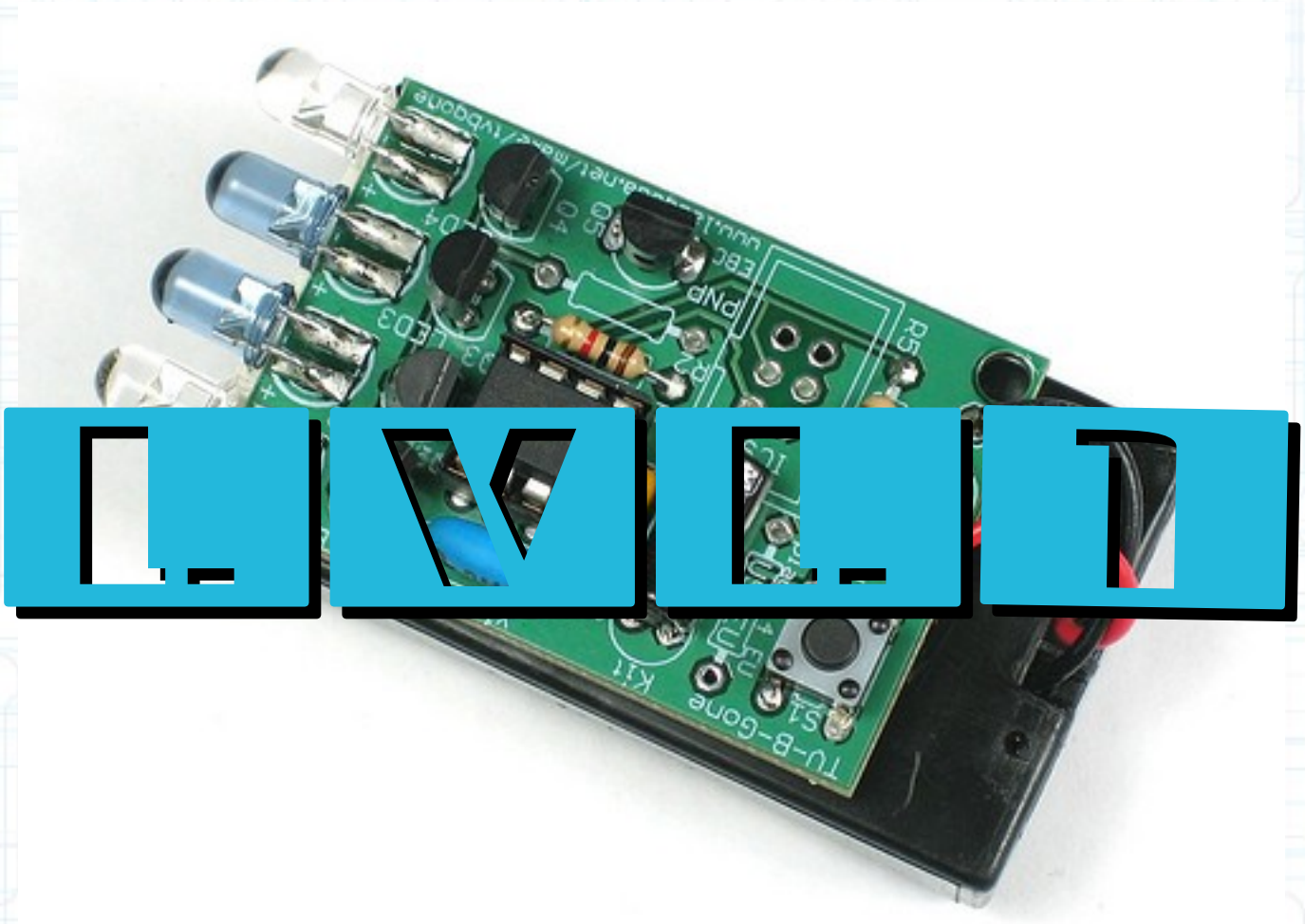
TV-B-Gone



Welcome!

Welcome to the LVL1 TV-B-Gone workshop. We will be covering the following:

- How the TV-B-Gone works
- Basic soldering technique
- Component identification
- Construction of a Super TV-B-Gone

About LVL1

- We are a Louisville makerspace and/or hackerspace initiative (depending on who you ask).
- We are incorporated as a legal entity (pending 501(c)3 status). We have a bank account, bylaws and officers. We are collecting dues from members and we put together workshops like these.

LVL1 Vision

LVL1's mission is to provide a shared space for collaborative technical and artistic experimentation in the Louisville area. We are a non-profit organization following the hackerspace model currently flourishing in cities all over the world. Our goal is to create an open workspace where engineers, artists and educators can meet and collaborate. LVL1 is where we begin making amazing things.

What is LVL1 about?

- Above all else, it's about having FUN
- People bring in all kinds of cool projects; get inspired and learn from them.
- We collaborate on creative tech projects.
- We are a community that teaches each other about diverse tech related topics.

Say hello to your neighbors

- They will be your strongest allies.
- Check with each other before soldering components. This is the best way to AVOID MISTAKES!

About the Super TV-B-Gone

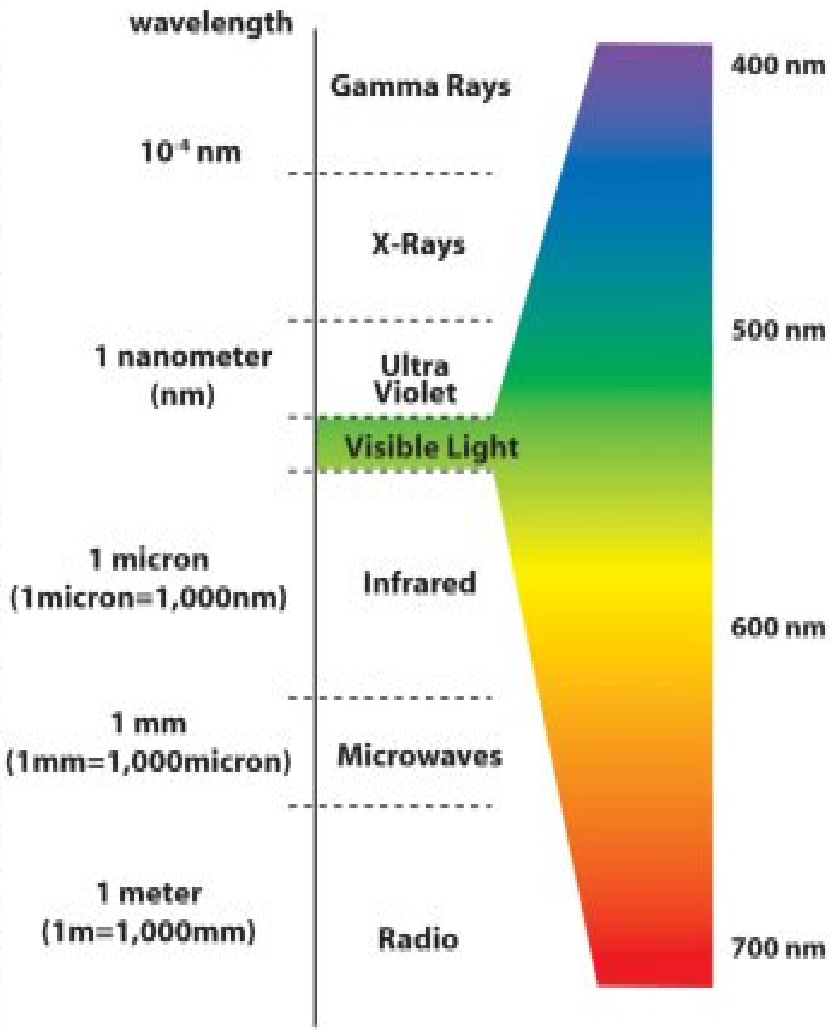
The Super TV-B-Gone is a 'Universal Remote Control' device for TVs, with only one function: 'On/Off'. It's programmed with over 230 common TV power codes.

About Super TV-B-Gone (cont.)

- Original TV-B-Gone invented by Mitch Altman.
- The Super TV-B-Gone kit was developed by limor fried of Adafruit Industries in collaboration with Mitch Altman.
- Kits are pre-programmed with TV power codes, but can be reprogrammed with updated or alternate code.

About Super TV-B-Gone (cont.)

Infrared Light

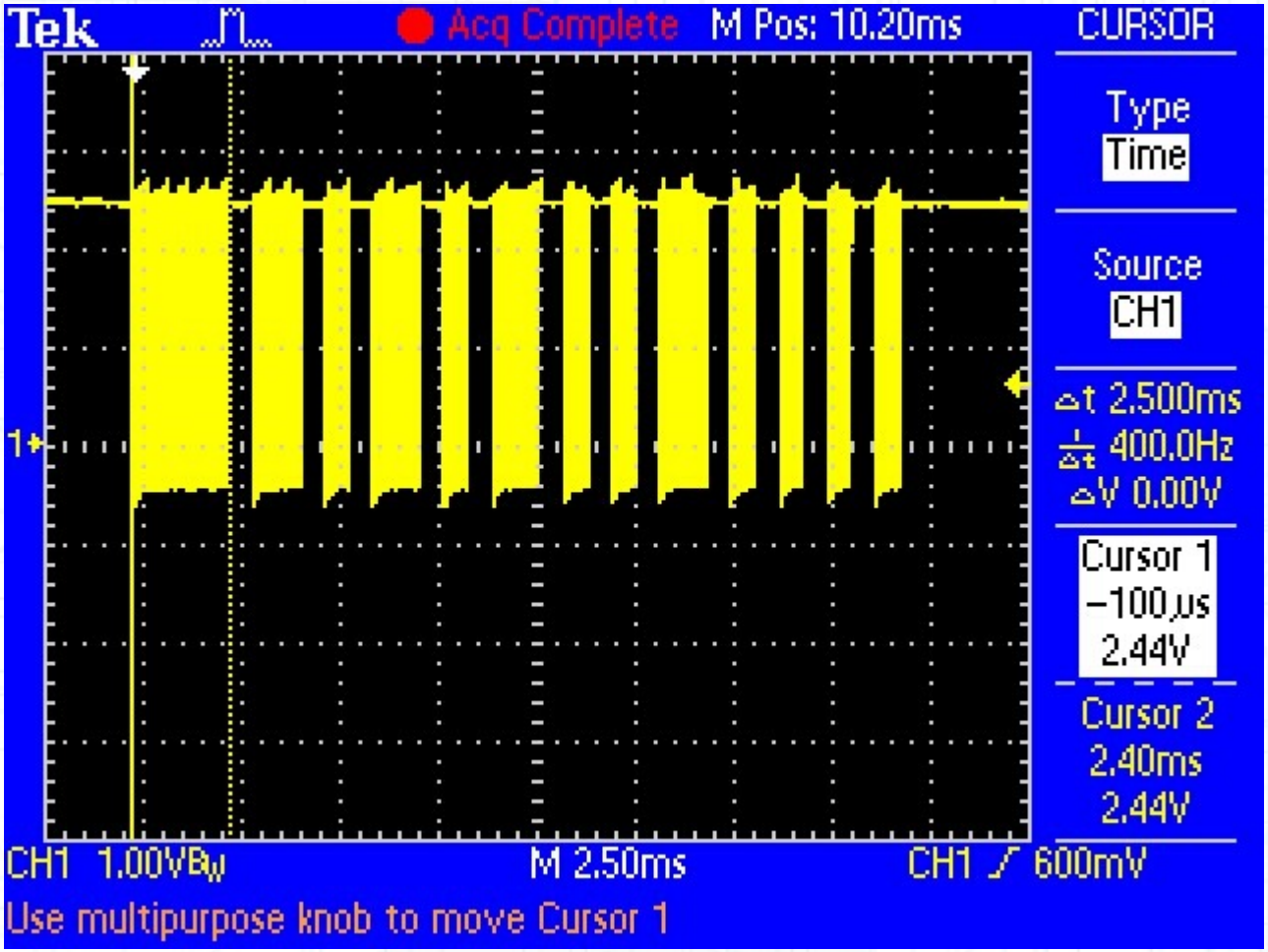


- Infrared light has a longer wavelength than visible light.
- It is invisible to the human eye.
- Infrared LEDs are cheap and very available.

Remote Control Devices

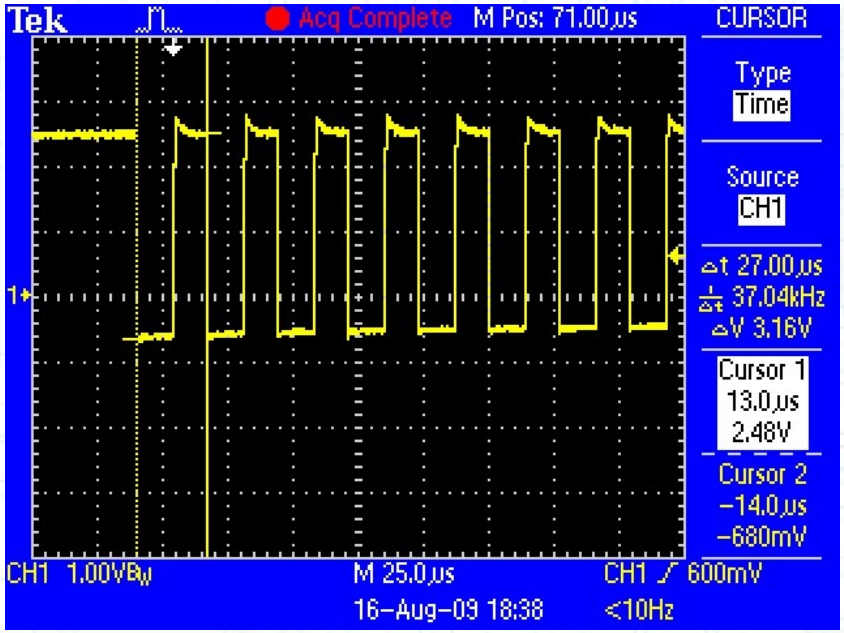
- Consumer electronic devices (Tvs, stereos, DVD players, etc) detect infrared pulses.
- Remote controls emit infrared pulses.
- Unique IR pulse codes control unique functions such as On/Off, Channel, Volume, etc.

What IR codes look like...



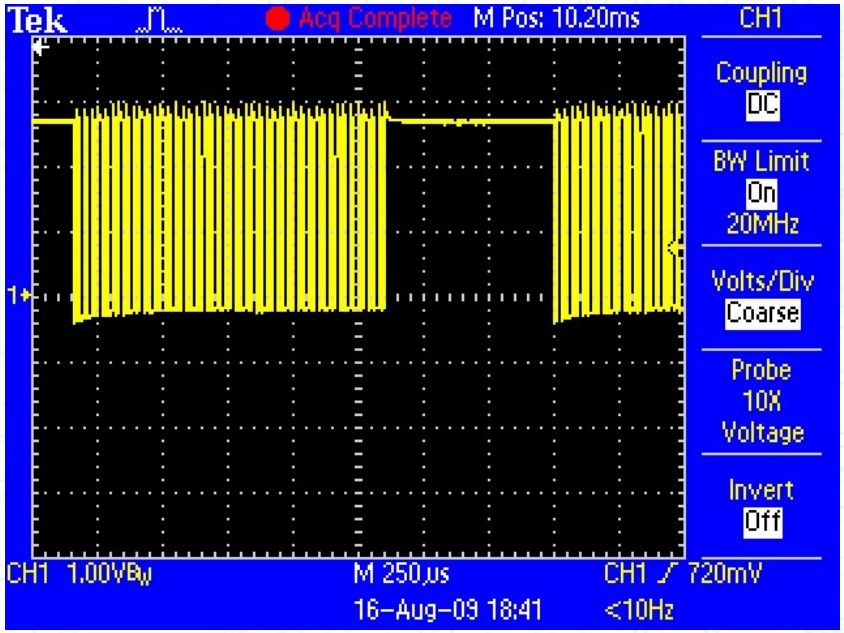
IR codes continued...

- If you zoom in, these blocks are actually very fast Pulse Wave Modulation signals.
- The IR LEDs are pulsing on/off very fast to transmit bursts of PWM signals.



IR codes continued...

- So these longer pulses are composed of blocks of carrier frequency PWM.
- Big pulses can be around 2.5ms for example.
- The carrier PWM is in the KHz range. 99% of TVs use 38KHz



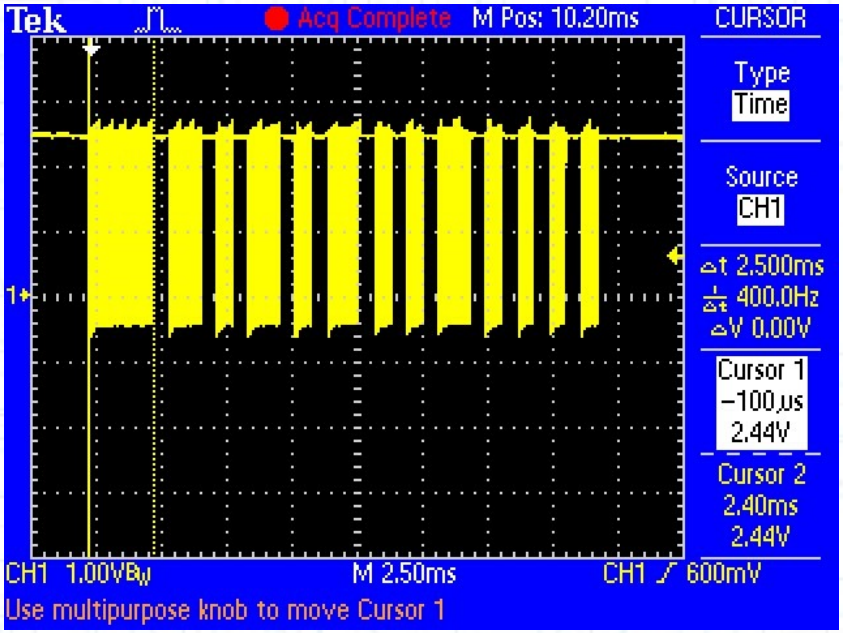
Why not just turn the IR LED on/off?

- Most importantly, you reduce the effects of ambient lighting. TVs are only looking for changes in light levels that clock at say, the 38KHz range. More on this in a minute.
- Codes are distinguishable so a Sony TV at 38KHz won't respond to codes of a JVC DVD player at 50KHz.
- The PWM allows the LEDs to 'cool off' as they aren't designed to hold their on state at large currents.

A Ridiculous Analogy...

- Humans can interpret sound frequencies as musical notes.
- Say the whole human race responds to signals in B flat.
- 5 short notes in 1 second in B flat will make me fall asleep.
- 8 bursts of B flat makes a human fall asleep.
- But dogs will ignore signals in B flat and only respond to signals in D.

Back to the codes...



- So the duration and sequence of these PWM bursts create the codes that TVs will listen to.
- It's similar to morse code with dots, dashes and (important) silence.

Sample Sony Pulse Code

PWM ON	OFF
2.4 ms	0.6 ms
1.2 ms	0.6 ms
0.6 ms	0.6 ms
1.2 ms	0.6 ms
0.6 ms	0.6 ms
1.2 ms	0.6 ms
0.6 ms	0.6 ms
0.6 ms	0.6 ms
1.2 ms	0.6 ms
0.6 ms	0.6 ms
0.6 ms	0.6 ms
0.6 ms	0.6 ms
0.6 ms	270 ms

Your TV-B-Gone has many codes!

- Your Super TV-B-Gone contains tons of these codes for all kinds of manufacturers.
- It loops though it's entire database very rapidly shooting out the codes.
- Any TV in range that recognizes it's own power code will dutifully turn itself off.
- These same codes will also turn the TV on!

Soldering Iron

- Used to transfer heat to components intended to be soldered together.
- Higher wattage can transfer more heat.

Solder

- Low melting temp
- Conductive
- Fusable Alloy
- Tin/Lead - Rosin Flux mix
- Rosin improves electrical conductivity and mechanical strength.

Avoid Common Soldering Mistakes

- Use the soldering iron to transfer heat to ALL components needing to be joined together.
  - Don't 'carry' solder to the components. Don't melt solder on the iron, melt solder on the components leads / vias.
- Keep your tip CLEAN!
  - Use a sponge or pad to clean the tip. Use tip cleaner. Tin the tip with some solder.

Avoid Common Soldering Mistakes (cont.)

- Timing is everything.
  - It should only take a couple of seconds to heat up the components enough to melt solder. If you miss your window, stop for a second and let it cool off again. A heavy hand can melt and/or damage components.
- Avoid 'Cold Solder Joints'.
  - A dull blob of solder that doesn't flow around the joint is neither electrically conductive, nor mechanically strong.

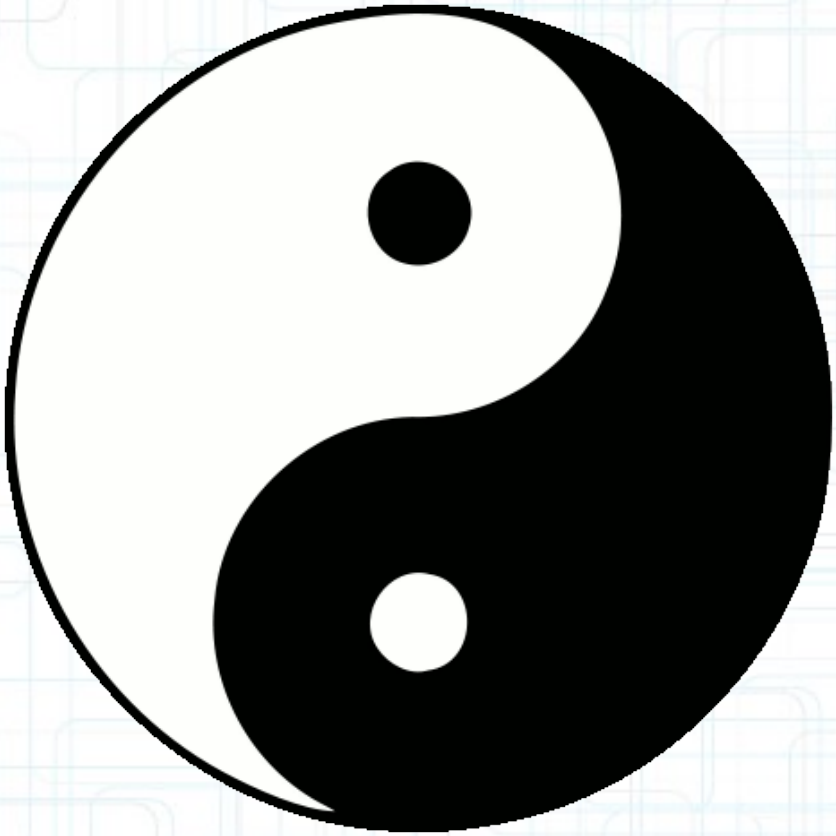
Soldering is a Manual Skill and you are not Neo

Soldering is a Manual Skill (cont.)

- Your hominid brain cannot master soldering by reading or otherwise 'downloading' information about correct techniques. It uses entirely different nerve pathways.
- You will only master soldering by actually soldering.
  - Like playing a guitar, or shooting an arrow, or removing an appendix.

You Will Make Mistakes

- An equally important skill is desoldering
- It is the yang to soldering, allowing you to undo what has been done.
- When you screw up, you can always desolder.

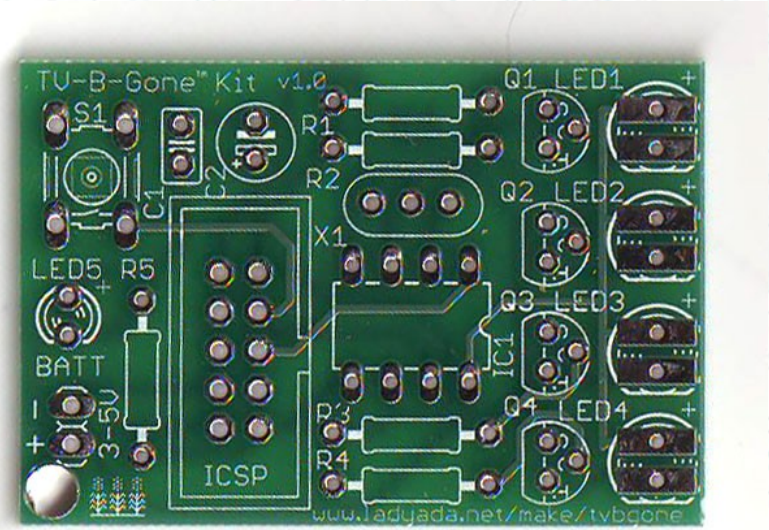


Desoldering

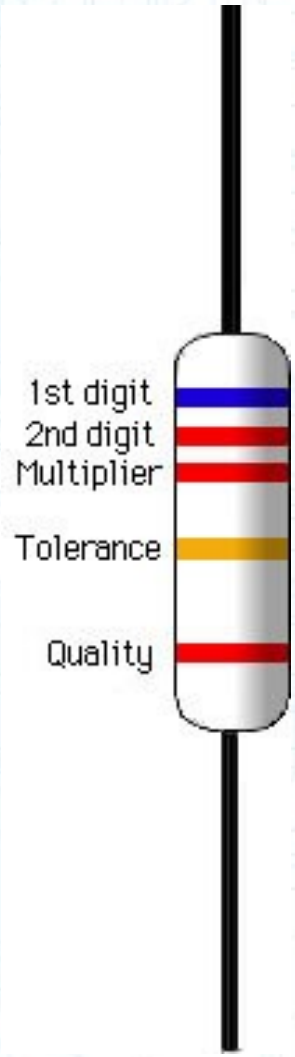
- Soldering wick does what it says.
- There are also soldering suction devices that will remove solder.

Components

- Resistors
- Capacitors
- LEDs
- Transistors
- Microcontroller
- Odds and Ends



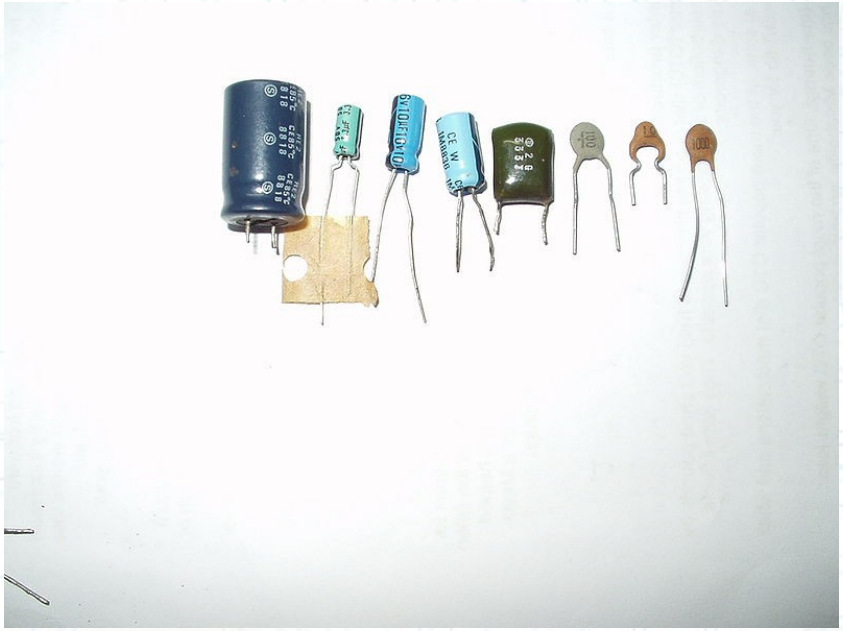
Resistors



- Color-coded bands tell you the ohm resistance value.
- Bend the leads after inserting into the PCB to keep them secure.

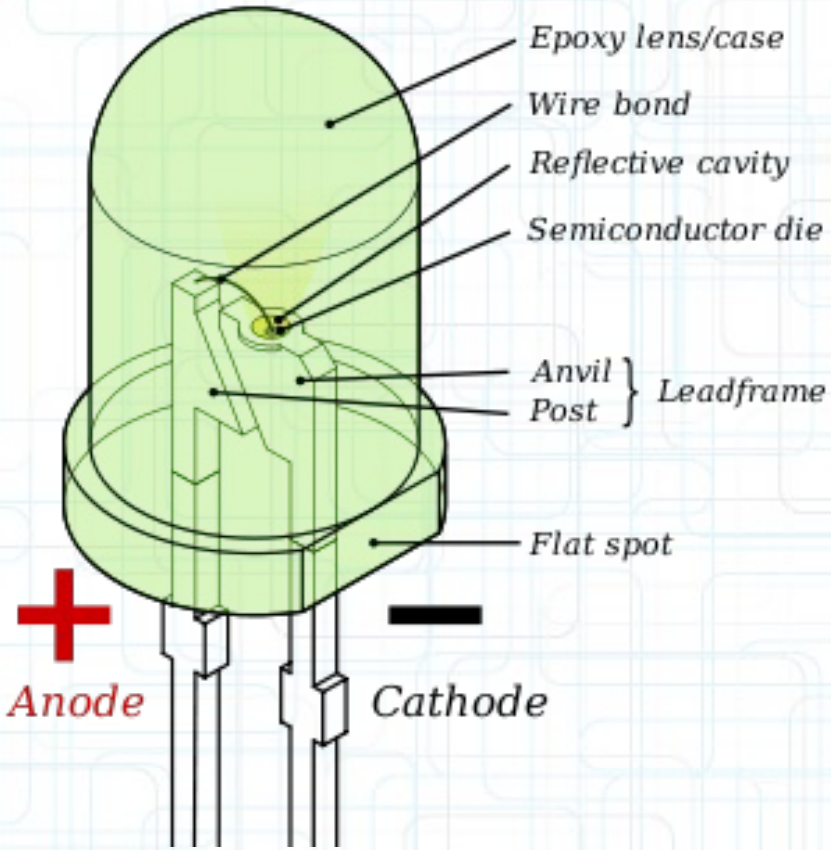
Capacitors

- Values are either labeled literally (on electrolytics) or 3-digit code (i.e. 101, 475)
- Electrolytic capacitors have polarity. Longer lead is ”+”.



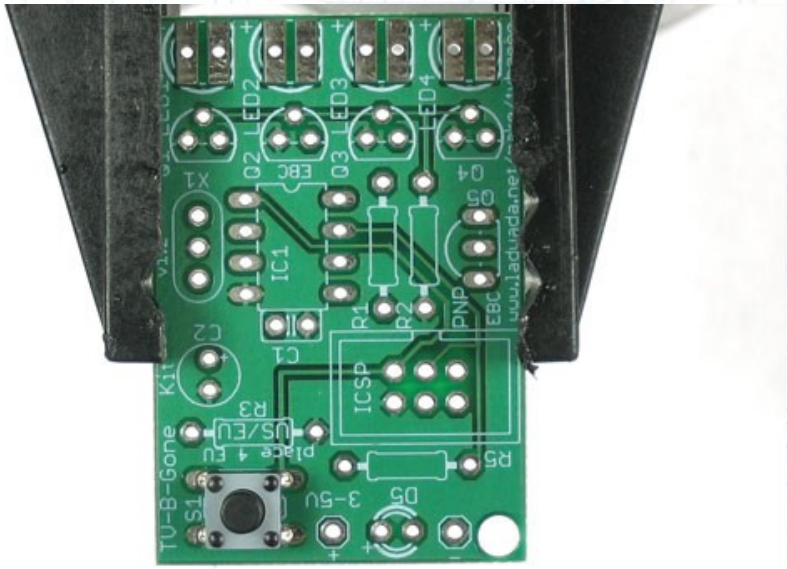
LEDs and other Diodes

- LED polarity is indicated by lead length. Longer lead is ”+”.
- Diode polarity is marked by a strip indicating ”+”. Match the PCB graphic.

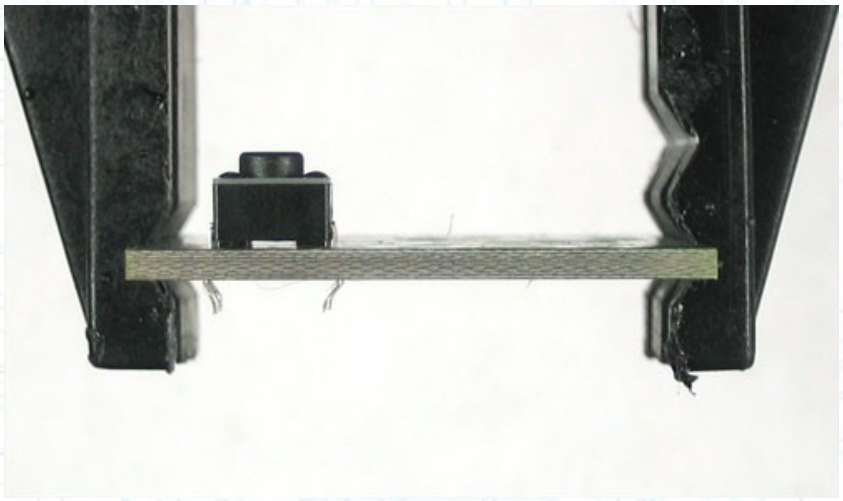


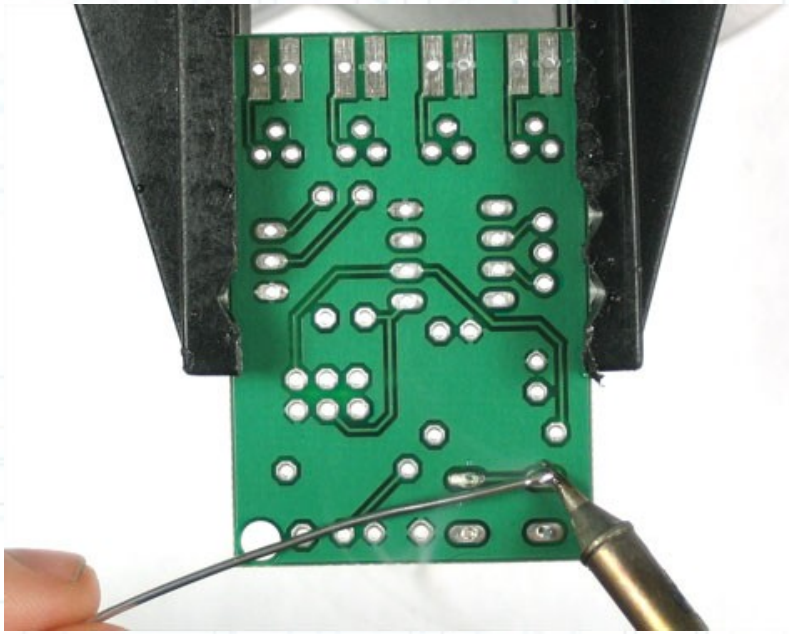
Time to Solder!

- Start with the button



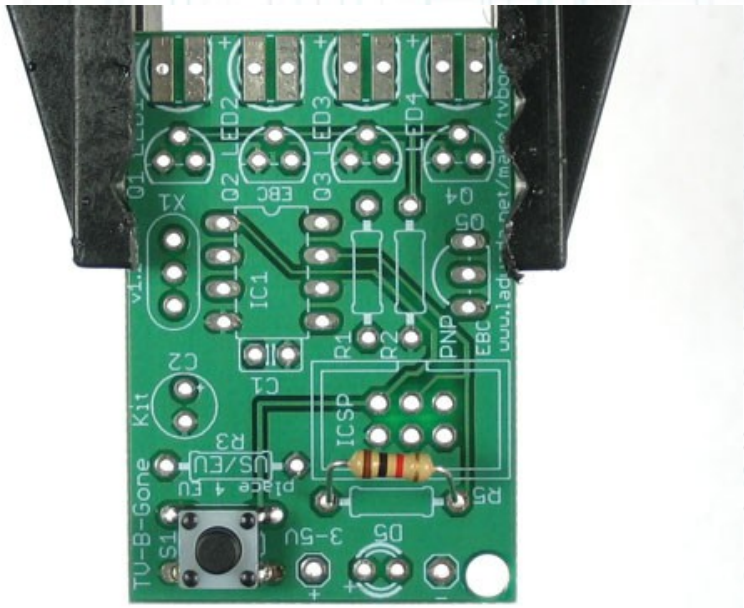
Button Soldering



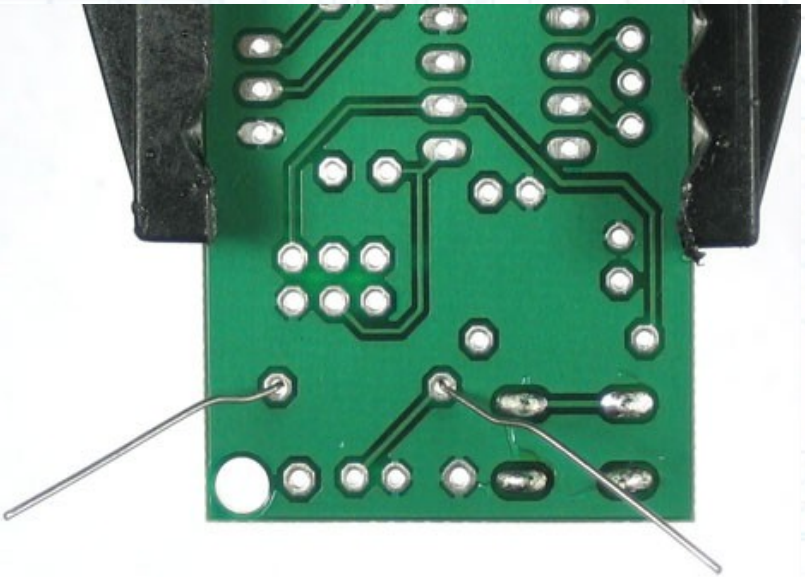


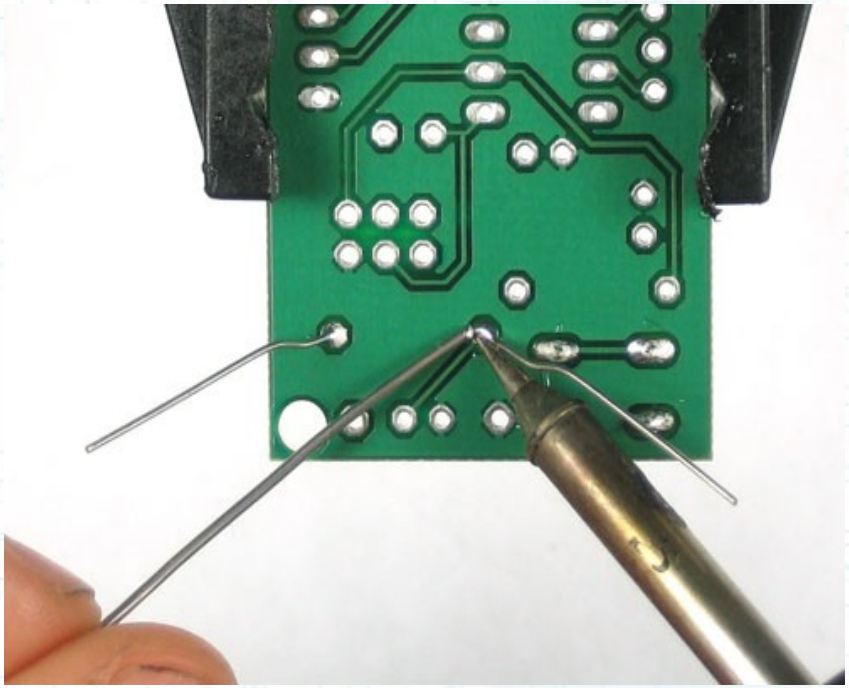
Resistor R5 1Kohm

- Brown-Black-Red
- e.g. 1 – 0 – 2(x100)
- = 1000 ohms

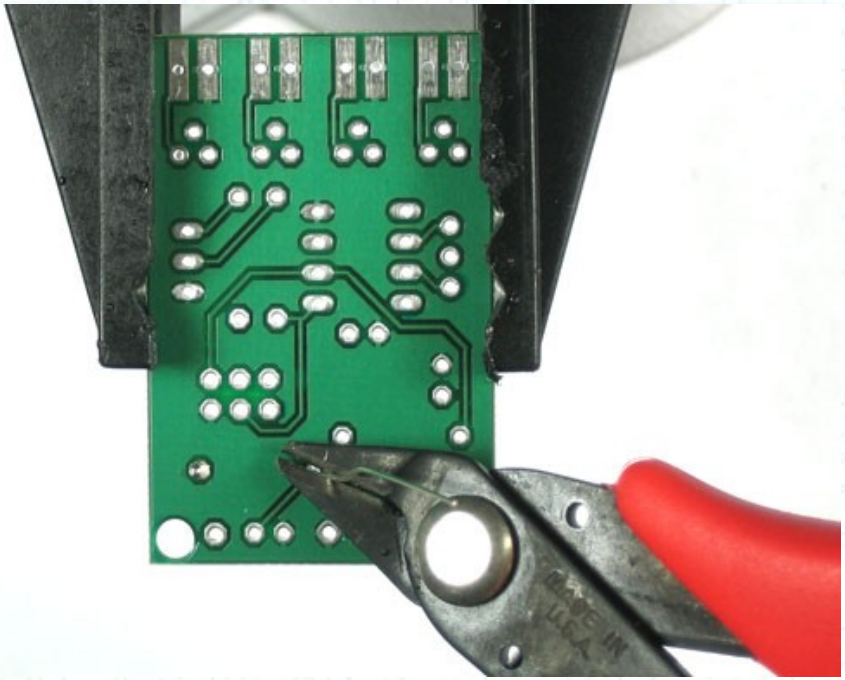


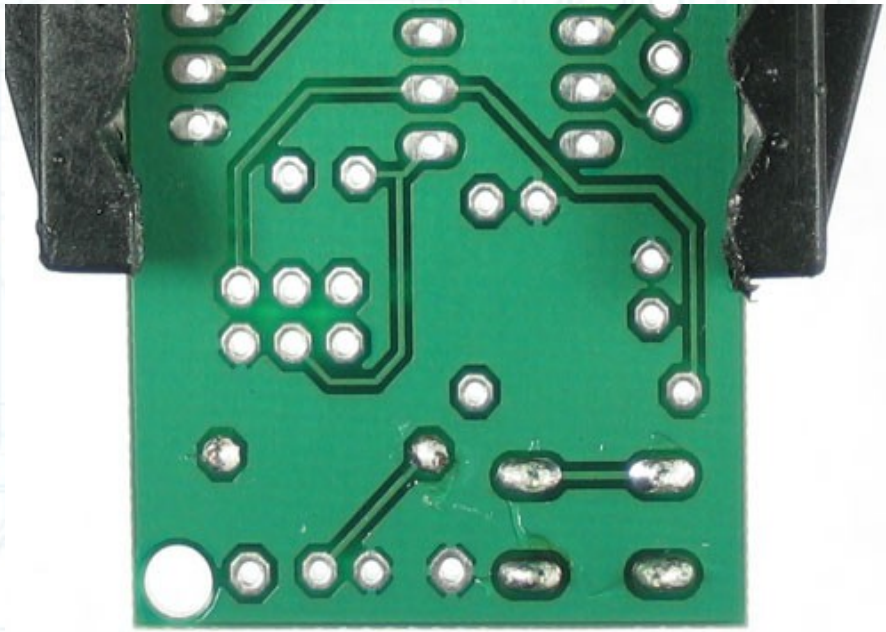
Soldering Resistor R5





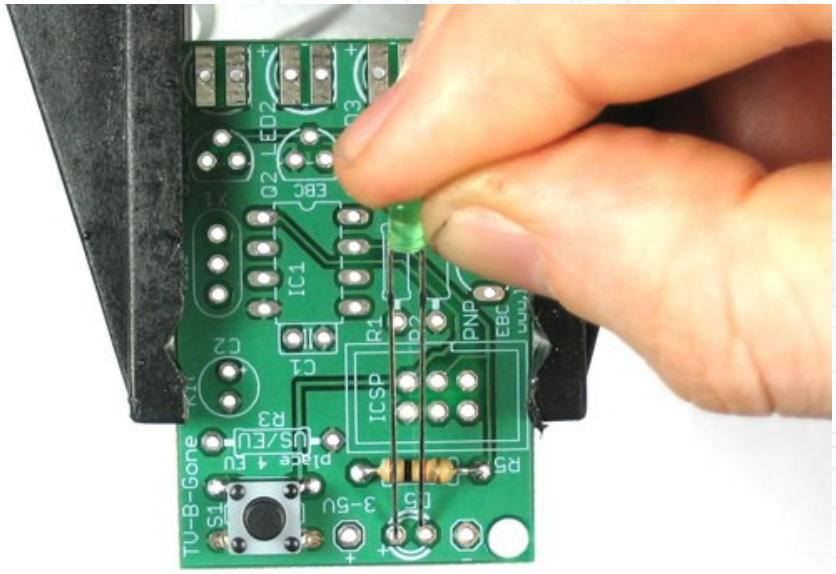
Finishing Resistor R5



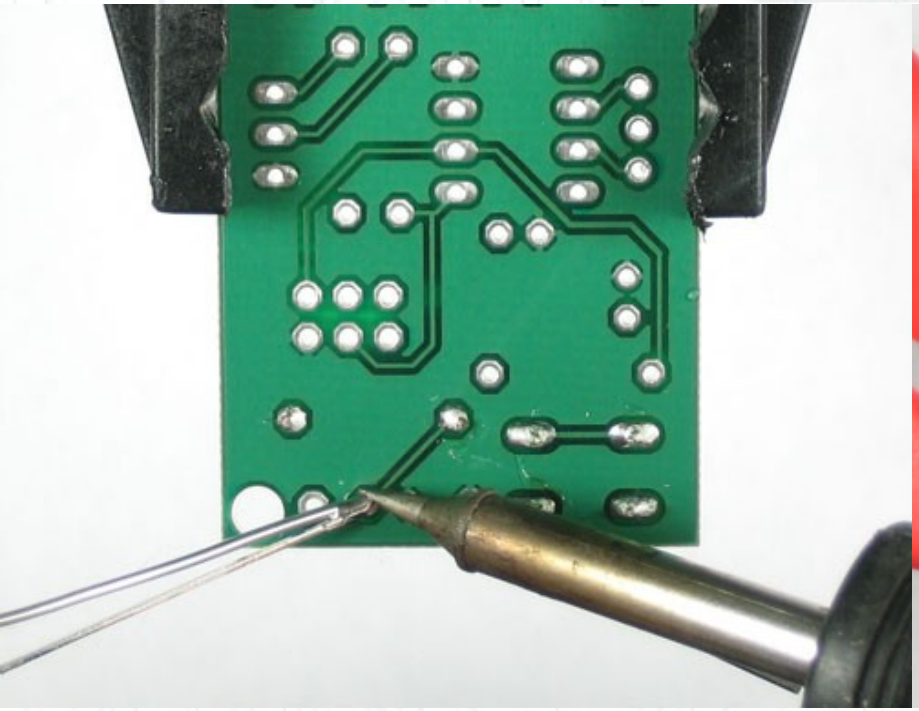


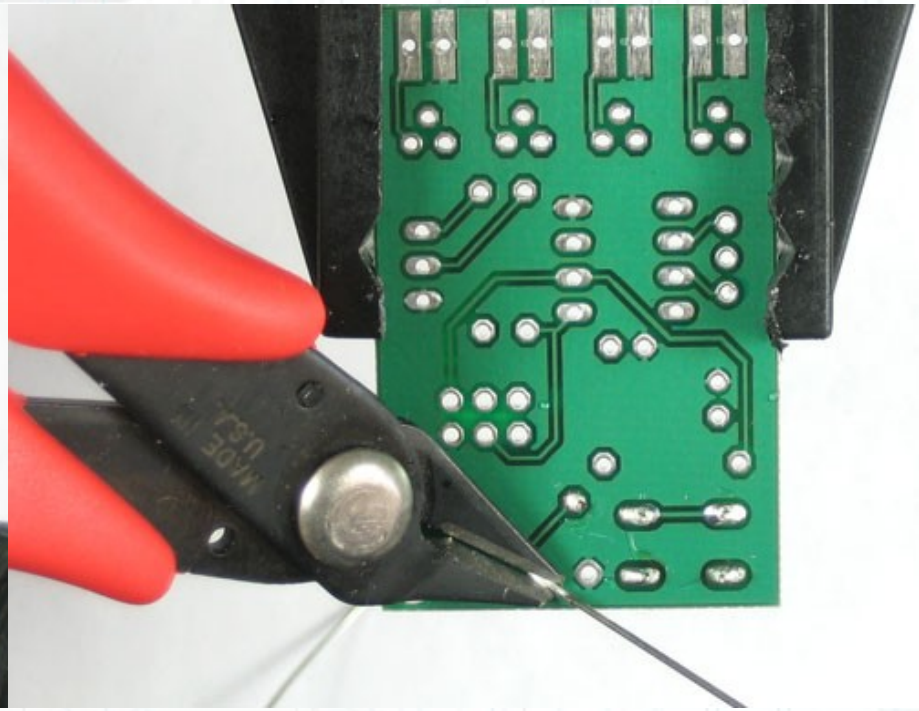
LED - LED5

- Green LED
- Longer lead is the positive (+) on the PCB



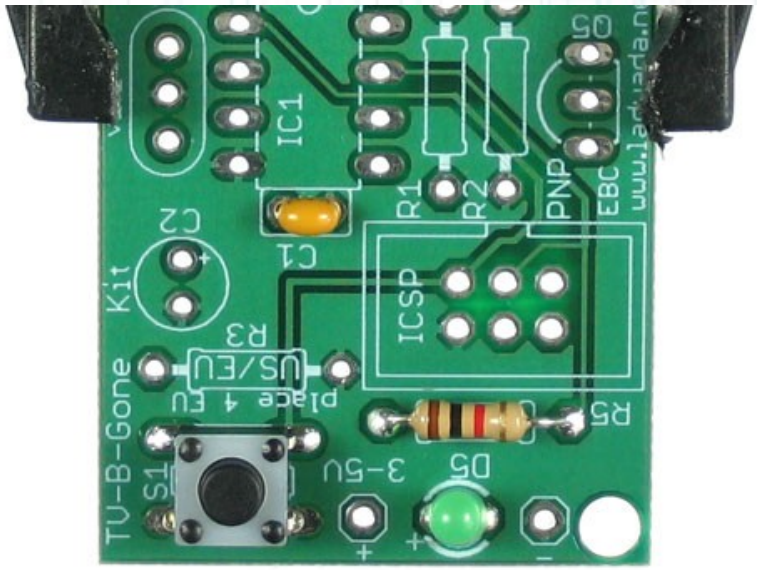
Finish LED5





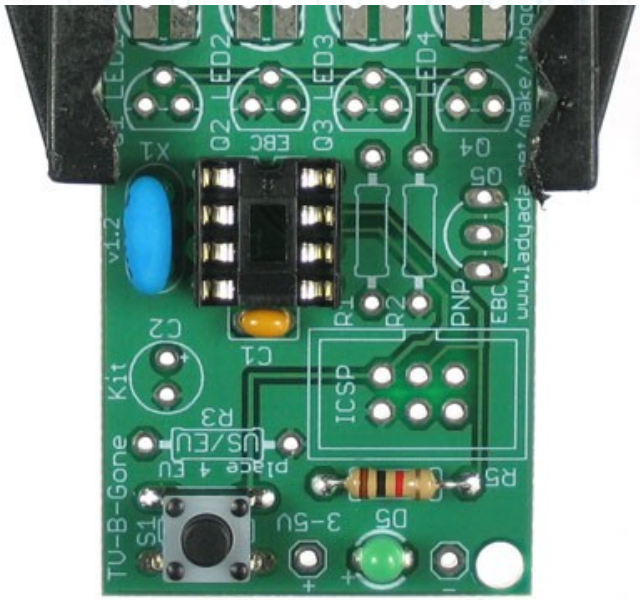
Capacitor C5

- This is a ceramic capacitor and has **no** polarity. It can go in either way.
- It's the only one, but note it's marked 104 for 1,0,0000 or 10[0000]pF or 0.1uF



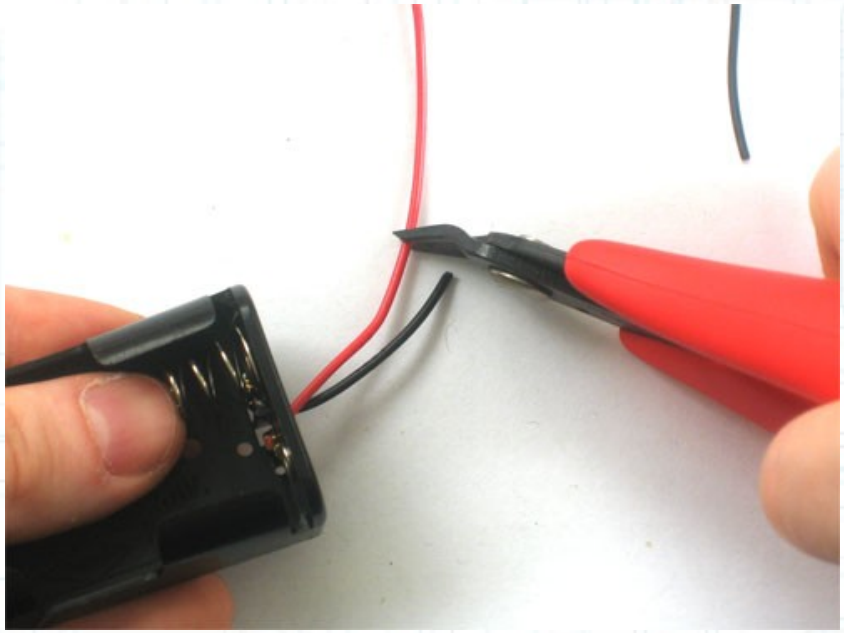
Ceramic Oscillator and 8-pin Socket

- The ceramic oscillator is the blue 3-pin component.
- There is a notch on one end of the 8-pin socket. Make sure it matches the graphic on the PCB.
- Bend the socket leads.

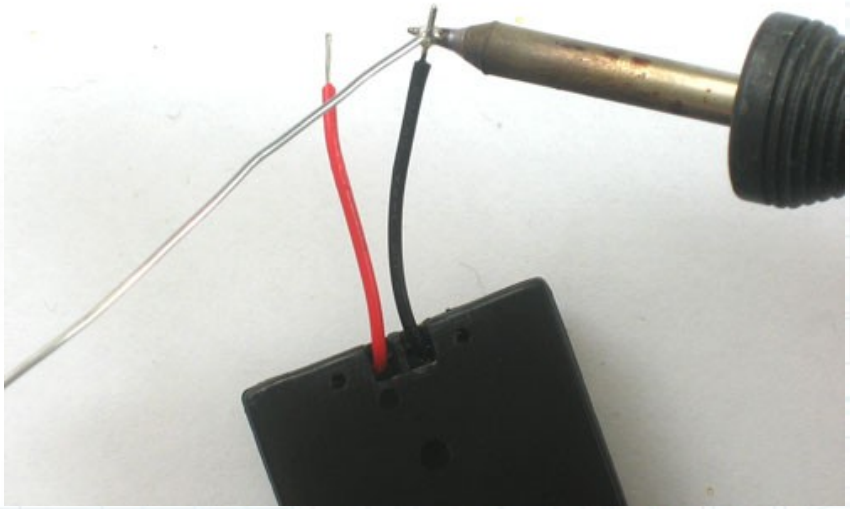


Battery Holder

- We'll clip the excess wire off the battery holder leads.
- You want about 1.5 inches long.

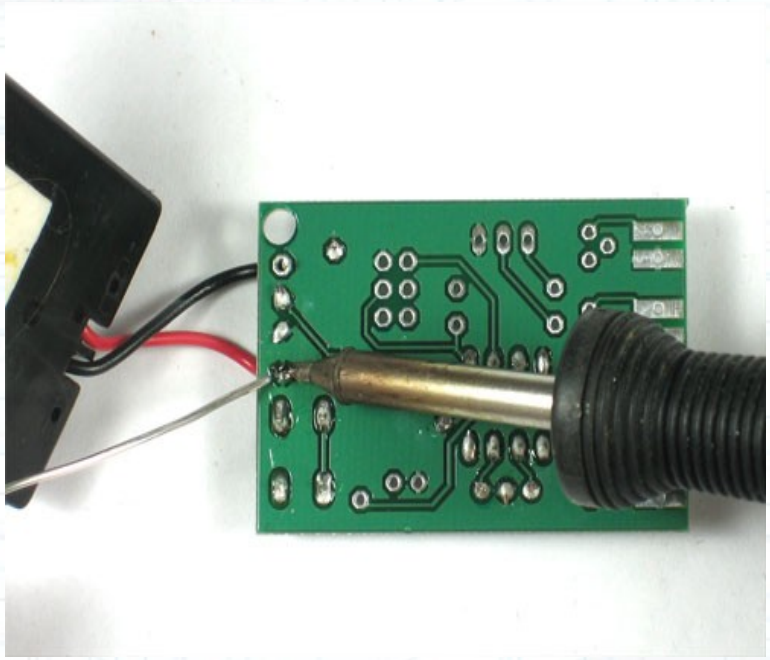


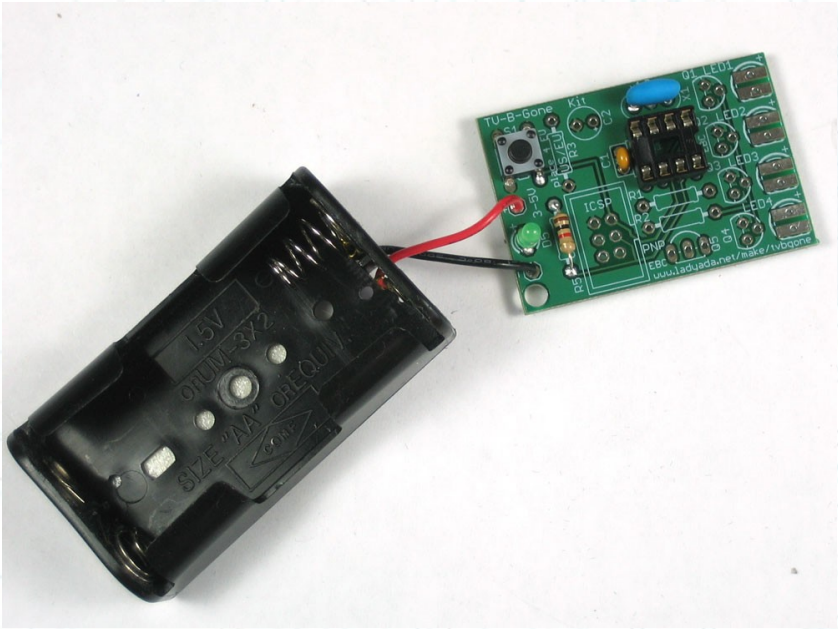
Battery Holder – Strip and tin the wires to make soldering to the PCB easier



Battery Holder Soldering

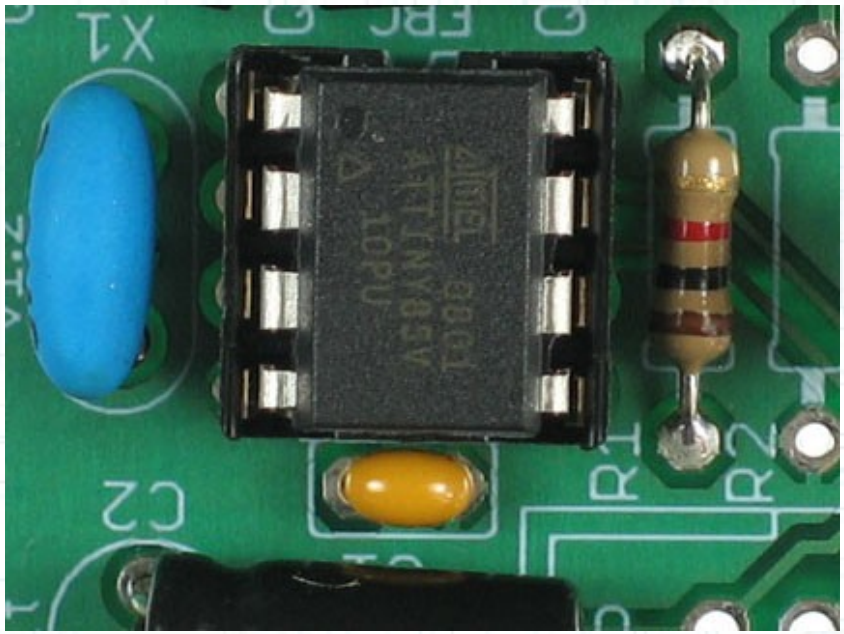
- Red wire to ”+”
- Black wire to ”-”





Insert the IC into the Socket

- The little circle indentation marks pin 1 of the IC. This side should be positioned along with the little notch on the socket.
- Carefully bend leads on each side against a table to straighten them.

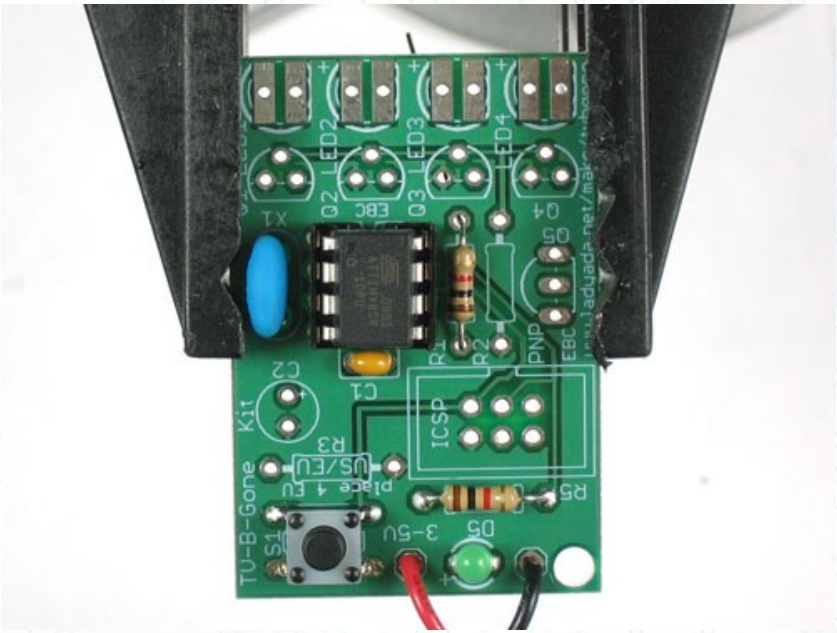


Put batteries in to test power

- This is just to check everything's OK before we move on.
- Put the batteries in and push the button and you're green LED should light up.

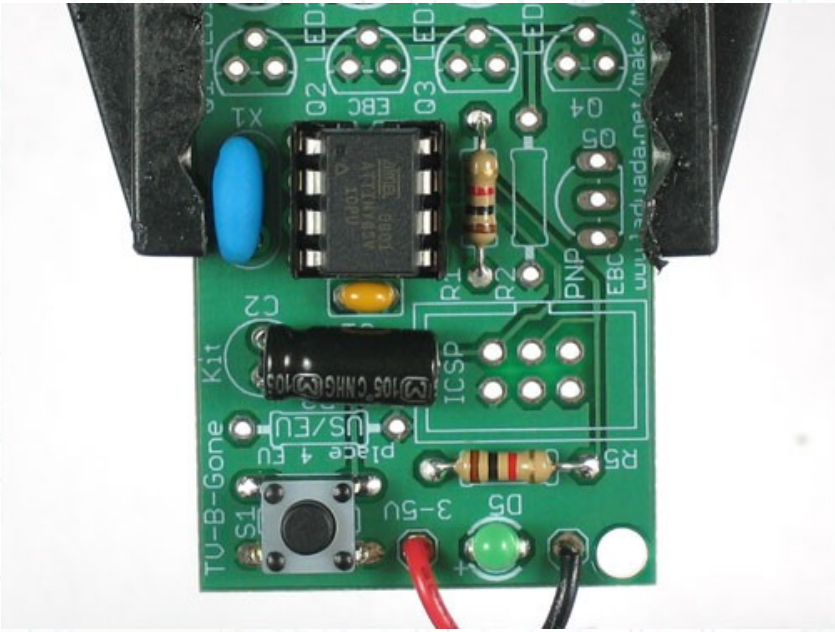
Resistor R1 1Kohm

- Brown-Black-Red
- e.g. 1 – 0 – 2(x100)
- = 1000 ohms



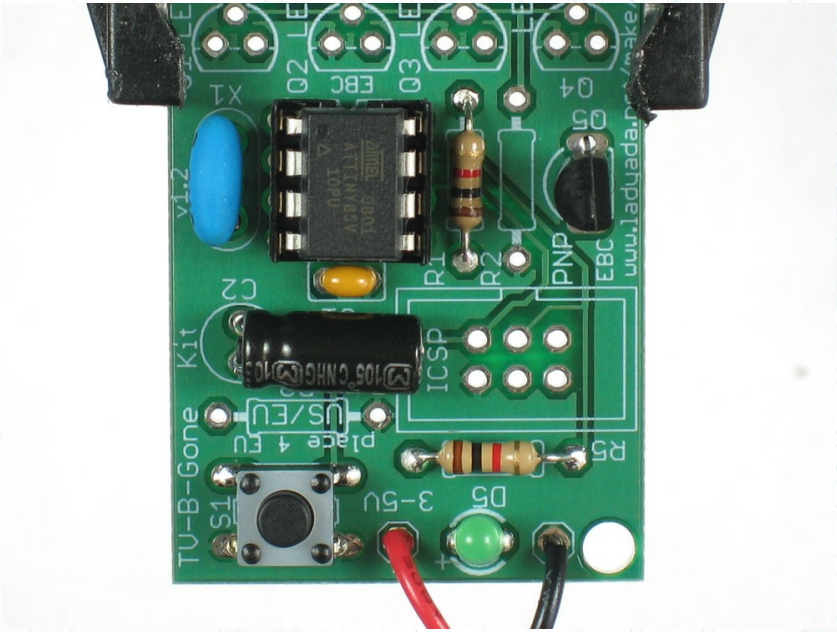
Capacitor C2

- The capacitor is marked 220uF.
- It is an electrolytic and therefore **polarized**. The longer lead goes in the + side.
- Before soldering, bend it sideways so it doesn't stick up off the board.



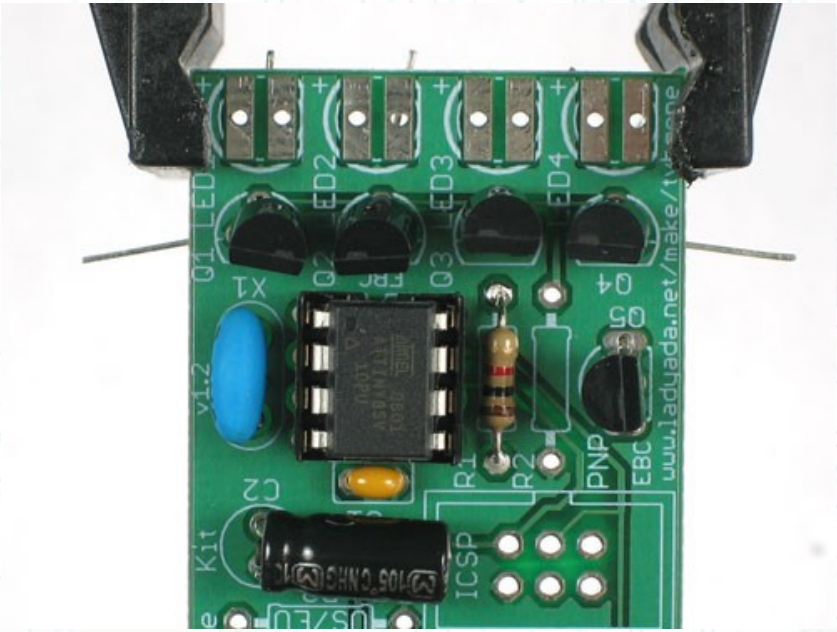
Transistor Q5 - 2N2907

- You'll see 2N2907 written on the flat side of the transistor.
- Match the curved shape with the graphic on the PCB.



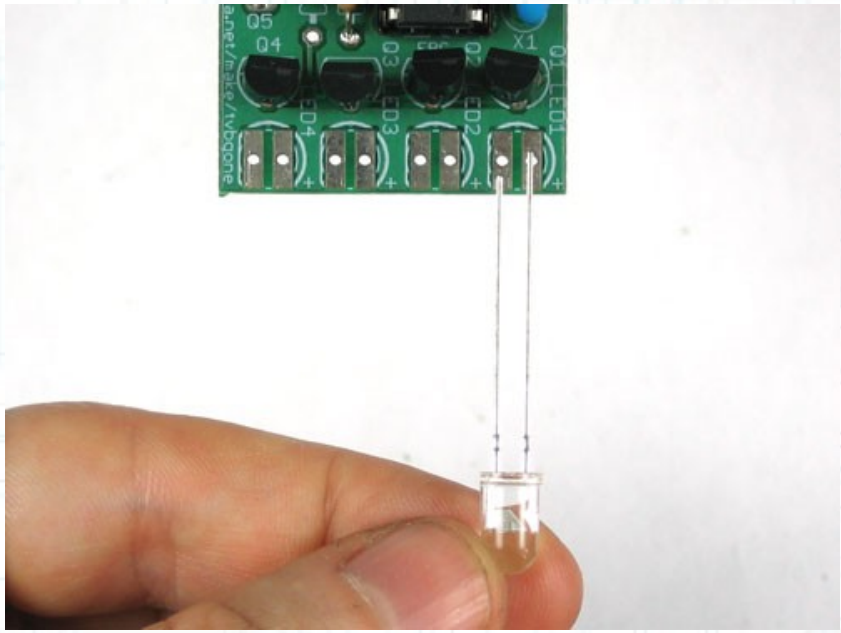
Transistors Q1, Q2, Q3, Q4

- Marked 2N2222
- Match the rounded ends with the PCB graphic
- These NPN transistors power the LEDs, since the microcontroller doesn't have enough juice on it's own to do it.



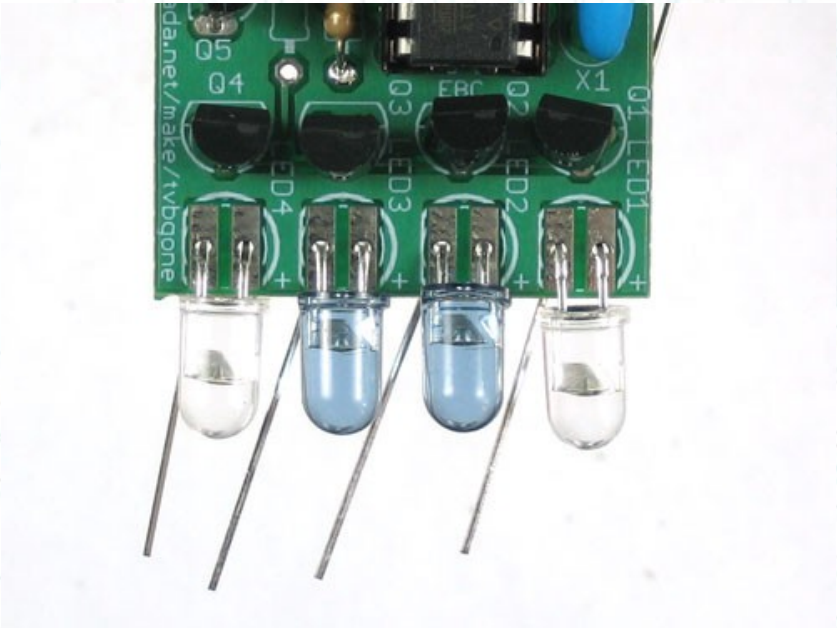
Infrared LEDs

- Longer leads of the LEDs go to '+'.
- 'Clear' LEDs go on the ends. These are standard, wider/shorter range.
- 'Blueish' LEDs go in the center. These are narrow, longer range.



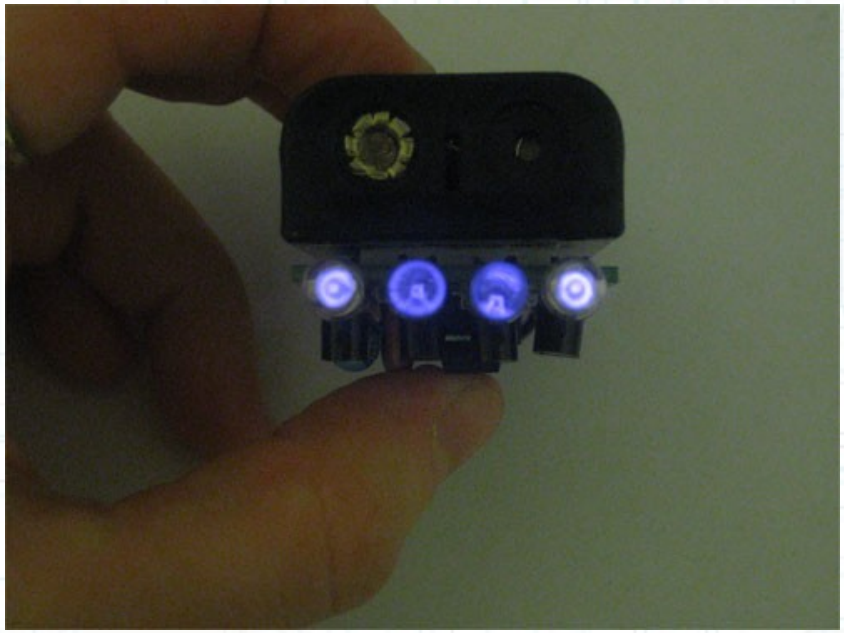
Infrared LEDs continued..,

- Bend the LEDs over the board so they are pointing outwards.
- Once you've soldered the back of the LEDs, also solder the front **before** clipping the leads. This is just to hold them extra steady.



HUZZAH YOU'RE DONE!

- Place the batteries in and test!
- R3 is only put in if you want to include EU TV codes.
- The 6-pin header is only necessary if you want to reprogram it later.
- Use sticky tape on the board/battery housing.



Final Thoughts

- Use your power wisely.
- Pranks on friends and families are fun.
- Strangers in a sports bar may have a different opinion.
- Use your TV-B-Gone as a way to teach others what you have learned.
- Check out http://www.adafruit.com/tvbgone for all the details on hardware and code.
- HAVE FUN!