**Stockton Flashlight**

Instructions for Revision 3.1

# Parts

## Large plastic bag

1. Flashlight body (150mm length of 1” Schedule 40 PVC tube)
2. Flashlight reflector coupler (1” Schedule 40 PVC coupler modified to hold the reflector)
3. Flashlight reflector (Plastic, 35mm or 40mm diameter)
4. Anti-static bag (see below)
5. Small plastic bag (see below)

## Anti-static bag

1. LED (High-brightness)
2. Current regulator (350ma)

## Small plastic bag

1. Top printed circuit board
2. Bottom printed circuit board
3. Two solder tabs
4. Two small screws
5. Two pieces of copper tape (~180mm long, adhesive-backed, ¼” wide)
6. Copper spring
7. Push-button switch

# Tools

* Soldering iron
* Solder
* Wire cutters
* Phillips screwdriver
* Long-nose pliers
* Tweezers
* Magnifying glass
* Silicone adhesive
* Mallet or hammer and small piece of wood
* Flat file

# Assembly

These instructions are divided into two groups. The first group builds the components of the flashlight and these can be done in any order. The second group puts these components together and should be performed in the indicated order.

## Building the components

### Top board

The top board is labeled as such; it holds two components: The LED (Light Emitting Diode) and a current regulator. The LED is the part that produces the light and the regulator controls the electrical voltage to prevent the LED from burning out. These two components are sensitive and should be handled with care, usually only with the tweezers. These components are also very small; you may find it easier to install them using a magnifying glass.

Before soldering anything to the top board, first cut off any tabs sticking out from the sides and file the edges of the board smooth. The board needs to fit snugly, but not tightly, inside the PVC coupler; file the rounded ends of the board until you achieve that fit.

#### Attach the LED

The LED has four legs that protrude ever so slightly near the corners of the case. The LED must be installed a specific way round: On the board this is marked with a diagonal on one corner of the white outline; on the LED a similar shape is molded into one corner of the package.

The LED also has a pad on its underside that is used to conduct heat away; The LED will become very hot during use and this allows it to dissipate much of that heat.

The footprint for the LED on the board has five exposed pads; four small pads for the LED legs and one oblong pad for the heat pad.

Techniques for hand-soldering this type of device vary, but one that often works for beginners is to pick one of the corner pads on the board and then apply some solder to it. Then pick up the component with tweezers and, whilst keeping the solder on the board molten, slide the component into place; once positioned (being careful to ensure the component is flat on the board) remove the soldering iron. When the solder has cooled, proceed to solder the remaining legs.

Soldering the heat-dissipation pad is a little trickier, since it is under the LED package. To help with this the footprint on the board has been extended beyond the edge of the LED. Simply apply solder to this pad on each side of the LED; Feed the solder in generously, allowing a bit of a blob to form. After a few seconds some of the molten solder will be drawn under the LED by capillary action. Be careful not to keep the LED hot for more than 5 seconds or you may damage it.

#### Attach the regulator

The regulator is a three-legged device with a large solder tab. The large solder tab is for heat dissipation.

Similar to the LED, a reasonable technique for soldering the regulator to the board is to pick one leg, apply solder to its pad and then use tweezers to slide the component into place ensuring the device is flat against the board. Once set, solder the other two legs and the big solder tab.

### Bottom board

The bottom board is labeled as such; It hosts two components: A spring on one side and a push-button switch on the other.

Before soldering anything to the board, first cut off any tabs sticking out from the sides and file the edges of the board smooth.

#### Attach the spring

It’s usually easier to install the spring first; it also helps if you have a friend who can use the pliers to hold the spring in place while you solder it.

The spring-side of the board is marked with the word “SPRING” and a star-like pattern in the exposed trace. The spring should be centered and soldered to the board at four points around its base.

#### Attach the button

The push-button switch goes on the other side of the board. This will be easier to do if you have something to reset the board on which has a hole in it that the spring can rest inside.

The button has two legs that protrude straight out from on side of the body. These need to be carefully bent to go straight down (the top of the button being the side that has the part you press). The legs can then be cut flush with the bottom of the button.

Glue the button to the center of the board with the two legs aligning with the traces labeled 1 and 3. Then solder the legs to these traces.

Note that silicone glue takes some time to set; be careful when handling this board.

### Body

The body has two holes drilled into it on opposite sides of the tube; the end with the holes is the bottom end of the tube and of the flashlight. (If for some reason your tube has two sets of holes, one pair at each end, you get to choose which end is the bottom.)

#### Attach copper tape

The copper tape carries the negative terminal of the batteries up to the light. There are two for reliability.

The tape runs along inside of tube, aligned with the screw holes. The tape has an adhesive backing that is exposed by removing the white backing material. It’s a good idea to keep the tape flat when removing the backing to reduce curling.

You want the tape to start just below the screw hole on the outside, fold over the end inside the tube, run the length on the inside and fold over the top end. Trim flush with the outside of the top end. Repeat for the other size.

#### Attach solder tabs

There are two holes at the bottom end of the tube. These are to accept screws that hold solder tabs in place. These solder tabs will later attach to the bottom board.

First you must start the thread on the holes. The holes are drilled smaller than the screws so that a thread will form the first time you insert the screw. This can be difficult, though it may be easier if you have a friend who will hold the tube steady for you.

Whilst holding the tube, try to insert the threaded end of a screw into the hole with your fingers; it won’t go far, but should hold in place enough to being the screwdriver to it. Whilst applying a moderate amount of force, turn the screwdriver clockwise to start threading the screw into the hole.

When the head of the screw gets close to the body be very careful not to over-tighten! This would strip the thread in the hole and make it useless. Stop at this point and remove the screw.

Repeat this exercise for the opposite side.

Once both holes are threaded, place a solder tab over each screw and then affix these to the body, again being very careful not to over–tighten the screws. Make sure that before the screws tighten the tabs are parallel to the body and pointing towards the bottom; they should protrude past the bottom by about 5mm.

## Combining the components

### Attach the top board

### Attach the bottom board

### Reflector

# Testing

To test the flashlight we will need batteries. It takes three “C”-sized cells.

Undo the screws that hold the bottom board in place and insert three batteries into the tube. The correct polarity is with the positive (+) end of the batteries pointing toward the top end of the flashlight.

The spring on the bottom board holds the batteries firmly in place; to re-attach the bottom board some force may need to be applied before the screw holes line up and you may need a friend to hold something to achieve it the first time.

If the flashlight comes on when you reassemble, great! That means the switch is on the on position.

One you have screwed the bottom board in place, if the flashlight is not on, operate the switch and it should come on.