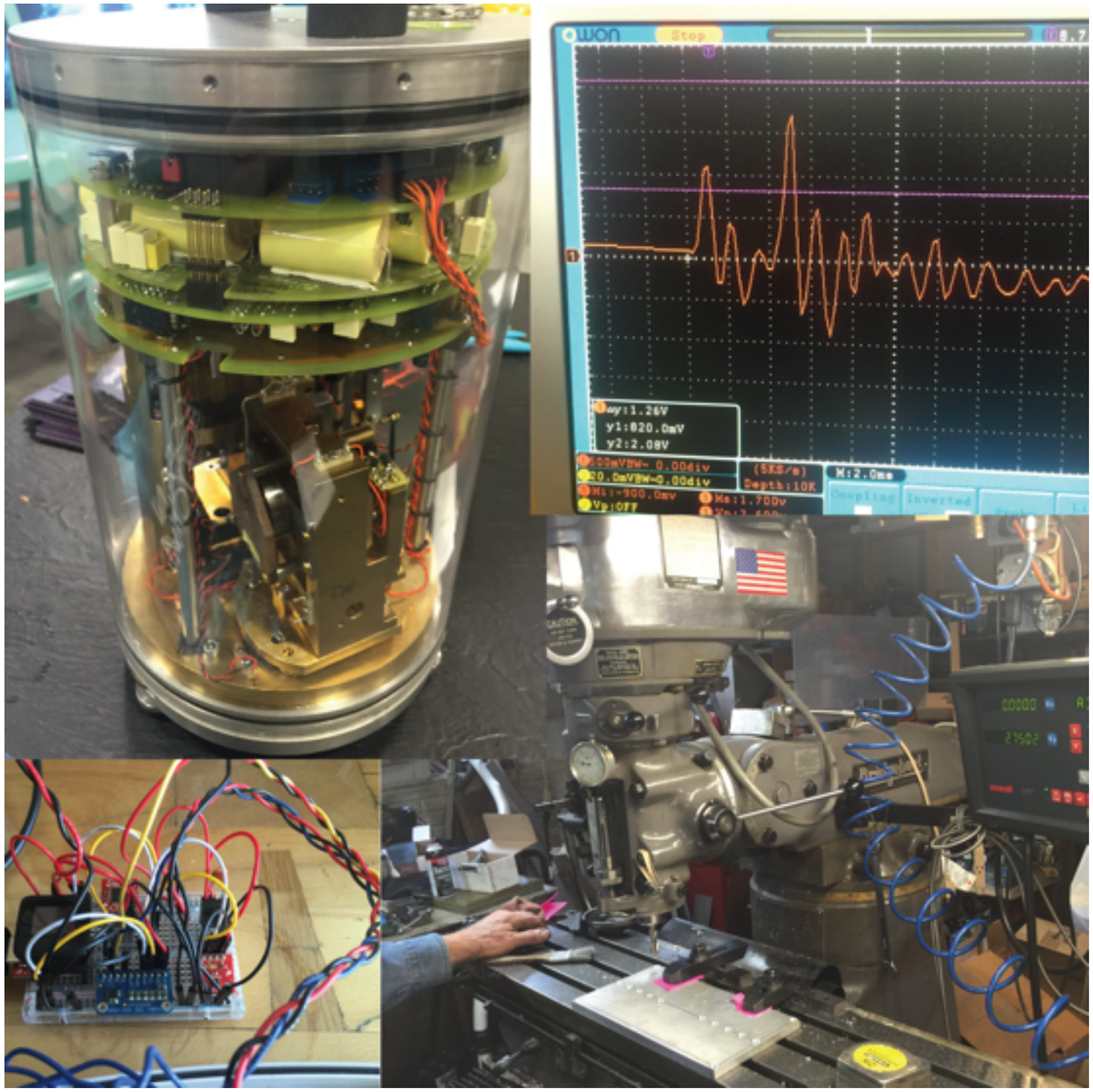
Electronics Prototyping

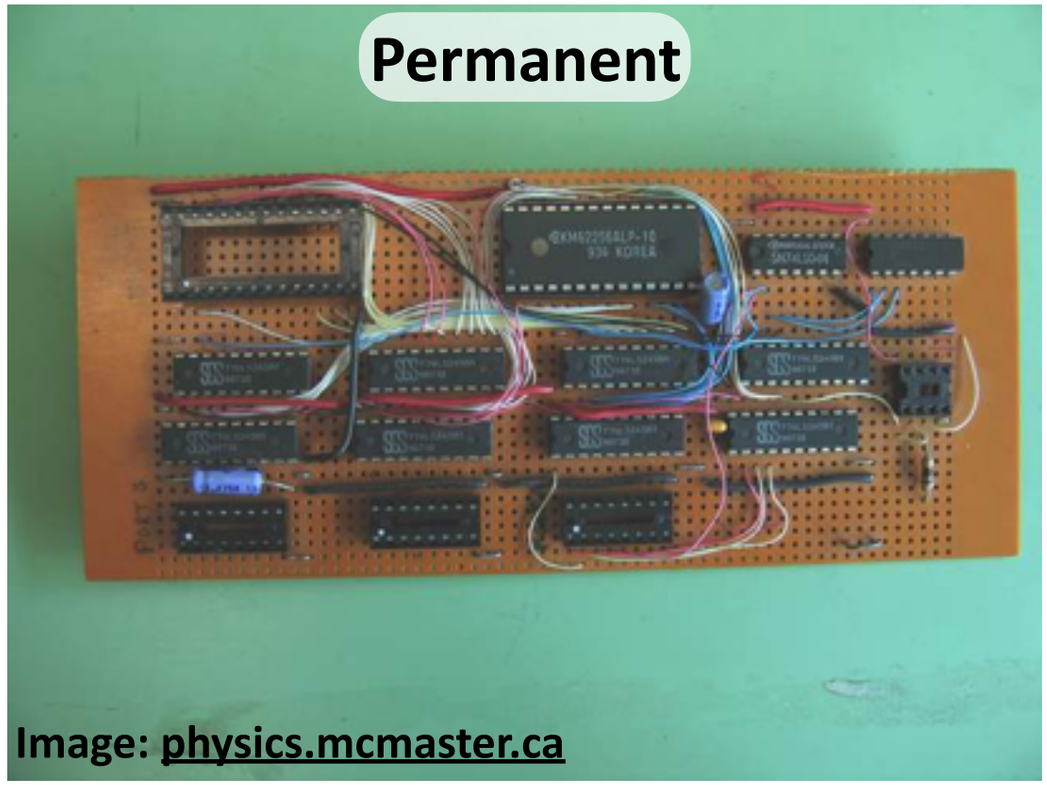
J.R. Leeman and C. Marone

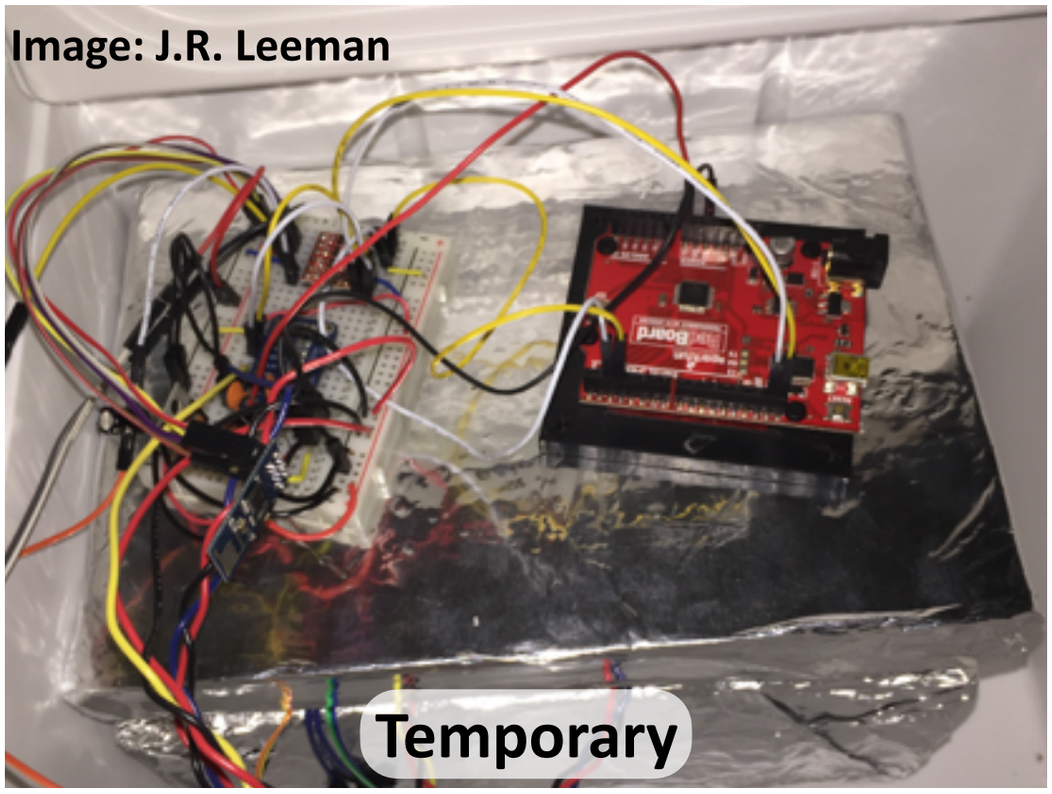
Techniques of Geoscientific Experimentation

September 8, 2016



When building and prototyping electronics we need different levels of permanence





Breadboards offer quick prototyping and let you reuse components

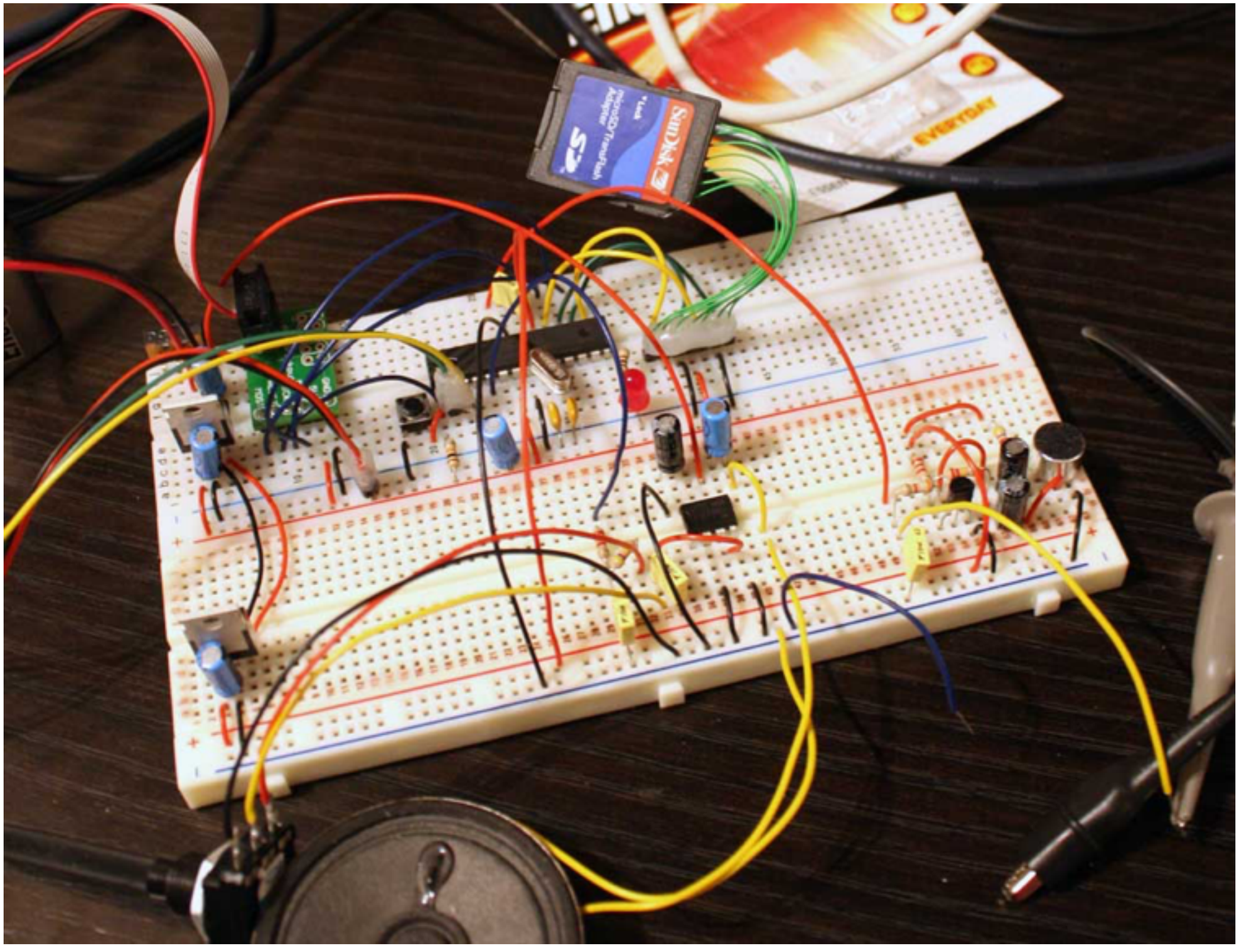


Image: elasticsheep.com

They have columns of interconnected spring clips internally

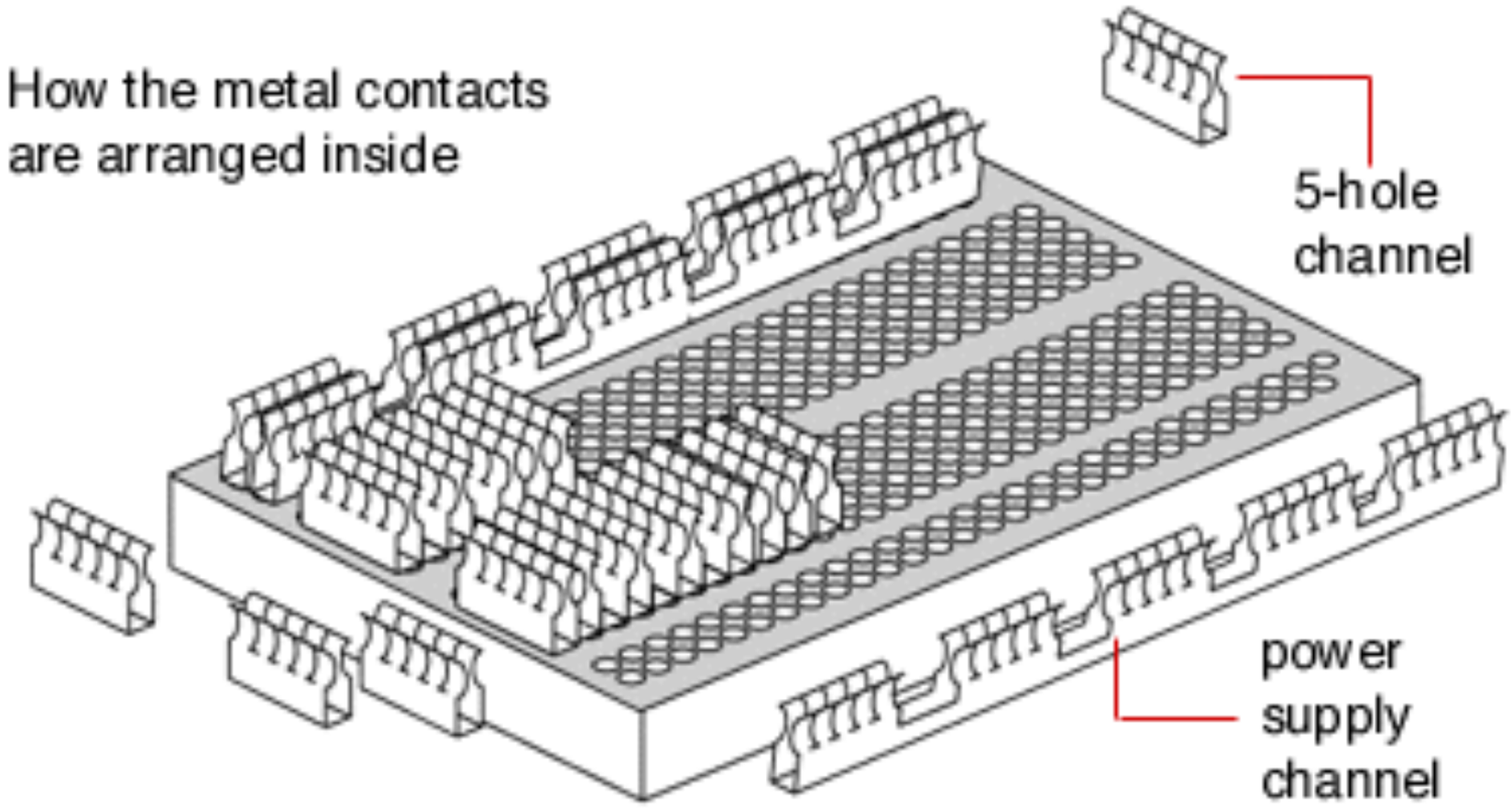


Image: electronics-sarath.blogspot.com

Image: sciencebuddies.org

Cut off or clean the glued ends of components

Image: prismglow.com

There are many ways to create your circuit on a breadboard

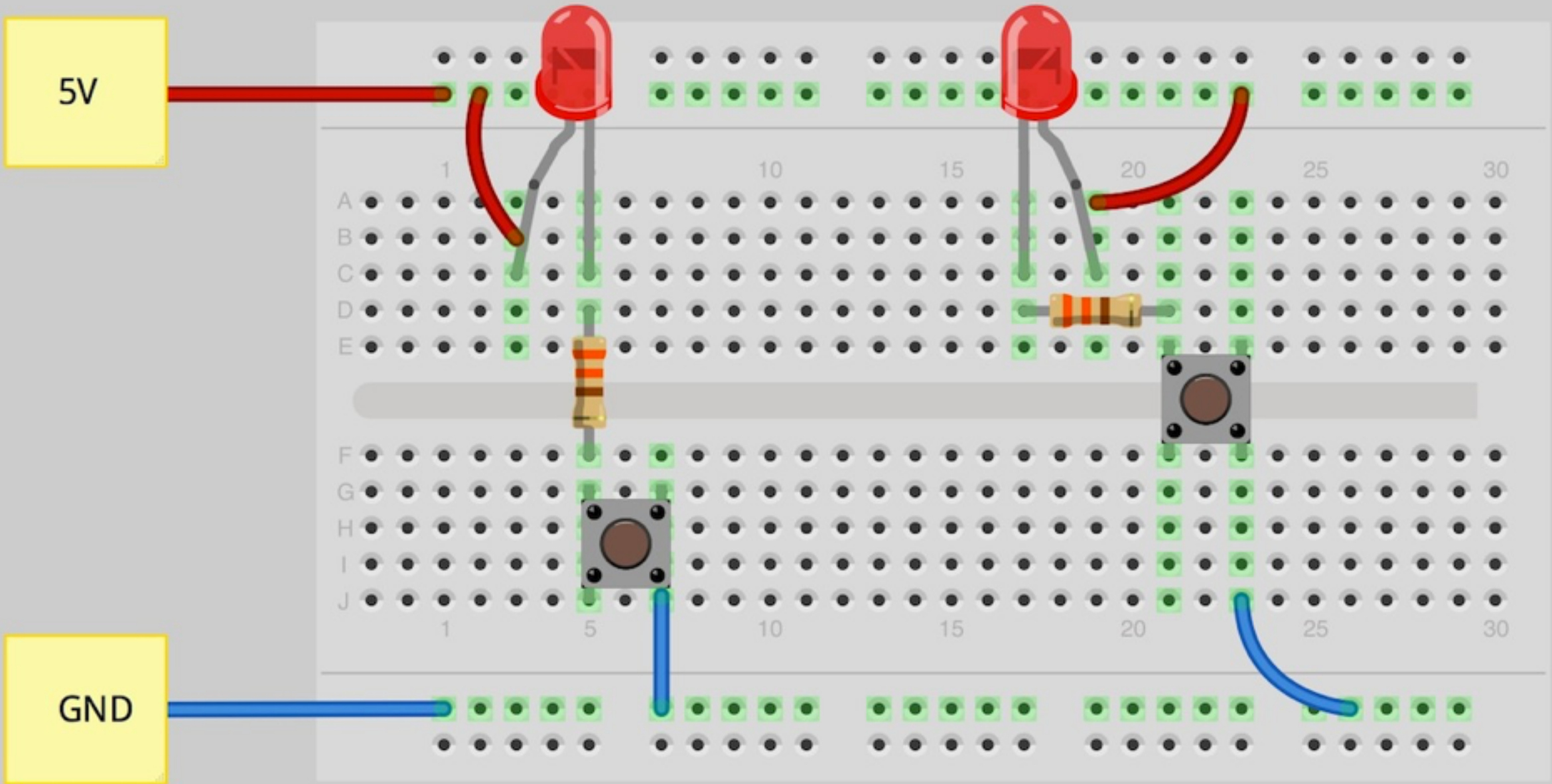


Image: sparkfun.com

Breadboards can present problems for high-frequency designs

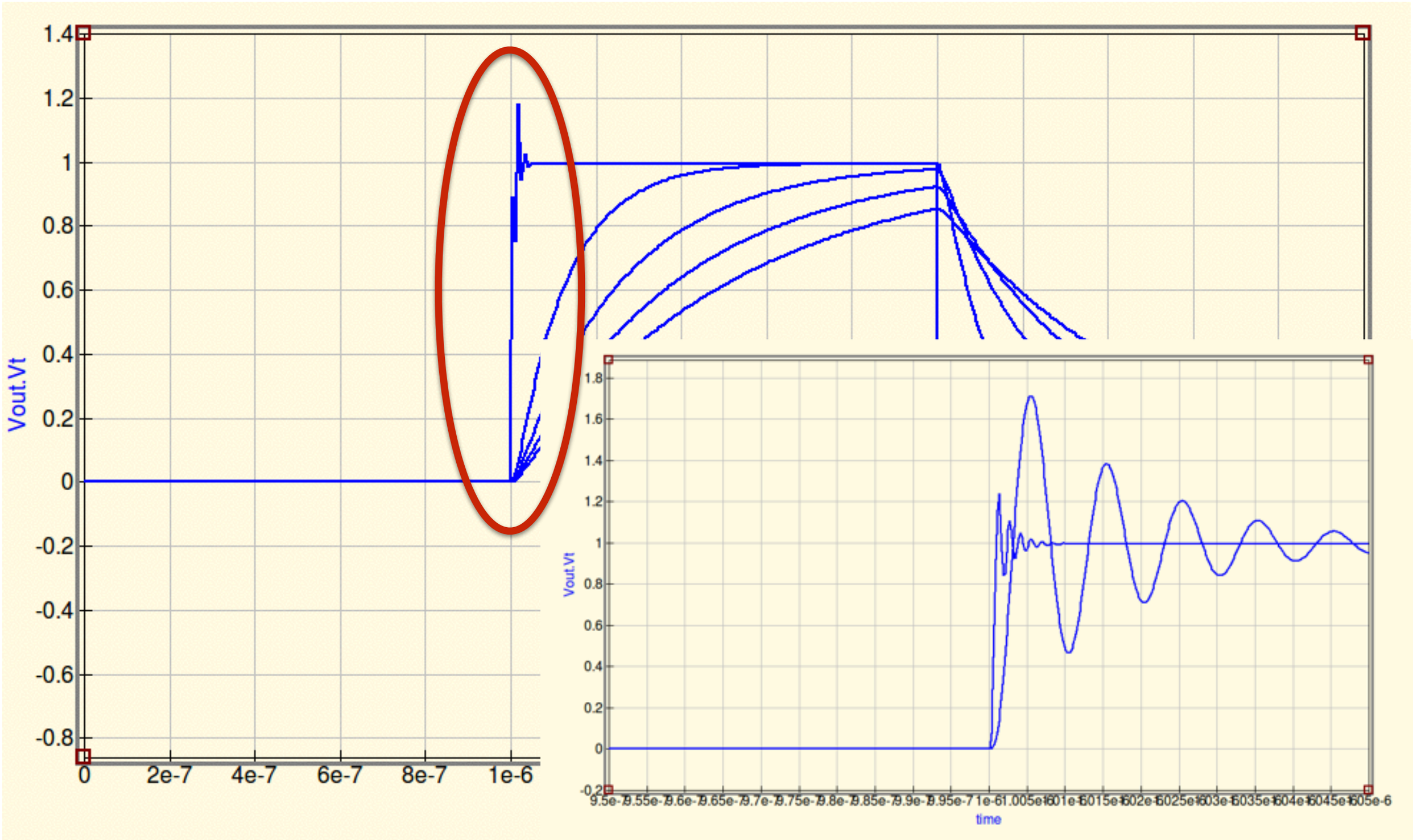
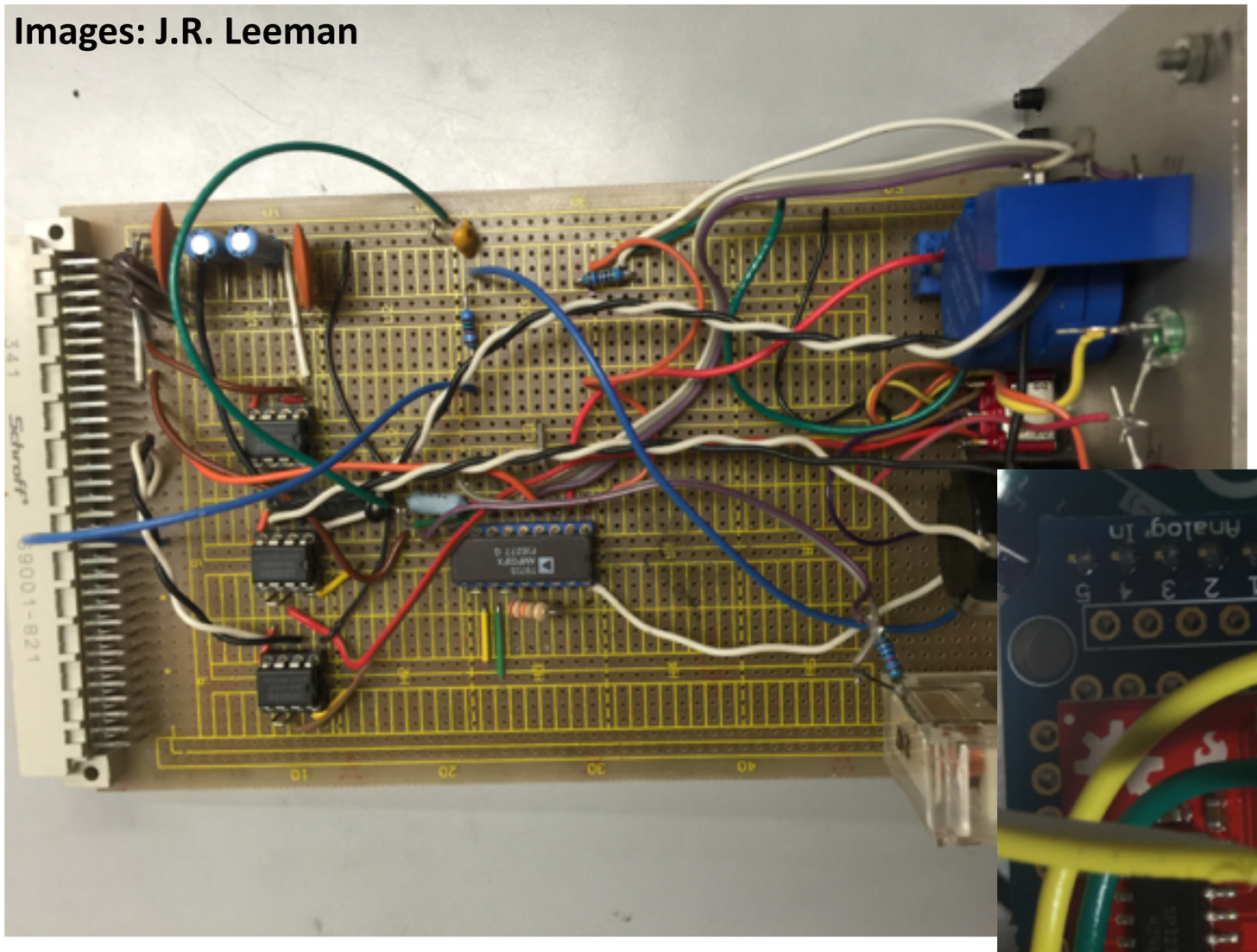
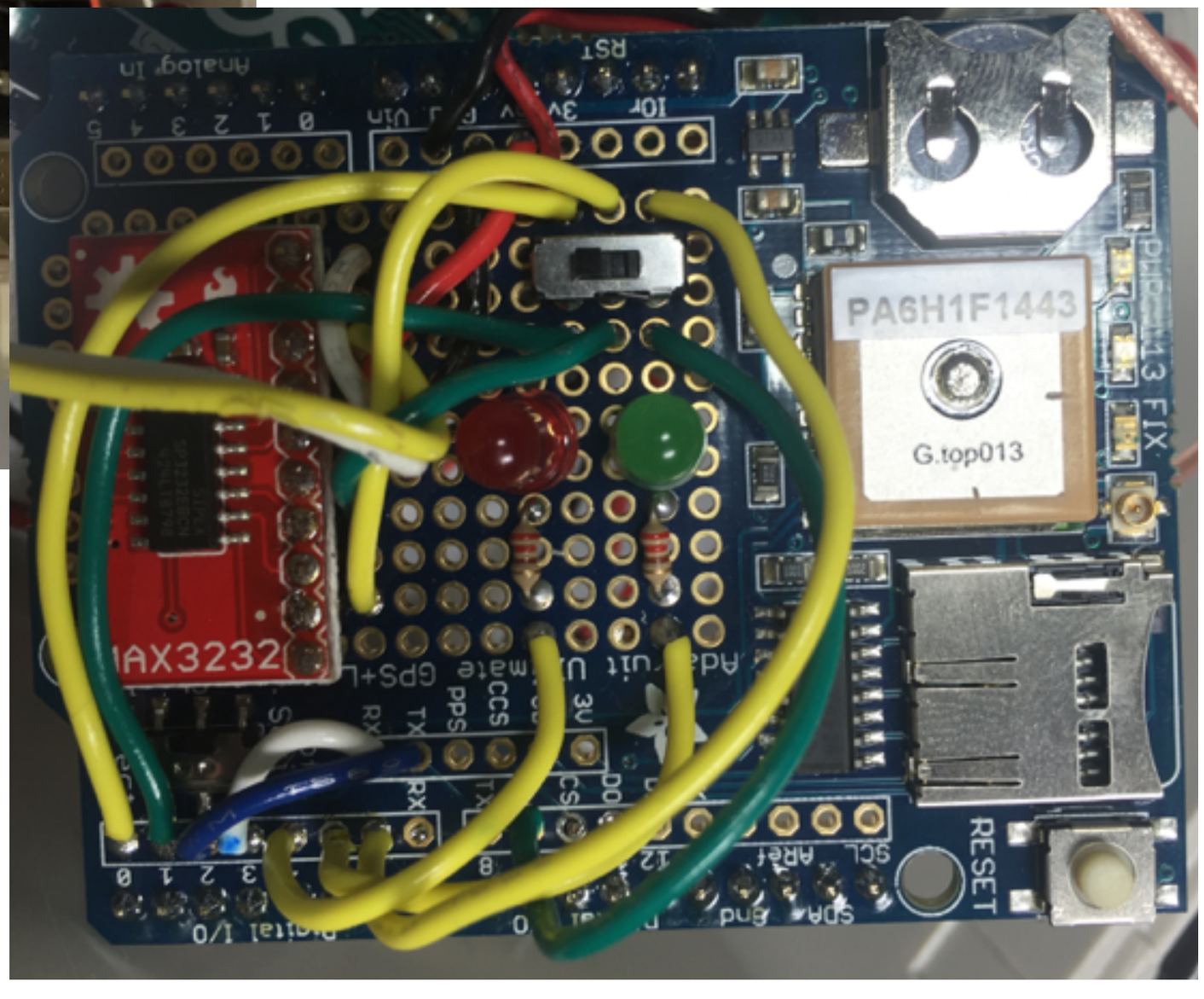


Image: http://electronics.stackexchange.com/questions/19975/effect-of-parasitic-capacitance-on-an-ideal-signal

Perfboard/veroboard is a more permanent construction technique

Images: J.R. Leeman





But it can be done very poorly

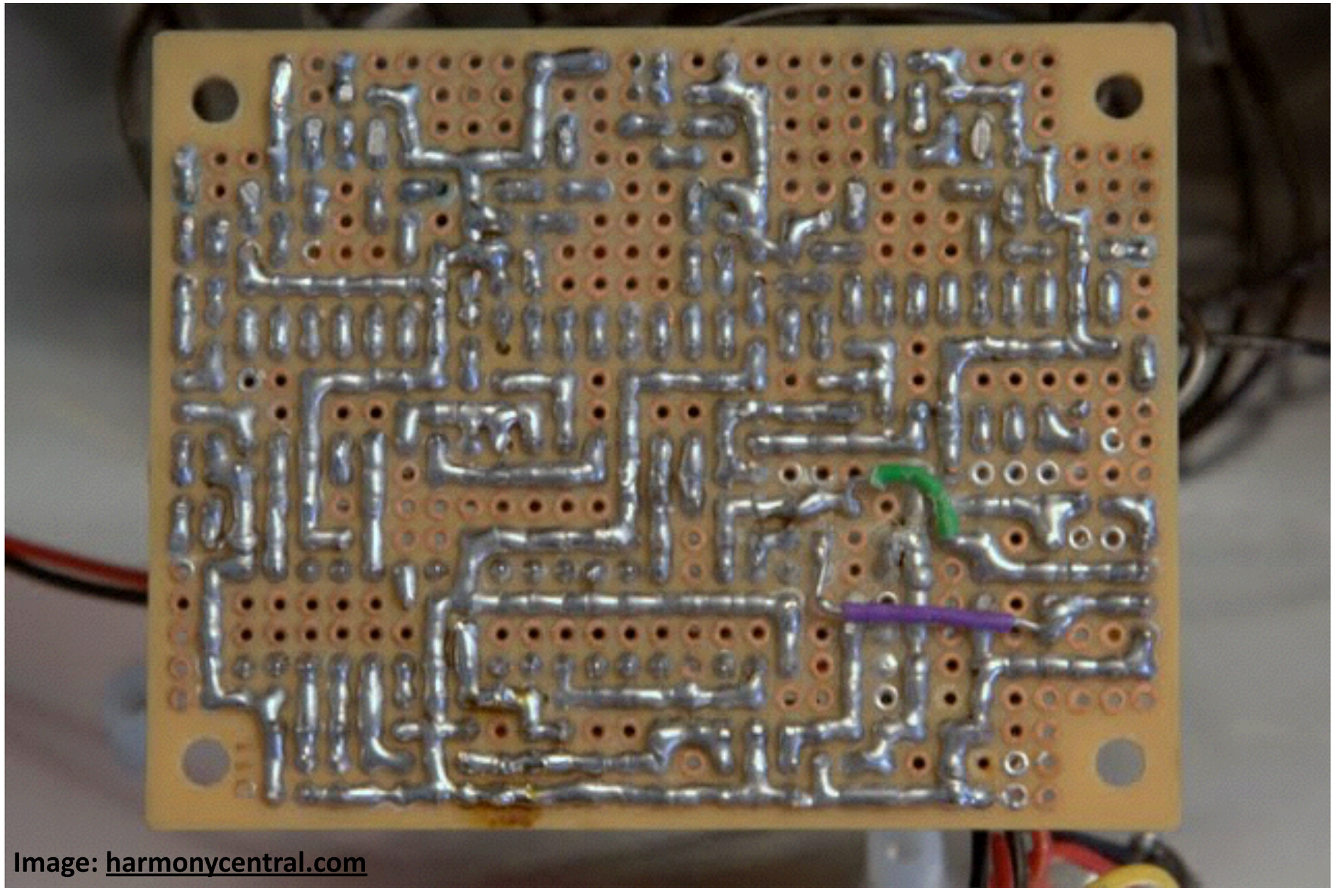
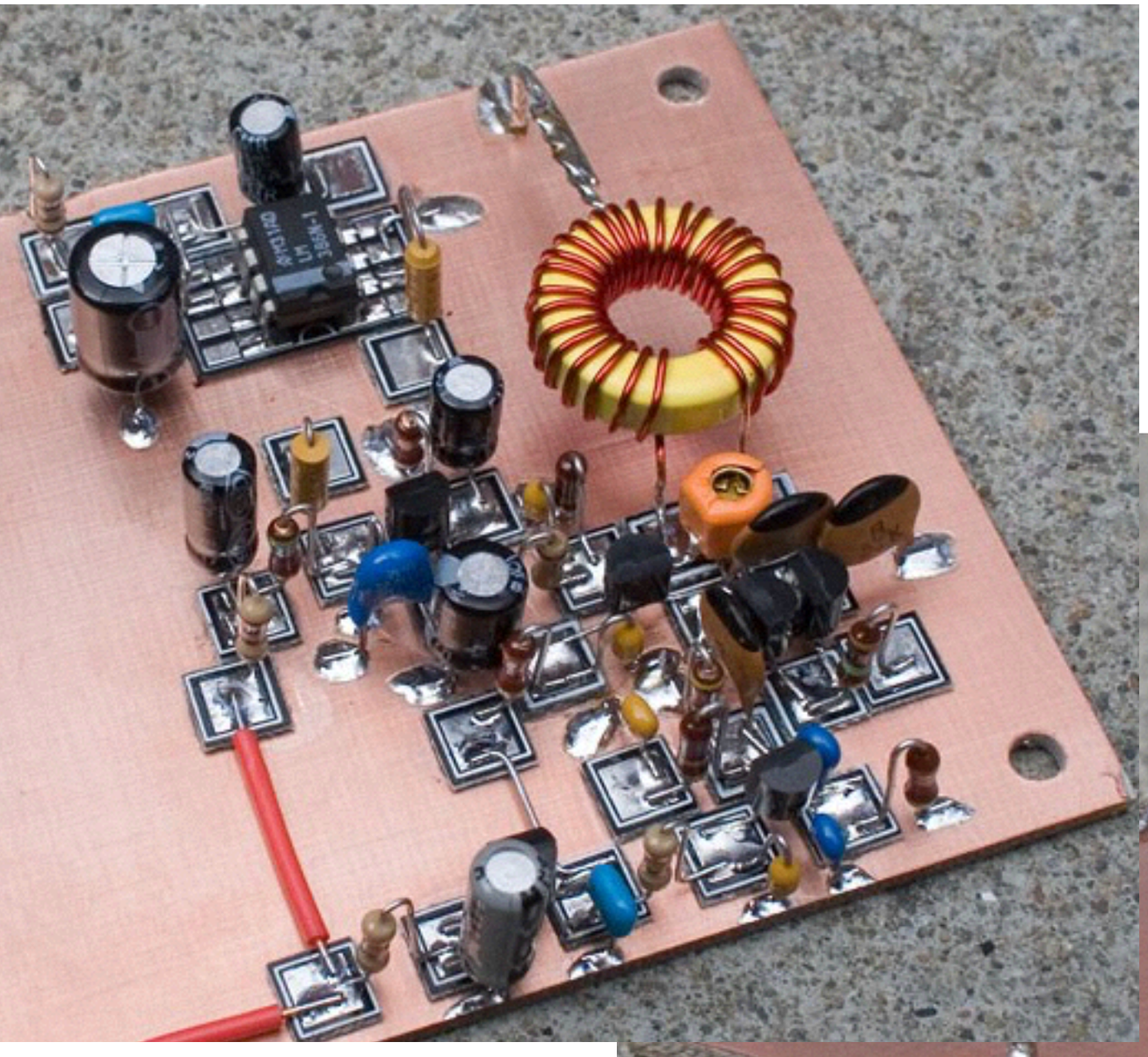


Image: harmonycentral.com

Manhattan/deadbug is often used for high frequency designs



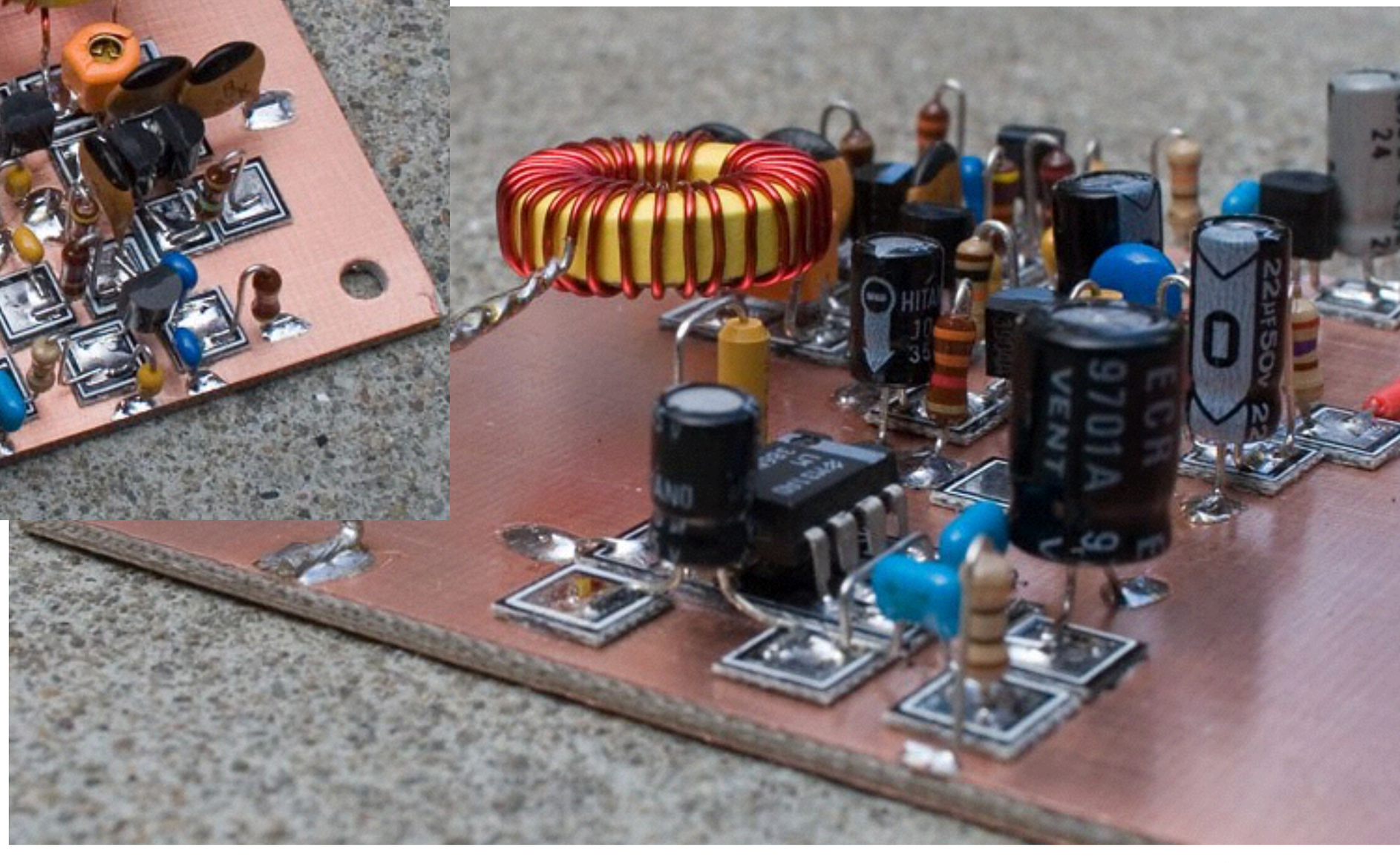


Image: aa7ee.wordpress.com

Manhattan/Deadbug is a common high frequency construction technique

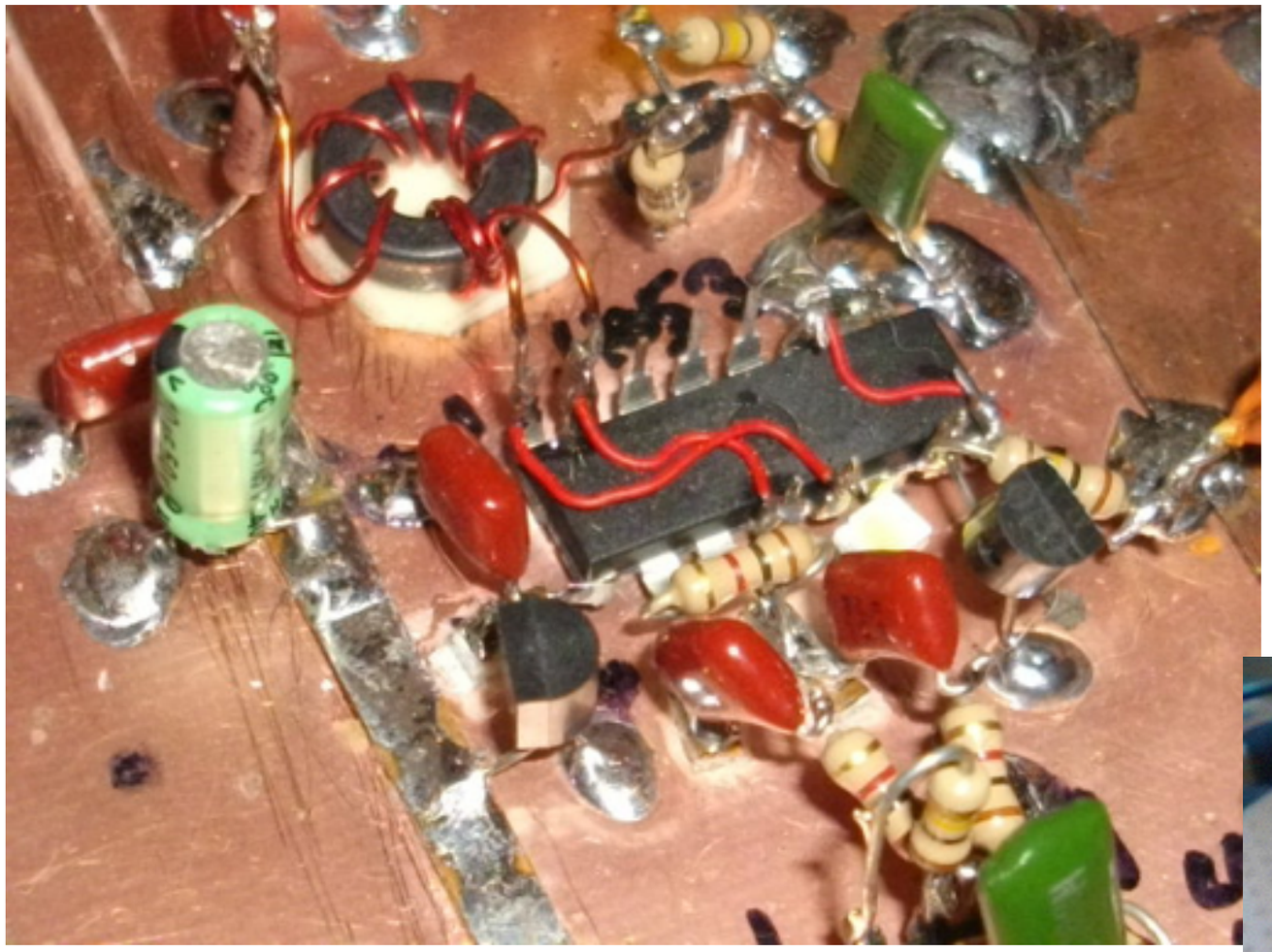
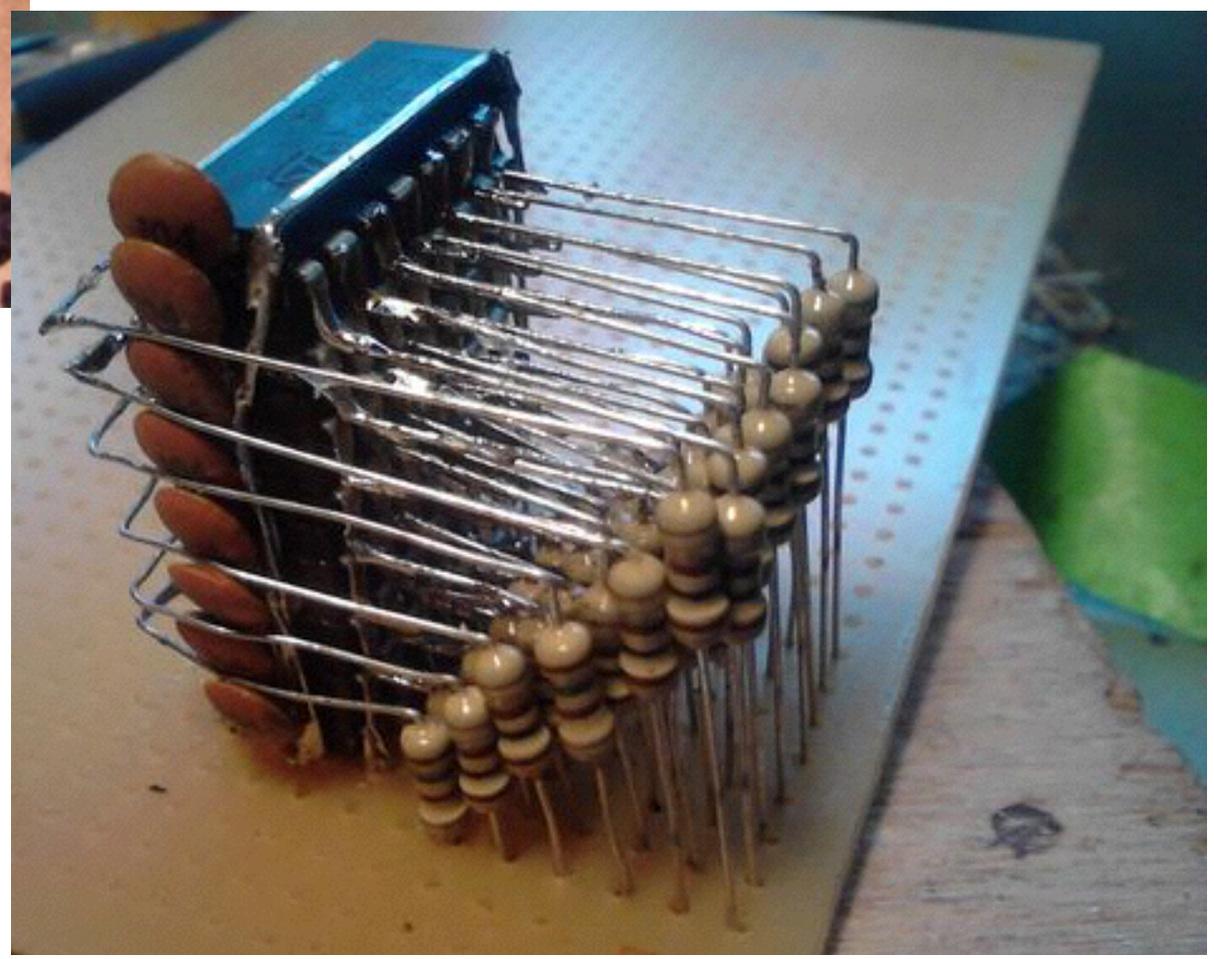


Image: gsl.net

Image: instructables.com



Some people even build enclosures out of the copper-clad board

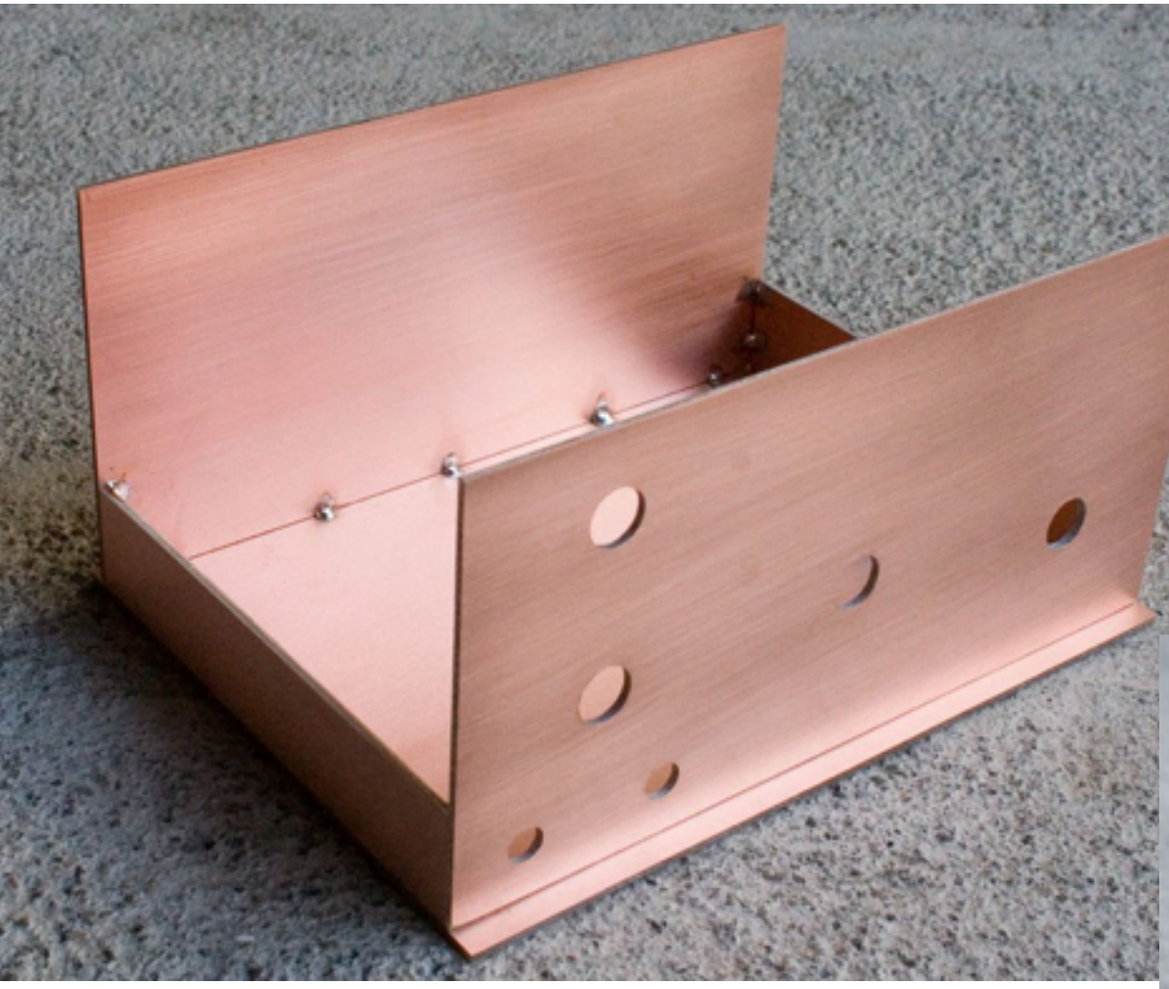
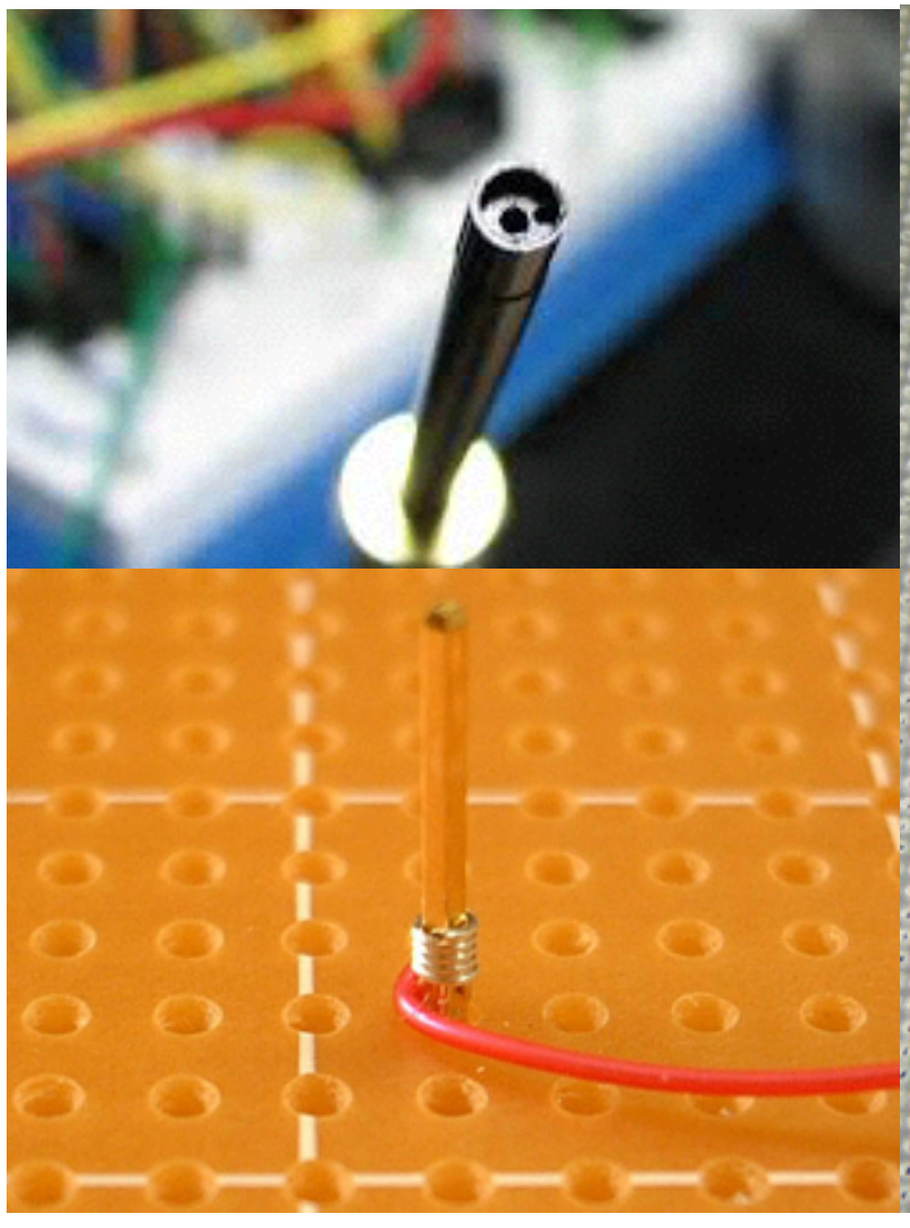
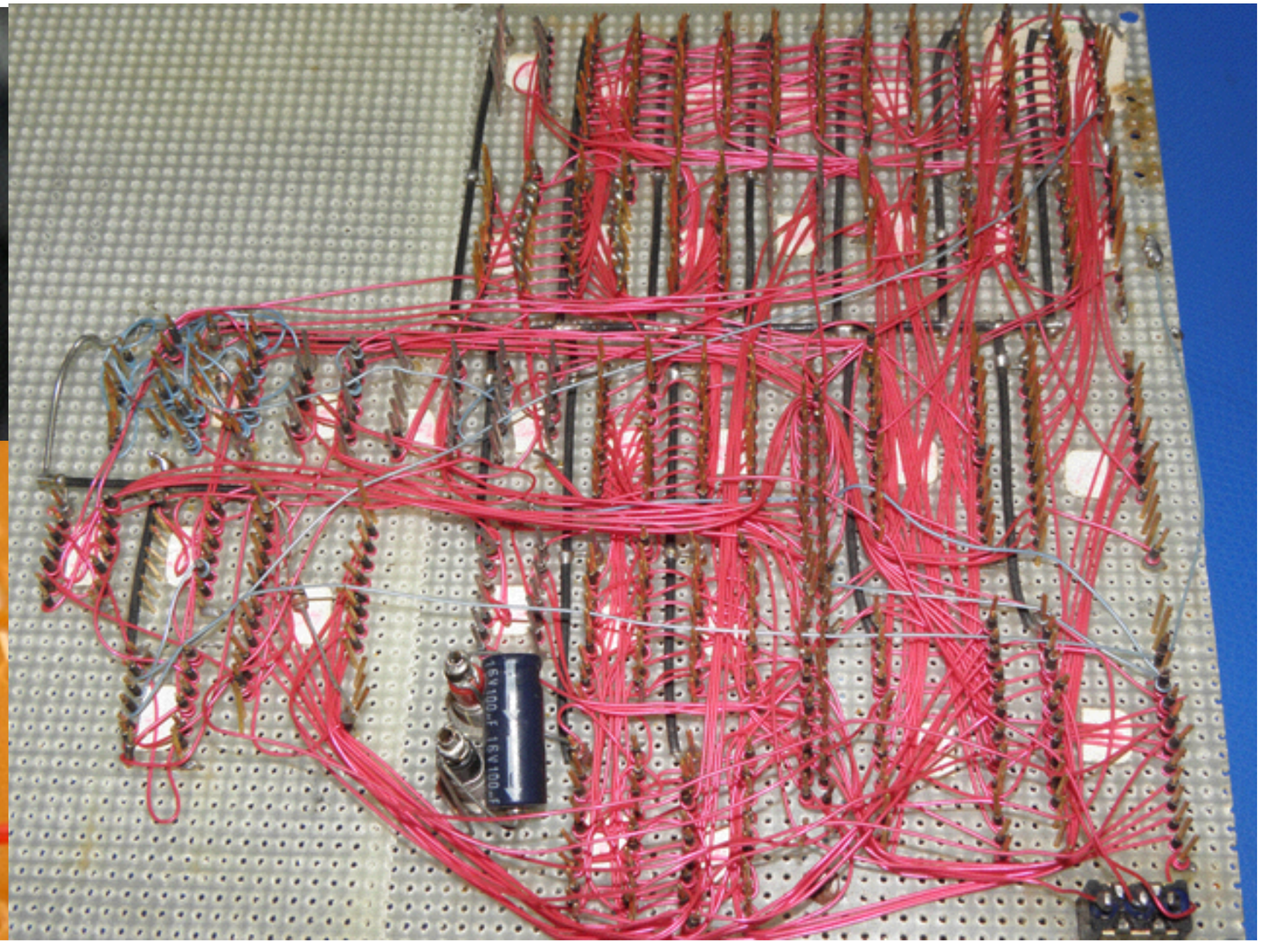


Image: aa7ee.wordpress.com

Wire wrap is a good technique for digital designs





Images: Wikipedia, Hackaday

Custom PCBs are cheaper than ever and offer good performance at the cost of changeability

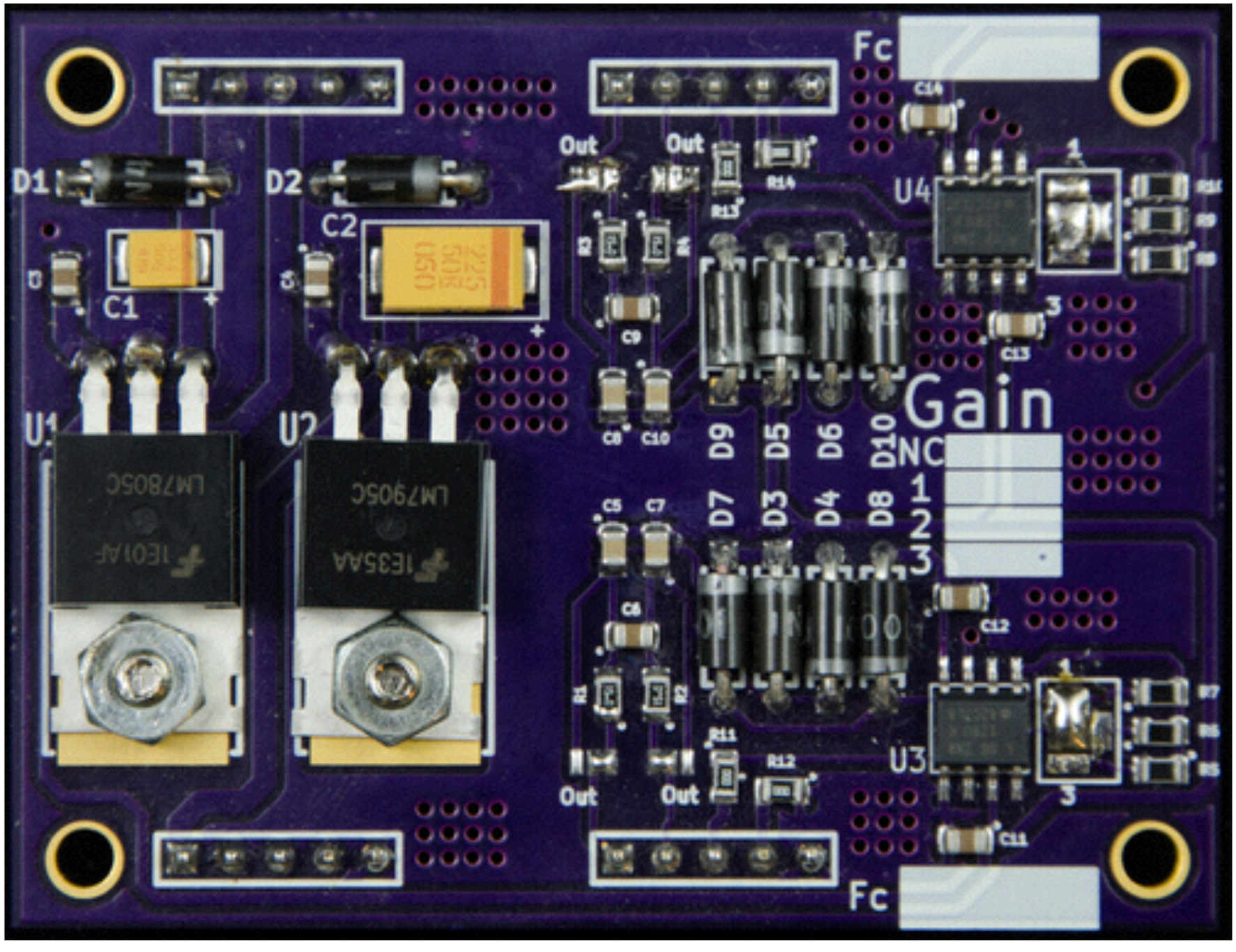


Image: leemangeophysical.com

Soldering is the most popular connection technique

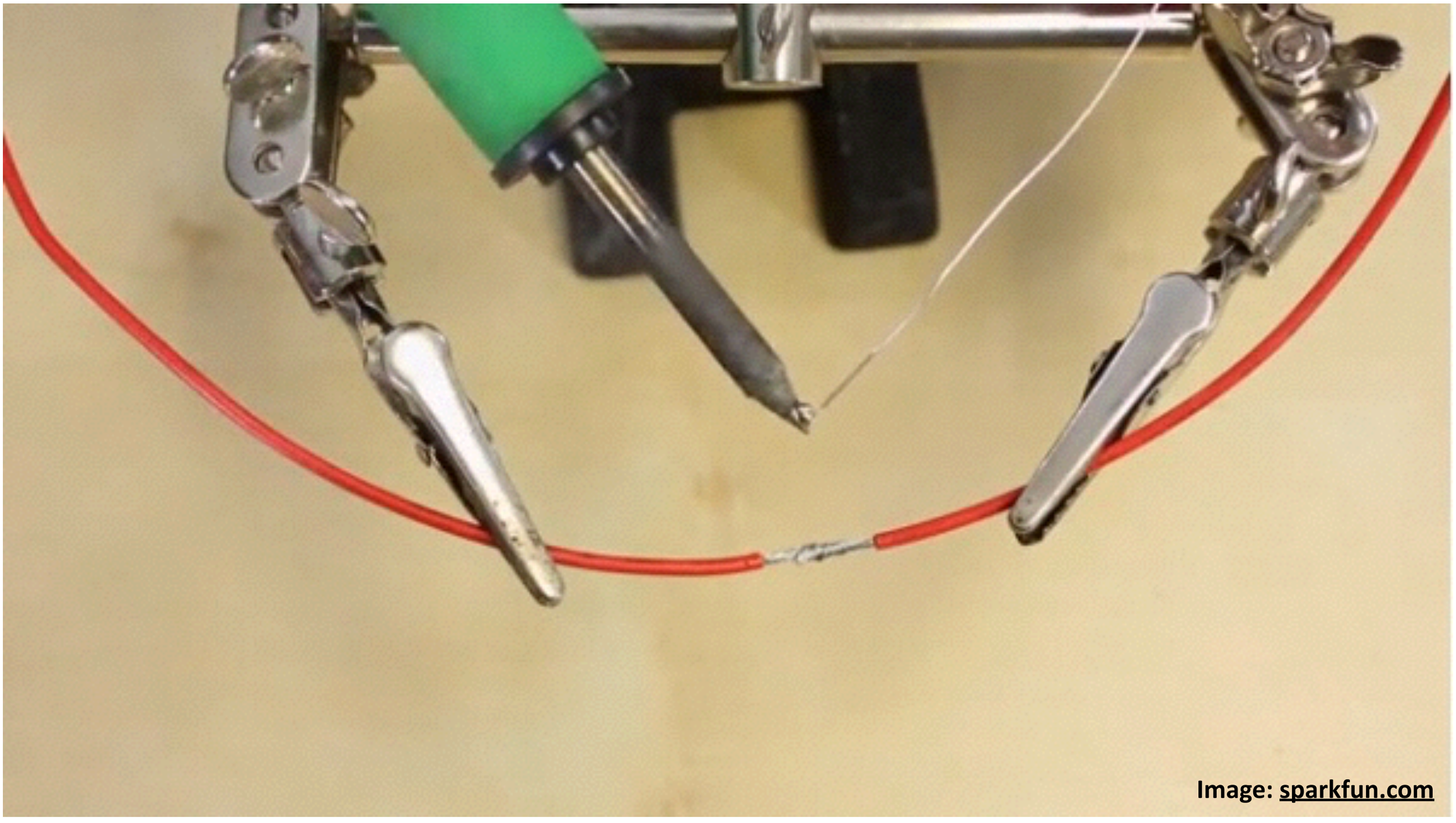


Image: sparkfun.com

A variable temperature soldering iron is a must

Image: sparkfun.com

A narrow chisel tip is the most versatile

Images: adafruit.com

Use a multi-core solder (lead and lead-free available)

*I prefer a fine gauge solder

Image: [sparkfun.com]

Flux can be used to clean the connection

Images: Adafruit, Wikipedia

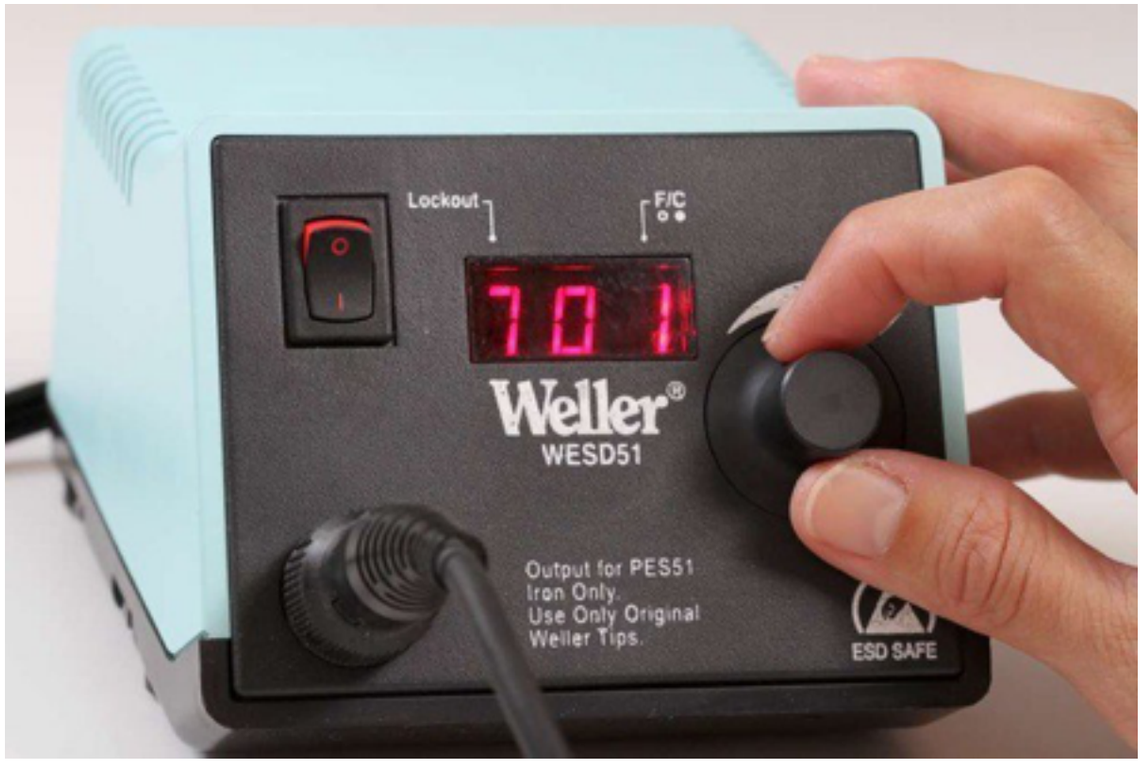
Desoldering is done with braid or a solder vacuum

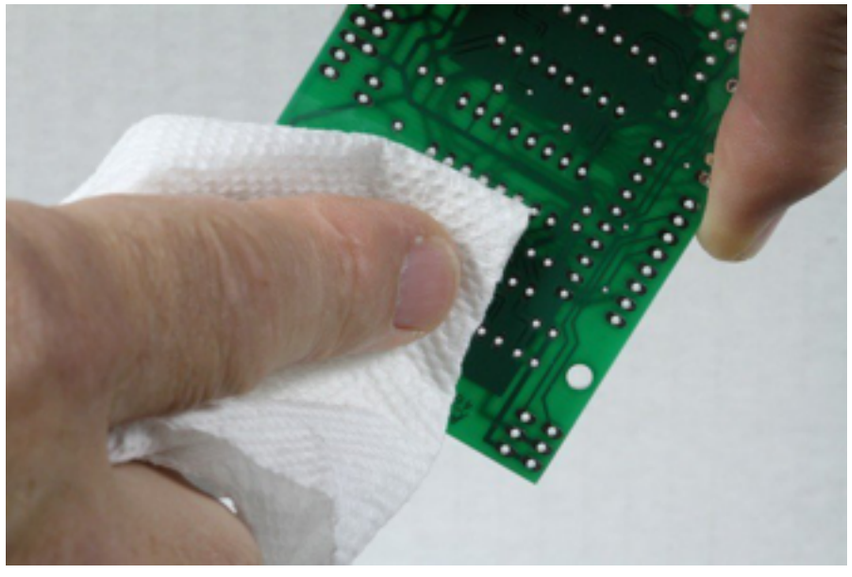
Images: adafruit.com

Prepare your work area and iron

Images: adafruit.com

Prepare your work area and iron





Images: adafruit.com

1. Make a good mechanical connection

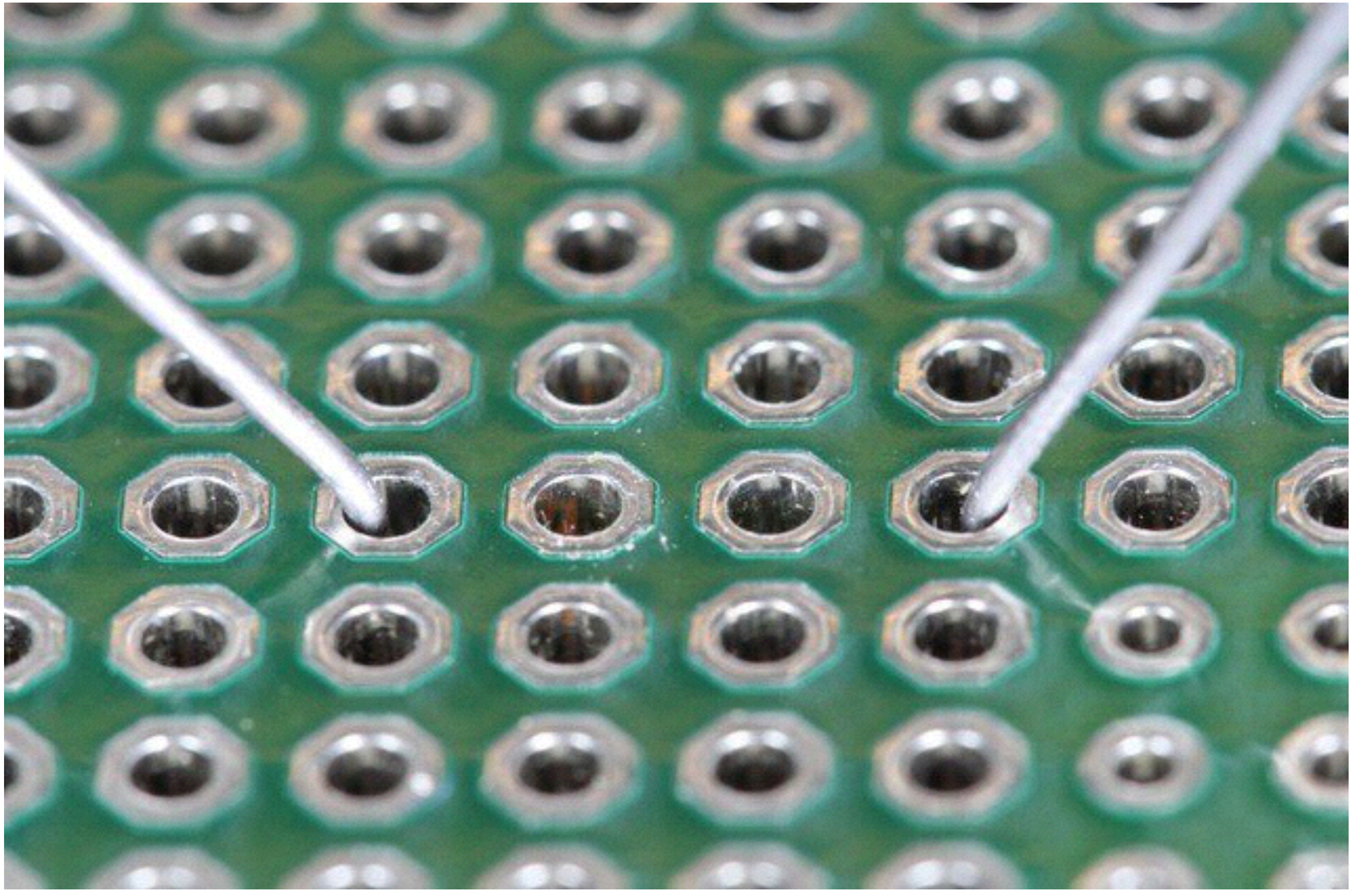


Image: adafruit.com

2. Heat the entire joint

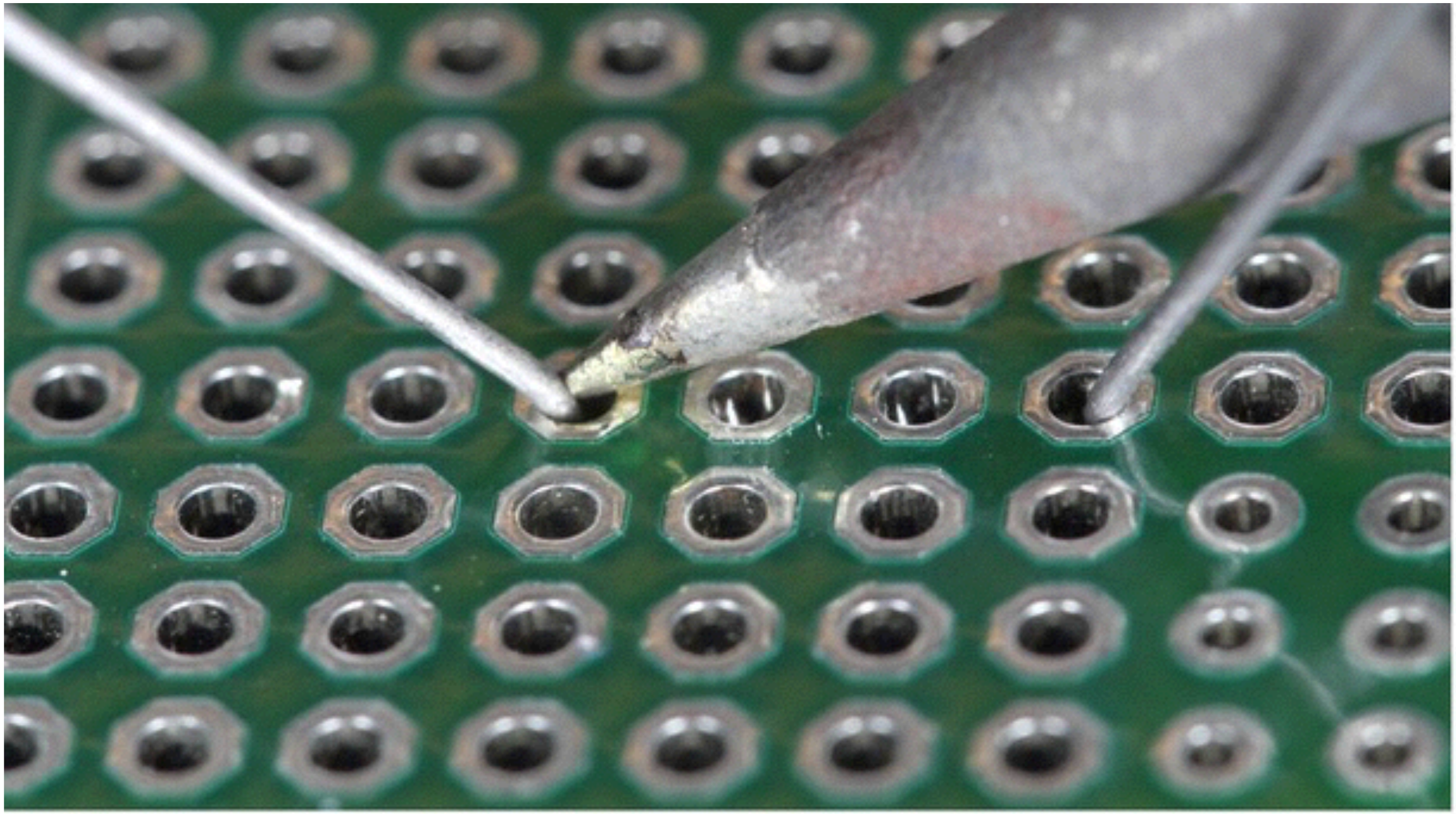


Image: adafruit.com

3. Flow solder into the joint

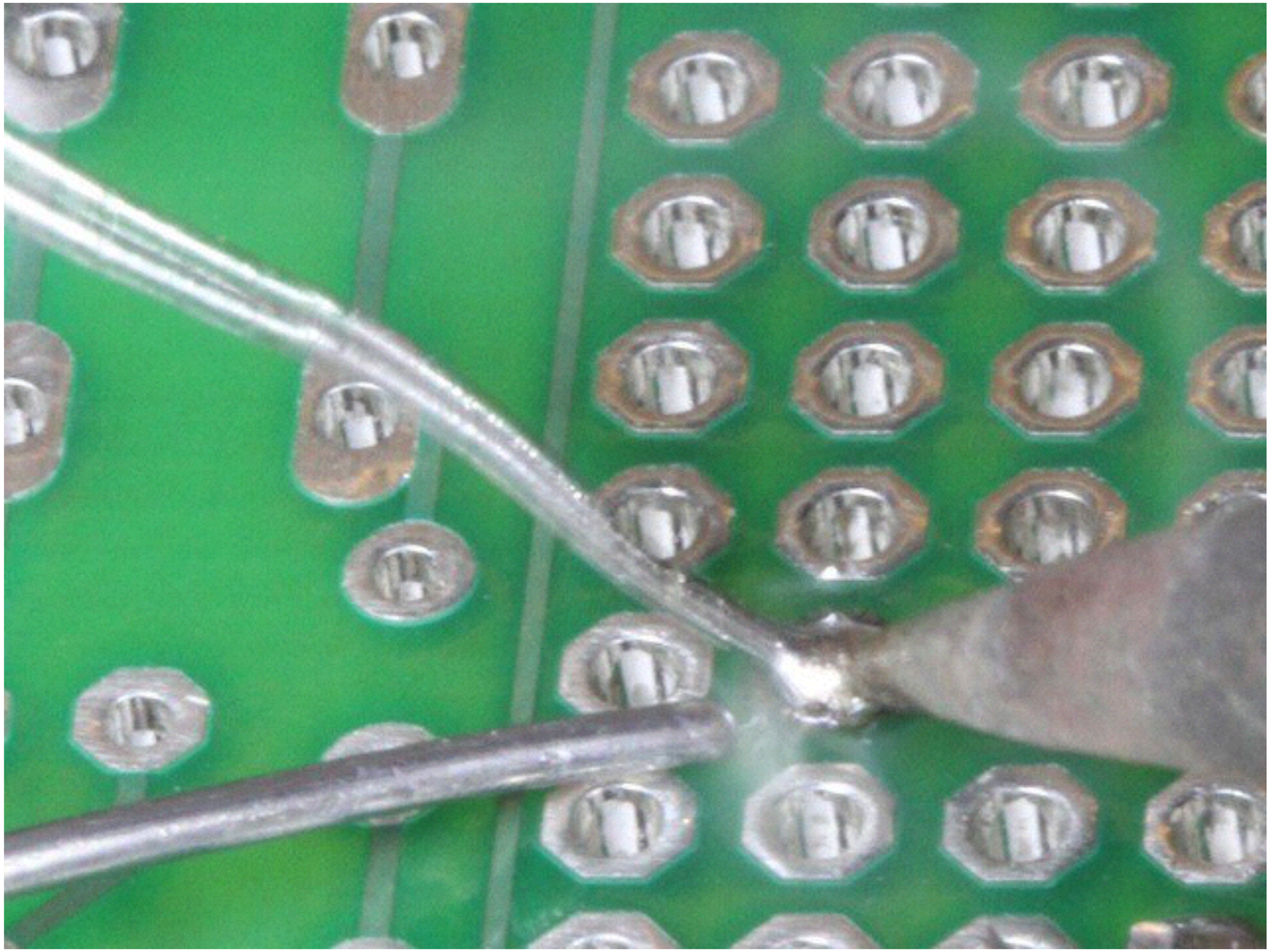


Image: adafruit.com

4. Let the joint cool and trim/clean

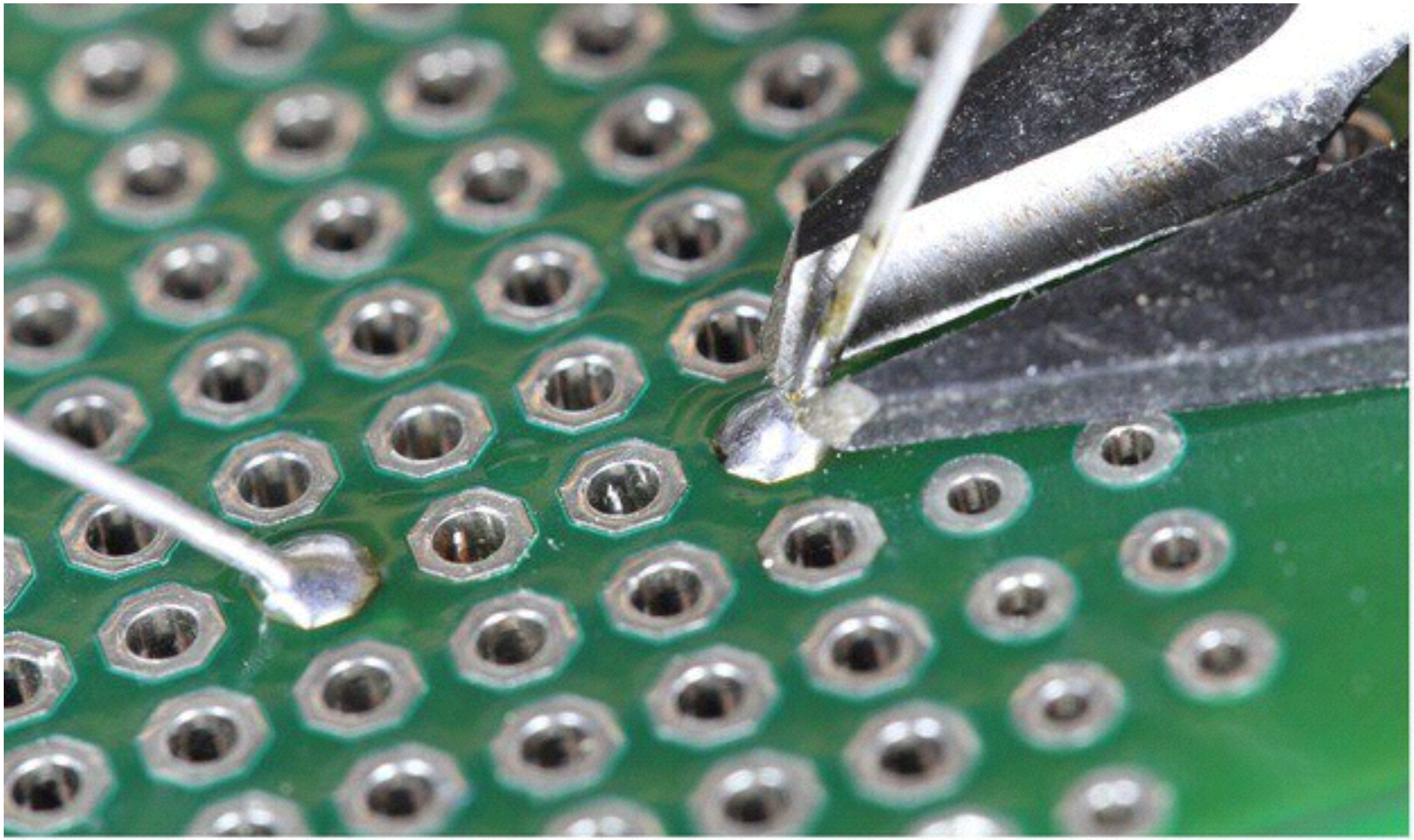
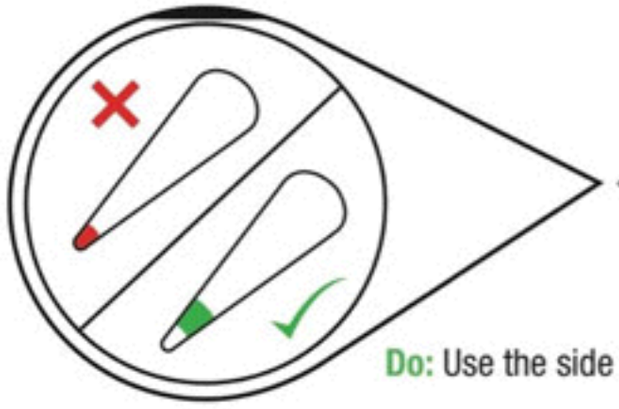


Image: adafruit.com



Don't: Use the very tip of the iron.

Do: Use the side of the tip of the iron, "The Sweet Spot."

Do: Touch the iron to the component leg and metal ring at the same time.

Do: While continuing to hold the iron in contact with the leg and metal ring, feed solder into the joint.

Don't: Glob the solder straight onto the iron and try to apply the solder with the iron.

Do: Use a sponge to clean your iron whenever black oxidization builds up on the tip.

A Solder flows around the leg and fills the hole - forming a volcano-shaped mound of solder.

B Error: Solder balls up on the leg, not connecting the leg to the metal ring.
Solution: Add flux, then touch up with iron.

C Error: Bad Connection (i.e. it doesn't look like a volcano)
Solution: Flux then add solder.

D Error: Bad Connection...and ugly...oh so ugly.
Solution: Flux then add solder.

E Error: Too much solder connecting adjacent legs (aka a solder jumper).
Solution: Wick off excess solder.

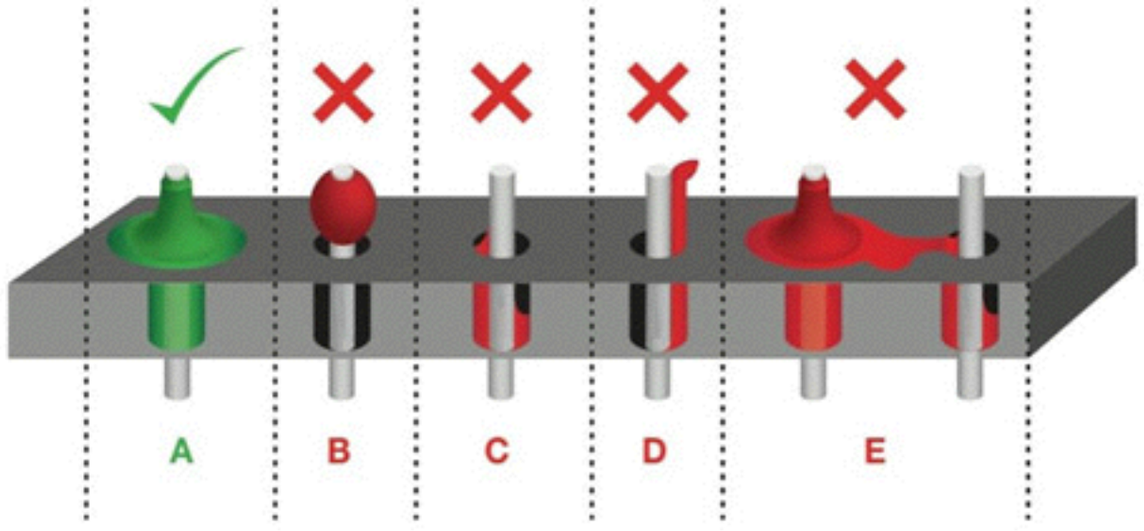
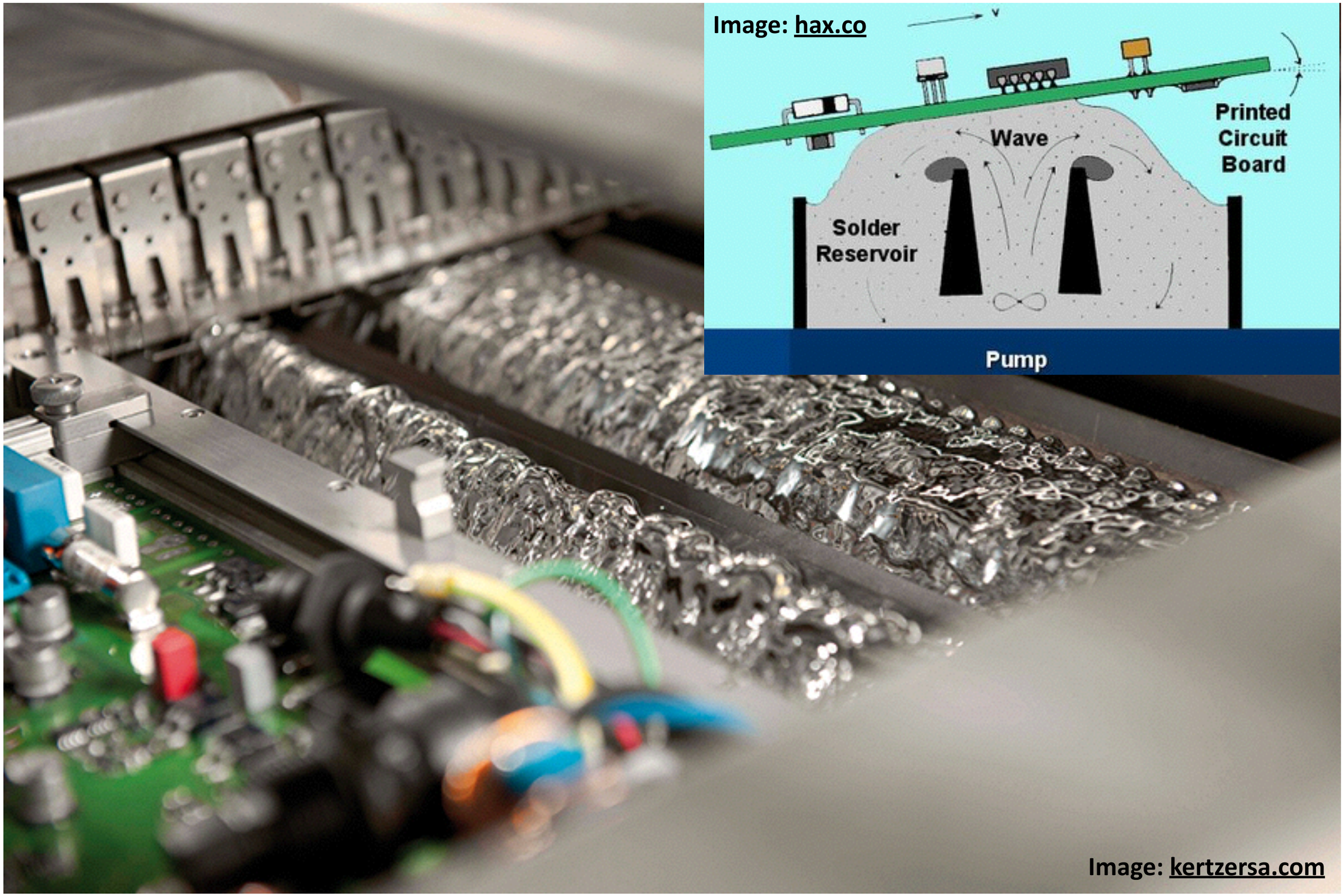


Image: sparkfun.com

Reflow soldering can be used on surface mount boards

Image: J.R. Leeman, Wikipedia

Wave soldering is another common commercial process



Activity: Blinky 2.0

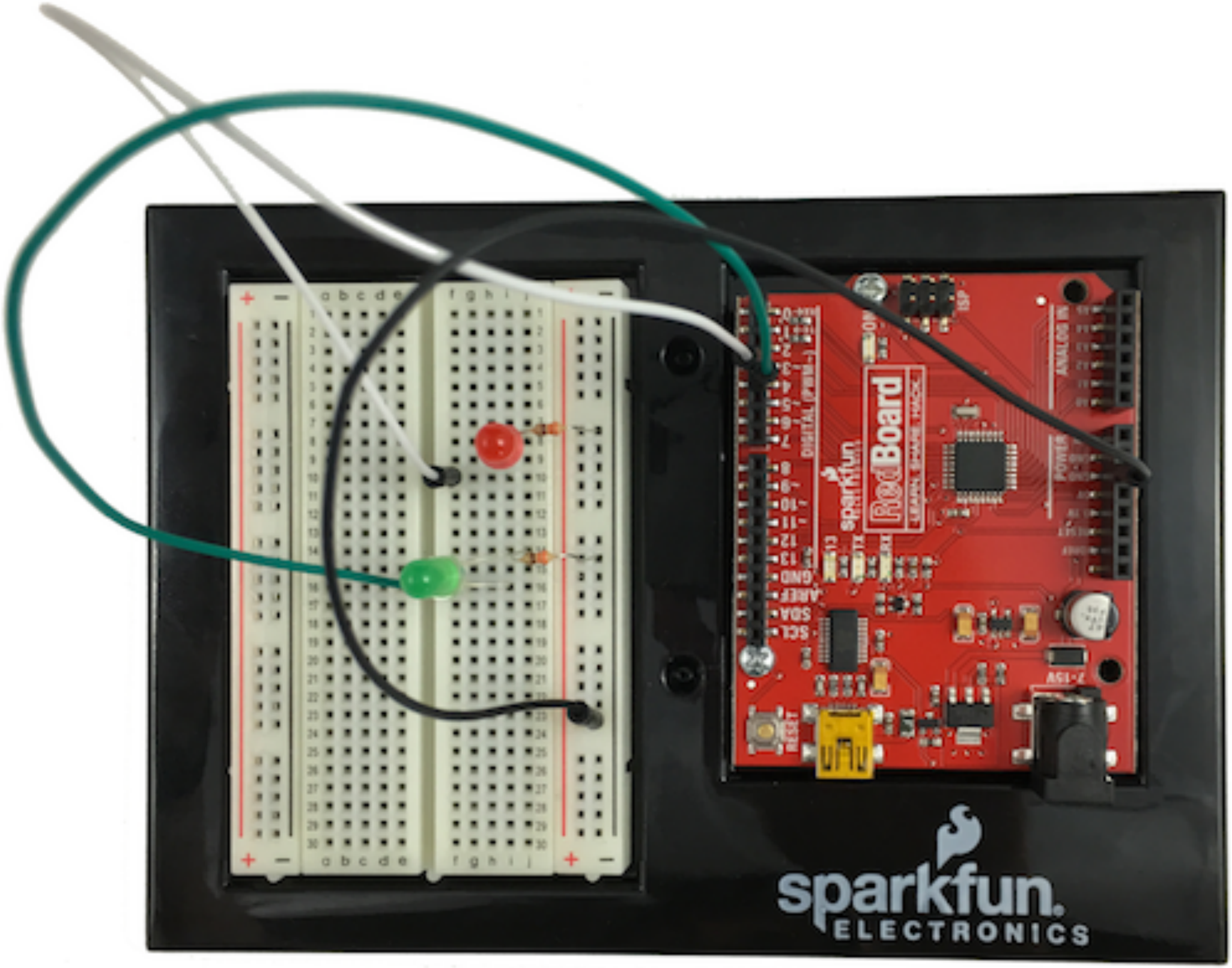
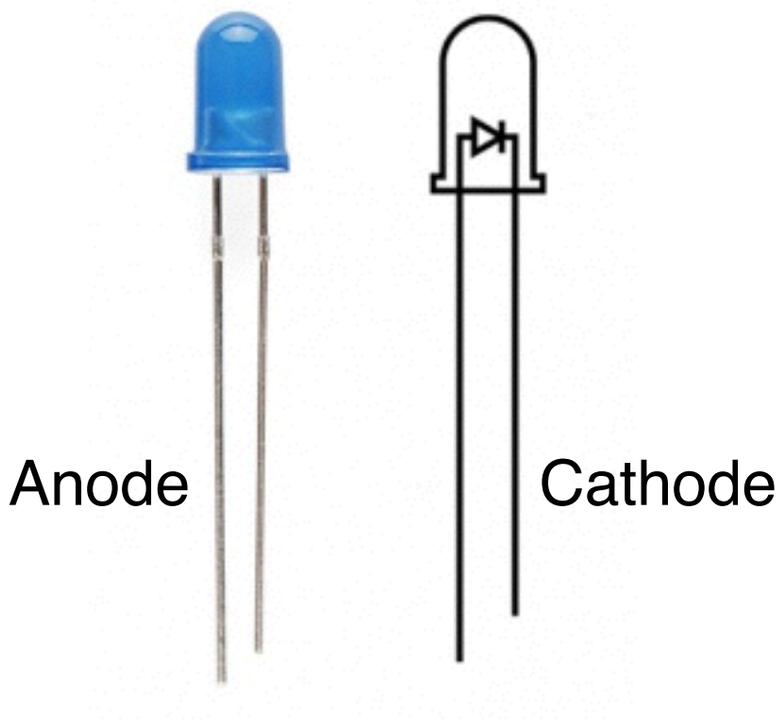


Image: J.R. Leeman

A note about LEDs



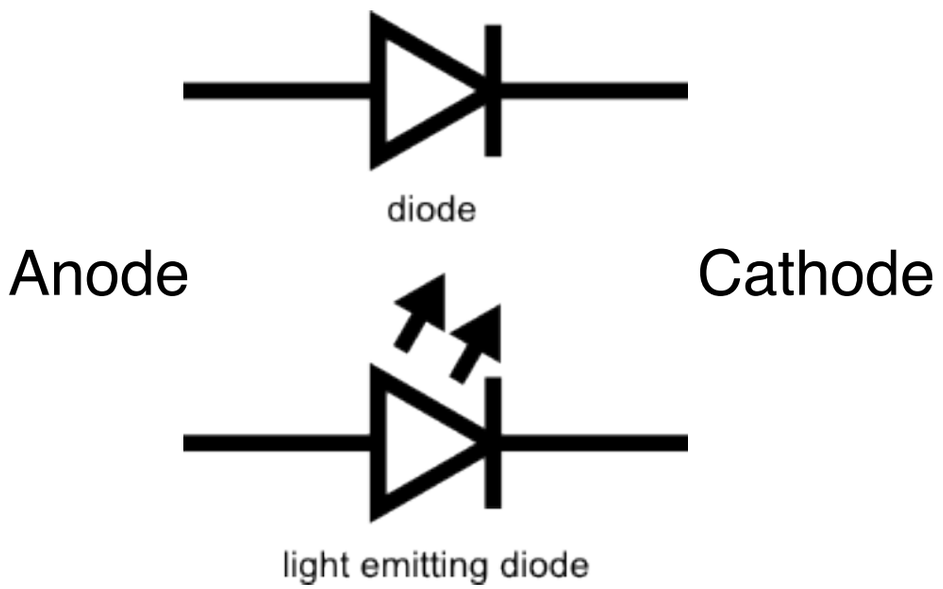
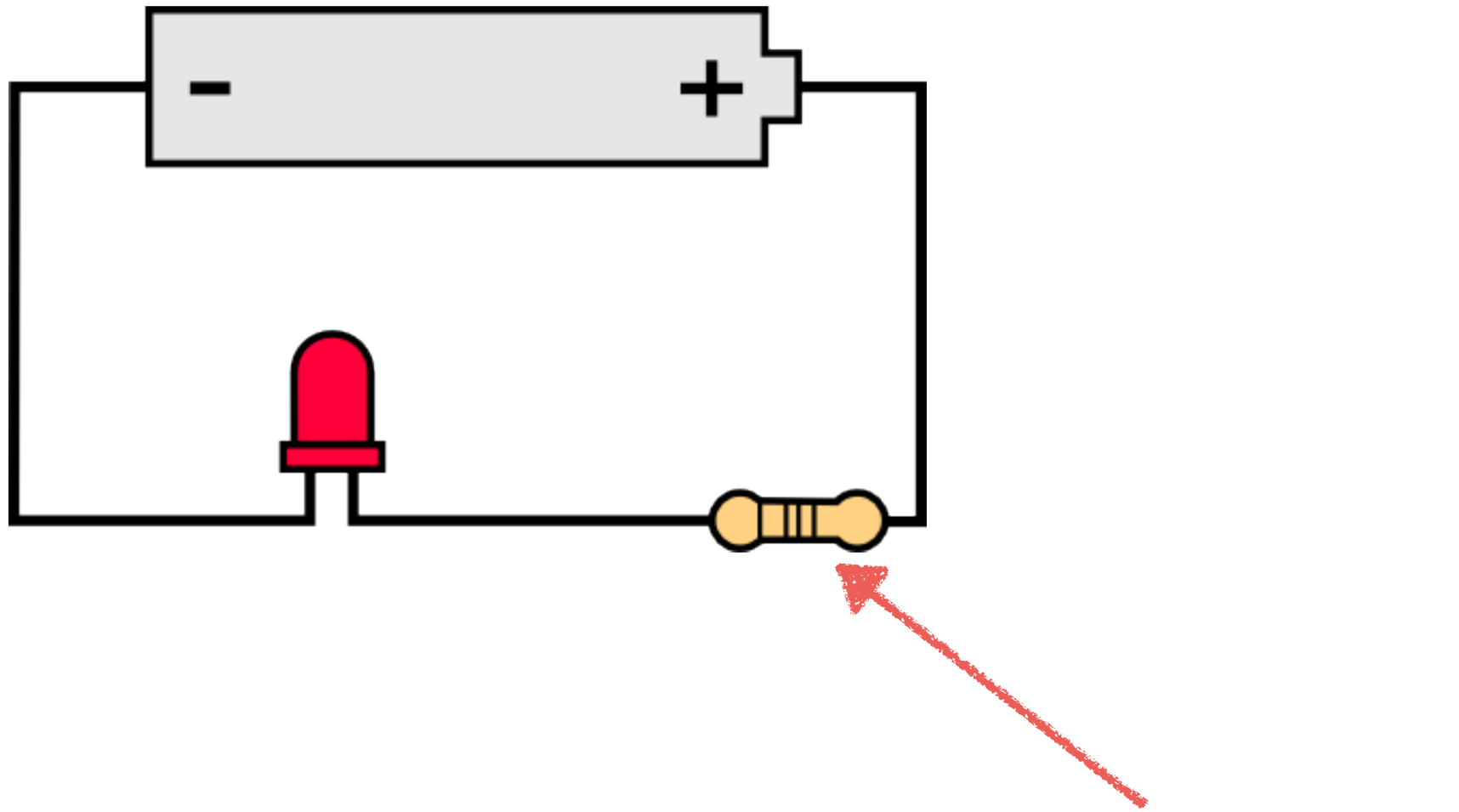


Image: sparkfun.com

A note about LEDs



Calculating the resistor value: https://www.sparkfun.com/tutorials/219

Image: sparkfun.com

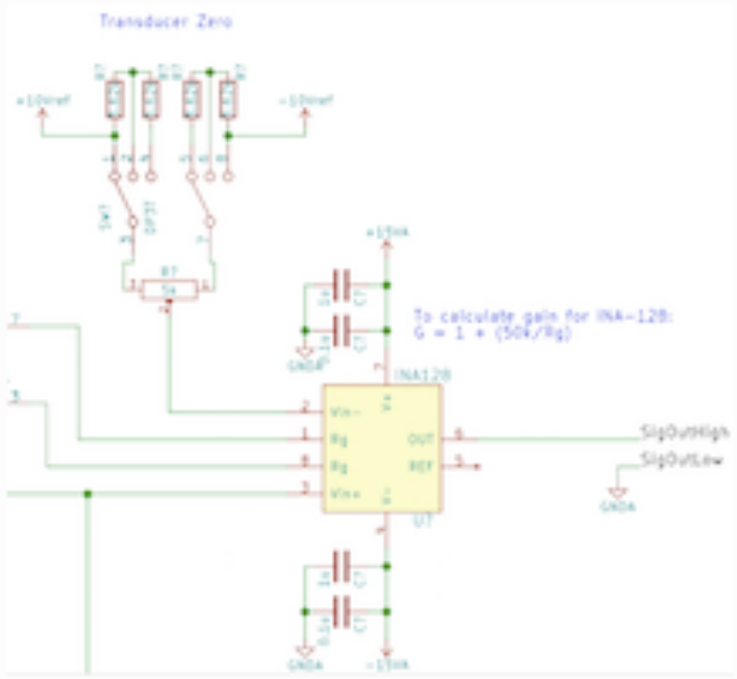
Assignment: Project Proposal

Project Proposal

After you have discussed your potential project ideas from the Project Brainstorm activity with the instructors, it is time to nail down exactly what your project will be and what the deliverables will be. Write a summary of one page or less that describes:

- What your project is
- What it will do
- What resources you will need to complete it.

This will serve as the specification document for your project goals at the end of the term.



DUE: 9/15/16

Assignment Summary

* Threading Activity: Next Tuesday (9/13/16)
* Blinky 2.0 (Photo/Code emailed): Next Tuesday (9/13/16)
* Project Proposal: Next Thursday (9/15/16)