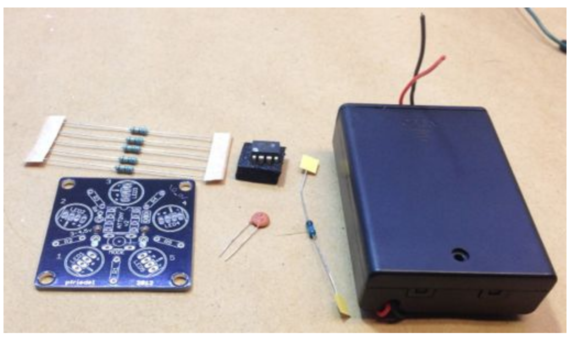
Tiny RGB Build Instructions

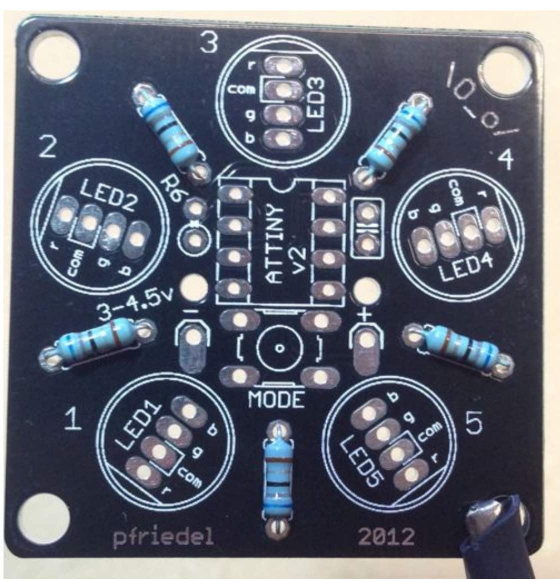
PARTS LIST:

Quantity	Name	Location	Description
1	Circuit Board	-	
5	10mm Common Anode RGB LEDs	LED1-LED5	
5	68 Ω resistors	R1-R5	blue - gray - black - silver - brown
1	10k Ω resistor	R6	brown - black - black - red - brown
1	100 nF capacitor	-	Labeled “104”
1	8 pin socket	ATTINY	
1	ATtiny85	ATTINY	ATTINY85-20PU
1	Tact Switch	MODE	6 x 6 x 15 mm
1	3 x AA Battery Box		

BUILD INSTRUCTIONS:



1.The contents of the kit - the circuit board, five 68 ohm resistors on a strip, a solitary 10k resistor, the 100 nF capacitor, the microcontroller in a piece of foam and the battery box. The LEDs, socket and tact switch are all inside the battery compartment.

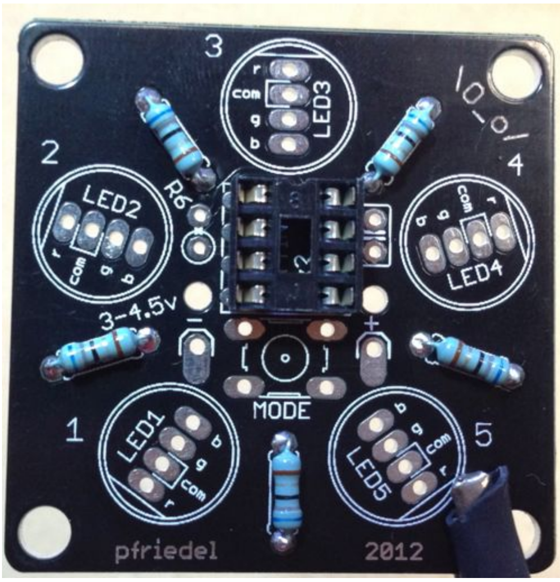


2. First insert all five 68 Ω resistors in positions R1 through R5 as shown. Flip the circuit board over and solder them and clip the excess leads once they’re soldered. Resistors don’t have any polarity, so you can insert them in either direction.

The 68 Ω resistor looks like this:

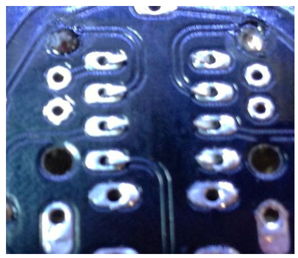
These resistors act as current limiters for the LEDs. If you swap them for ones with smaller values, the first thing that tends to happen is the microcontroller goes into a constant state of reset. If you let it happen for long enough, you could also burn out the microcontroller or possibly damage an LED. As this is voltage sensitive, if you intend on using this from a 3v source, you can get away with smaller resistors - 27 Ω is comfortable for 3v for example. 68 Ω is plenty for 4.5v.

3. Open the battery box and remove the parts. You'll need the 8 pin socket for the next step, so retrieve it and set the other parts aside.

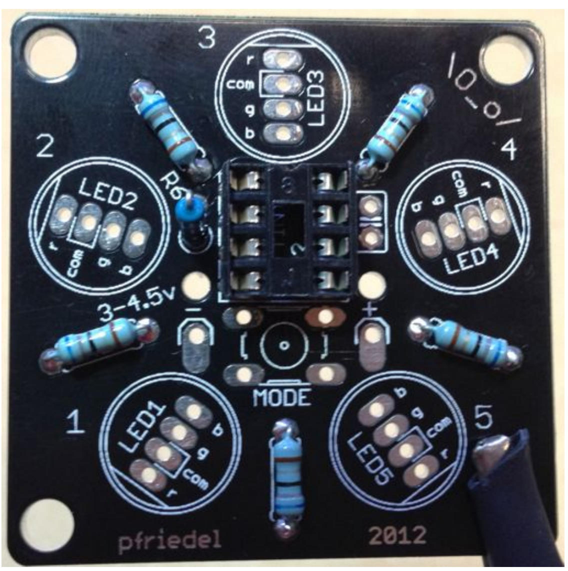


4.Insert the 8 pin socket in the spot labeled ATTINY. Make sure the little cutout in the socket matches the cutout on the silkscreen

While it isn't strictly necessary, I find that it helps to fold over the socket legs on the other side of the board. Since the power lines run right along here, it helps to reduce the number of points that can stab through the power leads.



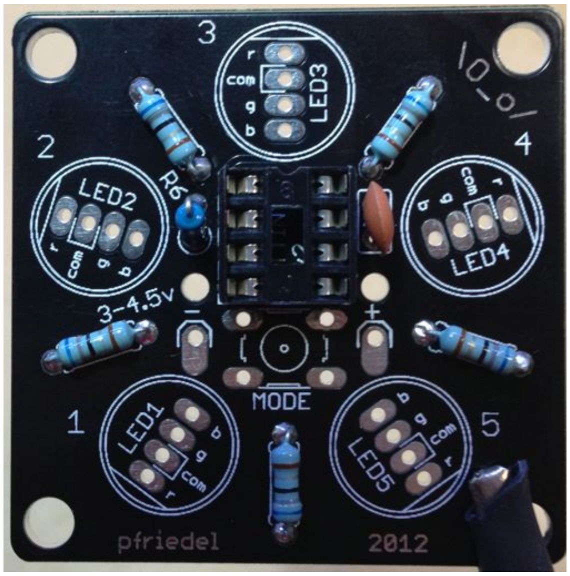
Solder the socket in place. Since the leads are so short, you usually don't need to trim them, and if you fold them over you definitely won't be able to.



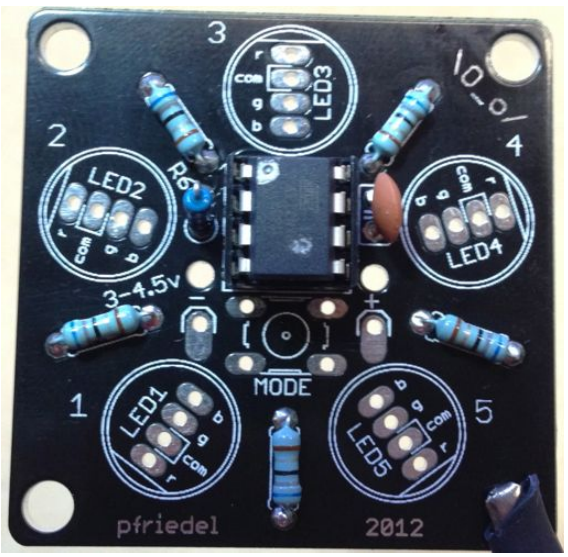
5. Insert the remaining 10k Ω resistor in the spot marked R6. You'll have to fold the resistor in half like so to get it into the holes.

Once you have it in place, solder it and clip the leads again. It doesn't matter if you fit the resistor body up against the circle on the silkscreen, that's merely an aesthetic choice.

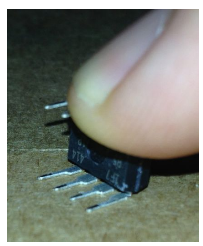
This resistor acts as a pull-up for the reset pin and helps prevent noise from generating an unintended reset.

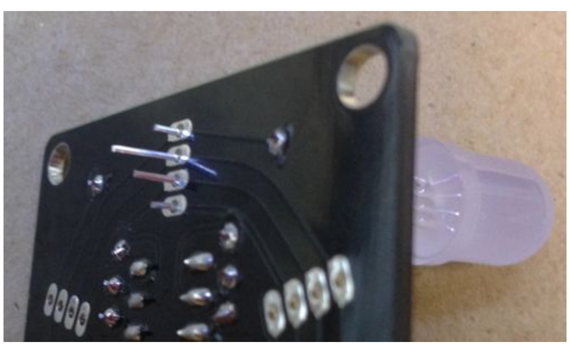


6.Insert the 100 nF capacitor marked “104” in the holes on the opposite side of the socket. Solder it into place and clip the leads. Ceramic capacitors like this aren’t polarized, so it doesn’t matter which lead goes into which hole. This capacitor acts as a noise filter from the high frequency noise that the circuit can generate. Each LED will get turned on and off at a high rate, and every time the LED is turned on and off, the current draw from the battery is changed - this capacitor acts as a buffer for those changes.

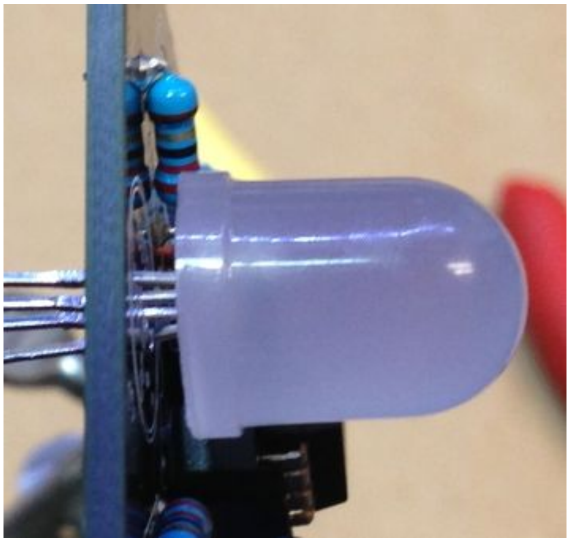


7.Now you should insert the ATtiny85 microcontroller in the socket. I’ve put a little silver paint dot indicating which pin is pin 1 on the microcontroller. This should be on the same side as the cutout in the socket. If you inserted the socket backwards, don’t worry, just make sure that the microcontroller is oriented correctly. When you receive the microcontroller, its legs will be splayed a bit. In order to get the chip in the socket, you will need to bend the legs in so they are parallel. With 8 pin chips such as the ATtiny85, you can usually just gently squeeze them between your fingers, but if you aren’t comfortable doing that, you can also use your bench top to flatten them like so:





8. Now you will need to insert and solder the LEDs. The LEDs are polarized, which means that it’s important you get the right legs into the right holes. You’ll notice that the holes are all marked “r”, “com”, “g” and “b” - those line up with the legs of the LEDs. Insert the longest leg into the “com” hole and the next longest leg into the “g” hole. Feed the next two legs into the “r” and “b” holes, then gently push the LED into place. As you start, the legs will look like the picture to the left.

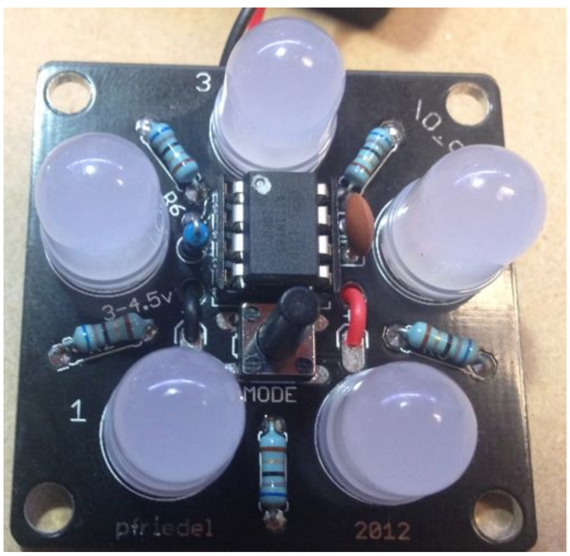


If you look carefully at the legs you'll see a section where they're slightly flatter than the rest of the leg. Your goal will be to get the led seated far enough that the shoulder of those flat spots is just through the circuit board. The LED will not be seated flat to the board - it will look like the picture to the left. Solder one of the legs and then look at the LED carefully and try to make it as square to the board as you can. Once you're happy with the LED's position, you can solder in the other 3 legs. Be gentle with the LEDs during this step - if you push too hard, you could rip the leg right out of the LED which would ruin the LED. Once you've soldered all 20 legs, clip the legs flush to the board.

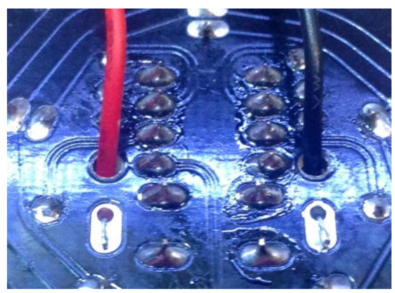
9. Once you're done with the LEDs, your board should look like this. Insert the tact switch in the board - it's slightly rectangular, so it should only want to snap in to the board one way. If in doubt, the silver legs come off of the left and right side of the switch. If you get this rotated 90 degrees off, the reset button will be constantly depressed, and the microcontroller won't start to run the program.

10. At this point, the controller board is done. If you want to power it from a USB cable, you should be able to power it directly to the negative and positive terminals on the board. If you want to power it from the included battery box, follow along on the next page.

11. Thread the black negative lead up from the back of the board to the front of the board and do the same for the red positive lead. Adjust the length of the wires so there isn't too much extra loose wire. At this point I usually try to make a mark on the wire where it passes over the hole and where it passes over the lower bound of the solder pad. Then I unthread the wire and trim it to length with a wire cutter and strip back the insulation and tin the exposed wire.



12.Once you have trimmed and tinned the battery wires, thread them up from the back of the board again and loop them over to the solder pads as shown on the left.



The back of the board should look like this. Solder the wires into place and tighten the excess from the front. Attach the board to the battery box with double sided sticky tape or hot glue. The board is now finished. Insert batteries and flip the power switch and it should start from mode 1.

DISPLAY MODES:

Each time you hit the MODE button, the board will advance modes. The board will tell you which mode you are entering by lighting up the LED associated with that mode which is next to a number on the board. 1-5 are indicated by red LEDs while 6-10 are indicated by green LEDs.

1. A slow walk through all the hues of the color spectrum.
2. A faster walk through the color hues.
3. Even faster than #2.
4. A slow progression with every color mapped one to one to LEDs. While mMode 6odes 1-3 work with a wide virtual LED space, this mode and the next one work only with the physical LEDs.
5. A faster version of #4.
6. Random colors at random positions, changing every second or so.
7. Bouncing up and down in hue saturations, slowly walking through hues.
8. The same as #7, with a faster hue progression.
9. Displays the red, green and blue LEDs directly without mixing. Useful for spotting a bad LED.
10. Randomly selects any of the prior 9 modes and displays it for 5 minutes before selecting the next mode.

The system will automatically enter a low power sleep mode after 4 hours of modes 1-9, but mode 10 will run until the batteries run down. If you hit the MODE button, the system will wake up and resume the running the previous mode for another 4 hours. If you hit the MODE button again while it is still indicating which mode it is about to enter, it will advance to the next mode.

The low power mode is drawing just under 2 μA, so the power switch isn't strictly necessary - 2 μA is on the order of the battery's self discharge rate.

In normal use the board draws about 20 mA - I've had a set of standard alkaline cells powering one nonstop for over 128 hours now with only minimal loss of brightness. As the batteries die, the LEDs will slowly start to fade and each color will start to fail one by one.

SOURCE CODE:

The software repository for this project is at https://github.com/pfriedel/TinyFiveCircle

Any questions? Mail me - pfriedel@compulsive.net.