

Brain Machine kit

Hack Your Brain With Sound & Light



open source
hardware



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cornFIELD electronics

What is a Brain Machine?



Photo by Sam Murphy

“Entrain” your brain to a desired brainwave sequence
through light and sound.

“Entrain” – definition:



Photo by Sam Murphy

“Entrain”: When your brain synchronizes to external brainwave frequencies

Brainwave Types

Beta: 13 to 30Hz

Conscious, External Focus

Alpha: 8 to 13Hz

Spacey, Dreamy, Receptive, Passive

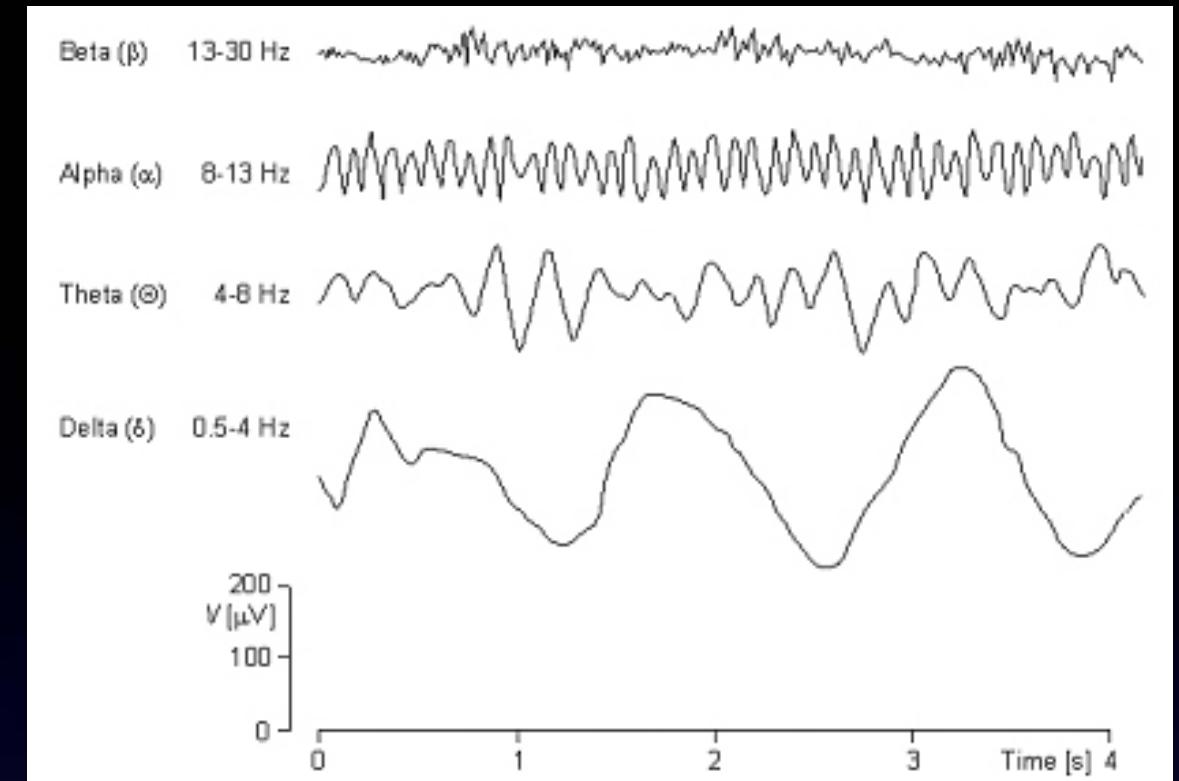
Theta: 4 to 8Hz

Subconscious, Deep Relaxation, Creativity

Delta: ½ to 4Hz

Unconscious, Intuition, Insight

Gamma: 30 to 100Hz Not well understood, linked to Perception, Alertness, Anxiety



Brainwave Sequences

Essentially the same for all healthy adults

Such as

Awake → Sleep

or

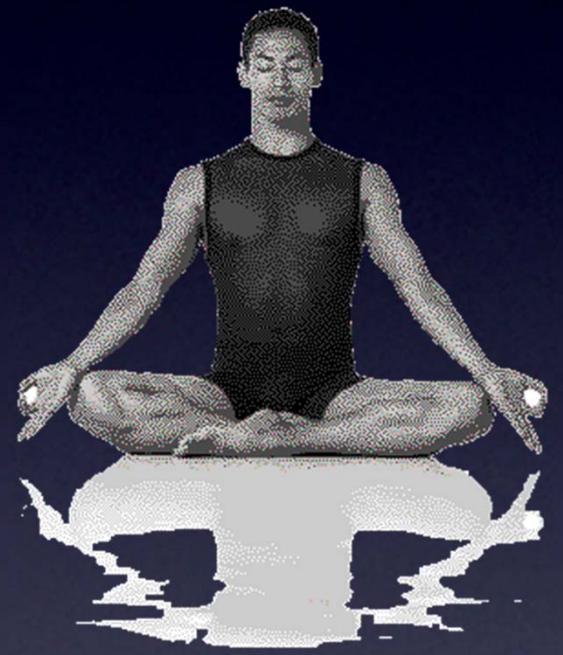
Awake → Meditation

Measurable with EEG
(brainwave monitor)

Brainwave Sequences

Essentially the same for all healthy adults

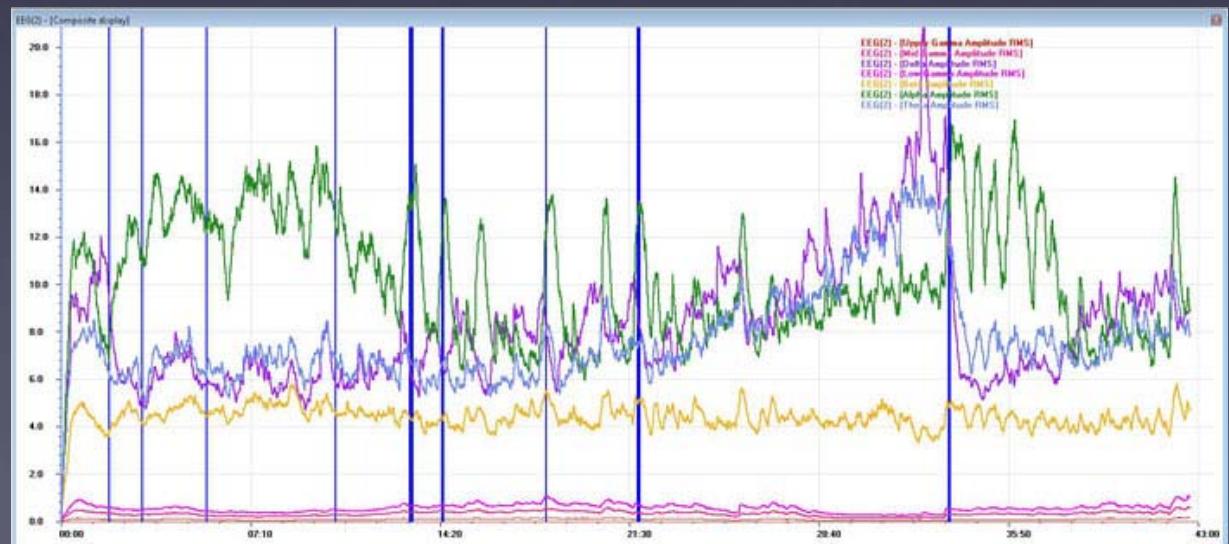
Example – Awake → Meditation:



- Beta (awake)
- add Alpha (spacey, dreamy)
- less Beta (less awake)
- add Theta (subconscious)
- Delta (unconscious, insight)

- hang out here awhile
- reverse process

(come up feeling fabulous)



Genesis of My Idea (1993)

Questions popped up while meditating:

What would happen if you played back a
brainwave sequence?

Would your brain synch up?

Would you be in the associated state?

Brief history



Pulsing Sound in Ancient times:
Alpha and Theta
induced by ritual drum rhythms

Pulsing Light in the 2nd Century:
Ptolemy



Brief history (cont'd)



1920s:
Invention of EEG
Hans Berger categorizes
brainwave types

1930s:
W. Grey Walter first to knowingly
play brainwaves

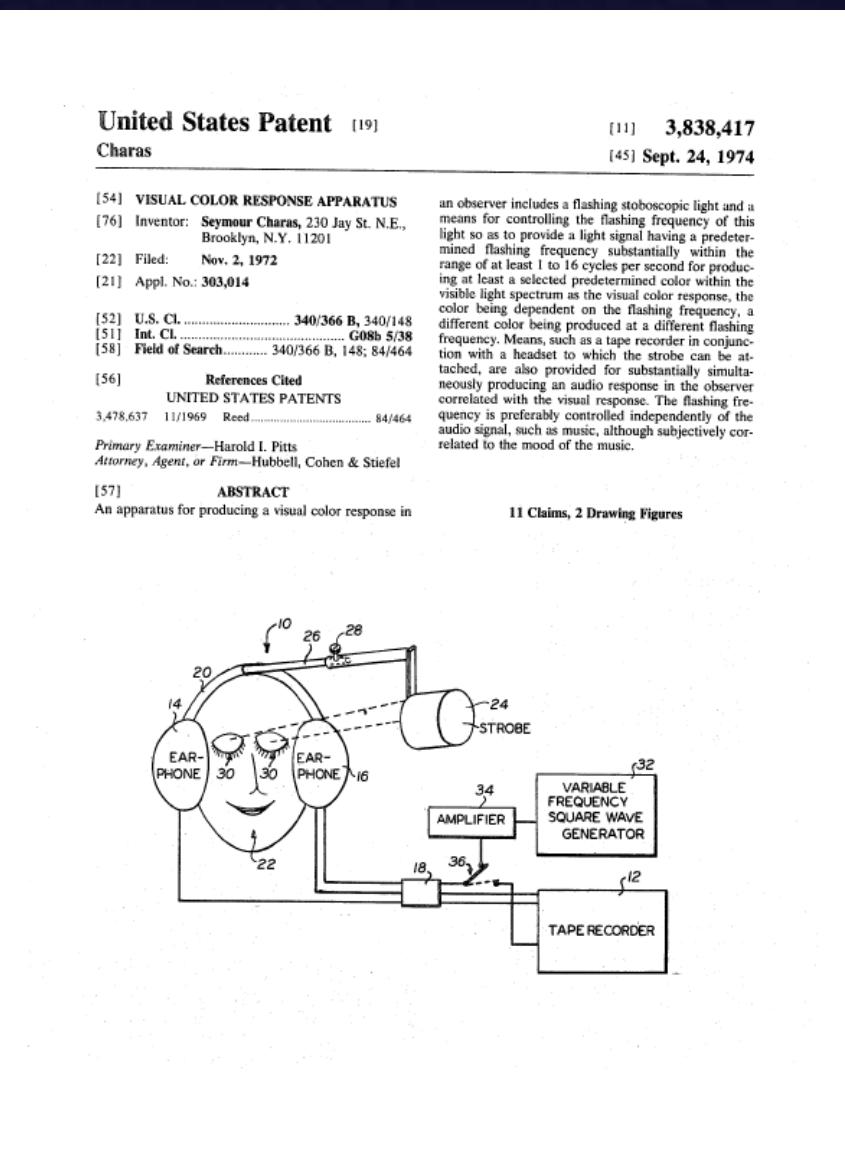


Brief history (cont'd)



1950s:
Invention of Dream Machine

1970s:
Research, first patent,
recordings of brainwave
sequences, Monroe Institute



Brief history (cont'd)

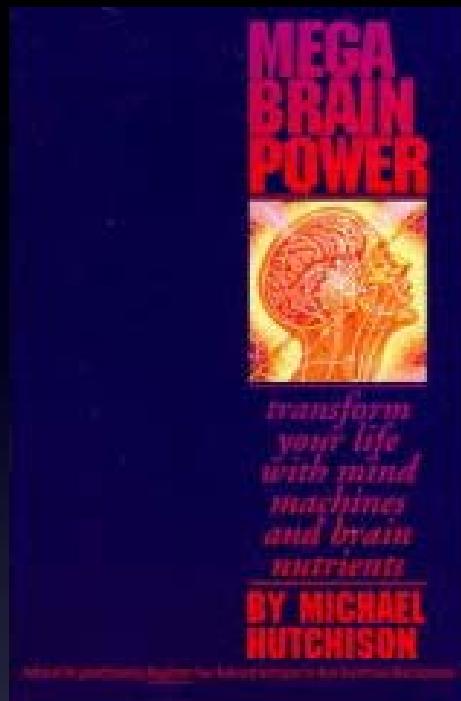


1950s:
Invention of Dream Machine

1970s:
Research, first patent,
recordings of brainwave
sequences, Monroe Institute,
Disco



Brief history (cont'd)



1980s & 1990s:
Medical studies
“Megabrain Power” by Hutchison
Popularity in mass culture
Beneficial claims

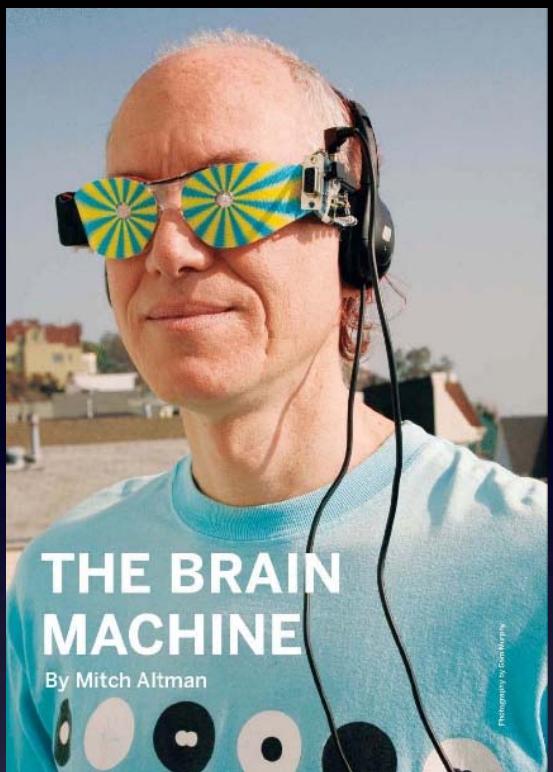
Are claims real?
Maybe some?
Certainly not all.
But why not try and see for yourself?

Cautionary Note:



Light and Sound Machines, such as this one, can be fun for many of us, but may be seriously dangerous for those prone to seizures or who are photosensitive.

Brief history (cont'd)



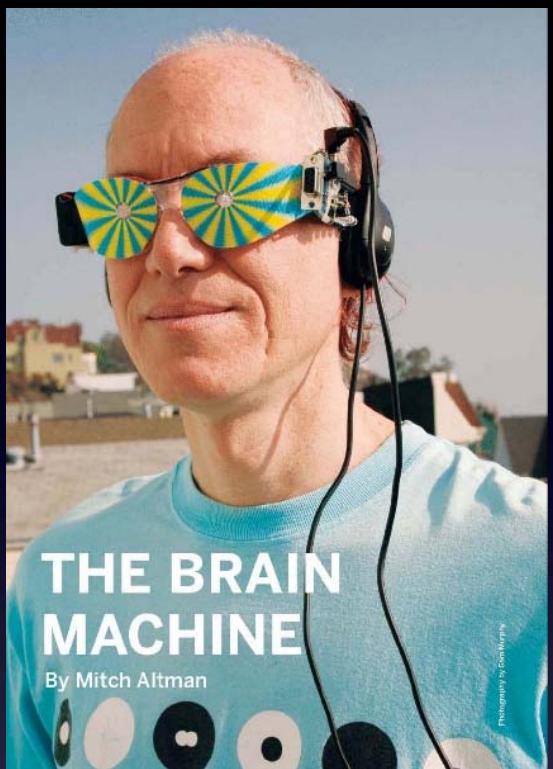
2007:
Make your own Brain Machine
article in MAKE #10

Brief history (cont'd)



“Weekend Projects” video by Bre Pettis, 2007

Brief history (cont'd)



2007:
Make your own Brain Machine
article in MAKE #10

Popular at parties



Motivation for MAKE Brain Machine

- Cheap (commercial “Mind Machines” cost \$\$\$)
- Beginner’s project
- Show how fun microcontrollers are
- Hallucinate wildly without side-effects
- Trick people into meditating



Hack of
Ladyada's
MiniPOV kit

New Version of the Brain Machine kit

- Way easier to solder
- Uses Arduino – way easy to re-program and hack on
- Very well documented – easy to modify, great to learn from
- Easily add Gamma waves to a Brainwave sequence
- Easily to add alternate blinking LEDs (left/right)
- Runs on one AAA battery – light-weight / more comfortable



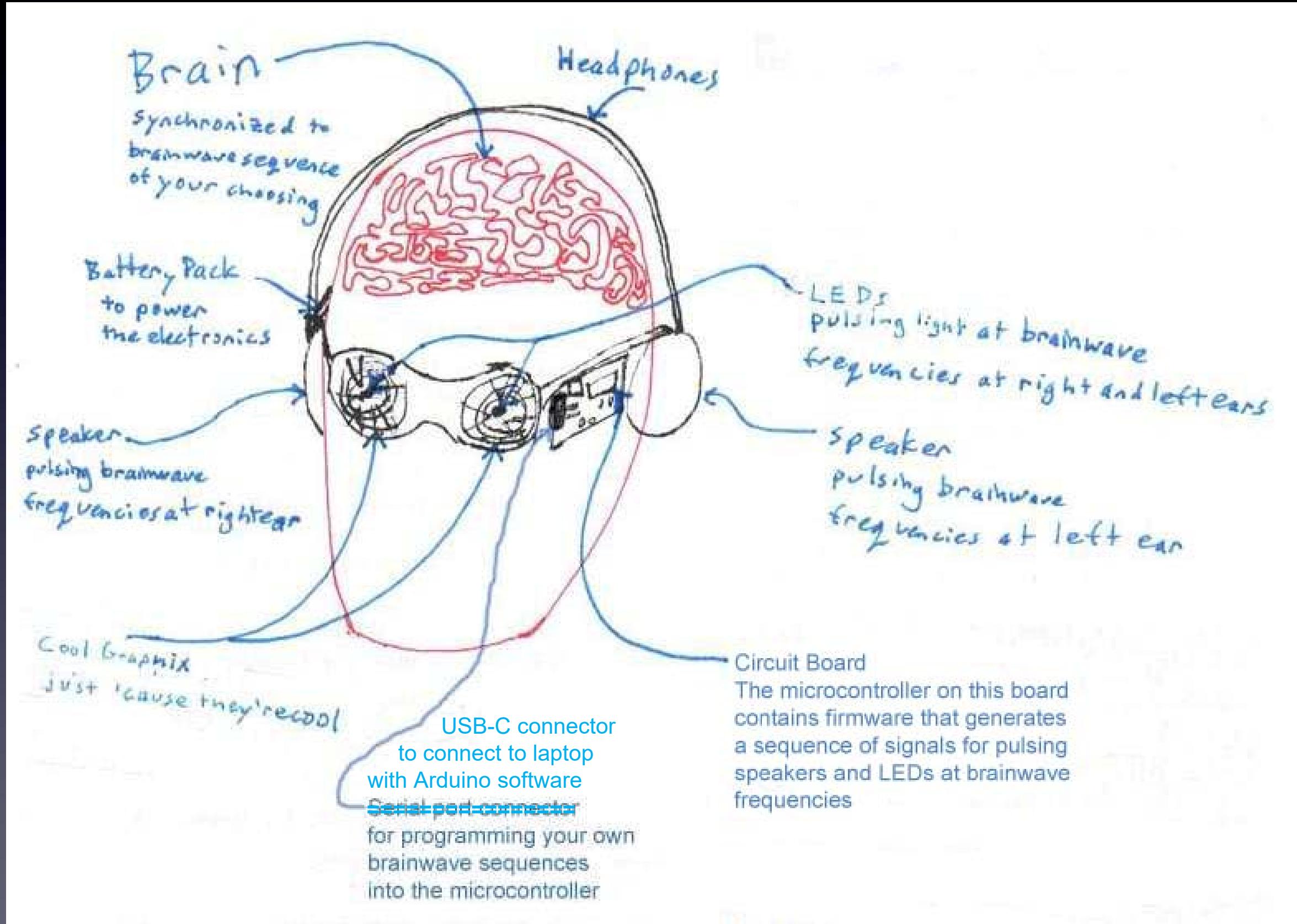
Brain Machine Theory

Sound & Light together
to entrain (non-invasively)
your brain to a brainwave sequence

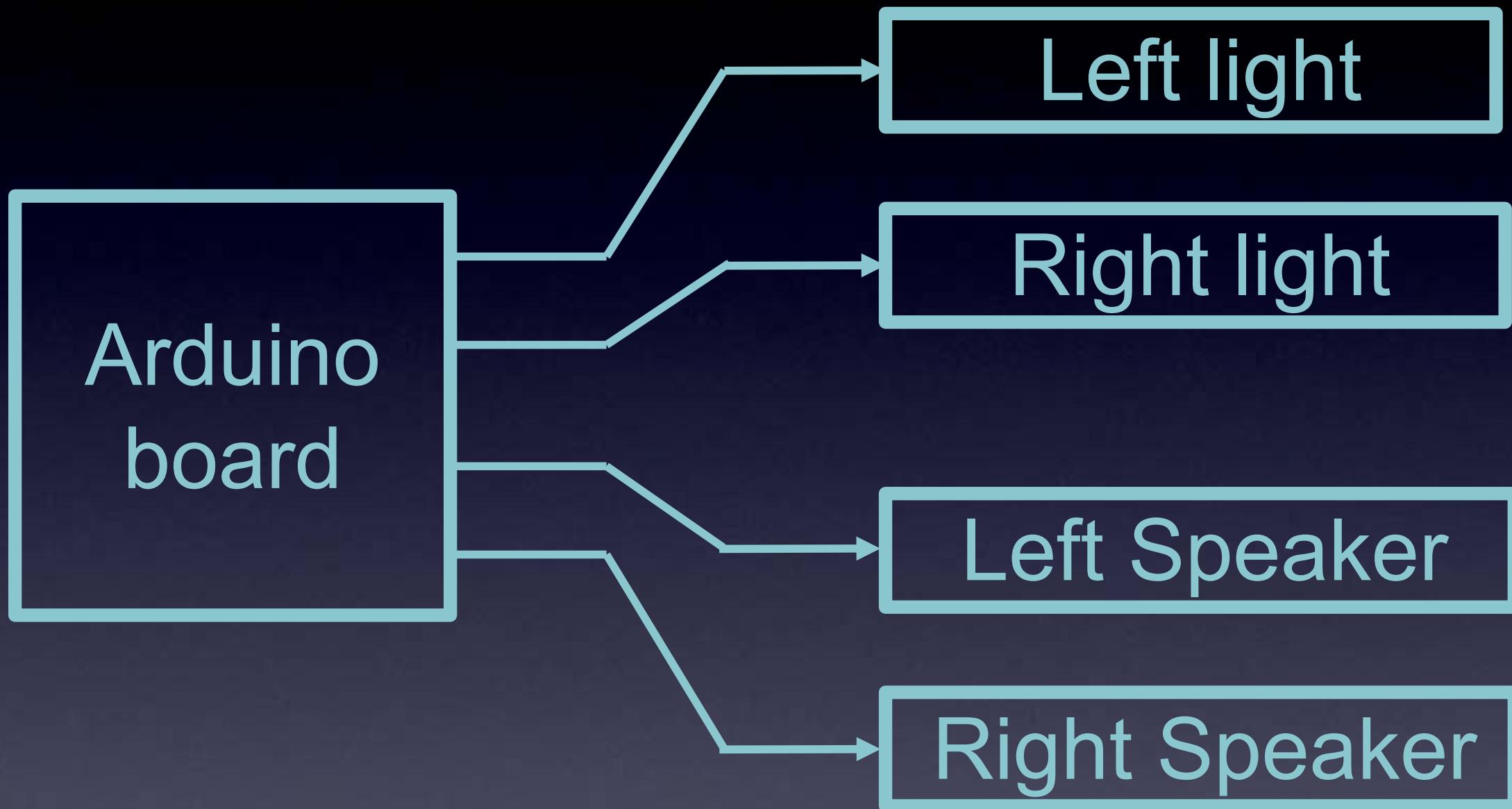
Simplified model for a brainwave sequence:
only one brainwave frequency at a time

Brain Hacking:

By pulsing sound & light at brainwave frequencies
you can make your brain track any sequence you like



Hardware



Program / Firmware / “Sketch”

Brainwave Table

Play
each entry
in the
Brainwave Table

- Start with lots of Beta
(awake / conscious)
- Add Alpha
(dreamy / trancy)
- Reduce Beta
(less conscious)
- Start adding Theta
(more subconscious)
- Pulse in some Delta
(creativity)
- Then reverse
the above

(to come up refreshed)

Program / Firmware / “Sketch”

Brainwave Table (detailed)

```
} const brainwaveTab[] PROGMEM = {  
    { 'b', 600000 }, ← Beta waves for 60 seconds  
    { 'a', 100000 }, ← Alpha waves for 10 seconds  
    { 'b', 200000 },  
    { 'a', 150000 }, (divide by 10,000 to get seconds)  
    { 'b', 150000 },  
    { 'a', 200000 },  
    { 'b', 100000 },  
    { 'a', 300000 },  
    { 'b', 5000 },  
    { 'a', 600000 },  
    { 't', 100000 },  
    { 'a', 300000 },  
    { 't', 200000 },  
    { 'a', 300000 },  
    { 't', 300000 },  
    { 'a', 150000 },  
    { 't', 600000 },  
    { 'a', 150000 },  
    { 'b', 10000 },  
    { 'a', 150000 },  
    { 't', 600000 },  
    { 'd', 10000 },
```

```
{ 't', 100000 },  
{ 'd', 10000 },  
{ 't', 100000 },  
{ 'd', 10000 },  
{ 't', 300000 },  
{ 'a', 150000 },  
{ 'b', 10000 },  
{ 'a', 150000 },  
{ 't', 300000 },  
{ 'a', 150000 },  
{ 'b', 10000 },  
{ 'a', 200000 },  
{ 'b', 50000 },  
{ 'a', 200000 },  
{ 'b', 150000 },  
{ 'a', 150000 },  
{ 'b', 200000 },  
{ 'a', 100000 },  
{ 'b', 250000 },  
{ 'a', 50000 },  
{ 'b', 600000 },  
{ '0', 0 }           ← last entry is always {'0', 0}  
};
```

- use Upper-Case for alternating blinking Left/Right (instead of simultaneous blinking in both eyes)
example: {‘B’, 600000}, -- Blink lights alternately at Beta for 60 seconds
- use ‘g’ or ‘G’ for Gamma waves
example: {‘g’, 6000000}, -- Blink lights at Gamma for 600 seconds (10 minutes)

Binaural Beats

An effective means for entraining
your brain to sound

Somewhat like beat frequencies:



Base tone Alpha Offset tone Alpha Beat Frequency

Binaural Beats

An effective means for entraining
your brain to sound

Somewhat like beat frequencies:



Base tone Alpha Offset tone Alpha Beat Frequency

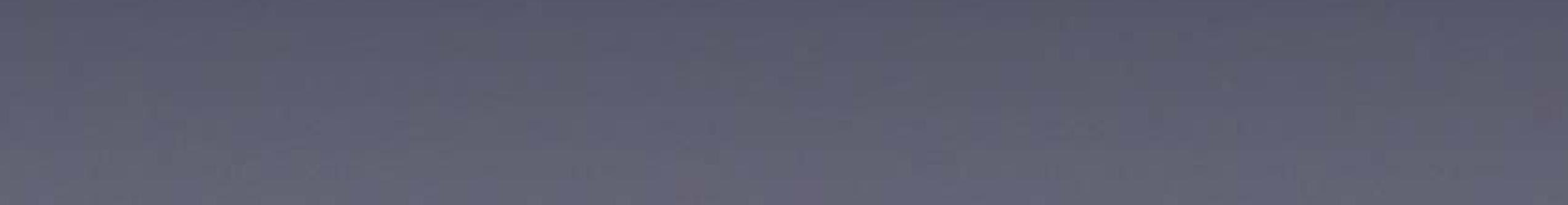
*Except it's just in your head!
(not physical – only perceived)*

Meditation

Here are just a few different ways to meditate:

- breathe
- follow thoughts
- ignore thoughts
- focus on an intention (like a problem)
- make up your own way

What's It Like?



What's It Like?

A few photos

from my

Brain Machine workshop

at Chaos Communications Camp 2007:

What's It Like?



What's It Like?



What's It Like?



What's It Like?



What's It Like?



What's It Like?



What's It Like?



What's It Like?



What's It Like?



What's It Like?



What's It Like?



What's It Like?



What's It Like?



What's It Like?



What's It Like?



What's It Like?



What's It Like?



What's It Like?



What's It Like?



What's It Like?



What's It Like?



What's It Like?



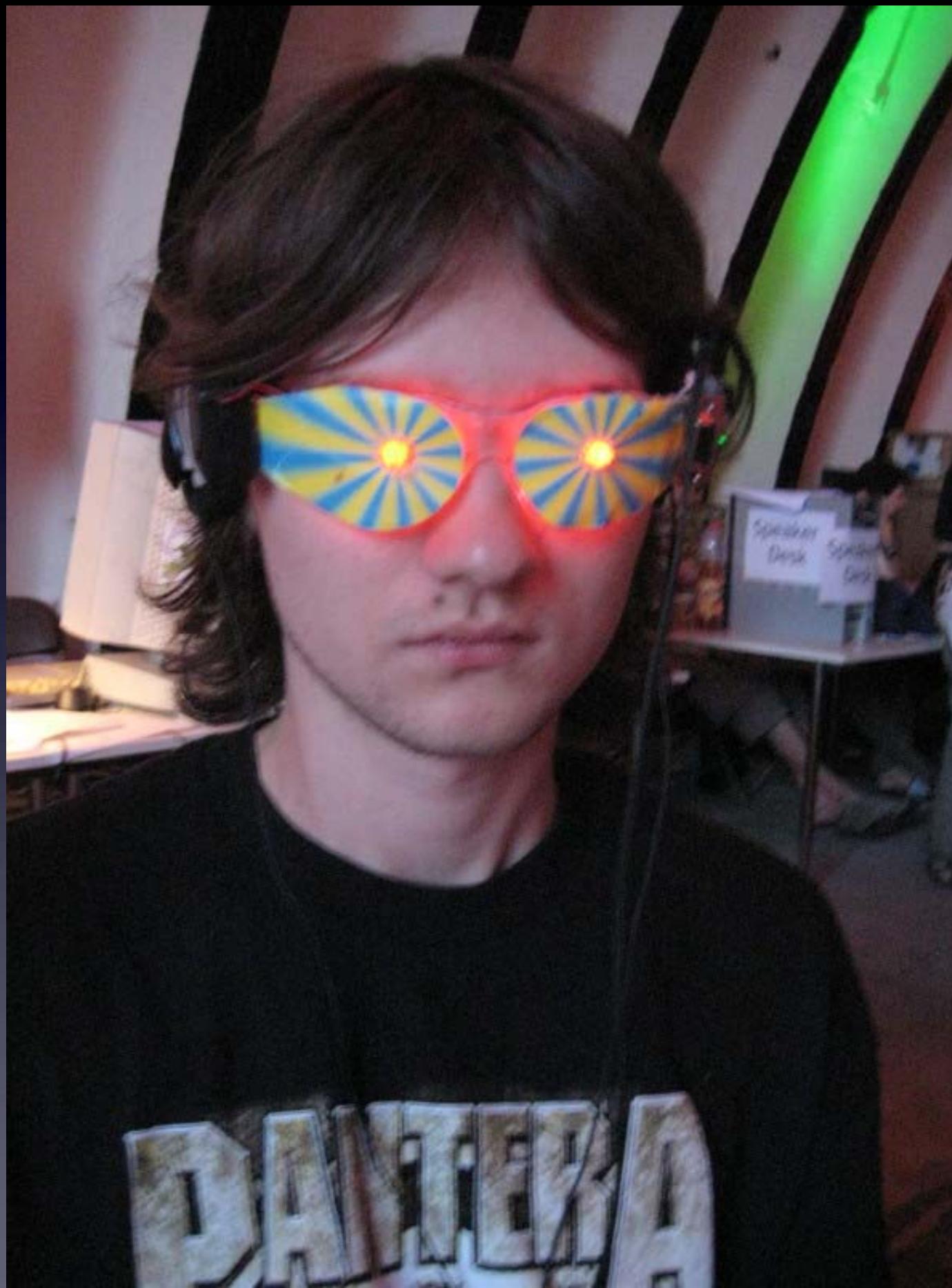
What's It Like?



What's It Like?



What's It Like?



What's It Like?



What's It Like?



What's It Like?



What's It Like?



What's It Like?



What's It Like?



What's It Like?



What's It Like?



What's It Like?



What's It Like?



What's It Like?



What's It Like?



What's It Like?



What's It Like?



What's It Like?



What's It Like?



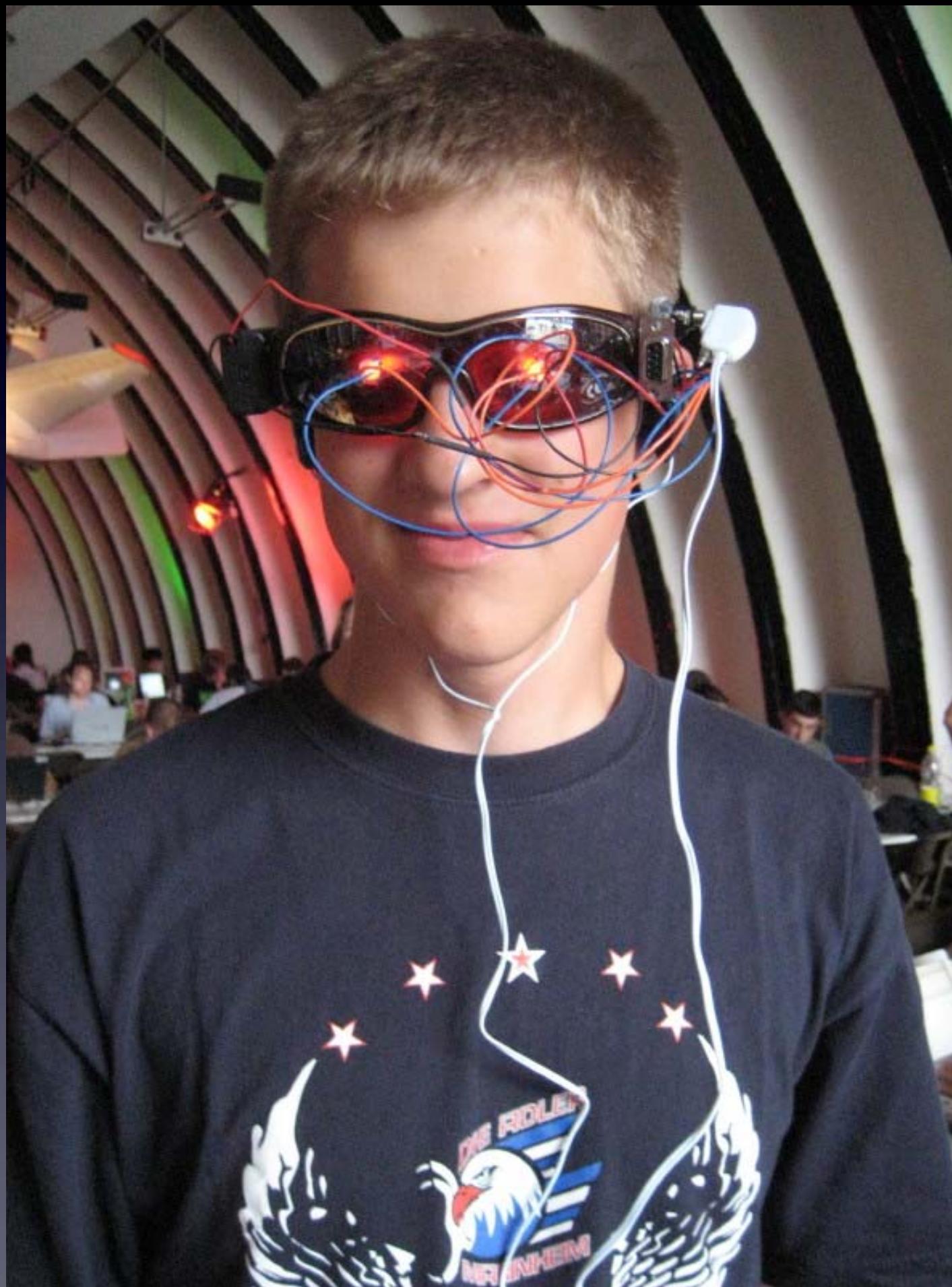
What's It Like?



What's It Like?



What's It Like?



What's It Like?



What's It Like?



What's It Like?



What's It Like?



What's It Like?



What's It Like?



What's It Like?



What's It Like?



What's It Like?



What's It Like?



What's It Like?



What's It Like?



What's It Like?



What's It Like?



Further Study

Books:

“Megabrain Power: New Tools and Techniques for Brain Growth and Mind Expansion.” by Michael Hutchison, Ballantine Books, 1996

“The High-Performance Mind” by Anna Wise, Tarcher, 1997

“Dreamachine Plans” by Brion Gysin, Temple Press, 2006

“The Living Brain” by W. Grey Walter, Penguin, 1967

Websites:

Anna Wise:

<http://www.annawise.com>

– *Unfortunately, Anna Wise died in 2010, and since then not much has happened with her technology*

“Clinical Guide to Light and Sound” by Thomas Budzynski, PhD:

<http://sica.stanford.edu/events/brainwaves/theclinicalguidetoundsoundandlight.pdf>

– *Unfortunately, this link no longer works, and the PDF seems to have disappeared from the internet*

Seymour Charas’ 1974 patent (first SLM patent):

<https://ppubs.uspto.gov/pubwebapp/static/pages/ppubsbasic.html>

Quick lookup: 3838417

The Monroe Institute:

<http://www.monroeinstitute.com/>

– *Unfortunately, the founder, Robert Monroe, died in 1995, and since then the website has lost its repository of useful information*

Wikipedia has some interesting pages. A good starting place is the “Mind Machine” page:

http://en.wikipedia.org/wiki/Mind_machine

Questions?

(Don't bring these
home)

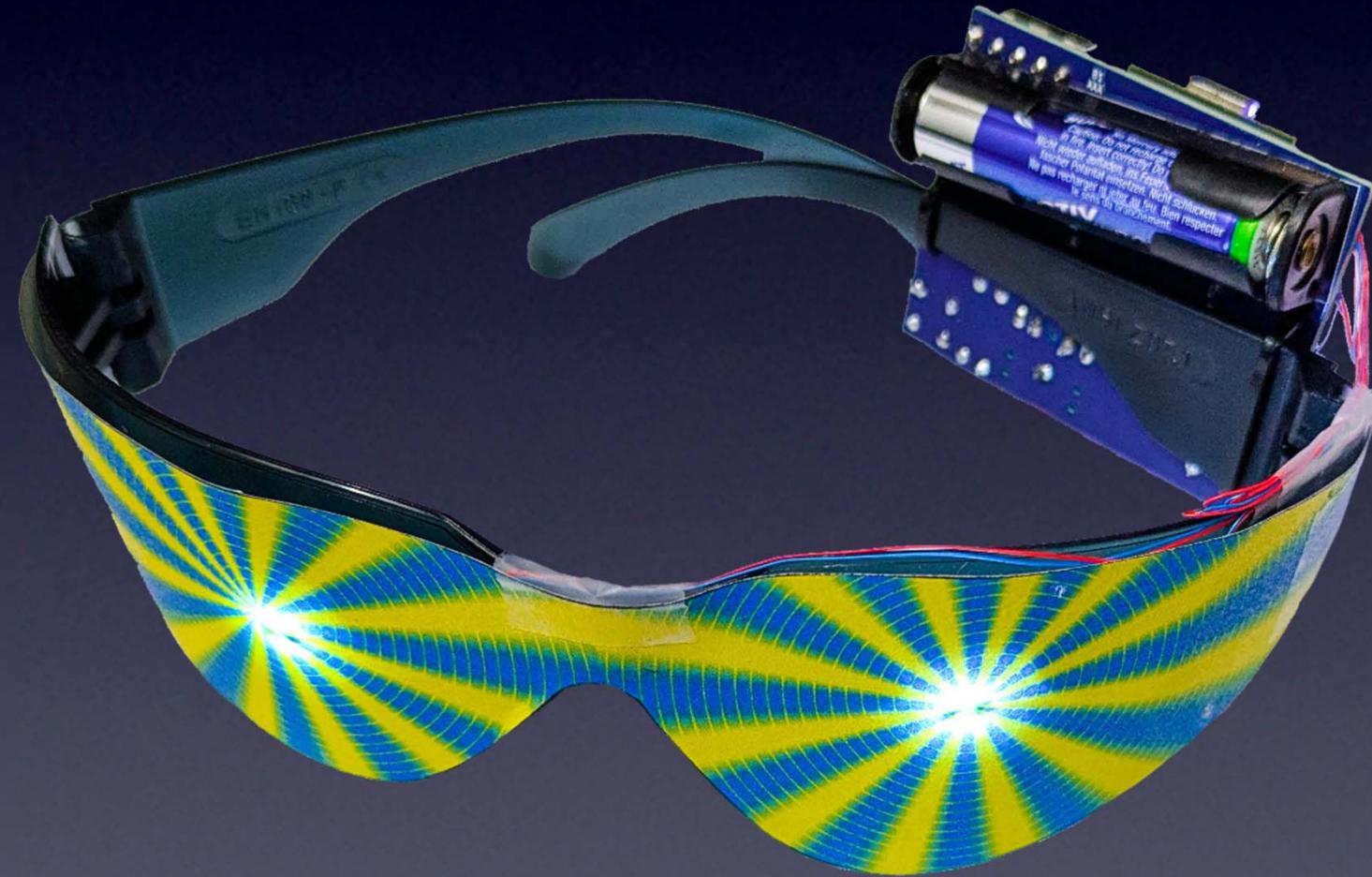


Tools



Your Brain Machine

Yours to bring home !



Learn To Solder

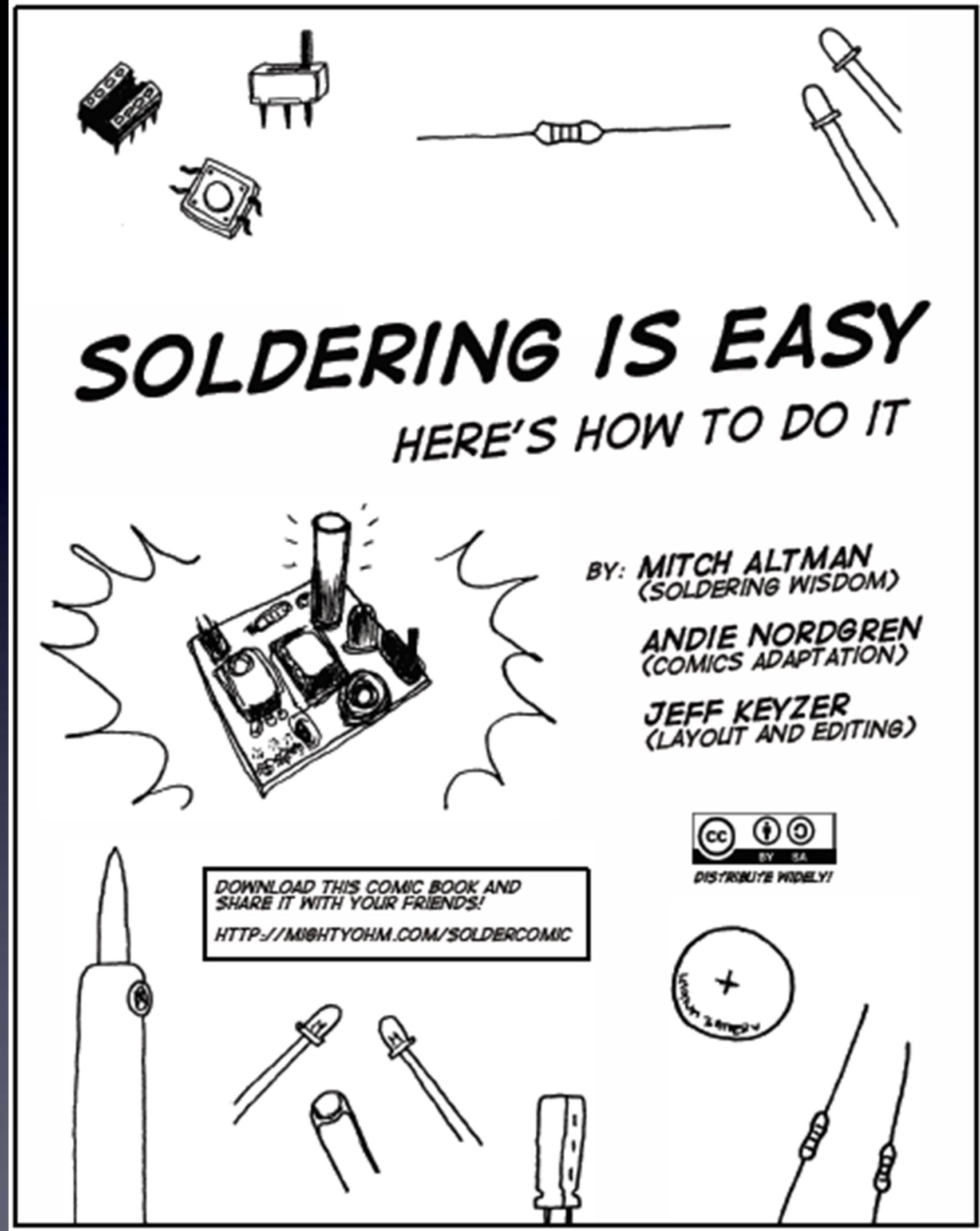


The following photos will show you how to solder.
But feel free to download the “Soldering Is Easy” comic book for free!

(In many different languages.)

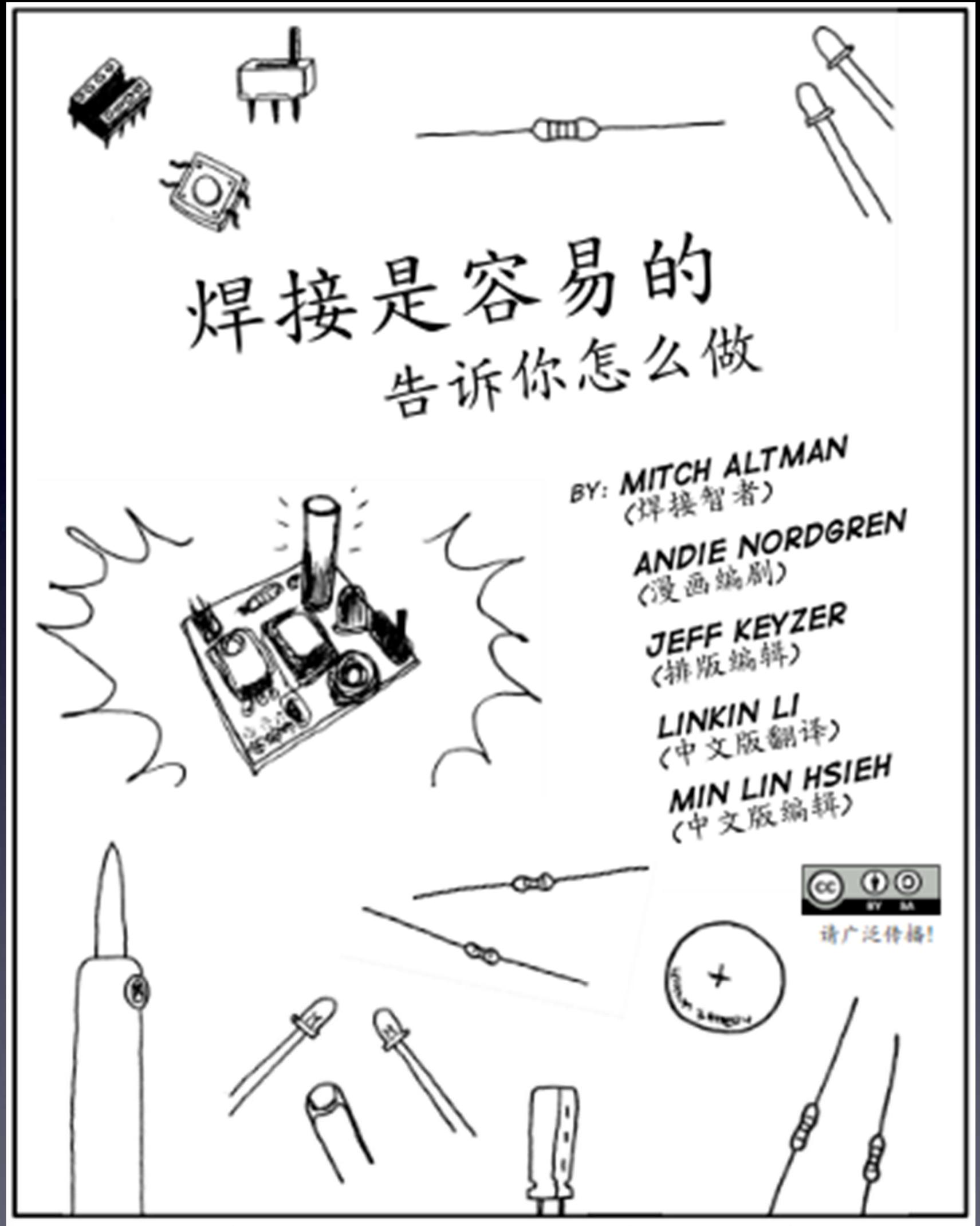
download for free at:
<http://mightyohm.com/soldercomic>

Learn To Solder



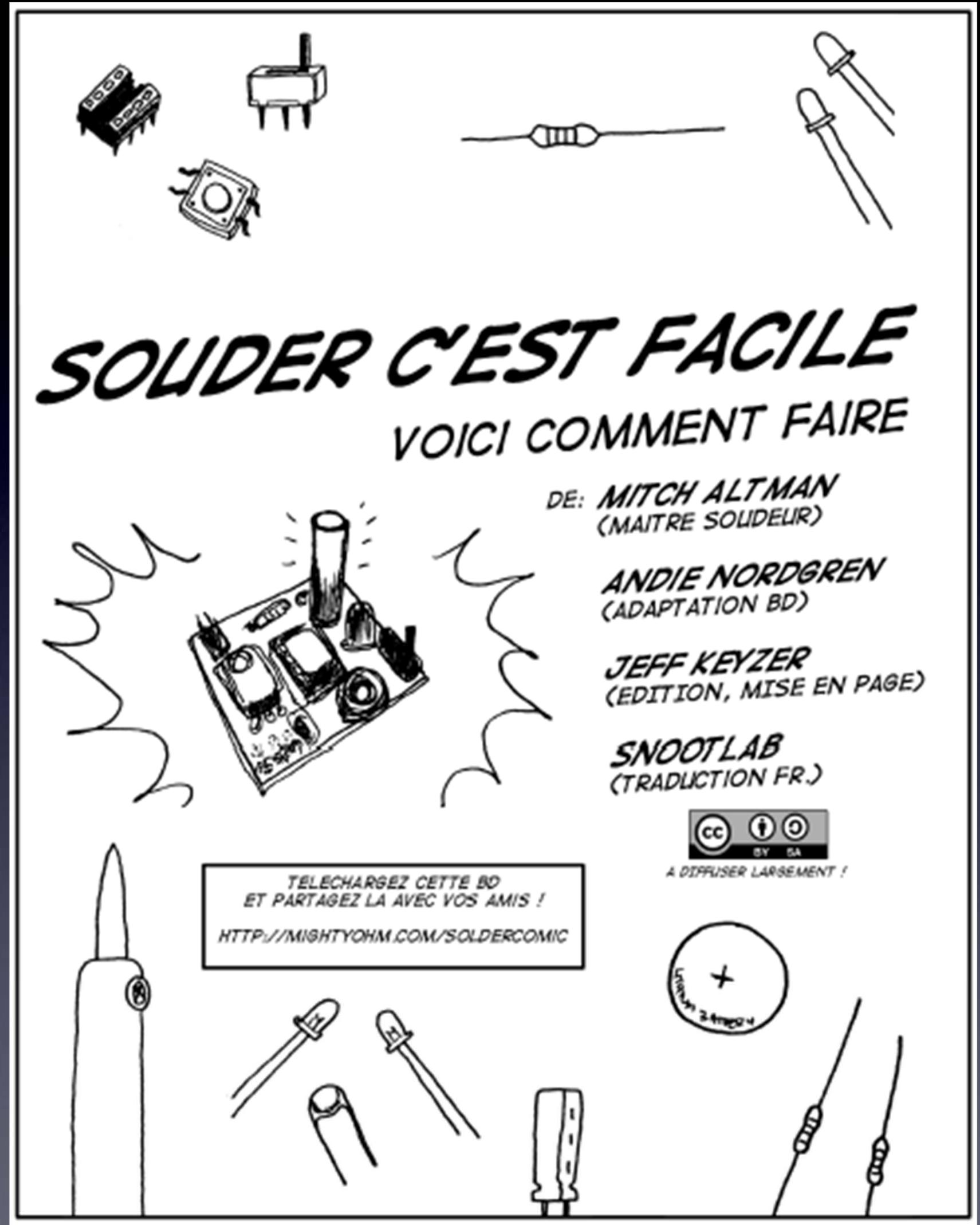
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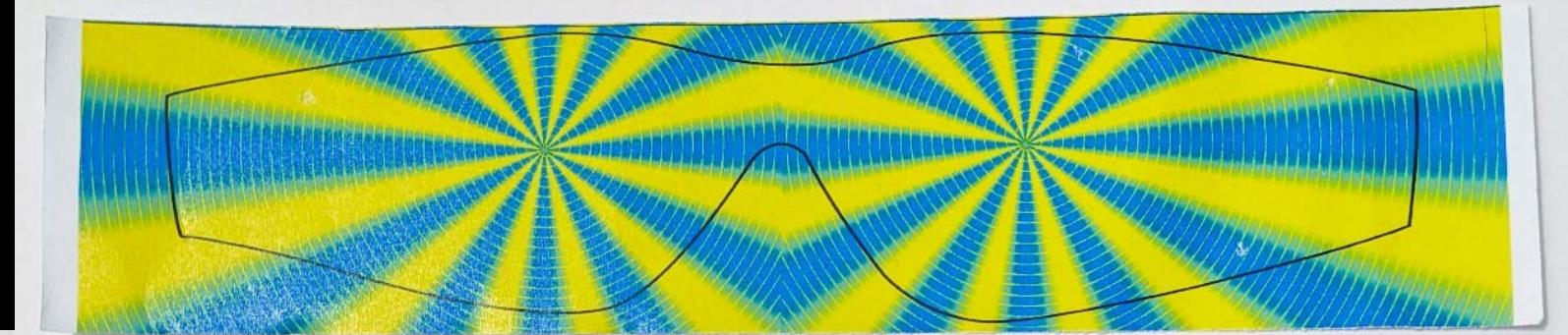
download for free at:
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Learn To Solder

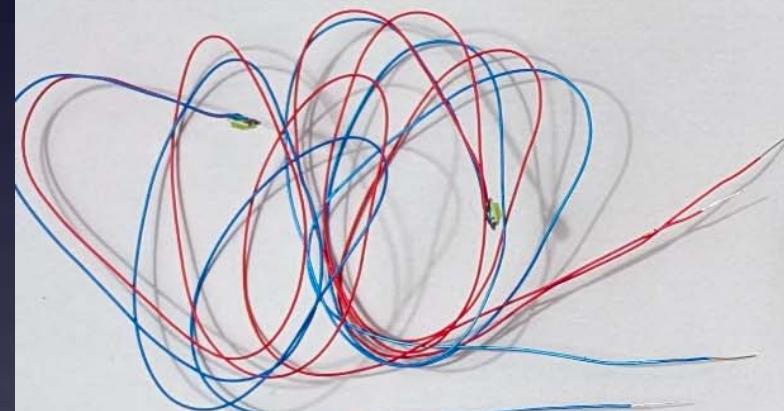


download for free at:
<http://mightyohm.com/soldercomic>
(In many different languages.)

Trippy Graphix



LED1, LED2



J1



C1, C2



Header pins

Arduino Nano

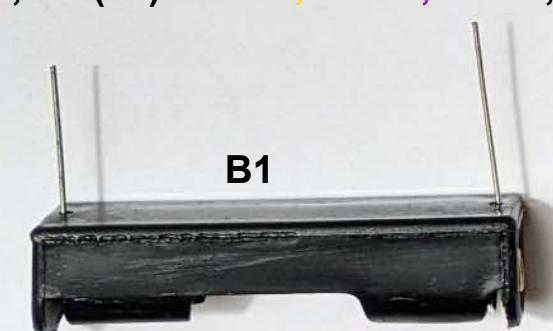


Power Supply

R1, R2 (4.7K) Yellow, Violet, Red, Gold



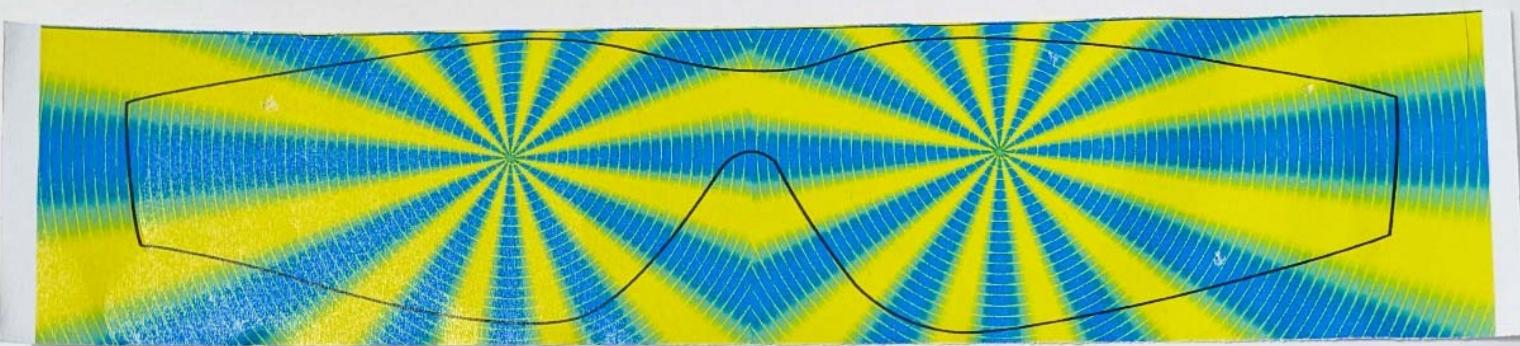
R3, R4 (47) Yellow, Violet, Black, Gold



B1



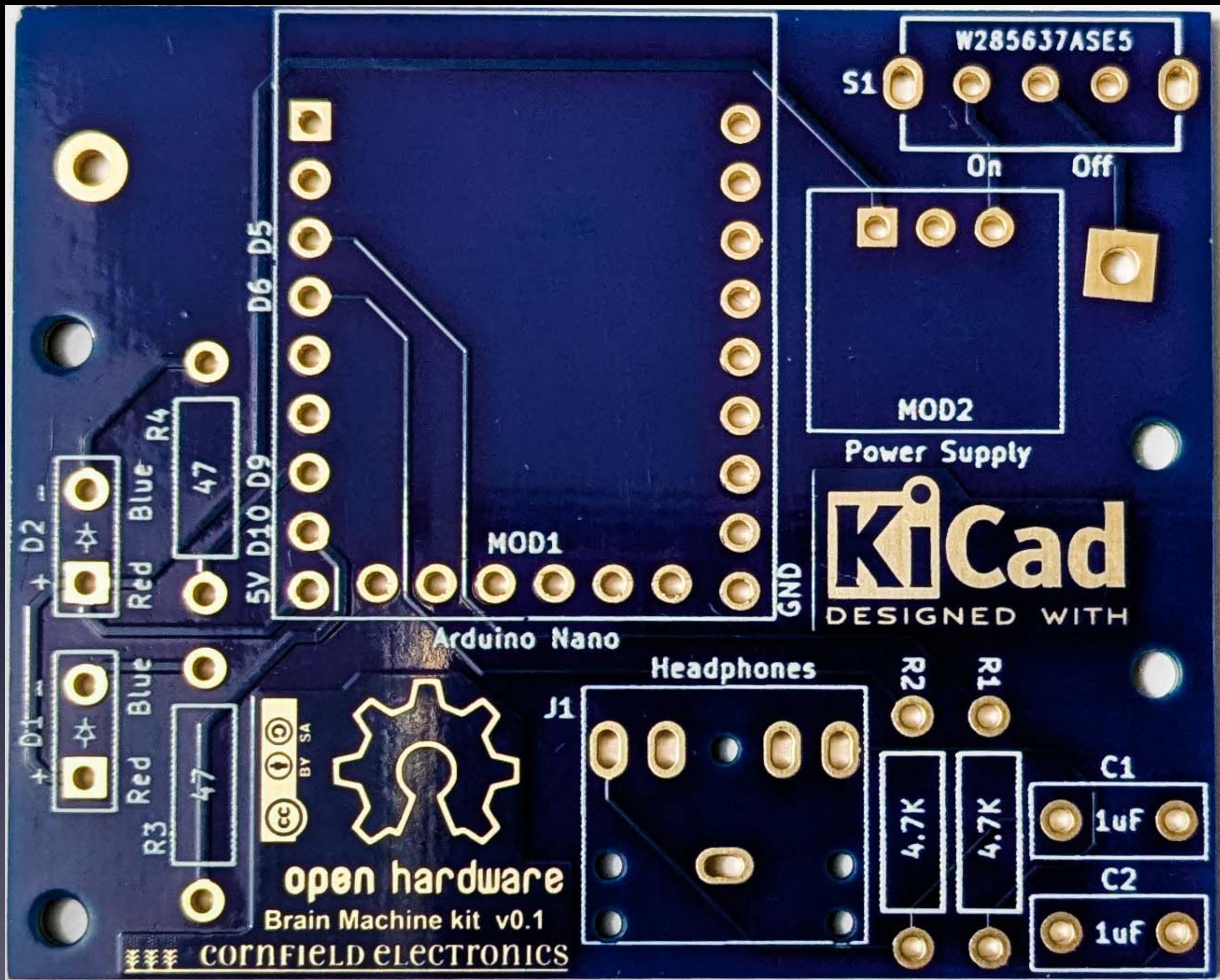
S1



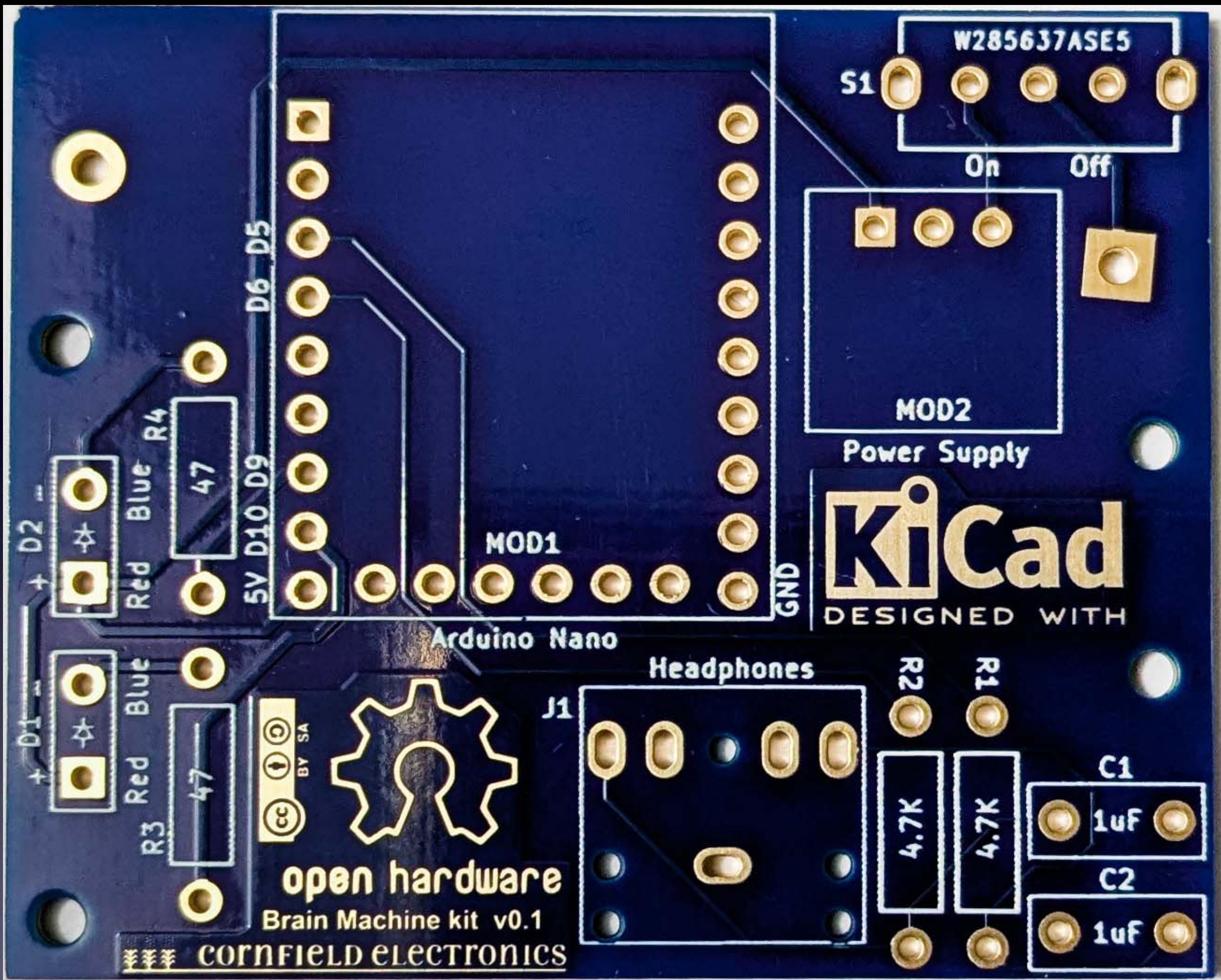
Glasses

Zip ties

All of the parts



The board we'll solder the parts to



Front/Top of board



Back/Bottom of board



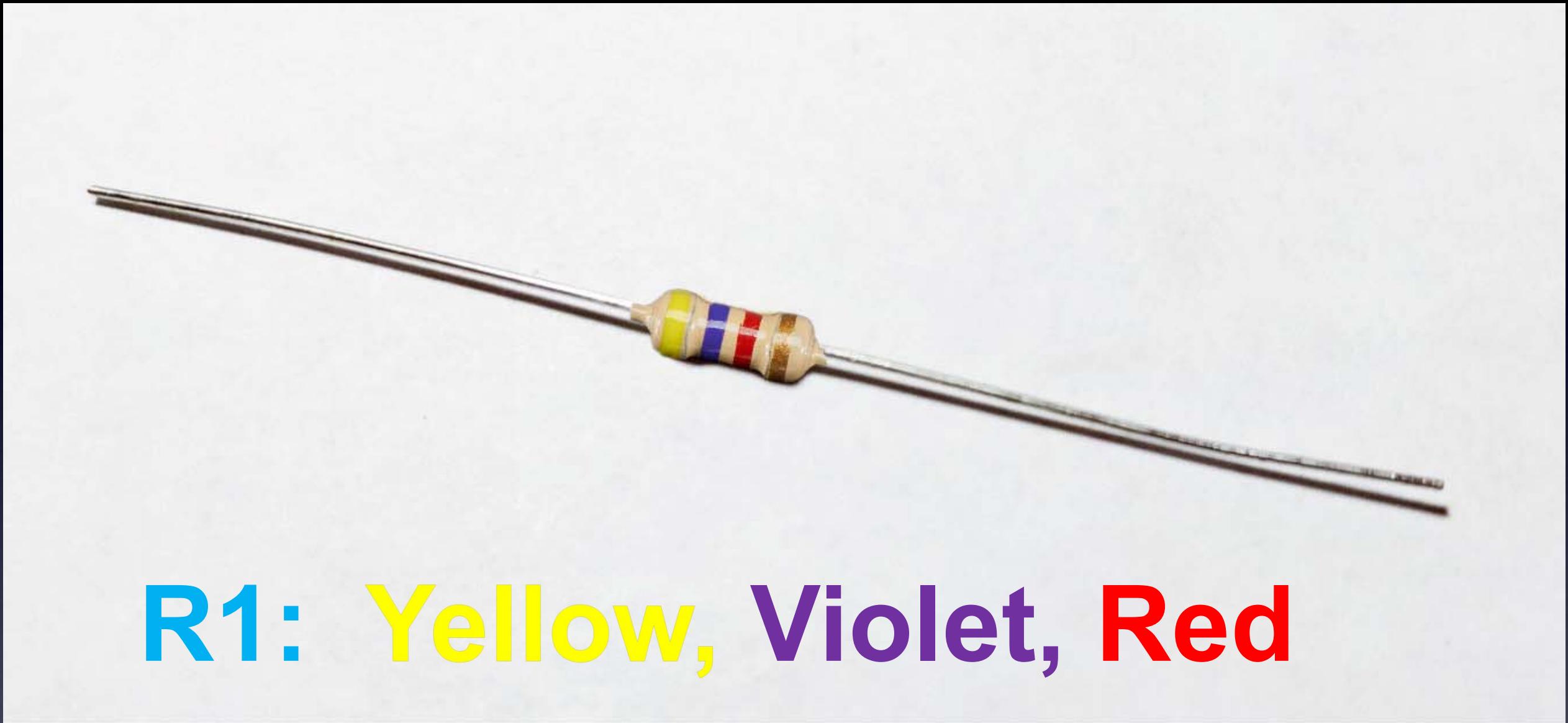
The tools you'll need:

- soldering Iron (35W or less)
- solder (*more details coming*)
- soldering iron stand
- cellulose kitchen sponge (*not plastic!*)
- *small* wire cutter
- tape
- felt-tip pen
- scissors

Note:
Since we will use
Lead-Free solder
it is very helpful
to also have
flux paste in a syringe
And Isopropyl Alcohol



Our first part



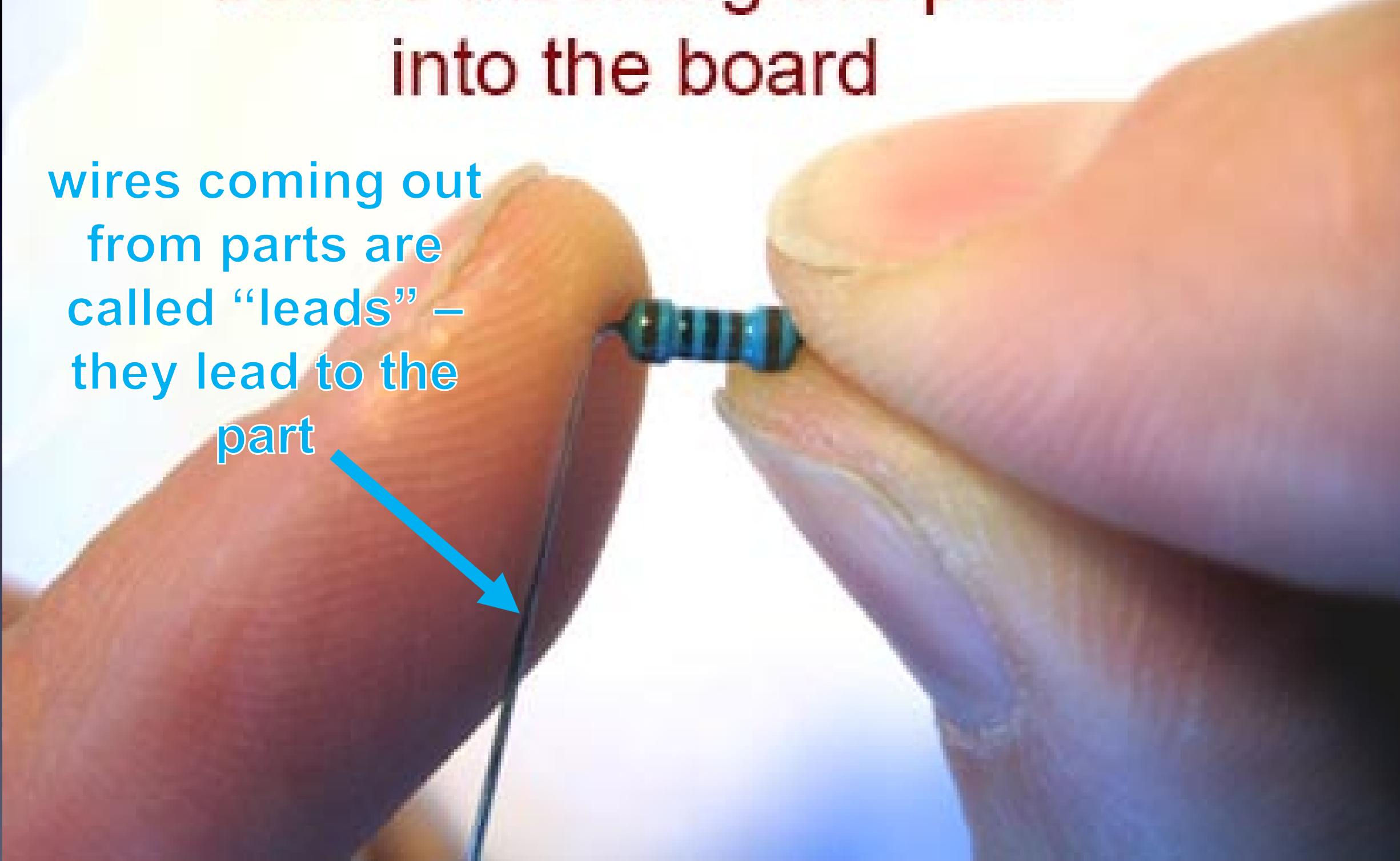
R1: **Yellow, Violet, Red**

(not: **Yellow, Violet, Black**)

Some parts, such as resistors, need their leads bent first

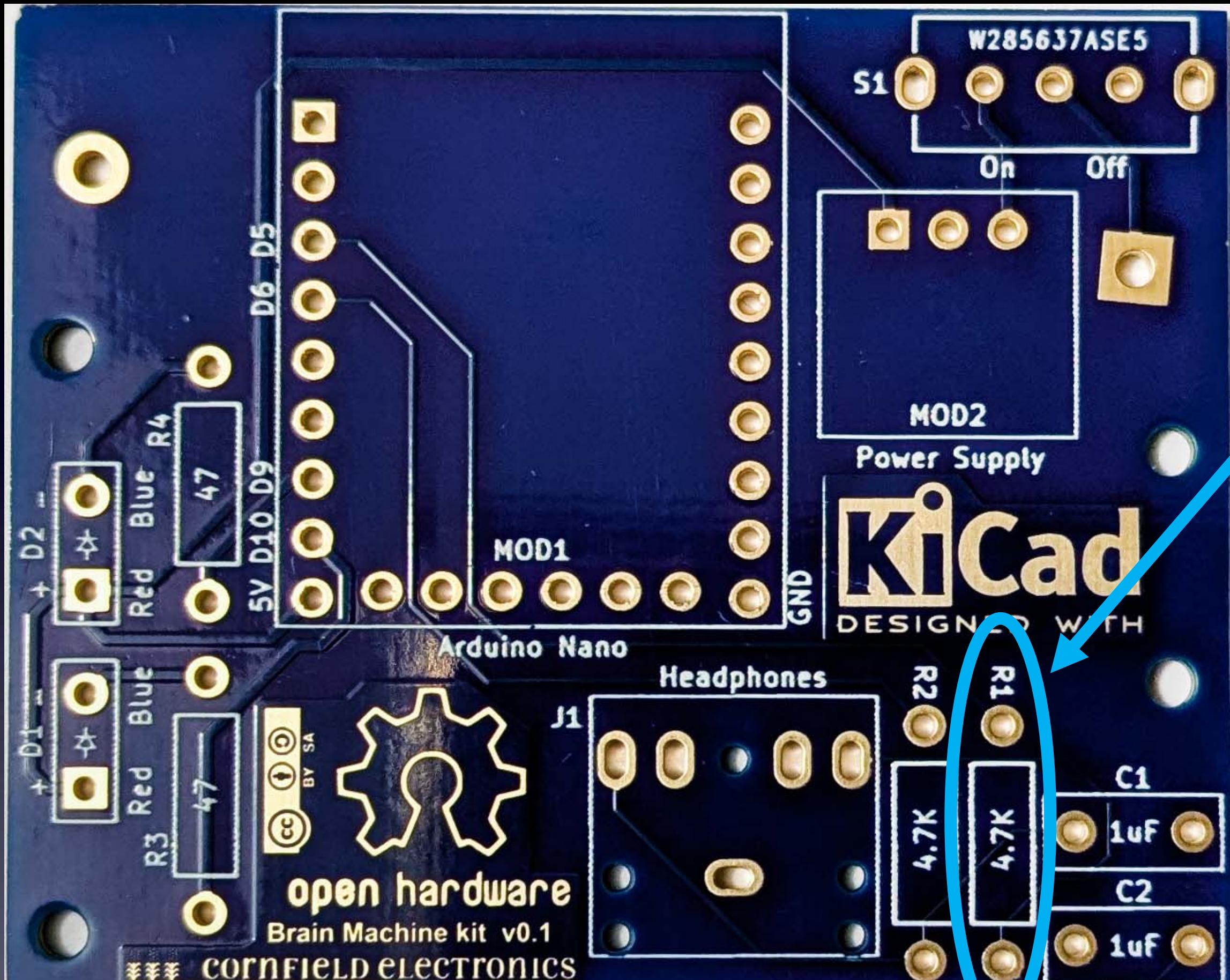
If necessary, Bend leads
before inserting the part
into the board

wires coming out
from parts are
called “leads” –
they lead to the
part





R1 – this is how it will look *before* inserting it into the board

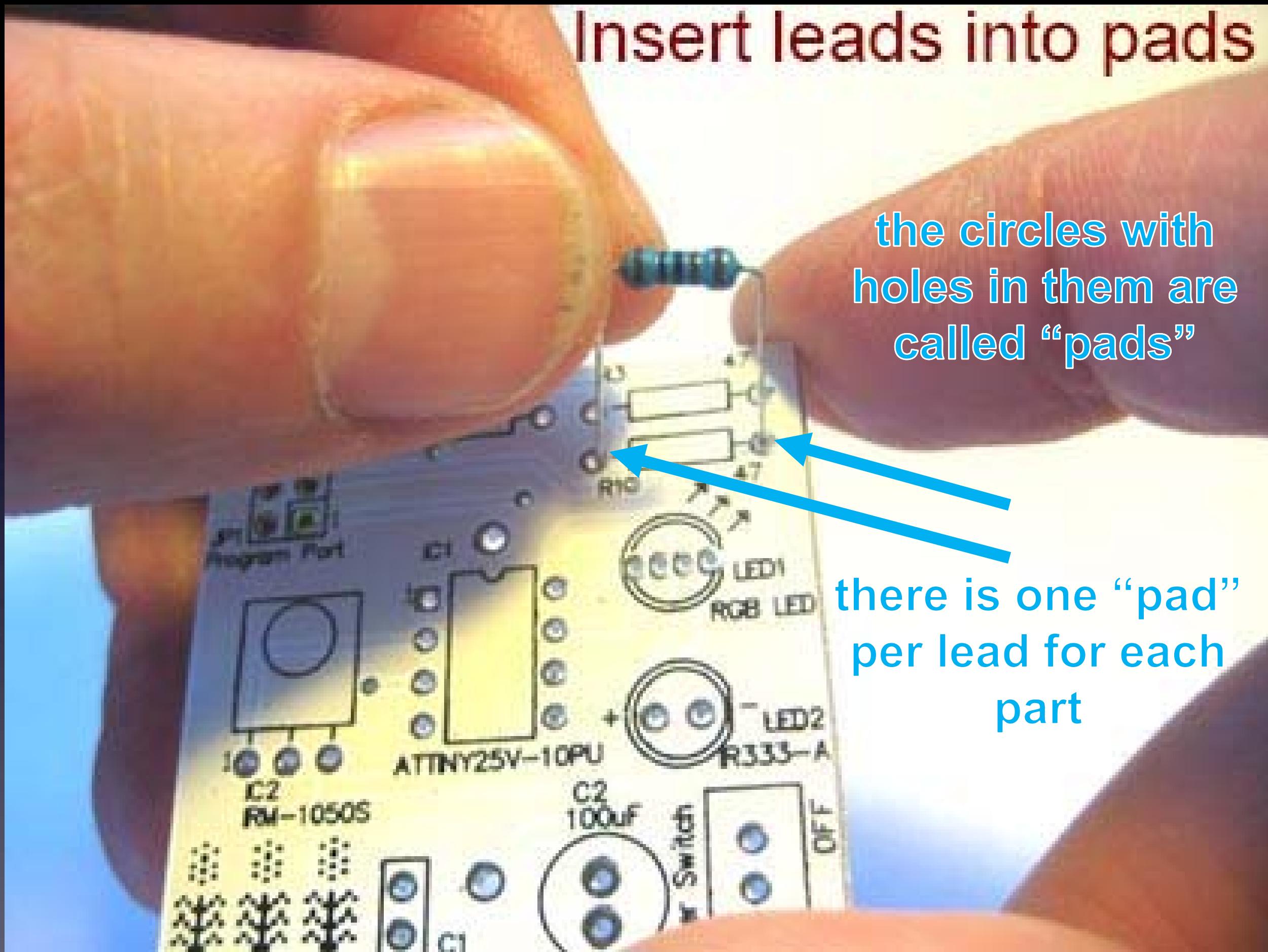


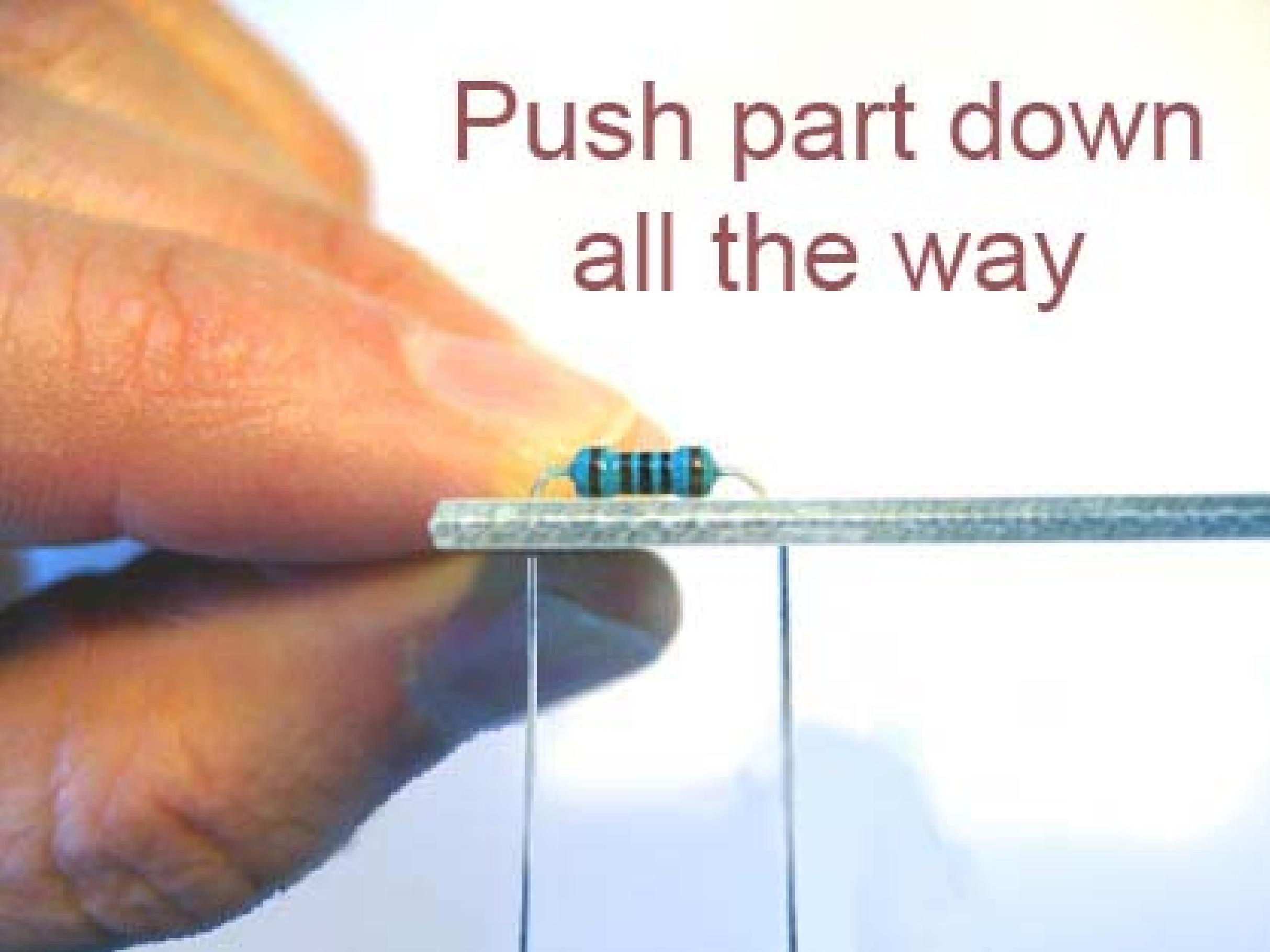
R1 – this is where it goes

Insert leads into pads

the circles with
holes in them are
called “pads”

there is one “pad”
per lead for each
part



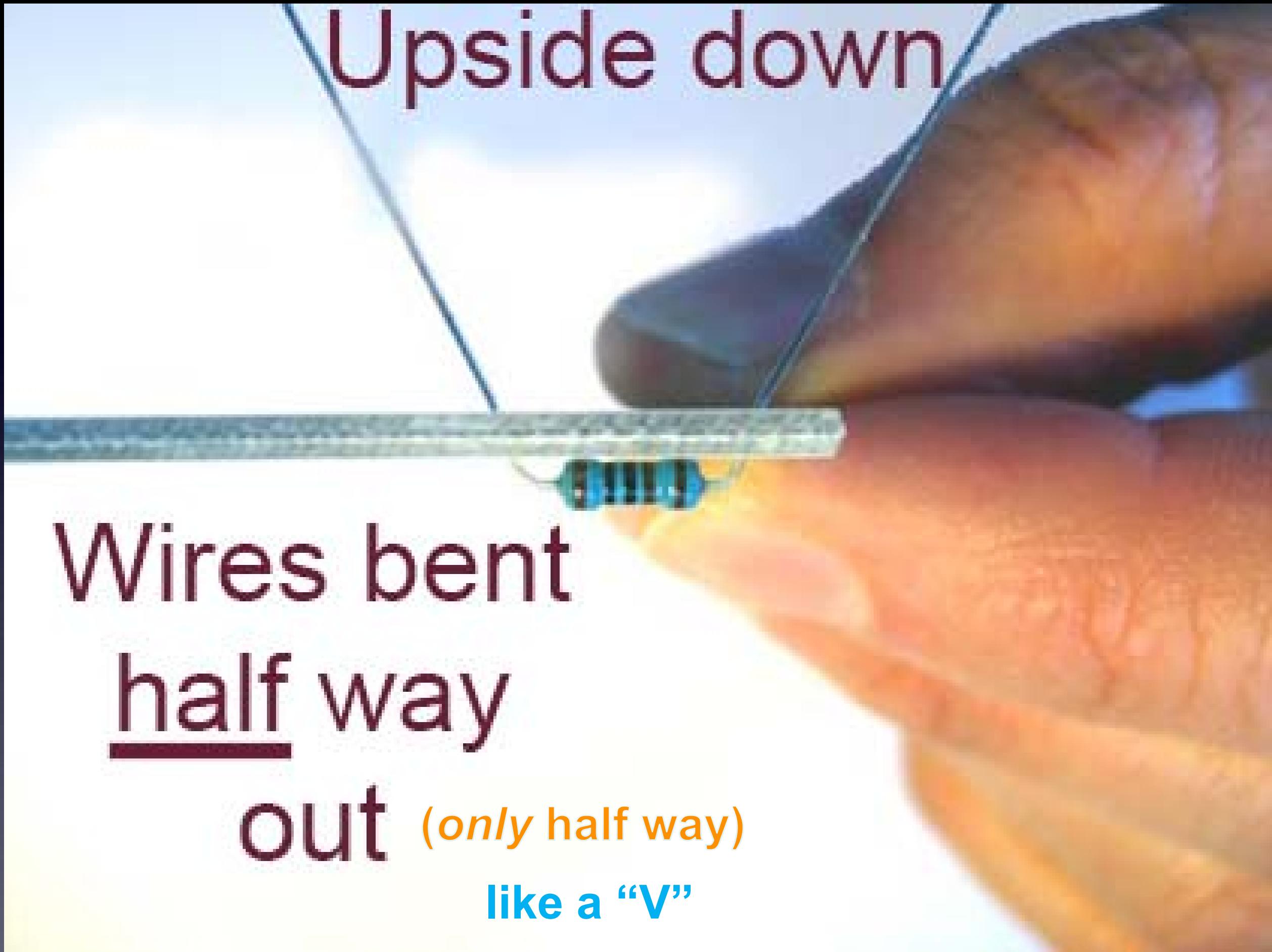


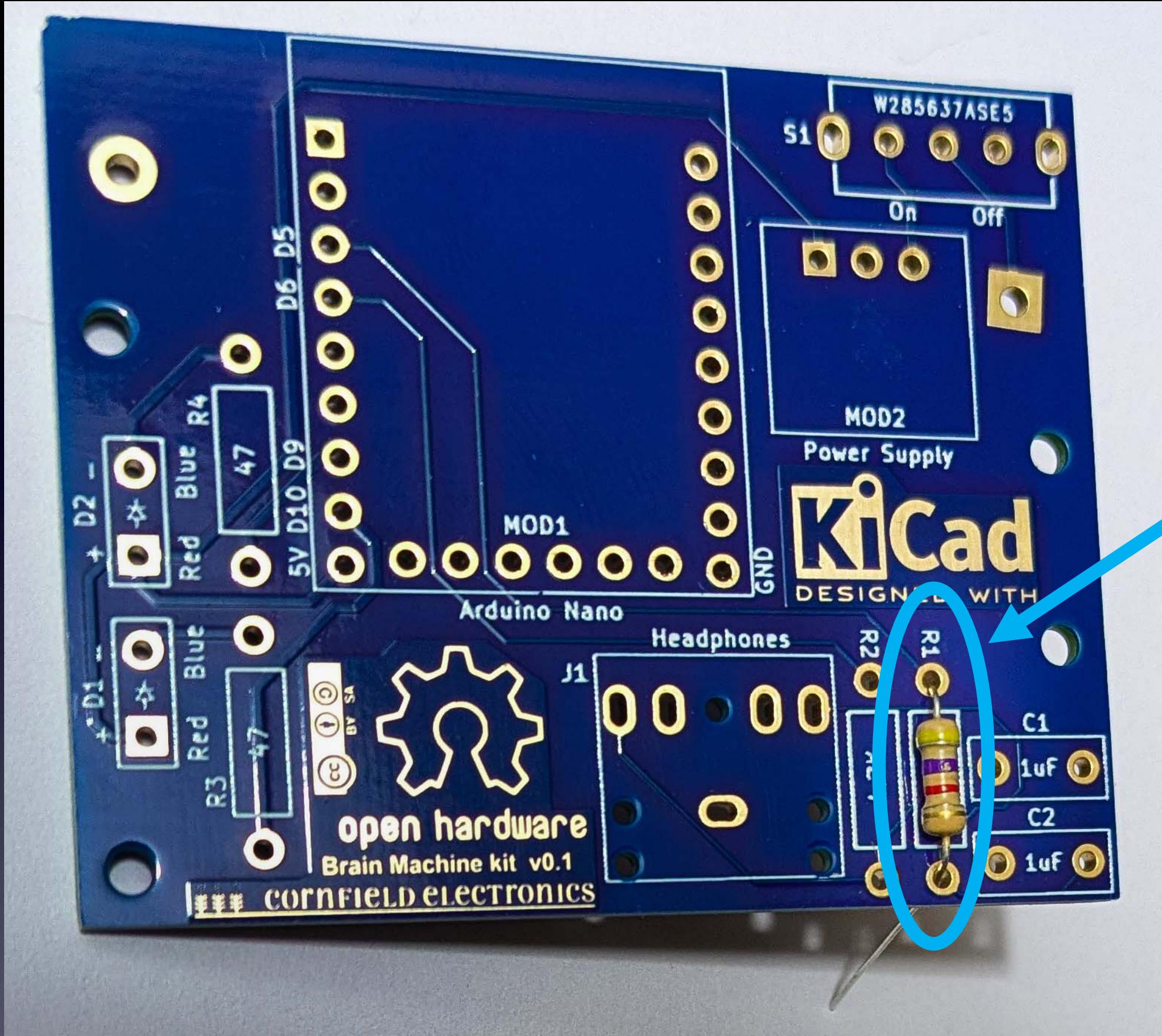
Push part down
all the way

Upside down

Wires bent
half way
out (*only half way*)
like a “V”

so that the part won't fall out while soldering it





R1 – inserted into the board

Direction does not matter



How to hold a soldering iron

(Like a pencil – held from underneath)

Important

The best kind of solder for DIY electronics:

(Sn – Tin / Pb – Lead)

63/37 rosin core,
0.031" (0.8mm) diameter (or smaller)

(60/40 is also good)

Note:

Most
Lead-Free solder
has poisonous fumes!

This is what we will use:

A decent kind of solder for DIY electronics:

*This is the only good Lead-Free solder I have found!
(after years of searching)*



Chip Quik Germanium-Doped Solder
Sn99/Cu0.7/Ni0.05/Ge0.006

0.031" diameter (0.8mm)

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Sn99/Cu0.7/Ni0.05/Ge0.006
0.031" diameter (0.8mm)

Note:

Since we will be using **Lead-Free** solder
it is **very helpful**
to also have
flux paste in a syringe
And Isopropyl Alcohol



3 Safety Tips...

Safety Tip #1:

Hot !!

(When you touch the tip,
you *will* let go quickly every time!)

Safety Tip #2:

Soldering chemicals
are toxic

But they easily wash off your hands
with soap and water

Safety Tip #3:

(coming soon)

2 secrets
to good soldering...

Secret #1:

Clean the tip!

(before every solder connection)

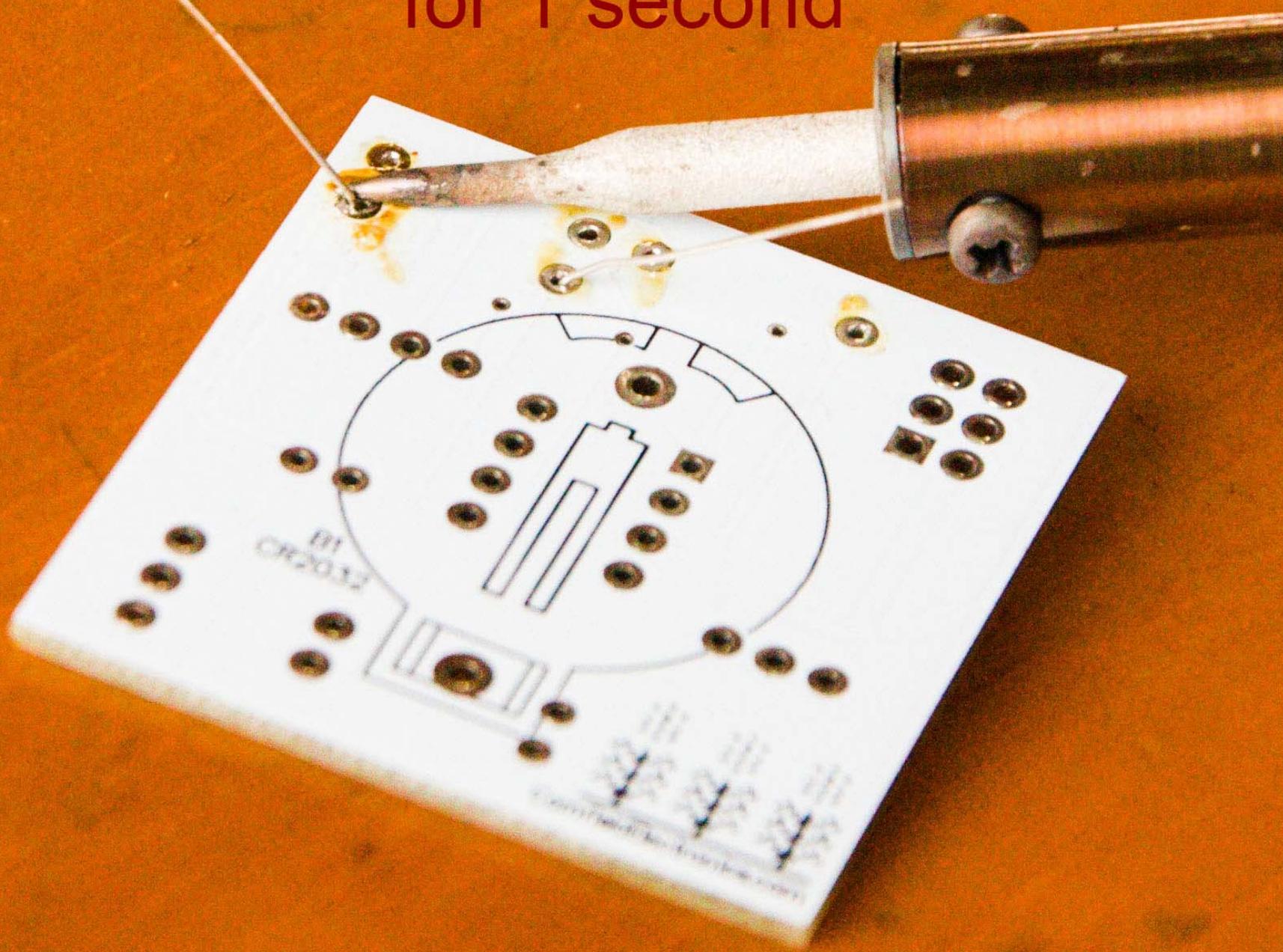
Bang (lightly) 3 times,

Swipe, Rotate, Swipe (on the sponge):

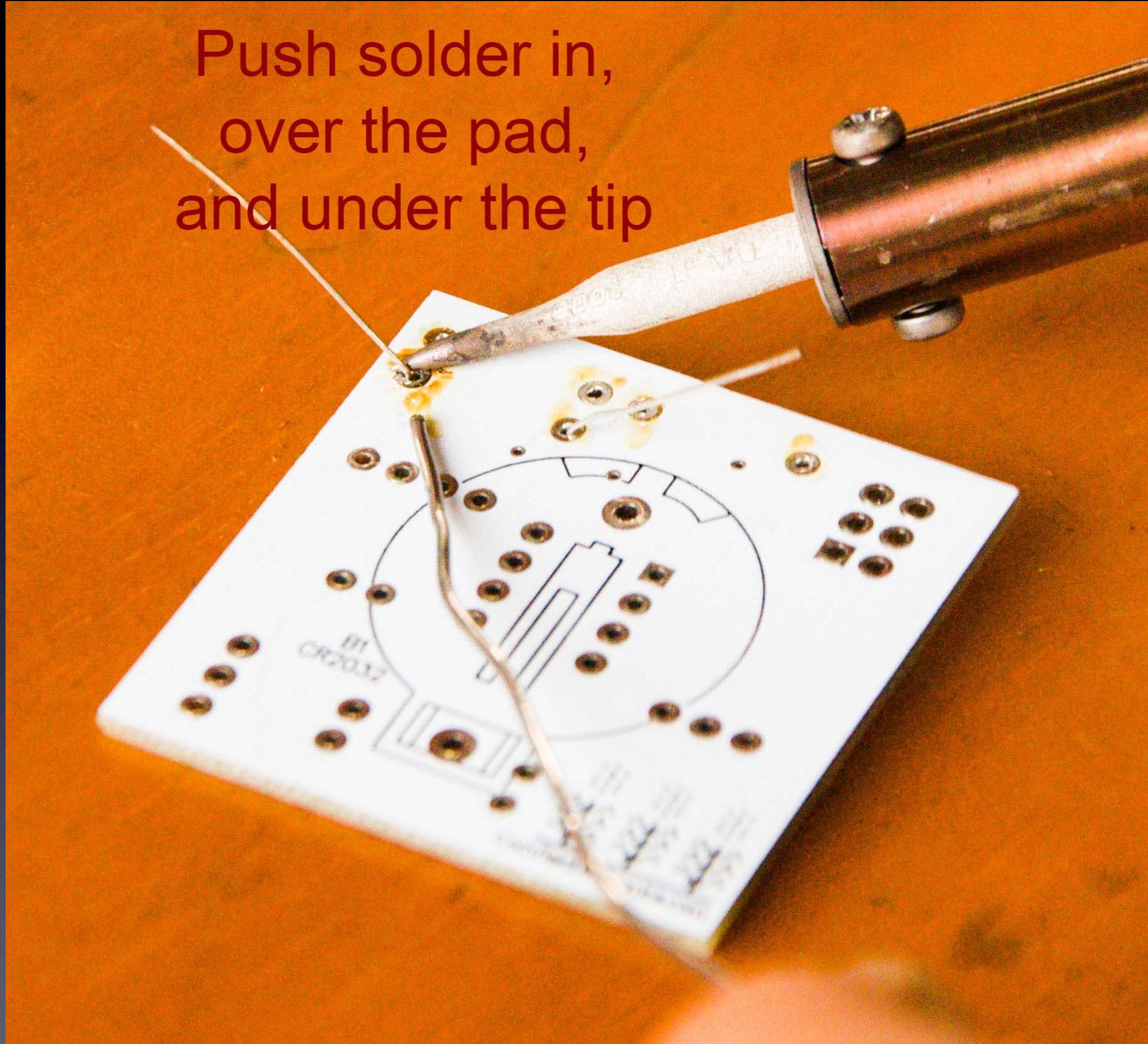
Keep the tip shiny silver!

knock solder off the tip

Lay clean tip across half of the pad,
touching the pad and lead
for 1 second

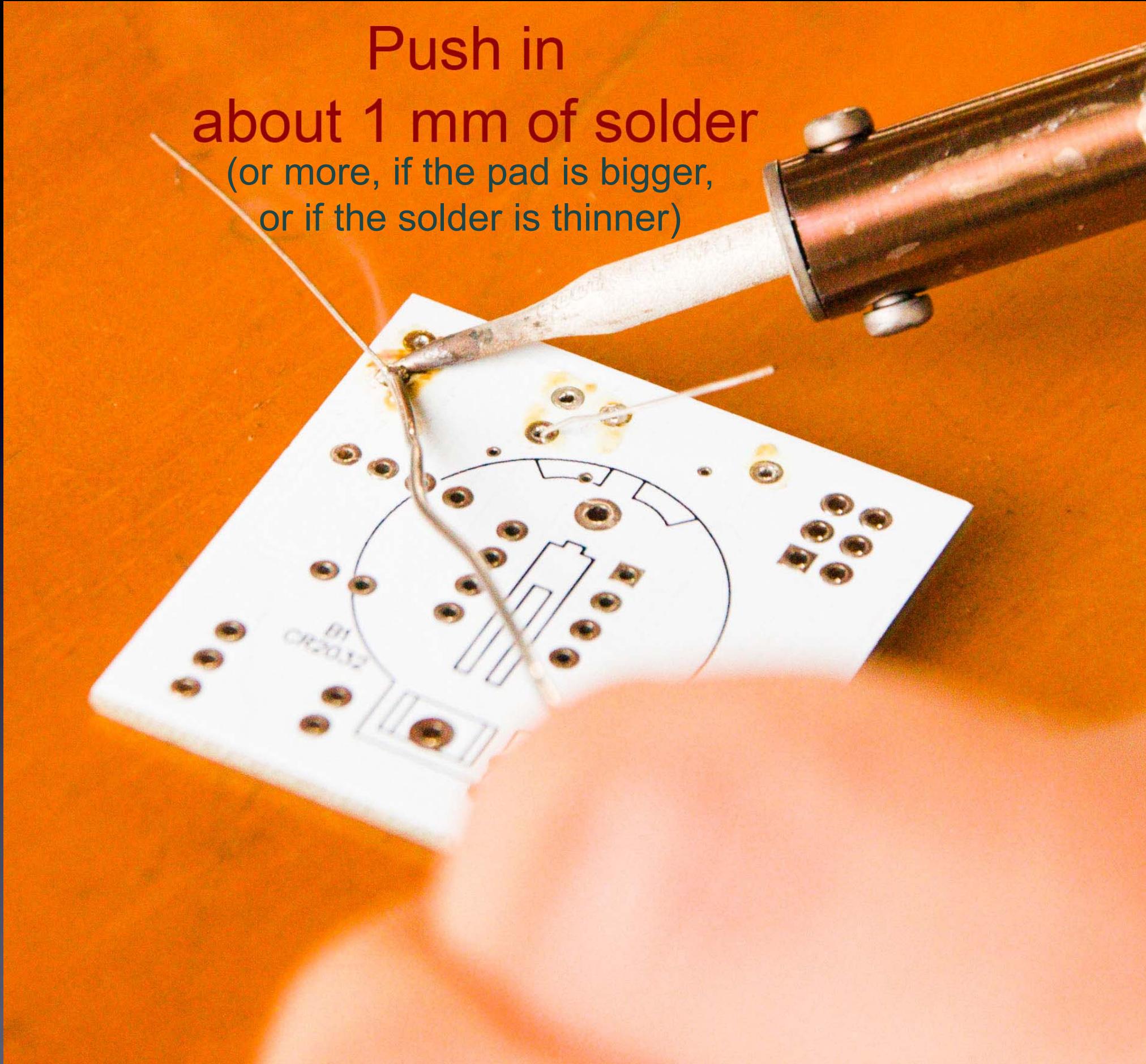


Do this quickly (slowly doesn't work well) – solder in & out in about 1 second

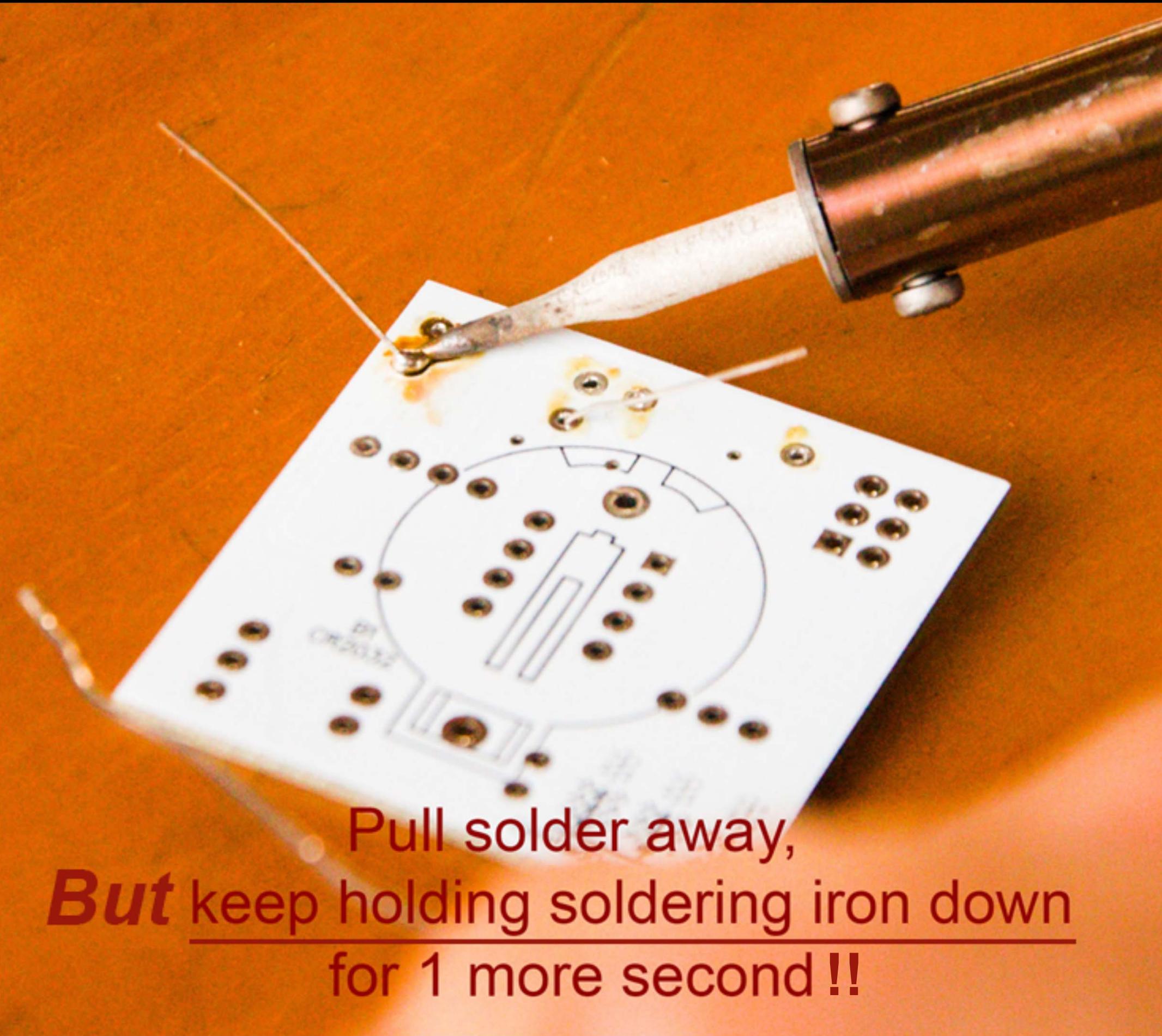


Make sure solder melts on the underside of the soldering iron tip
(not the side or top of the soldering iron tip)!

Do this quickly (slowly doesn't work well) – solder in & out in about 1 second



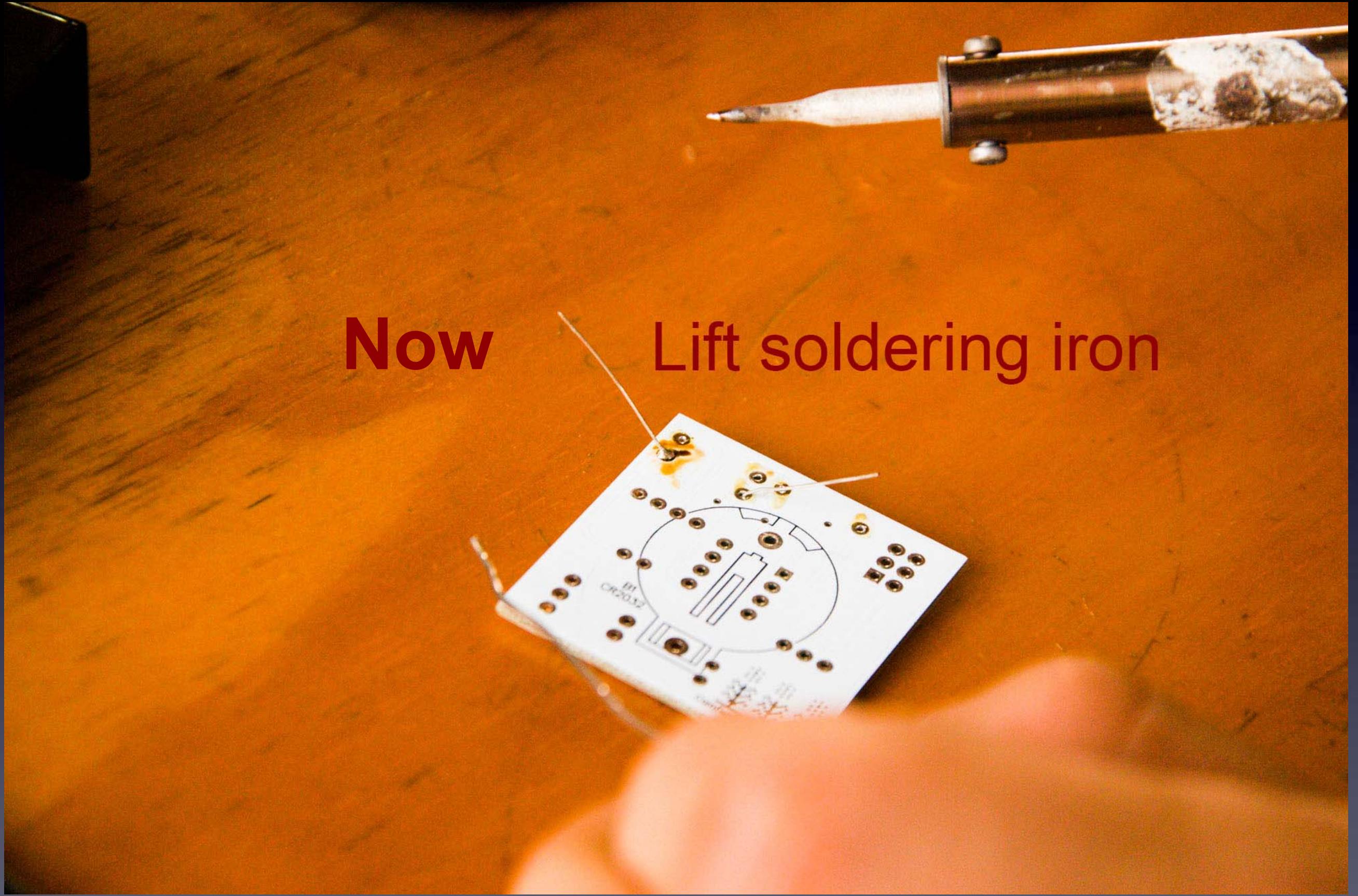
Make sure solder melts on the underside of the soldering iron tip
(not the side or top of the soldering iron tip)!



Pull solder away,
But keep holding soldering iron down
for 1 more second !!

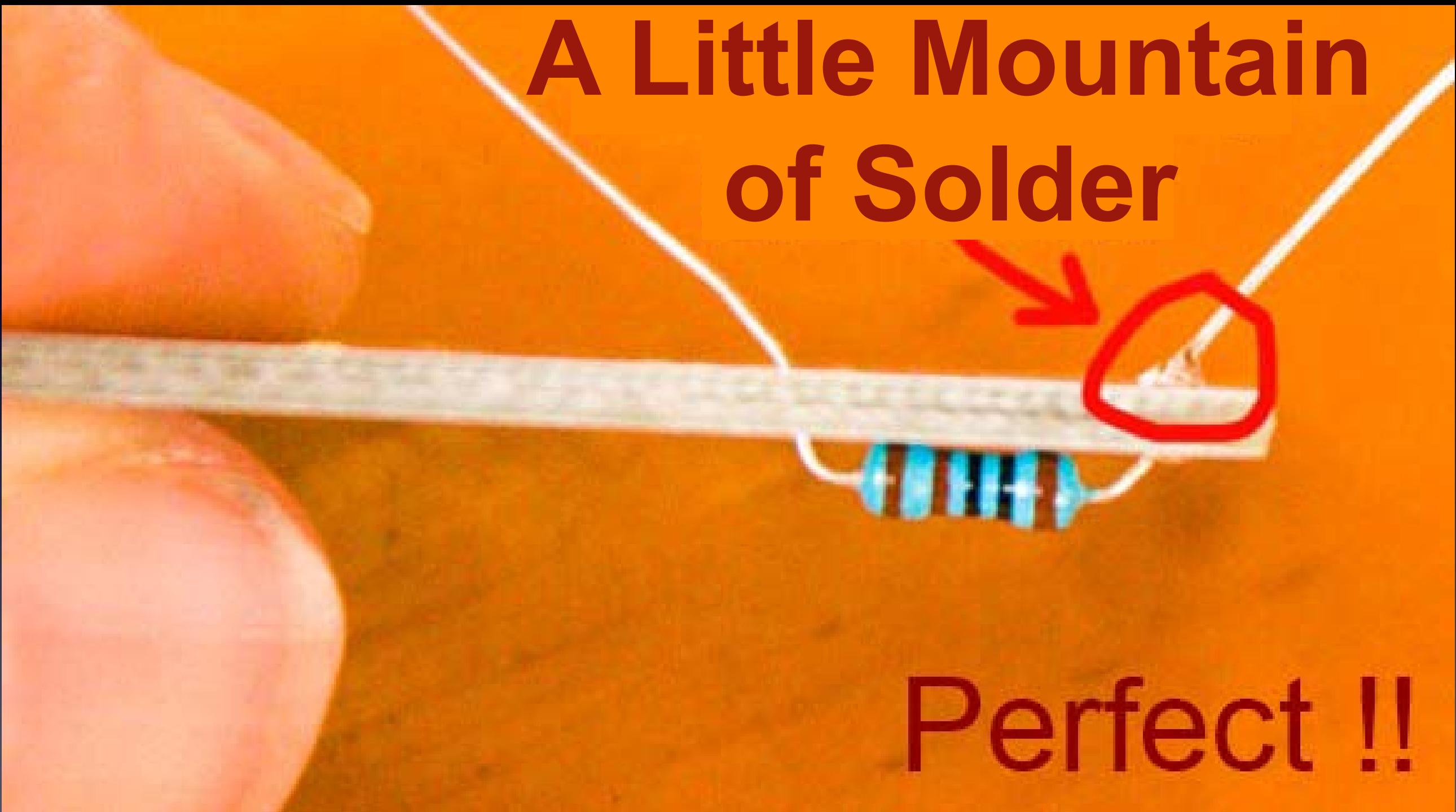
Secret #2:

Keep hot tip down
1 second
for solder to flow !!



Now

Lift soldering iron



A Little Mountain
of Solder

Perfect !!

If you can see any of the pad, or the hole, you need more solder – so, just do all the steps again to make it perfect.

The Rhythm !
is just as important as the preceding steps!

The Rhythm !
and speed (about 1 second per step)



The Rhythm !
and speed (about 1 second per step)
Clean the tip



The Rhythm !
and speed (about 1 second per step)



Tip Down

The Rhythm !
and speed (about 1 second per step)



Solder In

The Rhythm !
and speed (about 1 second per step)



Solder Out

The Rhythm !
and speed (about 1 second per step)



WAIT !

The Rhythm !
and speed (about 1 second per step)



Lift Tip

The Rhythm !
and speed (about 1 second per step)



The Rhythm !
and speed (about 1 second per step)
Clean the tip



The Rhythm !
and speed (about 1 second per step)



Tip Down

The Rhythm !
and speed (about 1 second per step)



Solder In

The Rhythm !
and speed (about 1 second per step)



Solder Out

The Rhythm !
and speed (about 1 second per step)



WAIT !

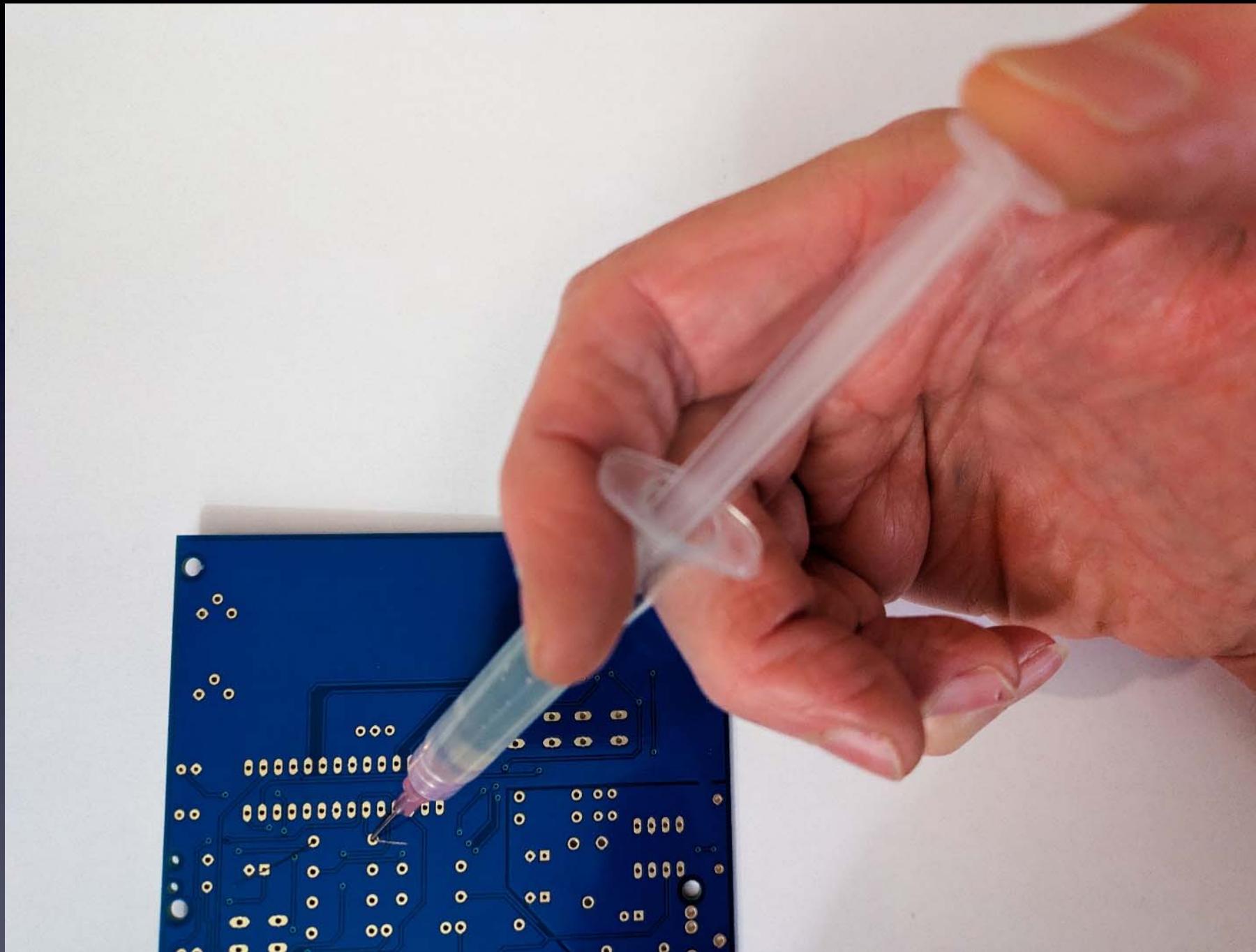
The Rhythm !
and speed (about 1 second per step)



Lift Tip

Since we will use *Lead-Free* solder:

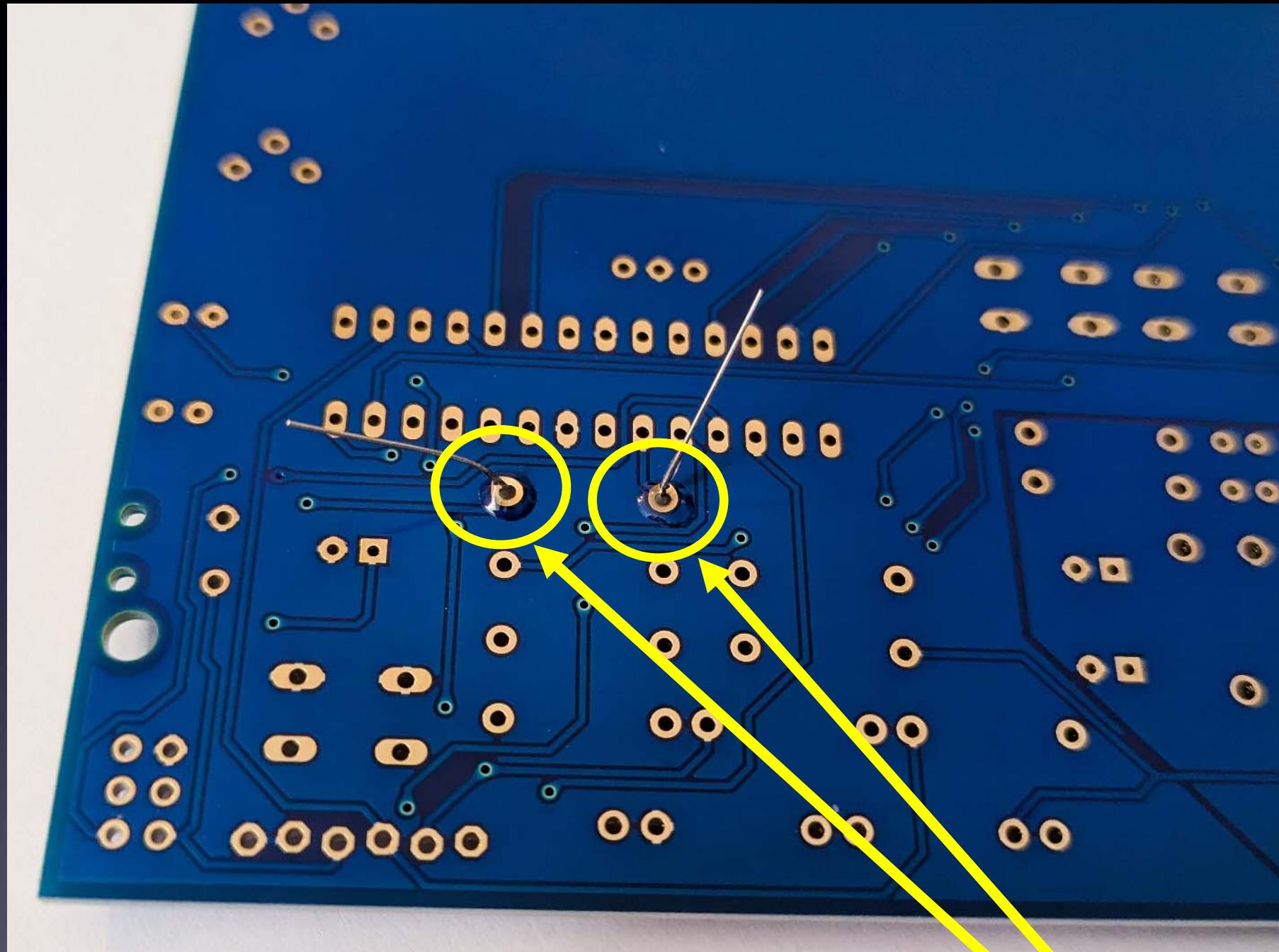
First add flux !



For *Lead-Free* solder, add flux to each pad before soldering !
For this part there are two pads

Since we will use *Lead-Free* solder:

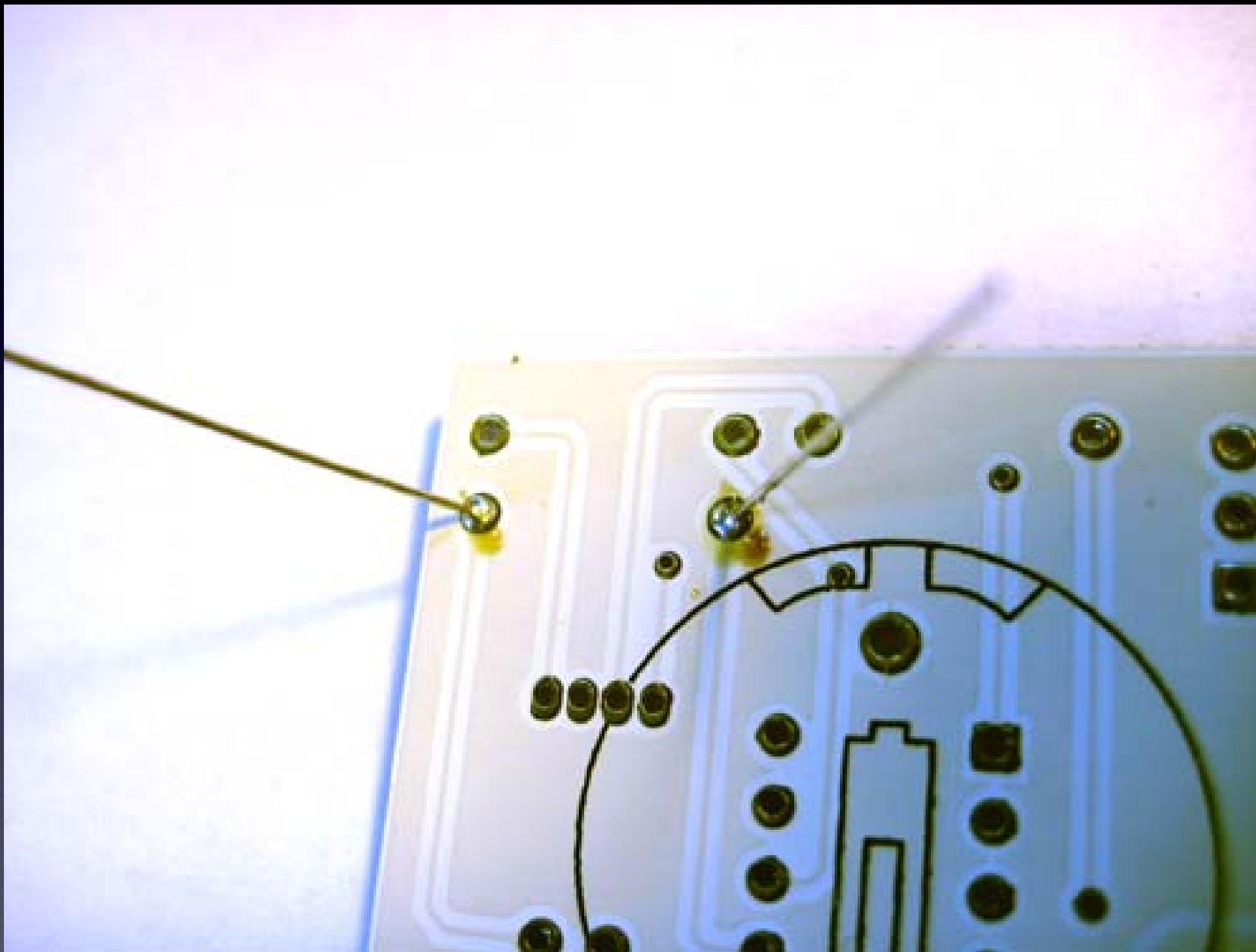
Add flux to the pads before soldering



Here you can see flux over each of the two pads.

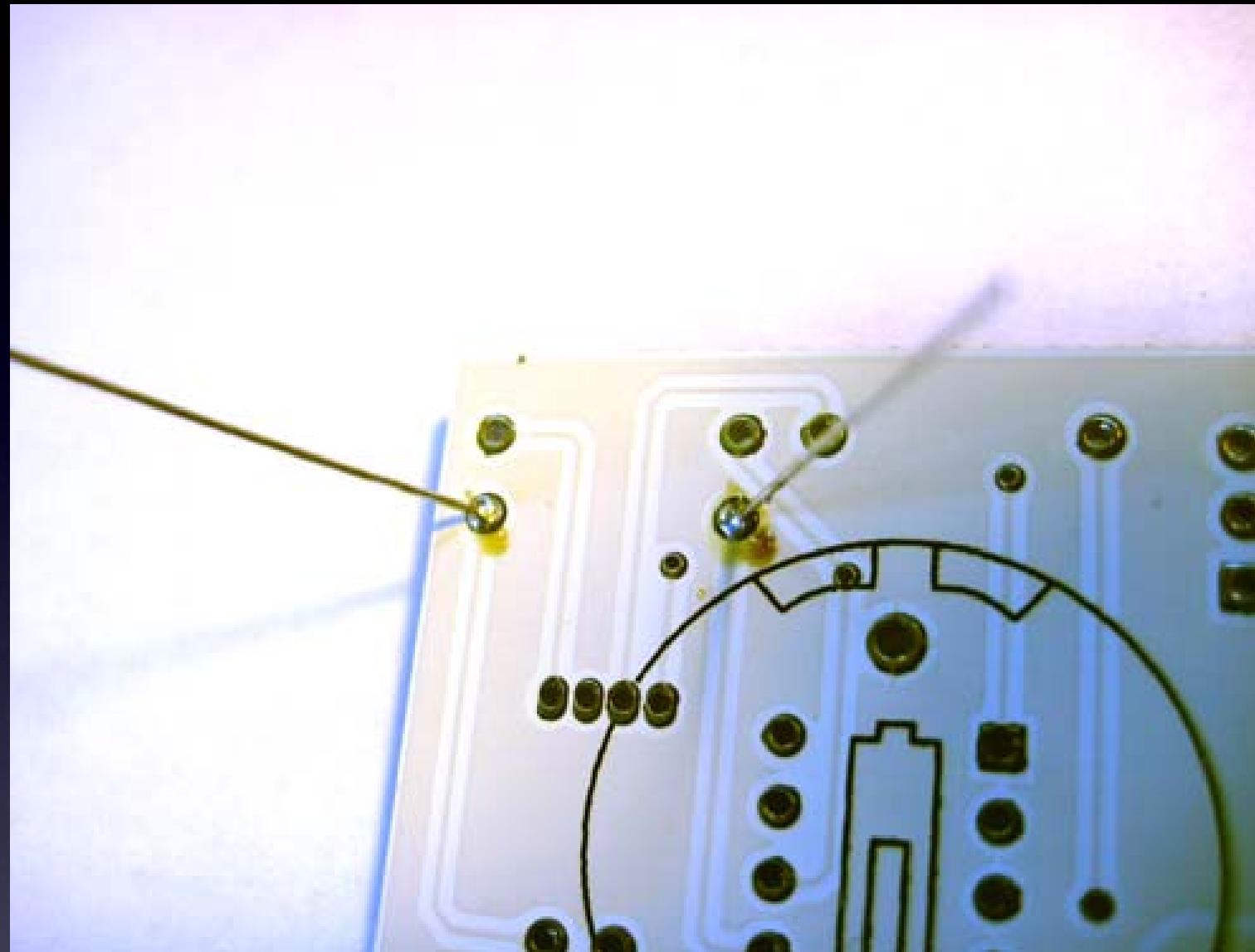
Now these leads are ready to solder with your *Lead-Free* solder.

Solder all of the leads of the part to the board



For this part, there are two leads
Here you can see two good solder connections

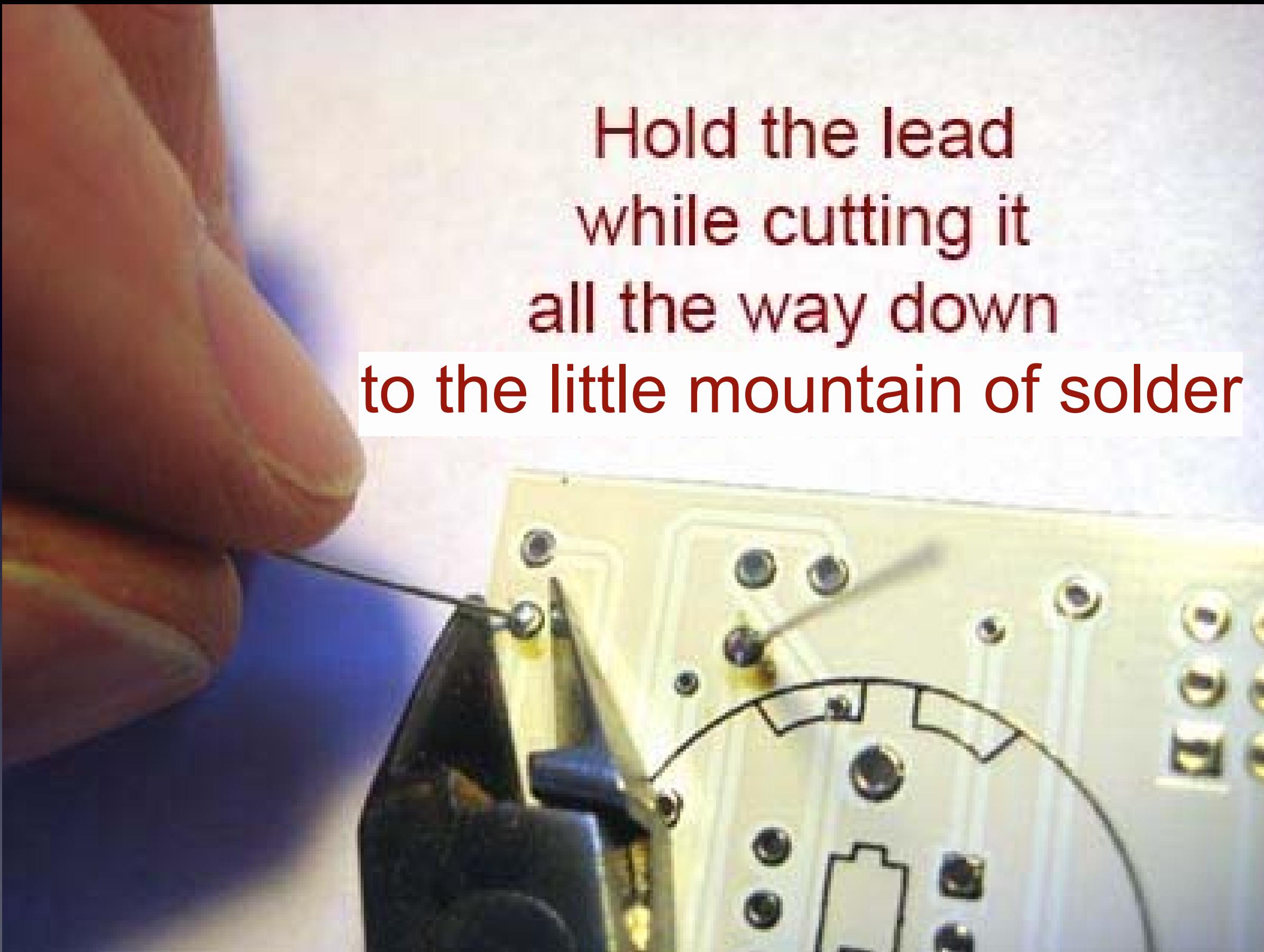
Two good solder connections



- Little mountains (not flat)
- Pads totally covered in solder
- Can't see the hole
- No connections to other pads

Now cut the leads short

Hold the lead
while cutting it
all the way down
to the little mountain of solder



Cutting with the tip of the wire cutter gives you more control

Safety Tip #3:

Hold or cover the lead !

(or it will fly into your eye!)

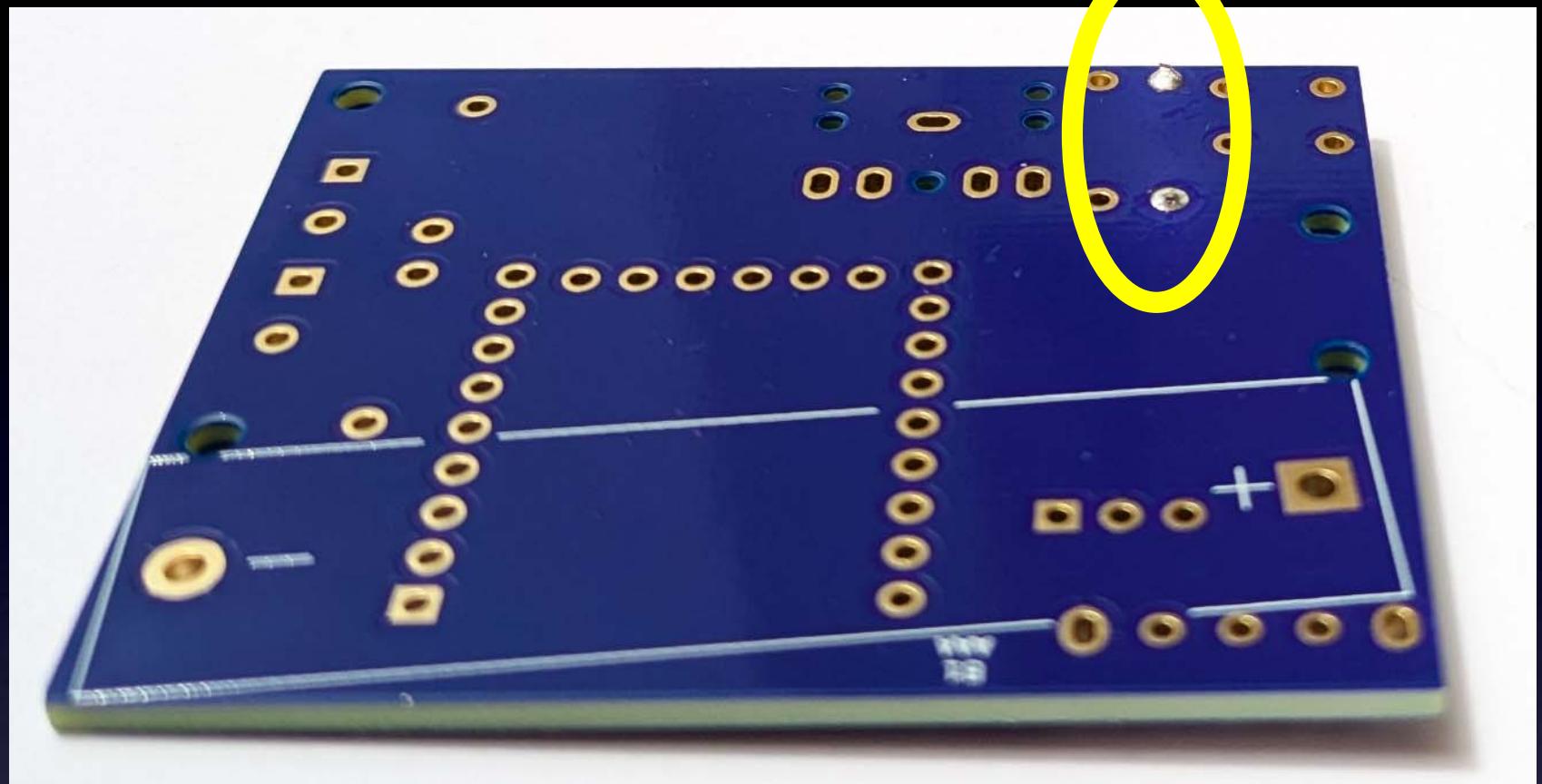
(They like doing that – so please hold or cover the lead when you cut.)



All done !

No wires sticking out

R1 soldered to the board



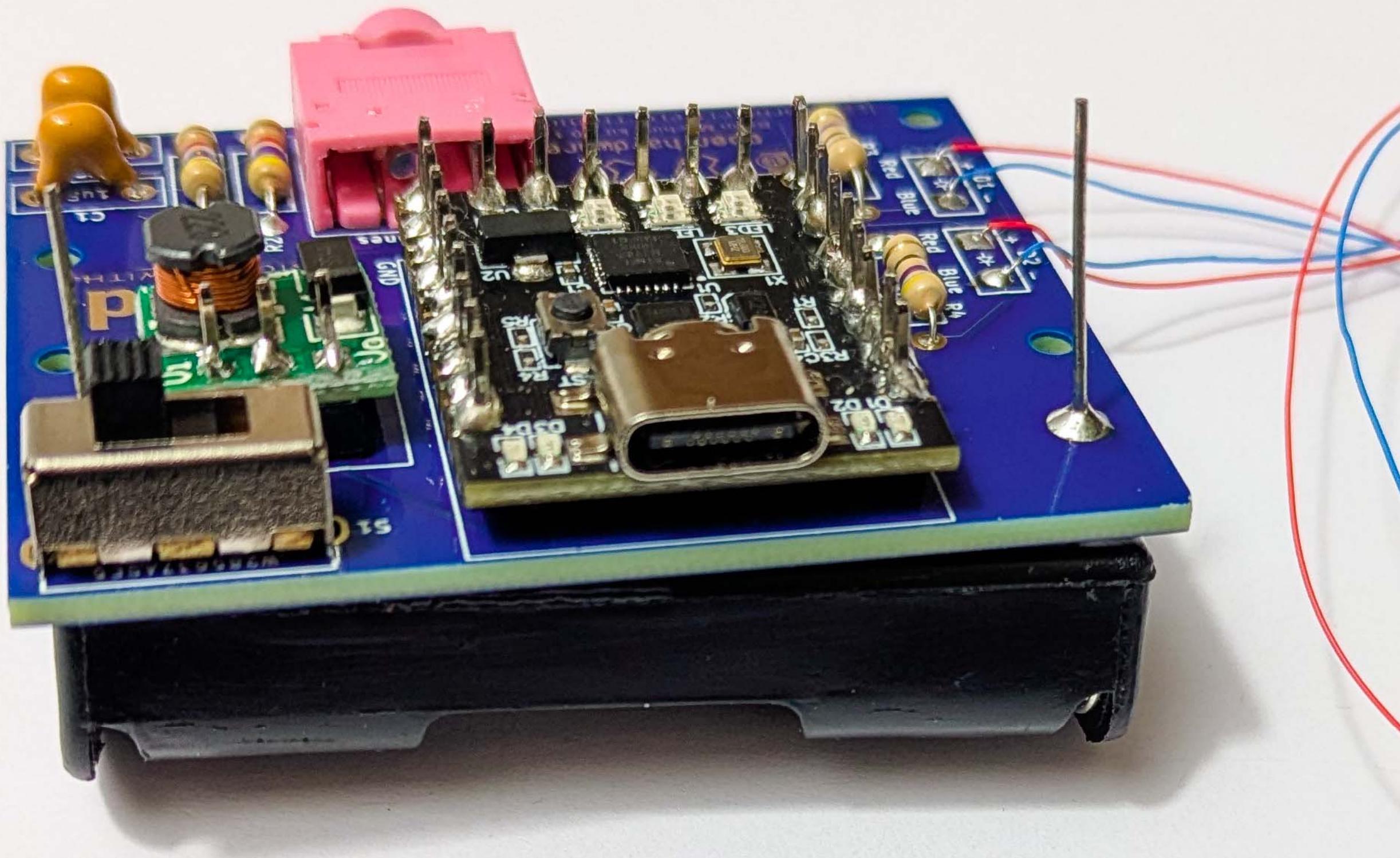
2 good solder connections

Notice that:

- Each connection is a small mountain (not flat)
- You cannot see any pad (they're totally covered with solder)
- You cannot see the holes (they're totally covered with solder)
- No connections to other pads

One part at a time

Till all the parts are soldered

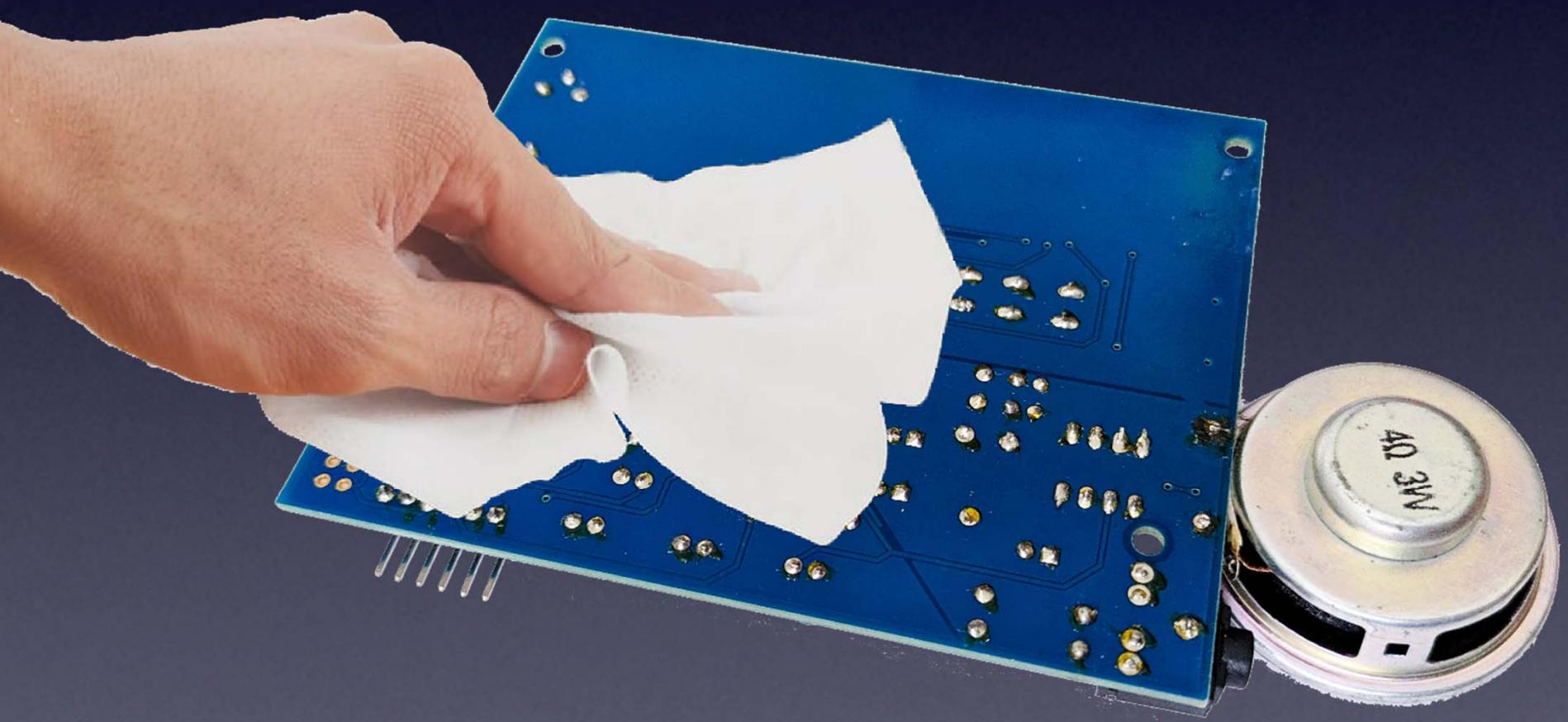


And it will look like this when you're done soldering.

Since we will use **Lead-Free** solder
and
flux paste in a syringe



The bottom of the PCB will be sticky from the flux



*You can clean it with a cloth
wet with Isopropyl Alcohol*

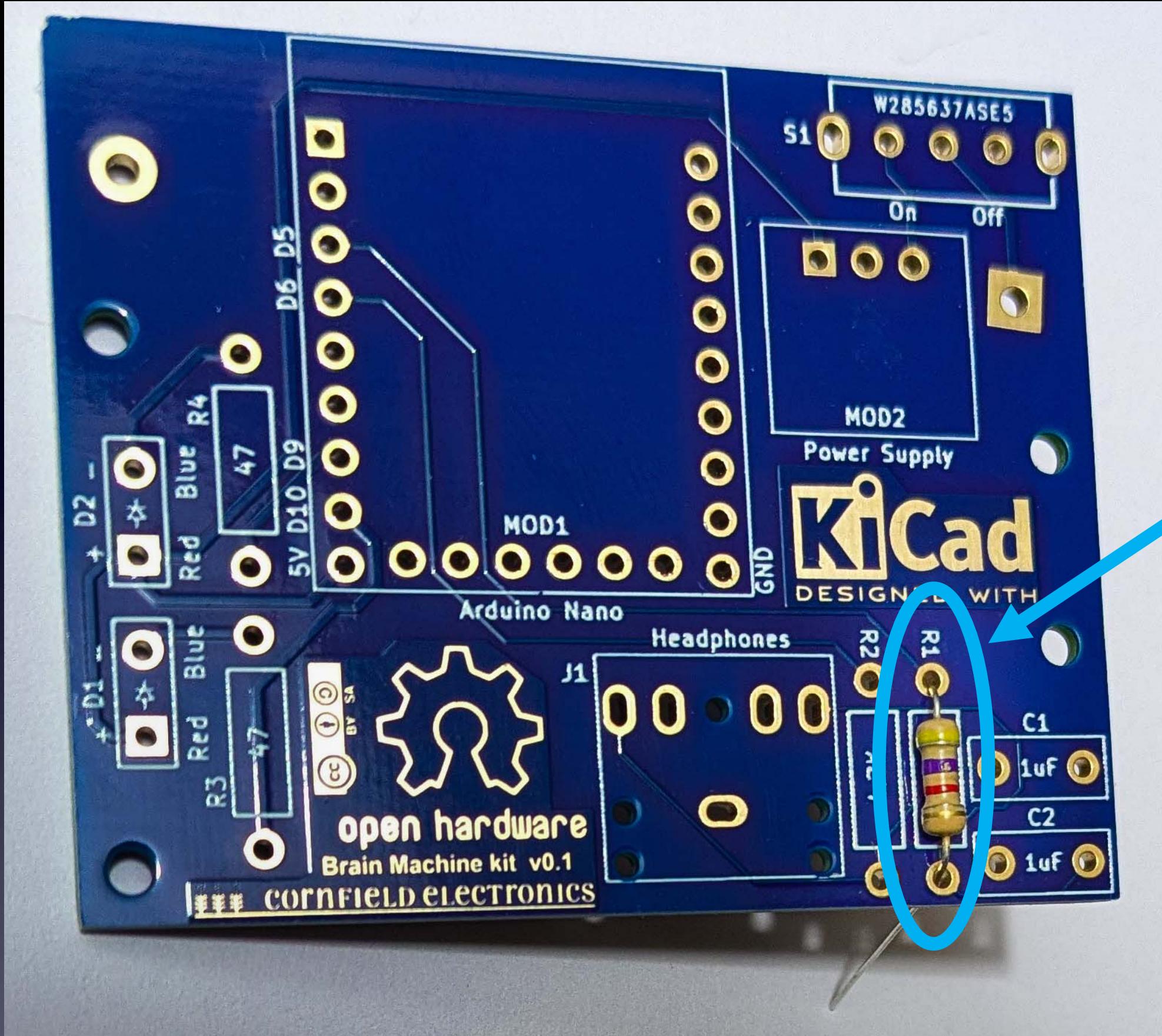
Then put in the battery,

Turn it on,

And it works!

(Or you start debugging.)

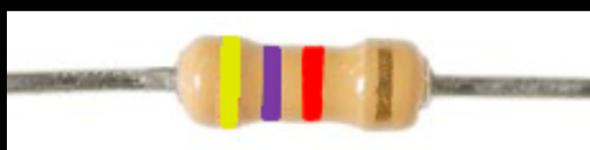
Let's start!



Direction does not matter

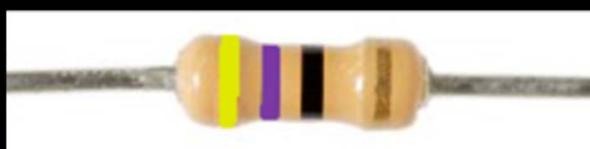
If you haven't done so already, solder R1: Yellow, Violet, Red

R1, R2:

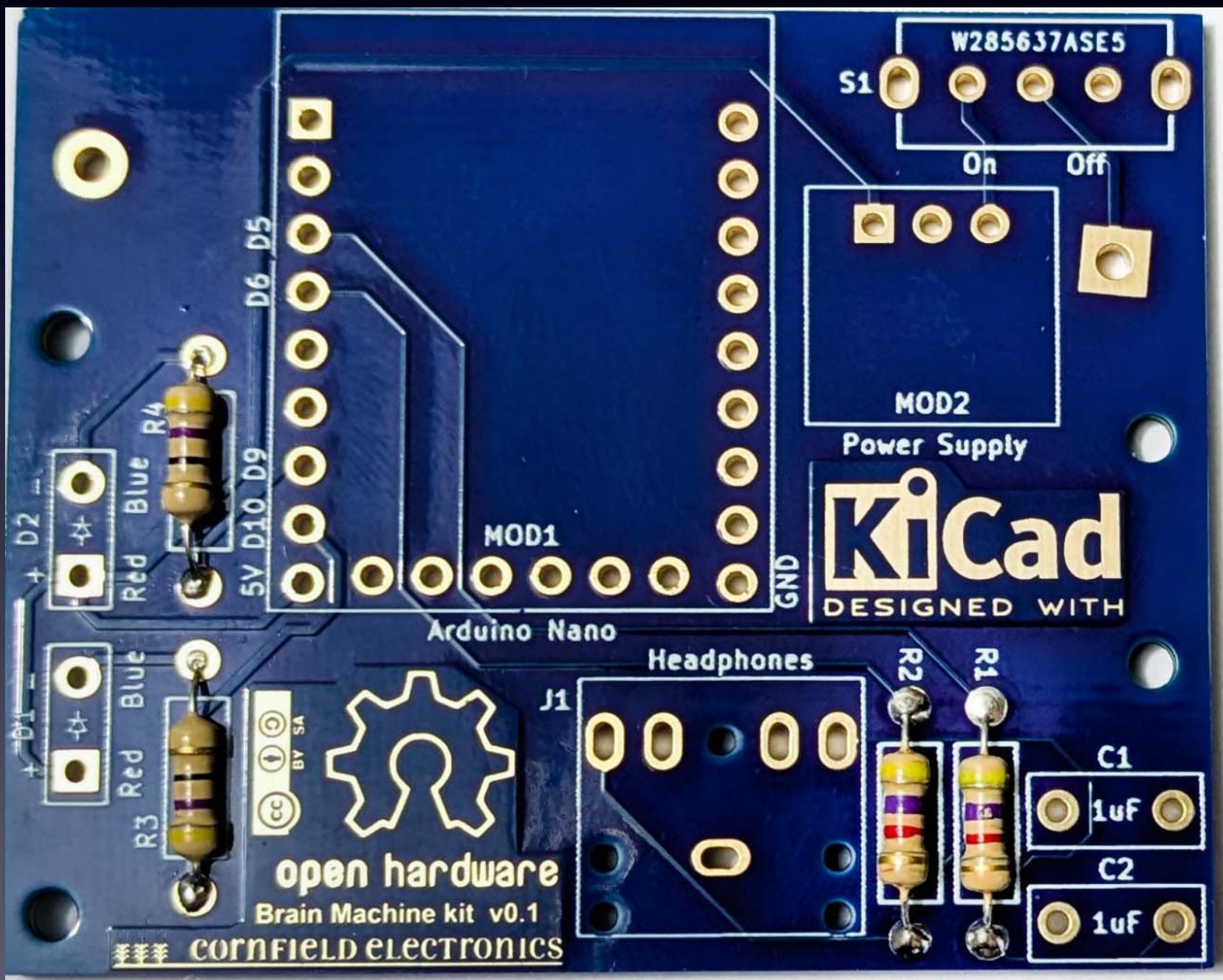


4.7K: Yellow, Violet, Red

R3, R4:



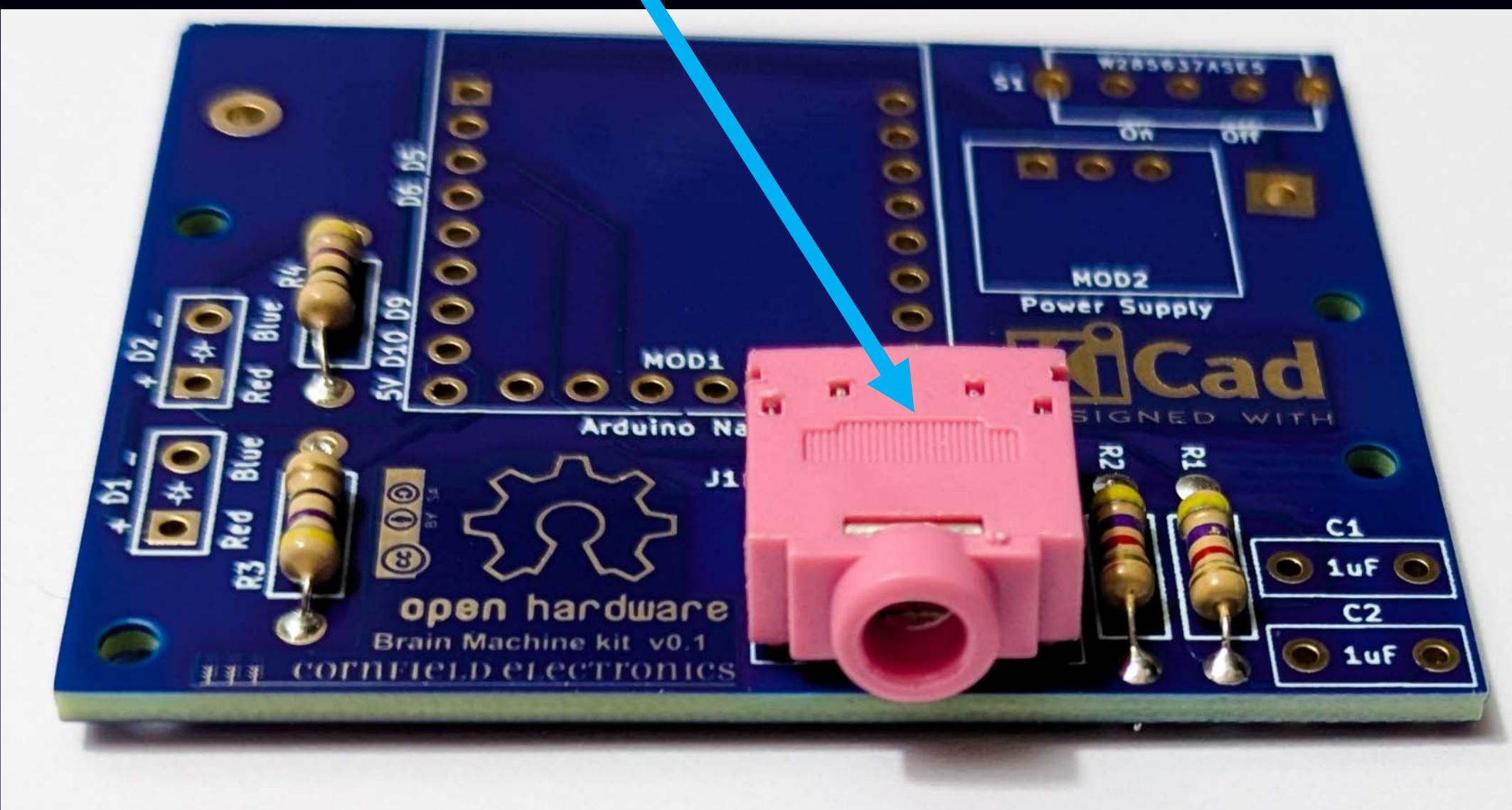
47: Yellow, Violet, Black



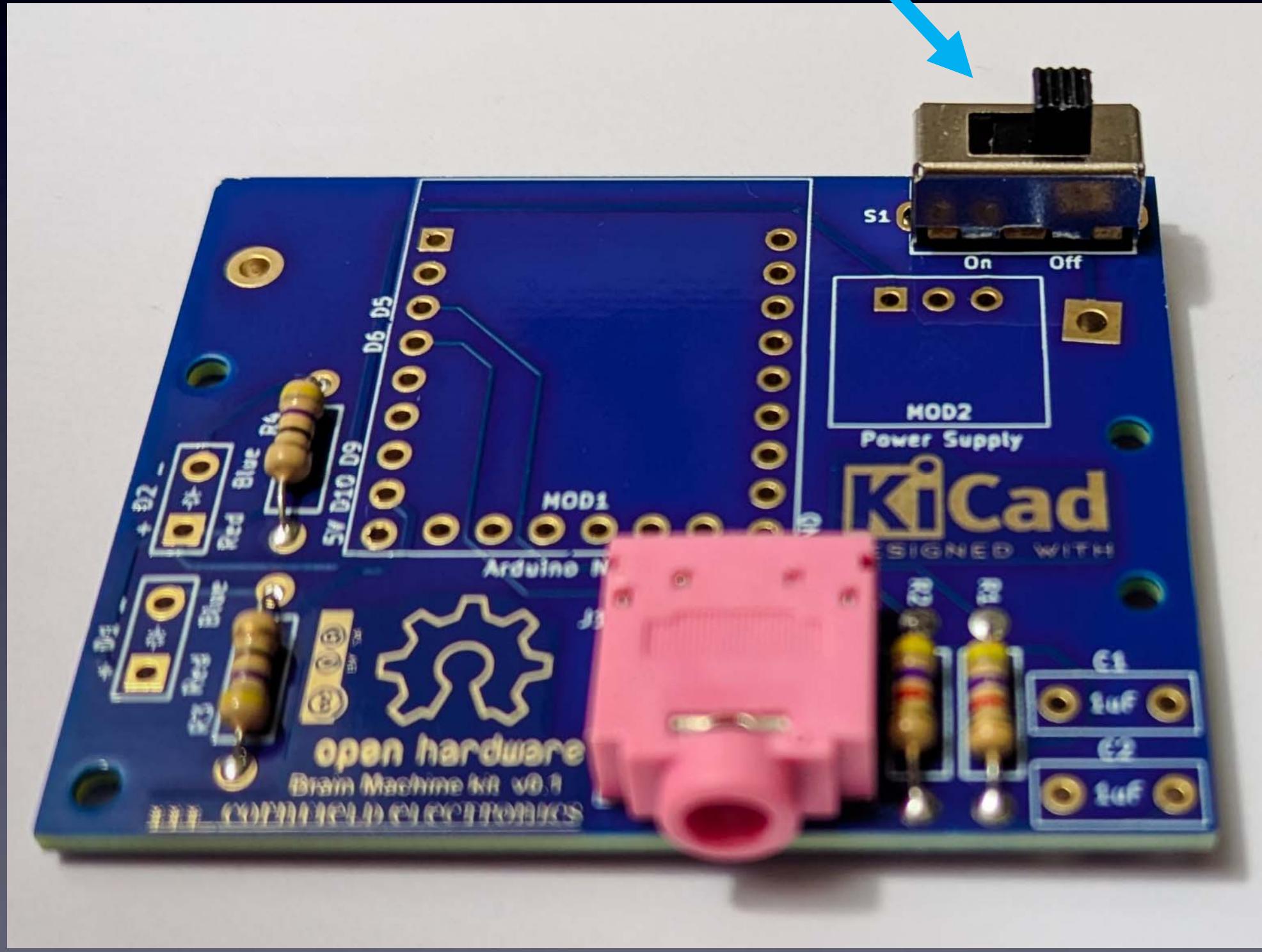
Direction does not matter

All 4 resistors

J1: Headphone Jack

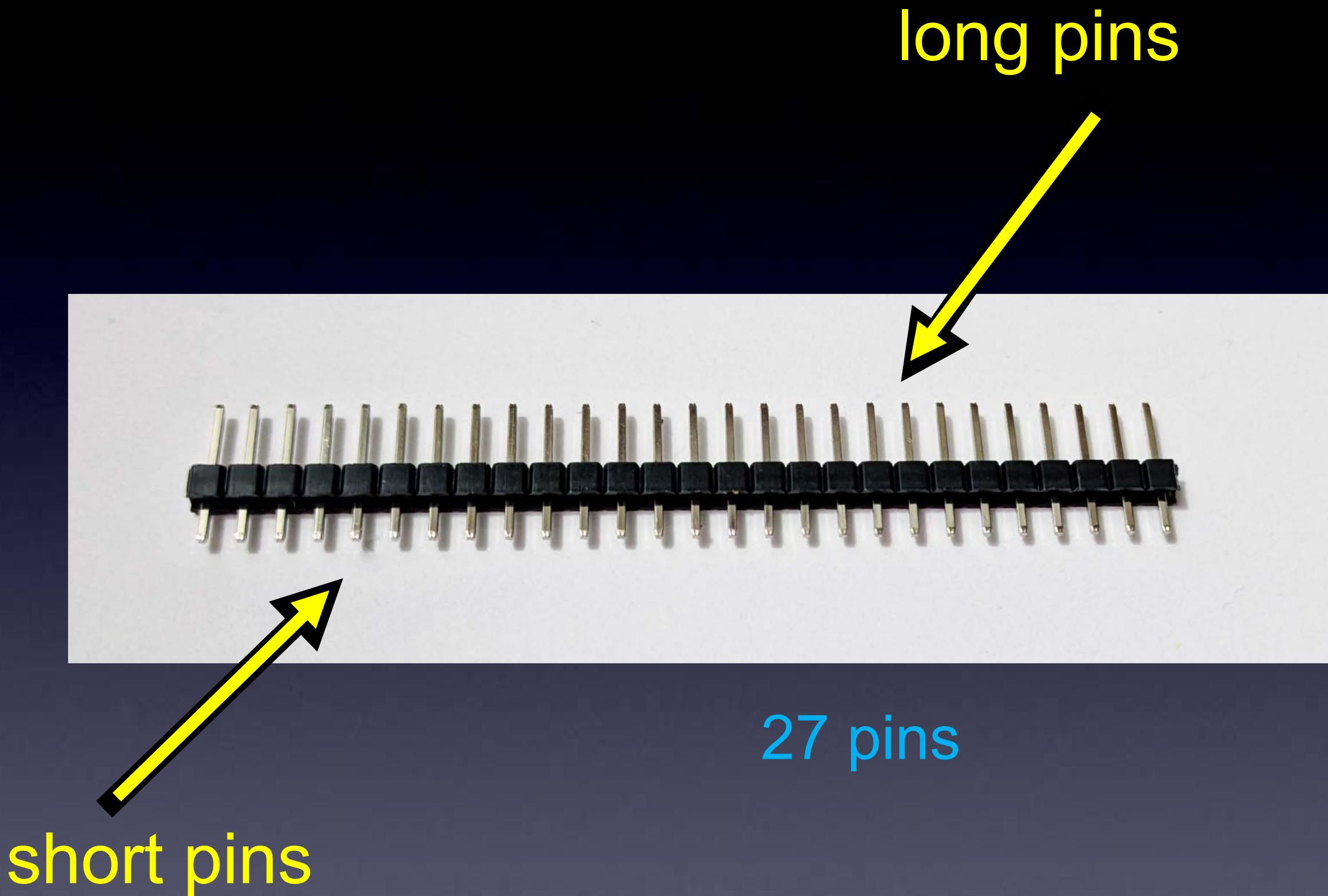


S1: On/Off switch



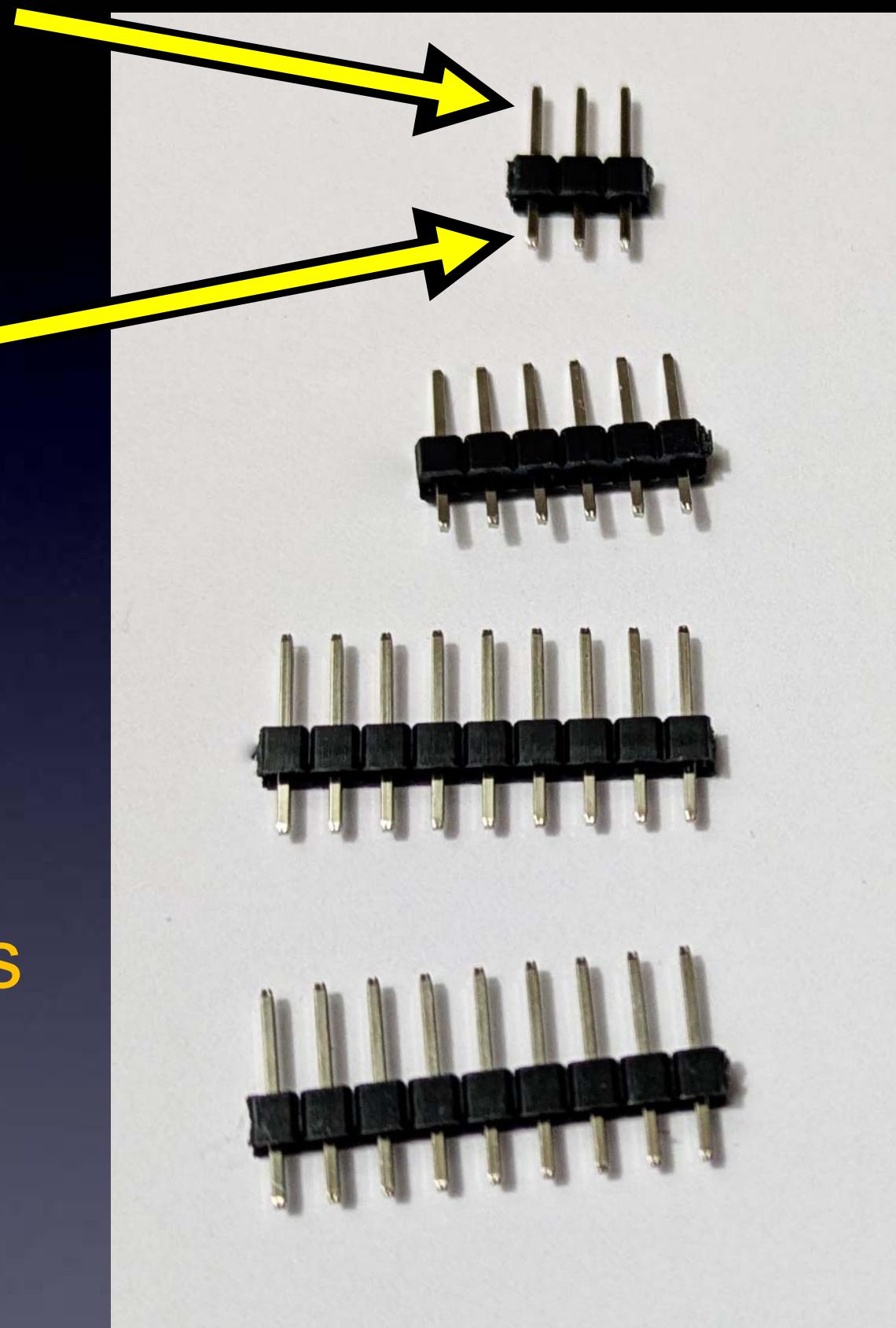
Direction does not matter

Pin Headers



Pin Headers

long pins



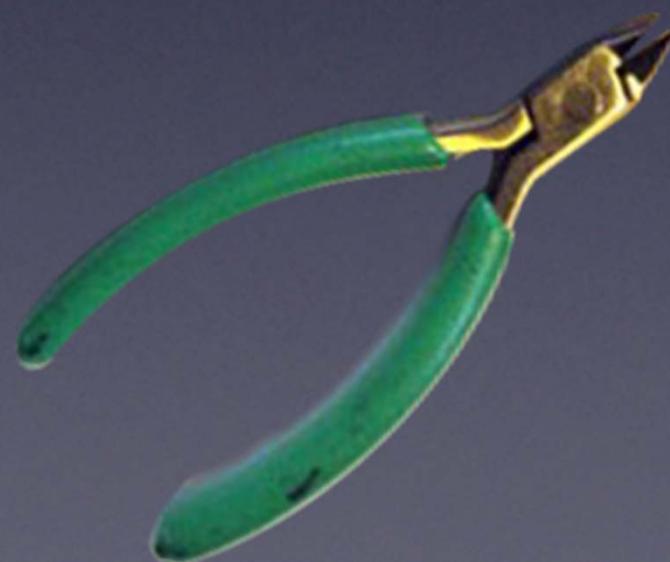
3 pins

6 pins

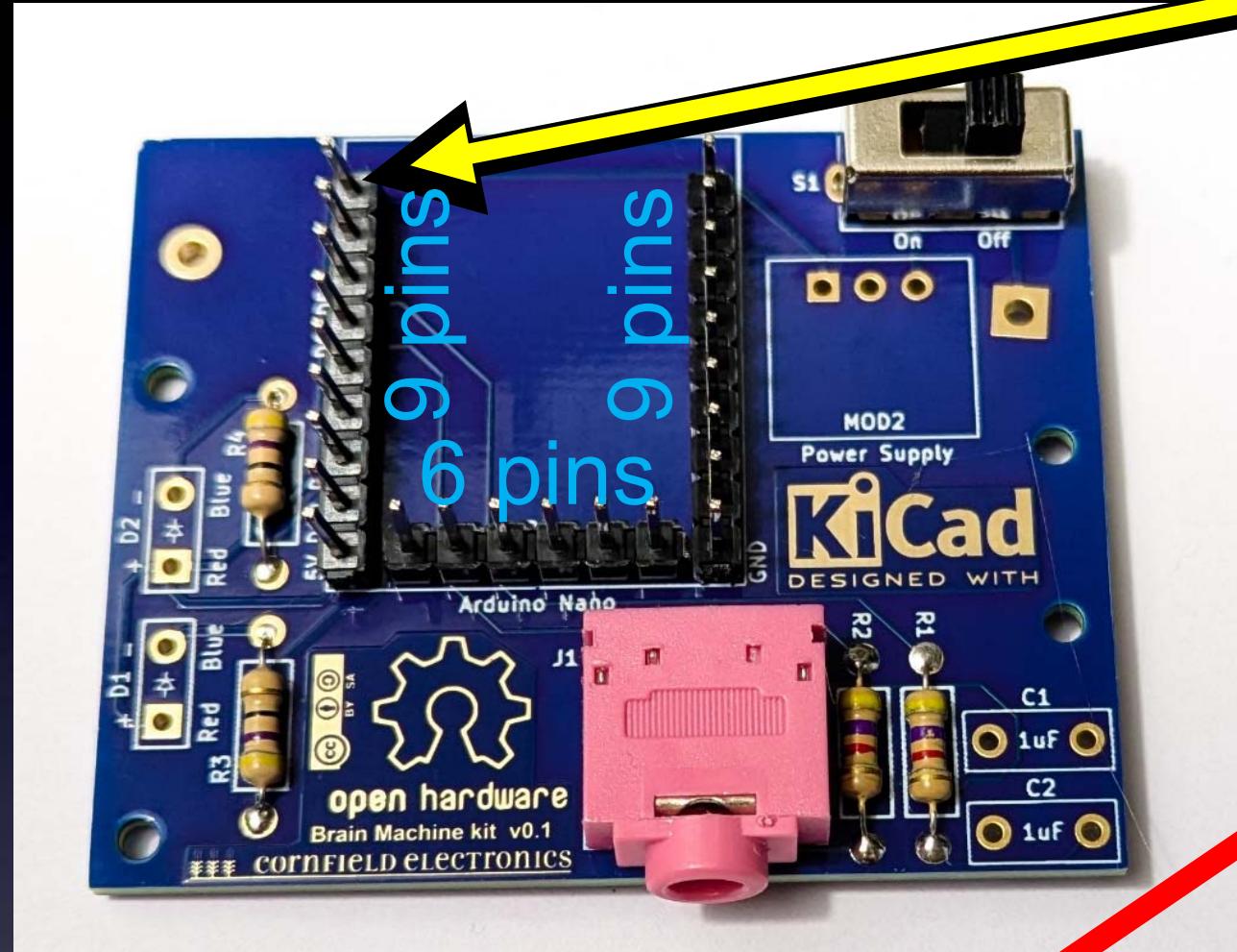
9 pins

9 pins

Use wire cutters



Pin Headers for Arduino Nano



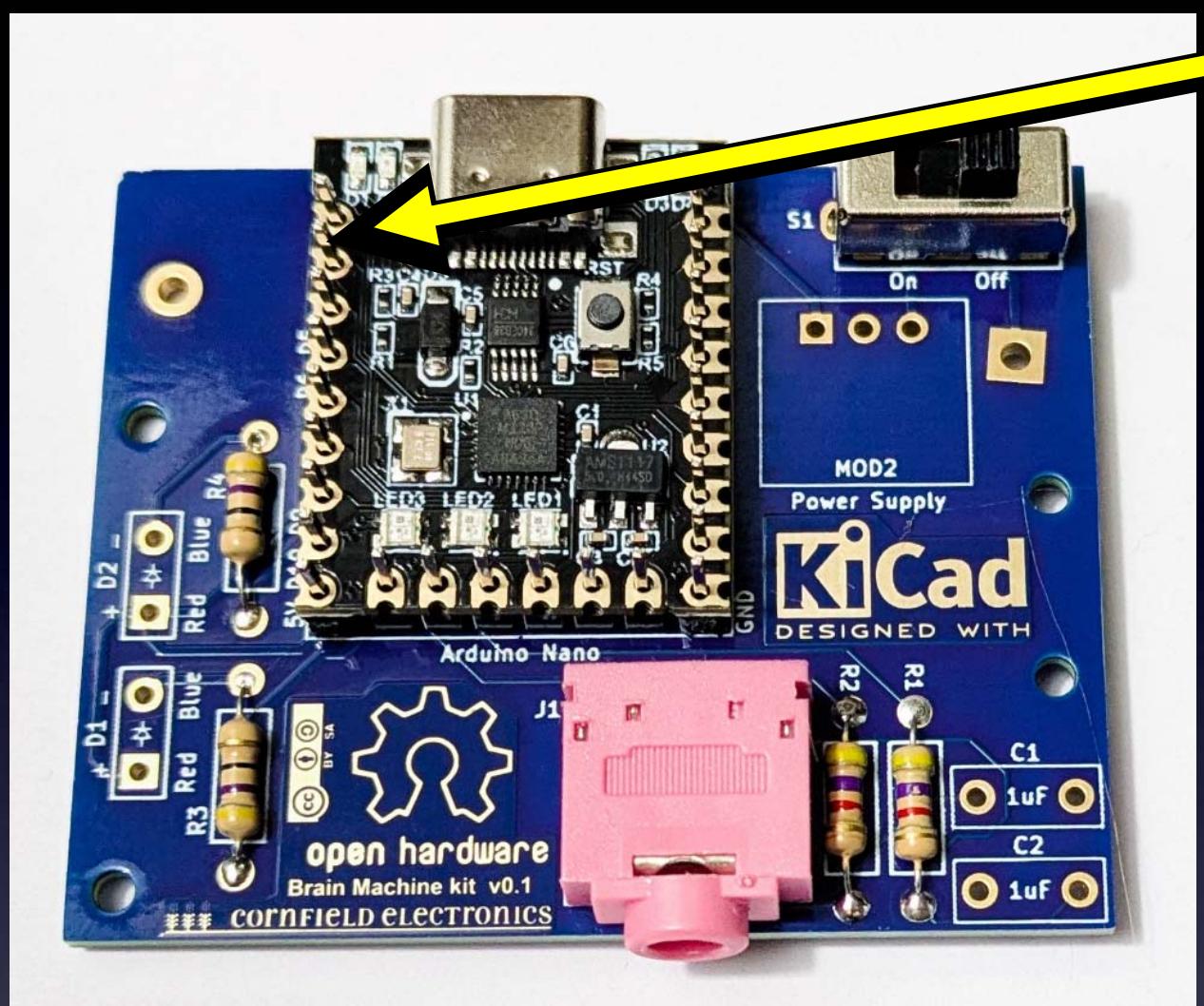
long pins sticking up

IMPORTANT!

→ Short pins go into the board ! ←

→ Do Not solder, yet ←

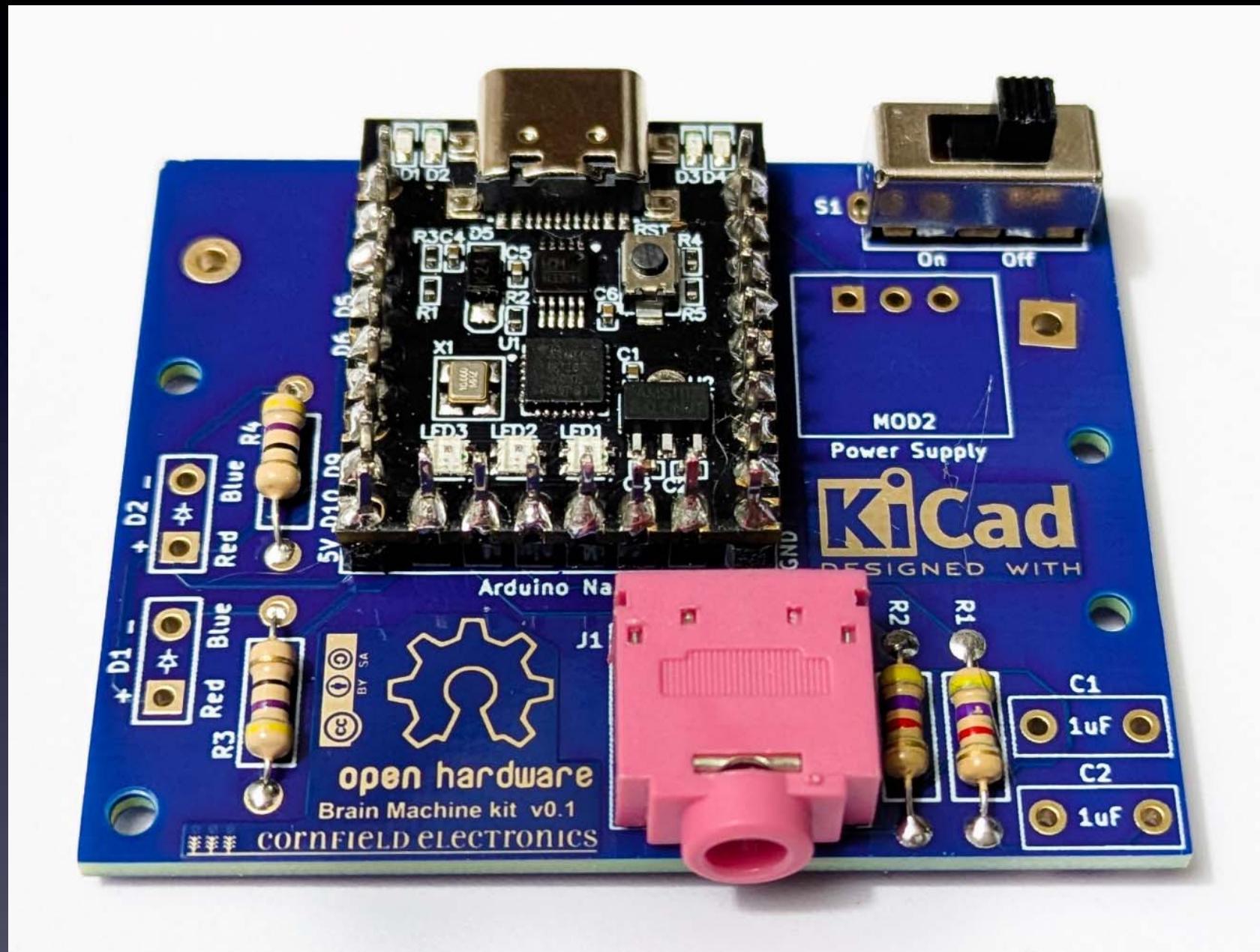
Arduino Nano placed on its pins



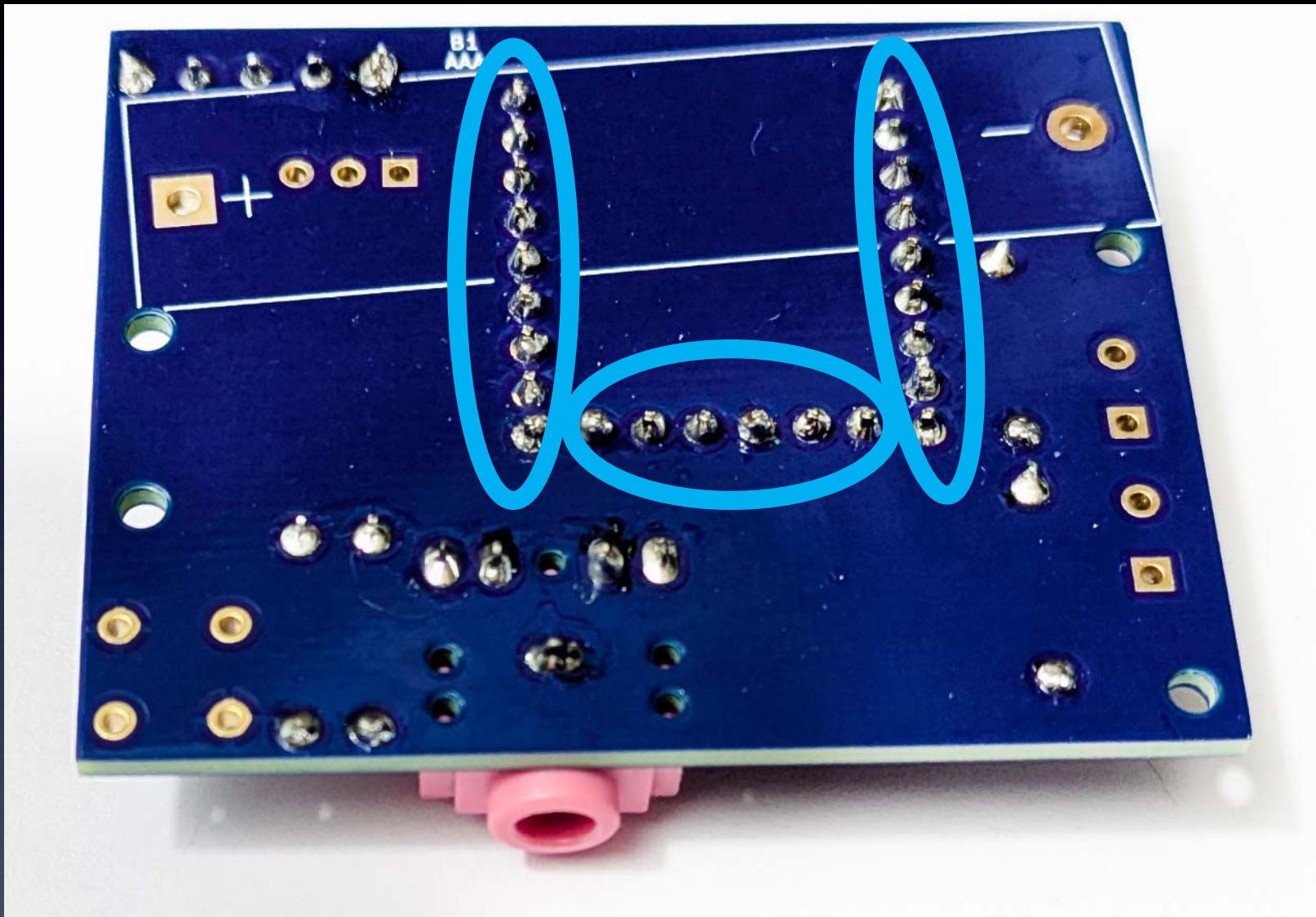
long pins sticking up

→ Short pins go into the board ! ←

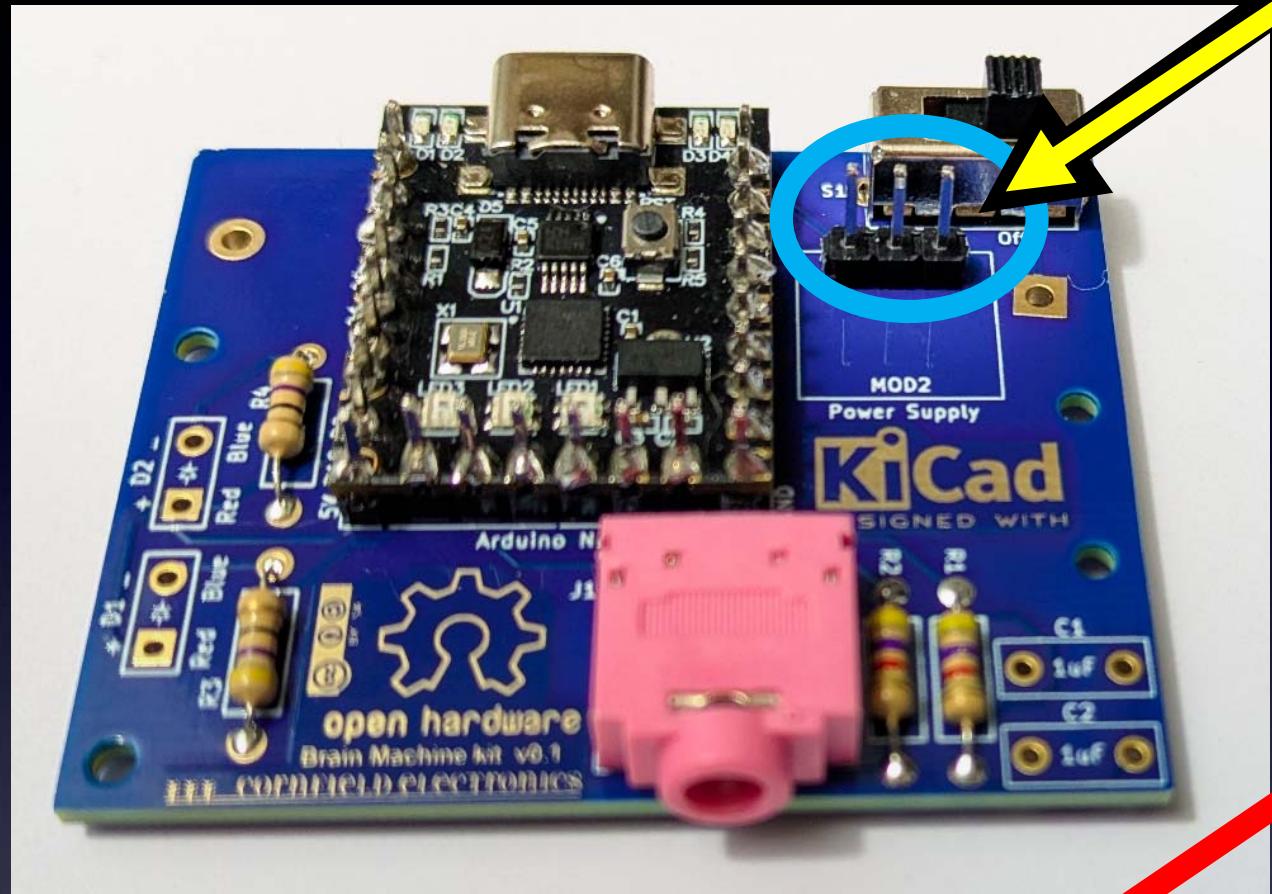
Arduino Nano soldered to its pins



Arduino Nano soldered to board



Pin Headers for Power Supply



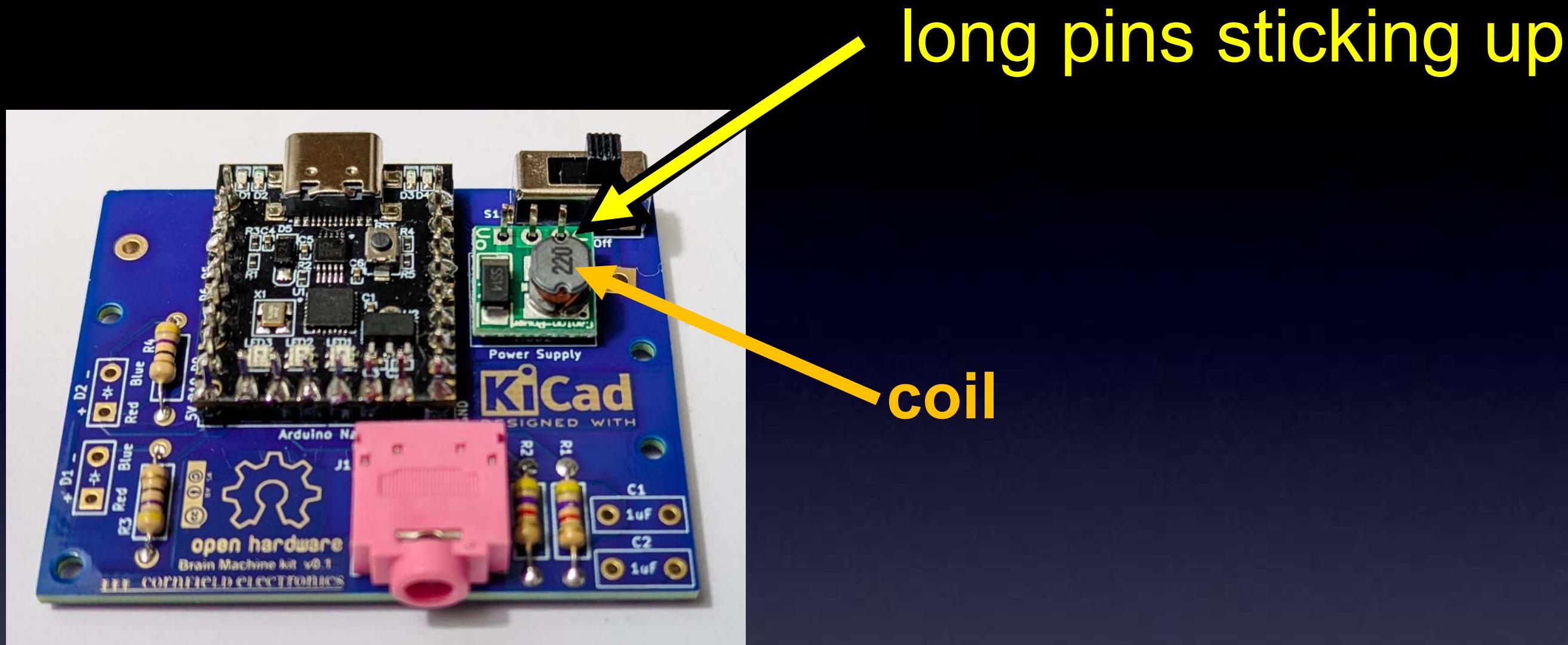
long pins sticking up
3 pins

IMPORTANT!

→ Short pins go into the board ! ←

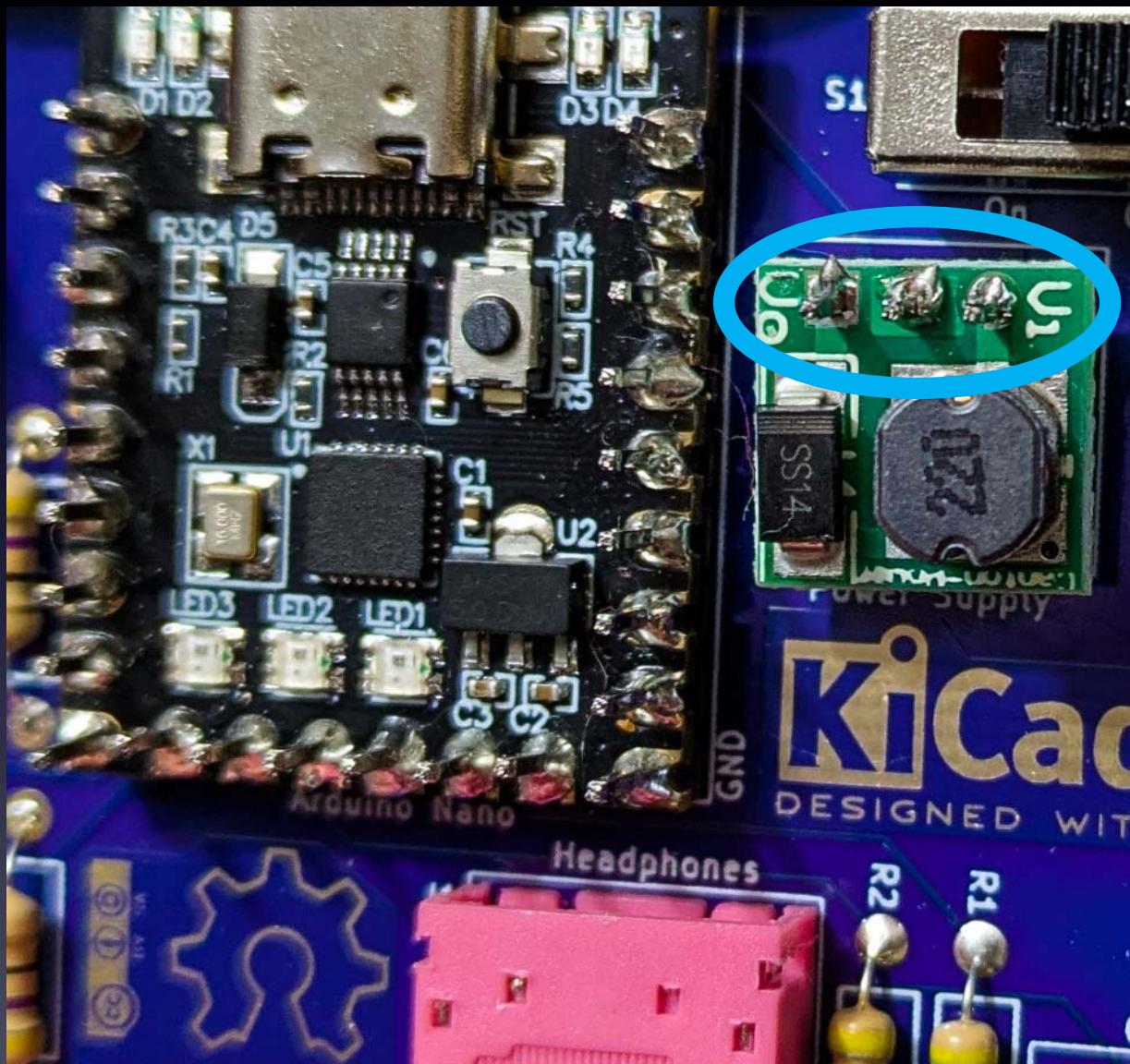
→ Do Not solder, yet ←

Power Supply placed on its pins

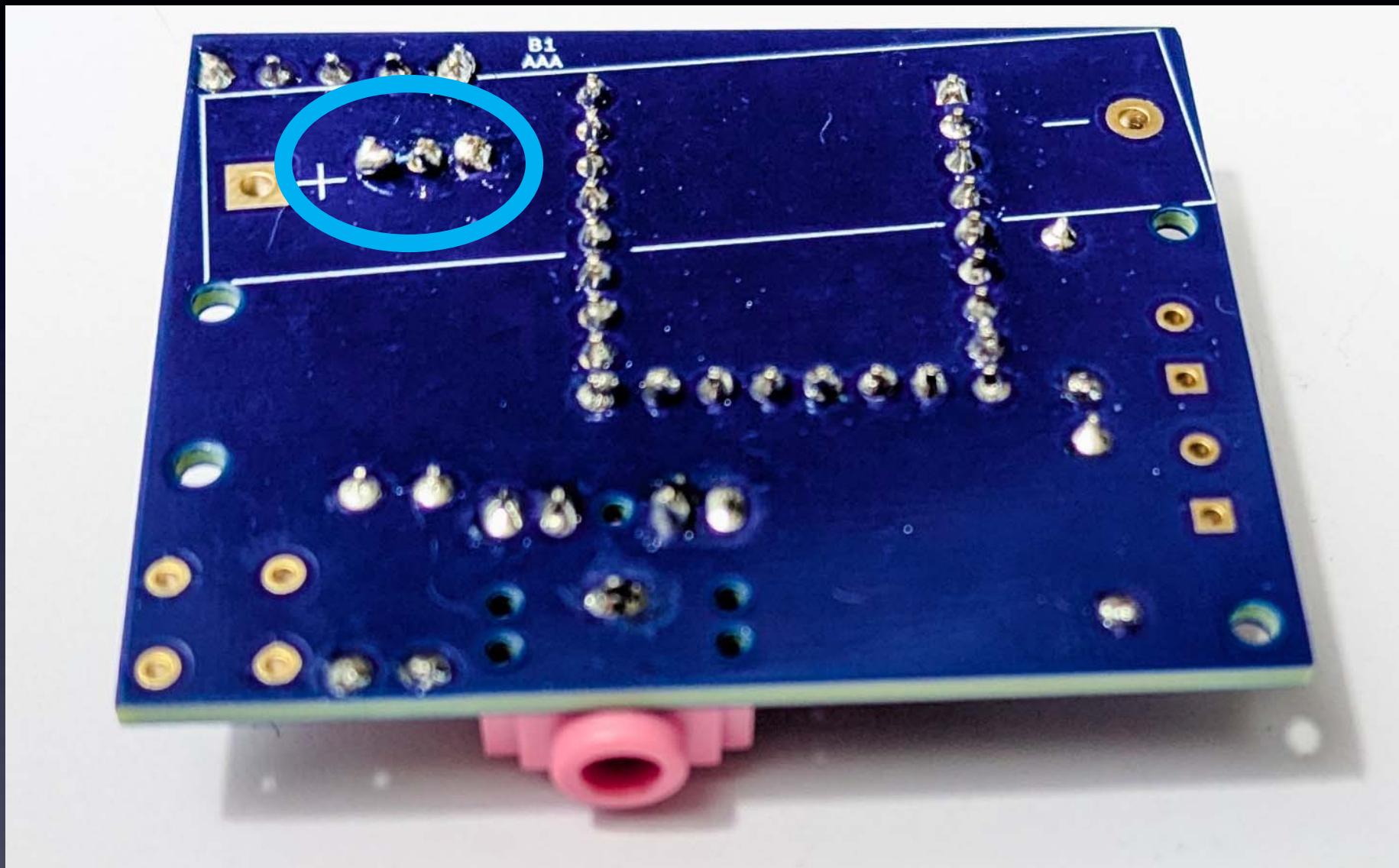


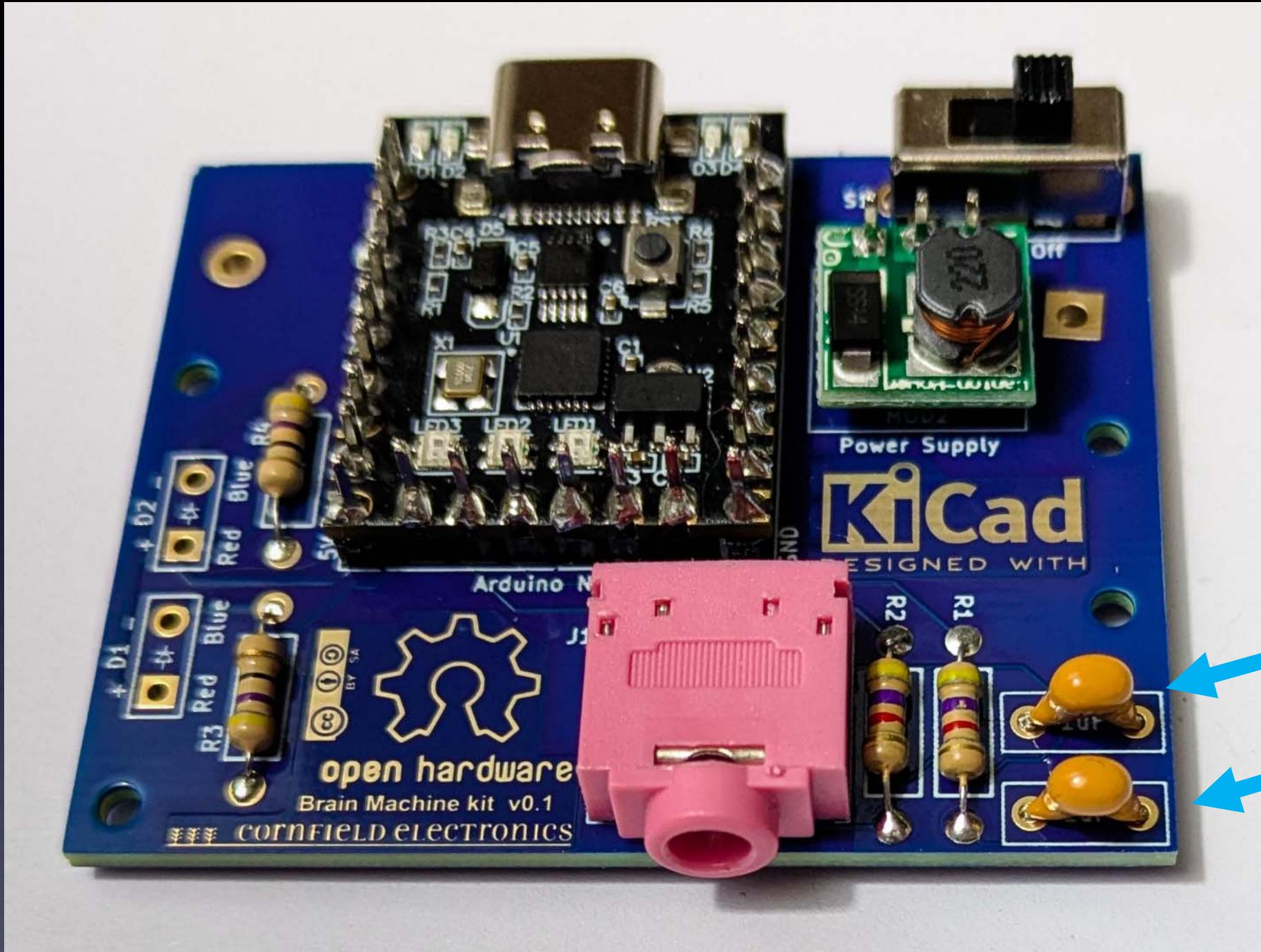
→ IMPORTANT: Power Supply must go in this way ! ←
(coil is facing up)

Power Supply soldered to its pins



Power Supply soldered to board

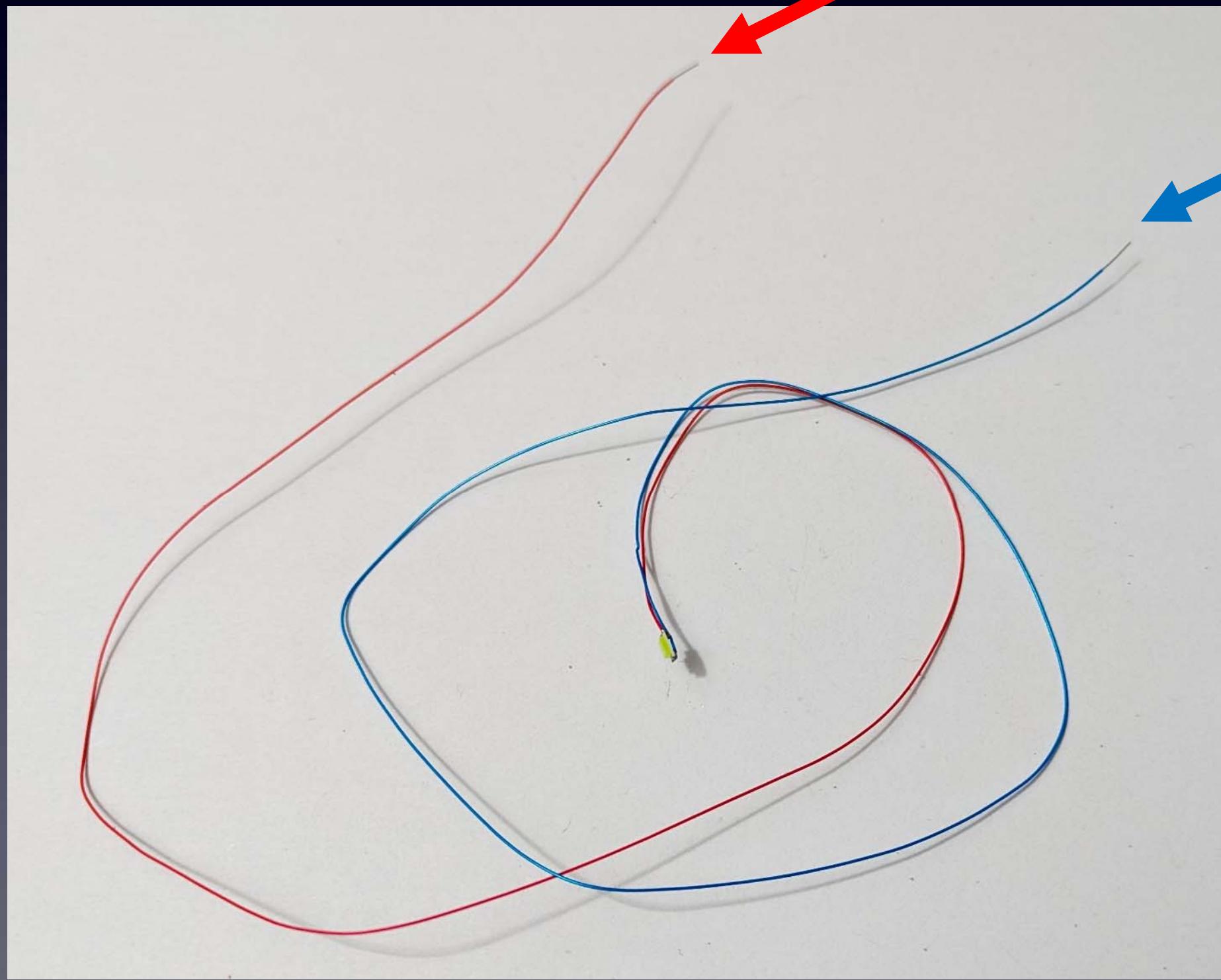




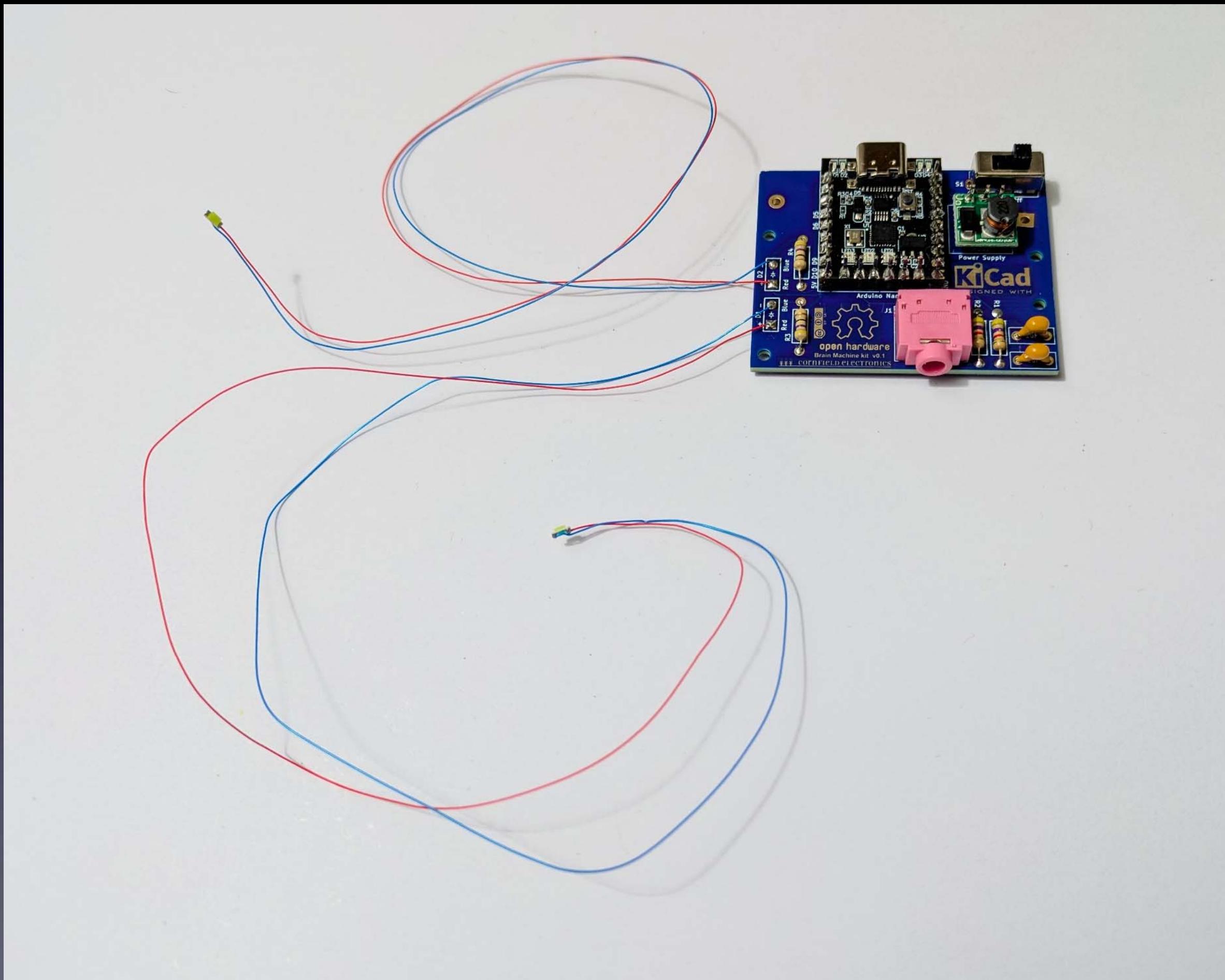
C1, C2

Direction does not matter

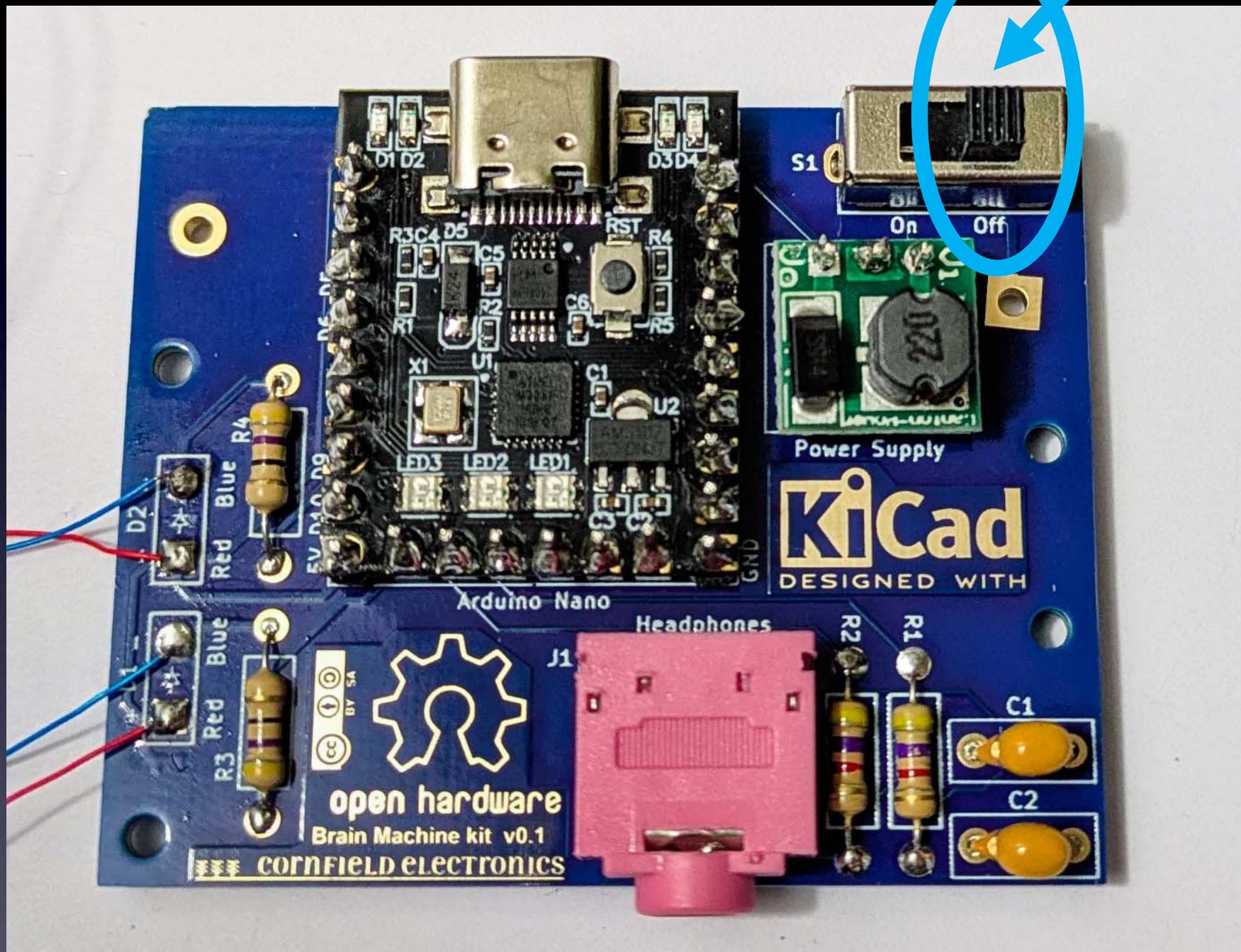
**LED1 and LED2:
Red wire
and
Blue wire**



LED1, LED2 soldered to board



Let's Test !



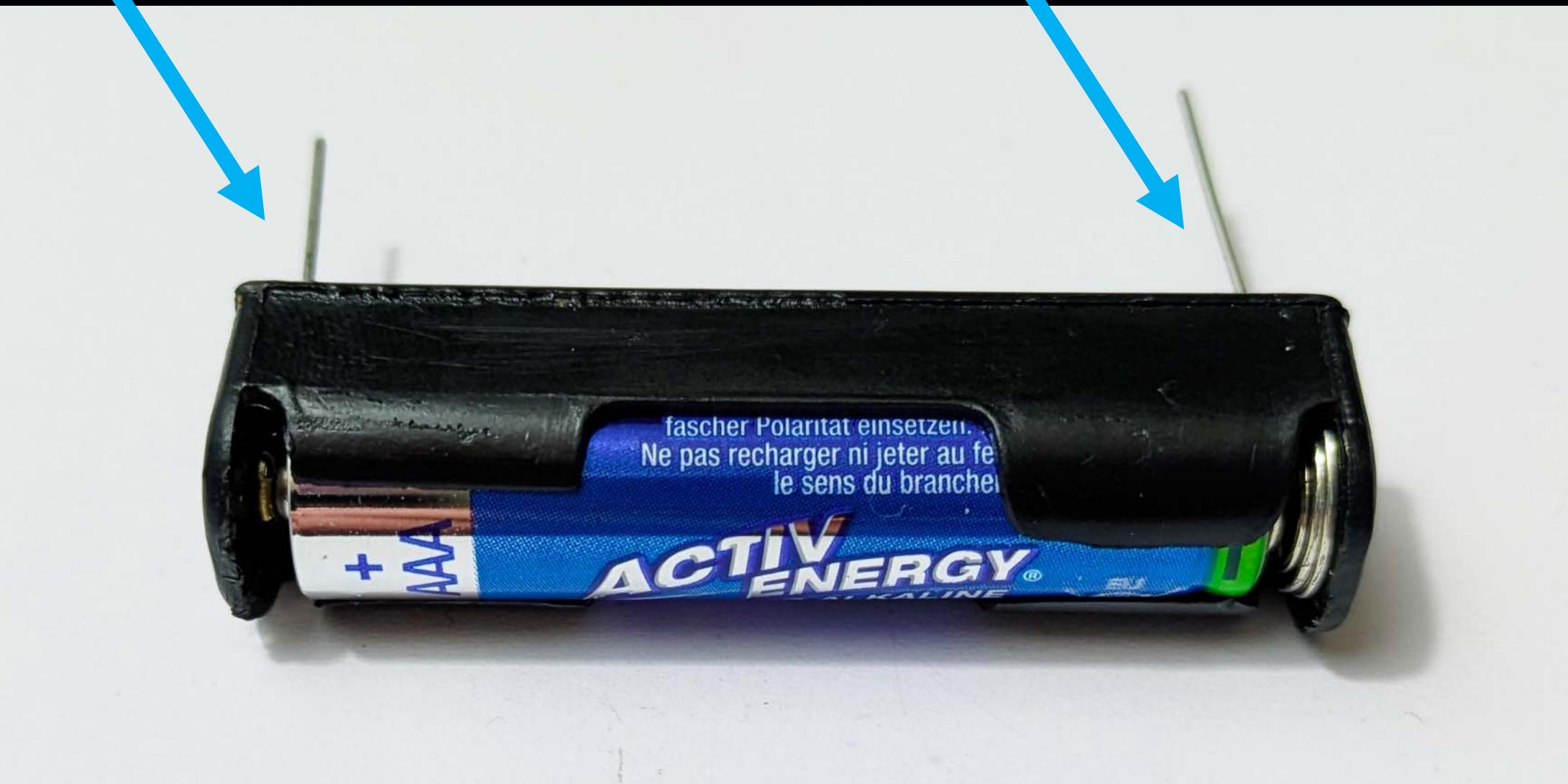
S1 in OFF position

Let's Test !

“+”

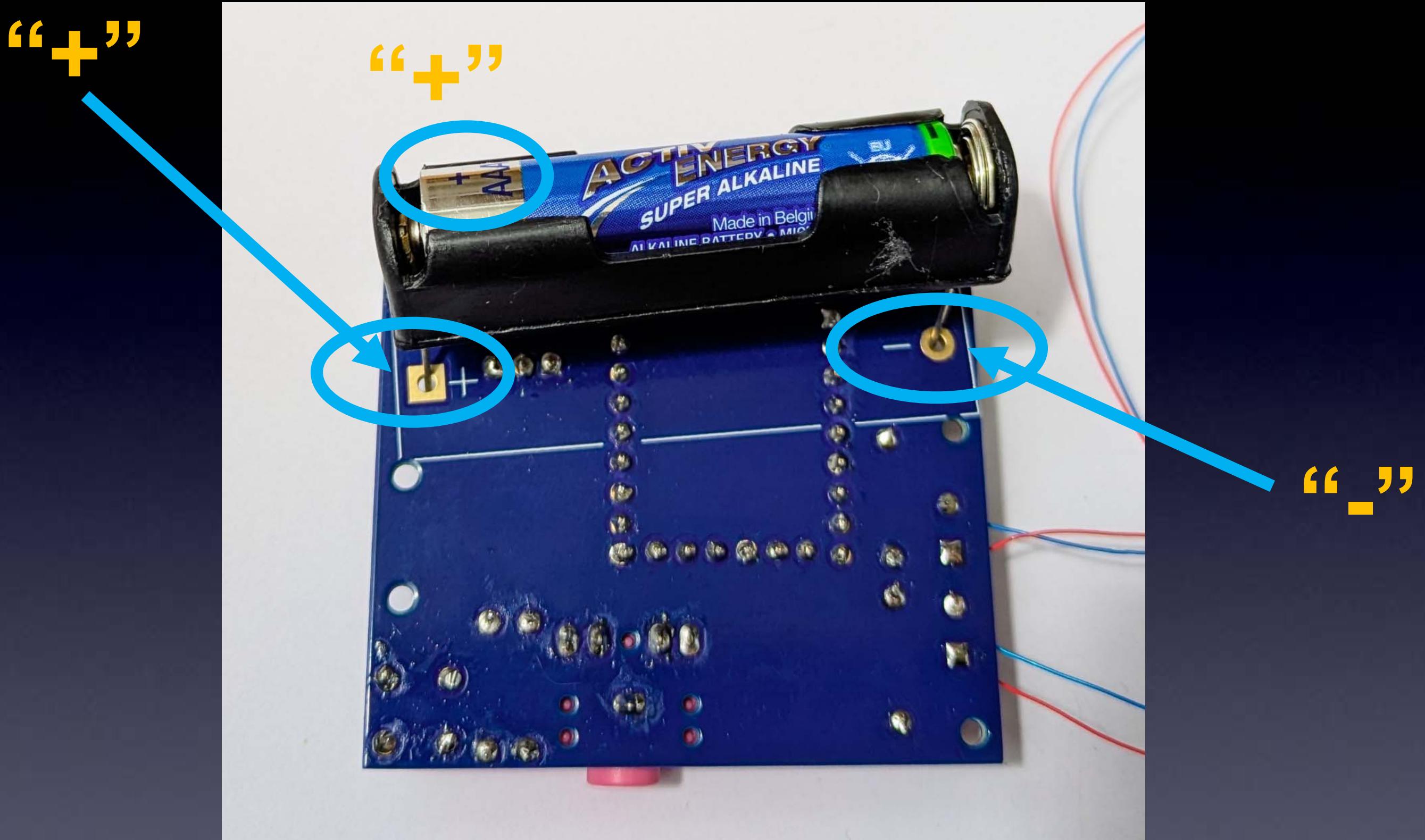
“-”

(spring)



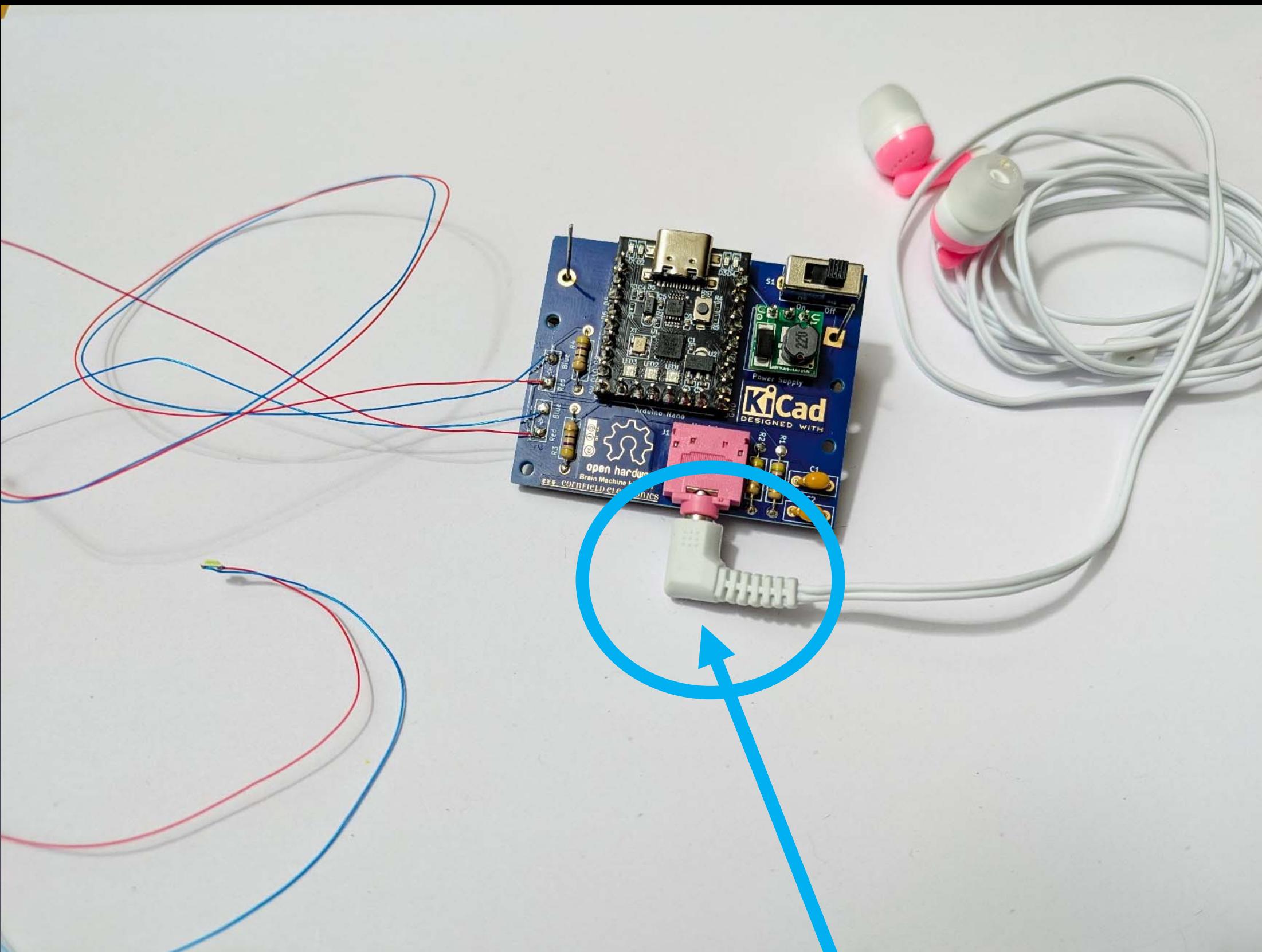
AAA Battery in its holder

Let's Test !



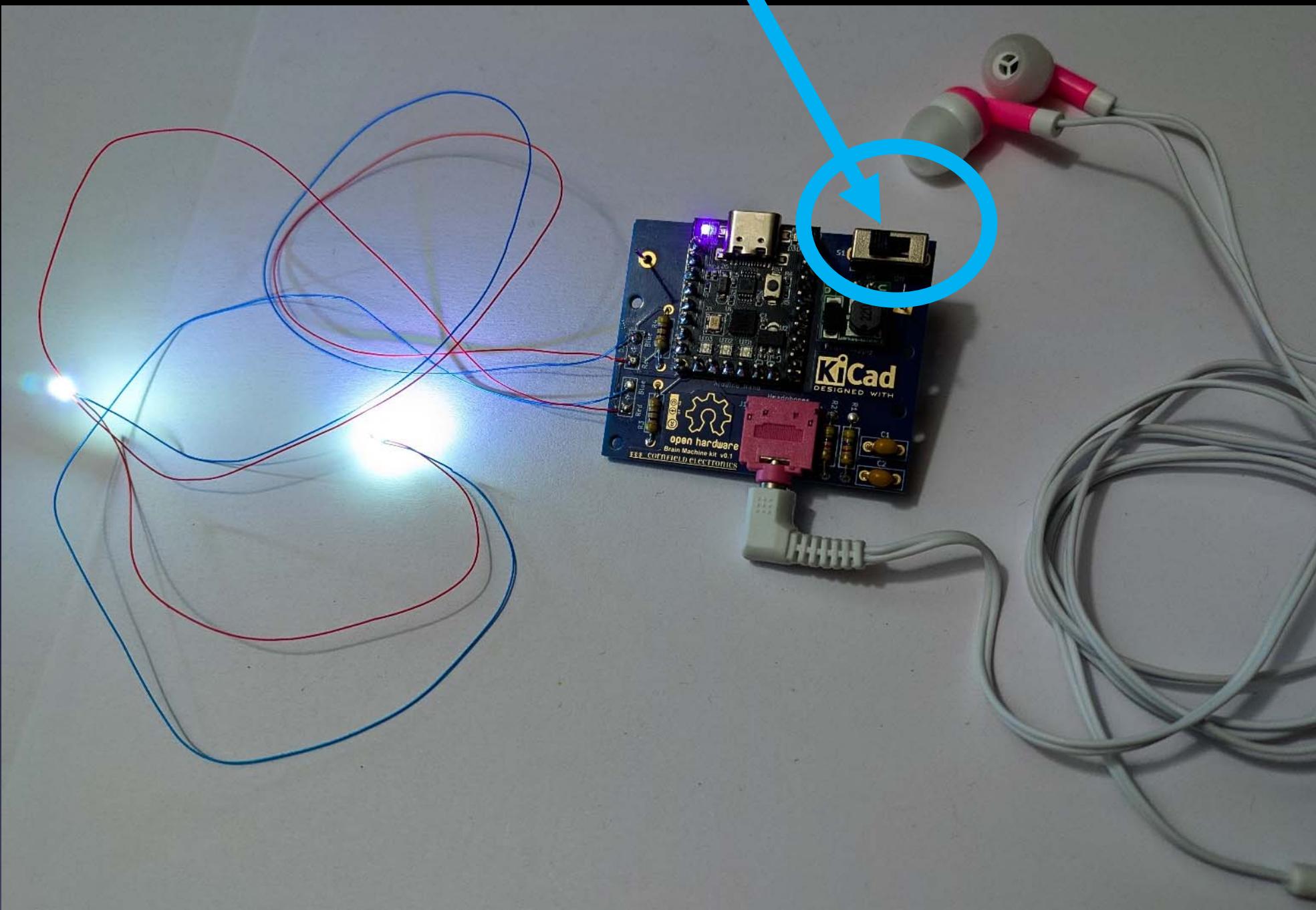
Place AAA Battery holder in place
→ Do Not solder, yet ←

Let's Test !



Insert Earbuds

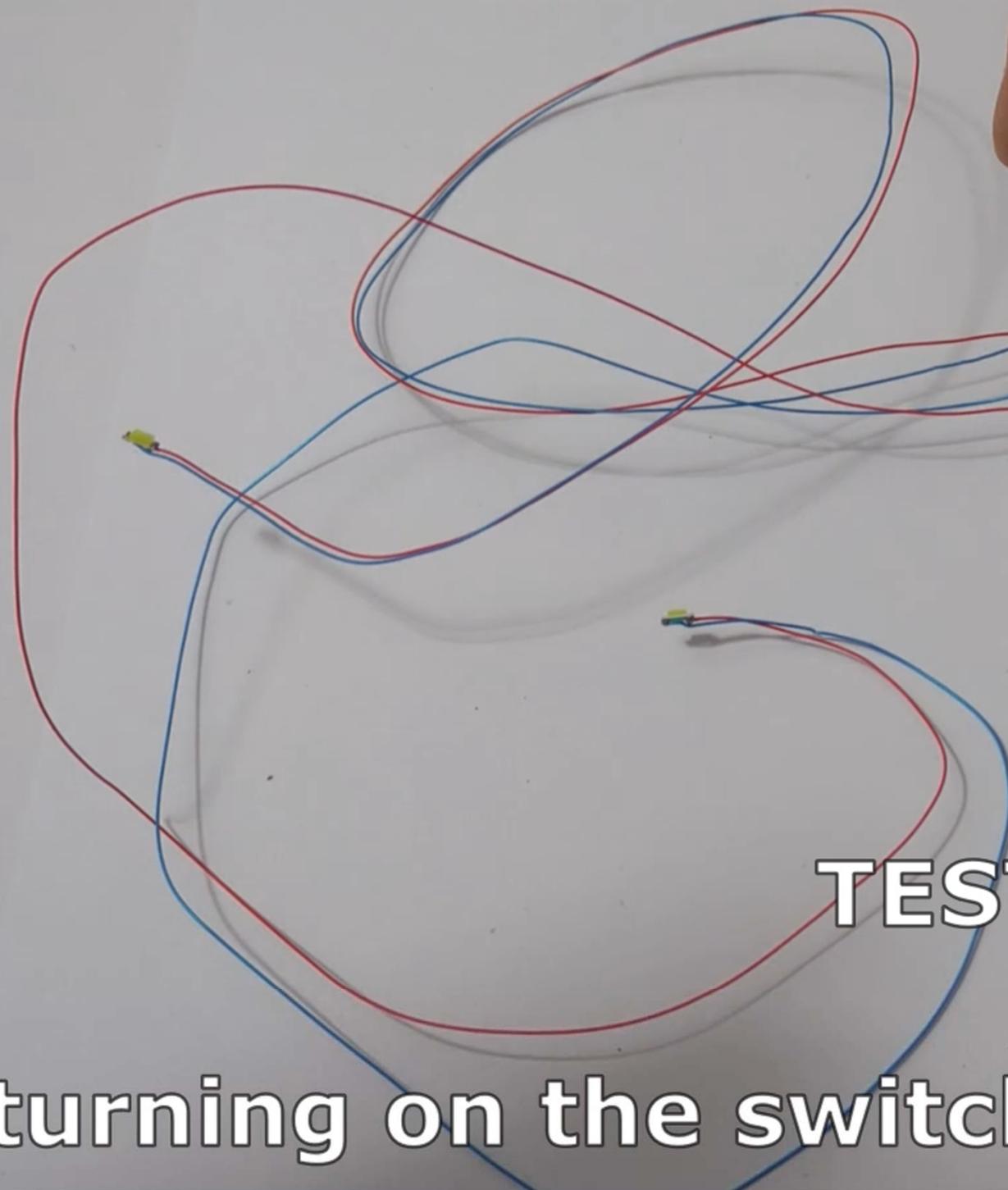
Let's Test !



Turn ON

- ❖ LEDs flicker
- ❖ Each ear has a different pitch

Let's Test !



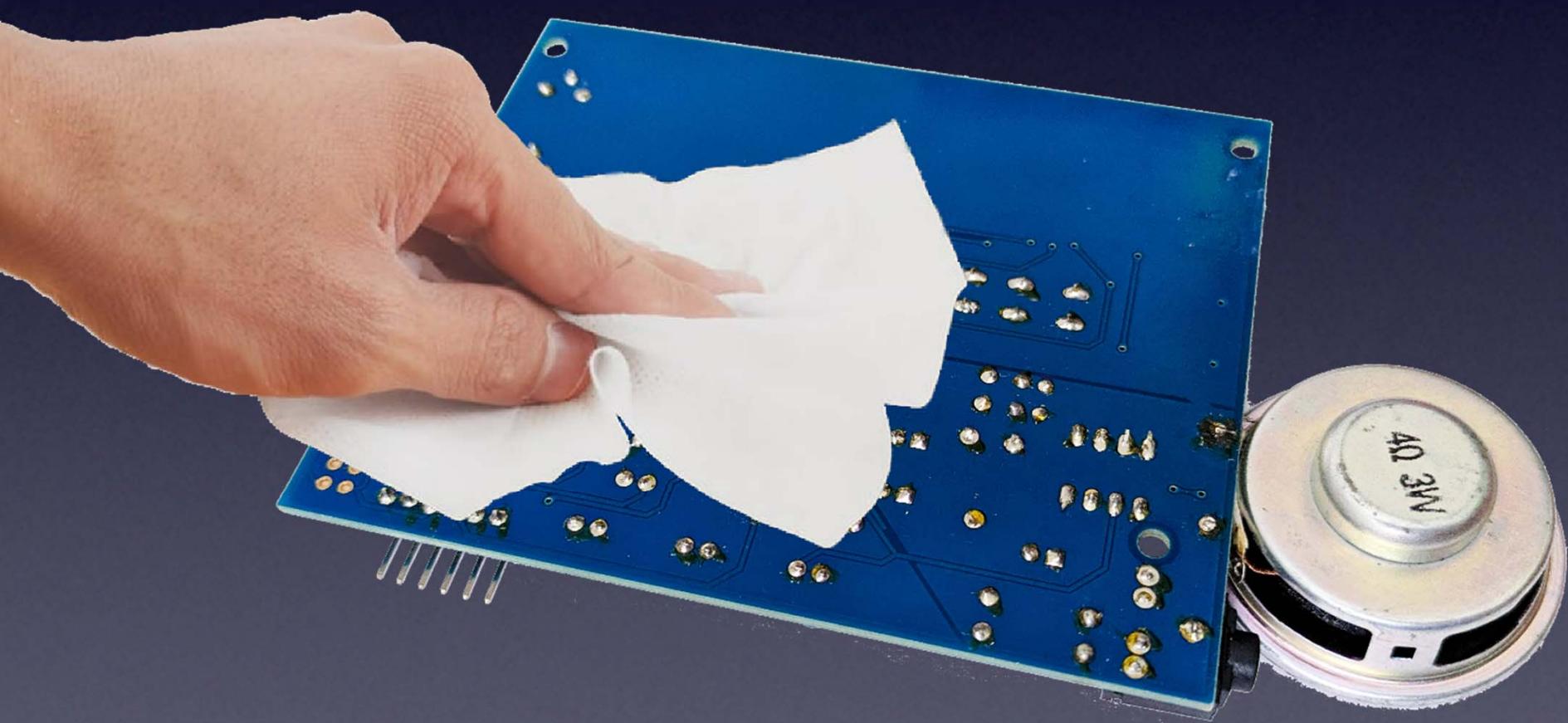
After turning on the switch, both LEDs will flicker.

Video

Since we used **Lead-Free solder**
and
flux paste in a syringe

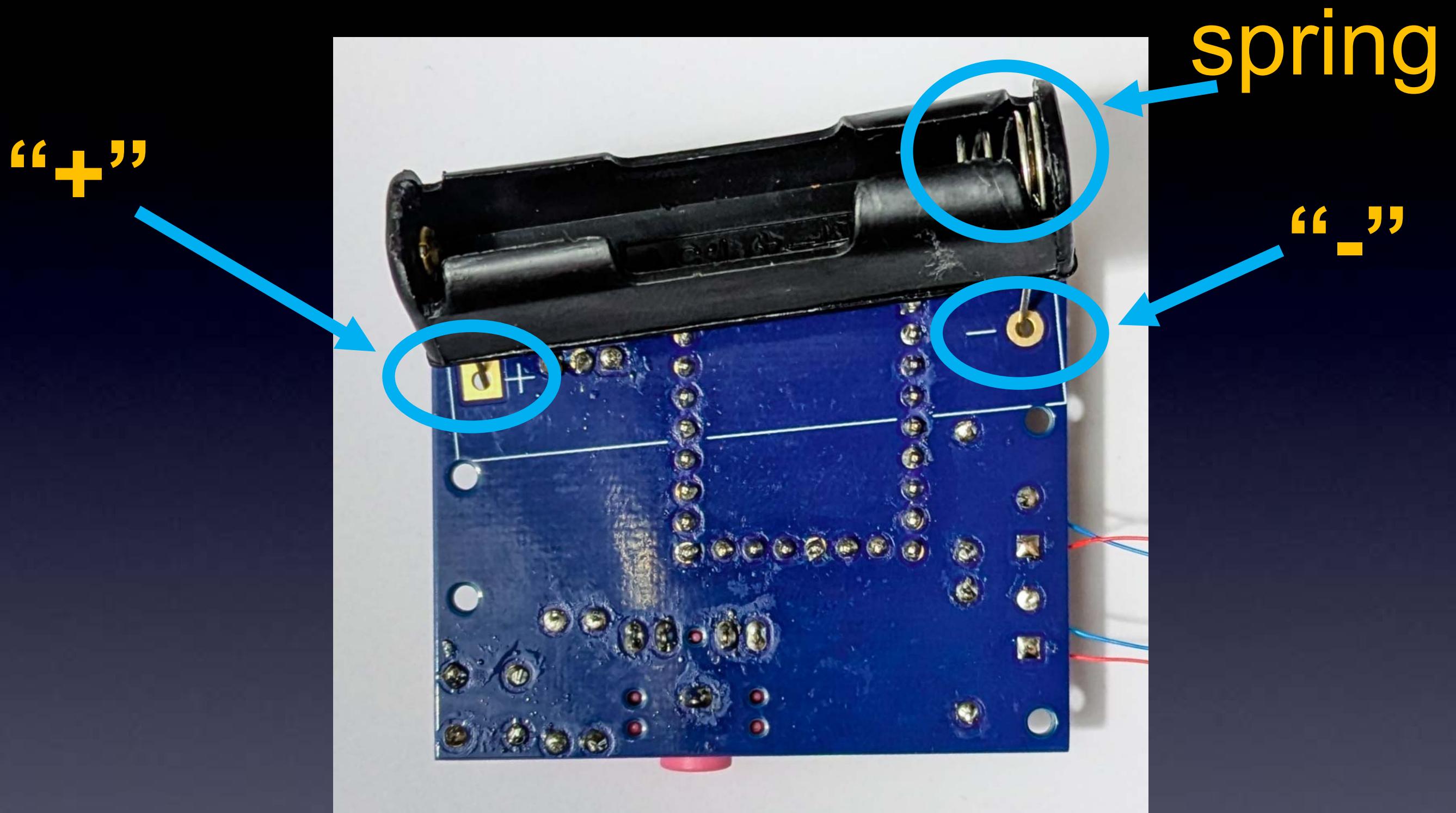


The bottom of the PCB will be sticky from the flux

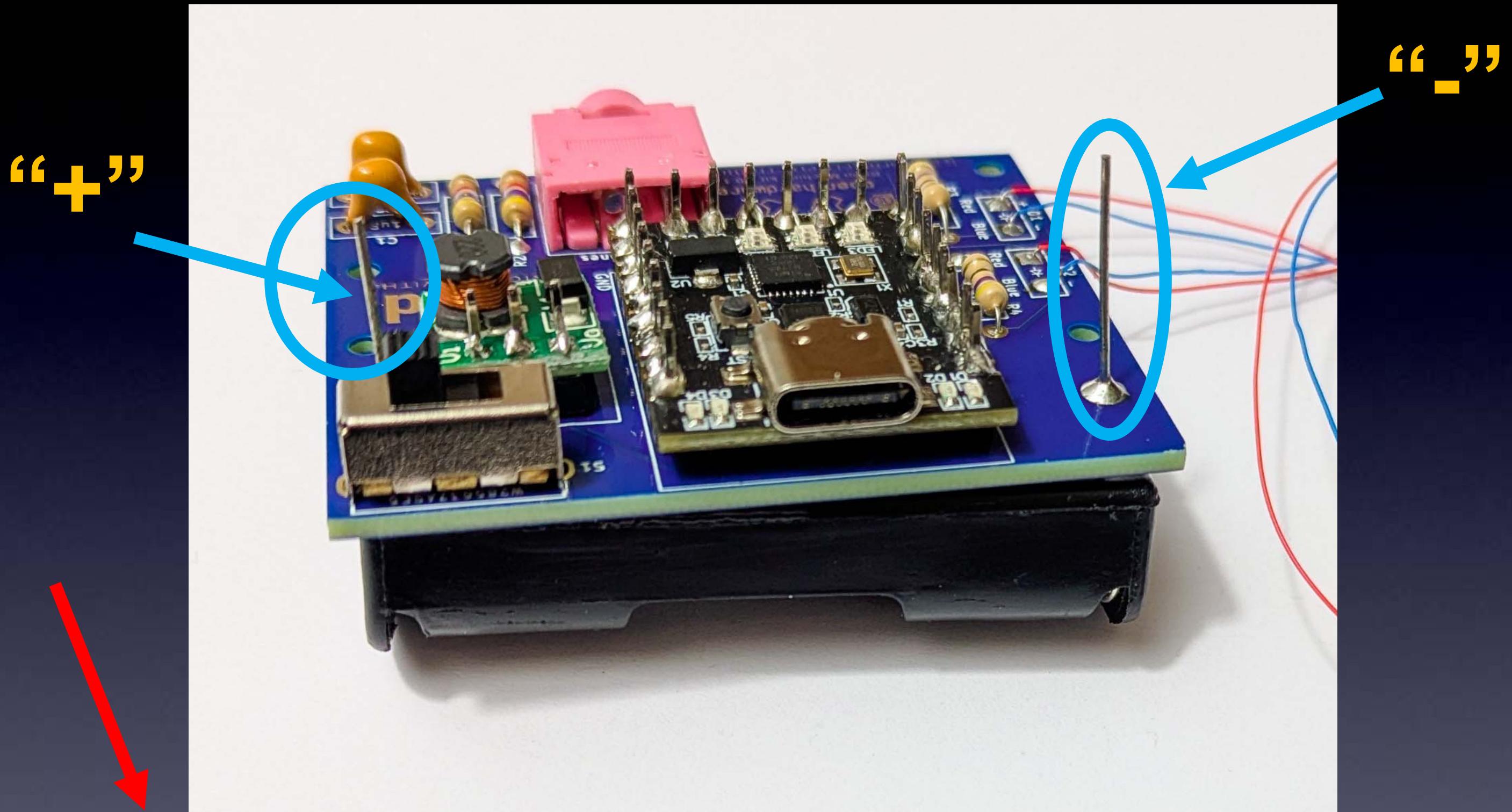


*You can clean it with a cloth
wet with Isopropyl Alcohol*

Insert Battery Holder



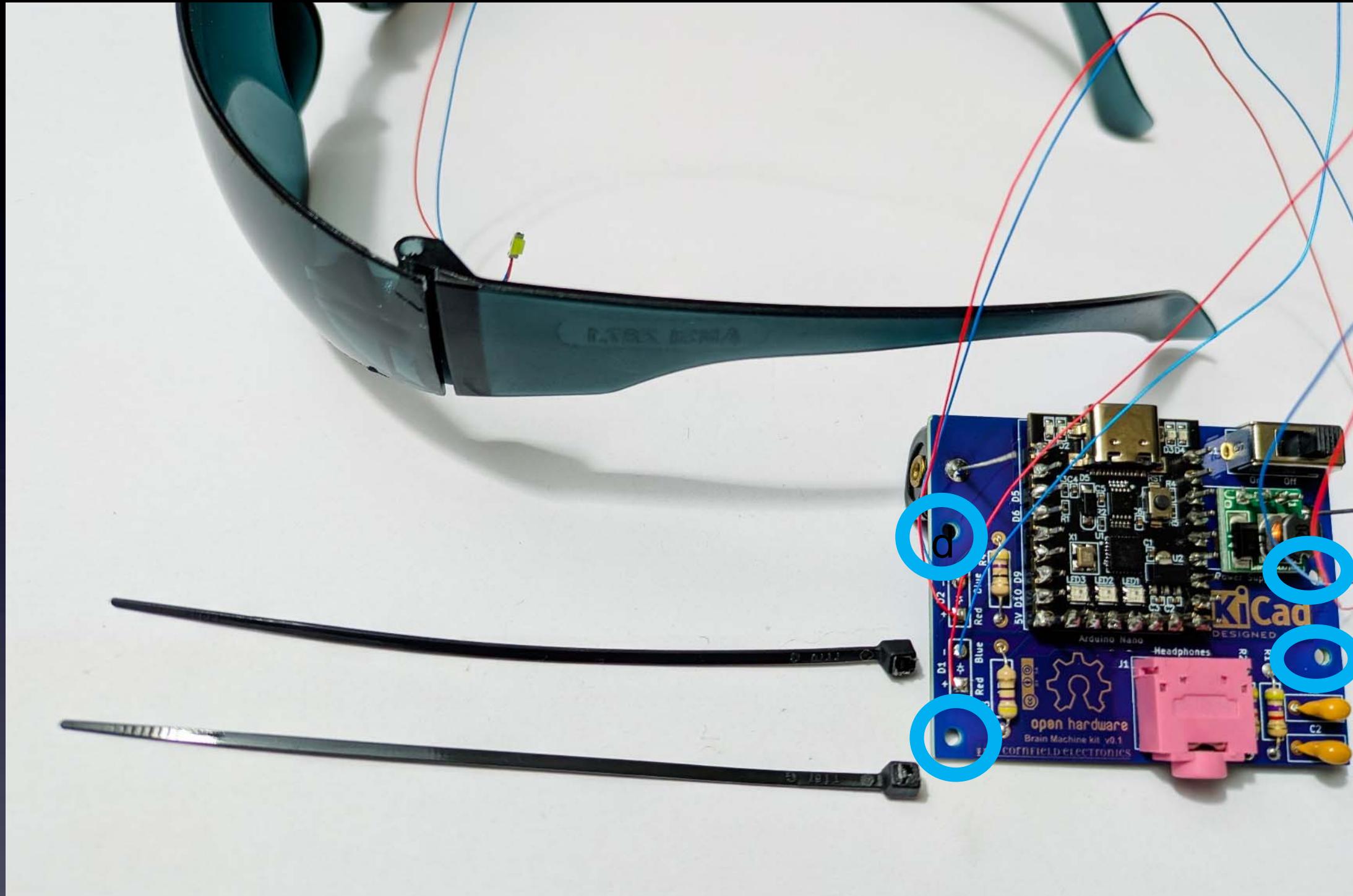
Battery Holder Soldered



→ ***DO NOT*** cut battery holder leads ! ←

↑ (That will destroy the wire cutters)

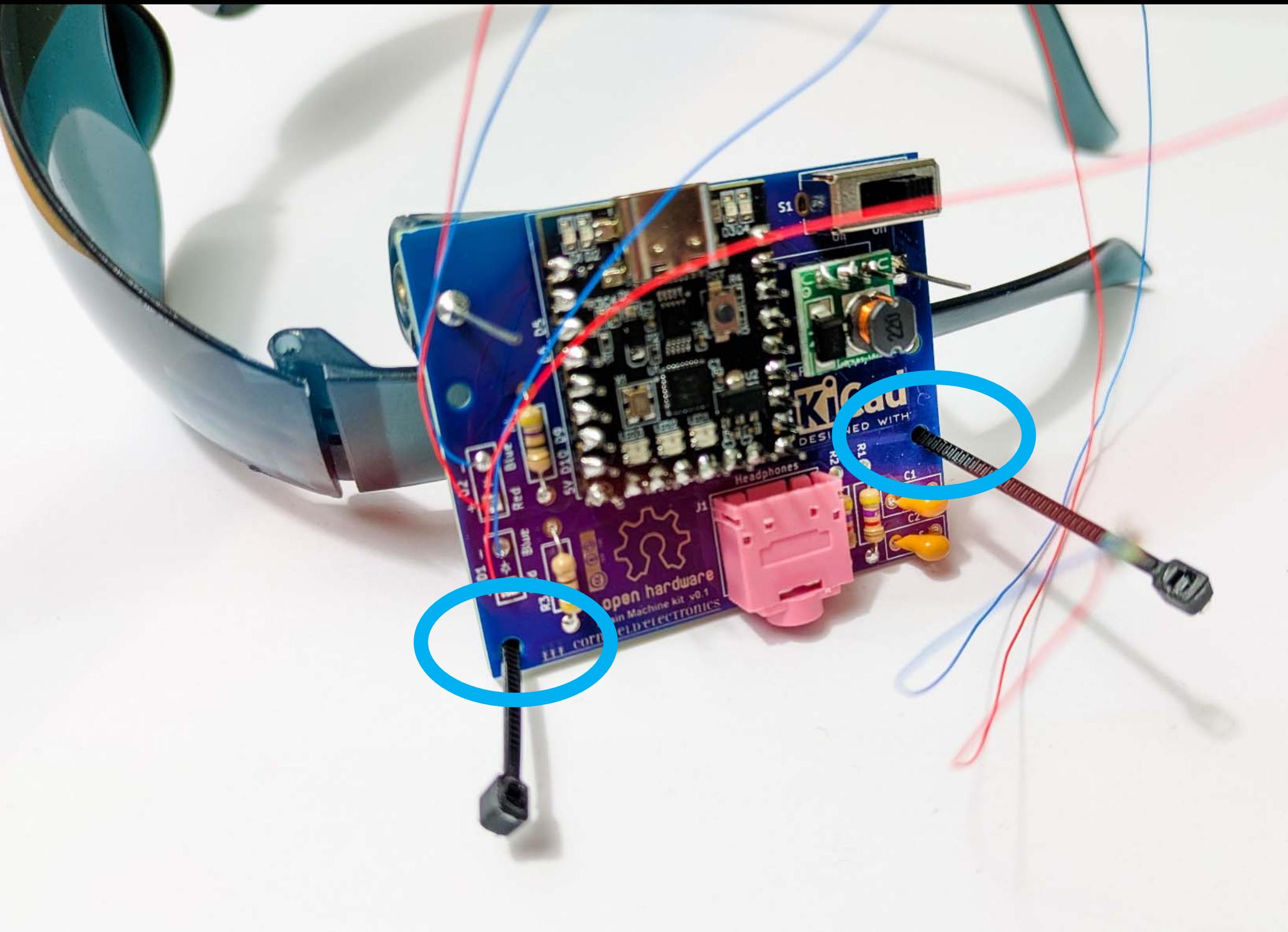
Attach Board to Glasses



Notice the 4 holes in the board
for the zip ties

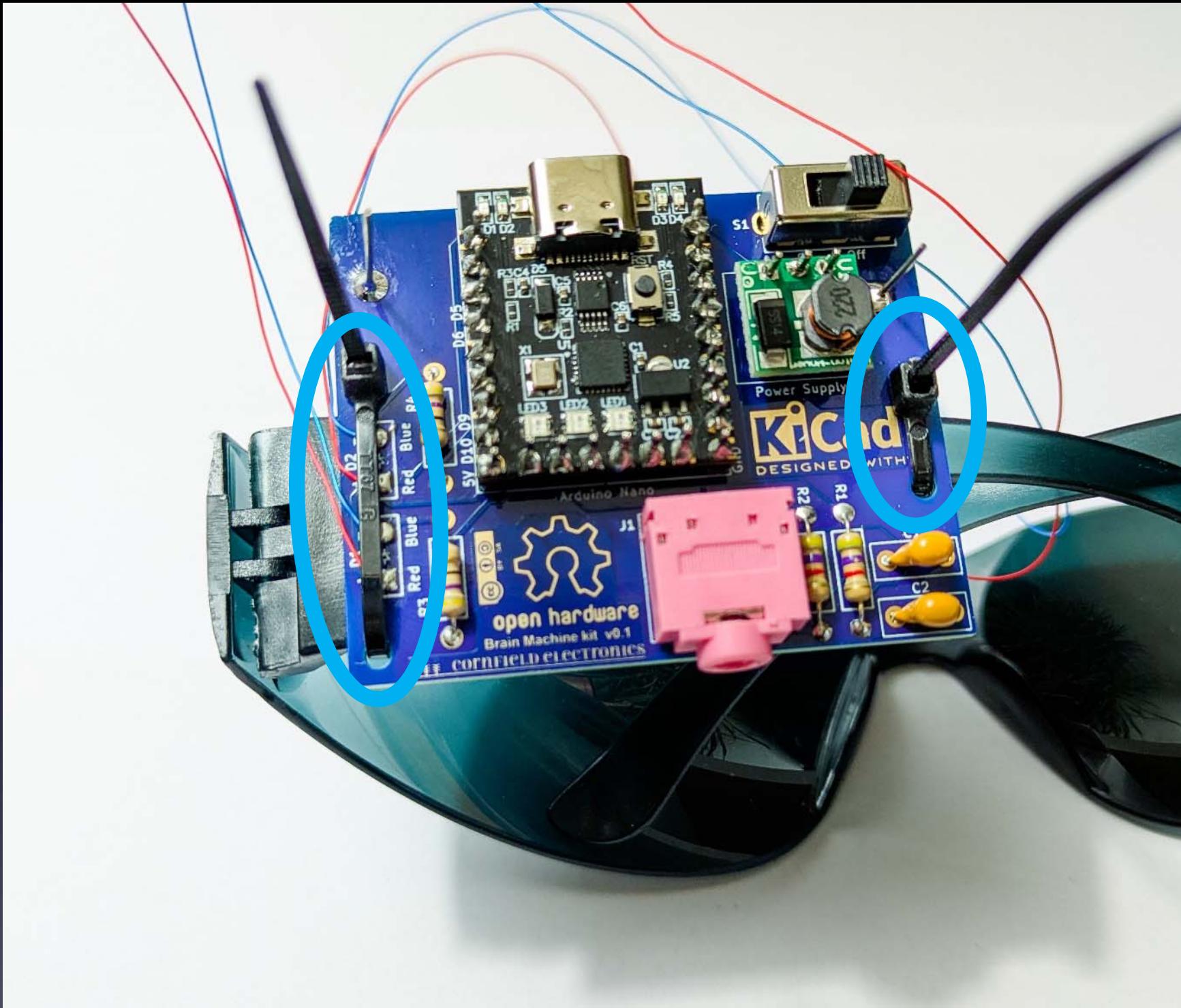
→ Use left side of glasses ←

Attach Board to Glasses



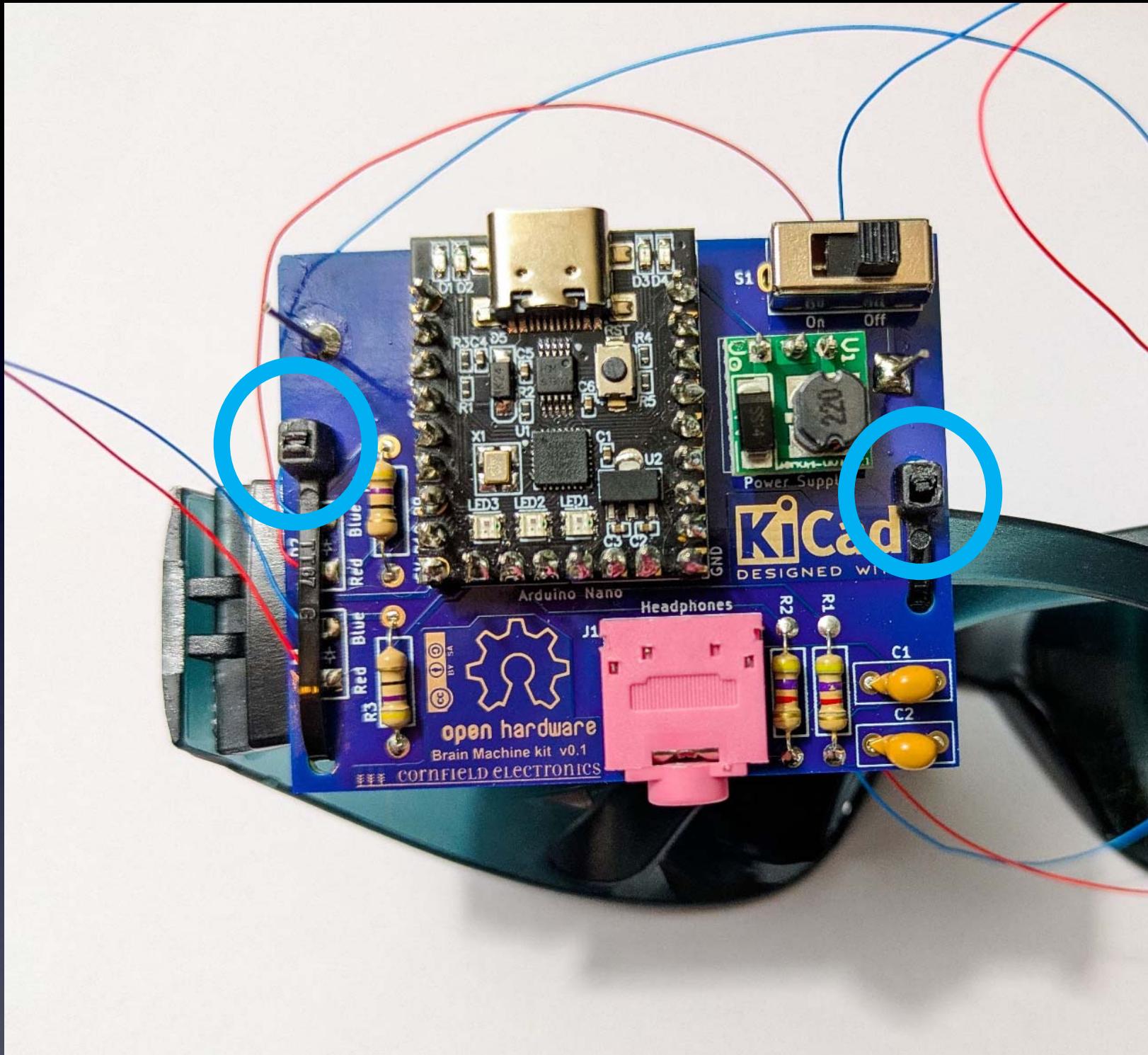
Insert zip-ties into lower mounting holes

Attach Board to Glasses



Wrap zip-ties around, and secure

Attach Board to Glasses



Cut zip-ties short

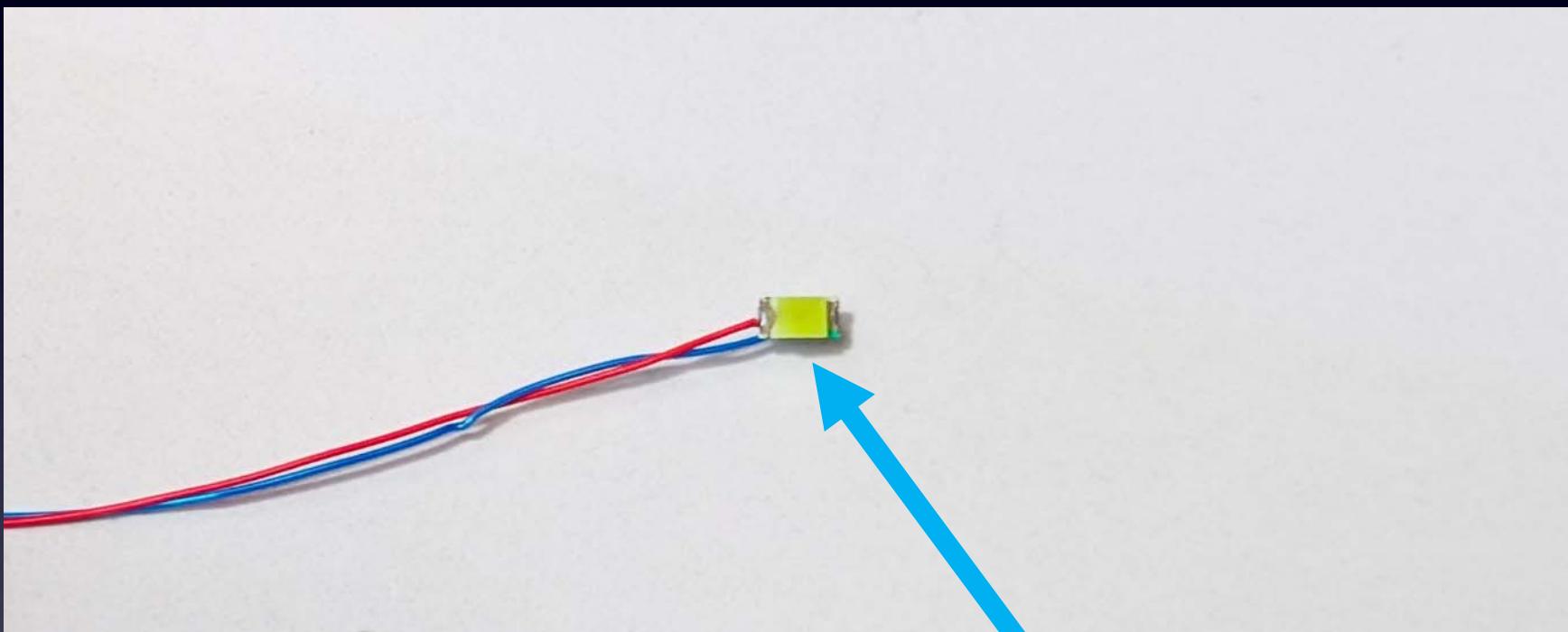
Mark where LEDs will go



For each eye:

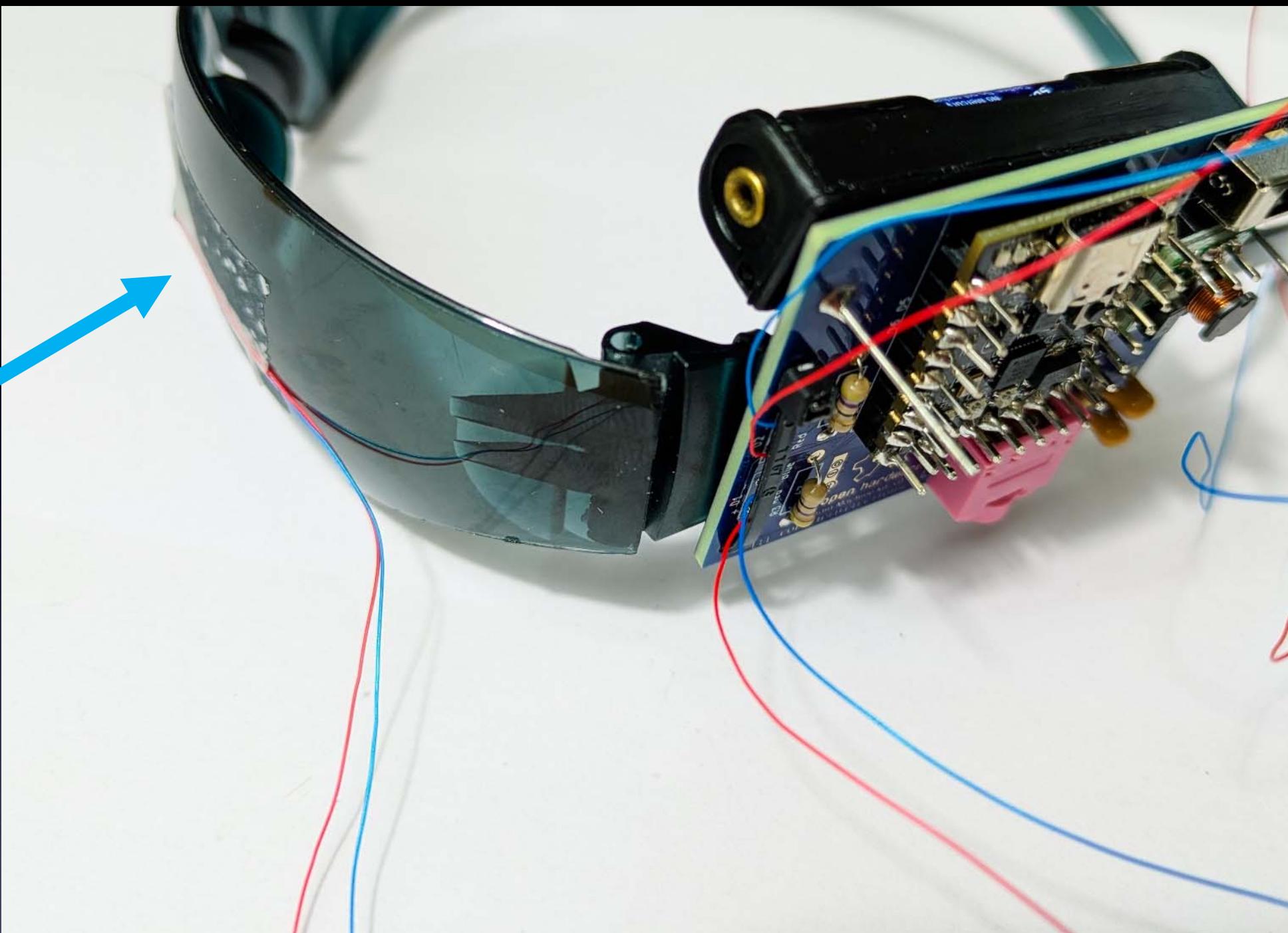
Slowly move the marker toward your eye
to make a mark directly in front of your eye.

LEDs light up on one side



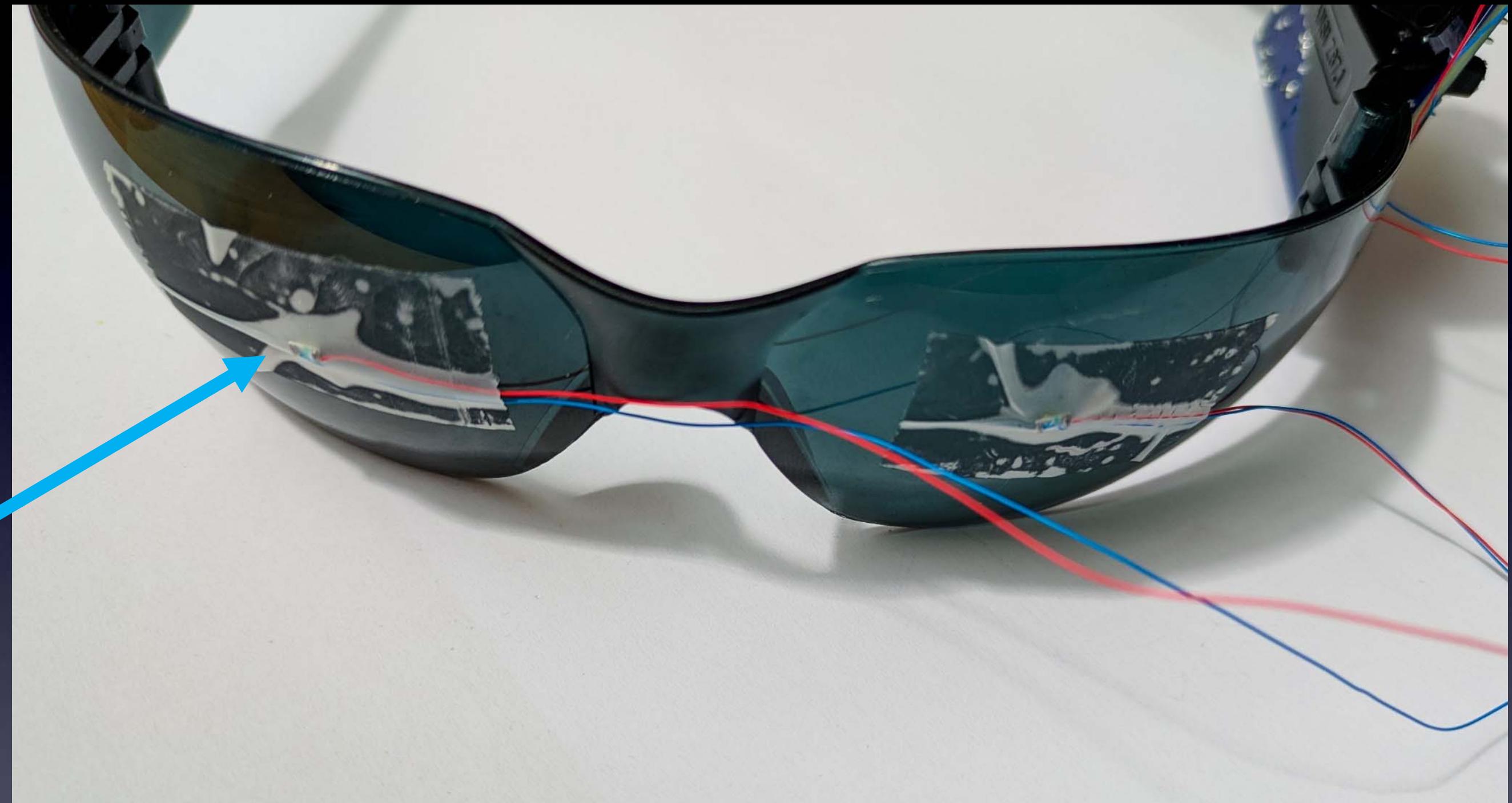
The LEDs light up on the flat white side

Tape Left LED to Glasses



**Tape the flat white side of D1 over the left mark
(so the light will shine on your eye)**

Tape Right LED to Glasses



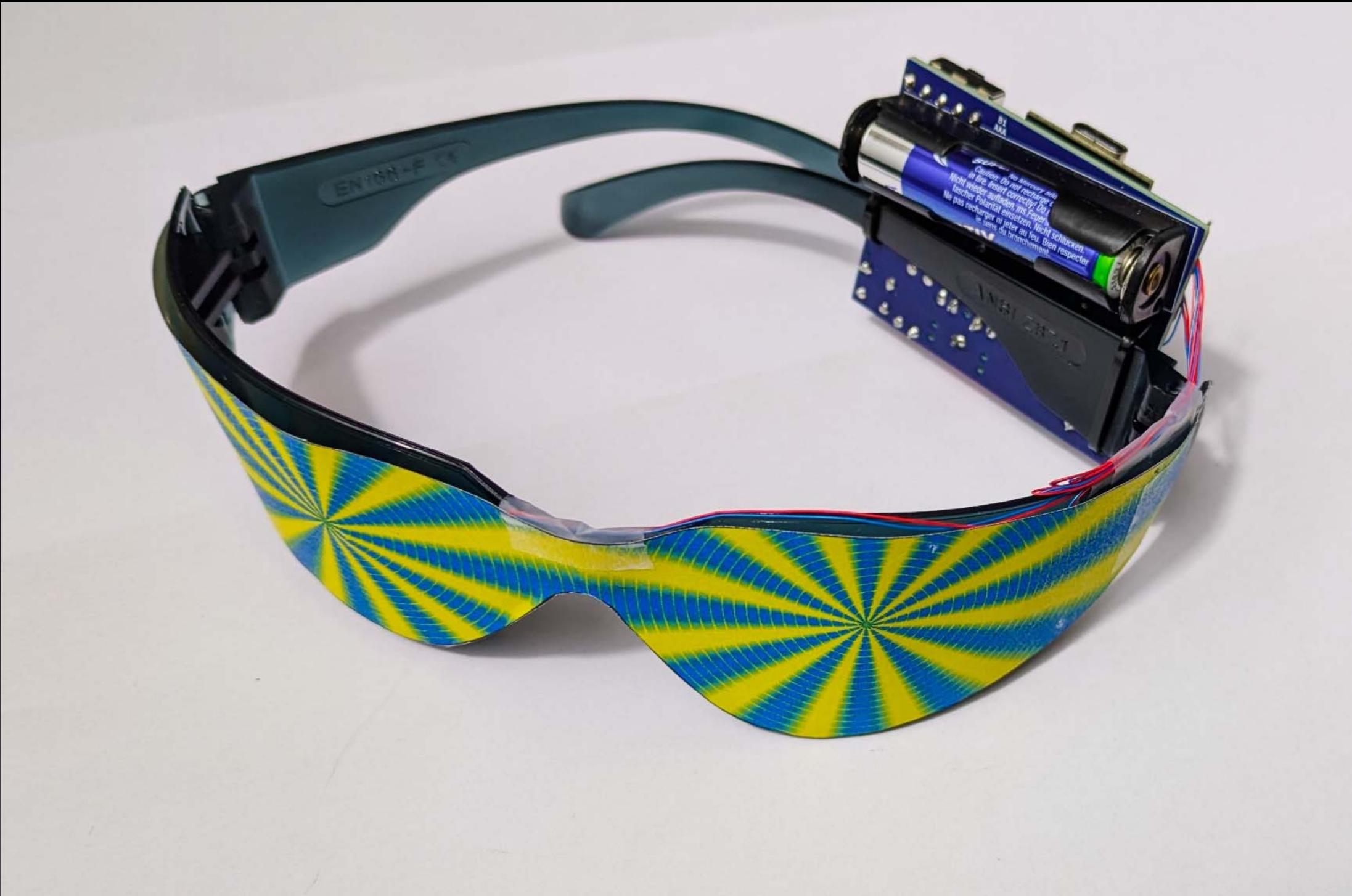
Tape the flat white side of D2 over the right mark
(so the light will shine on your eye)

Secure LED wires on Glasses



Use tape to clean up and secure the LED wires

Add Trippy Graphics !



Cut out the Trippy Graphics
and tape them over the glasses

Done!



Enjoy (with your eyes closed)



Meditate, Hallucinate, Trip Out !

Please Remember:

to

Wash your hands
after soldering

Let's Meditate

**Your Brain Machine comes pre-programmed
with a really nice 14-minute Meditation.**

**And, along the way you will hallucinate beautiful colors and patterns
from your imagination.**



Re-Programming

**Your Brain Machine comes pre-programmed
with a really nice 14-minute Meditation.**

If you are happy with
this meditation sequence
then no need to re-program
your Brain Machine.

But if you want to program
other brainwave sequences
the next pages show you how...



Re-programming the Brain Machine

We have one other sequence ready for you to use.

It is 1 hour of 40 Hz Gamma Waves

The following slides show you
how to program this sequence into your Brain Machine...



Re-programming the Brain Machine

We have one other sequence ready for you to use.

To program in a new sequence into your Brain Machine, you will need:

- the Arduino software
[<http://arduino.cc>](http://arduino.cc)
- a USB-C cable
- the “sketch” for the other brainwave sequence
[<http://cornfieldelectronics.com/cfe/projects.php#brainmachine>](http://cornfieldelectronics.com/cfe/projects.php#brainmachine)

The following slides show you how to do the above, in detail.



Arduino

**Arduino is a very powerful tool!
But it is very easy to use.
It was designed for total beginners to use successfully.**

I won't give a complete tutorial here – just some basics.
For more info, there are many good Arduino tutorials online.
A good place to start is:
[<https://www.arduino.cc/en/Tutorial/HomePage>](https://www.arduino.cc/en/Tutorial/HomePage)



Arduino

First:
Download and install the Arduino software
< <http://arduino.cc> >

Any version is OK



Re-programming the Brain Machine

Second:

Download the Brain Machine brainwave sequence sketch
[<http://cornfieldelectronics.com/cfe/projects.php#brainmachine>](http://cornfieldelectronics.com/cfe/projects.php#brainmachine)

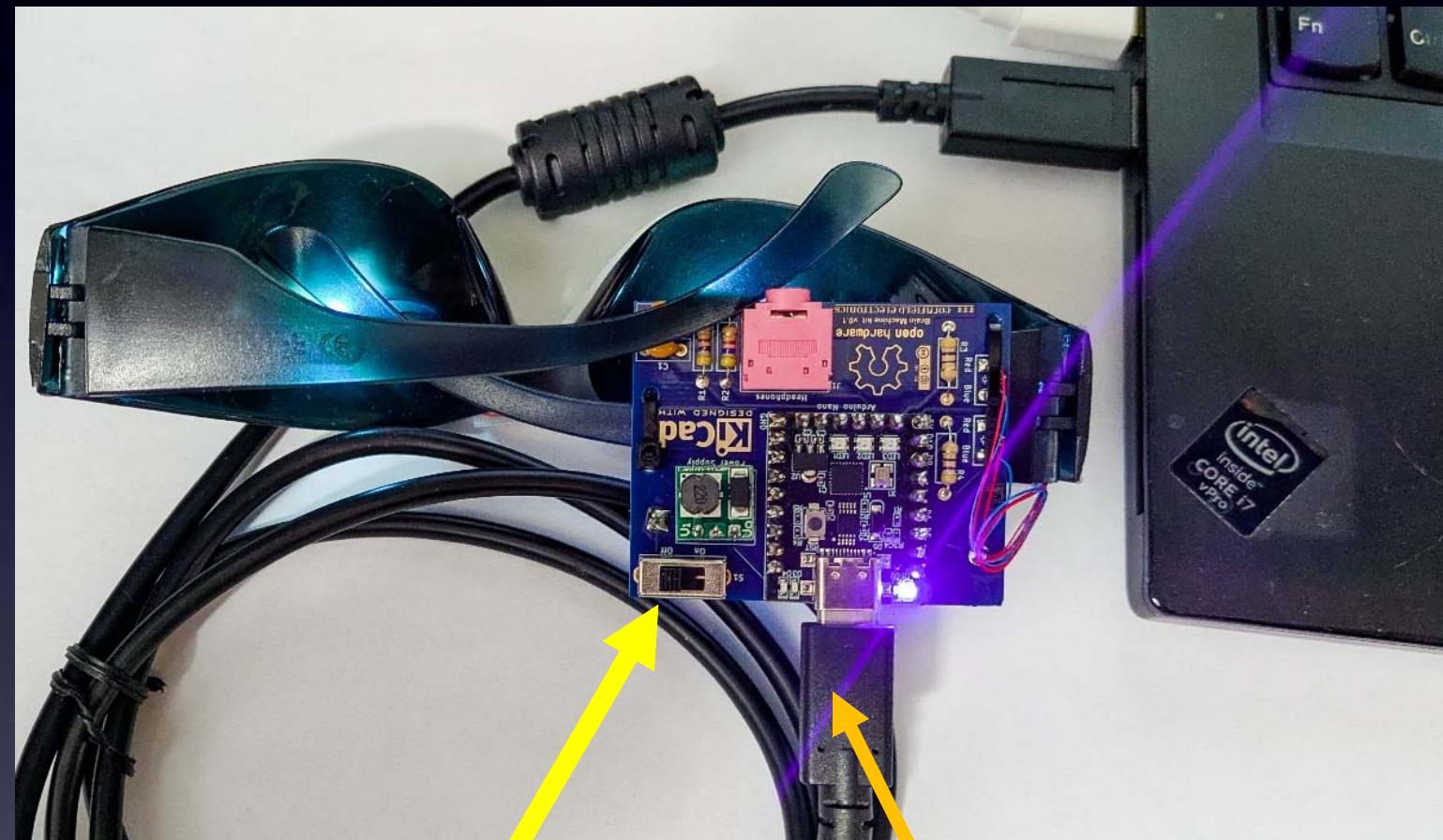
Store it on your computer anywhere you like.

(details on this soon)



Connecting your Brain Machine to your computer

USB-C cable

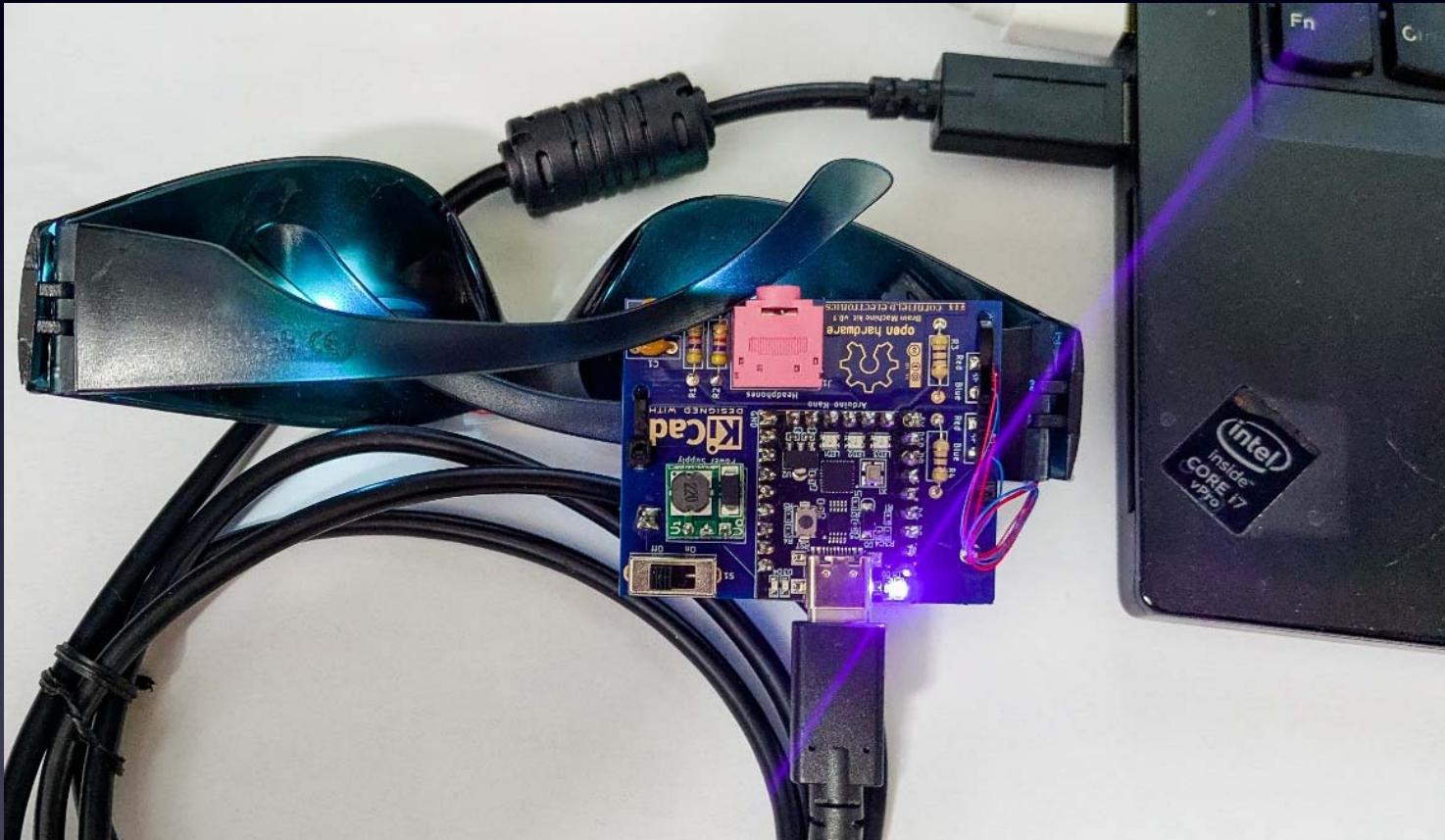


IMPORTANT:
Make sure the
Switch on your
Brain Machine
is ***OFF***

to computer's USB

Connecting your Brain Machine to your computer

USB-C cable



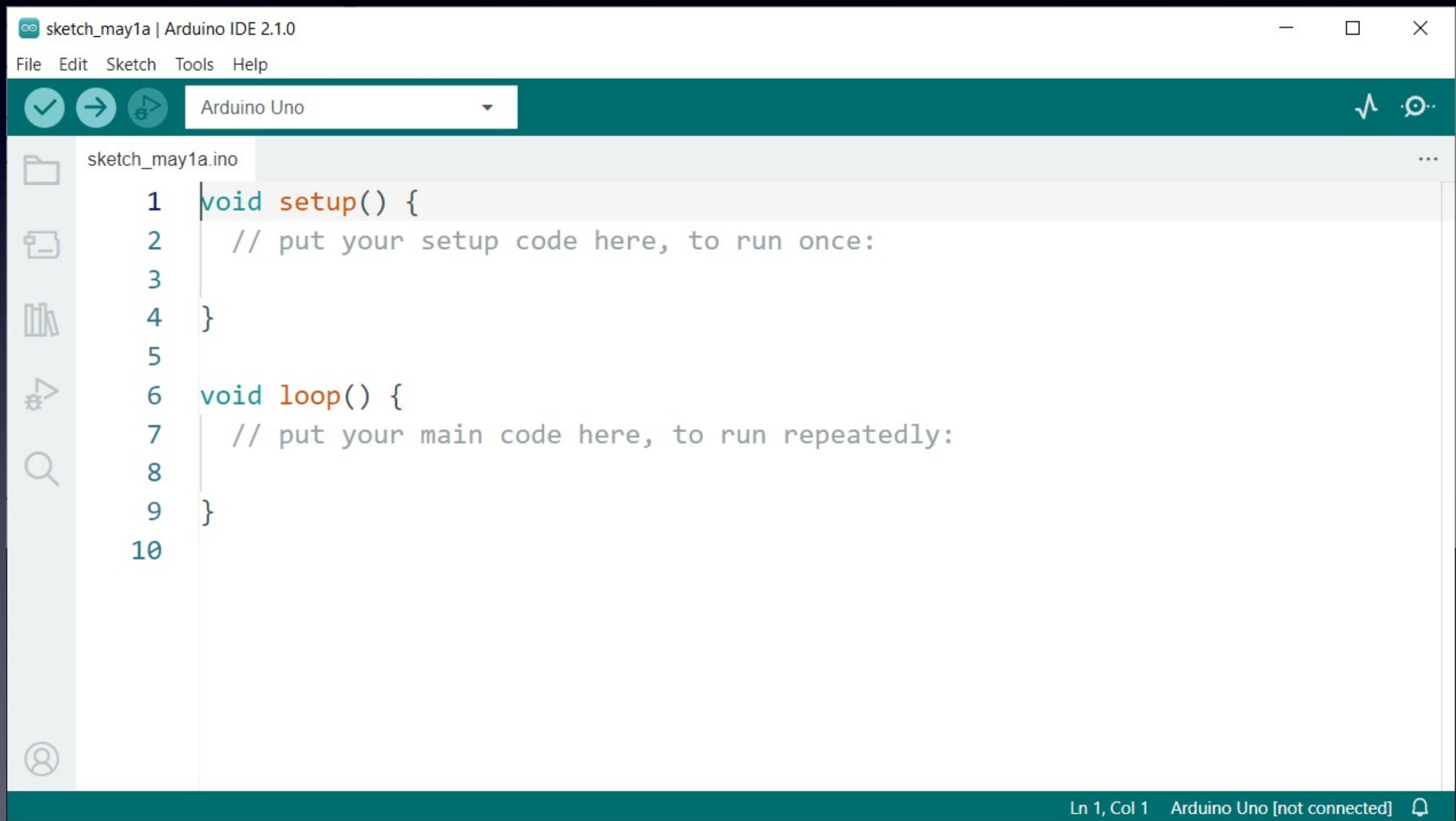
You may need to download and install a driver
for your Operating System (Windows, MacOS, or Linux):

<<https://learn.sparkfun.com/tutorials/how-to-install-ch340-drivers/all>>

Or search for:
“CH340 driver”

Arduino

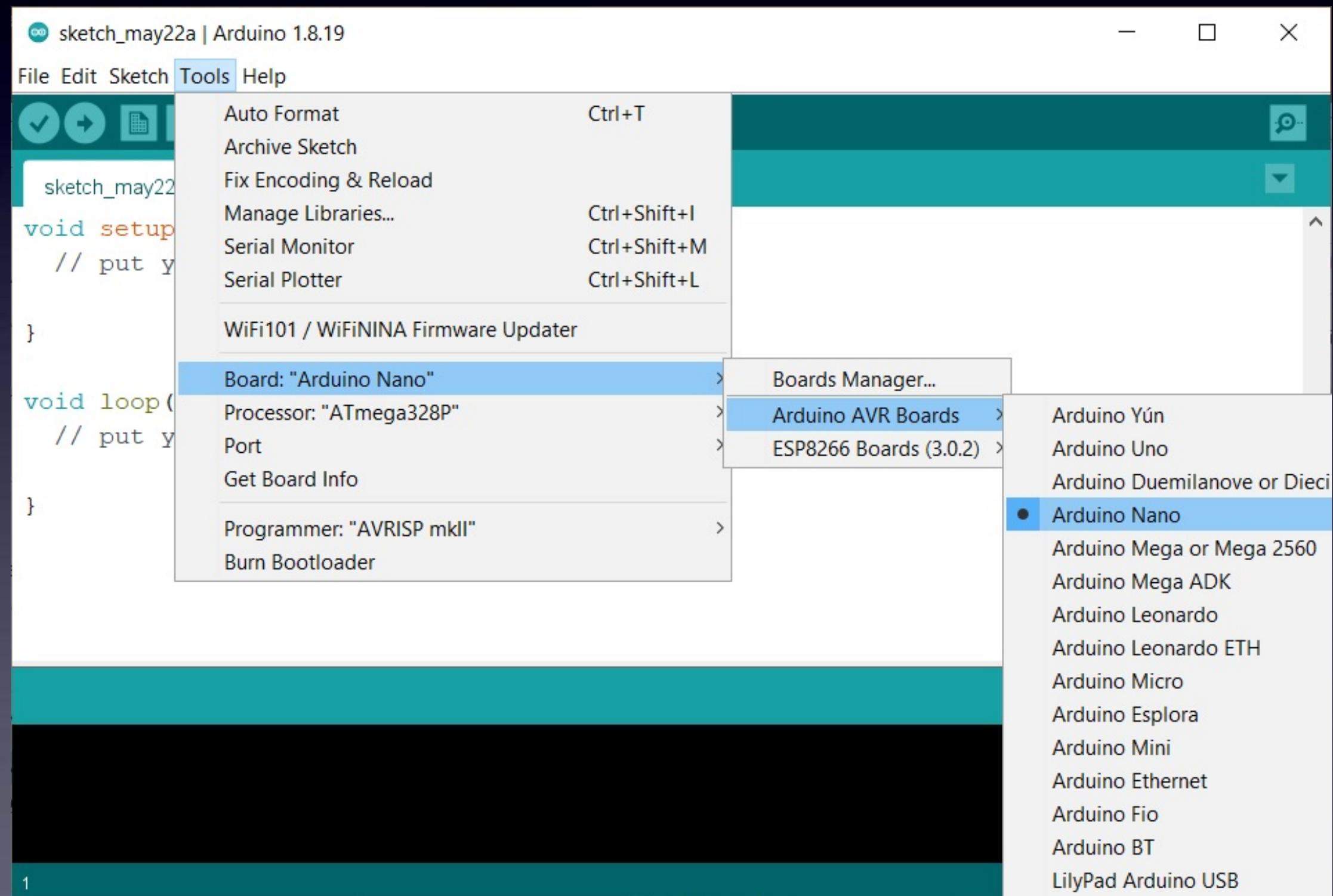
After you download and install the Arduino software start it, and you will see a screen that looks like this:



Arduino

The first time you start your Arduino software
you need to set things up

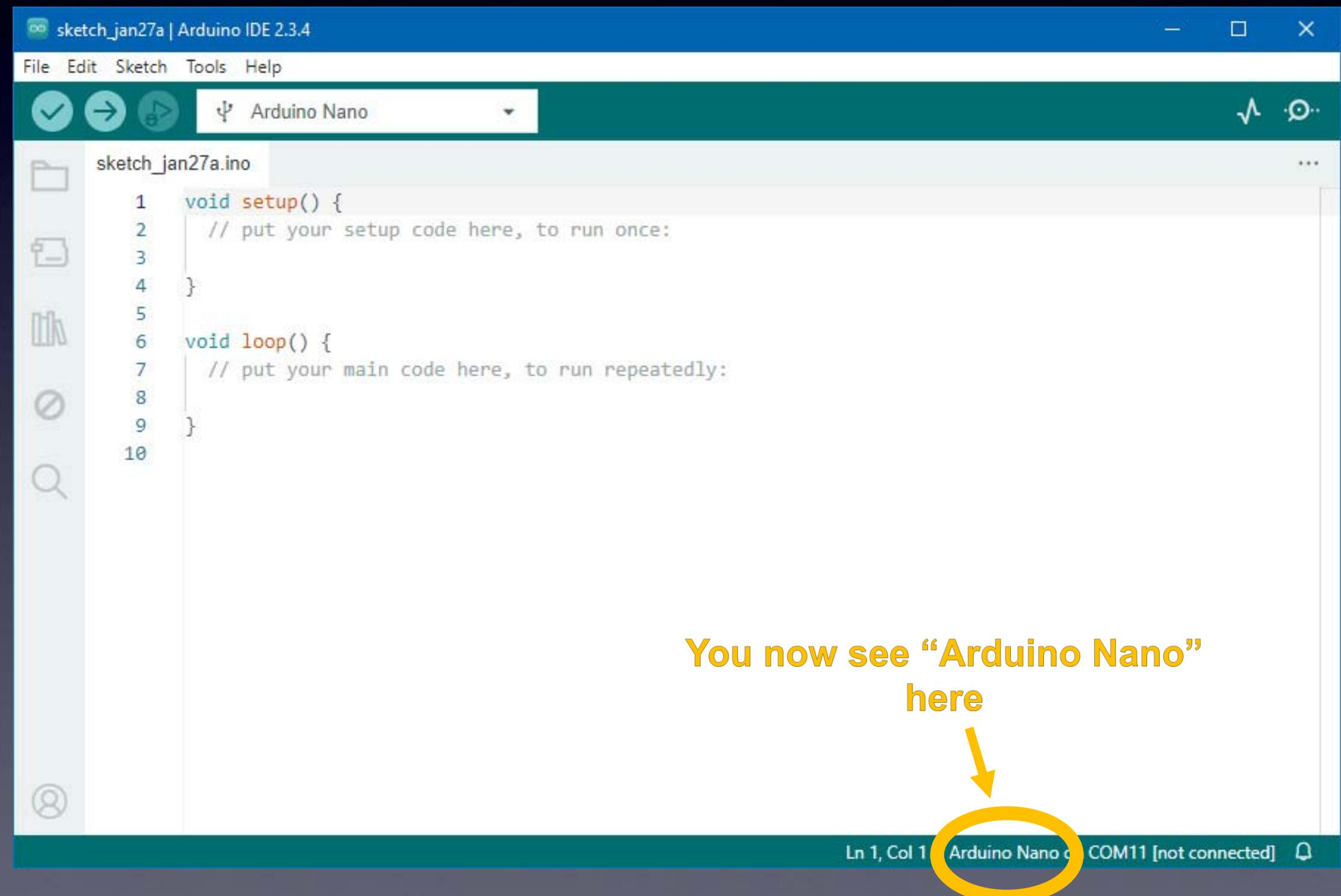
(1)
Choose
“Arduino Nano”
as the Board



Arduino

The first time you start your Arduino software
you need to set things up

(1)
Choose
“Arduino Nano”
as the Board



Arduino

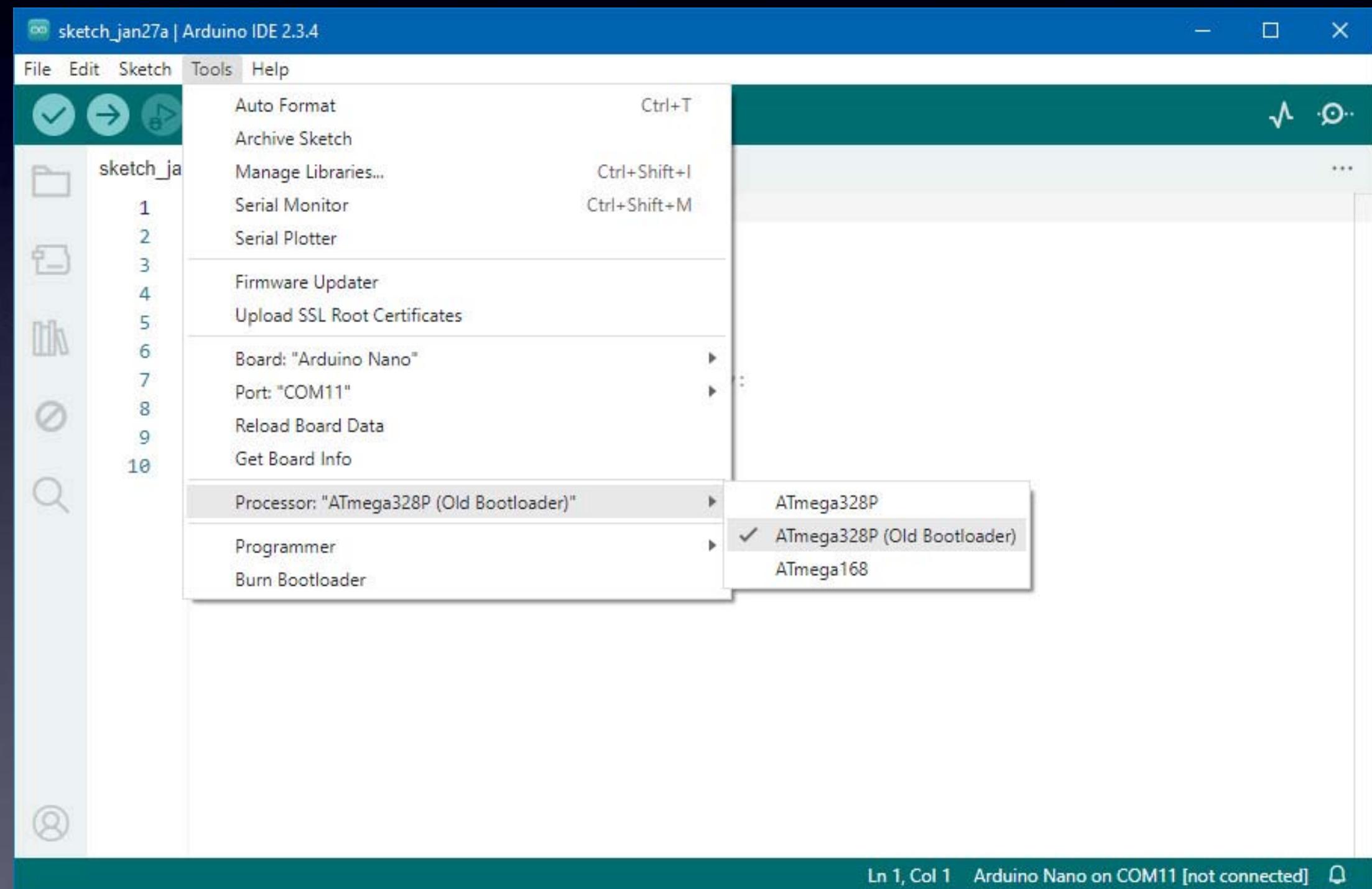
The first time you start your Arduino software
you need to set things up

(2)
Choose
your Processor

“ATmega328P (Old Bootloader)”



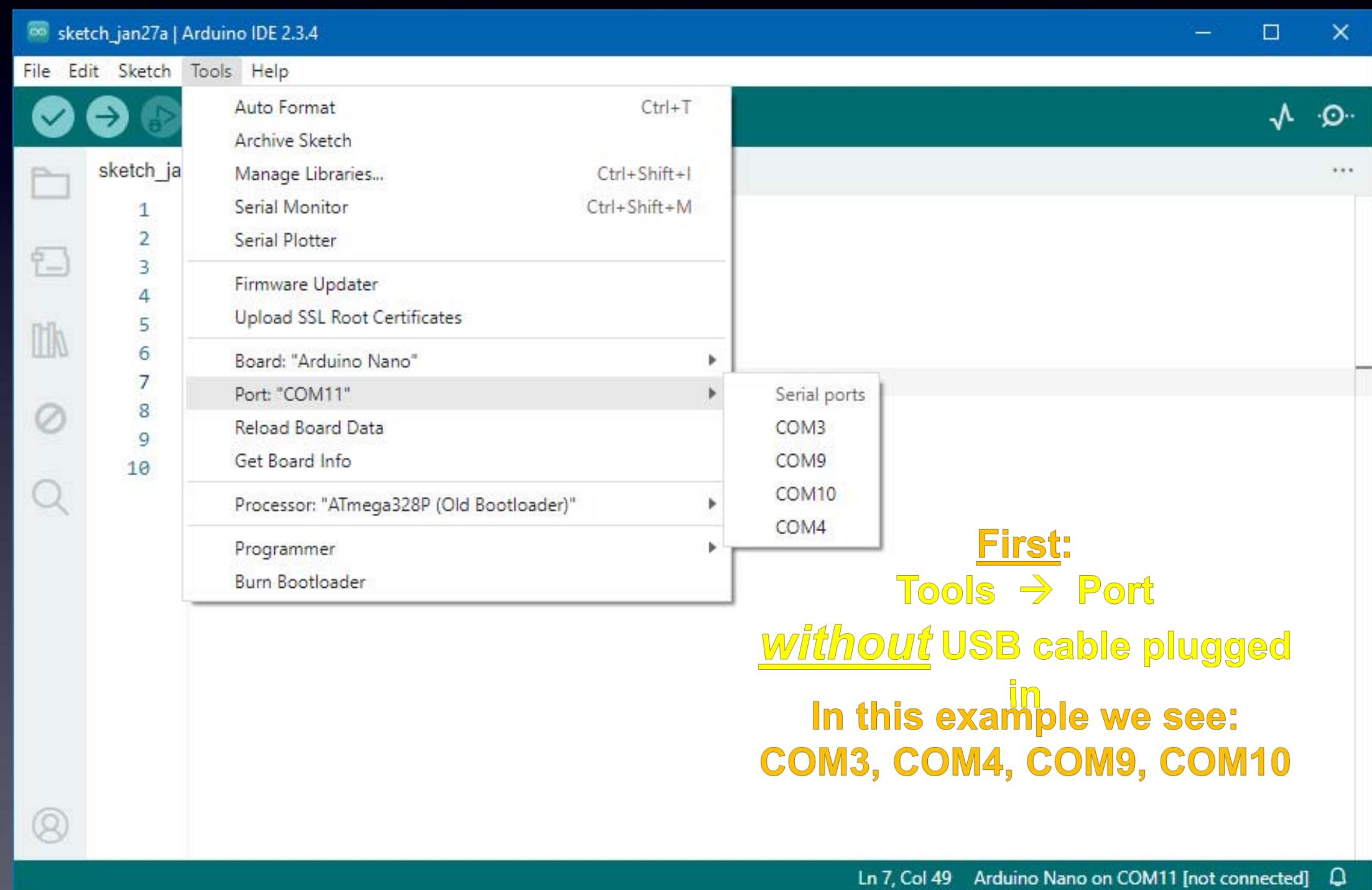
If this one doesn't work,
then
choose
“ATmega328P”



Arduino

The first time you start your Arduino software
you need to set things up

(3)
**Choose
the Port
(this will be
different
depending on
your Operating
System)**

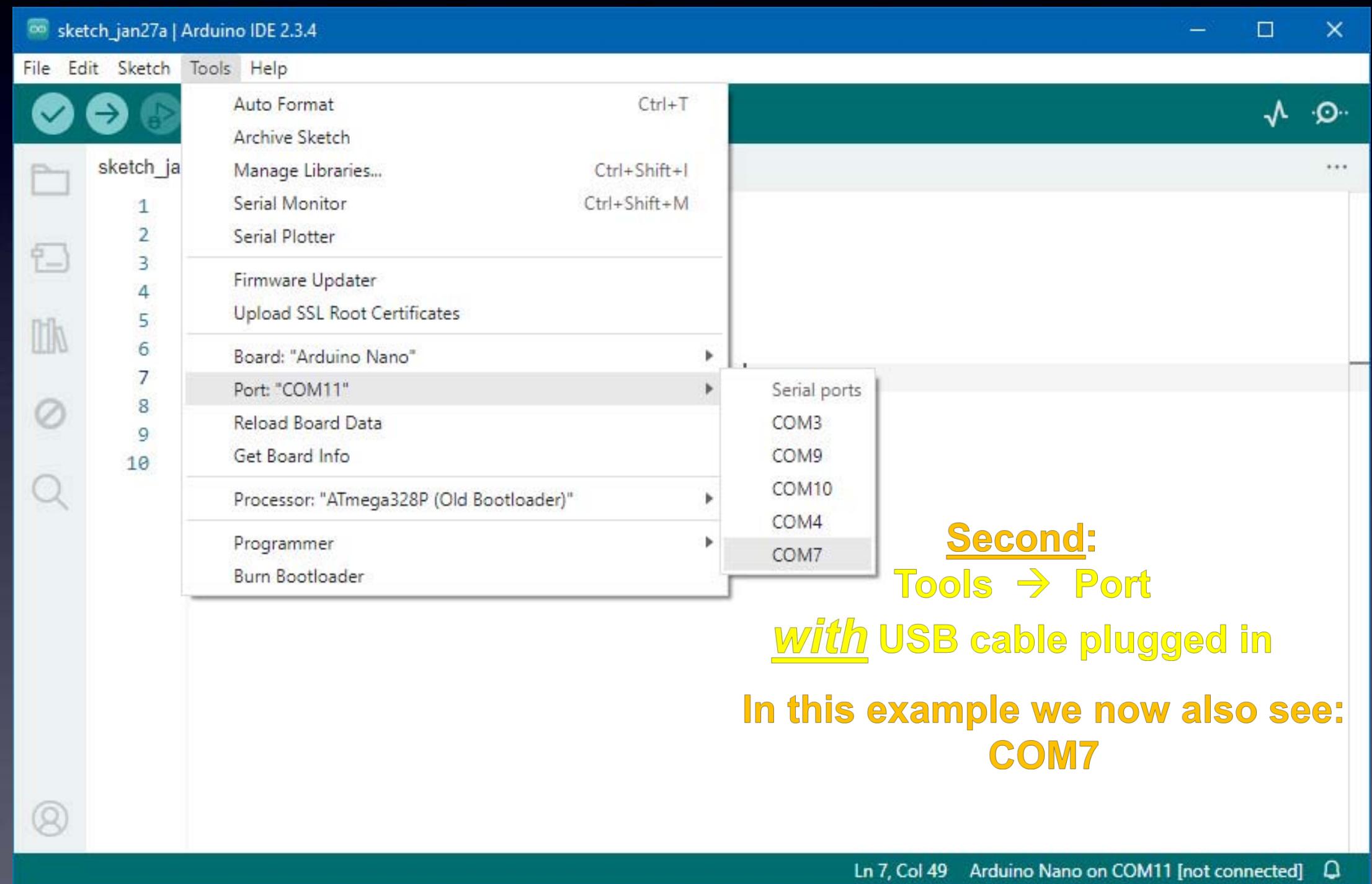


Arduino

The first time you start your Arduino software
you need to set things up

(3)
**Choose
the Port
(this will be
different
depending on
your Operating
System)**

(After installing
the driver
for your Arduino
(USB-Serial adapter),
with your Arduino
plugged in,
your operating system
will see a serial port
and it appears here.)



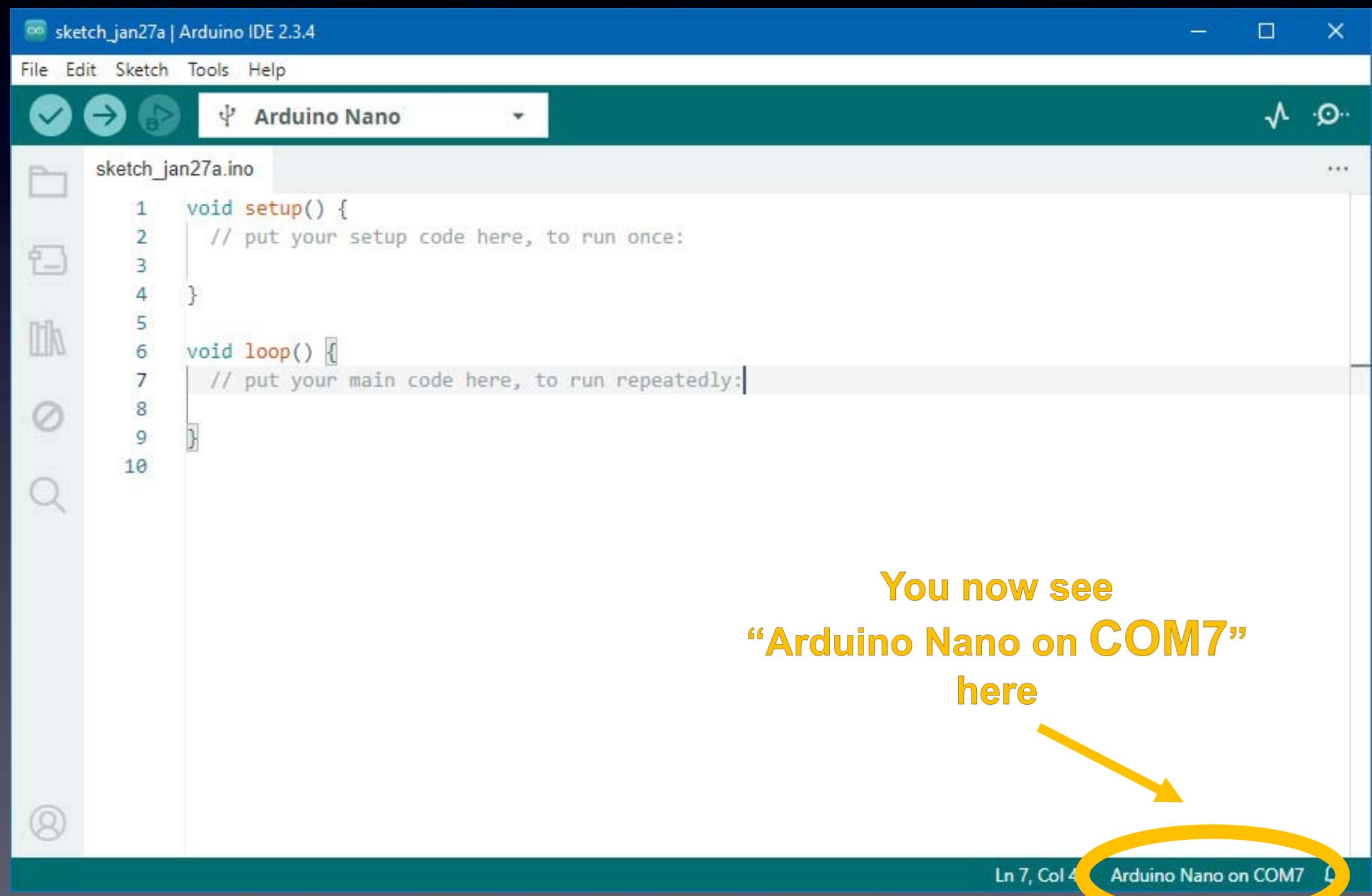
Second:
Tools → Port
with USB cable plugged in
In this example we now also see:
COM7

Arduino

The first time you start your Arduino software
you need to set things up

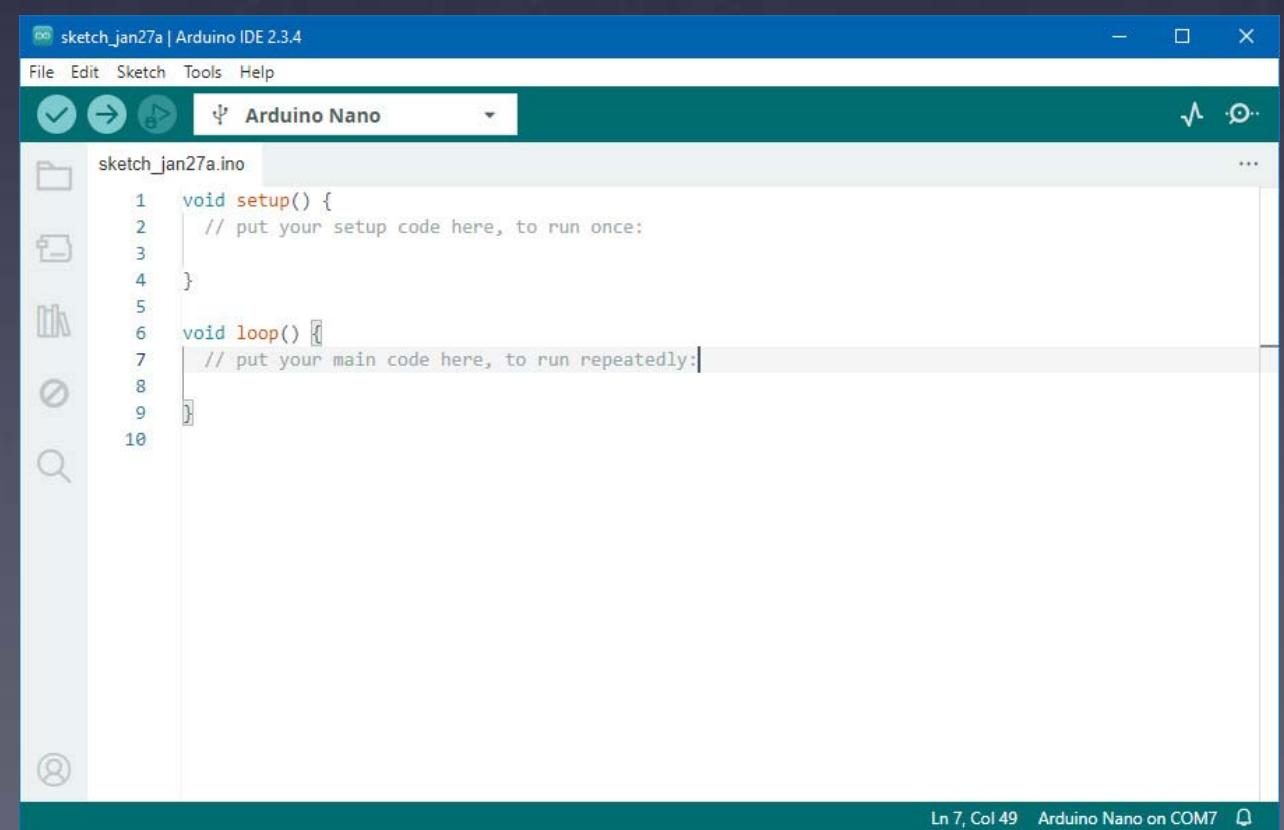
(3)
**Choose
the Port
(this will be
different
depending on
your Operating
System)**

(After installing
the driver
for your Arduino
(USB-Serial adapter),
with your Arduino
plugged in,
your operating system
will see a serial port
and it appears here.)



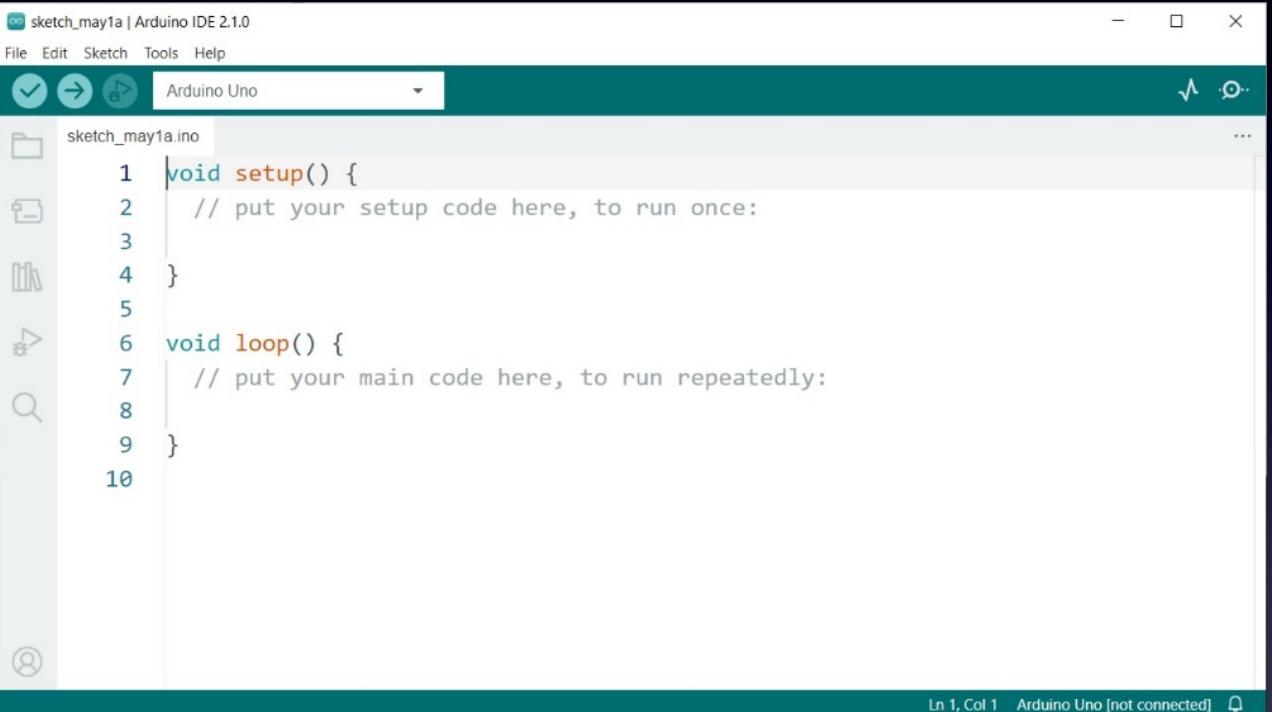
Arduino

Your Arduino software is now ready
to program a new brainwave sequence sketch
into your Brain Machine !



Arduino

Designed for non-geeky artists



The screenshot shows the Arduino IDE interface with a sketch titled "sketch_may1a.ino". The code editor displays the following Arduino pseudocode:

```
1 void setup() {
2     // put your setup code here, to run once:
3
4 }
5
6 void loop() {
7     // put your main code here, to run repeatedly:
8
9 }
10
```

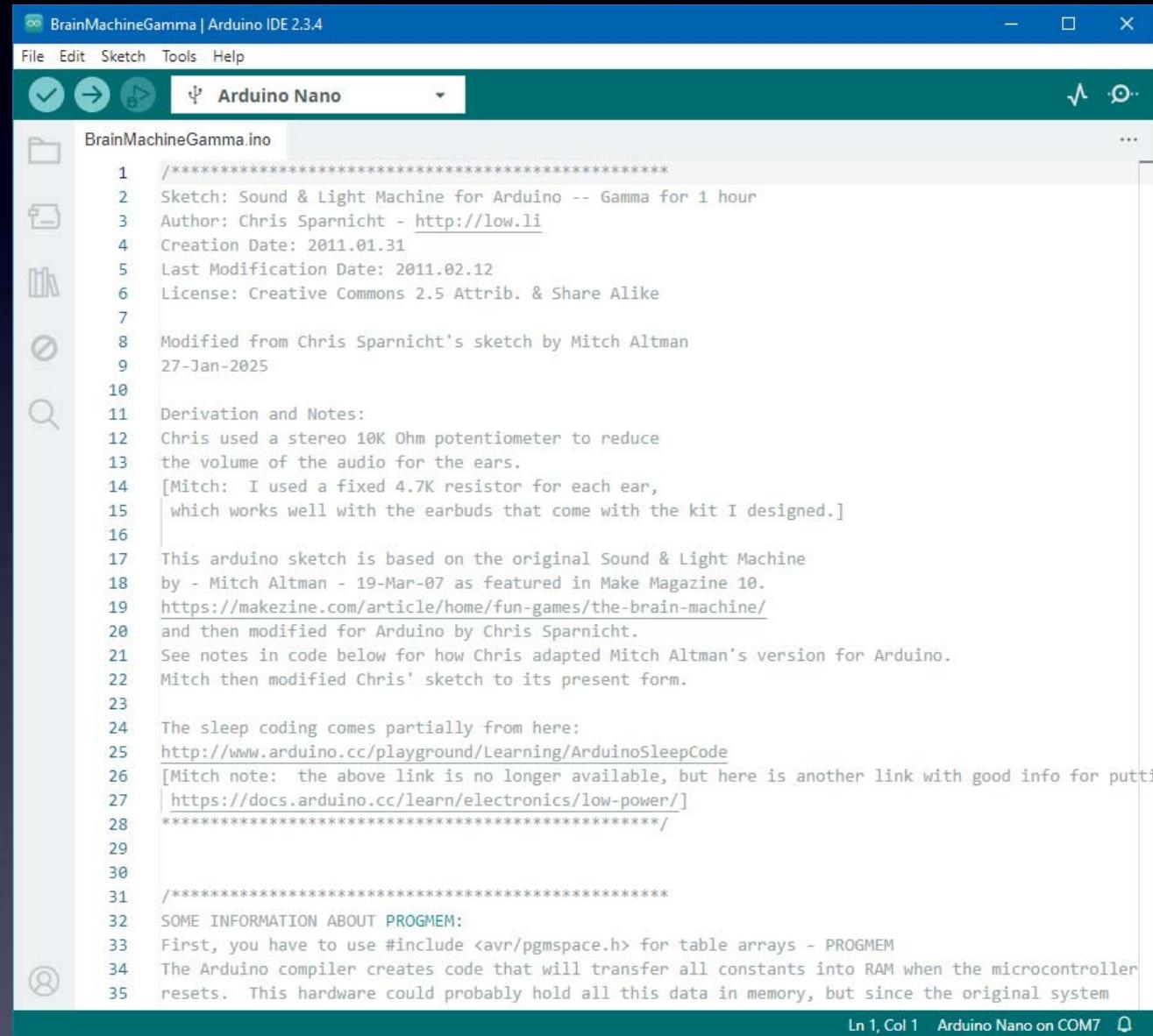
The status bar at the bottom indicates "Ln 1, Col 1" and "Arduino Uno [not connected]".

Definition of
“Sketch” :
an Arduino program

Arduino

Designed for non-geeky artists

Download
the new
Gamma
“sketch”



The screenshot shows the Arduino IDE 2.3.4 interface with the title bar "BrainMachineGamma | Arduino IDE 2.3.4". The central code editor window displays the "BrainMachineGamma.ino" sketch. The code is a multi-line text file containing comments and notes about the sketch's origin and modifications. It includes details about the author (Chris Sparnicht), creation date (2011.01.31), last modification date (2011.02.12), license (Creative Commons 2.5 Attrib. & Share Alike), and derivation from Chris Sparnicht's original sketch. The code also mentions Mitch Altman's version from Make Magazine 10 and provides links to the original source and Mitch's notes. The bottom status bar indicates "Ln 1, Col 1 Arduino Nano on COM7".

```
1  ****
2  Sketch: Sound & Light Machine for Arduino -- Gamma for 1 hour
3  Author: Chris Sparnicht - http://low.li
4  Creation Date: 2011.01.31
5  Last Modification Date: 2011.02.12
6  License: Creative Commons 2.5 Attrib. & Share Alike
7
8  Modified from Chris Sparnicht's sketch by Mitch Altman
9  27-Jan-2025
10
11 Derivation and Notes:
12 Chris used a stereo 10K Ohm potentiometer to reduce
13 the volume of the audio for the ears.
14 [Mitch: I used a fixed 4.7K resistor for each ear,
15 which works well with the earbuds that come with the kit I designed.]
16
17 This arduino sketch is based on the original Sound & Light Machine
18 by - Mitch Altman - 19-Mar-07 as featured in Make Magazine 10.
19 https://makezine.com/article/home/fun-games/the-brain-machine/
20 and then modified for Arduino by Chris Sparnicht.
21 See notes in code below for how Chris adapted Mitch Altman's version for Arduino.
22 Mitch then modified Chris' sketch to its present form.
23
24 The sleep coding comes partially from here:
25 http://www.arduino.cc/playground/Learning/ArduinoSleepCode
26 [Mitch note: the above link is no longer available, but here is another link with good info for putting
27 https://docs.arduino.cc/learn/electronics/low-power/]
28 ****
29
30
31 ****
32 SOME INFORMATION ABOUT PROGMEM:
33 First, you have to use #include <avr/pgmspace.h> for table arrays - PROGMEM
34 The Arduino compiler creates code that will transfer all constants into RAM when the microcontroller
resets. This hardware could probably hold all this data in memory, but since the original system
```

“Sketch” :
an Arduino program

The following slides show where to find this sketch...

Arduino

Download a new brainwave sequence “sketch”

The screenshot shows a web browser window with the URL <https://cornfieldelectronics.com/cfe/cfe.main.php>. The page has a yellow header bar with the text "cornFIELD electronics" and "useful electronics for a better world". Below the header, there's a navigation menu with links for "home", "buy", "about us", "press", "distributors", "projects", and "show cart". The main content area features several product images: a blue Arduino-like microcontroller board, a white electronic kit with a small screen, a purple "Neuro Dreamer" sleep mask, and a black remote control. To the right, a large headline reads "Take CONTROL". Below it, a paragraph encourages users to explore products and make choices. There are also sections for "join our mailing list", "TV-B-Gone", "NeuroDreamer", and "ArduTouch music synthesizer kit". At the bottom, there are links for "legal notices & privacy policy", a CC BY-SA license logo, and the text "2023 cornfield electronics".

At Cornfield Electronics we create devices that give people opportunities for effective choices in their lives. Each of us can decide whether to watch TV monitors, and when to watch. Each of us can decide when to get the rest we want, and how we dream. Everyone can learn to make cool things with our kits. Please explore our [products](#), make your own choices, and see how *your* life can be enhanced.

join our mailing list

Love it or hate it, TV screens are all around us. **TV-B-Gone®** universal remote control is the first fruit of our technical savvy, embodying our belief in empowerment, and sense of humor. This universal remote control fits in your pocket and allows you to discreetly turn TVs off wherever you go. TV-B-Gone fans around the world are using it for a variety of practical, philosophical, and humorous purposes. Imagine the possibilities...

Years in the making **NeuroDreamer** sleep mask is another of our personal empowerment inventions. We all need rest, but we don't always get it in our busy lives. NeuroDreamer sleep mask lets you use your own brainwaves to

bring you the rest you need. And with the **lucid dreaming model**, you can take control of your dreams.

Want to learn electronics? We make way cool, fun, intriguing, educational **kits** that **anyone can make!** Our most **POPULAR** kits are: [ArduTouch music synthesizer kit](#) and [TV-B-Gone kit!](#)

We make truly useful technological solutions that put you in charge.

Welcome to our better world!

NOTE: As of 14-Feb-2023 Cornfield Electronics is a sole proprietorship of Mitch Altman.

<https://CornfieldElectronics.com>

Arduino

Download a new brainwave sequence “sketch”

The screenshot shows a web browser window with the URL <https://cornfieldelectronics.com/cfe/cfe.main.php>. The page is titled "cornFIELD electronics" with the tagline "useful electronics for a better world". A green arrow points from the text "‘Projects’ tab" at the bottom right towards the "projects" link in the top navigation bar. The main content area features a large heading "Take control" and several product images, including a circuit board, a purple sleep mask labeled "Neuro Dreamer", and a black remote control. Text on the page discusses Cornfield Electronics' mission to empower users through their products.

At Cornfield Electronics we create devices that give people opportunities for effective choices in their lives. Each of us can decide whether to watch TV monitors, and when to watch. Each of us can decide when to get the rest we want, and how we dream. Everyone can learn to make cool things with our kits. Please explore our [products](#), make your own choices, and see how *your* life can be enhanced.

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“Projects” tab

Arduino

Download a new brainwave sequence “sketch”

The screenshot shows a web browser window with the following details:

- Header:** File, Edit, View, History, Bookmarks, Tools, Help.
- Title Bar:** Cornfield Electronics :: Projects.
- Address Bar:** https://cornfieldelectronics.com/cfe/projects.php?PHPSESSID=d5d4714nuevrq25drkkoirr1m3
- Page Content:**
 - Cornfield Electronics Logo:** A stylized illustration of four corn stalks.
 - Header Navigation:** home, buy, about us, press, distributors, projects, show cart.
 - Section Header:** DO-IT-YOURSELF PROJECTS by [Mitch Altman](#), and friends. Last modified: 5-Oct-2022
 - Text:** You Can Make Cool Things With Electronics! The projects on this page were all created for total beginners, with no experience, so everyone can complete them successfully at my workshops, or at home, or anywhere!
 - Text:** All you need is:
a desire, a handful of parts, a soldering iron (with stand and sponge), a wire-cutter, a wire-stripper, solder, and an afternoon.
 - Image:** A photograph showing a soldering iron, a roll of solder, and some pliers.
 - Text:** [Here](#) is a really nice tutorial on how to solder -- for total beginners!
[Soldering Tutorial for total beginners](#)
 - Text:** Open Hardware!
Everything on this page (and everything I do) is free and open source!
(That's *free* as in *freedom*.)
(But everything here is free to download -- and that is *free* as in *beer*.)
If you have any questions on anything, please feel free to email me:
Transferring data from cornfieldelectronics.com... mitch AT CornfieldElectronics DOT com

“Projects” tab

Arduino

Download a new brainwave sequence “sketch”

Click here to
download the
Gamma wave
sequence
sketch

Project: Brain Machine kit
-- Make your own Brain Machine!



The Brain Machine is a Sound and Light Machine kit for total beginners to learn to solder. When you are finished, wear them (with your eyes closed), turn it on, and your brain will automatically follow along to the really nice pre-programmed 14-minute-long meditation brainwave sequence, presented through pulsing lights and sound. Oh, and you will also hallucinate really beautiful colors and patterns along the way!

This project is based on my original article in [MAKE Magazine](#). The first Brain Machine kit was a collaboration between Mitch and [Ladyada / Adafruit](#). This new version of the Brain Machine kit makes use of the [Arduino Brain Machine project, created by Chris Sparnicht "LaughterOnWater"](#). All documentation for this new version of the Brain Machine kit is available on my Github: [Brain Machine kit Github page](#).

DISCLAIMER: Light and Sound Machines, such as this one, can be fun for many of us, but may be seriously dangerous for those prone to seizures or who are photosensitive.

This kit takes about 60 minutes to complete.

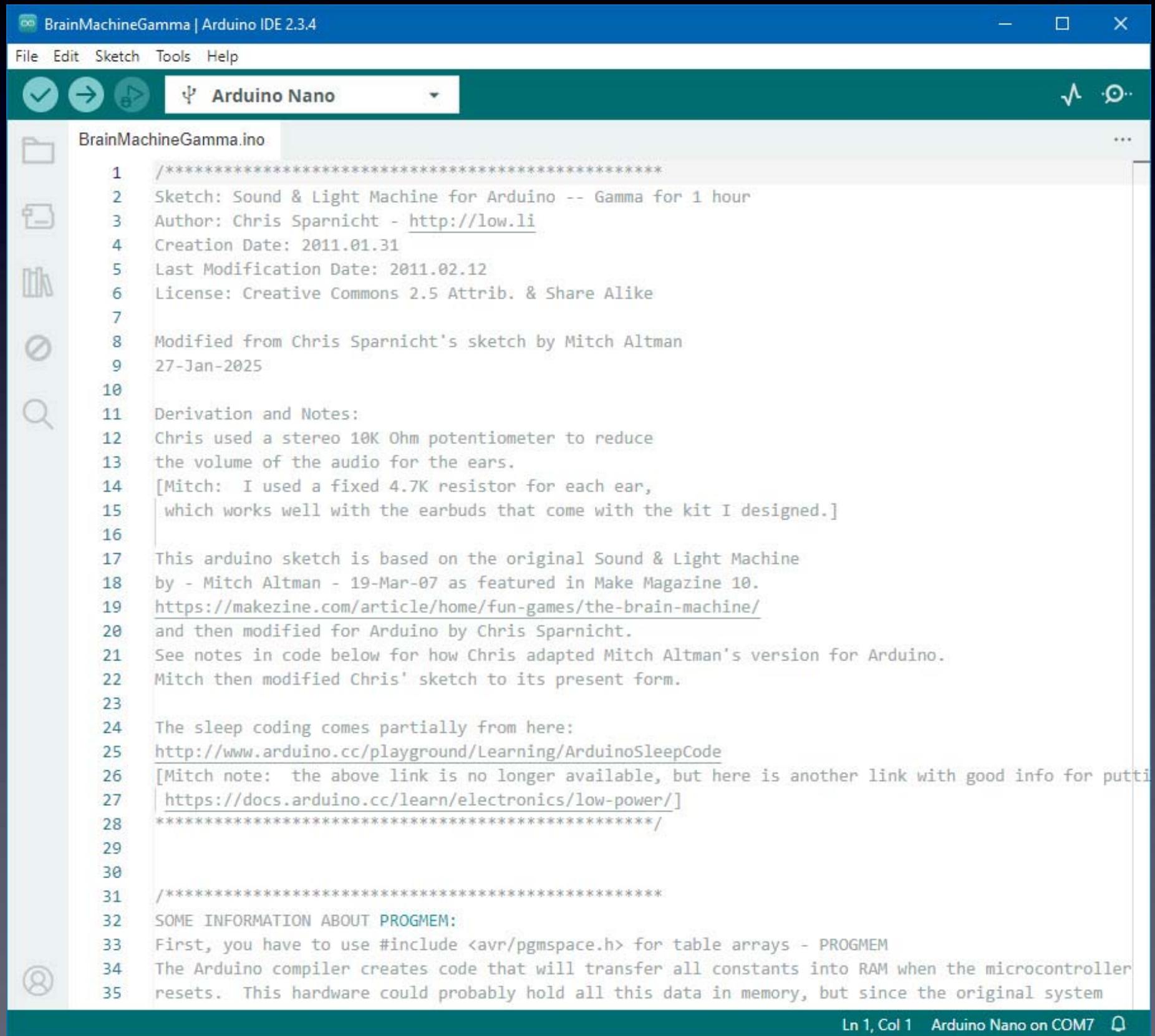
For assembly instructions, please see: [Brain Machine kit assembly instructions](#)

Arduino Sketches for brainwave sequences:
[Brain Machine Meditation sequence sketch](#) -- to play a nice 14-minute Meditation
[Brain Machine Gamma sequence sketch](#) -- to play Gama waves (40.0 Hz) for 1 hour

Early research over the last few years at MIT and other research labs shows that "plaque" (which is one cause of Alzheimer's pathology) is reduced in mice. Studies are ongoing for helping humans with Alzheimer's pathology. 40 Hz Gamma stimulation may also be helpful for "[chemo brain fog](#)". There may also be some benefit to people with CFS/ME, or people with "brain fog" from long Covid.

Arduino

You can now open the brainwave sequence sketch:
File → Open...



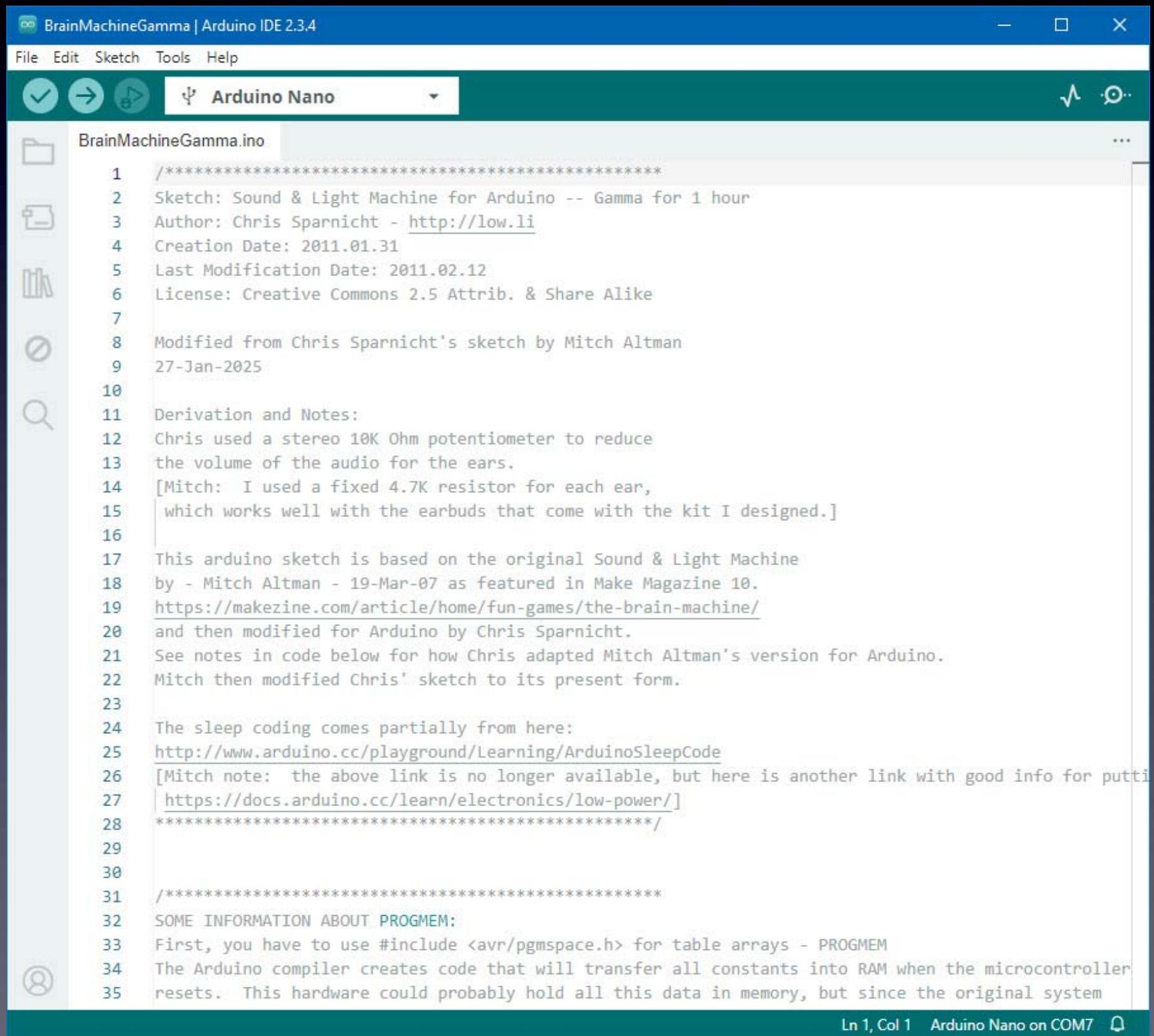
The screenshot shows the Arduino IDE 2.3.4 interface with the title bar "BrainMachineGamma | Arduino IDE 2.3.4". The menu bar includes File, Edit, Sketch, Tools, and Help. The toolbar has icons for file operations and a dropdown set to "Arduino Nano". The main area displays the code for "BrainMachineGamma.ino". The code is a multi-line comment containing metadata and derivation notes. It includes details about the sketch being a sound & light machine for Arduino, credits to Chris Sarnicht and Mitch Altman, and links to the original Make Magazine article and Mitch's notes. The code also mentions sleep coding and information about PROGMEM.

```
1  ****
2  Sketch: Sound & Light Machine for Arduino -- Gamma for 1 hour
3  Author: Chris Sarnicht - http://low.li
4  Creation Date: 2011.01.31
5  Last Modification Date: 2011.02.12
6  License: Creative Commons 2.5 Attrib. & Share Alike
7
8  Modified from Chris Sarnicht's sketch by Mitch Altman
9  27-Jan-2025
10
11 Derivation and Notes:
12 Chris used a stereo 10K Ohm potentiometer to reduce
13 the volume of the audio for the ears.
14 [Mitch: I used a fixed 4.7K resistor for each ear,
15 which works well with the earbuds that come with the kit I designed.]
16
17 This arduino sketch is based on the original Sound & Light Machine
18 by - Mitch Altman - 19-Mar-07 as featured in Make Magazine 10.
19 https://makezine.com/article/home/fun-games/the-brain-machine/
20 and then modified for Arduino by Chris Sarnicht.
21 See notes in code below for how Chris adapted Mitch Altman's version for Arduino.
22 Mitch then modified Chris' sketch to its present form.
23
24 The sleep coding comes partially from here:
25 http://www.arduino.cc/playground/Learning/ArduinoSleepCode
26 [Mitch note: the above link is no longer available, but here is another link with good info for putting
27 https://docs.arduino.cc/learn/electronics/low-power/]
28 ****
29
30
31 ****
32 SOME INFORMATION ABOUT PROGMEM:
33 First, you have to use #include <avr/pgmspace.h> for table arrays - PROGMEM
34 The Arduino compiler creates code that will transfer all constants into RAM when the microcontroller
35 resets. This hardware could probably hold all this data in memory, but since the original system
```

Ln 1, Col 1 Arduino Nano on COM7

Arduino

You can now program your Brain Machine with a new synth sketch !



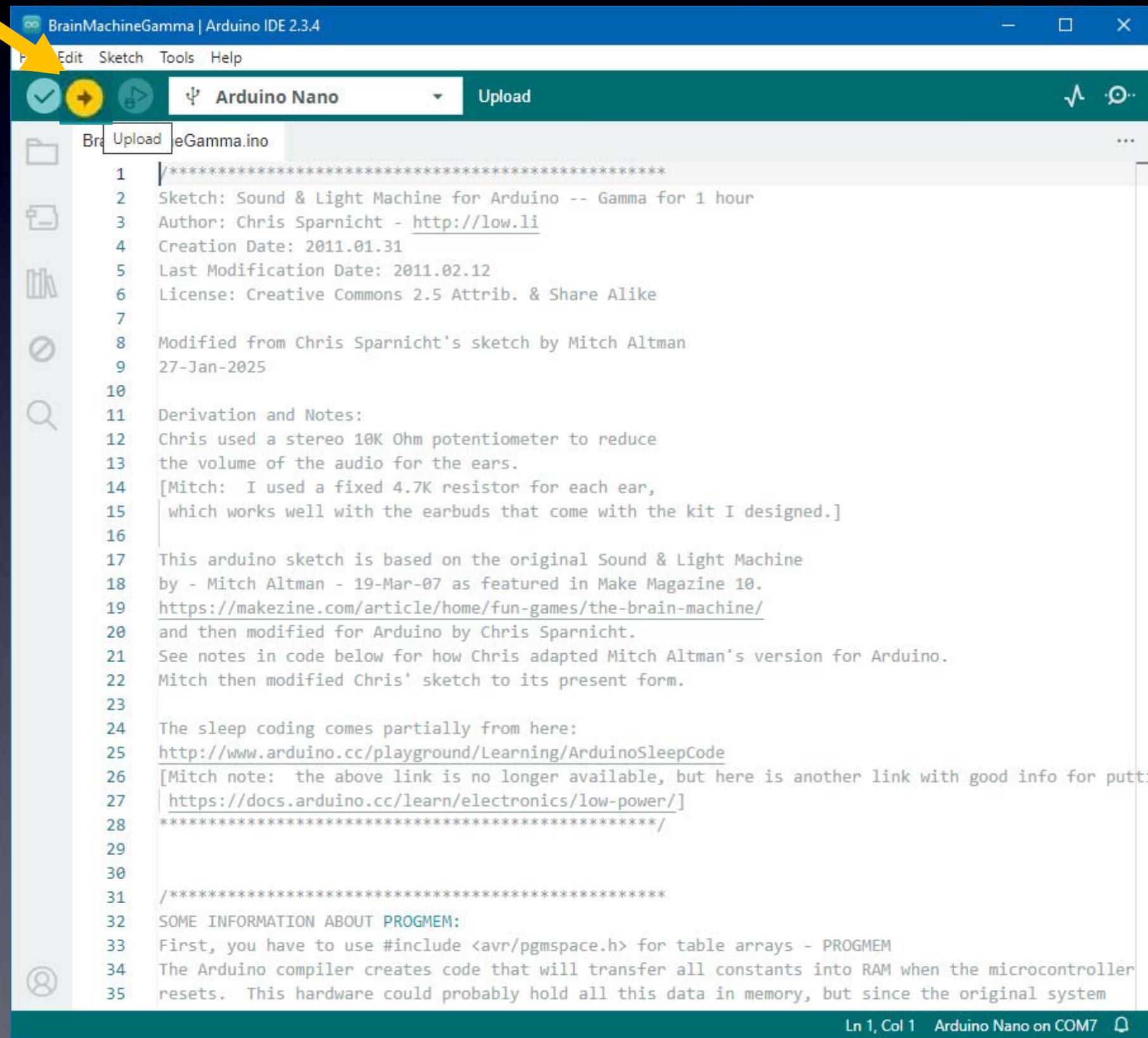
The screenshot shows the Arduino IDE 2.3.4 interface with the title bar "BrainMachineGamma | Arduino IDE 2.3.4". The toolbar includes icons for file operations, a checkmark, a right arrow, a left arrow, and a dropdown for the board type "Arduino Nano". The menu bar contains "File", "Edit", "Sketch", "Tools", and "Help". The main area displays the code for "BrainMachineGamma.ino". The code is a multi-line comment containing metadata and notes about the sketch. It includes details about the author (Chris Sarnicht), creation date (2011.01.31), last modification date (2011.02.12), license (Creative Commons 2.5 Attrib. & Share Alike), and a note about modifications by Mitch Altman. It also references the original "Sound & Light Machine" sketch by Mitch Altman from Make Magazine 10 and notes about sleep coding. The code concludes with information about PROGMEM and memory usage.

```
1  ****
2  Sketch: Sound & Light Machine for Arduino -- Gamma for 1 hour
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Ln 1, Col 1 Arduino Nano on COM7

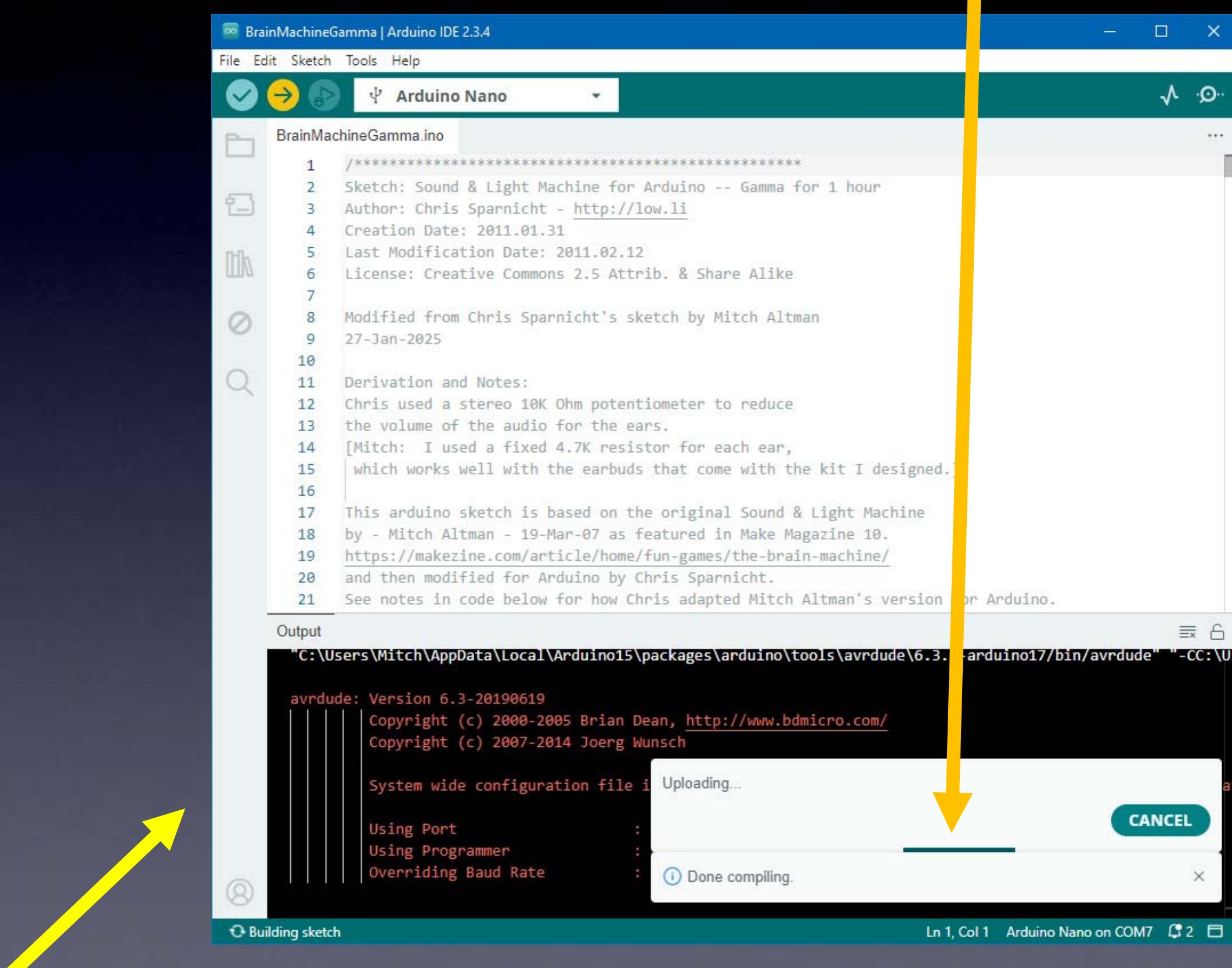
Arduino

**With the USB-C cable connected to your Brain Machine
press the “Upload” button**



Arduino

While uploading, you will see a progress bar...



...and when it's completed successfully, it says: “Upload done”

Brain Machine

**Disconnect your Brain Machine board
from the USB-C cable,**

turn on your Brain Machine,

And...

Let's Trip Out in New Ways !



Please Remember:

to

Wash your hands
after soldering

Brain Machine kit

Assembly Instructions & Programming Instructions



open source
hardware



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