

# The Rainbow Light Show™

## Hobby Electronics Soldering Kit

### Instruction Guide

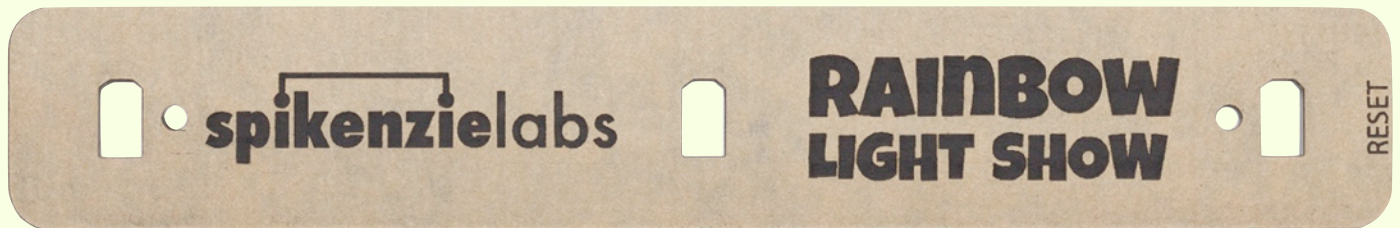
For the best outcome, follow each step in order.  
We recommend reading this guide entirely before you get started.



#### Tools required:

Soldering iron, solder, flush cutters, Phillips head and small flat blade screwdriver, safety glasses, masking tape.

## Laser cut acrylic parts and hardware



Bezel



Stand



Under bezel washers



Nuts



Screws

## Electronic components



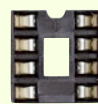
Resistors



DC barrel jack



3pin screw terminal



Socket



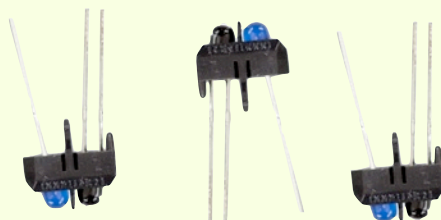
Button



IC



220uf capacitor



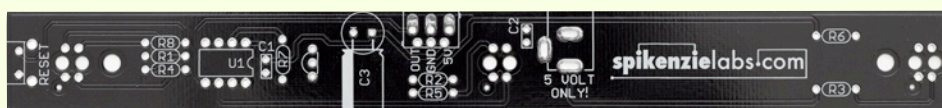
TCRT IR sensors (3)



0.1 capacitor



Transistor



PCB

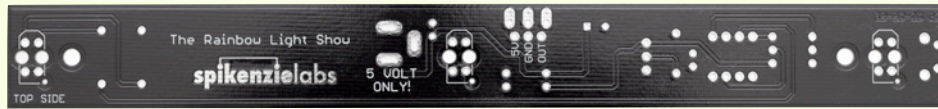


16 LED Strip

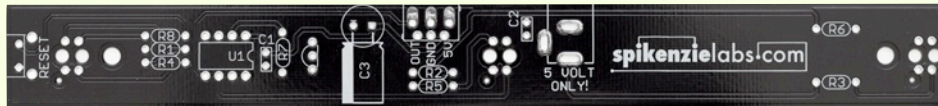


5v 2A Ac Adapter

The Rainbow Light Show PCB will have most components soldered to the bottom of the board, as well some on the top. In all cases, the component is soldered onto the side with a white printed outline.



**Top Side** of PCB



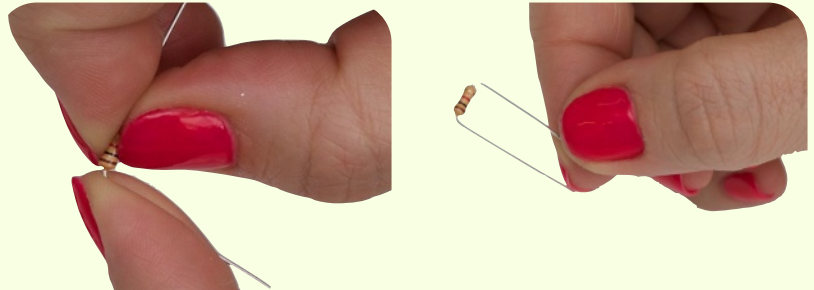
**Bottom Side** of PCB

## Resistor preparation and soldering

### Resistor bending:

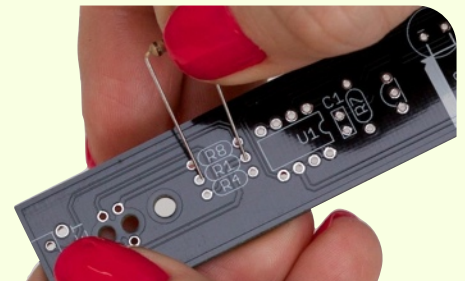
Bend each of the resistors like in these photos:

You want to have the bend of the leg as close as possible to the body of the resistor.

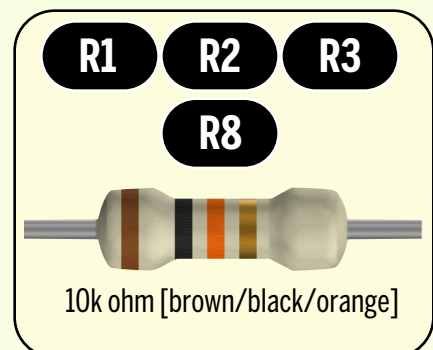
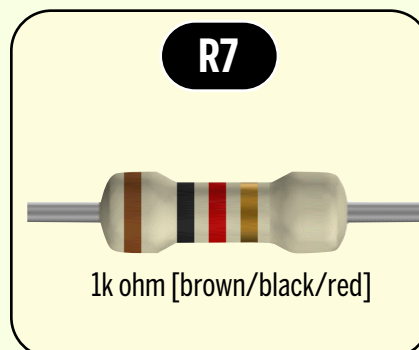
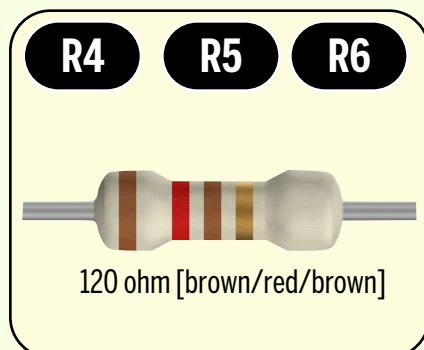


It is important to place each resistor in the appropriate area on the PCB. Prepare one resistor at a time, and insert it into the proper location on the PCB.

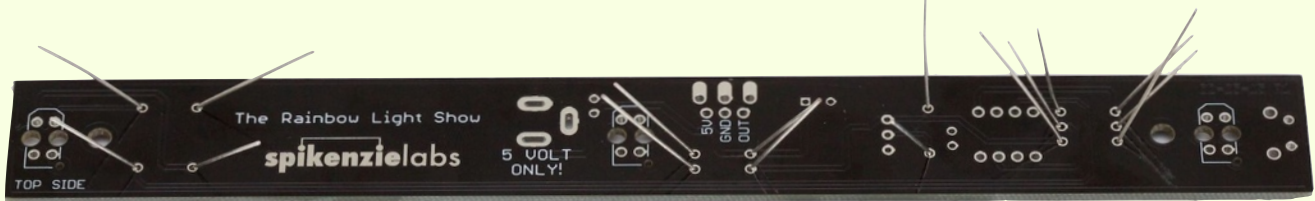
Be sure to install the resistors on the bottom side of the PCB.



Use this chart to place the proper resistor in the right location on the PCB. Note the R numbers printed on the PCB.



Flare out the legs to keep them in place. Be sure that the body of the resistor is flush against the PCB.



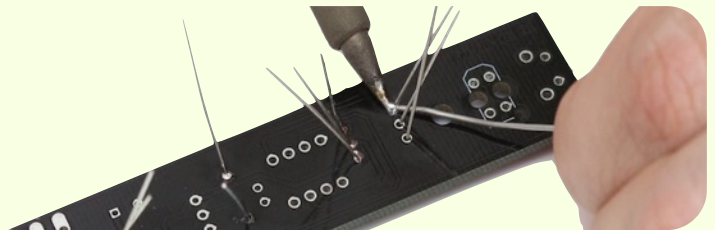
Solder the resistors in place. Make sure you don't forget to solder any of the legs.



**Safety Glasses On!**

Snip off the ends of the legs. Be sure not to scratch the surface of the PCB. Keep your safety glasses on!

Do this for each resistor leg.



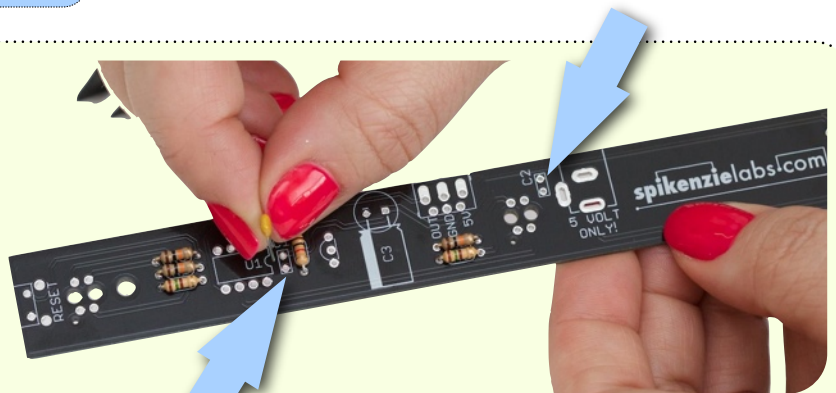
## Capacitor preparation and soldering

Place the capacitors in the two locations as seen in these photos. Marked as 0.1uf on the PCB.

Orientation does not matter for these.

Flare the legs out as you did for the resistors, and then solder both capacitors in place.

Snip the ends of the legs.



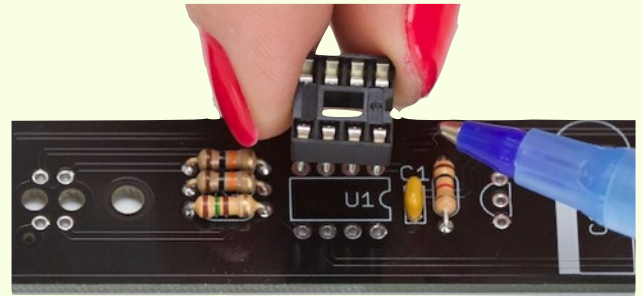


## The IC socket



Mind the notch!

The IC socket has a notch on one side. The PCB has a printed notch. When you are mounting the socket to the PCB, make sure the notch on the socket is lined up with the notch printed in white on the PCB.



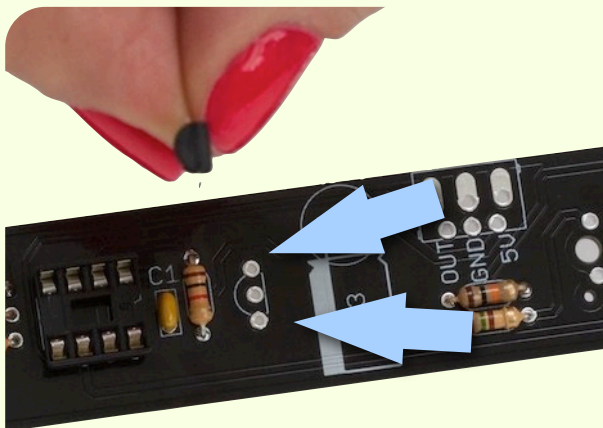
Solder the socket in place. You can use a piece of masking tape to hold the socket in place while soldering.



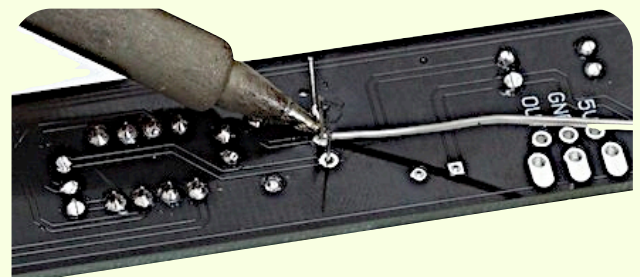
## Transistor preparation

Cut the 3 leg transistor from the tape. Look at it, and note that there is a rounded side as well as a flat side to the body. This is important for the next step.

Line up the transistor so that the flat side matches the white printed outline on the PCB.

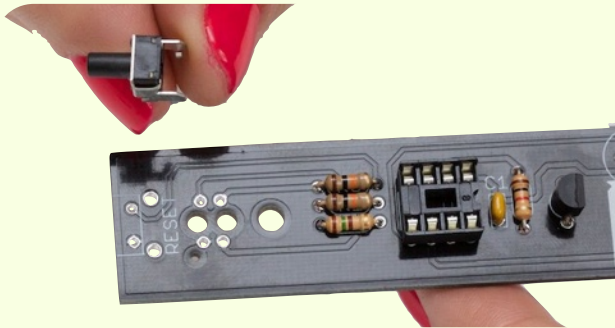


Solder the transistor in place.



## The calibrate / wake button

Line up the button over the PCB.

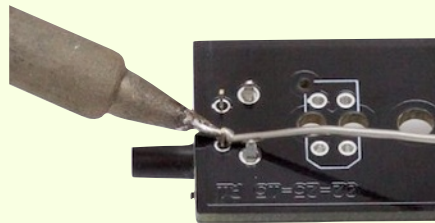


Mount the right angle button to the PCB.  
Note: The button has 4 legs.



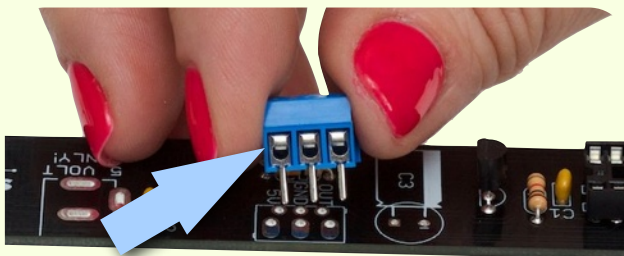
The button will hold itself in place. Make sure the button is flush to the surface of the PCB.

Solder the 4 legs, and trim the excess.

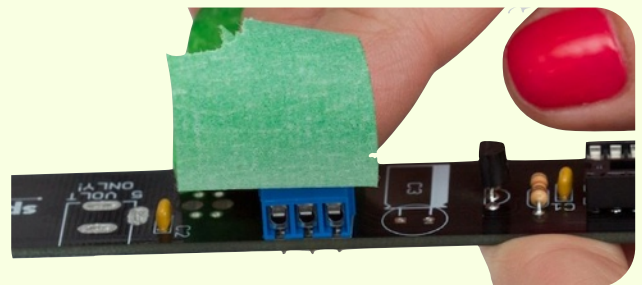


## Screw terminal block

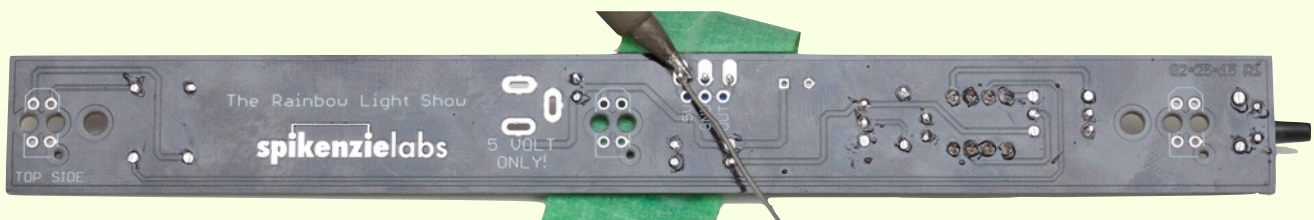
Place the 3 pin screw terminal block over the PCB.  
Note the orientation of the wire connect holes.



Slide the 3 pins through the holes. Hold in place with a piece of masking tape.

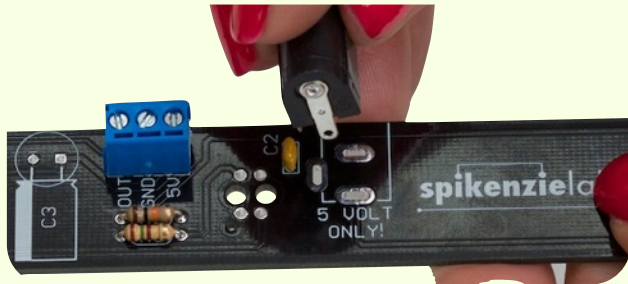


Solder the 3 pin screw terminal block in place.



## DC barrel jack installation

Place the DC barrel jack over the PCB.  
This can only be installed in one direction.



Slide the 3 tabs through the slots in the PCB, and  
hold in place with a piece of tape.

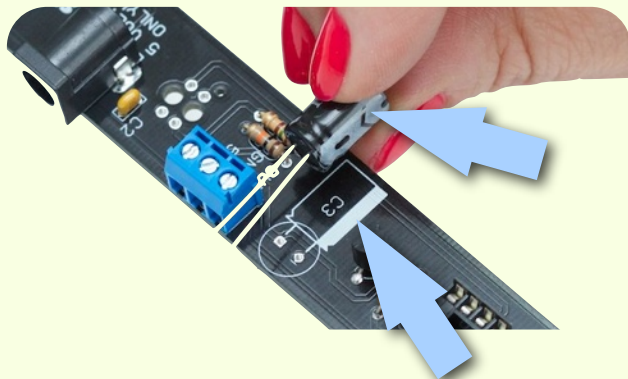


Solder the DC barrel jack in place.



## 220uf capacitor

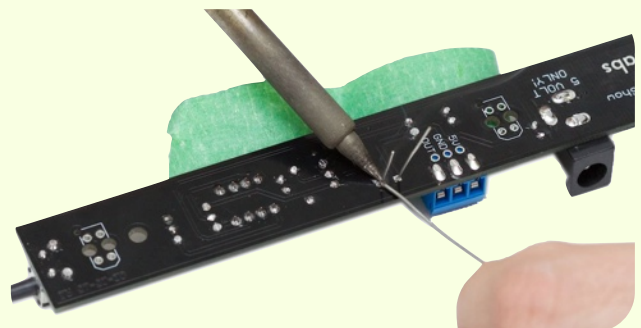
Line up the white indicator stripe on the body of  
the 220uf capacitor. Proper polarity is important  
for this component.



Insert the 2 legs, and lay the capacitor down like in  
this photo. Note the white stripe on the capacitor  
and the indicator on the PCB.



Hold the capacitor in place with a piece of tape,  
and solder both legs. Trim the excess.





The bottom of your PCB should now look like this:

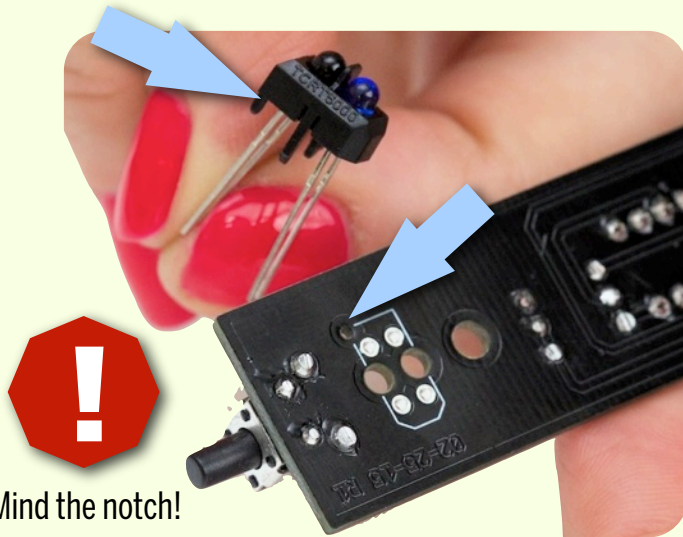


## IR Sensors

Next you will be installing the 3 IR sensors on the top side of the board, and soldering on the **bottom side**.

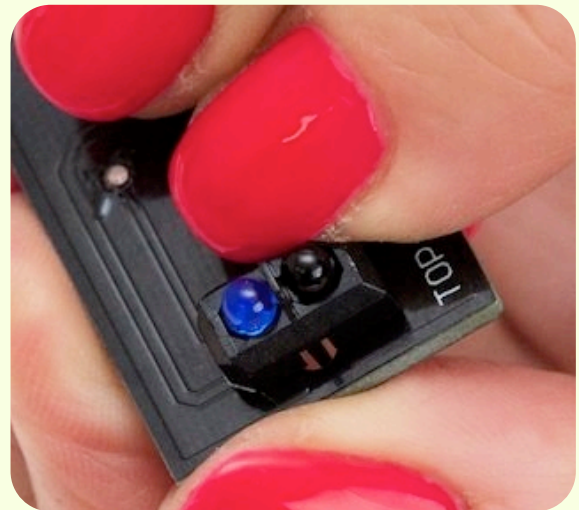
Note the corner insertion pin on the sensor. It fits inside the mount hole on the PCB. The body shape is also printed in white on the PCB for proper installation.

Slide the 4 legs through the PCB, and push the IR sensor all the way down. The insertion pin will mate with the hole in the PCB.



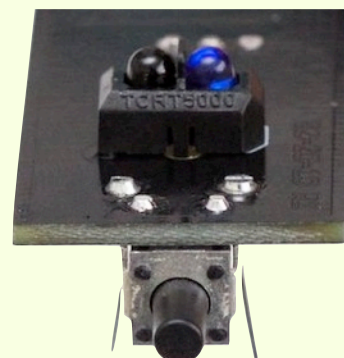
Mind the notch!

If the bottom of the IR sensor plastic housing has a deformity that stops it from laying flat on the PCB, trim the plastic with your snips, or a hobby knife.



Don't press on the 2 LEDs. Hold the sensor from the sides. If you press too hard on the leds they may break.

A properly mounted sensor should look like this before soldering.





Flare out the legs of the IR sensor as you have in previous steps.



Solder and trim the 4 legs for each of the sensors.



**Be Careful** when soldering the sensors on the already populated bottom side of the PCB. You don't want to accidentally burn any of the components. You may need to rotate the PCB to get a good angle for each of the 4 pins for each sensor.

## IC preparation

When manufactured, the legs are flared out slightly. To be mounted to the socket, the legs need to be closer to the body of the IC.

Remove the IC from the antistatic foam. Hold it firmly on either end, and press the legs down on a flat hard surface.

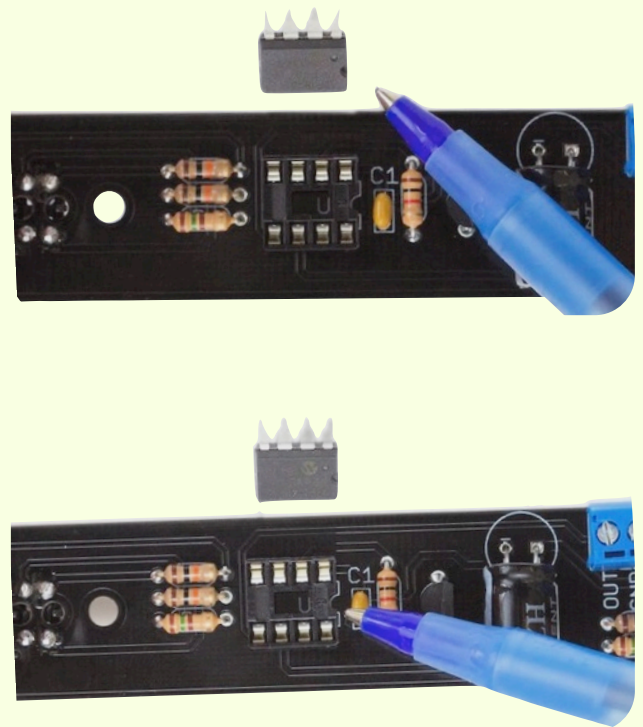
You can test fit it on the socket if you think you have them straight enough.



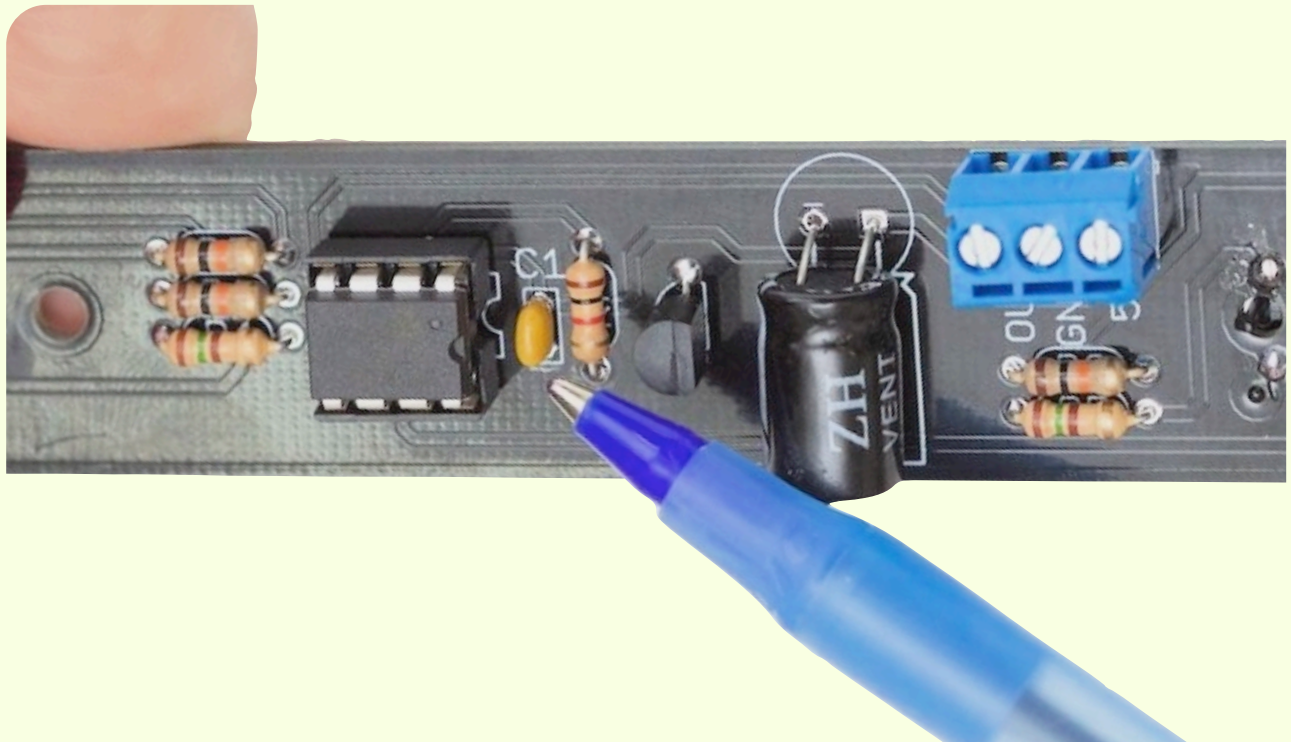
The IC, socket and PCB all have a notch indicating the correct orientation for the IC. Make sure they are all lined up. If you insert the chip in the wrong orientation, it will not work.



Mind the notch!

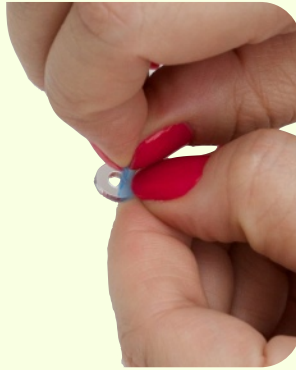


Place the IC over the socket. When you see that all of the legs are lined up, gently press down until it is seated flat against the socket..



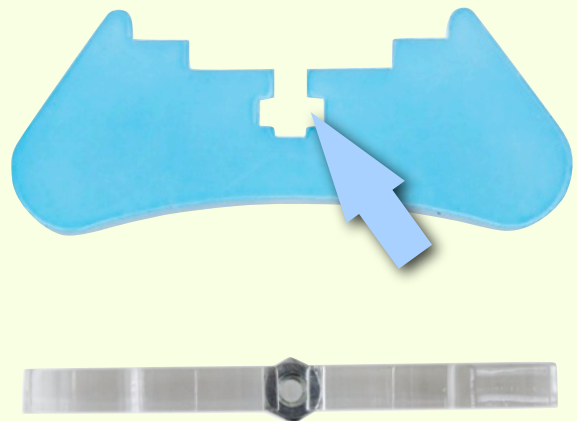
## Preparing the acrylic parts

Peel the protective plastic and paper from the 2 stands, washers and top bezel. For the pieces of paper that remain on the black acrylic, scratch at a corner with your fingernail, and then lift it away. Be careful not to scratch, bend or flex the acrylic. If the surface picks up fingerprints, we recommend cleaning acrylic surfaces with Windex, and a lint free cloth. Never use alcohol based cleaners on acrylic.



## The stands

Slide a nut into each stand. If the nut keeps sliding out the other side, you can put a small piece of masking tape on either side to hold it centered in place, until the screws are tight.



Place the fully populated PCB over the stands. Top side up. Center the screw holes directly over the center of each nut.



Place a washer over **both** of the screw holes on the PCB. Make sure that the nut has not slipped out. You will be able to see it if you look directly through the hole, from the top down.



Place the bezel over the PCB and washers. The 'reset' side of the bezel, goes over the button end of the PCB.



Slide a screw into each screw hole in the bezel. Slowly tighten each.

**Do not over tighten.** You may crack the acrylic.





Loosen the 3 flat blade screws of the screw terminal, about 4 turns each.

Line up the **Red** wire, with **5V**.

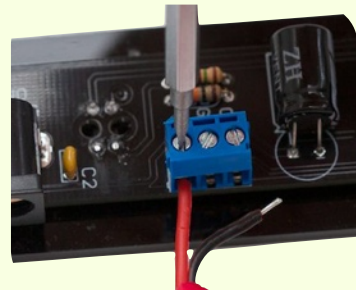
**Black** wire with **GND**.

**Yellow** wire with **OUT**.

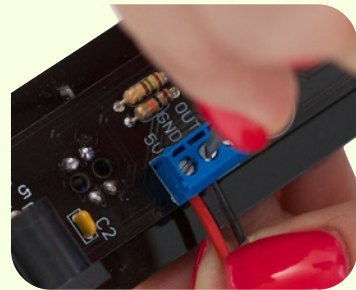
Double check to be sure this pattern is correct before connecting the AC adapter.



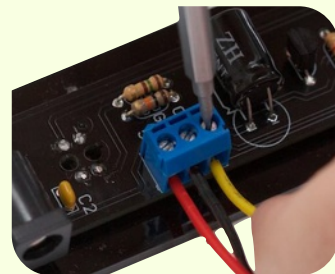
Insert and screw down the **Red** wire.



Insert and screw down the **Black** wire.

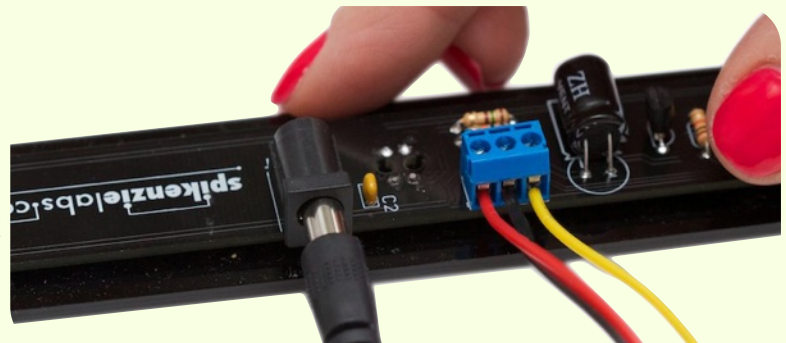


Insert and screw down the **Yellow** wire.



Plug in the AC adapter in to the wall, and then plug it in to the DC barrel jack.

**ONLY EVER USE THE SUPPLIED AC ADAPTER**  
**THIS DEVICE RUNS ON 5V DC ONLY**



## Quick Start:

In order to allow the RLS to produce nice smooth color transition and avoid false triggers we added a calibration function. When the RLS is first powered on (or awoken from sleep mode) the calibration function is run. At any time if you see random LEDs lighting up, (even when your hands are not near the RLS) simply press the "reset" button and the RLS will re-calibrate.

When recalibrating, do not stand too close to The Rainbow Light Show or put a hand over any of the sensors. The best way is to place you left index finger to the left of the left stand and use your right index finger to press the reset button on the lower right hand side of the RLS.

After 30 seconds of inactivity, The Rainbow Light Show will go to sleep. To wake it up, simply press the reset button in the same way you would to recalibrate it.



## The Rainbow Light Show • How it works

### What is the RLS?

The RLS is based on our SPLixel LED driver, that is, a microprocessor that is specially programmed to light up addressable RGB (Red, Blue and Green) LEDs.

We modified the SPLixel programming for the RLS to read three sensors and use those readings to produce an intensity of red, green and blue light on a LED. Using a shifting algorithm, the colors displayed from the first LED are shifted to the second and then to the third and so on, all the way up to 64 LEDs.

### **How it works:**

The RLS has three sensors. These sensors are IR (infrared) light proximity sensors. On each sensor there are two parts. The first part is an IR LED, that is shining a beam of IR light upward. The IR beam is invisible to the naked eye. If you look through your phone's camera you may be able to see it. The second part is a phototransistor. When the phototransistor is exposed to IR light it allows a current to pass through.

Since both the IR LED and IR phototransistor are pointed upwards on the RLS, we need something to reflect the IR light back into the phototransistor. This is where your hand comes in! When you bring a hand closer to the RLS's sensors more IR light is reflected back into the phototransistor and more current passes through. The microprocessor then reads an analog (read a variable) voltage produced due to the changing current flowing through the phototransistor. It does this for all three sensors and it uses these varying voltages to decide how bright to light up the red, green and blue channels of each LED.

### **Calibration:**

Did you know that your TV remote also uses IR light? So that your TV does not change channels by itself, TV manufacturers use a special type of phototransistor that only works when a specific frequency of IR light is received (typically 38 - 40 kHz). The TV remote is actually flashing an IR signal to the TV!

The type of IR proximity sensors used in the RLS do not have any special filtering. They can pick up stray IR light from other sources. This will make a series of random colors flow along on your RLS LEDs. We chose not to use IR phototransistors with filtering, since all the models that we tested were either excessively expensive or did not work well to produce a nice smooth analog voltage.

In order to allow the RLS to produce nice smooth color transition and avoid false triggers we added a calibration function. When the RLS is first powered on (or awoken from sleep mode) the calibration function is run and at any time if you see random LEDs lighting up, (even when your hands are not near the RLS) simply press the "reset" button and the RLS will re-calibrate.

### **How to Calibrate your RLS:**

As lighting changes or people move around causing both reflections or shadows you may have to recalibrate your RLS. Remember, IR light is invisible to your eyes so even if you don't see the "light" changing, light on the IR spectrum may have changed.

When the RLS does a recalibration, it turns off the three IR LEDs on the sensors and then reads the value of IR light coming in. It is important the RLS be able to see all of the ambient IR light while it is recalibrating. So, it is important that you do not stand too close to it or put a hand over any sensor while recalibrating. The best way is to place your left index finger to the left of the left stand and use your right index finger to press the reset button on the lower right hand side of the RLS.

When the RLS does a recalibration it reads the intensity of IR light coming in. It then adds a safety cut-off value to this reading and will then ignore any IR reading that is below this threshold. What this means for you, is that your RLS will work in many different lighting conditions. It prefers to be used in areas that are not too bright. Also, when the RLS is calibrated in a bright area, the threshold is set much higher, so in fact the RLS will be less sensitive to your hand. This means that your hand will have to be closer to the top of the RLS before it starts to produce colors.