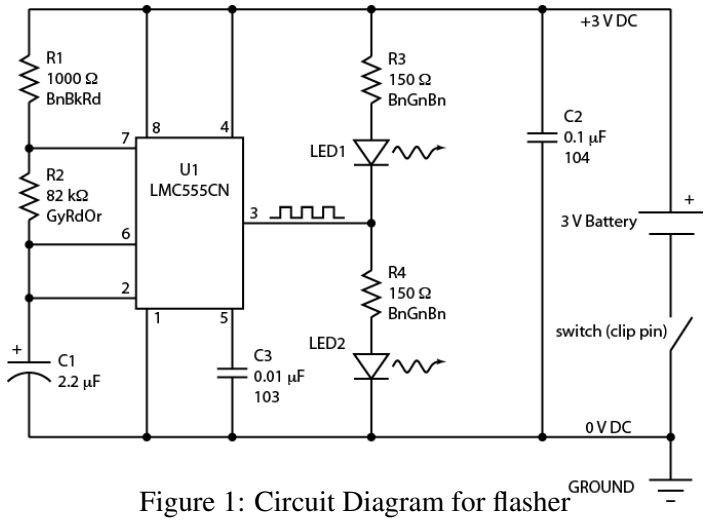

Figure 1: Circuit Diagram for flasher

The key technique you must master for this activity is **soldering**. The **solder** is a metallic substance that melts when it touches something hot. The **soldering iron** is the source of heat. The purpose of the solder is two-fold: 1) the solder **holds** electrical components in place; 2) the solder acts as an **electrical connection** between the parts and the circuit board.

The second point is the most important for the circuit to work. It is *vital* that the solder make a good connection to both the component (leg) and to the circuit board (pad)—see Figure 2. The best way to accomplish this is to get a little bead of solder on the tip of the soldering iron, then wedge this between the protruding leg and the surrounding pad. Once they are hot (a second or two), add solder to the *other* side of the joint, melting into a little tee-pee all the way around the leg. It should look like a hershey's kiss when you're done.

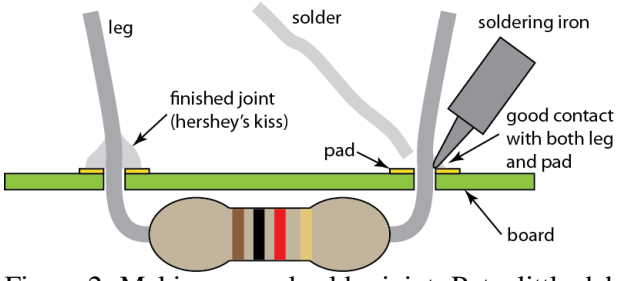

Figure 2: Making a good solder joint. Put a little dab of solder on the tip of the iron, then wedge into the space between the pad and the leg, touching both to heat them up (only takes a second). Then apply solder from the *other* side, melting it into the joint just enough to make a little tee-pee surrounding the leg and connecting it to the pad (see left leg above, and picture to right).

You will need to gather components to build the circuit. They are:

1. circuit board with switch/pin already soldered on
2. IC1: 555 timer chip (8 pins)

3. Two LEDs, of any color or color combination
4. C1: electrolytic 2.2 μF capacitor
5. C2: 0.1 μF capacitor (marked 104)
6. C3: 0.01 μF capacitor (marked 103)
7. R1: 1 kΩ resistor, with color markings **brown**, **black**, **red**
8. R2: 82 kΩ resistor, with color markings **gray**, **red**, **orange**
9. R3 and R4: both 150 Ω resistors, with color markings **brown**, **green**, **brown**
10. battery holder (get the battery at the end when assembly is done)

Your station should have a soldering iron, a string of solder, and helping hands to hold the circuit board while you use both of *your* hands to solder.

The layout of both sides of the board is shown in Figure 3. Components go on the side with printed labels, and the solder is applied to the solder side, where the component legs poke through the solder pads on the board.

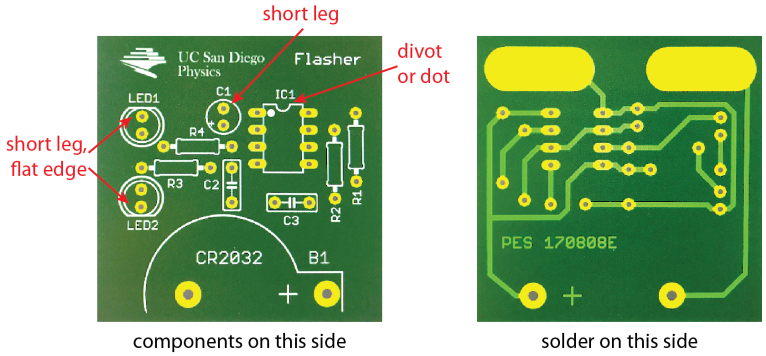

Figure 3: Circuit board layout. Note special orientations of IC1, C1, LED1, LED2, and the battery.

Start with the 8-pin 555 chip, IC1 (U1 on schematic). Be very careful to put it in the **right way**—paying attention to either the divot on one end or a dot by pin 1. Ask for help if you're not sure. It is *much* harder to unsolder a mistake than it is to solder it together in the first place.

Next, add whatever components you feel like, saving the battery holder for last. Notice that the LEDs, C1, and the battery holder need to be placed in the **correct orientation** for the circuit to work. The short leg on the LEDs (also the side that has a flat edge) marks the negative side. Note that the LEDs go in opposite orientations. For C1, the short leg *and* a stripe with a minus sign mark the negative side. The battery holder has a plus sign marking on the top. The solder joints for the battery legs can take a while to do, and do not *have* to make the full circle, as long as a robust contact is made between pad and leg. Just be patient and give time for the metal on the holder to heat up. But **be careful**: it gets **too hot to touch**!

If you're done early: The flash period is set by the combination of the resistor labeled R2 and the capacitor labeled C1. Multiplying their values gives the "time constant": 82 kilo-ohms times 2.2 micro-Farads is 82,000 times 0.0000022, which comes out to 0.18 seconds. This means you can speed up or slow down the flashing by changing R2. A larger resistance makes for slower blinking, while a smaller resistance makes it blink faster. Think of resistors as straws: A thicker straw means less resistance, so your drink gets slurped up faster. One trick you can do without messing with the solder is to hold another resistor in parallel to R2: bridging R2 with another resistor. This puts another straw in the drink, lowering the combined resistance and making the circuit flash faster.