



Make your own

TV-B-GONE®

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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CORNFIELD ELECTRONICS



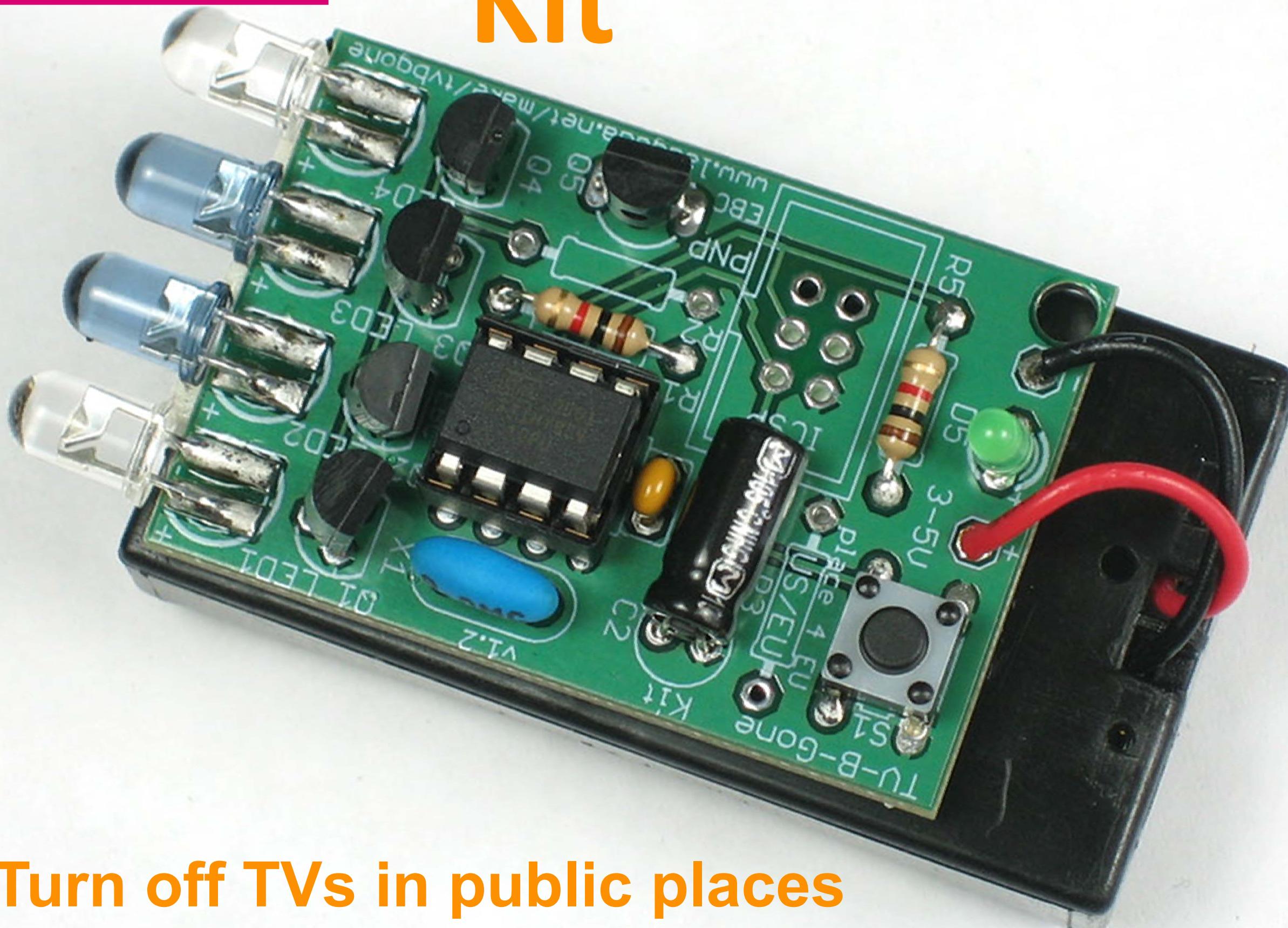
TV-B-Gone
*Just a remote control,
but only one button:
OFF !*





TV B GONE®

Kit



**Turn off TVs in public places
from 50 meters away!**

TV B GONE®

Kit: in a jacket



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



Kit: in a hat



makezine.com – TV-B-Gone Hat



Kit: Sonic Screwdriver



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



Takes about 60 seconds



About 150 IR “OFF” codes (one per blink)

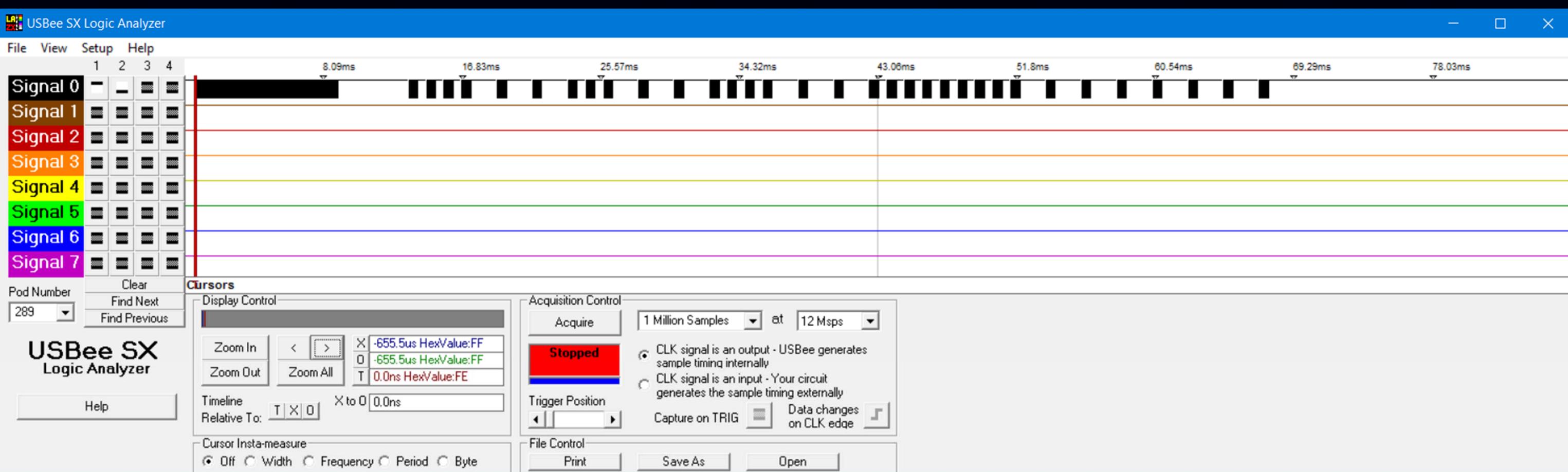
TV-B-Gone universal remote control

IR Remote control codes

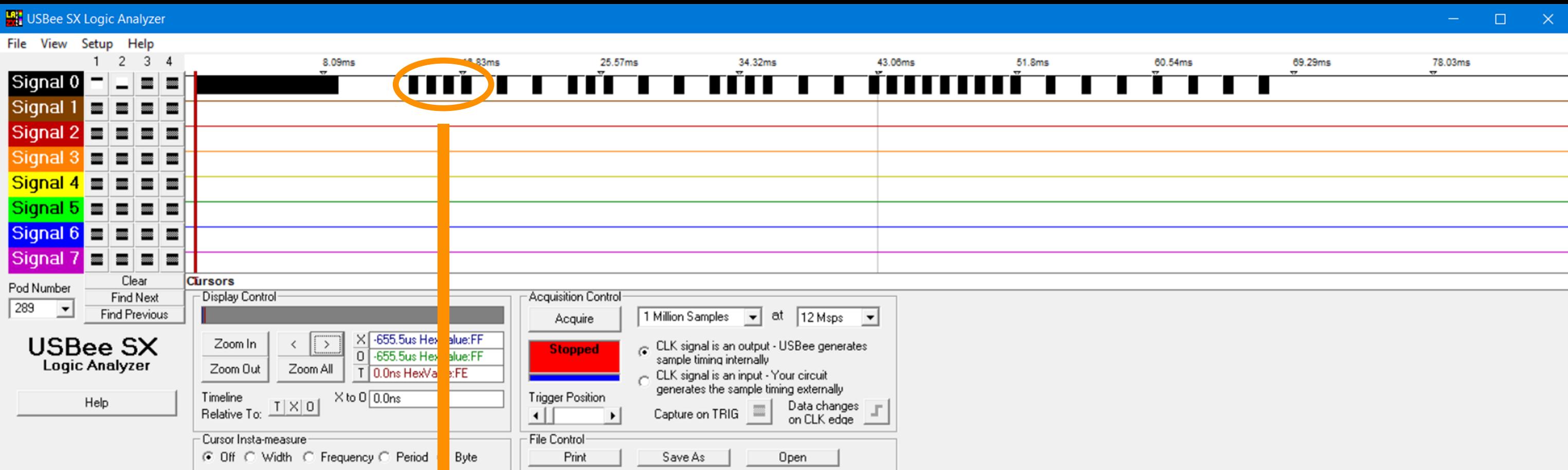


Allen Hall
NEC TV remote control

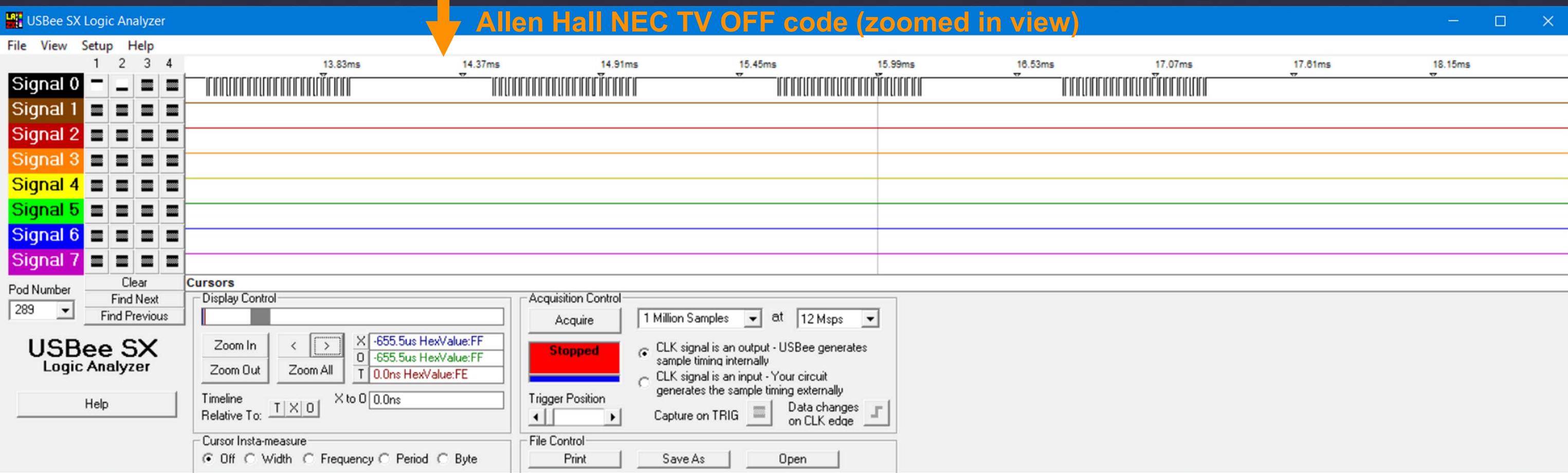
Allen Hall NEC TV OFF code



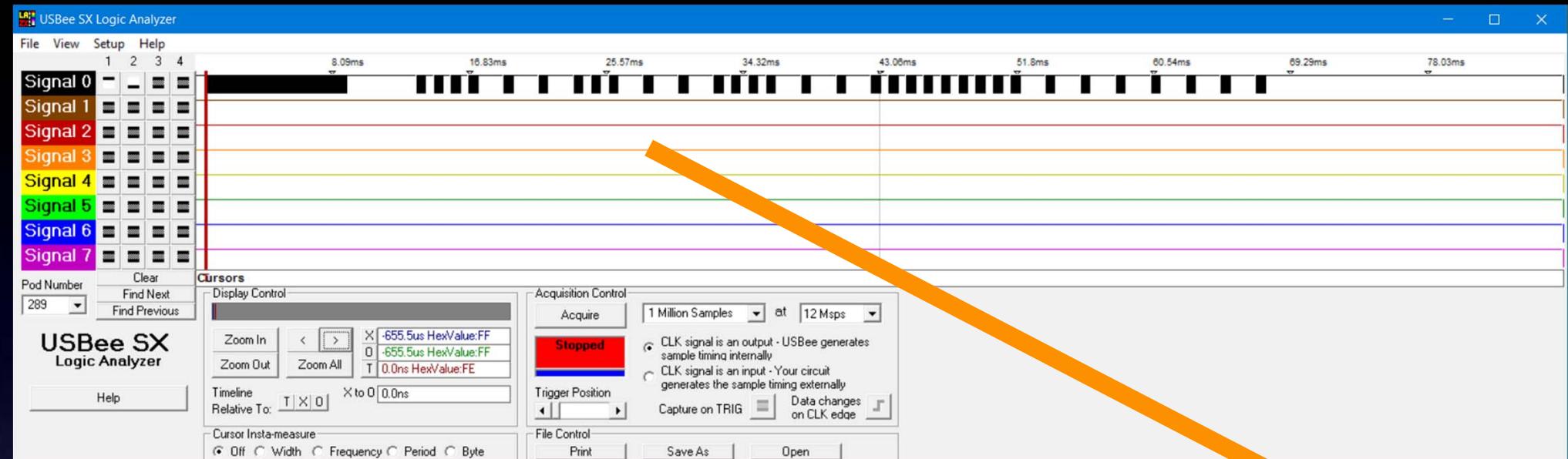
Allen Hall NEC TV OFF code



Allen Hall NEC TV OFF code (zoomed in view)

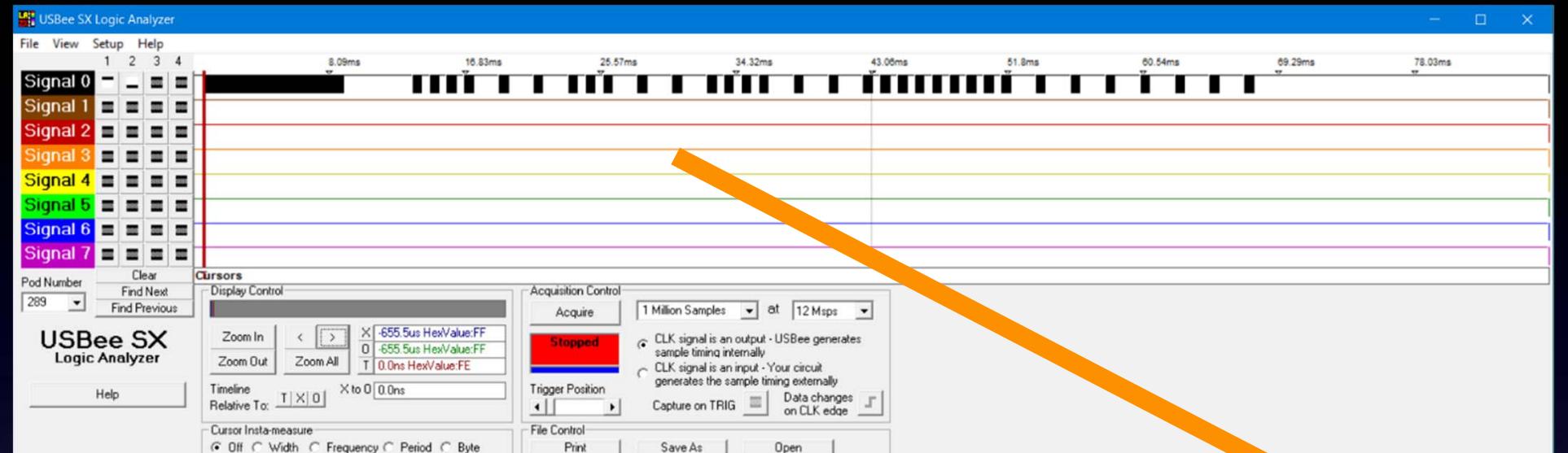


Allen Hall NEC TV OFF code



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

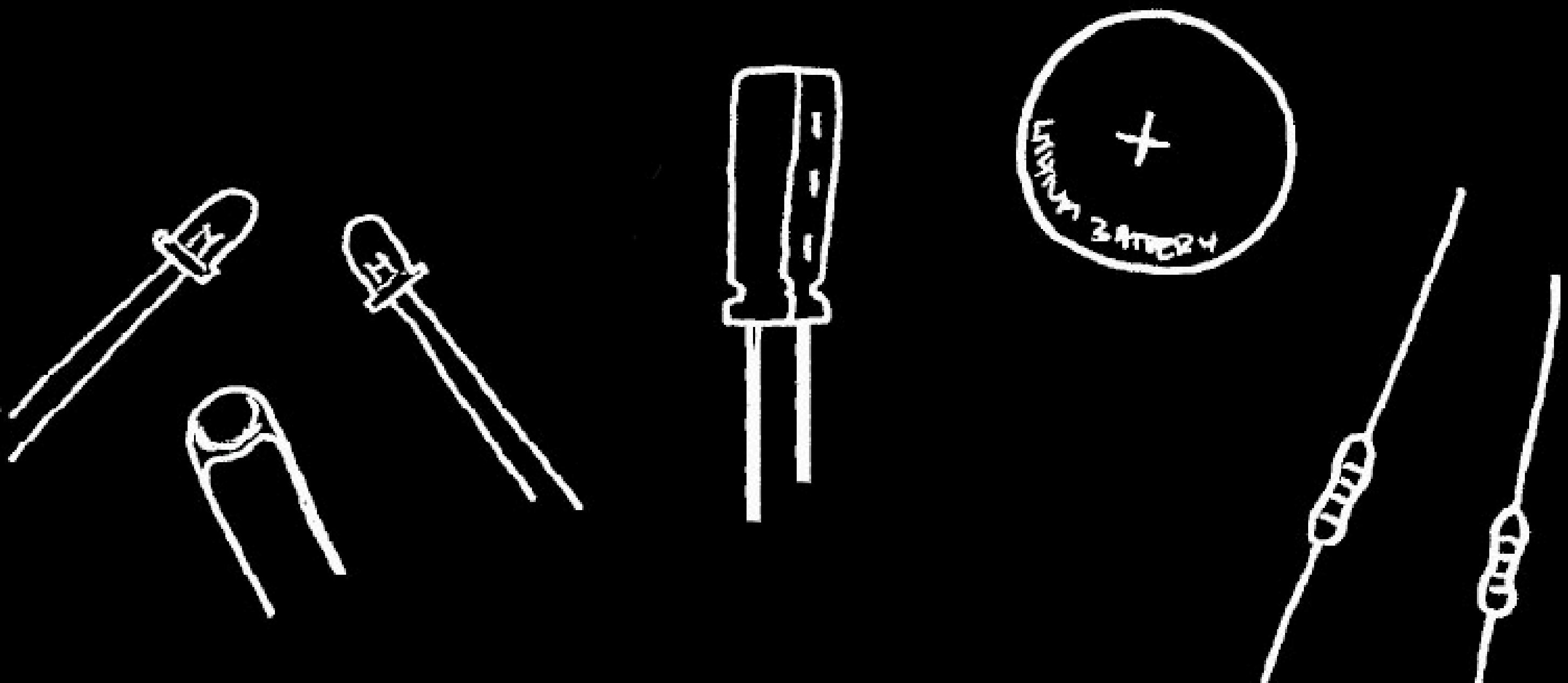
Allen Hall NEC TV OFF code



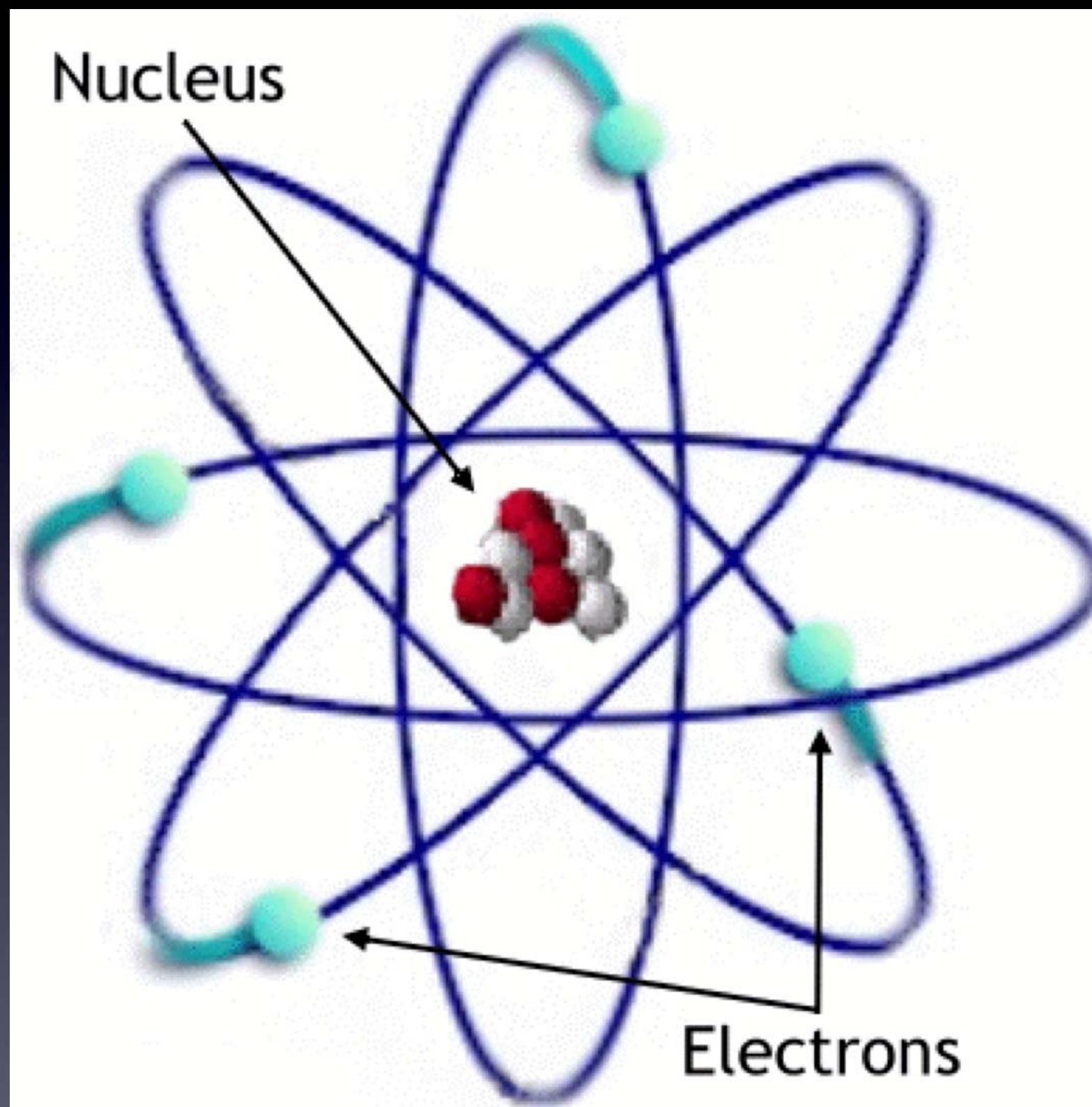
pair #	on-time	off-time	index
1	8,920 usec	4,450 usec	0
2	560 usec	560 usec	1
3	560 usec	560 usec	1
4	560 usec	560 usec	1
5	560 usec	1,680 usec	2
6	560 usec	1,680 usec	2
7	560 usec	1,680 usec	2
8	560 usec	560 usec	1
9	560 usec	560 usec	1
10	560 usec	1,680 usec	2
11	560 usec	1,680 usec	2
12	560 usec	1,680 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

A Little About Electronics

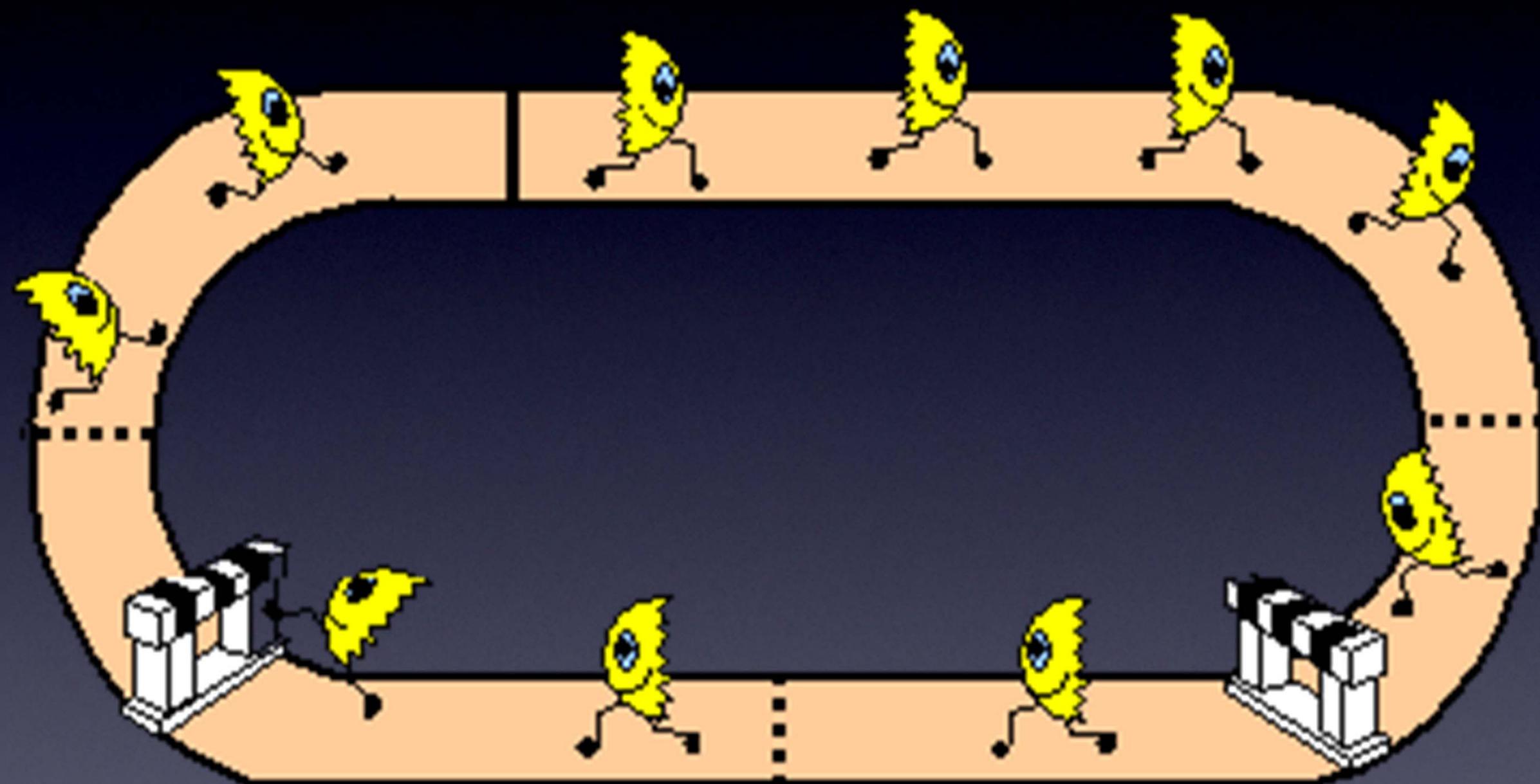


A Little About Electronics



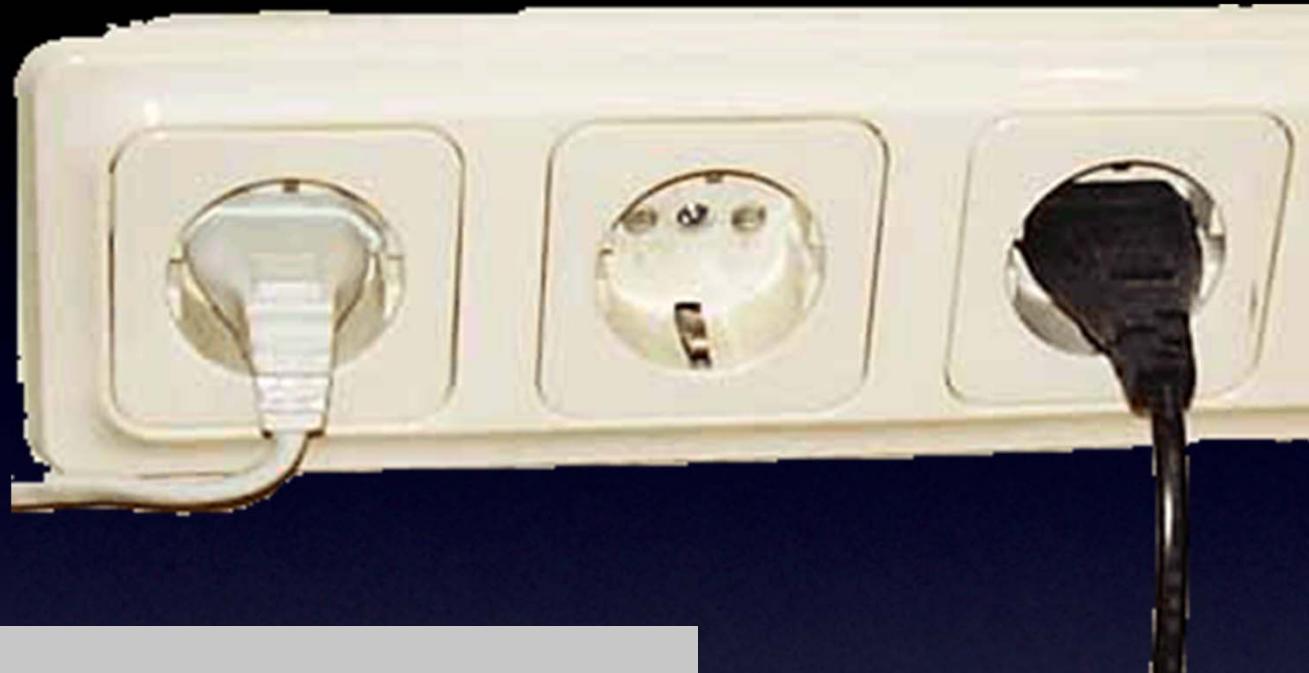
Electrons

A Little About Electronics



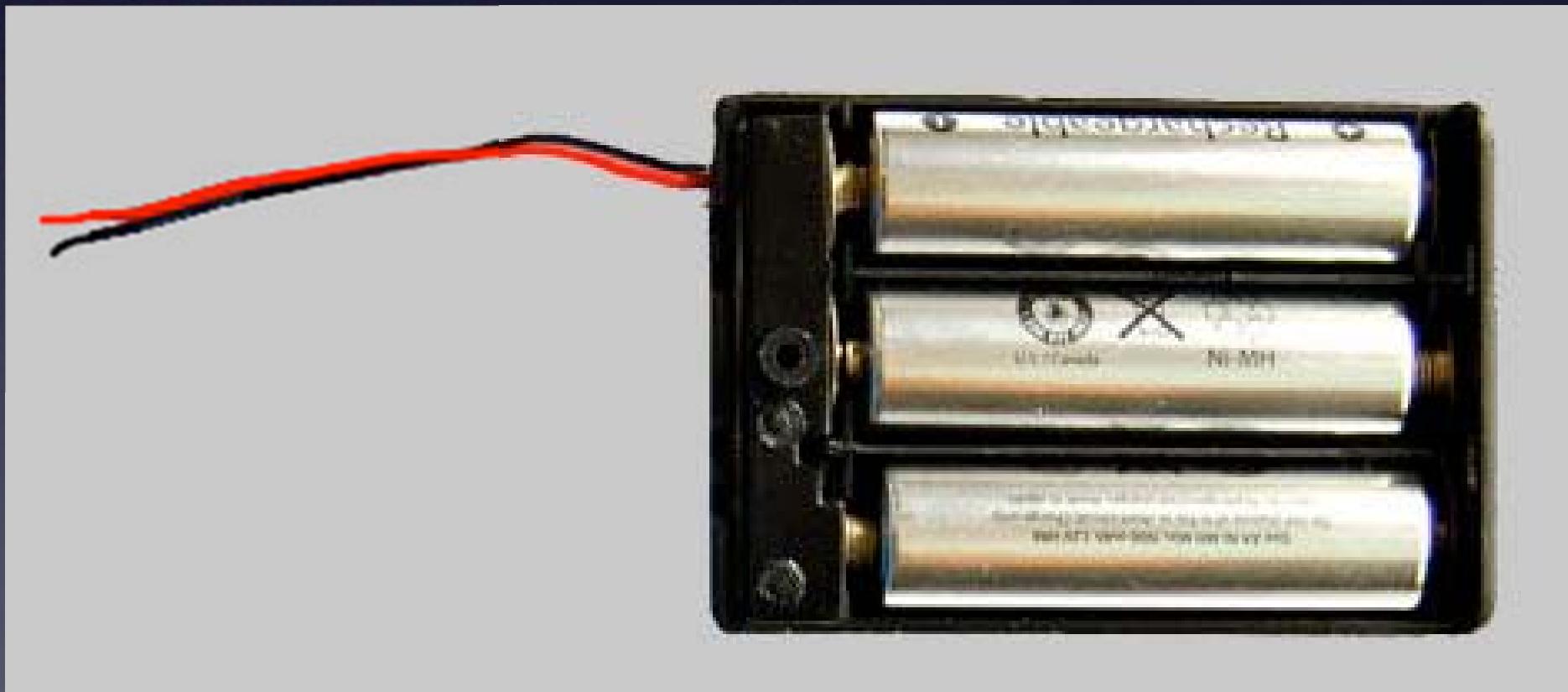
Circuit = Electrons going in complete circle = Magic!

A Little About Electronics



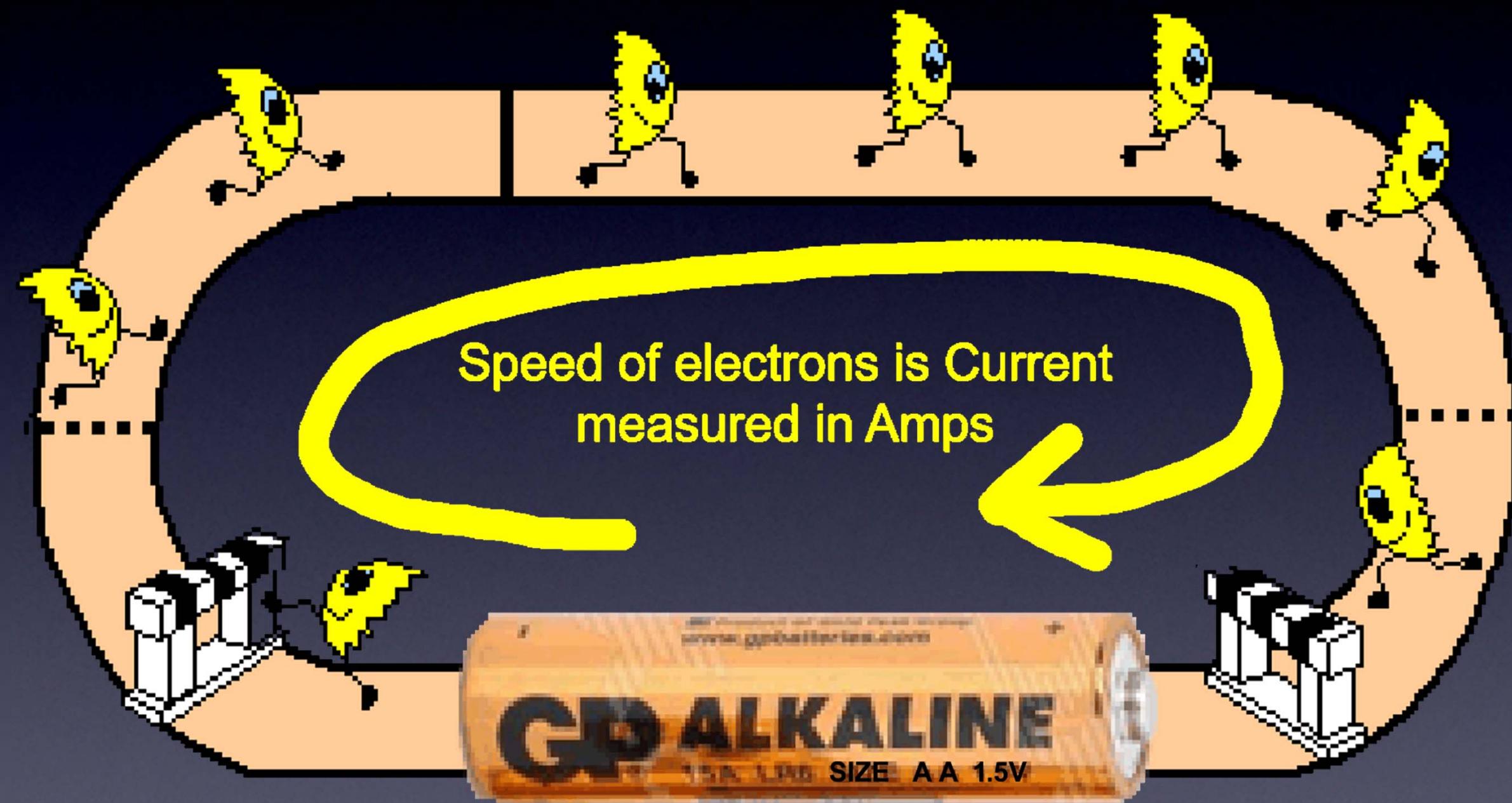
Power Supplies

Everything You Need to Know About Electronics



Voltage / Volts

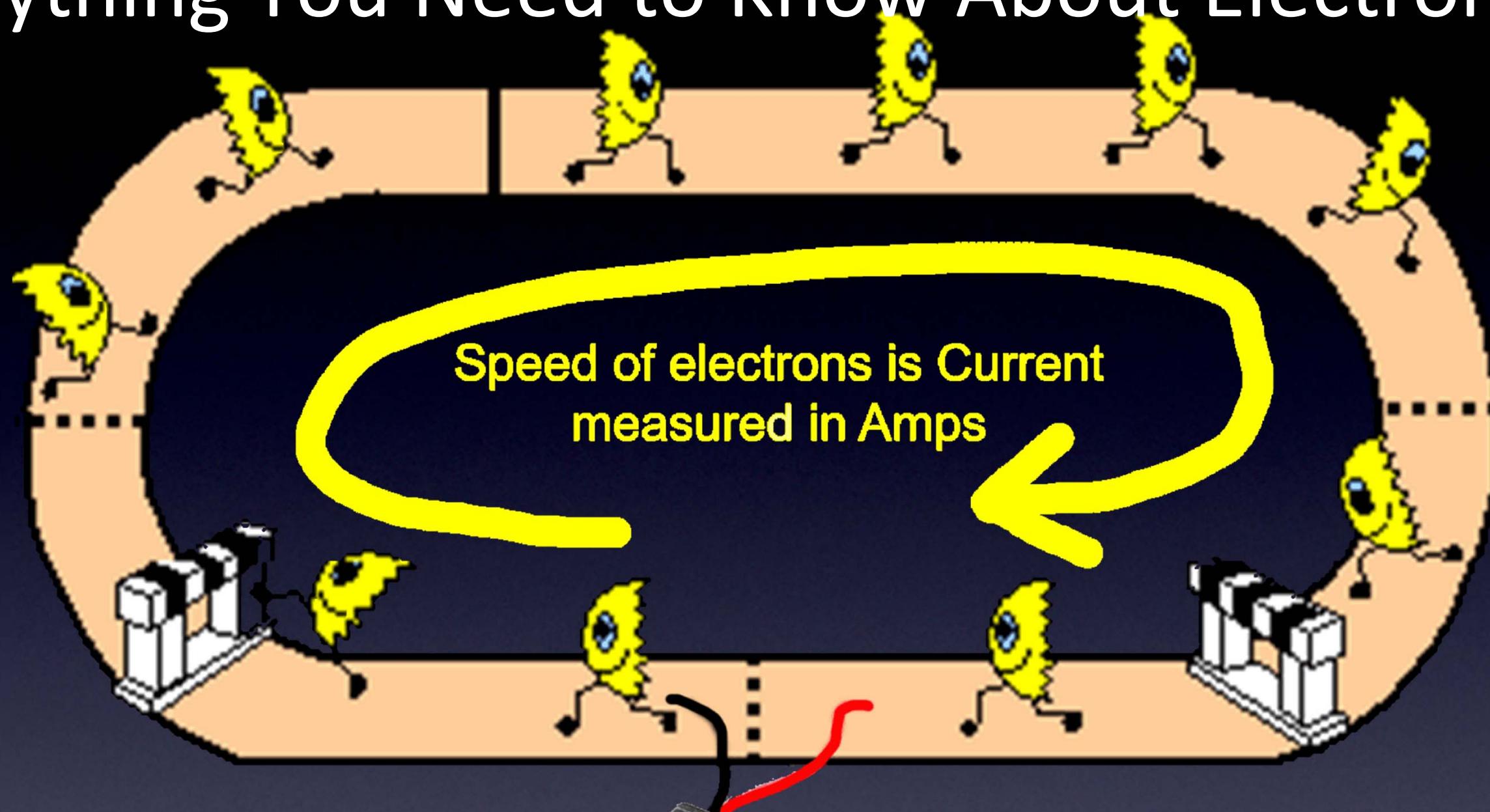
Everything You Need to Know About Electronics



Electrons pushed with 1.5V.
So, they move!

Current / **Amps**

Everything You Need to Know About Electronics



3 times more Volts
3 times more push
3 times faster electrons
3 times more current / Amps

Current / **Amps**

Everything You Need to Know About Electronics

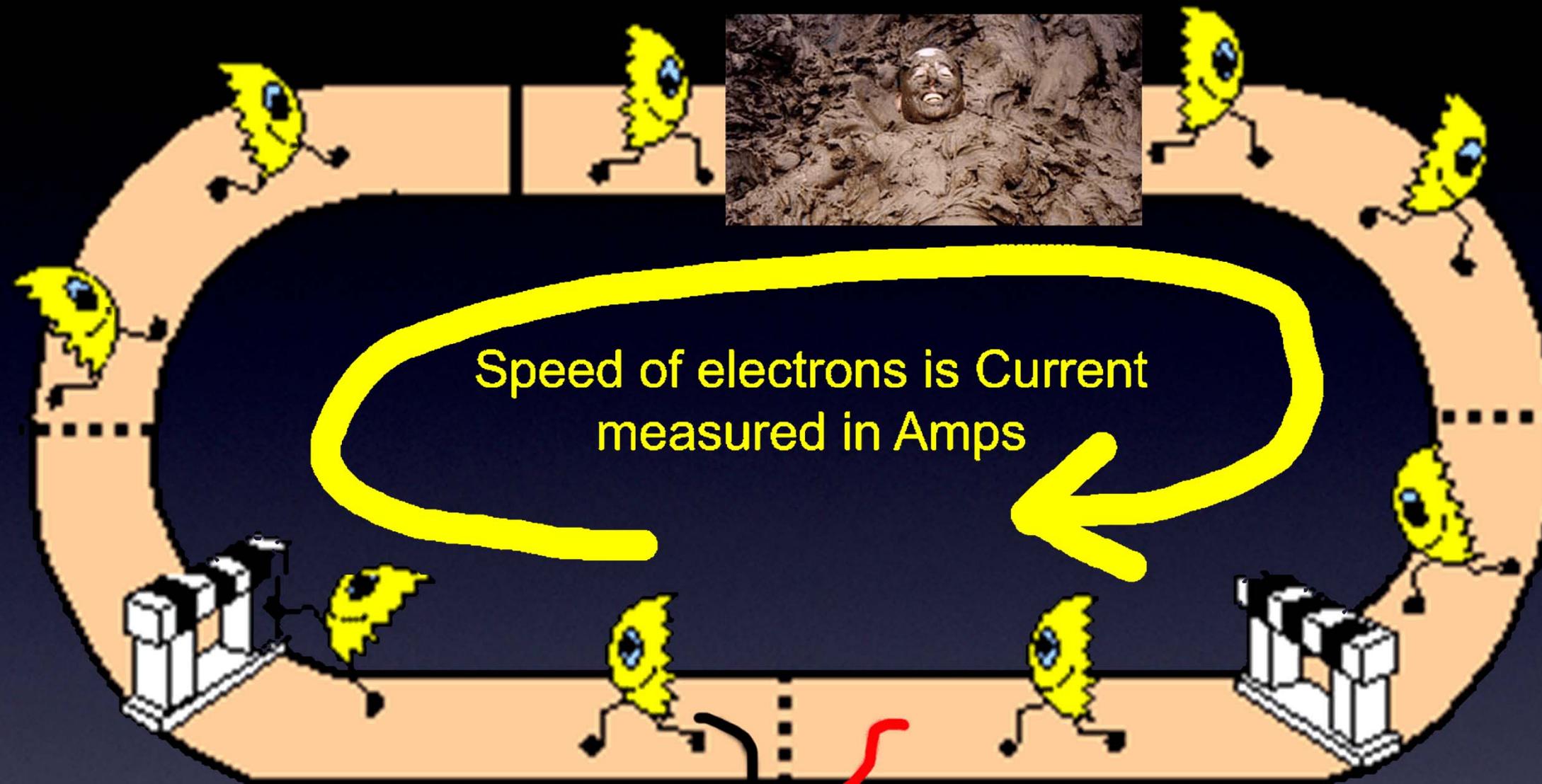


Too much energy?

Lots of energy!

Current / Amps

Everything You Need to Know About Electronics



Resistance in the electrons' path slows them down, which means less current (less Amps).

Resistance / Ohms

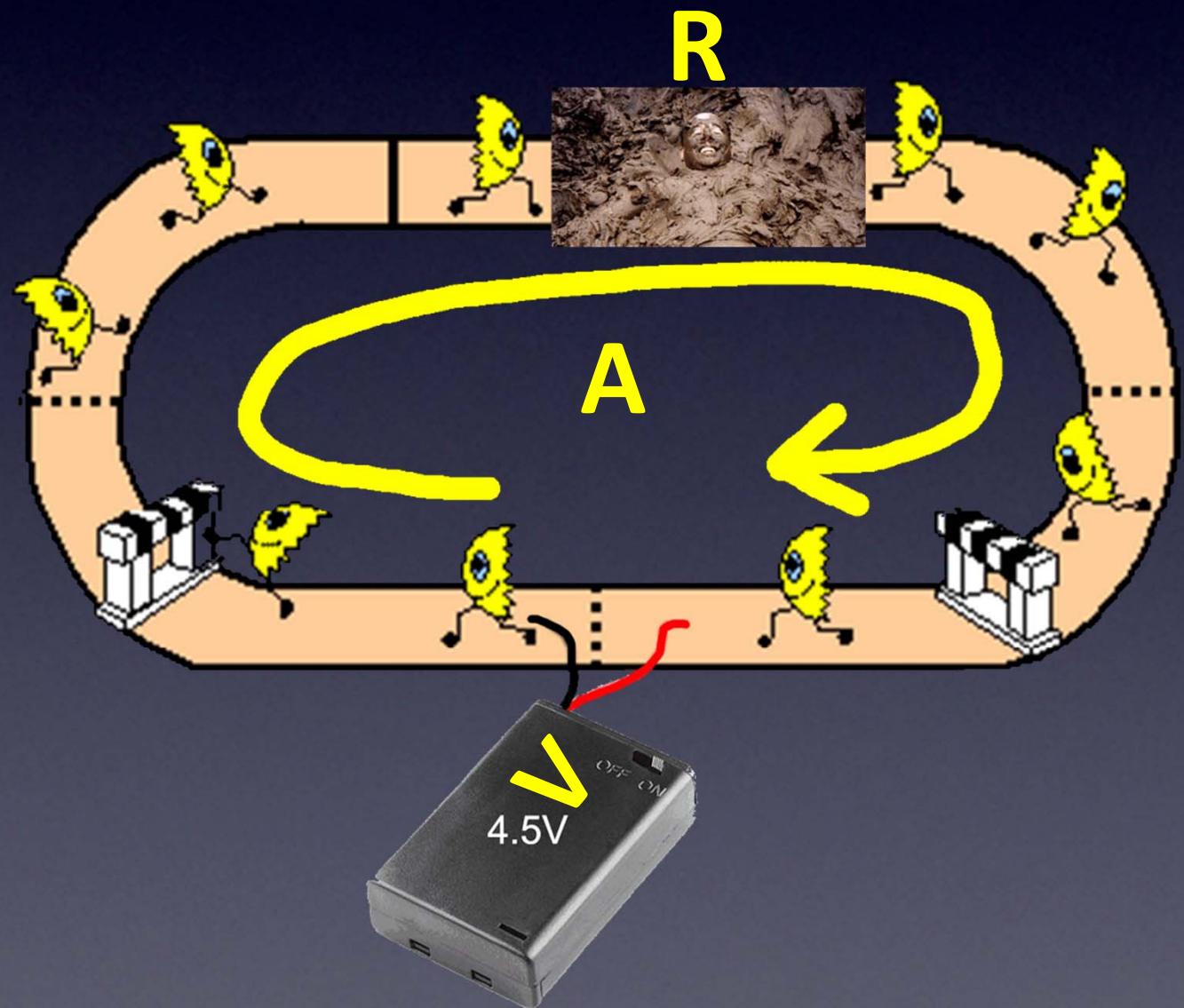
A Little About Electronics

Ohm's Law

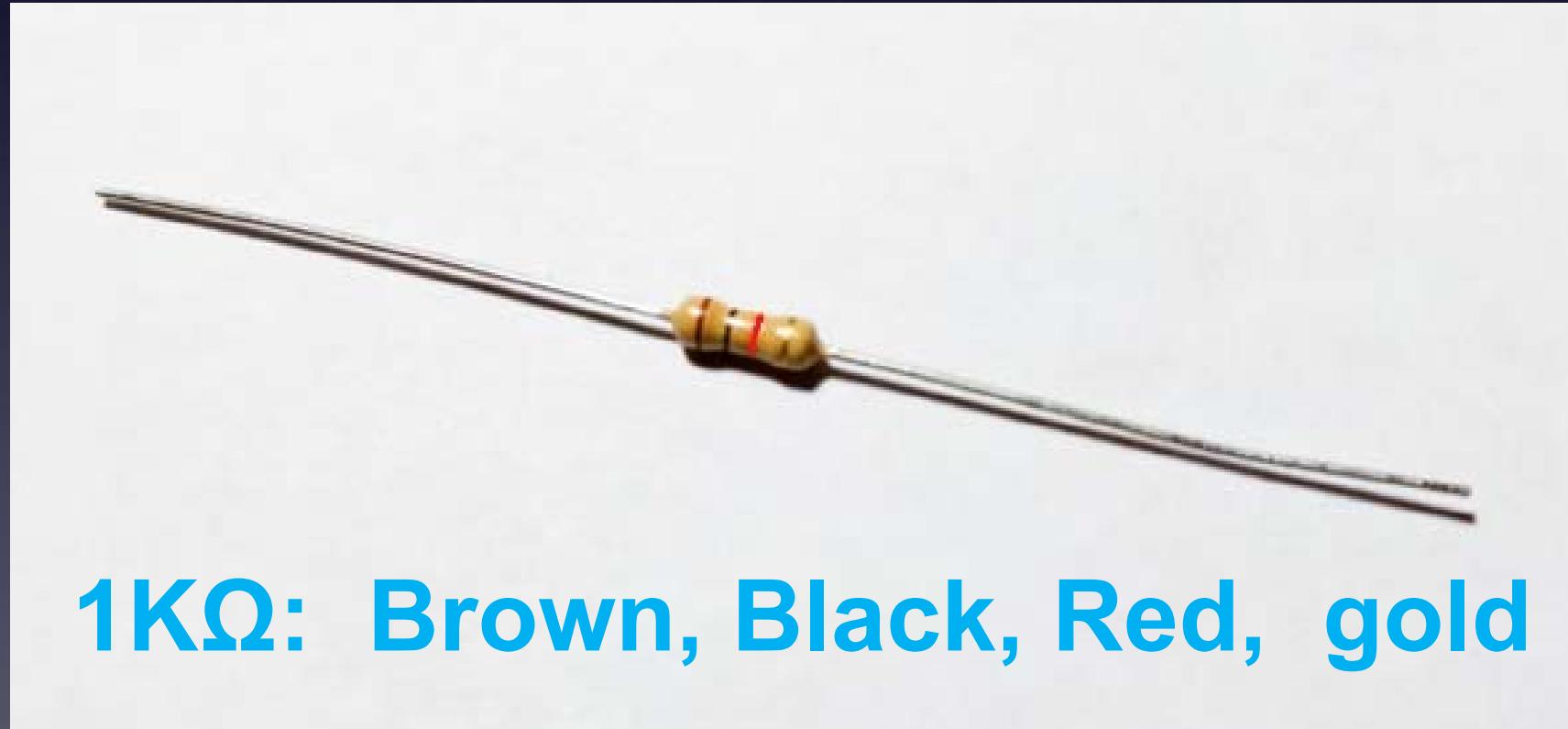
Volts -- **force** pushing electrons

Amps -- **speed** of electrons

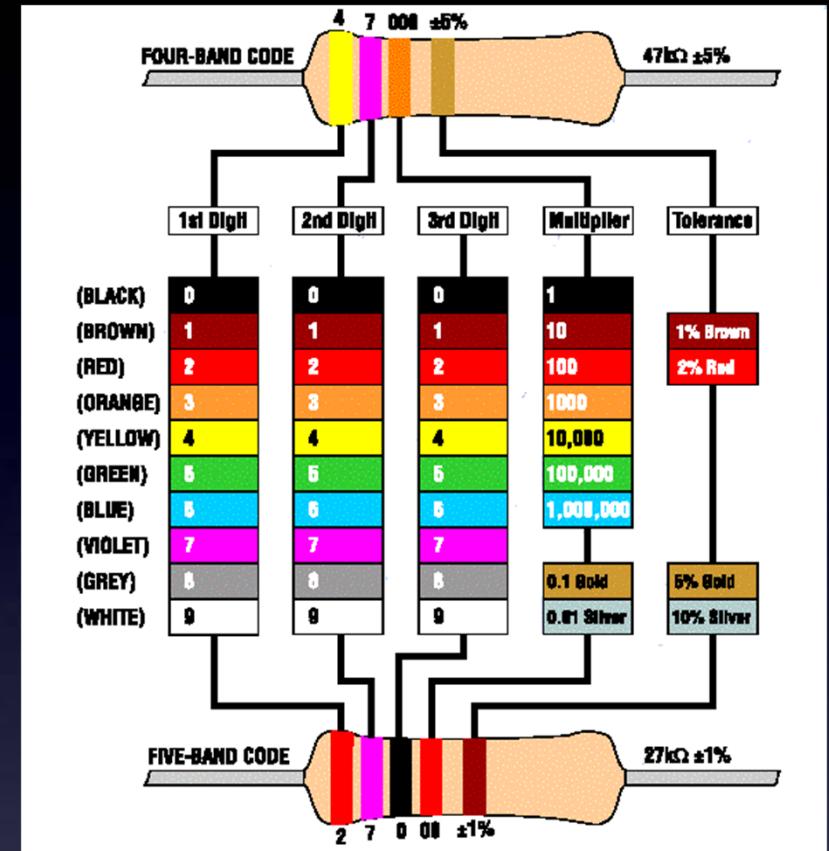
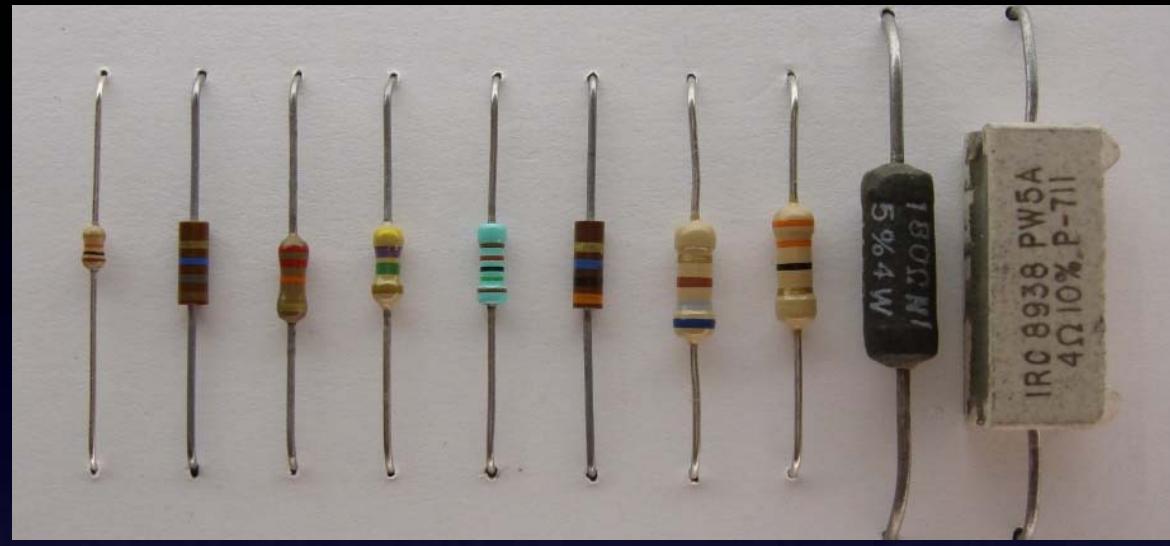
Ohms -- **Resistance** to flow of electrons



What You Need to Know About Electronics



1KΩ: Brown, Black, Red, gold



Resistor / Ohms

A Little About Electronics

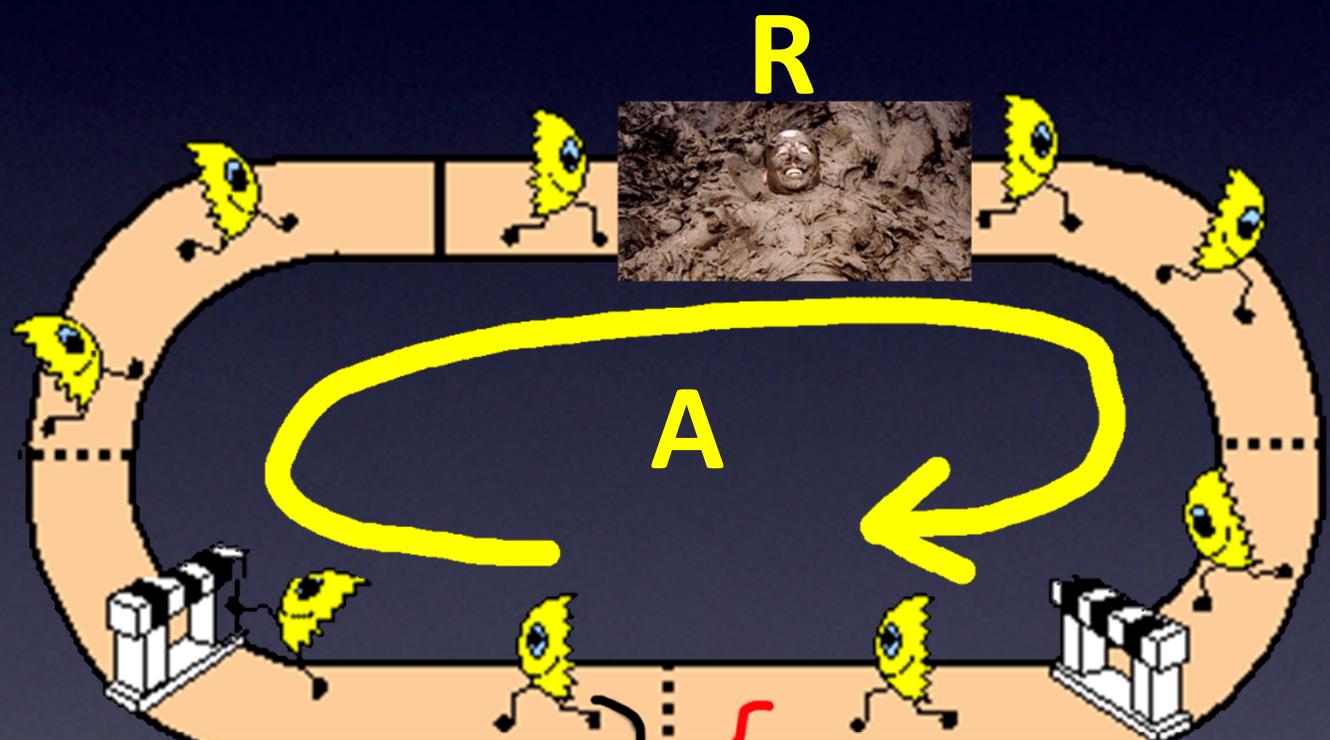
Ohm's Law

Volts -- **force** pushing electrons

Amps -- **speed** of electrons

Ohms -- **Resistance** to flow of electrons

$$\text{Volts} = \text{Amps} \times \text{R}$$



(Ohms)

A Little About Electronics

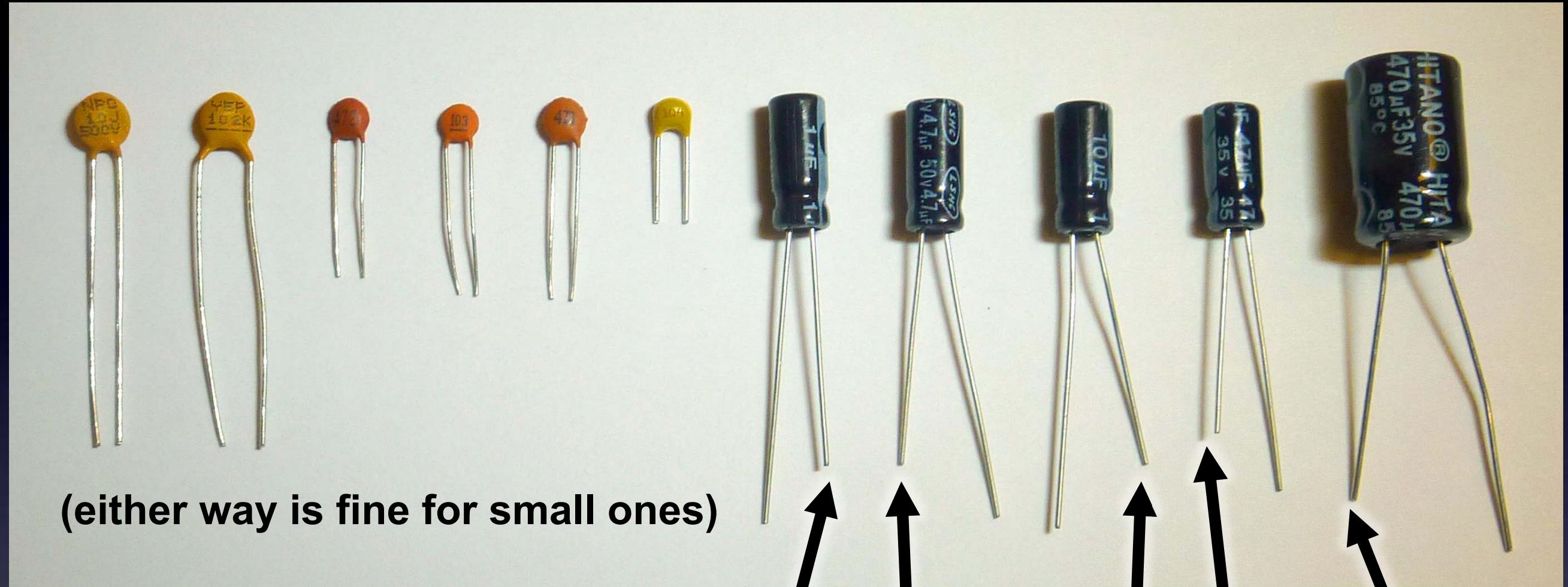


What happens?

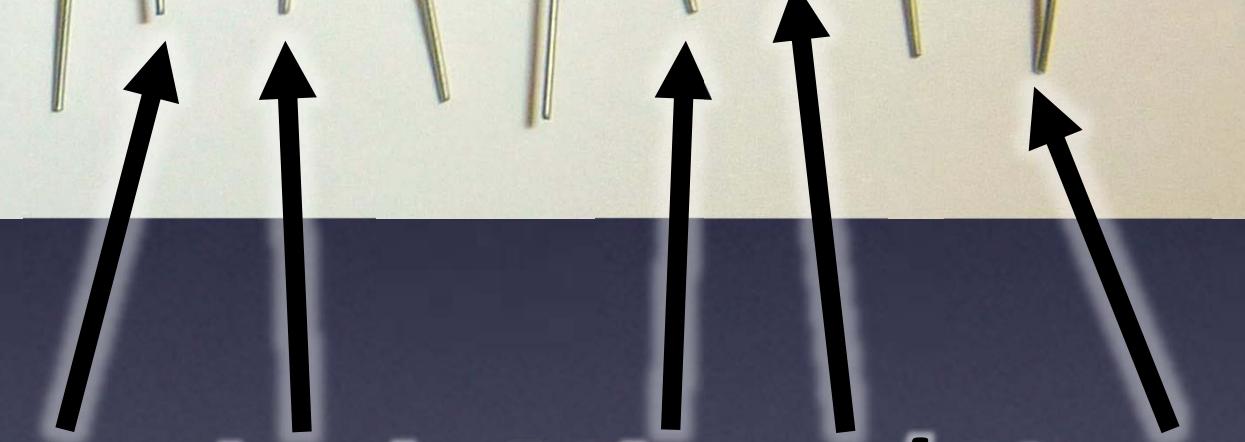
Polarity

Power Supply – it matters how you connect it!

A Little About Electronics



(either way is fine for small ones)

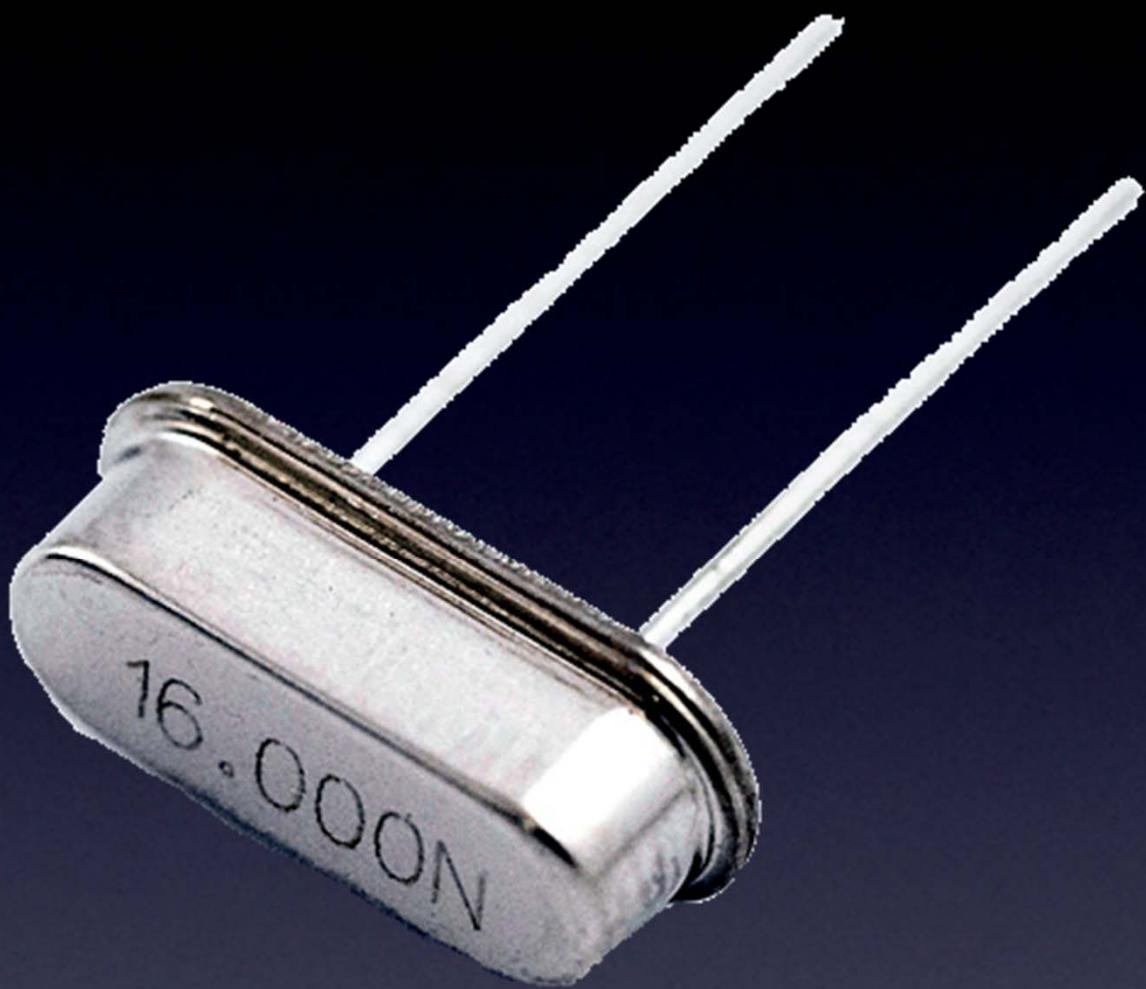


Short wire is Minus / Negative

Little buckets for electrons

Capacitor / Farads

A Little About Electronics

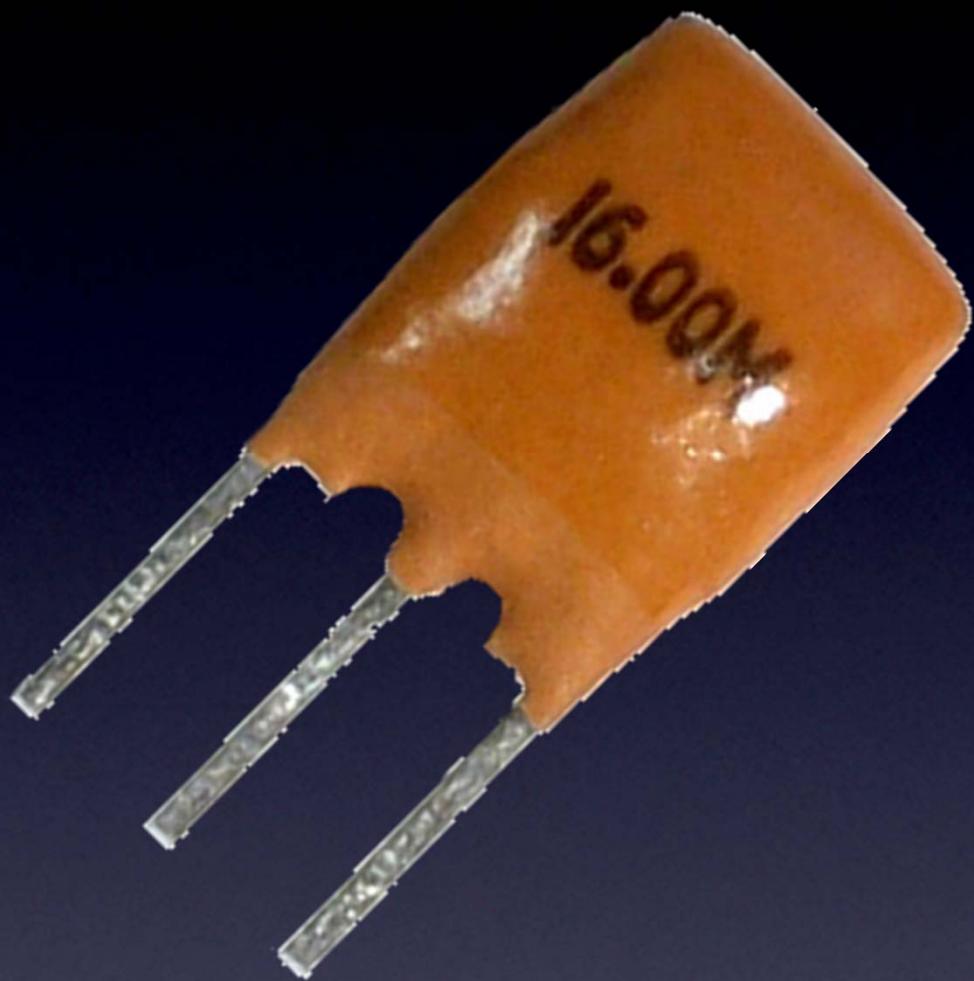


A precision cut piece of quartz crystal

For precise timing

Crystal / Hertz

A Little About Electronics

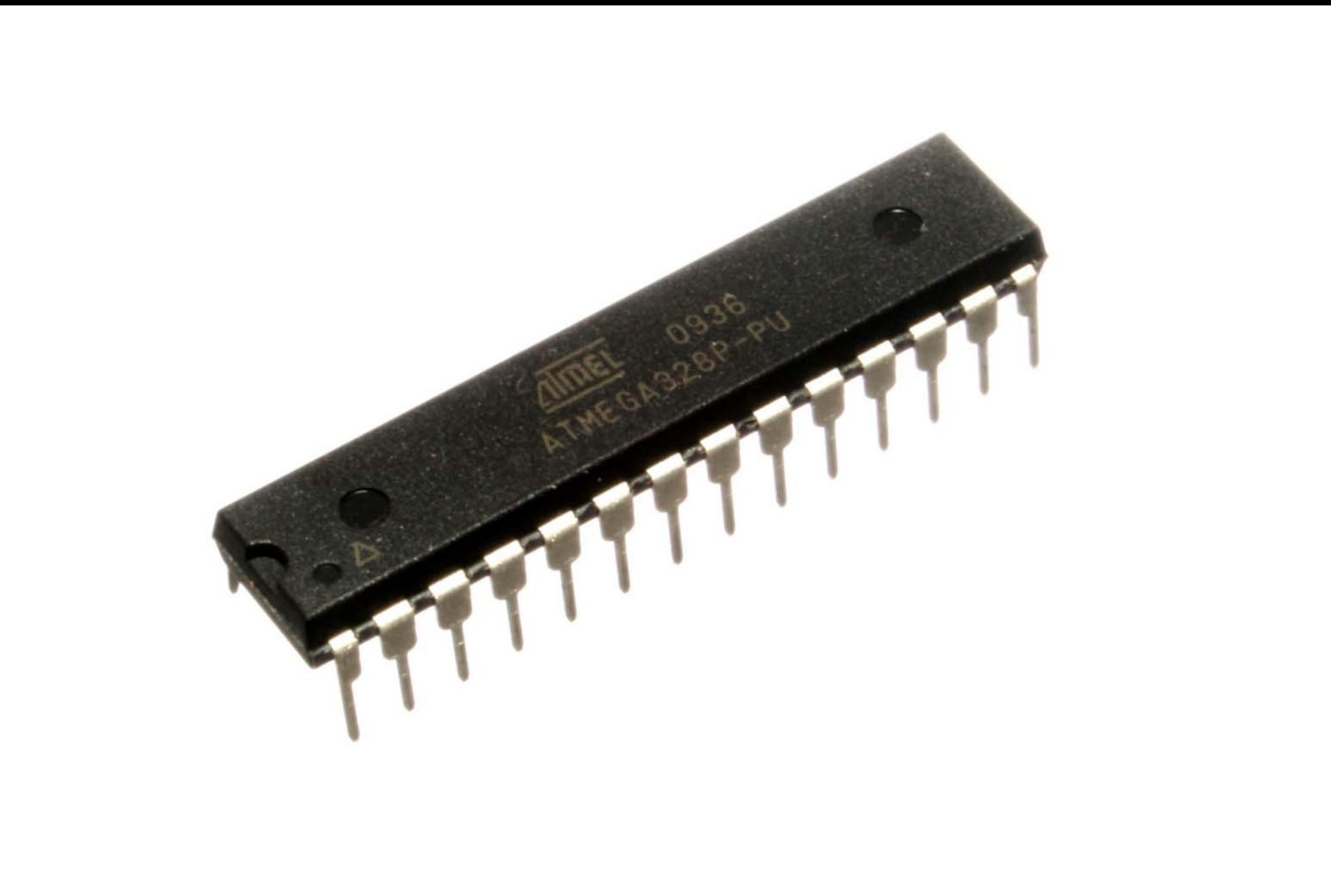


A bunch of resistors and capacitors

For precise timing (but less than a crystal)

Ceramic Resonator / **Hertz**

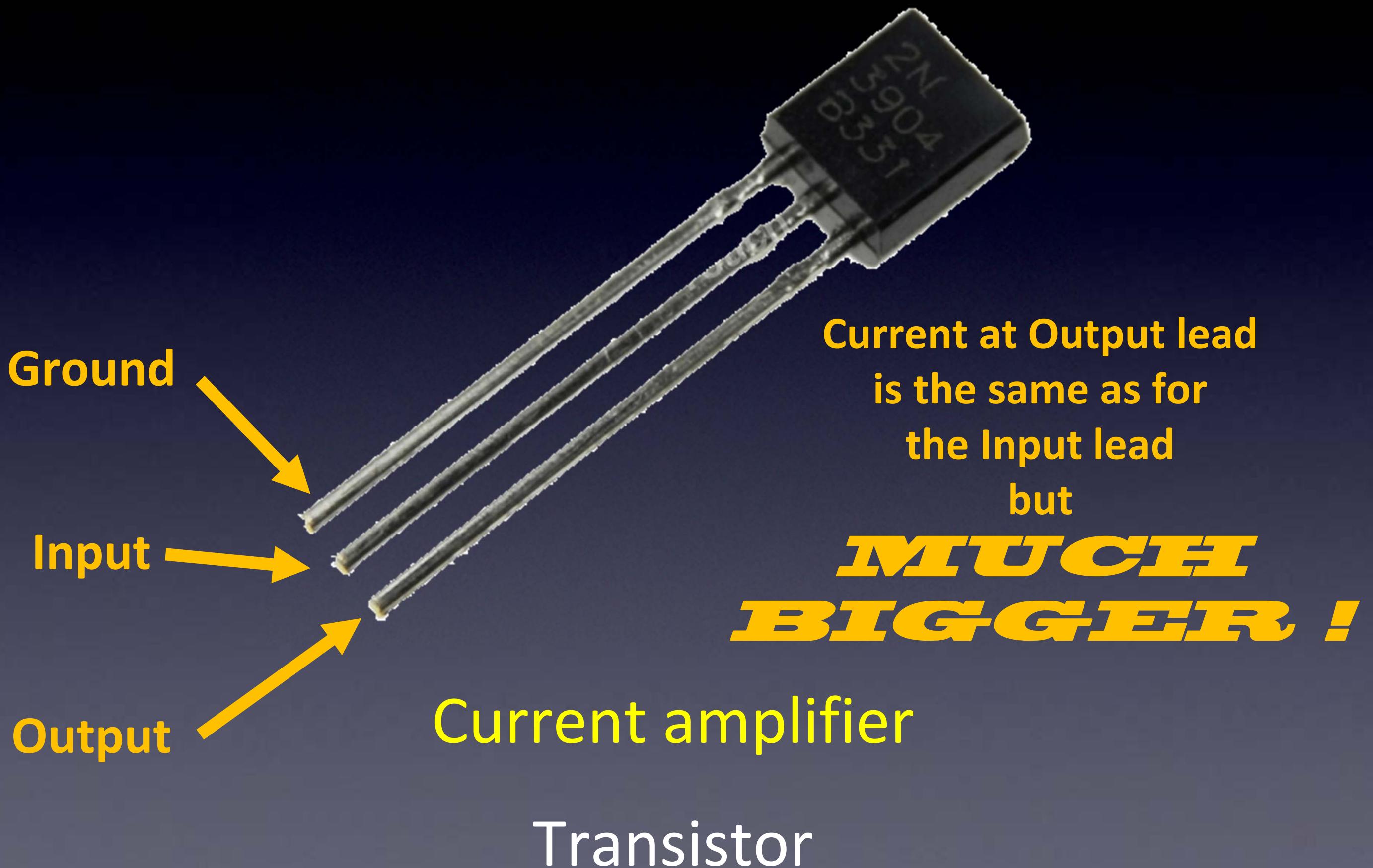
A Little About Electronics



A complete computer on a chip

Microcontroller

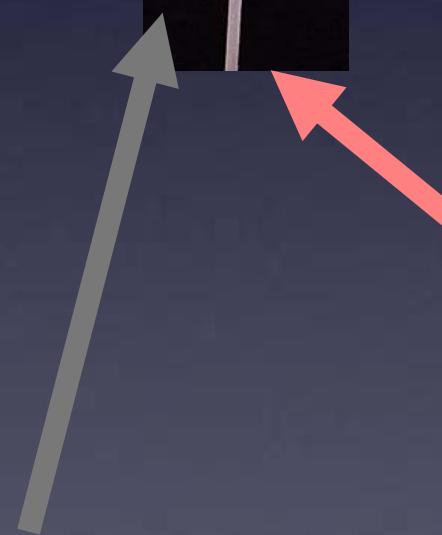
A Little About Electronics



LED

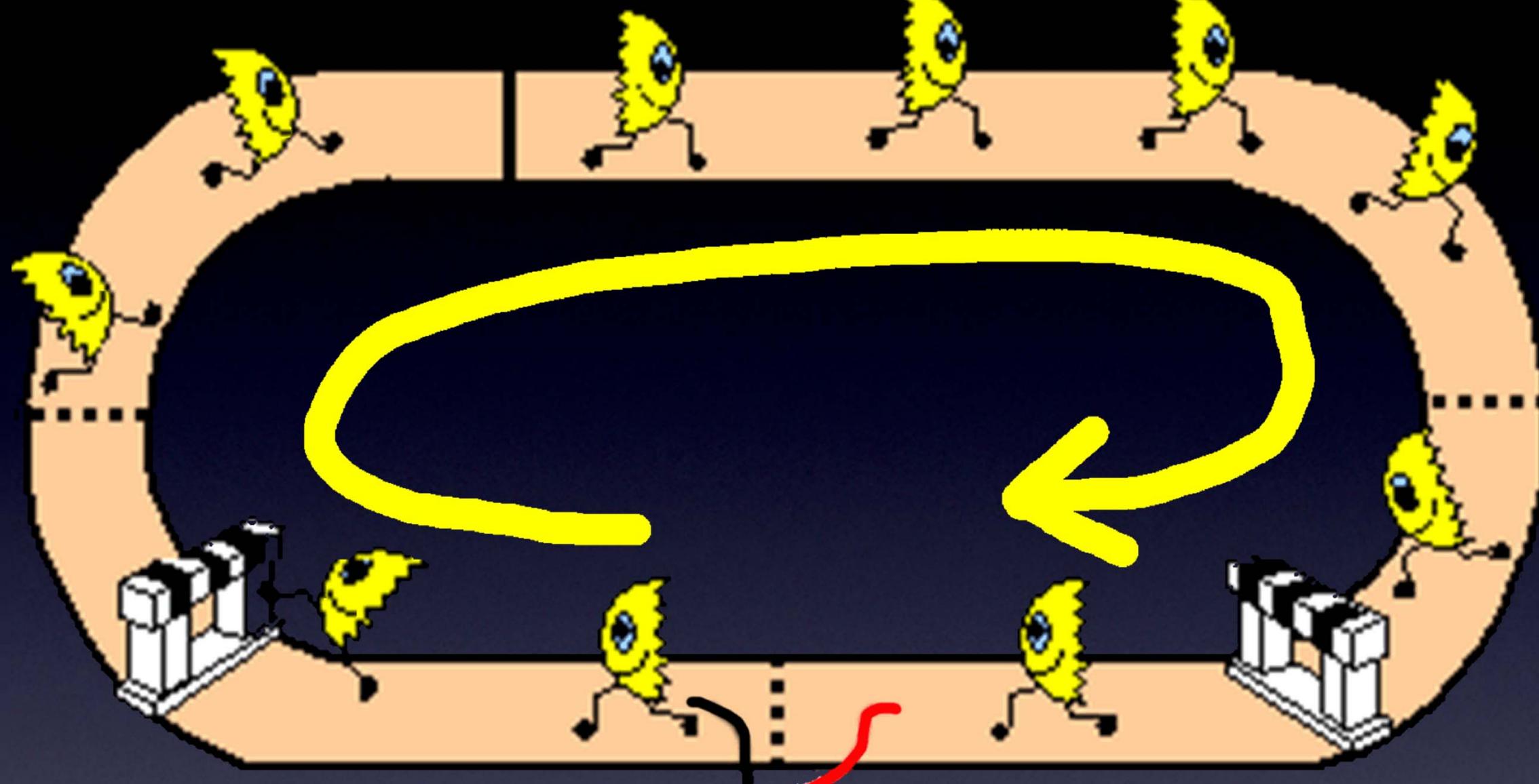


Minus / Negative (-)



Plus / Positive (+)

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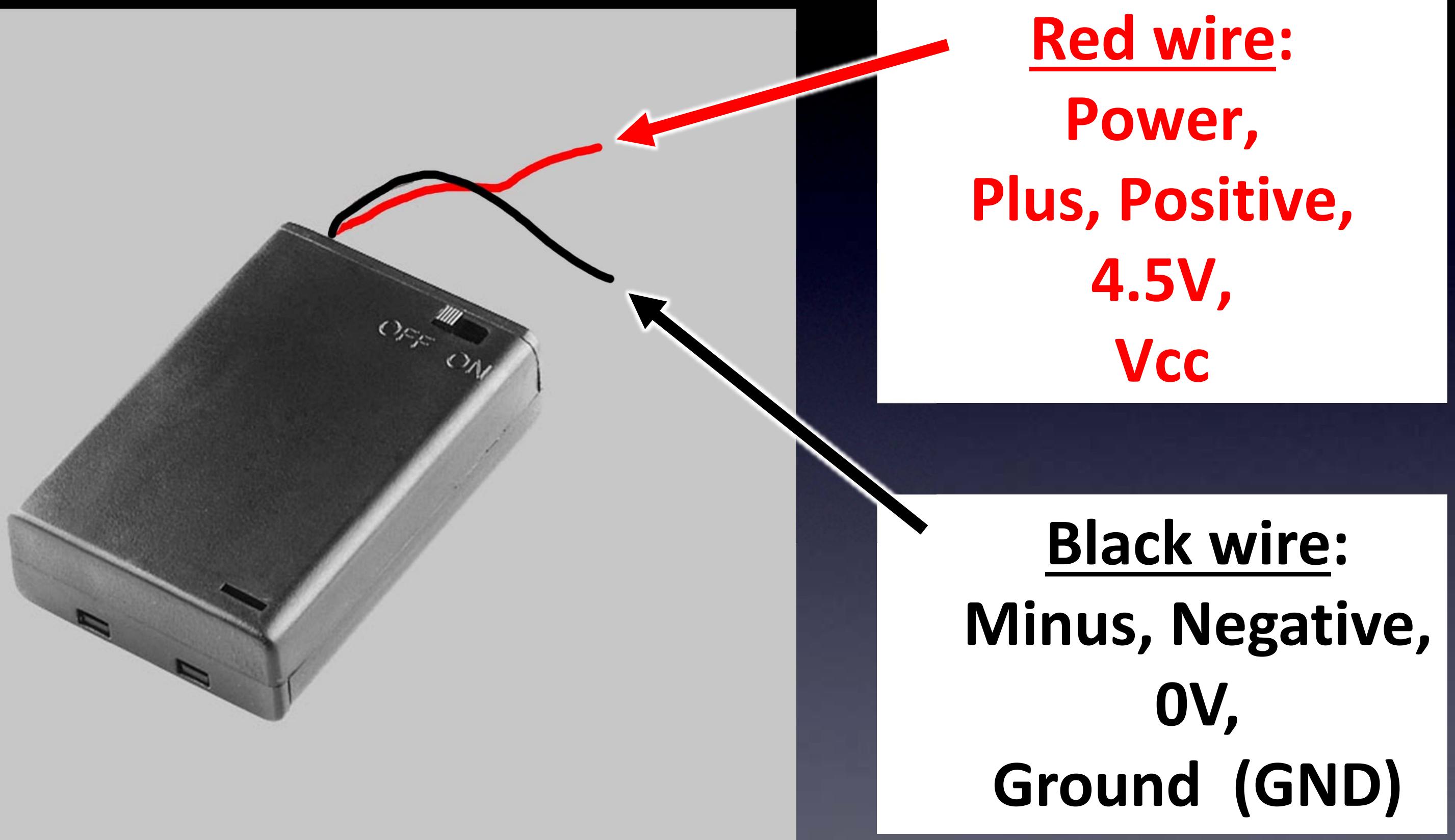
Black Wire = “-”



Red Wire = “+”

Power Supply – it matters how you connect it!

A Little About Electronics



Power Supply – it matters how you connect it!

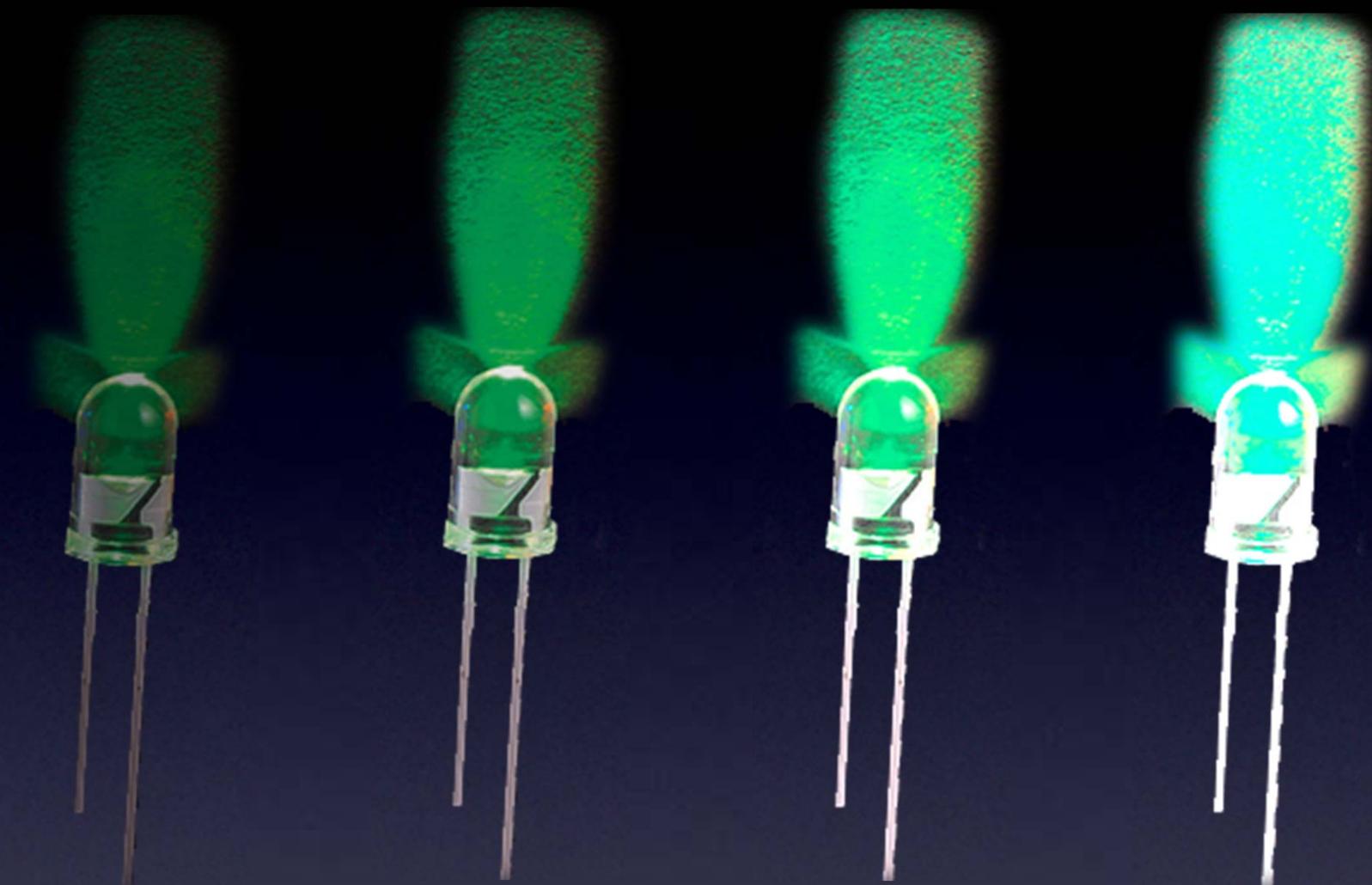
A Little About Electronics



Lots of different colored LEDs!

LED

A Little About Electronics



More current → More brightness! (until...)

LED

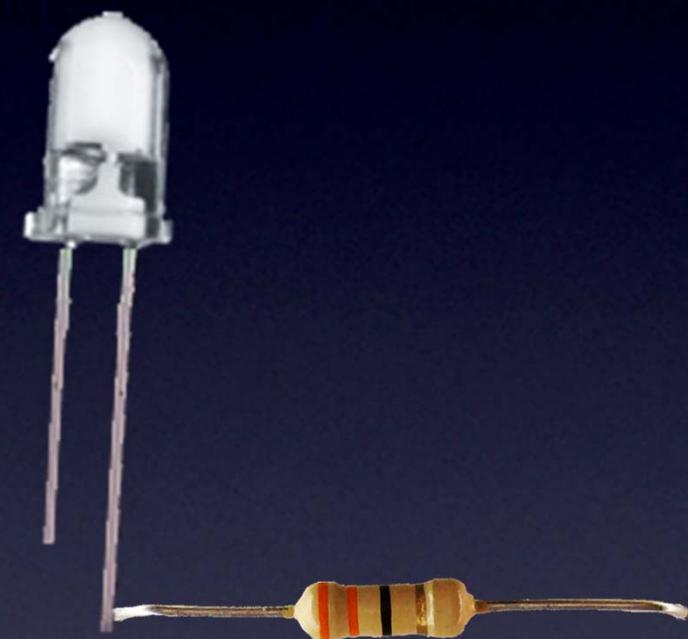
A Little About Electronics



More current → More brightness! (until...)

LED

A Little About Electronics

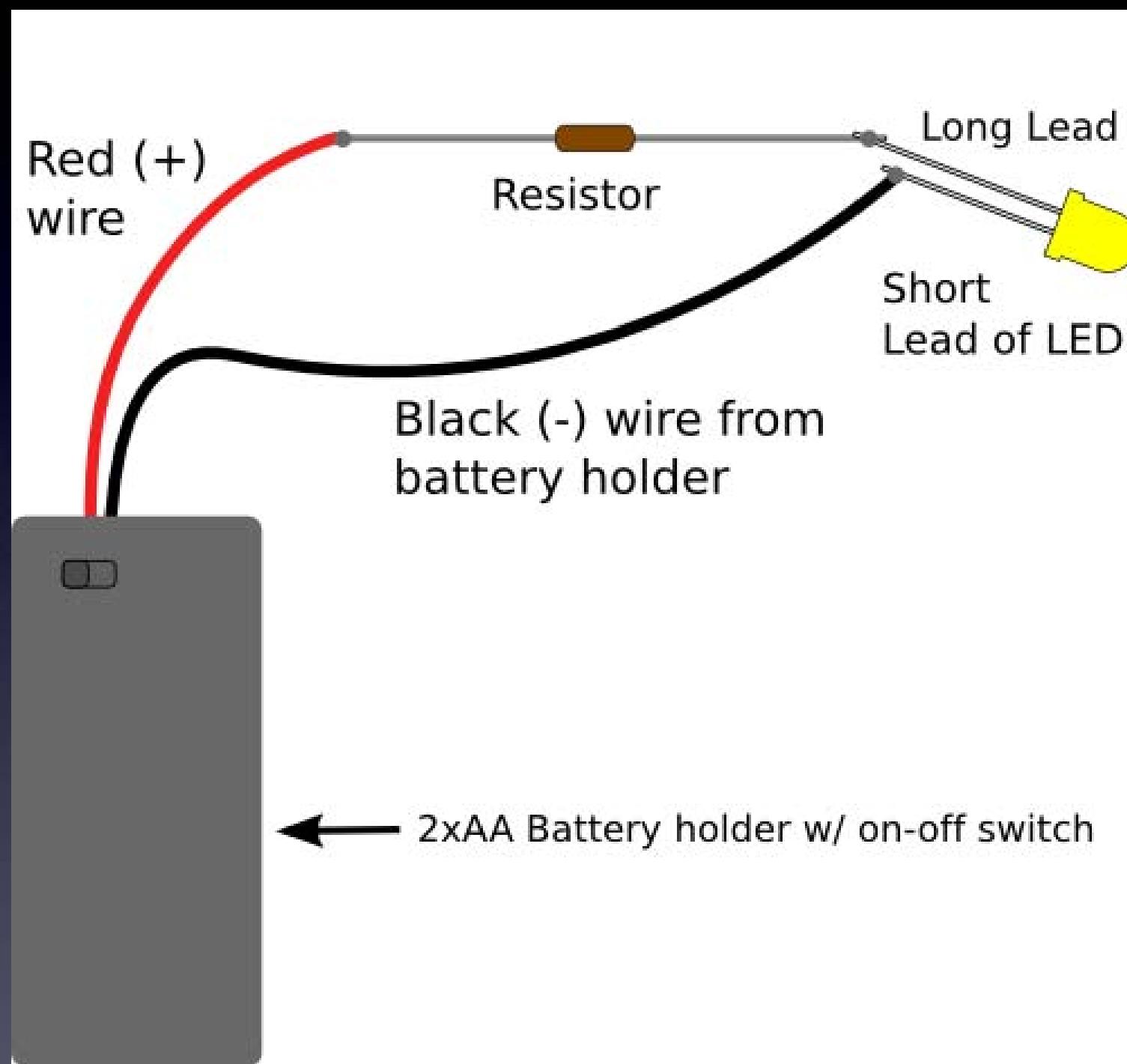


*(with a resistor
so no magic smoke goes away)*

This is why we put a resistor in line with an LED

LED

A Little About Electronics



Making an LED light up

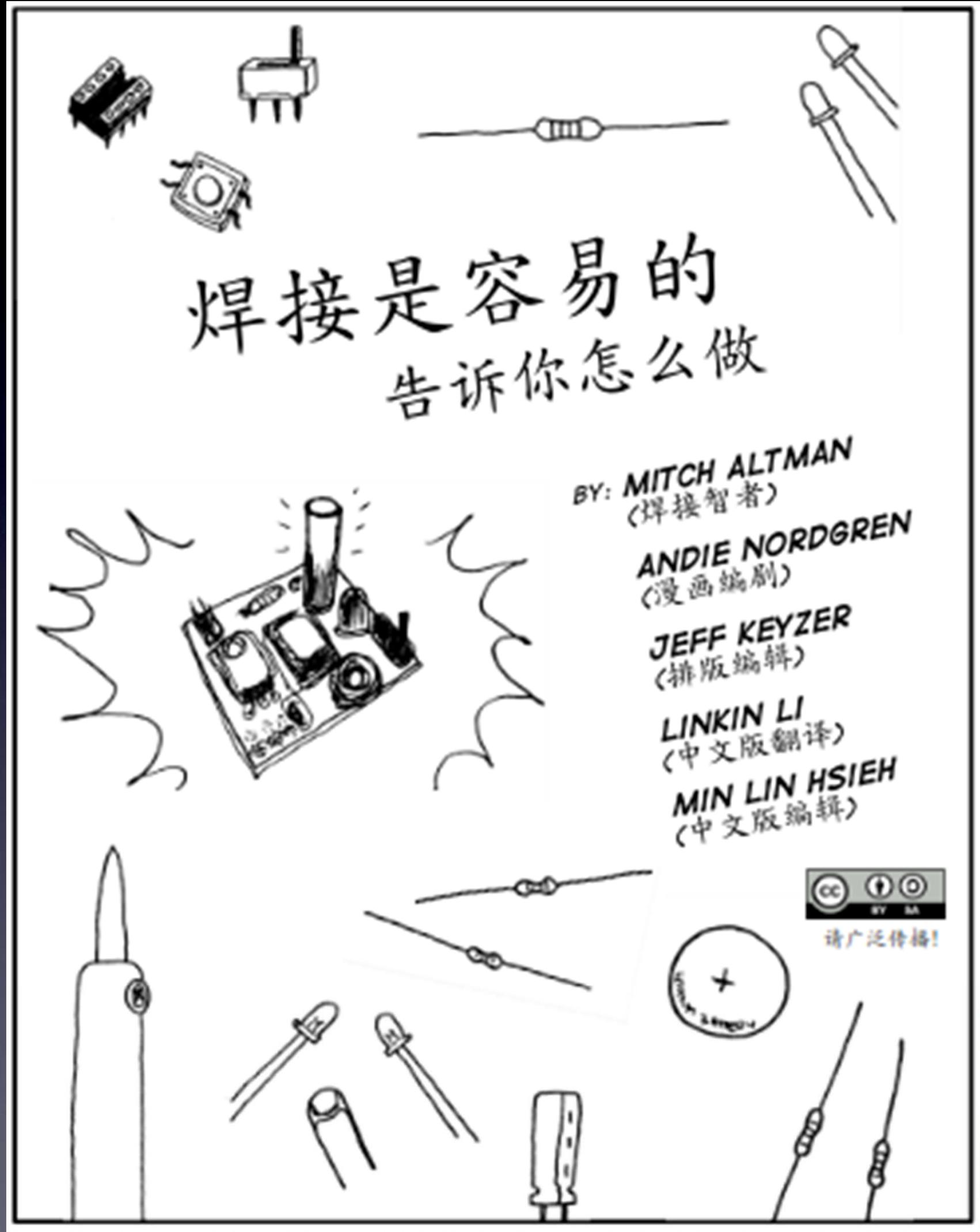
Learn To Solder



download for free at:

<http://mightyohm.com/soldercomic>

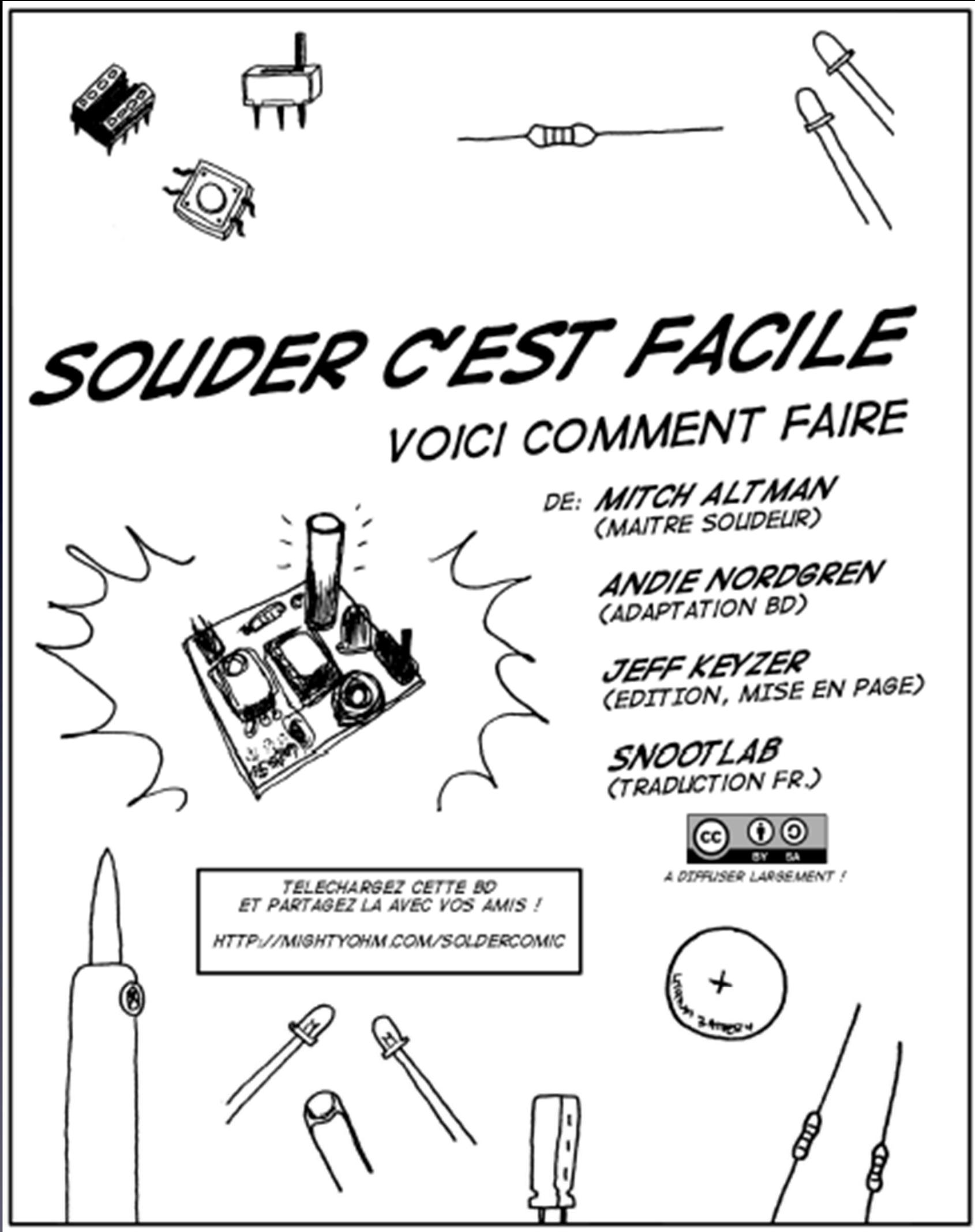
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Learn To Solder

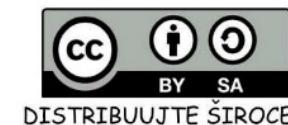
PÁJENÍ JE JEDNODUCHÉ
ZDE JE POPSÁNO JAK NA TO

BY: **MITCH ALTMAN**
(ZNALEC PÁJENÍ)

ANDIE NORDGREN
(TVORBA KOMIKSU)

JEFF KEYZER
(EDITACE A ROZLOŽENÍ)

JINDRA FUČÍK
(PŘEKLAD)



STÁHNĚTE SI TENTO KOMIKS A
SDÍLEJTE JEJ S PŘÁTELI!

[HTTP://MIGHTYOHM.COM/SOLDERCOMIC](http://mightyohm.com/soldercomic)



download for free at:

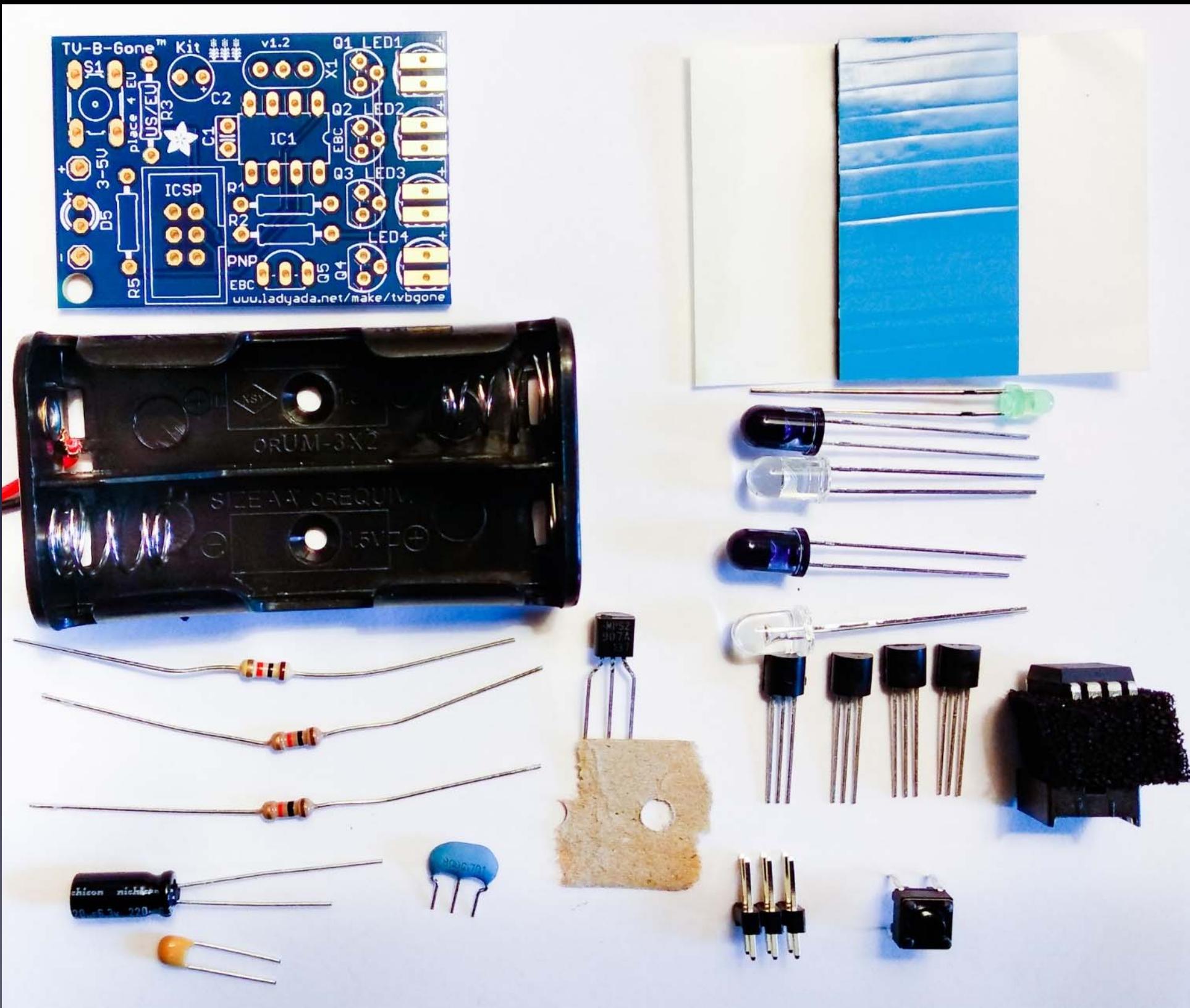
<http://mightyohm.com/soldercomic>

(Don't bring these
home)

Tools



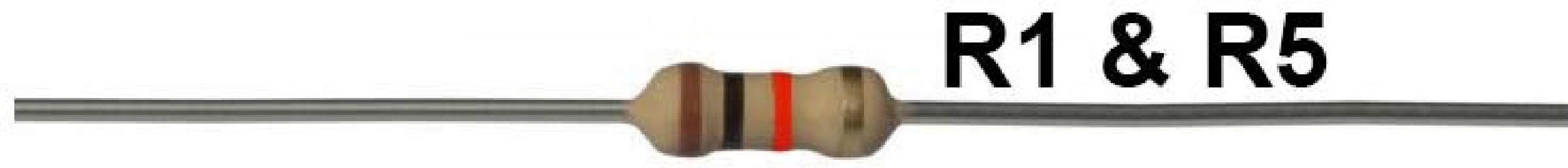
Parts



3 Resistors in the kit

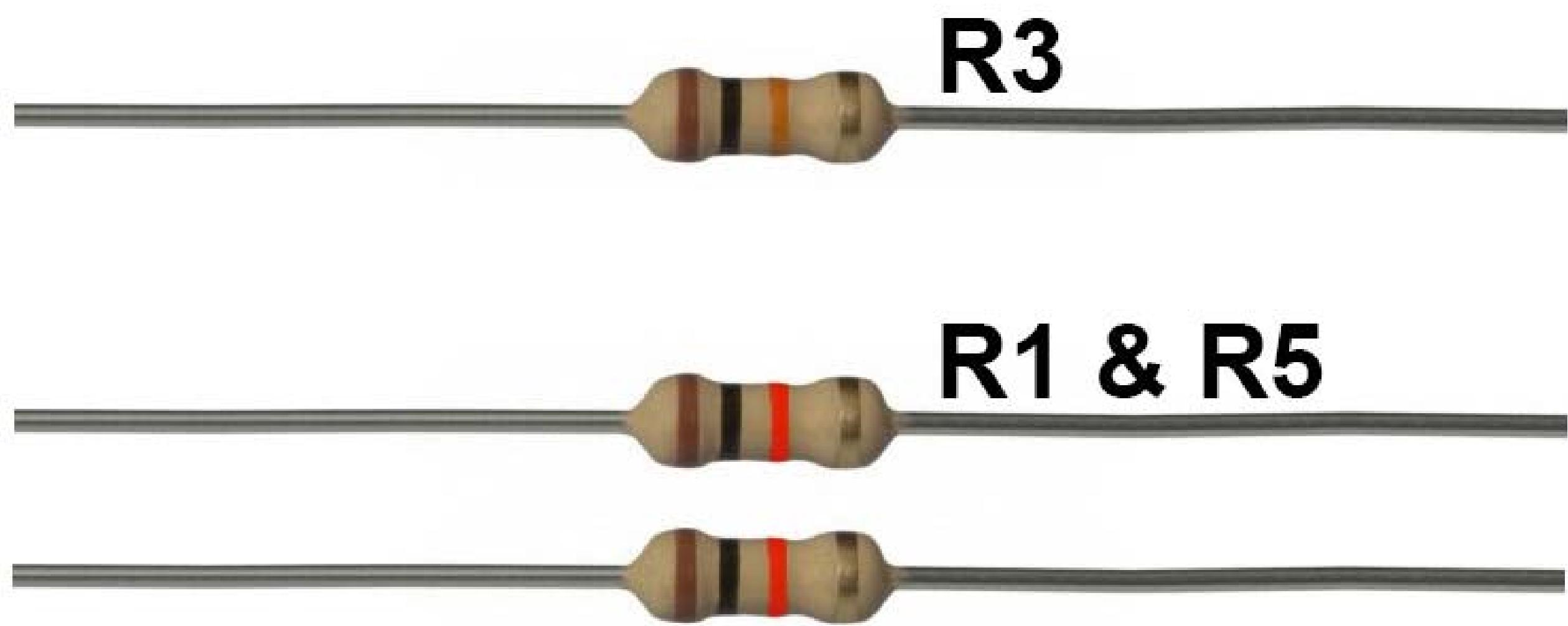


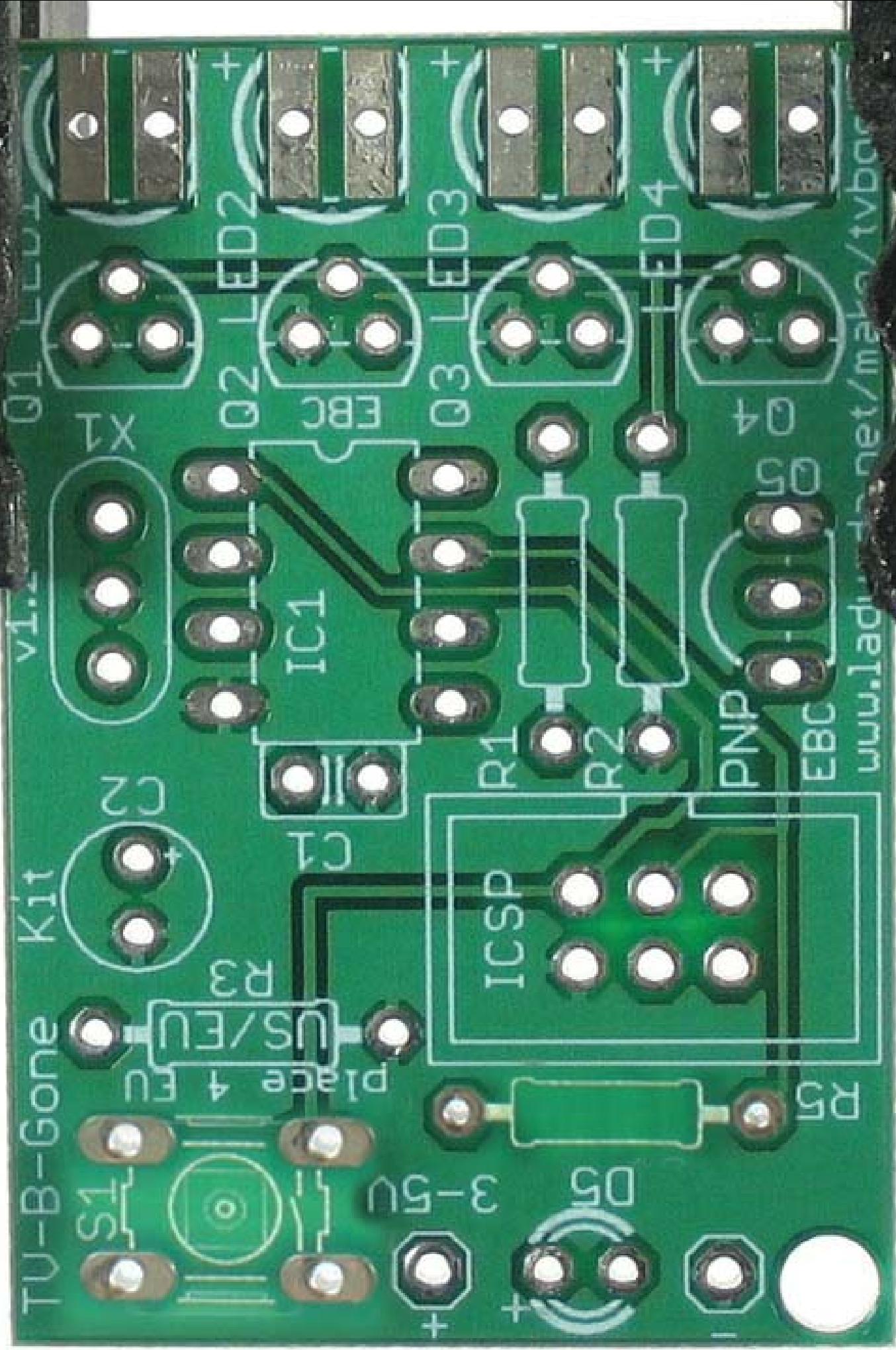
Brown, Black, Orange

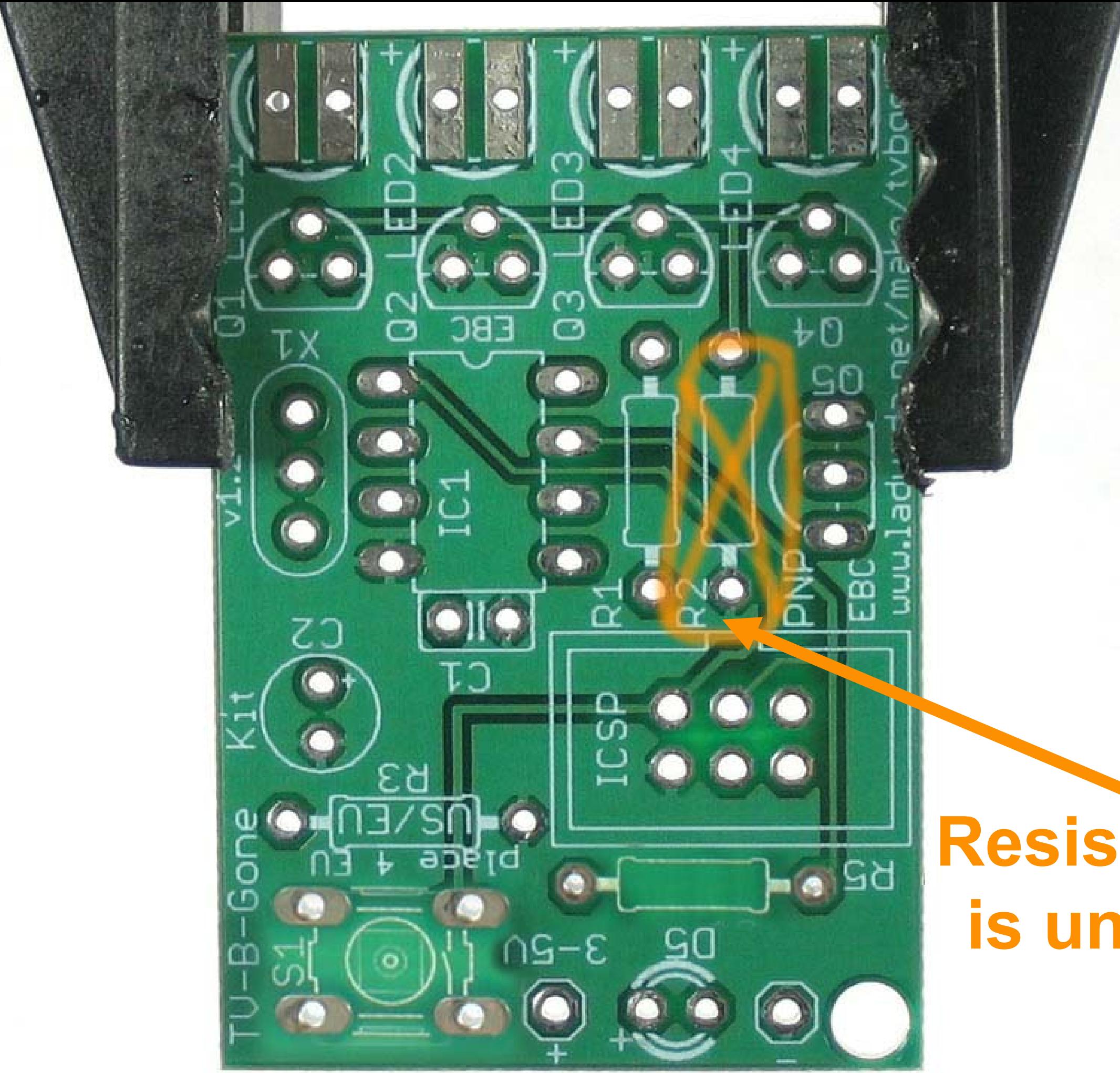


Brown, Black, Red

Look at the shape of these parts



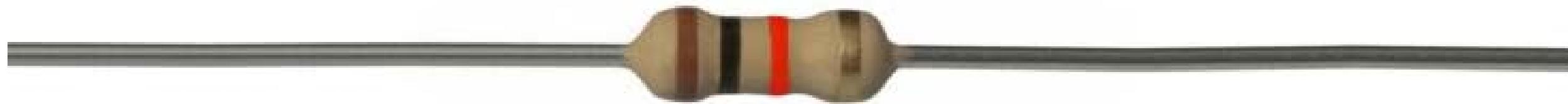




**Resistor R2
is unused**

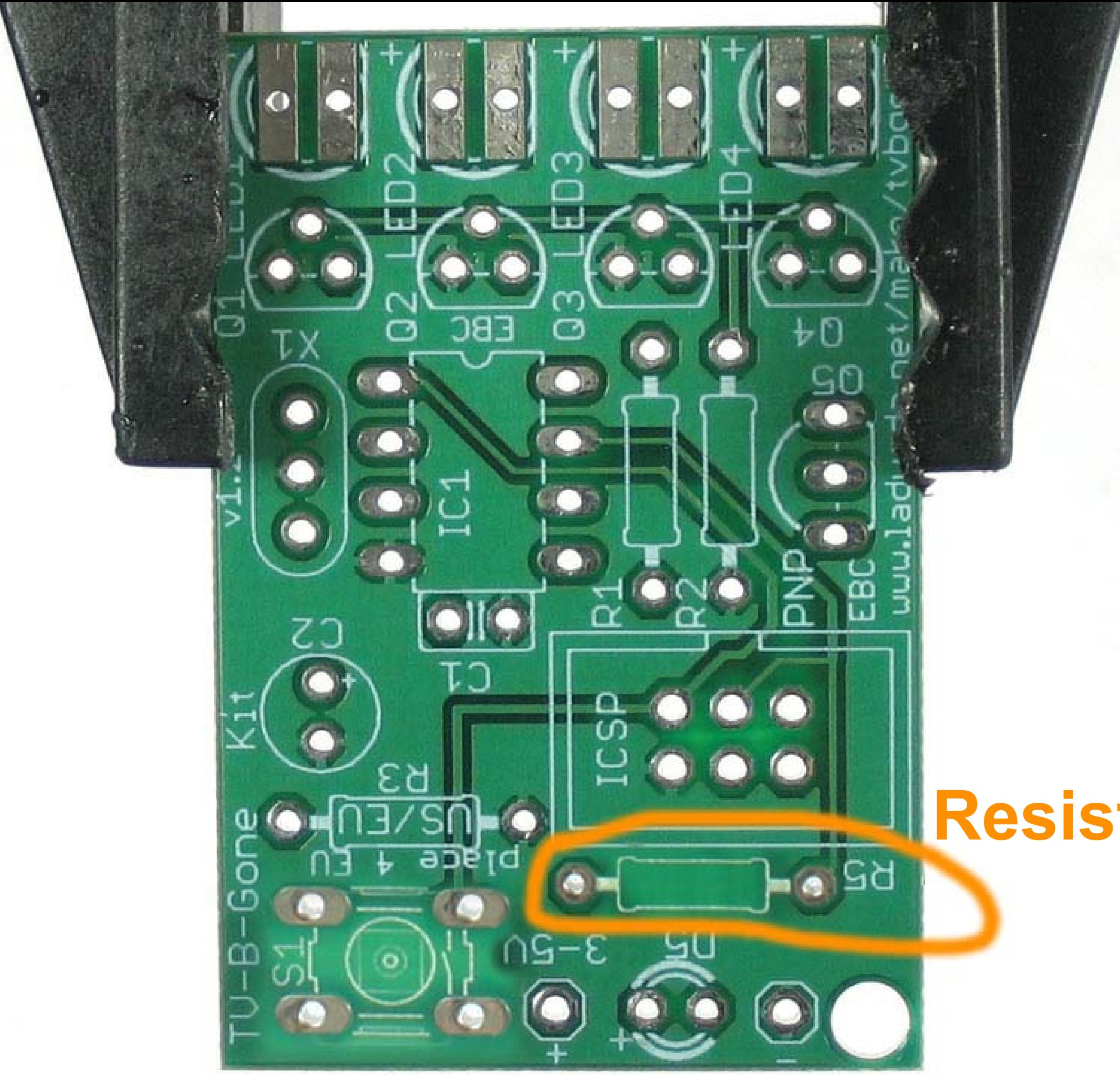
We will start with
Resistors R1 & R5

R1 & R5



1K Ohm: Brown, Black, Red



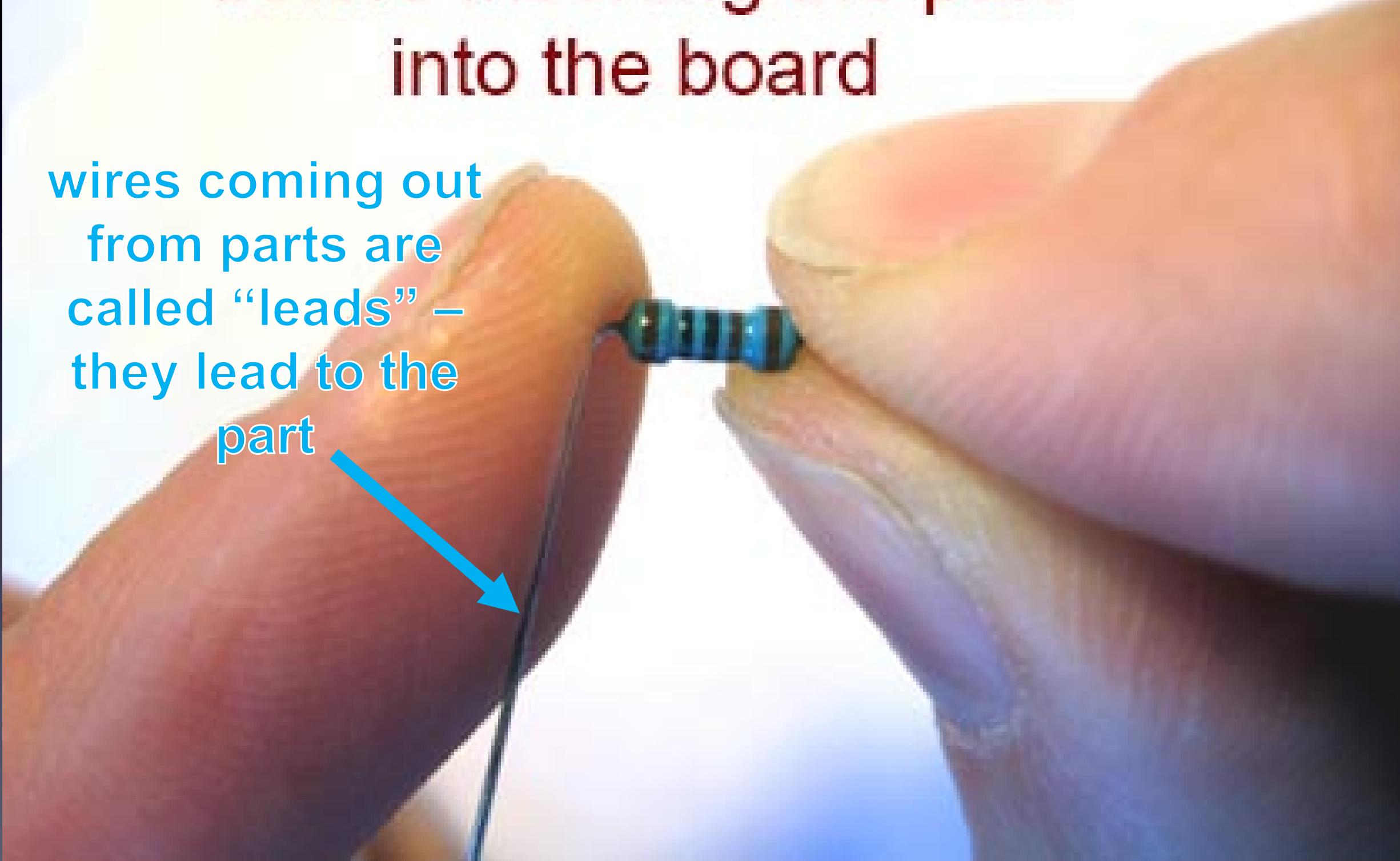


Resistor R5

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



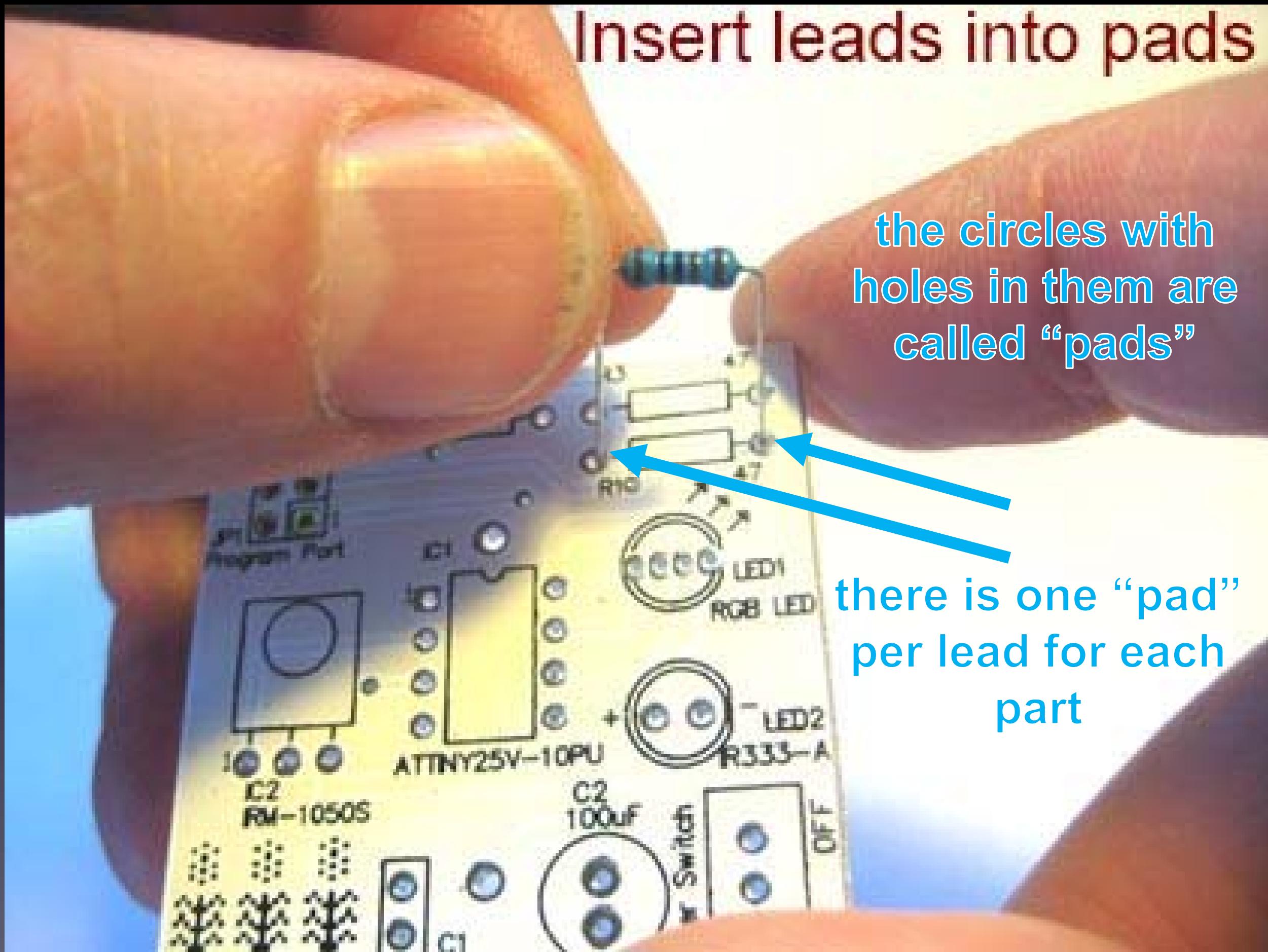


R5 – this is how it will look before inserting it into the board

Insert leads into pads

the circles with
holes in them are
called “pads”

there is one “pad”
per lead for each
part



R3: leads inserted
into their pads



R3: board upside down



Bend leads
half way out
(only half way) like a “V”

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

R3: board upside down



Bend leads
half way out
(only half way) like a “V”

Ready to Solder !



How to hold a soldering iron

(Like a pencil – held from underneath)

Important

The perfect kind of solder for
electronics:

60/40 rosin core,
0.031" (0.7mm) diameter (or smaller)

(63/37 is also good)

Important:

Use solder **WITH** lead (Pb) !!
lead-free solder
has very poisonous fumes!

The perfect kind of solder for electronics:

This is also good !

Lead-Free



Sn/Cu0.7/Ni0.05/Ge0.006

3 Safety Tips...

Safety Tip #1:

Hot !!

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

Safety Tip #2:

Lead (Pb) is toxic

But it easily washes 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):

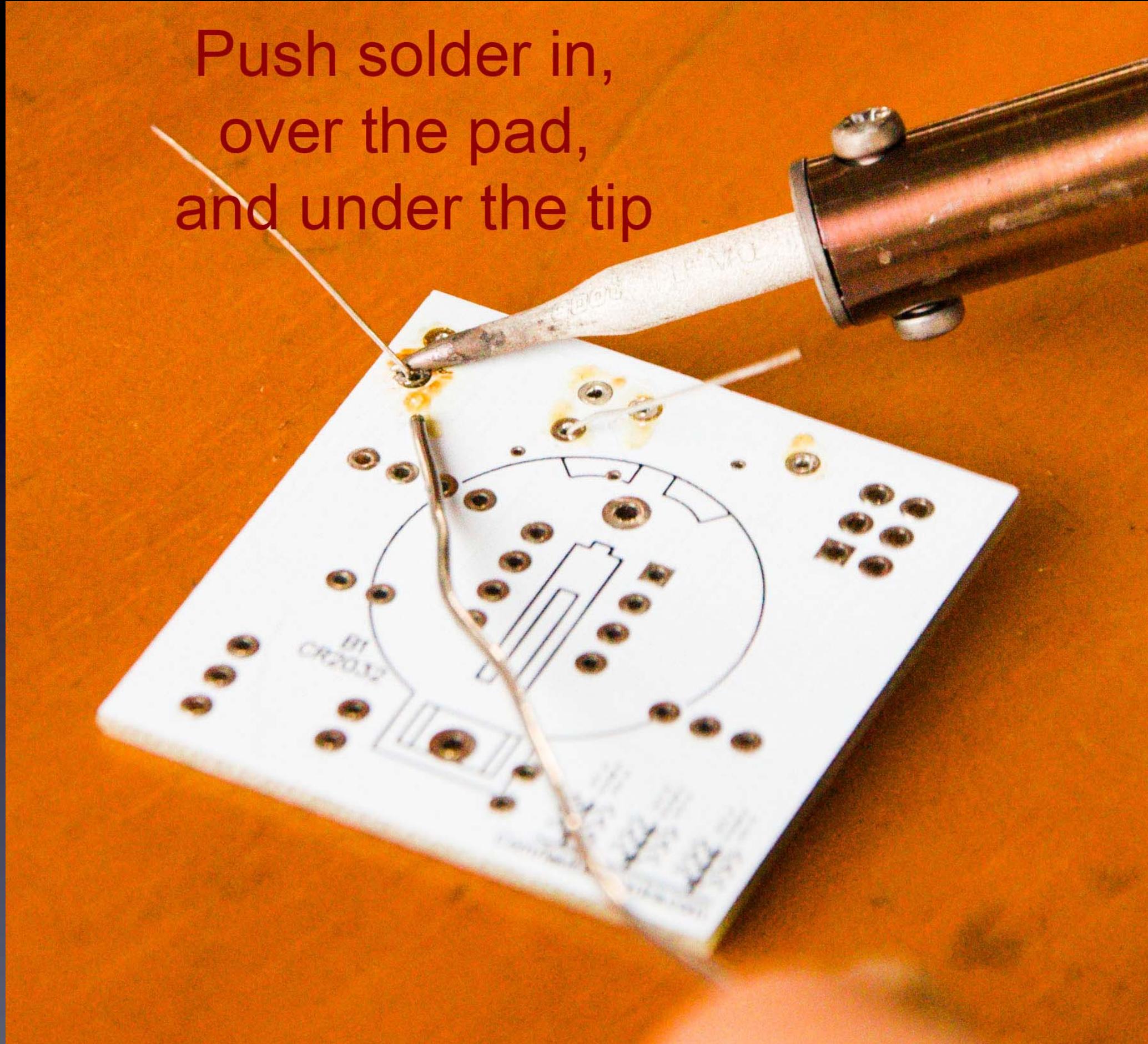
Keep the tip shiny silver!

knock solder off the tip

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

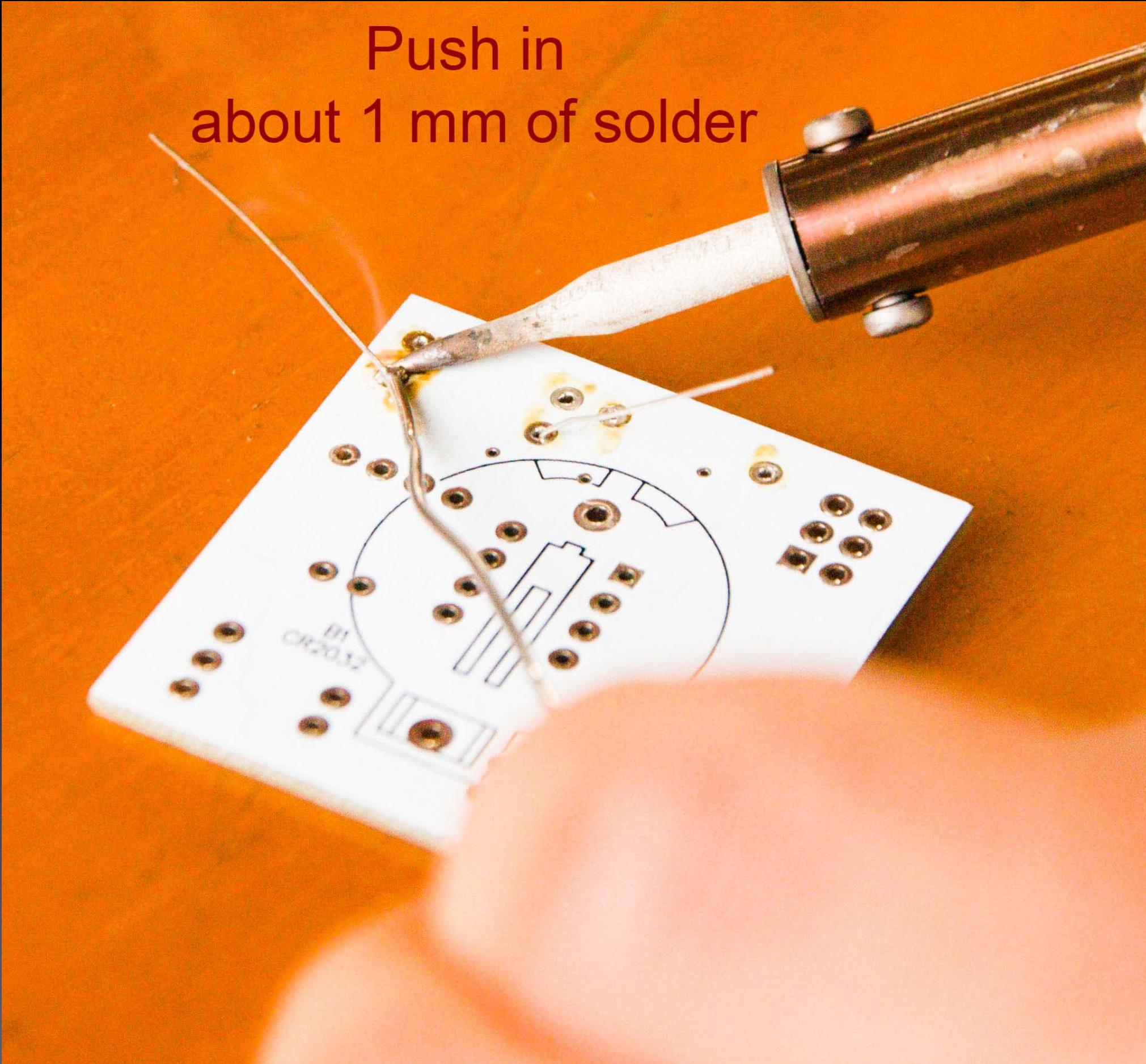


Do this quickly (slowly doesn't work well) – solder in & out in about 1 second

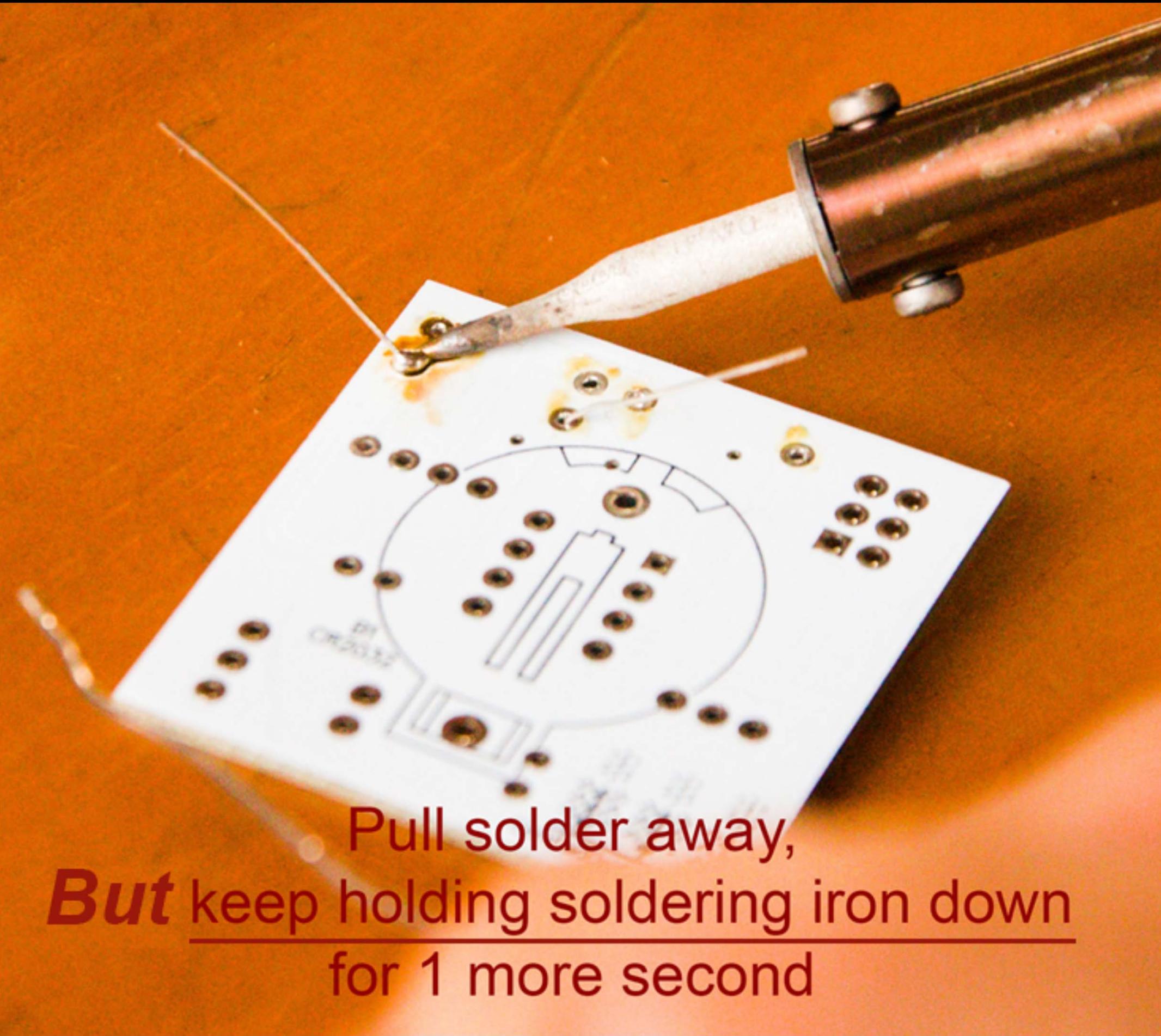


Make sure solder melts on the underside of the soldering iron tip
(not the side or top of the soldering iron tip)!

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



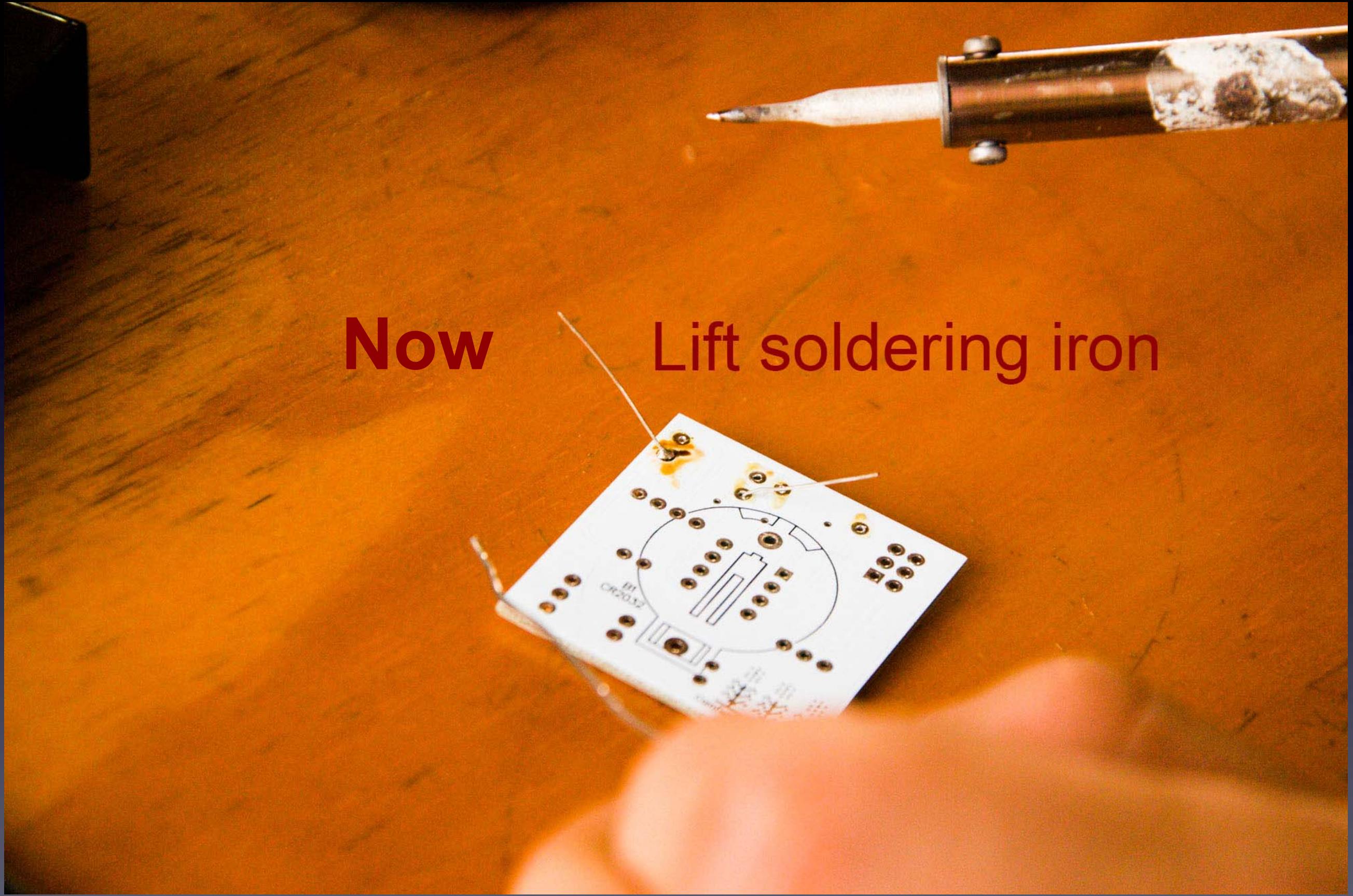
Make sure solder melts on the underside of the soldering iron tip
(not the side or top of the soldering iron tip)!



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

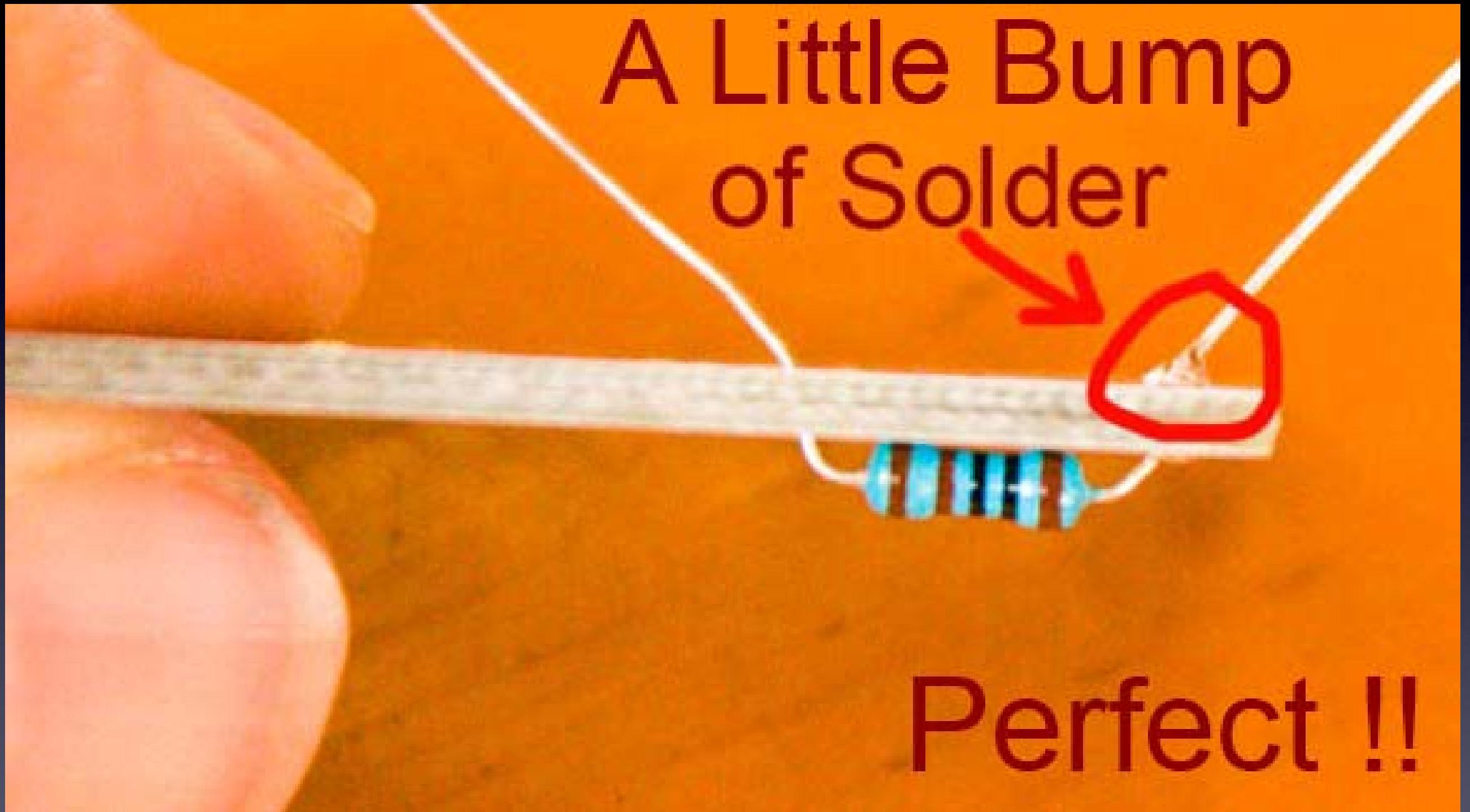
Secret #2:

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



Now

Lift soldering iron



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 !
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)



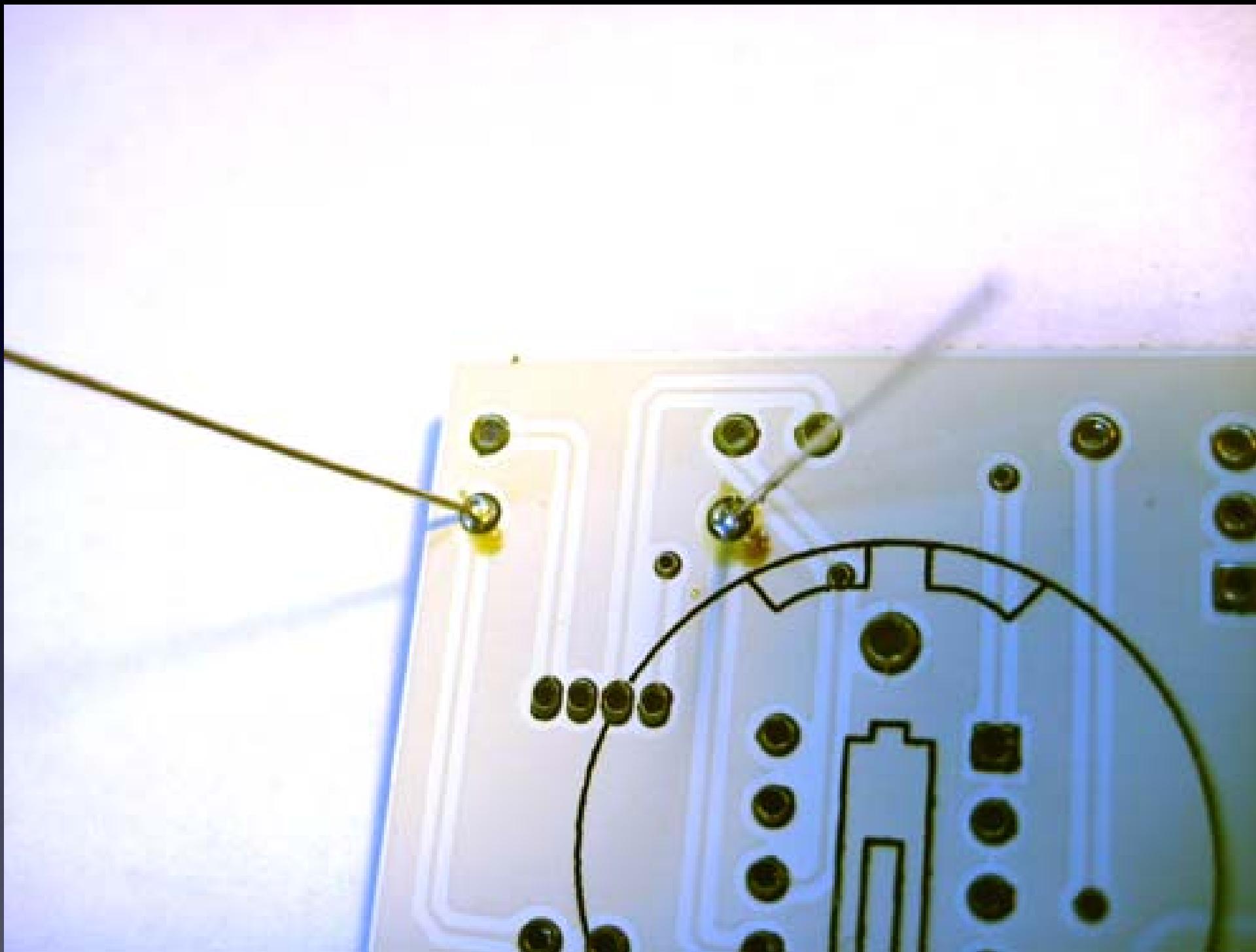
WAIT !

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



Lift Tip

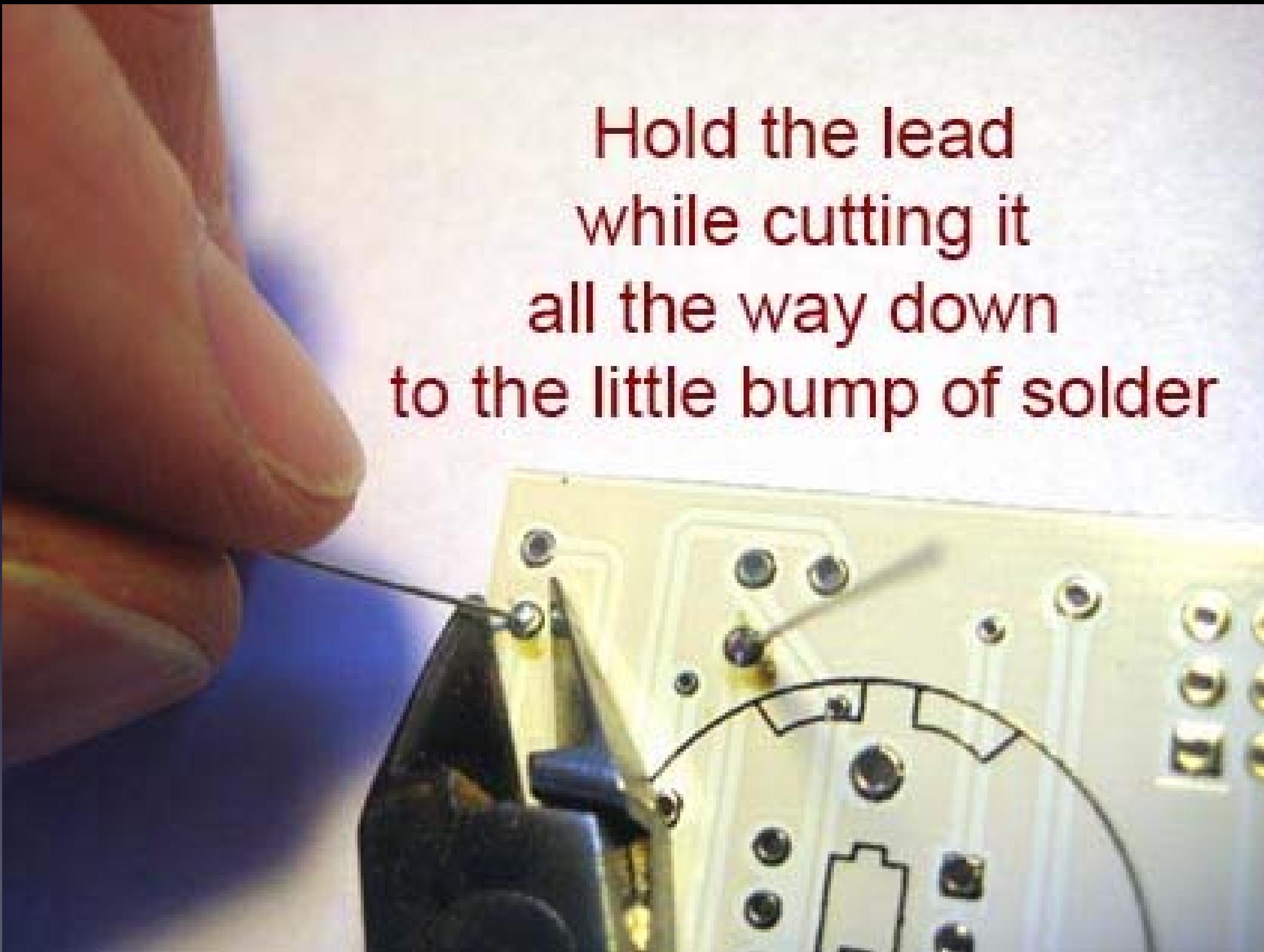
Solder all of the leads of the part to the board



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

Now cut the leads short

Hold the lead
while cutting it
all the way down
to the little bump 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.)

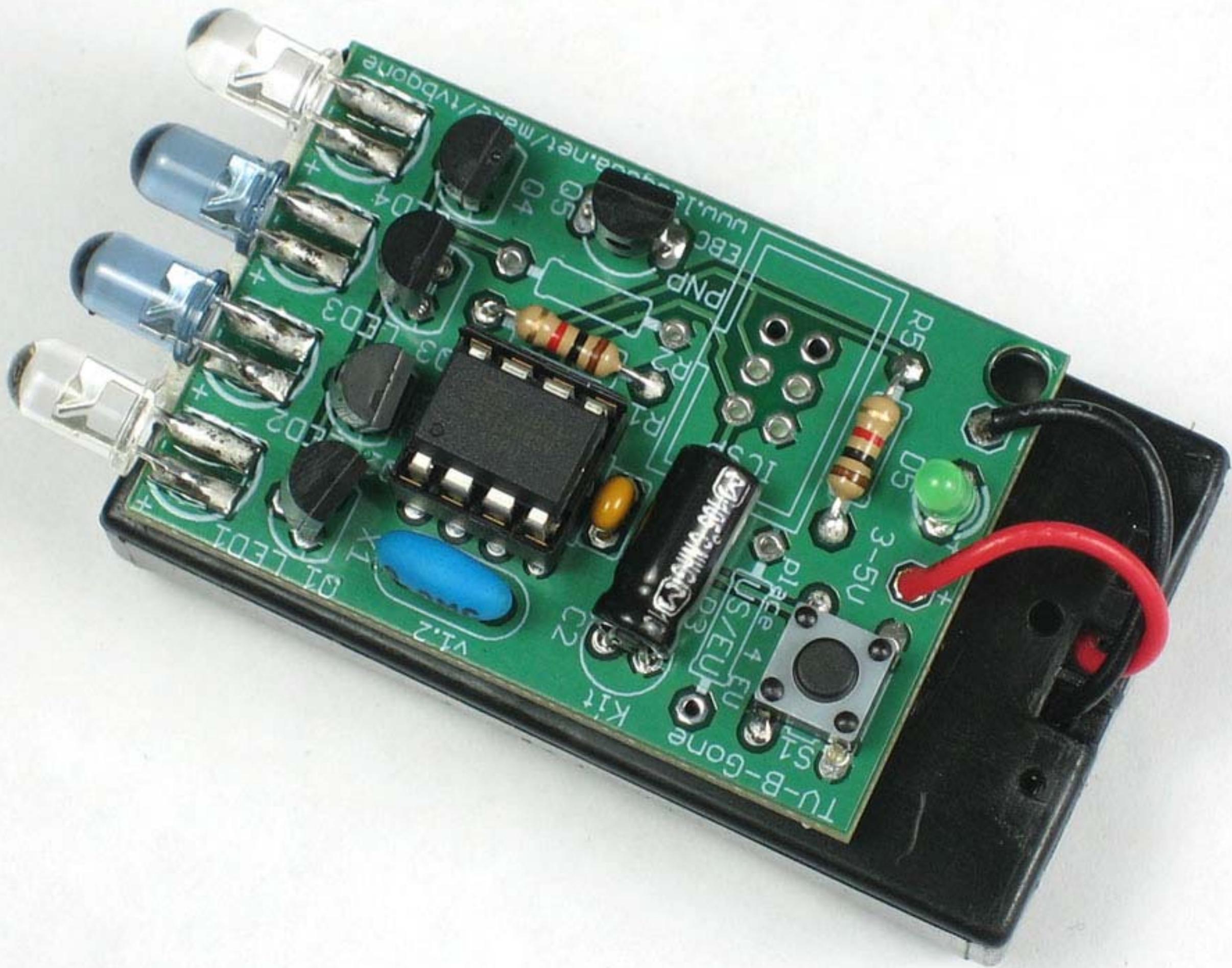


All done !

No wires sticking out

One part at a time

Till all the parts are soldered

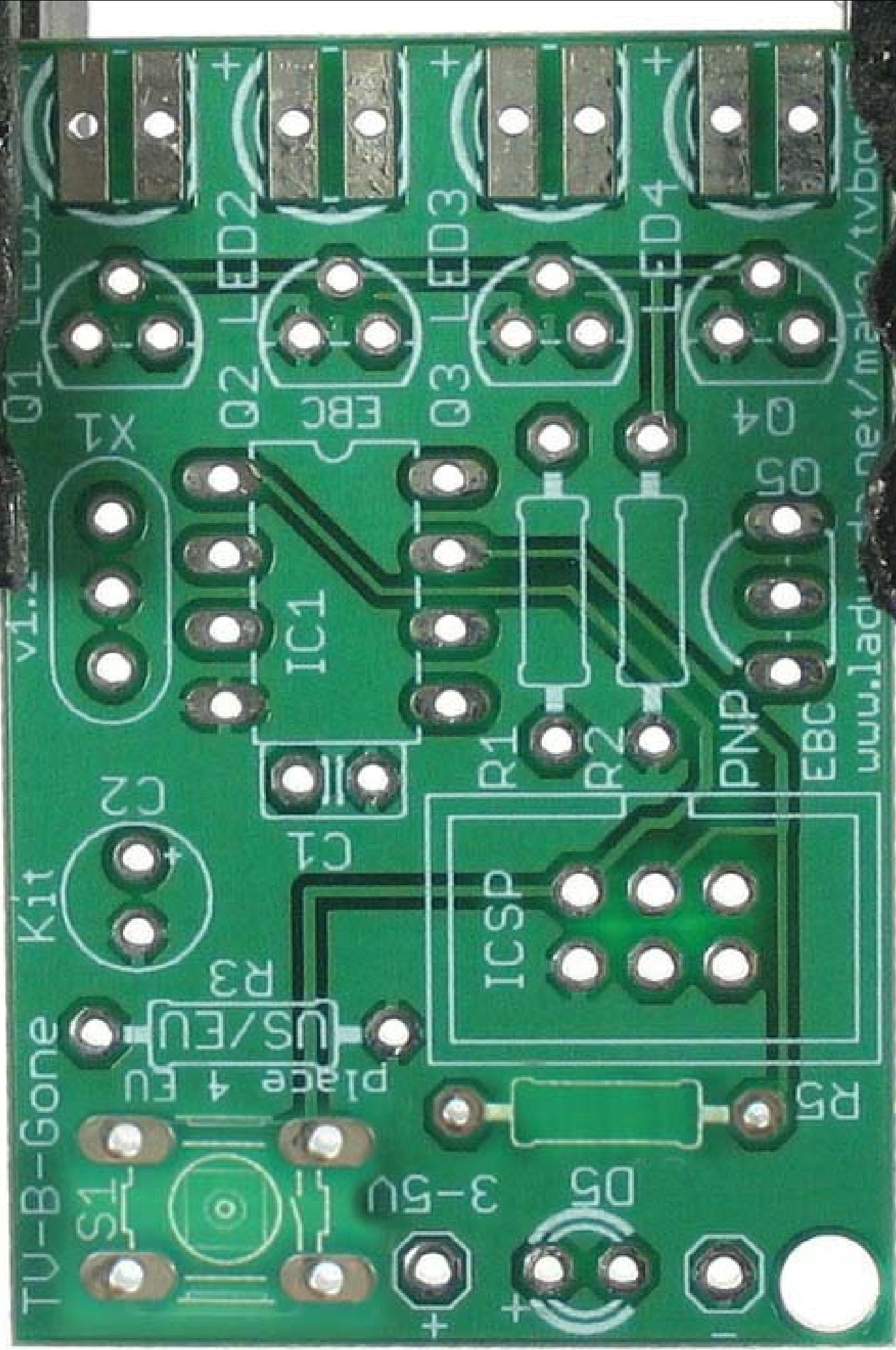


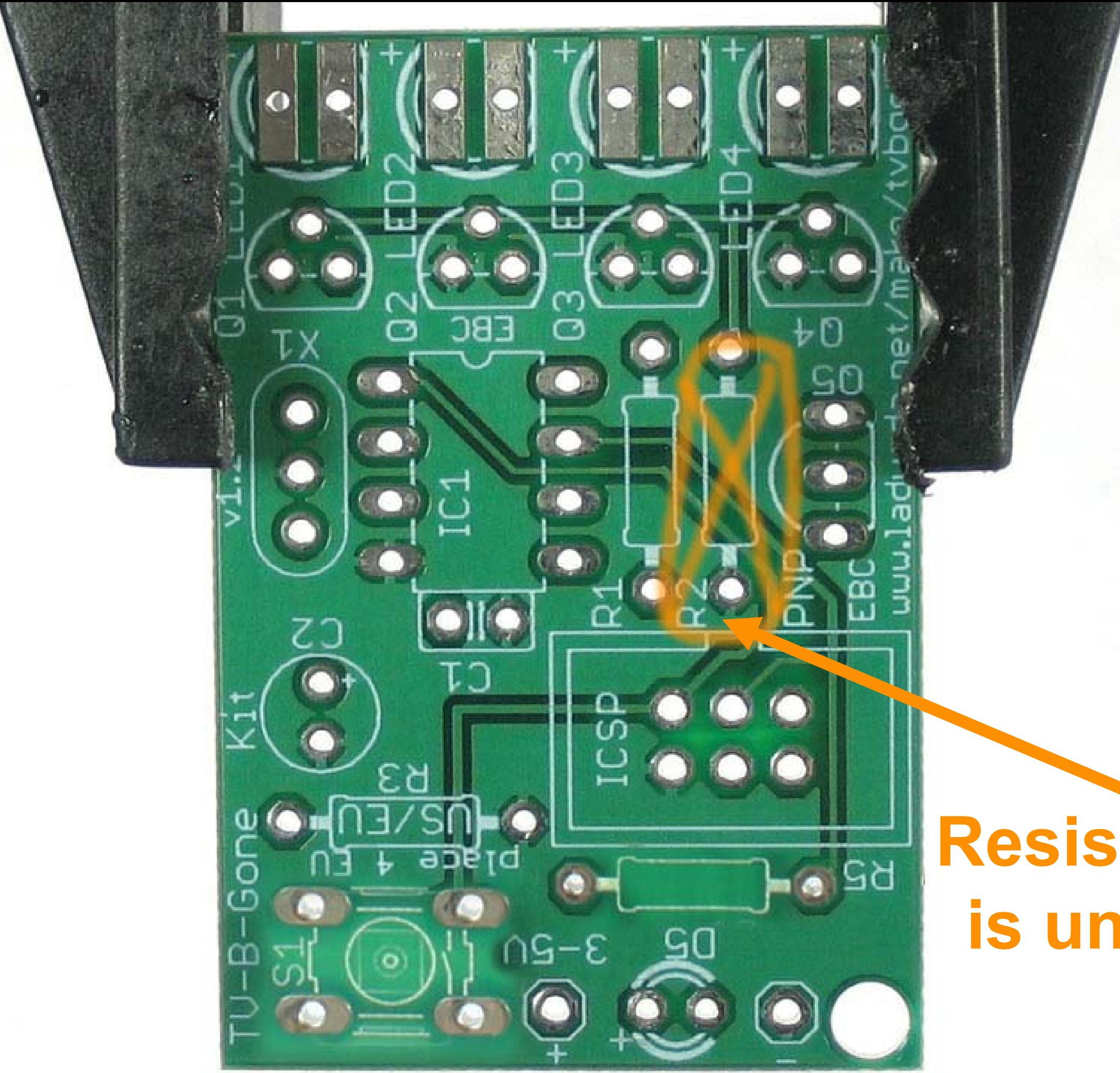
Then test with batteries,

And it works!

(Or you start debugging.)

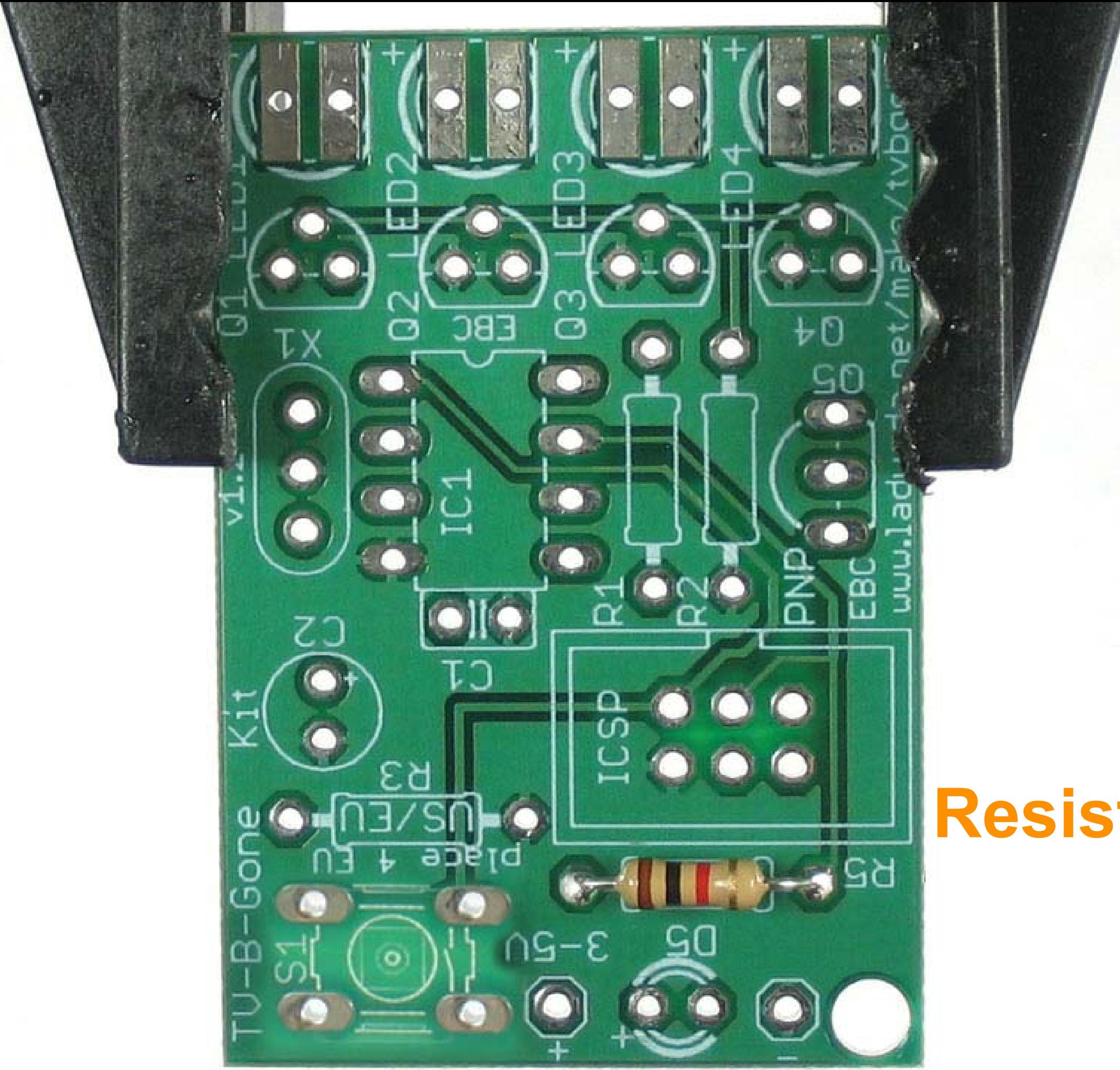
Let's start!

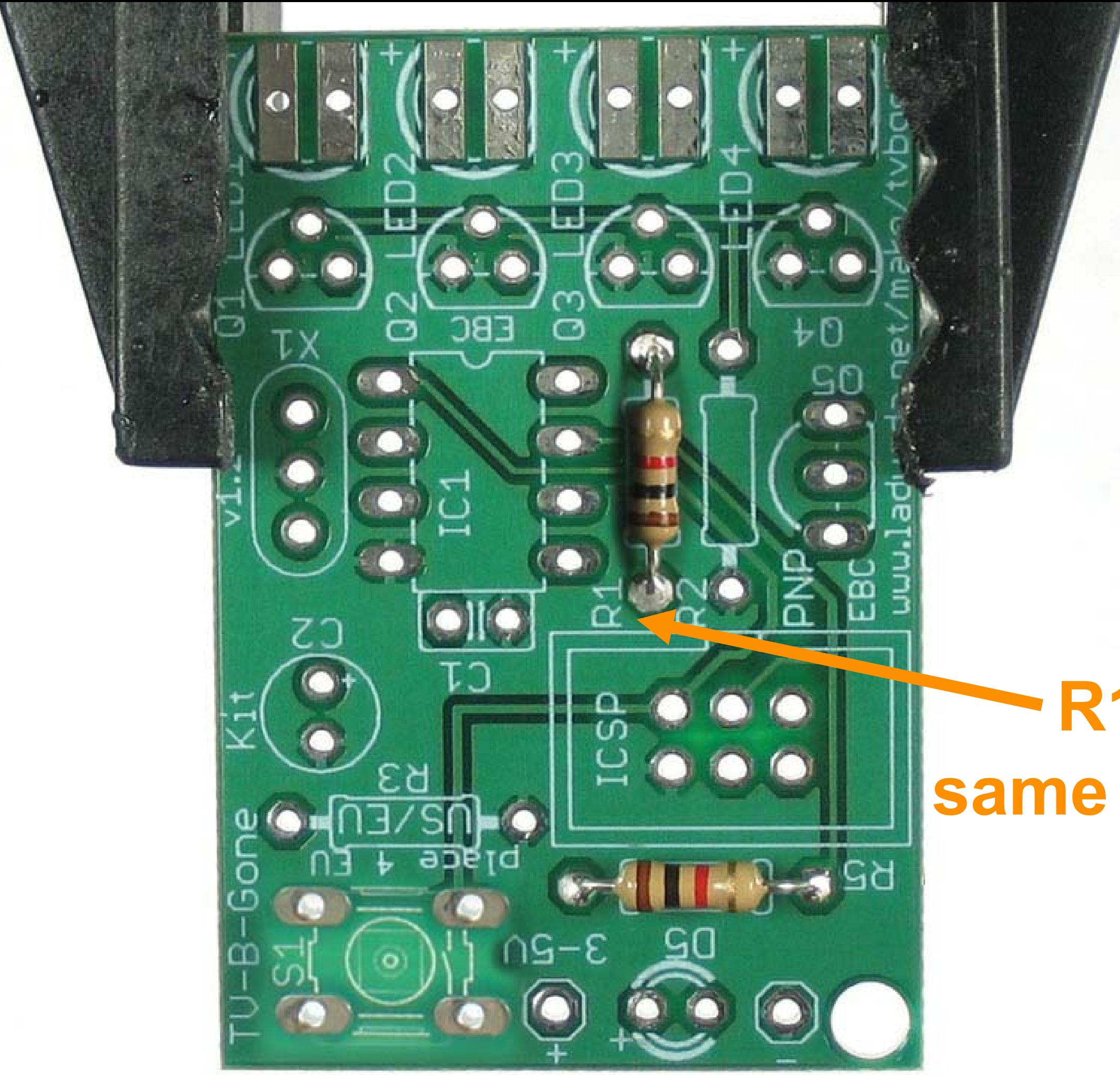




**Resistor R2
is unused**

Resistor R5



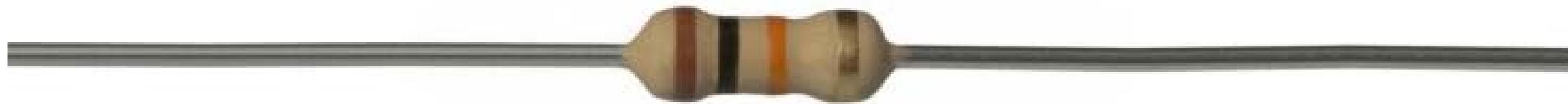


R1

same as R5

Resistor R3 is ONLY for Europe

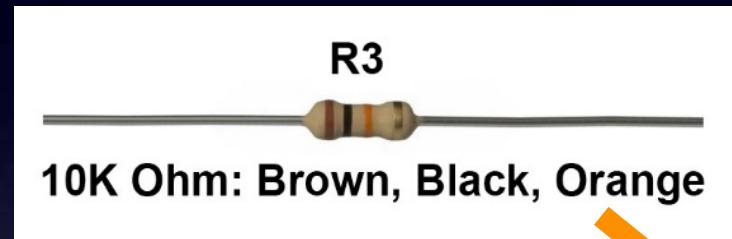
R3



10K Ohm: Brown, Black, Orange

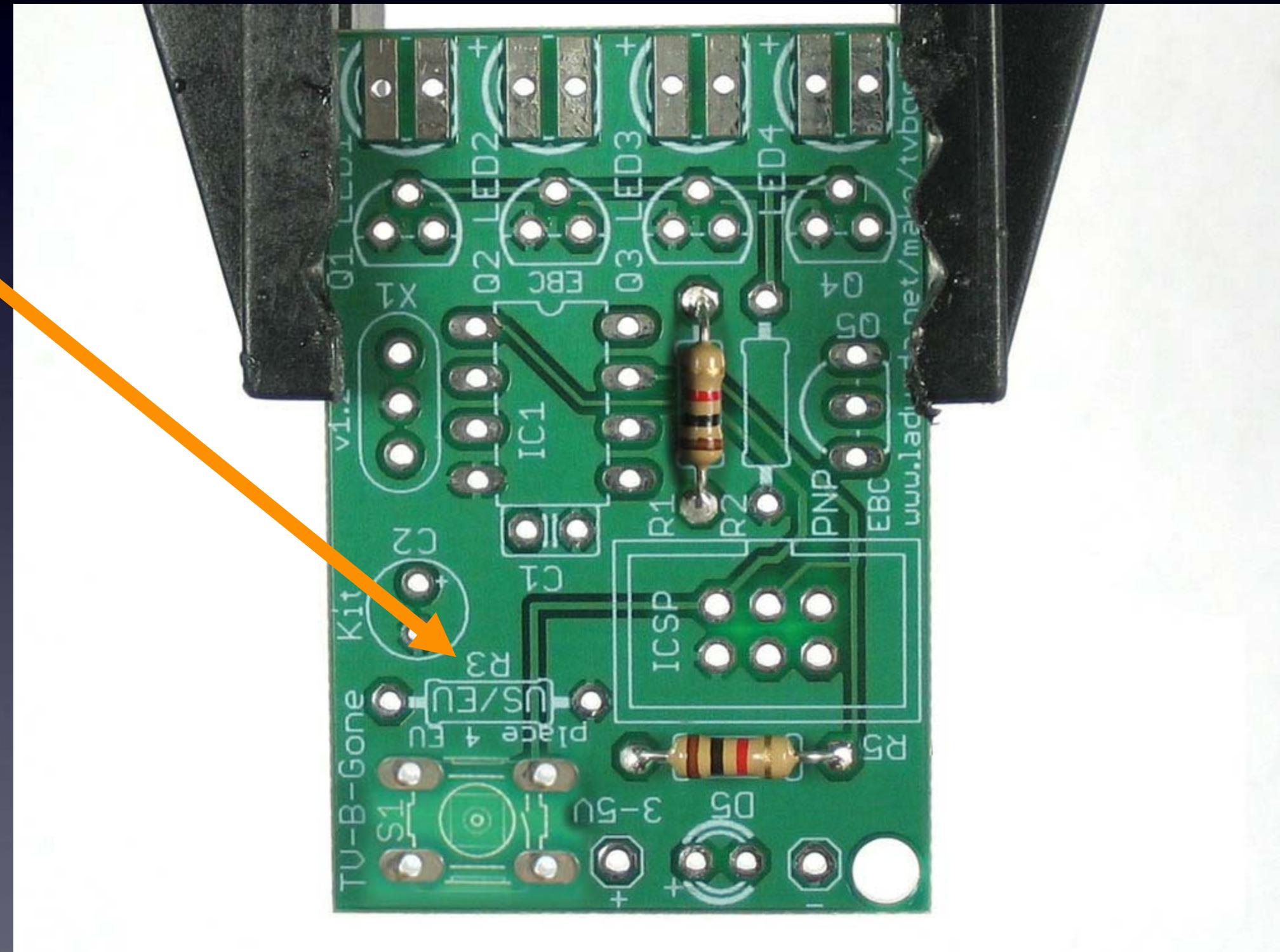


Resistor R3 is ONLY for Europe



For Europe:
use R3

For North
America:
no R3



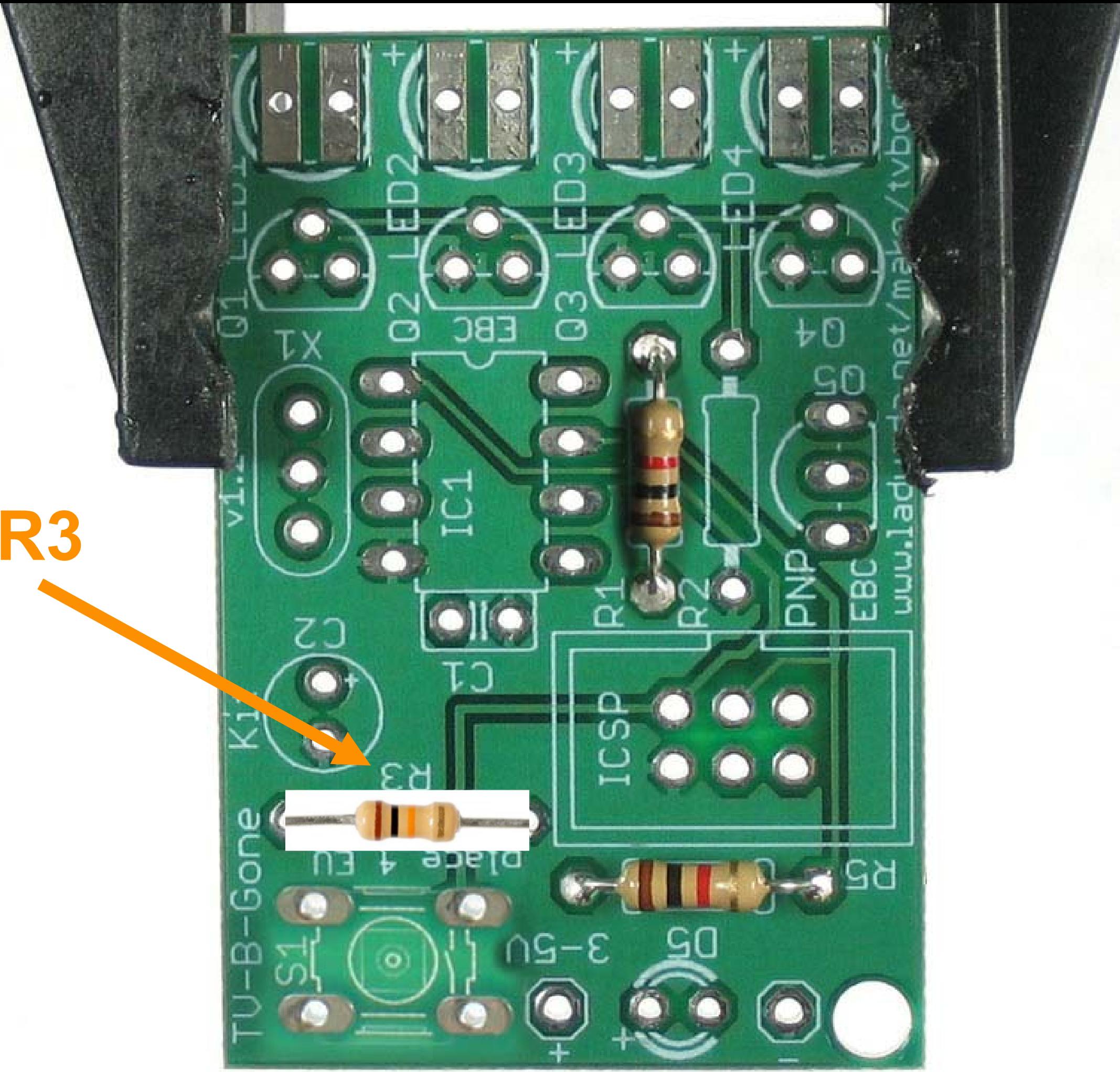
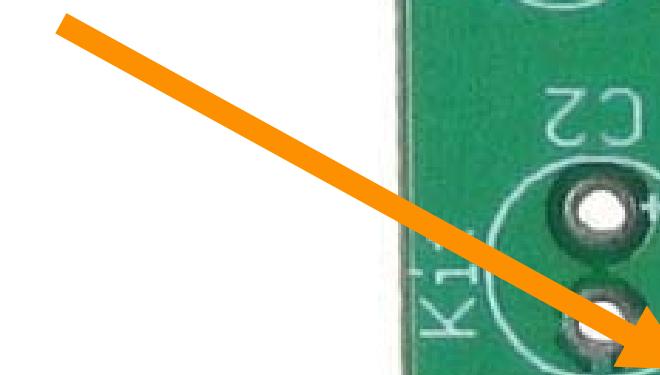
We will use
Resistor R3

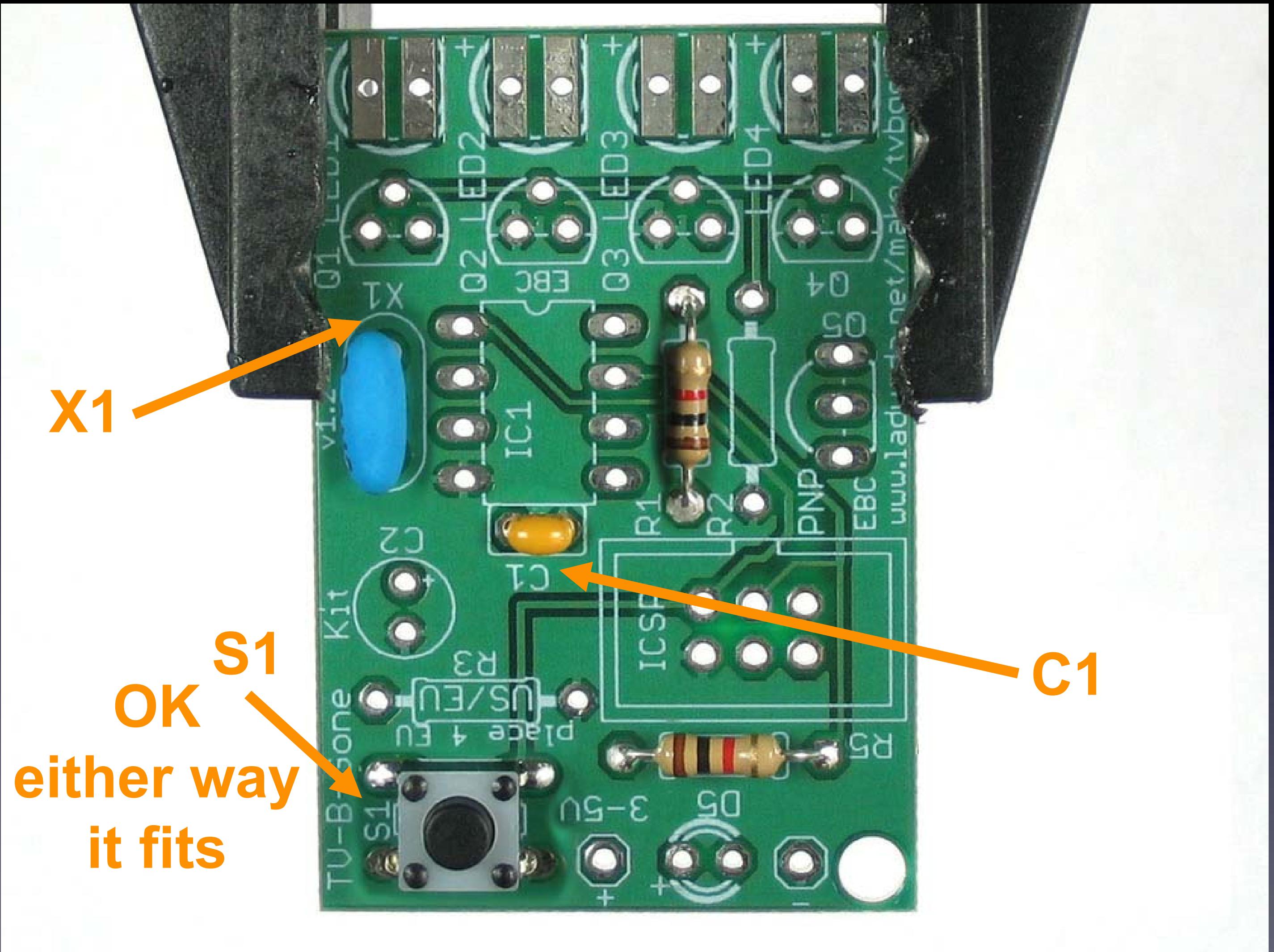


10K Ohm: Brown, Black, Orange

(for Europe)

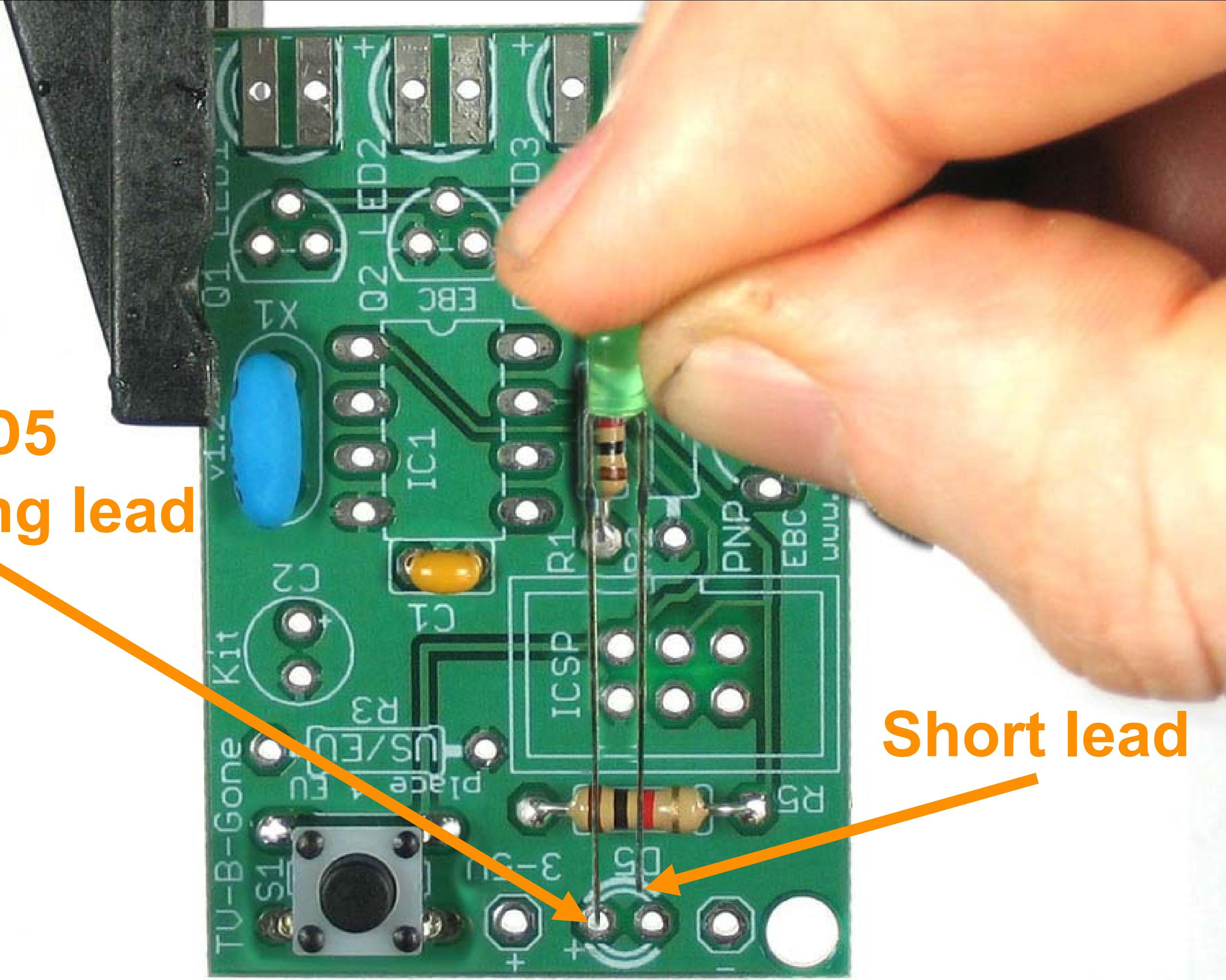
R3

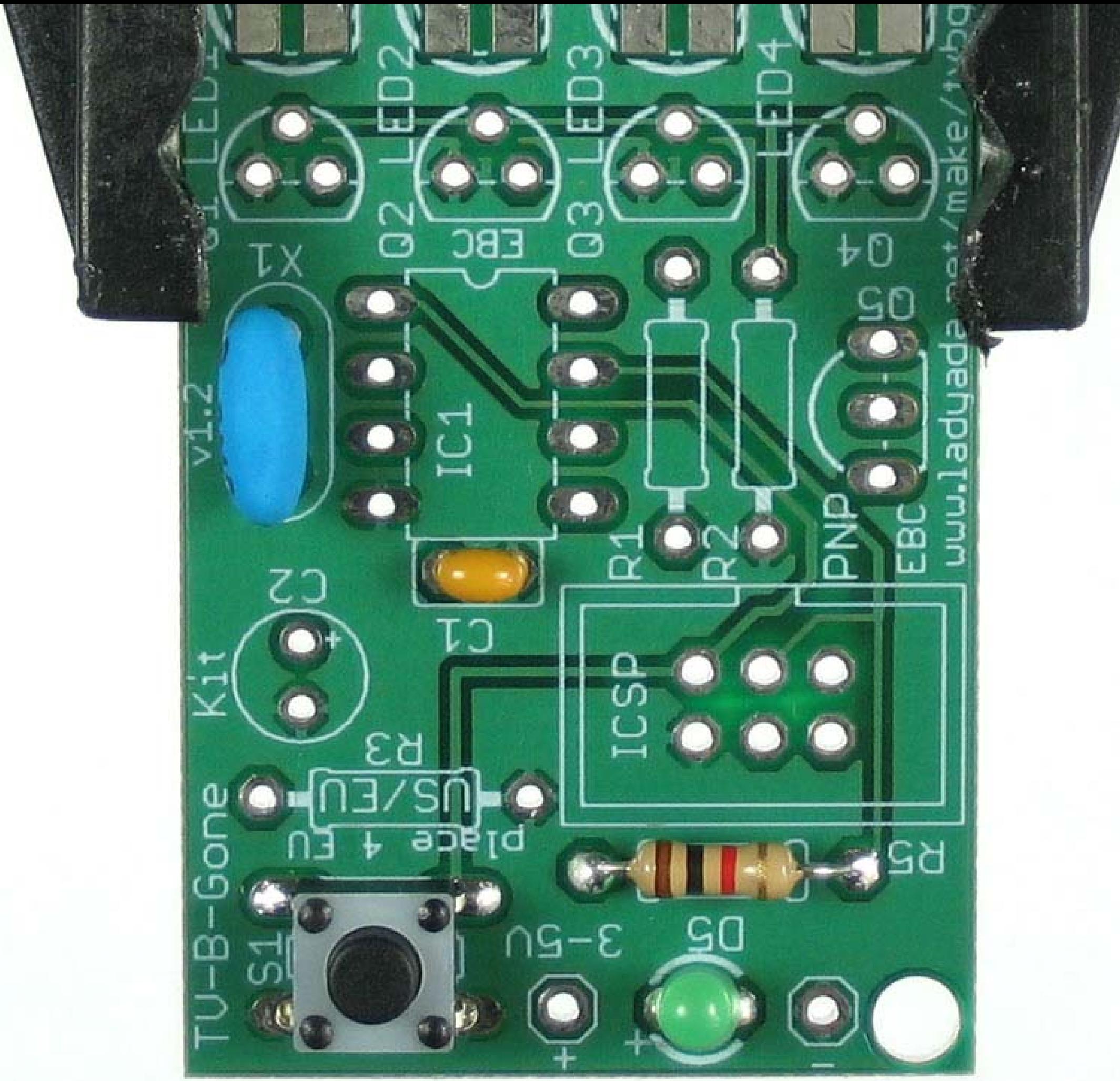




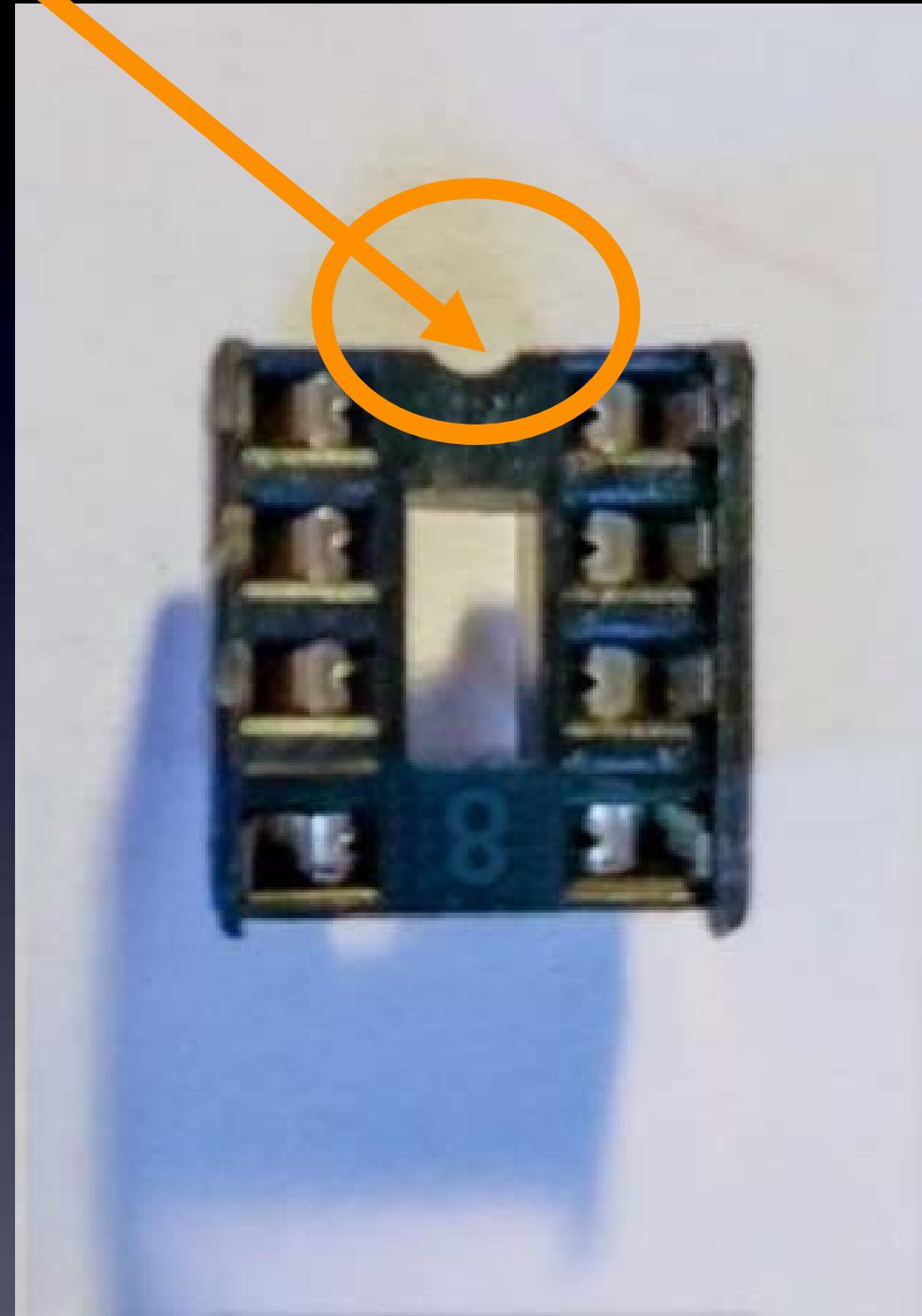
D5
Long lead

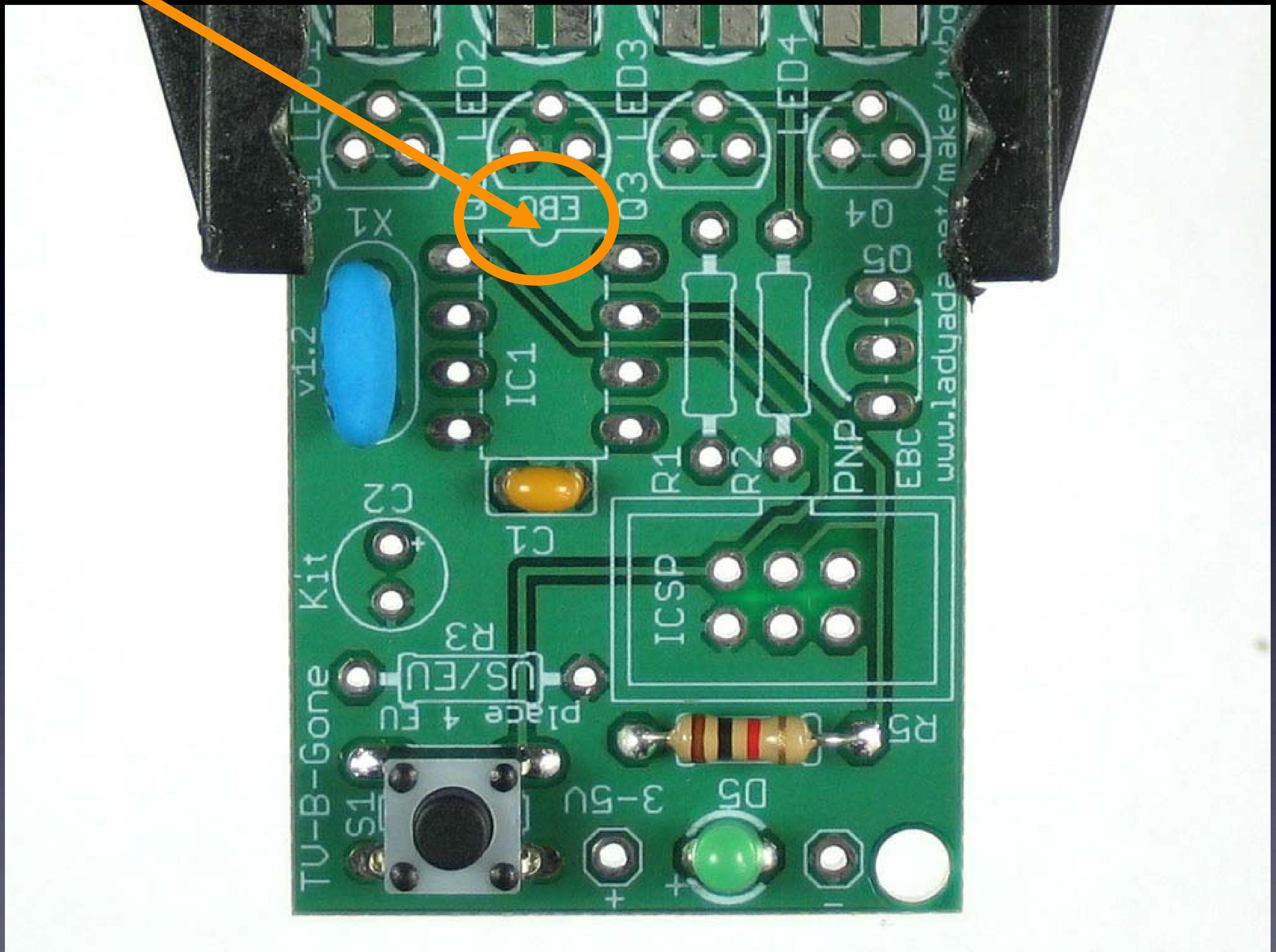
Short lead

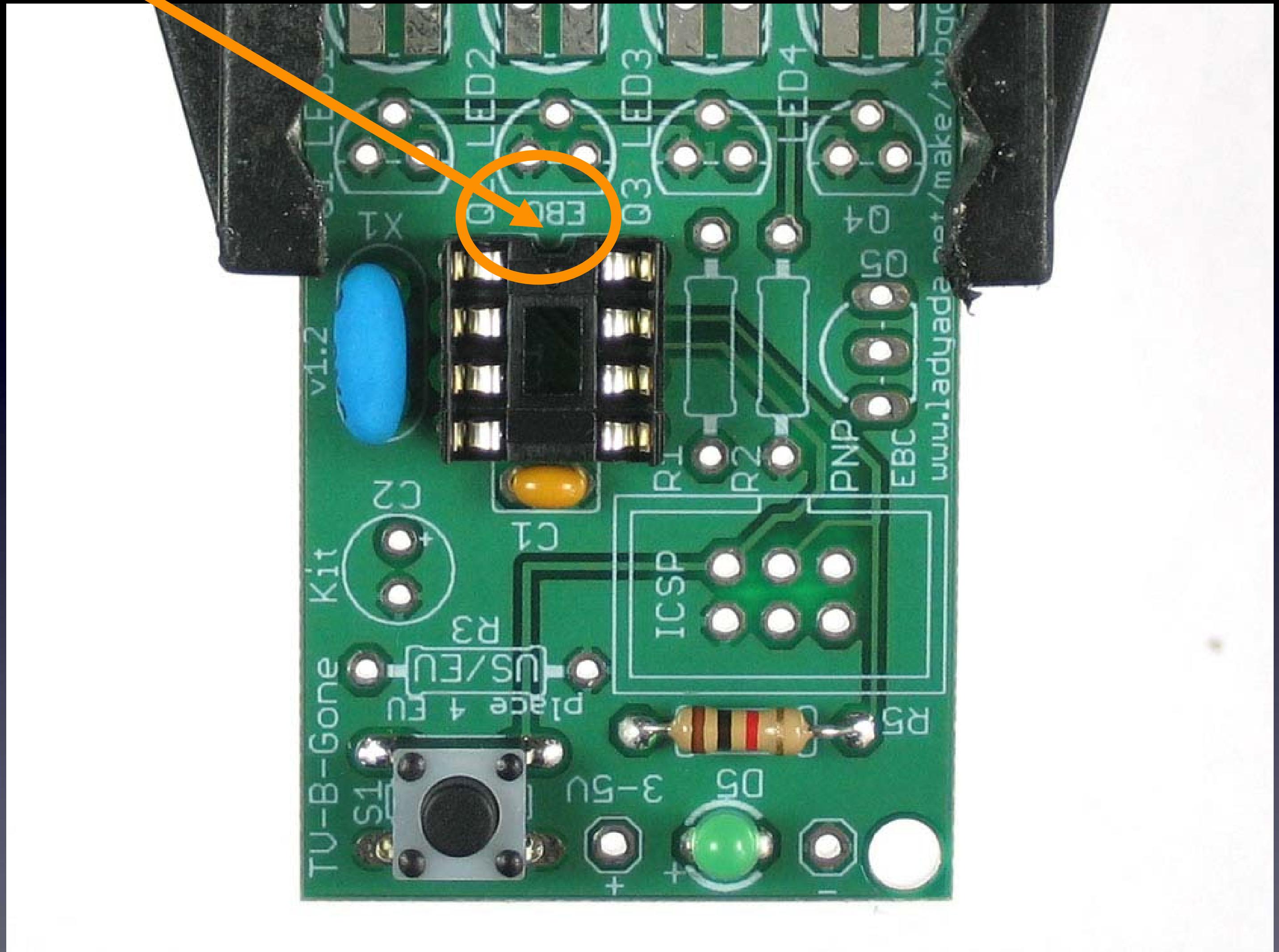




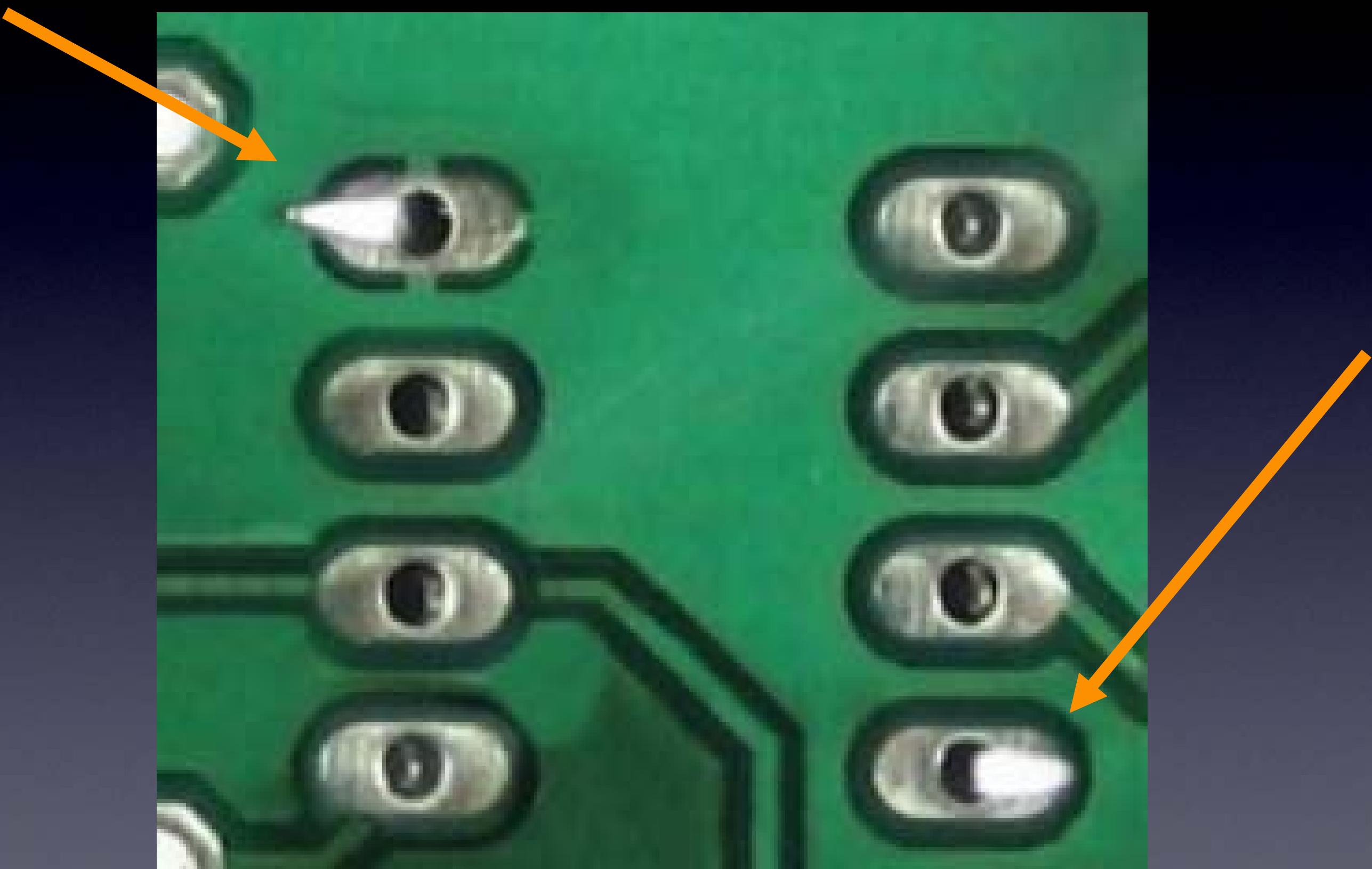








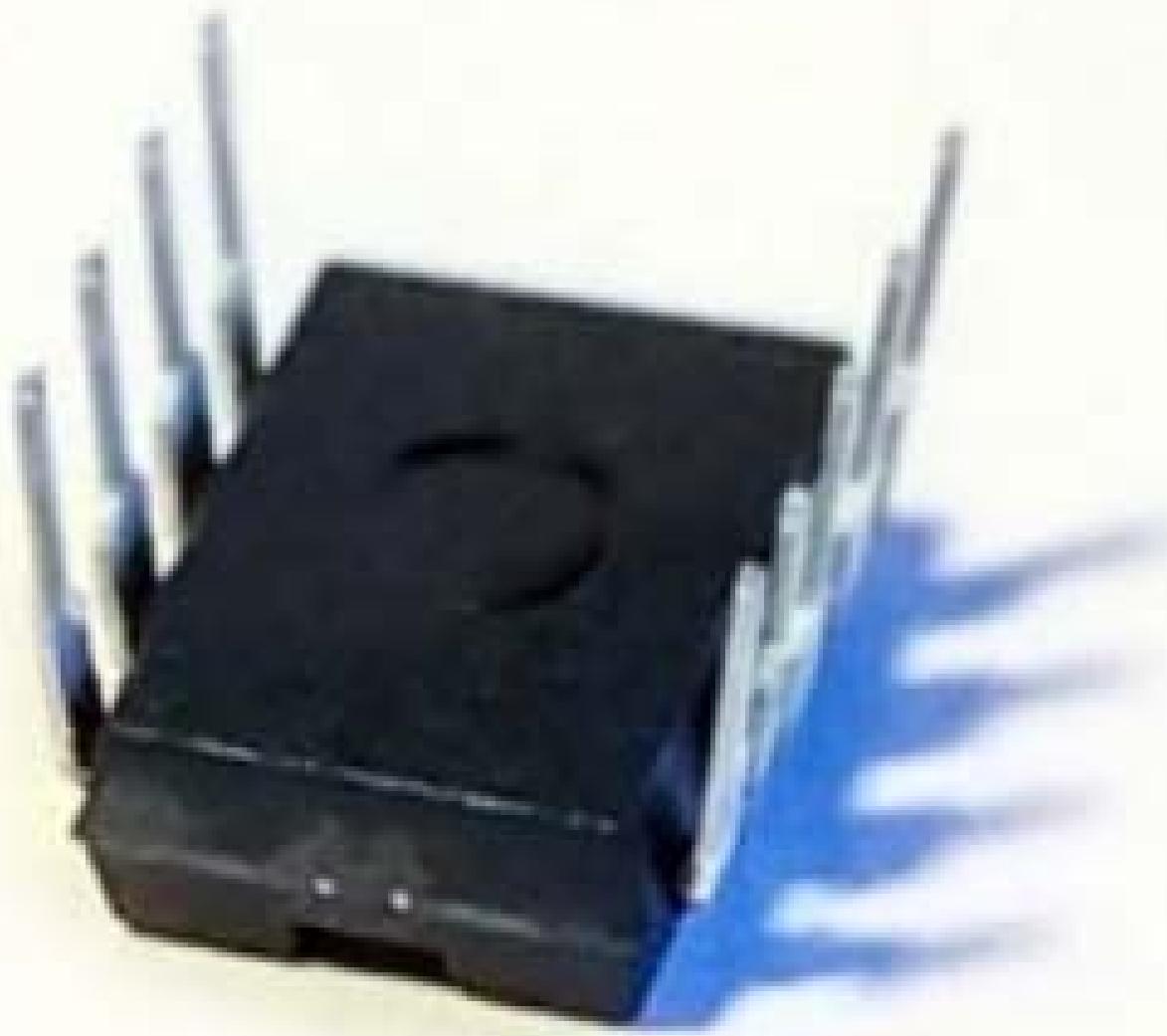
Bend pins on 2 opposite corners

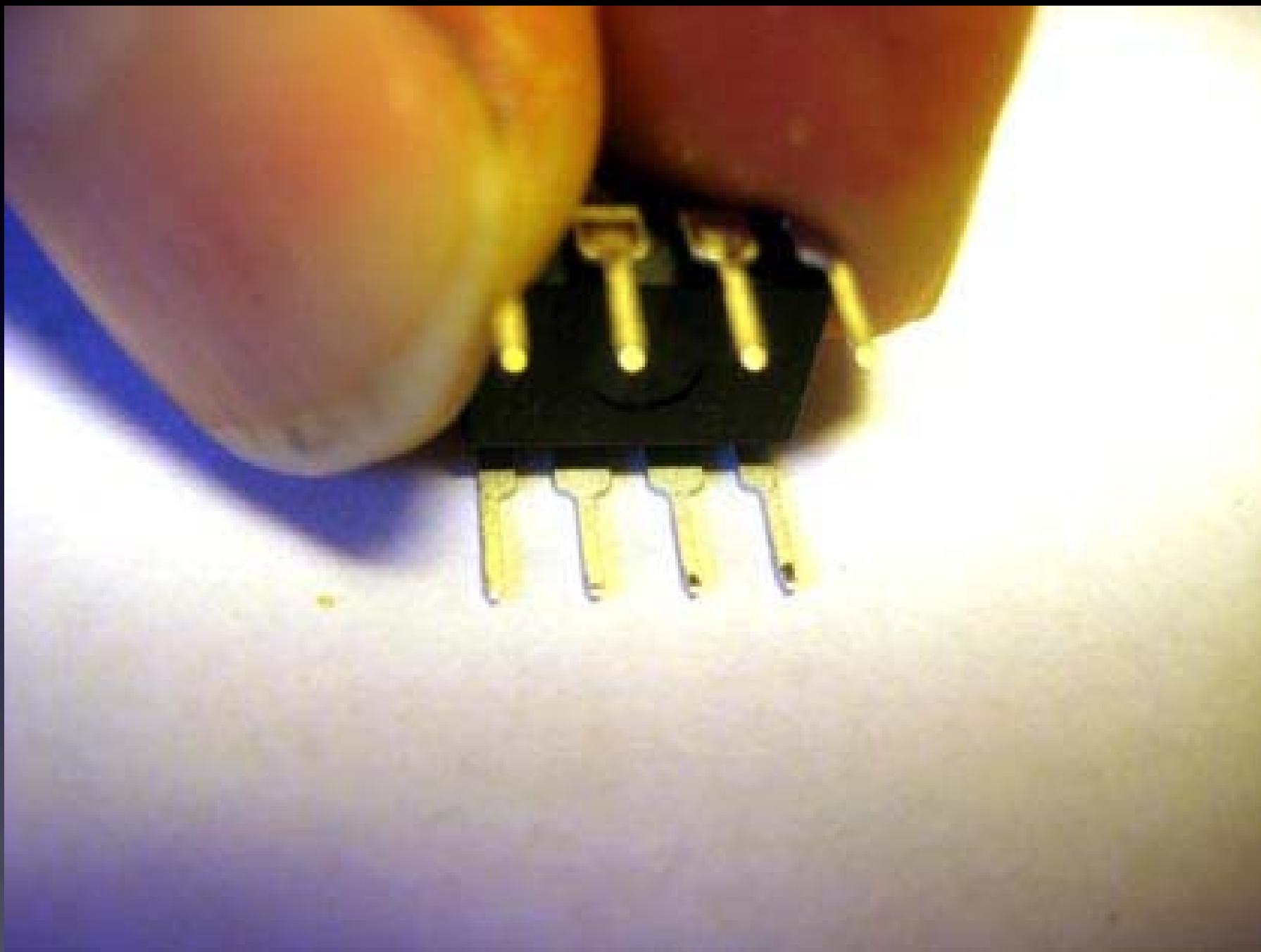


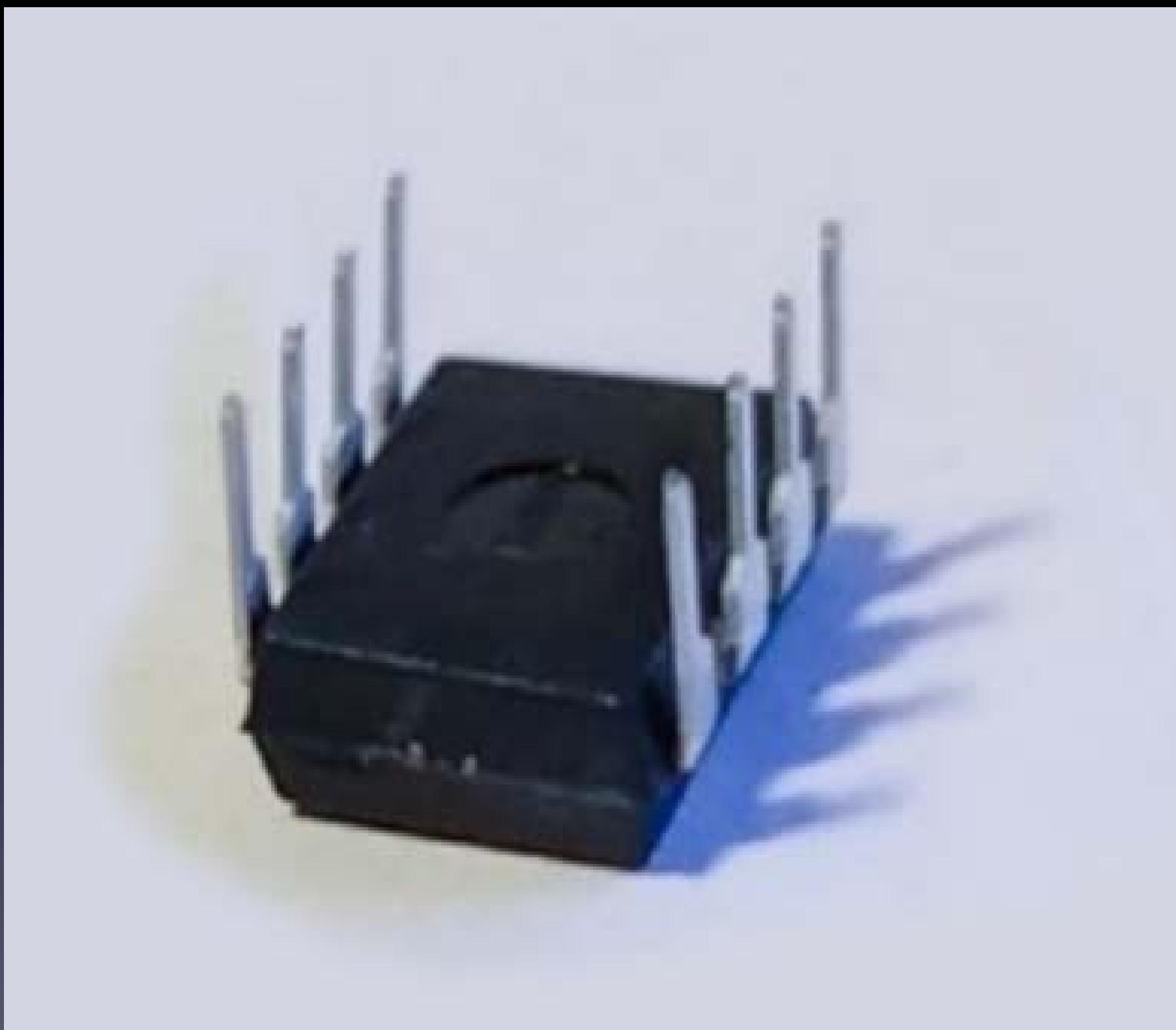
so socket won't fall out while soldering

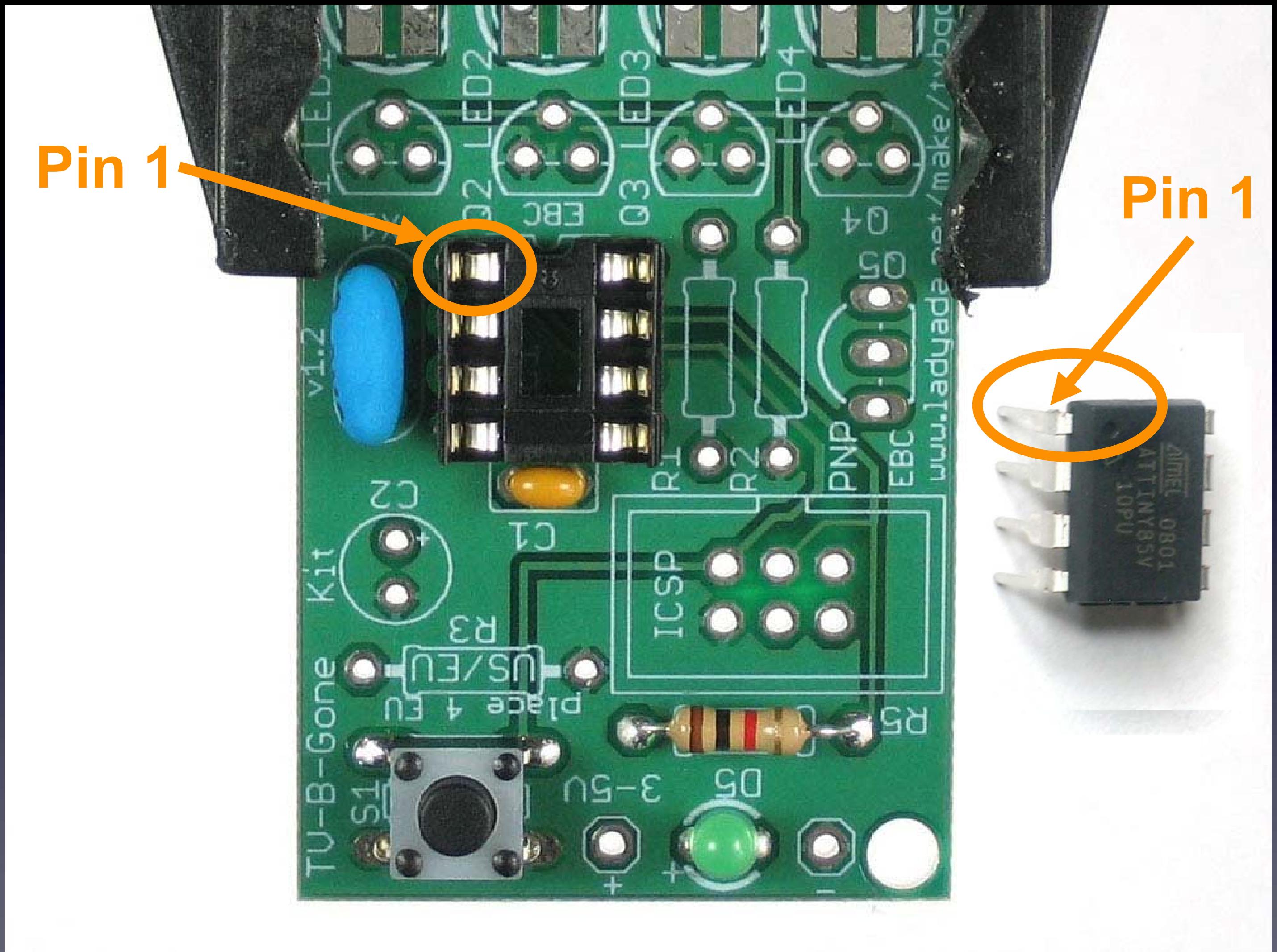
Pin 1

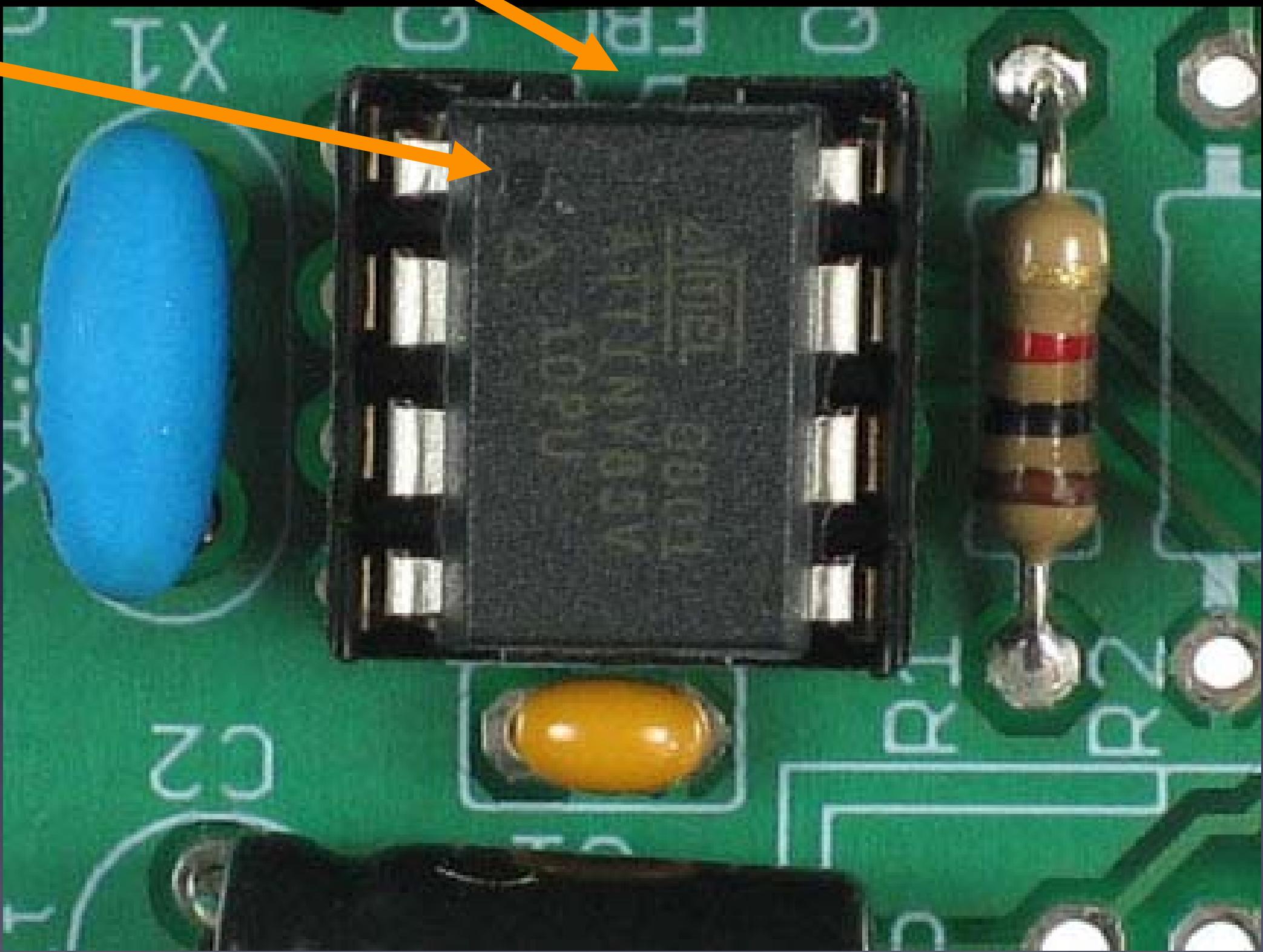


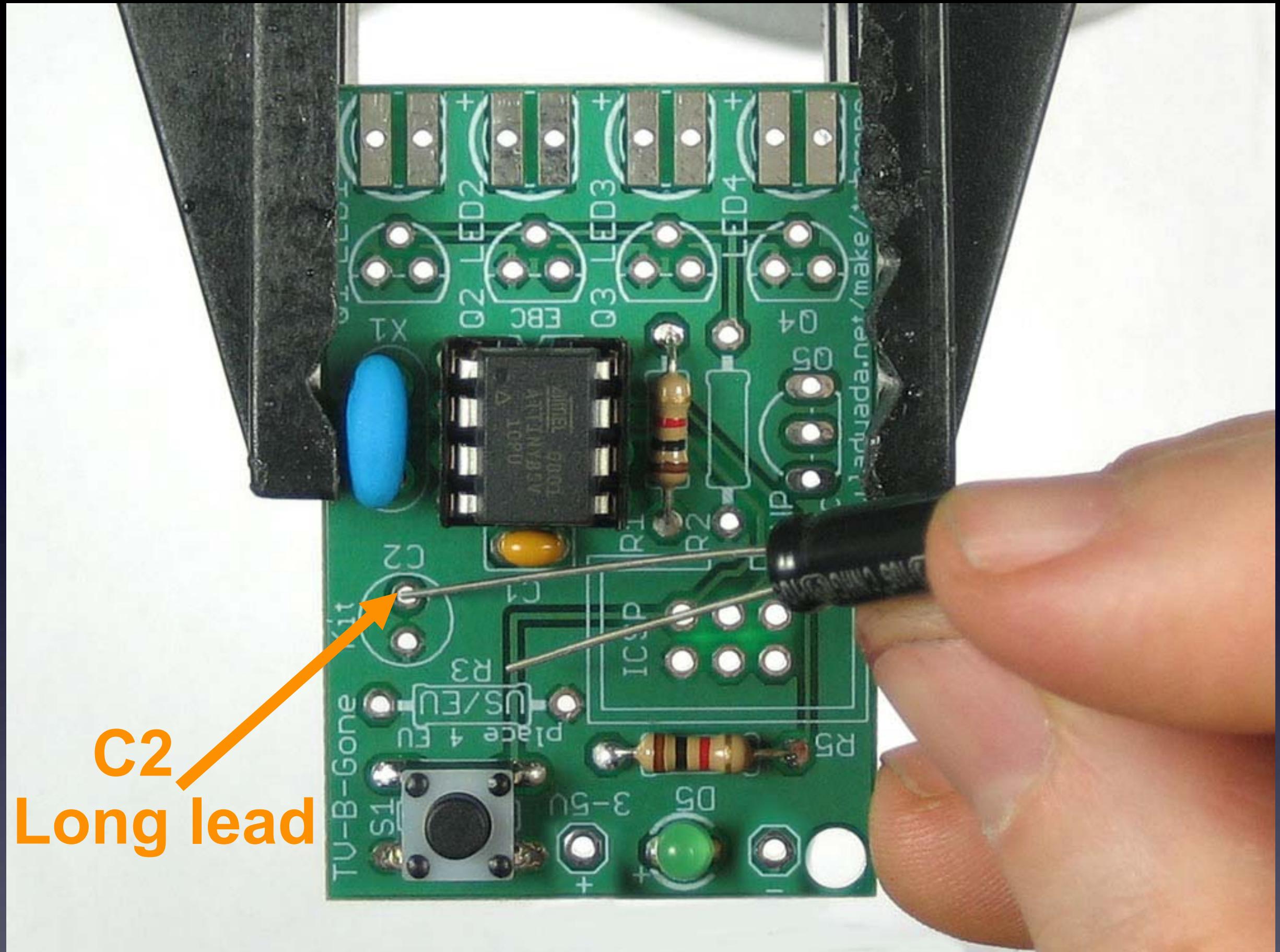






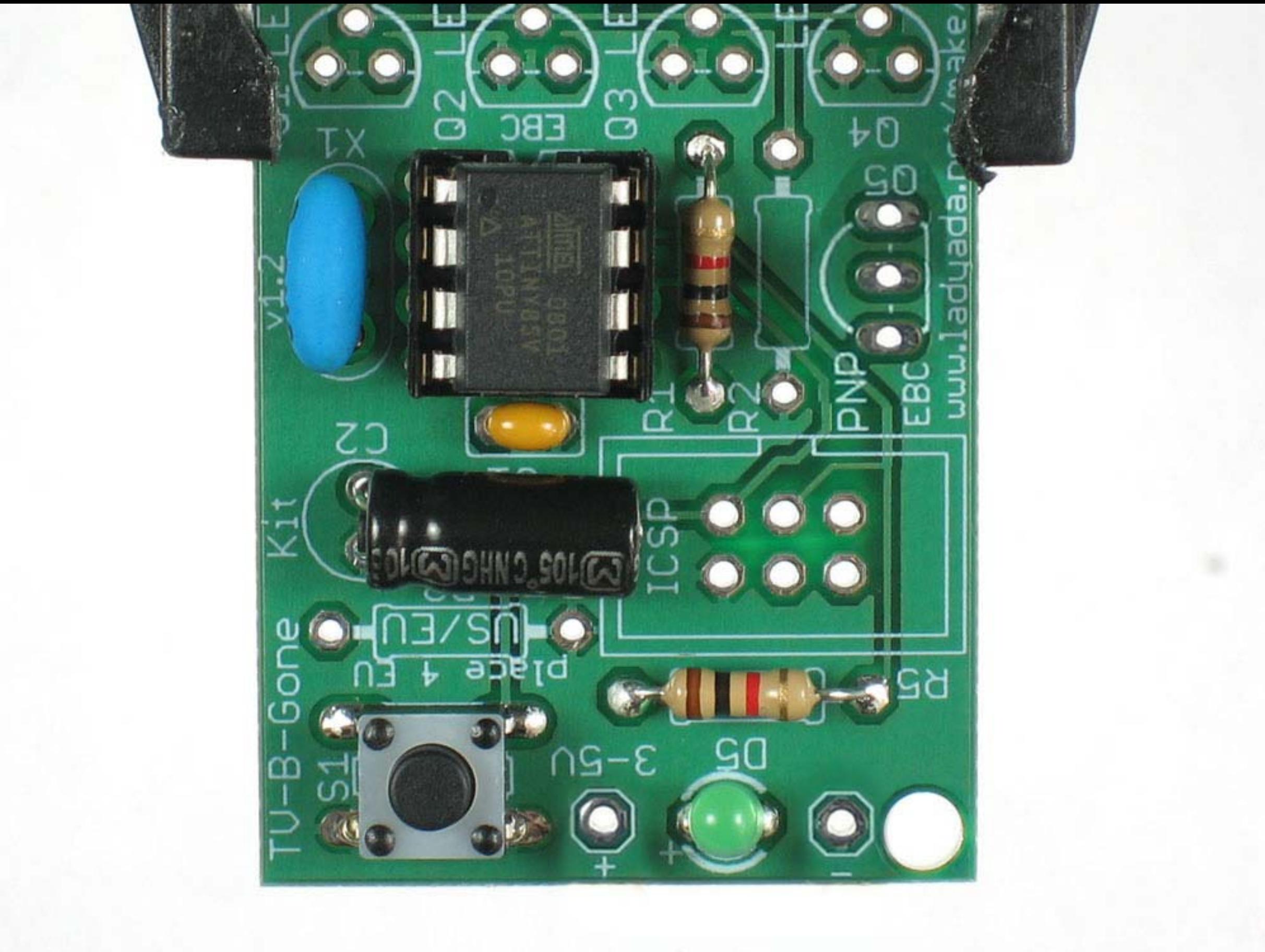






DO NOT solder C2 yet!

Bend C2 so it lays flat

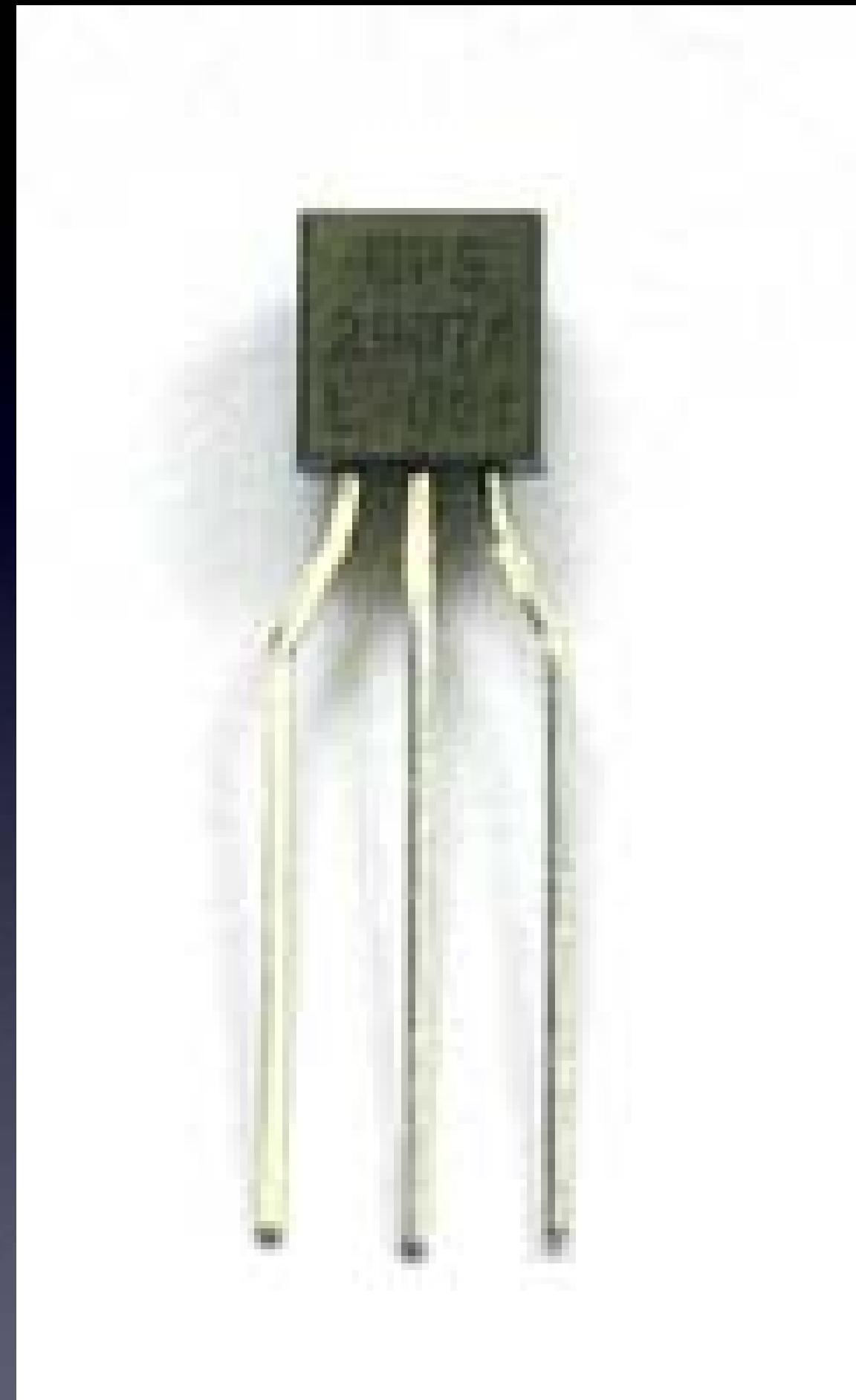


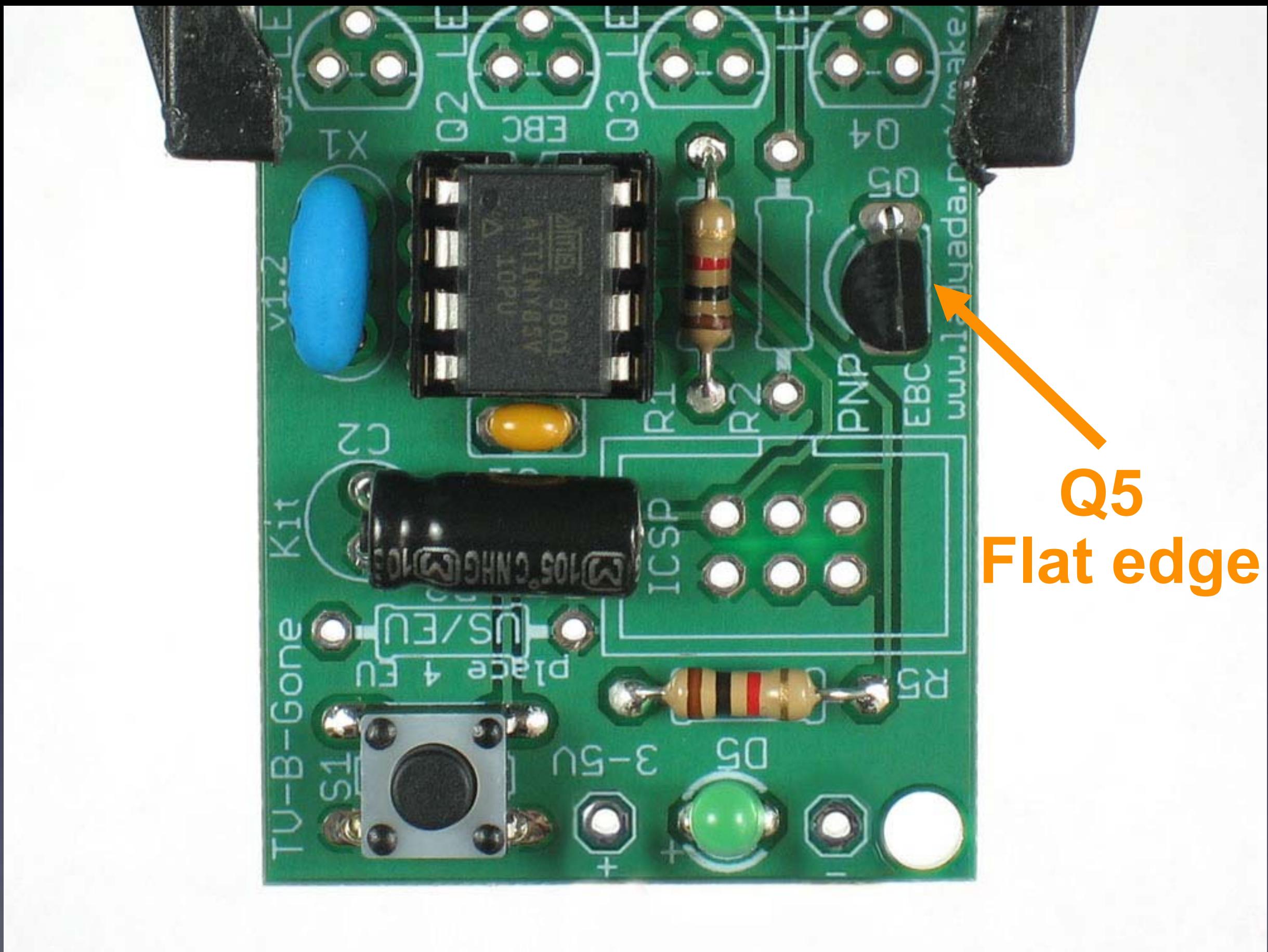
Q5

2N2907

**(the one that isn't
taped to others)**

Look at this shape:





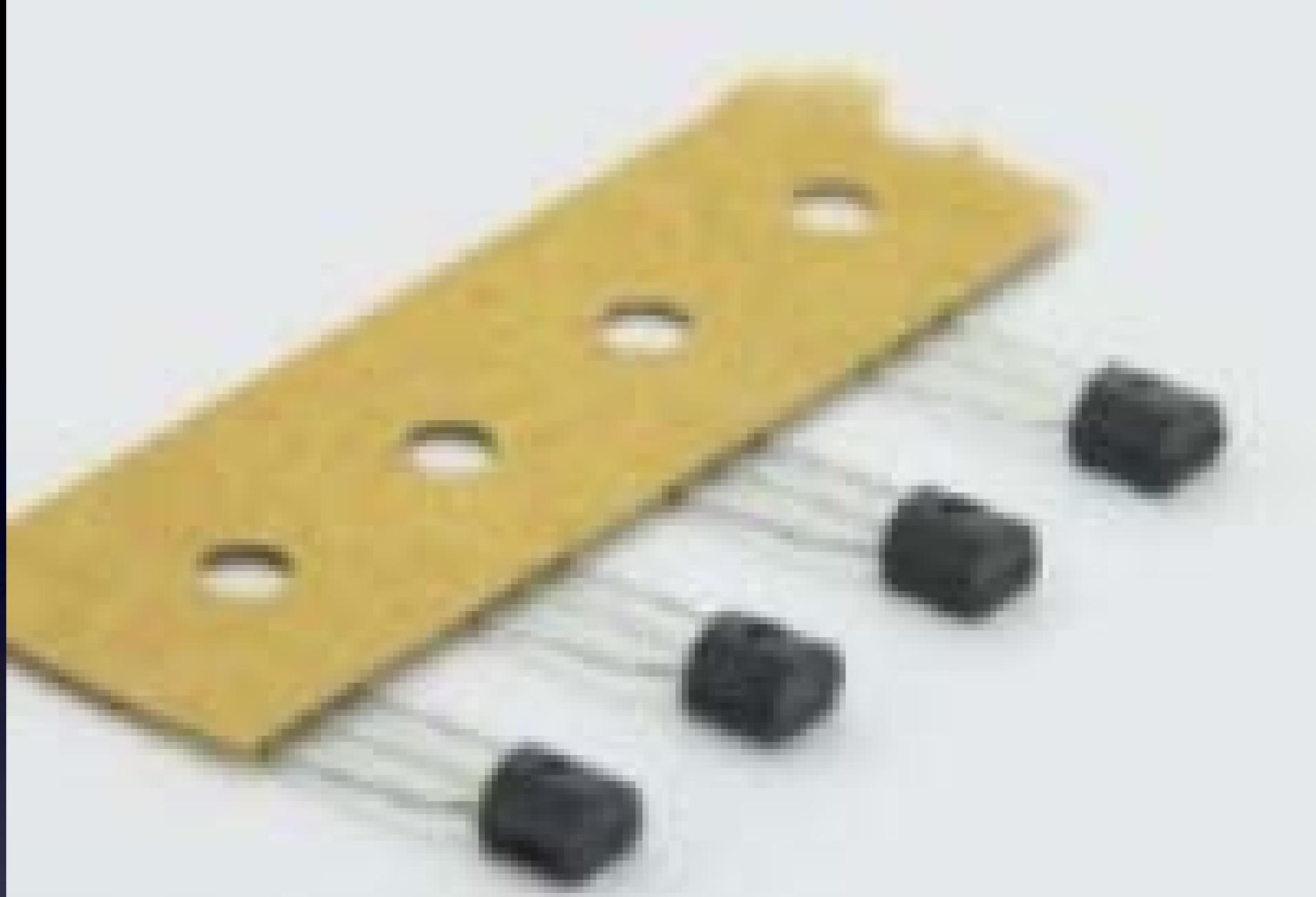
Q5
Flat edge

DO NOT push transistors all the way into the board

DO NOT push transistors all the way into the board



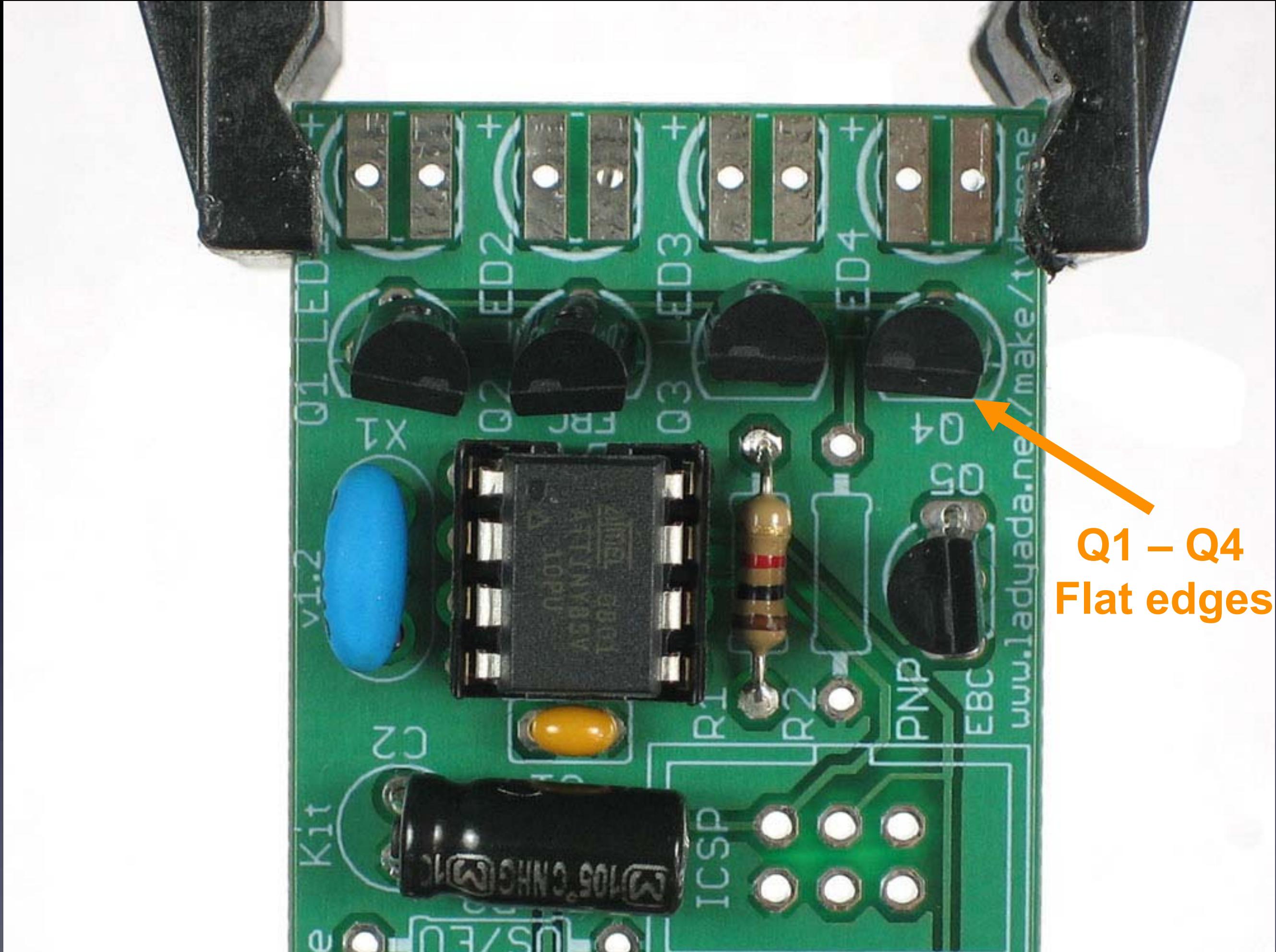
Only push till it's kinda hard to push more



Q1, Q2, Q3, Q4

2N2222

(taped together)



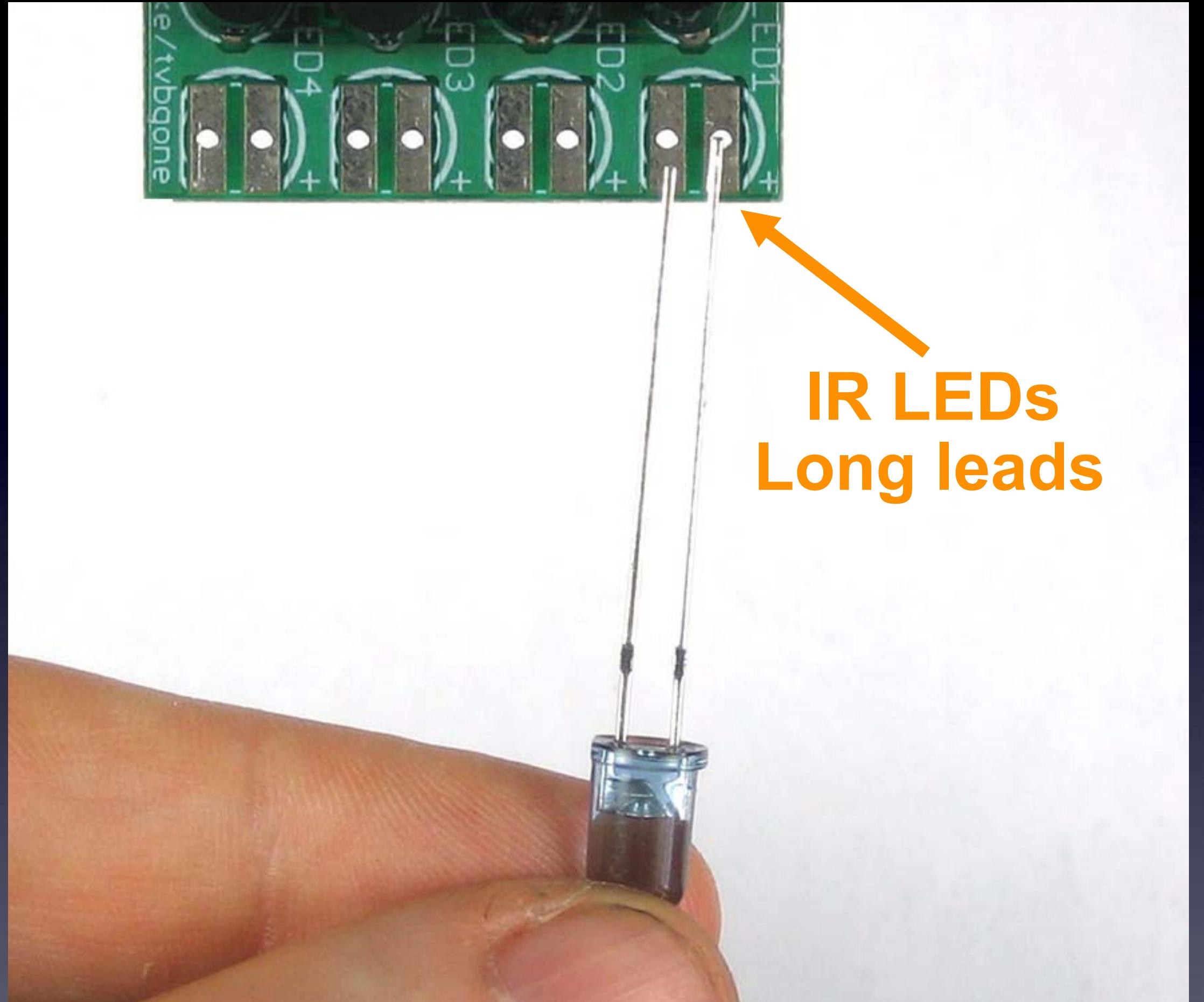
Q1 – Q4
Flat edges

DO NOT push transistors all the way into the board

DO NOT push transistors all the way into the board

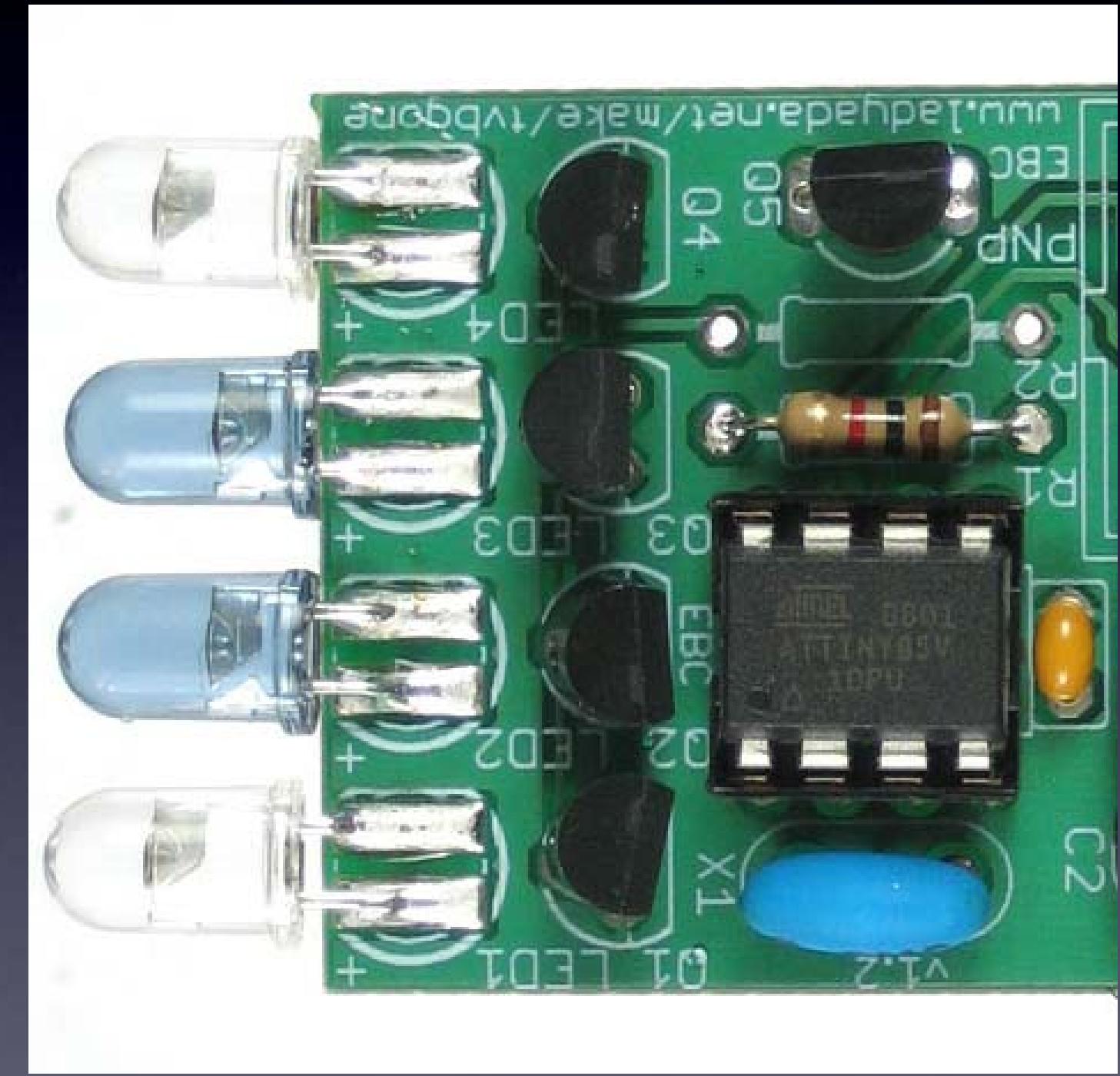


Only push till it's kinda hard to push more

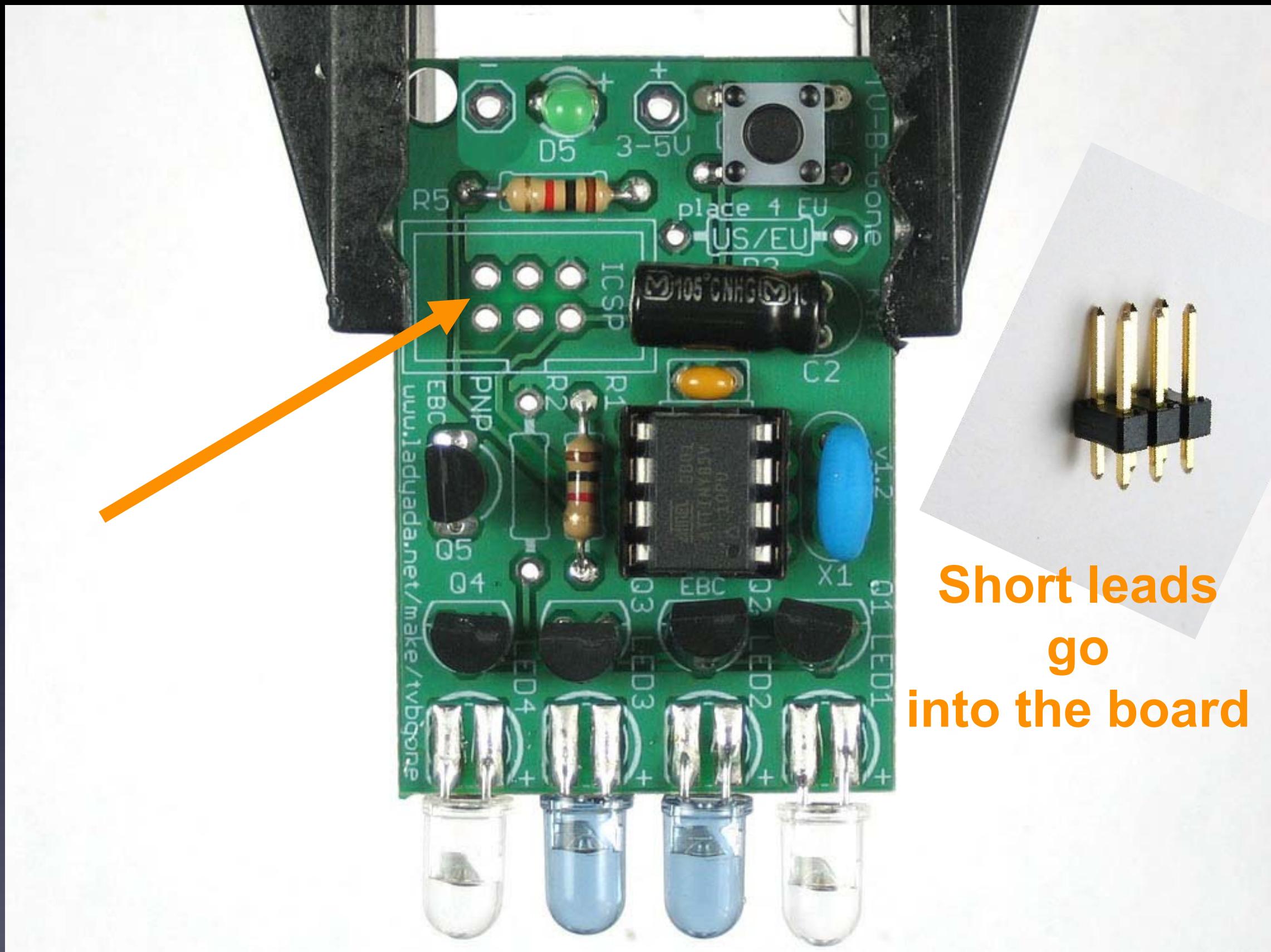


DO NOT solder these yet!

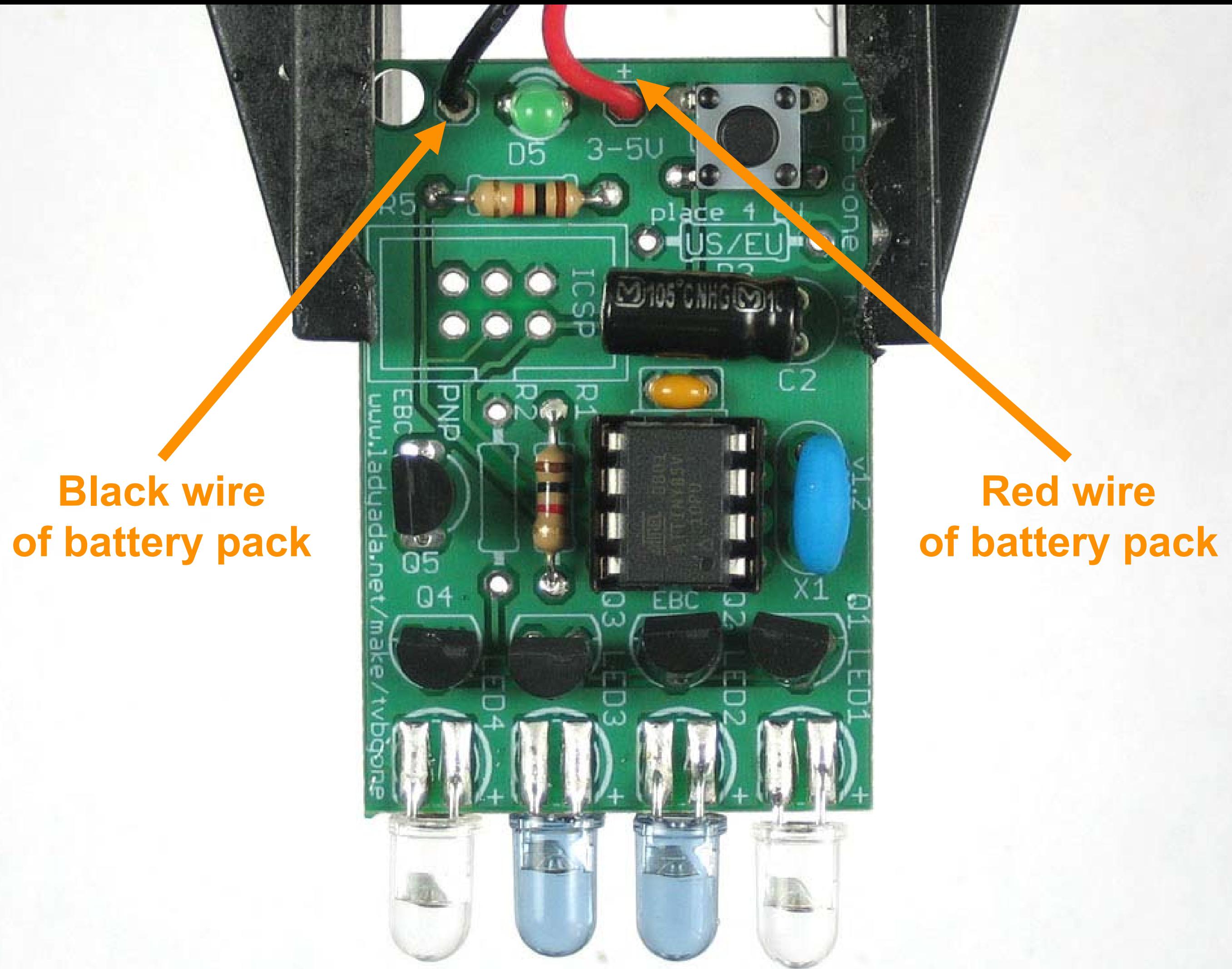
You may want to bend the IR LEDs over, like this:



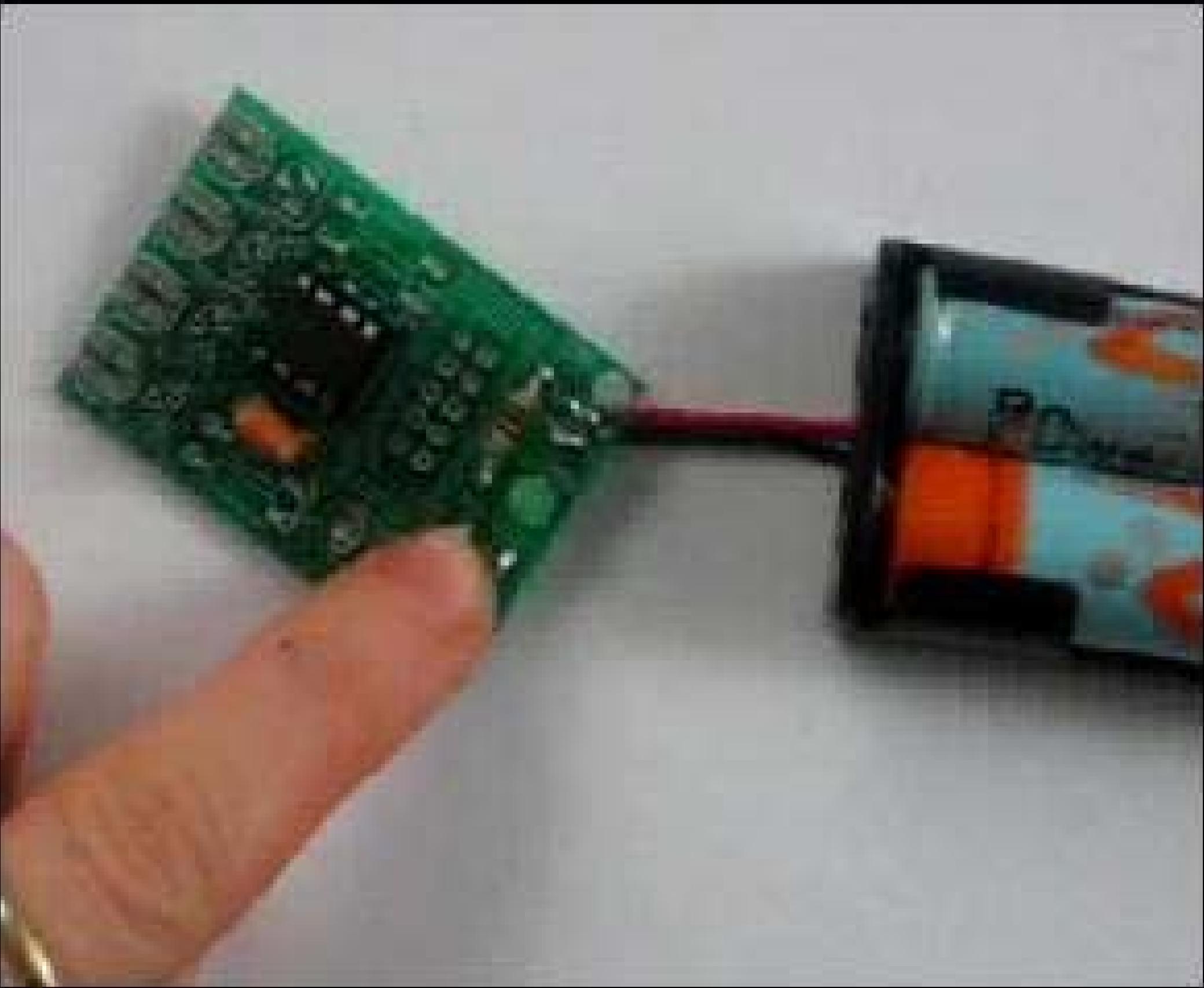
(the ordering of the LEDs is unimportant)



Optional: ICSP header
(for re-programming the microcontroller)

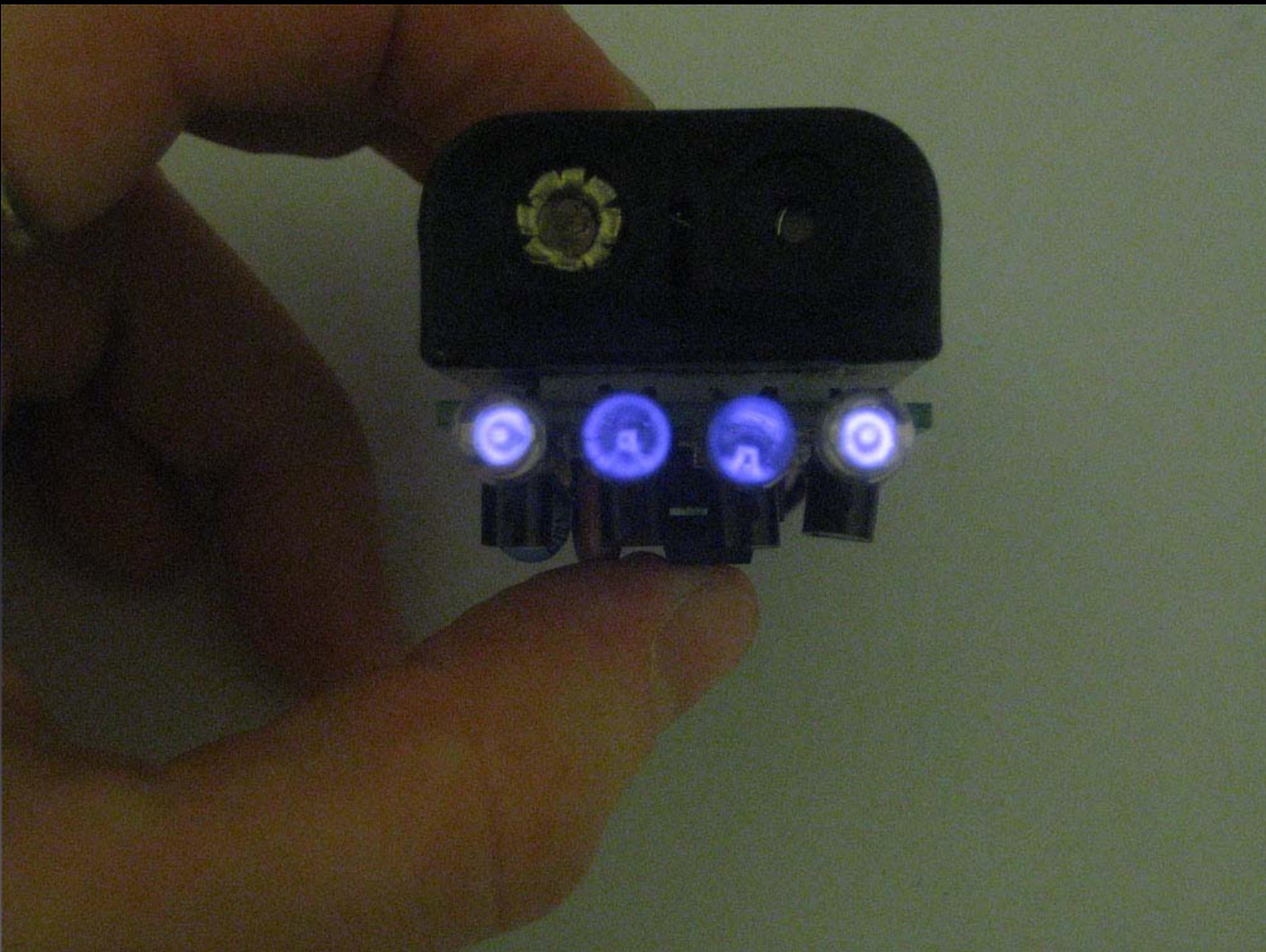


Test 1

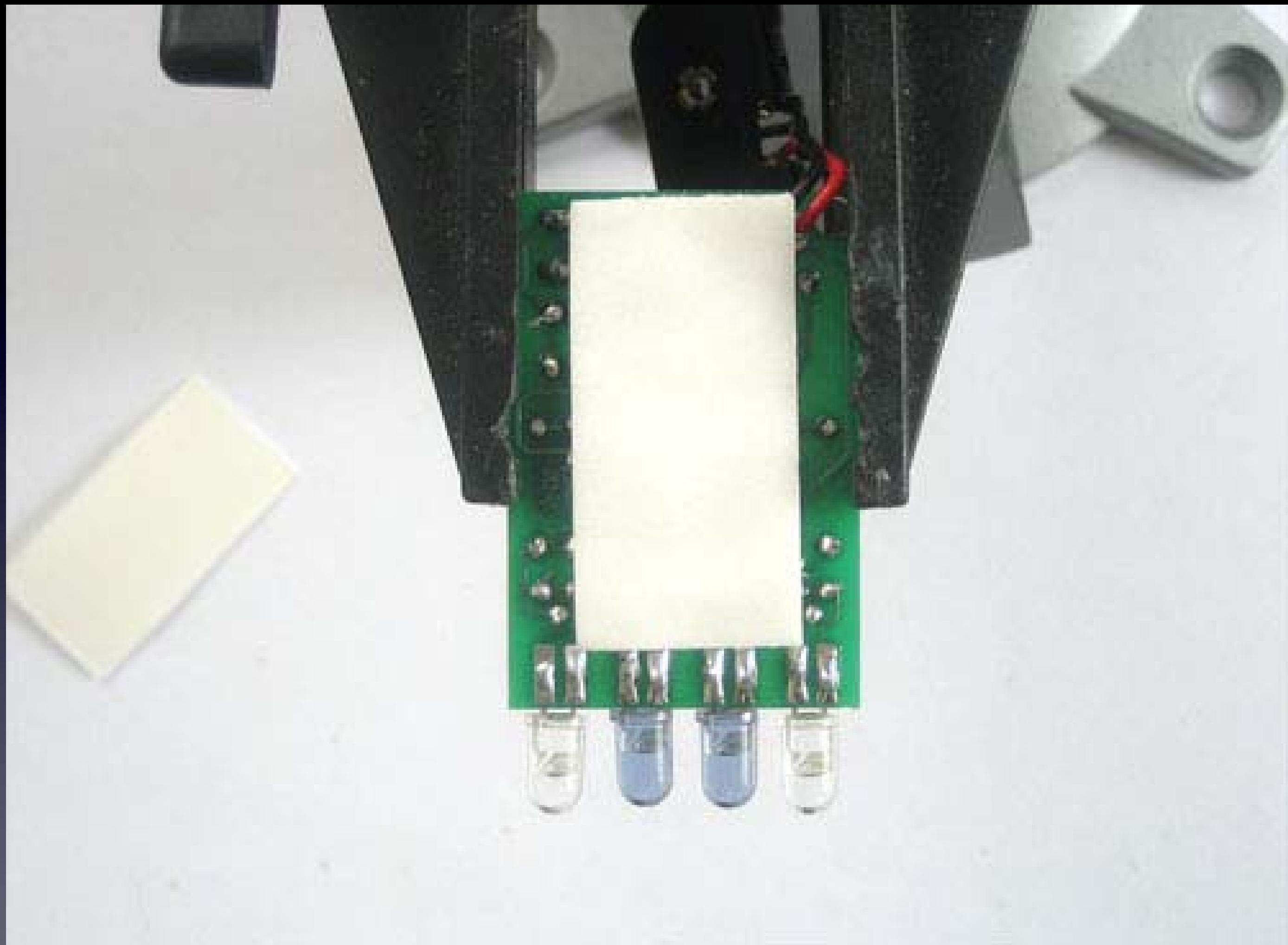


Green LED blinks

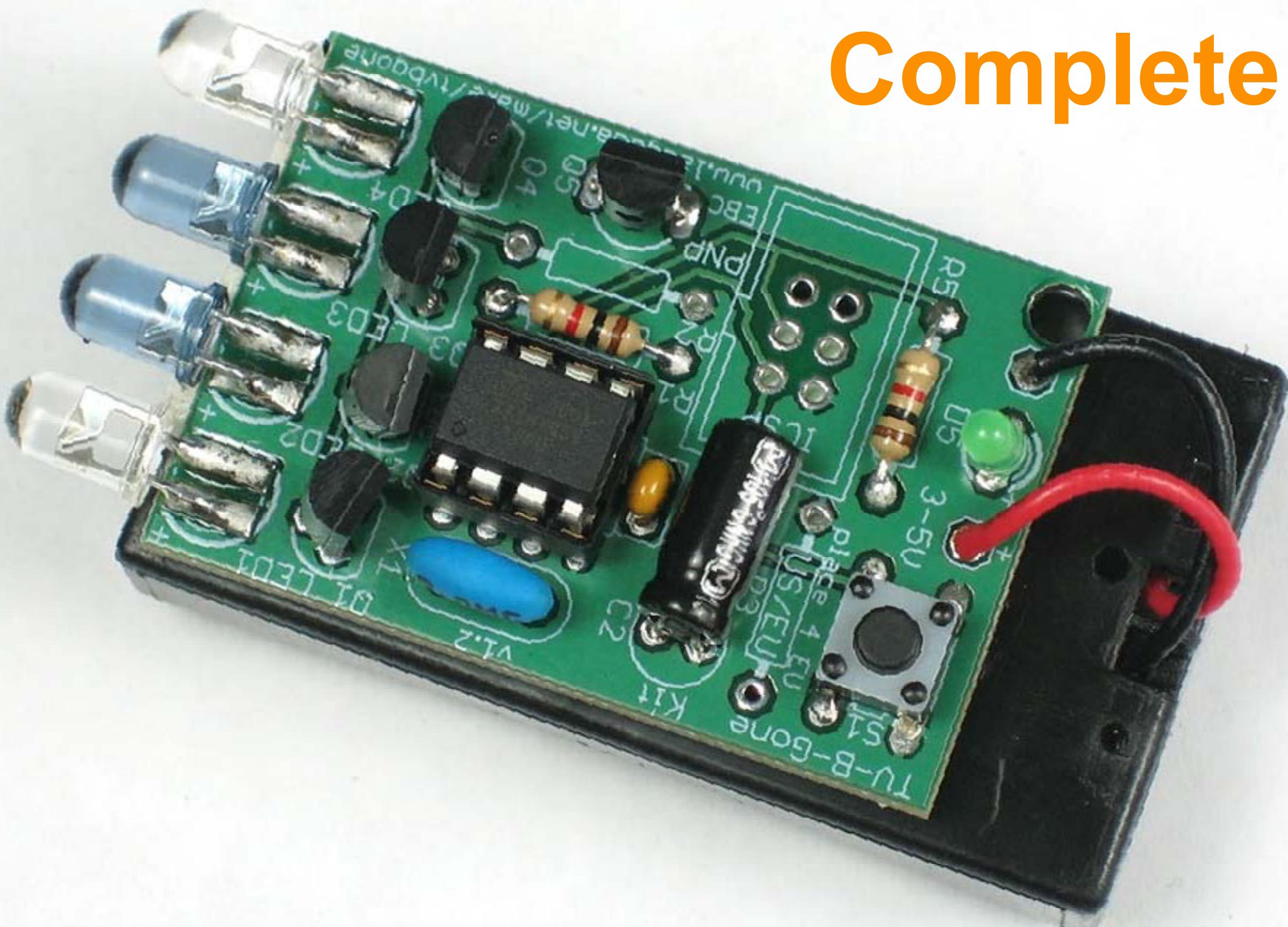
Test 2



All IR LEDs blink (using camera)



Complete!



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to

Wash your hands



Make your own

TV-B-GONE®

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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