



Make your own



V2_{r1}

Mitch Altman

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Inventor of **TV-B-Gone** universal remote controls

Co-founder of **3Ware** (successful Silicon Valley startup)

Pioneer of **VR** (in the mid-1980s)

Founding mentor at **HAX** (1st and biggest hardware accelerator)

Co-founder of **Noisebridge** (San Francisco hackerspace)

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flickr: [maltman23](https://www.flickr.com/photos/maltman23)

WeChat: [mitchaltman](#)

Fediverse: [@maltman23@mastodon.social](https://maltman23@mastodon.social)

Patreon: [mitchaltman](#)

THE BUNNY IS A LIE
EASTERHEGG 2026 | EH23



CORNFIELD ELECTRONICS

TV B GONE®



TV-B-Gone

*Just a remote control,
but only one button:
OFF !*

A black universal remote control with a keychain, set against a background of a man and a woman with surprised expressions. The background is a bright yellow and blue radial pattern.

HIGH POWER UNIVERSAL REMOTE CONTROL

Just Point & Click...
TURN ANY TV
On or Off! AMAZING!

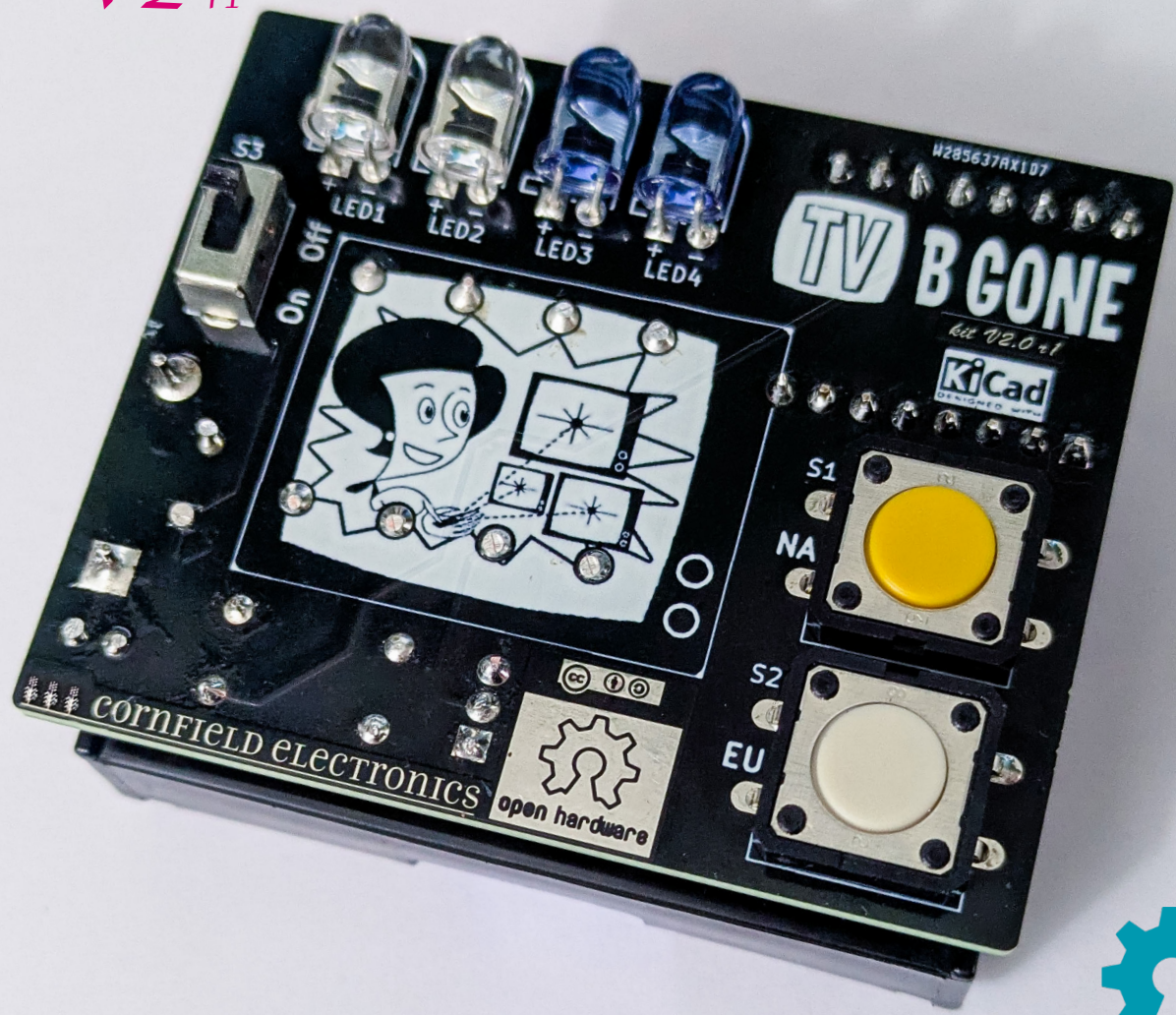
BATTERIES INCLUDED! READY TO GO!





Kit

V2 r1



Turn off TVs in public places from 50 meters away!





Kit: in a jacket



forbes.com – Turning Off Any TV You Want - Without Getting Caught

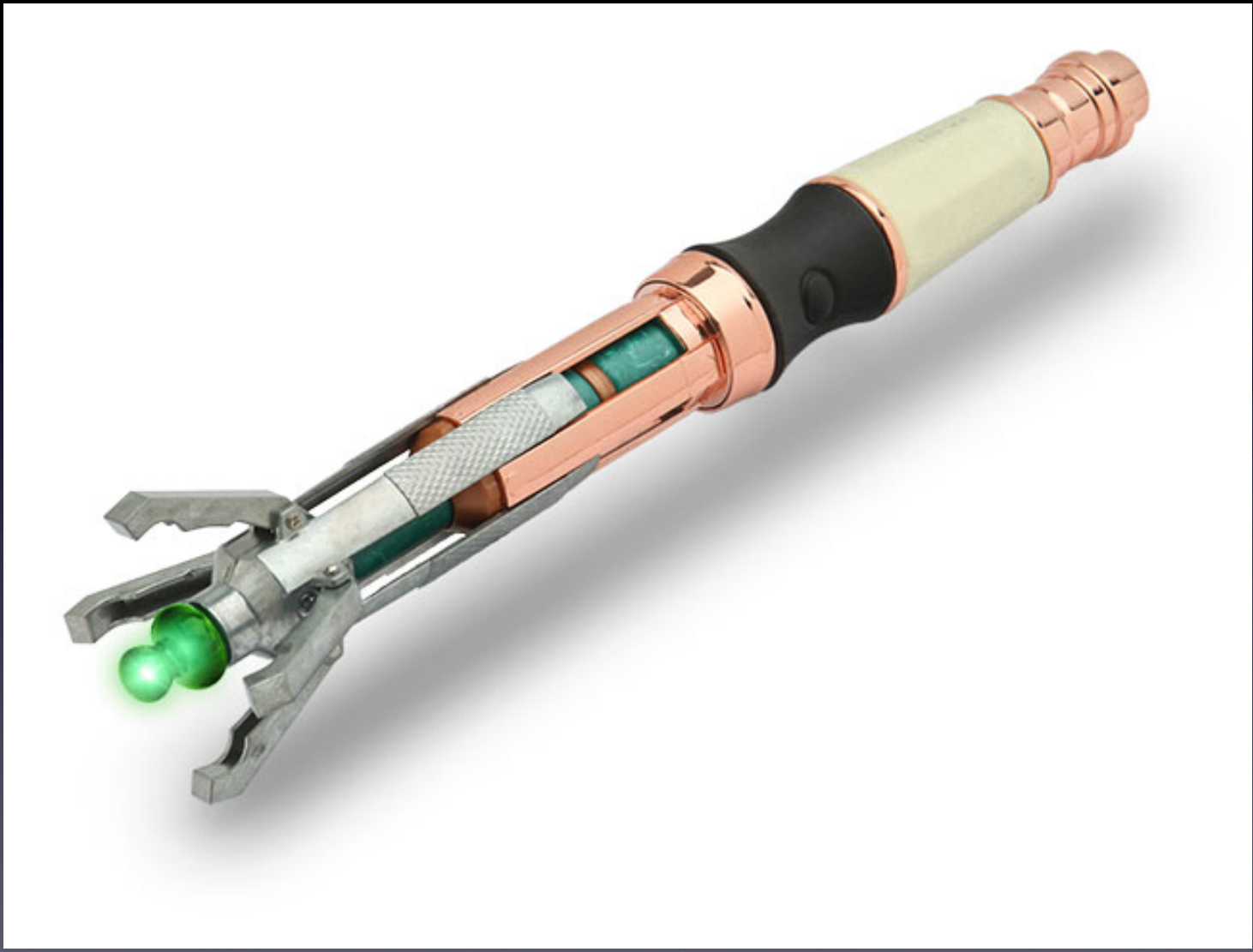


Kit: in a hat





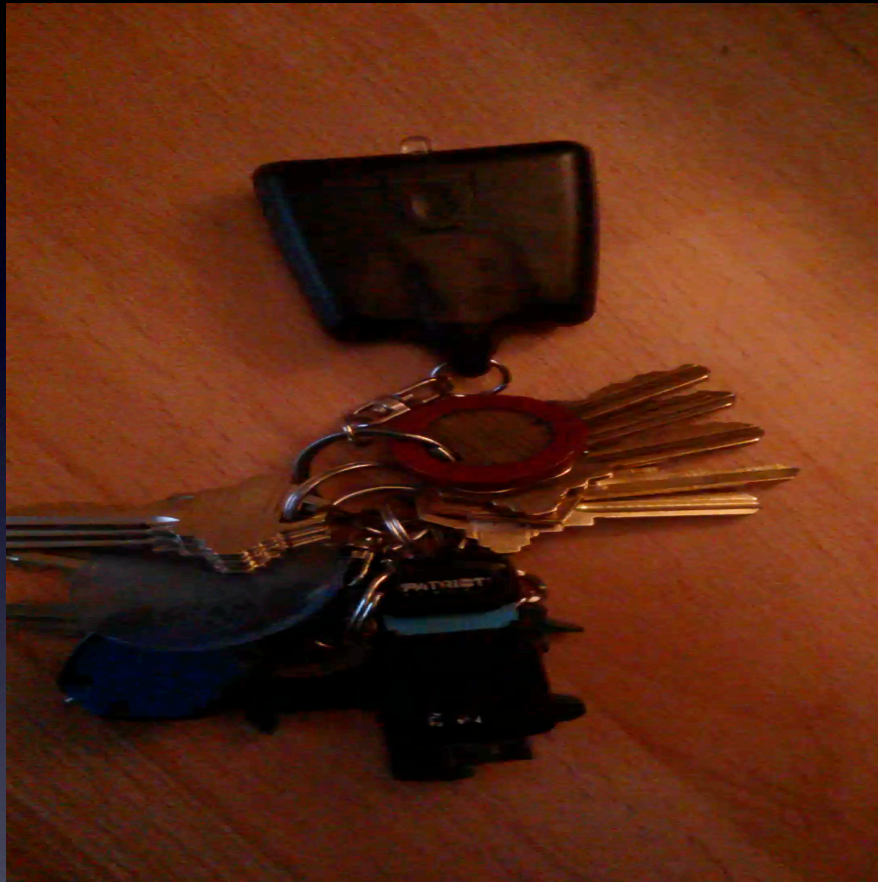
Kit: Sonic Screwdr



hackaday.com – Sonic Screwdriver Meets TV-B-Gone



Takes about 60 seconds



About 150 IR "OFF" codes (one per blink)

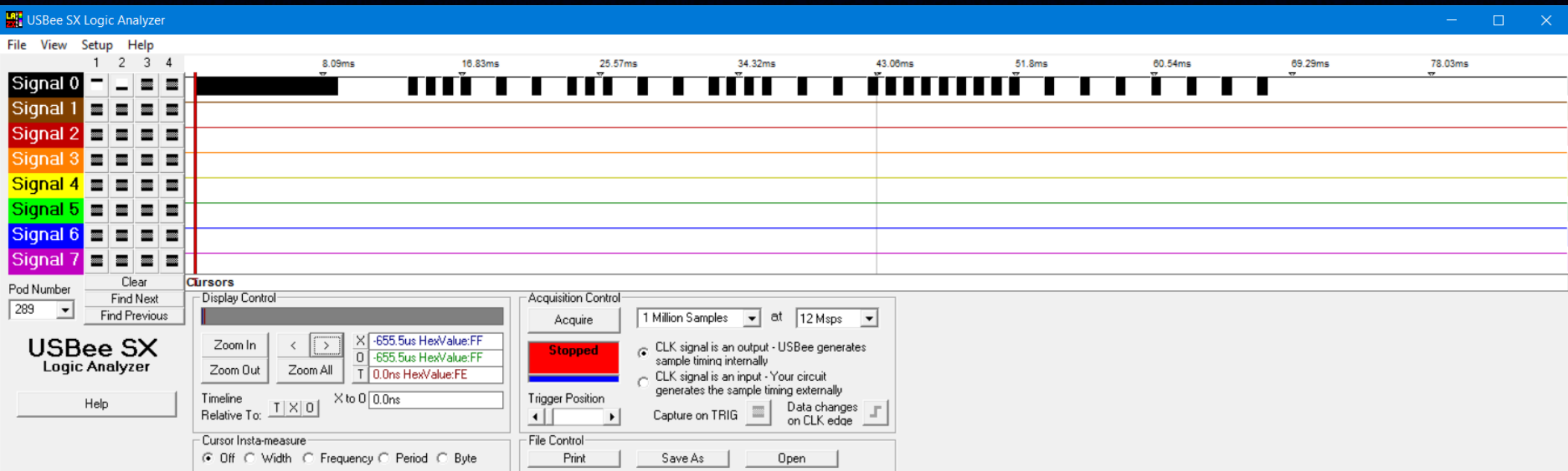
TV-B-Gone universal remote control

IR Remote control codes

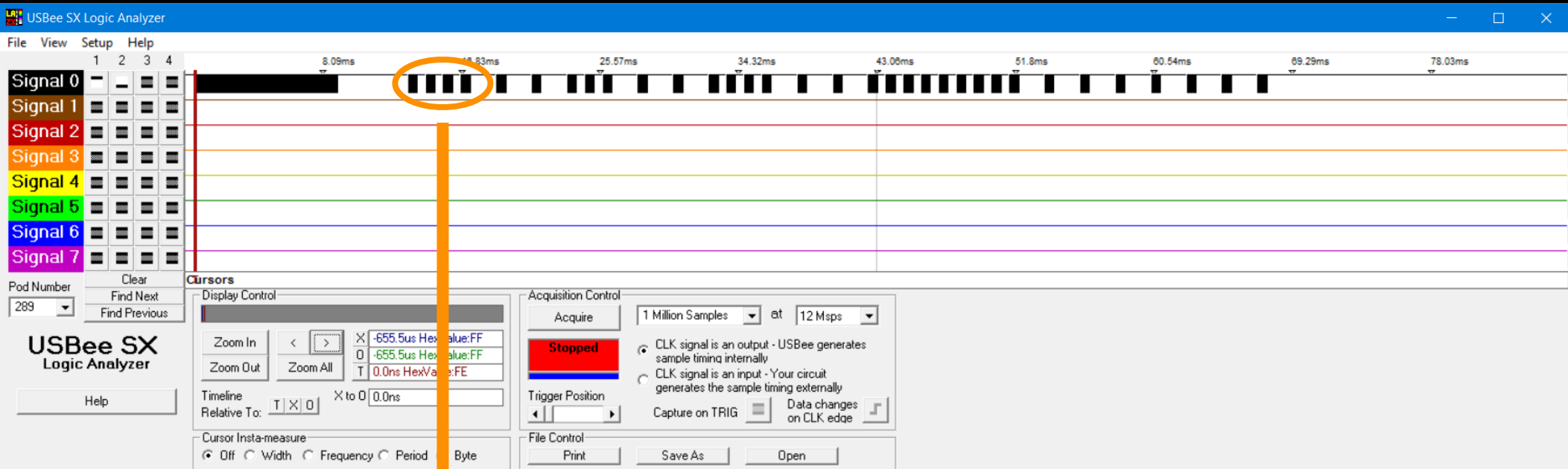


Allen Hall
NEC TV remote control

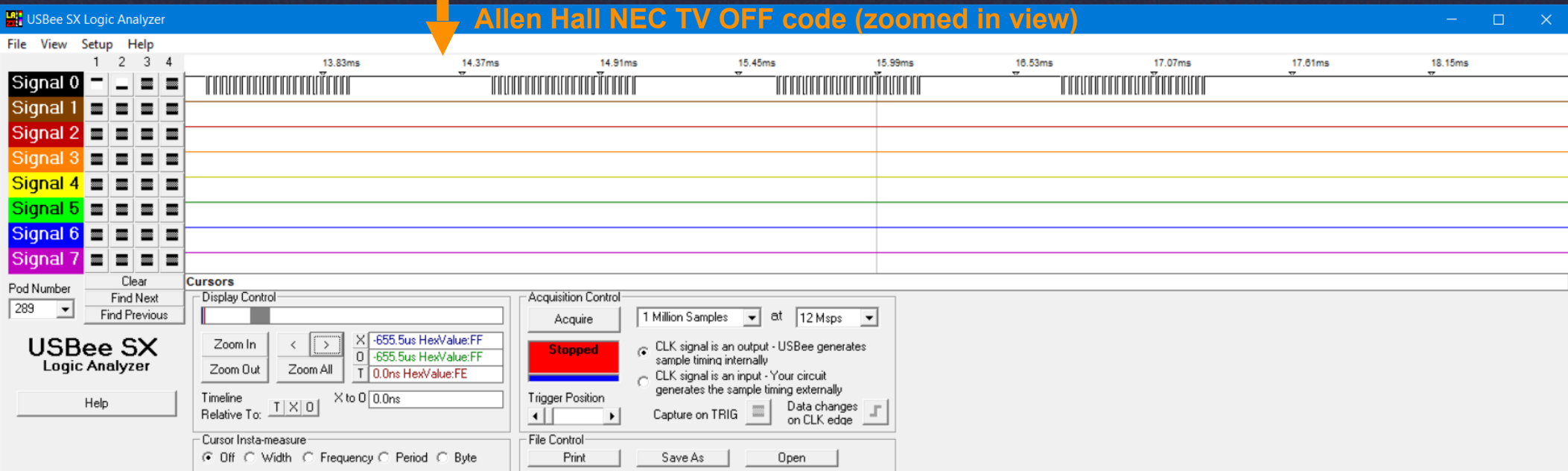
Allen Hall NEC TV OFF code



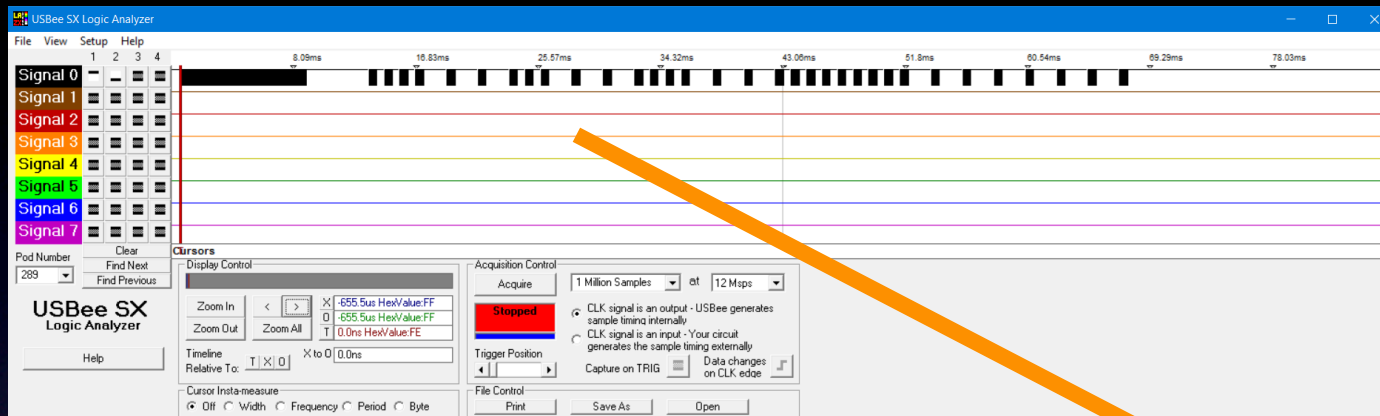
Allen Hall NEC TV OFF code



Allen Hall NEC TV OFF code (zoomed in view)

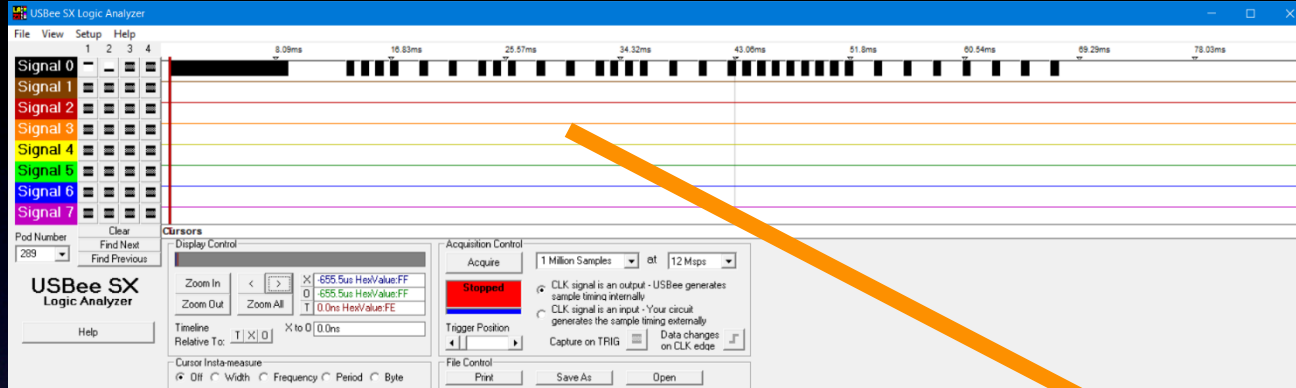


Allen Hall NEC TV OFF code



pair #	on-time	off-time
1	8,920 usec	4,450 usec
2	560 usec	560 usec
3	560 usec	560 usec
4	560 usec	560 usec
5	560 usec	1,680 usec
6	560 usec	1,680 usec
7	560 usec	1,680 usec
8	560 usec	560 usec
9	560 usec	560 usec
10	560 usec	1,680 usec
11	560 usec	1,680 usec
12	560 usec	1,680 usec
13	560 usec	560 usec
14	560 usec	560 usec
15	560 usec	560 usec
16	560 usec	560 usec
17	560 usec	1,680 usec
18	560 usec	1,680 usec
19	560 usec	560 usec
20	560 usec	560 usec
21	560 usec	560 usec
22	560 usec	560 usec
23	560 usec	560 usec
24	560 usec	560 usec
25	560 usec	560 usec
26	560 usec	560 usec
27	560 usec	1,680 usec
28	560 usec	1,680 usec
29	560 usec	1,680 usec
30	560 usec	1,680 usec
31	560 usec	1,680 usec
32	560 usec	1,680 usec
33	560 usec	1,680 usec
34	560 usec	560 usec

Allen Hall NEC TV OFF code



pair #	on-time	off-time	index
1	8,920 usec	4,450 usec	0
2	560 usec	560 usec	1
3	560 usec	560 usec	1
4	560 usec	560 usec	1
5	560 usec	1,680 usec	2
6	560 usec	1,680 usec	2
7	560 usec	1,680 usec	2
8	560 usec	560 usec	1
9	560 usec	560 usec	1
10	560 usec	1,680 usec	2
11	560 usec	1,680 usec	2
12	560 usec	1,680 usec	2
13	560 usec	560 usec	1
14	560 usec	560 usec	1
15	560 usec	560 usec	1
16	560 usec	560 usec	1
17	560 usec	1,680 usec	2
18	560 usec	1,680 usec	2
19	560 usec	560 usec	1
20	560 usec	560 usec	1
21	560 usec	560 usec	1
22	560 usec	560 usec	1
23	560 usec	560 usec	1
24	560 usec	560 usec	1
25	560 usec	560 usec	1
26	560 usec	560 usec	1
27	560 usec	1,680 usec	2
28	560 usec	1,680 usec	2
29	560 usec	1,680 usec	2
30	560 usec	1,680 usec	2
31	560 usec	1,680 usec	2
32	560 usec	1,680 usec	2
33	560 usec	1,680 usec	2
34	560 usec	560 usec	1

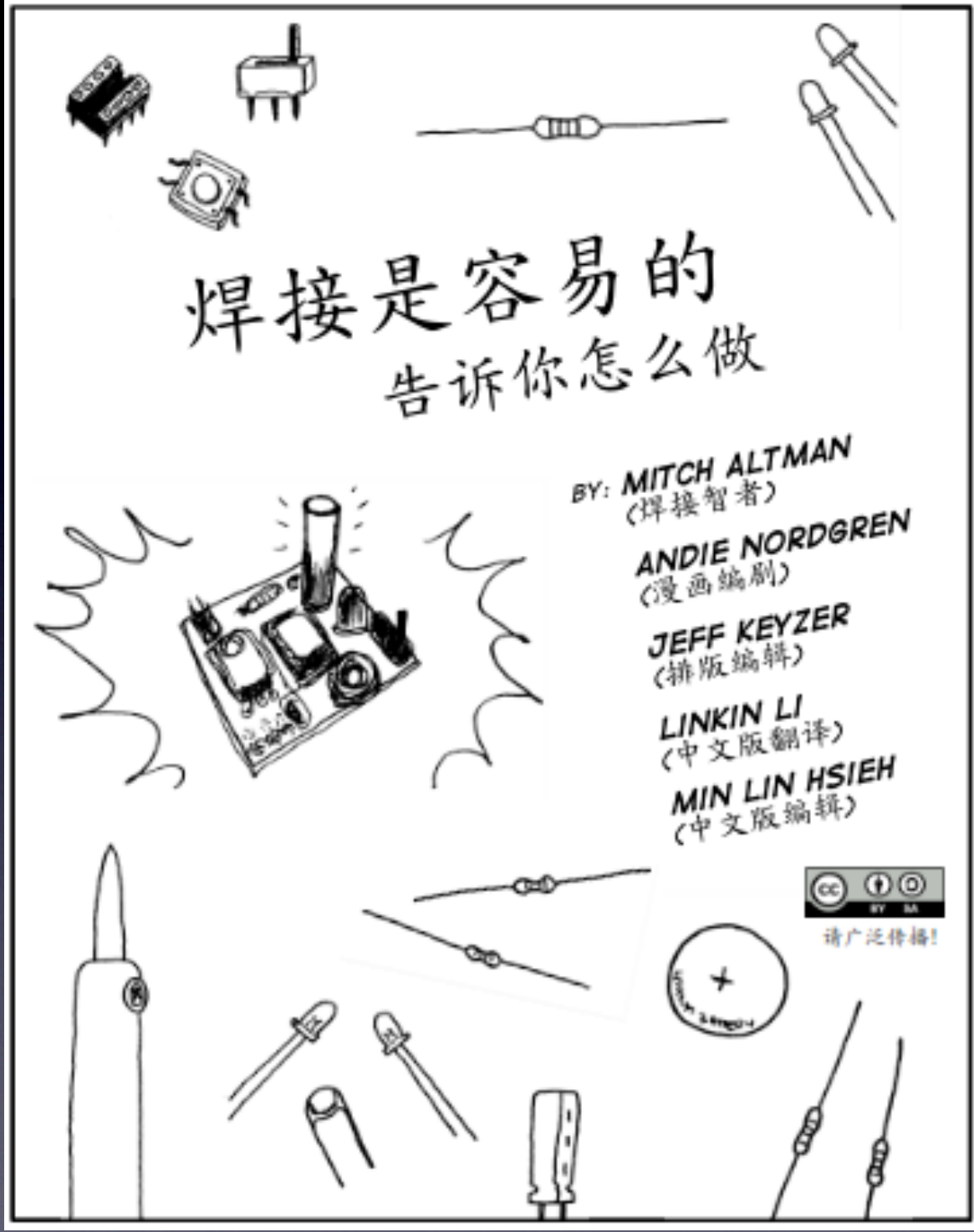
index
0 1 1 1
2 2 2 1
1 2 2 2
1 1 1 1
2 2 1 1
1 1 1 1
1 1 2 2
2 2 2 2
2 1

Learn To Solder



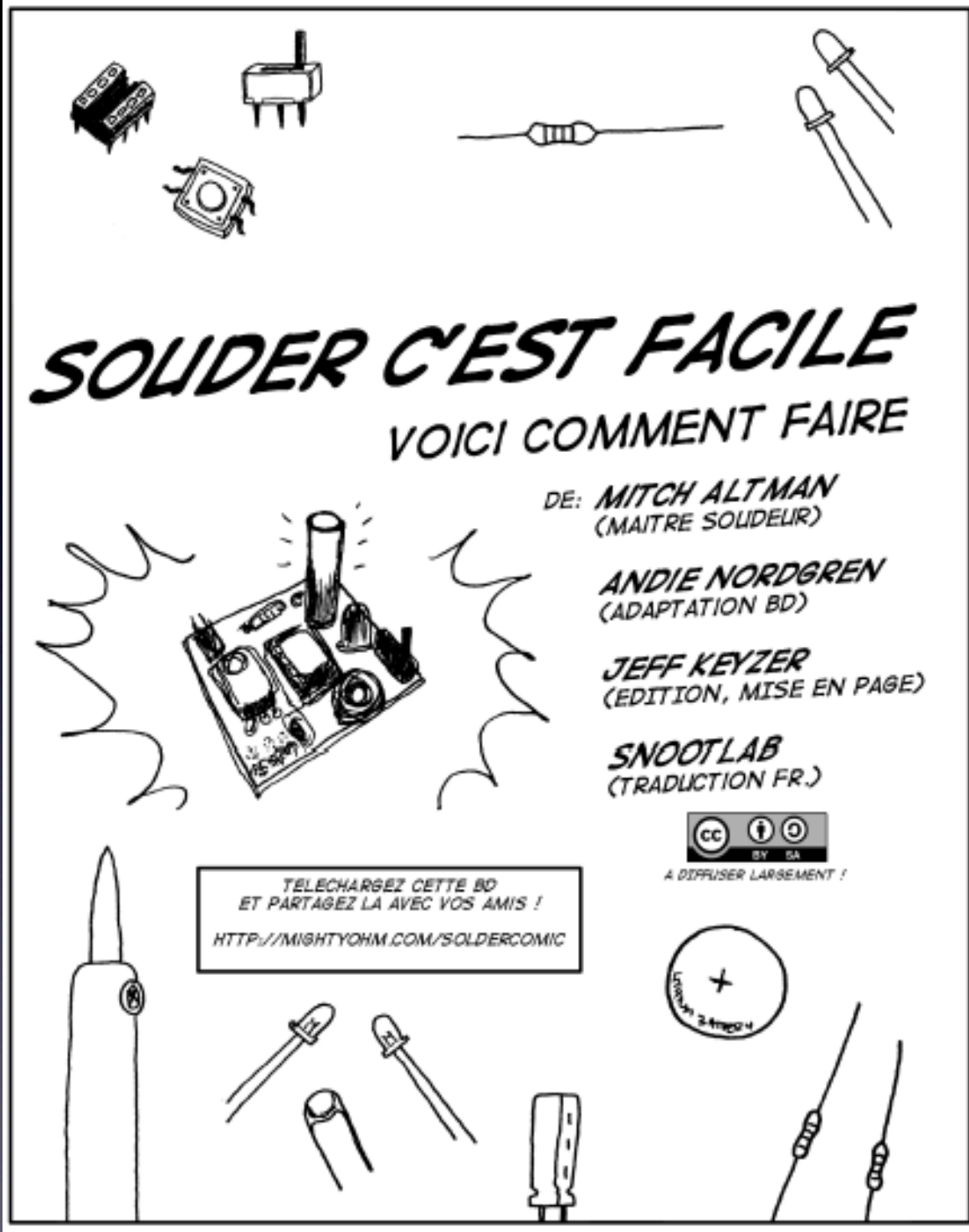
download for free at:
<http://mightyohm.com/soldercomic>
(In many different languages.)

Learn To Solder



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

Learn To Solder



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

Learn To Solder



SOLDAR ES FÁCIL!

APRENDE CÓMO HACERLO

POR: MITCH ALTMAN
(SABIDURÍA EN SOLDADO)

ANDIE NORDGREN
(ADAPTACIÓN A COMIC)

JEFF KEYZER
(DISEÑO Y EDICIÓN)



DISTRIBUYE AMPLIAMENTE!

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

Learn To Solder



LÖTEN IST EINFACH SO WIRD ES GEMACHT

VON: MITCH ALTMAN
(LÖTWEISHEITEN)
ANDIE NORDGREN
(KOMIK-UMSETZUNG)
JEFF KEYZER
(LAYOUT UND BEARBEITUNG)
ALEXANDER BODORA
(ÜBERSETZUNG UND BEARBEITUNG)
RICHARD MEINSEN
(ÜBERARBEITUNG UND KORREKTUR)

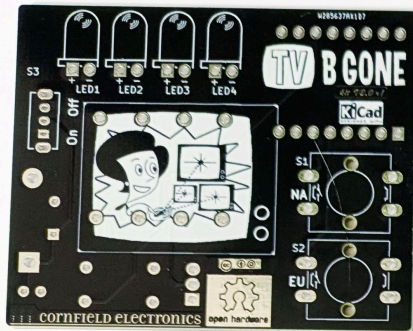


WEITER
VERTEILEN!

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

Parts

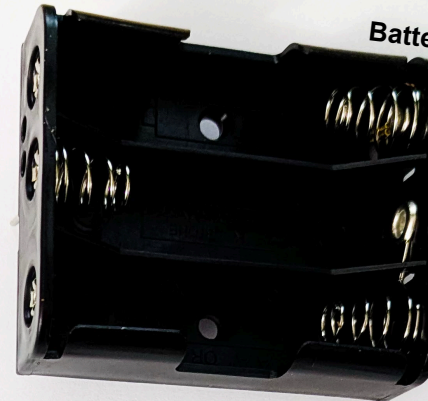
PCB



Double-sided tape
(to attach
Battery Pack
to
project)
↓



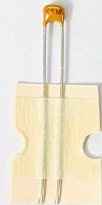
Battery Pack



MOD1



C1



C2



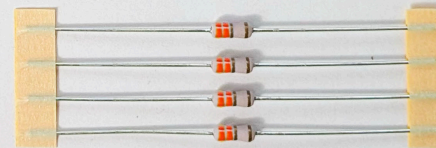
LED1, LED2



LED3, LED4



R1-R4 (3.3) Orange, Orange, Gold, Gold



R5 (56) Green, Blue, Black, Gold



R6 (47K) Yellow, Violet, Orange, Gold



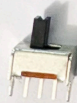
Q1



S1



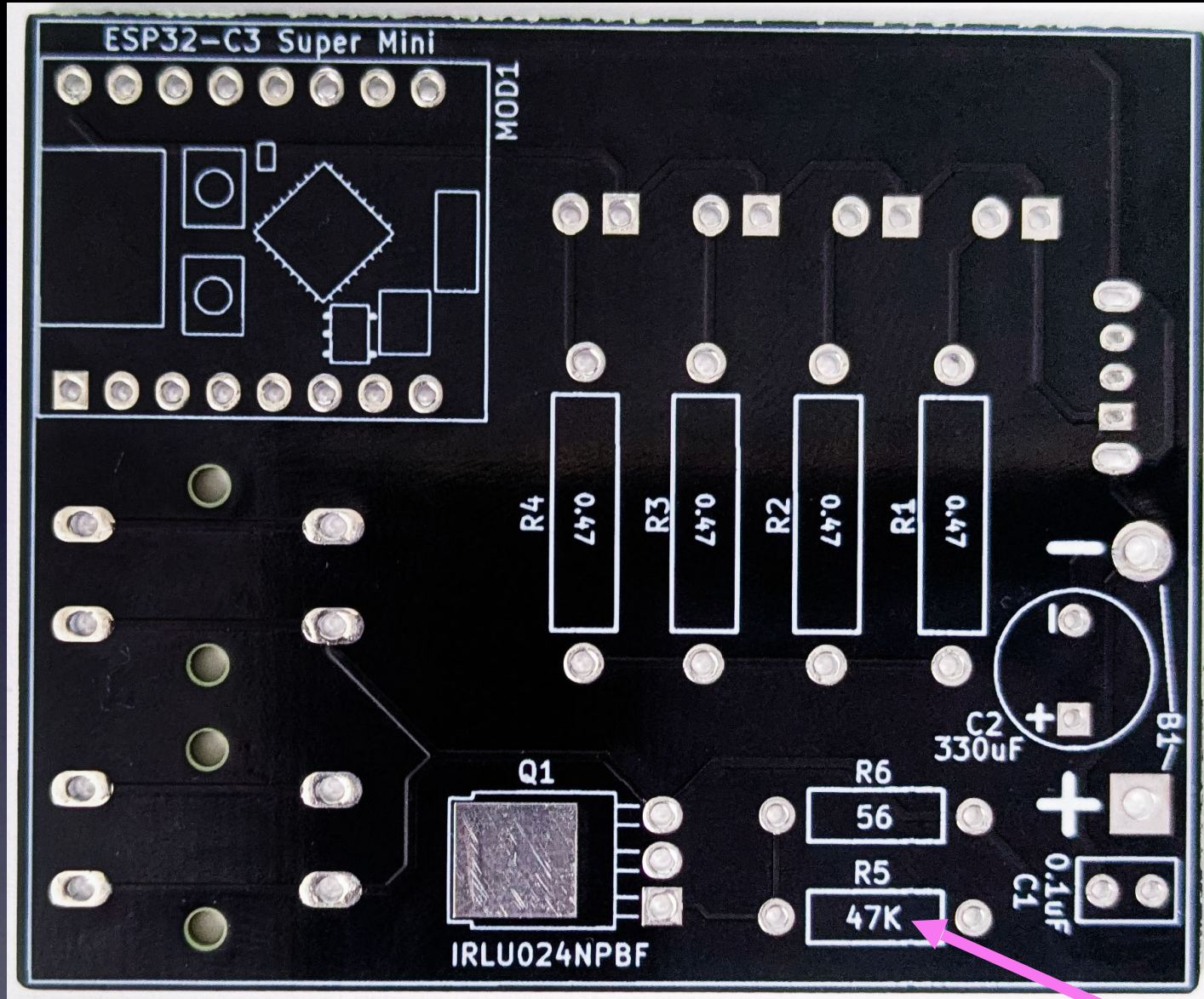
S2



S3

All of the parts

Board (PCB)

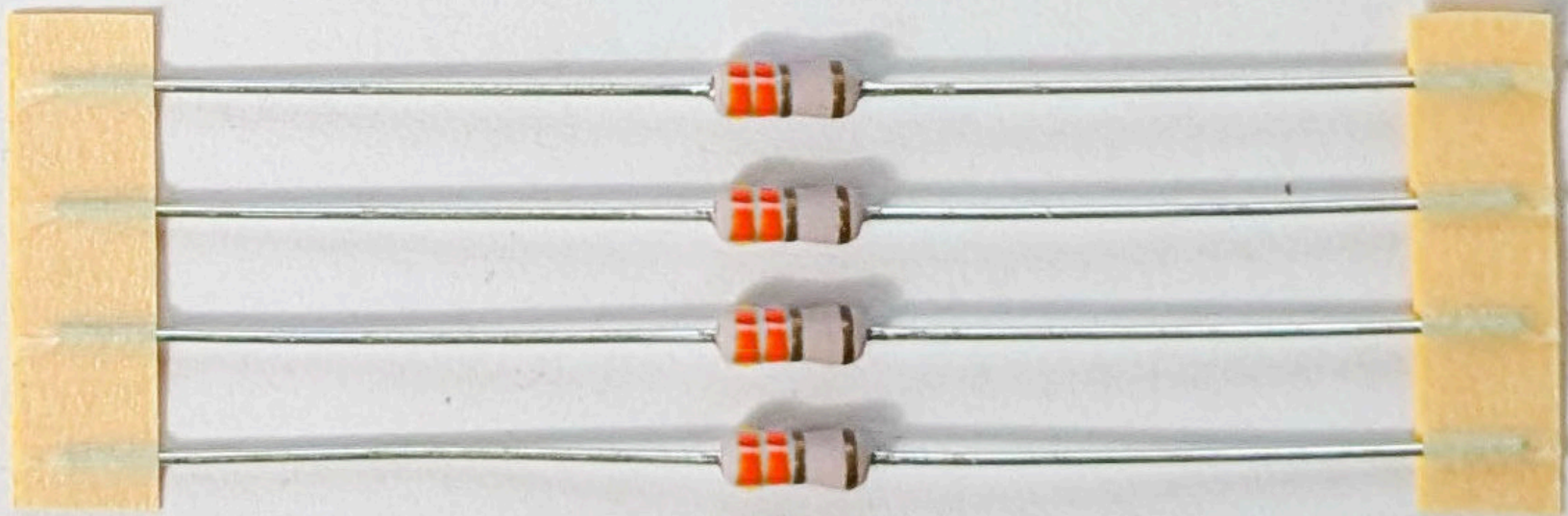


The Back

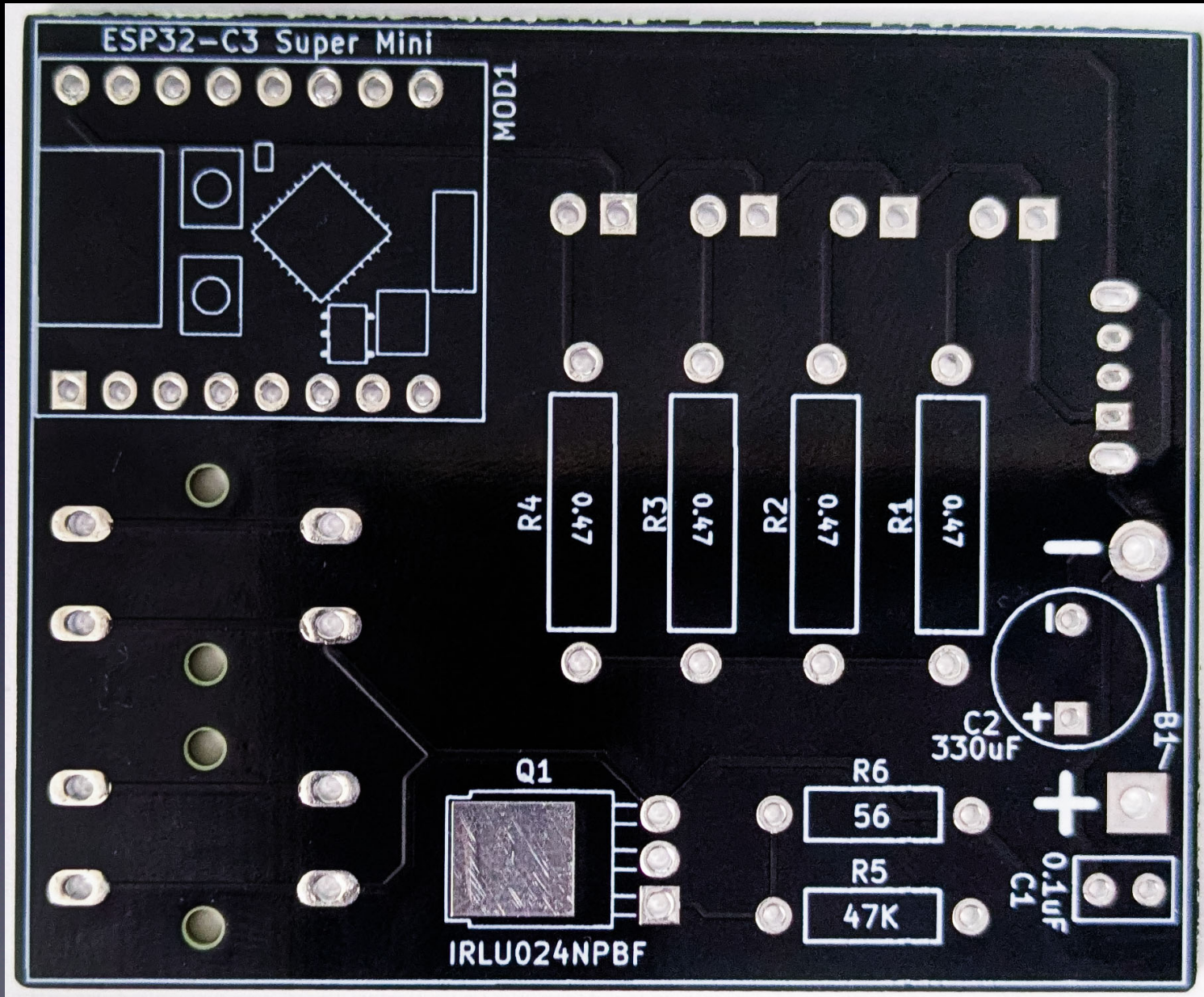
NOTE -- labeling error:
R5 should say 56
R6 should say 47K

Look at the shape of these parts

R1 - R4



See similar shapes on the PCB

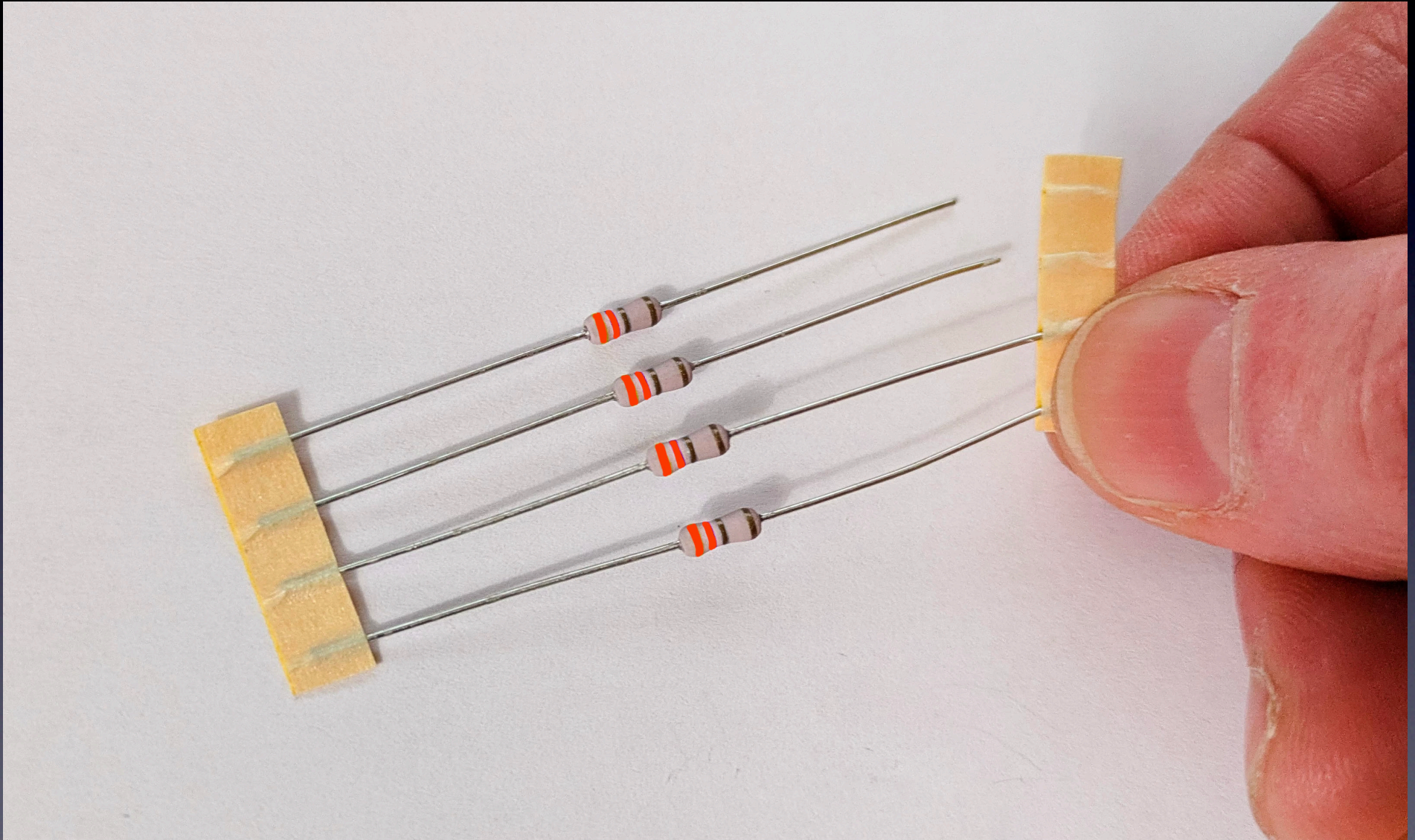


We will start with Resistor R1



R1-R4 (3.3) Orange, Orange, Gold, Gold

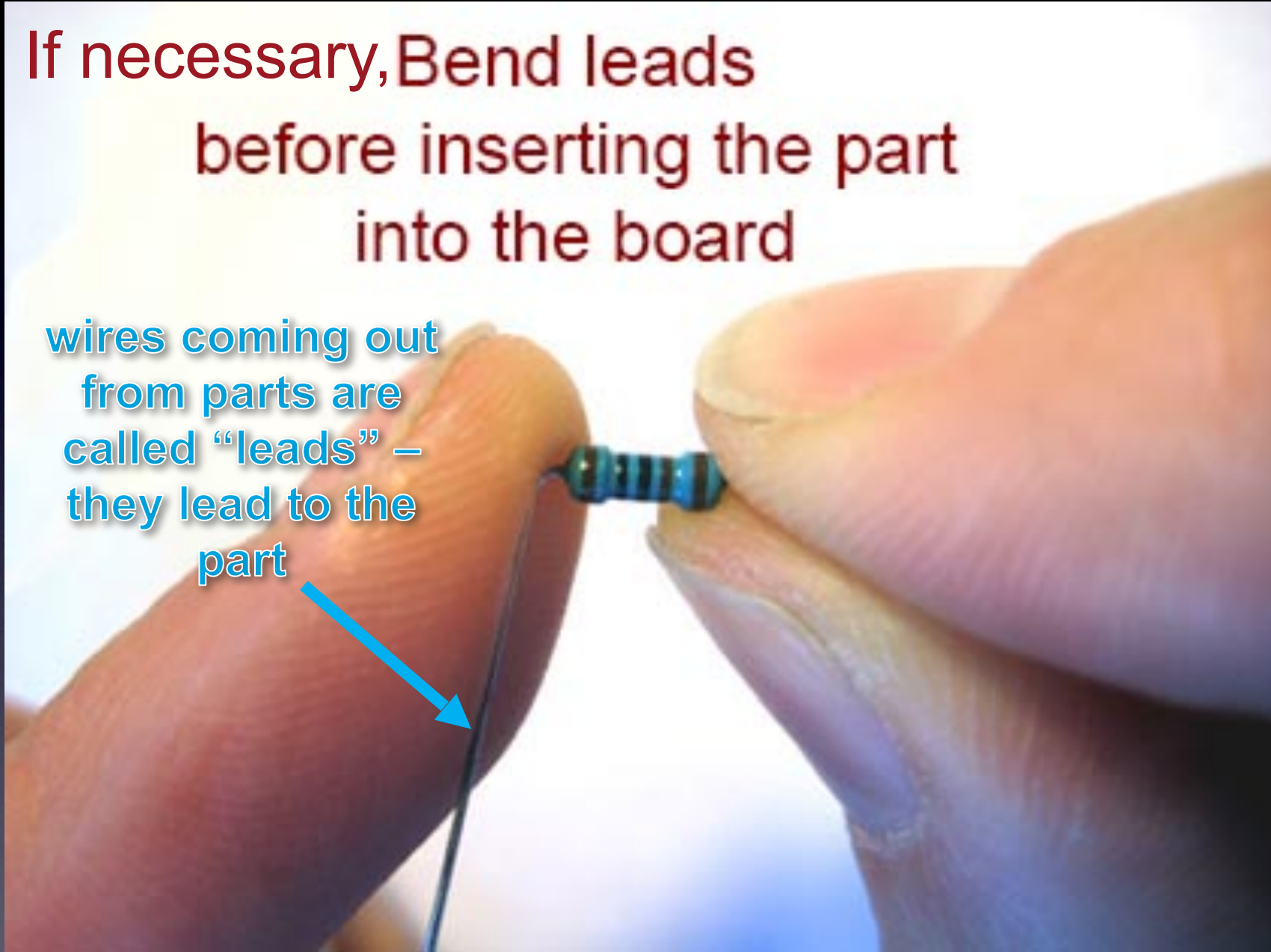
Pull tape off



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

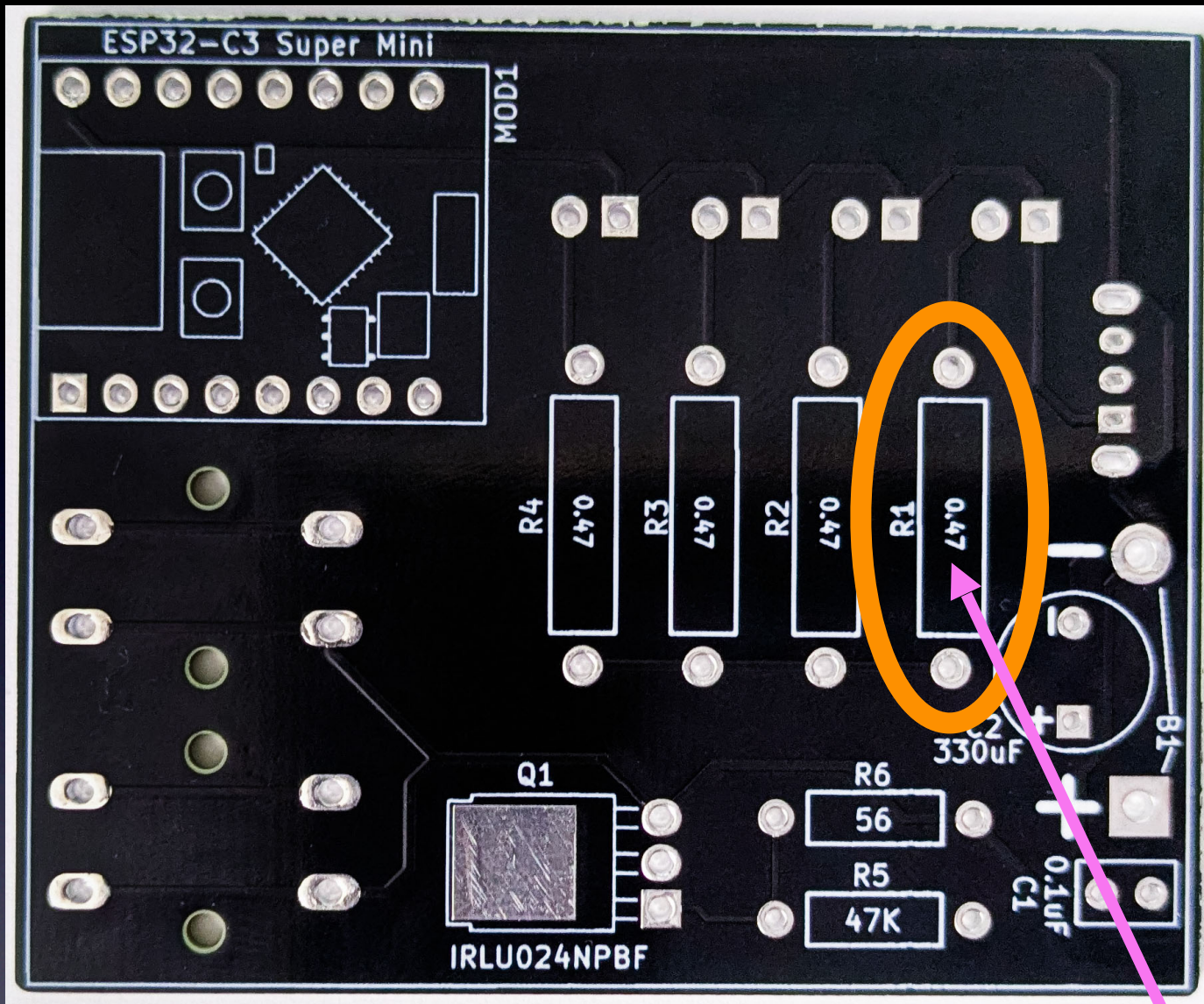
If necessary, Bend leads
before inserting the part
into the board

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



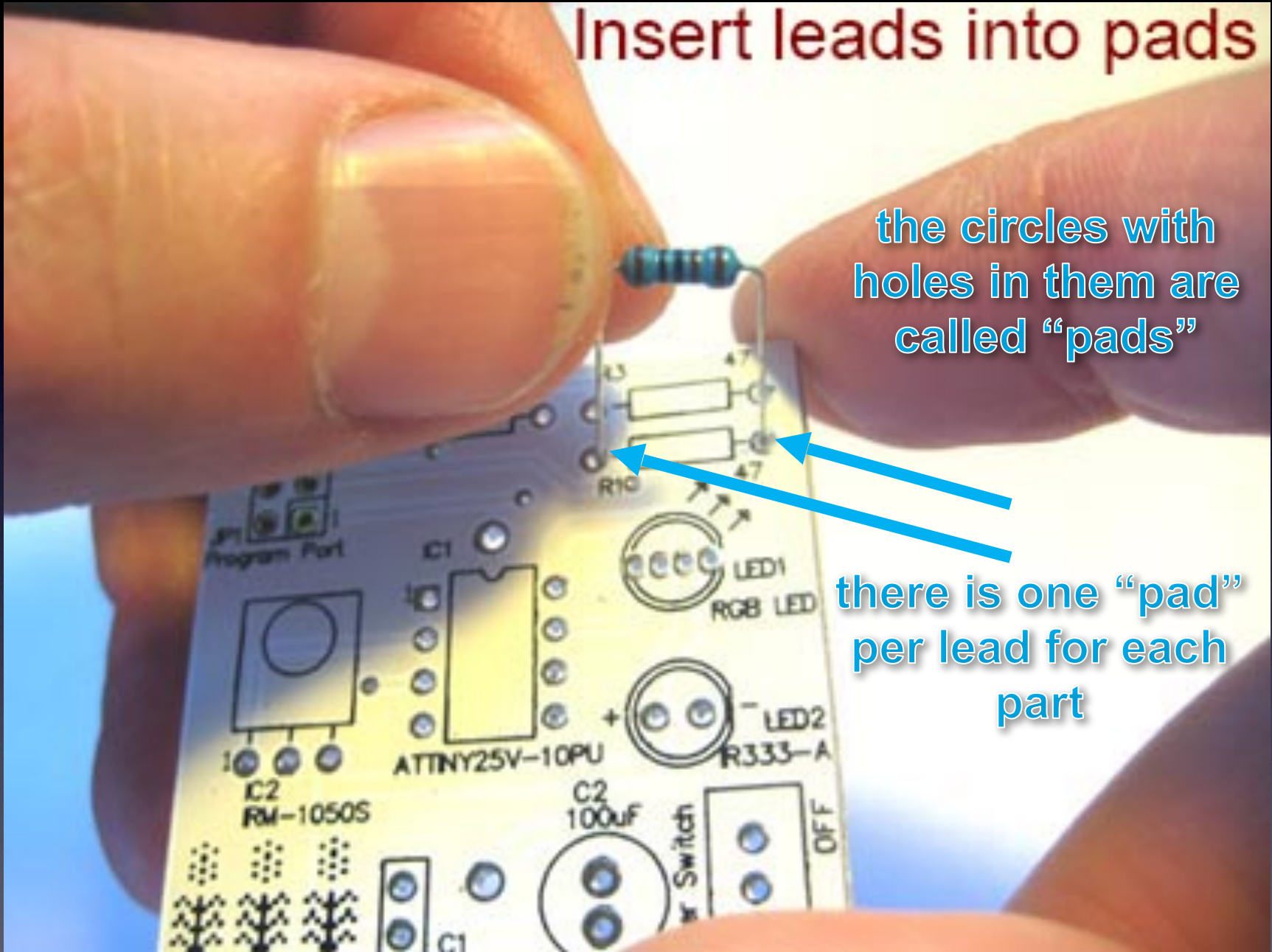
Resistor R1

NOTE:
R1-R4 say 0.47
but we are using 3.3

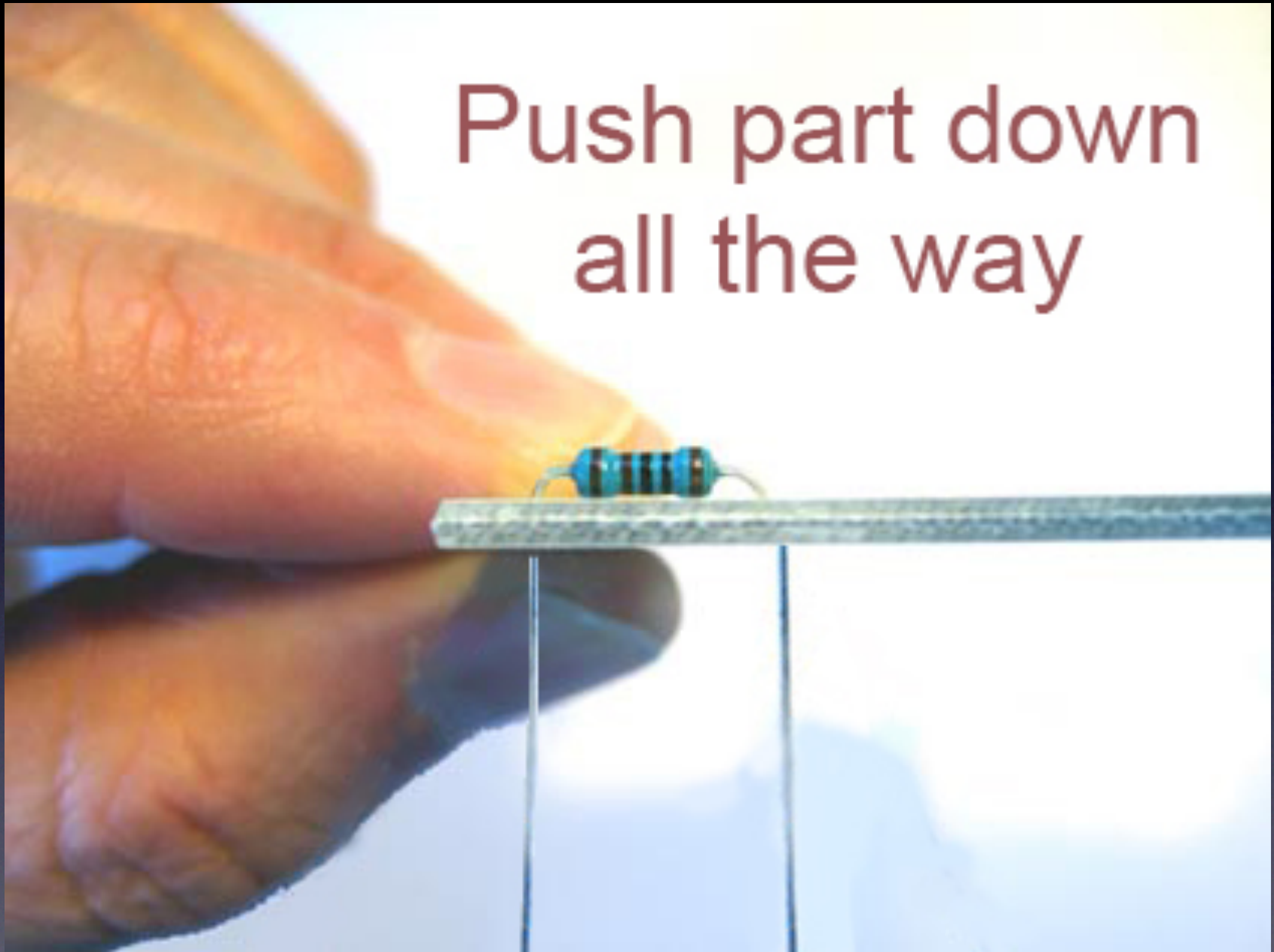
Insert leads into pads

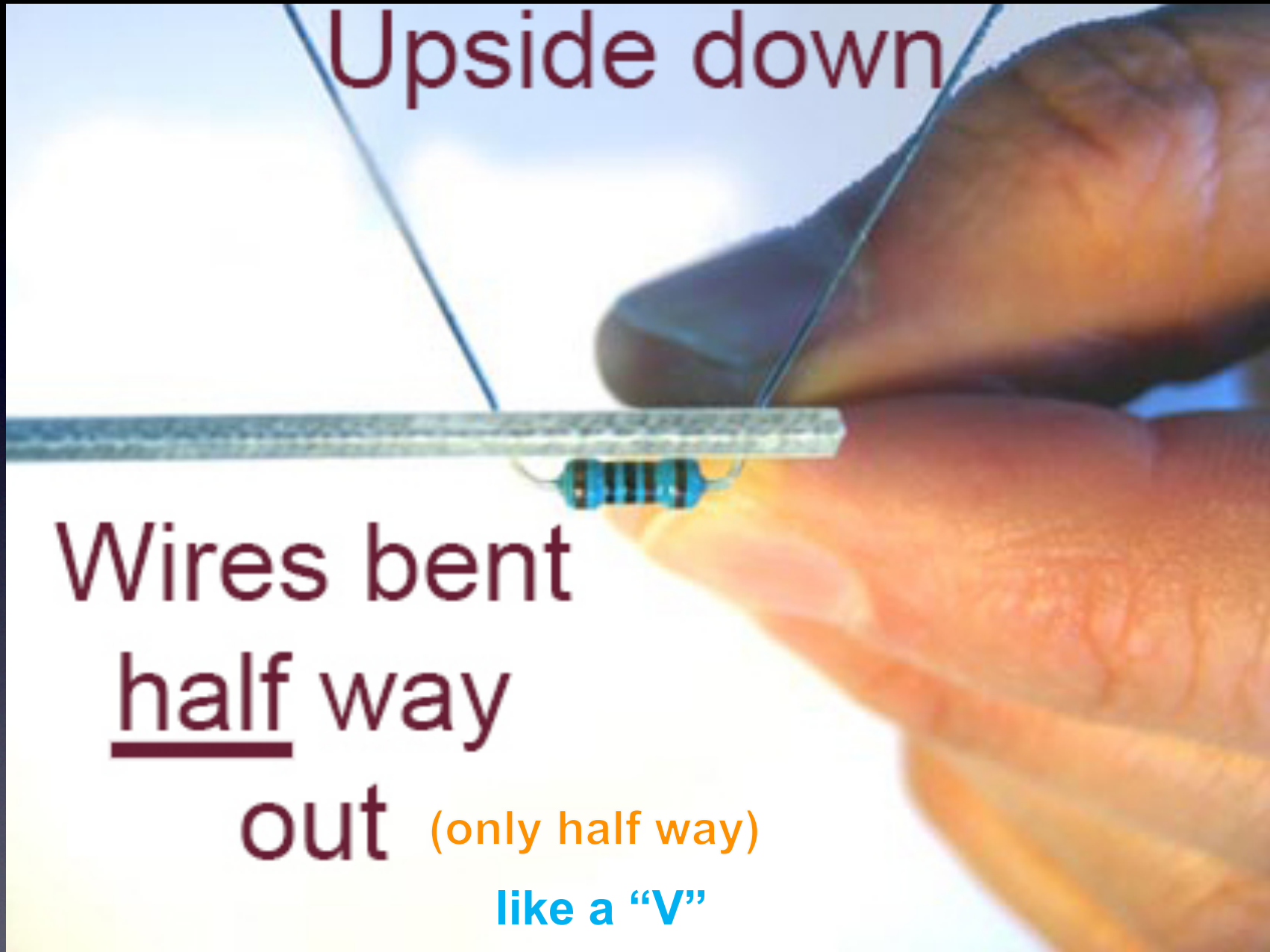
the circles with holes in them are called "pads"

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



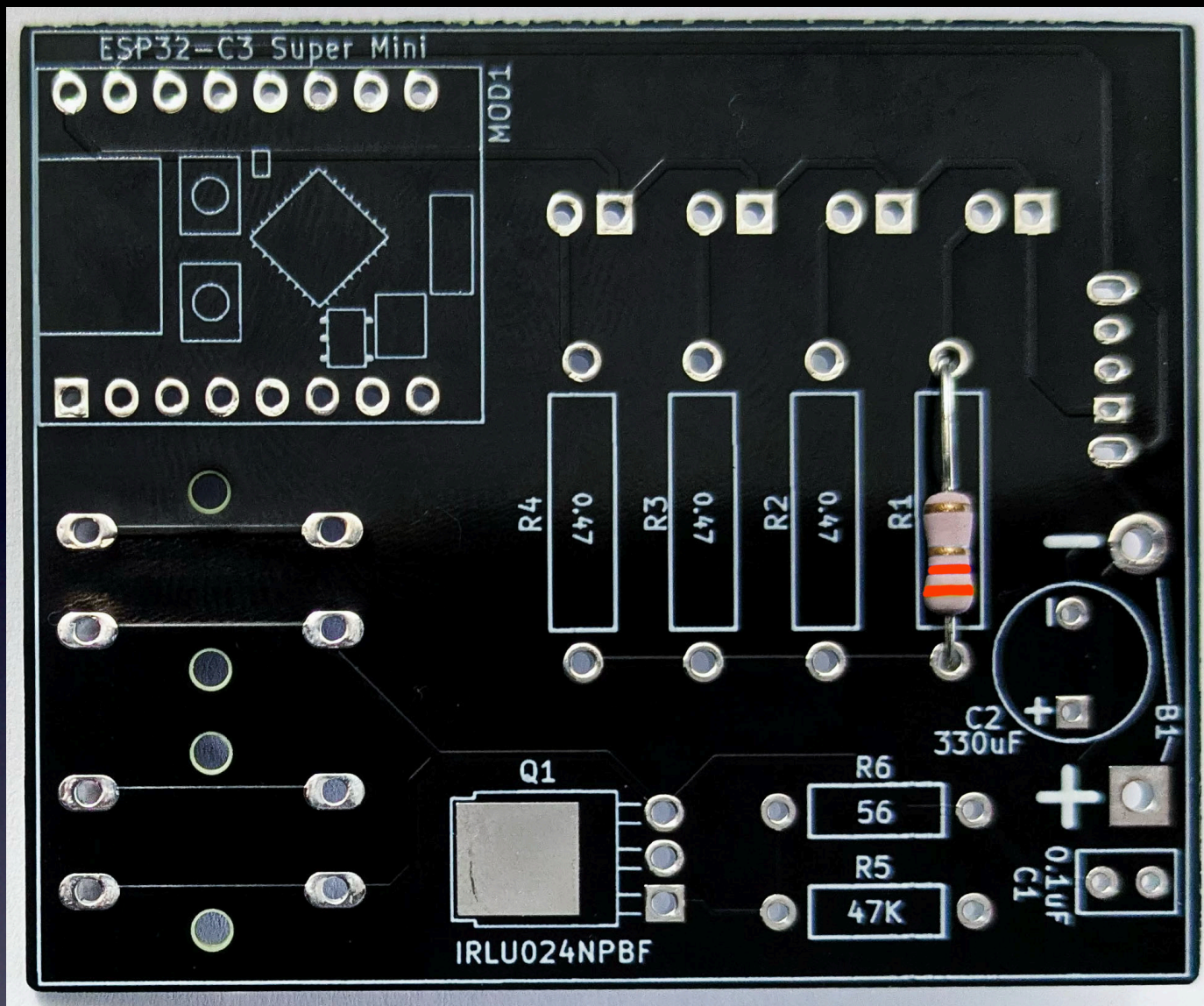
Upside down

Wires bent
half way
out

(only half way)

like a "V"

Ready to Solder !



**Resistor R1
inserted**



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 good kind of solder for DIY electronics:

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



Kester
K100LD Rosin
(not "No Clean")
0.031" diameter (0.8mm)

This is what we will use:

A good kind of solder for DIY electronics:

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

Kester **K100LD Rosin** Solder
0.031" diameter (0.8mm)



Note:

Since we will use **Lead-Free** solder it is helpful to also have **flux paste in a syringe** and **Isopropyl Alcohol**



99%



Another good kind of solder for DIY electronics:

*This is another good **Lead-Free** solder I have found!*



**Duratool
D01685 Rosin**

0.7mm diameter

*(as good as the
Kester K100LD Rosin)*

Another good kind of solder for DIY electronics:

This is another good **Lead-Free** solder I have found!



**MG Chemicals
4900 Rosin (112g, 227g, 454g)**

0.8mm diameter

*(as good as the
Kester K100LD Rosin)*

Another good kind of solder for DIY electronics:

*This is another good **Lead-Free** solder I have found!*



iFixit
IF145-077-2 (12g)
1.0mm diameter

*(as good as the
Kester K100LD Rosin)*

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)

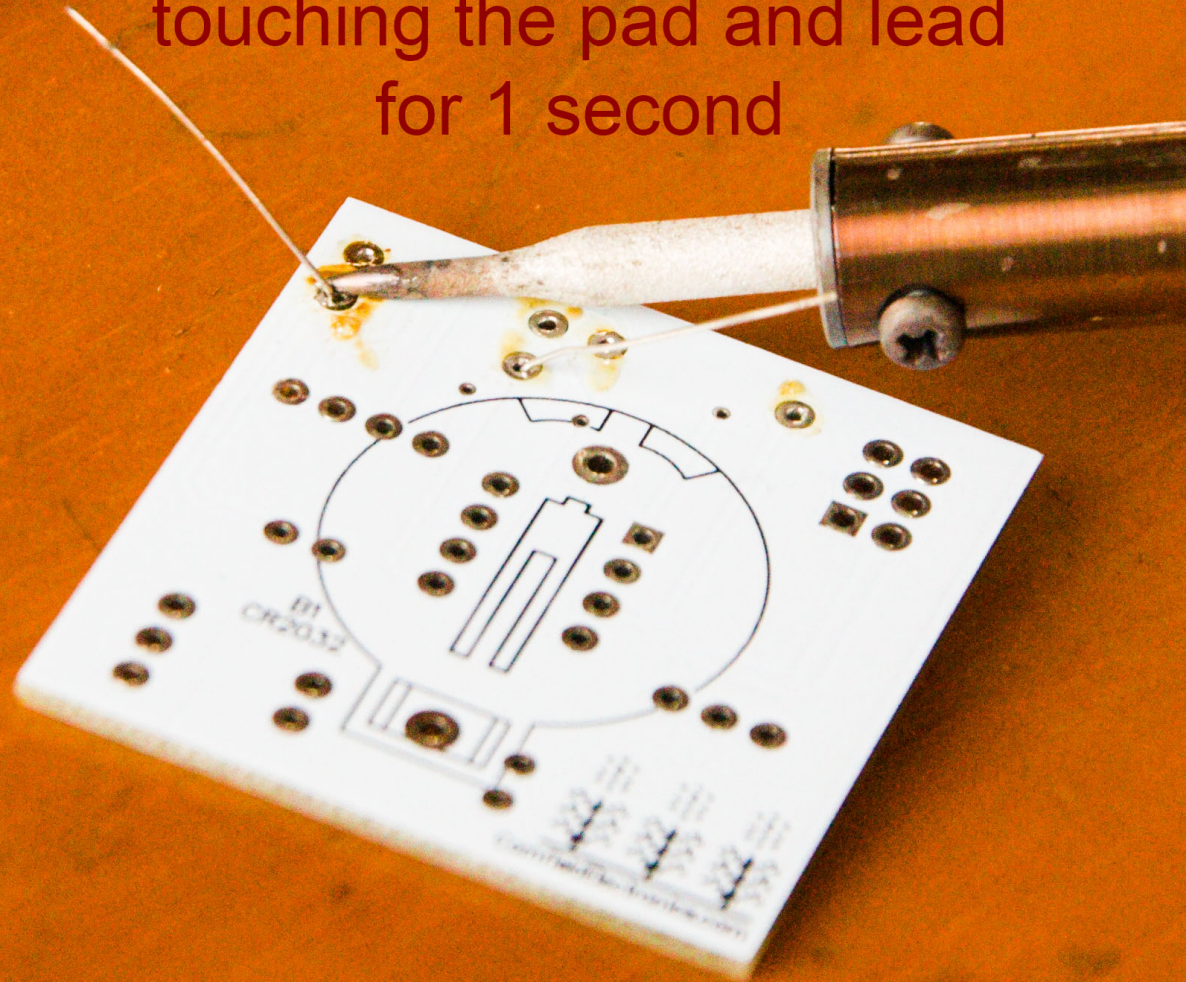
Bang (lightly) 3 times,

Swipe, Rotate, Swipe (on the sponge):

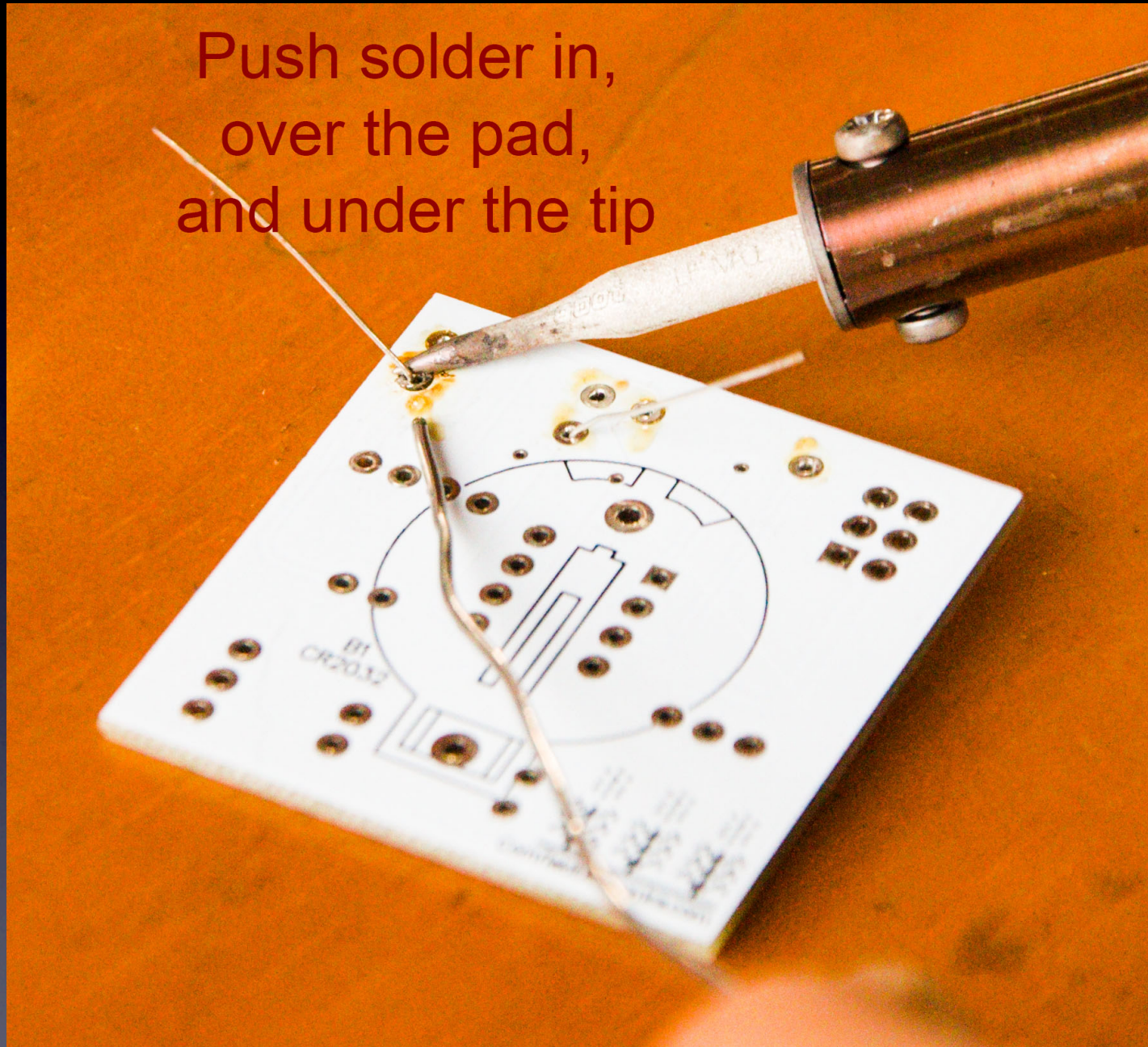
Keep the tip shiny silver!

knock solder off the tip

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

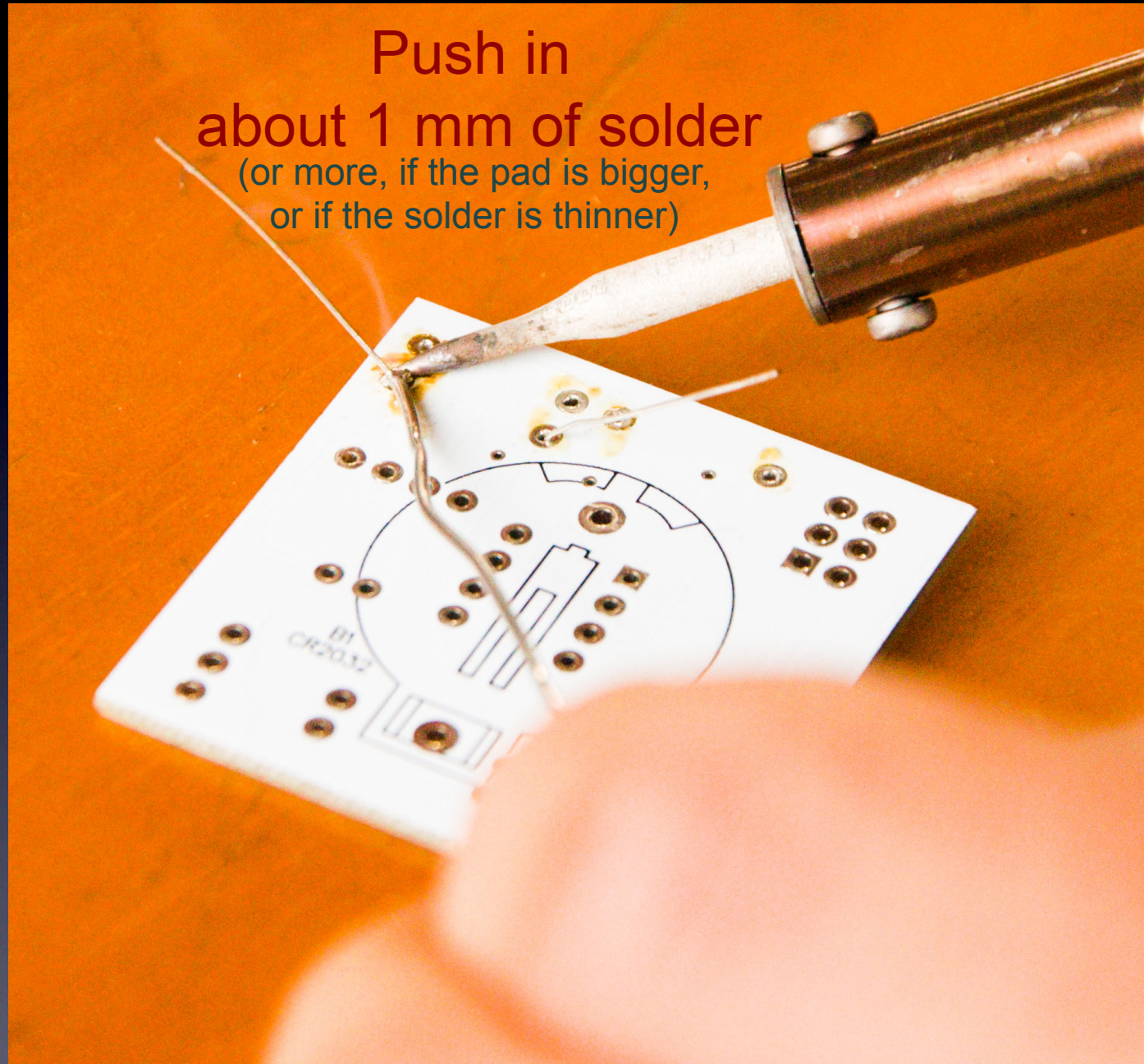


Do this quickly (slowly doesn't work well) – solder in & out in about 1 second



IMPORTANT: 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)!

HEY !!!

KEEP HOLDING TIP DOWN FOR 1 MORE SECOND !!



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

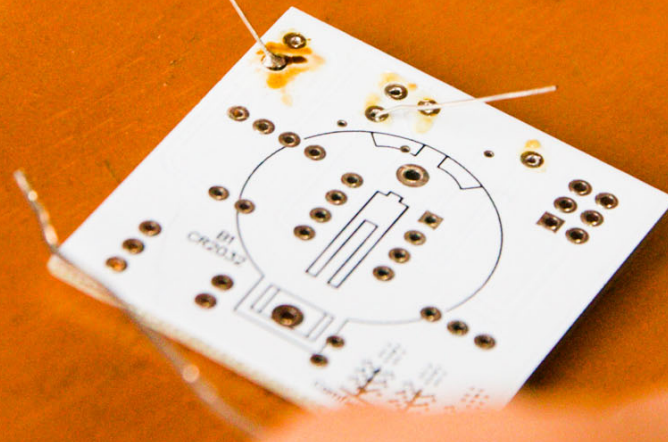
WAIT !!
Don't lift the tip !!

Secret #2:

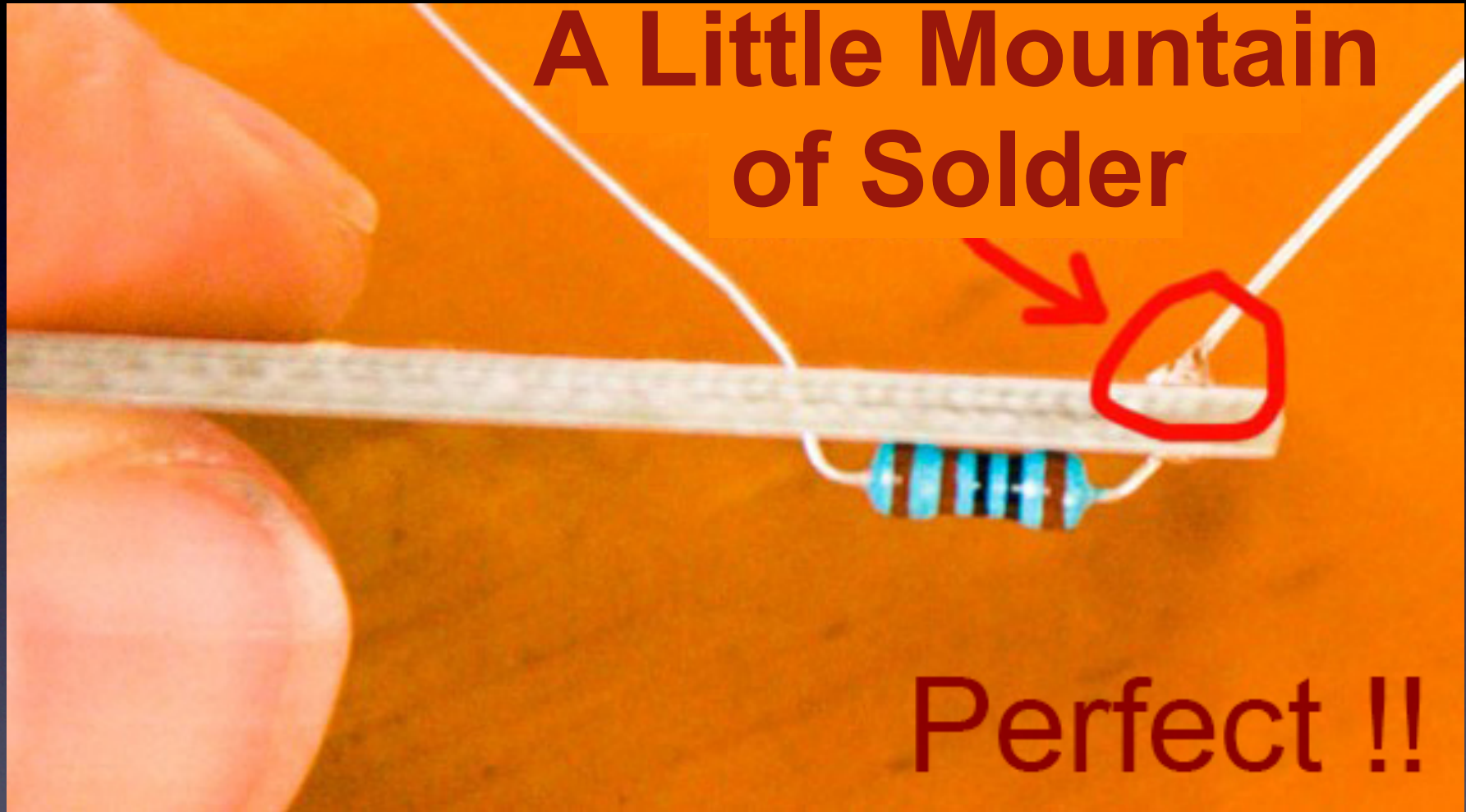
Keep hot tip down
1 second
For solder to flow !!

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

ONE MORE TIME



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 **O**ut

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



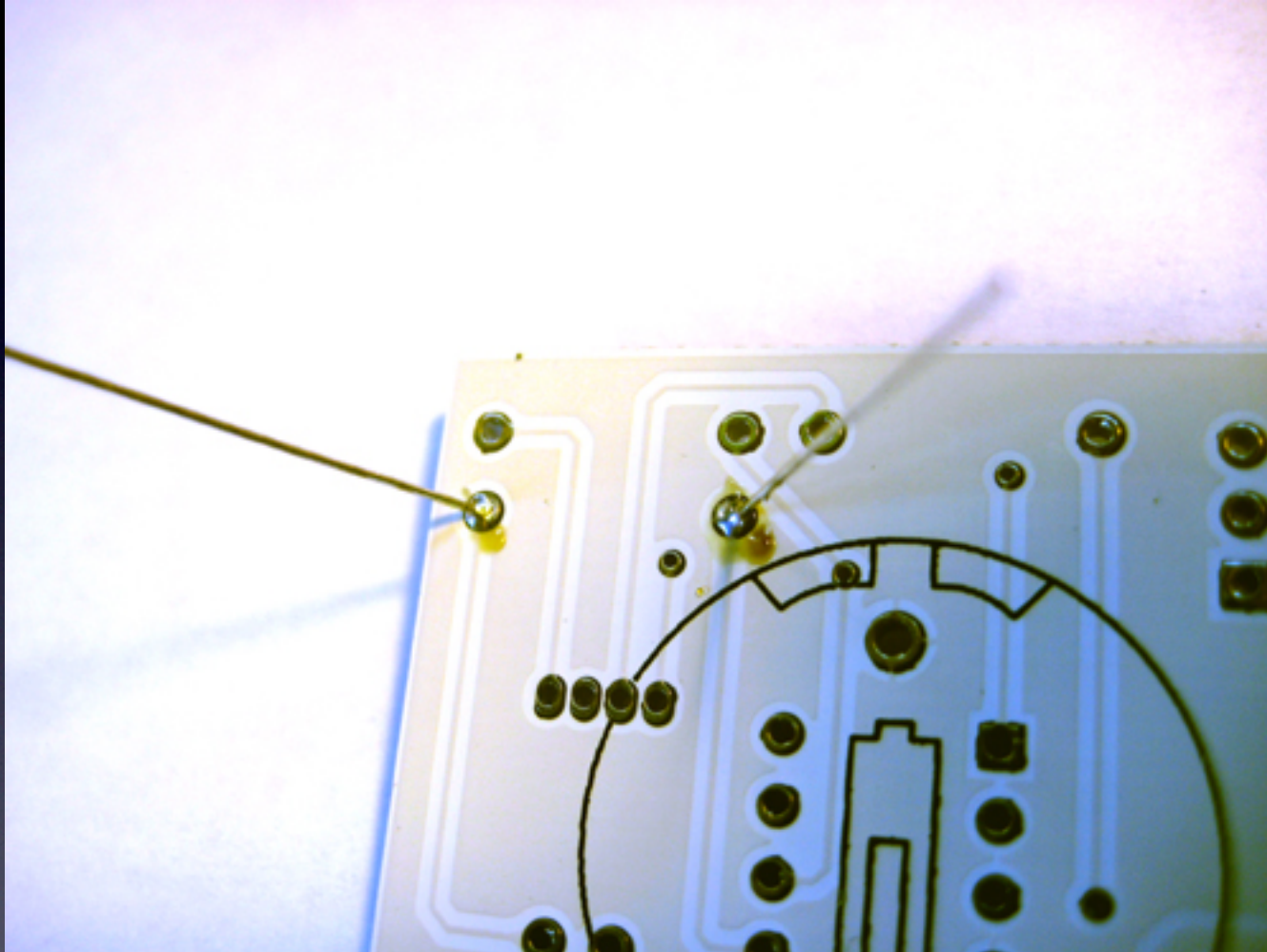
WAIT !

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



Lift Tip

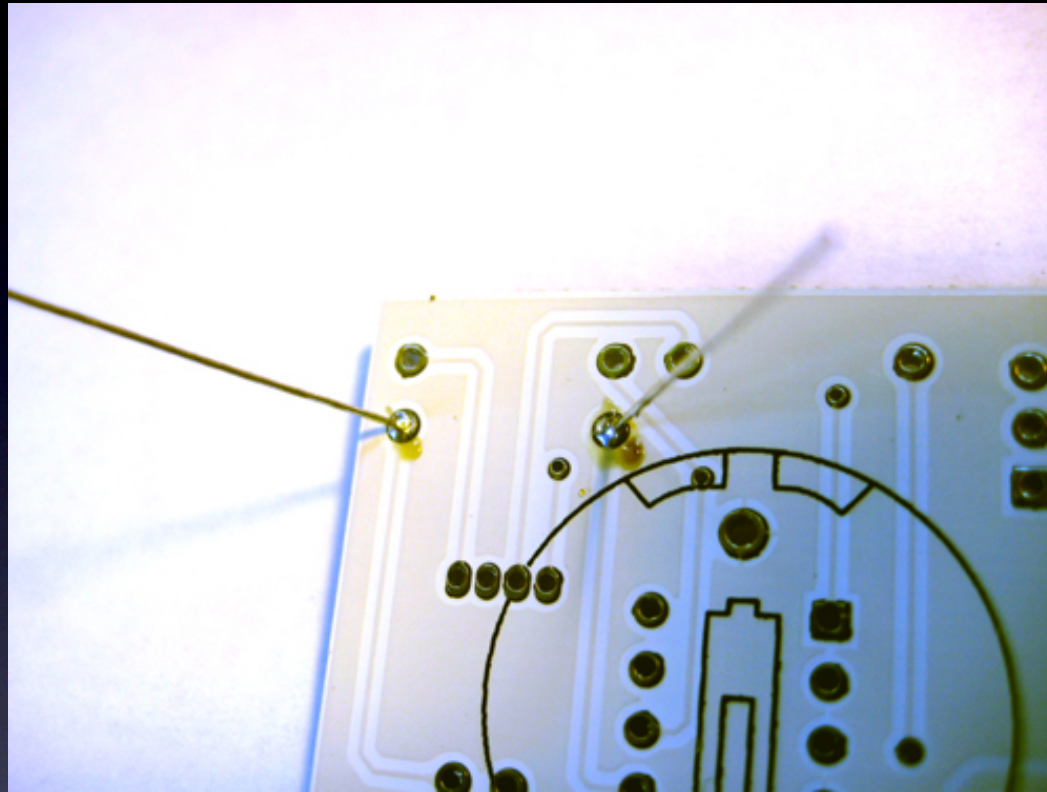
Solder all of the leads of the part to the board



For this part, there are two leads

Here you can see two good solder connections

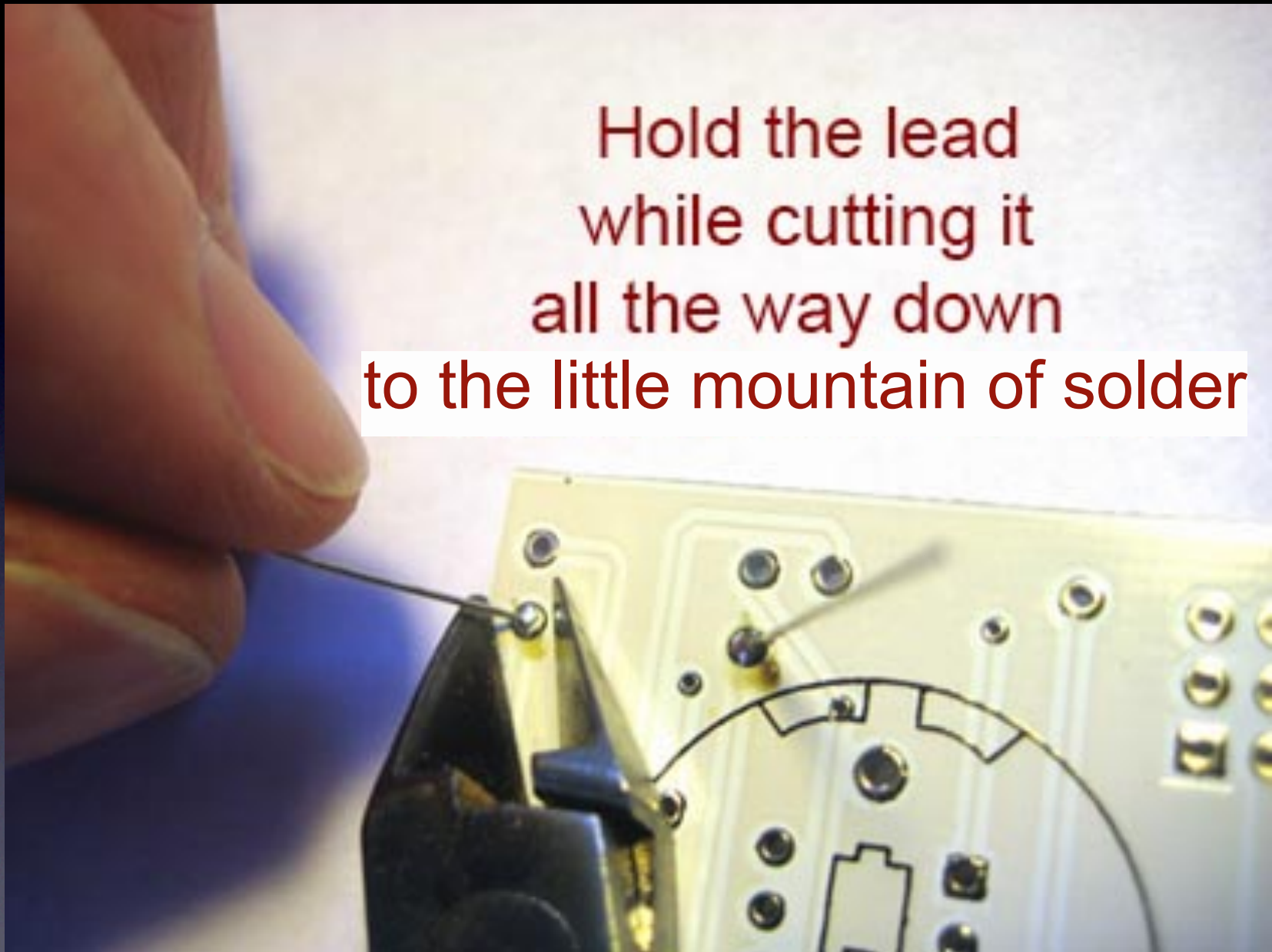
Two good solder connections



- 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:

Hole or cover the lead !

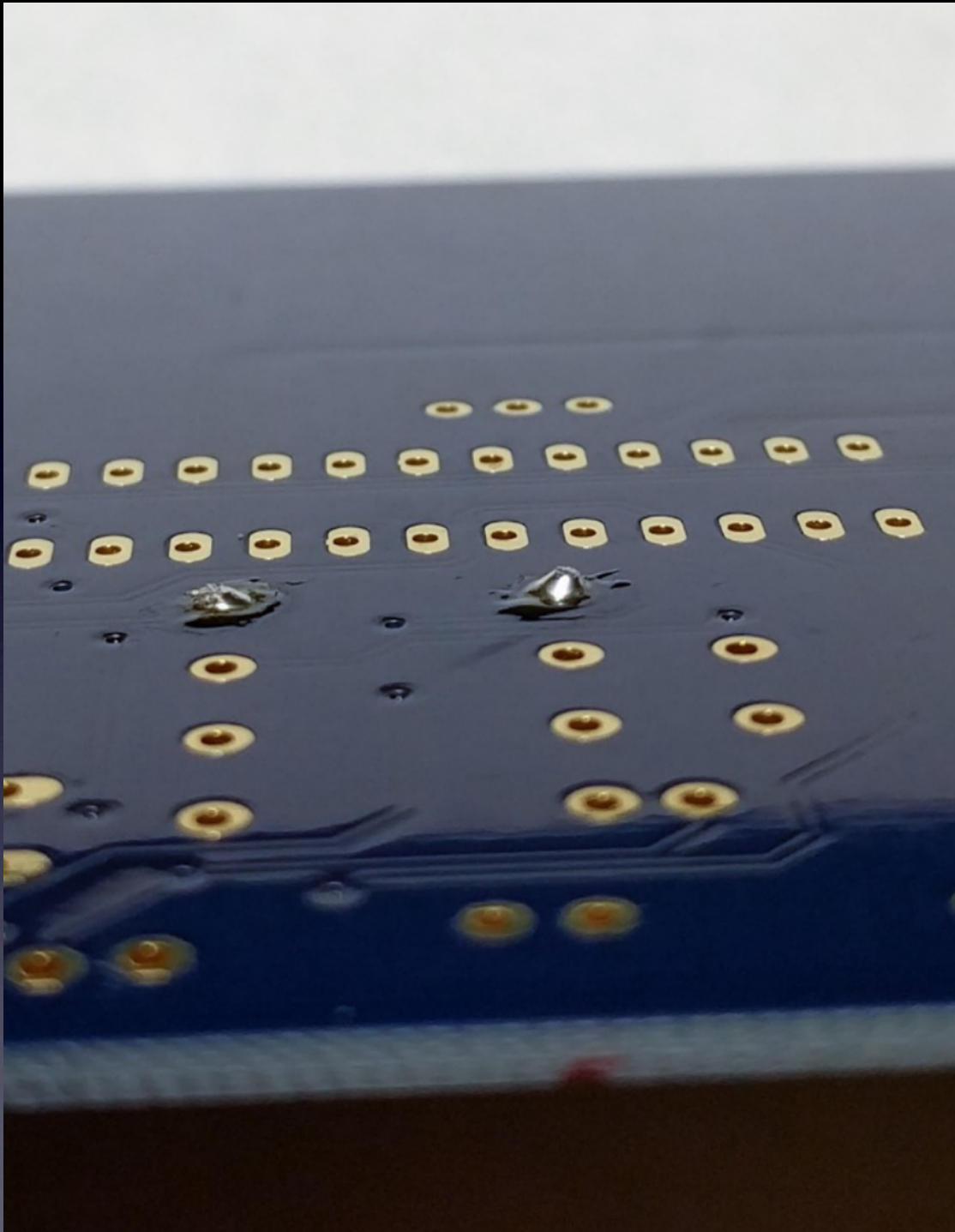
(or it will fly into your eye!)

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



All done !

No wires sticking out



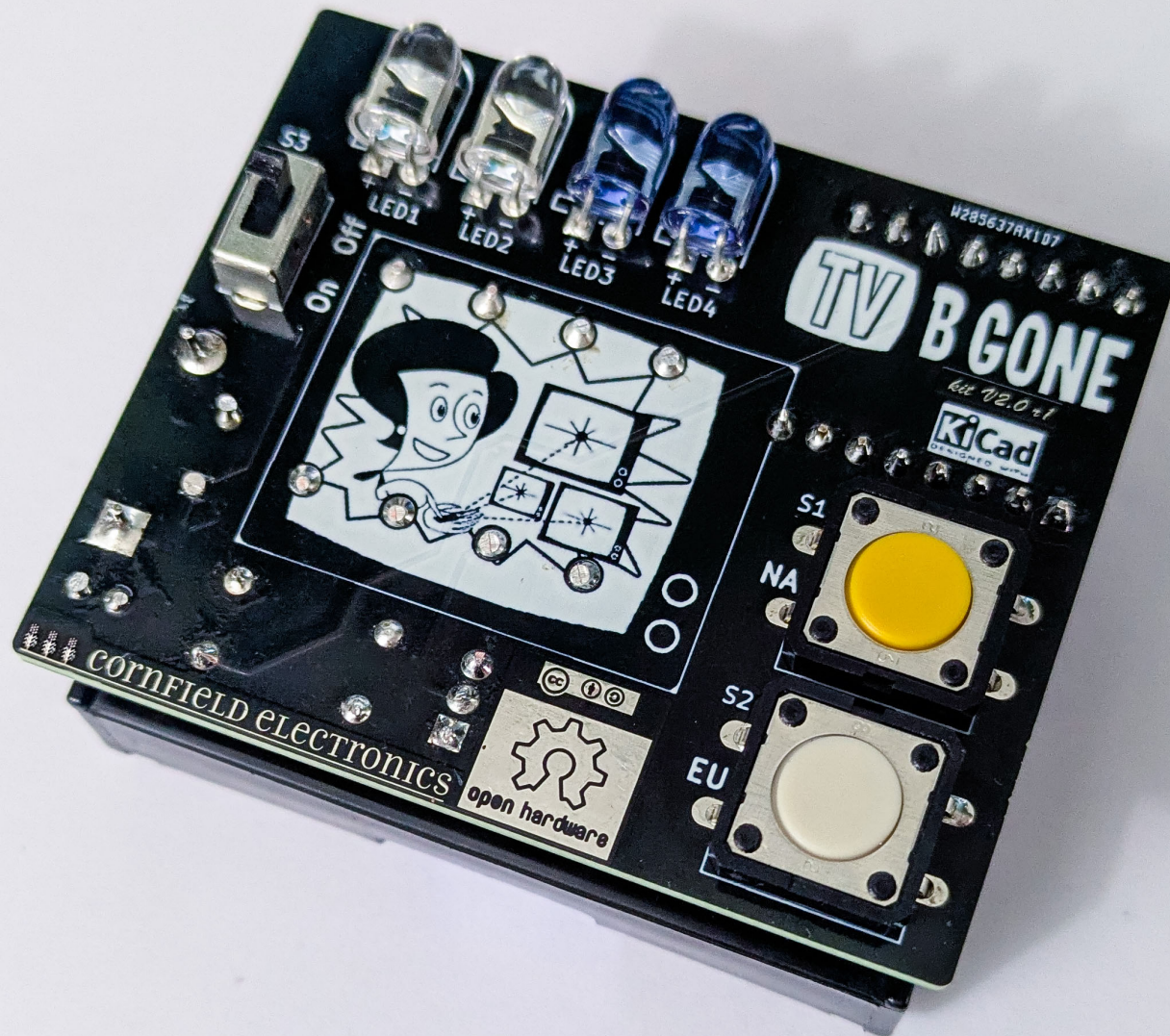
A closer look at good solder connections

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

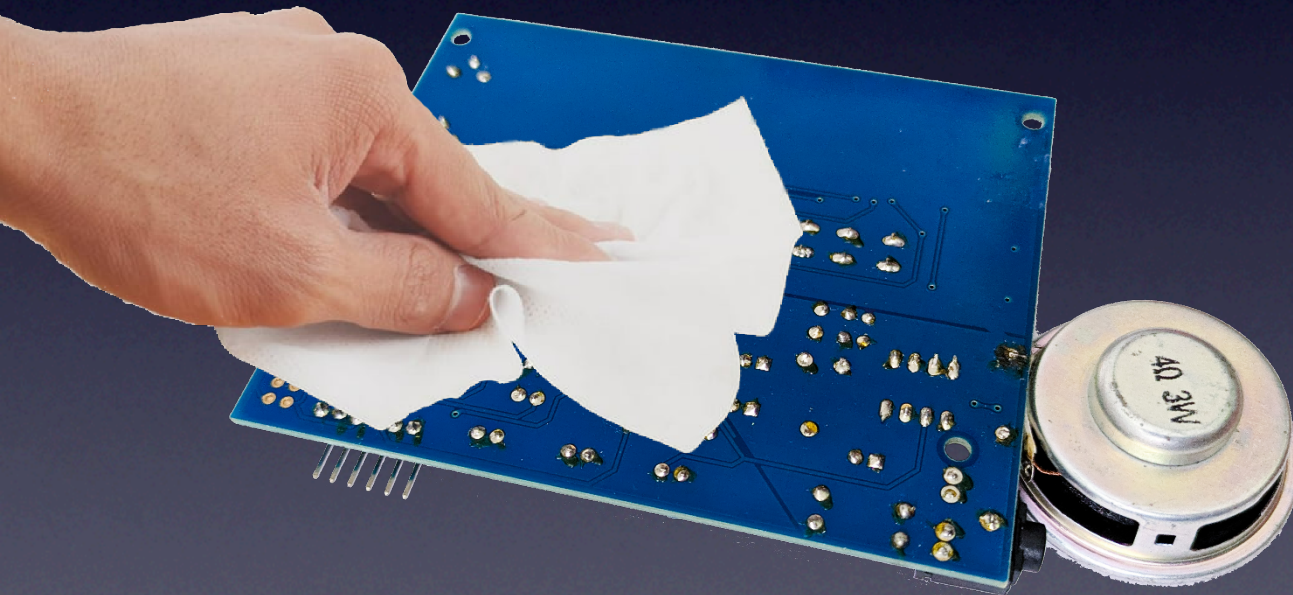


And it will look like this when you're done.

If you used any *flux paste* for re-working problems



The bottom of the PCB will be sticky from the flux



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

Then test with batteries,

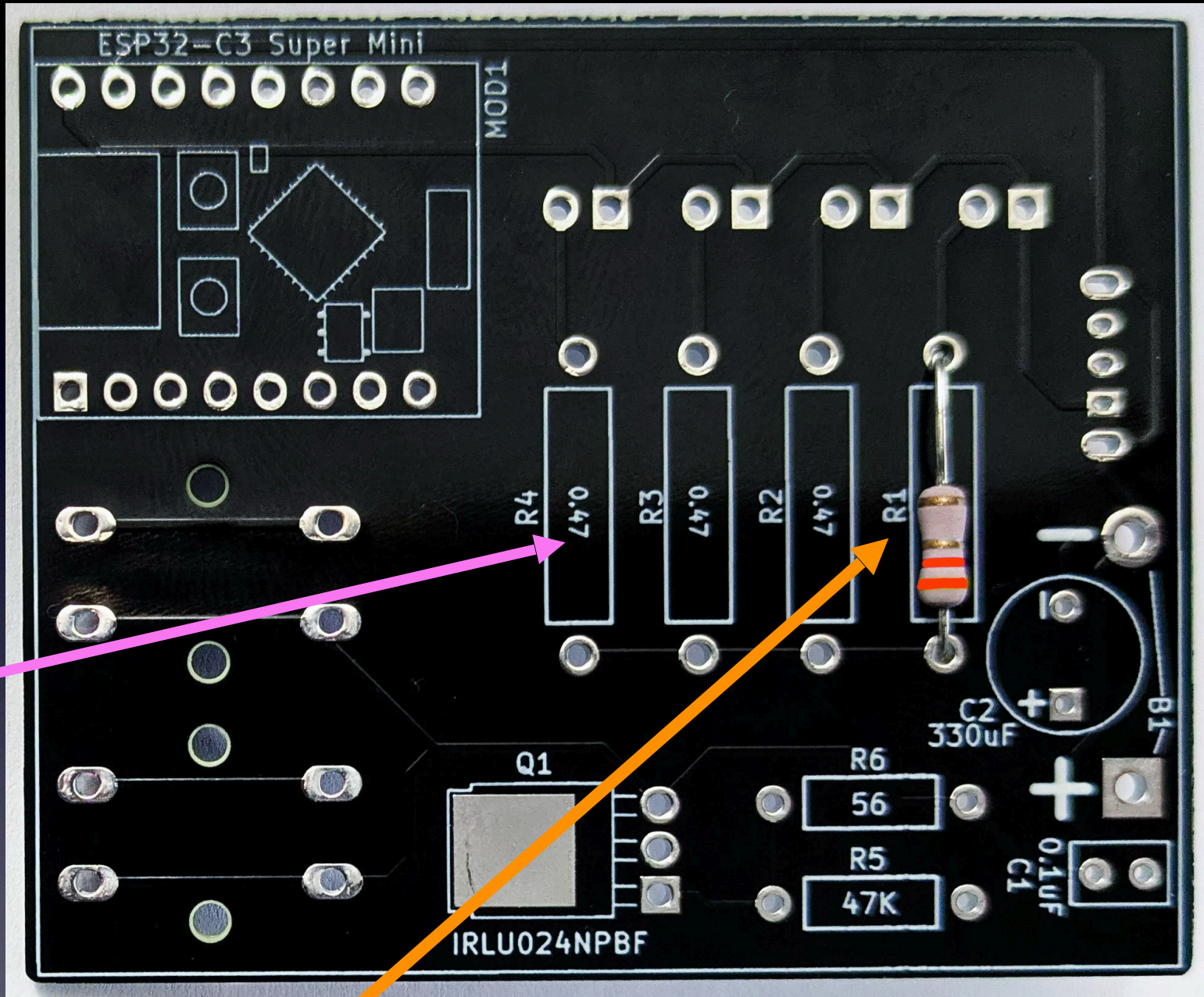
And it works!

(Or you start debugging.)

Let's start!

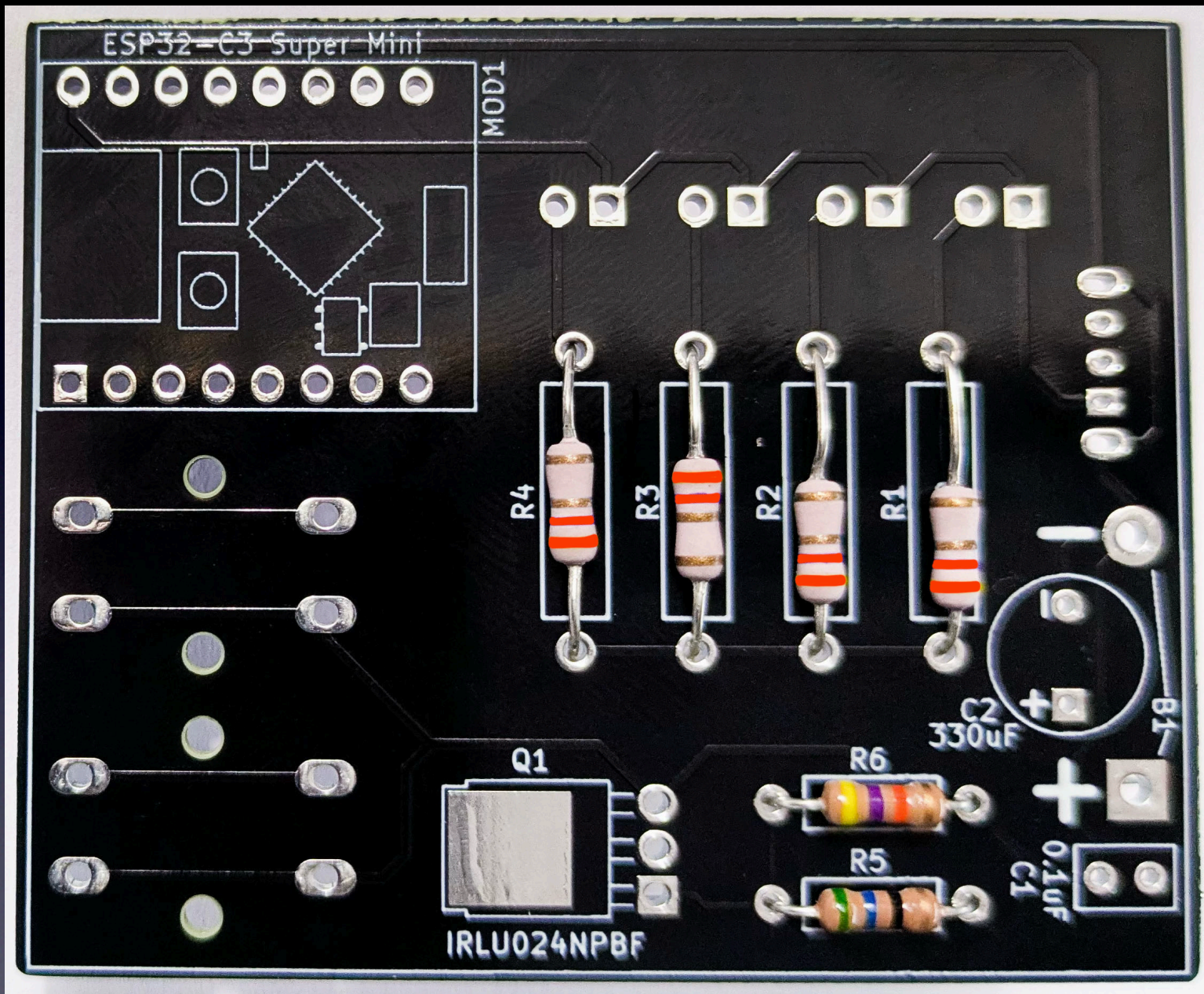
NOTE:

R1-R4 say 0.47
but we are using 3.3



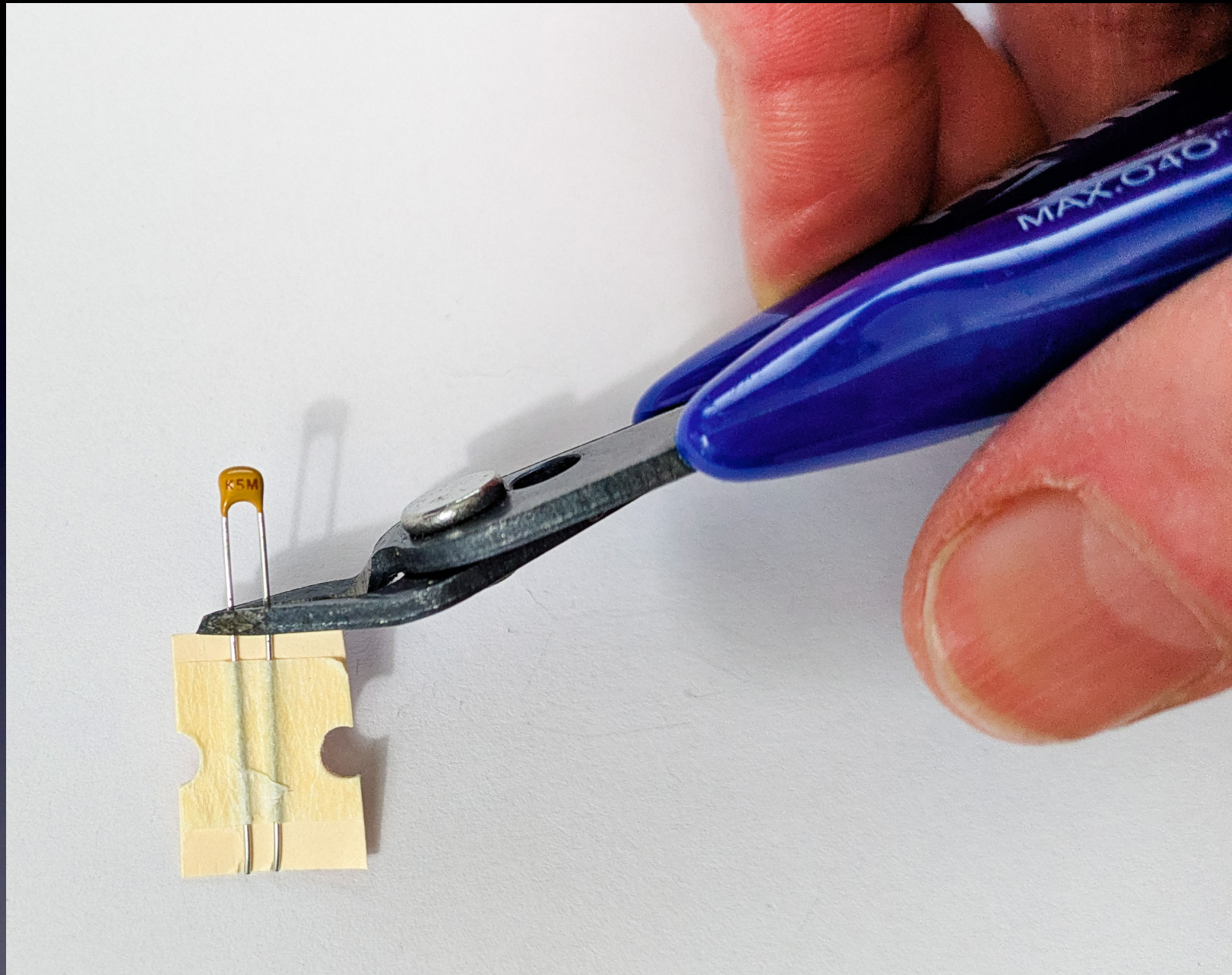
Resistor R1

(Direction does not matter)



All 6 Resistors: R1 - R6

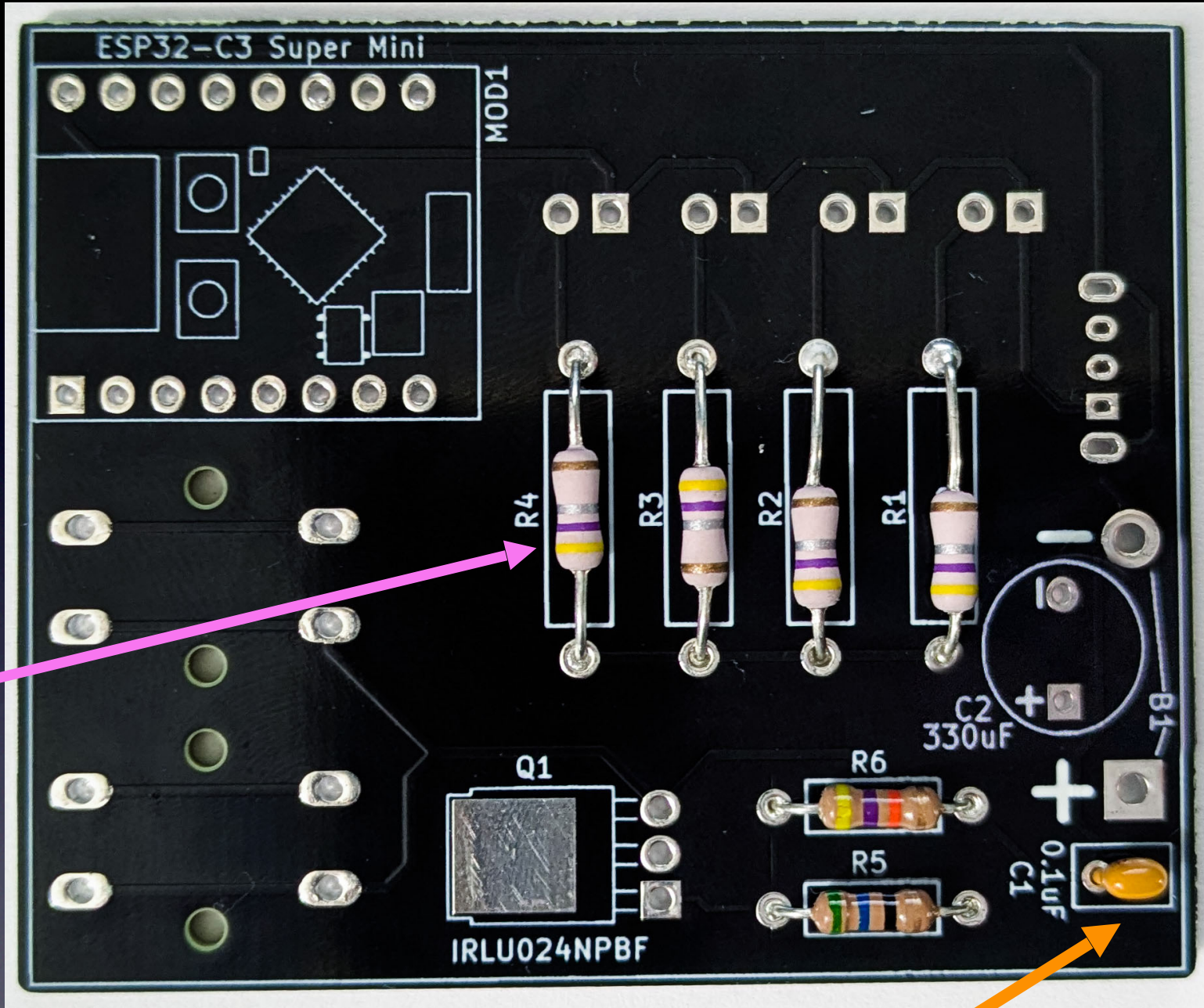
(Direction does not matter)



Capacitor C1 — cut off from tape

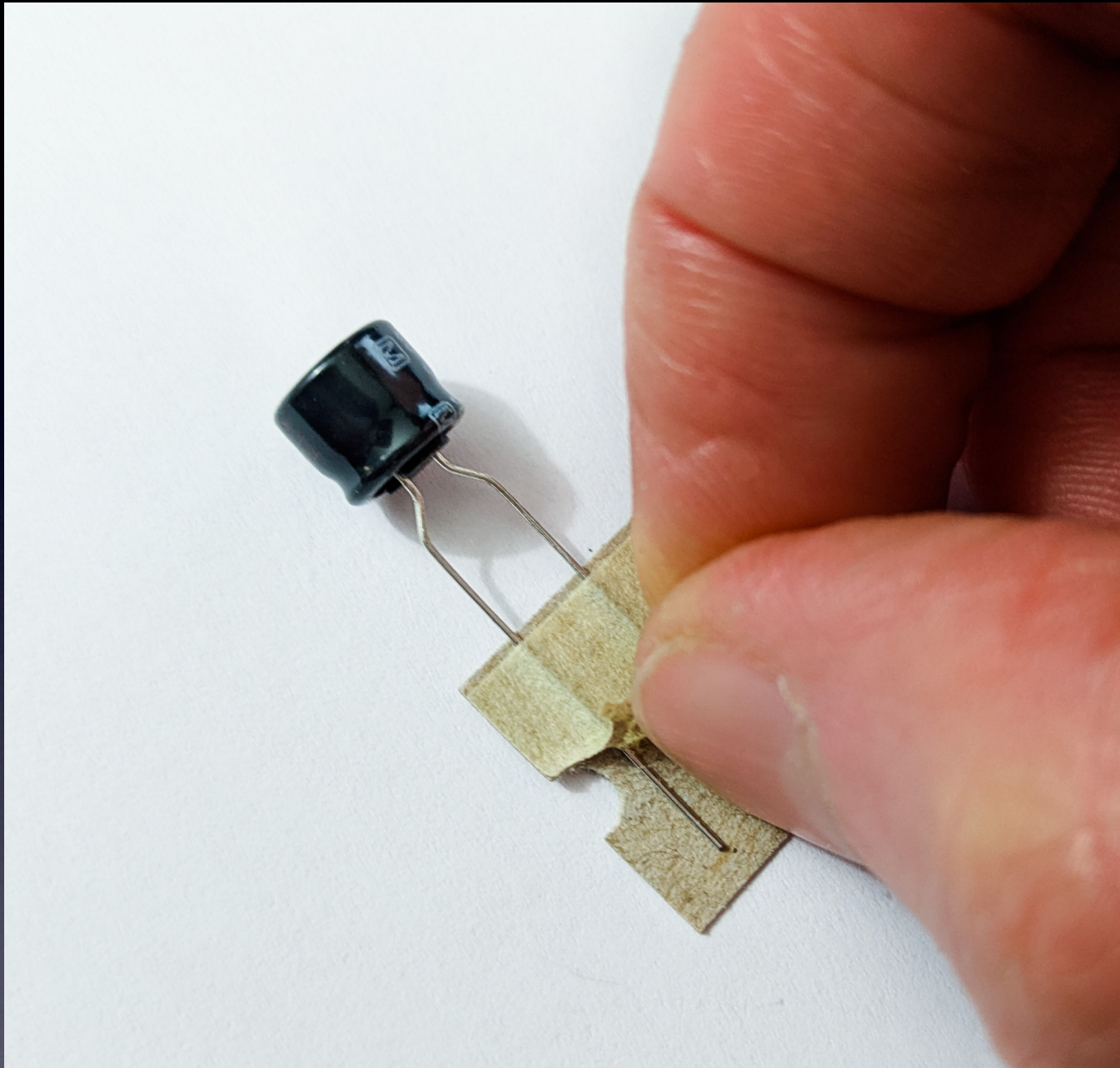
NOTE:

R1-R4 here are 0.47 — but we are using 3.3 .
All following photos show 0.47 .

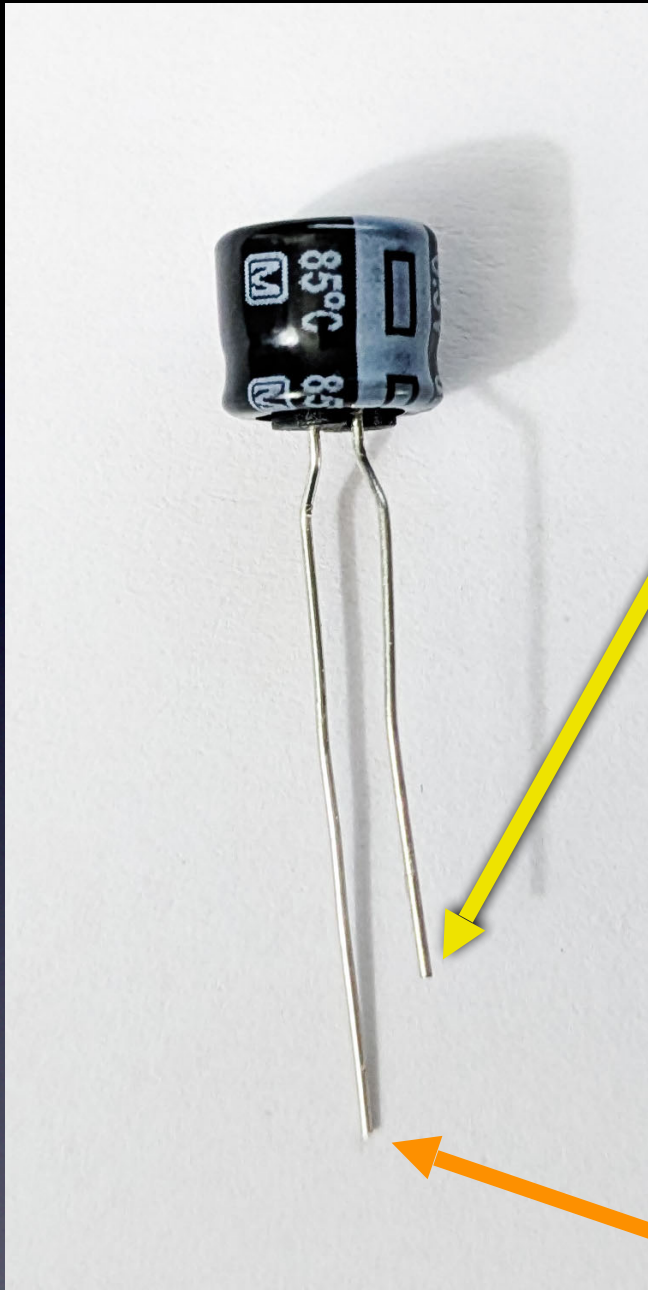


Capacitor C1

(Direction does not matter)

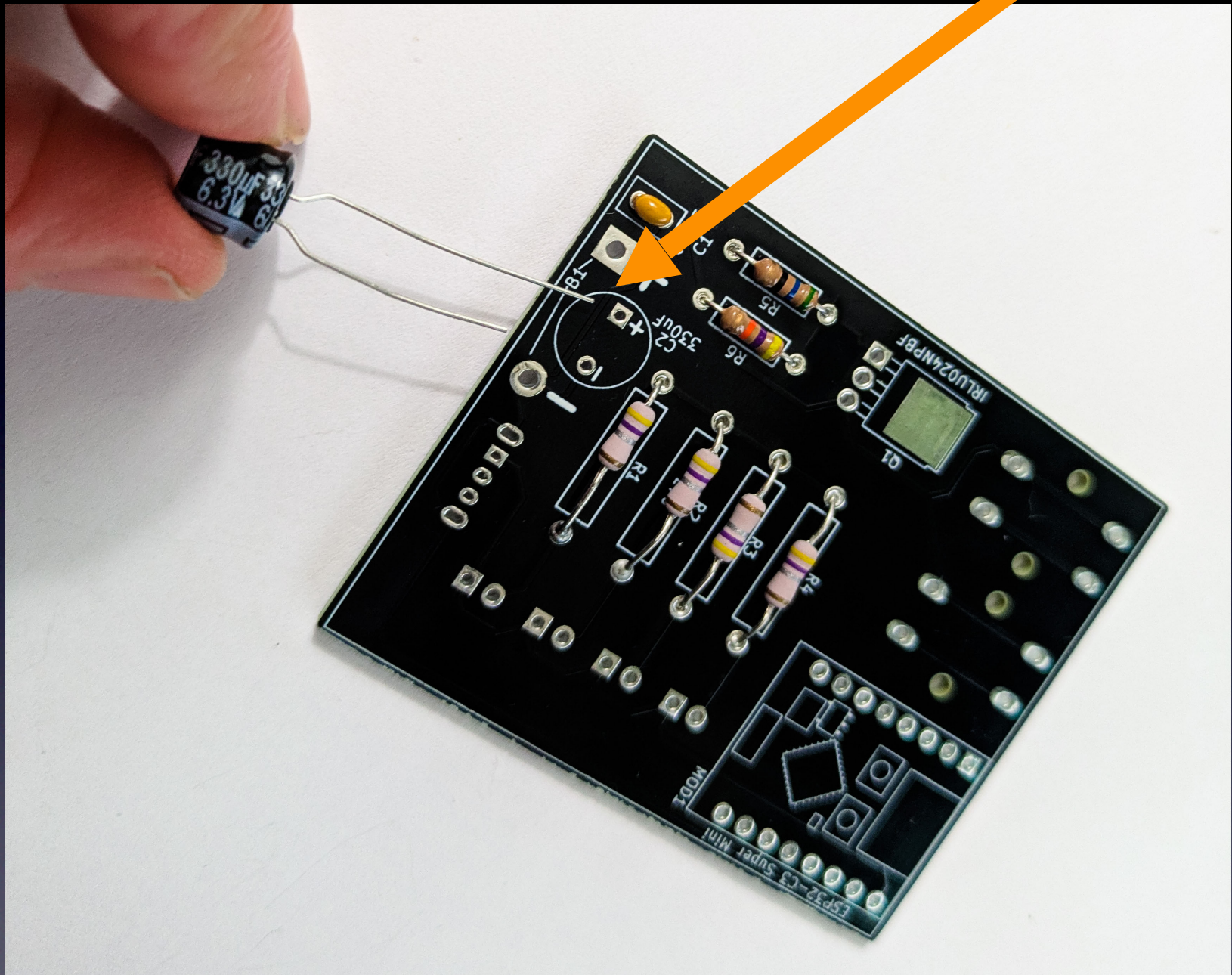


Capacitor C2 — peel off tape

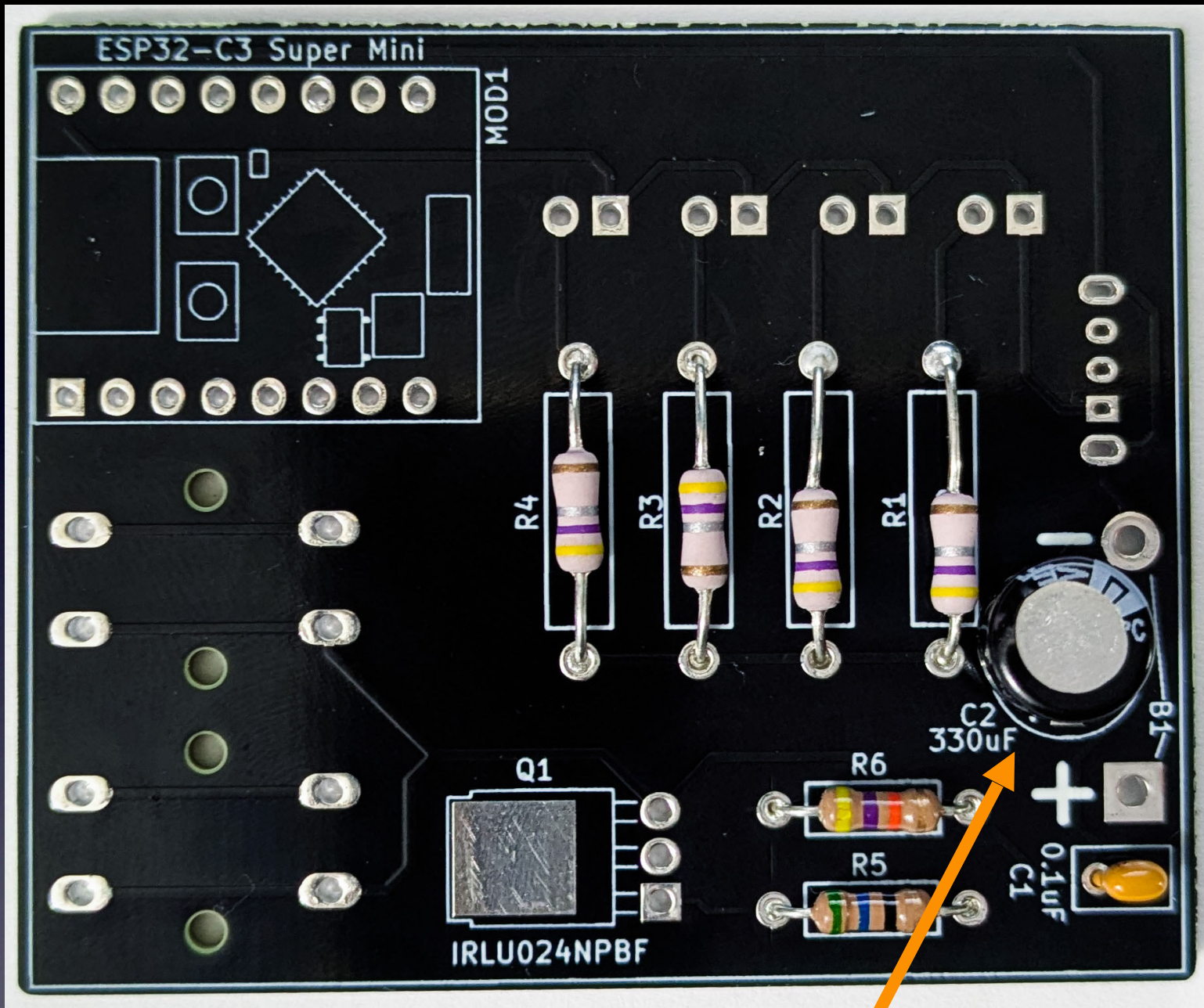


Short Lead is “-”

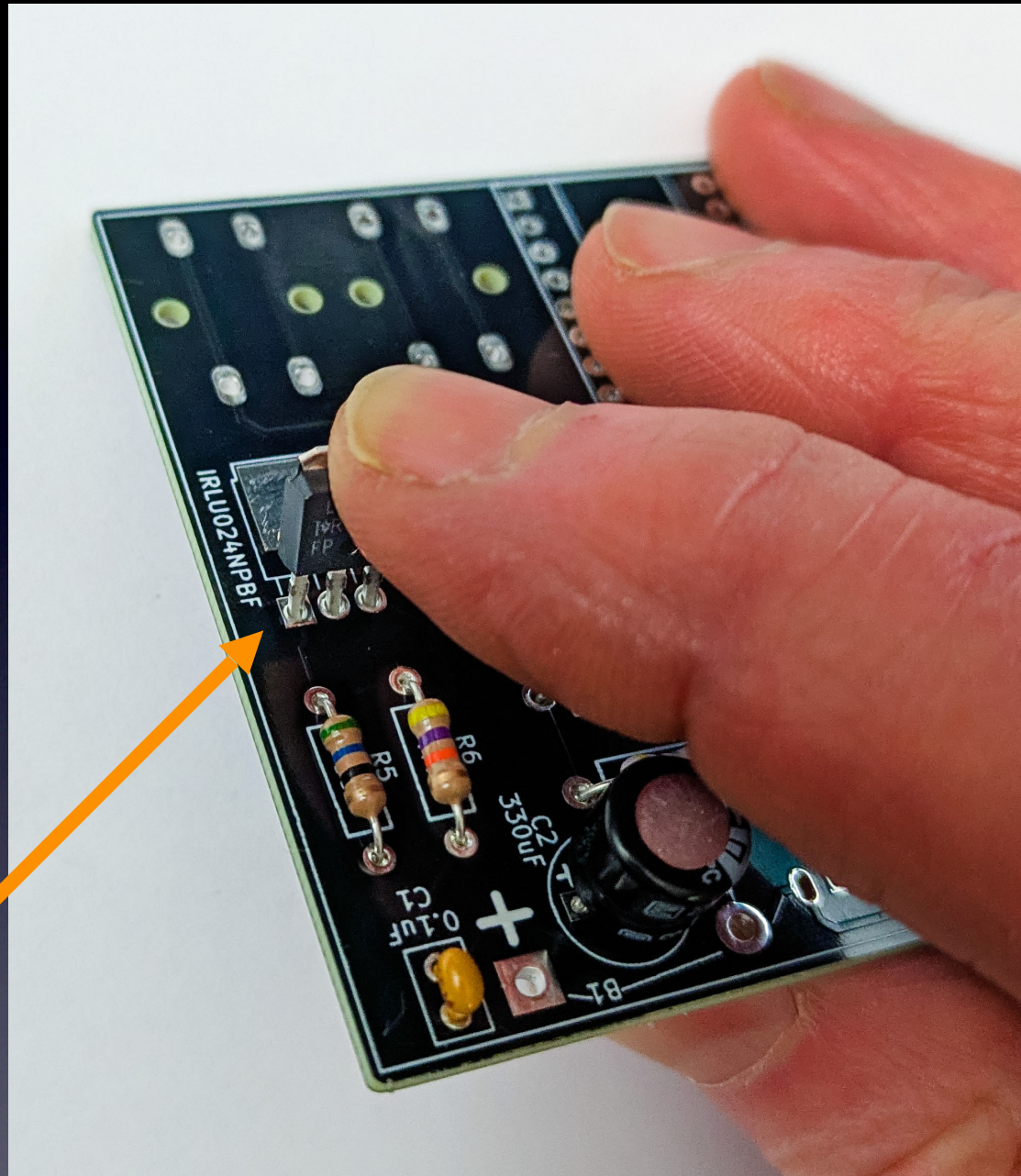
Capacitor C2 — Long Lead is “+”



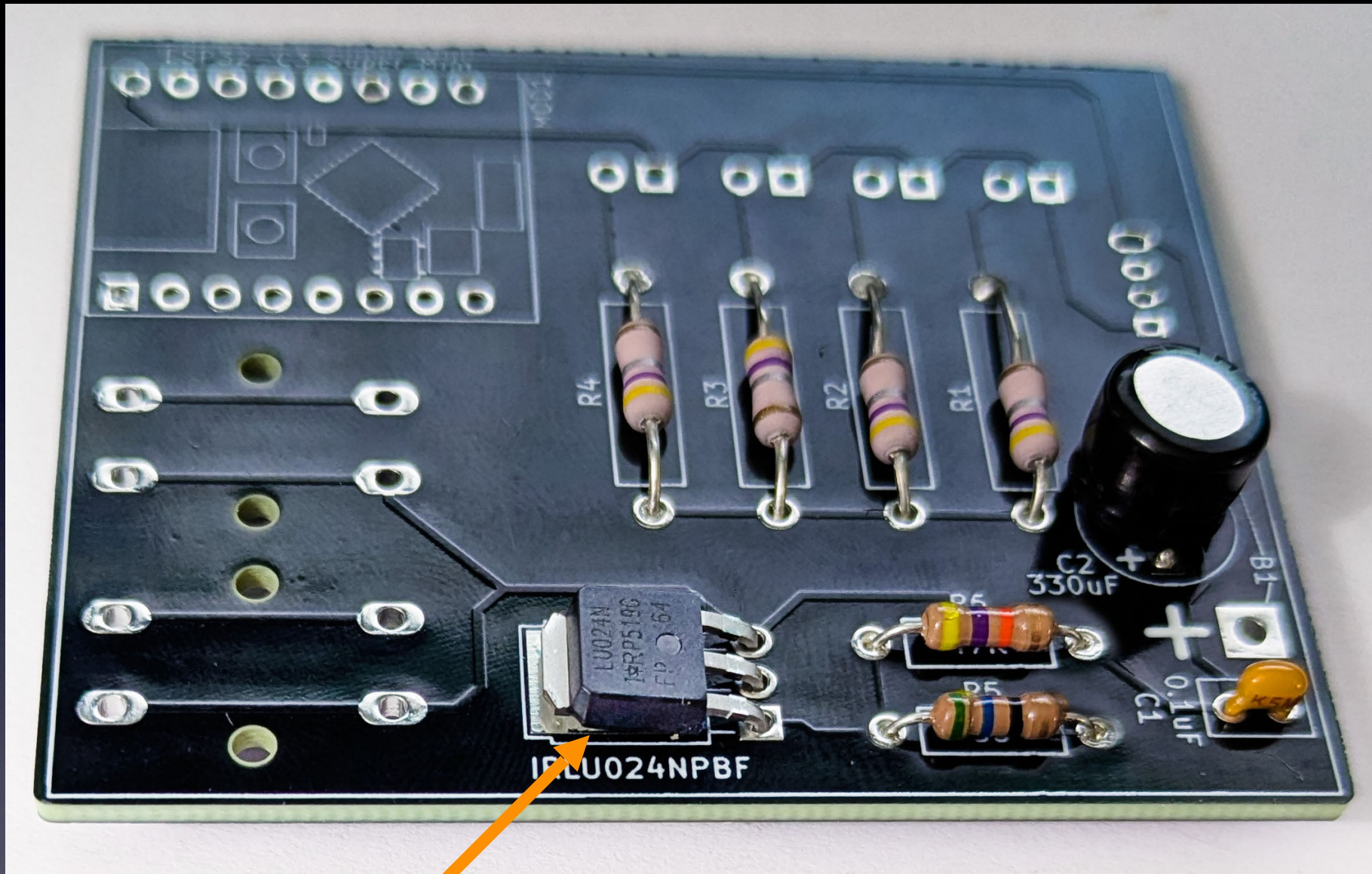
Capacitor C2 — Long Lead is “+”



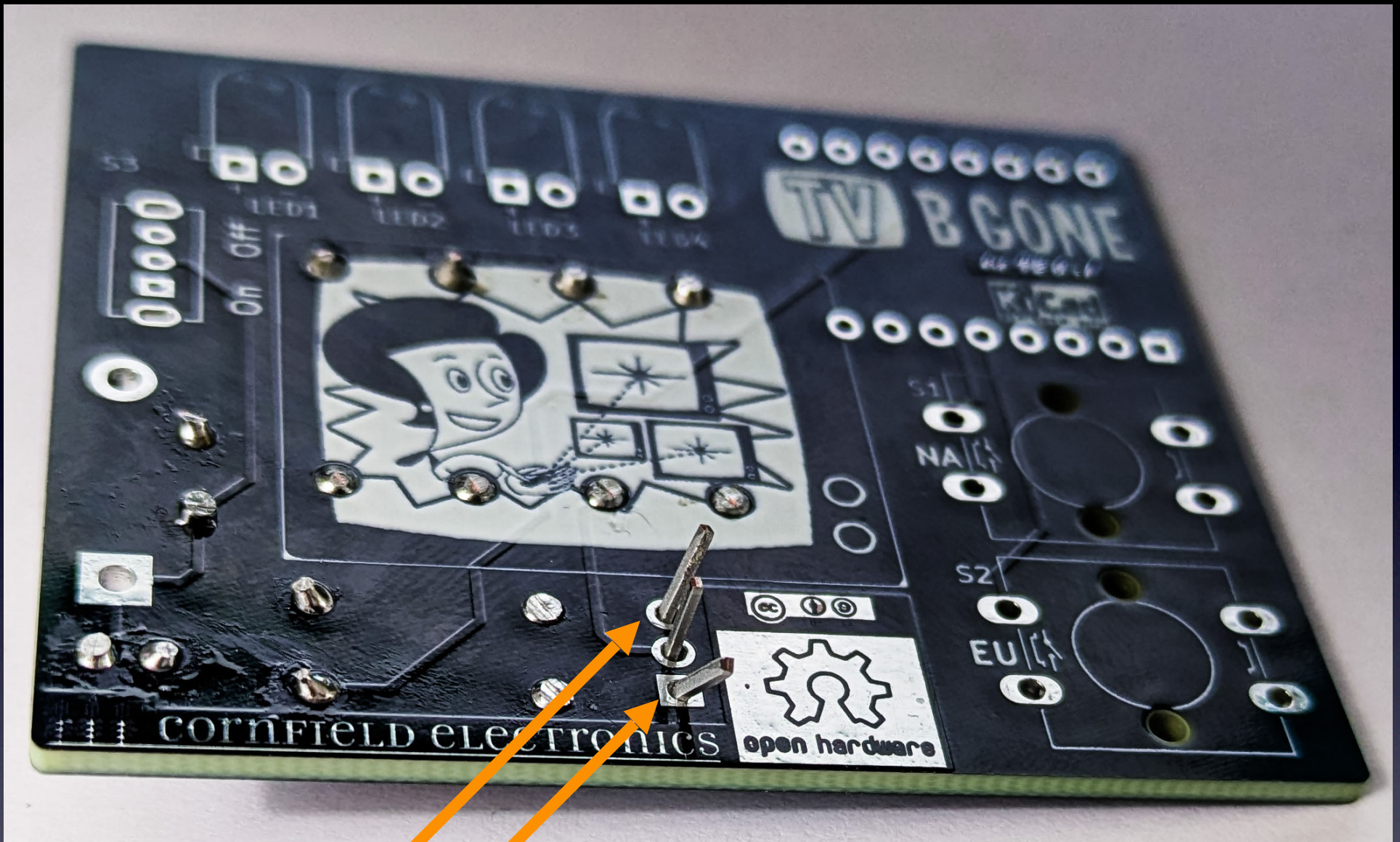
Capacitor C2



Transistor Q1 — put in place, ready to bend

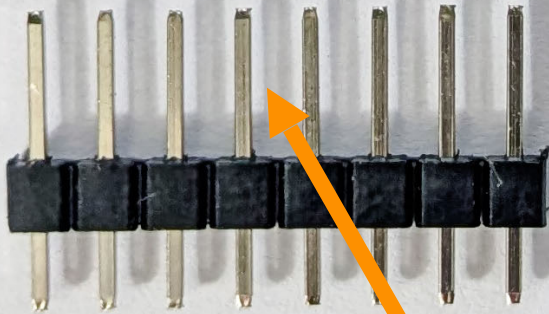
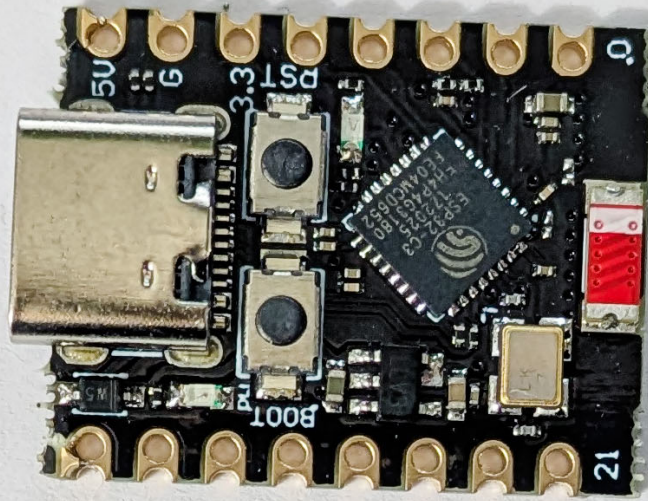


Transistor Q1 — bent down

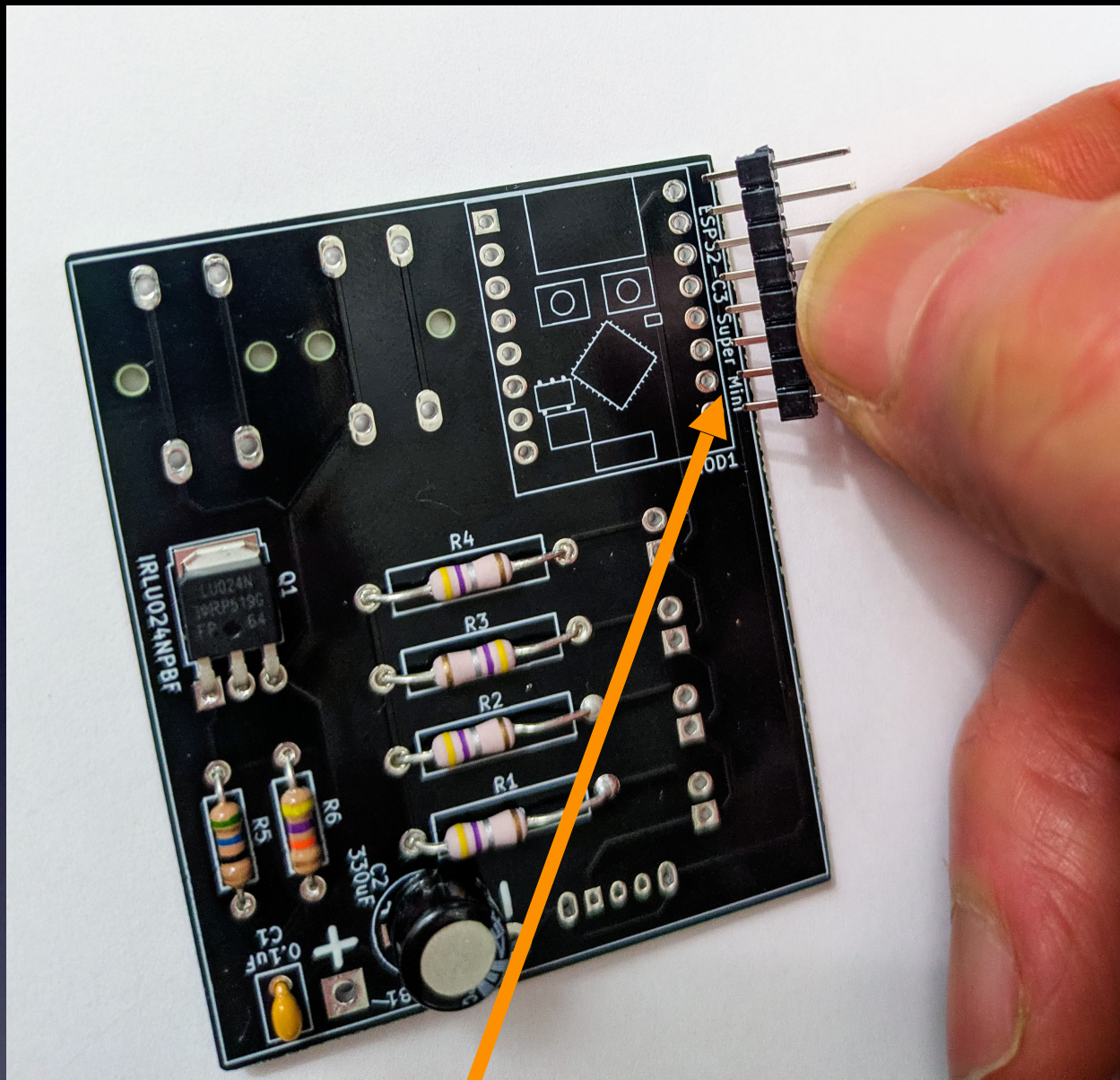


Transistor Q1 — 2 outside leads bent as a “V”
Ready to solder

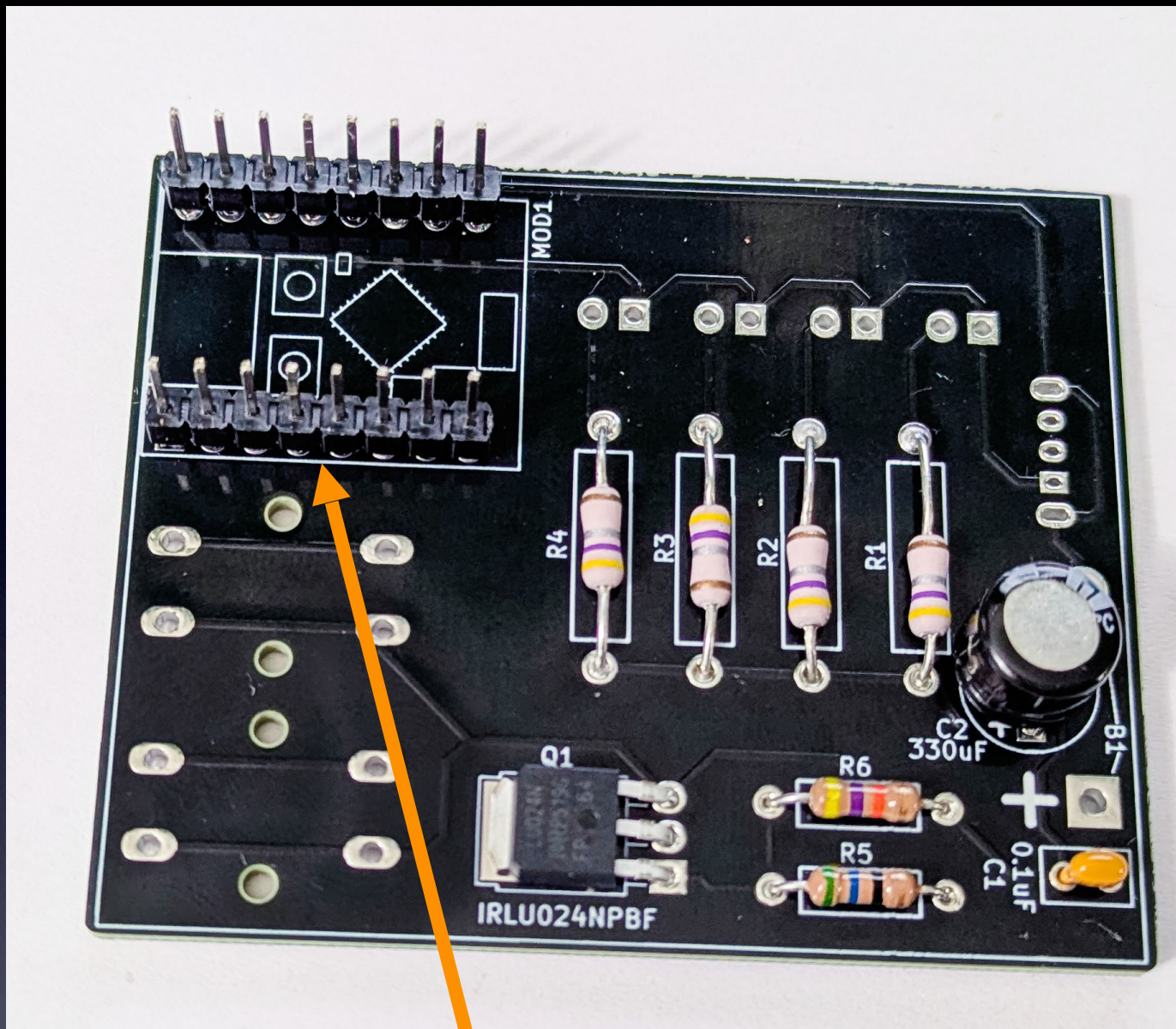
USB



MOD1 — notice long leads and short leads

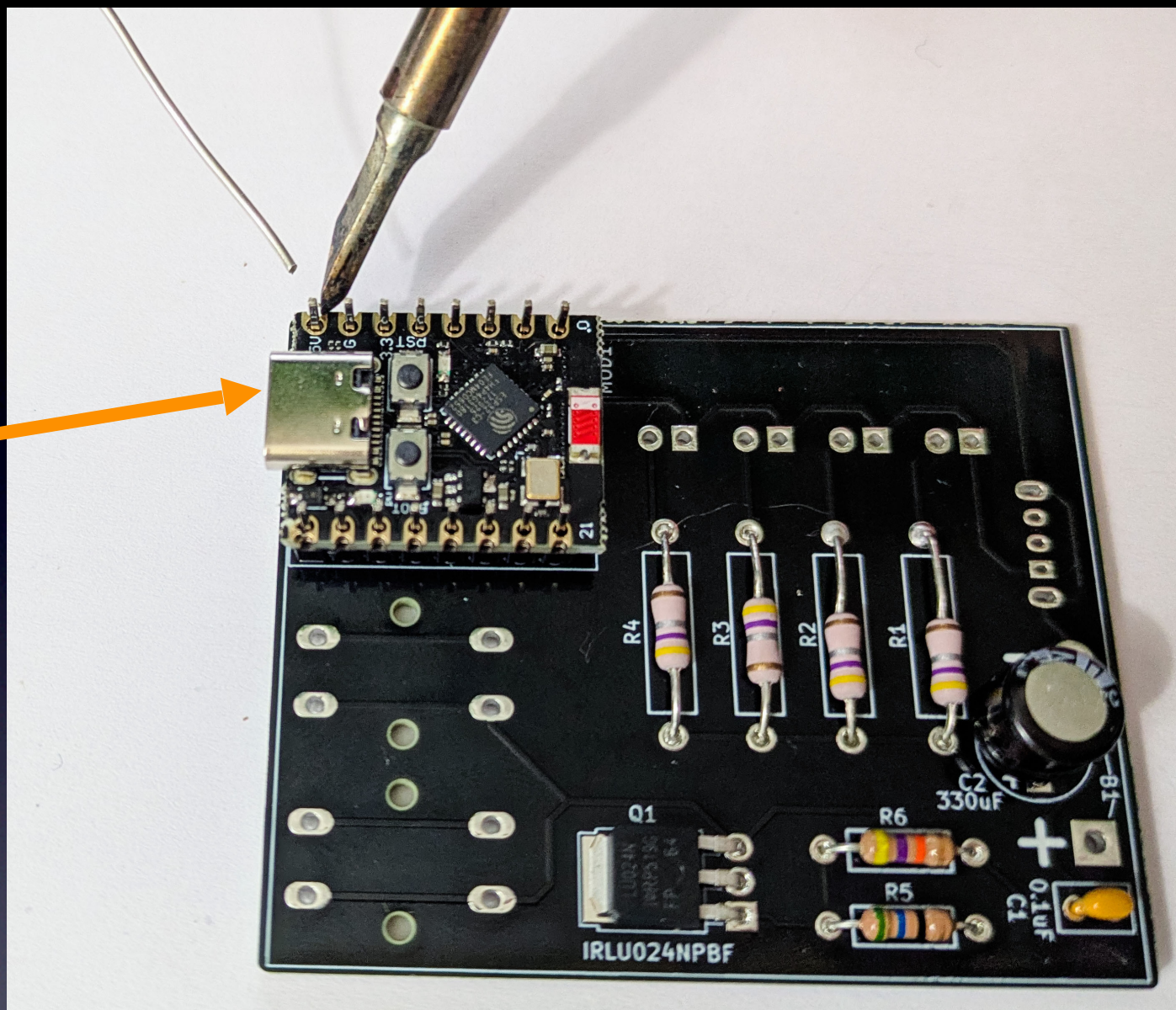


MOD1 — short pins go into PCB
(long leads stick up, away from PCB)

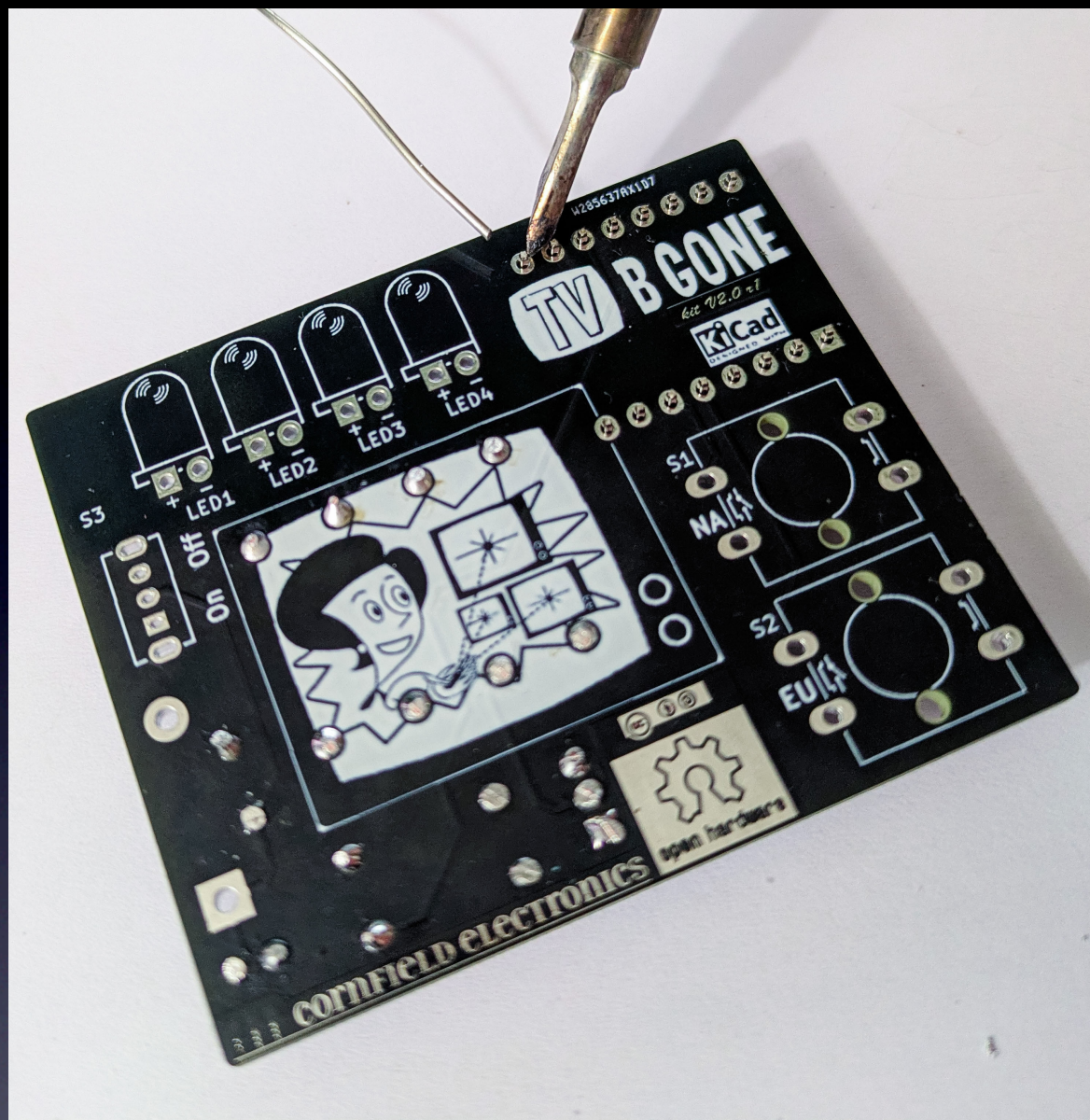


**MOD1 — header pins placed
DO NOT SOLDER !**

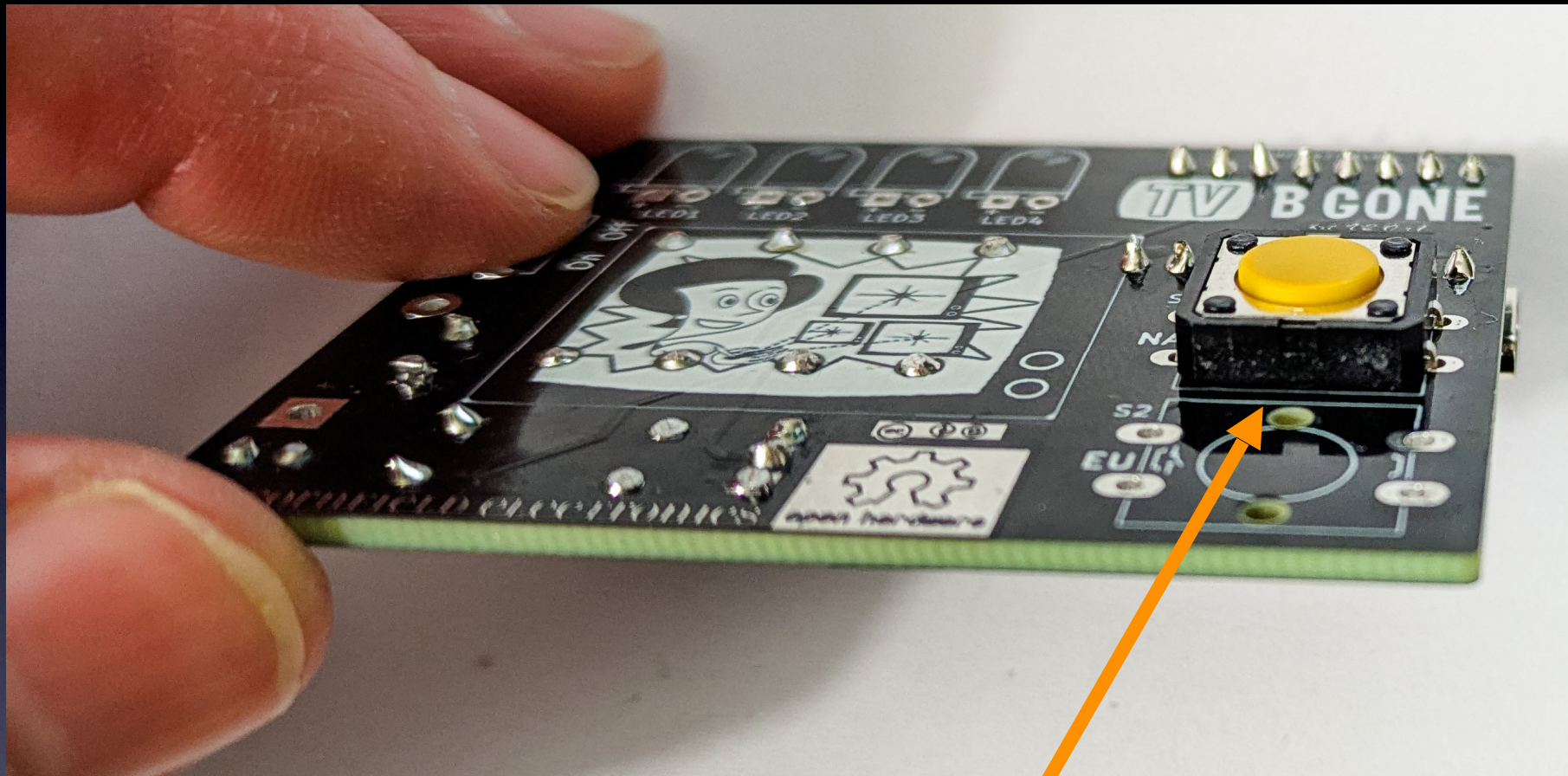
USB



MOD1 — place little board as shown
Solder the pins on the top

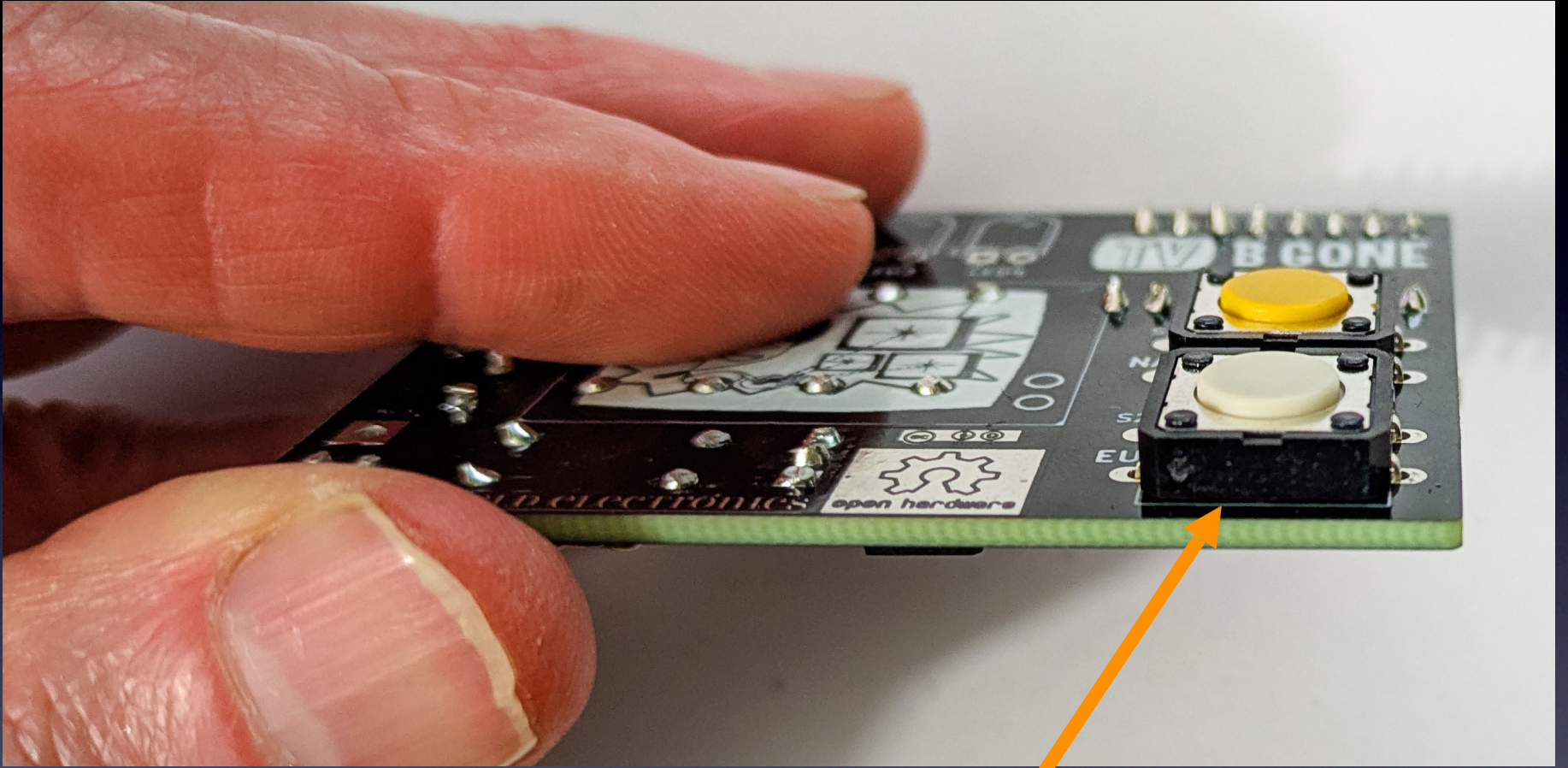


MOD1 — turn board over
Solder the pins on the bottom



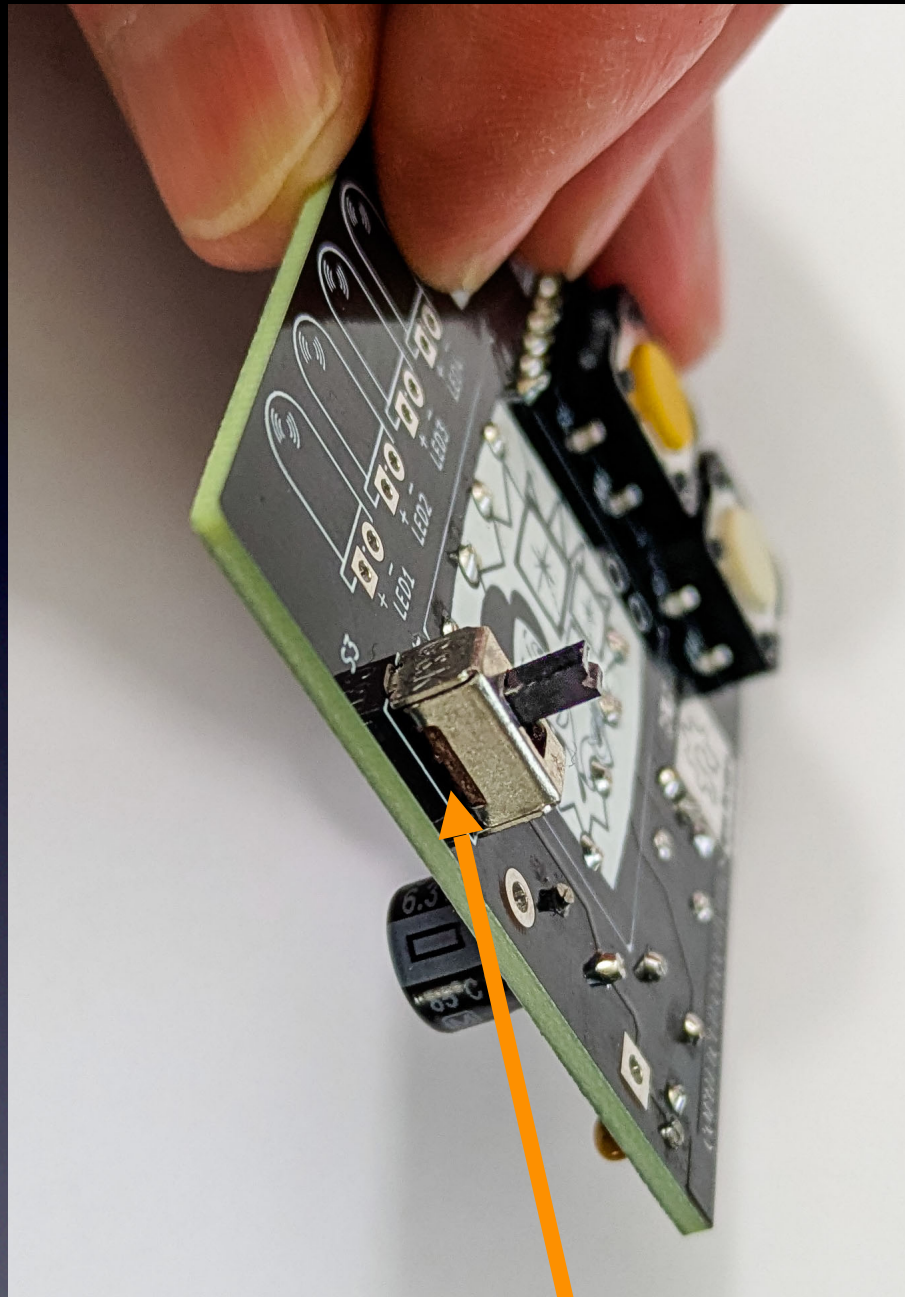
Switch S1

*(It will fit in two ways
— either way is fine)*



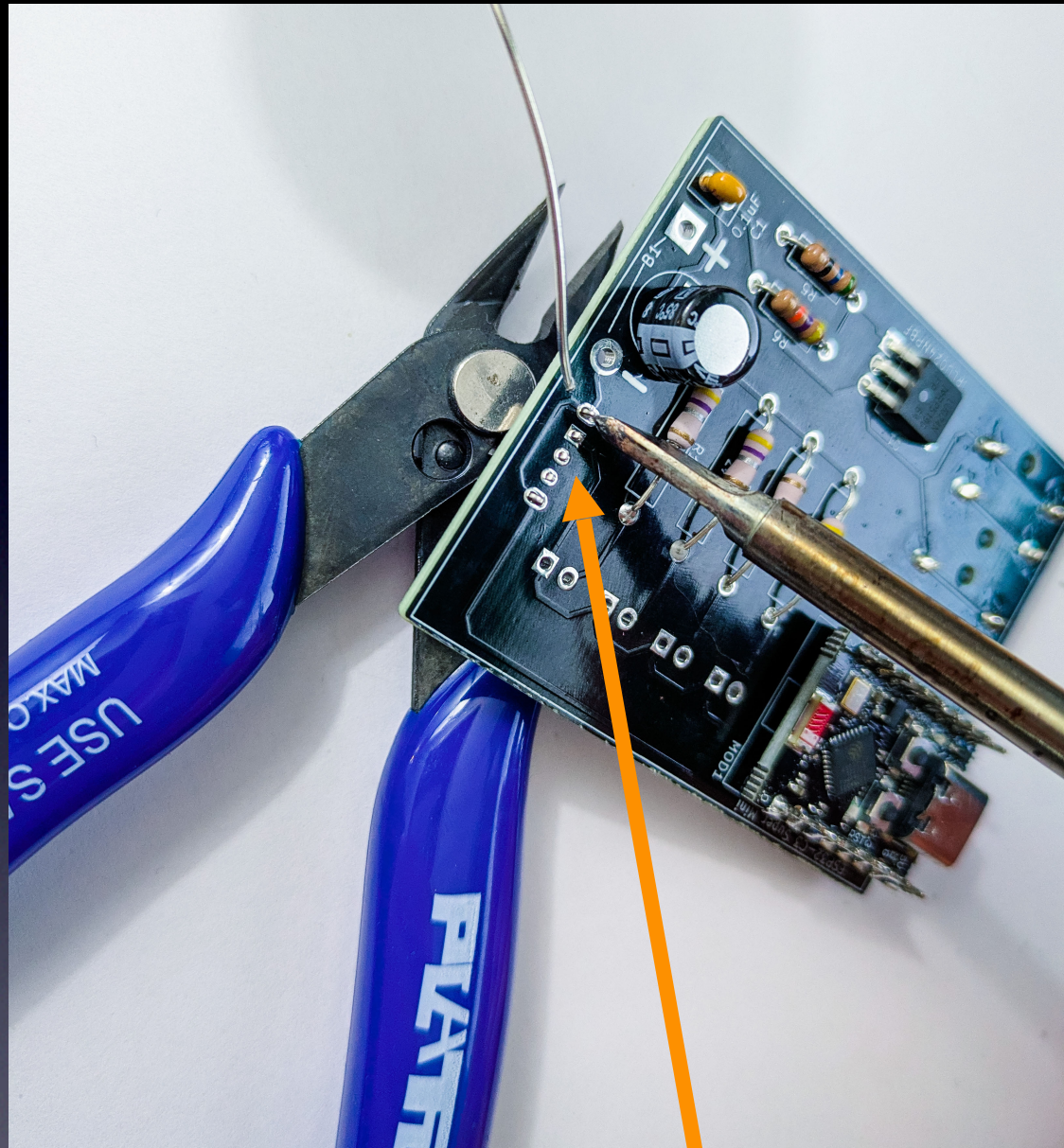
Switch S2

*(It will fit in two ways
— either way is fine)*

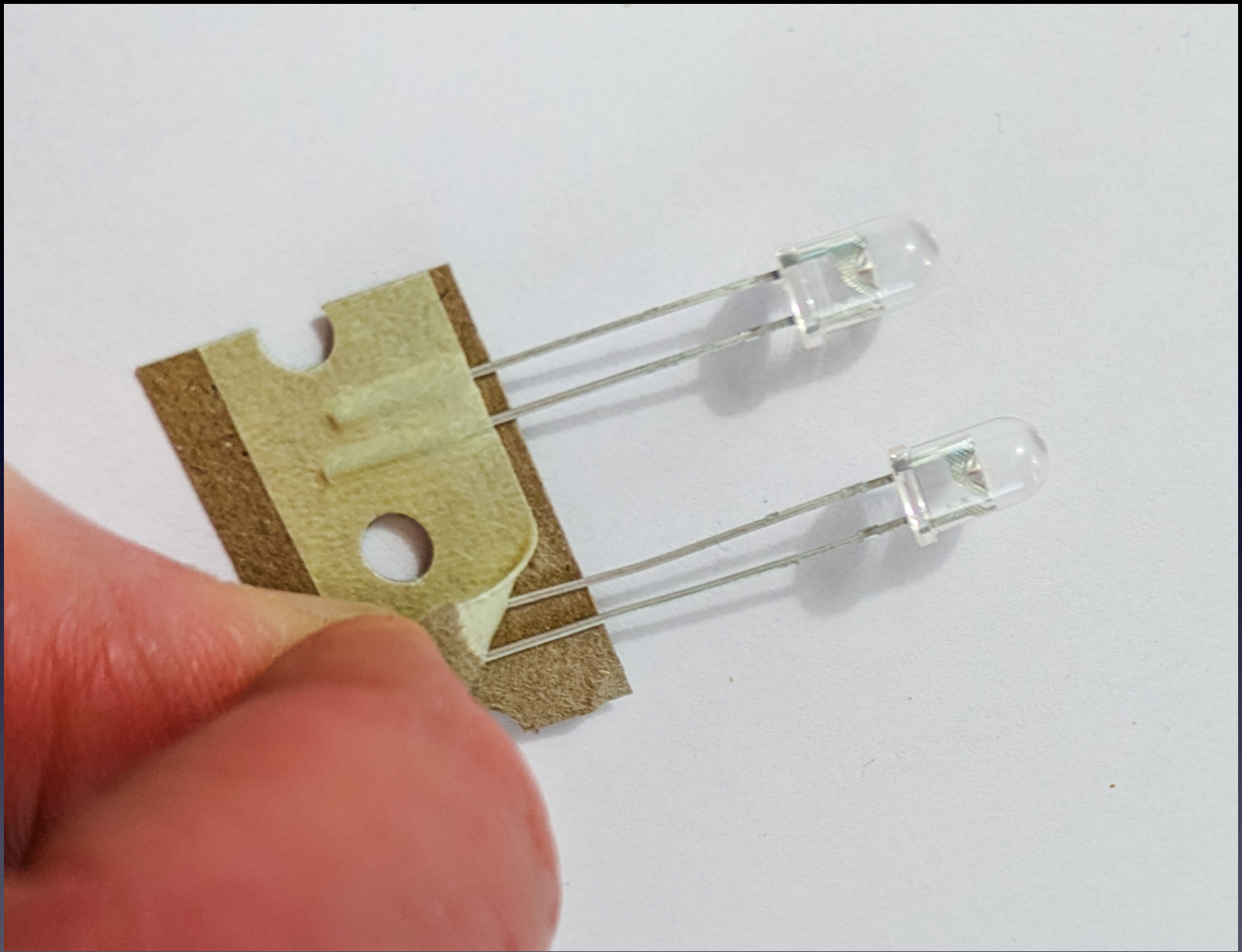


Switch S3

(Direction does not matter)



Switch S3 — resting on wire cutters to solder

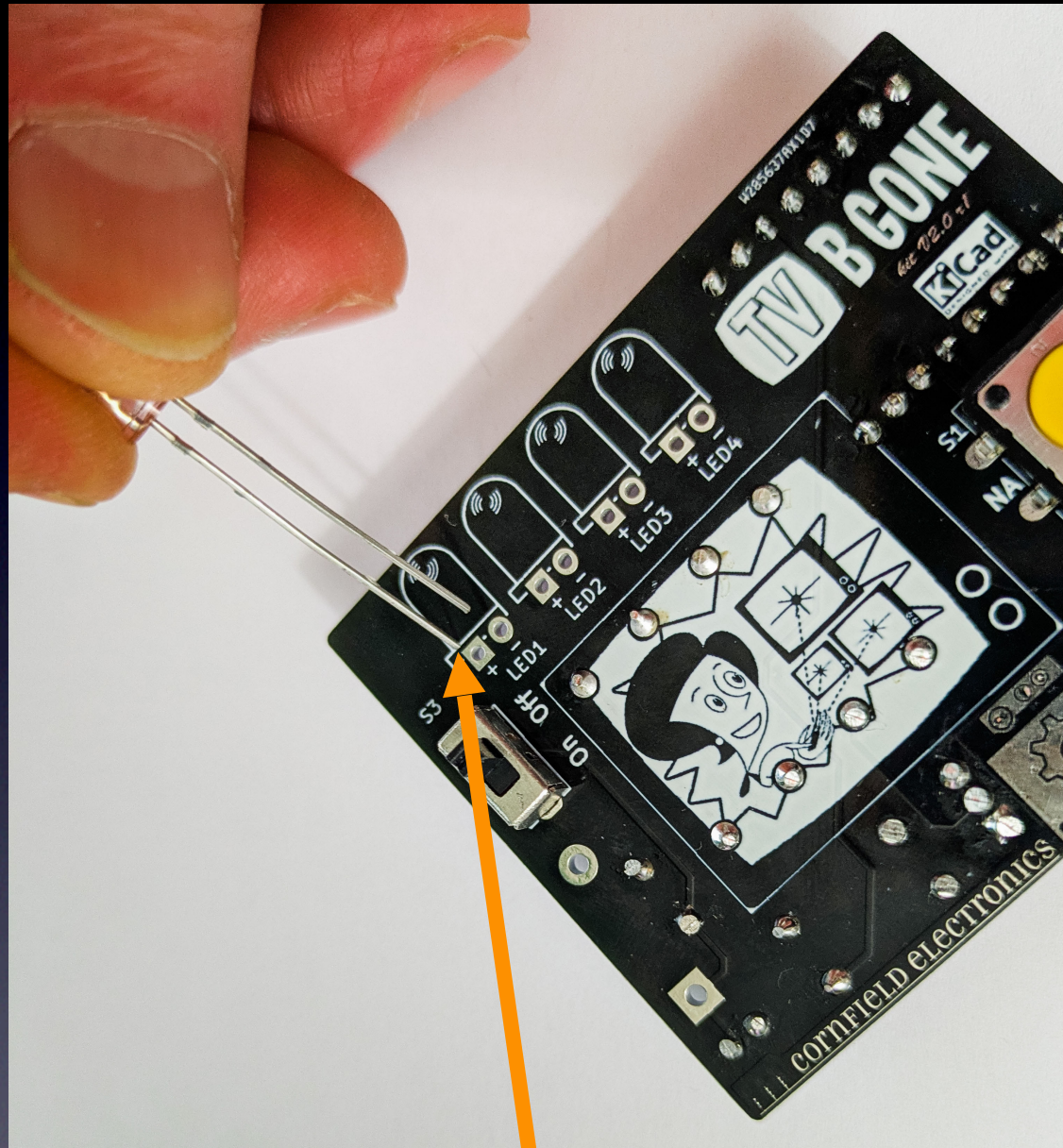


LED1 - LED2 — peel off tape

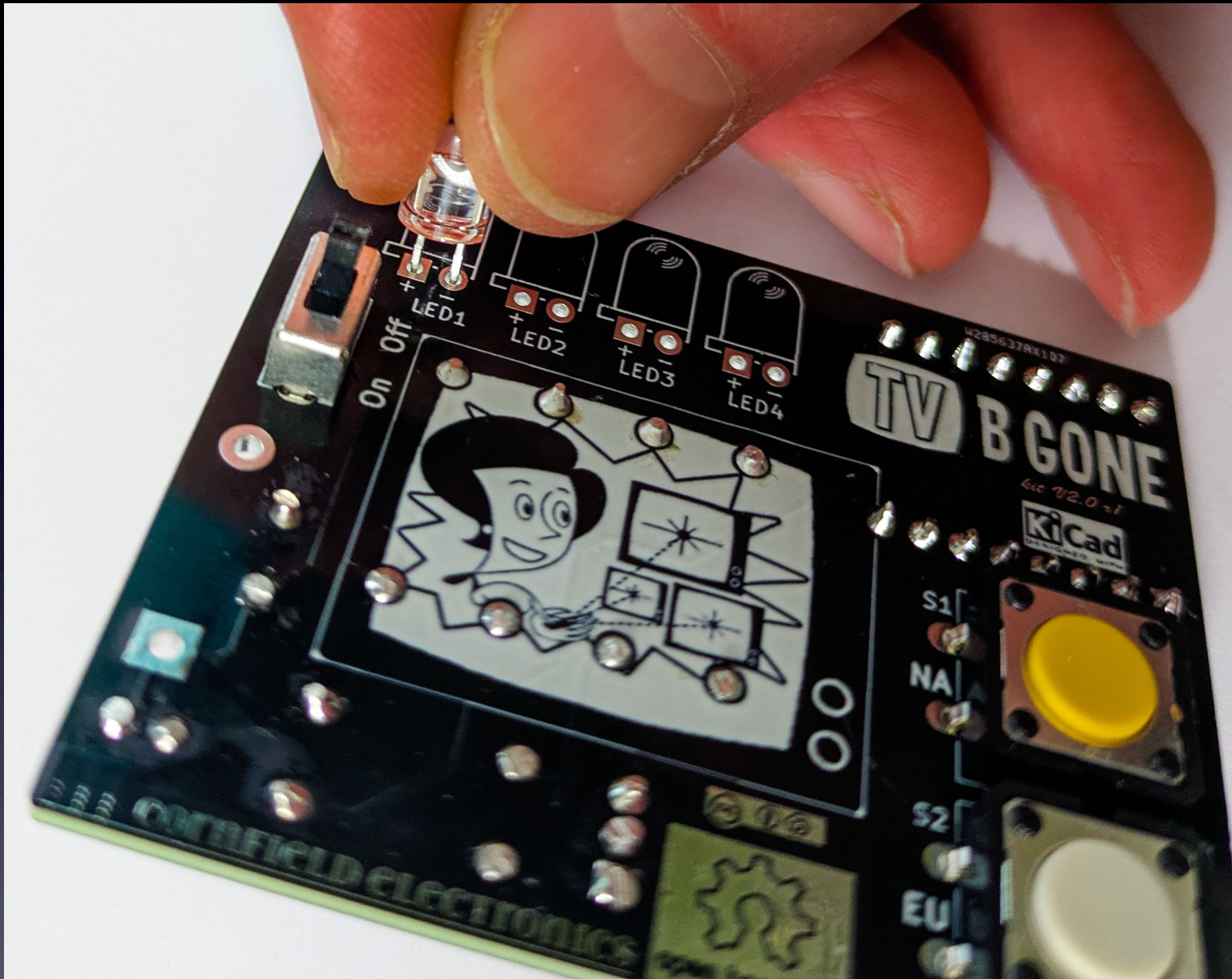


Short Leads are “-”

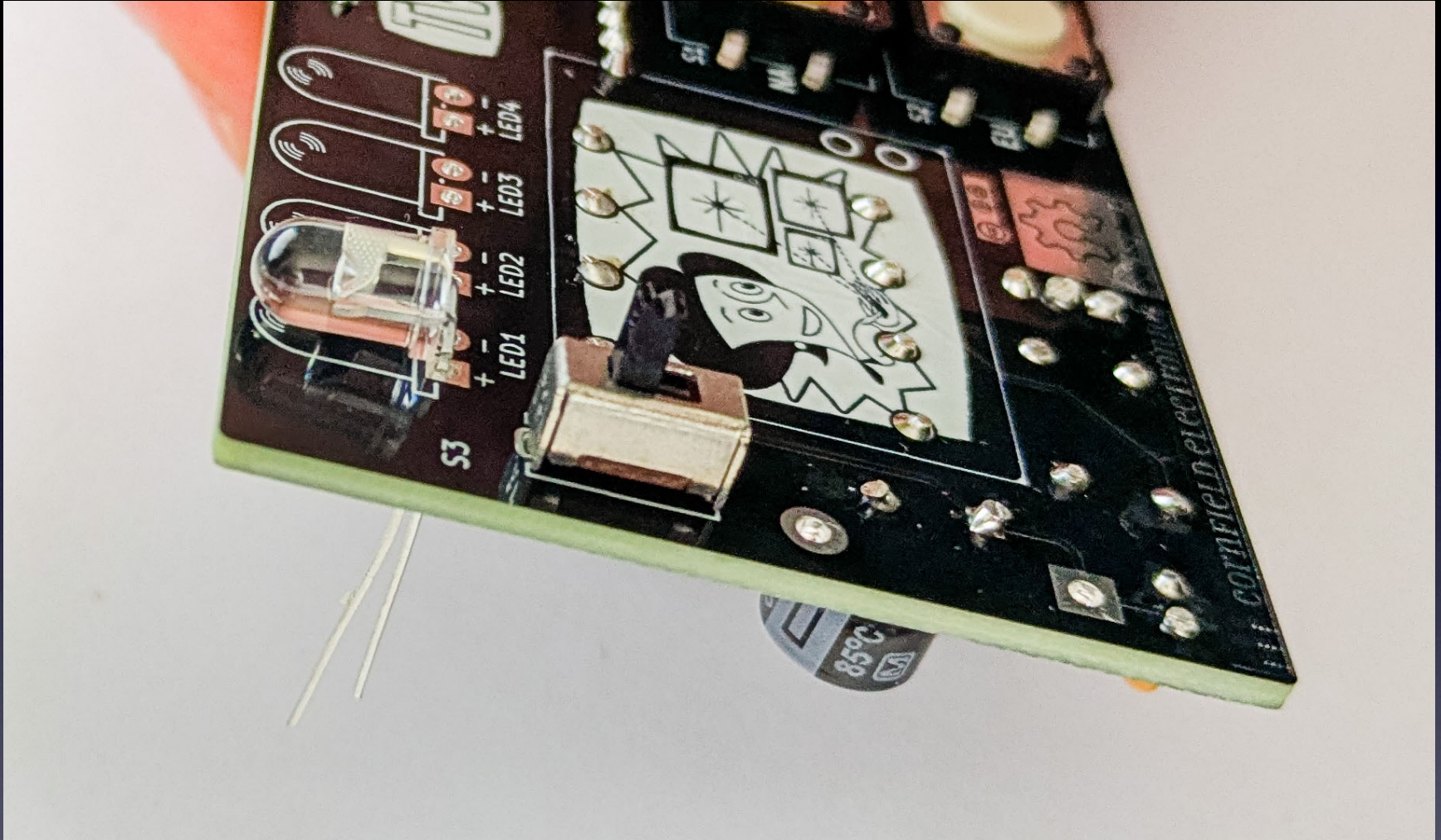
LED1 - LED2 — Long Leads are “+”



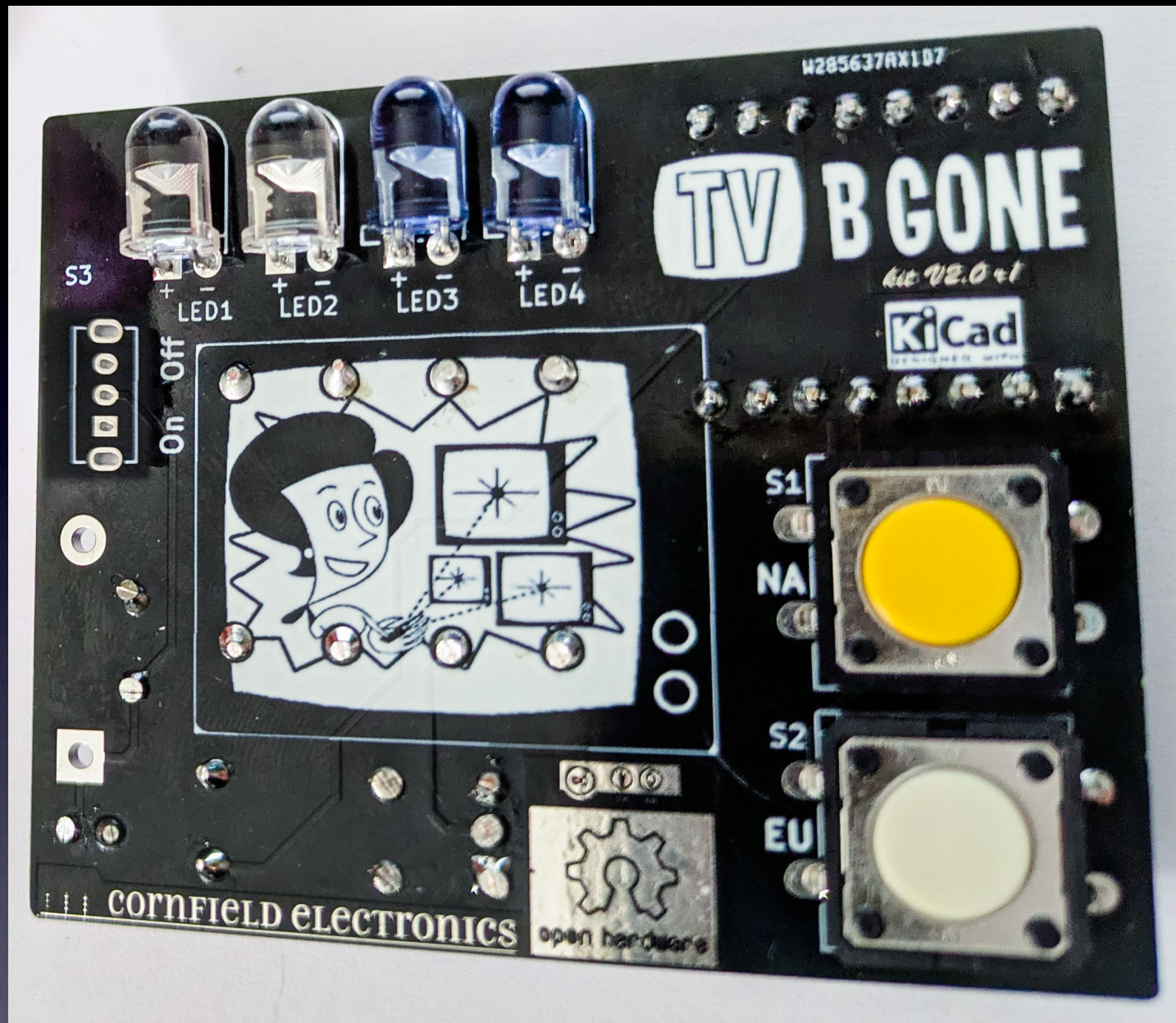
LED1 - LED2 — Long Leads are “+”



LED1 — put in place, ready to bend

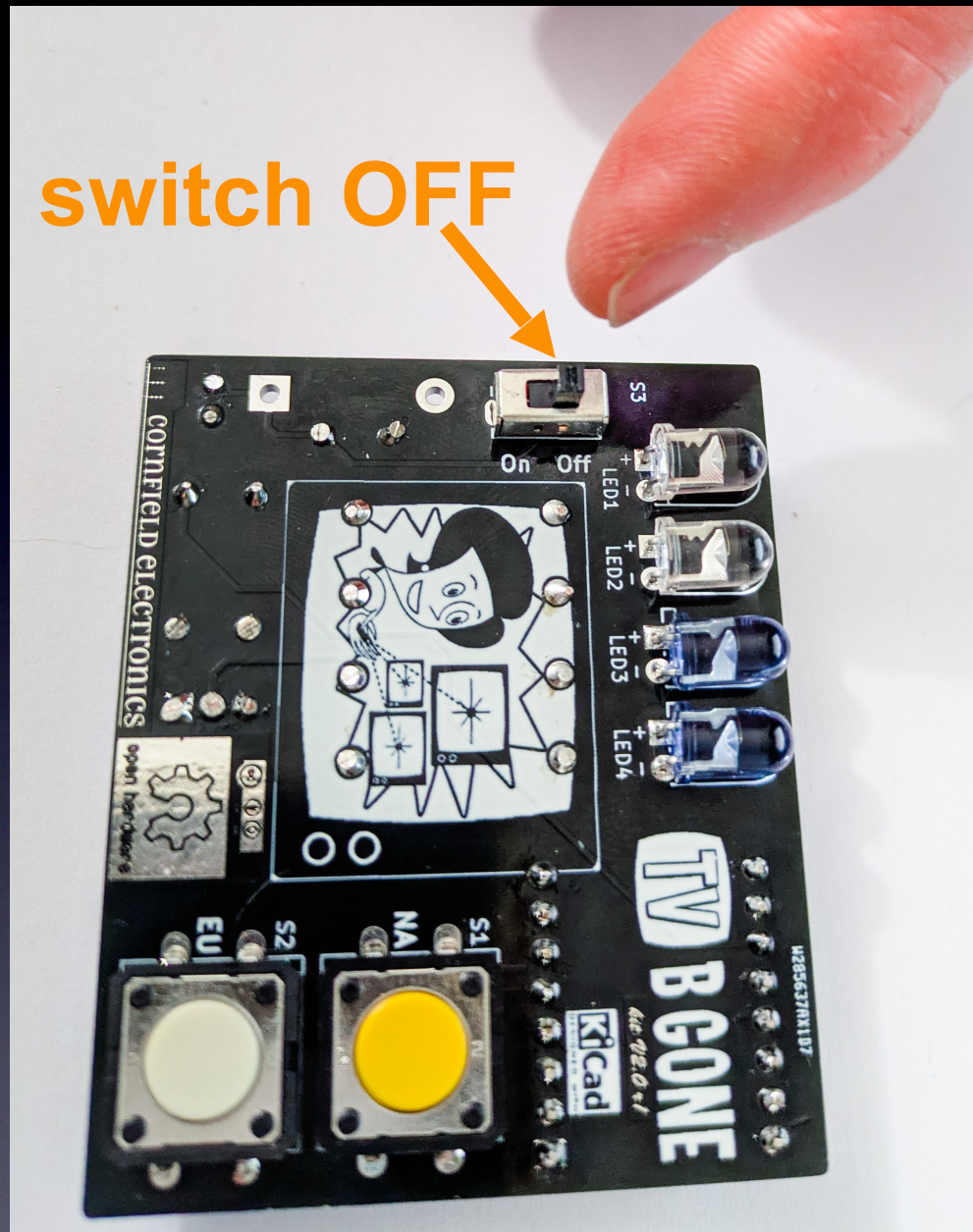


LED1 — bent down



LED1 - LED4 — all soldered in place

switch OFF



Get ready for testing !

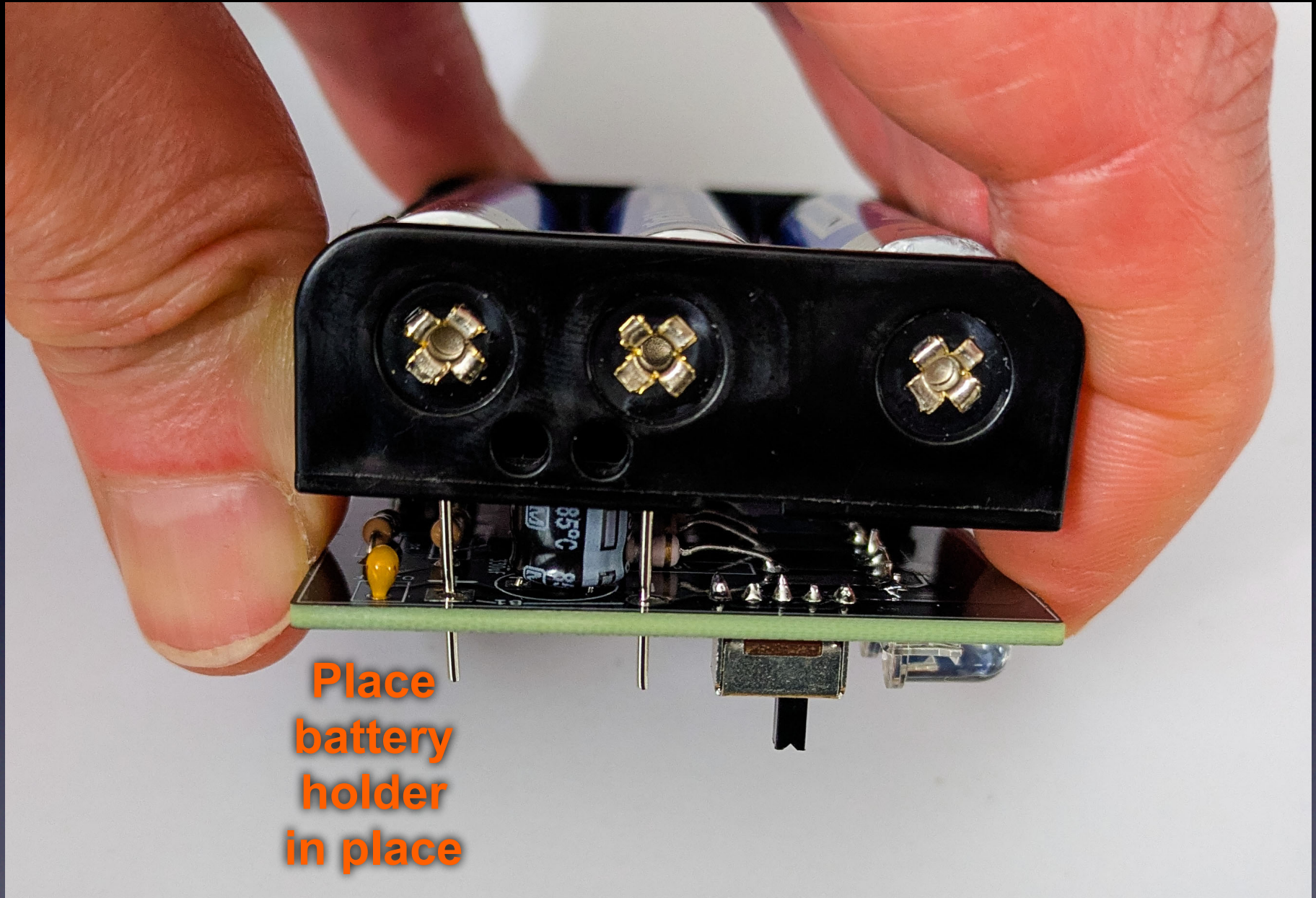
**Batteries
in
Holder**

**IMPORTANT:
Use Alkaline
AA batteries**

other kinds of AA batteries
will not work

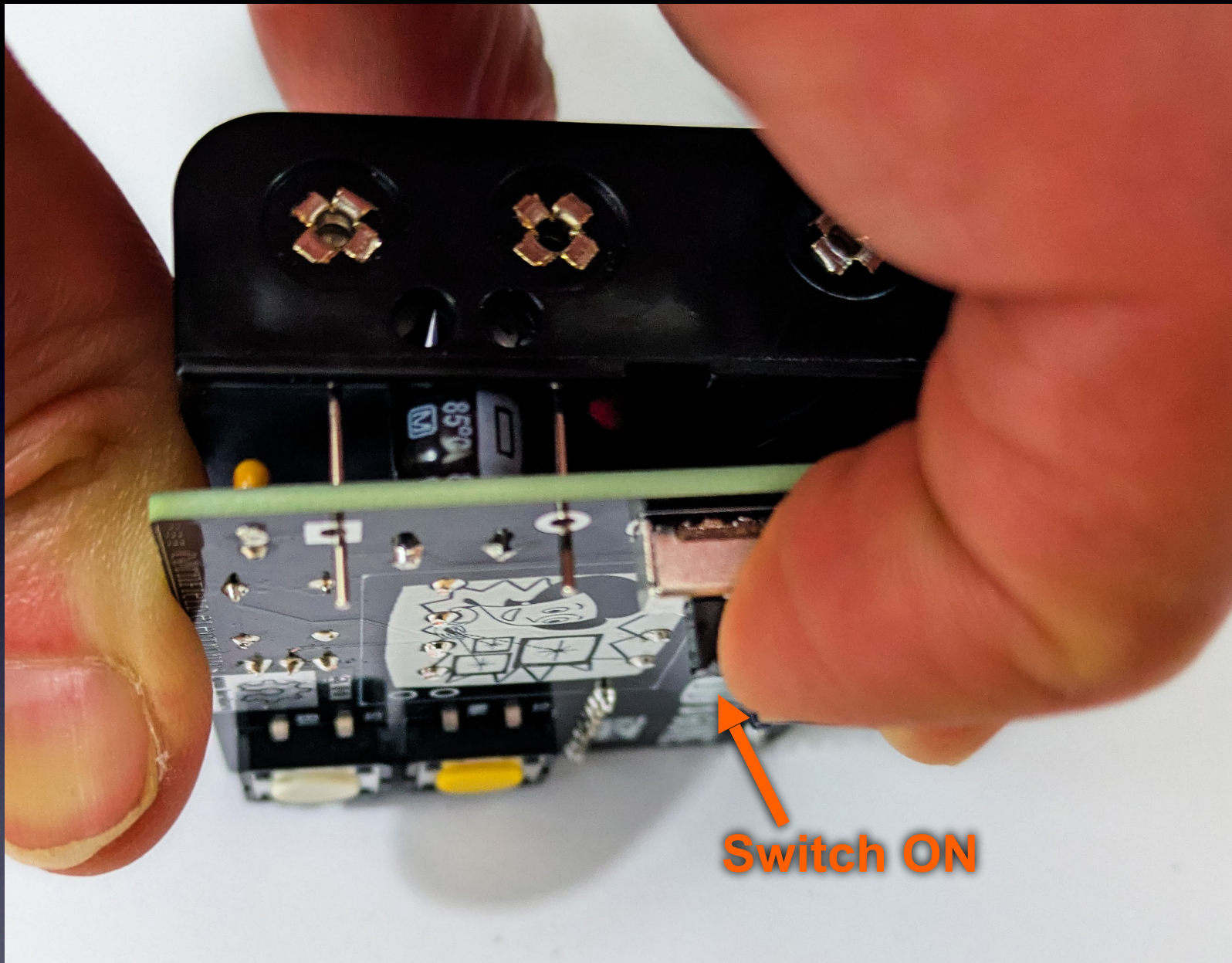


Get ready for testing !

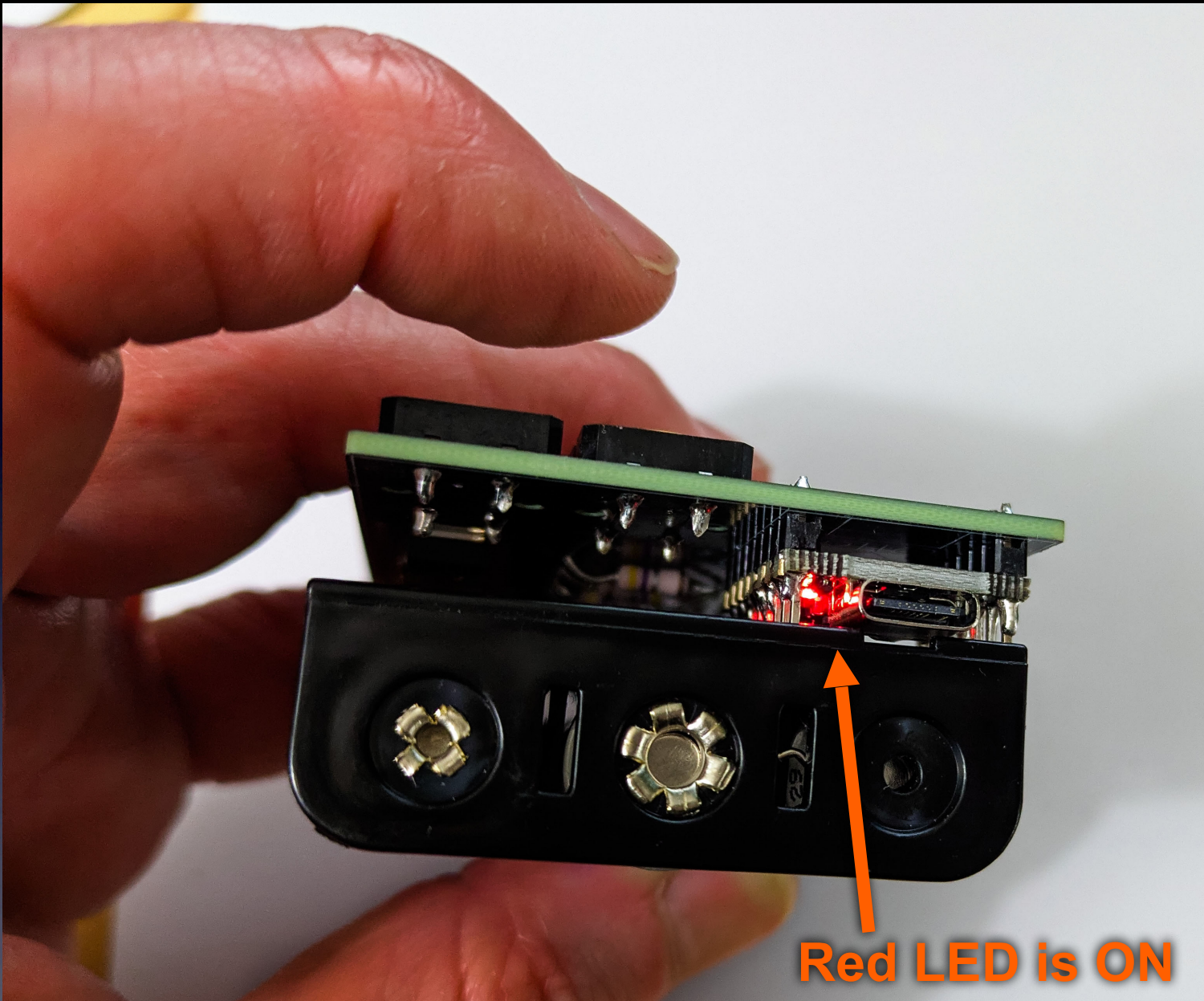


Place
battery
holder
in place

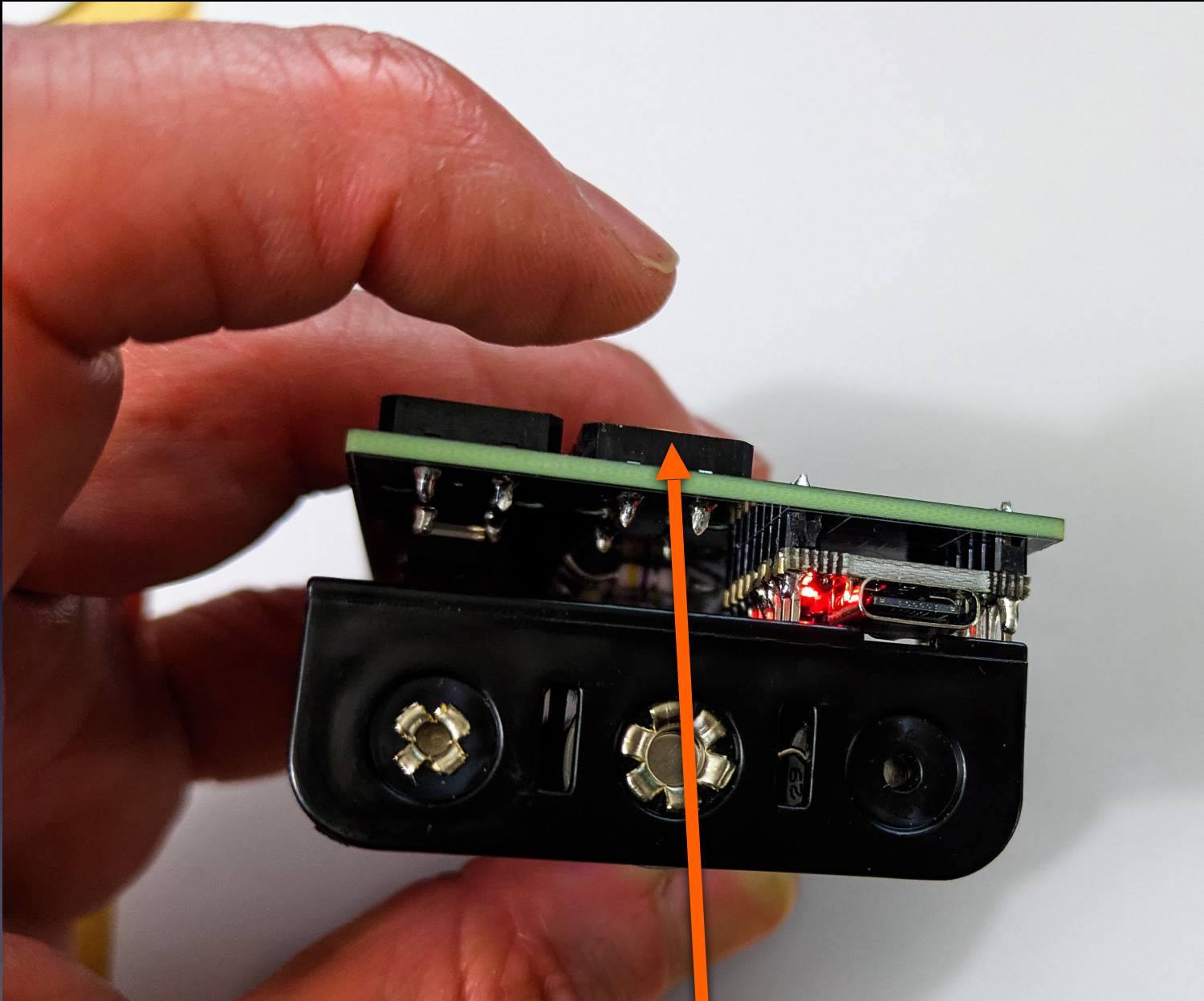
Get ready for testing !



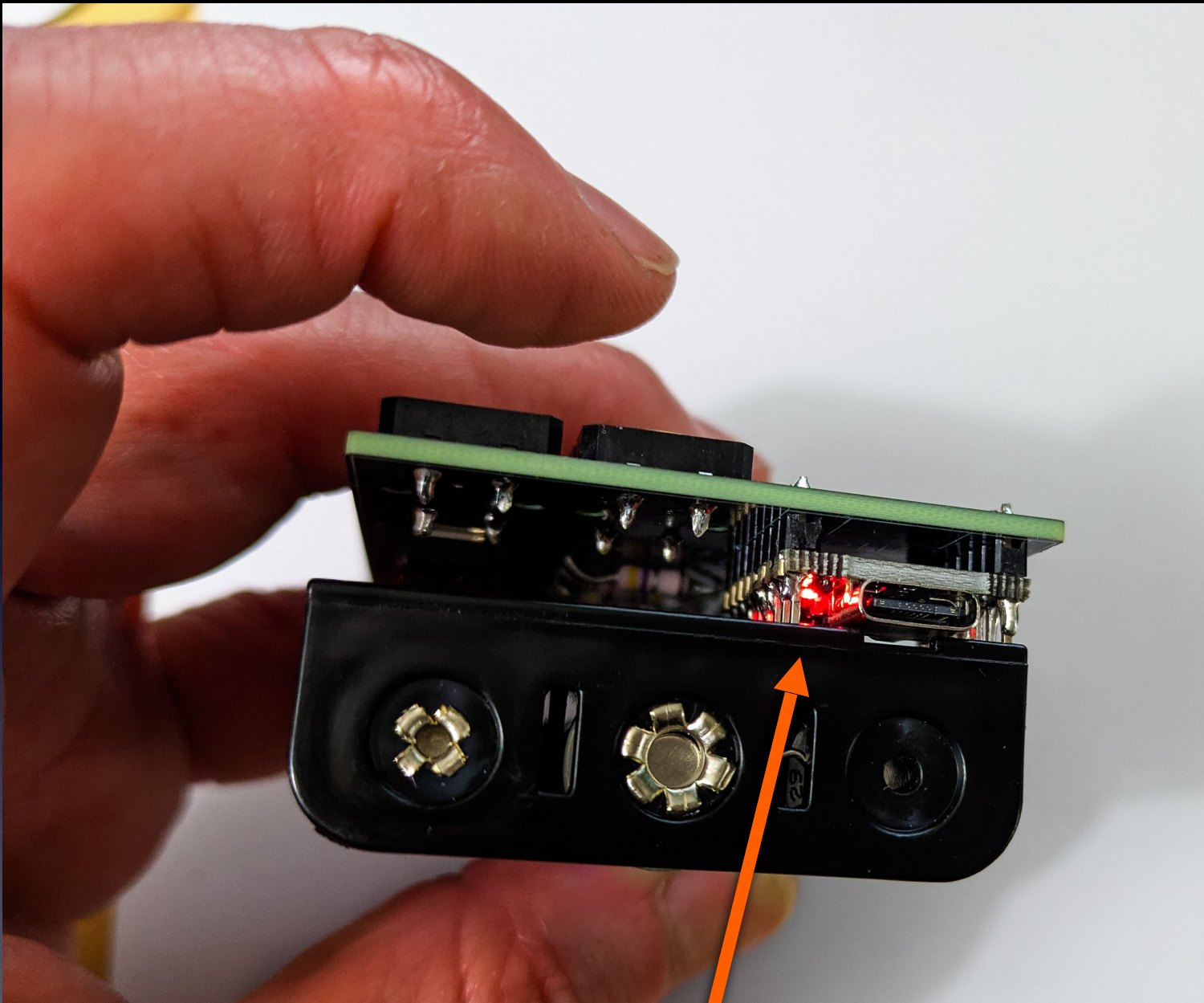
Testing !



First test: Red LED is on



Second test: push S1 (or S2) button



Second test: Blue LED blinks

Point IR LEDs
directly
into
phone camera
lens



IR LEDs flicker
(using
front-facing
phone camera)

Third test: IR LEDs flicker

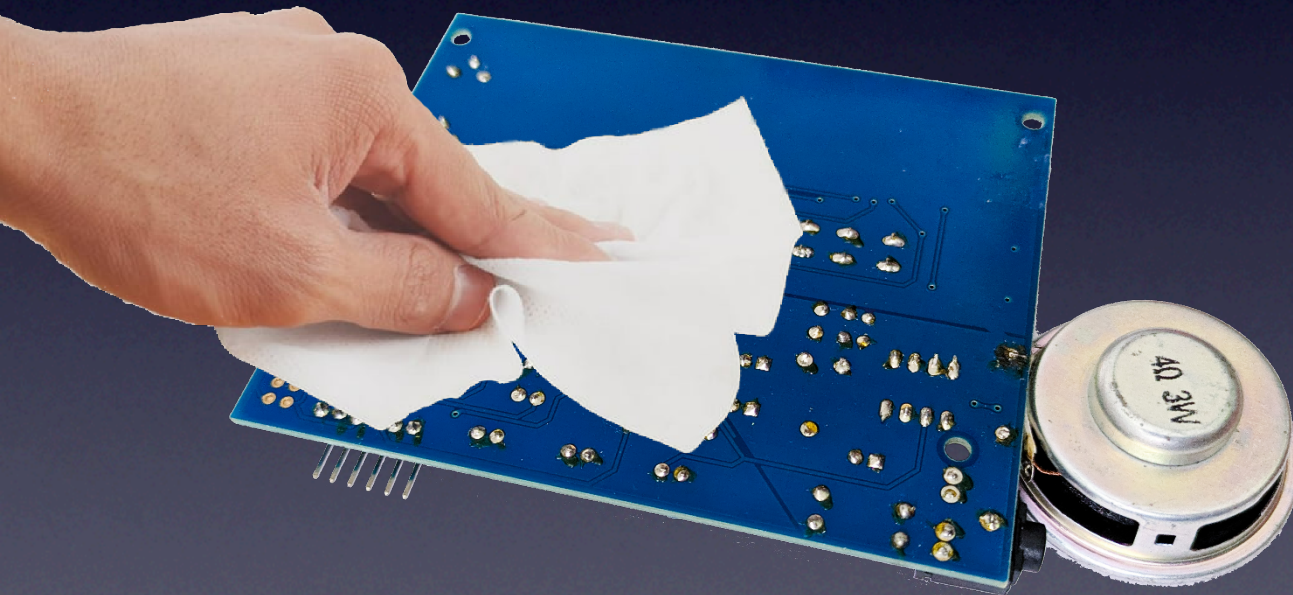
If the three tests are good,
it works!

Or you start debugging.

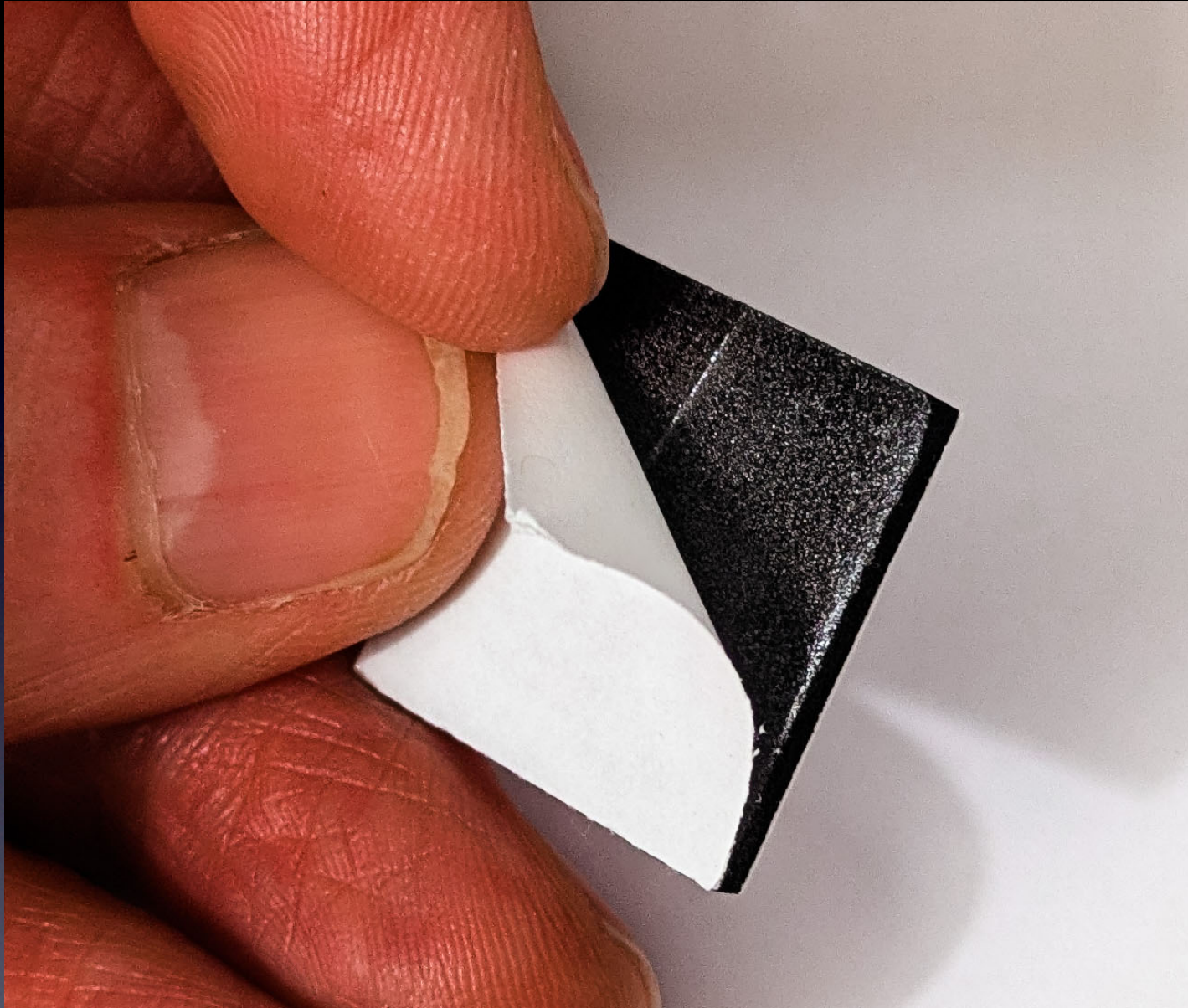
If you used any *flux paste* for re-working problems



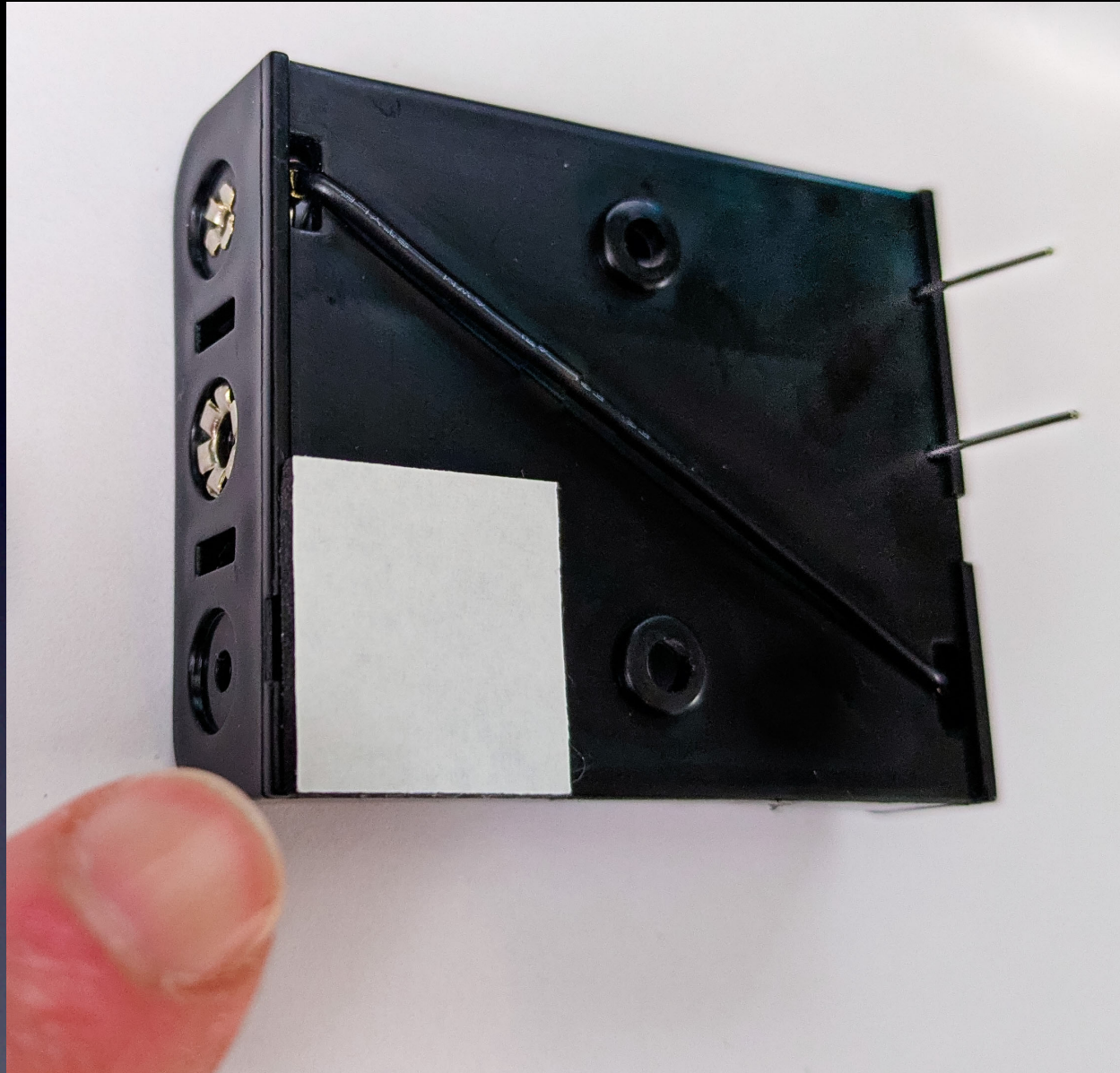
The bottom of the PCB will be sticky from the flux



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



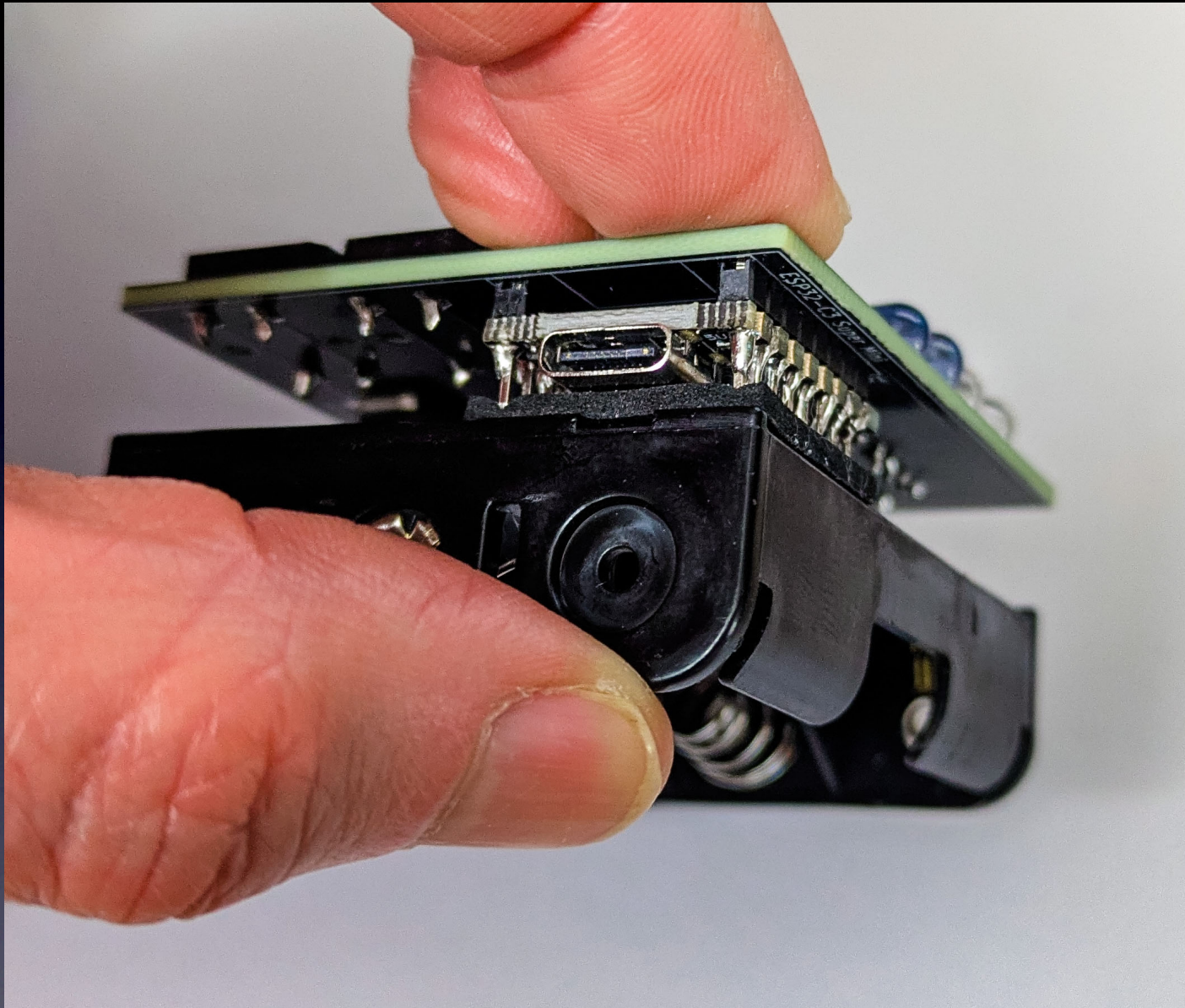
Peel back one side of double-sided foam tape



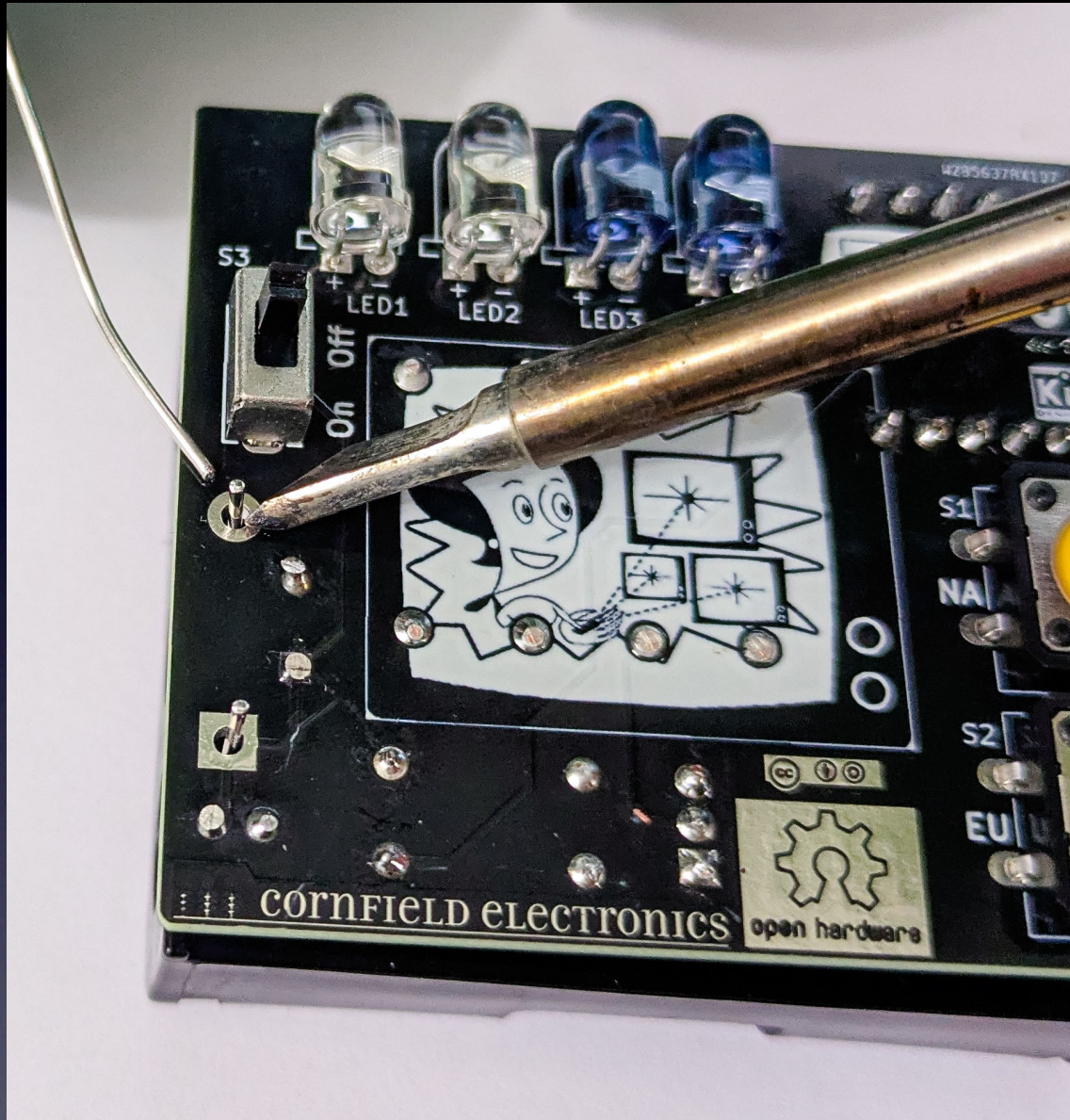
Stick foam in this corner of battery pack



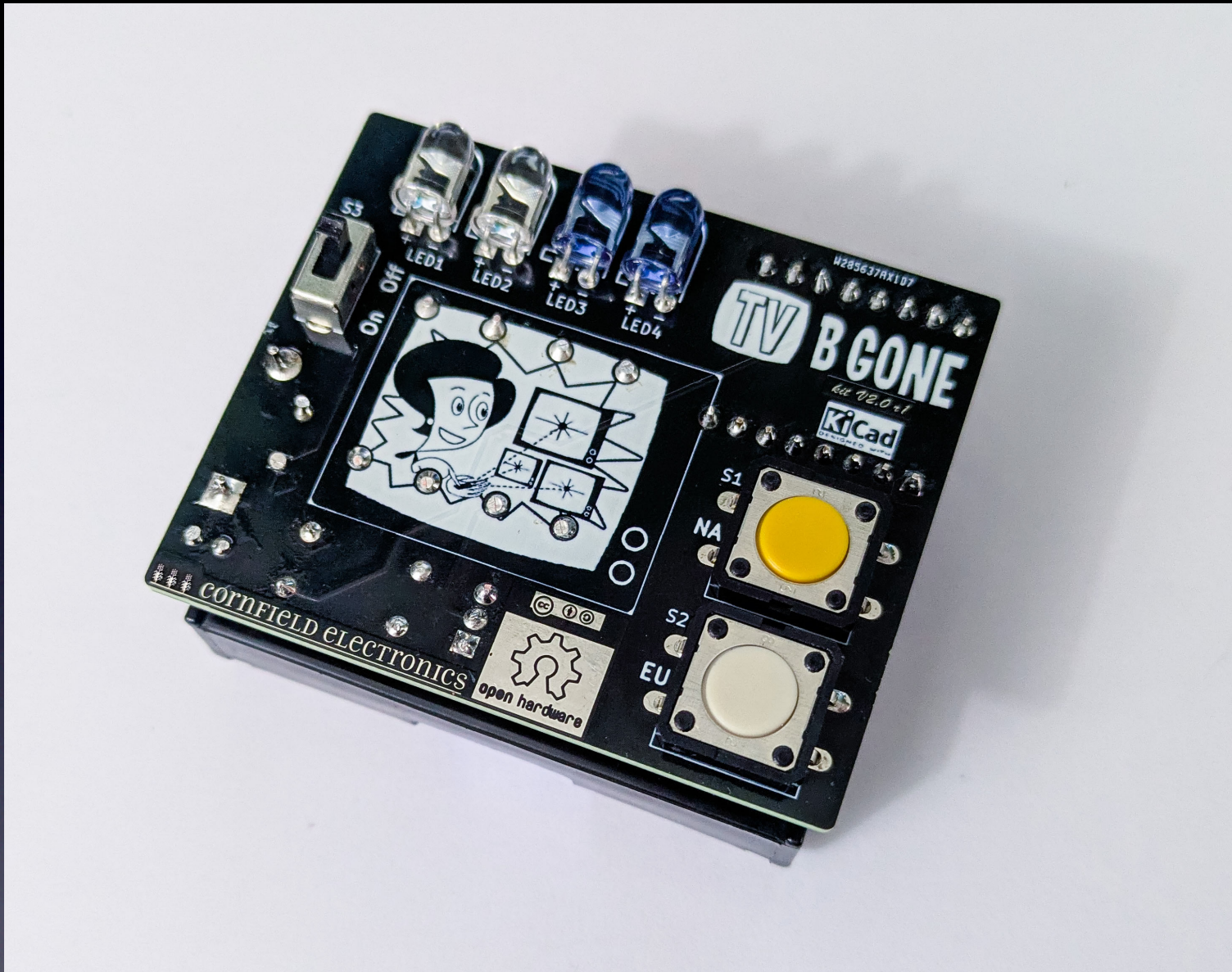
Peel back the other side of foam tape



Squeeze foam tape into MOD1



Solder both leads of the battery pack



Done !

TV B GONE®

Turn off TVs!!



Make the world a better place

Please Remember:

to

Wash your hands

after soldering



Make your own



V2_{r1}

Mitch Altman

Chief Scientist, **Cornfield Electronics**, San Francisco, CA

Inventor of **TV-B-Gone** universal remote controls

Co-founder of **3Ware** (successful Silicon Valley startup)

Pioneer of **VR** (in the mid-1980s)

Founding mentor at **HAX** (1st and biggest hardware accelerator)

Co-founder of **Noisebridge** (San Francisco hackerspace)

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Fediverse: [@maltman23@mastodon.social](https://maltman23@mastodon.social)

Patreon: [mitchaltman](#)

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