Rev 11c: 4-Jun-2024

Arduino For Total Newbies

w/ TV-B-Gone as example project

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)
email: **mitch@CornfieldElectronics.com**
site: **www.CornfieldElectronics.com**
facebook: **maltman23**
flickr: **maltman23**
WeChat: **mitchaltman**
Fediverse: **@maltman23@mastodon.social**
Patreon: mitchaltman

Stuff!

Bring all of this home with you!

DO NOT open this bag yet!

U-Do-It-Duino kit

Parts Pack

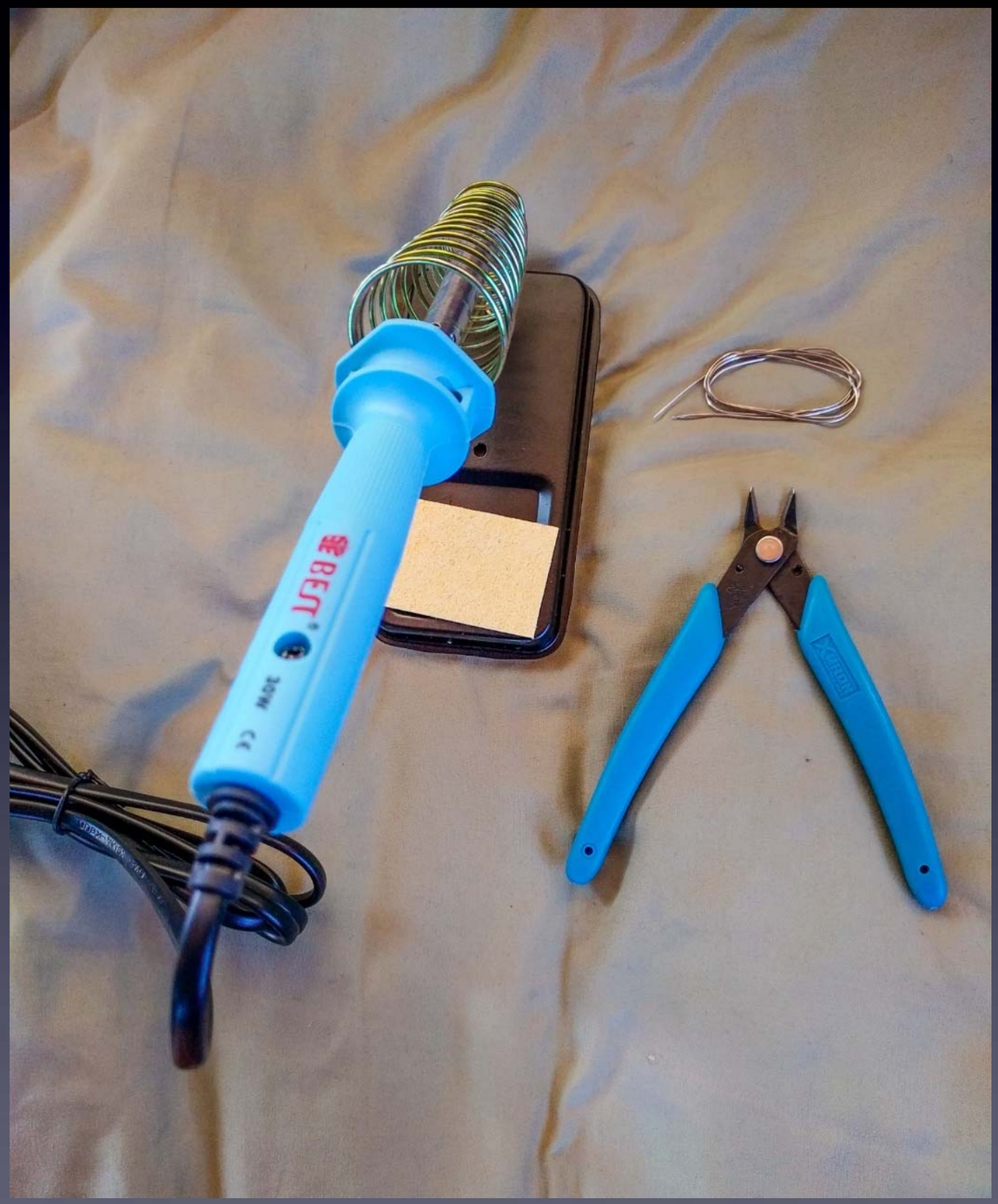
USB-Serial cable

Syllabus

- Intro
- Everything You Need to Know About Electronics
- How to solder / make your own Arduino
- How to Set Up and Use the Arduino Software
- How to Hack Arduino Programs (“Sketches”)
- How to Use Solderless Breadboards
- How to Read a Schematic
- Make a TV-B-Gone Remote Control with your Arduino Clone without soldering

(Don’t bring these home)

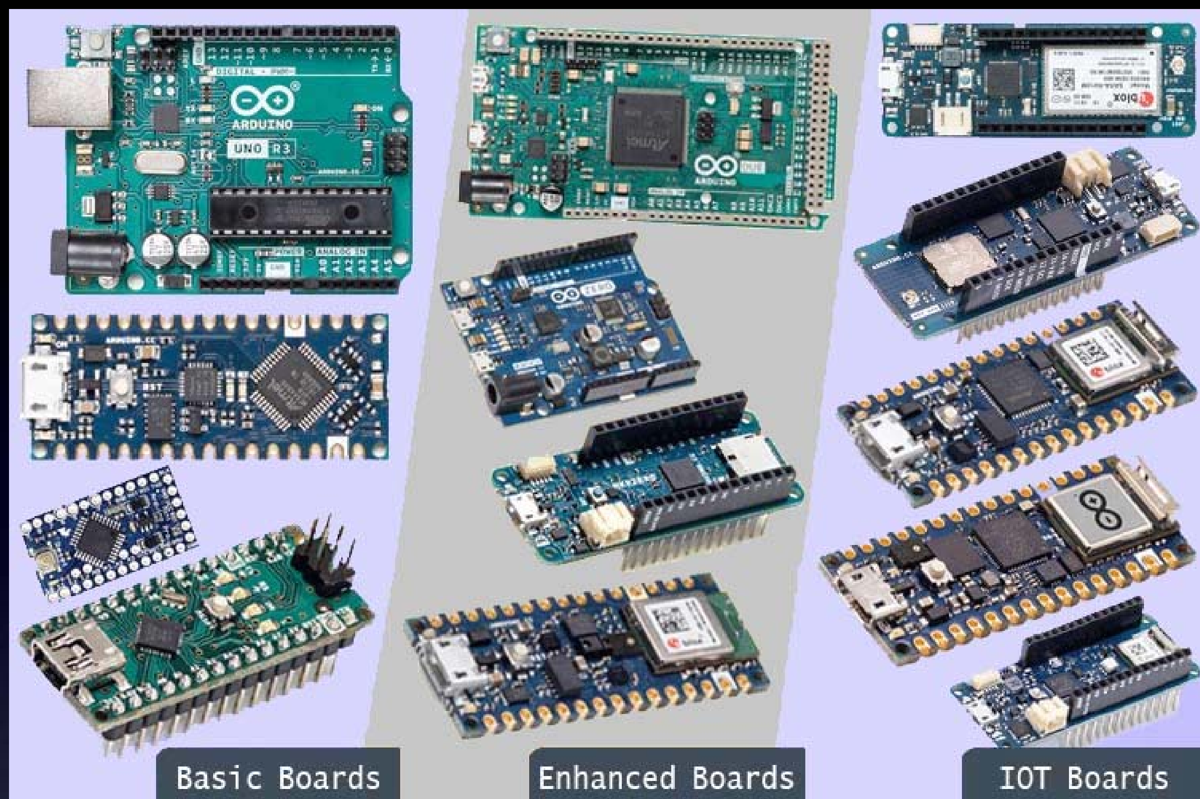
Tools

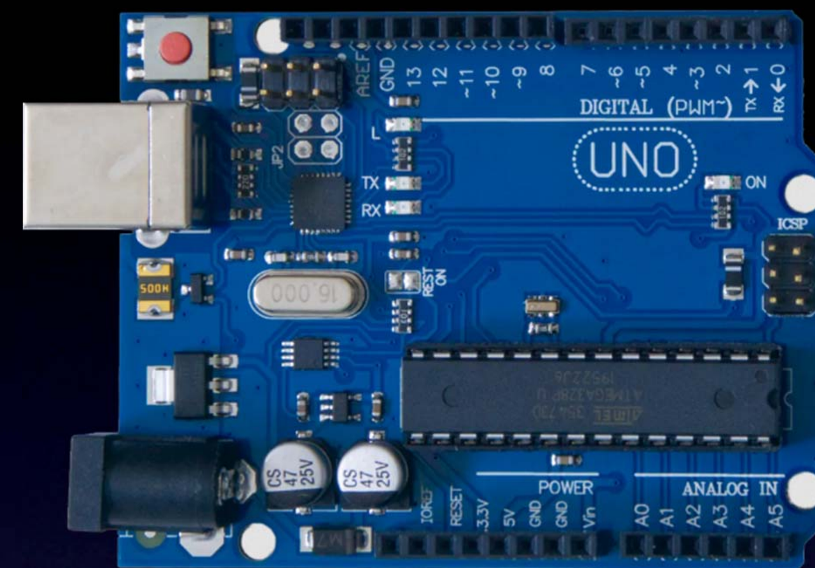


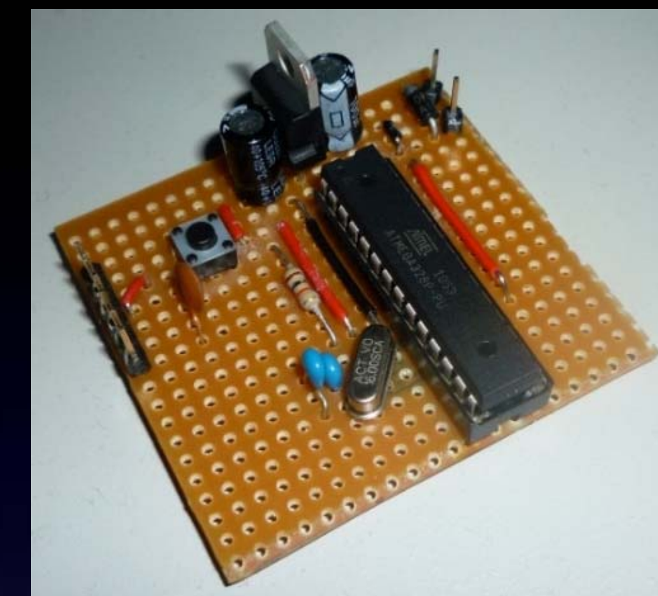
I have these Toolkits for sale

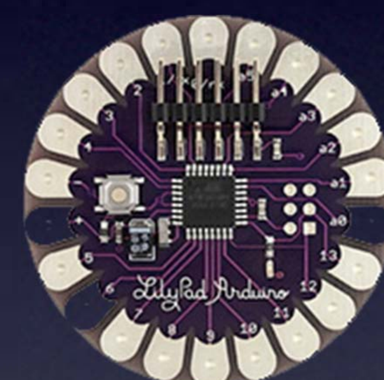
Tools

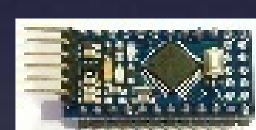
Intro

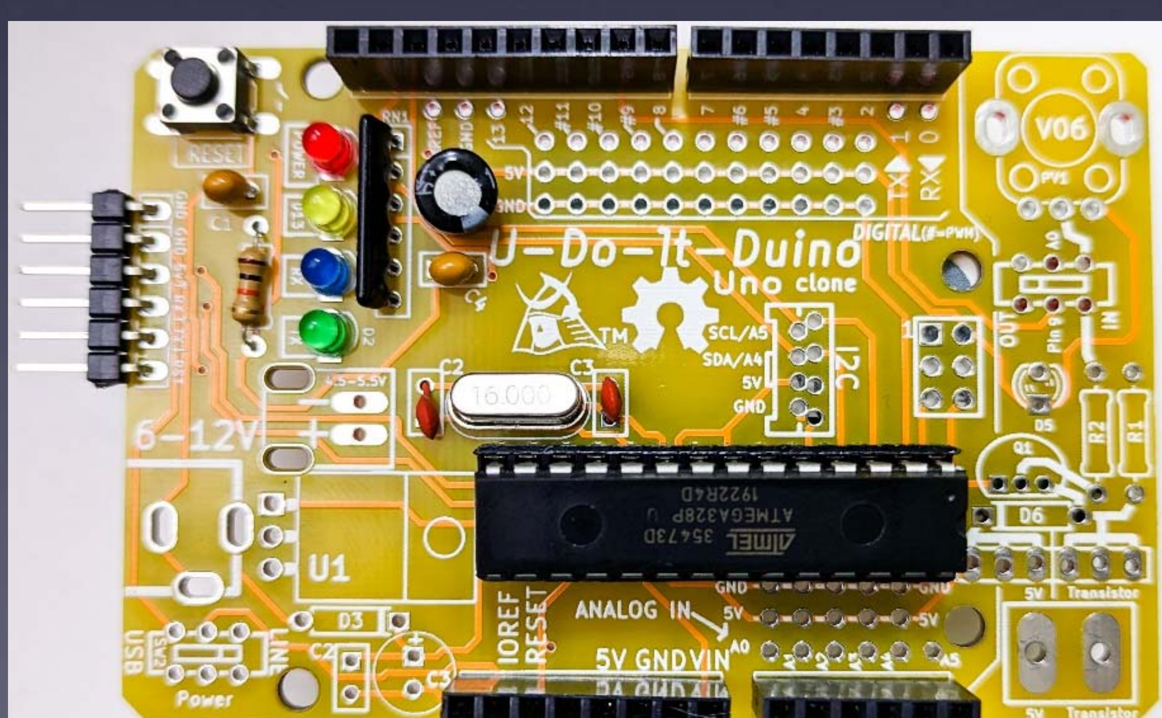

Basic Boards
Enhanced Boards
IOT Boards

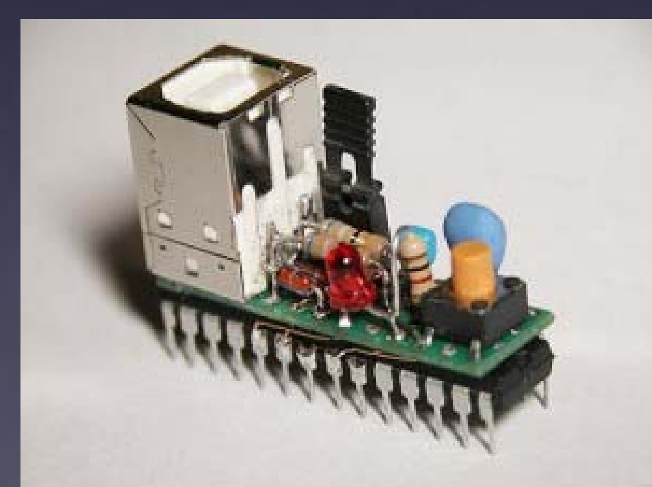

UNO
DIGITAL (PWM~)
POWER
ANALOG IN

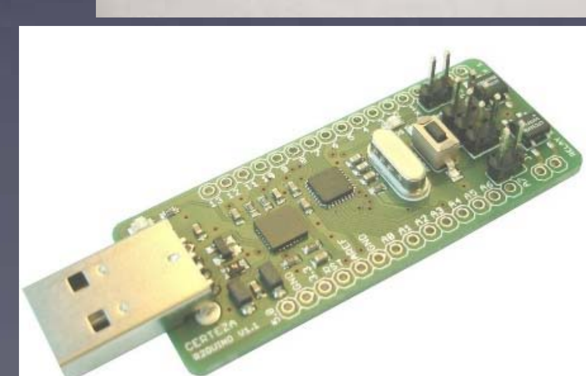






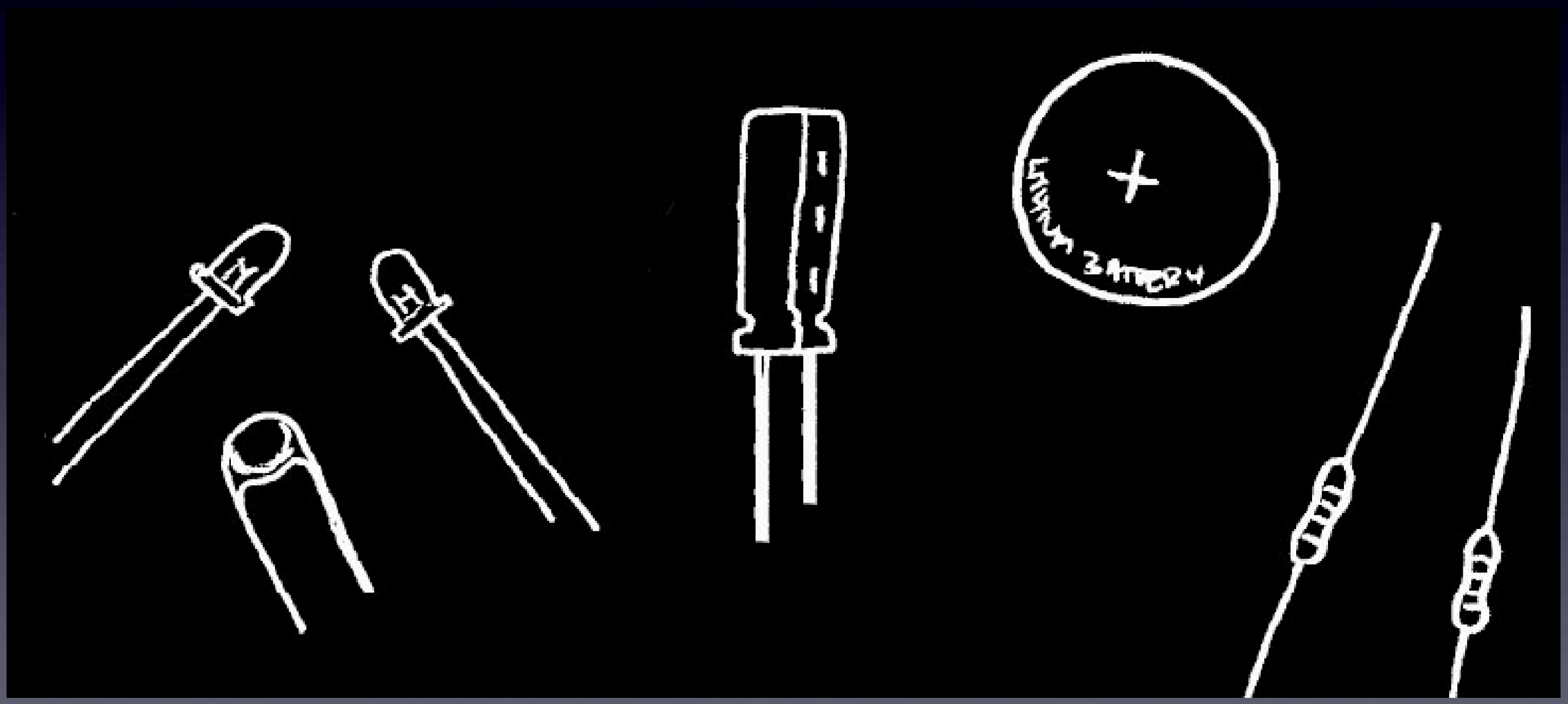

I-Do-It-Duino
Uno clone
6-12V



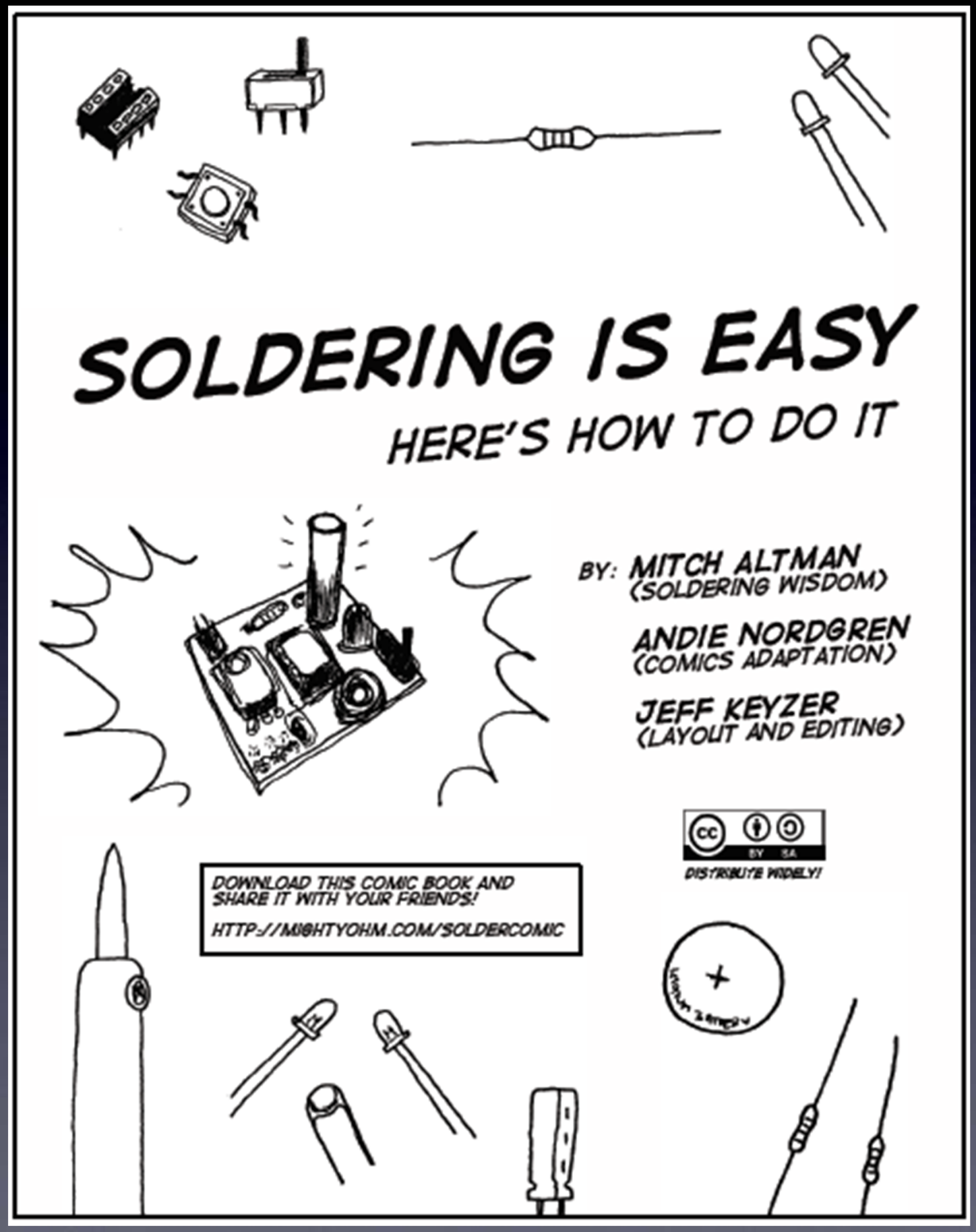



Diavolino
by Evil Mad Science

Everything You Need to Know About
Electronics



Learn To Solder



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

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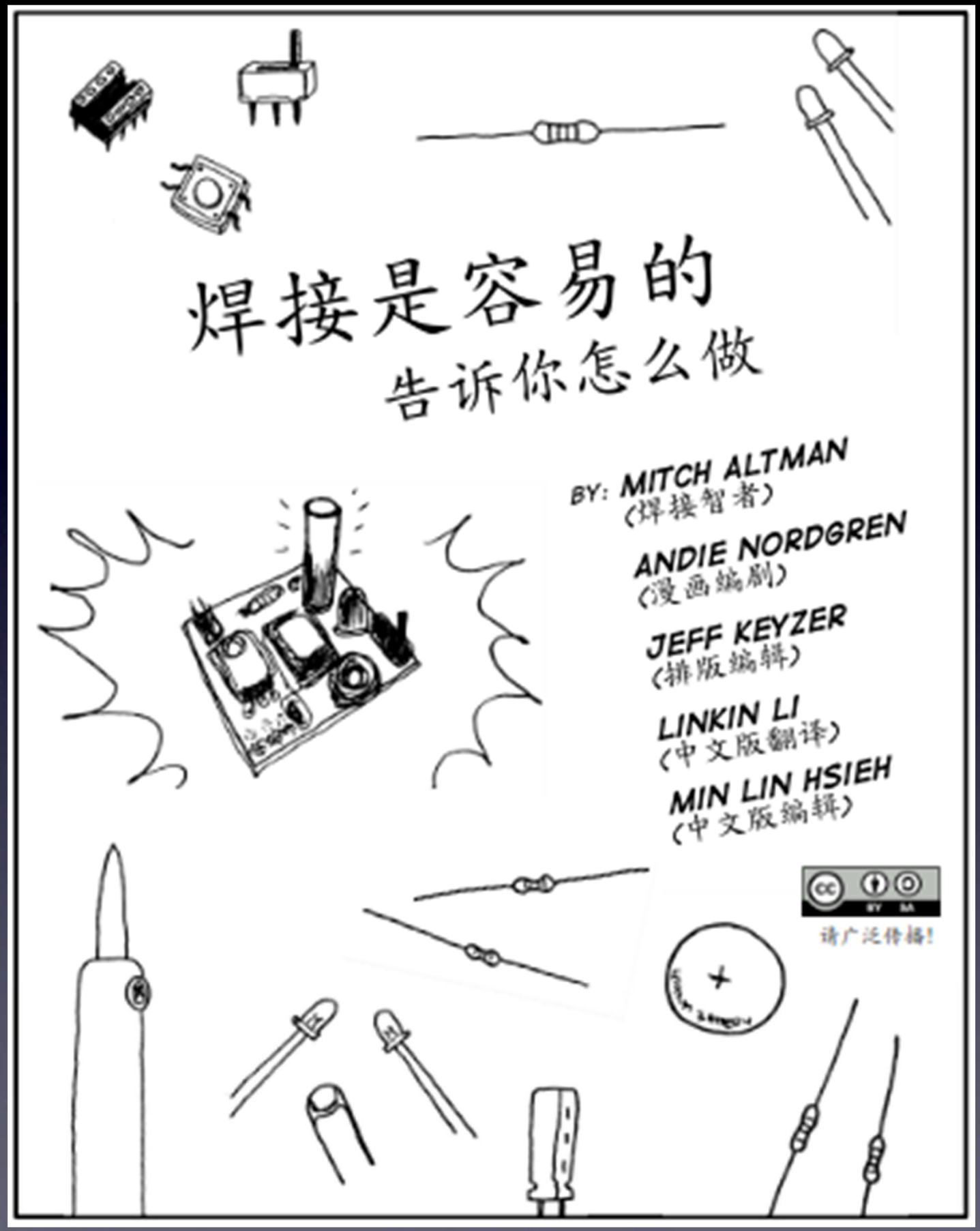

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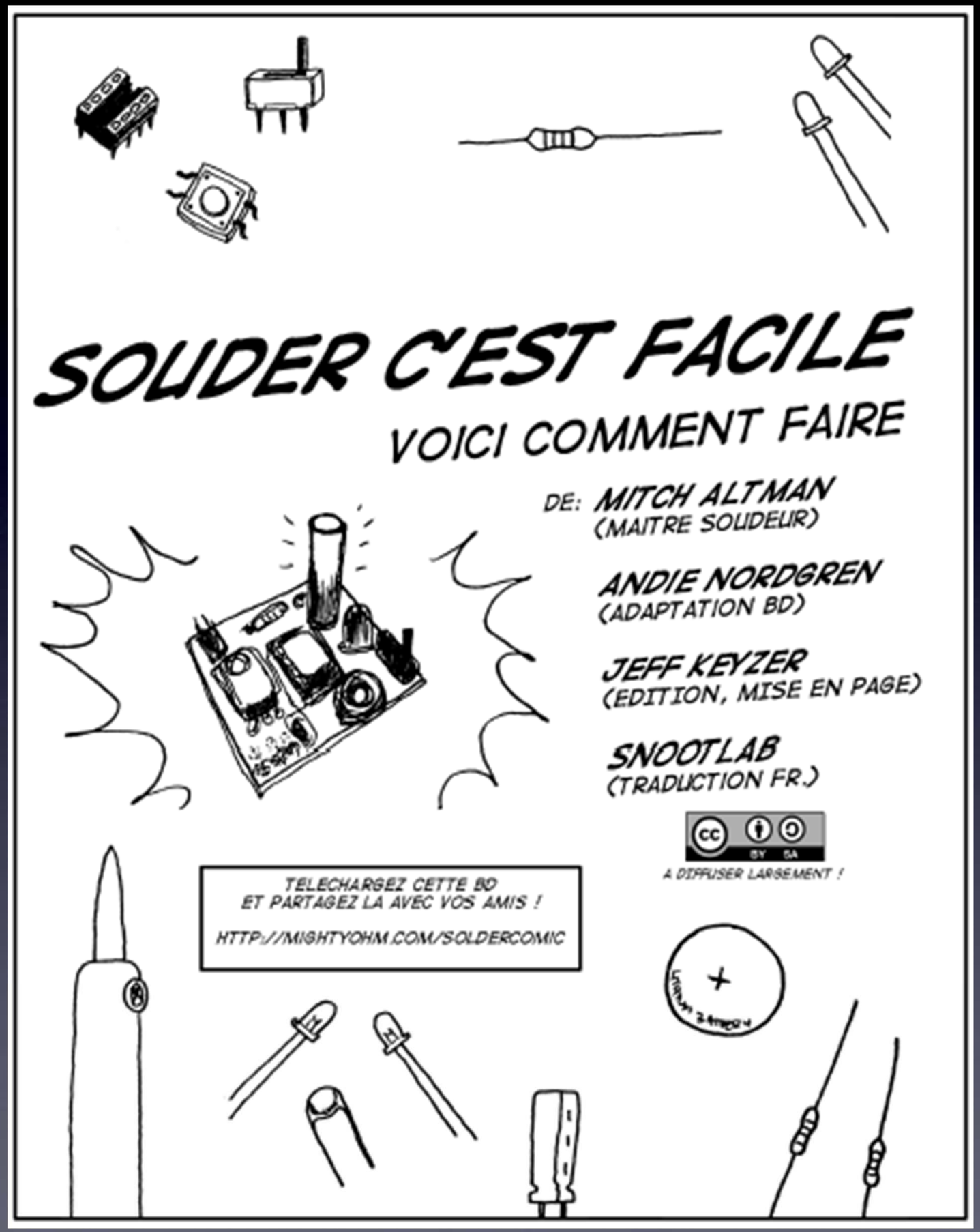

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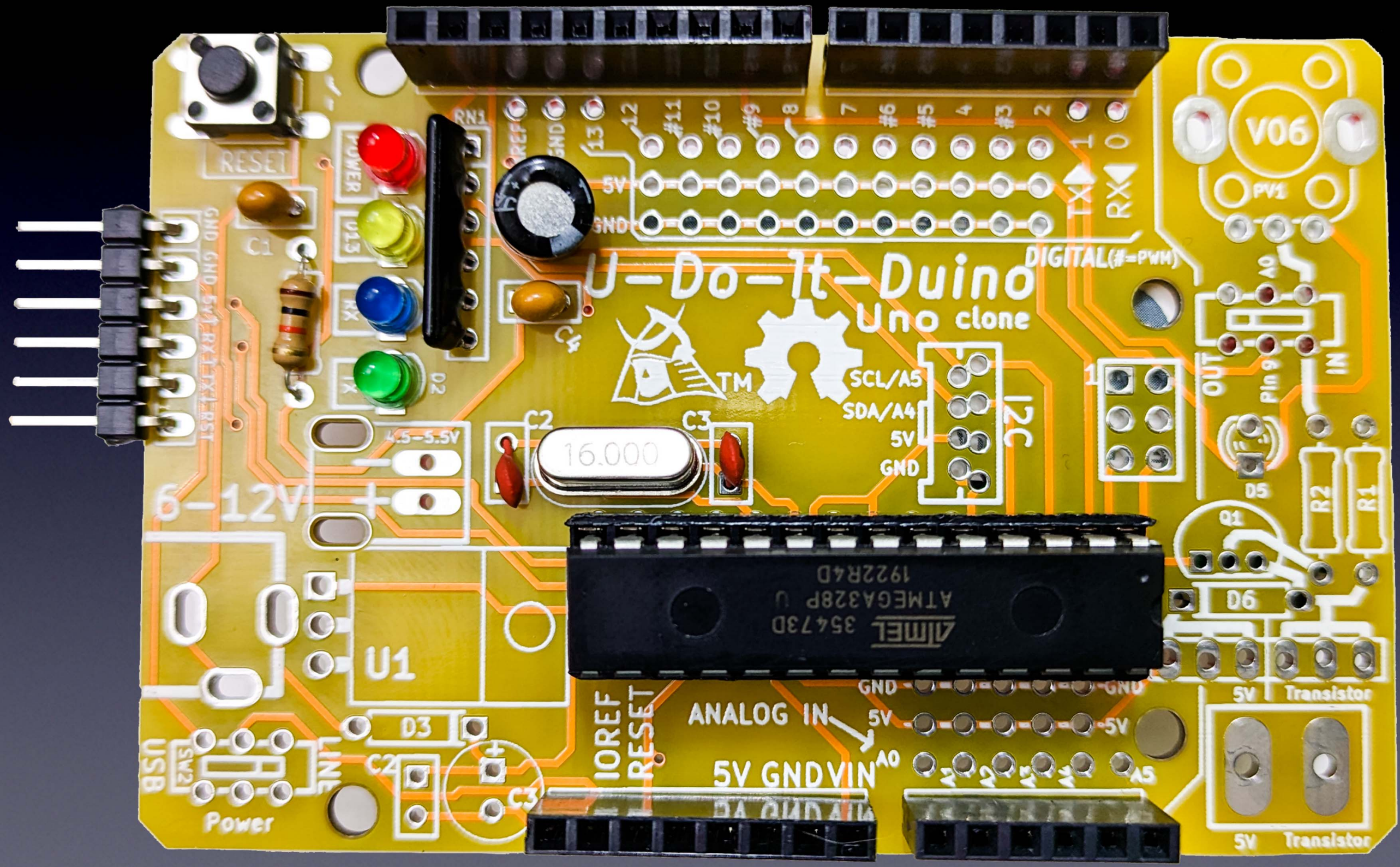
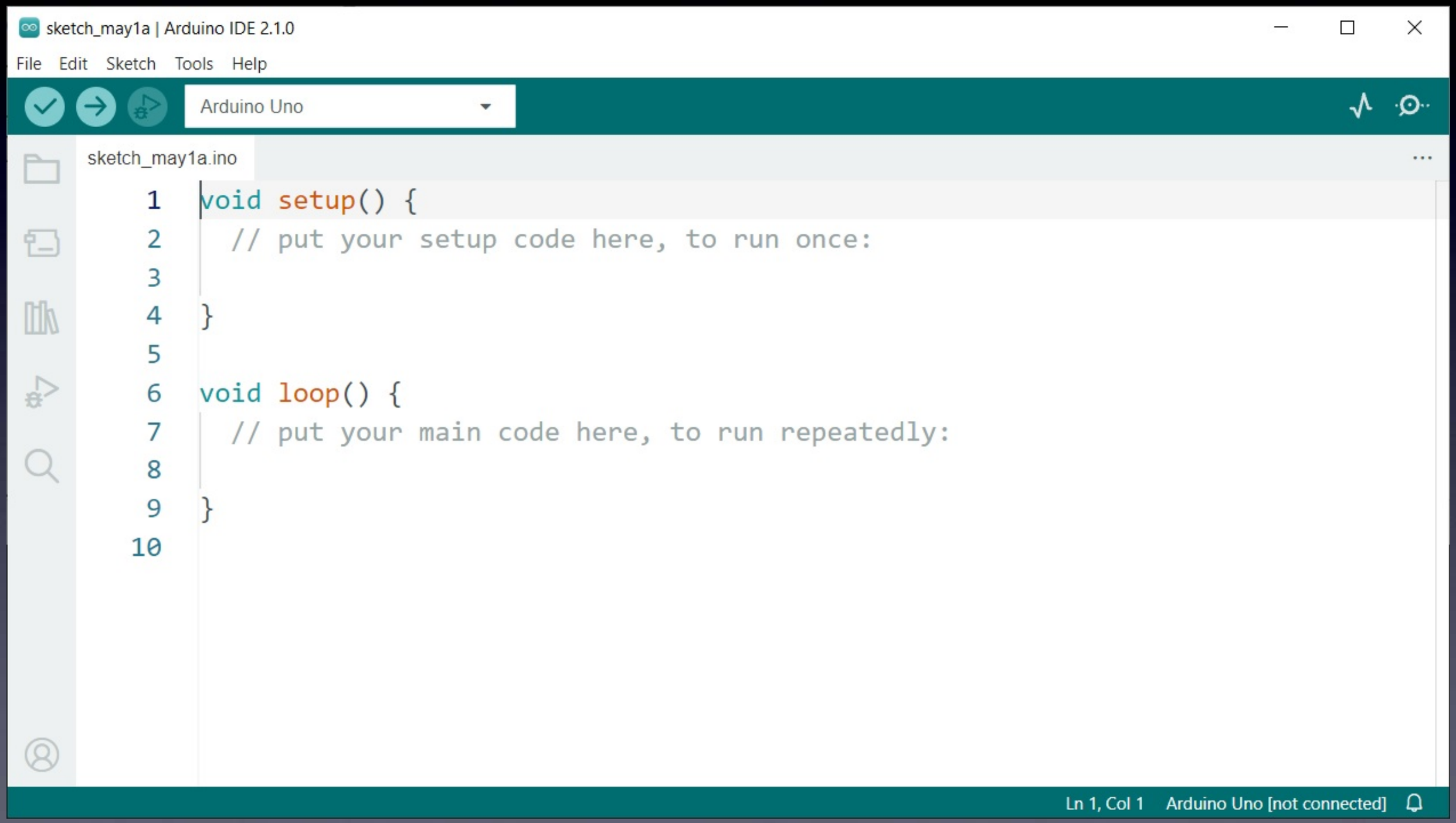
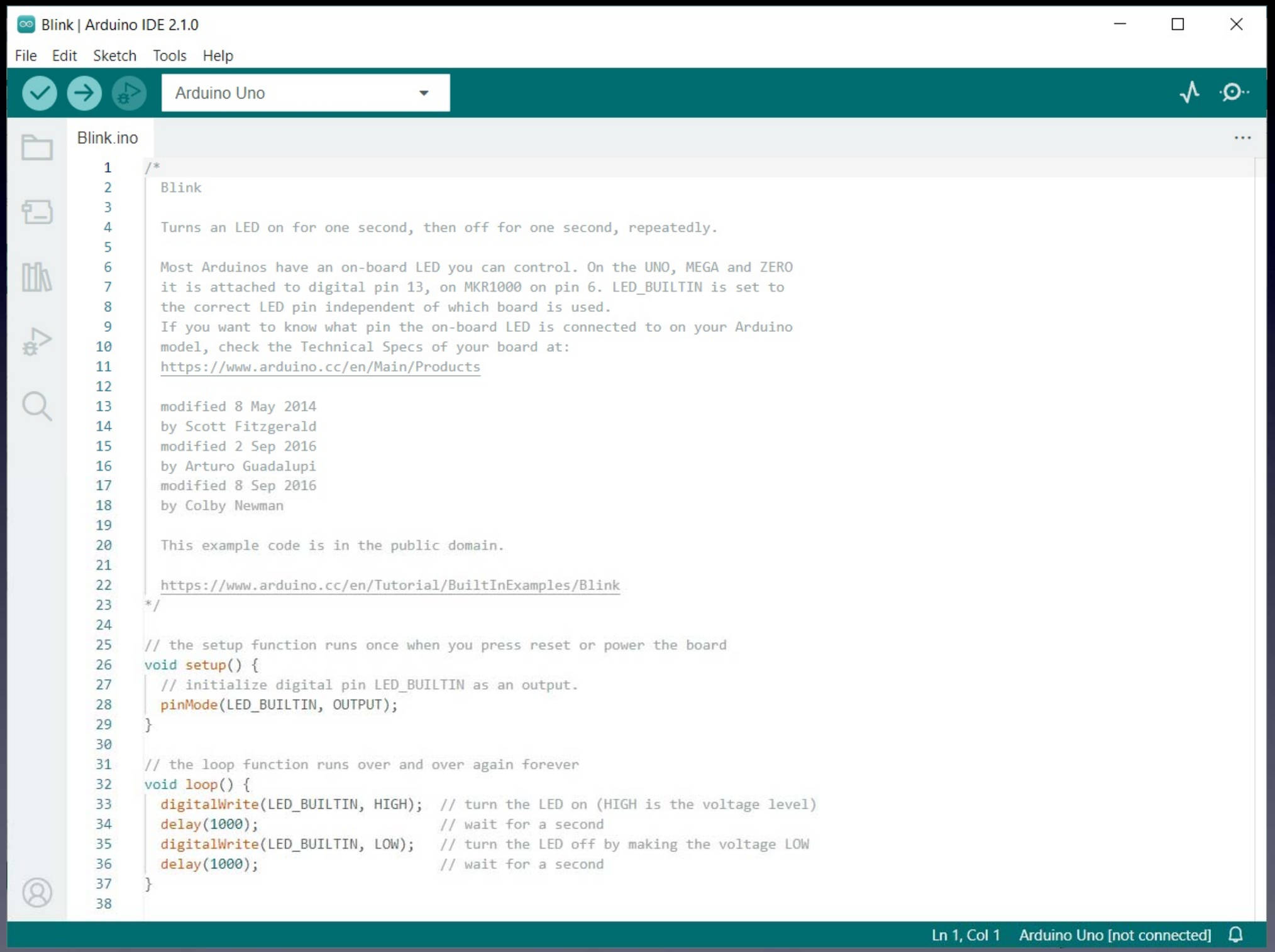
Solder Your Aruino Clone



How to Set Up and Use the Arduino Software

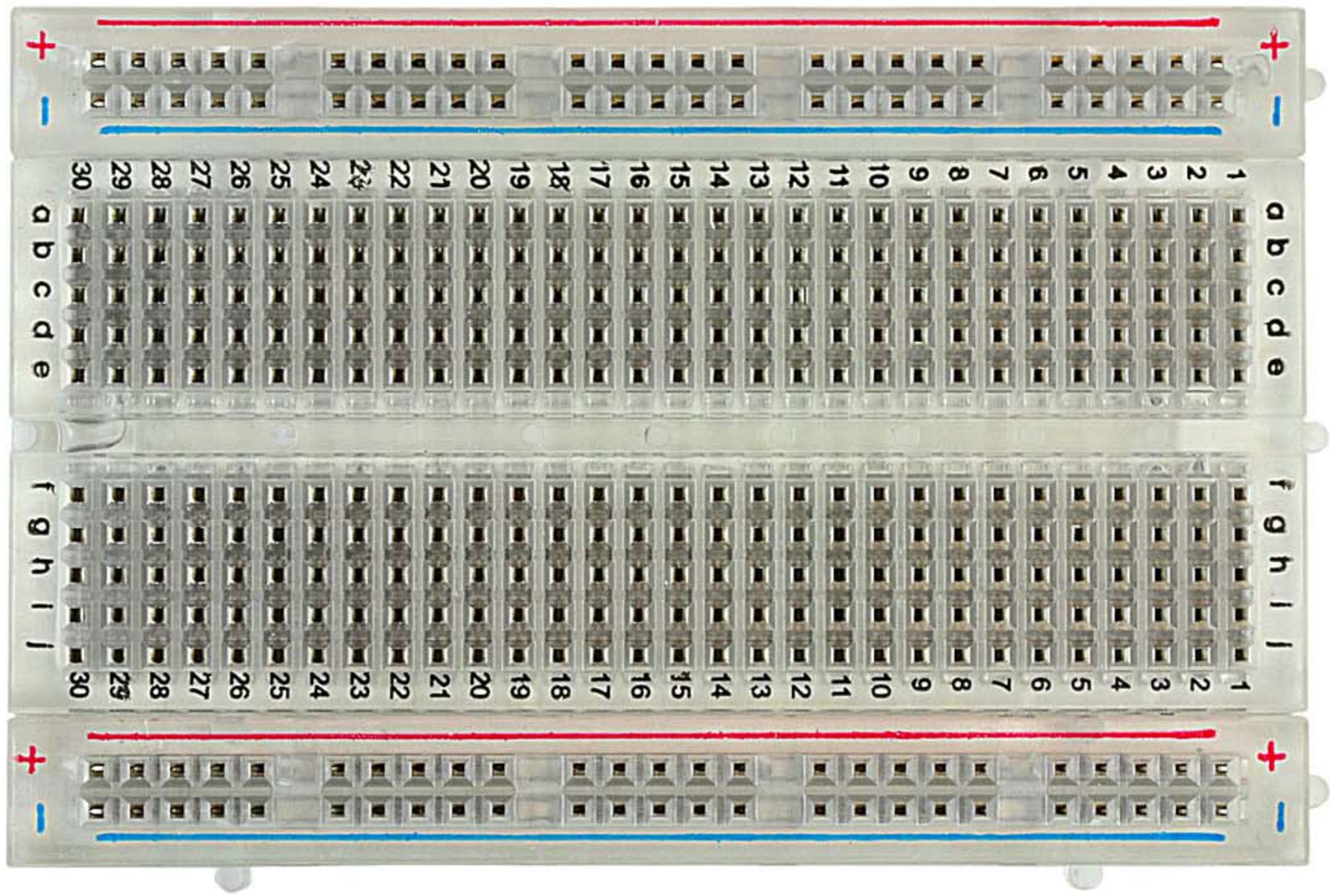


How to Hack Arduino Programs (“Sketches”)



How to Use Solderless Breadboards

Solderless Breadboard



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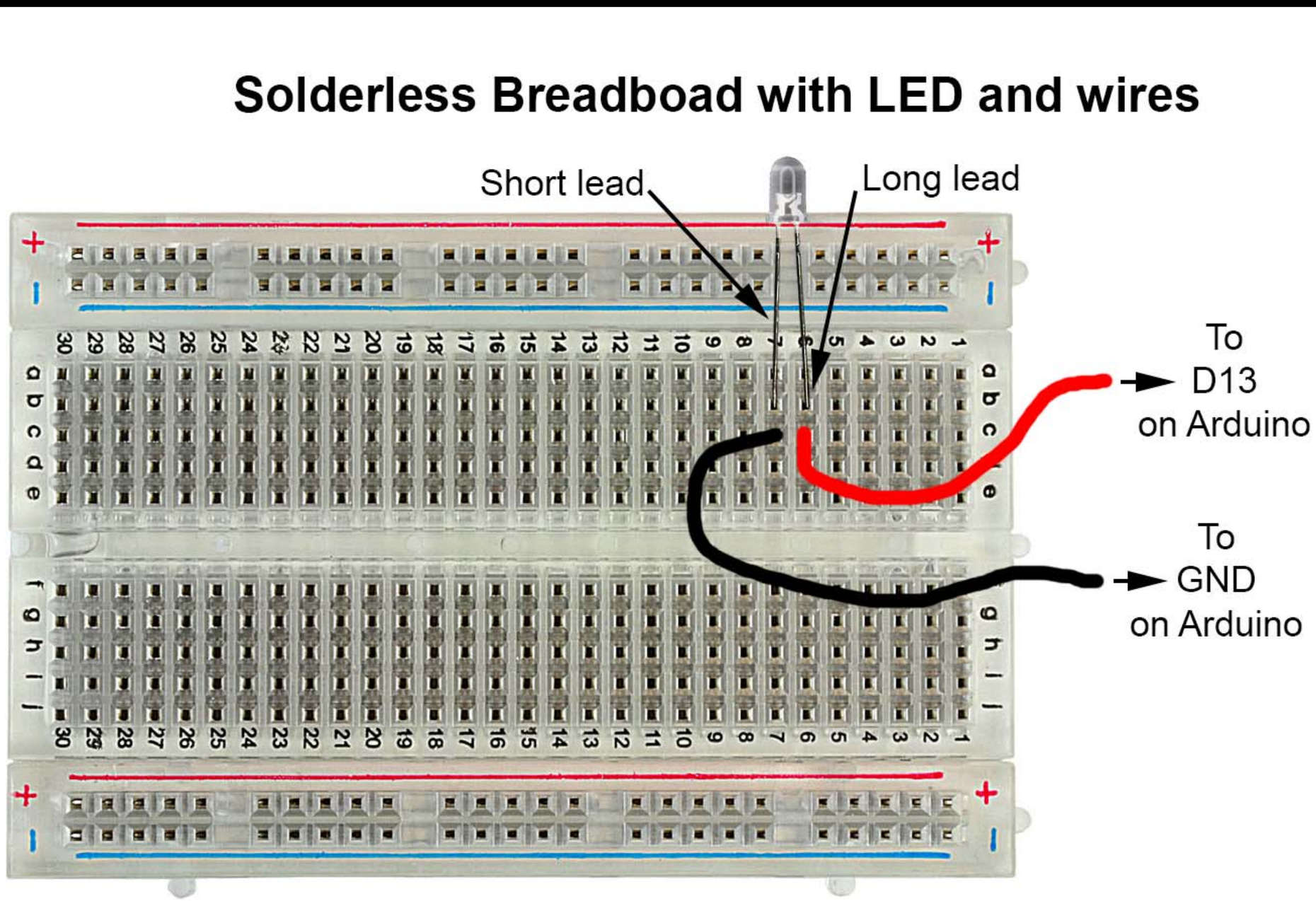
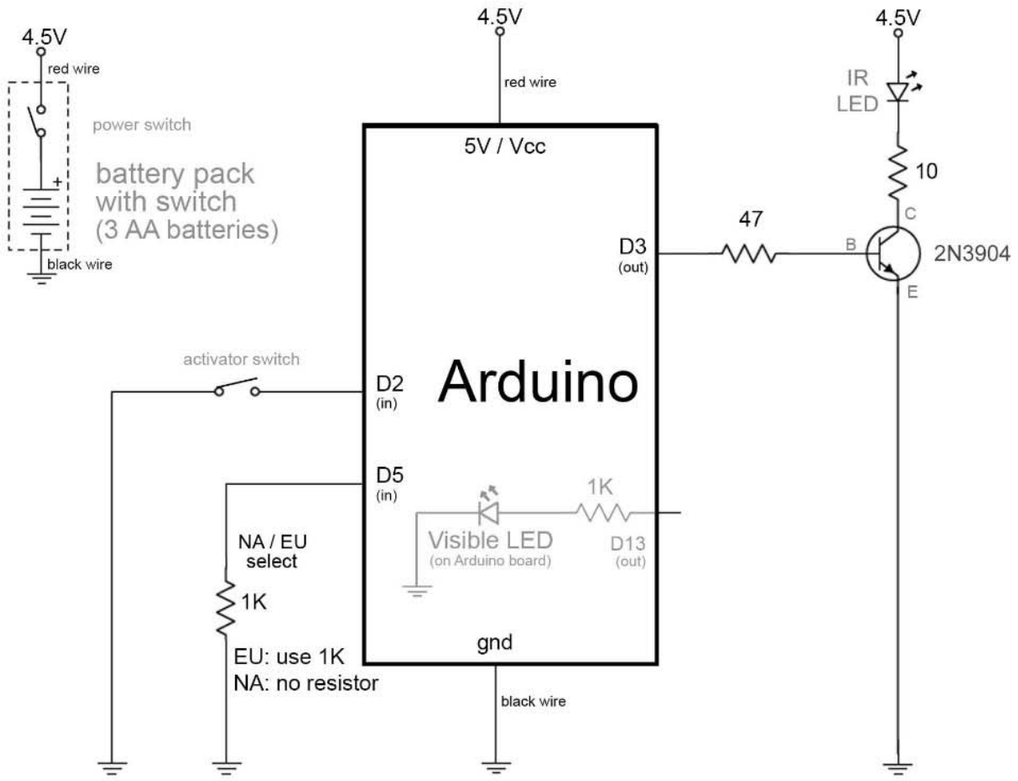


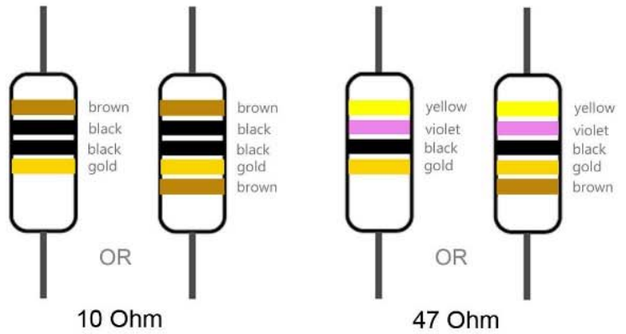
How to Read a Schematic

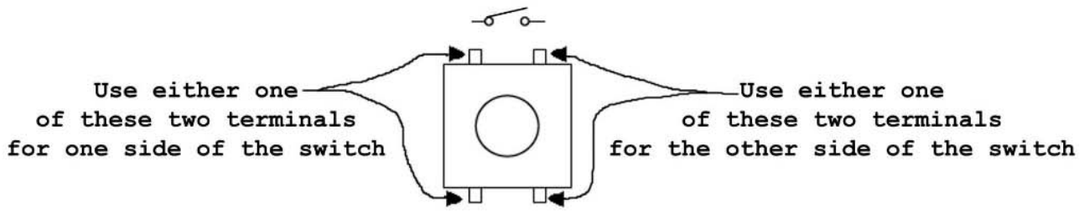
4-Sep-2015

Arduino For Total Newbies

Mitch Altman (original TV-B-Gone hardware and firmware, modified TV-B-Gone Arduino design)
Limore Fried (firmware modifications, kit design)
Ken Shirriff (original modifications for Arduino)
Johannes Schneemann (documentation)

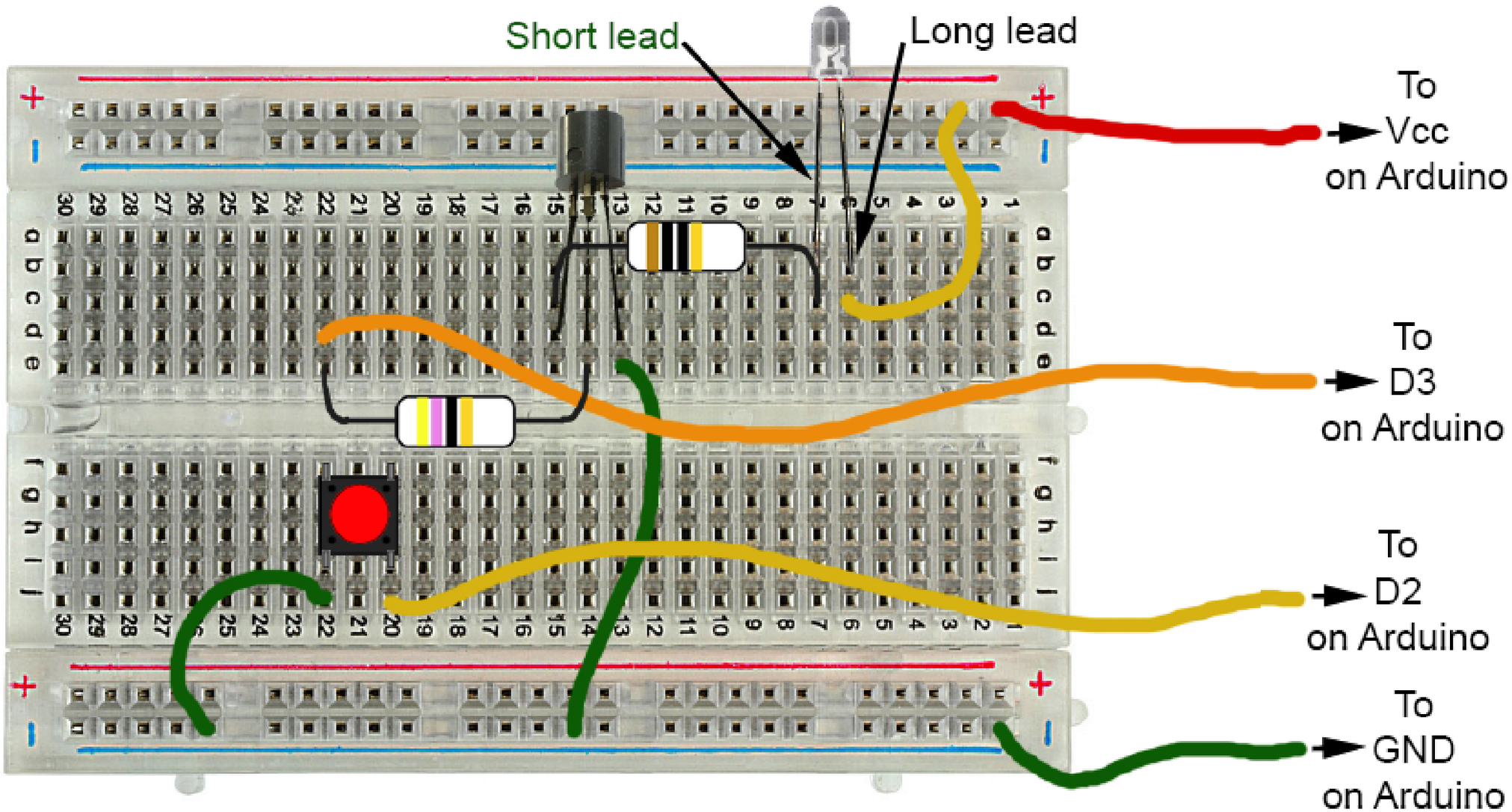


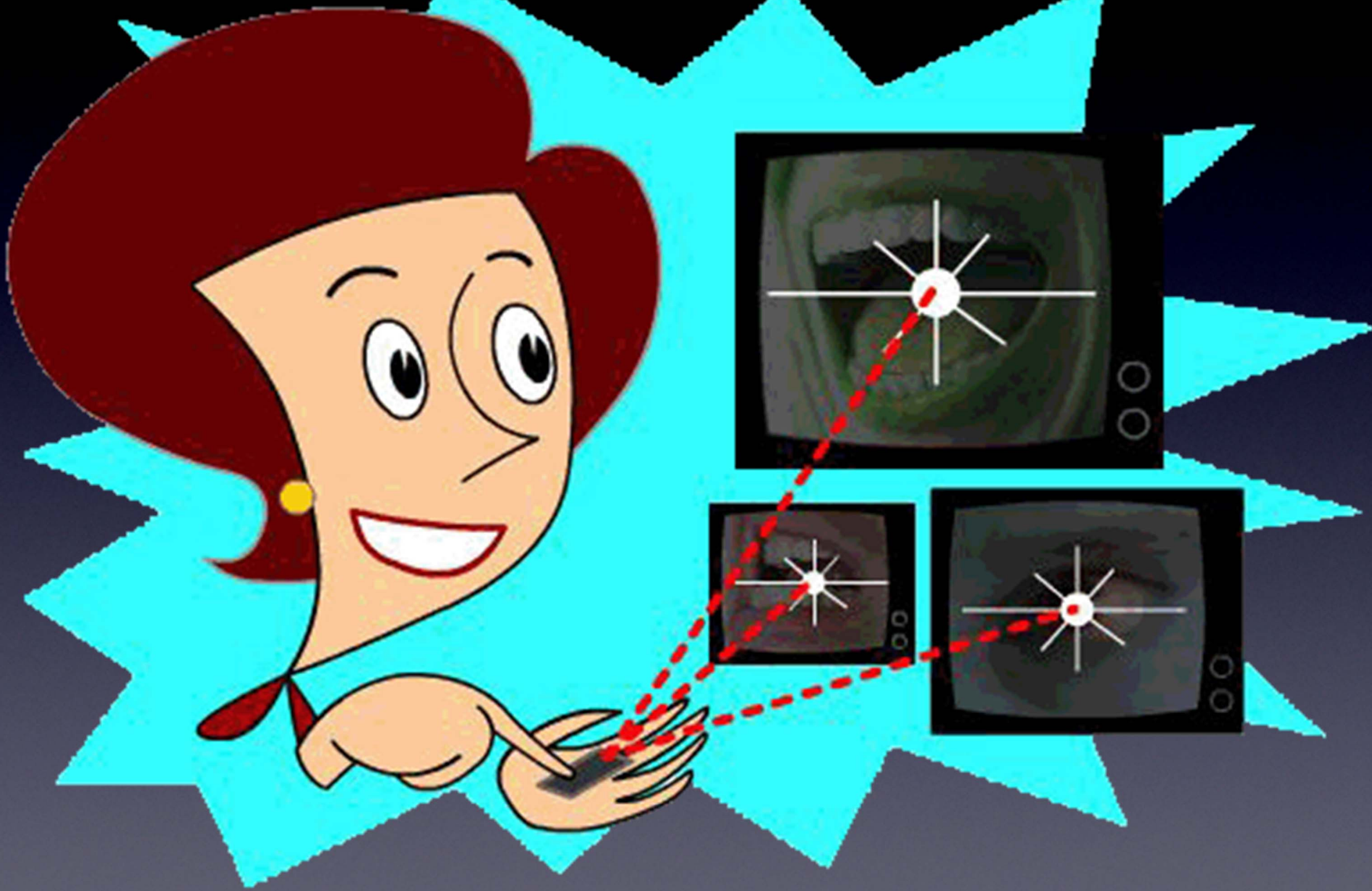




Make a TV-B-Gone Remote Control with your Arduino Clone without soldering

Solderless Breadboard with parts & wires for TV-B-Gone





Questions?

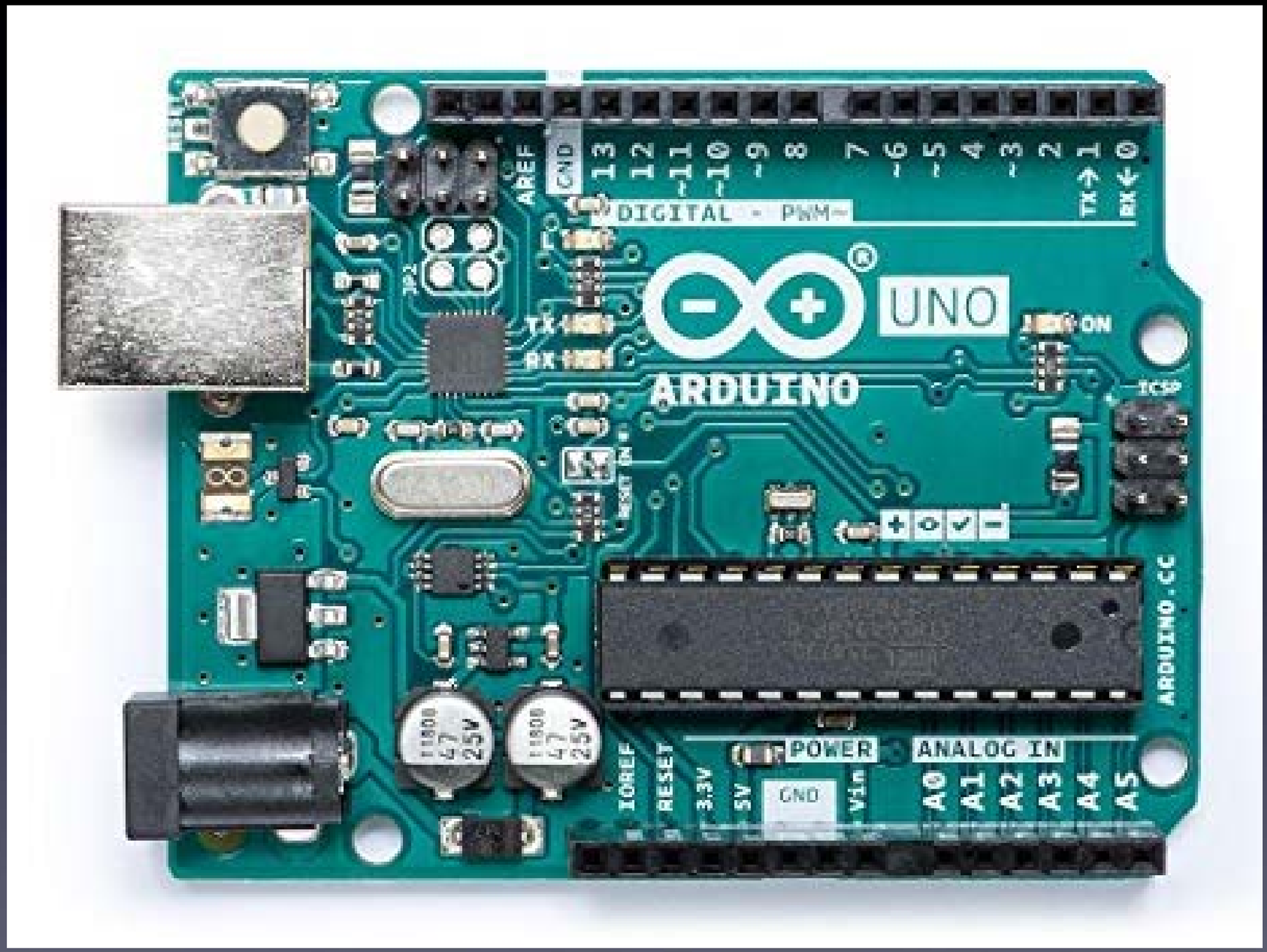
Intro

Noisebridge Hacker Space
https://noisebridge.net
2169.mission.sf.ca.us

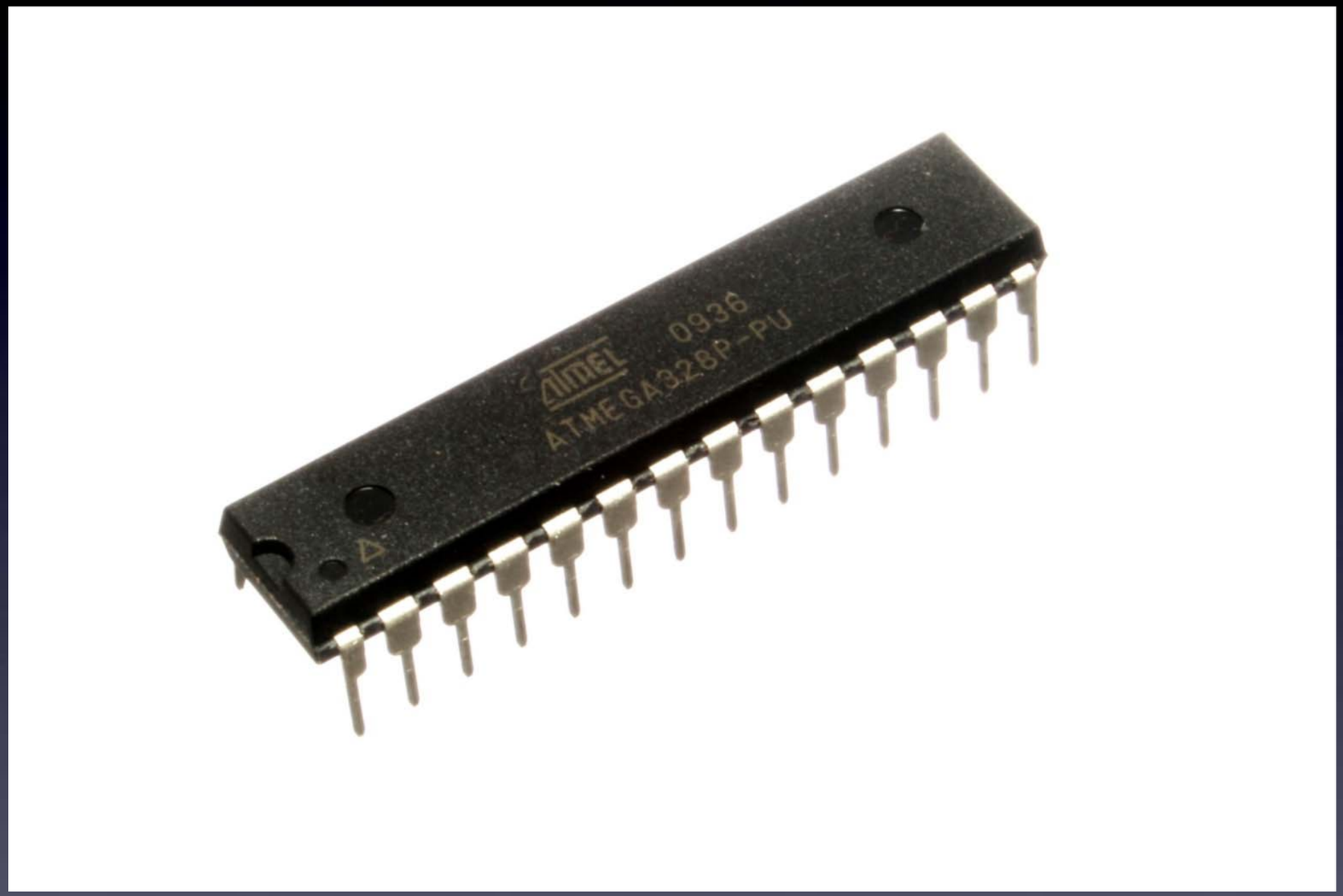
Intro

Arduino For Total Newbies Workshop at 30C3, Hamburg Germany

Intro to Arduino

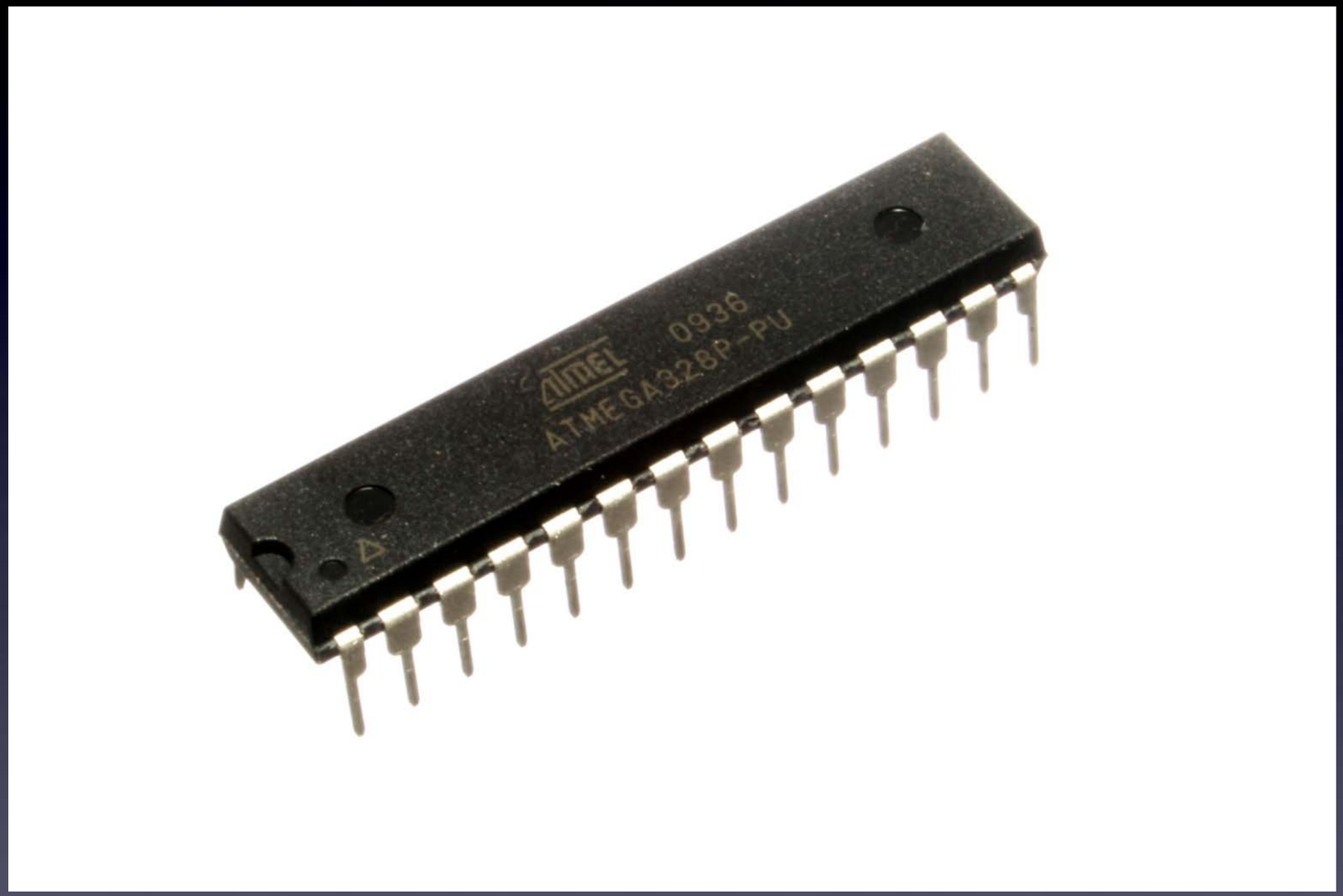


Intro to Arduino: microcontrollers



A complete computer on a chip

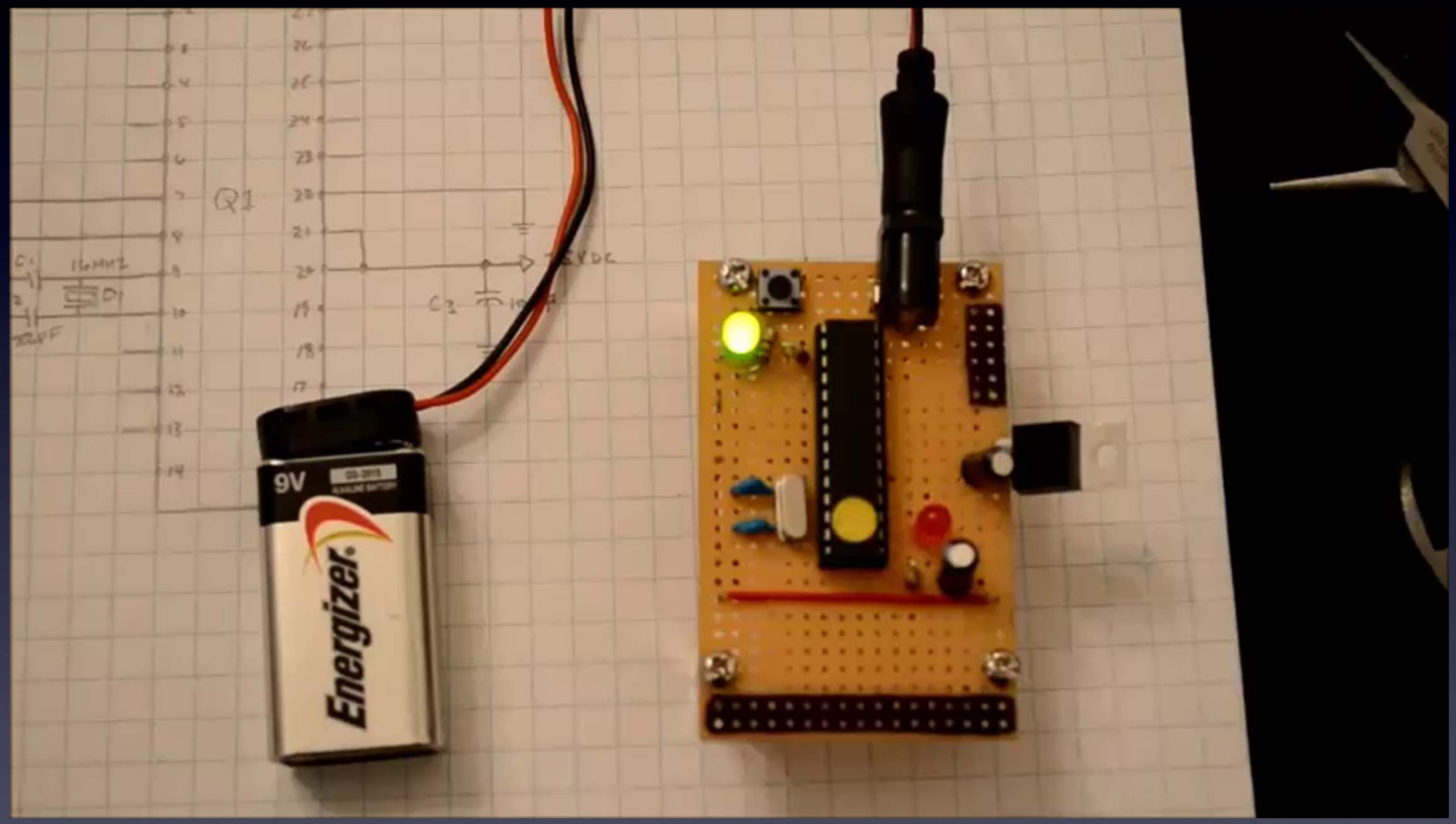
Intro to Arduino: microcontrollers



A complete computer on a chip:

they control parts connected to their pins

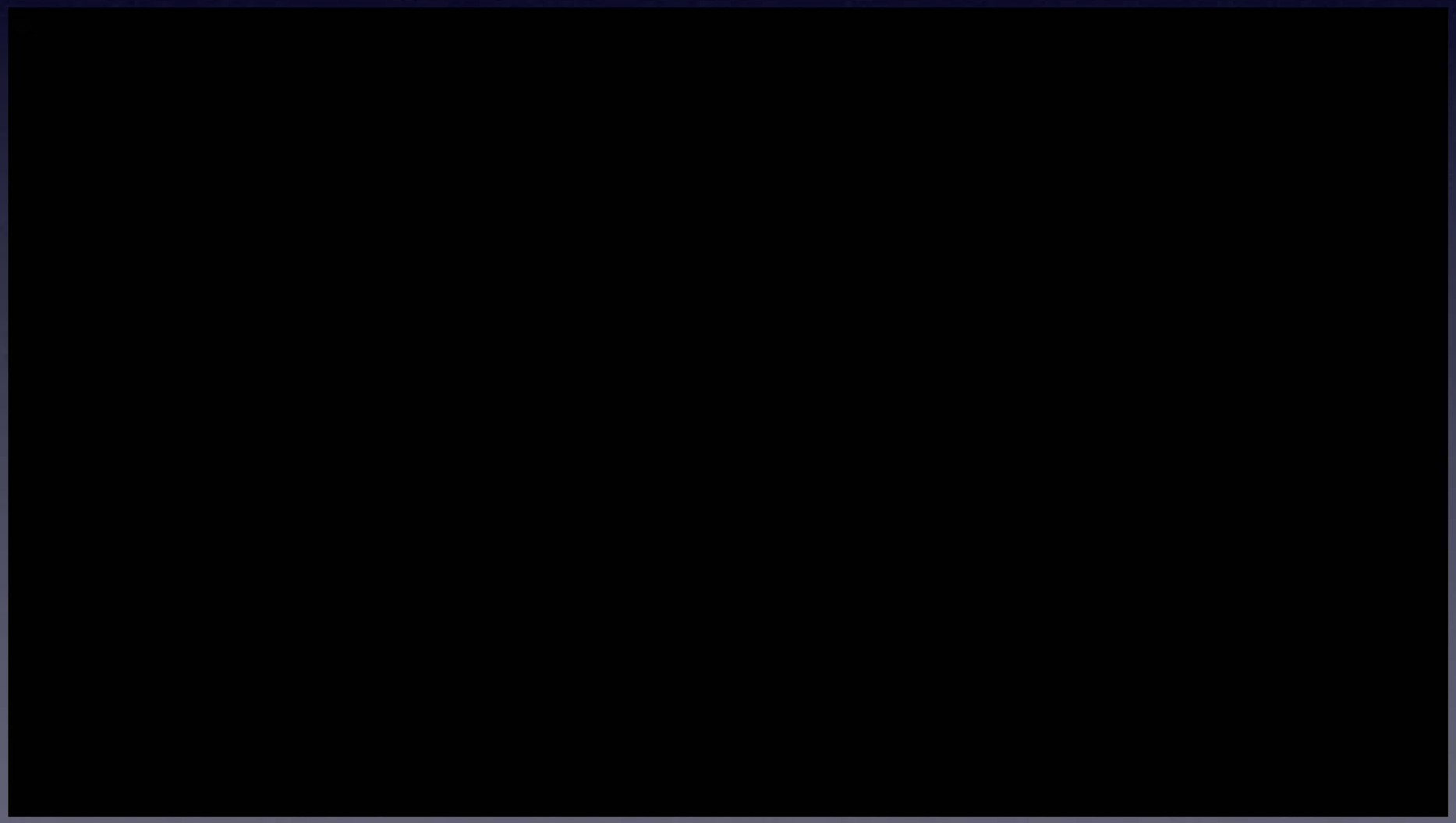
Intro to Arduino: microcontrollers



Intro to Arduino: microcontrollers

-- one of Mitch's projects --

ArduTouch music synthesizer *kit*



Intro to Arduino: microcontrollers

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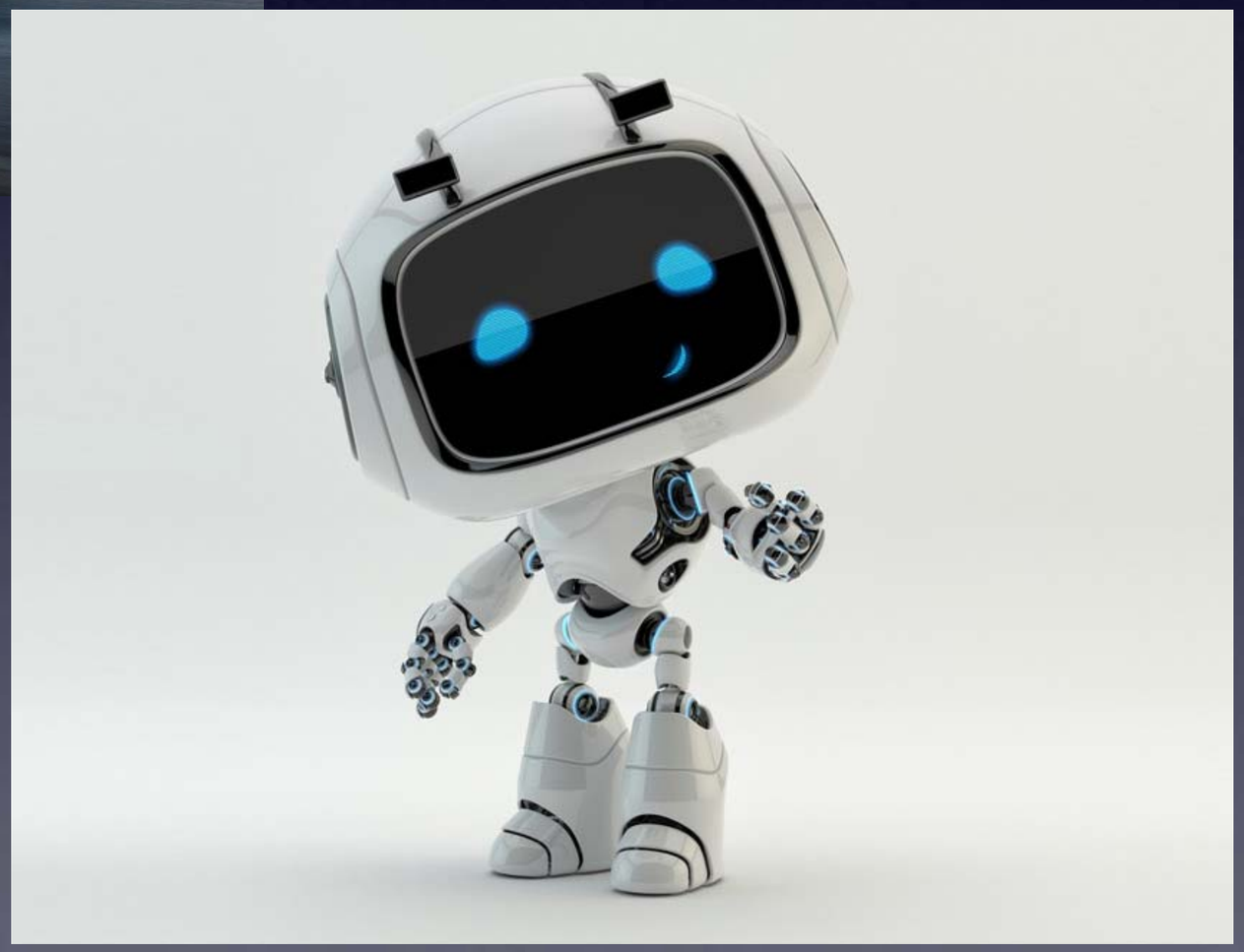

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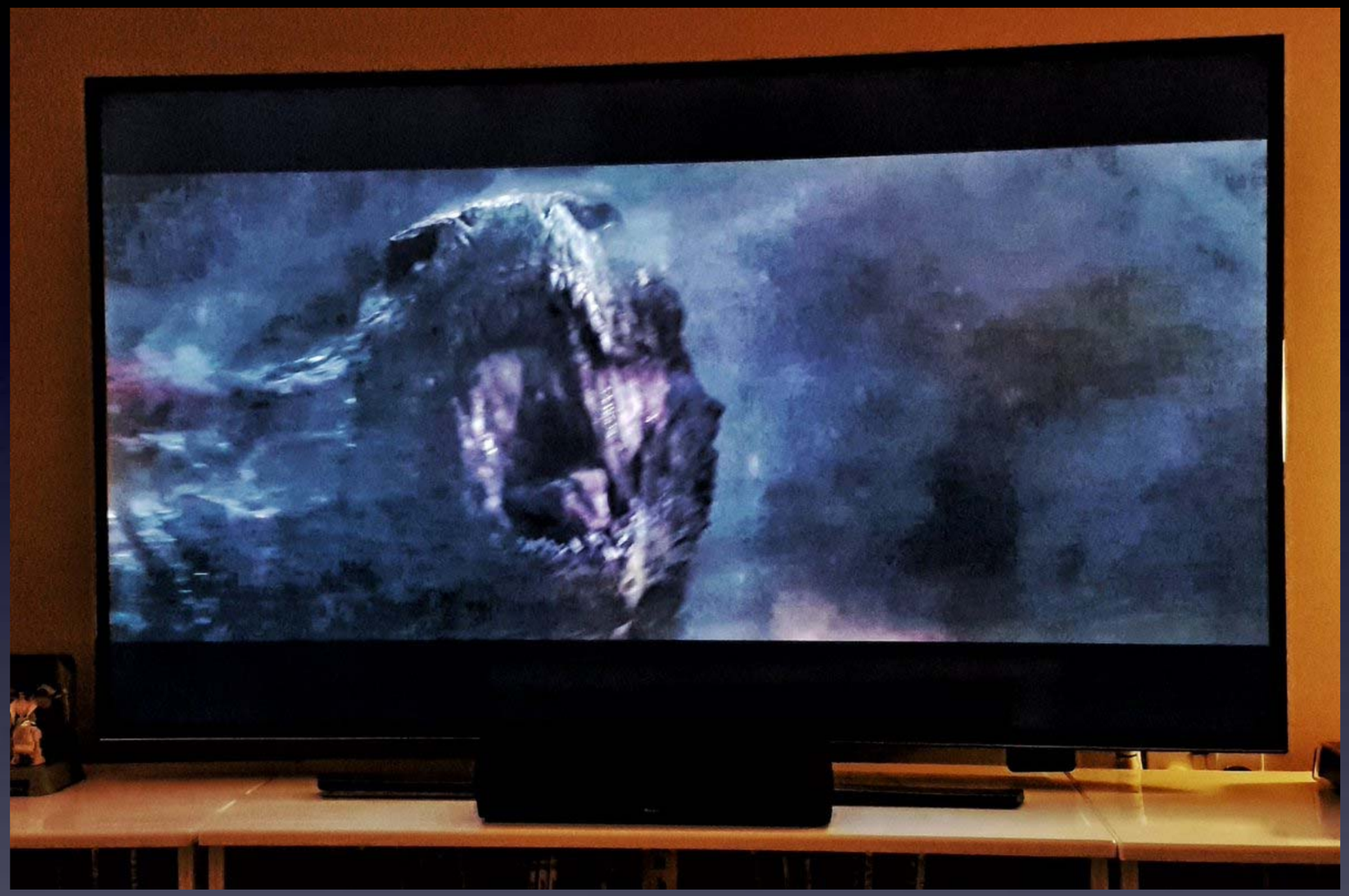

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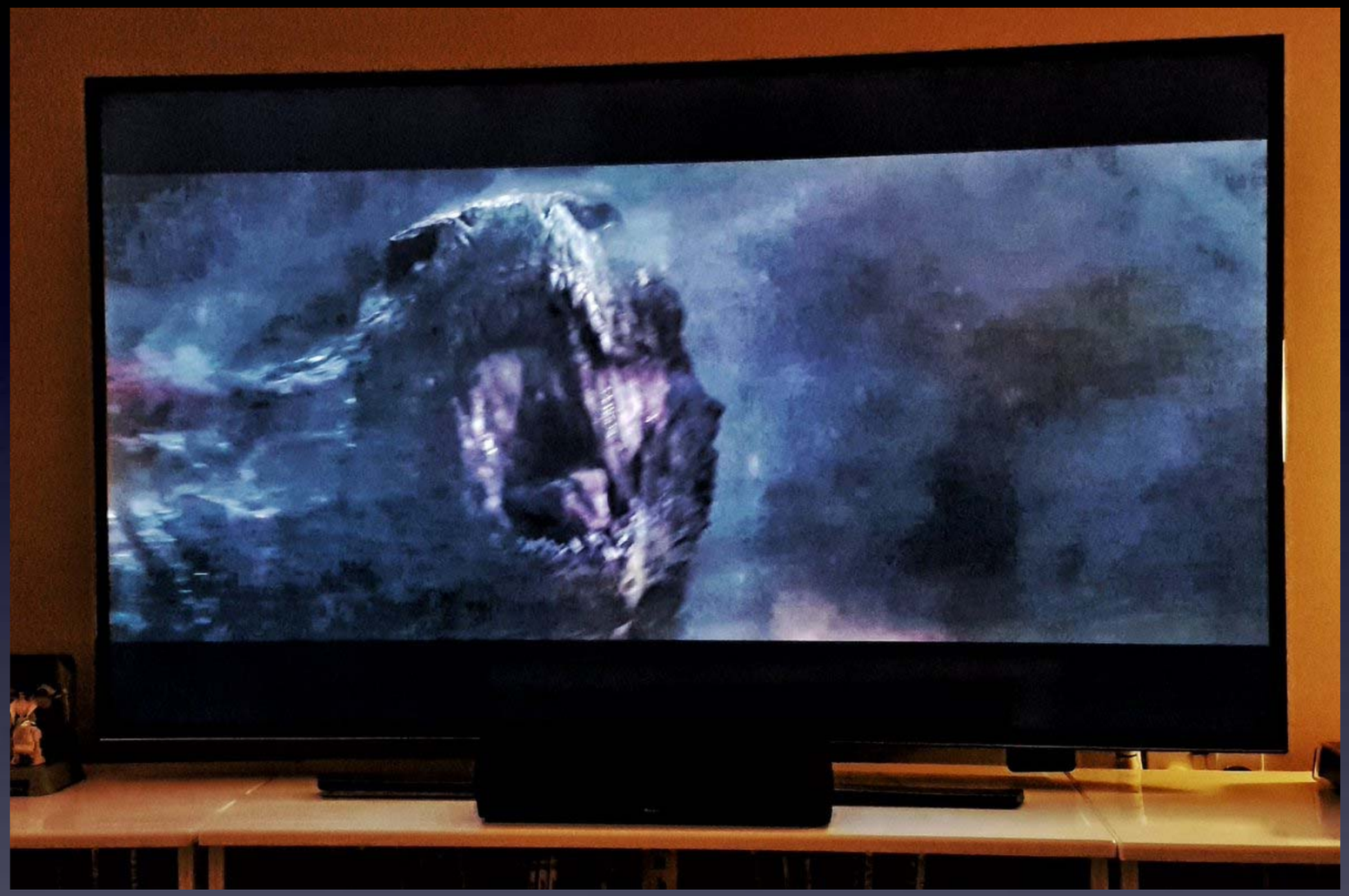


Intro to Arduino: microcontrollers

-- one of Mitch's projects --

TV-B-Gone

Intro to Arduino: microcontrollers

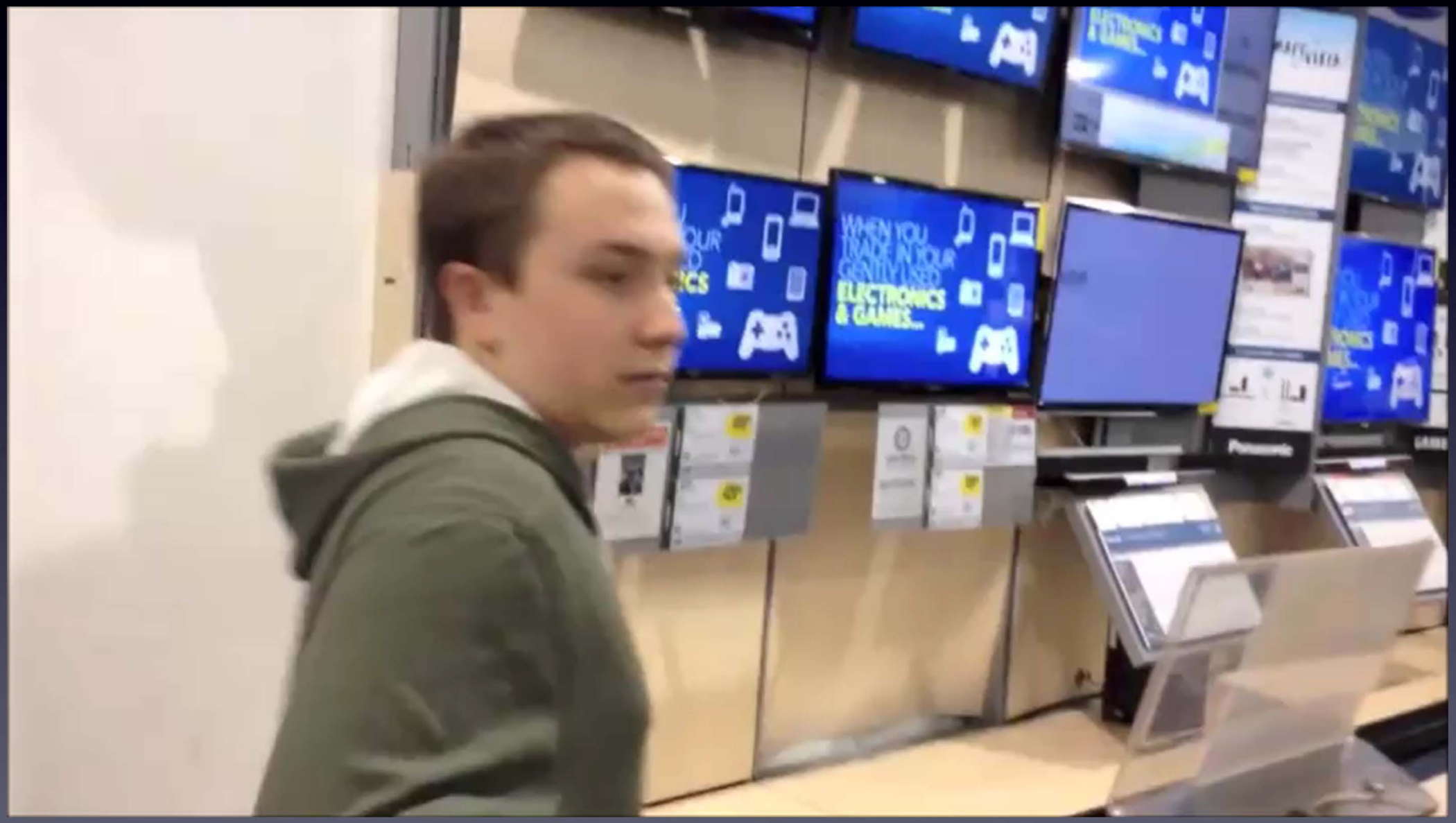
-- one of Mitch's projects --

TV-B-Gone

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

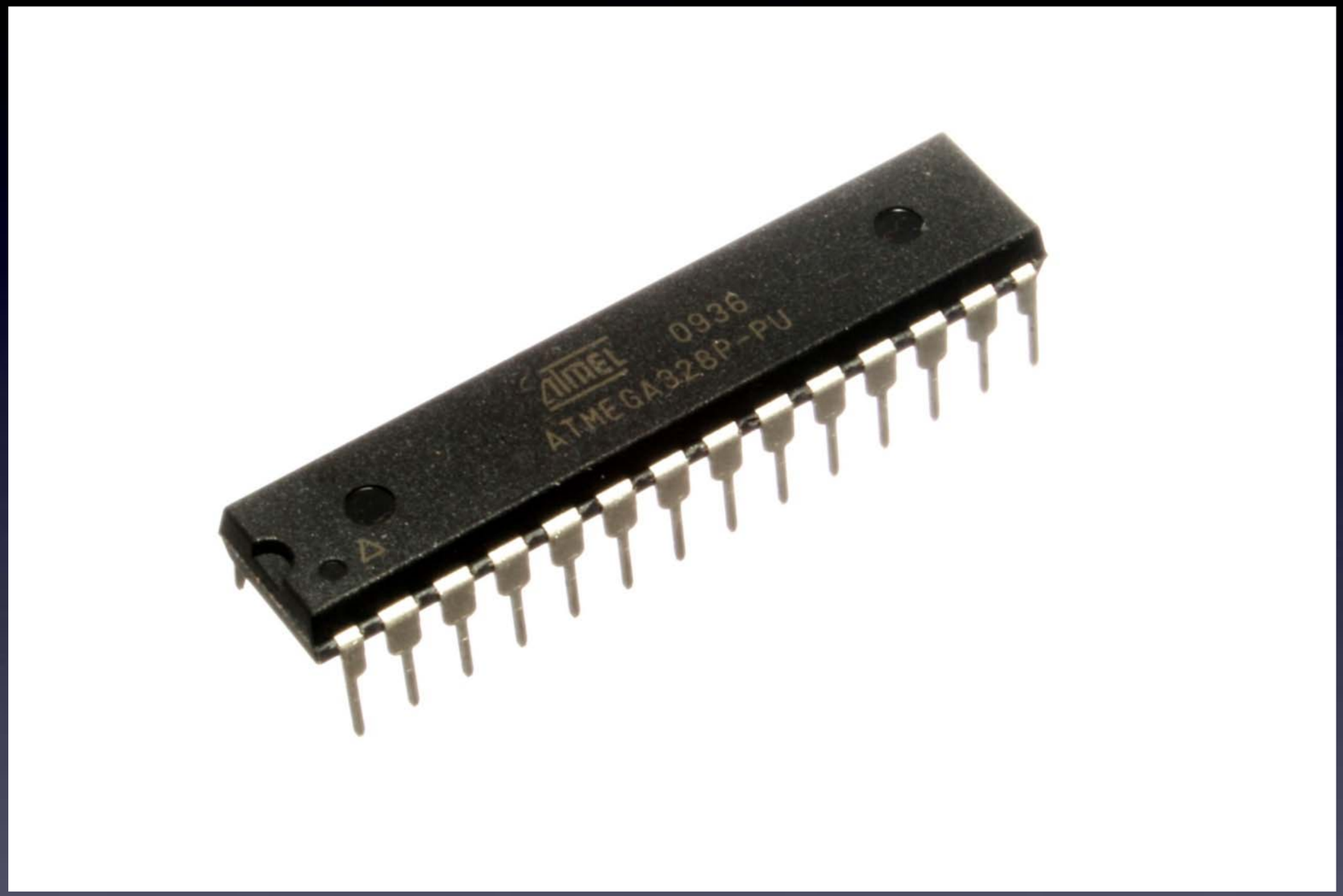
Intro to Arduino: microcontrollers

-- one of Mitch's projects --



TV-B-Gone

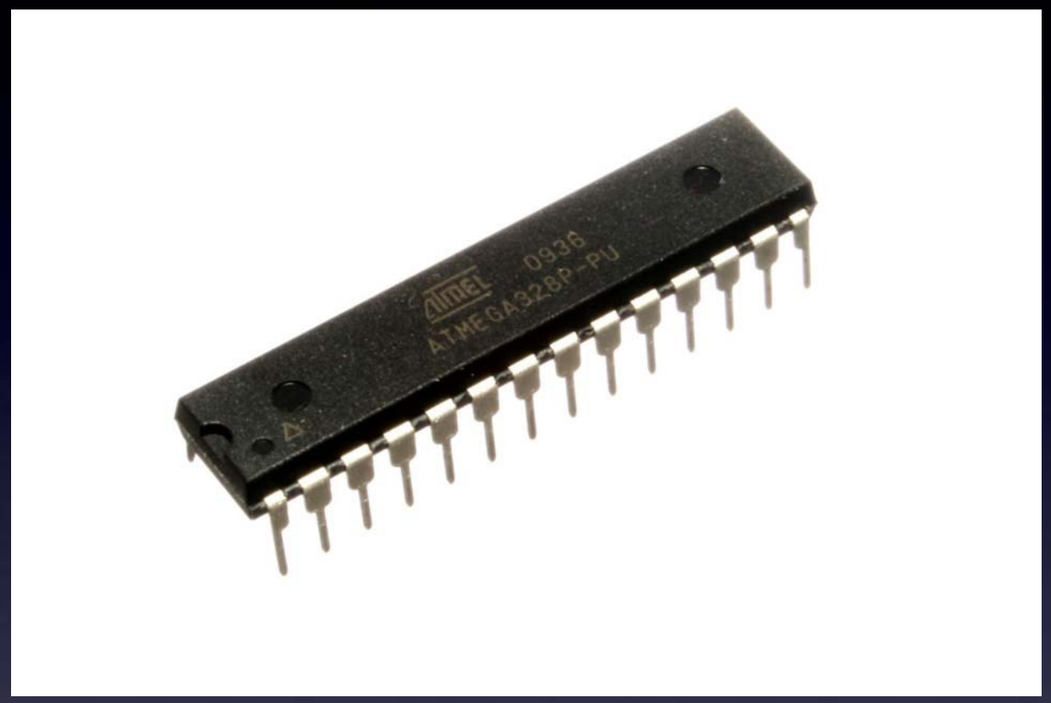
Intro to Arduino: microcontrollers



A complete computer on a chip:

they control parts connected to their pins

Intro to Arduino: microcontrollers



A complete computer on a chip:

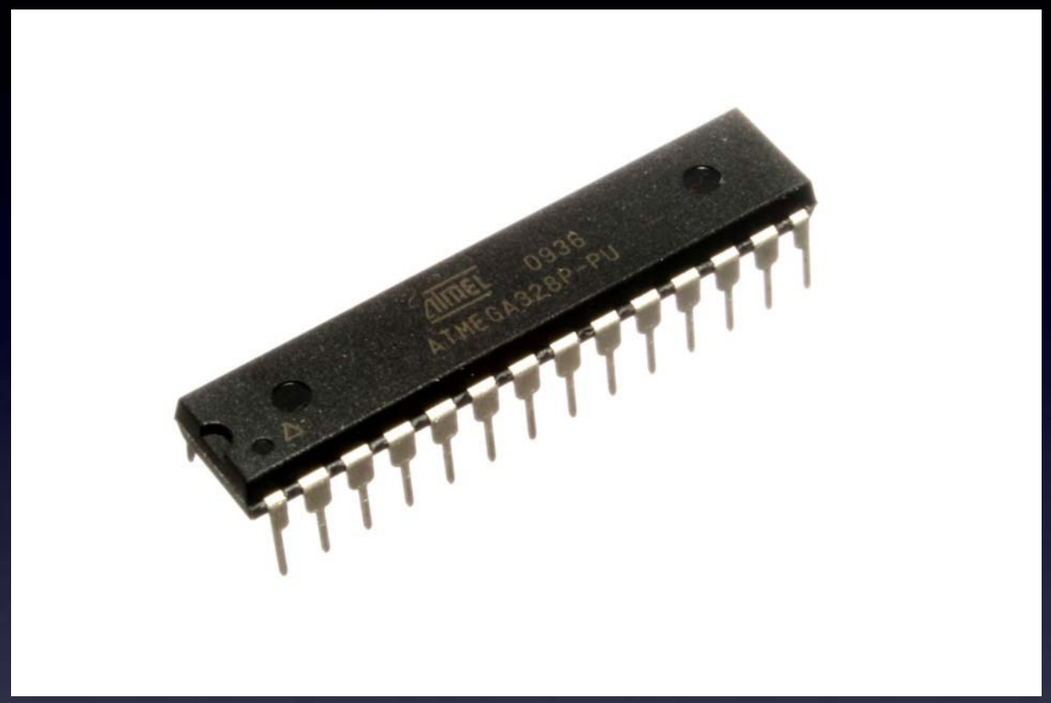
they control parts connected to their pins

But,

How do you
connect parts to its pins?

How do you
create and upload a program
to control the parts?

Intro to Arduino: microcontrollers



A complete computer on a chip:

they control parts connected to their pins

But,

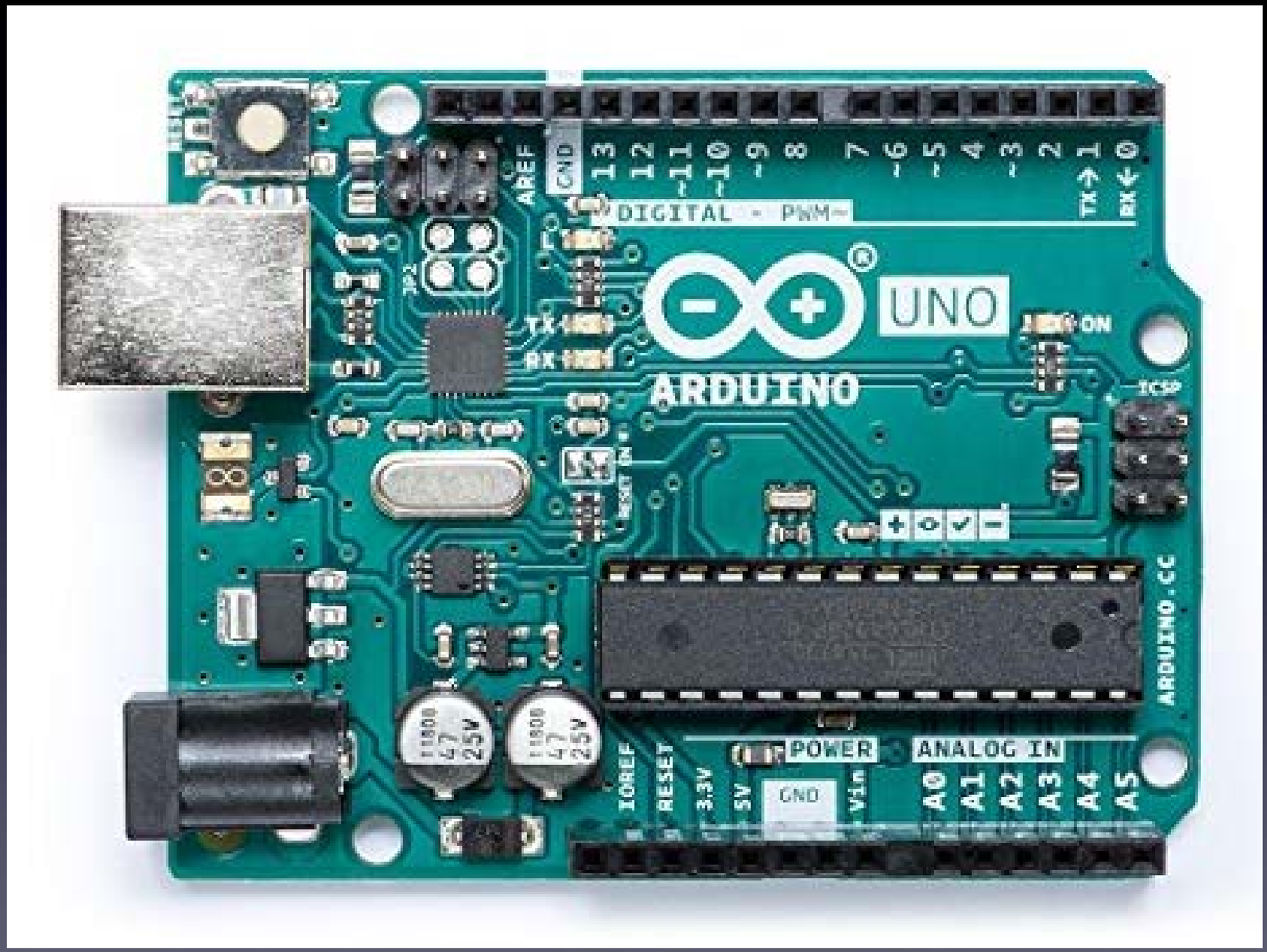
How do you
connect parts to its pins?

How do you
create and upload a program
to control the parts?

Answer: Be a geek, and learn how!

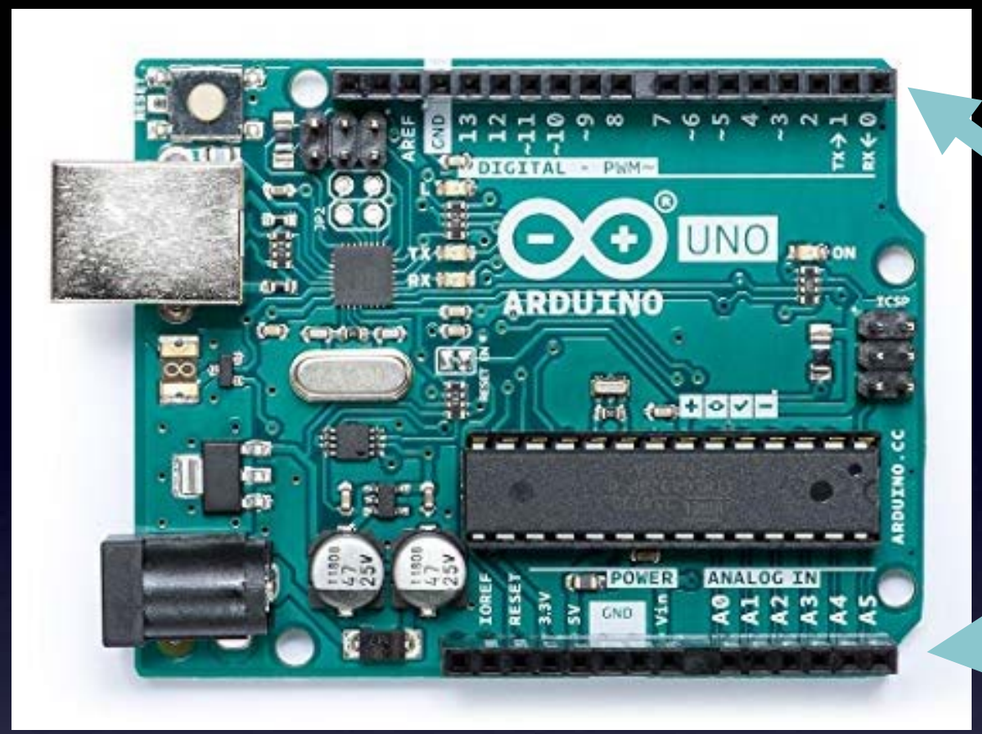
Or

Intro to Arduino



Use an Arduino board

Intro to Arduino



Super easy to
connect parts
to its microcontroller's pins

Use an Arduino board

Intro to Arduino

Use an Arduino board

Super easy to
connect parts
to its microcontroller's pins

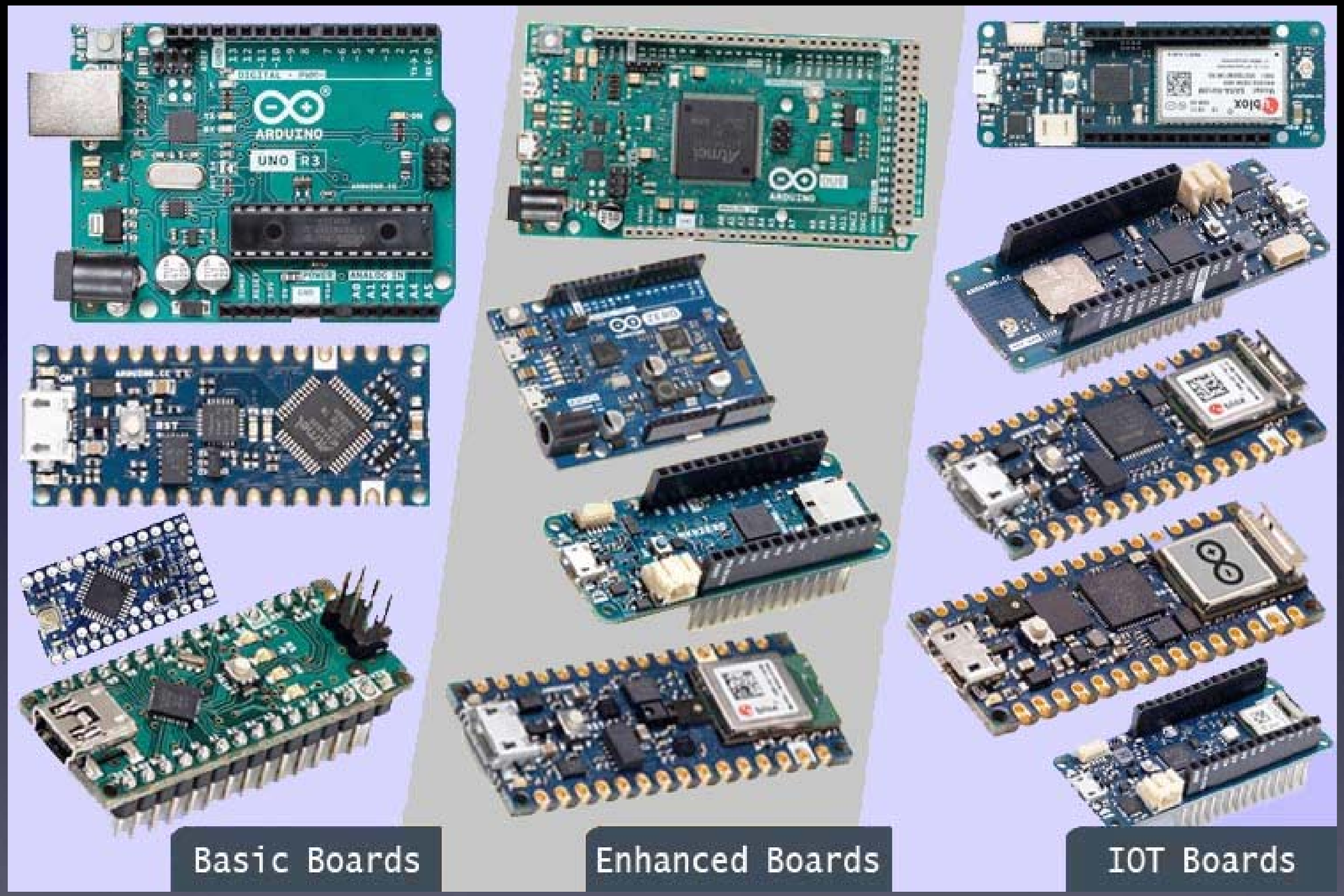
Super easy to
create and upload a program
to control the parts

Intro to Arduino

Arduino board

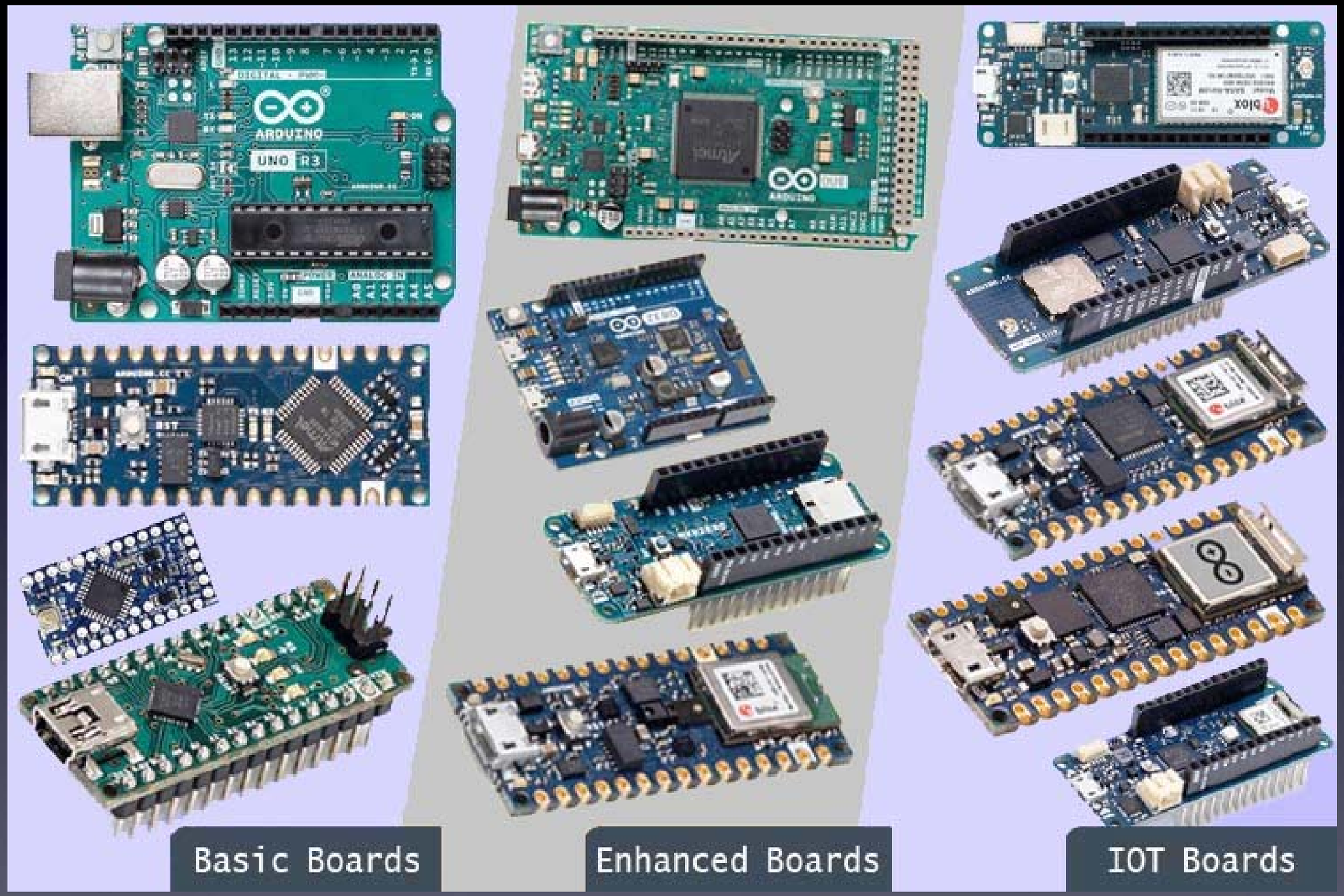
Designed for
non-geeky artists

Intro to Arduino



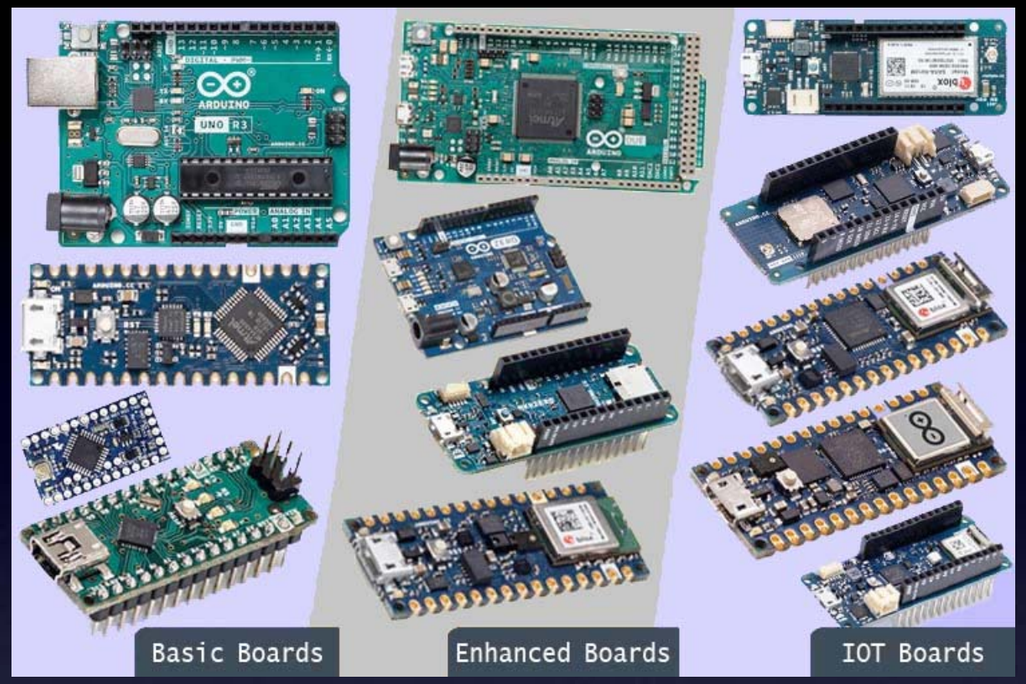
Many Arduino boards to choose from

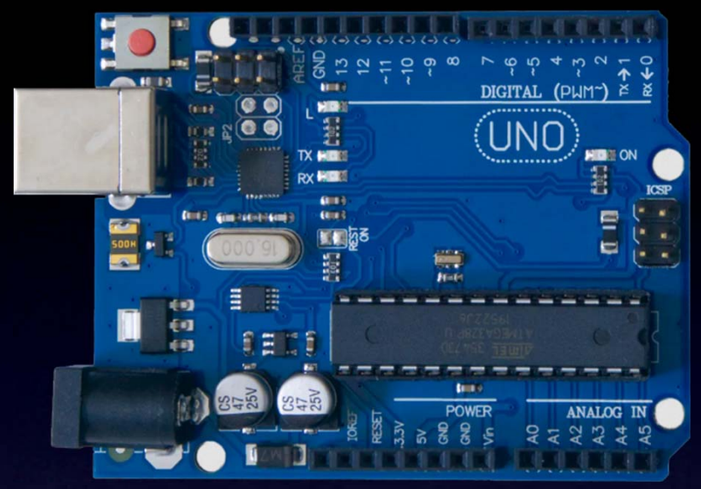
Intro to Arduino

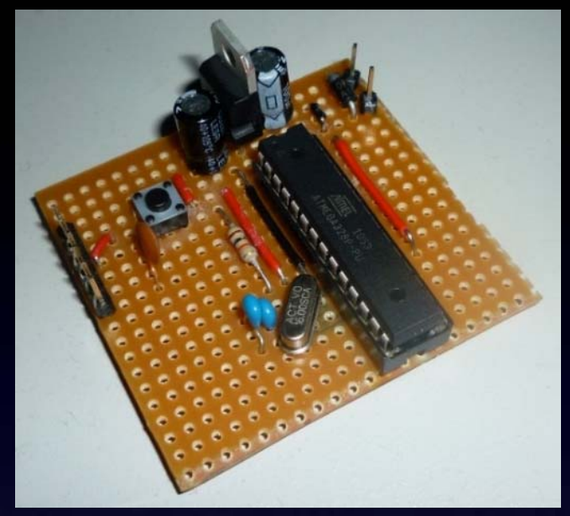


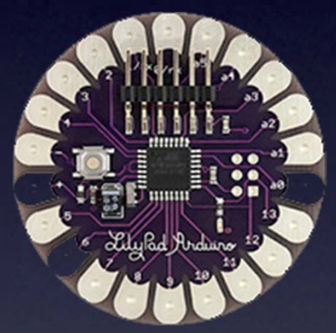
Open Source

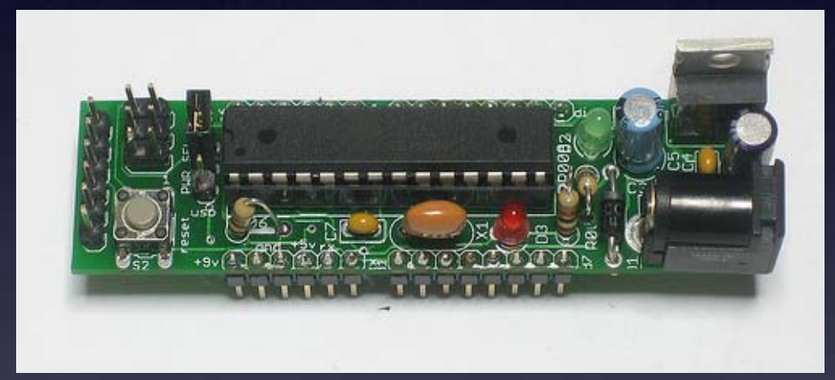
Intro to Arduino

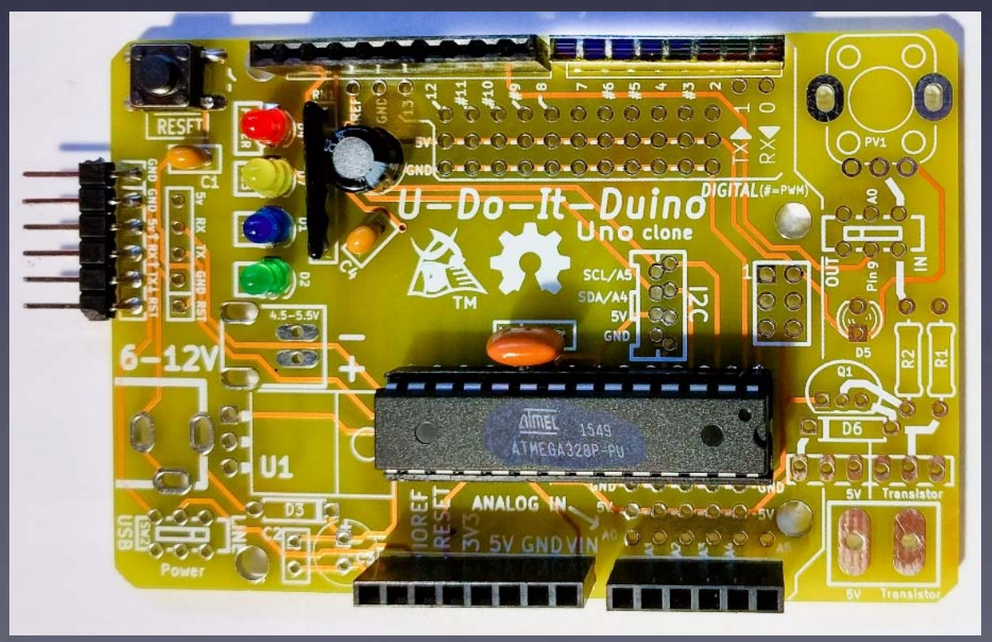


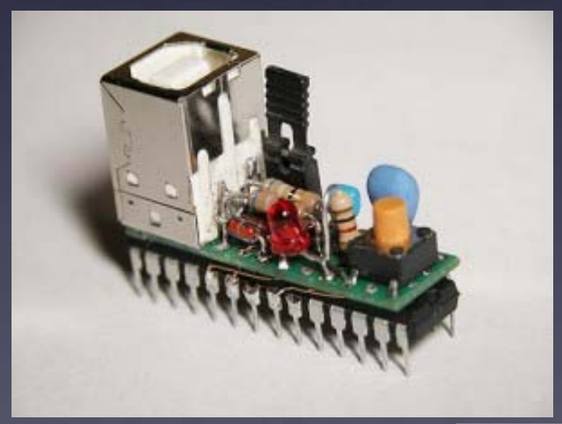


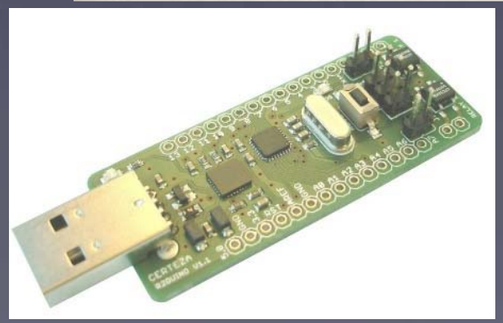








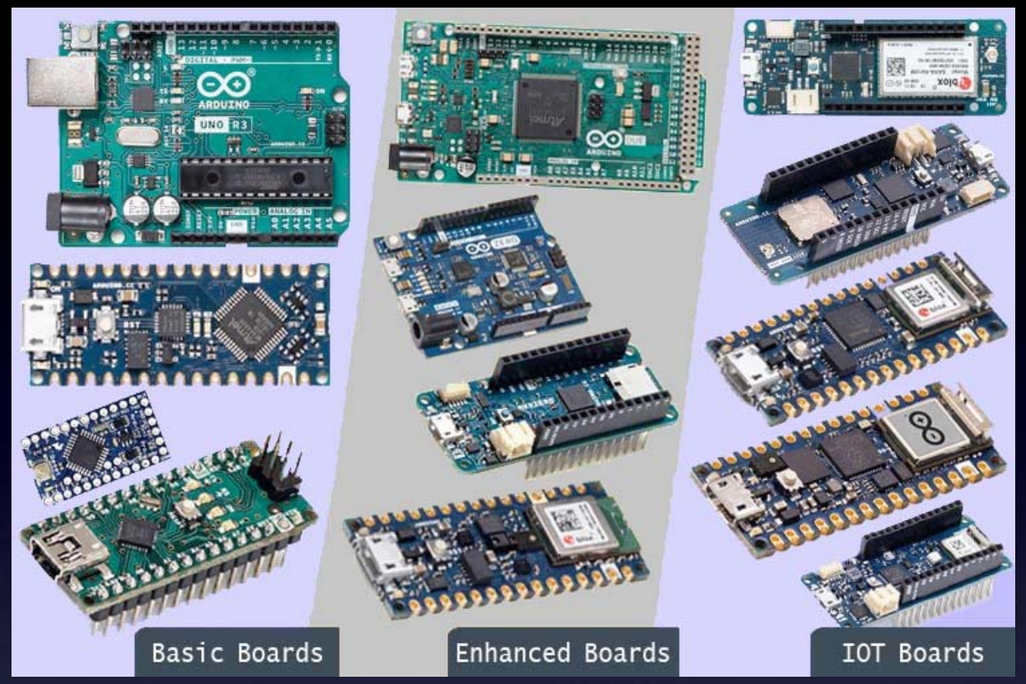


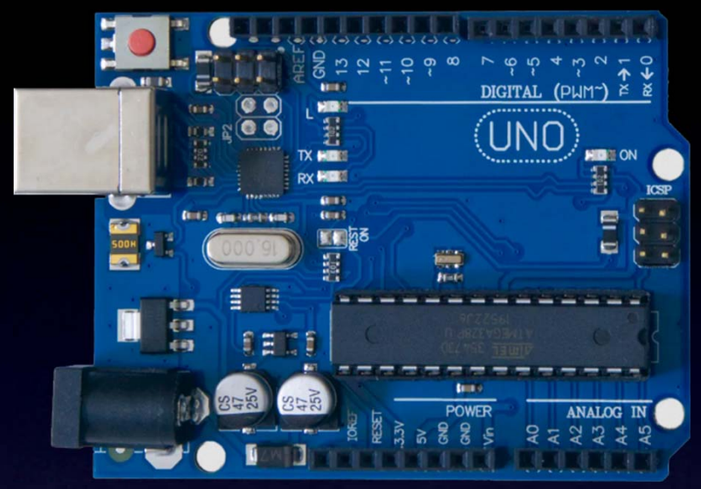


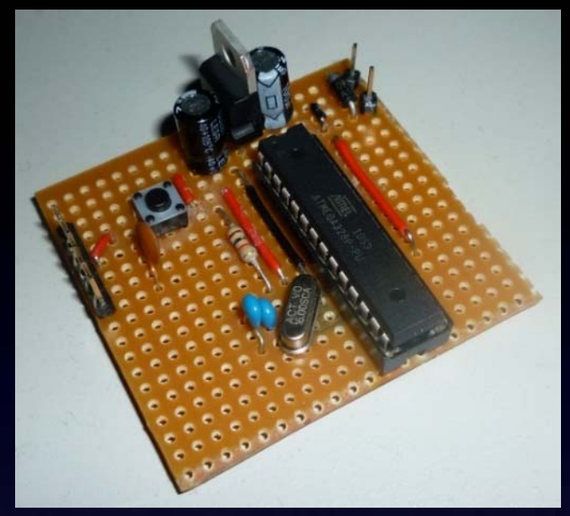
open hardware

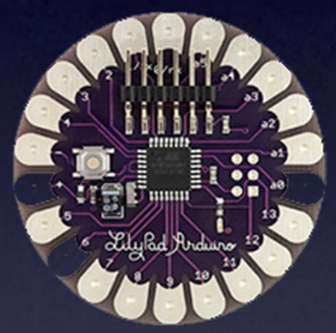
Open Source

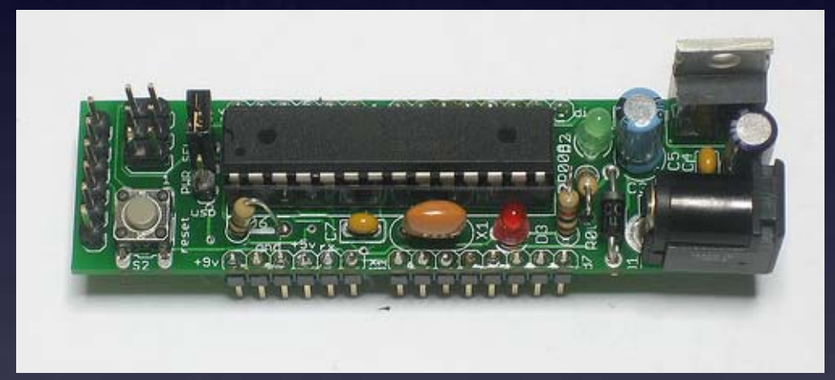
Intro to Arduino

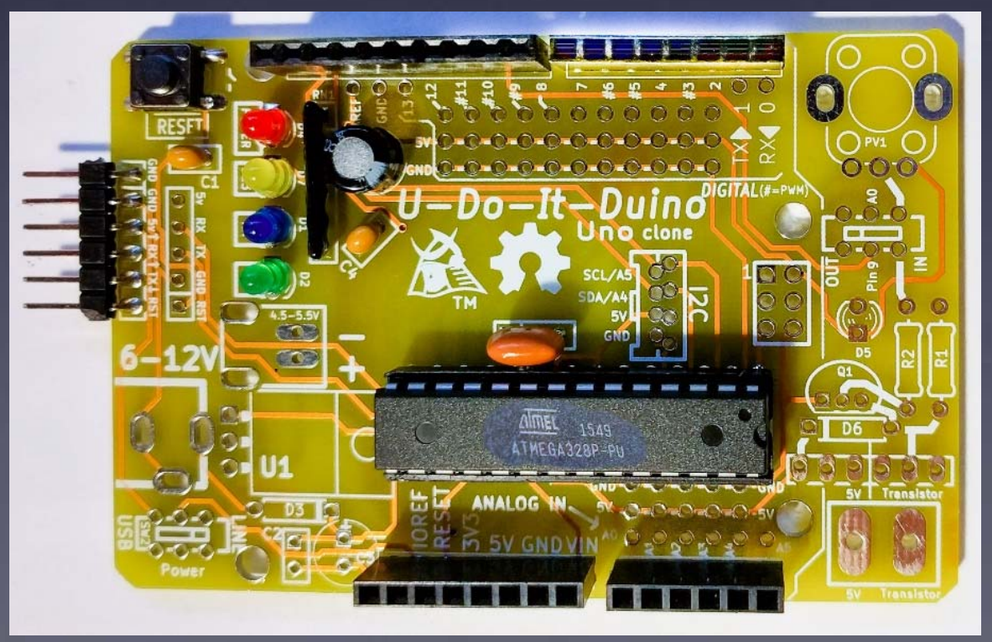


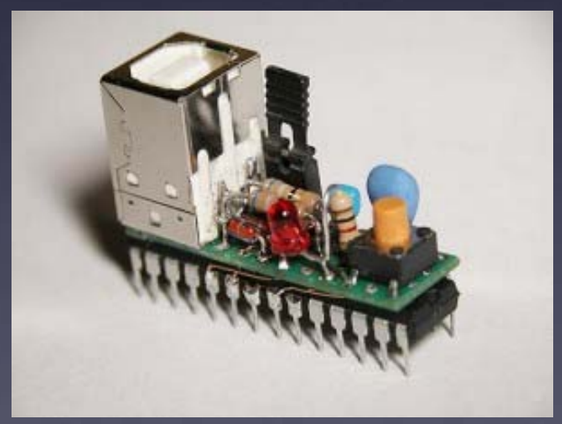


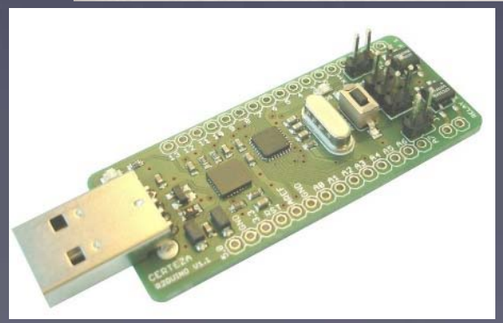






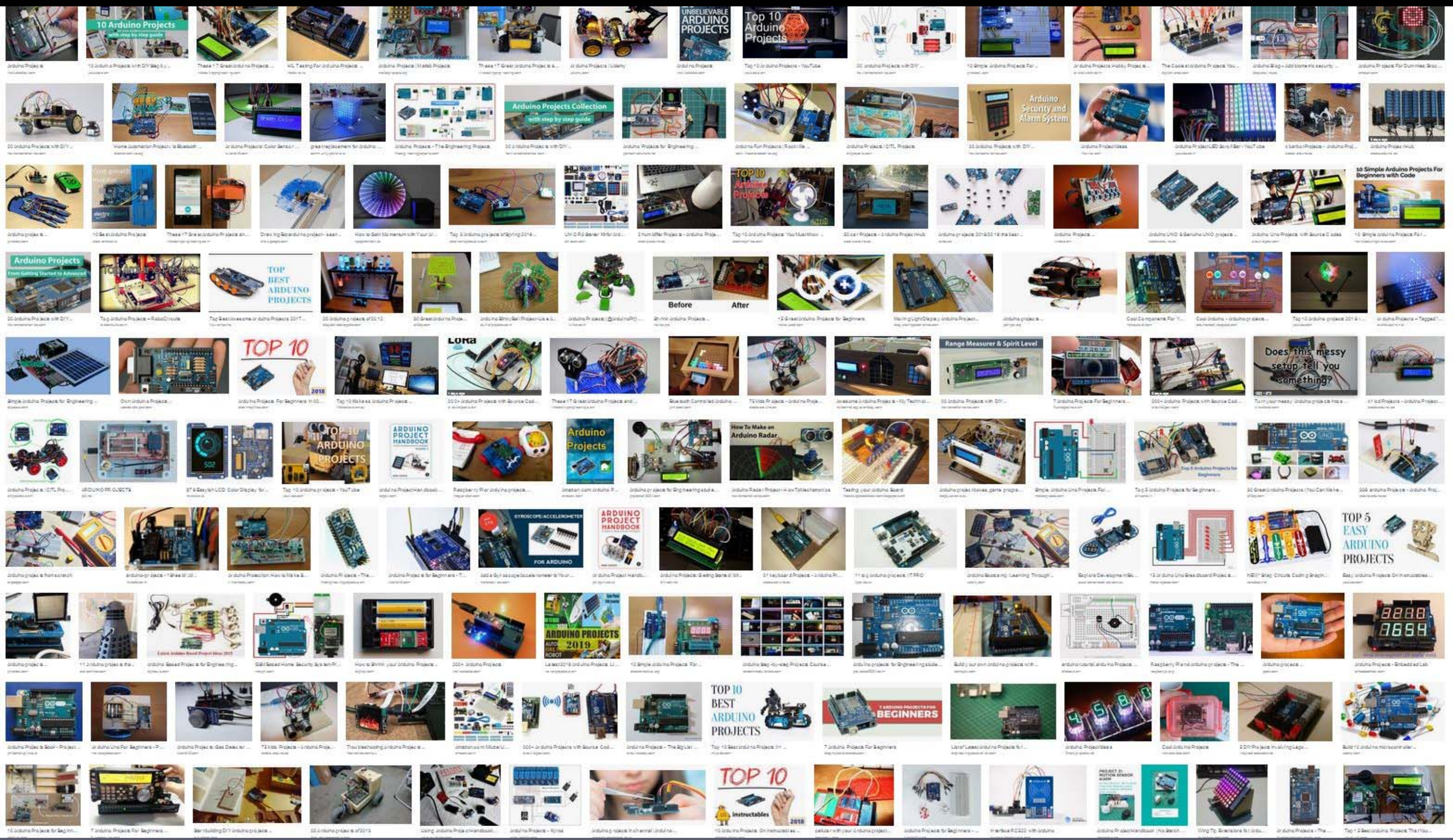






Arduino “Clones”

Intro to Arduino



hundreds of thousands of projects online!

Intro to Arduino

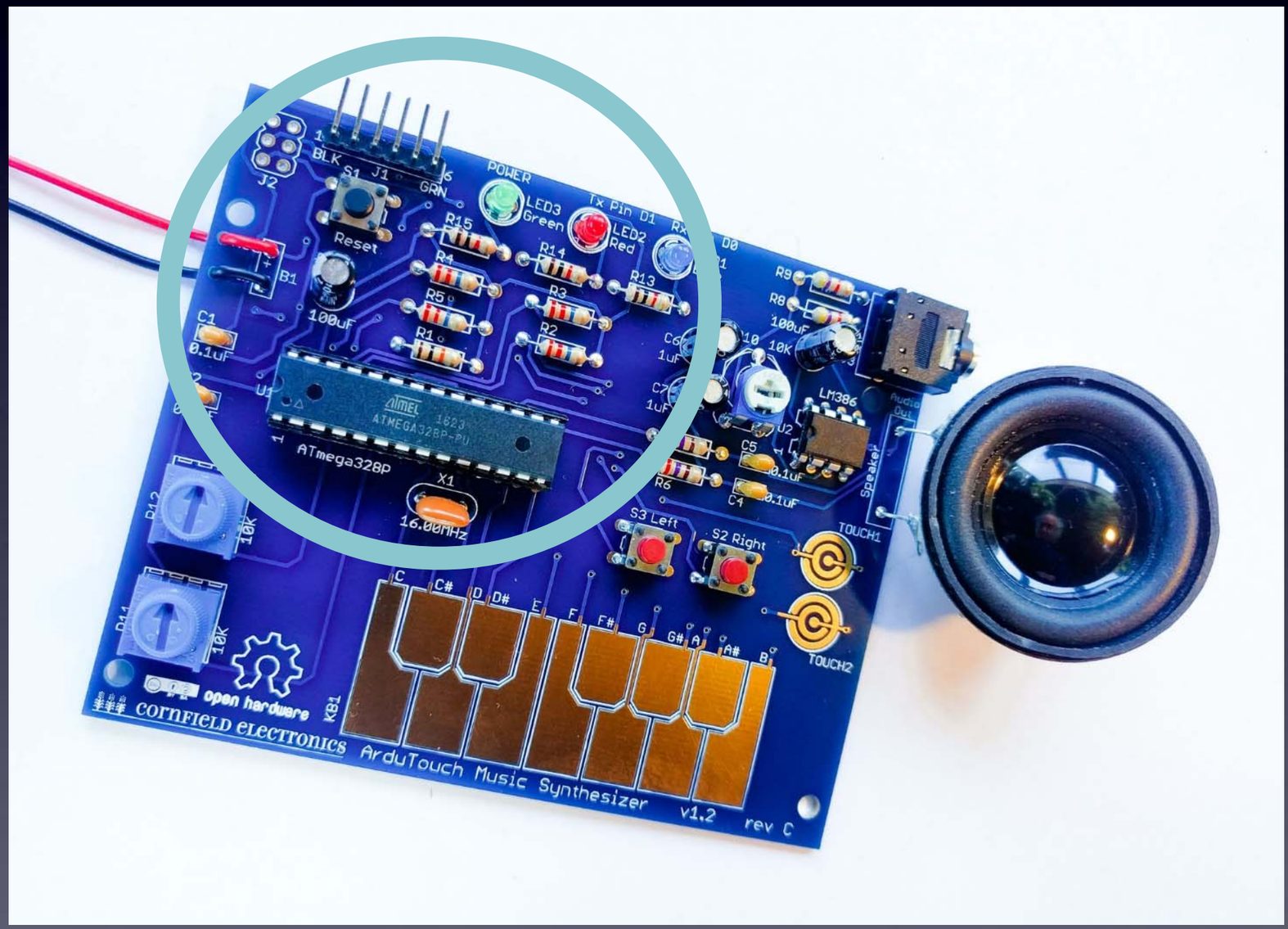
“Arduino-Compatible”

ArduTouch

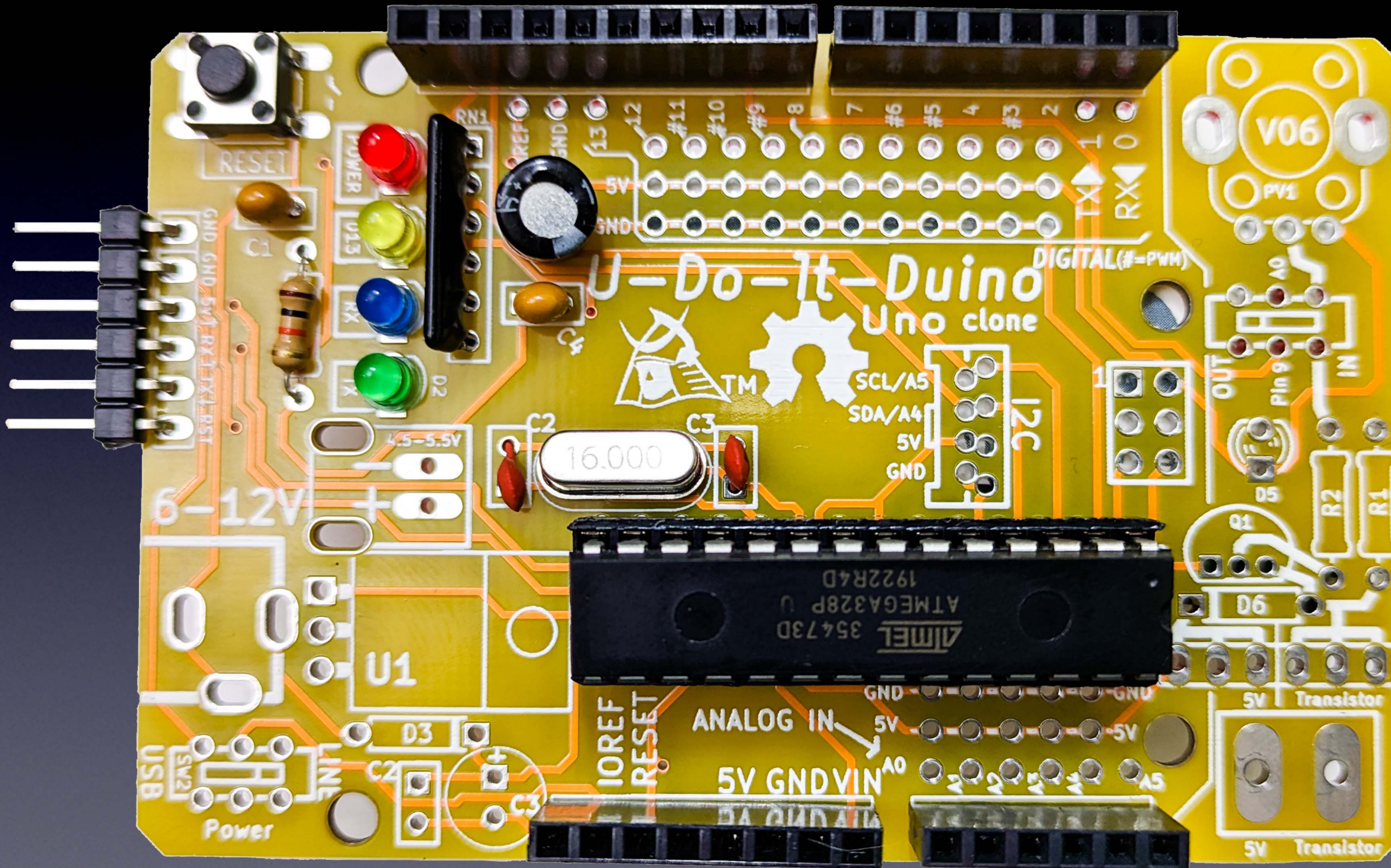
music

synthesizer

kit



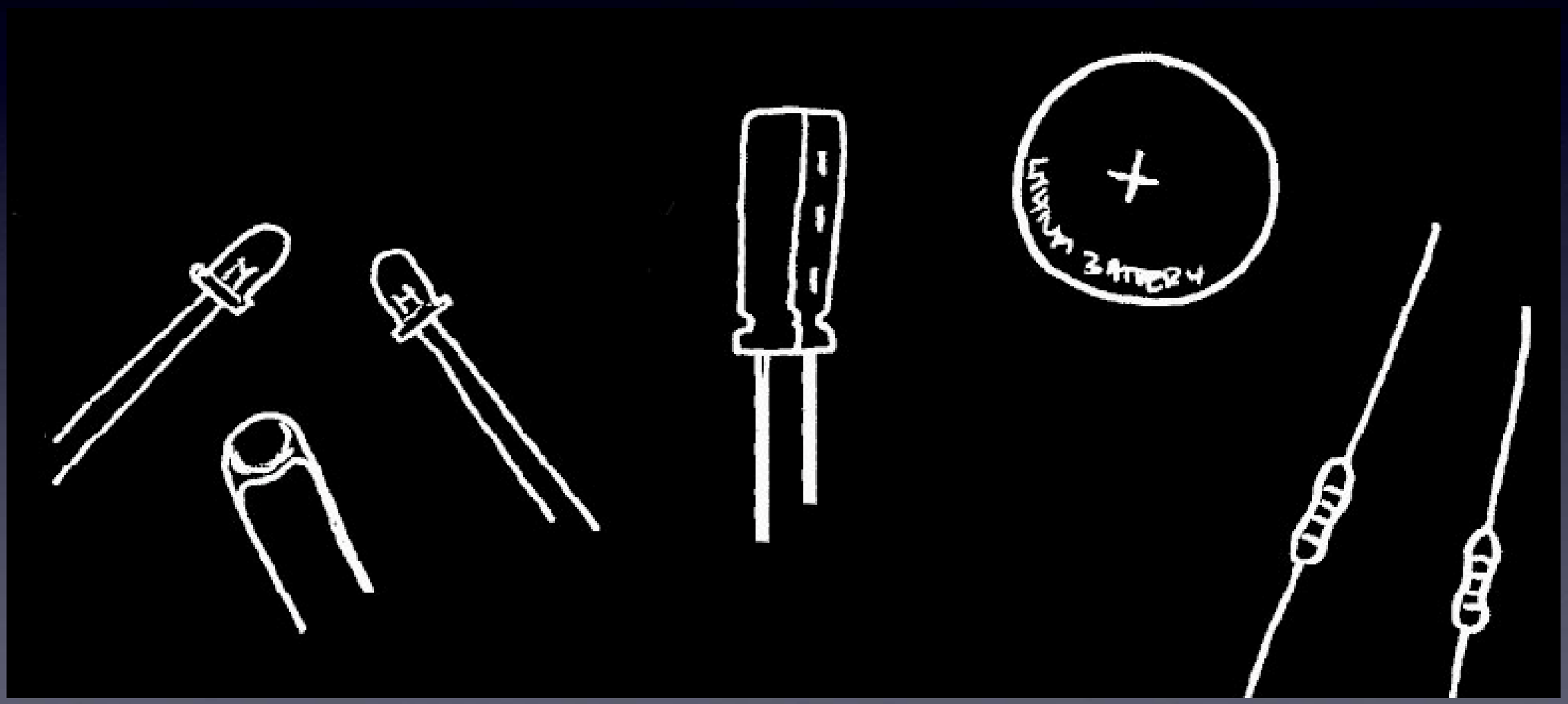
Intro



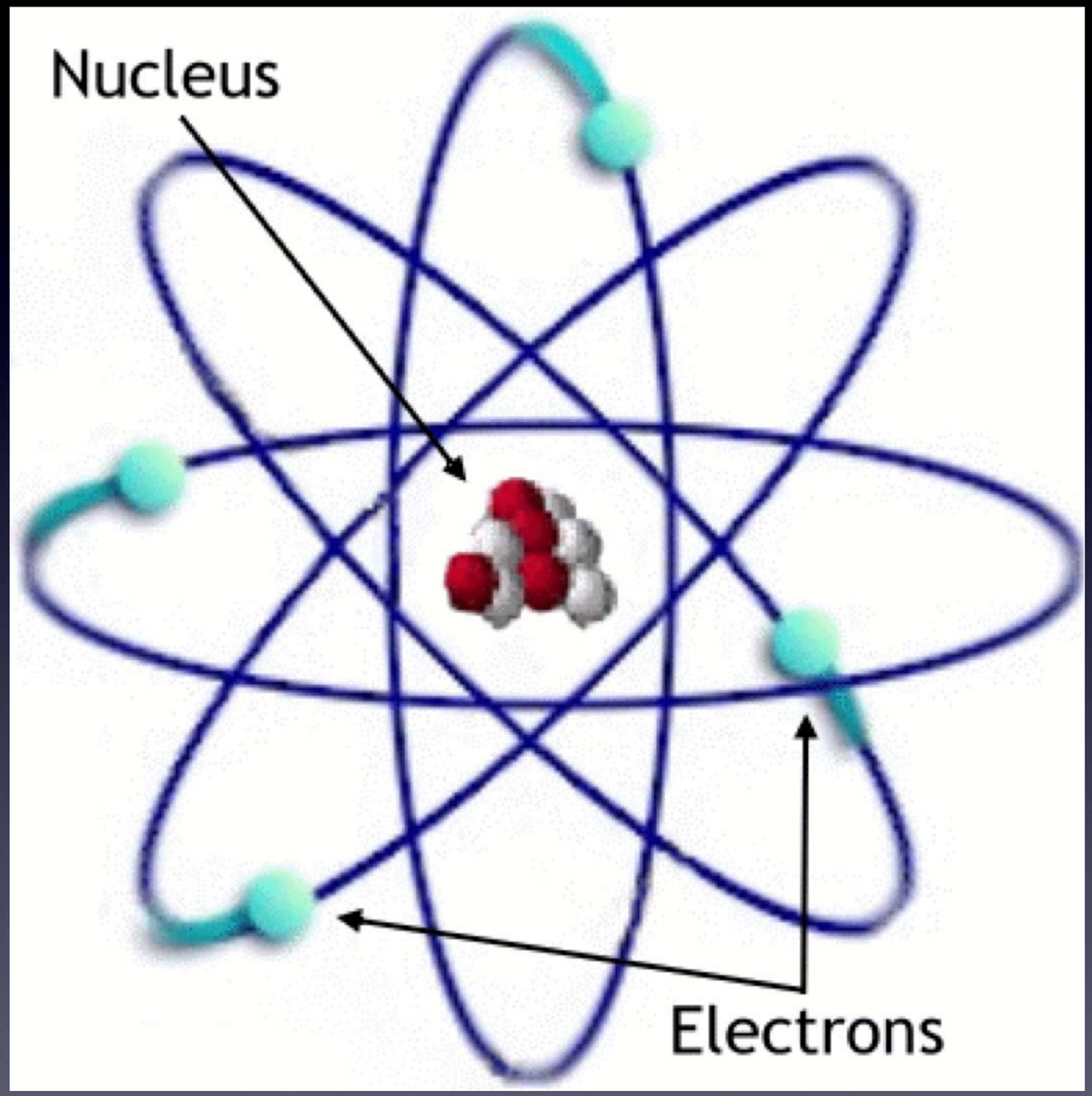
U-Do-It-Duino
Uno clone
RESET
POWER
D13
RX
TX
DIGITAL(#=PWM)
SCL/A5
SDA/A4
5V
GND
I2C
16.000
ATMEGA328P
6-12V
4.5-5.5V
U1
ANALOG IN
5V GND VIN
IOREF
RESET
Power
USB
LINE
V06
PV1
Transistor

Questions?

Everything You Need to Know About
Electronics

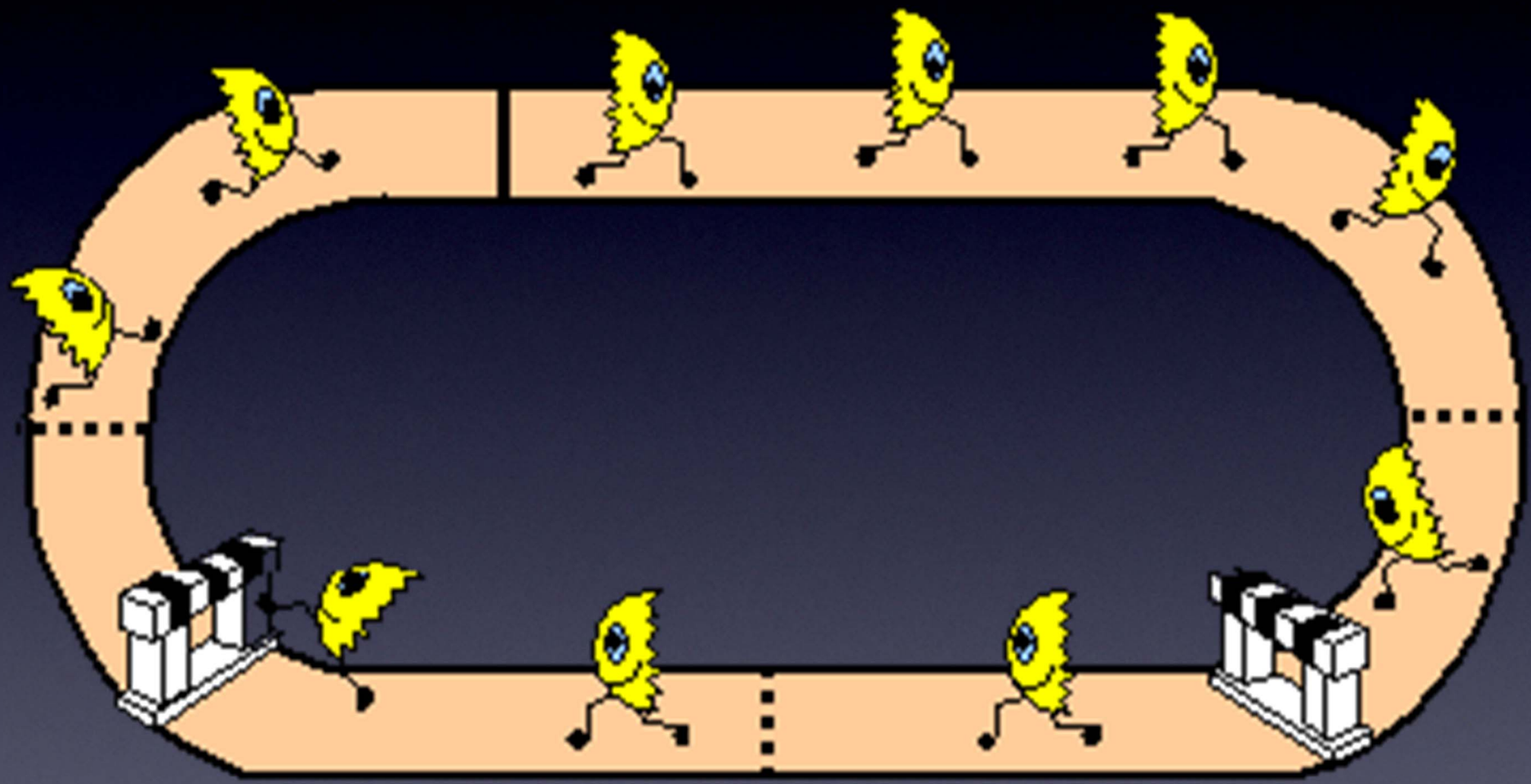


Everything You Need to Know About Electronics



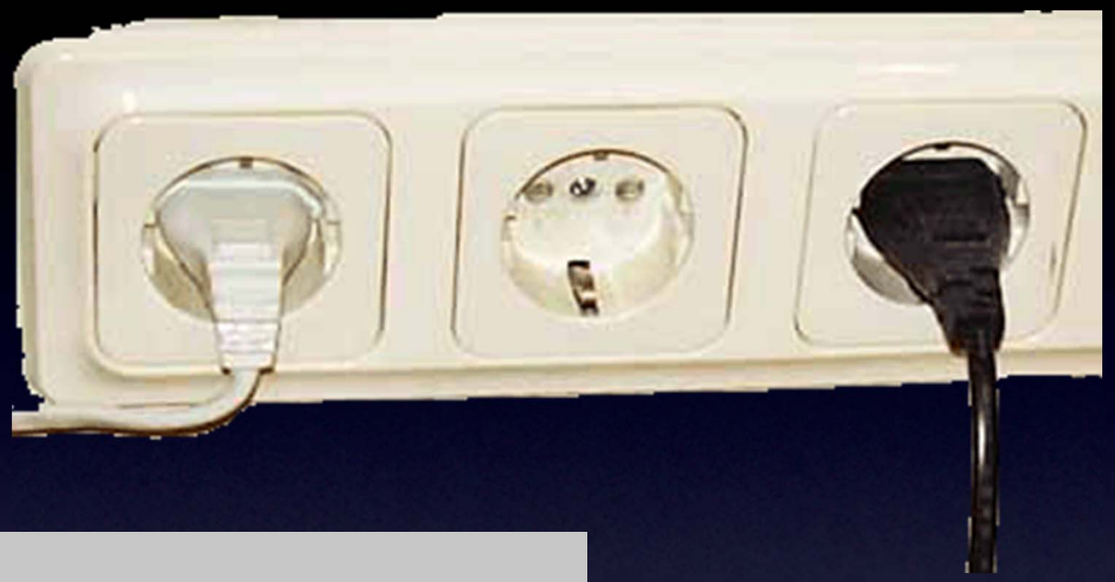
Electrons

Everything You Need to Know About Electronics



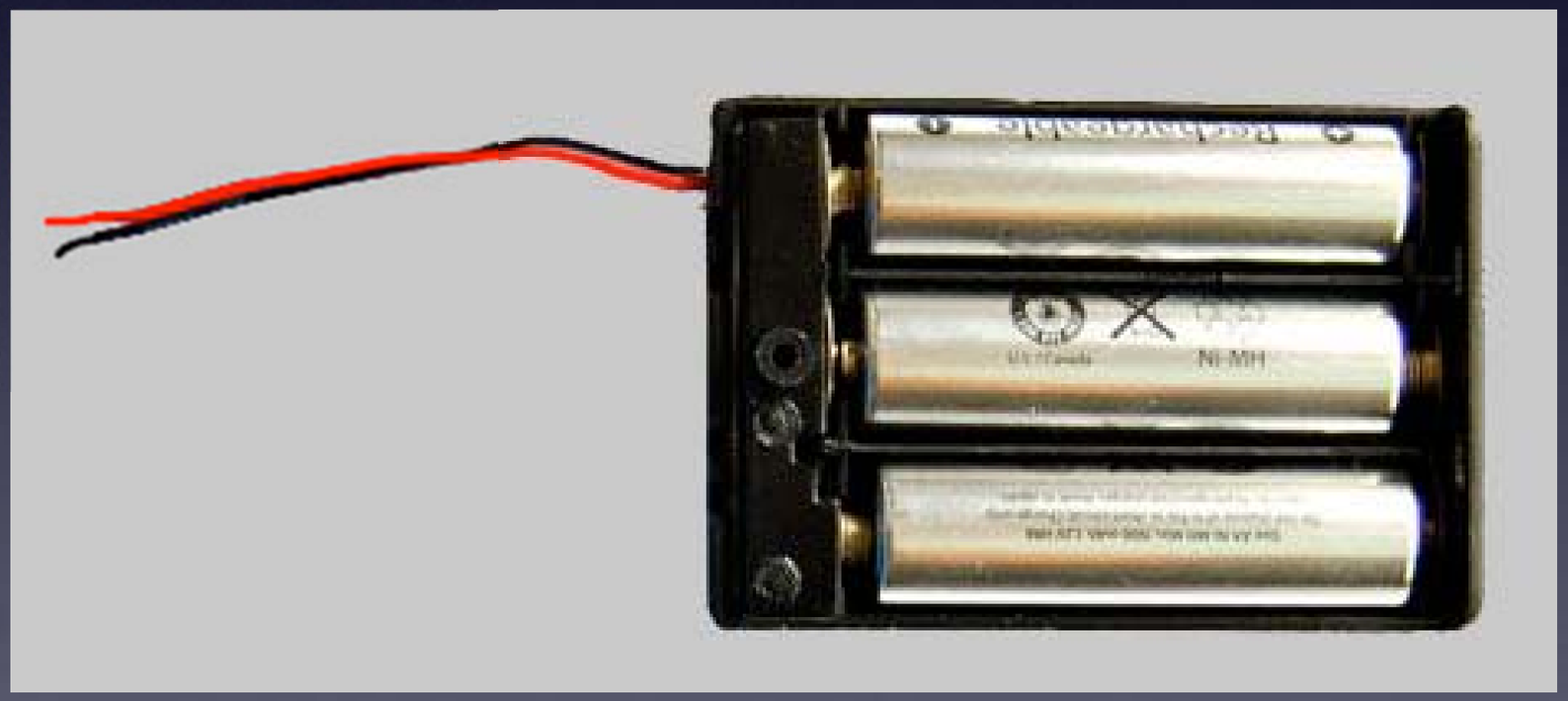
Circuit = Electrons going in complete circle = Magic!

Everything You Need to Know About Electronics



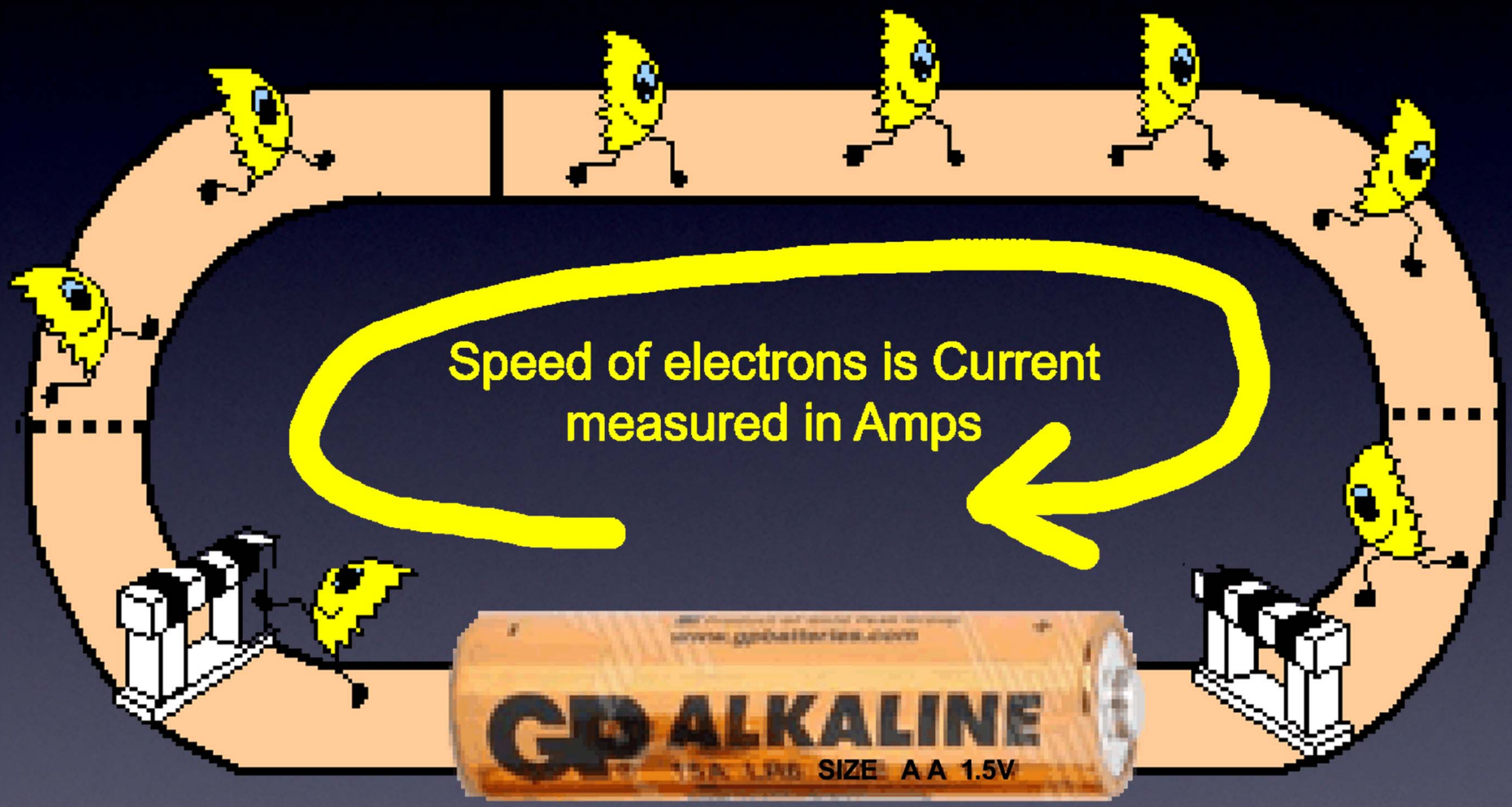
Power Supplies

Everything You Need to Know About Electronics



Voltage / **Volts**

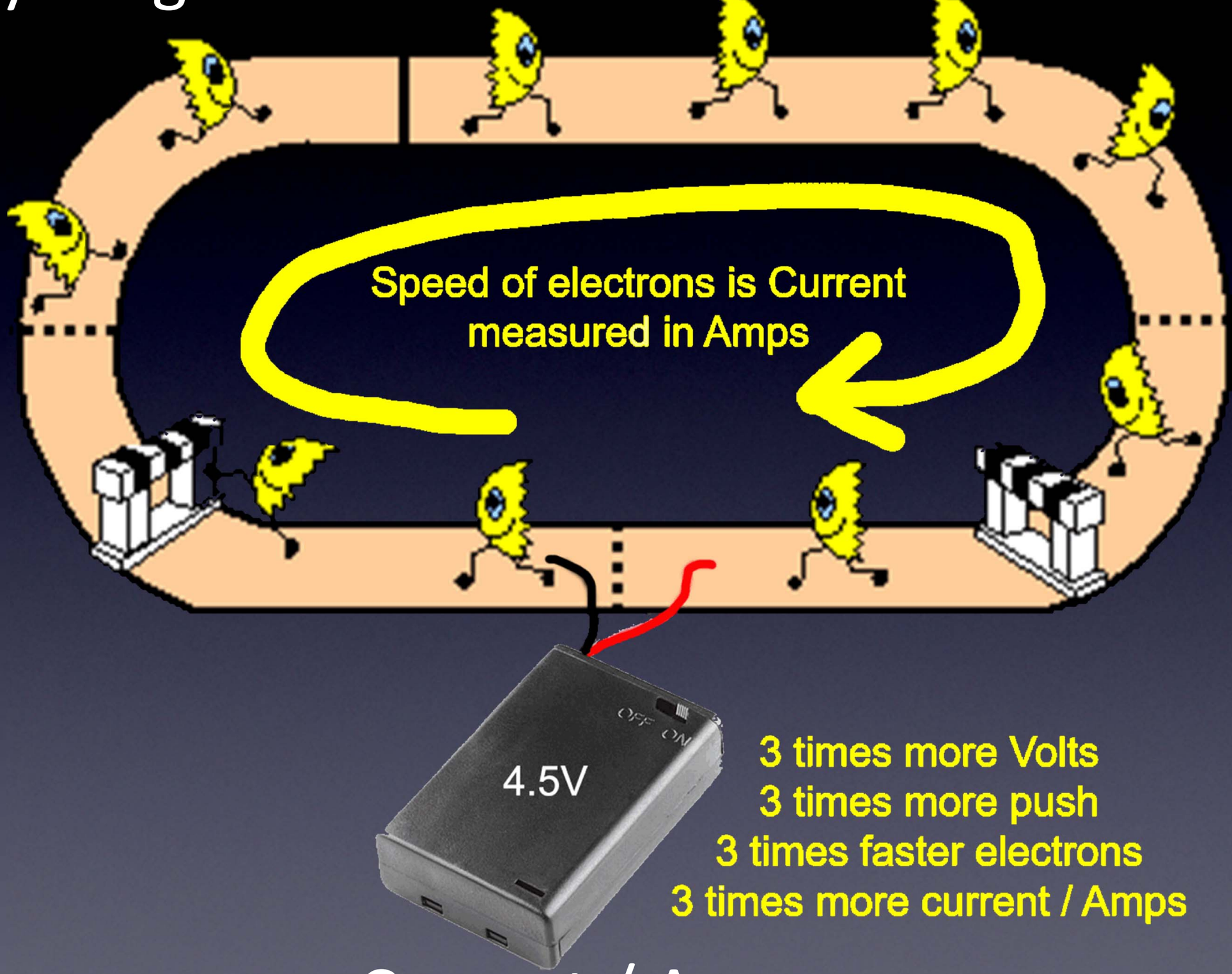
Everything You Need to Know About Electronics



Electrons pushed with 1.5V.
So, they move!

Current / **Amps**

Everything You Need to Know About Electronics

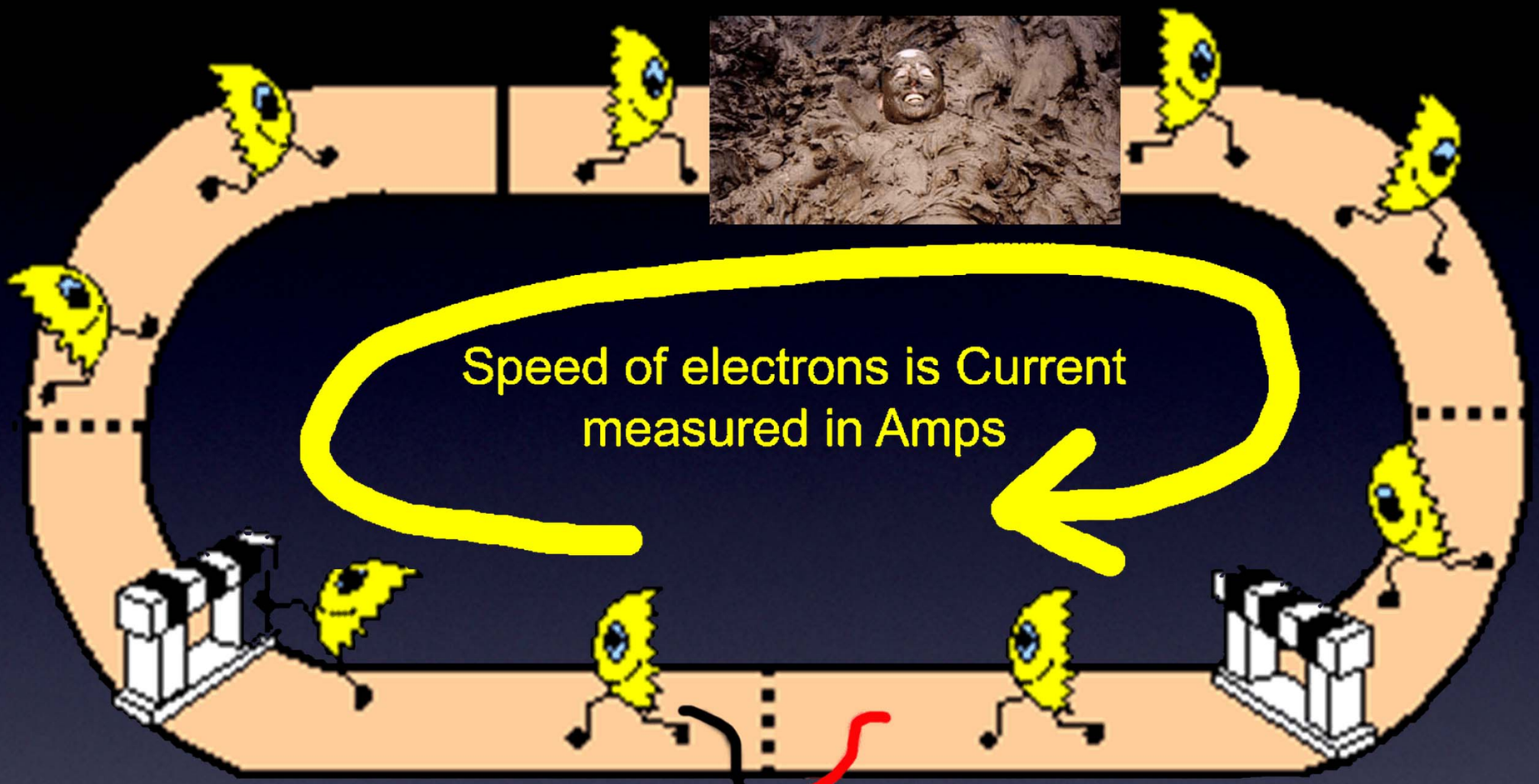


Current / Amps

Everything You Need to Know About Electronics

Current / Amps

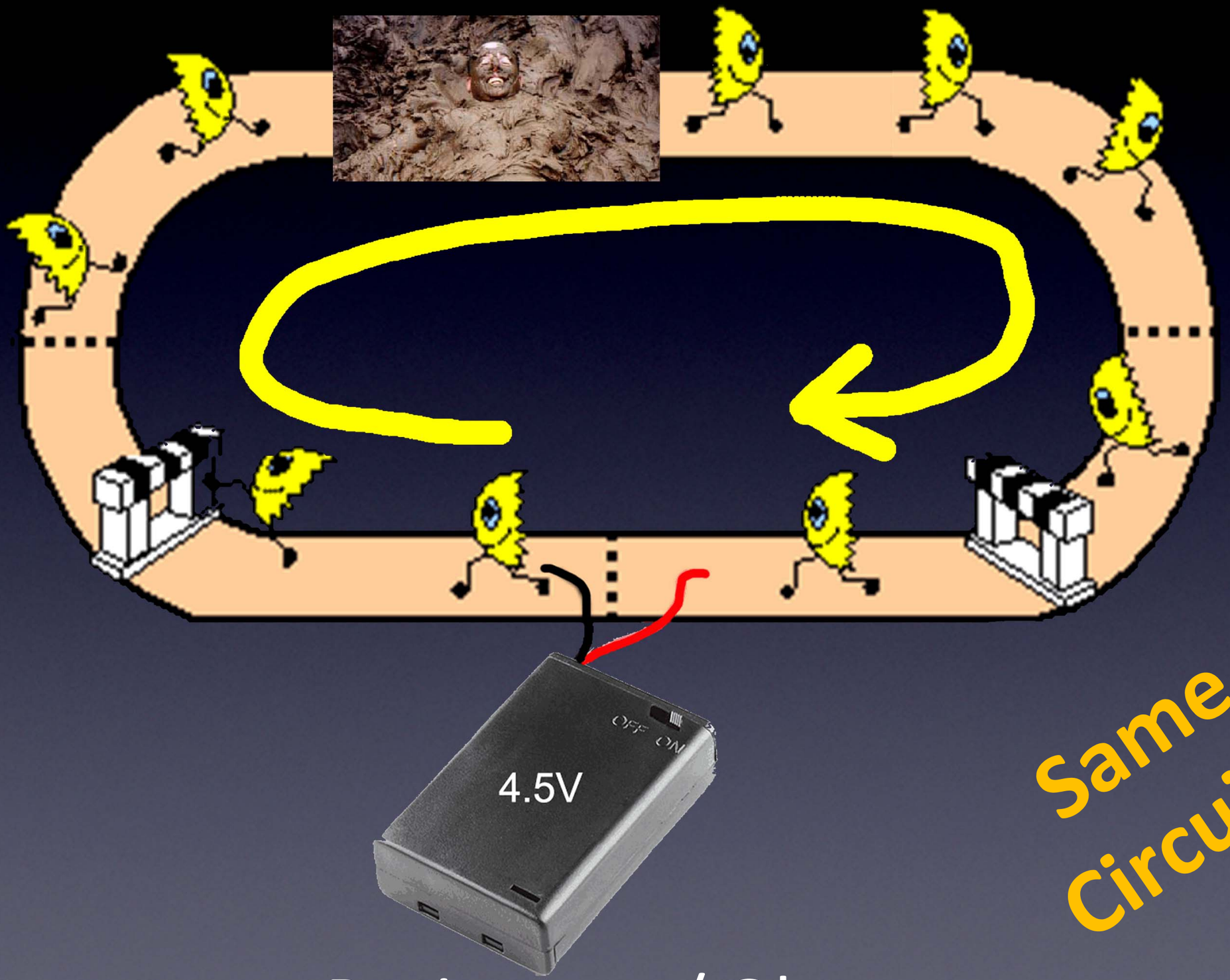
Everything You Need to Know About Electronics



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

Resistance / **Ohms**

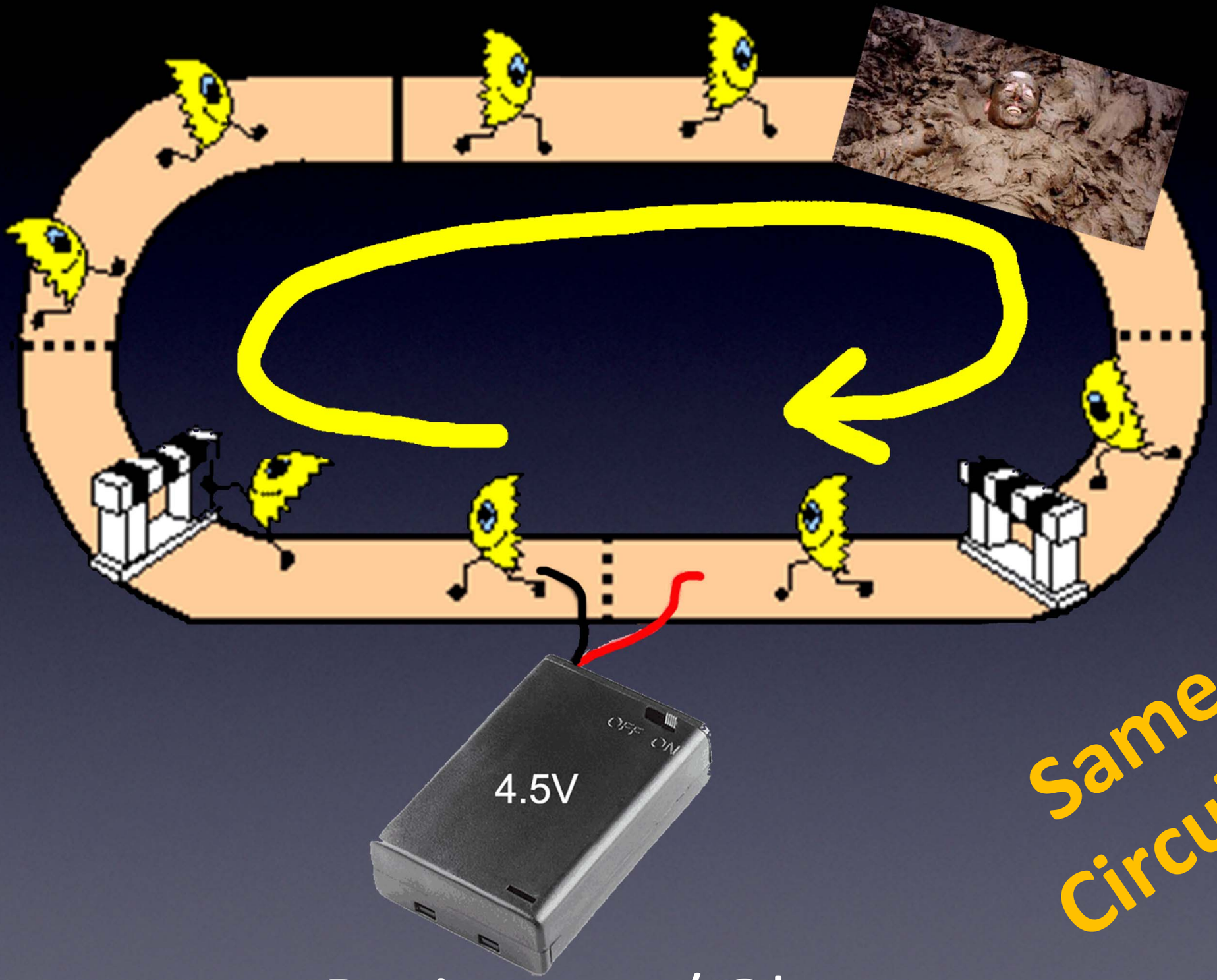
Everything You Need to Know About Electronics



Same Circuit !

Resistance / Ohms

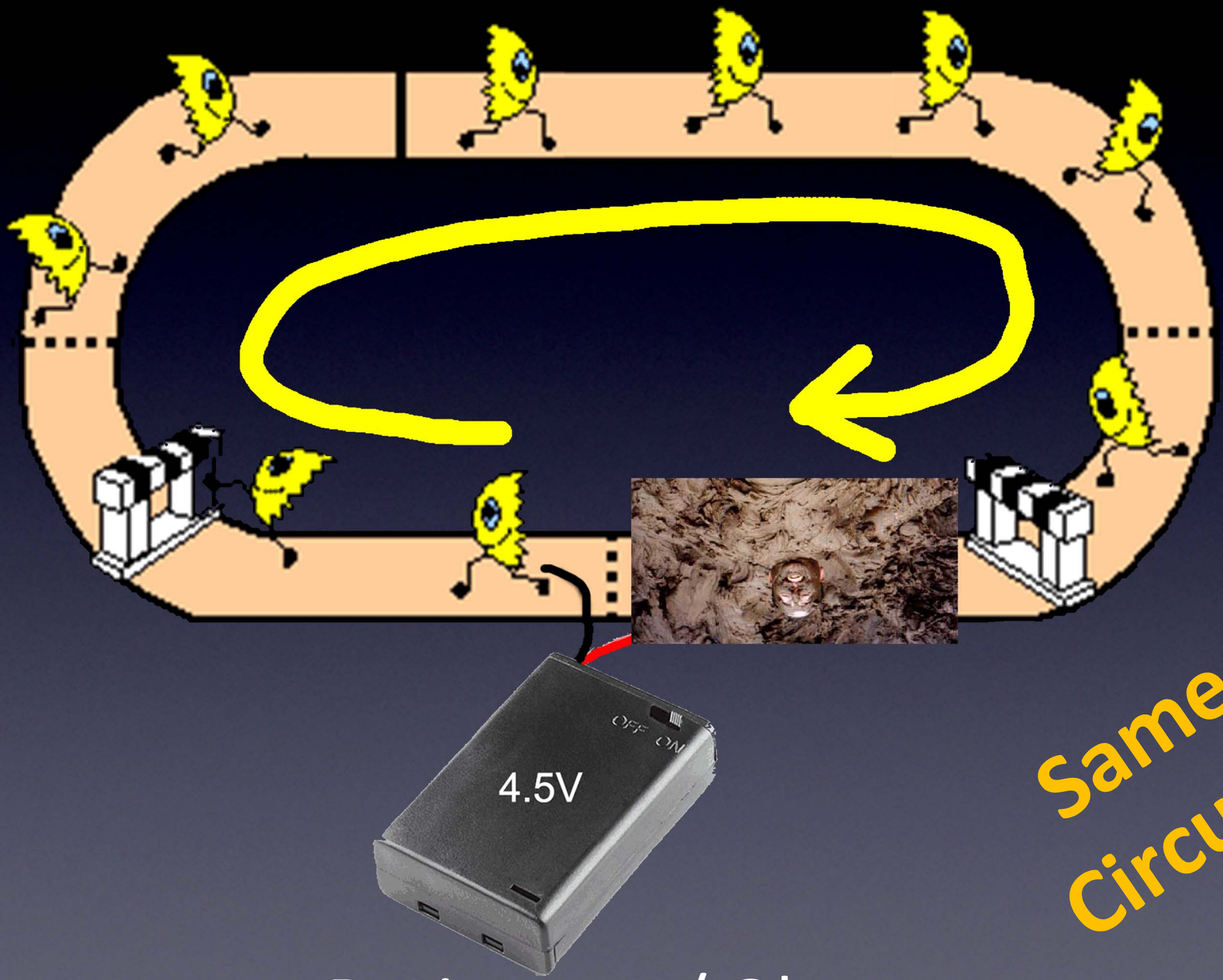
Everything You Need to Know About Electronics



Same Circuit !

Resistance / Ohms

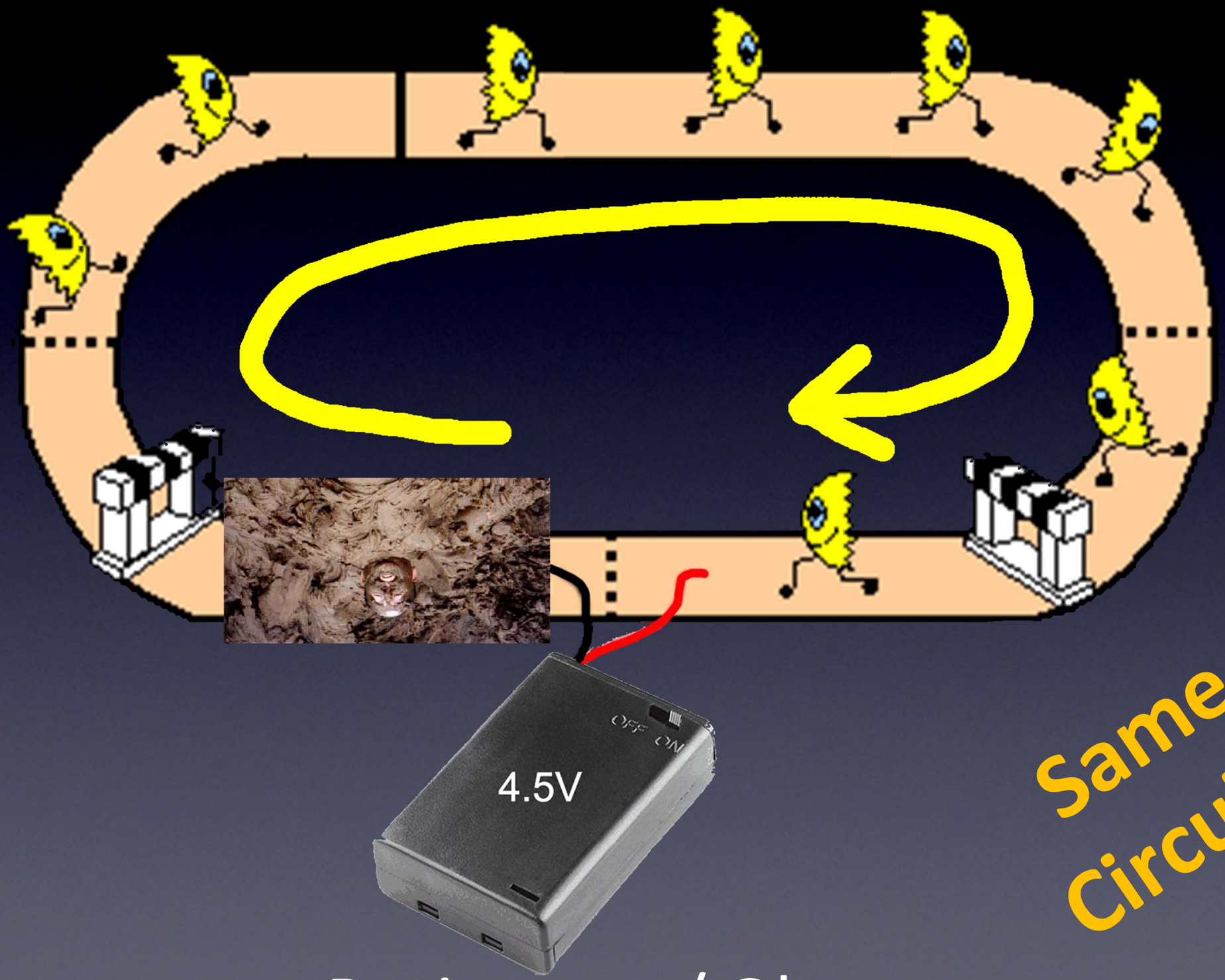
Everything You Need to Know About Electronics



Same Circuit !

Resistance / Ohms

Everything You Need to Know About Electronics



Same Circuit !

Resistance / Ohms

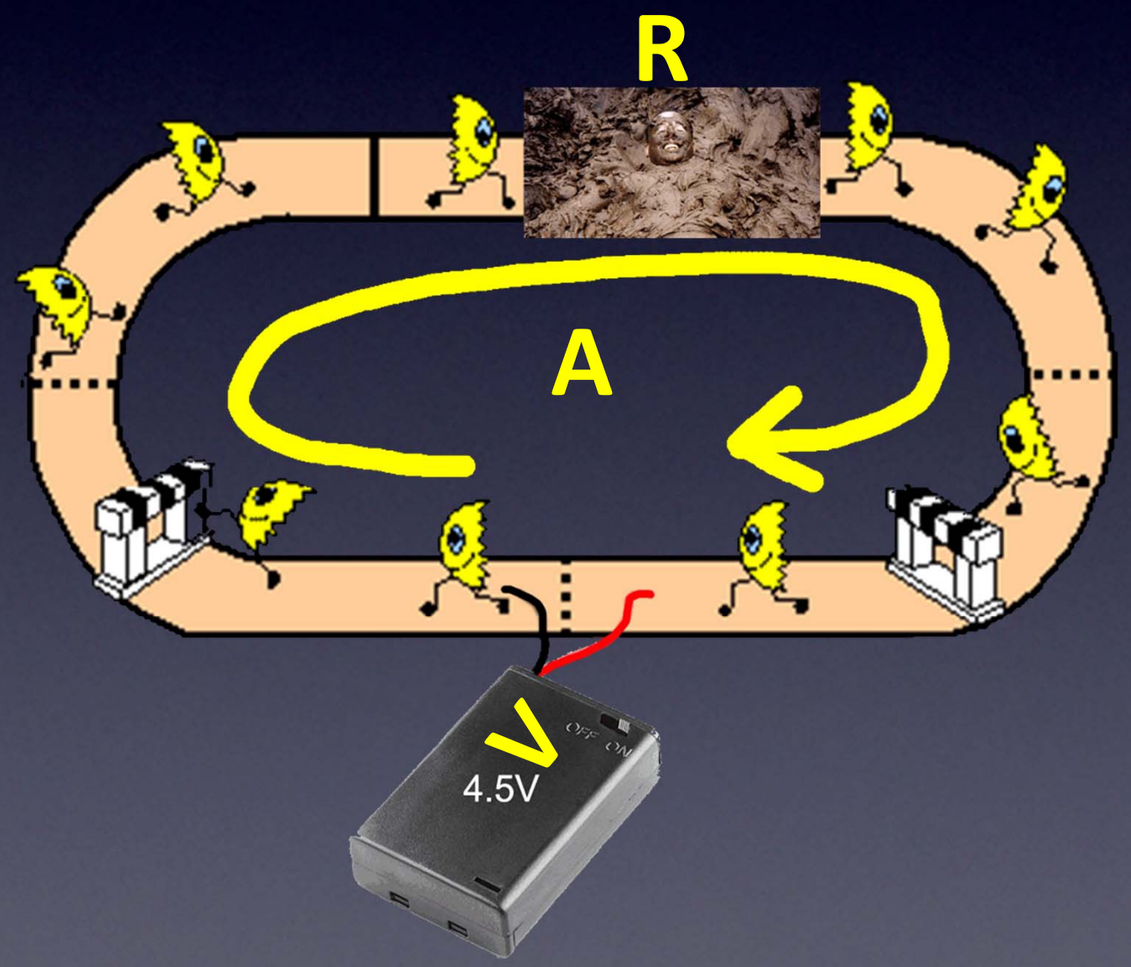
Everything You Need to Know About Electronics

Ohm's Law

Volts -- ***force*** pushing electrons

Amps -- ***speed*** of electrons

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



Everything You Need to Know About Electronics

Ohm's Law

Volts -- ***force*** pushing electrons

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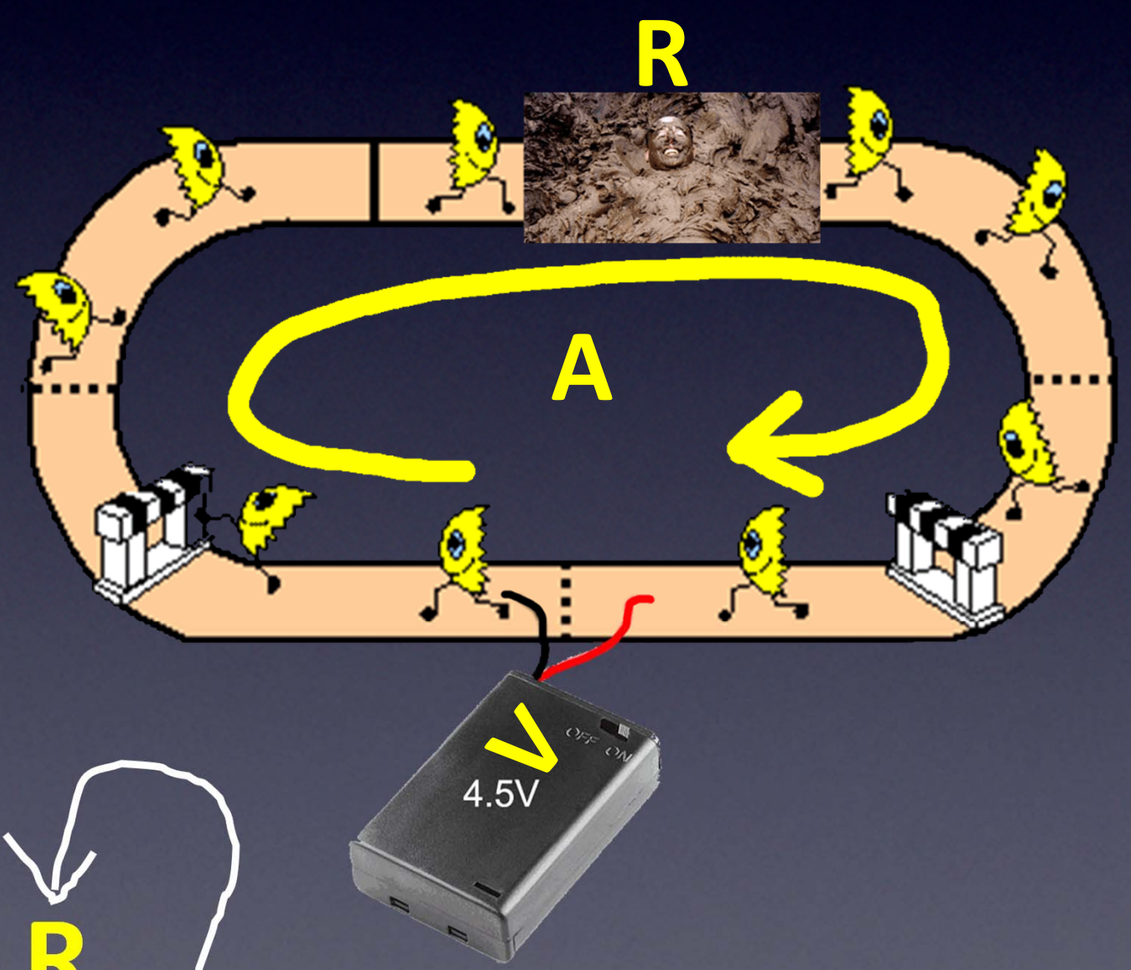


Volts = **A**mps x **R**

(Ohms)

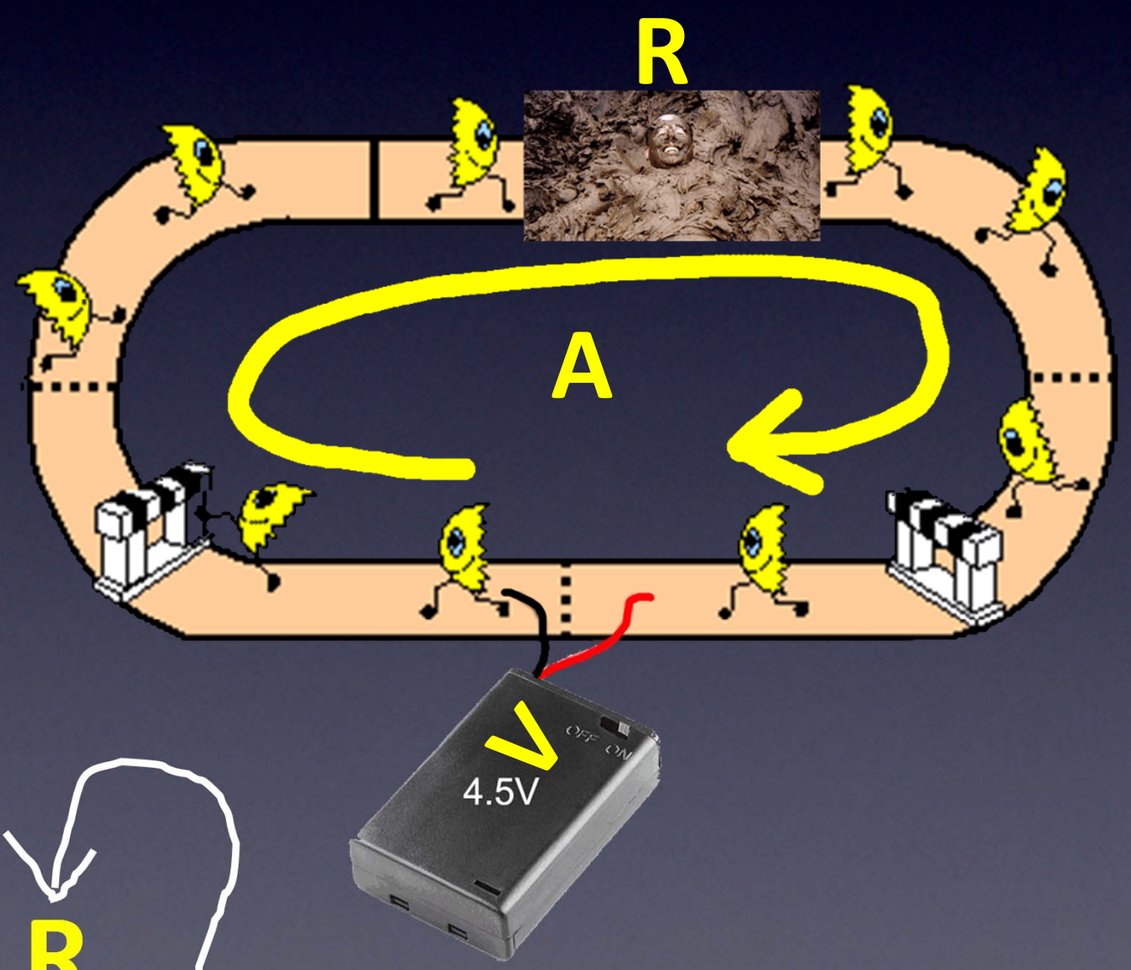
Everything You Need to Know About Electronics

Ohm's Law

Volts -- ***force*** pushing electrons

Amps -- ***speed*** of electrons

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



Volts = **A**mps x **R**

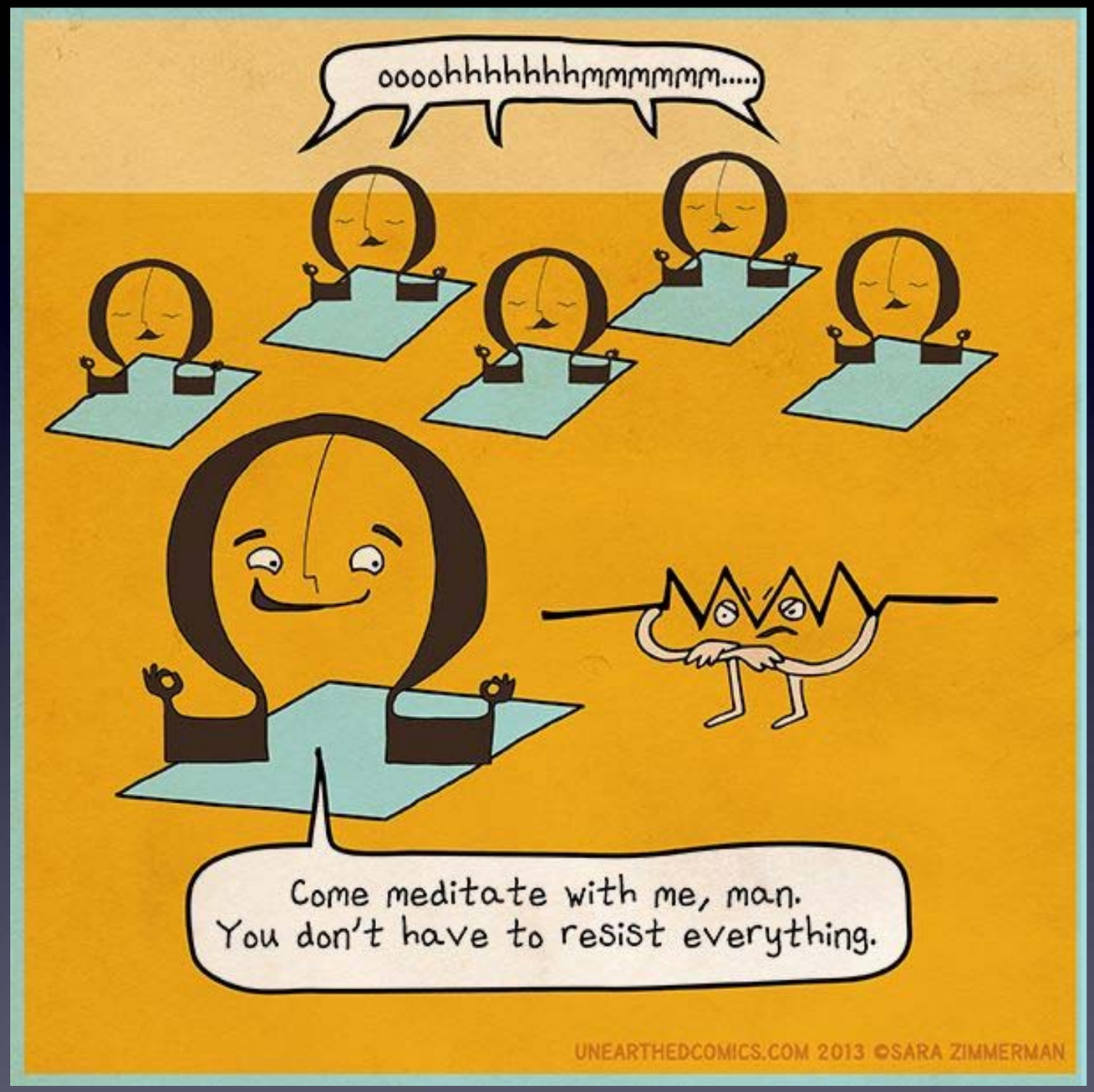
(Ohms)

Also commonly written: **E** = **I** x **R**

Everything You Need to Know About Electronics

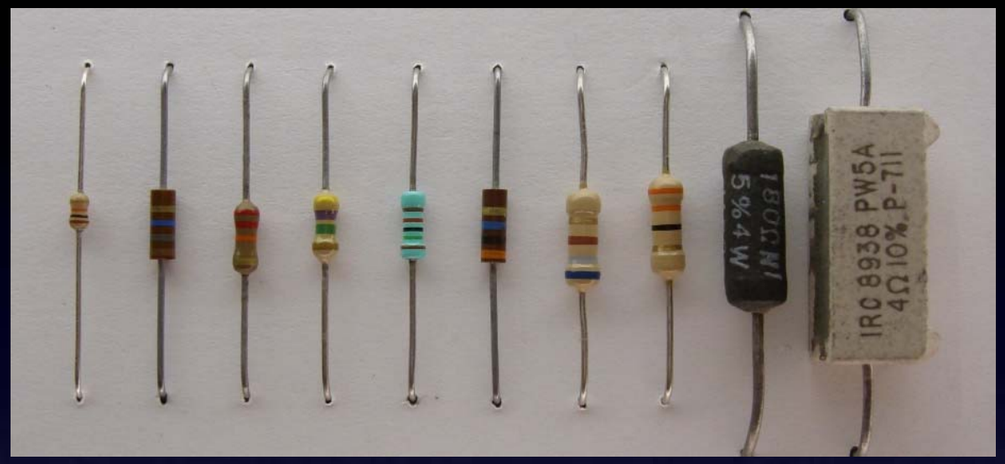
The symbol for **Resistance**:

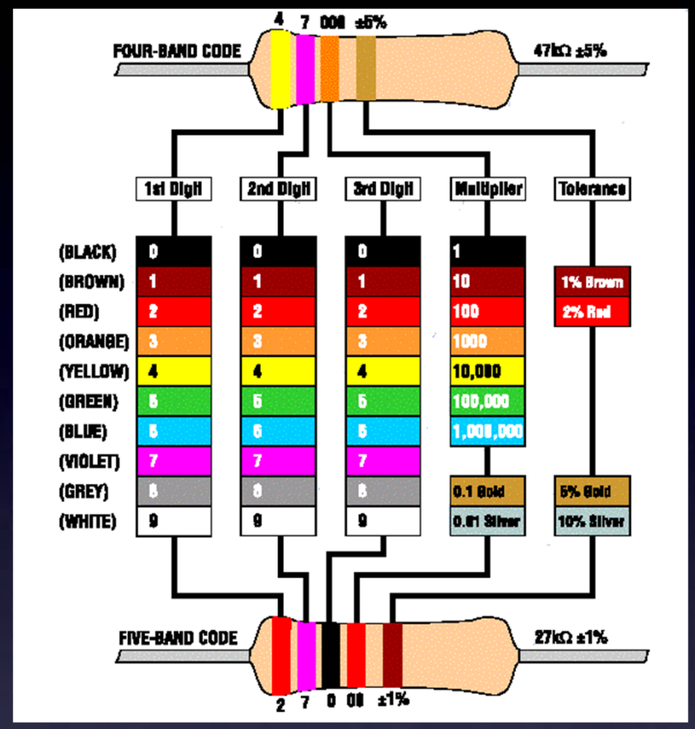
Ω

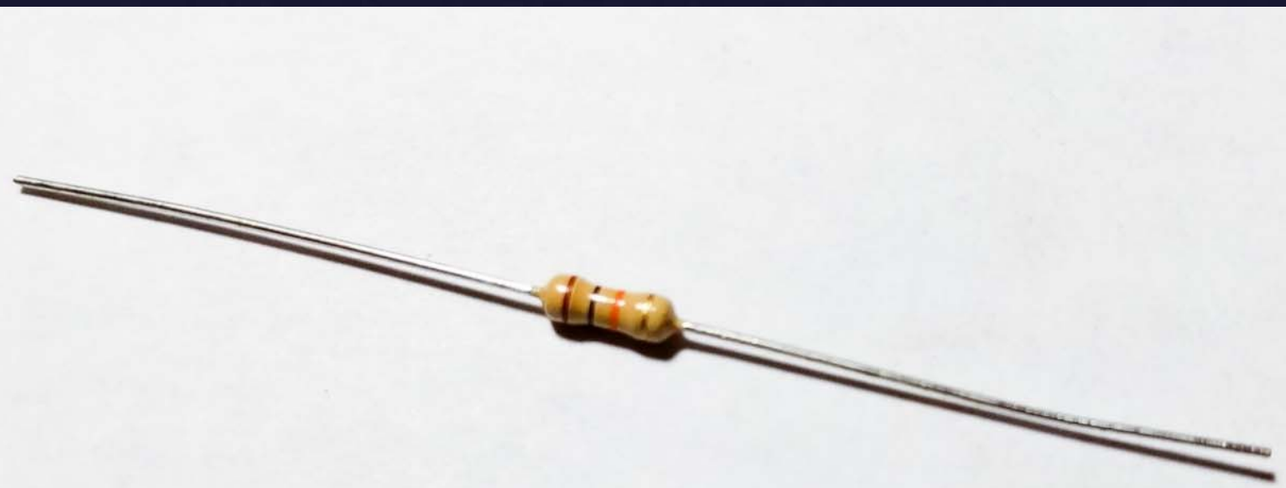


Resistor / Ohms

What You Need to Know About Electronics



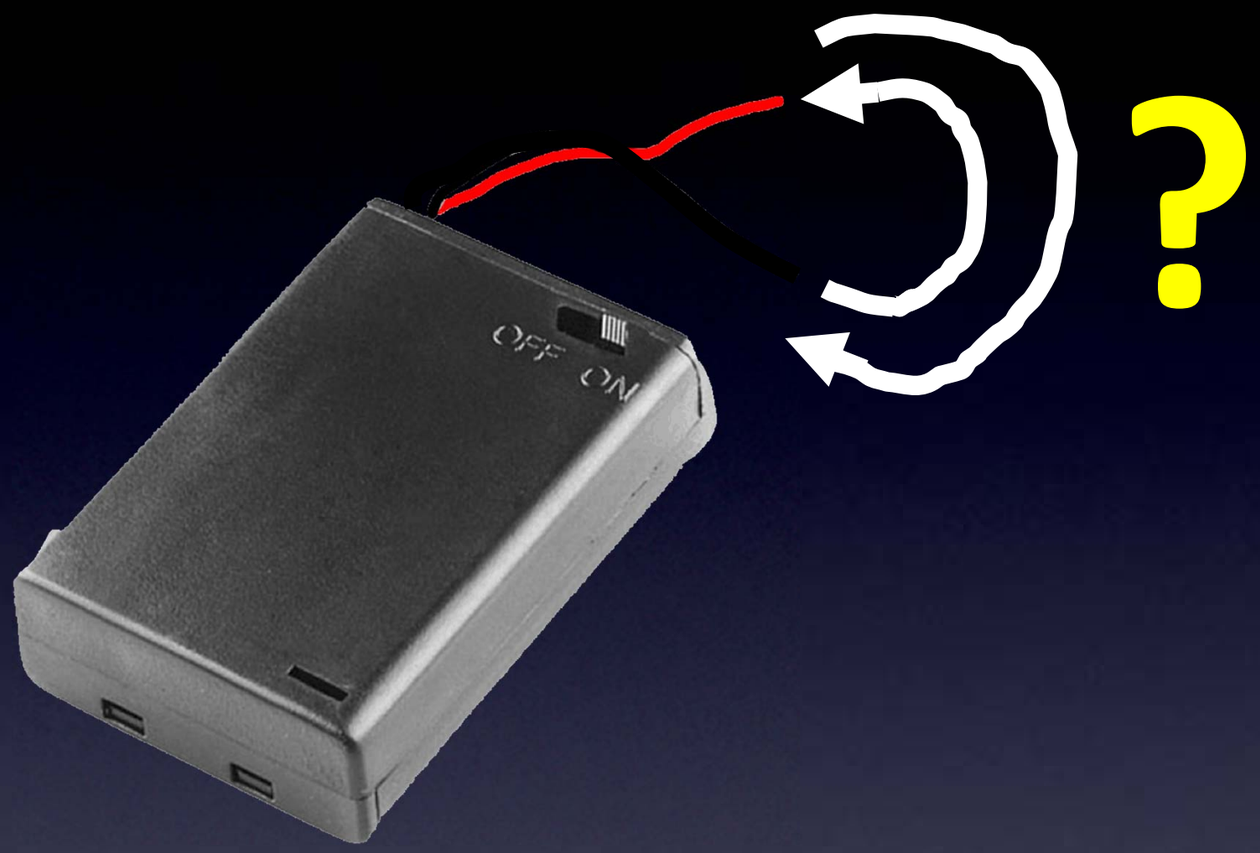




10KΩ: Brown, Black, Orange

Resistor / Ohms

Everything You Need to Know About Electronics

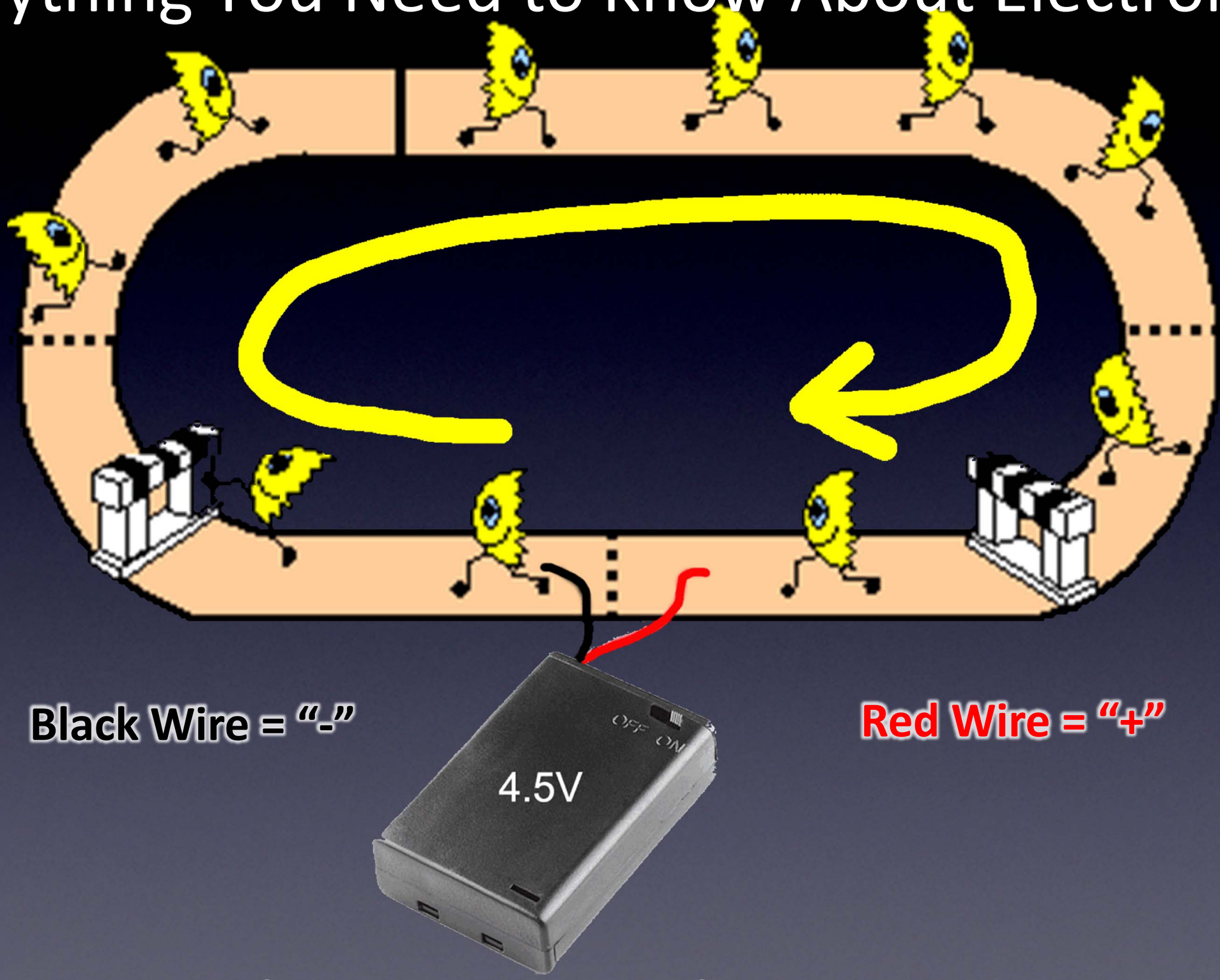


What happens?

Polarity

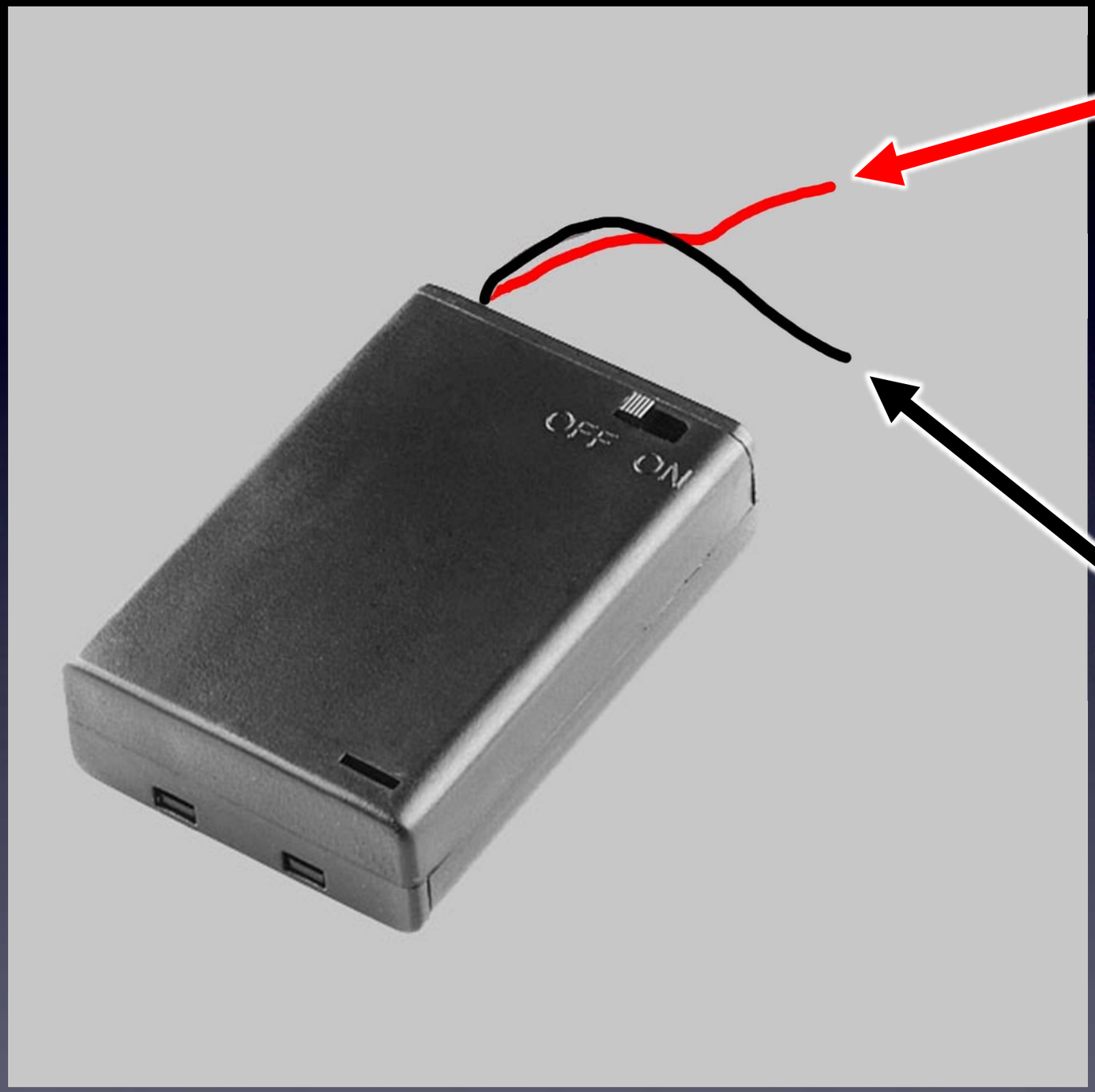
Power Supply – it matters how you connect it!

Everything You Need to Know About Electronics



Power Supply – it matters how you connect it!

Everything You Need to Know About Electronics



<u>Red wire</u>:
Power,
Plus, Positive,
4.5V,
Vcc

<u>Black wire</u>:
Minus, Negative,
0V,
Ground (GND)

Power Supply – it matters how you connect it!

Everything You Need to Know About Electronics

or

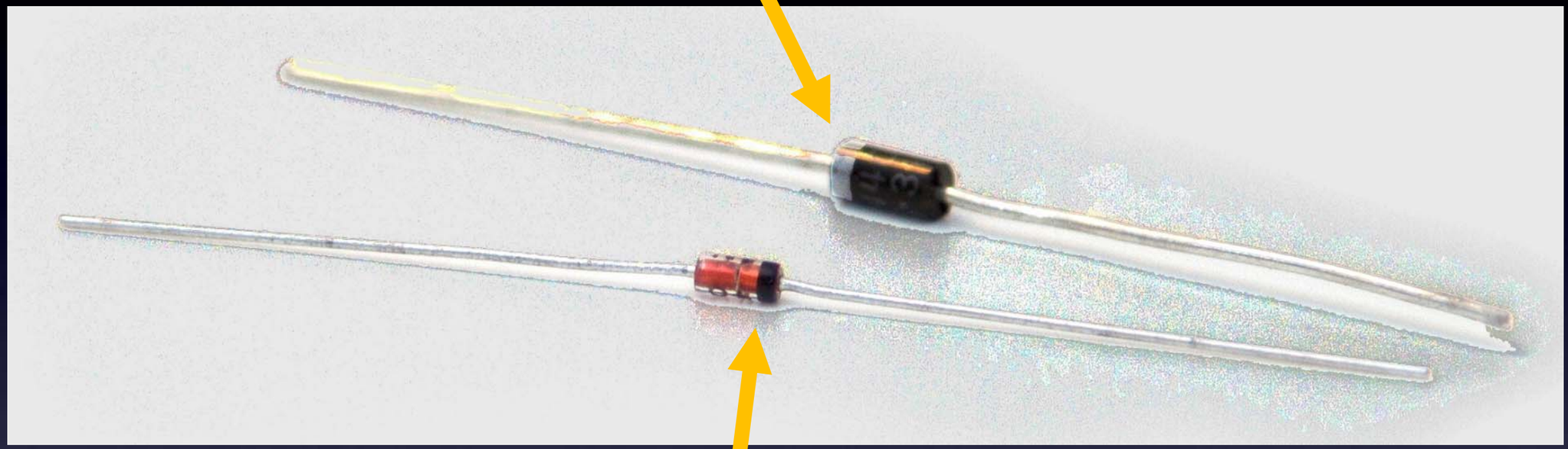
or

(electrons slowed down the same either way)

Resistors – it doesn’t matter which way

Everything You Need to Know About Electronics

Minus / Negative side



Minus / Negative side

Diodes – One-Way valve for electrons

Diodes – it matters which way!

Everything You Need to Know About Electronics

Short wire is Minus / Negative

Special kind of Diode – it Emits Light!

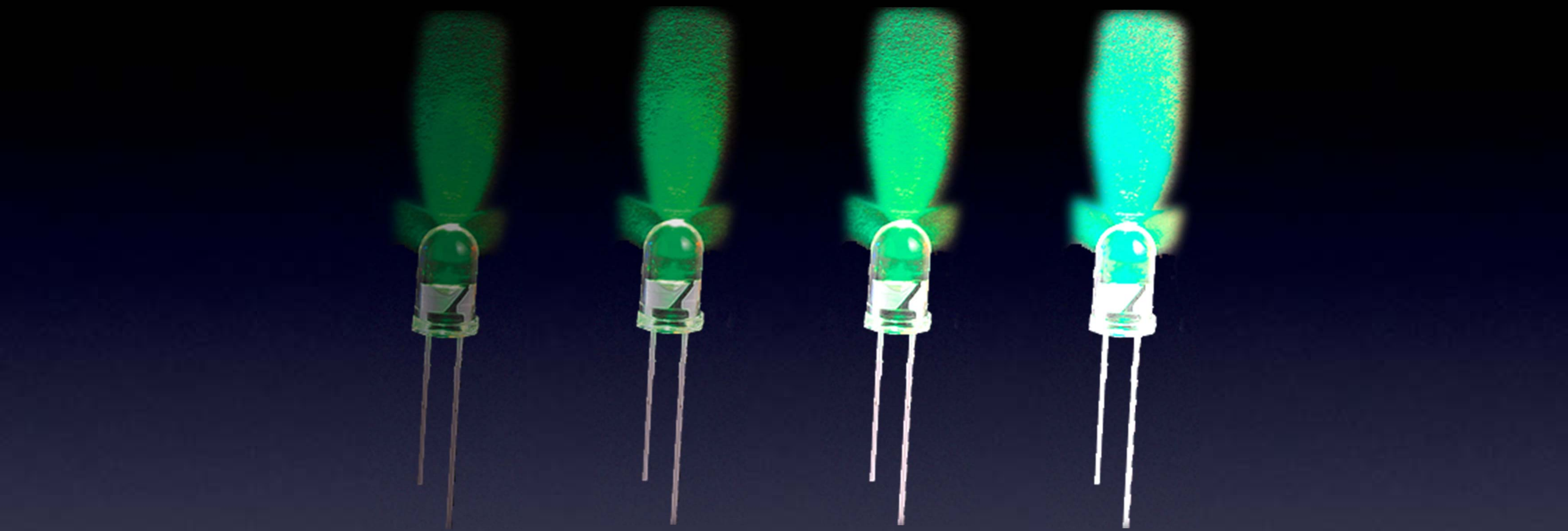
LED – it matters which way!

Everything You Need to Know About Electronics

Lots of different colored LEDs! (including IR)

LED

Everything You Need to Know About Electronics



More current → More brightness! (until…)

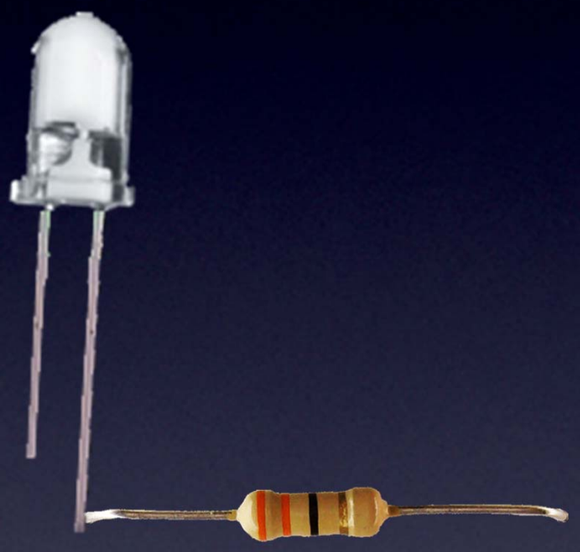
LED

Everything You Need to Know About Electronics

More current → More brightness! (until…)

LED

Everything You Need to Know About Electronics

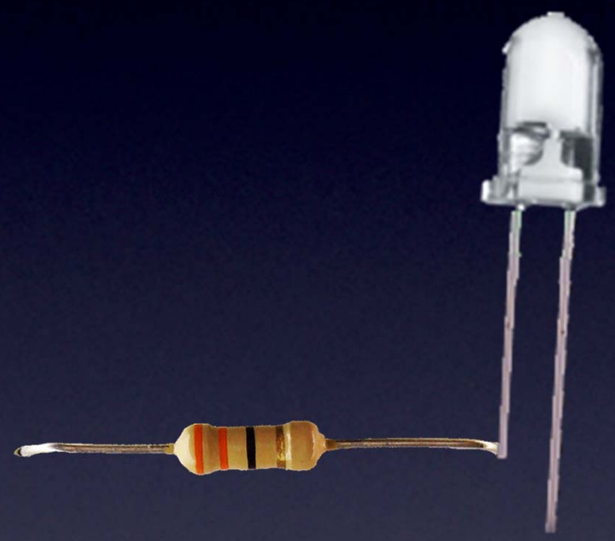


(with a resistor
so no magic smoke goes away)

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

LED

Everything You Need to Know About Electronics



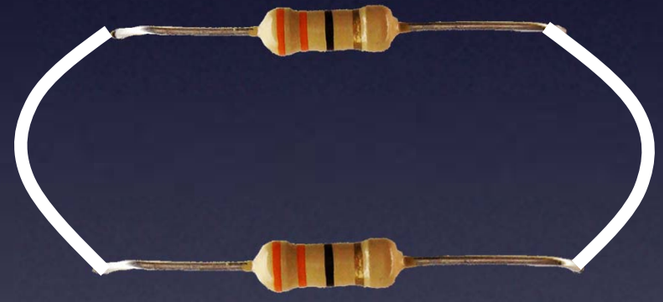
(the resistor can go on either side)

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

LED

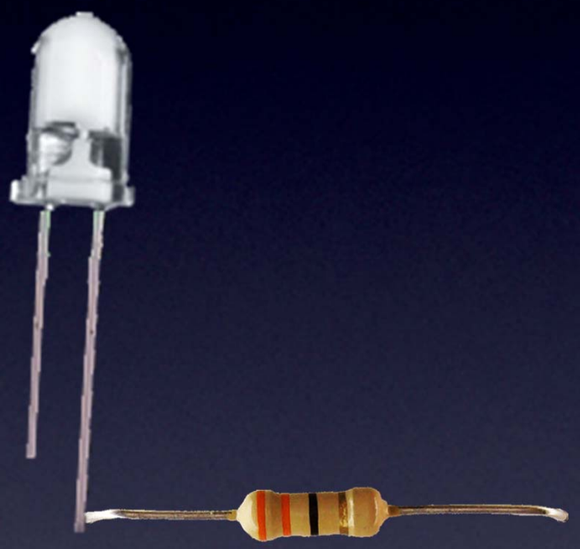
Everything You Need to Know About Electronics

Series = in line



Parallel = across

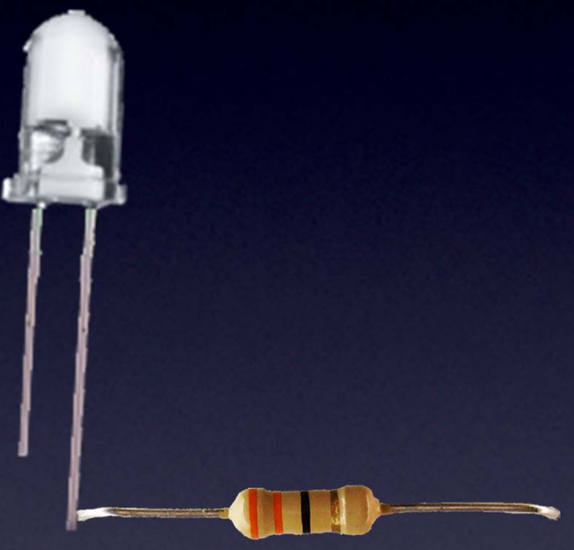
Everything You Need to Know About Electronics



Let’s make this light up!

LED

Everything You Need to Know About Electronics

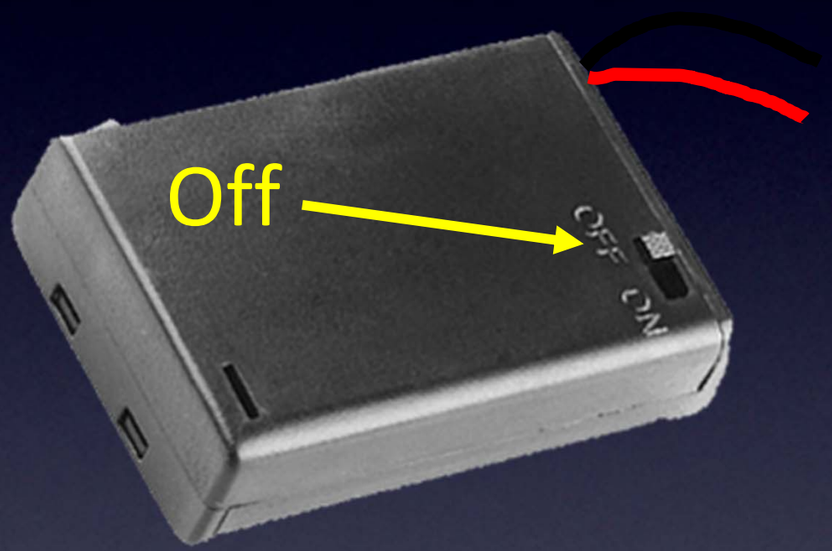


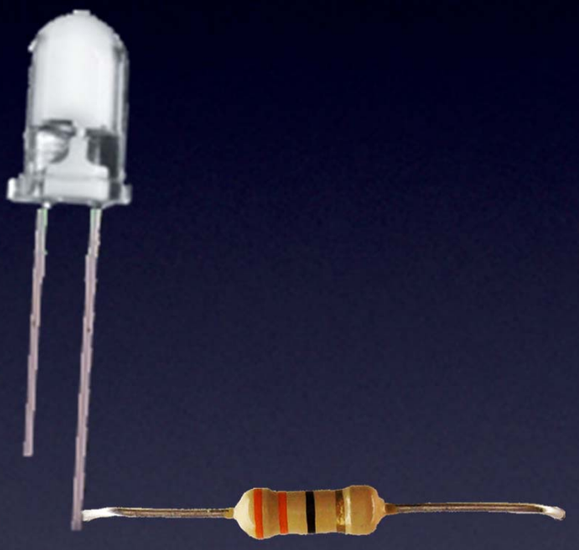
(add a power supply)

Let’s make this light up!

LED

Everything You Need to Know About Electronics



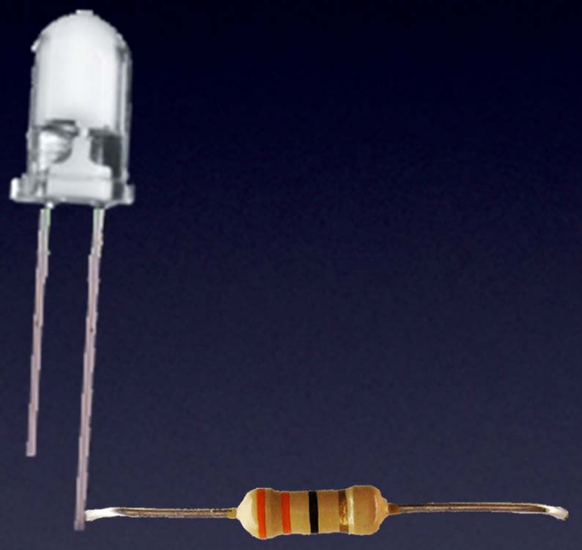


Let’s make this light up!

LED

Everything You Need to Know About Electronics

Black wire: “-” (ground)



Red wire: “+” power)

Let’s make this light up!

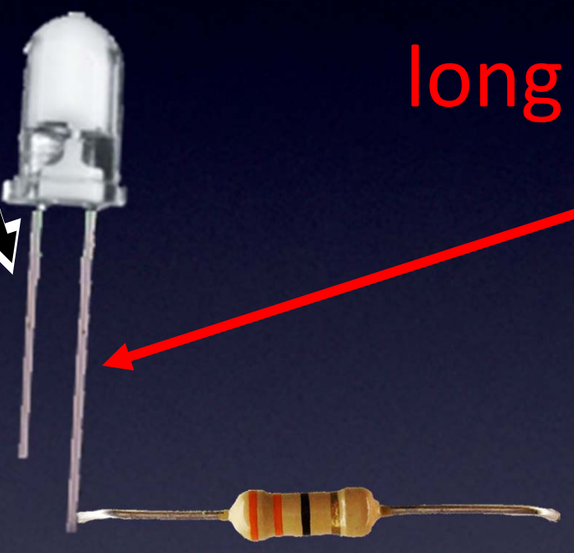
LED

Everything You Need to Know About Electronics

short lead: “-”

Black wire: “-” (ground)

long lead: “+”

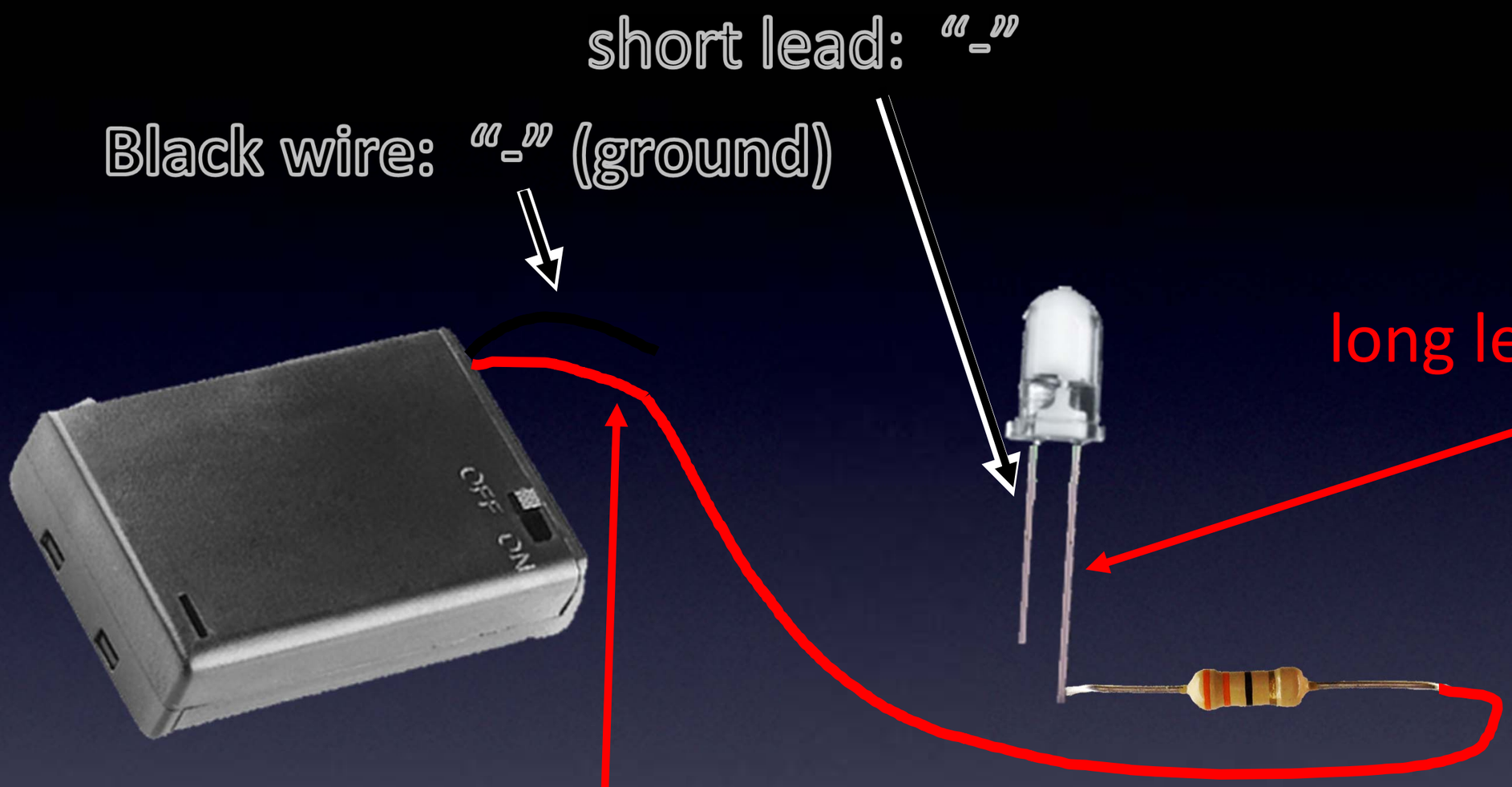


Red wire: “+” power)

Let’s make this light up!

LED

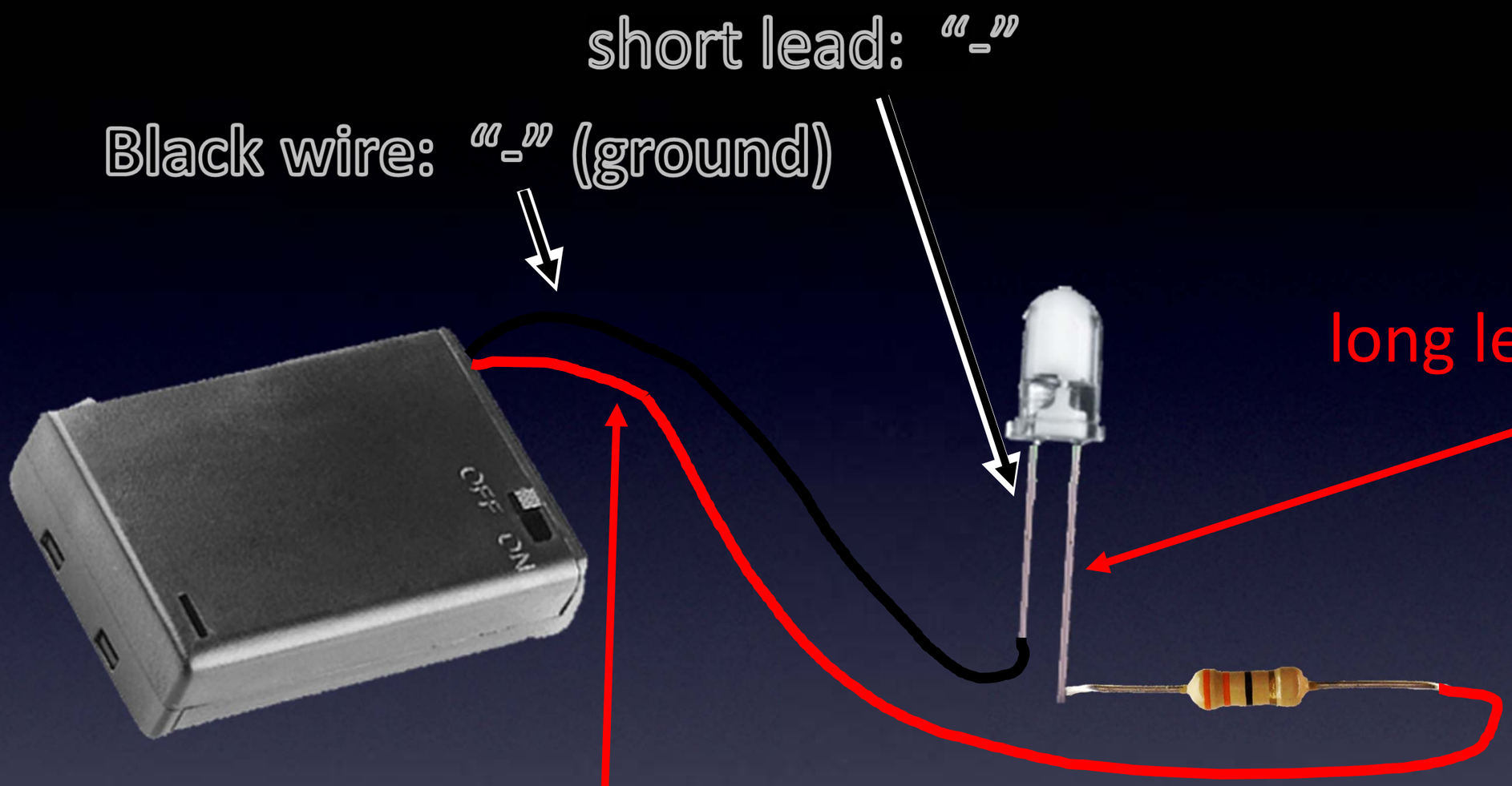
Everything You Need to Know About Electronics



Let’s make this light up!

LED

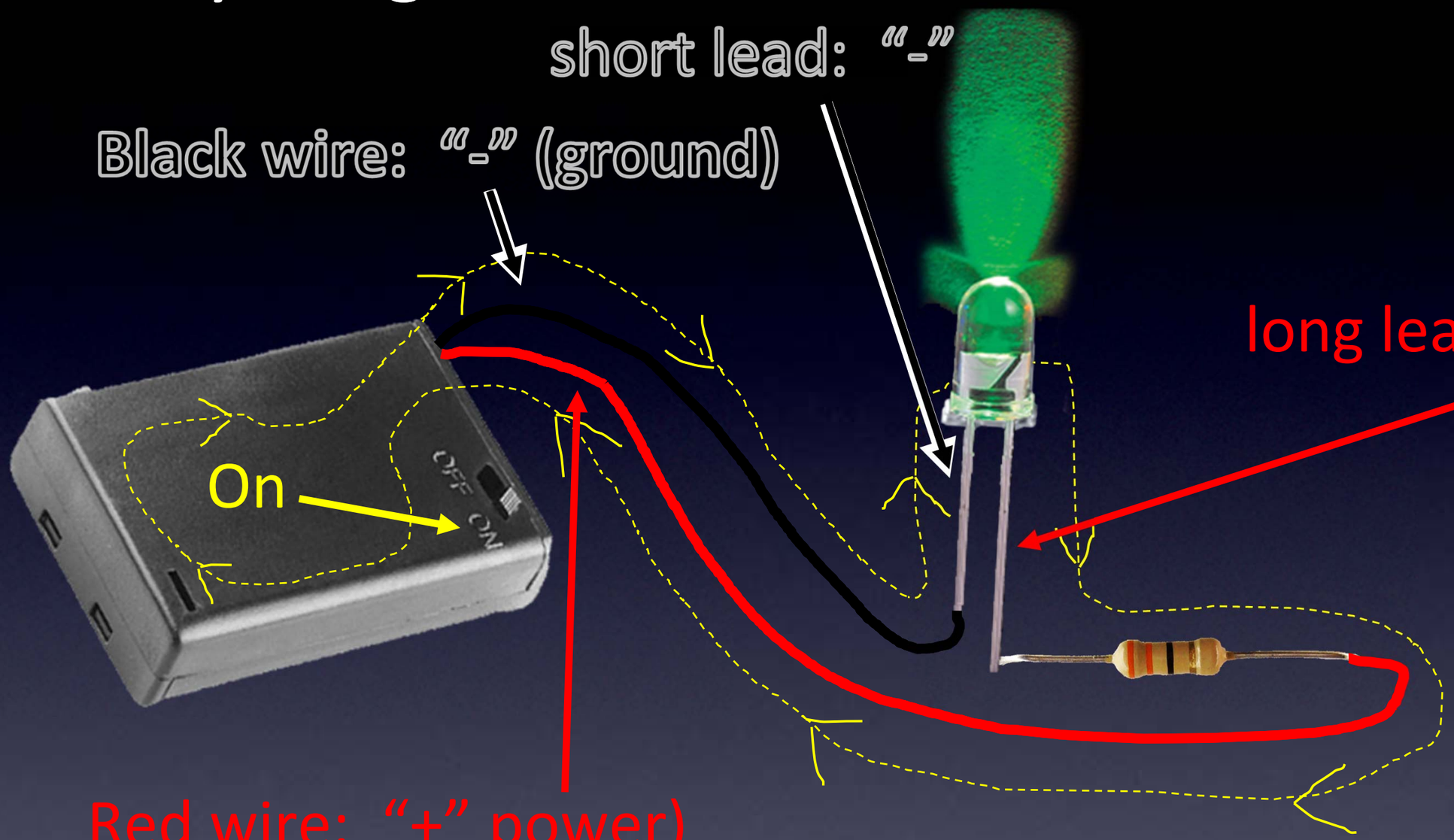
Everything You Need to Know About Electronics



Let’s make this light up!

LED

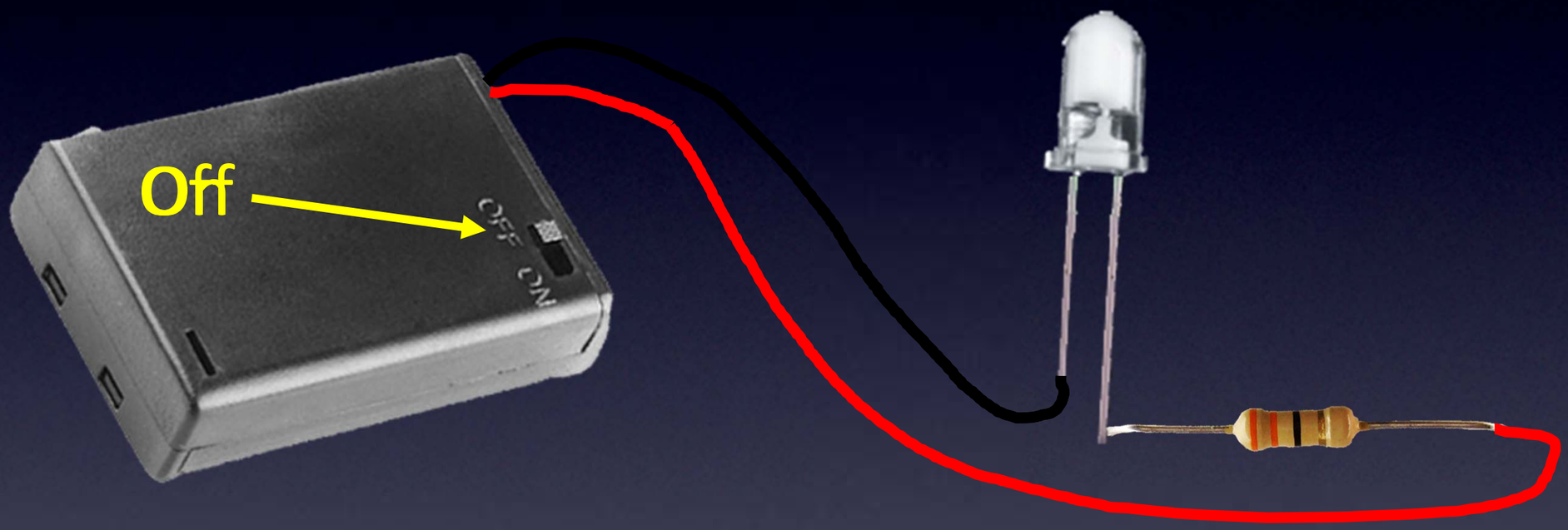
Everything You Need to Know About Electronics



It lights!

LED

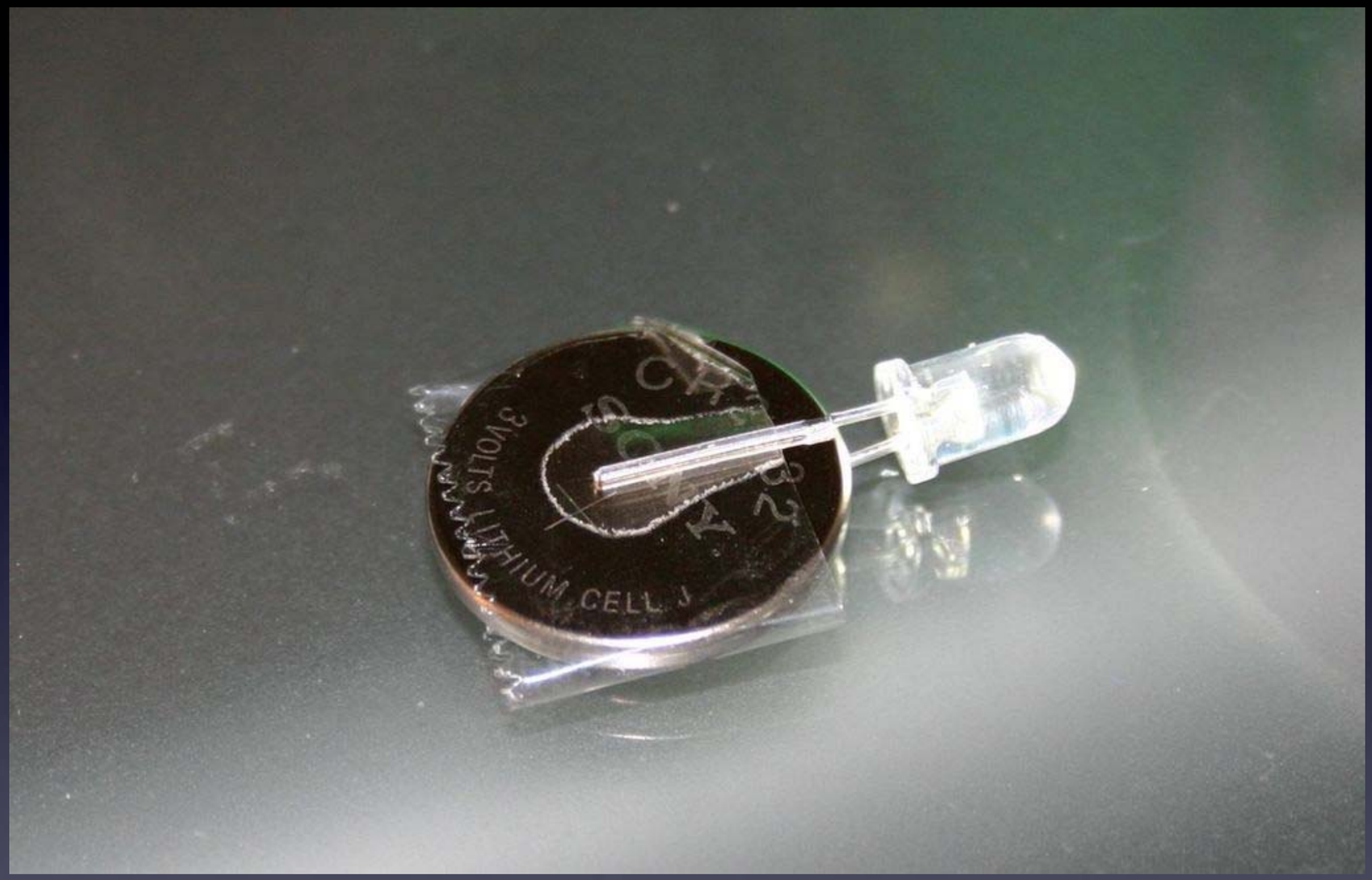
Everything You Need to Know About Electronics



It’s off

LED

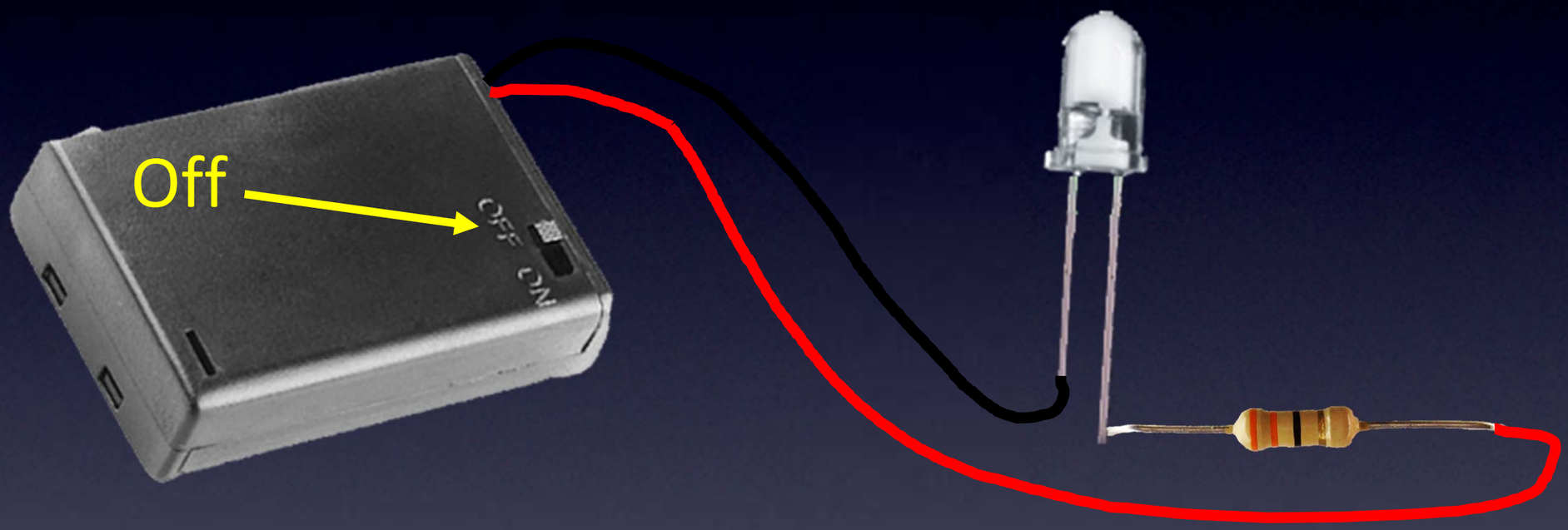
Everything You Need to Know About Electronics



LED & battery

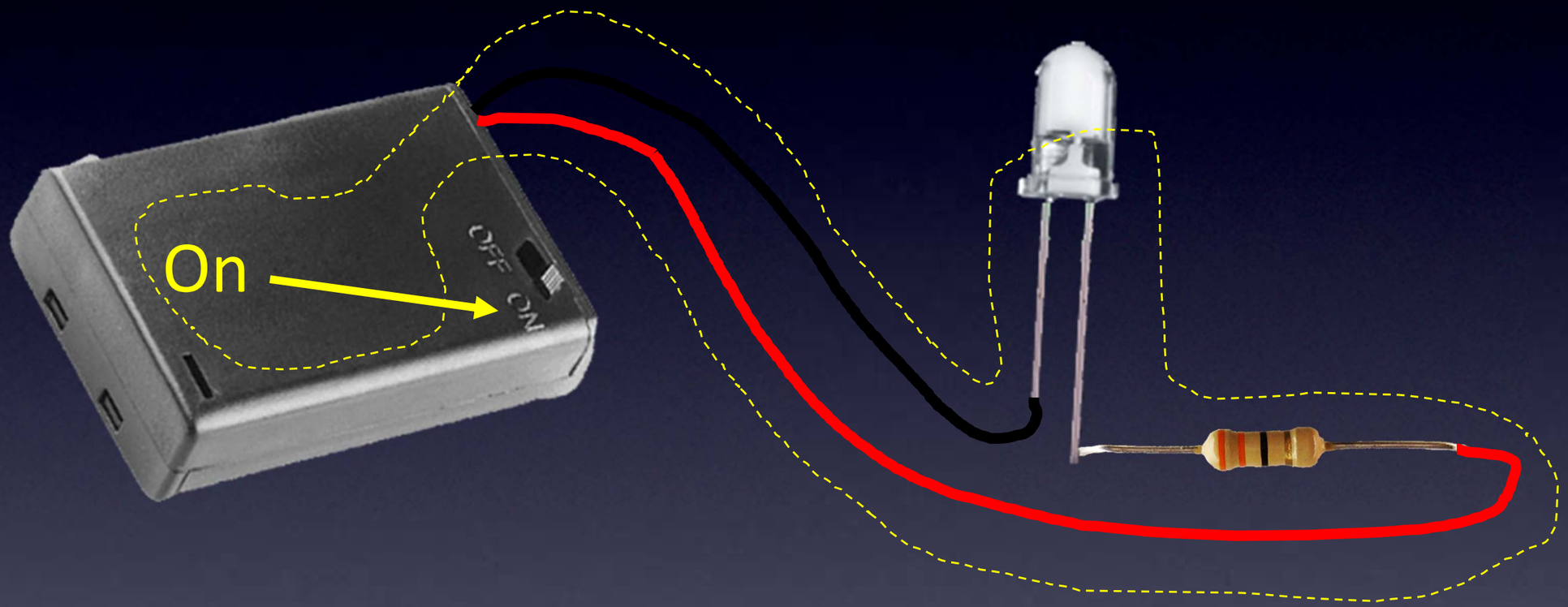
Our first circuit

Everything You Need to Know About Electronics



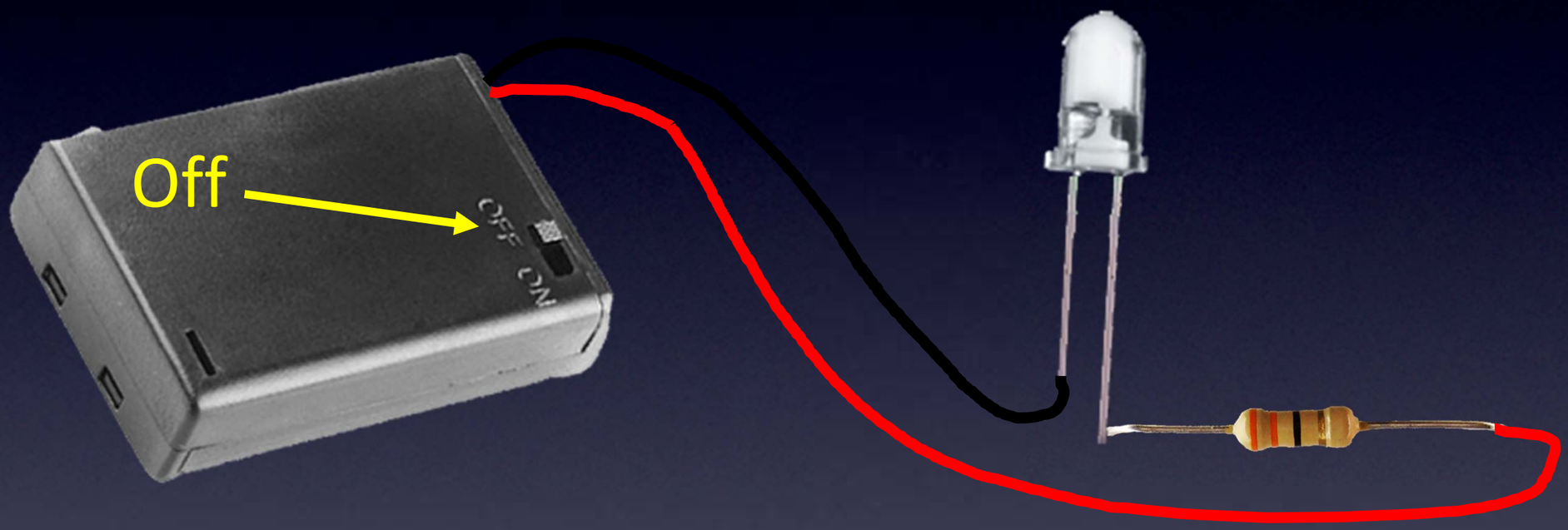
IR LED

Everything You Need to Know About Electronics



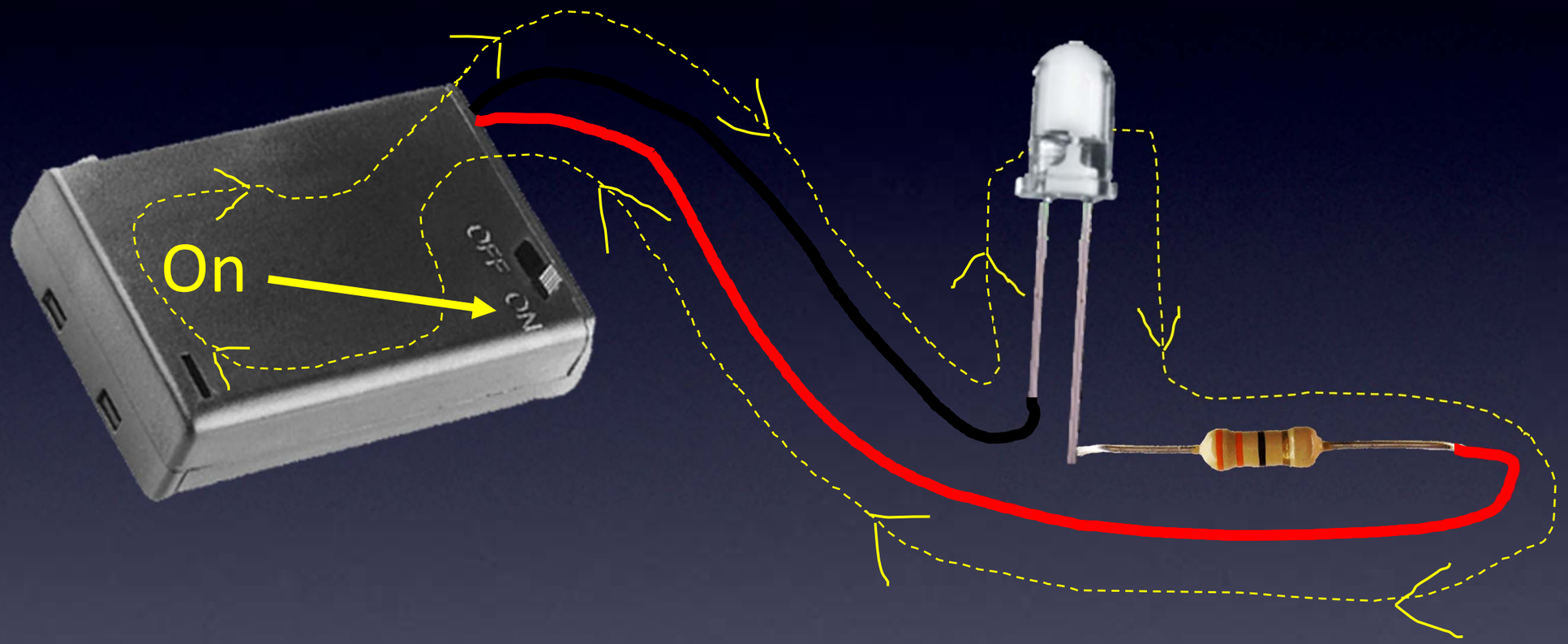
IR LED

Everything You Need to Know About Electronics



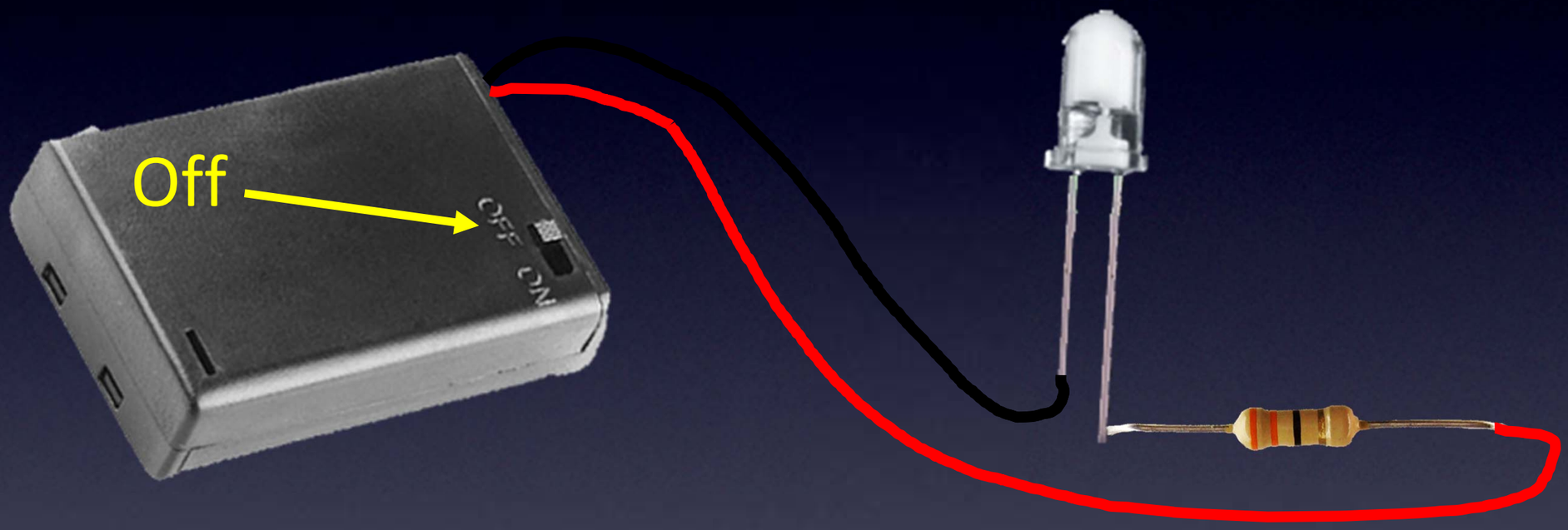
IR LED

Everything You Need to Know About Electronics



IR LED

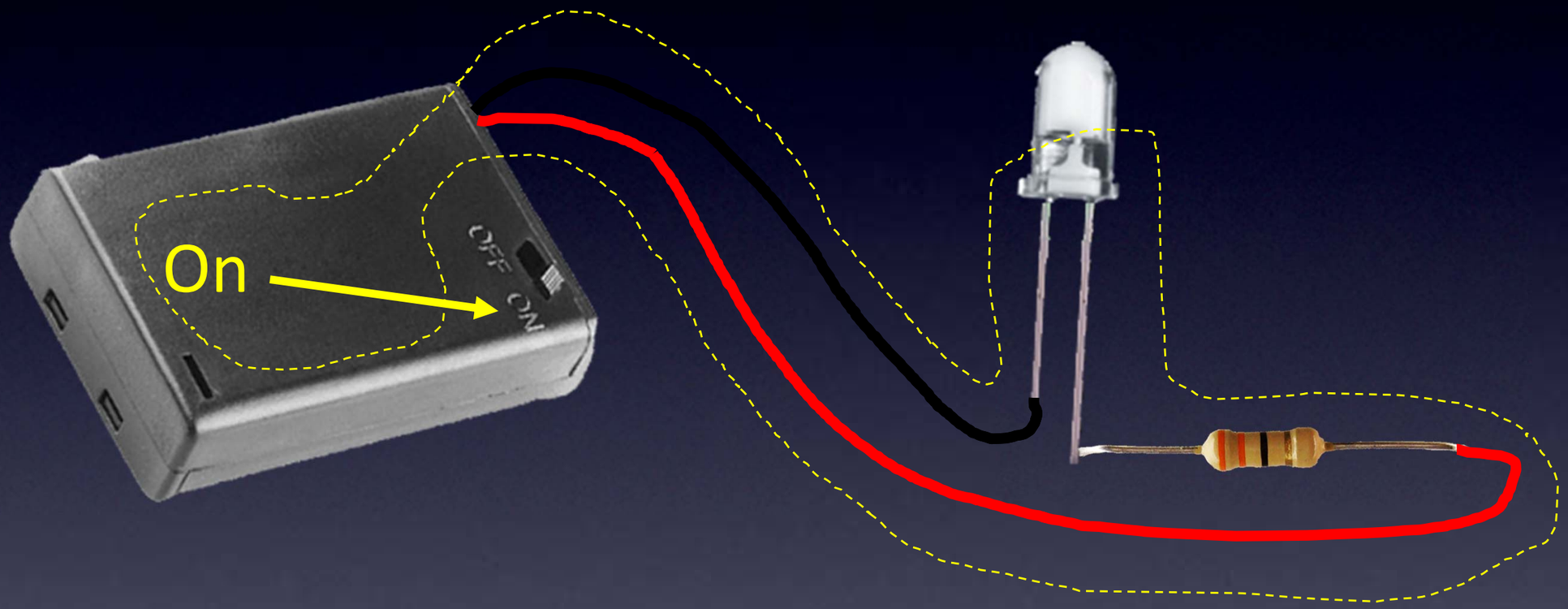
Everything You Need to Know About Electronics



A “code” is IR light blinking on-off-on-off…

IR Remote Control

Everything You Need to Know About Electronics



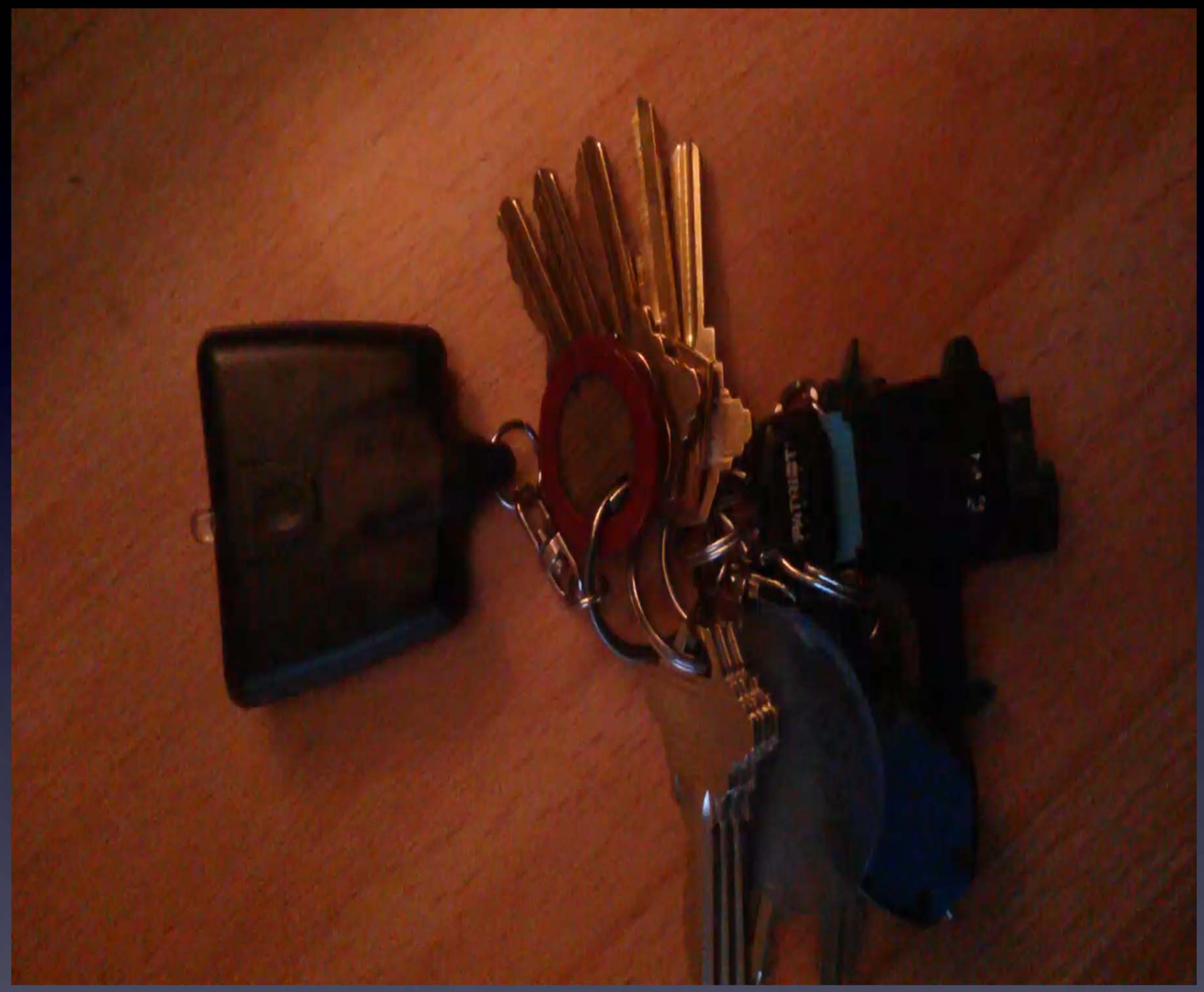
A “code” is IR light blinking on-off-on-off…

(we can’t do this, but microcontrollers can!)

IR Remote Control

Everything You Need to Know About Electronics

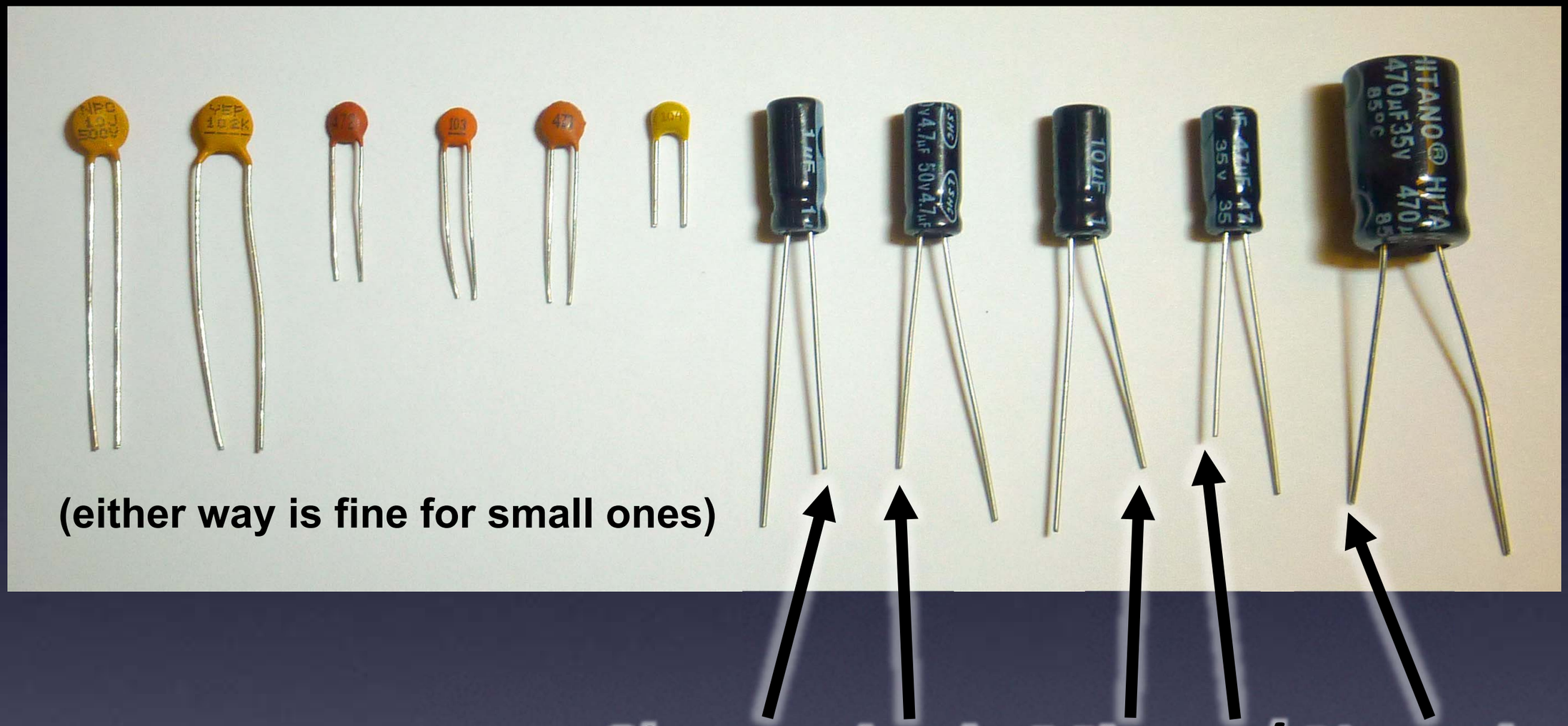
Takes about 60 seconds



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

TV-B-Gone universal remote control

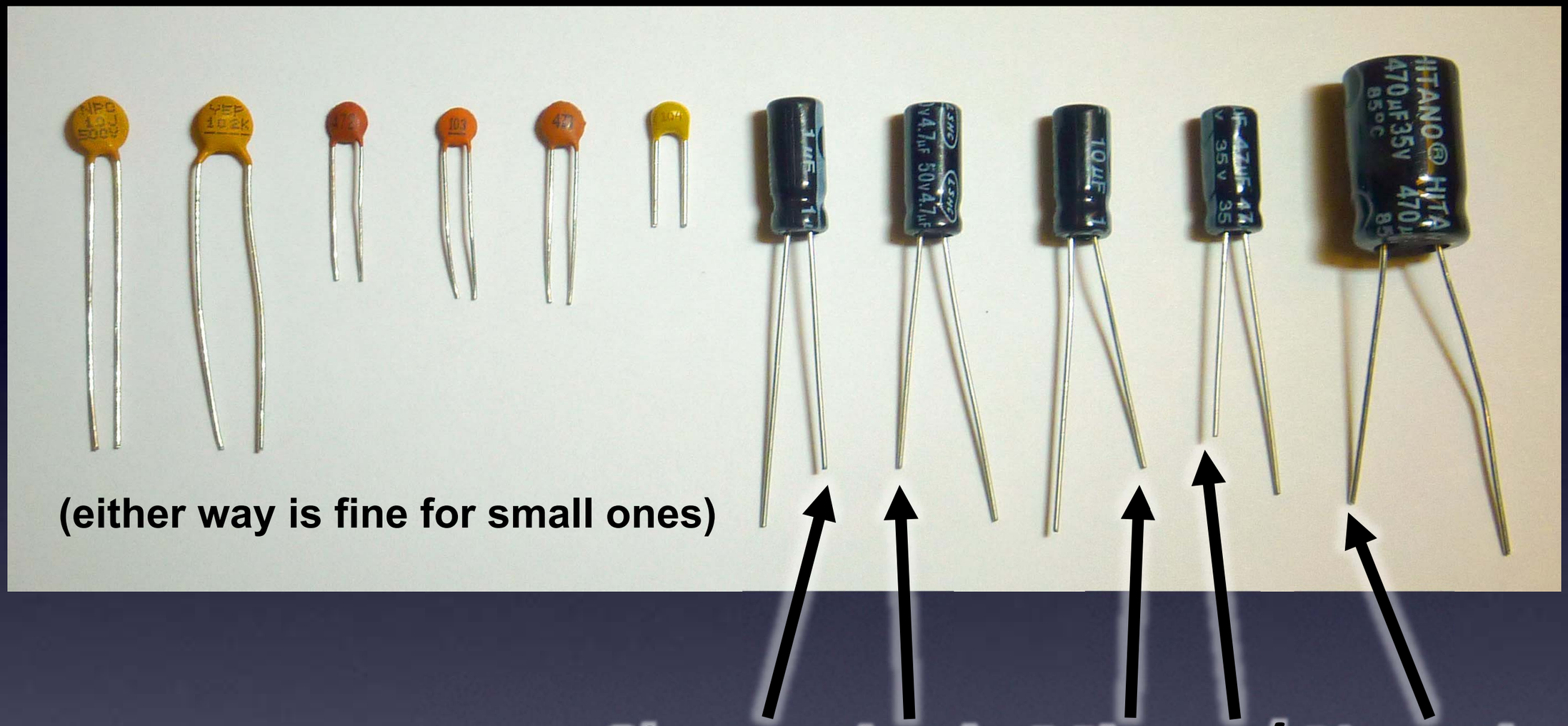
Everything You Need to Know About Electronics



Little buckets for electrons

Capacitor / Farads

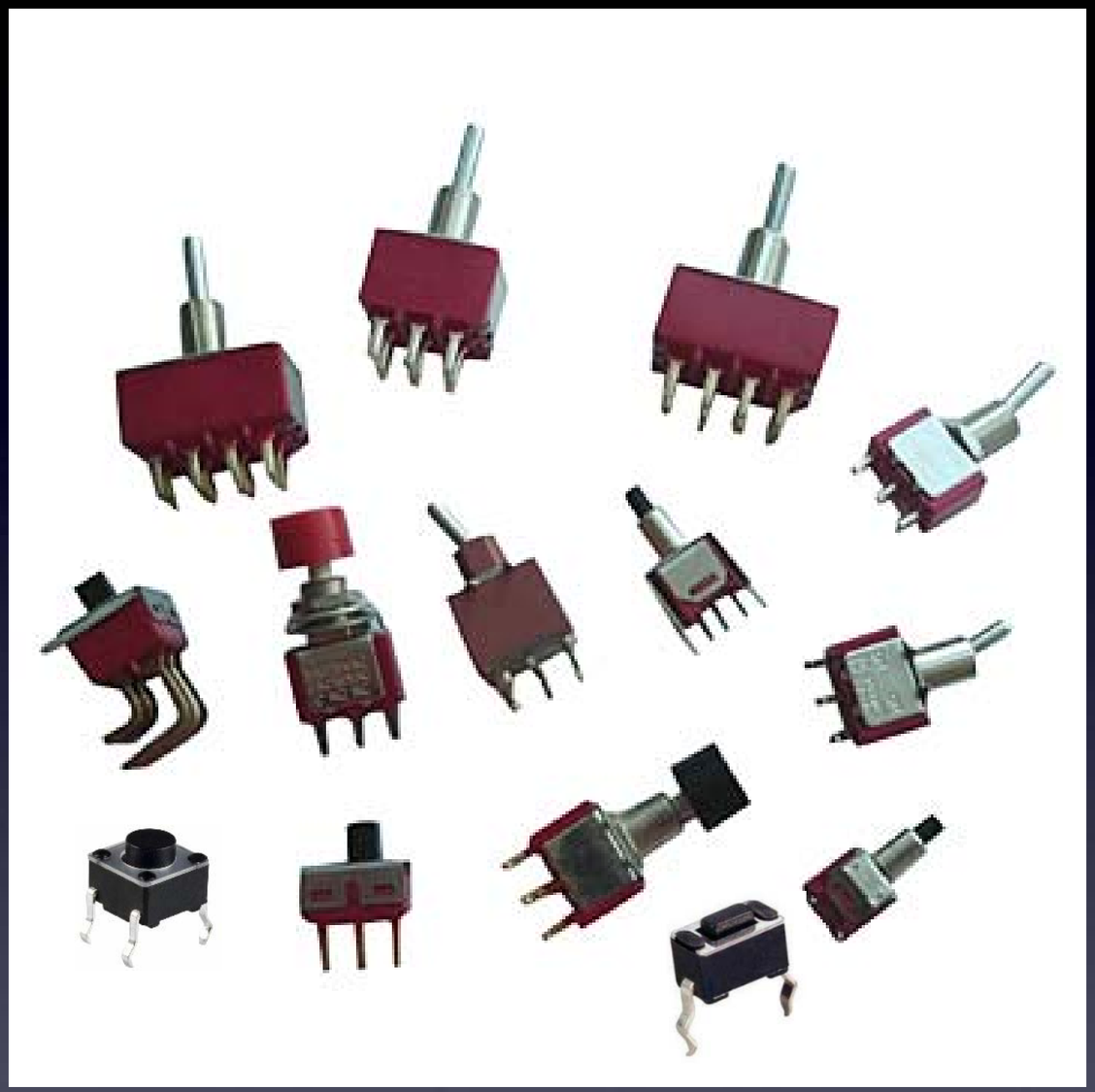
Everything You Need to Know About Electronics



Little buckets for electrons

Capacitor / **Farads**

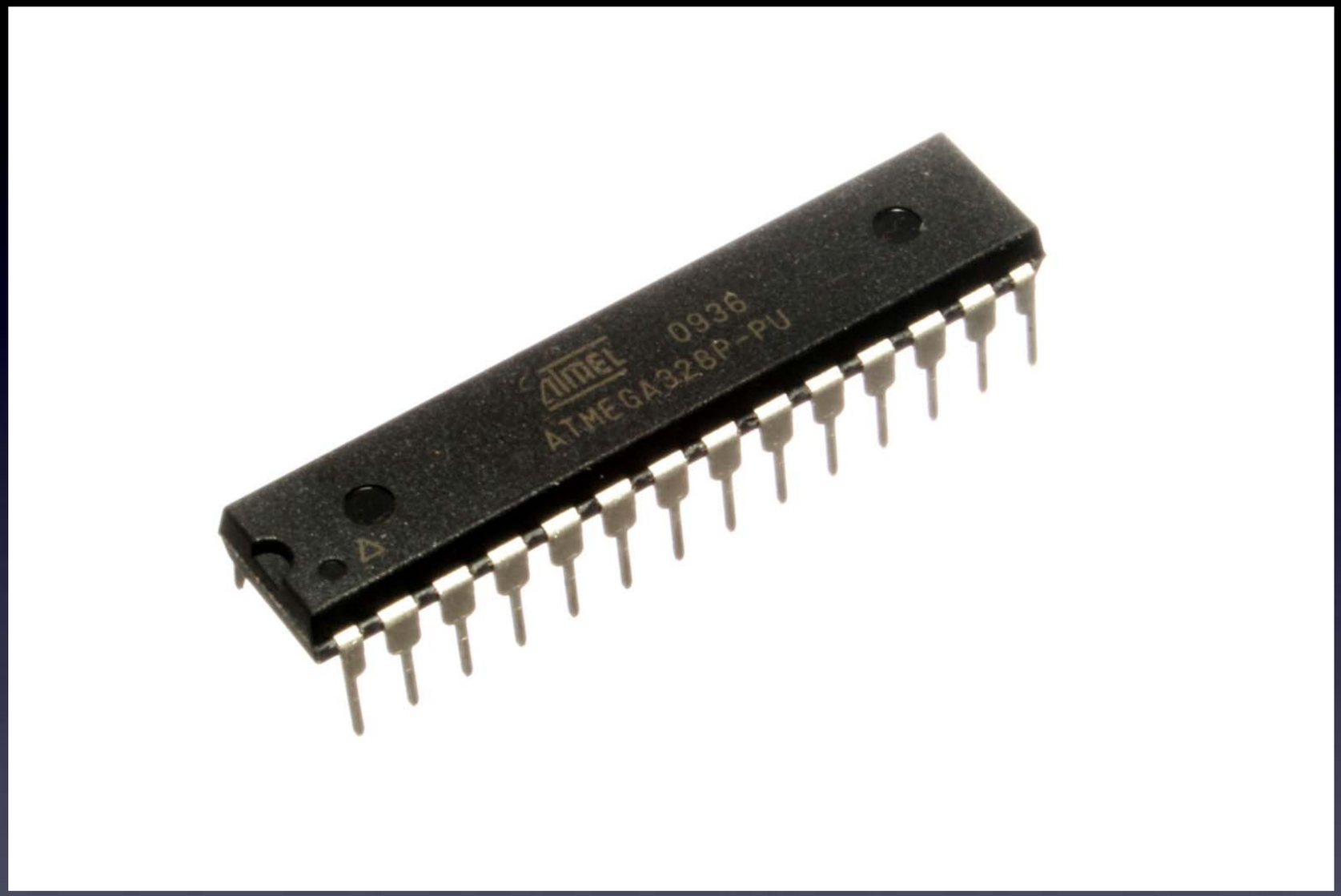
Everything You Need to Know About Electronics



Strips of metal connected together – or not

Switch

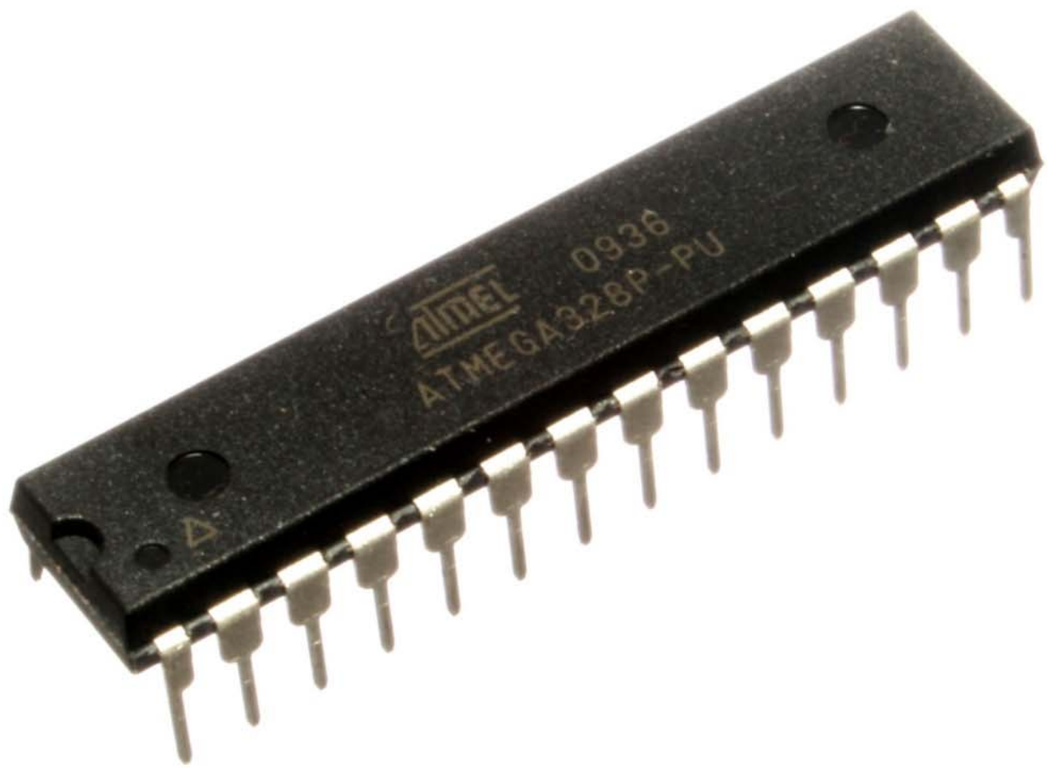
Everything You Need to Know About Electronics



A complete computer on a chip

Microcontroller

Everything You Need to Know About Electronics



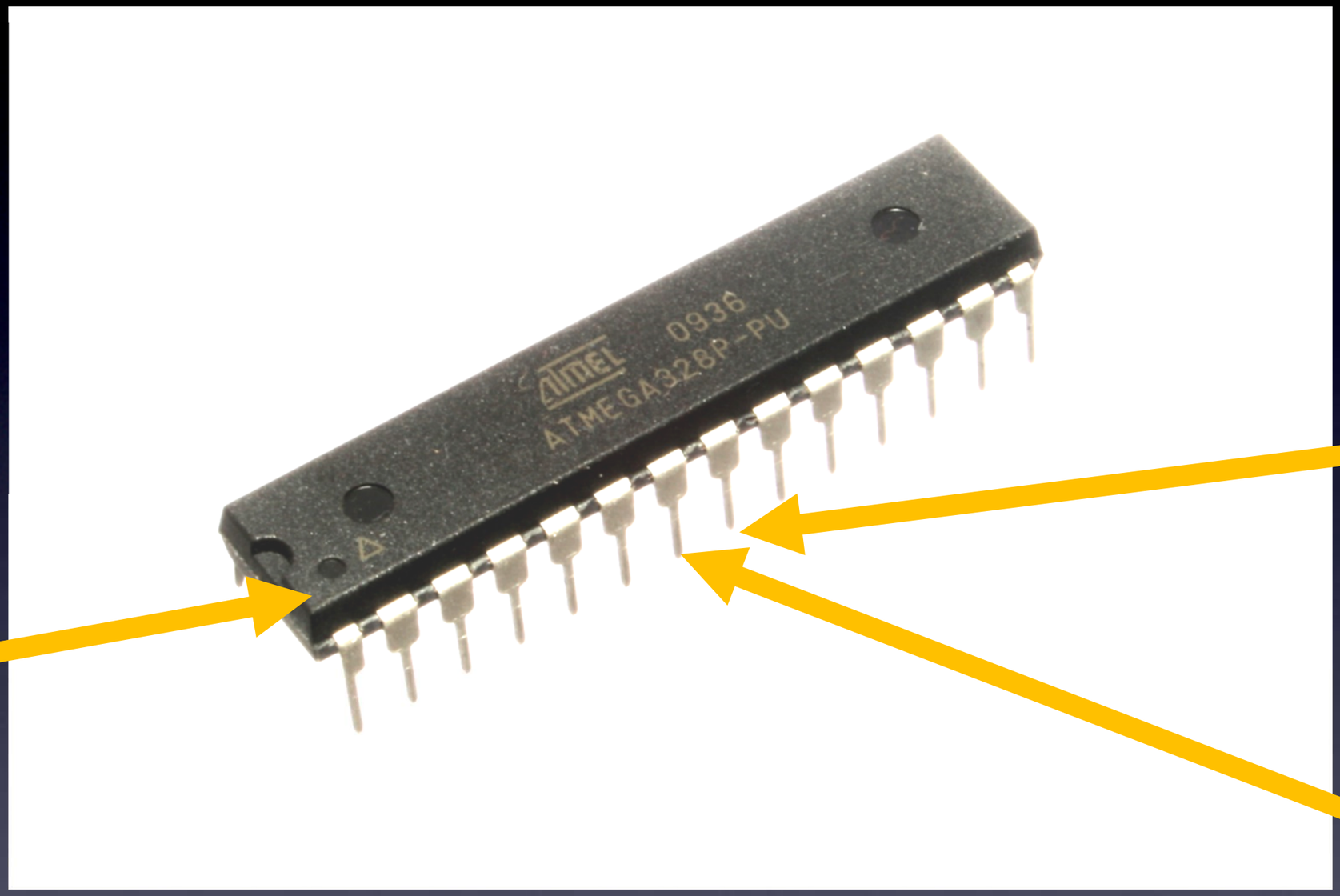
It runs programs

that control electronic parts connected to its pins.

Microcontroller

Everything You Need to Know About Electronics

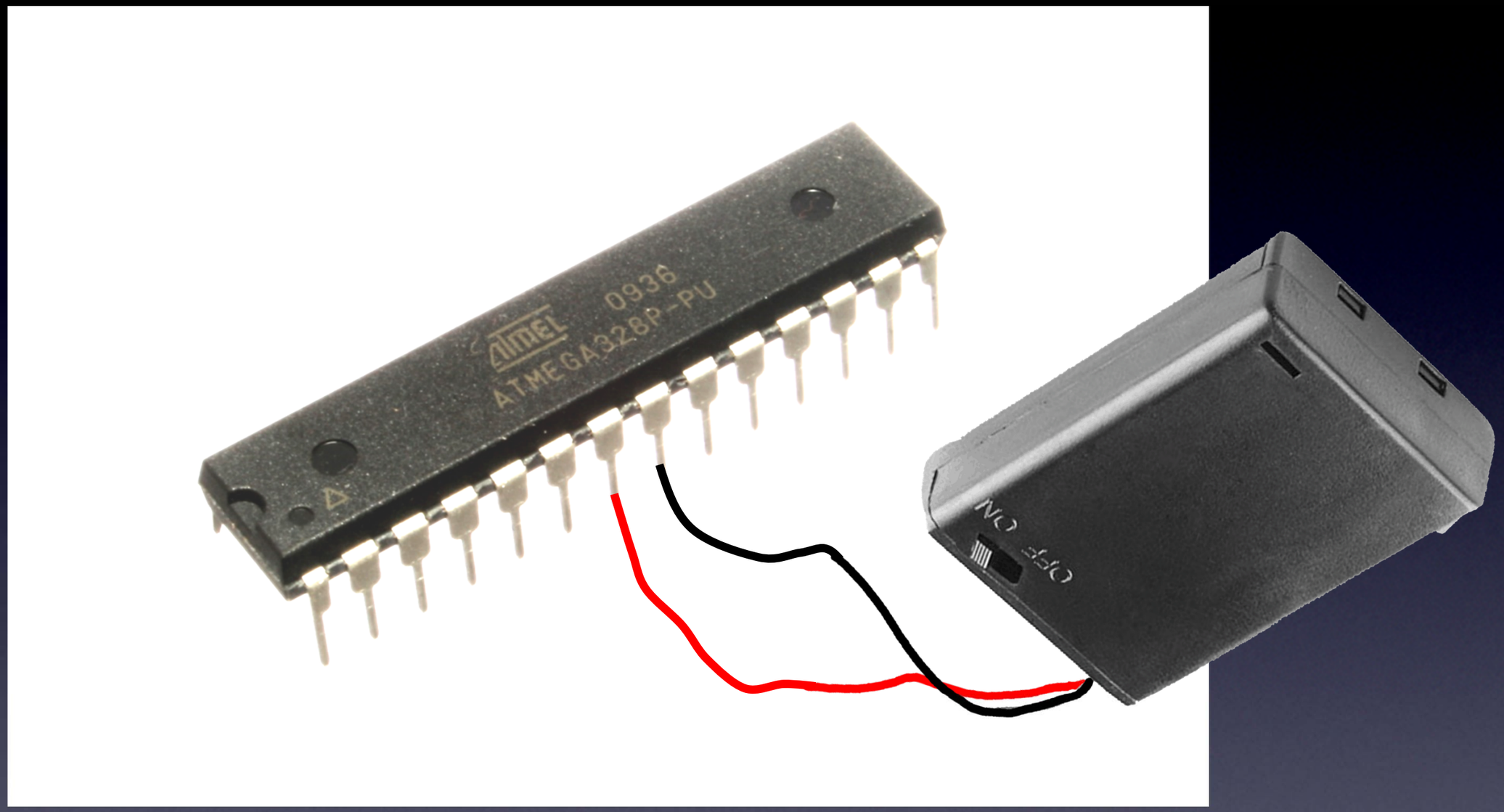
2 special pins:



A complete computer on a chip

Microcontroller – it matters how you hook it up!

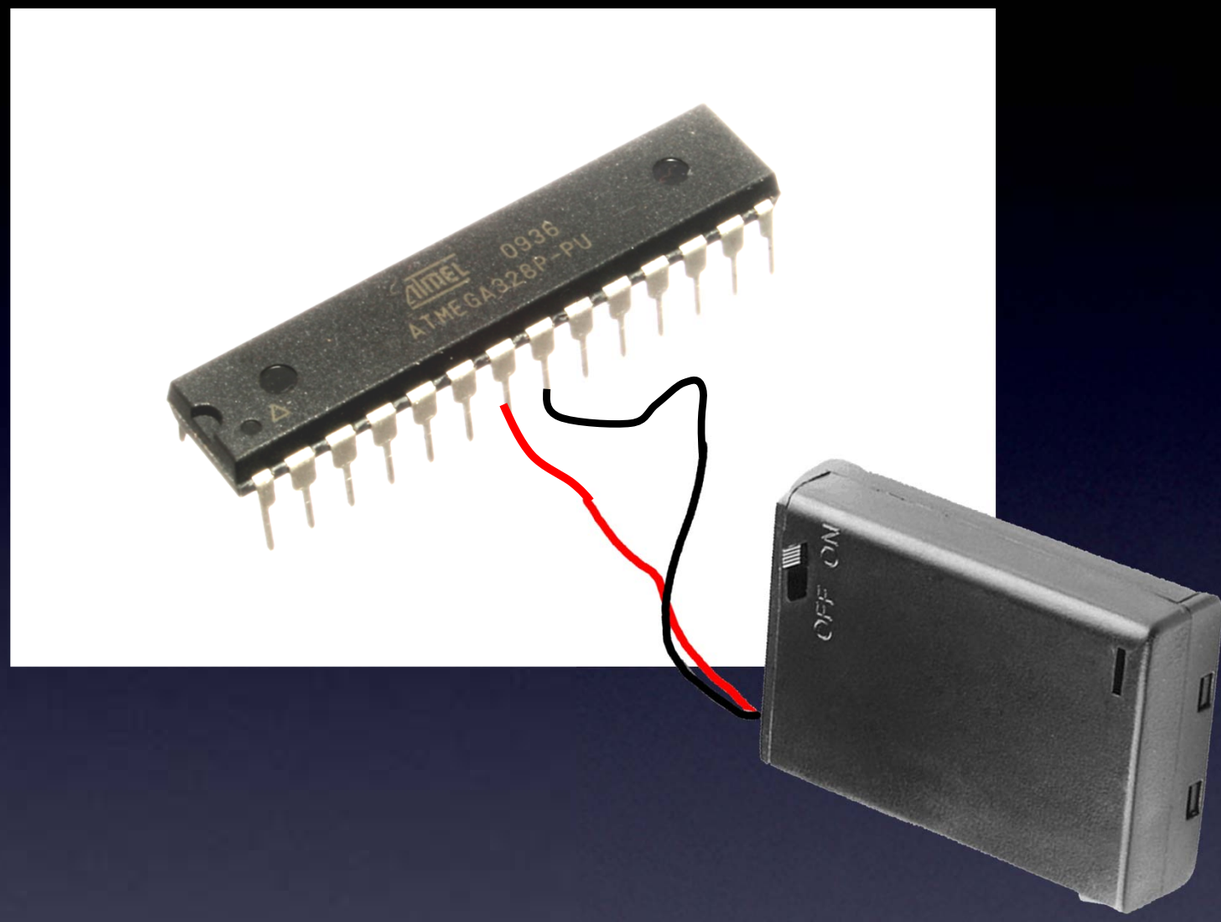
Everything You Need to Know About Electronics



A complete computer – running a program!

Microcontroller – turned on!

Everything You Need to Know About Electronics



all other pins are

Input pins

or

Output pins

Your program controls electronics parts
on these other pins

Microcontroller

Everything You Need to Know About Electronics

Analog Electronics:

Any voltage between Ground (0V) and Vcc

Digital Electronics:

Only 2 choices: Ground (0V) or Vcc

2 types of electronics

Everything You Need to Know About Electronics

Ground (0V)	**Power / Vcc**
Low	**High**
Off	**On**
0	**1**

(without Voltage / with Voltage)
(without current / with current)

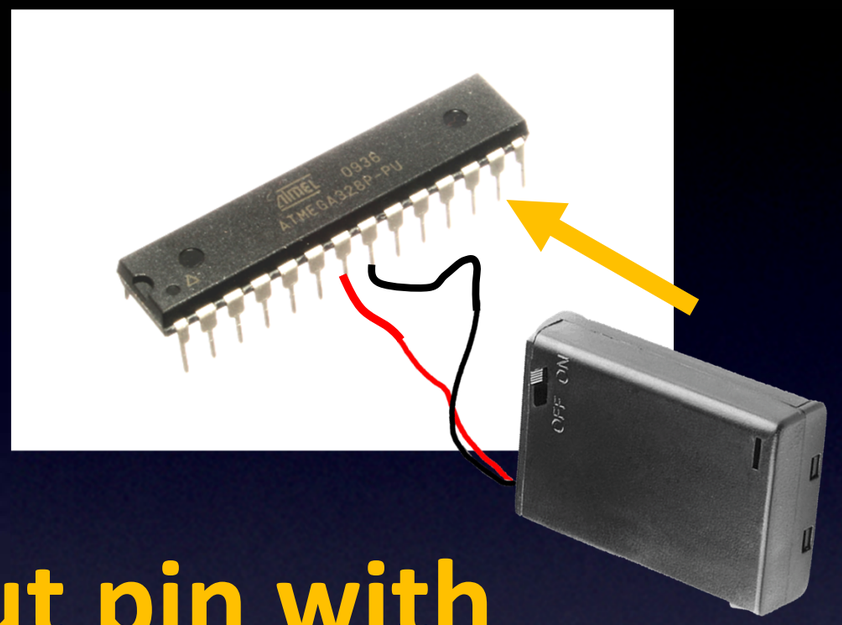
Digital Electronics:

Only 2 choices: Ground (0V) or Vcc

Digital Electronics

Everything You Need to Know About Electronics

To make a pin an
Output pin



you tell it to become an Output pin with a statement in your program

Let’s tell pin 13 to be an Output pin

Microcontroller – Output pins

Everything You Need to Know About Electronics

Low	**High**
Off	**On**
(0V)	(Power supply voltage)
	-- like the Red wire of our power supply
	-- but controlled by our program!

Only 2 choices: High or Low

Microcontroller – Output pins

A real world example

How to make an LED blink?

`Hello World`

Microcontroller

Everything You Need to Know About Electronics

Software

Type:

```
Hello World
```

on your screen

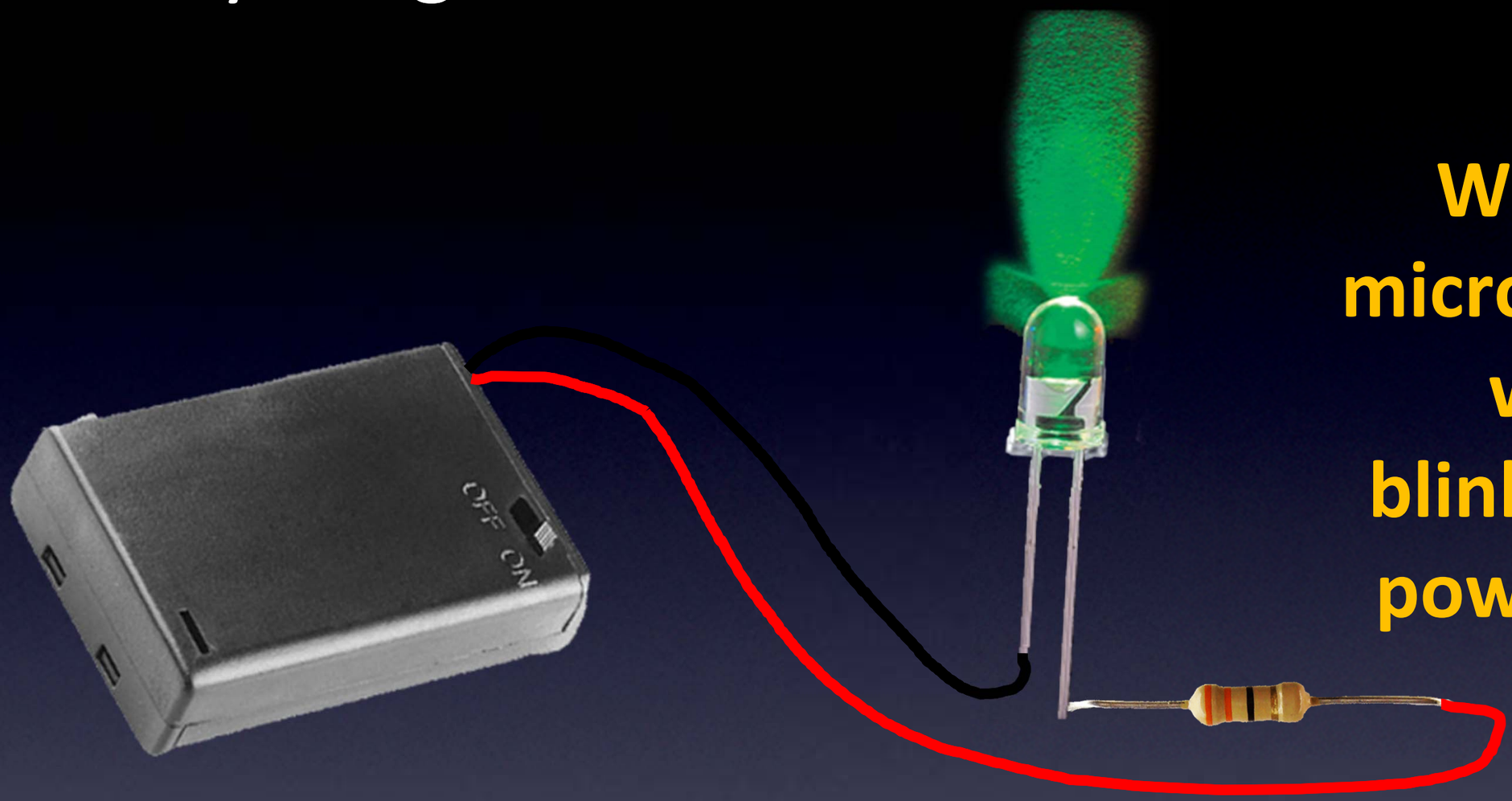
Microcontrollers

make an LED blink

```
Hello World
```

Microcontroller

Everything You Need to Know About Electronics



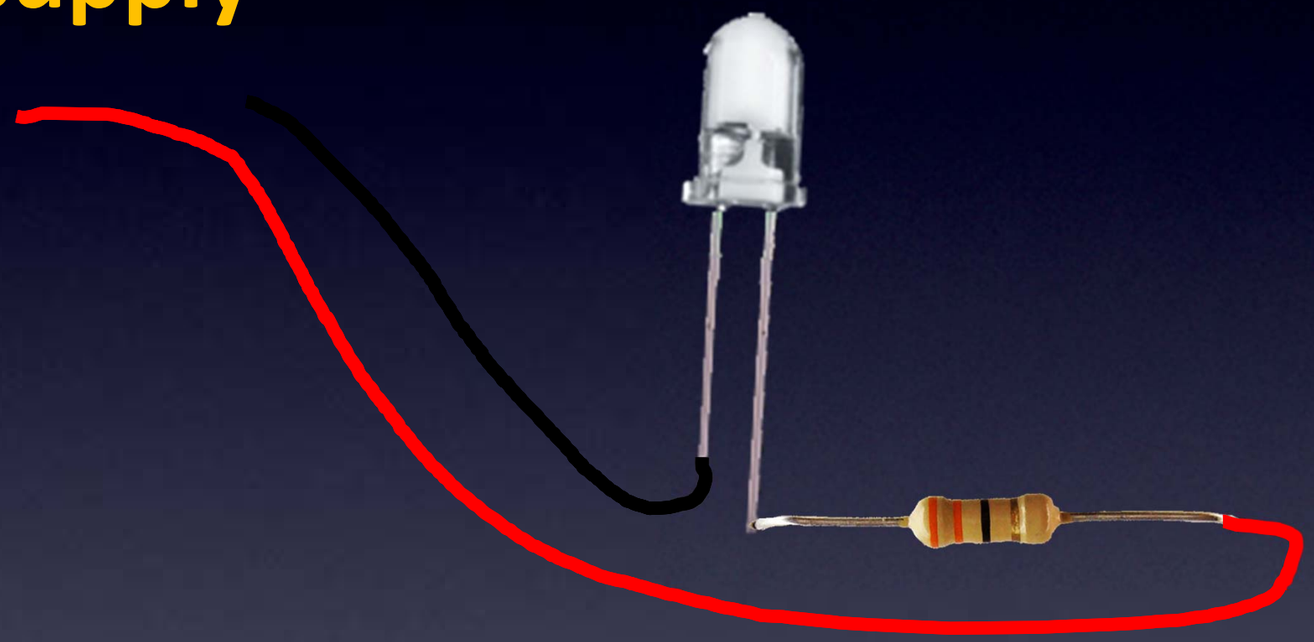
Without a microcontroller we can blink with our power supply

Turning an LED on and off

(Leading up to `Hello World`)

Everything You Need to Know About Electronics

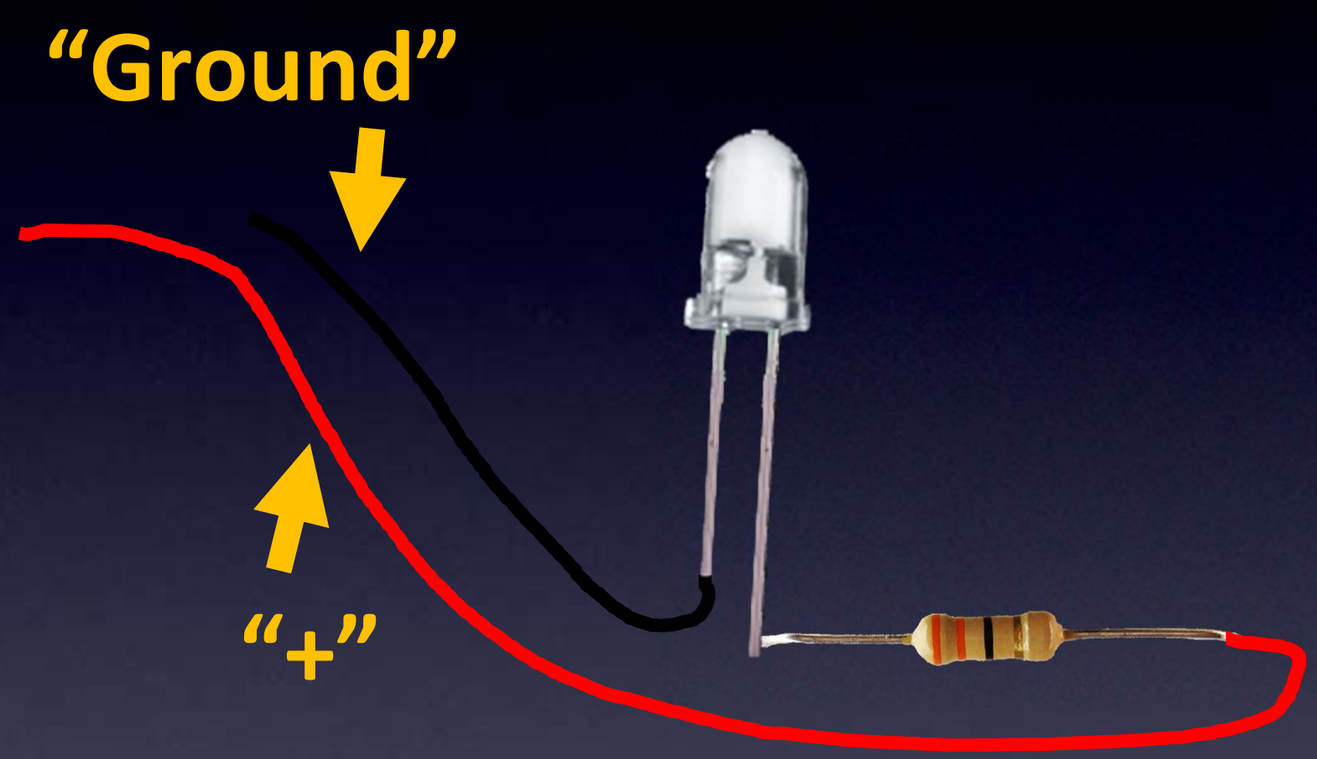
Let's replace the power supply



Turning an LED on and off

(Leading up to `Hello World`)

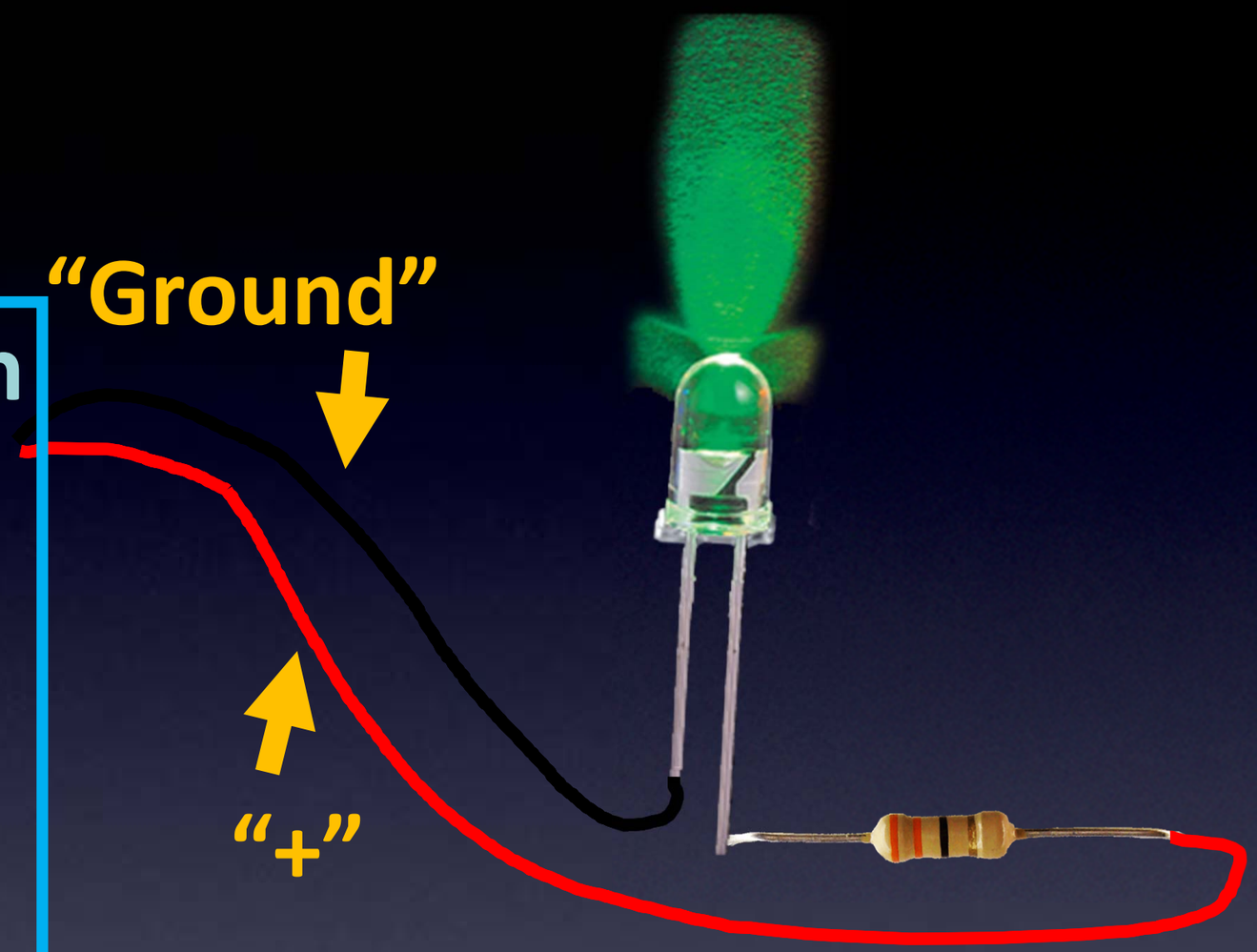
Everything You Need to Know About Electronics



Turning an LED on and off

(Leading up to `Hello World`)

Everything You Need to Know About Electronics



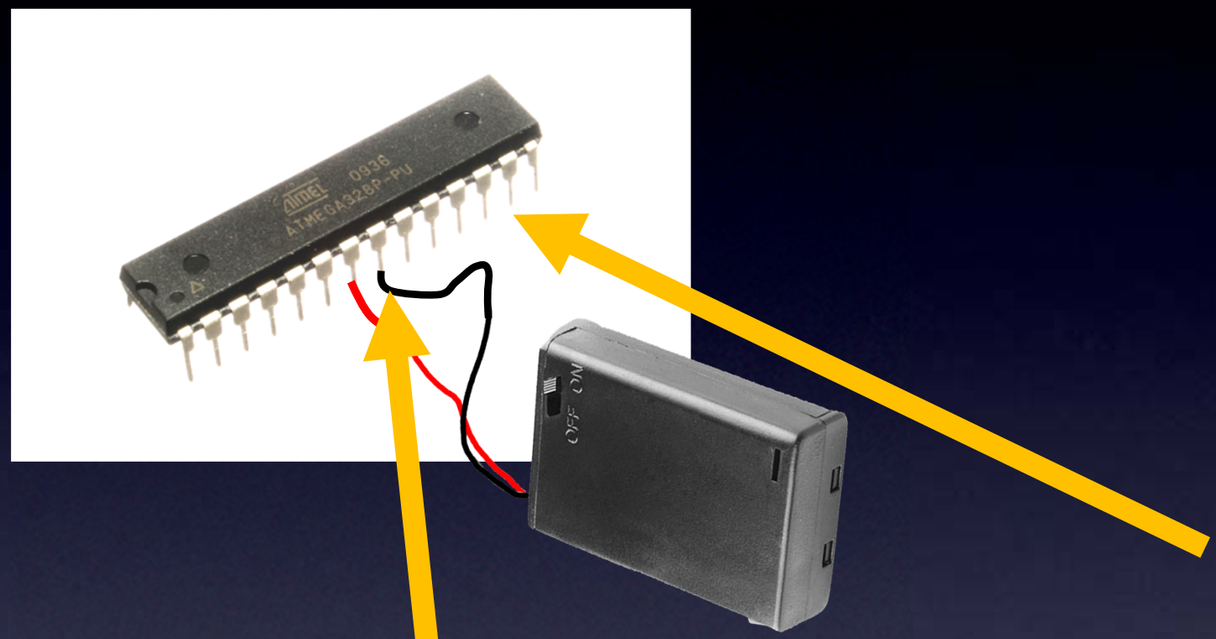
We can use an Output pin (and Ground)

as our power supply

Turning an LED on and off

(Leading up to `Hello World`)

Everything You Need to Know About Electronics



Ground

Pin 13

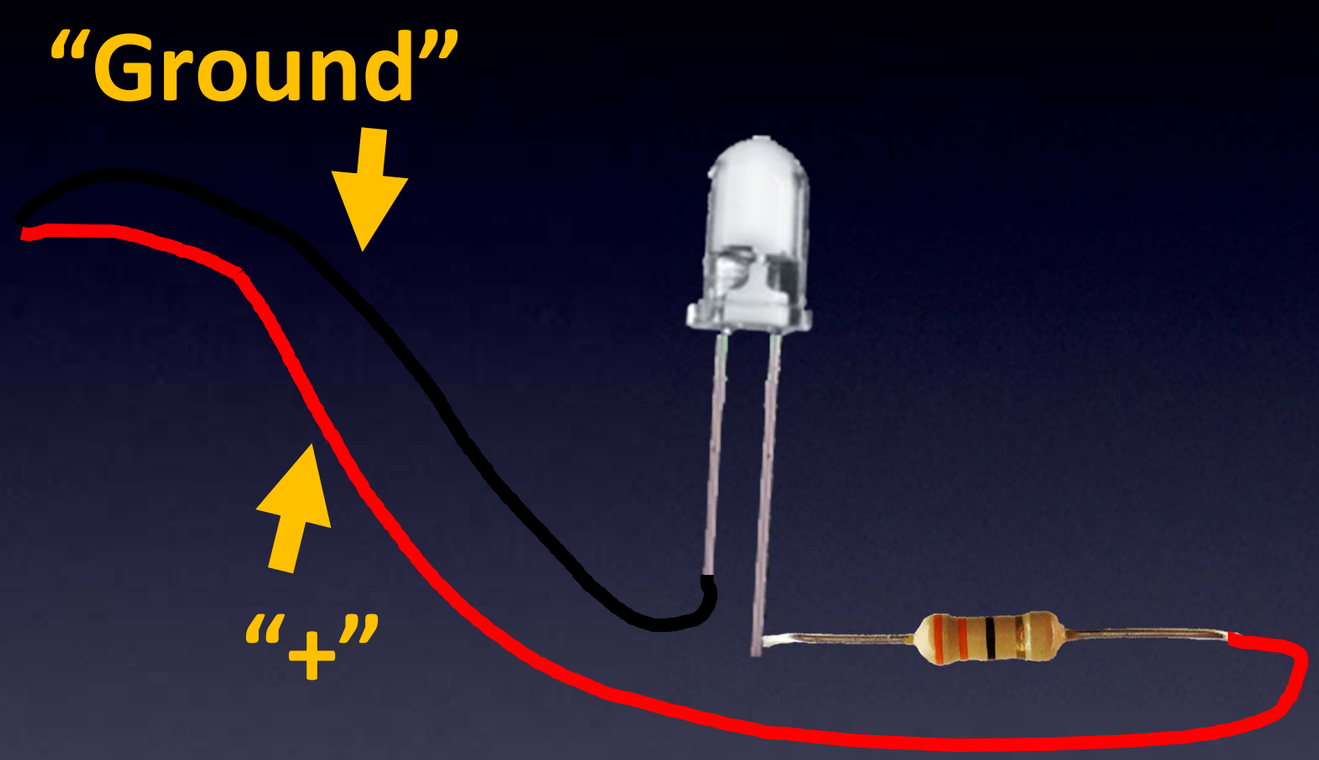
is our Output pin

(which can be On or Off)

Turning an LED on and off

(Leading up to `Hello World`)

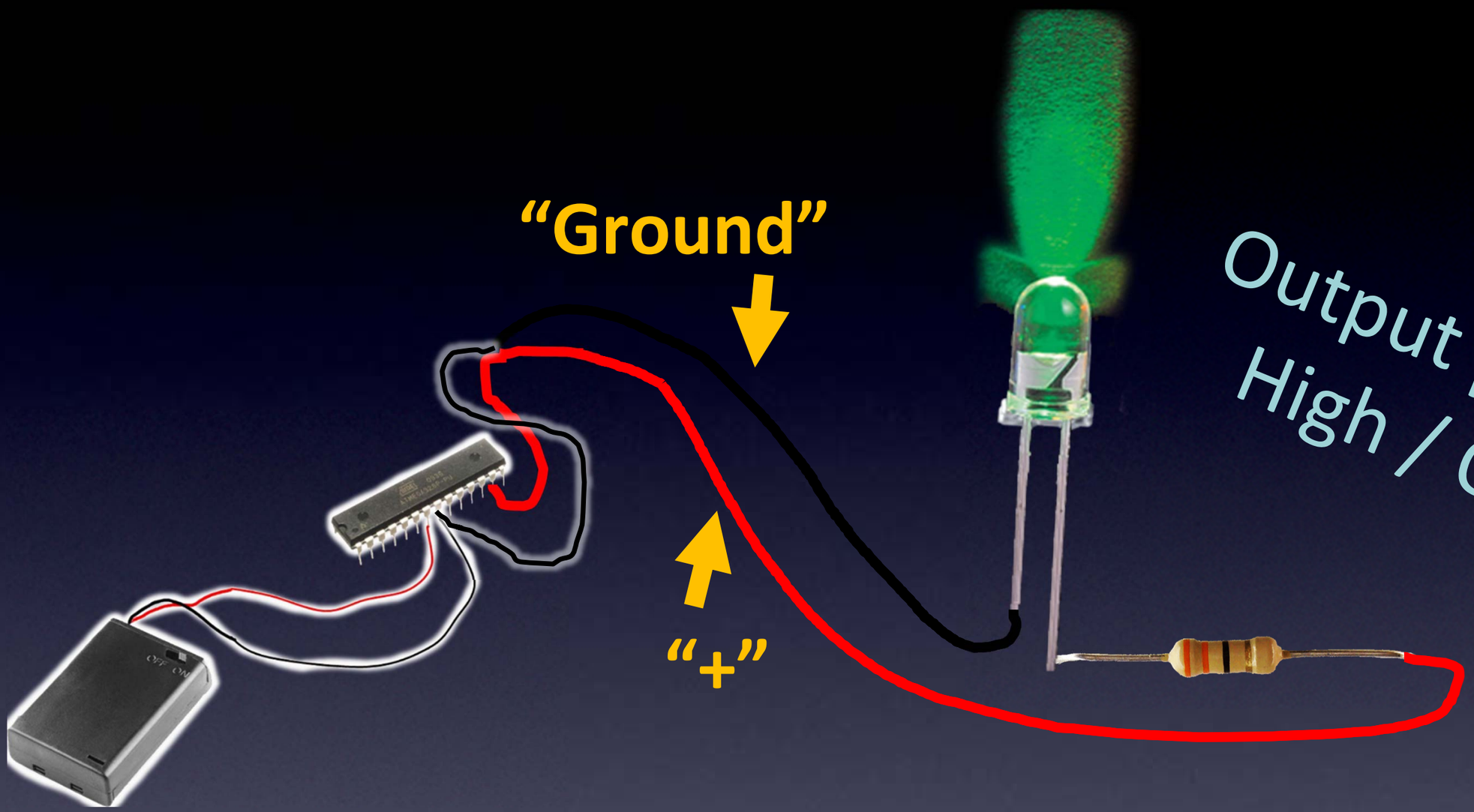
Everything You Need to Know About Electronics



Turning an LED on and off

(Leading up to `Hello World`)

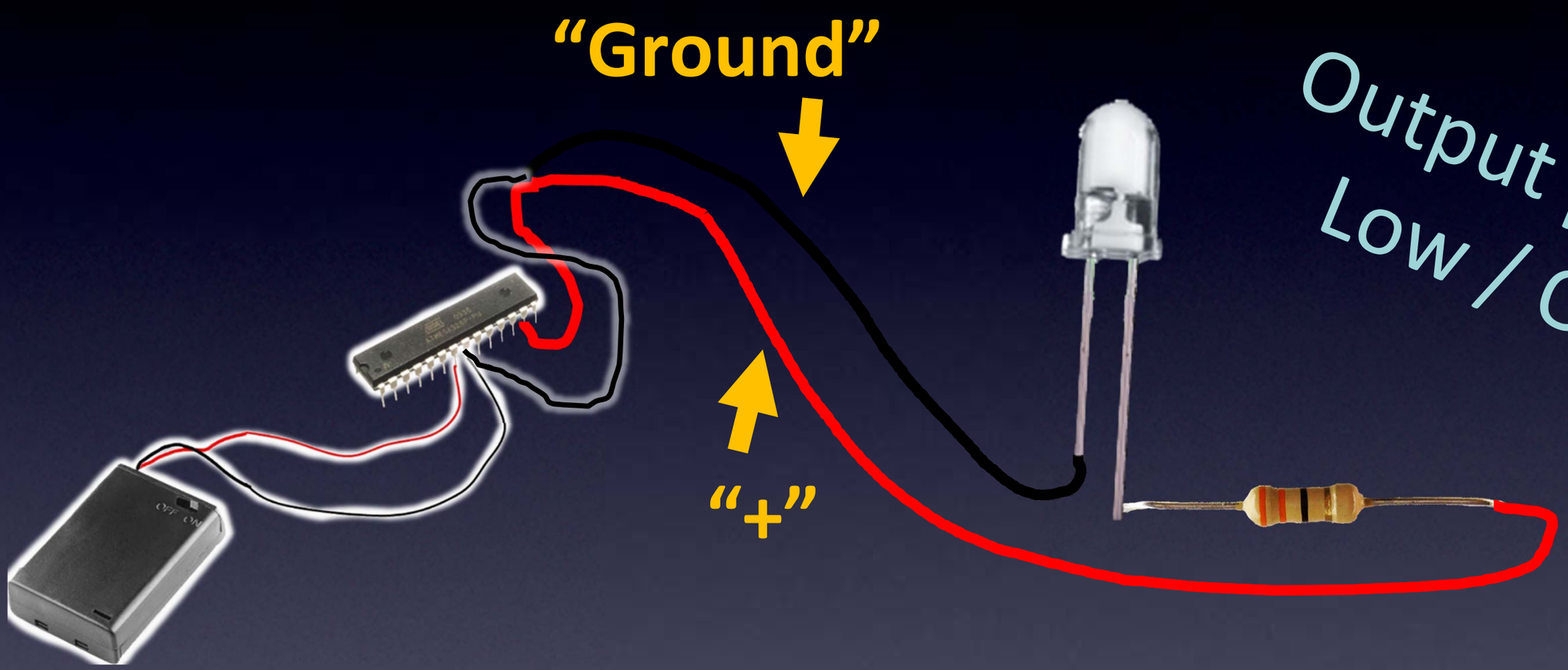
What You Need to Know About Electronics



Turning an LED on and off

(Leading up to `Hello World`)

What You Need to Know About Electronics

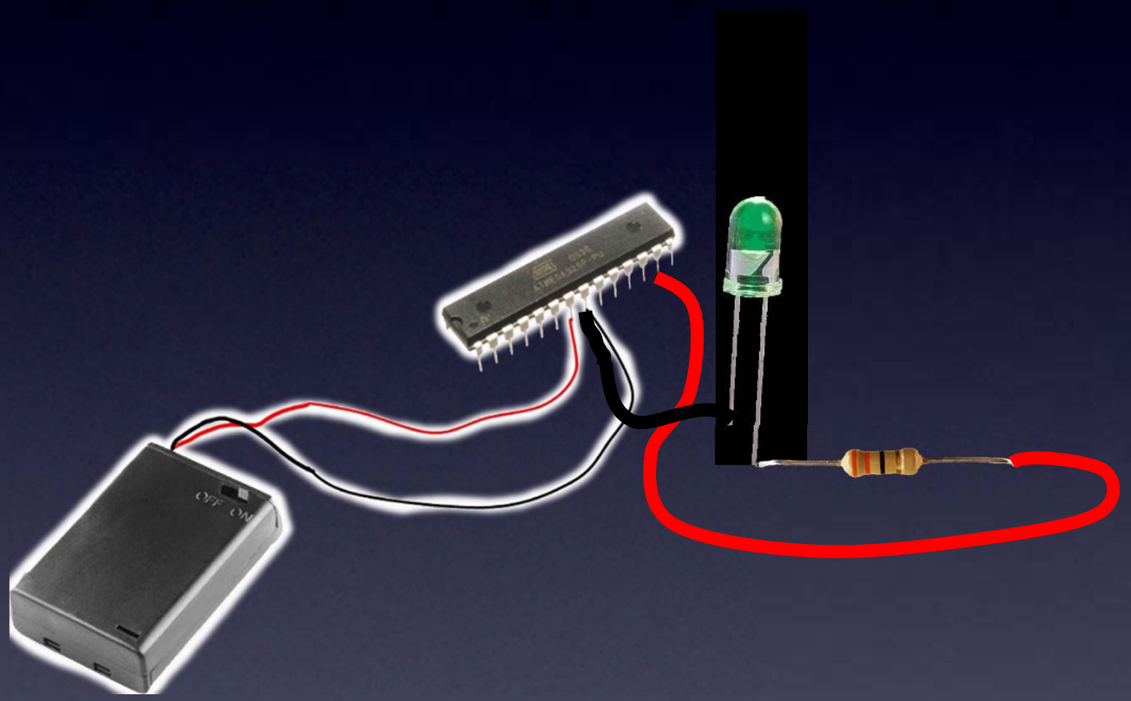


Turning an LED on and off

(Leading up to `Hello World`)

Everything You Need to Know About Electronics

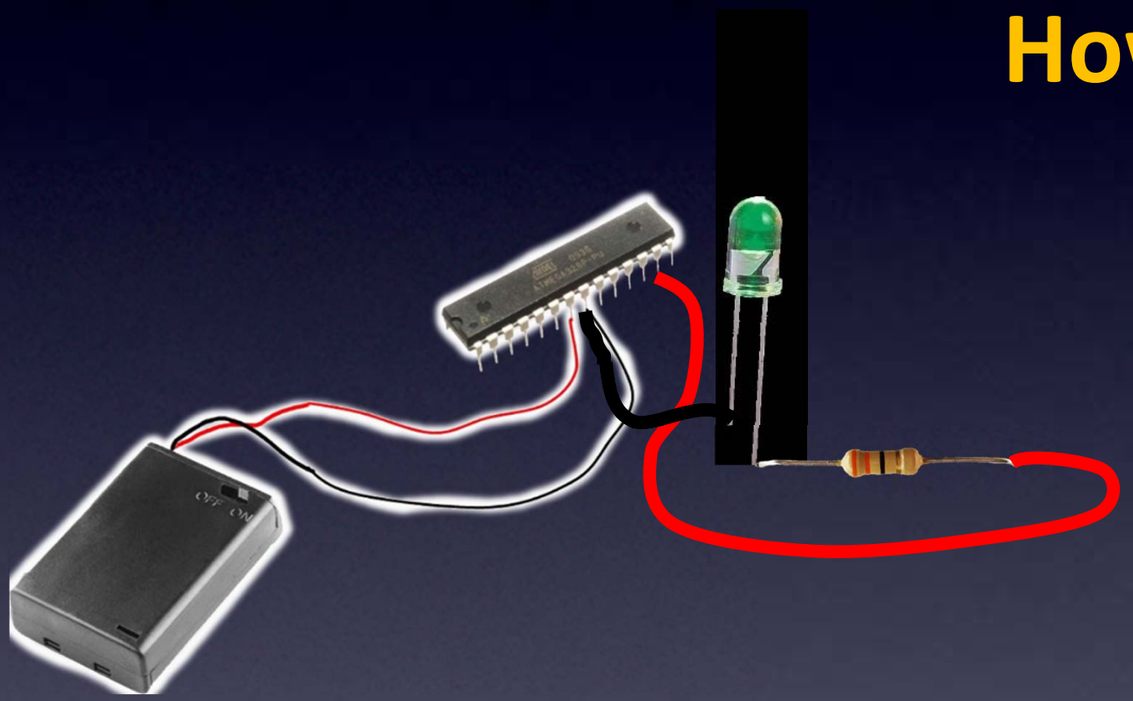
This is our **Hardware** for `Hello World!`



Turning an LED on and off

`Hello World`

Everything You Need to Know About Electronics



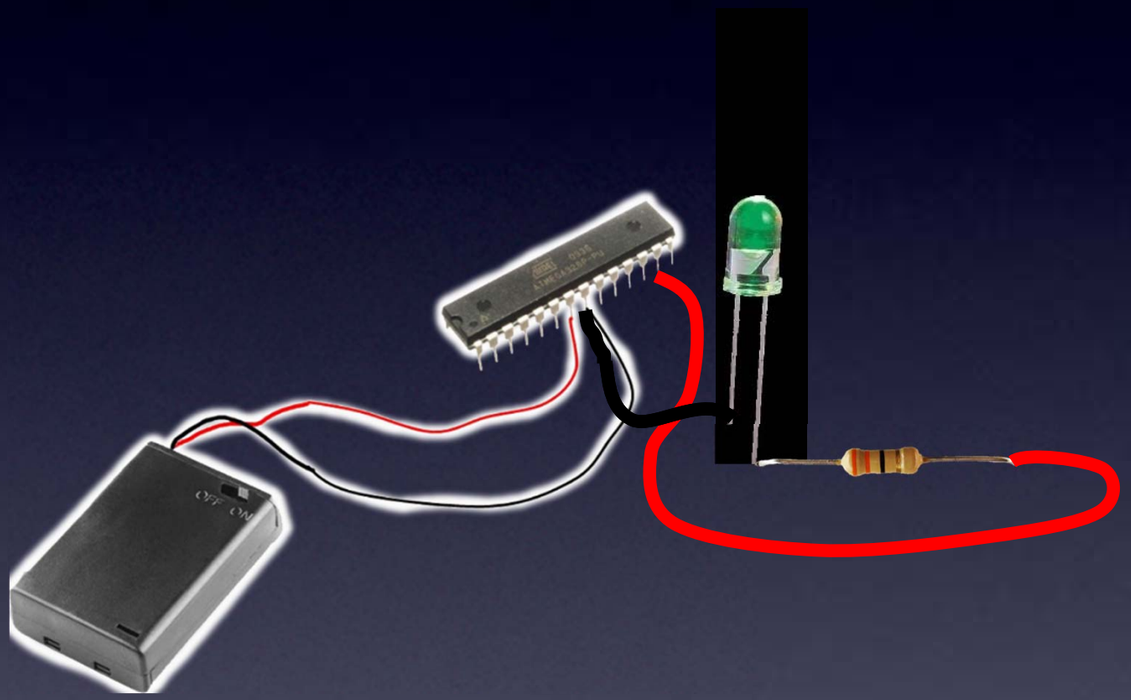
How about our program?

Turning an LED on and off

```
Hello World
```

Everything You Need to Know About Electronics

Programs on microcontrollers are called “Firmware”

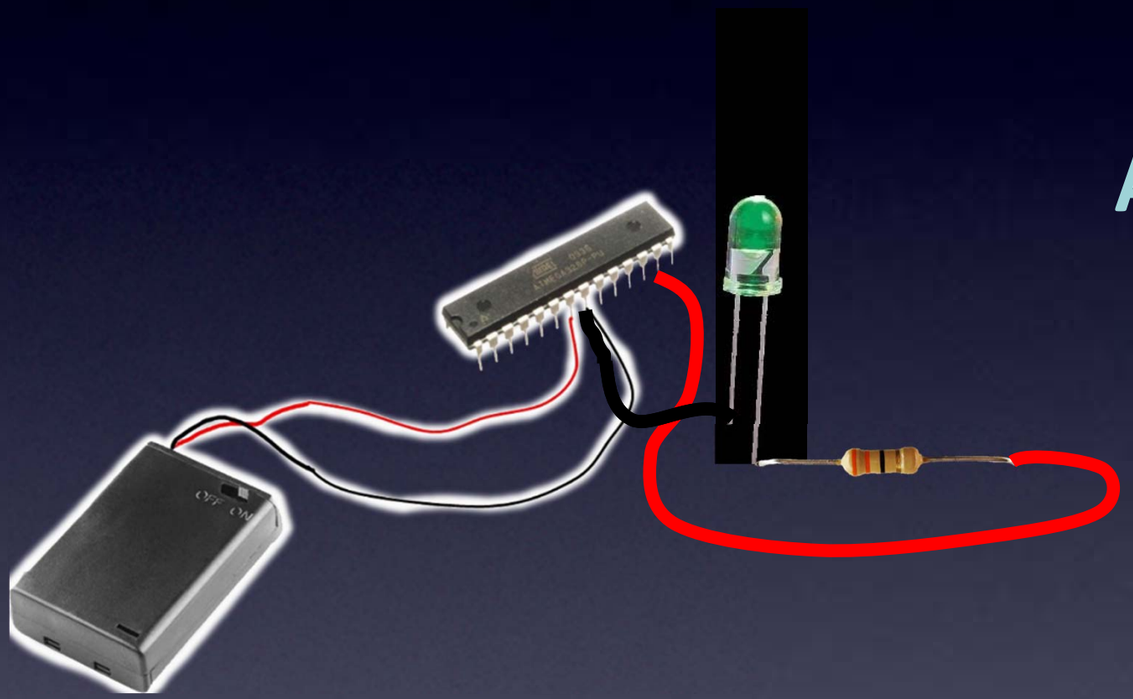


Turning an LED on and off

```
Hello World
```

What You Need to Know About Electronics

Programs on microcontrollers are called “Firmware”



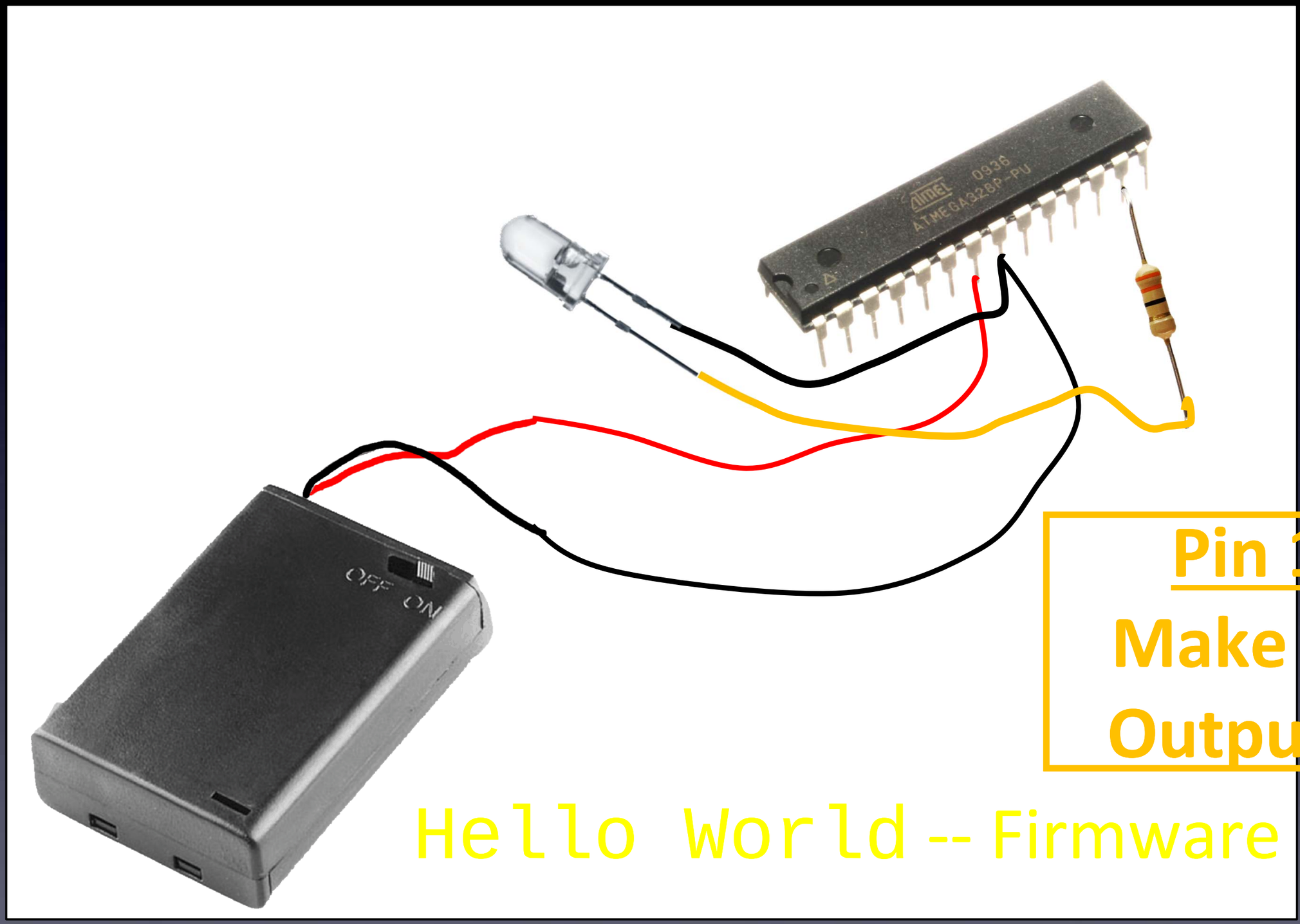
A programs for Arduino is called a

“Sketch”

Turning an LED on and off

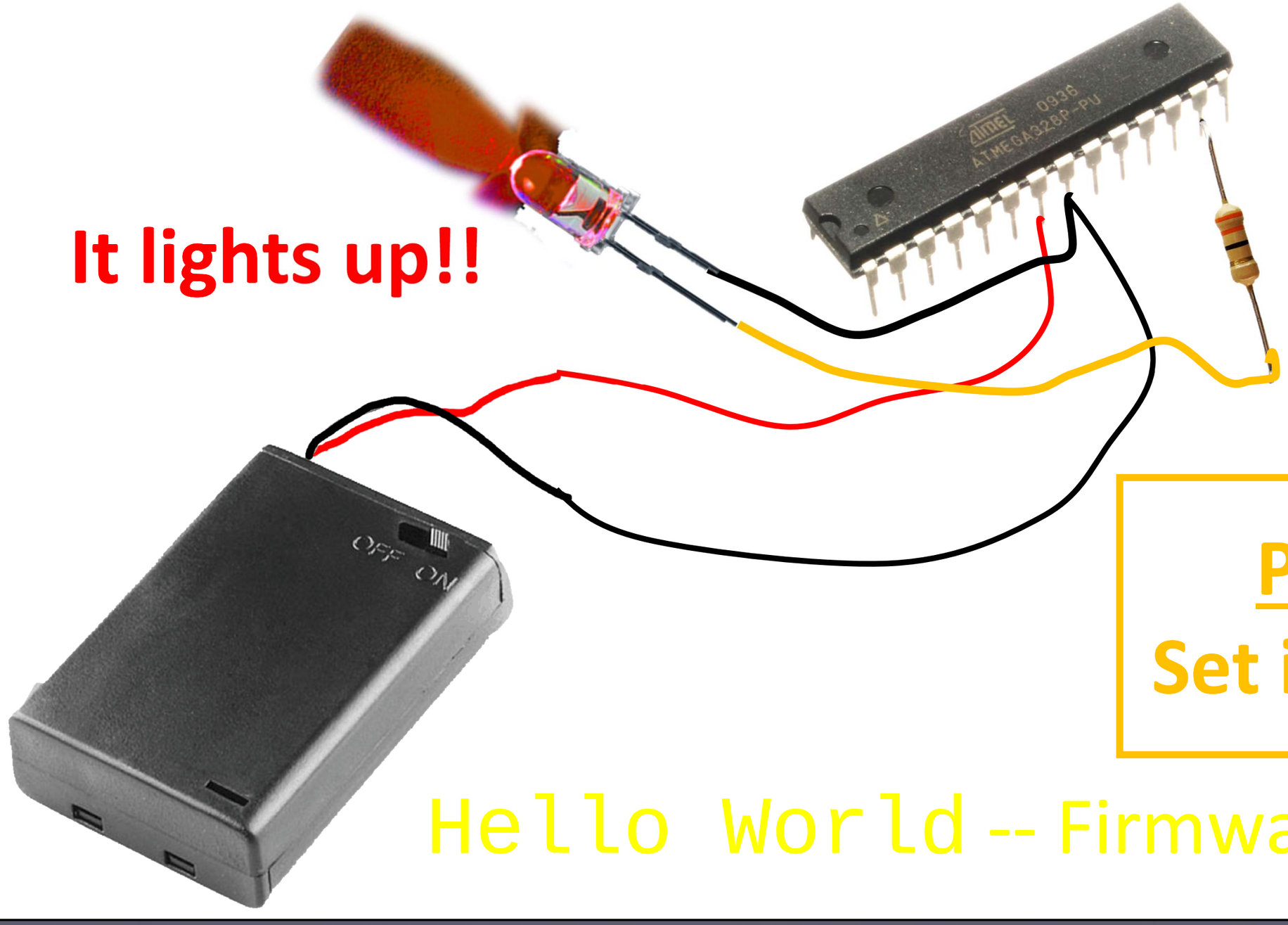
```
Hello World
```

Everything You Need to Know About Electronics



Microcontroller

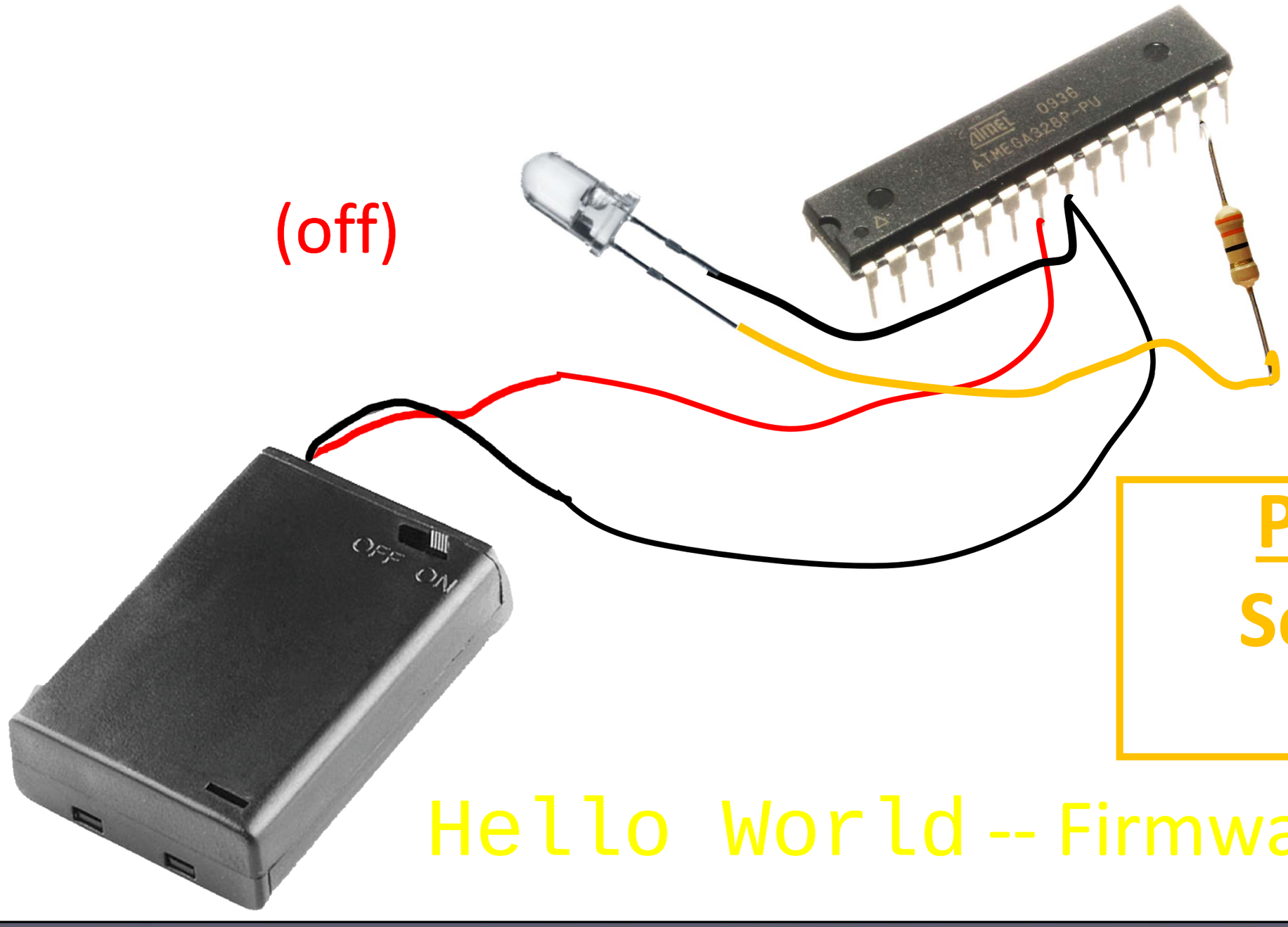
Everything You Need to Know About Electronics



Microcontroller

Everything You Need to Know About Electronics

(off)



Pin 13:
Set it to Low

`Hello World` -- Firmware

Microcontroller

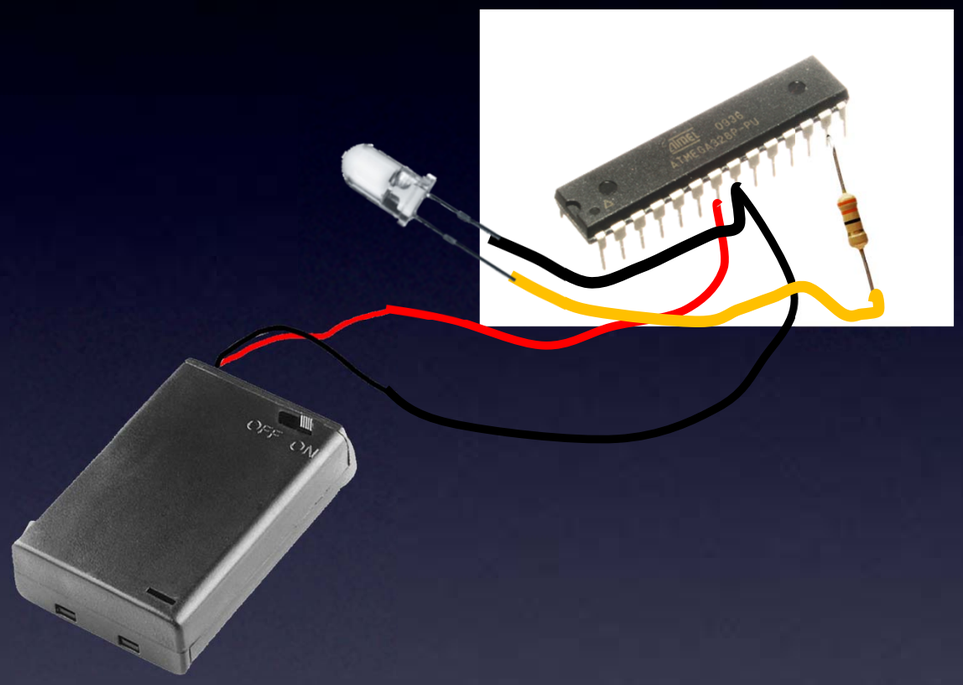
Everything You Need to Know About Electronics

We now have

`Hello World !`

Microcontroller

Everything You Need to Know About Electronics



We now have

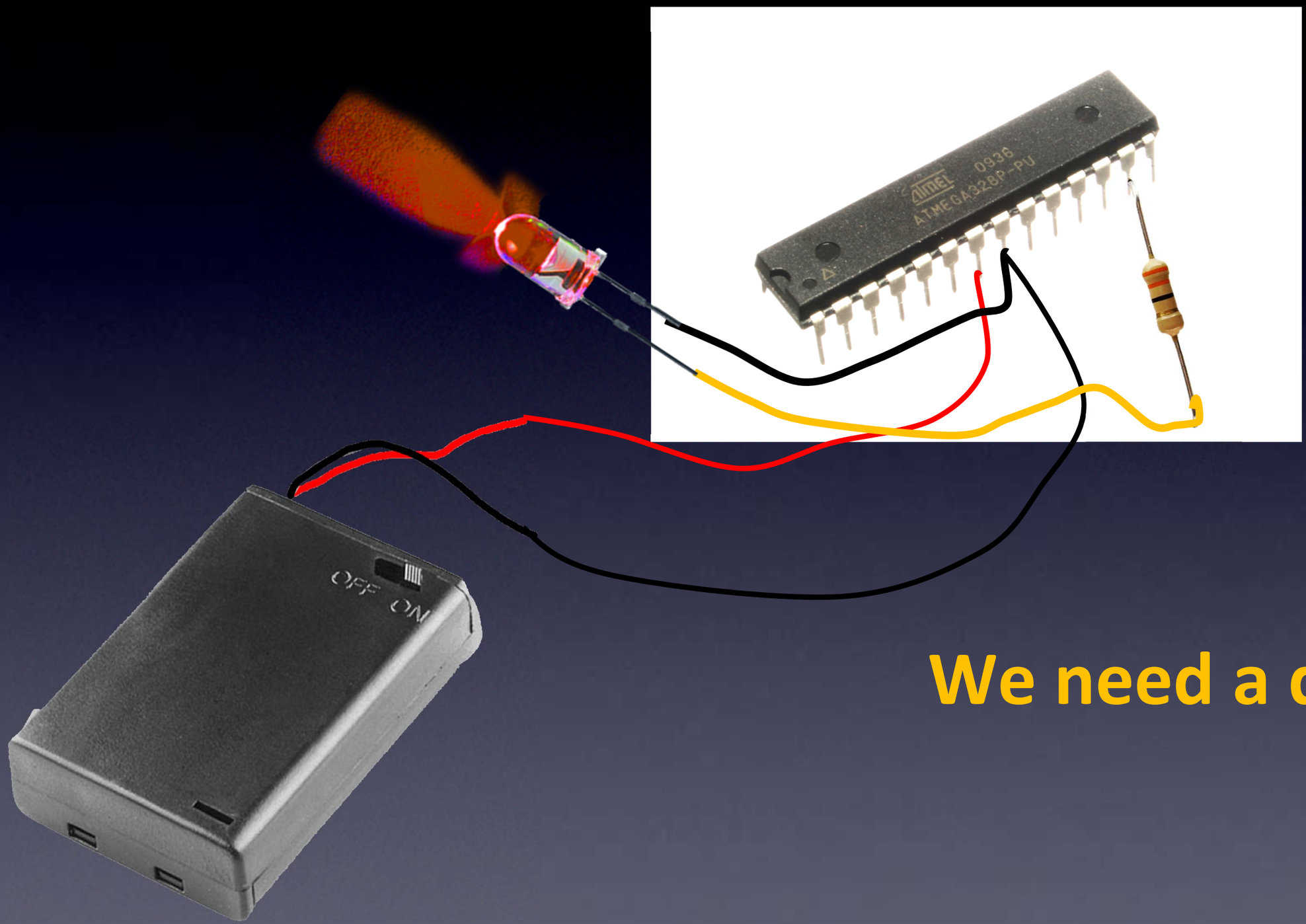
`Hello World !`

Except

We won’t see it

Microcontroller

Everything You Need to Know About Electronics

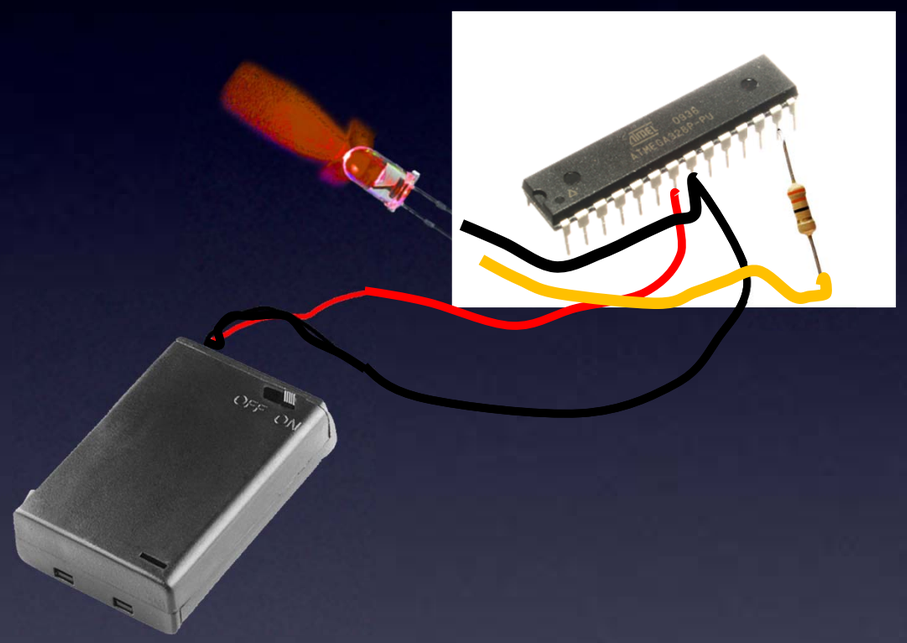


We need a delay

Microcontrollers – they go really fast!

Everything You Need to Know About Electronics

Hardware



Firmware

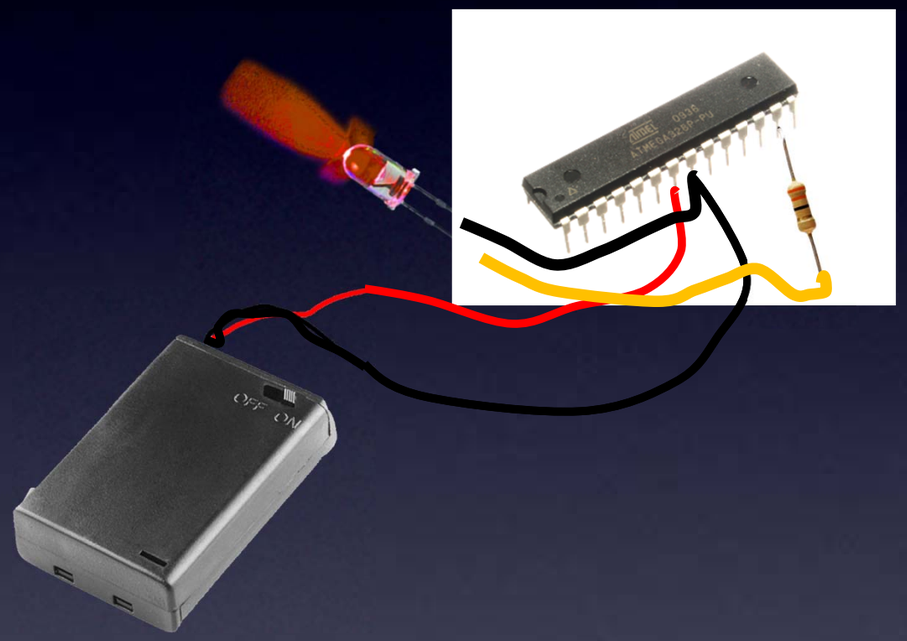
- **pin 13 is Output pin**
- **set pin 13 High**
- **delay**
- **set pin 13 Low**

`Hello World` – for real now!

Microcontroller – Firmware

What You Need to Know About Electronics

Hardware



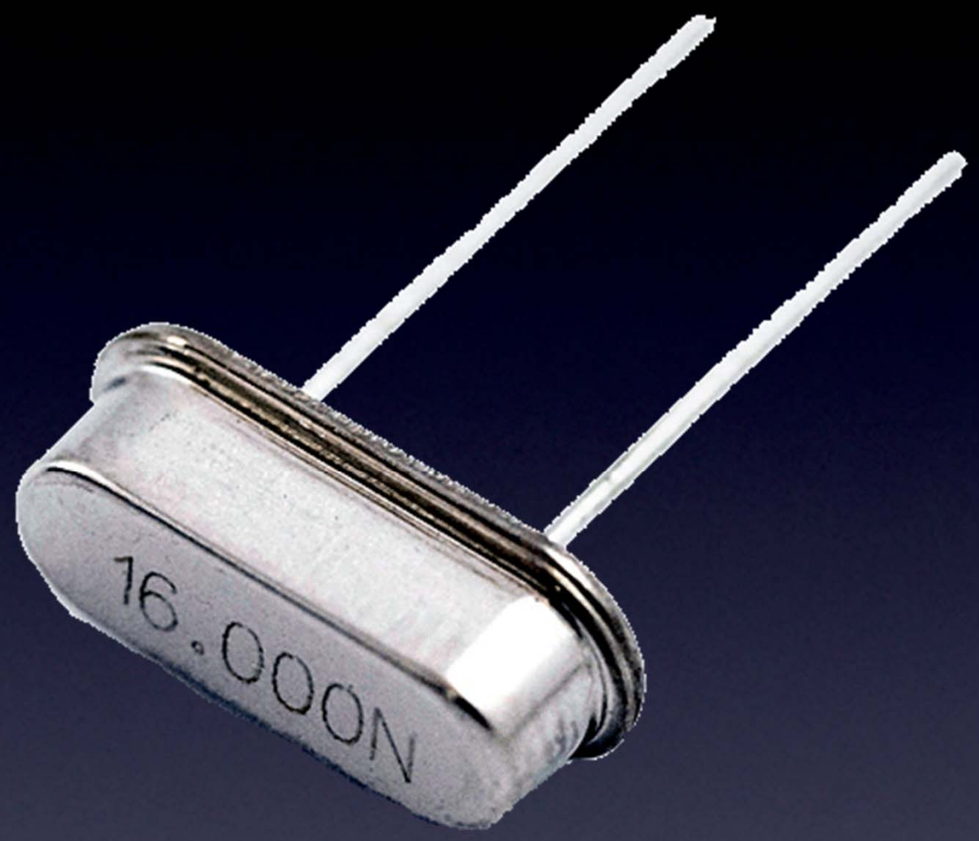
Firmware

- **pin 13 is Output pin**
- **set pin 13 High**
- **delay**
- **set pin 13 Low**
- **delay**

`Hello World` – for real now!

Microcontroller – Firmware

Everything You Need to Know About Electronics

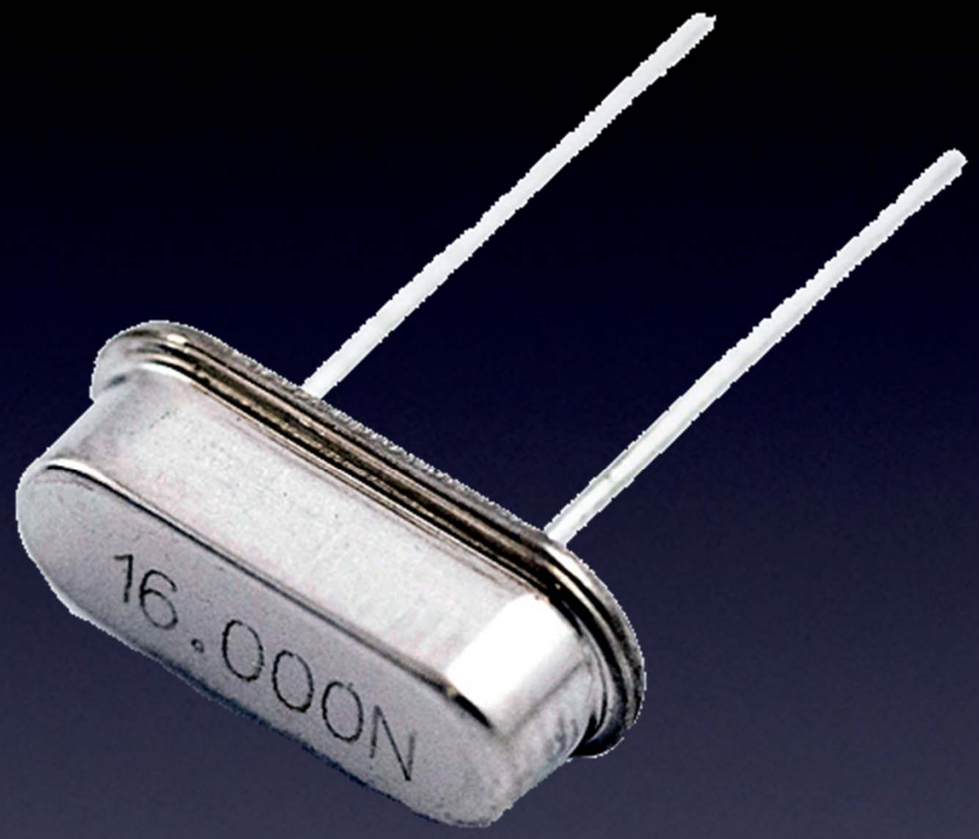


A precision cut piece of quartz crystal

For precise timing

Crystal / Hertz

Everything You Need to Know About Electronics

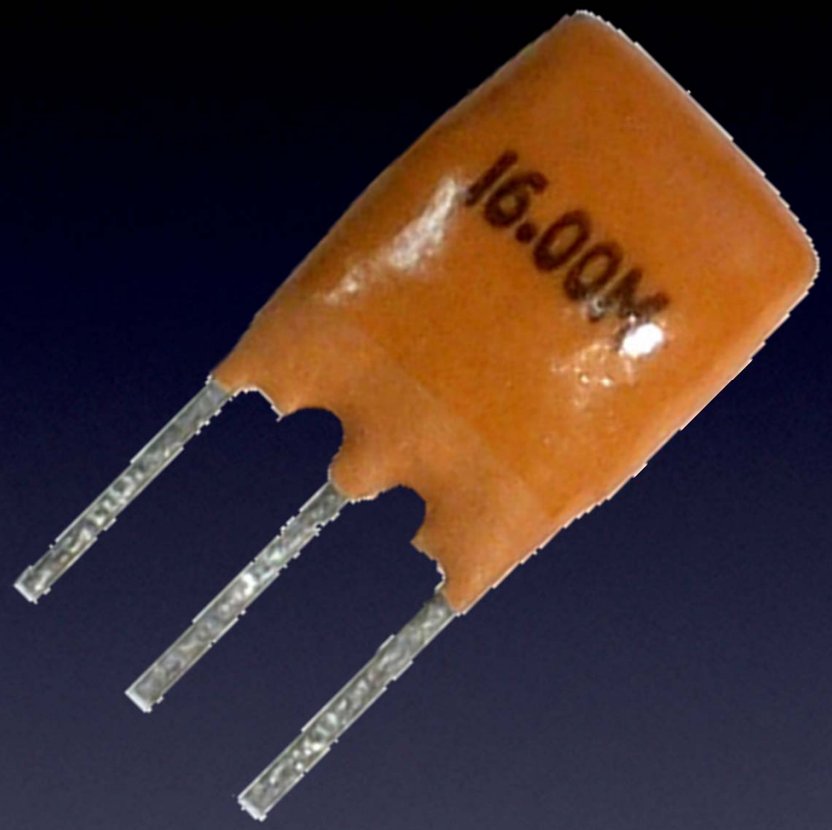


Frequency, measured in Hertz

For precise timing (but less than a crystal)

Crystal / Hertz

Everything You Need to Know About Electronics



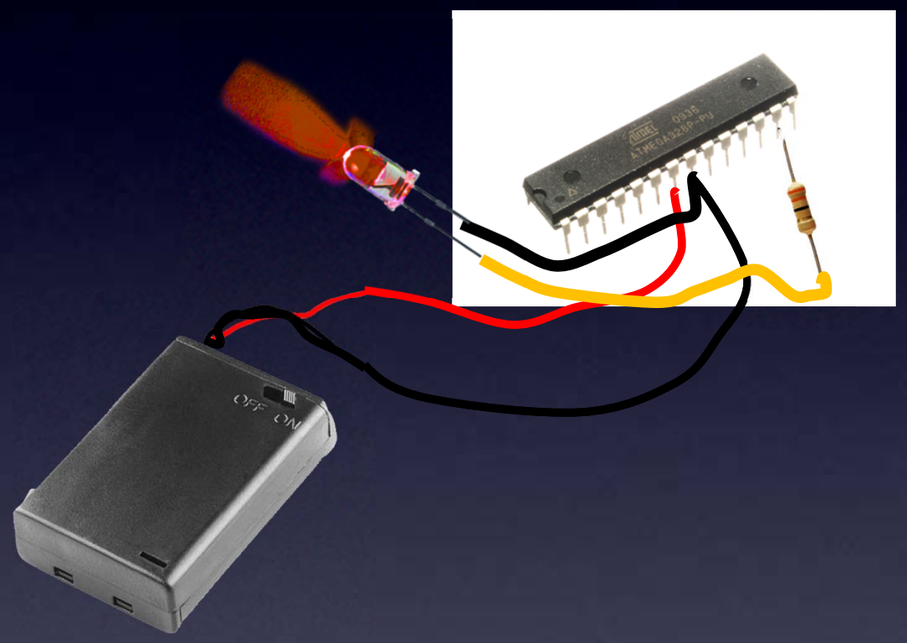
A bunch of resistors and capacitors

For precise timing (but less than a crystal)

Ceramic Resonator / Hertz

Everything You Need to Know About Electronics

Hardware



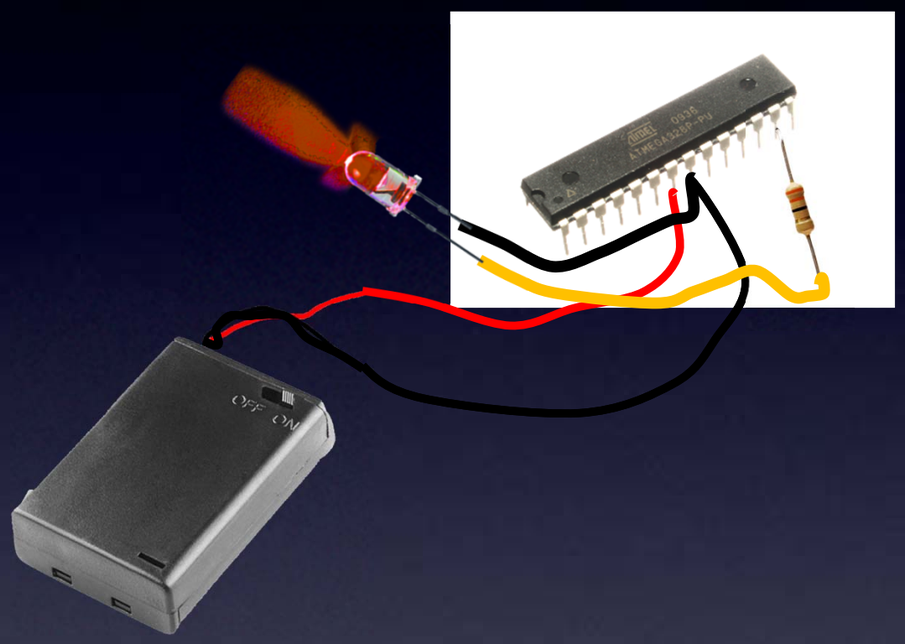
Firmware

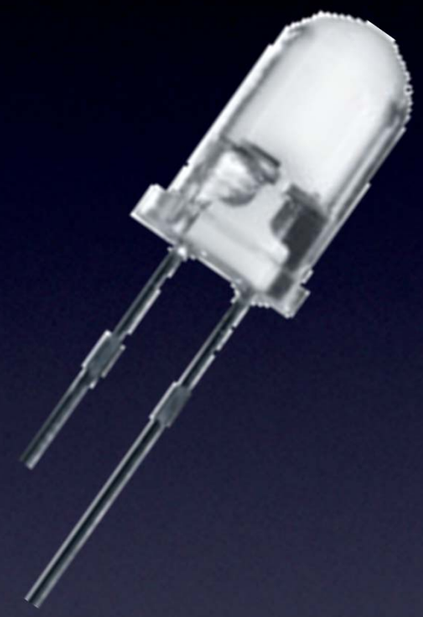
- **pin 13 is Output pin**
- **set pin 13 High**
- **delay**
- **set pin 13 Low**

Let's hack Hello World!

Microcontroller

Everything You Need to Know About Electronics



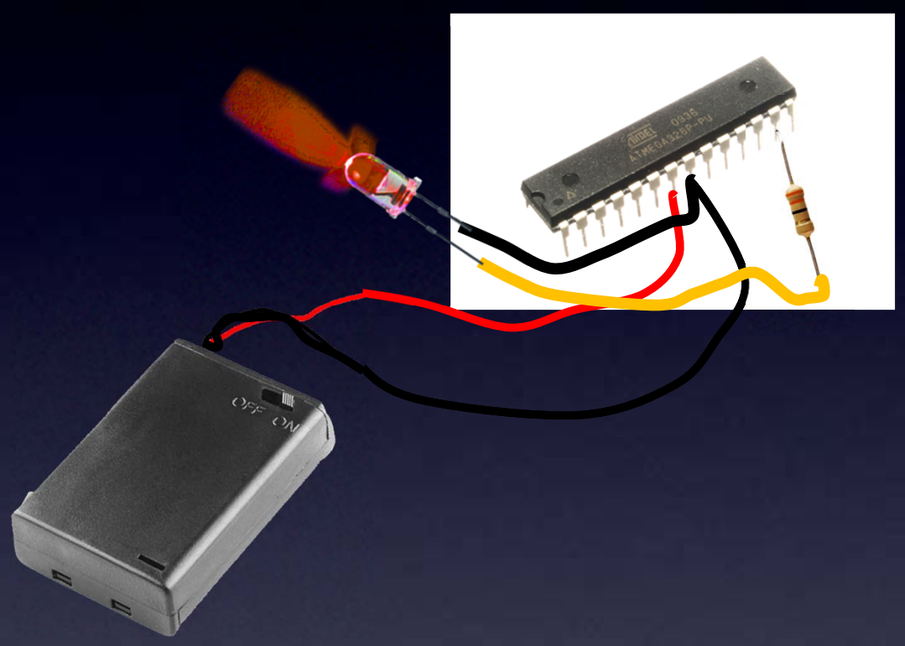


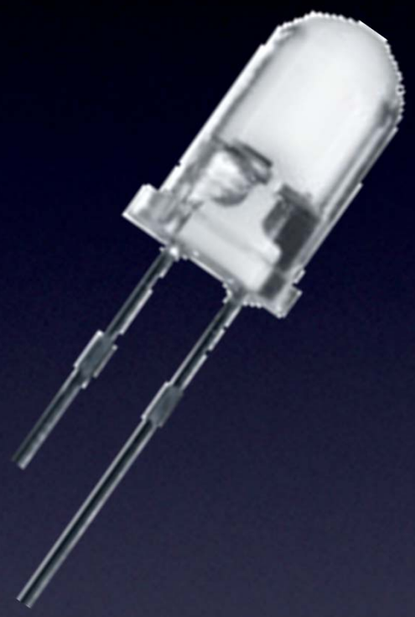
Add an IR LED to another pin

IR “OFF” codes

Microcontroller

Everything You Need to Know About Electronics



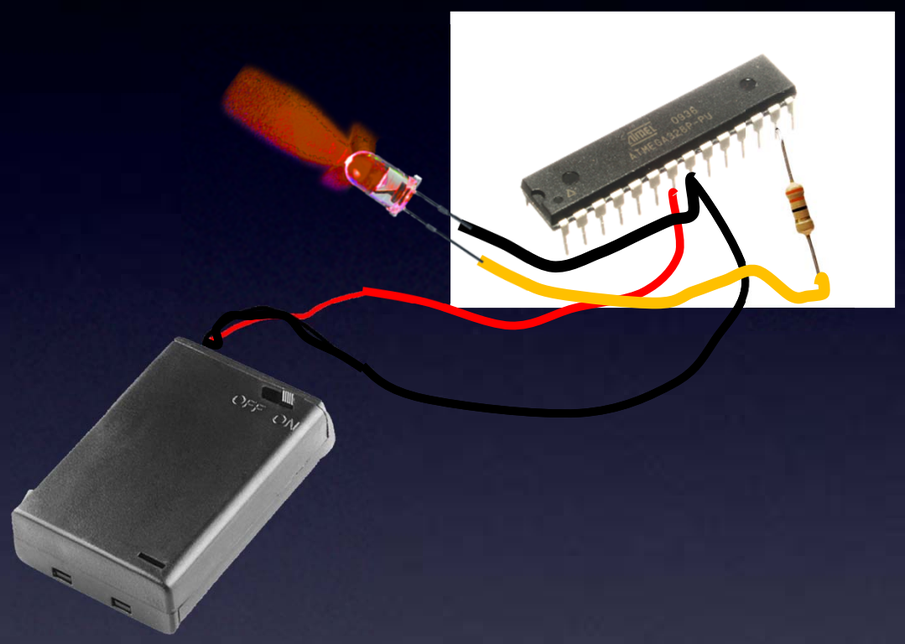


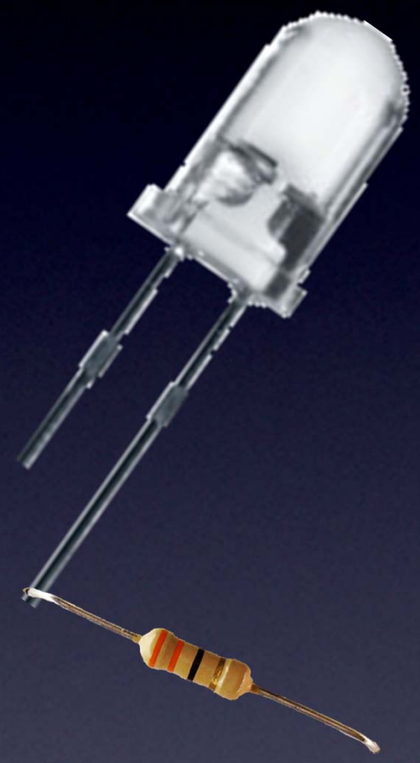
Add an IR LED to another pin (say, pin3)

IR “OFF” codes

Microcontroller

Everything You Need to Know About Electronics





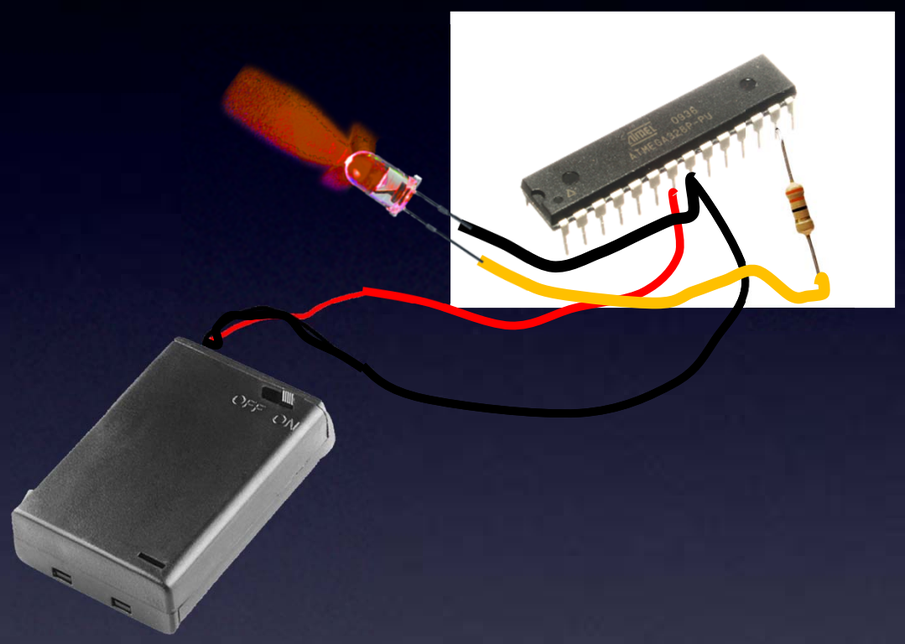
Add an IR LED to another pin (say, pin3)

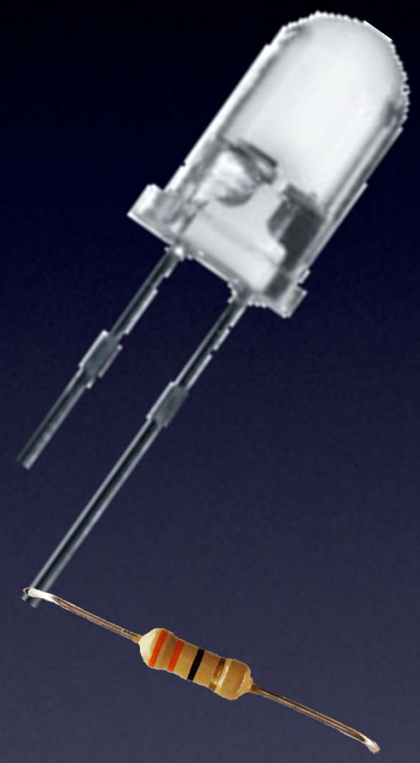
and a resistor so no magic smoke goes away

IR “OFF” codes

Microcontroller

Everything You Need to Know About Electronics



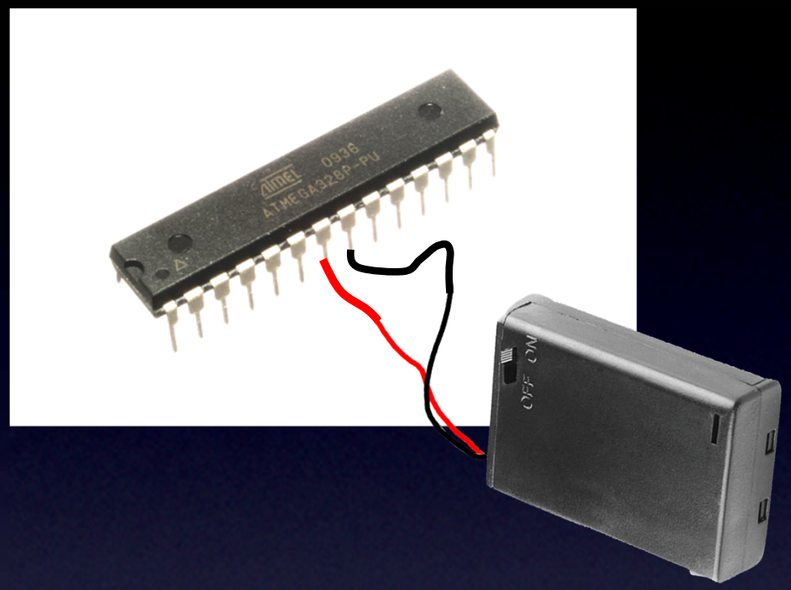


But, *When*?

IR “OFF” codes

Microcontroller

Everything You Need to Know About Electronics



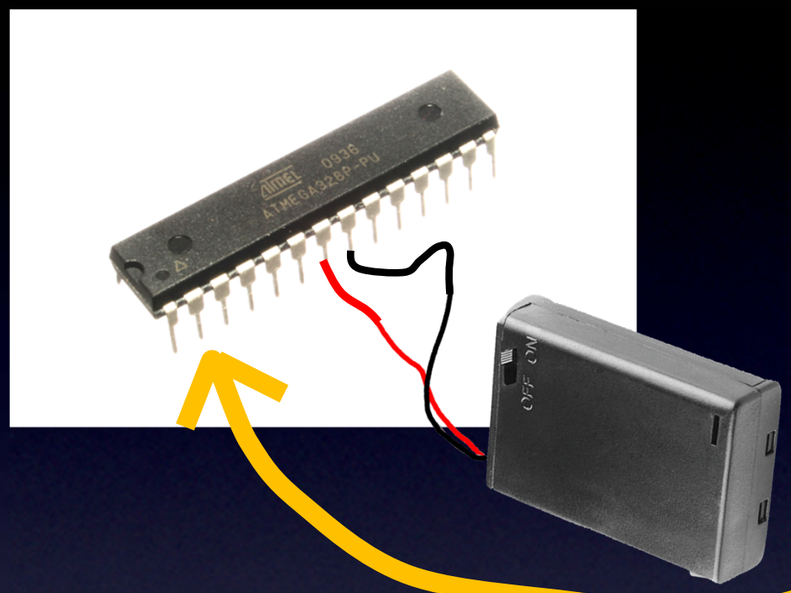
Let’s add an Input pin!

and

We can add a Start button

Microcontroller

Everything You Need to Know About Electronics



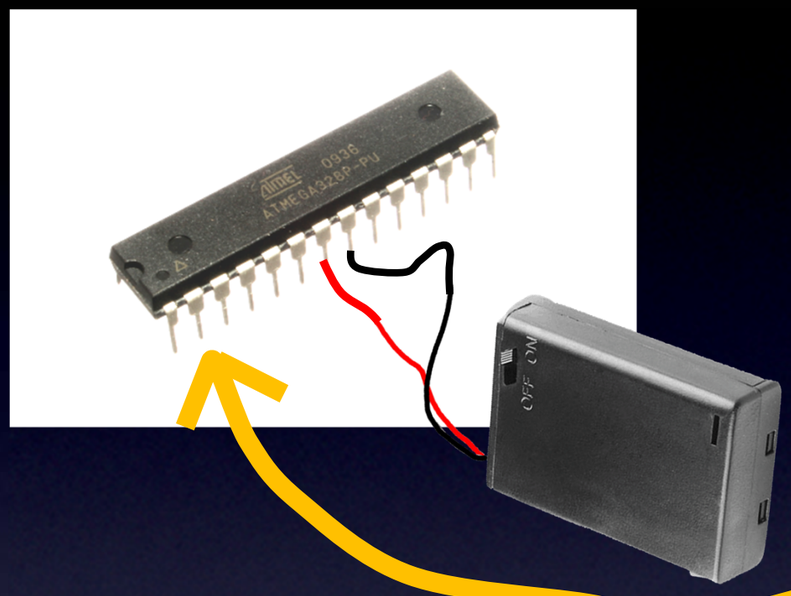
How do we make a pin an Input pin?

We tell it to be one – with our program.

Any pin can be an Input pin (like, pin 2).

Microcontroller – Input pins

Everything You Need to Know About Electronics

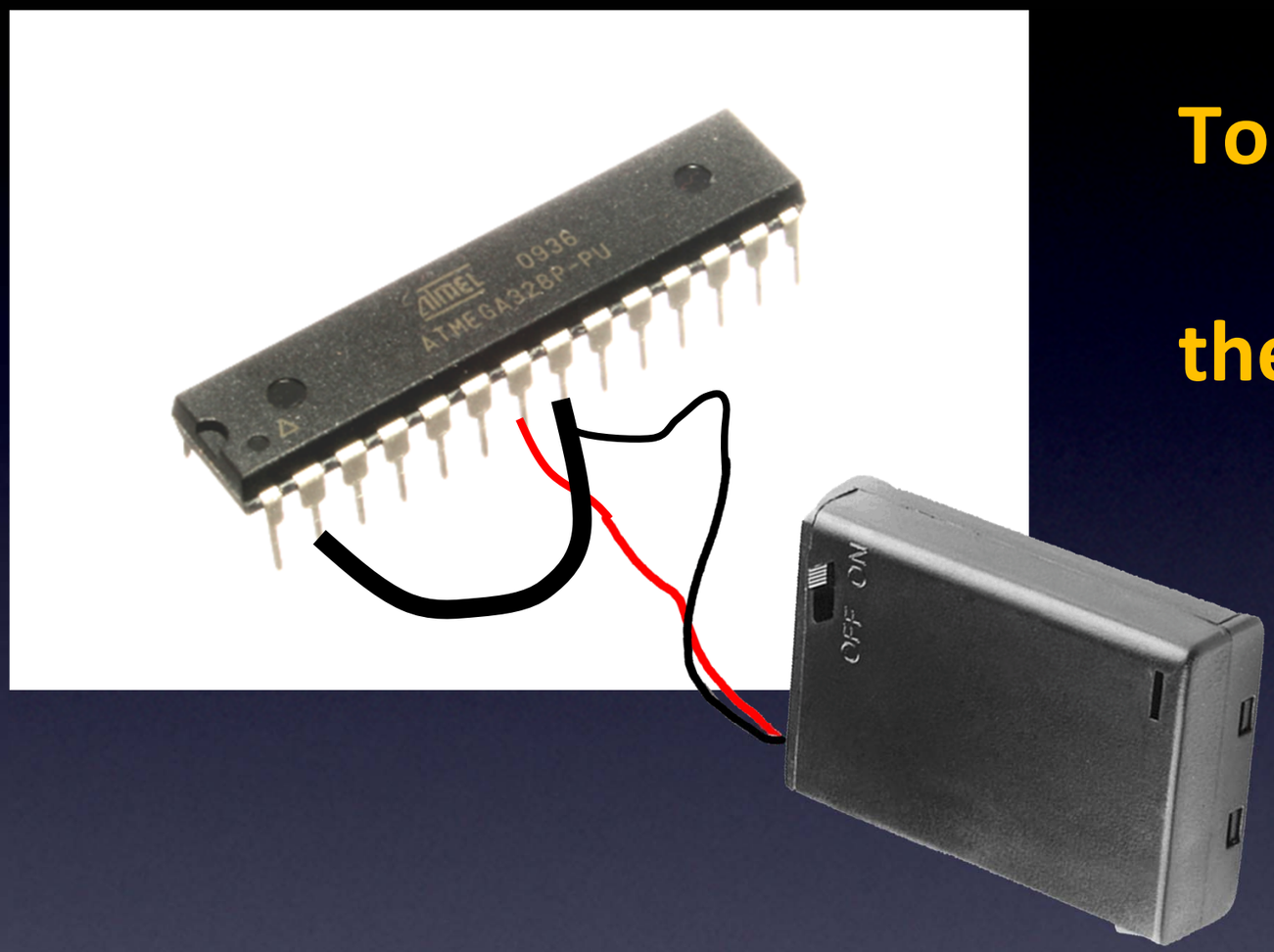


Once we have an **Input pin** (like, pin 2):

only 2 choices – is the Input pin: **High** or **Low** ?

Microcontroller – Input pins

Everything You Need to Know About Electronics

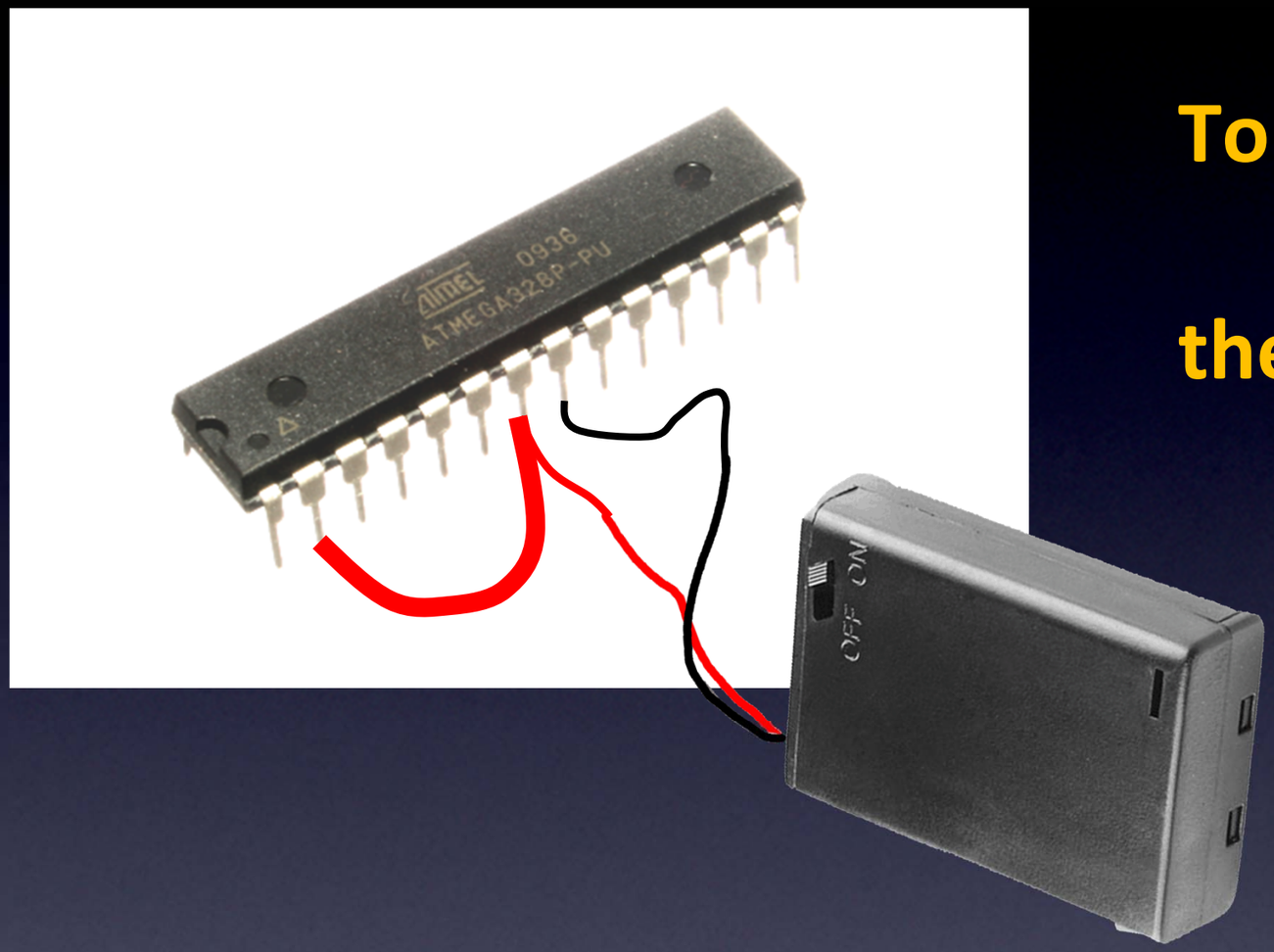


To make the Input pin Low, connect it to the Black wire of our power supply (Ground).

Low

Microcontroller – Input pins

Everything You Need to Know About Electronics

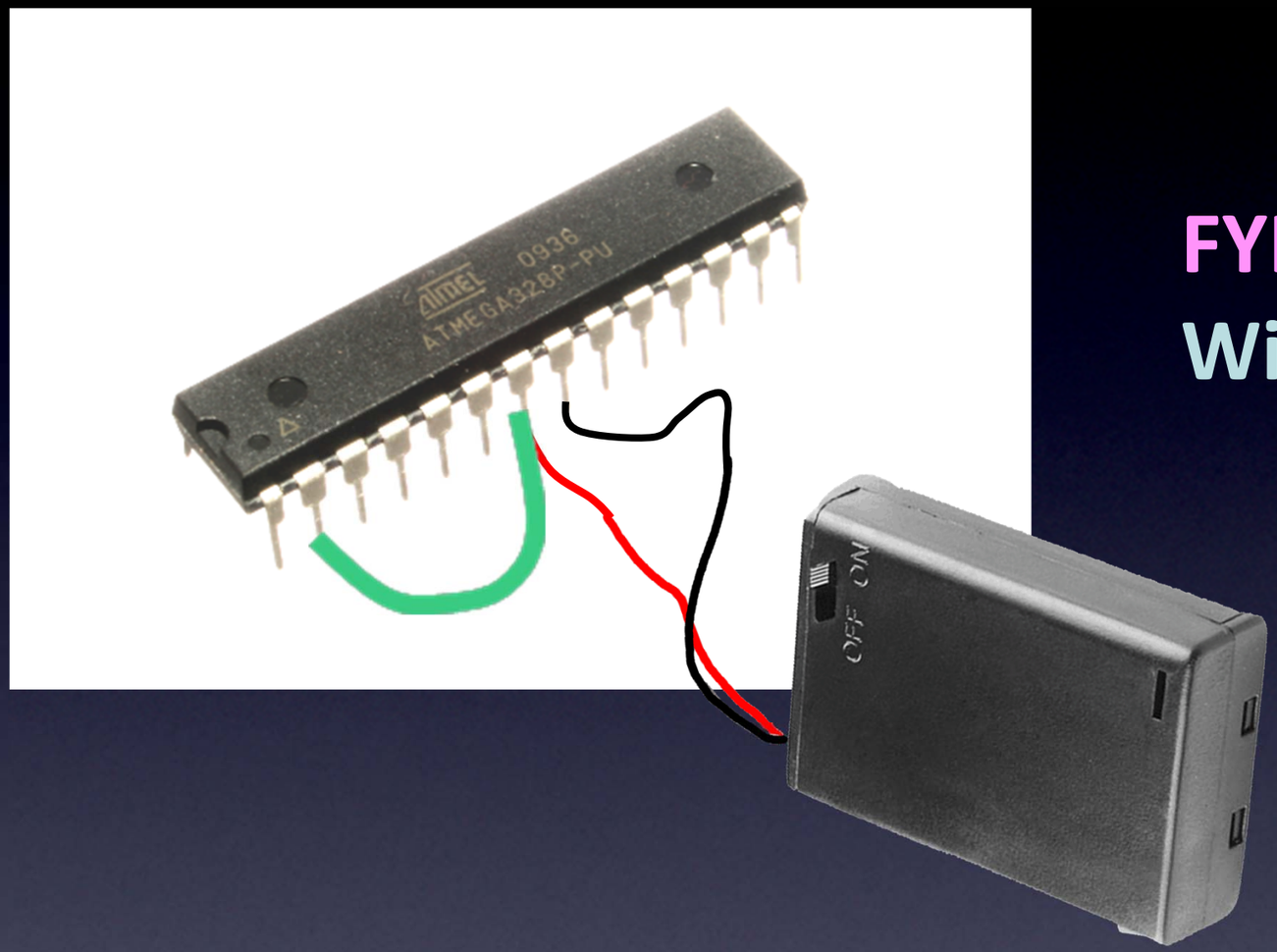


To make the Input pin High, connect it to the Red wire of our power supply (Vcc).

High

Microcontroller – Input pins

Everything You Need to Know About Electronics



FYI:

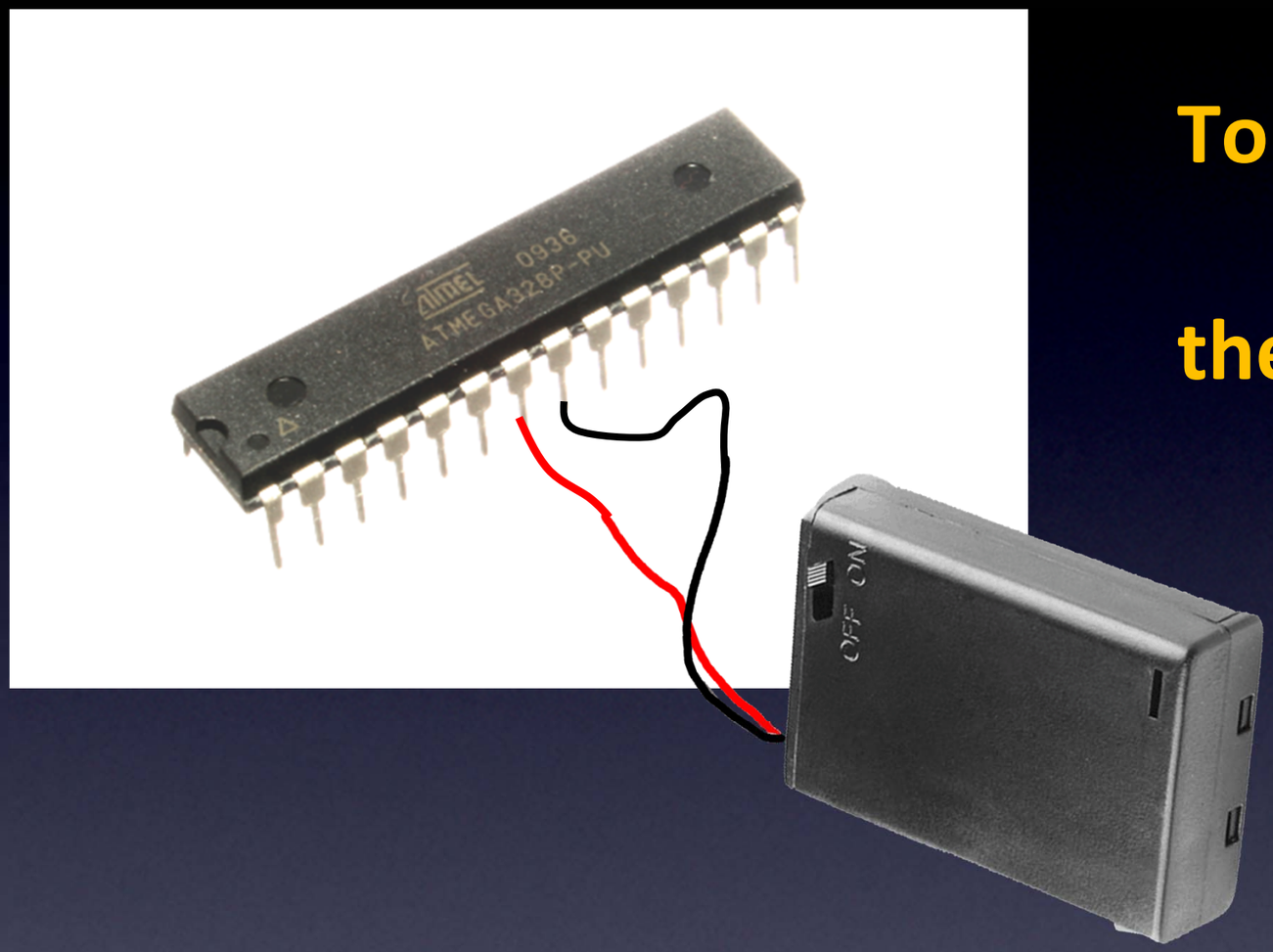
Wire color does not matter !

(electrons don’t care)

High

Microcontroller – Input pins

Everything You Need to Know About Electronics



To make the Input pin High, connect it to the Red wire of our power supply (Vcc).

OR:

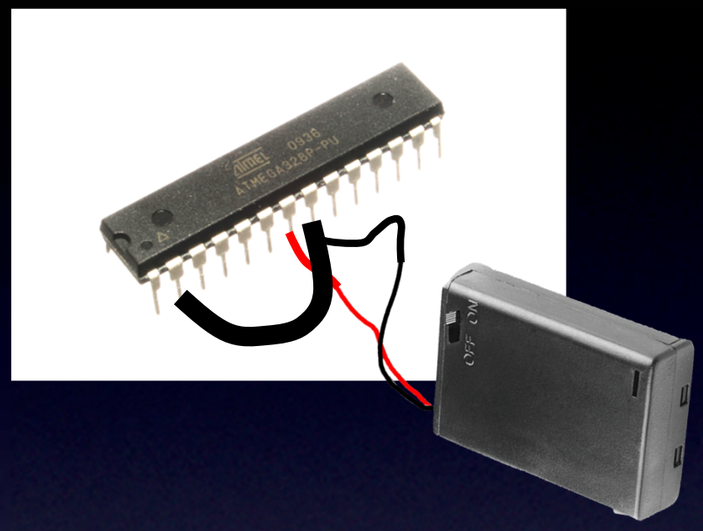
just leave it blank

(built-in resistors on each pin)

High

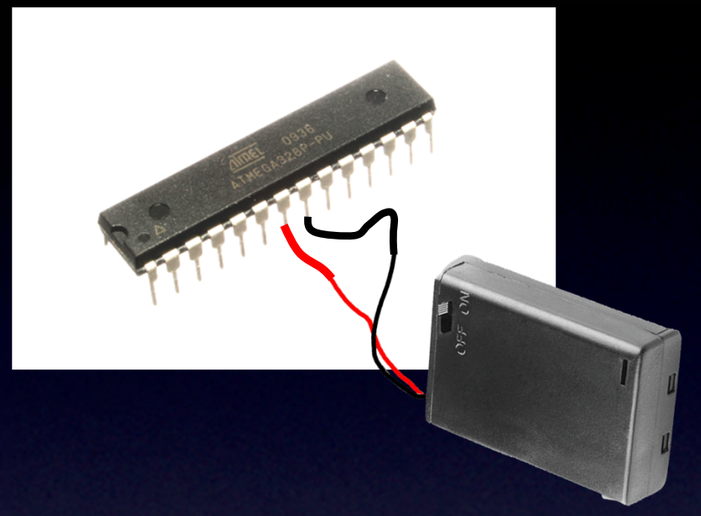
Microcontroller – Input pins

Everything You Need to Know About Electronics



If firmware looks at
Pin 2 when it's like this,
it reports back:

Low



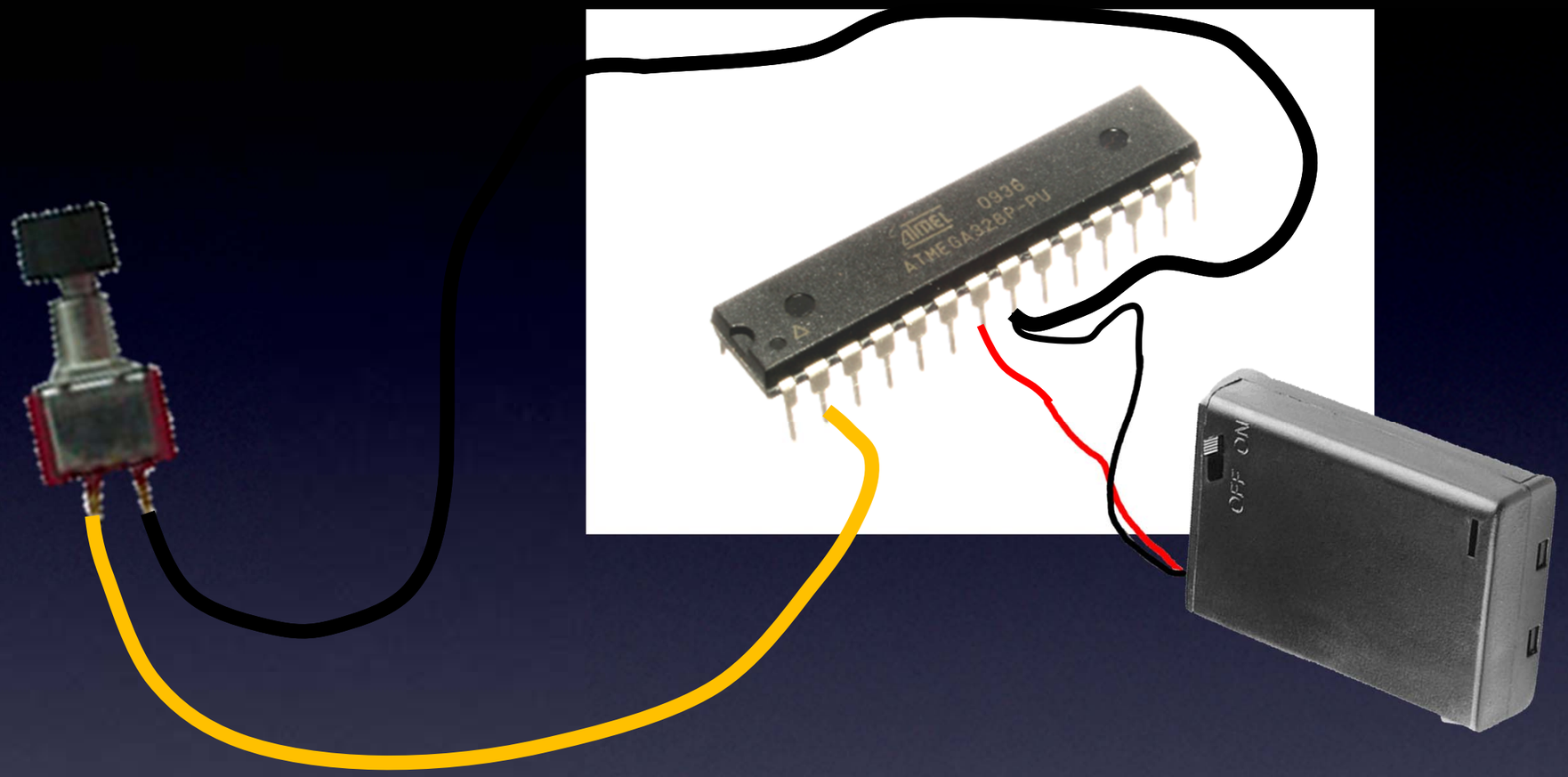
If firmware looks at
Pin 2 when it's like this,
it reports back:

High

Reading the Input pin

Microcontroller – Input pins

Everything You Need to Know About Electronics



Reading the Input pin, with Switch

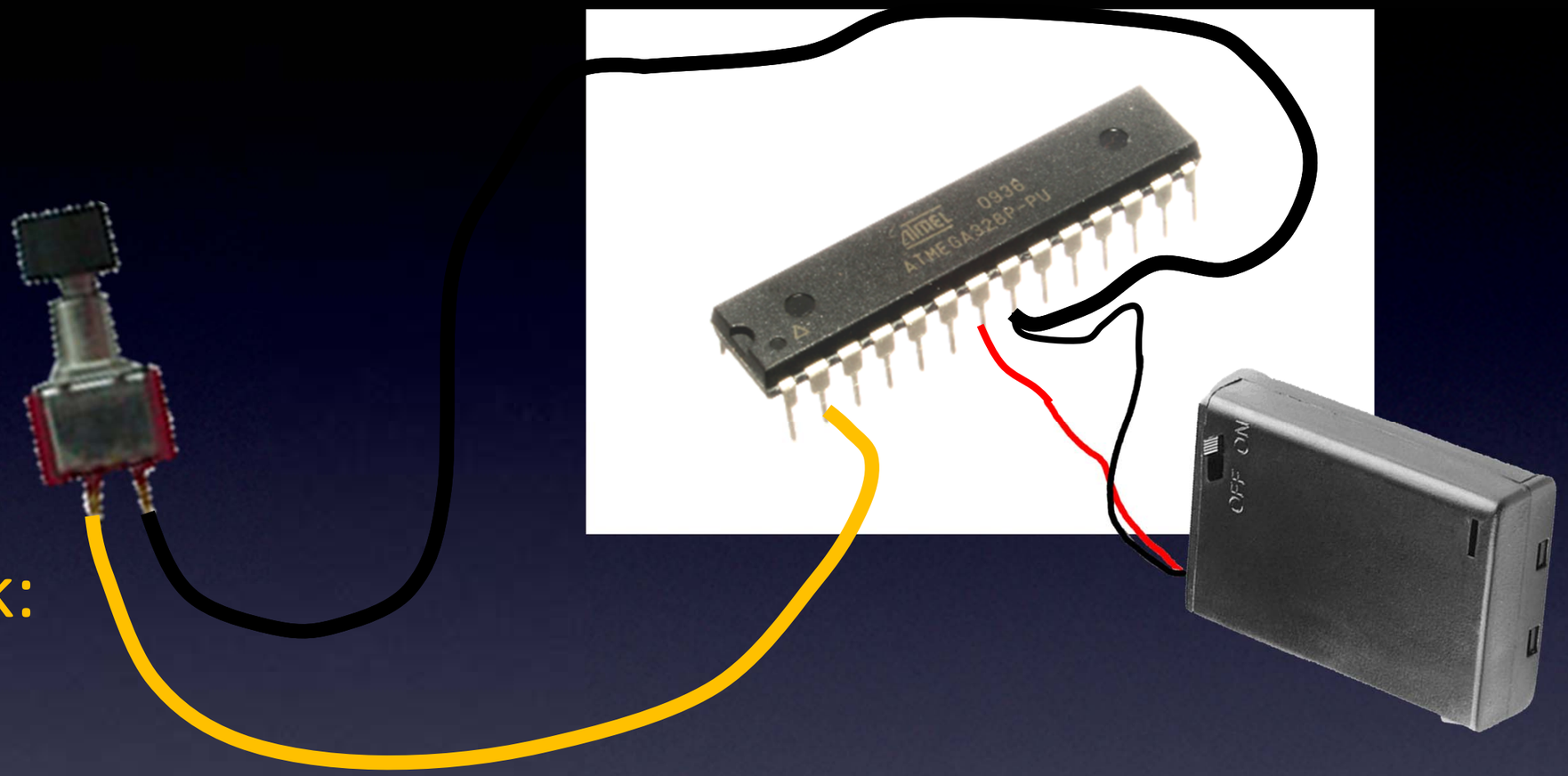
Microcontroller – Input pins

Everything You Need to Know About Electronics

If firmware looks at Pin 2 when switch NOT pushed,

it reports back:

High



Reading the Input pin, with Switch

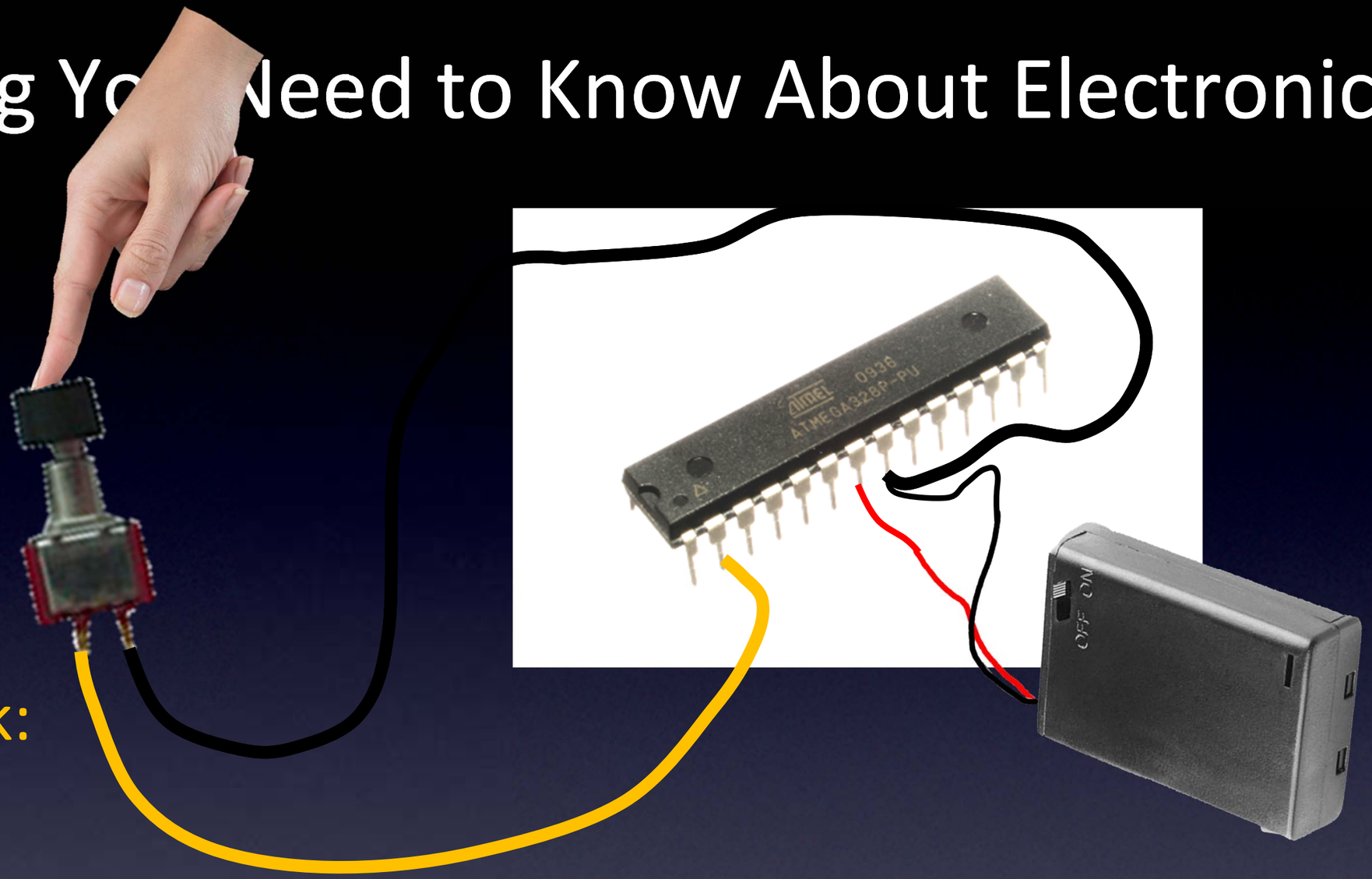
Microcontroller – Input pins

Everything Yo Need to Know About Electronics

If firmware looks at Pin 2 when switch pushed,

it reports back:

Low



Reading the Input pin, with Switch

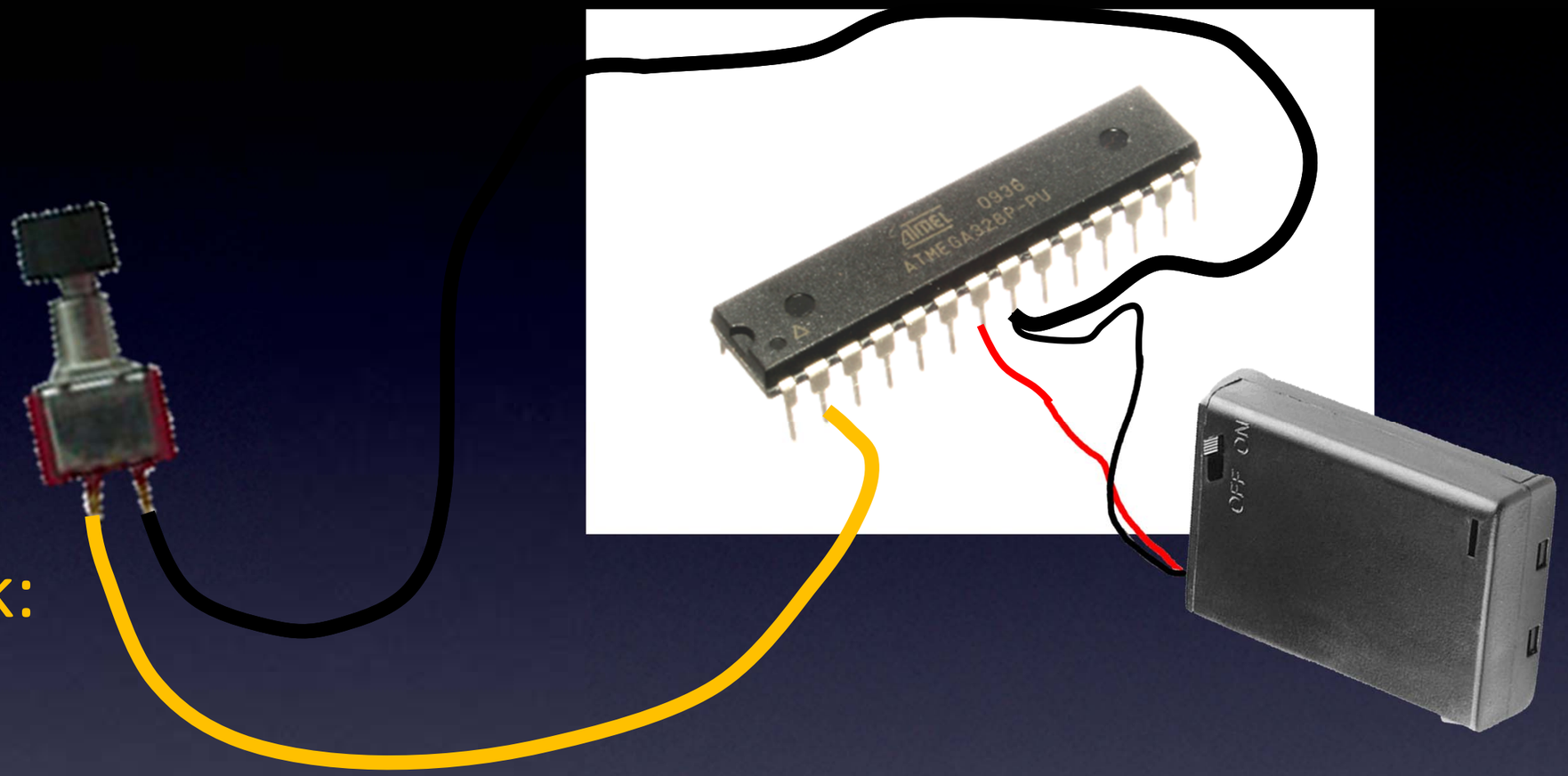
Microcontroller – Input pins

Everything You Need to Know About Electronics

If firmware looks at Pin 2 when switch NOT pushed,

it reports back:

High

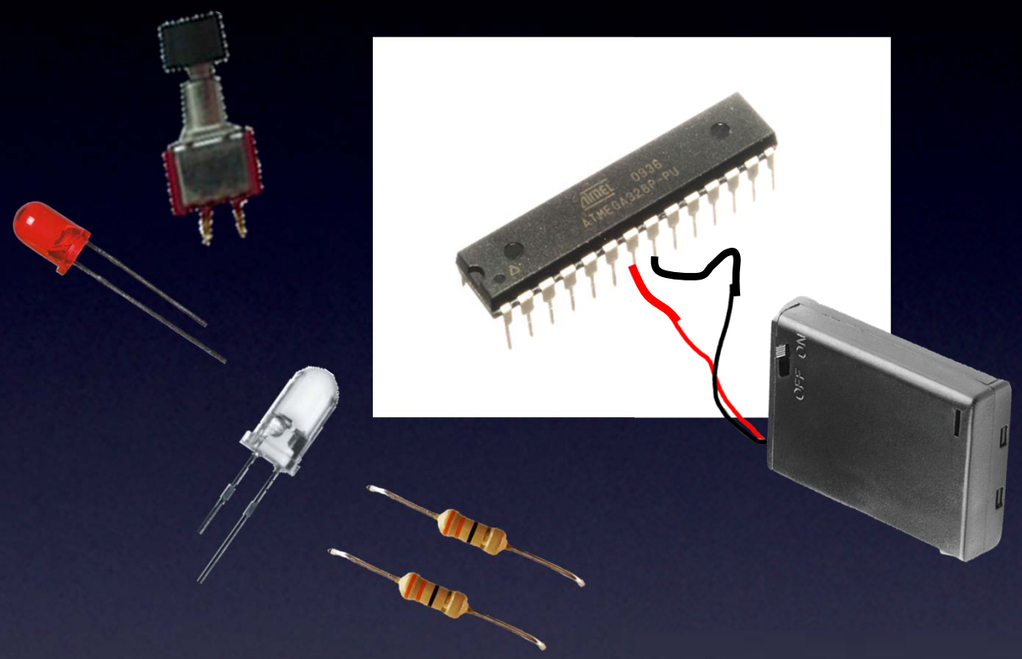


Reading the Input pin, with Switch

Microcontroller – Input pins

Everything You Need to Know About Electronics

Hardware



Firmware

Pin 13 Output – visible LED pin
Pin 3 Output – IR LED pin
Pin 2 Input – Push Button

Wait for Switch to be Low

Blink visible LED:
High, Delay, Low
Pulse IR LED for Sony “OFF” code:
High, Delay, Low, Delay…

Blink visible LED:
High, Delay, Low
Pulse IR LED for Panasonic “OFF” code:
High, Delay, Low, Delay…

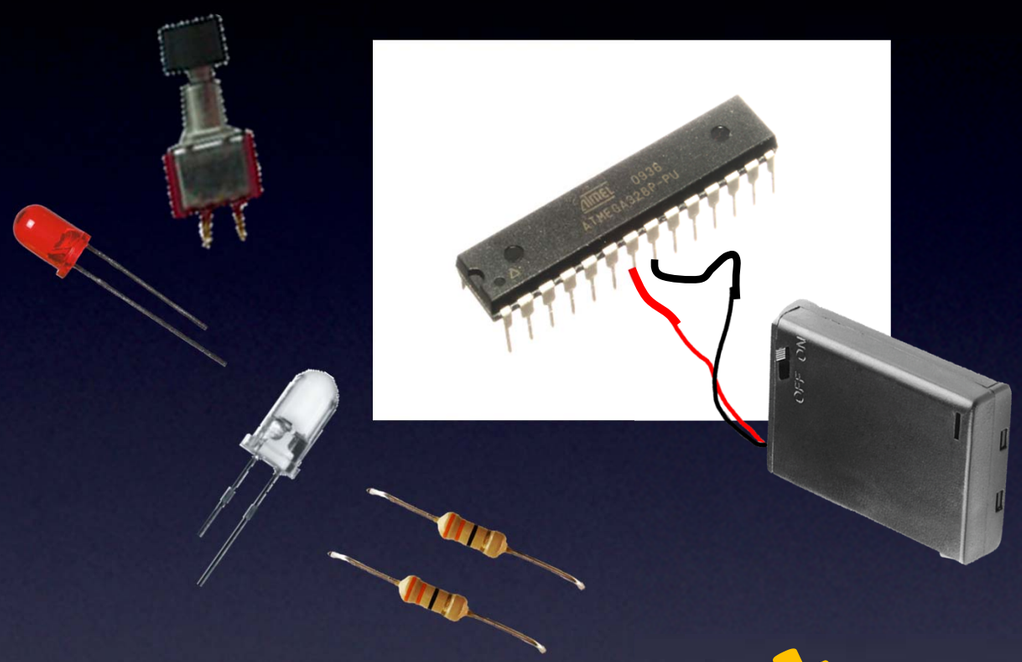
Etc for all “OFF” codes

TV-B-Gone remote control

Microcontroller

Everything You Need to Know About Electronics

Hardware



Except

doesn't go very far

Firmware

Pin 13 Output – visible LED pin
Pin 3 Output – IR LED pin
Pin 2 Input – Push Button

Wait for Switch to be Low

Blink visible LED:
High, Delay, Low
Pulse IR LED for Sony "OFF" code:
High, Delay, Low, Delay…

Blink visible LED:
High, Delay, Low
Pulse IR LED for Panasonic "OFF" code:
High, Delay, Low, Delay…

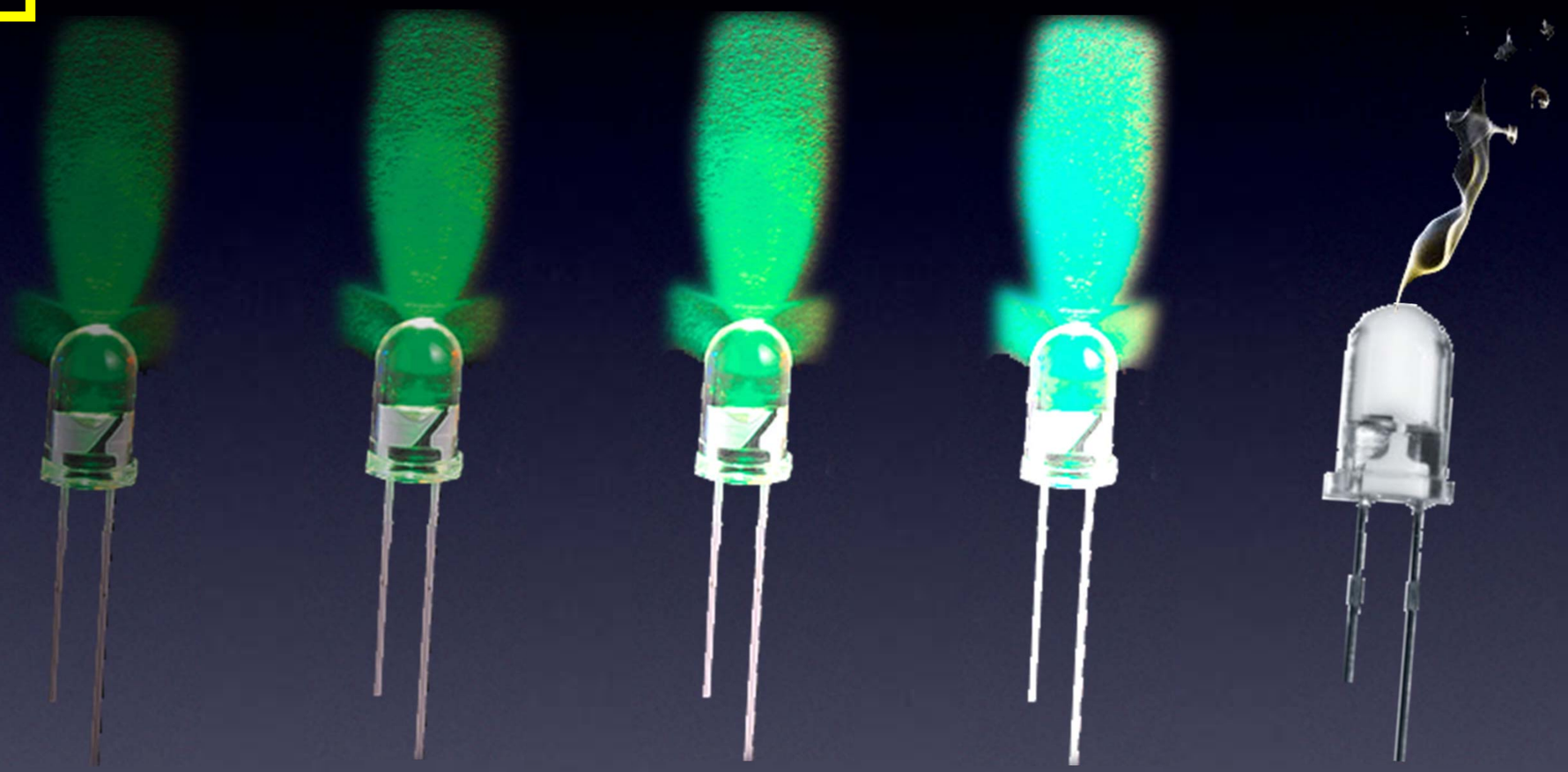
Etc for all "OFF" codes

TV-B-Gone remote control

Microcontroller

Everything You Need to Know About Electronics

Review:



More current → More brightness! (until…)

LED

Everything You Need to Know About Electronics

Output pin – only 2 choices:

Low

Off

(0V)

High

On

(Power supply voltage

-- controlled by our Firmware!)

Output pins

only allow

limited current

(built-in resistors on each pin)

Microcontroller – Output pins

Everything You Need to Know About Electronics

dimmly lit LED

So,
IR LED
can only light up
dimly
from the Output pin

Output pin – only 2 choices:

Low	**High**
Off	**On**
(0V)	(Power supply voltage
	-- controlled by our Firmware!)

Output pin – only limited current

Microcontroller – Output pins

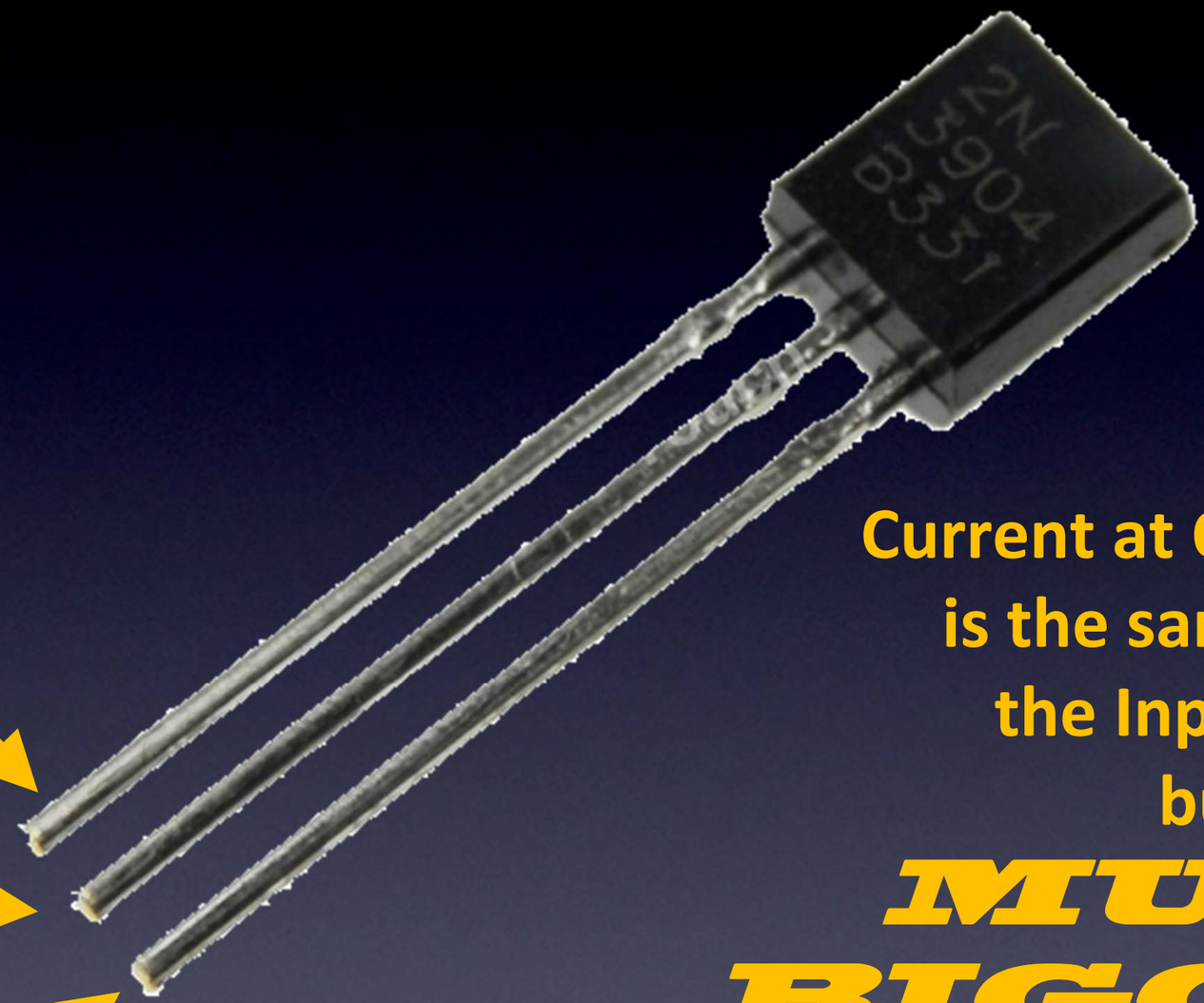
Everything You Need to Know About Electronics

So,
let's amplify
the current
from the Output pin

with
a

Current amplifier !

Everything You Need to Know About Electronics



Ground

Input

Output

Current at Output lead is the same as for the Input lead but

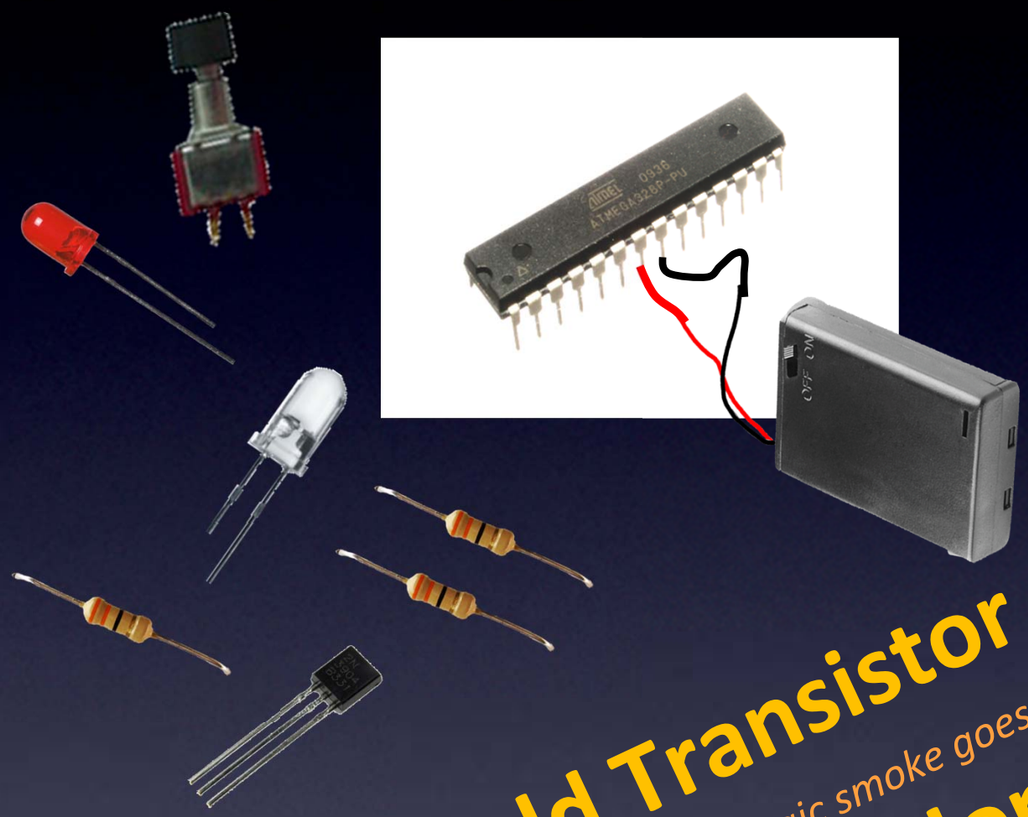
MUCH BIGGER !

Current amplifier

Transistor

Everything You Need to Know About Electronics

Hardware



Add Transistor

(and a resistor so no magic smoke goes away)

and, we're done!

Firmware

Pin 13 Output – visible LED pin
Pin 3 Output – IR LED pin
Pin 2 Input – Push Button

Wait for Switch to be Low

Blink visible LED:
High, Delay, Low
Pulse IR LED for Sony "OFF" code:
High, Delay, Low, Delay…

Blink visible LED:
High, Delay, Low
Pulse IR LED for Panasonic "OFF" code:
High, Delay, Low, Delay…

Etc for all "OFF" codes

TV-B-Gone remote control – we're done!

Microcontroller

And, that is

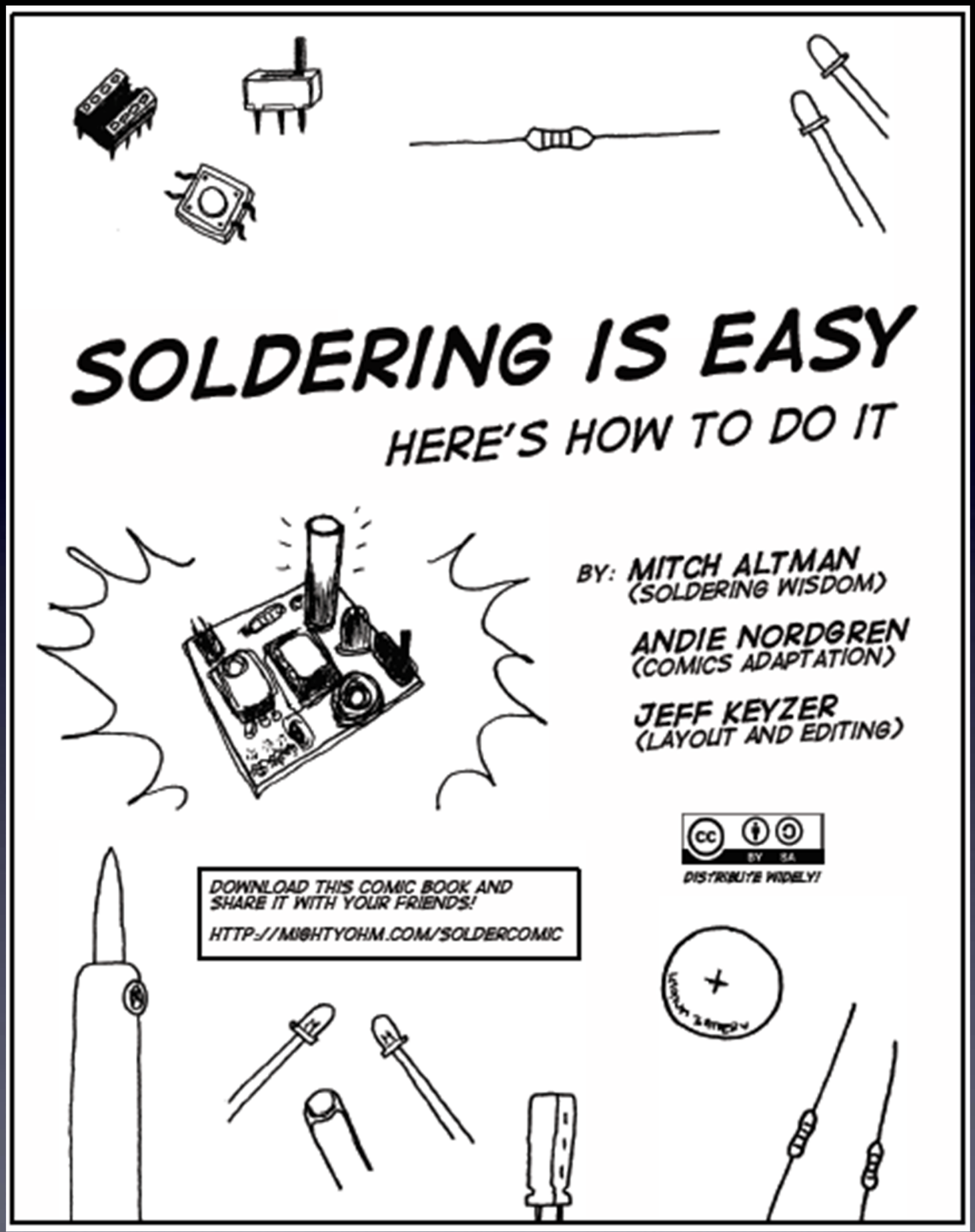
And, that is

Everything You Need to Know About

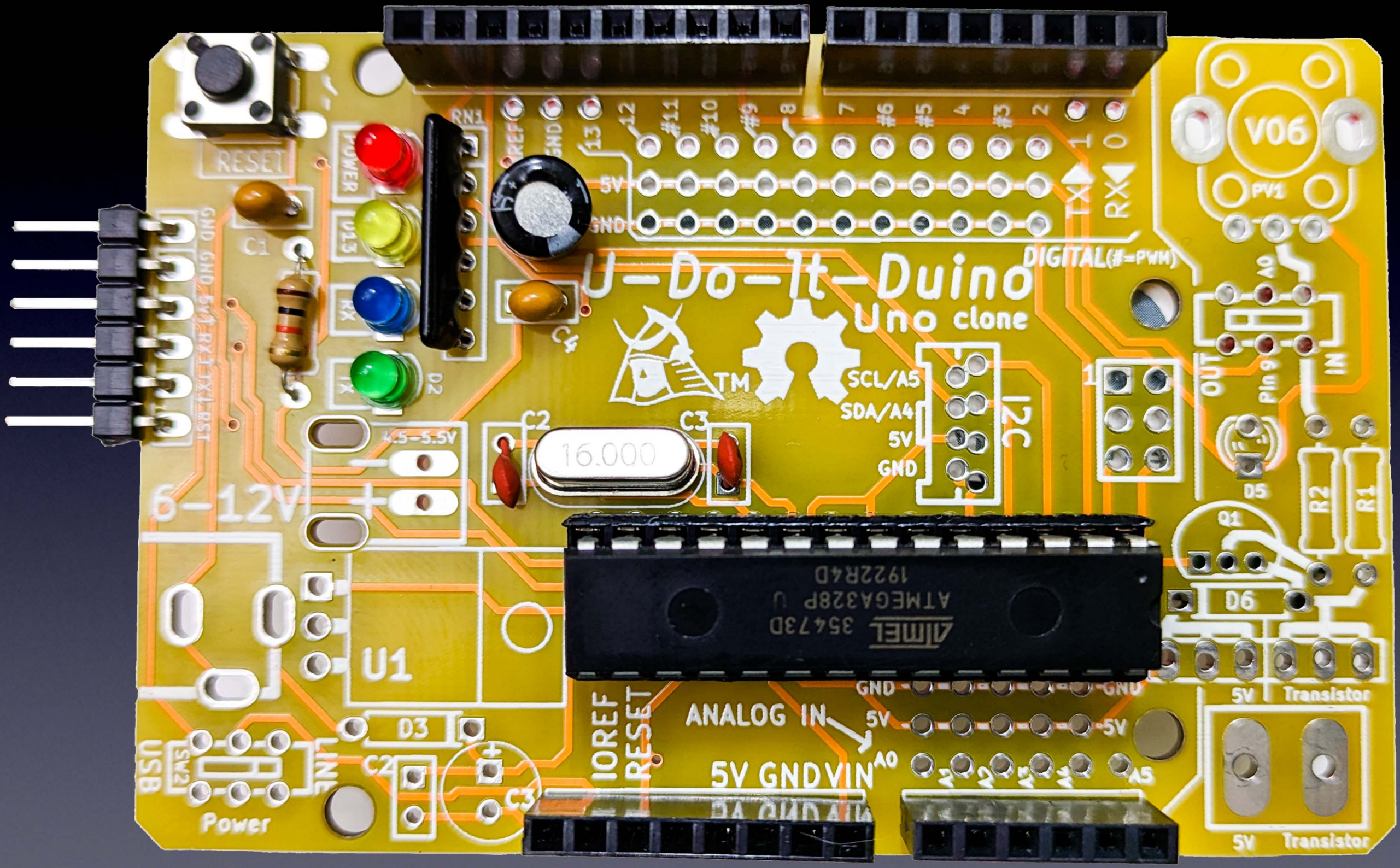
Electronics

Questions?

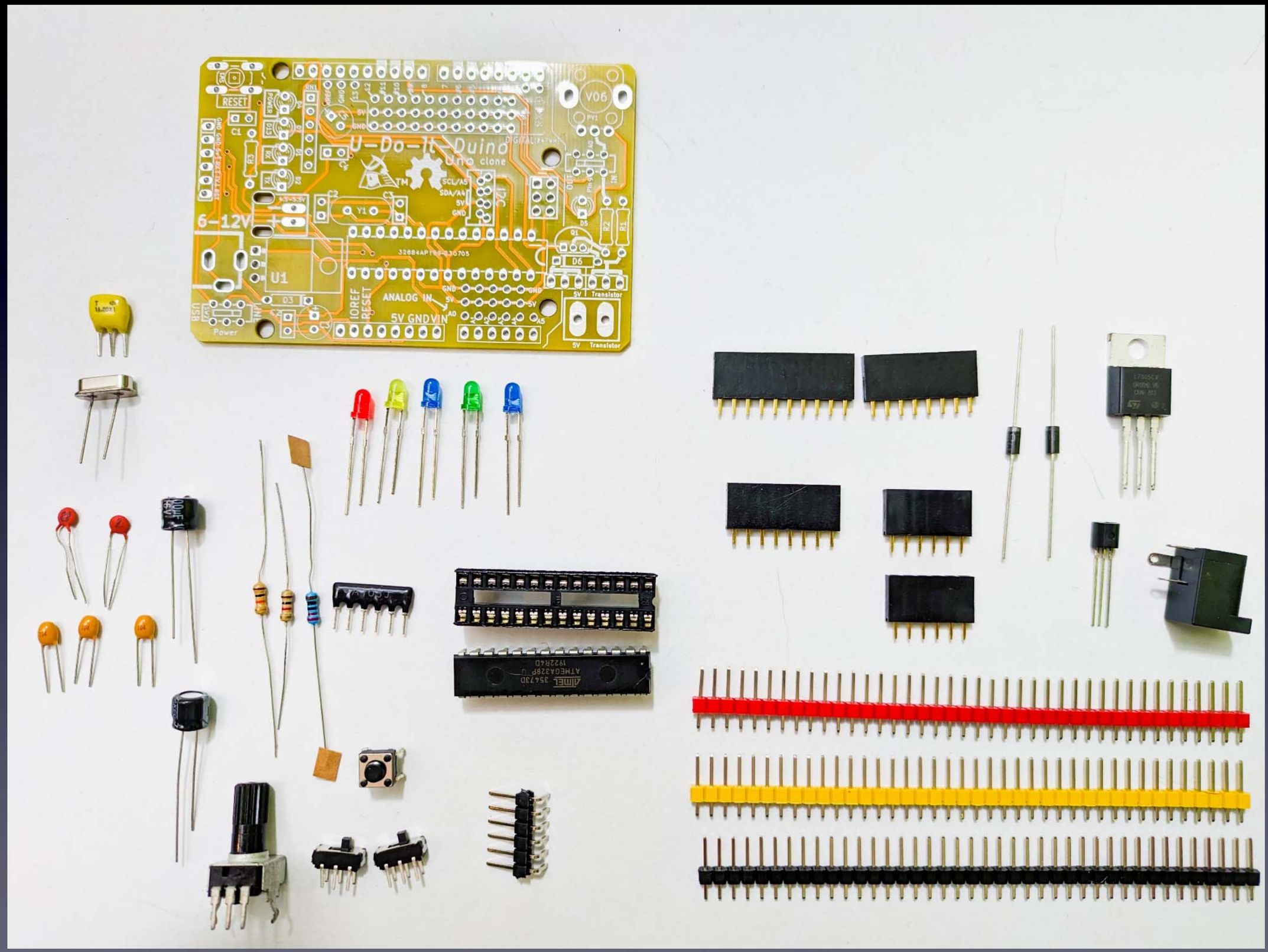
Learn To Solder



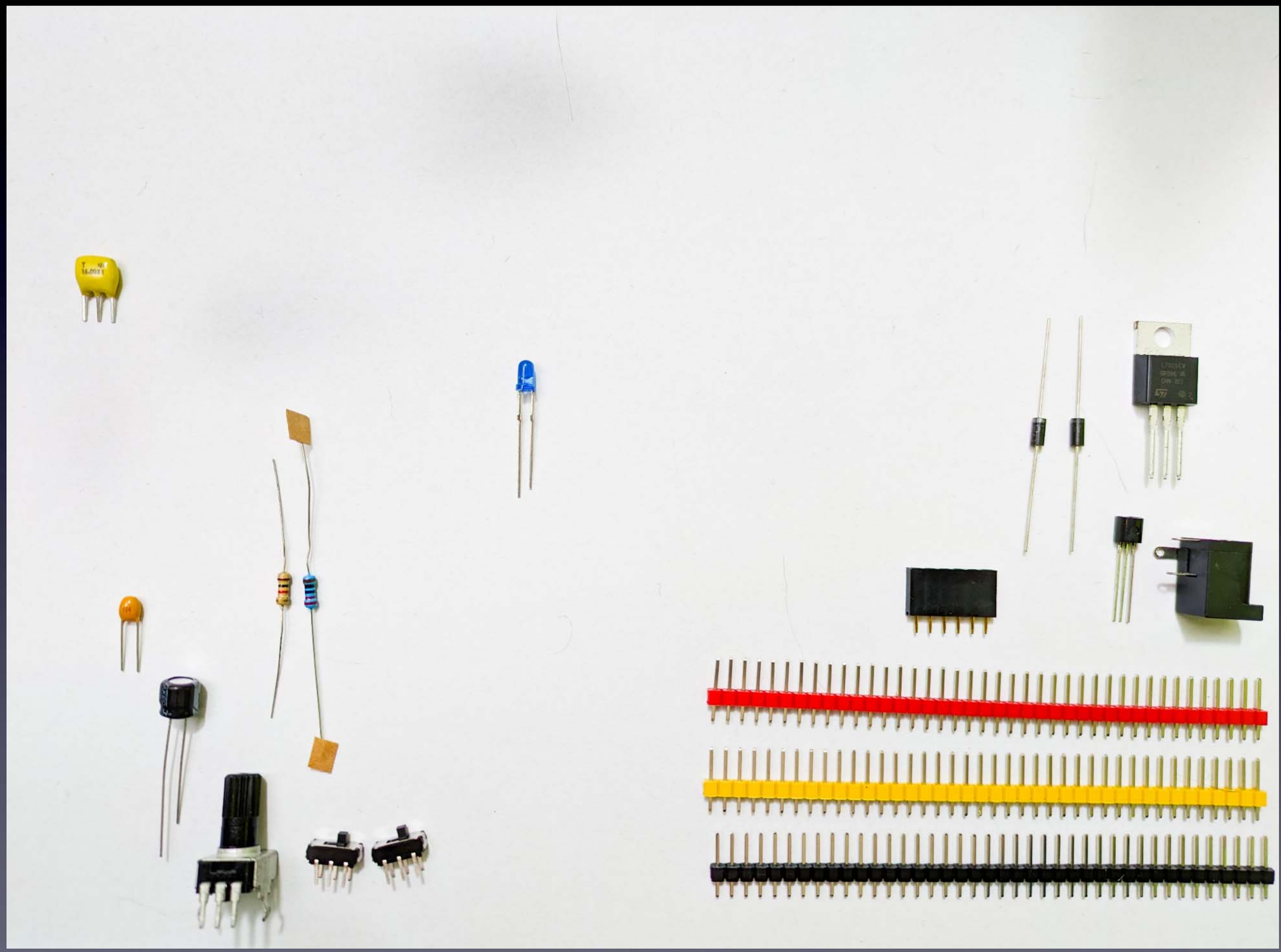
download for free at:
http://mightyohm.com/soldercomic


U-Do-It-Duino
Uno clone
TM
RESET
POWER
L13
TX
RX
C1
C4
RN1
D2
4.5-5.5V
6-12V
16.000
C2
C3
U1
ATMEGA328P U
1922R4D
ATMEL 3547JD
SCL/A5
SDA/A4
5V
GND
I2C
DIGITAL(#=PWM)
V06
PV1
A0
OUT
IN
Pin 9
D5
R2
R1
Q1
D6
5V
Transistor
GND
5V
ANALOG IN
5V GNDVIN
A0
A1
A2
A3
A4
A5
IOREF
RESET
D3
USB
Power
SW2

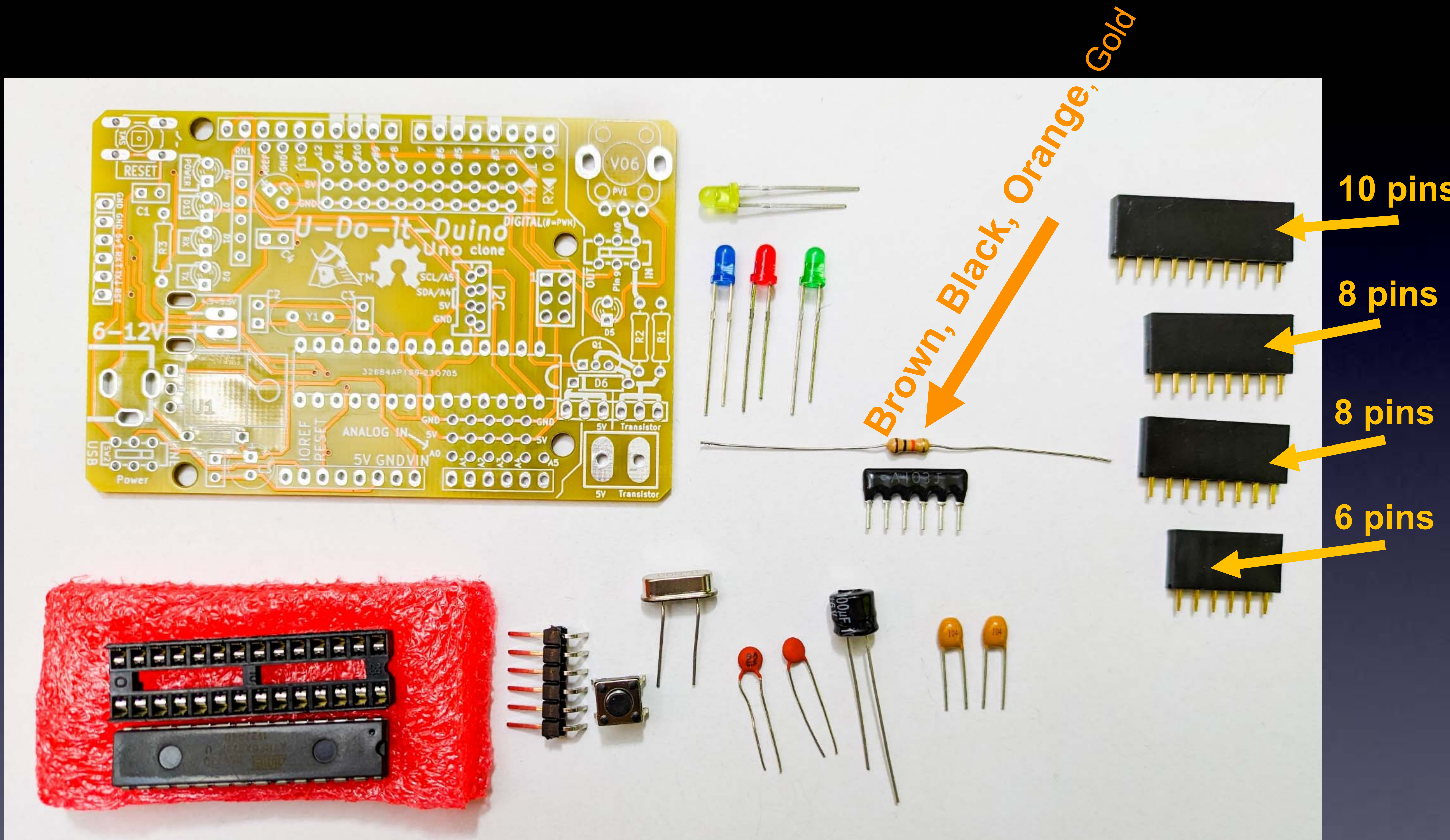
U-Do-It-Duino – we won’t use all of the parts



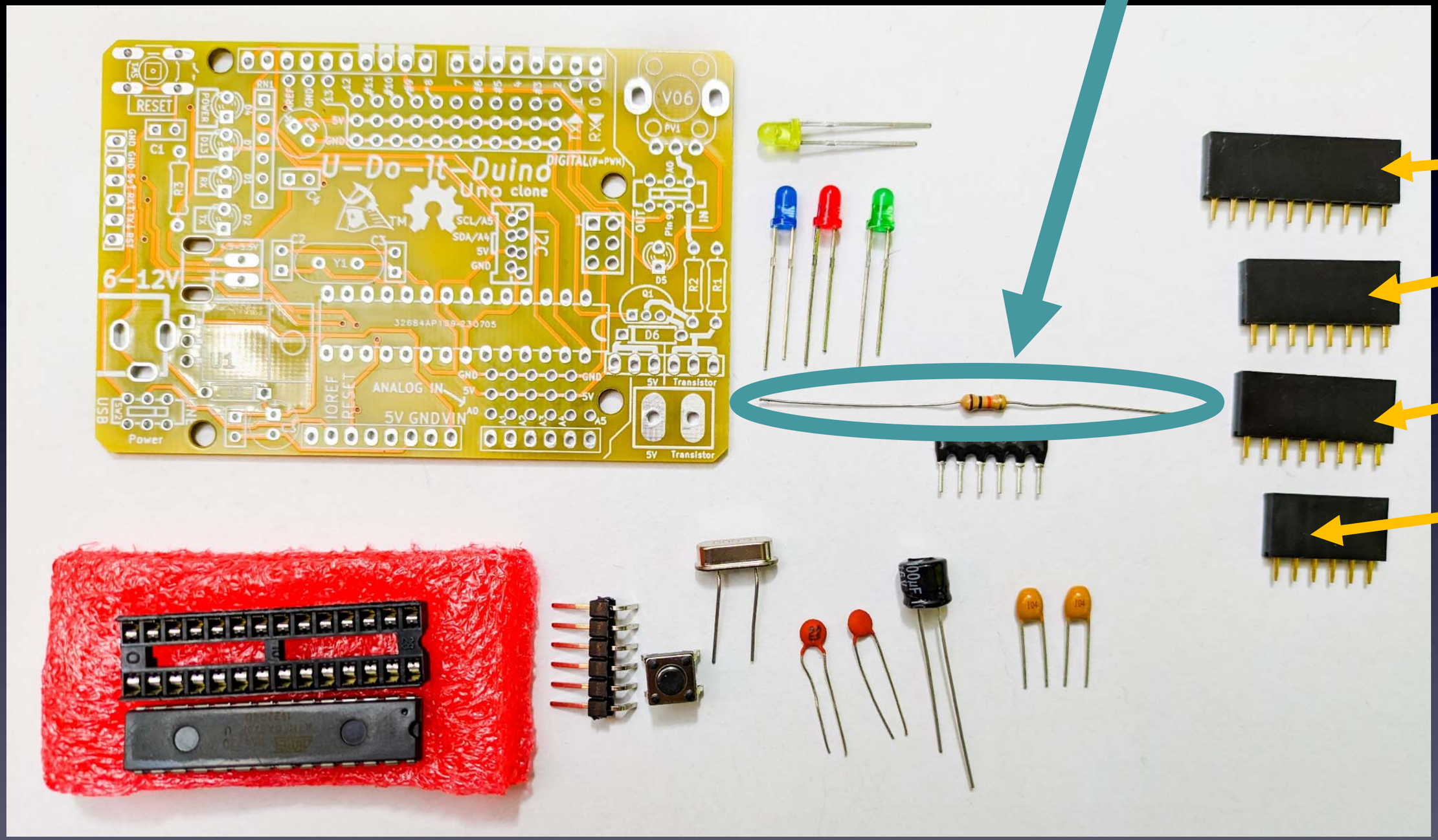
Unused parts



Parts to use



Our first part to solder: R3

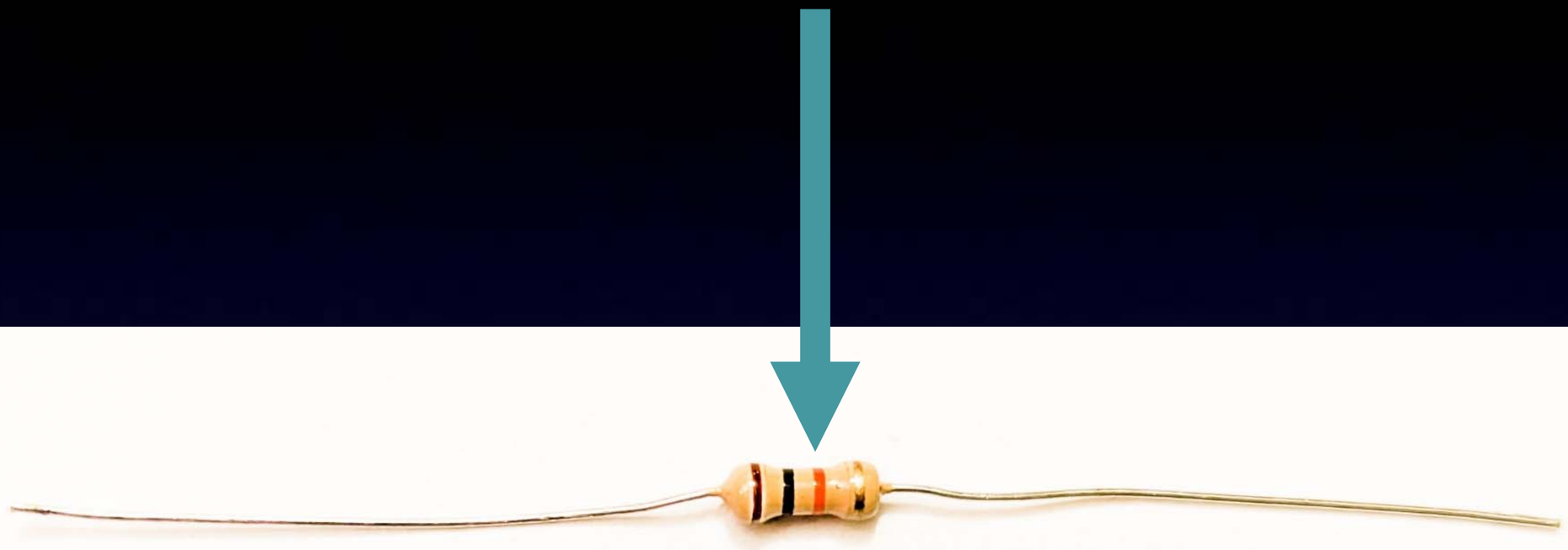


Our first part to solder: R3

R3: Brown, Black, Orange, Gold

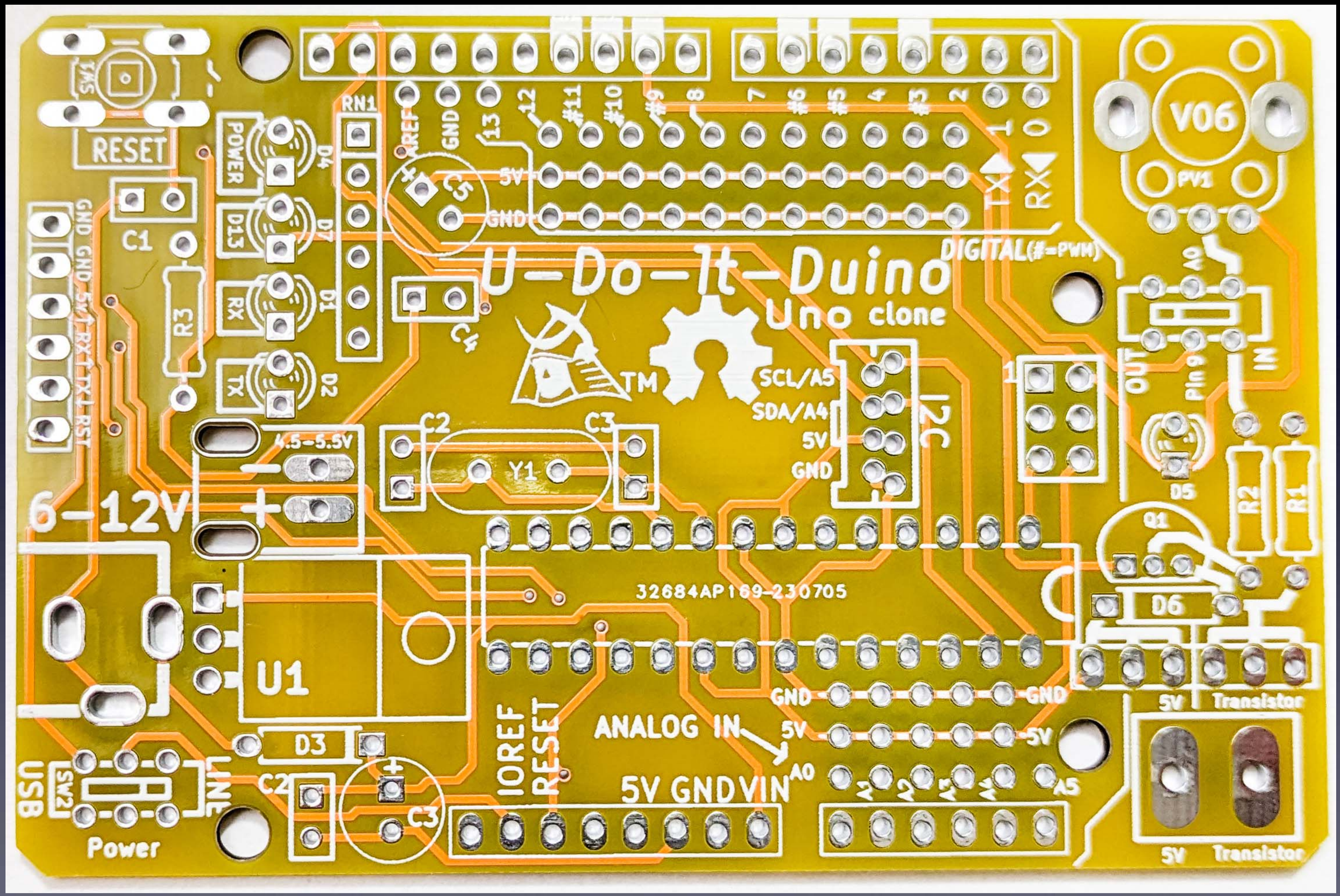
(*NOT* Brown, Black, Red, Gold)

R3: Look down at the shape of this part

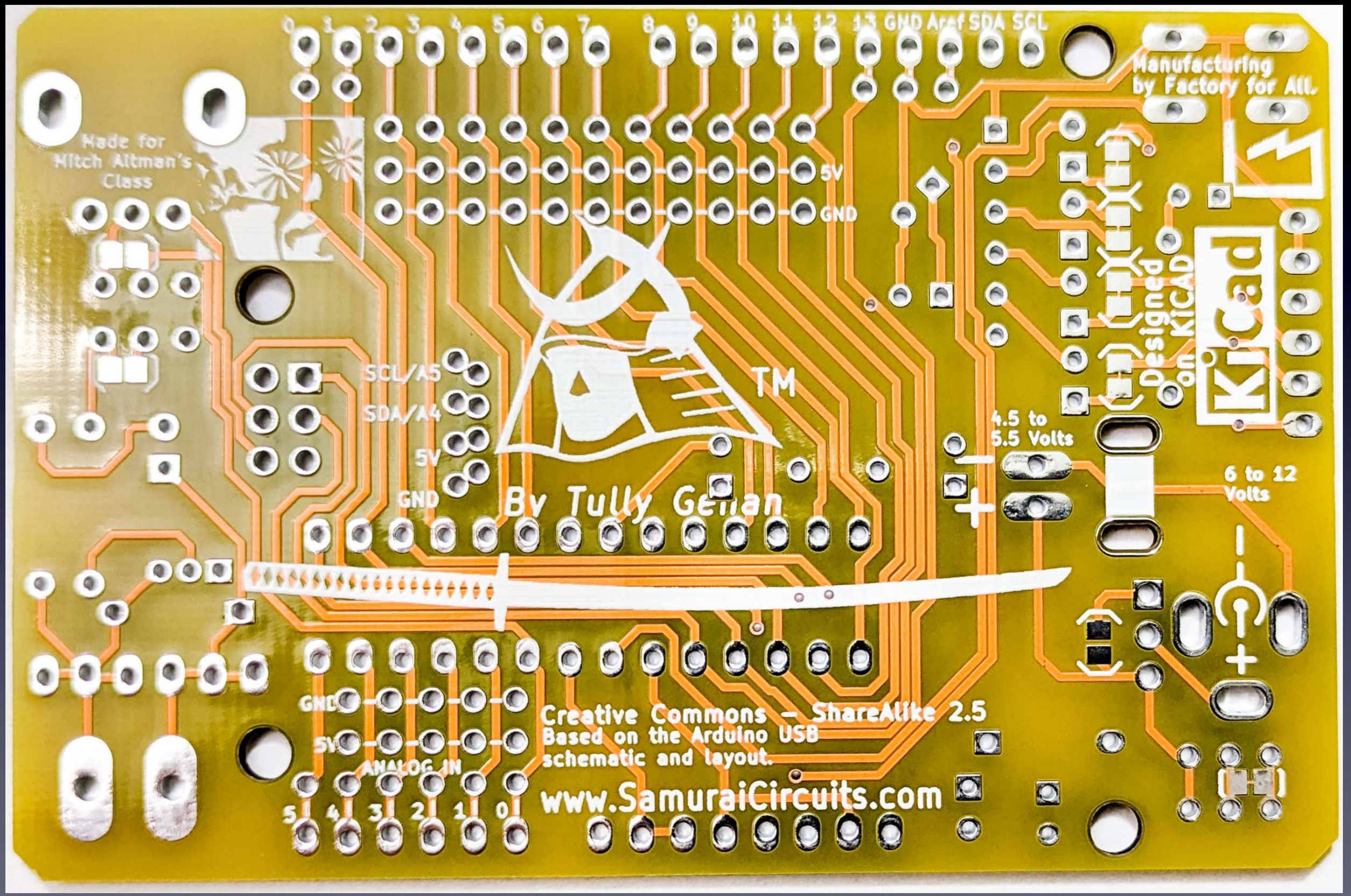


R3: Brown, Black, Orange, Gold

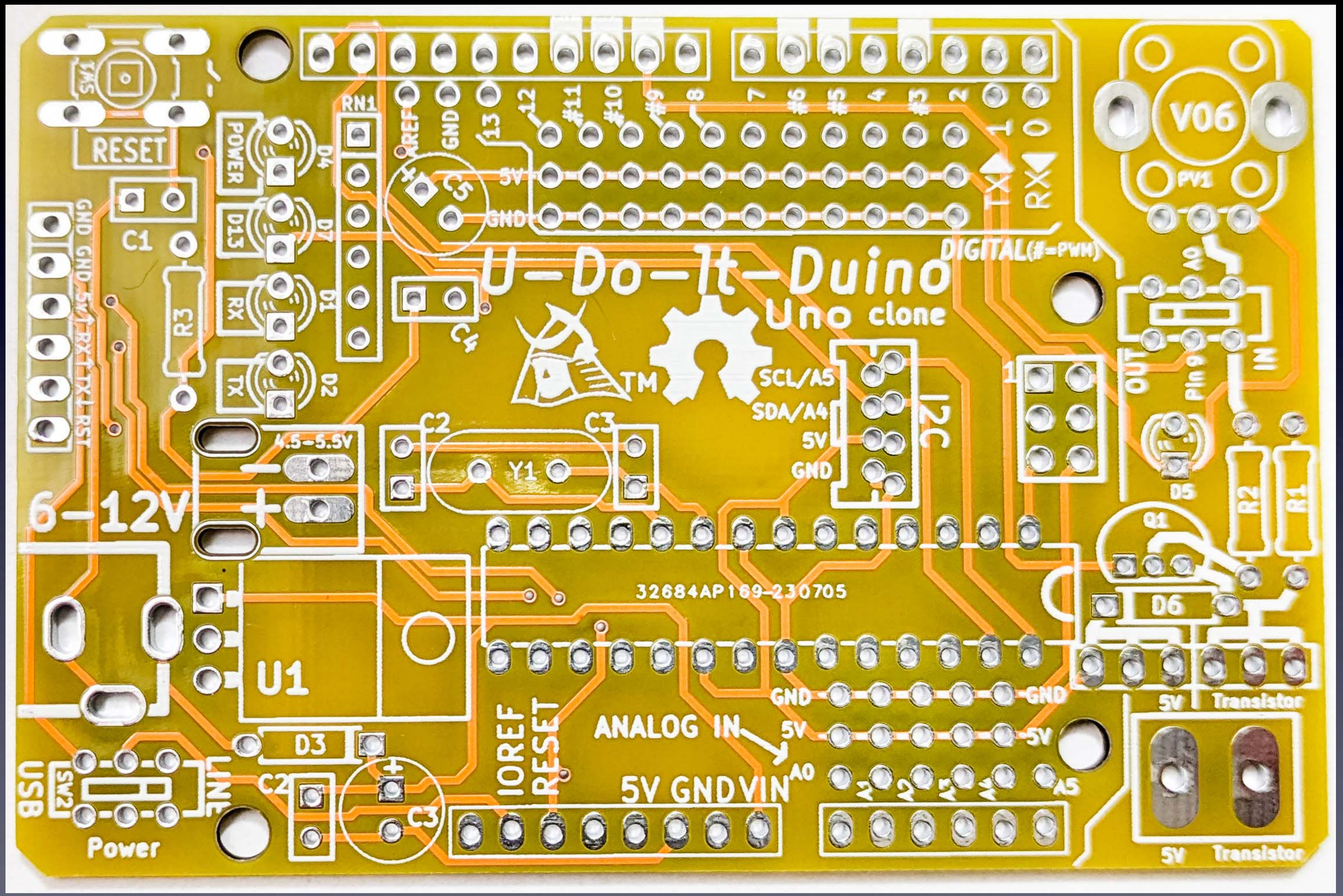
Top of Board

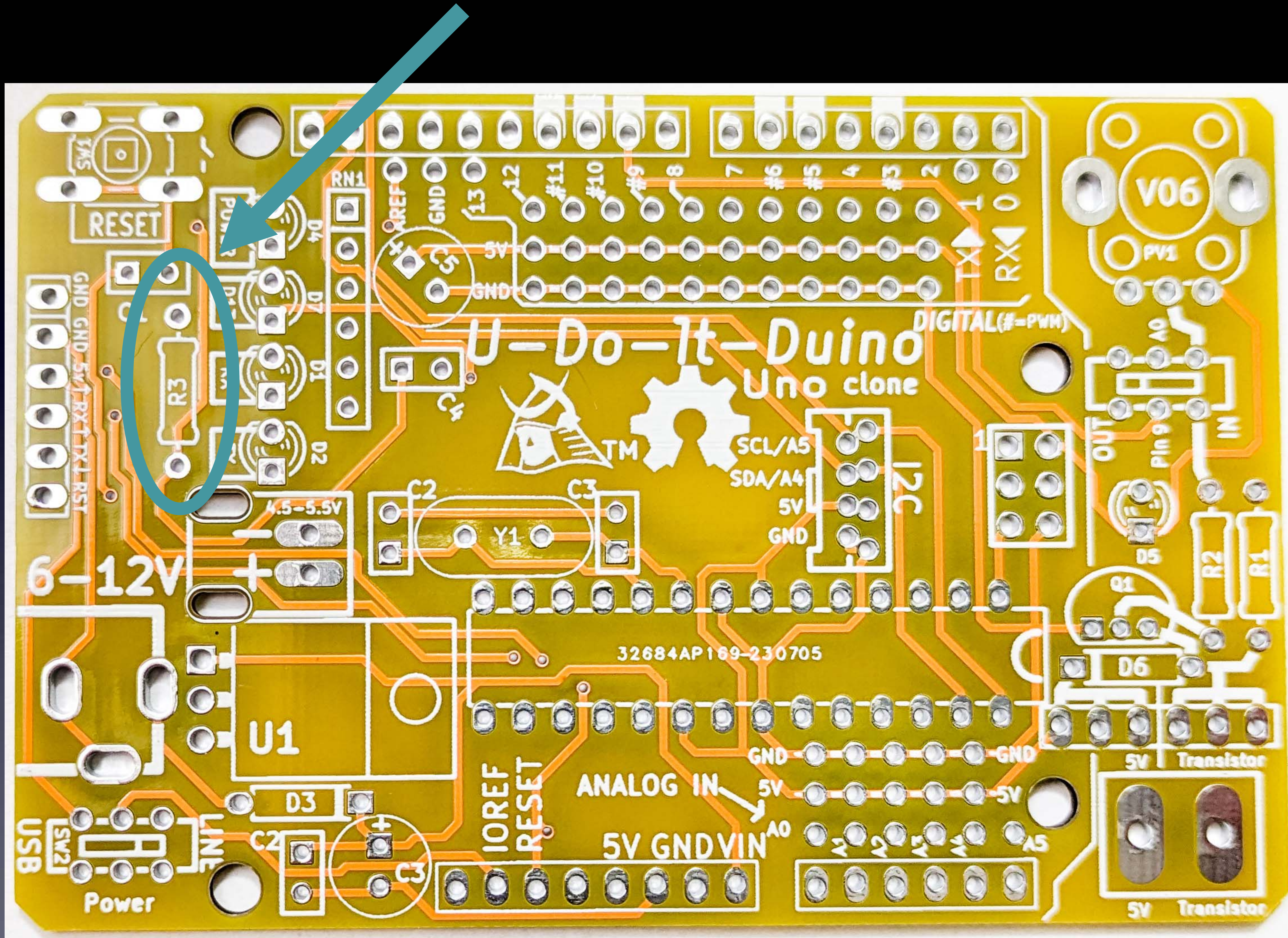

RESET
POWER
D13
RX
TX
D4
D7
D1
D2
RN1
AREF
GND
13
12
#11
#10
#9
8
7
#6
#5
4
#3
2
TX 1
RX 0
V06
PV1
C5
C4
C1
R3
5V
GND
DIGITAL(#=PWM)
U-Do-It-Duino
Uno clone
TM
SCL/A5
SDA/A4
5V
GND
I2C
A0
OUT
IN
Pin 9
D5
R2
R1
Q1
D6
5V
Transistor
4.5-5.5V
6-12V
C2
C3
Y1
32684AP169-230705
U1
GND
GND
5V
5V
ANALOG IN
IOREF
RESET
5V GNDVIN
A0
A1
A2
A3
A4
A5
D3
C2
C3
USB
SW2
Power
5V
Transistor

Bottom of Board



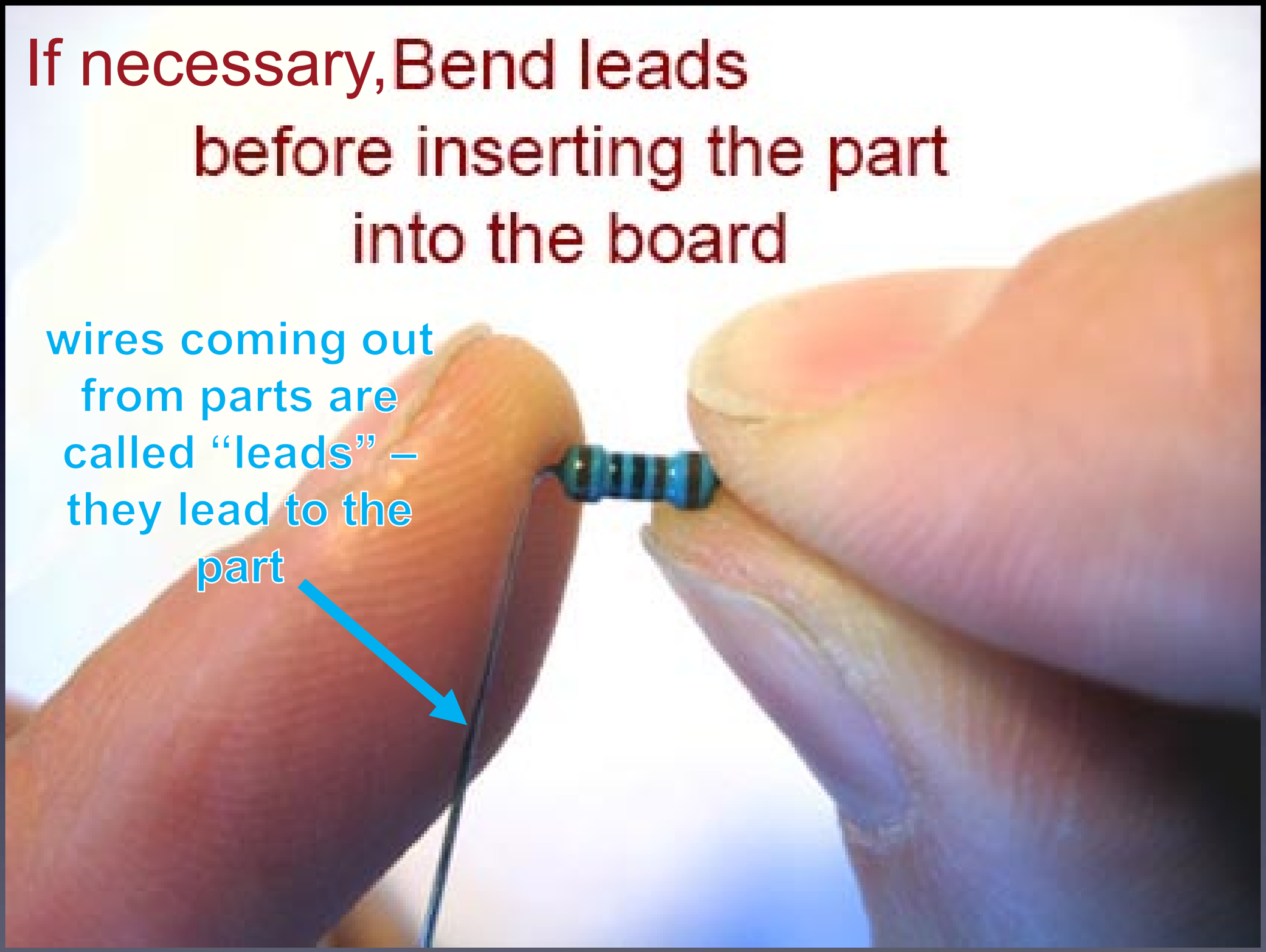
All Parts are soldered on the Top of Board !



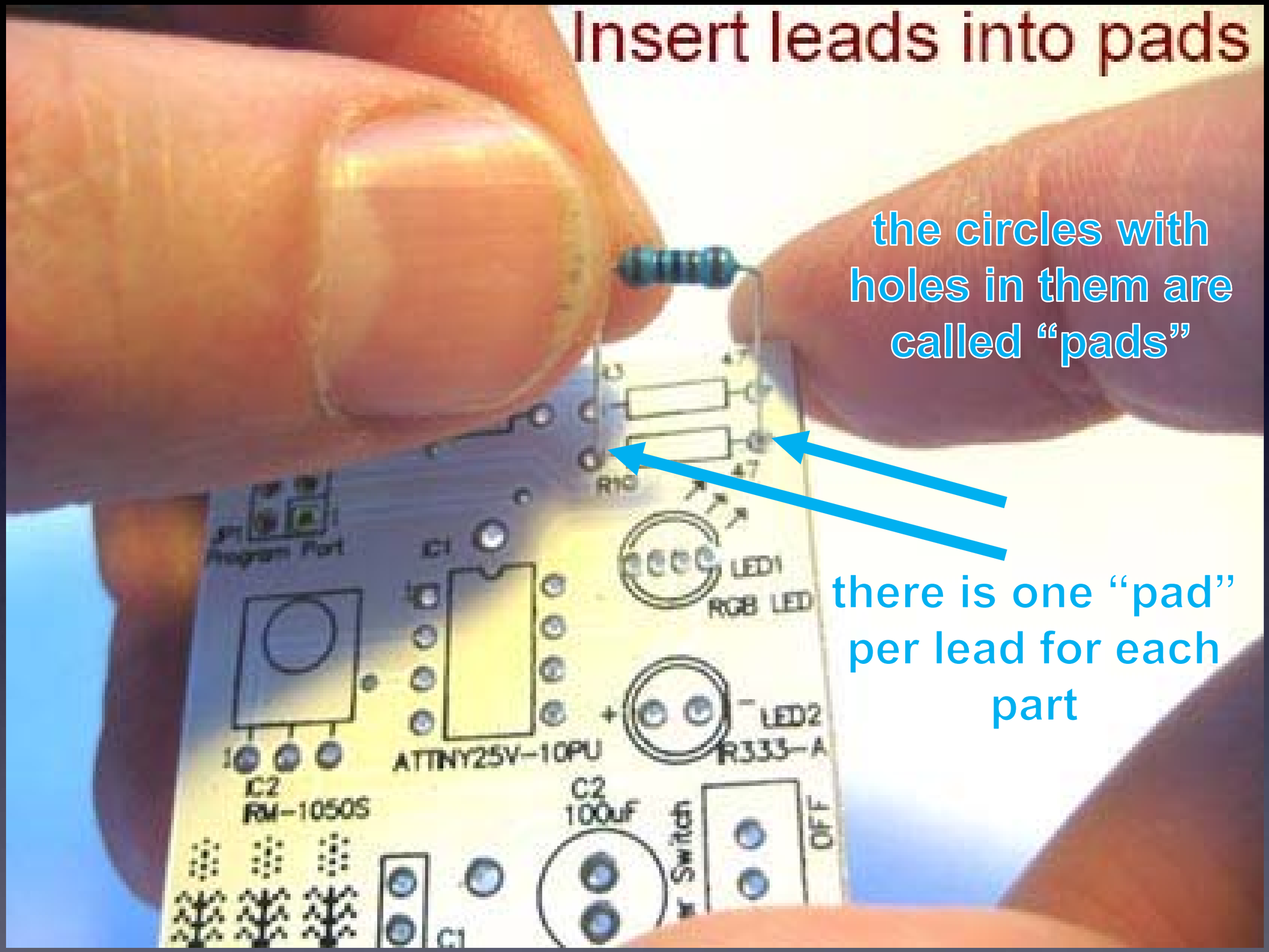


RESET
SW3
POWER
RN1
AREF
GND
13
12
#11
#10
#9
8
7
#6
#5
4
#3
2
1
0
5V
GND
C5
TX
RX
DIGITAL(#=PWM)
V06
PV1
U-Do-It-Duino
Uno clone
C4
D4
D7
D1
D2
R3
C1
GND GND 5V RX TX1 RST
TM
SCL/A5
SDA/A4
5V
GND
I2C
A0
OUT
Pin 9
IN
D5
R2
R1
Q1
4.5-5.5V
6-12V
C2
C3
Y1
32684AP169-230705
D6
U1
D3
IOREF
RESET
ANALOG IN
5V GND VIN
A0
A1
A2
A3
A4
A5
GND
5V
SW2
USB
LINE
Power
5V
Transistor

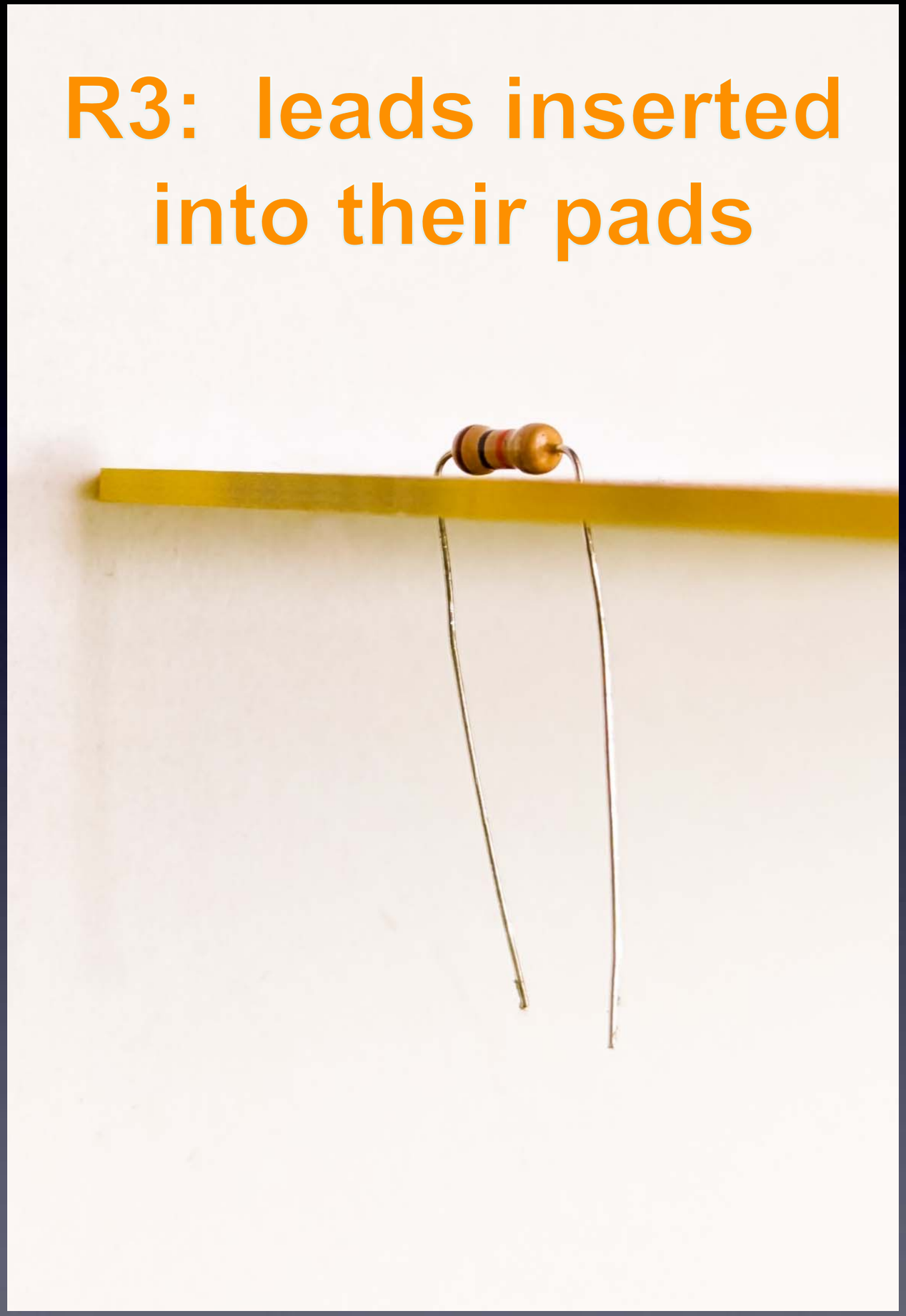
Some parts, such as resistors, need their leads bent first



This is how a resistor looks *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
R10
47
LED1
RGB LED
IC1
ATTINY25V-10PU
LED2
R333-A
IC2
RM-1050S
C2
100uF
C1
OFF

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,

(63/37 is also good)

0.031” (0.7mm) diameter (or smaller)

Note:

Most lead-free solder has poisonous fumes!

The perfect kind of solder for electronics:

This is the only good Lead-Free solder I have found!

(after years of searching)

Chip Quik Germanium-Doped Solder

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)

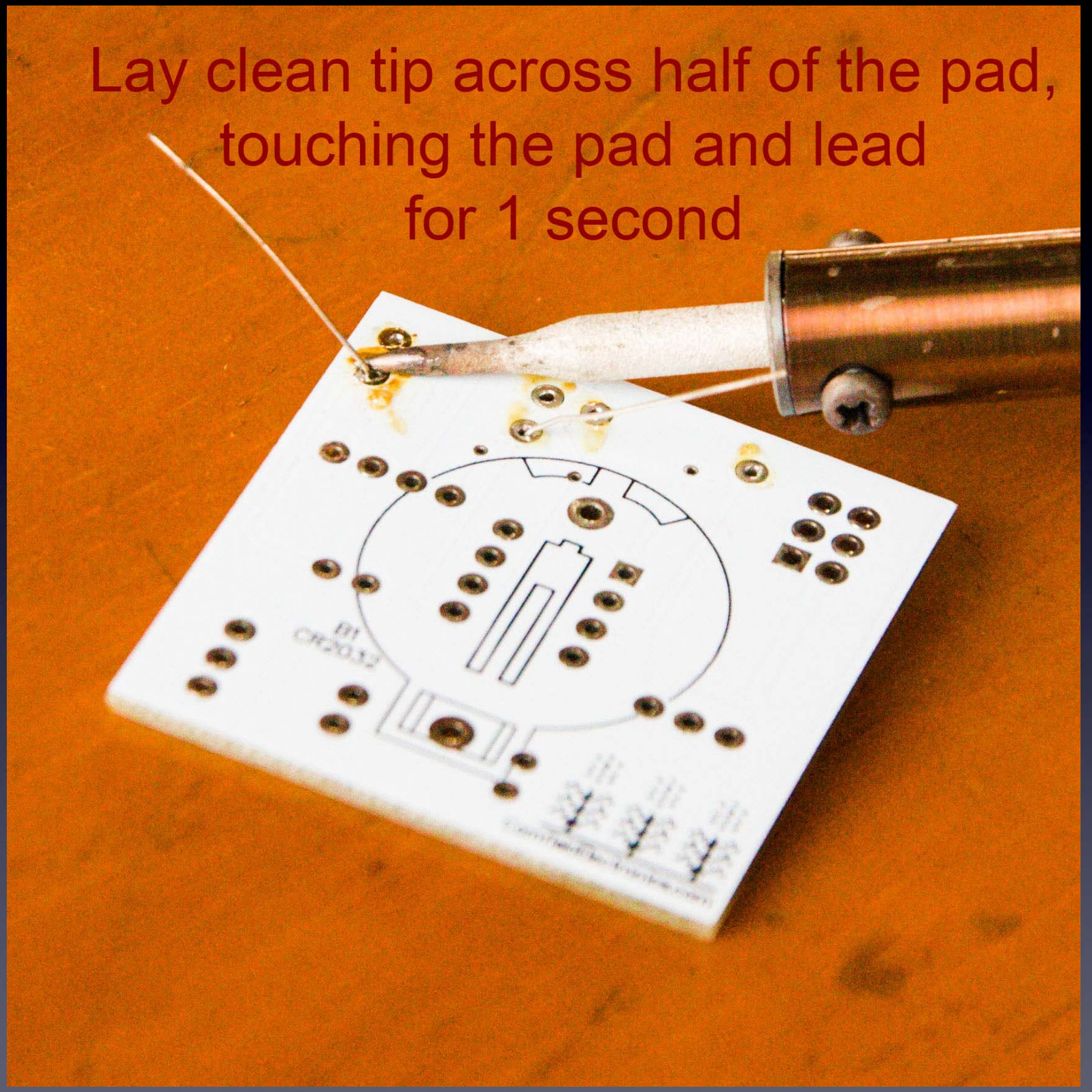
Bang (lightly) 3 times,

Swipe, Rotate, Swipe (on the sponge):

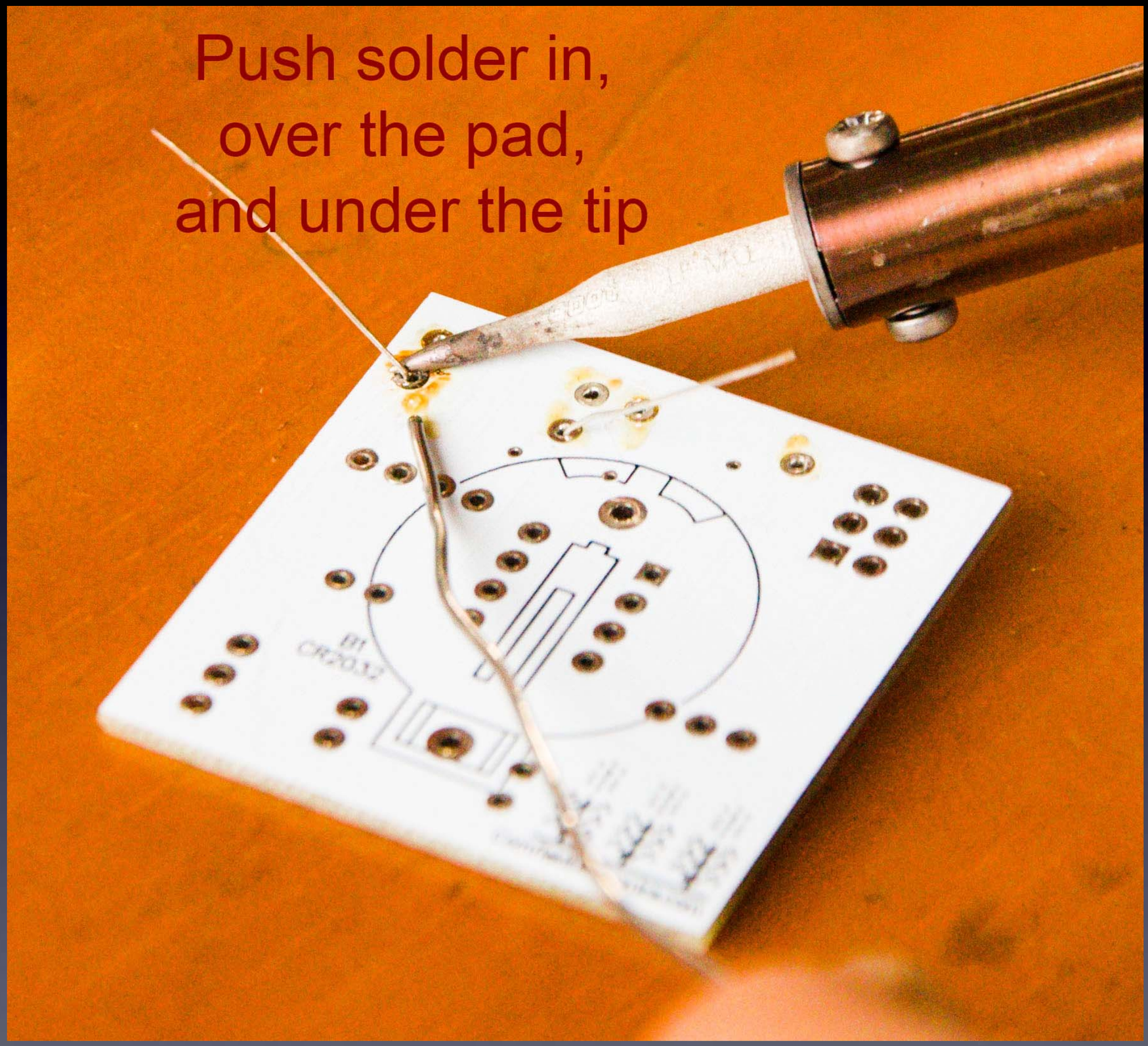
Keep the tip shiny silver!

knock solder off the tip

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

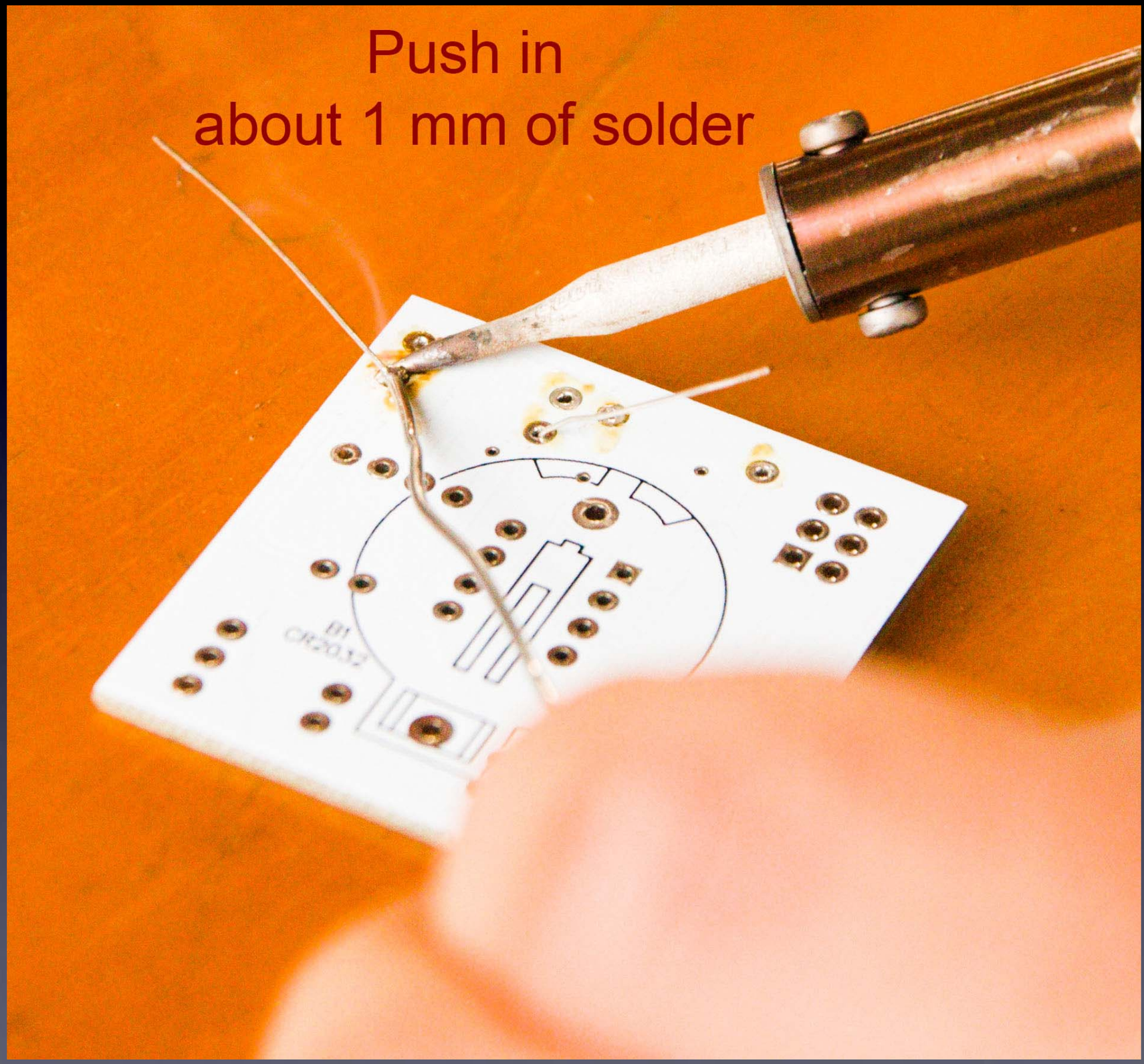


Do this quickly (slowly doesn't work well) – solder in & out in about 1 second



Make sure solder melts on the <u>underside</u> 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



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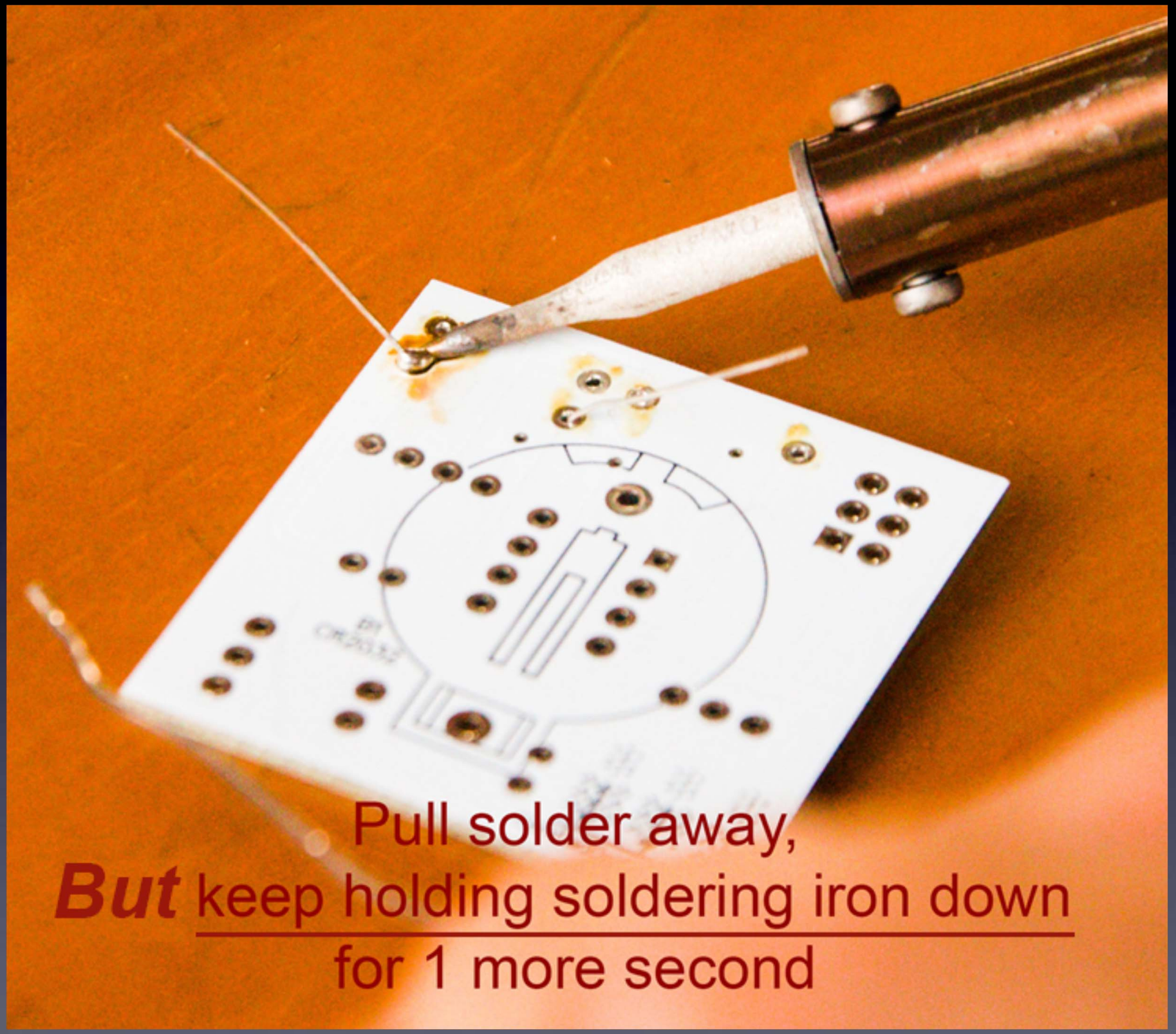
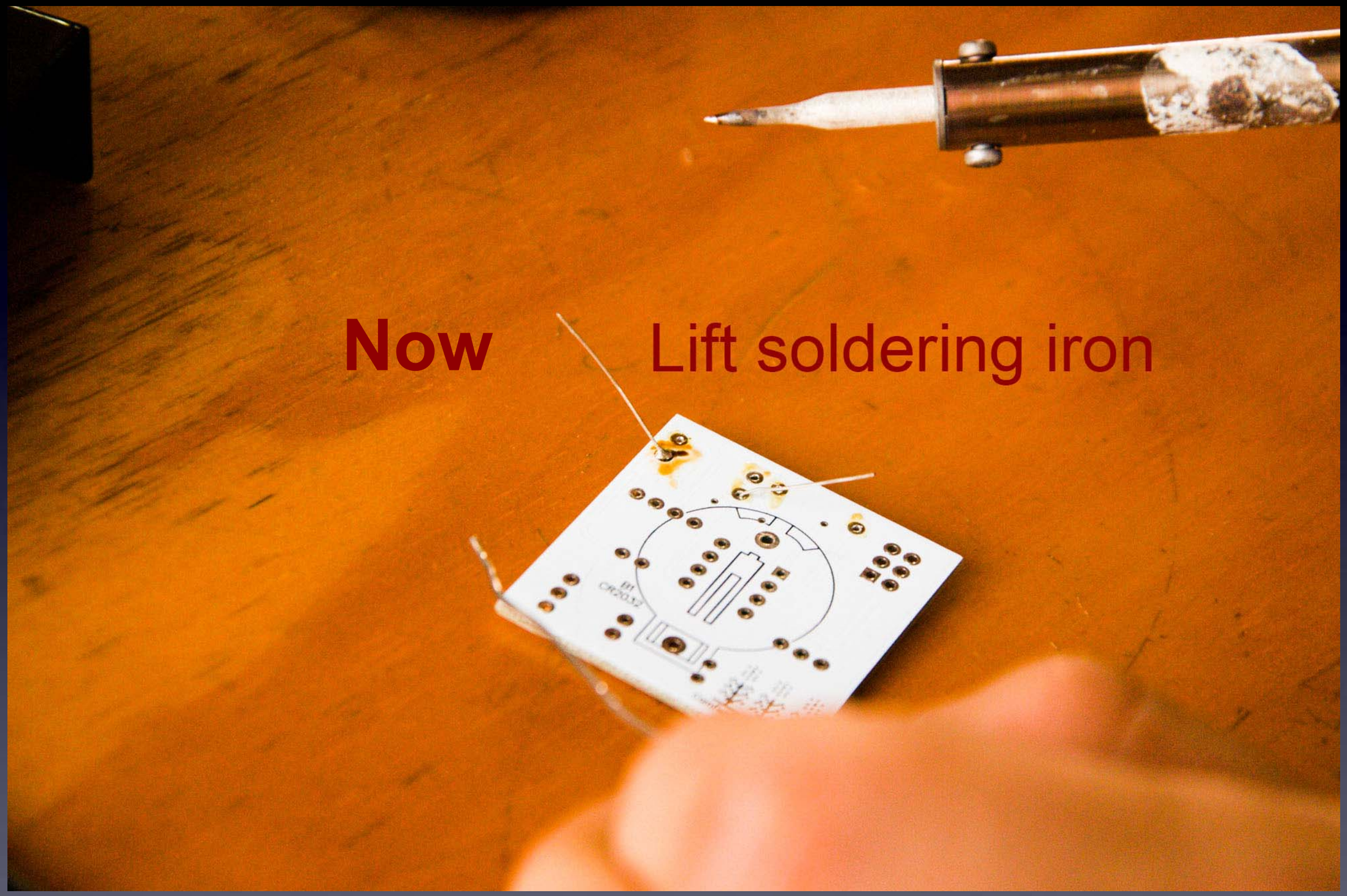
(not the side or top of the soldering iron tip)!

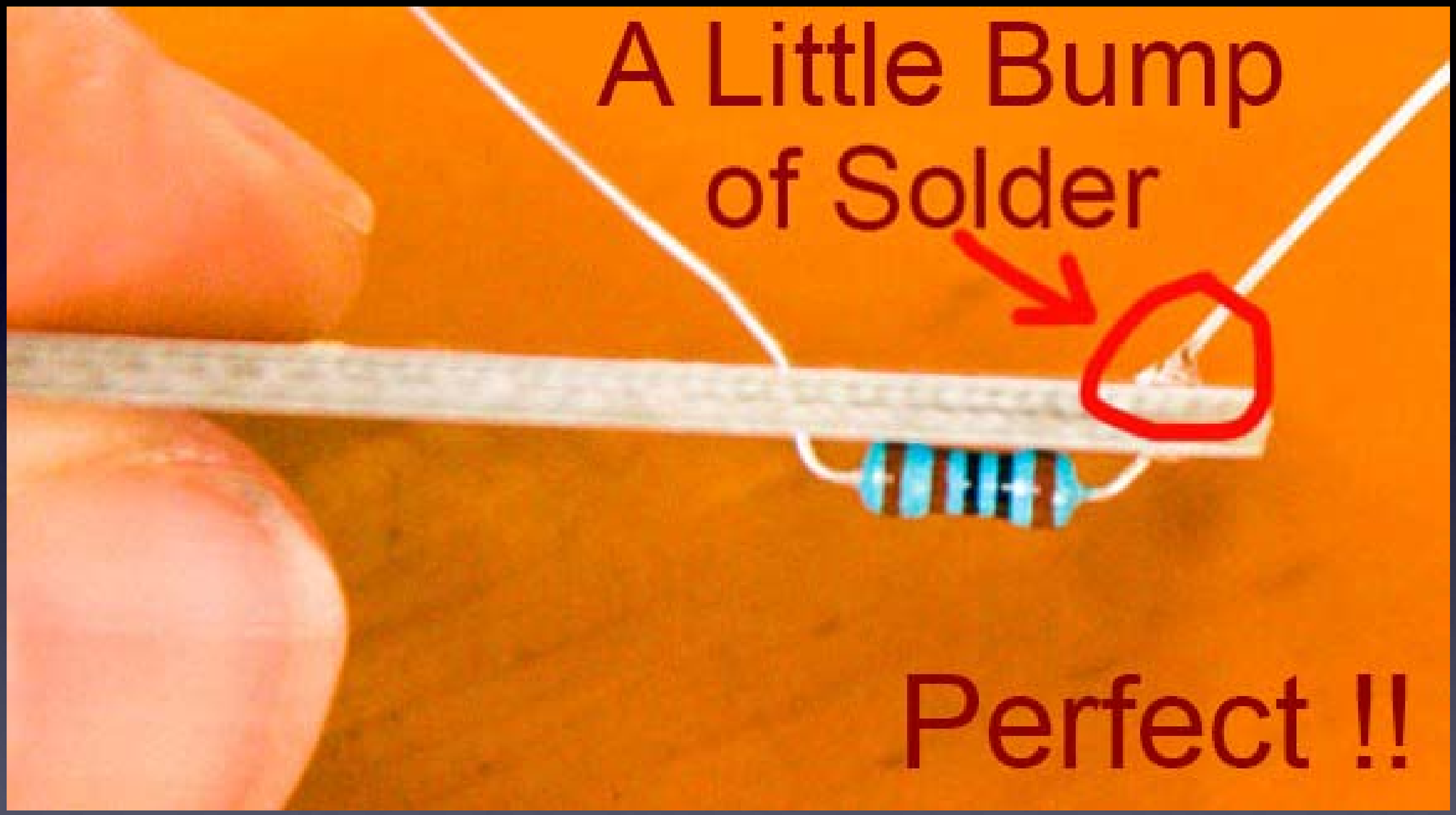

Pull solder away,
But keep holding soldering iron down
for 1 more second

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)

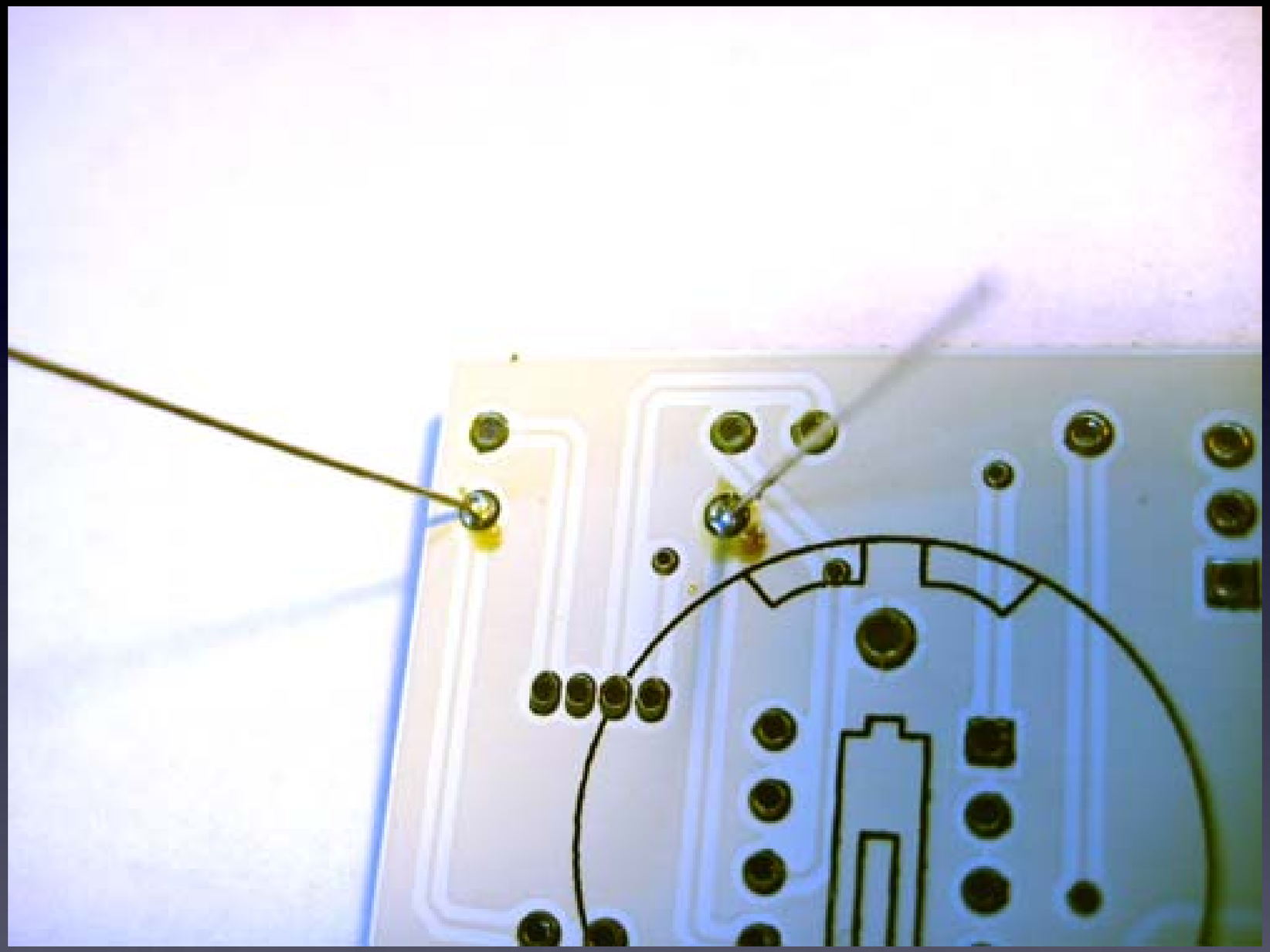
WAIT !

The Rhythm !

and speed (about 1 second per step)

Lift Tip

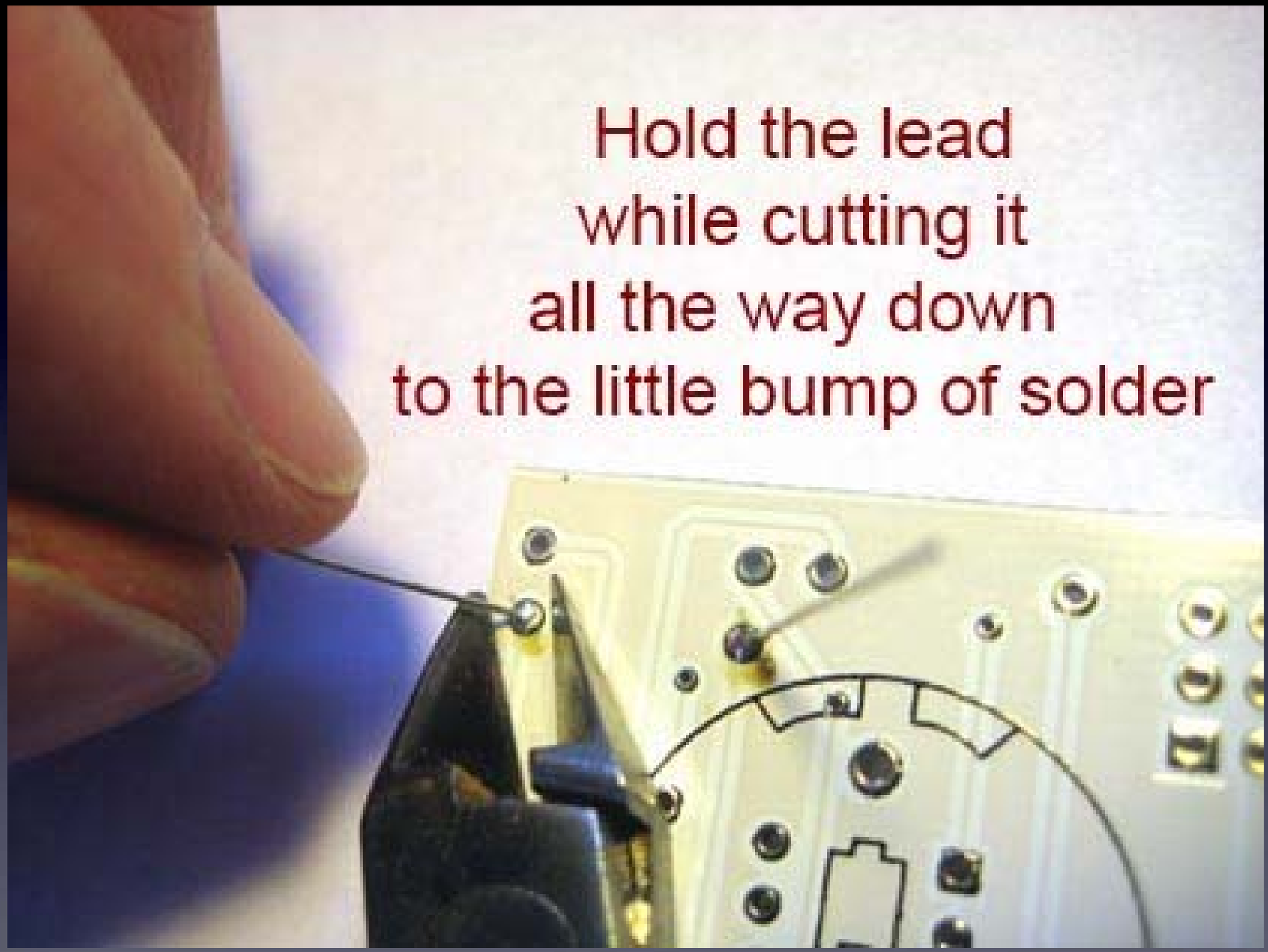
Solder all of the leads of the part to the board



For this part, there are two leads

Here you can see two good solder connections

Now cut the leads short



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

Safety Tip #3:

Hold or cover the lead !

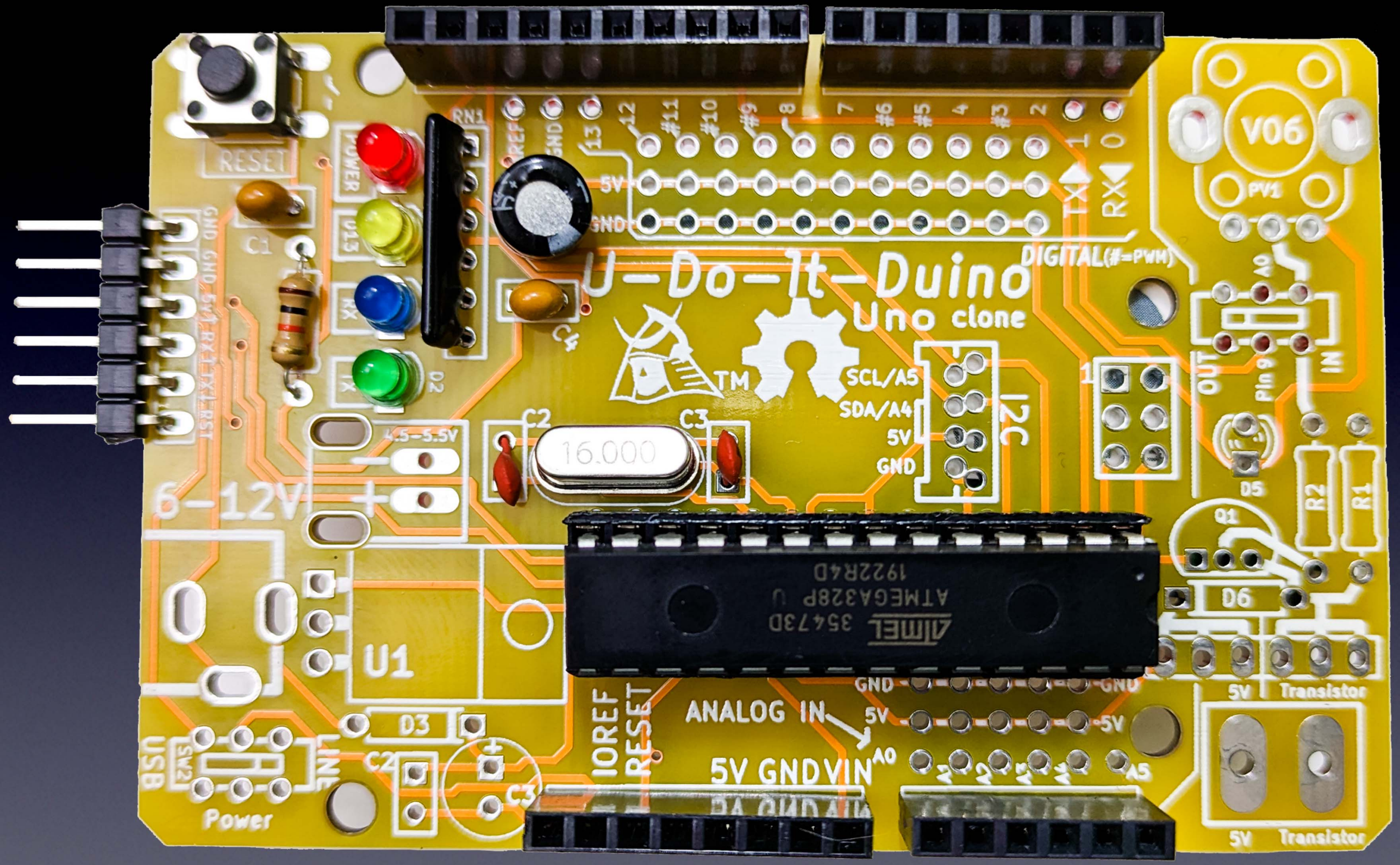
(or it will fly into your eye!)

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

No wires sticking out

One part at a time

Till all the parts are soldered



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

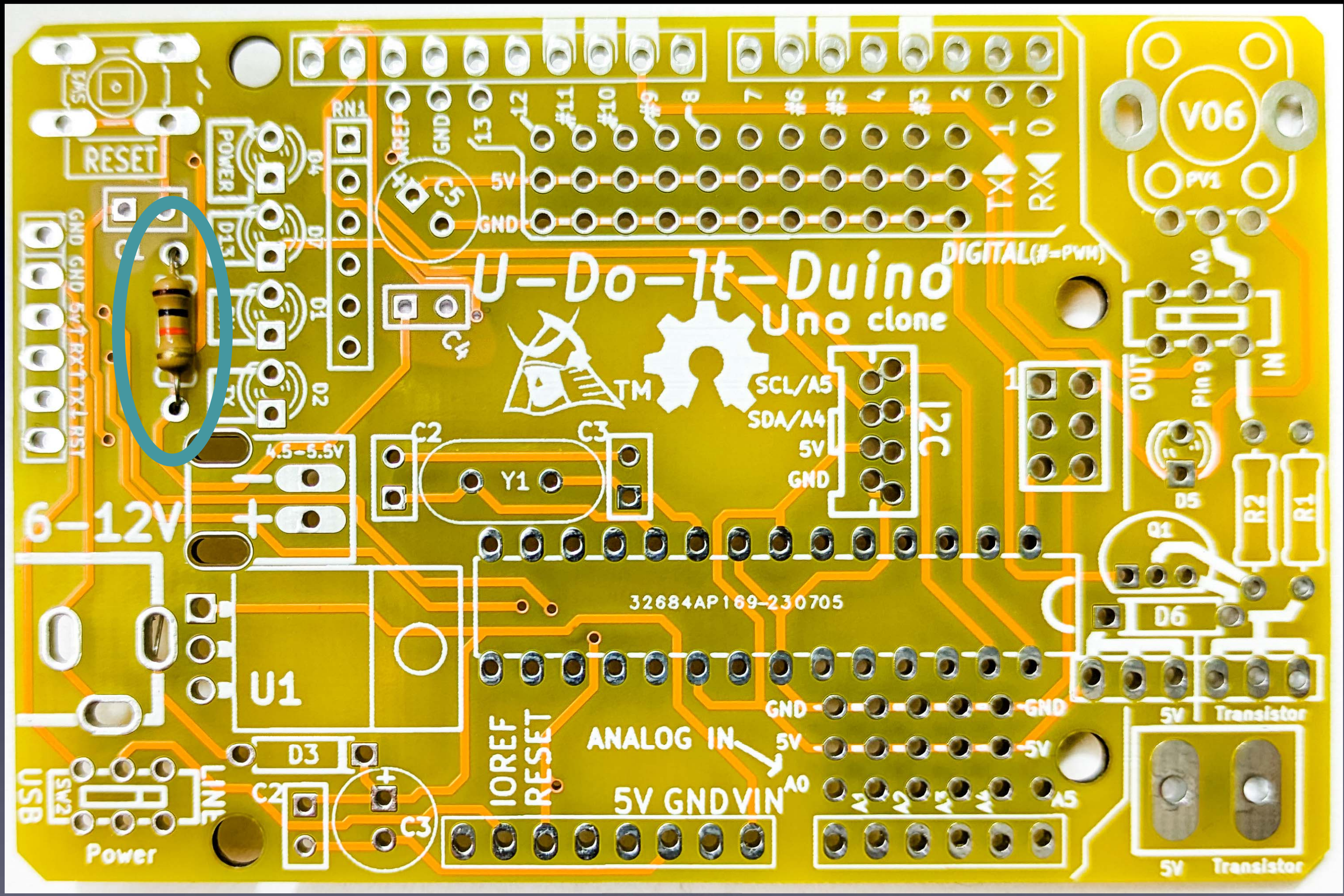
Then test with battery pack,

Turn it on,

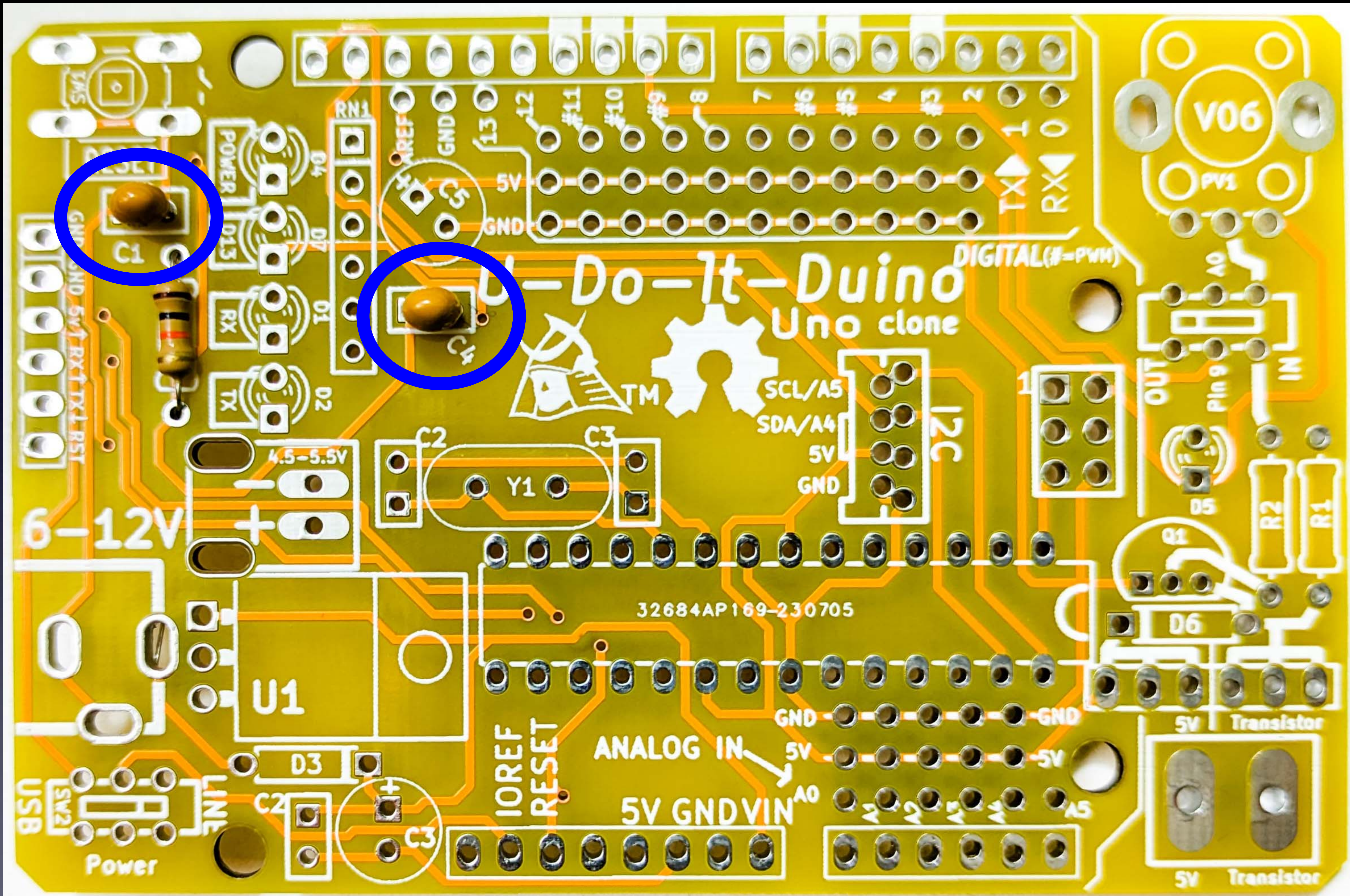
And it works!

(Or you start debugging.)

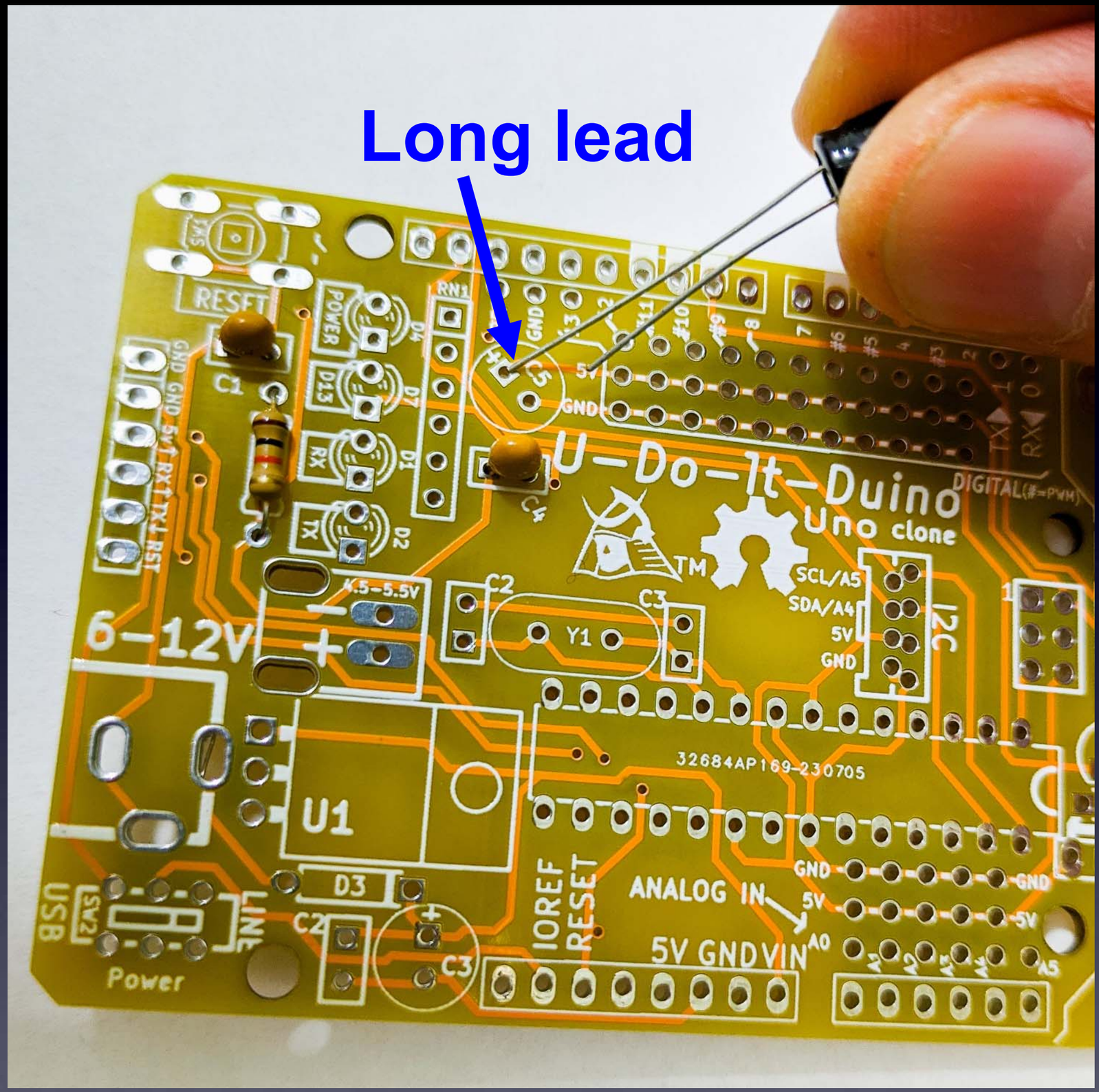
Let’s start!


U-Do-It-Duino
Uno clone
RESET
POWER
RN1
SHAREF
GND
13
12
#11
#10
#9
8
7
#6
#5
4
#3
2
TX 1
RX 0
DIGITAL(#=PWM)
5V
GND
SCL/A5
SDA/A4
5V
GND
I2C
V06
PV1
A0
OUT
IN
Pin 9
D5
R2
R1
Q1
D6
5V
Transistor
5V
Transistor
C5
C4
C2
C3
Y1
4.5-5.5V
6-12V
U1
32684AP169-230705
D3
USB
LINE
SW2
Power
IOREF
RESET
ANALOG IN
5V GNDVIN
GND
5V
A0
A1
A2
A3
A4
A5
D4
D13
D1
D2
SW1

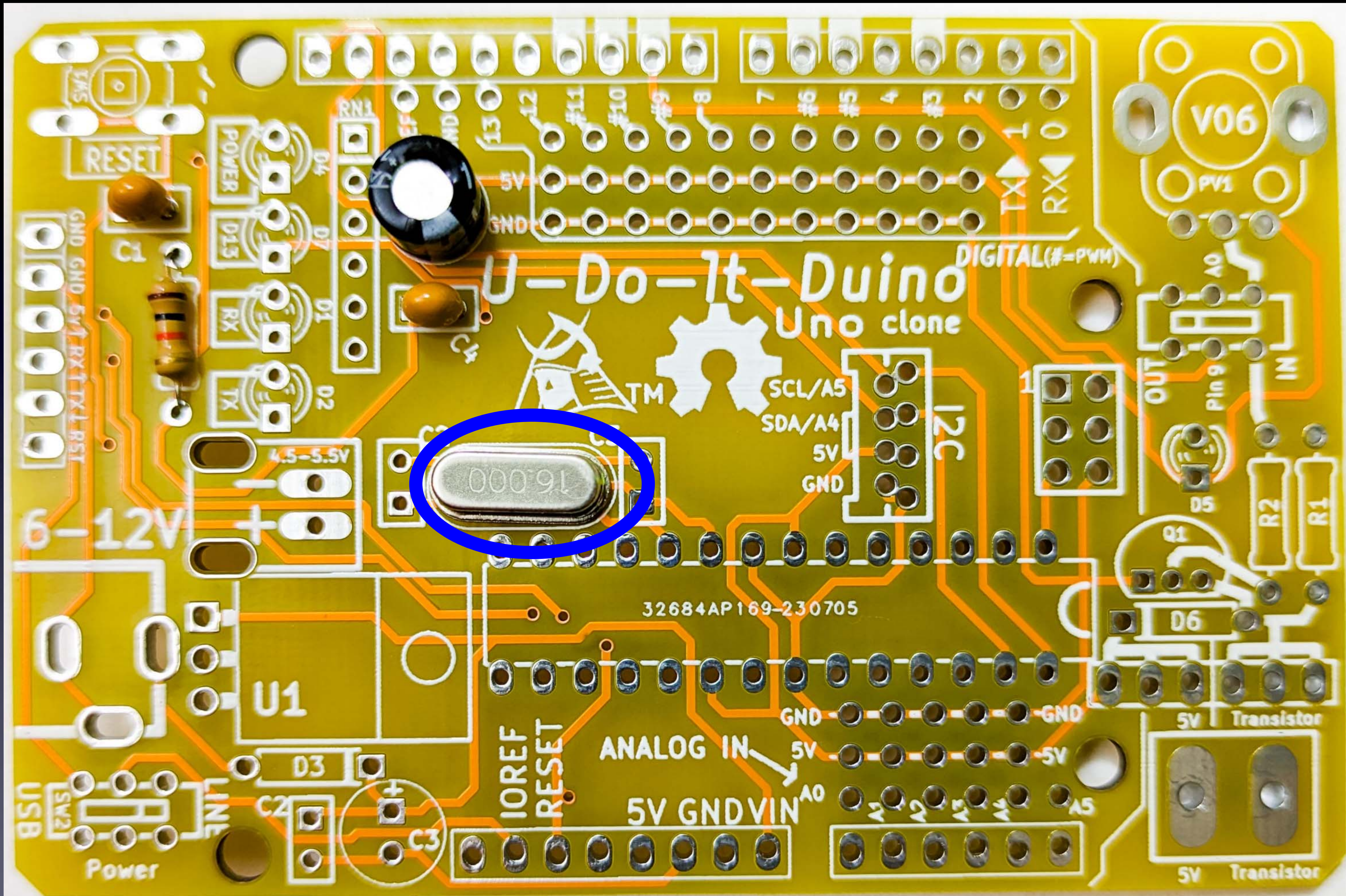
R3


U-Do-It-Duino
Uno clone
DIGITAL(#=PWM)
RESET
C1
C4
C5
RN1
AREF
GND
13
12
#11
#10
#9
8
7
#6
#5
4
#3
2
1
0
TX
RX
5V
GND
POWER
D13
RX
TX
V06
PV1
SCL/A5
SDA/A4
5V
GND
I2C
C2
C3
Y1
4.5-5.5V
6-12V
U1
32684AP169-230705
D3
D5
D6
Q1
R1
R2
OUT
Pin 9
IN
ANALOG IN
IOREF
RESET
5V GND VIN
A0
A5
USB
SW2
LINE
Power
5V
Transistor

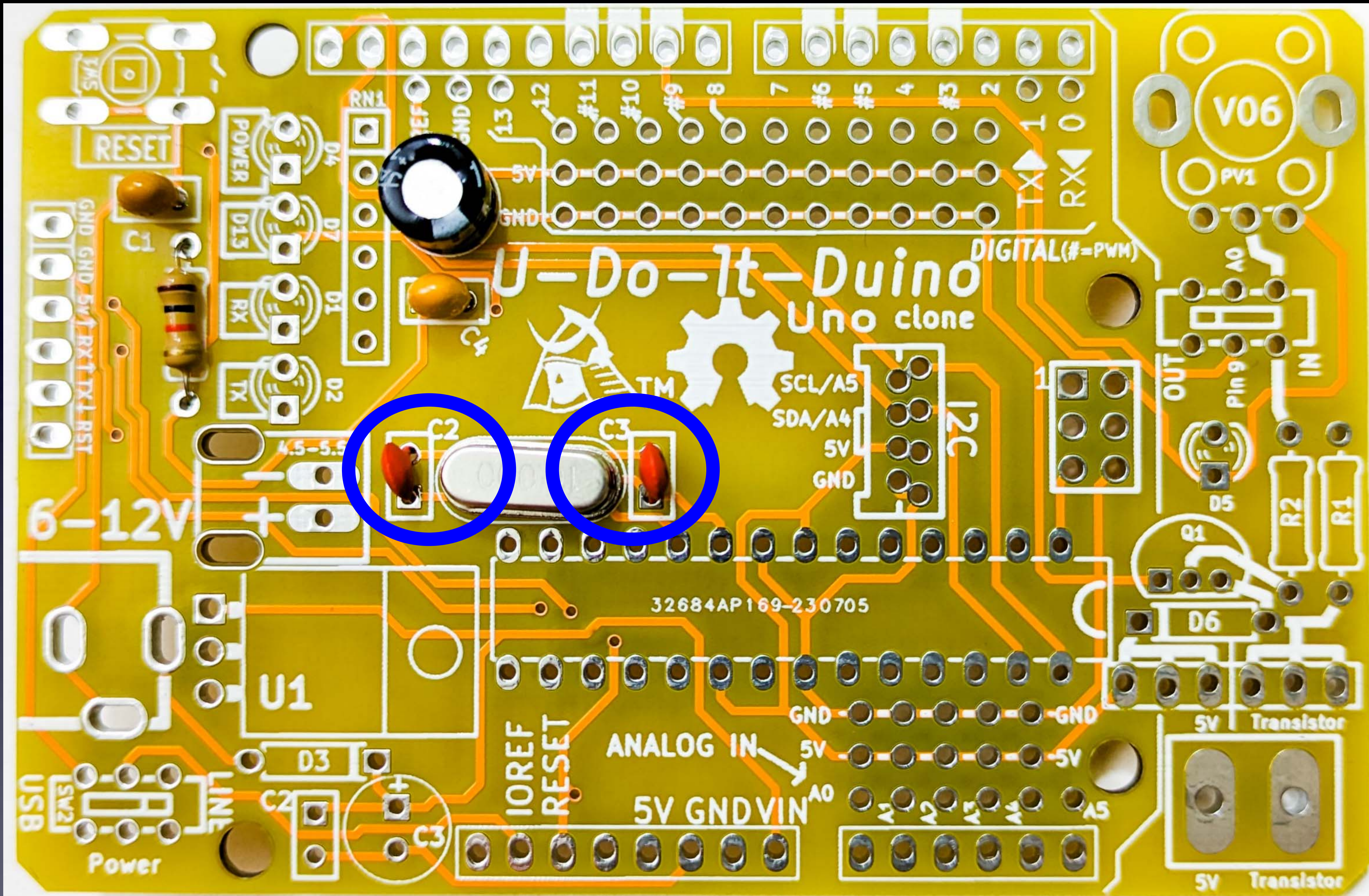
C1 and C4



C5: Long lead “+” (square pad)


U-Do-It-Duino
Uno clone
DIGITAL(#=PWM)
RESET
POWER
D13
RX
TX
RN1
C1
C4
SCL/A5
SDA/A4
5V
GND
I2C
V06
PV1
D5
Q1
R2
R1
D6
16.000
4.5-5.5V
6-12V
U1
32684AP169-230705
D3
C2
C3
USB
SW2
LINE
Power
IOREF
RESET
5V GND VIN
ANALOG IN
A0
A5
5V
Transistor

Y1


U-Do-It-Duino
Uno clone
DIGITAL(#=PWM)
RESET
POWER
D13
RX
TX
C1
C4
C2
C3
RN1
5V
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SCL/A5
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4.5-5.5
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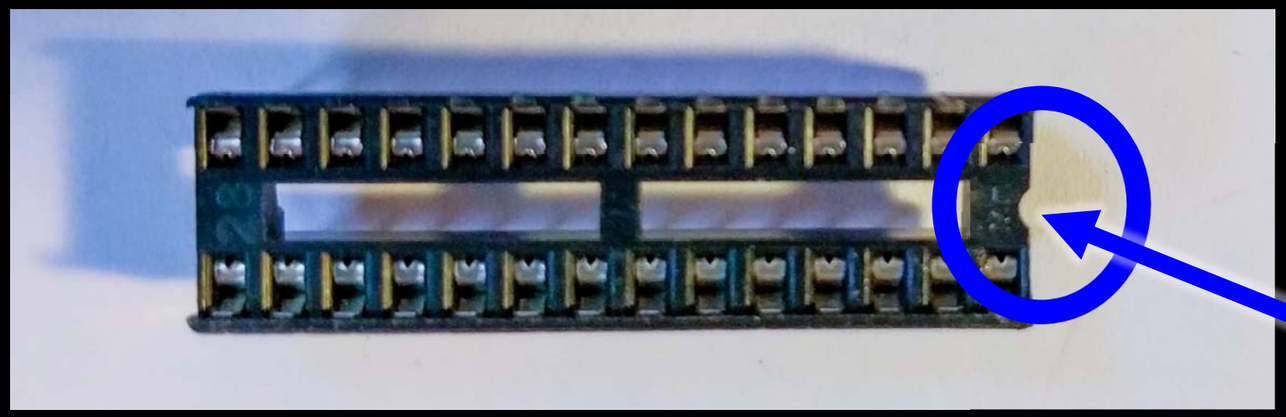
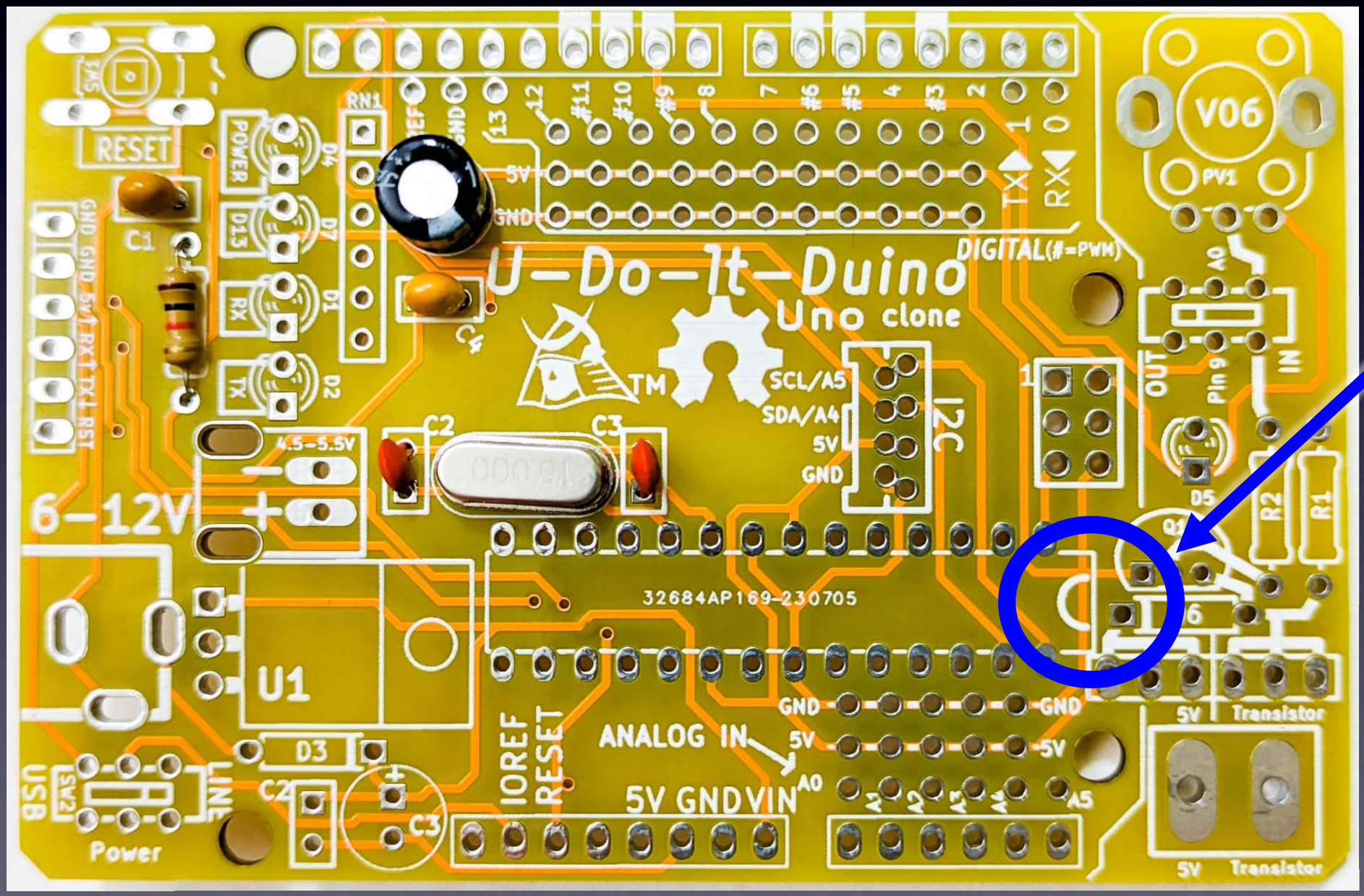
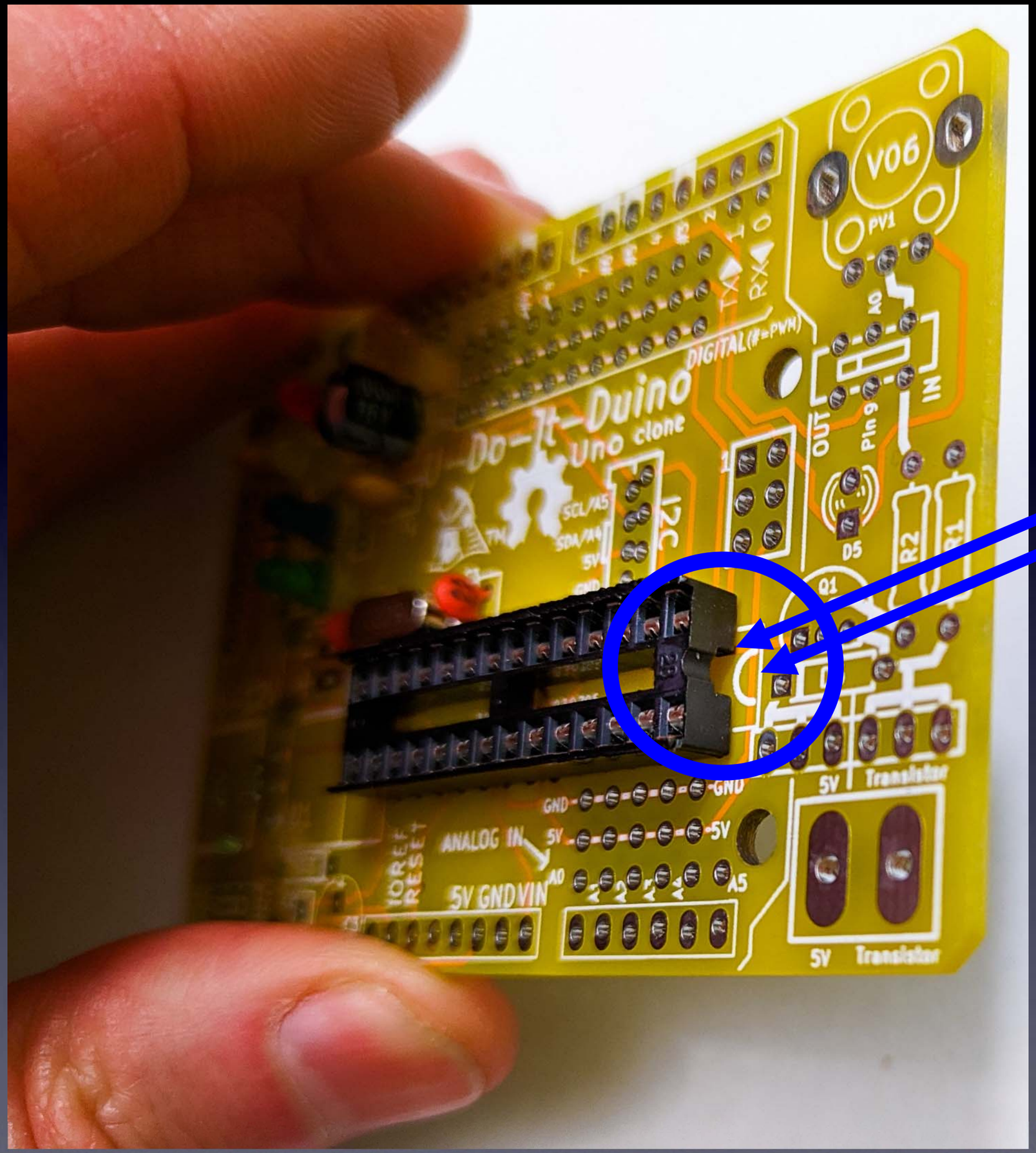
D5
D6
Q1
R1
R2
OUT
IN
Pin 9
32684AP169-230705
ANALOG IN
IOREF
RESET
5V GND VIN
A0
A1
A2
A3
A4
A5
USB
SW2
LINE
Power
5V
Transistor

C2 and C3



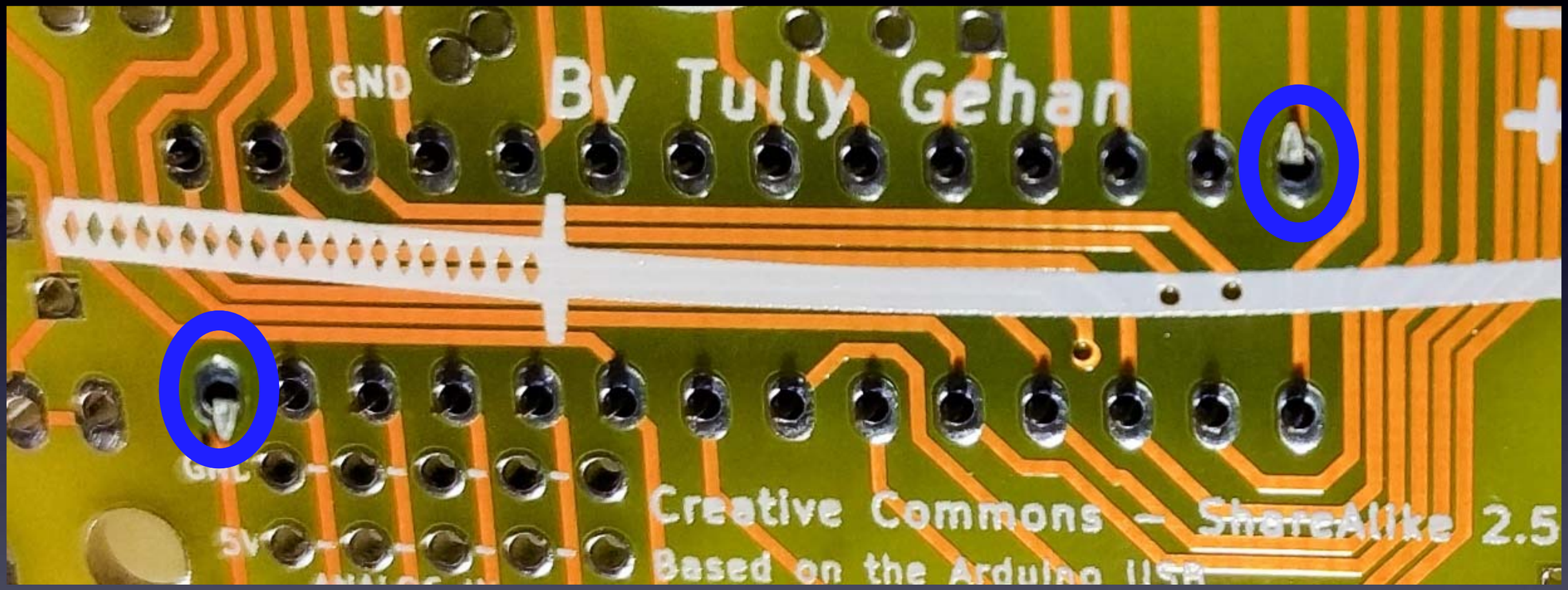


Orientation of Microcontroller Socket

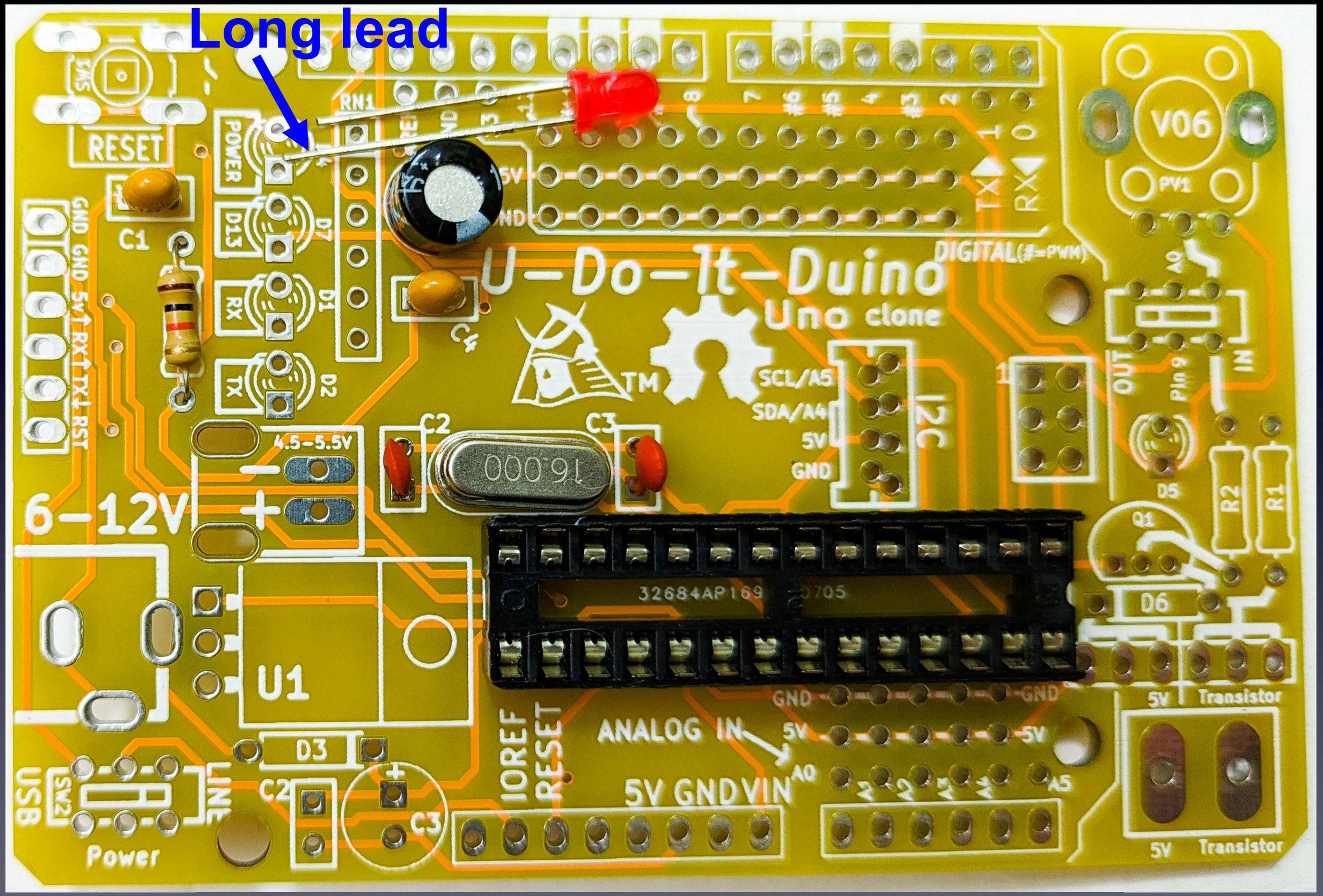


Orientation of Microcontroller Socket

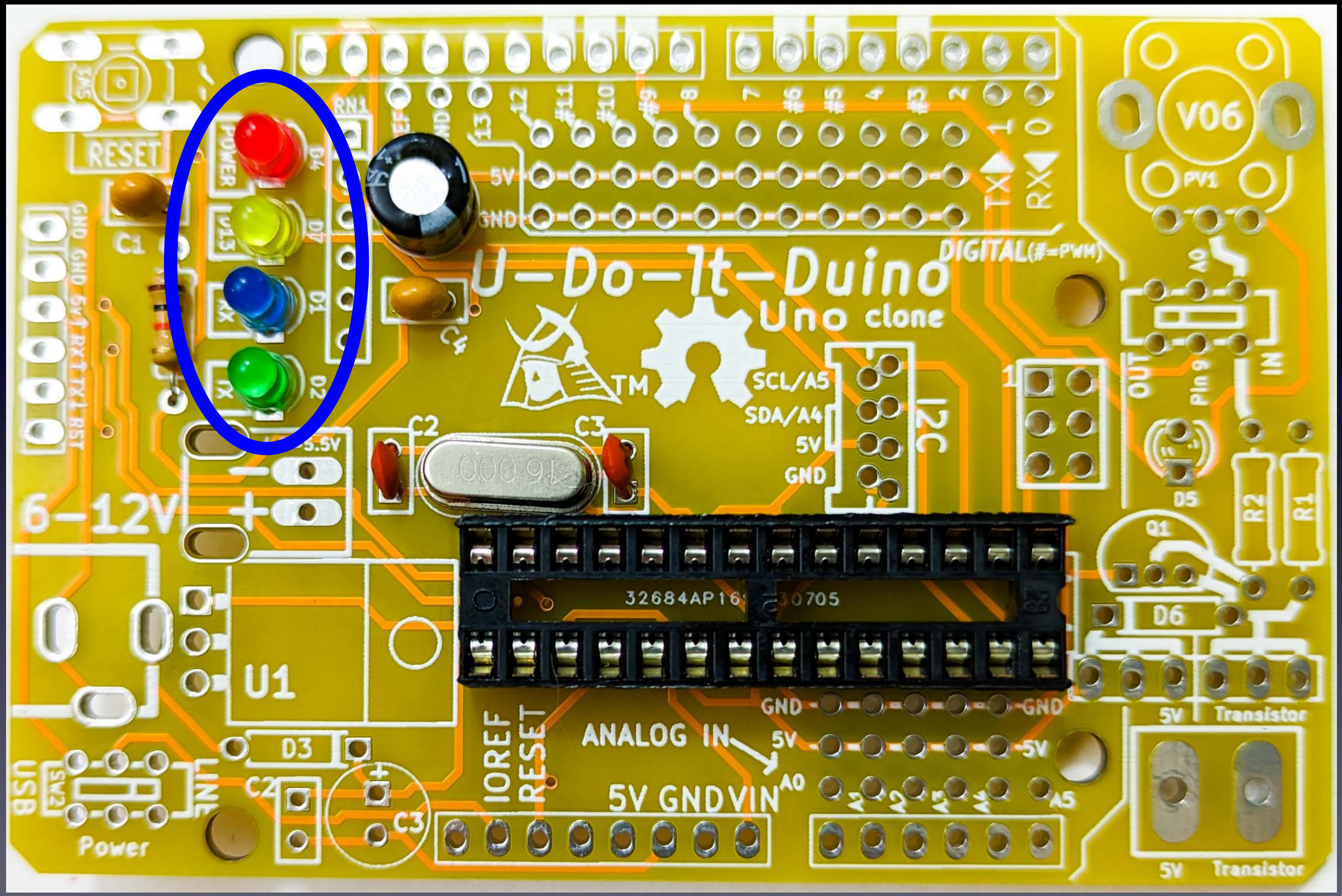
Bend pins down on two opposite corners



- Solder all 28 pins.
- Only need to clean the tip after it gets dirty.
- No need to cut the pins short after soldering.

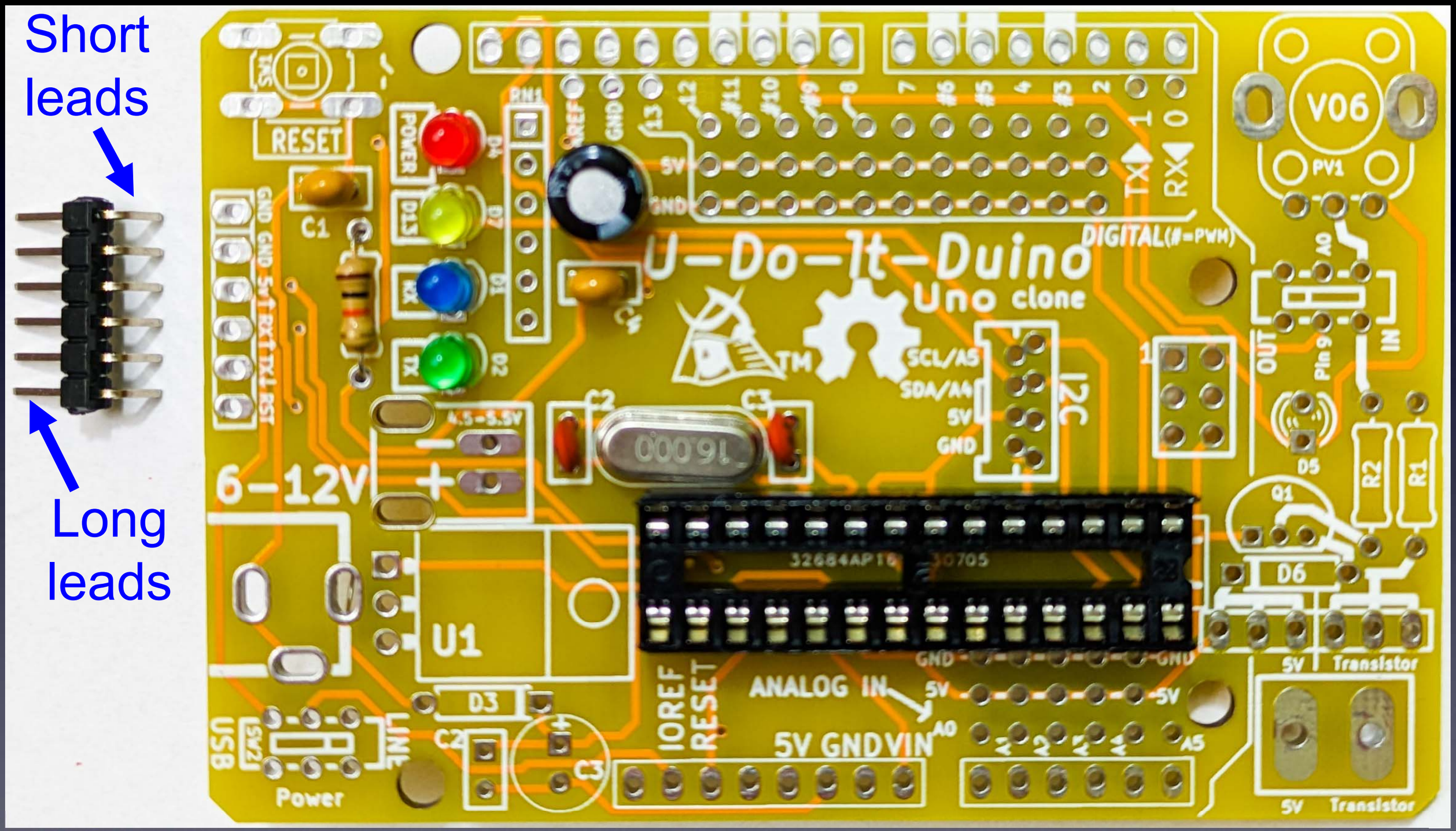


LEDs: Long lead “+” (square pad)



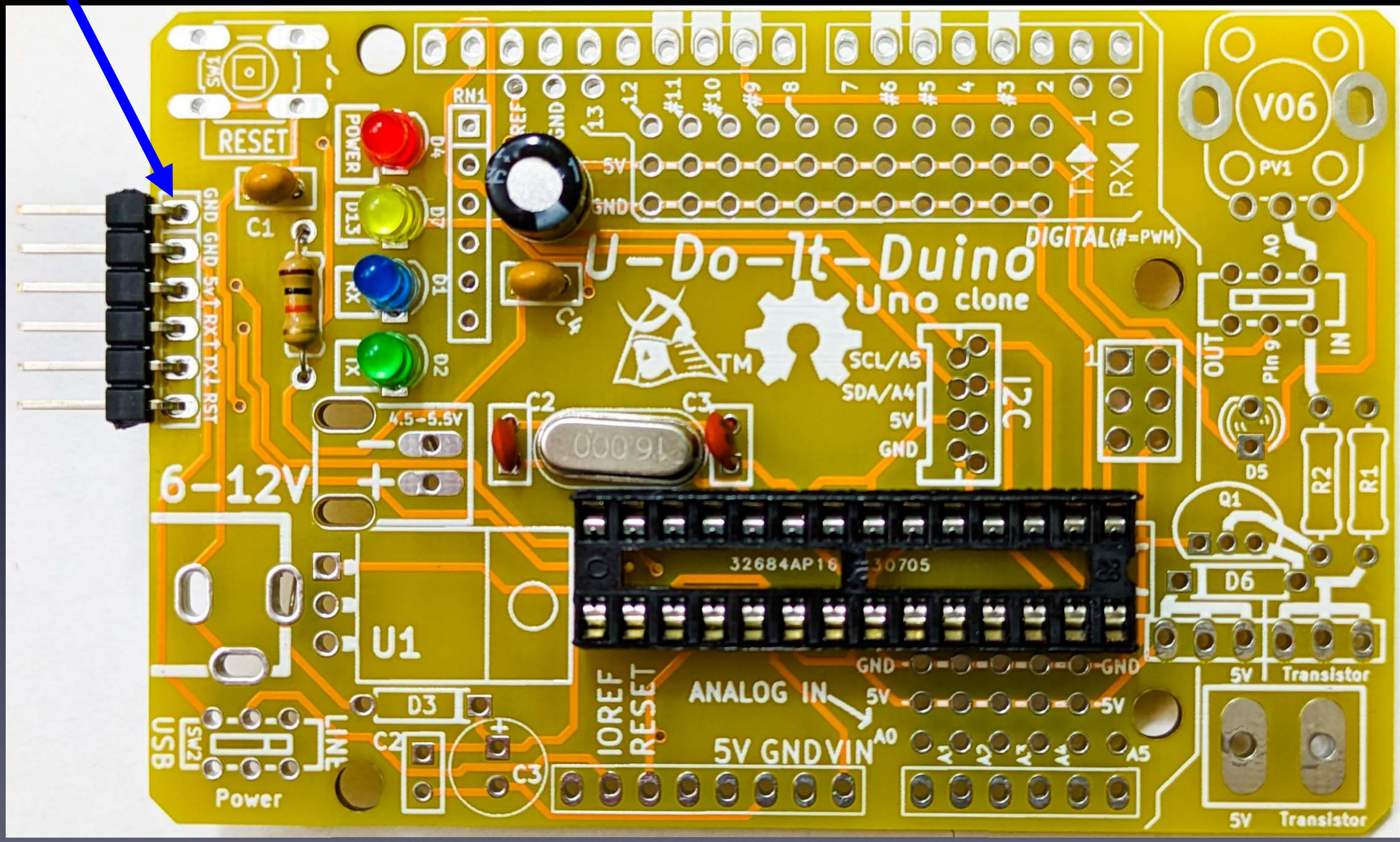
LEDs: Long lead “+” (square pad)

Short leads of the Serial Port Connector go into the board



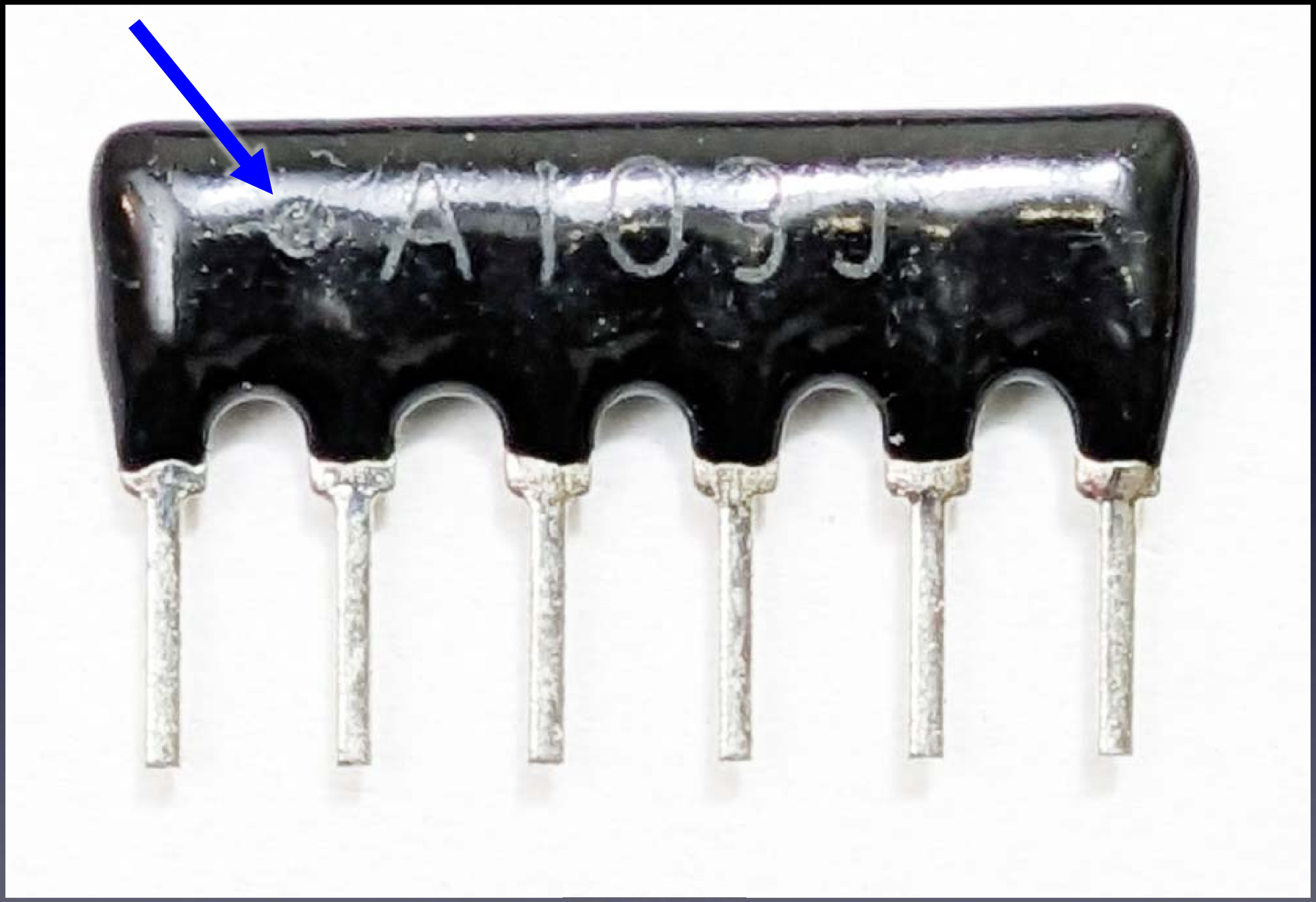
Serial Port Connector: Long leads point to the left

Solder on top of board if it falls out upside down



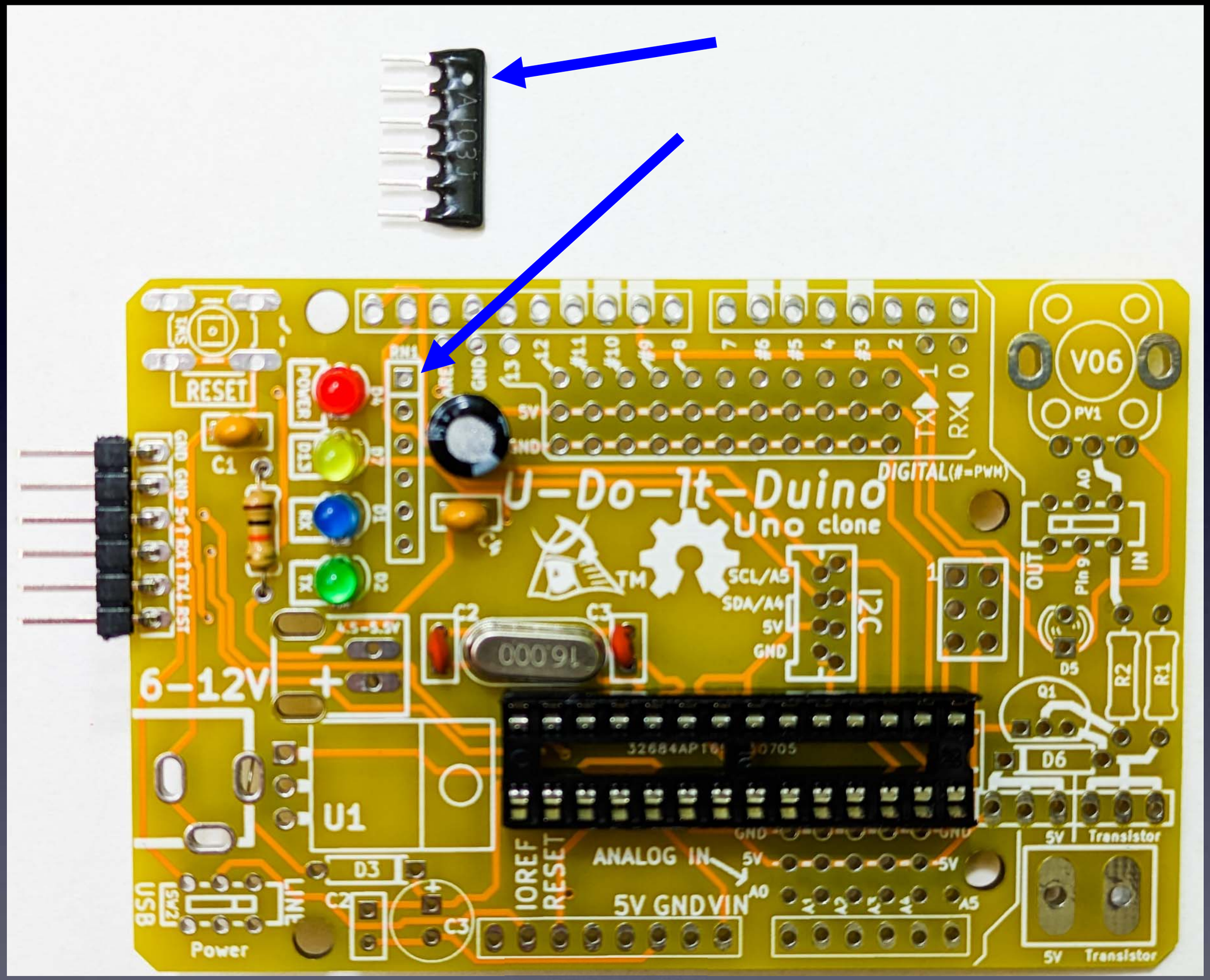
Serial Port Connector

The white circle (or diamond)



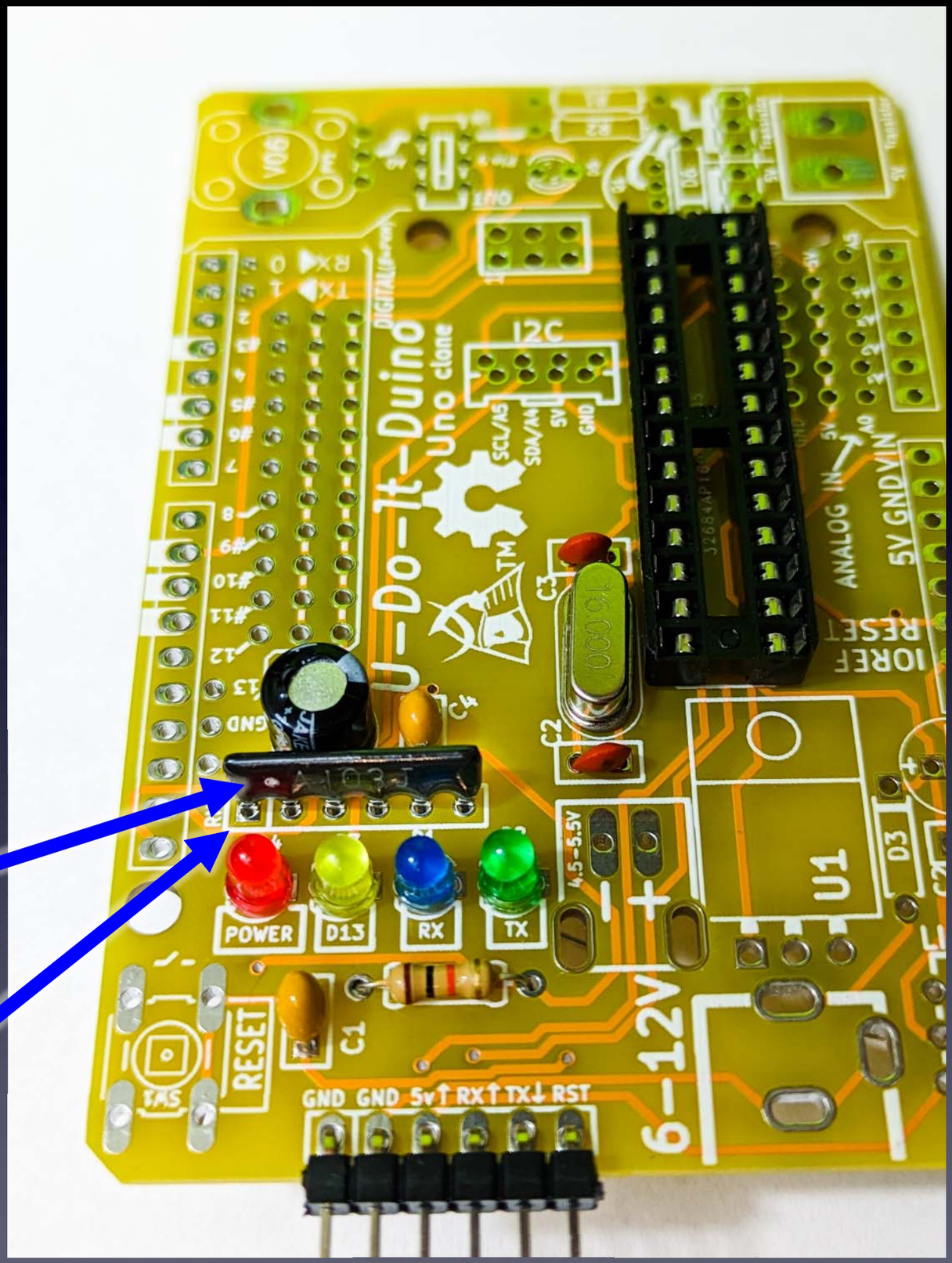
RN1

The white circle (or diamond) goes in the square pad



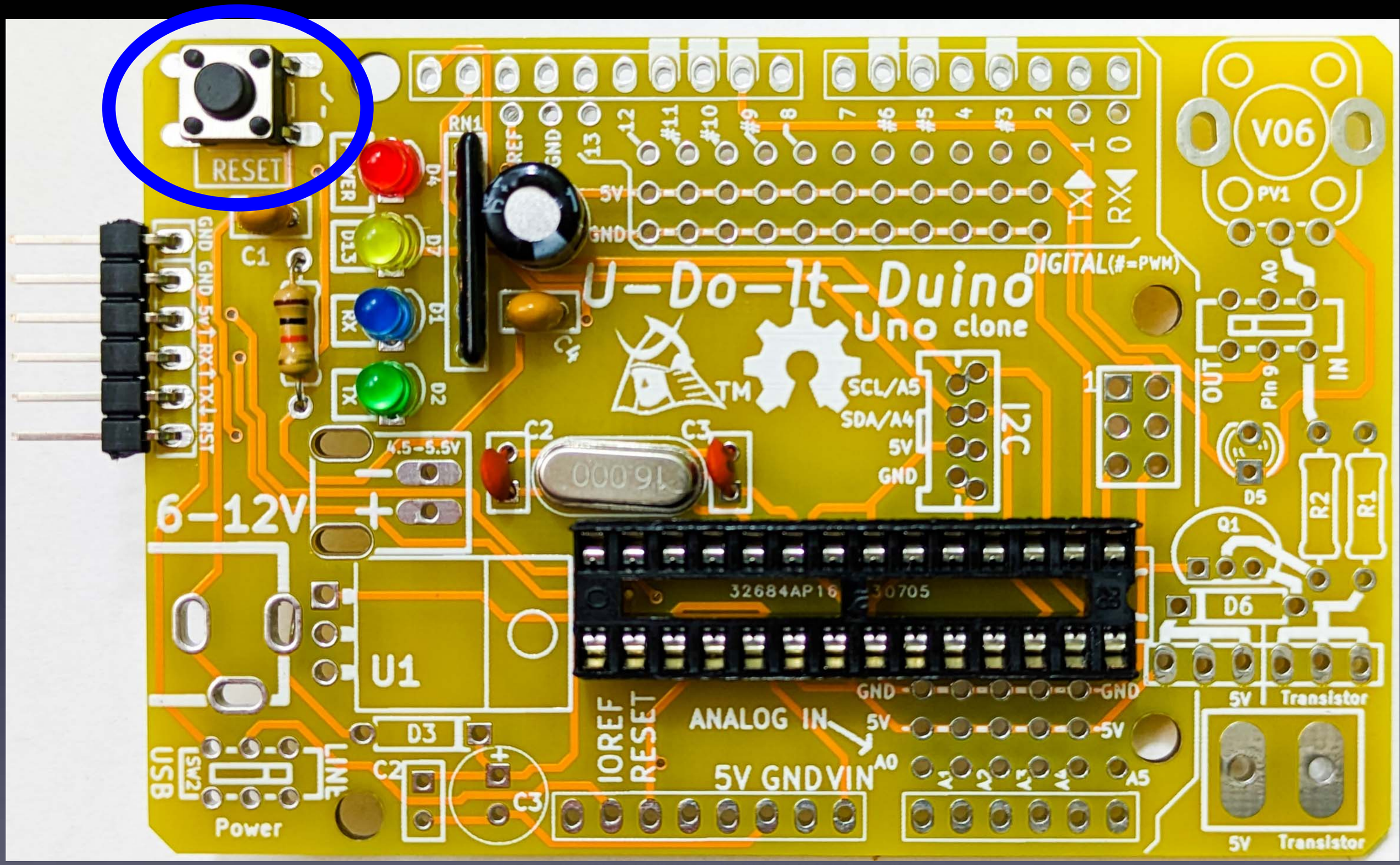
RN1

The white circle (or diamond) goes in the square pad

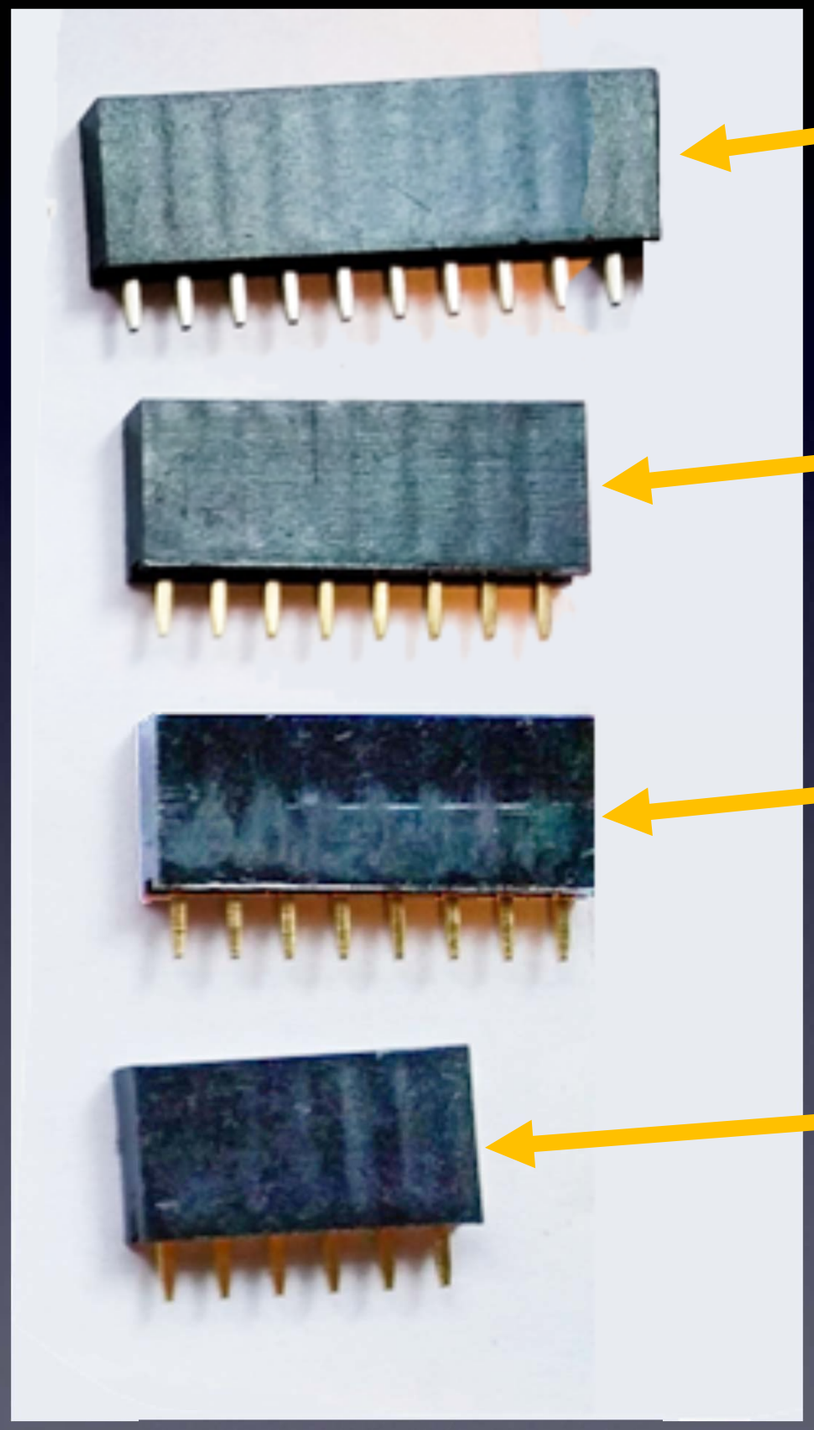


RN1

The Reset Switch fits in 2 ways – either way is fine

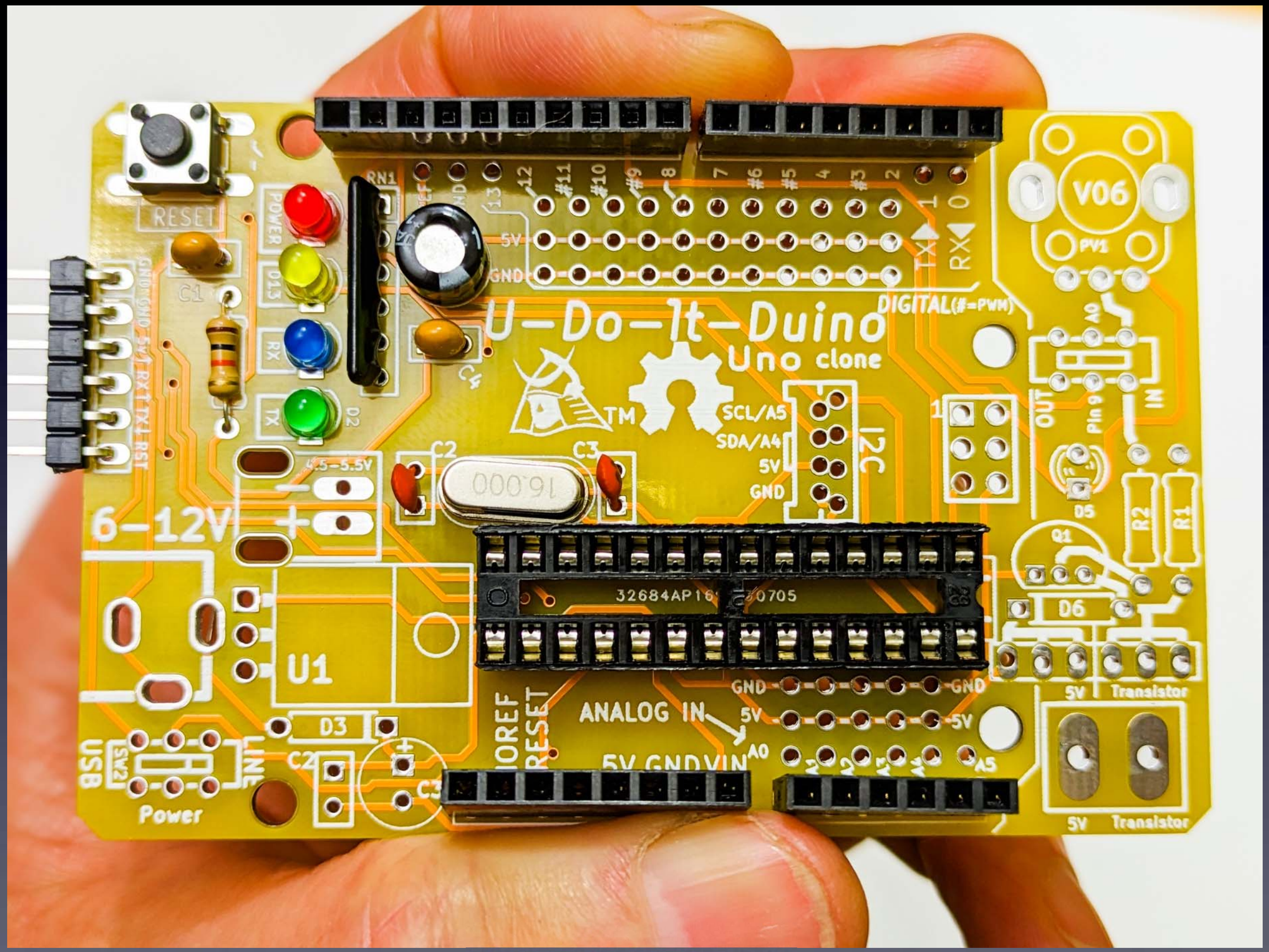


Reset Switch



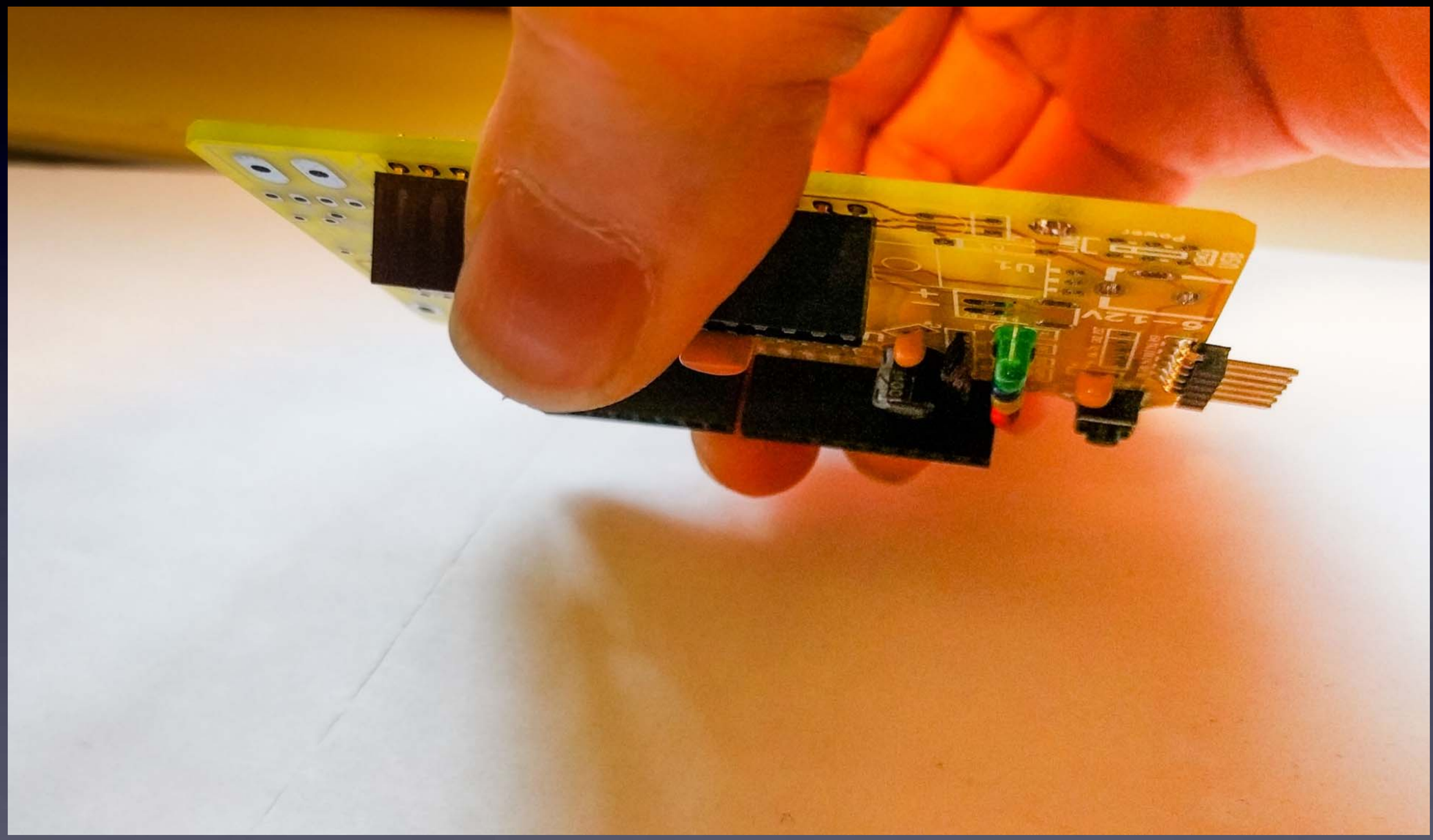
Headers

It’s easiest to solder all Headers at once.
Insert, and hold them like this:



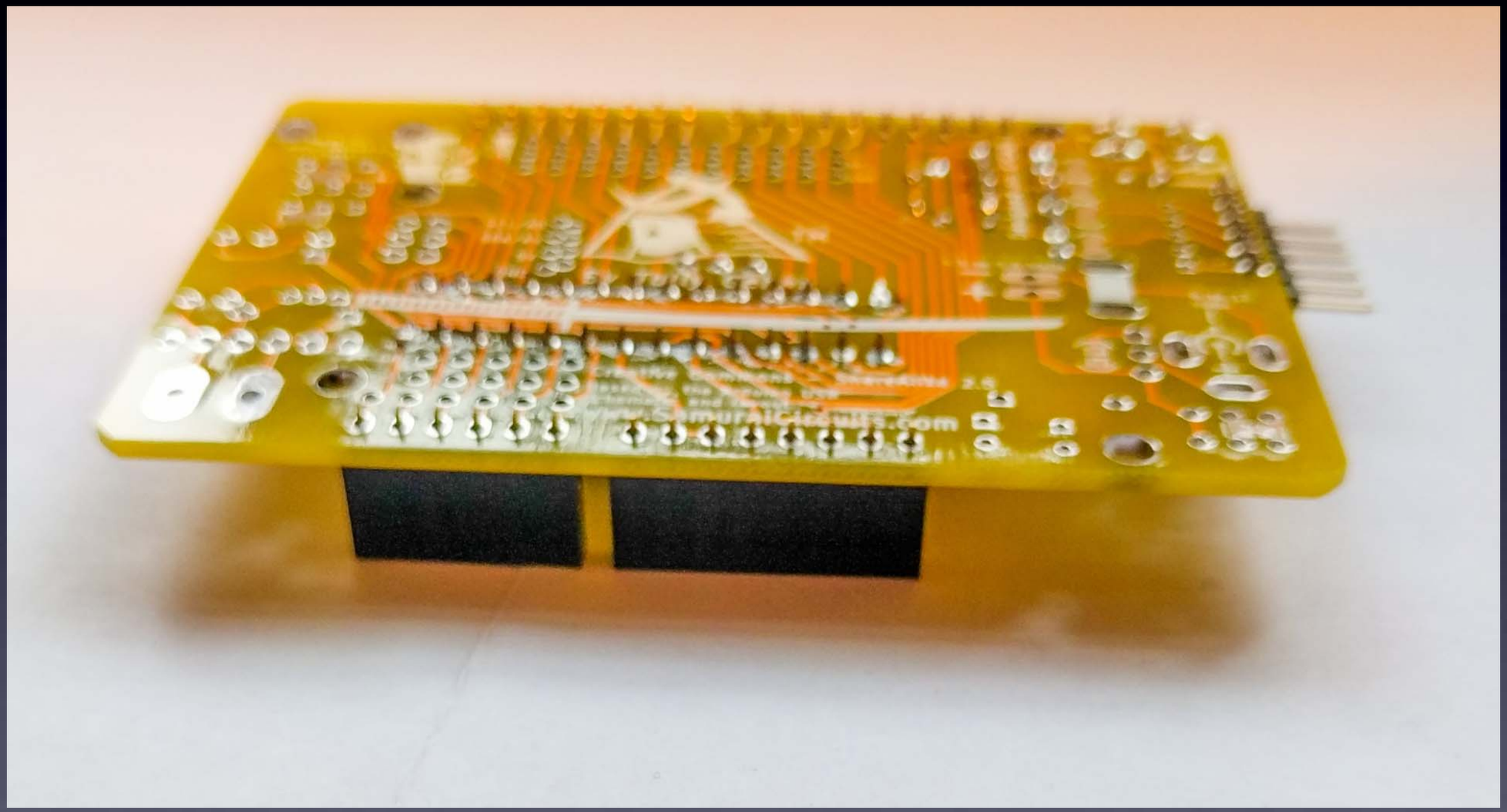
Headers

It’s easiest to solder all Headers at once.
Lay it all on the table:



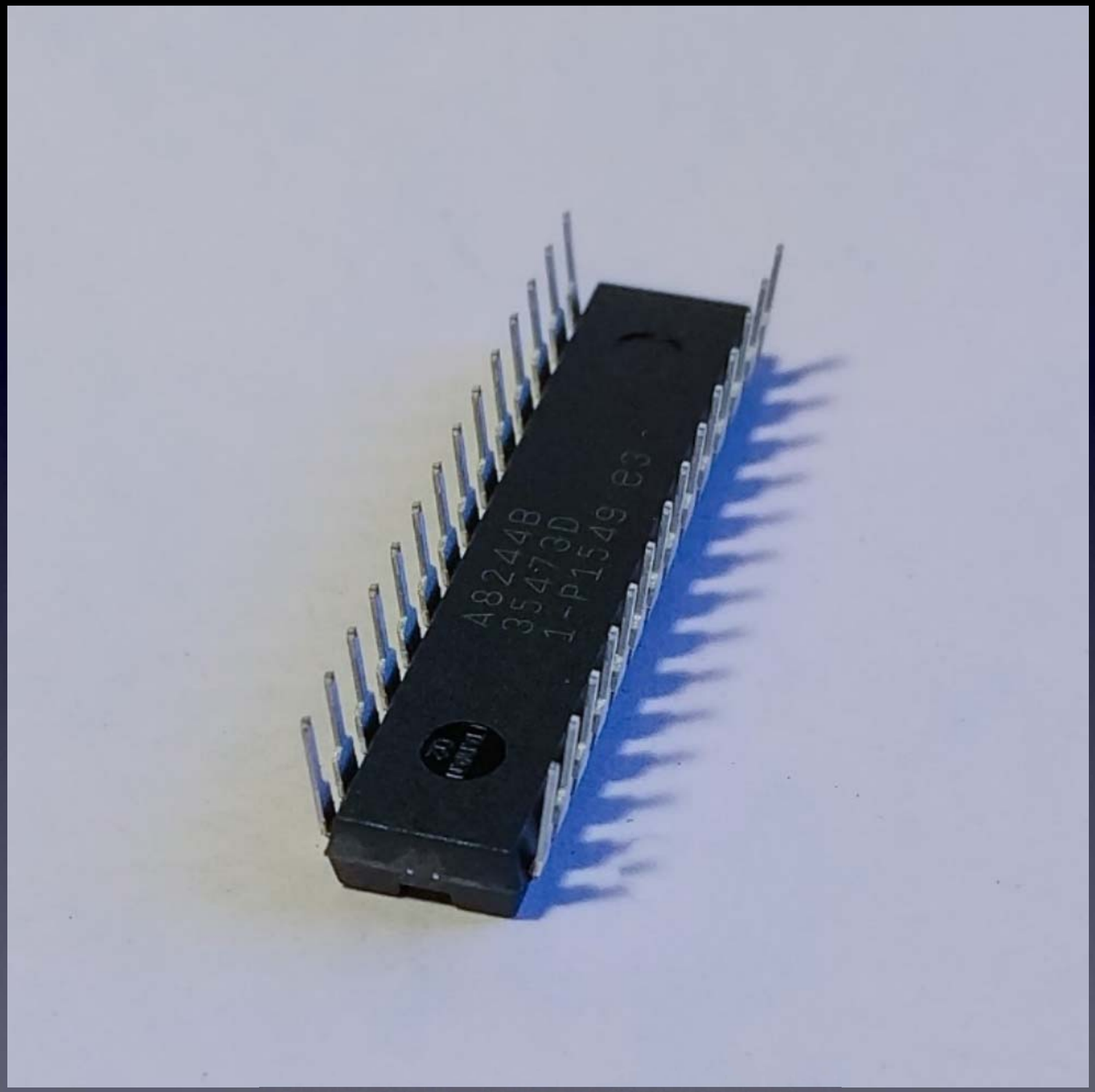
Headers

Now it is easy to solder all of the Header pads at once.



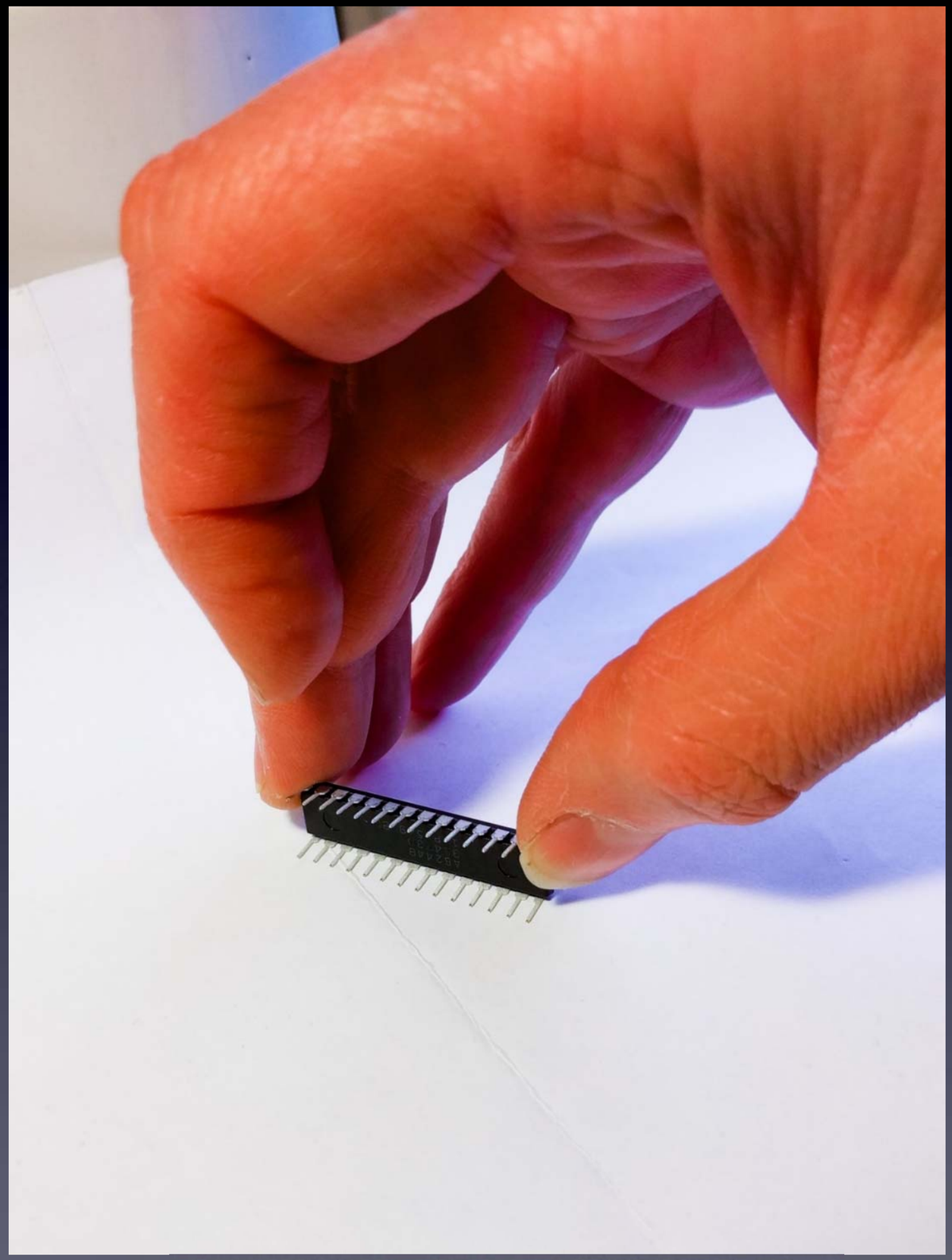
Headers

You probably need to bend the pins so they're parallel



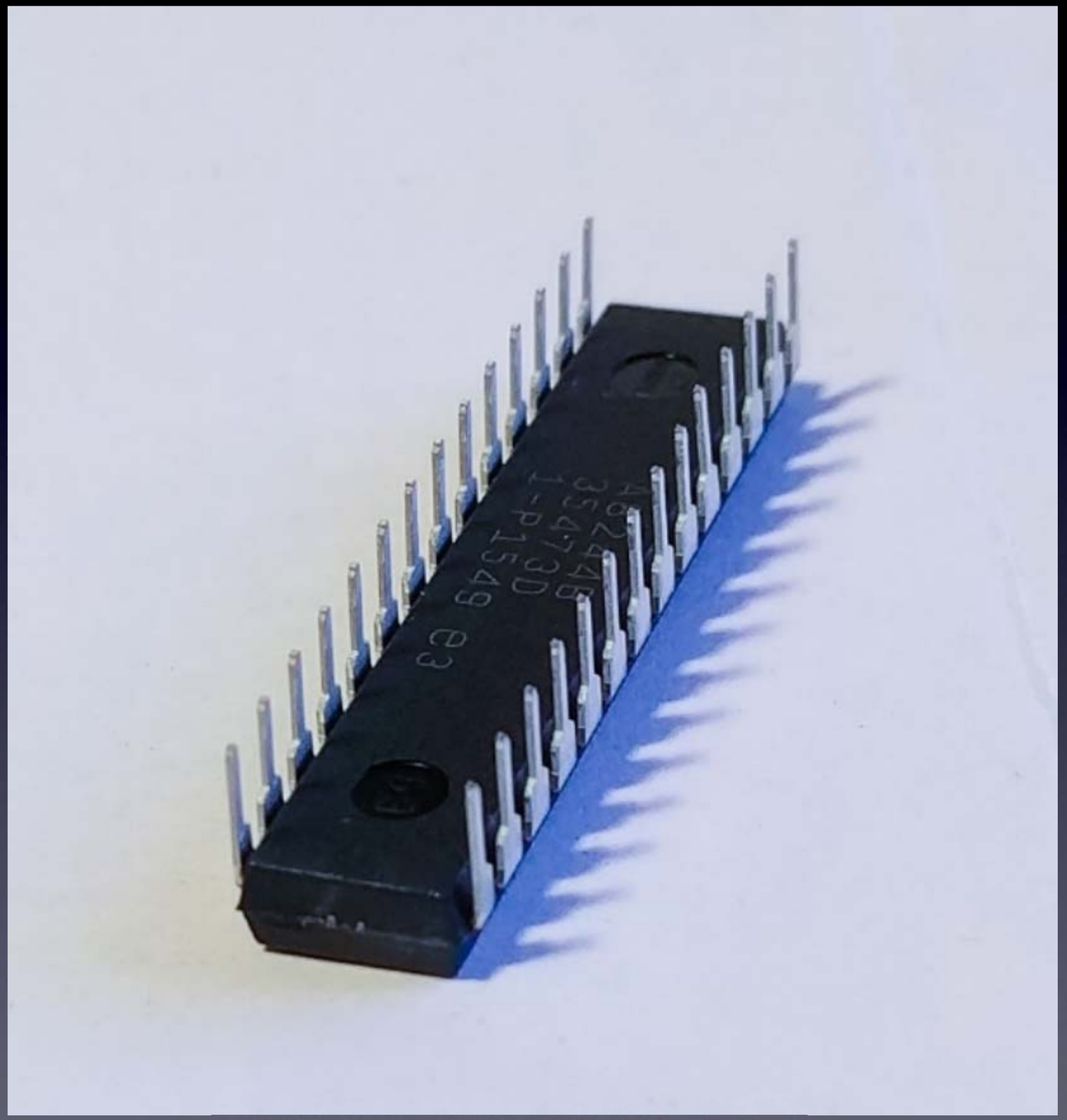
Microcontroller

You probably need to bend the pins so they're parallel



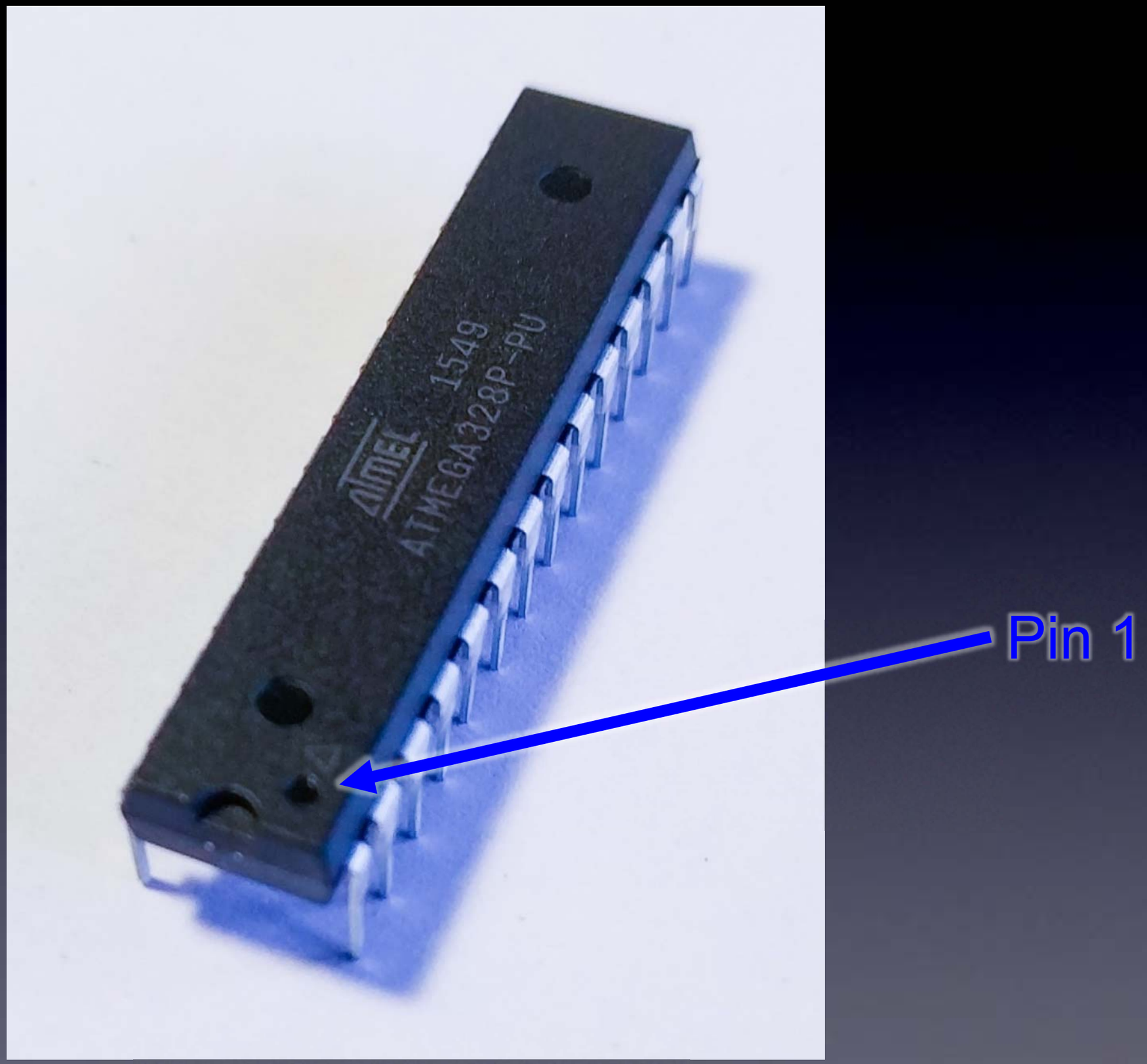
Microcontroller

You probably need to bend the pins so they're parallel

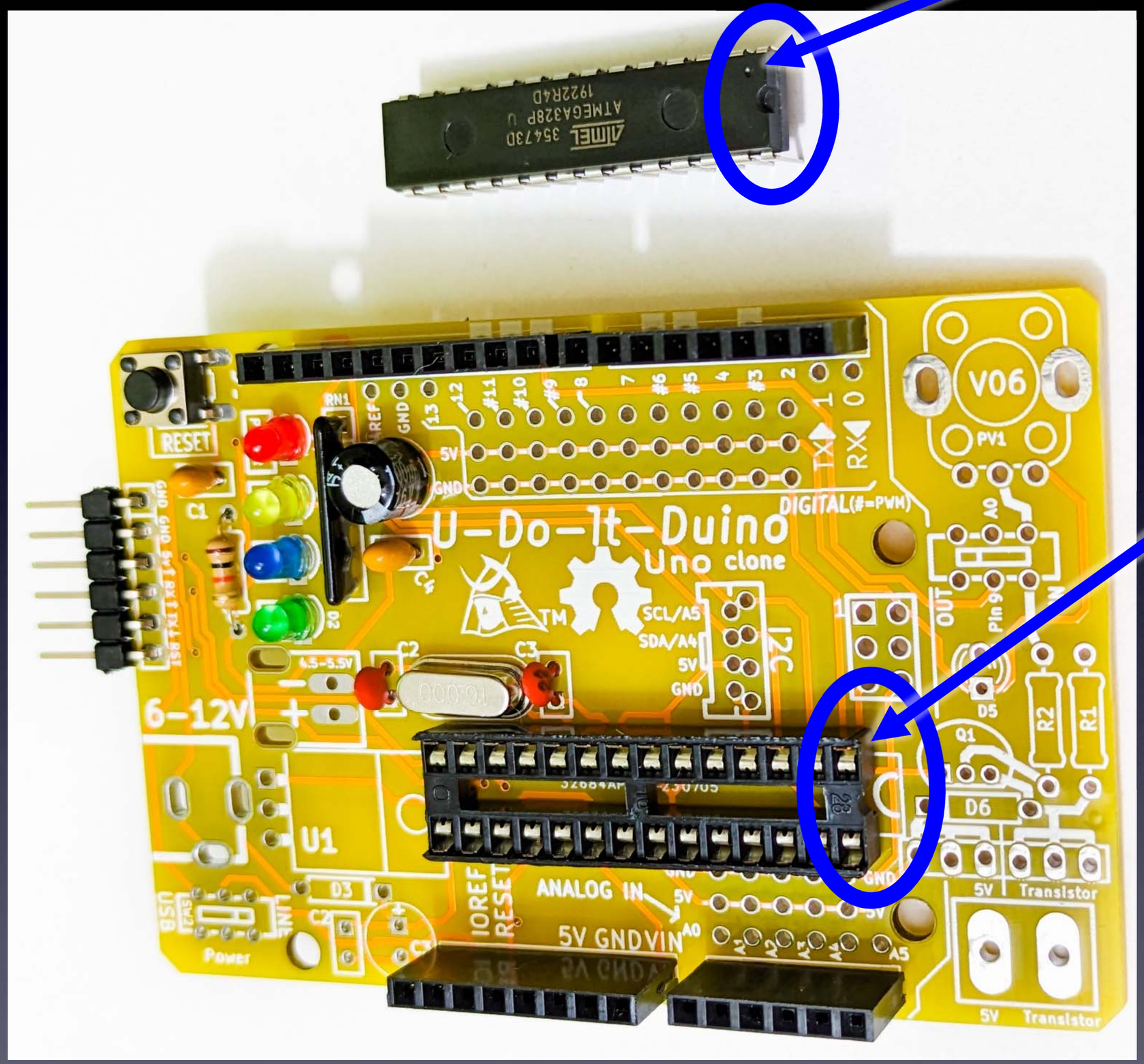


Microcontroller

Ready to insert into its socket

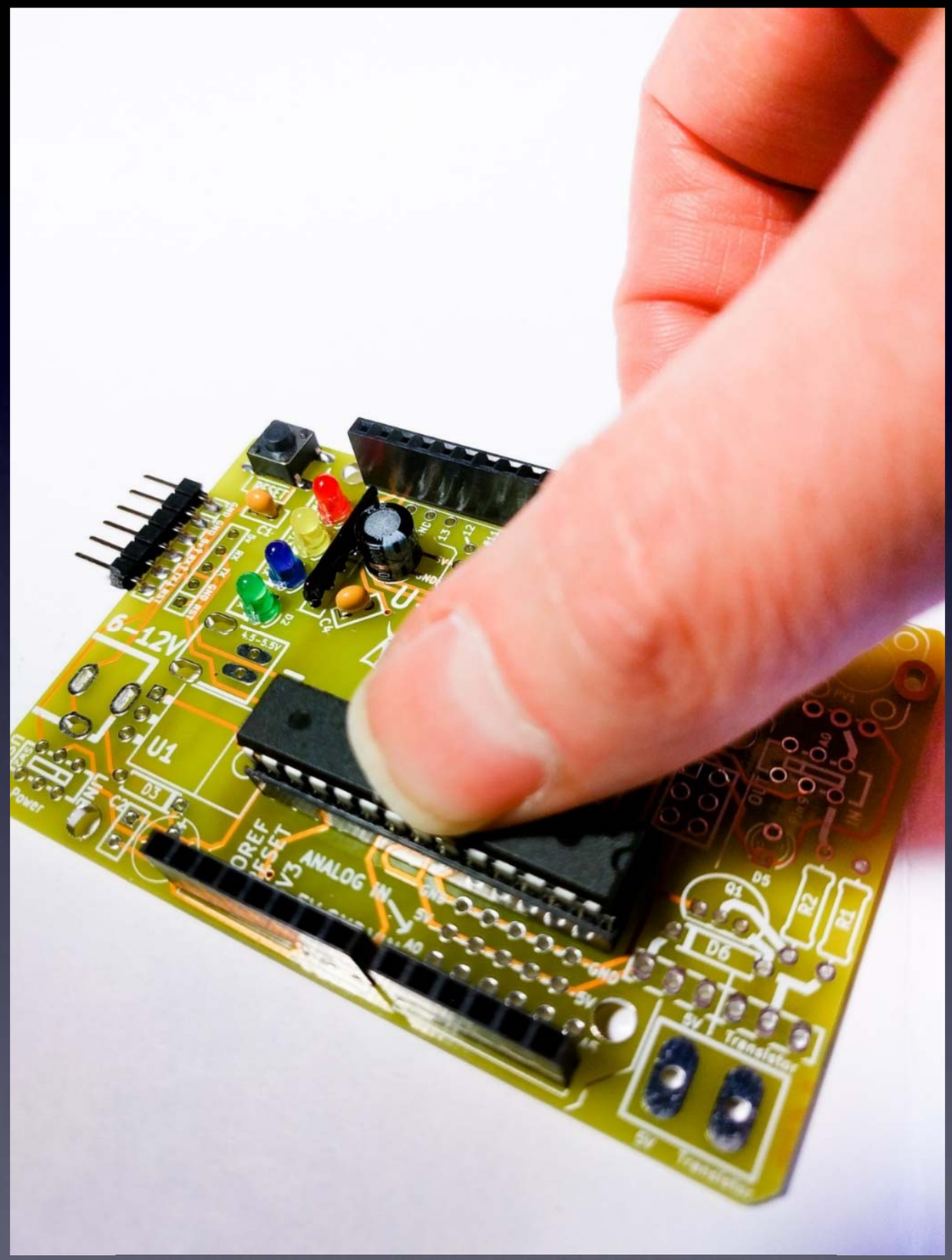


Microcontroller



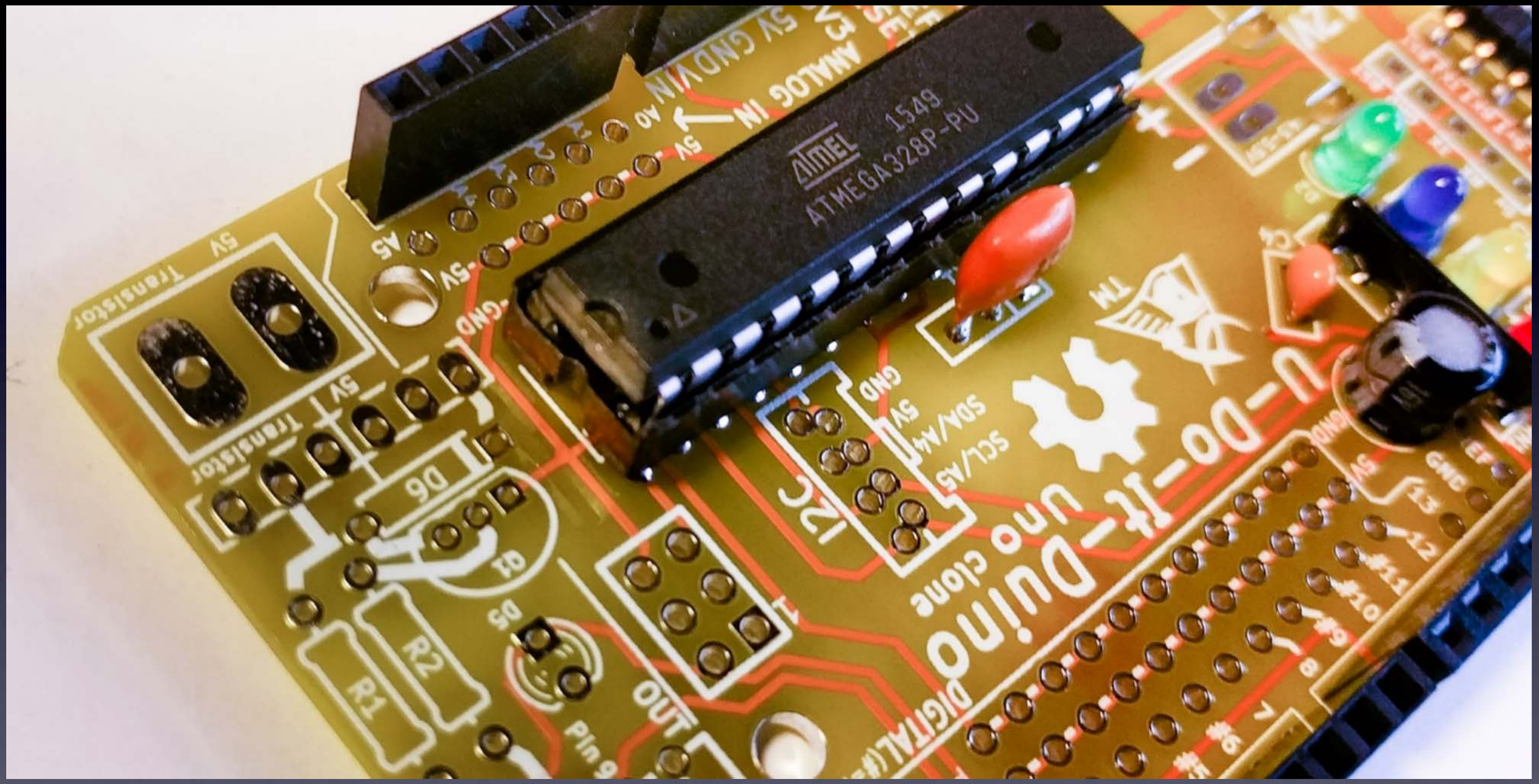
Microcontroller

When all pins fit in their holes,
use both thumbs to push chip into socket



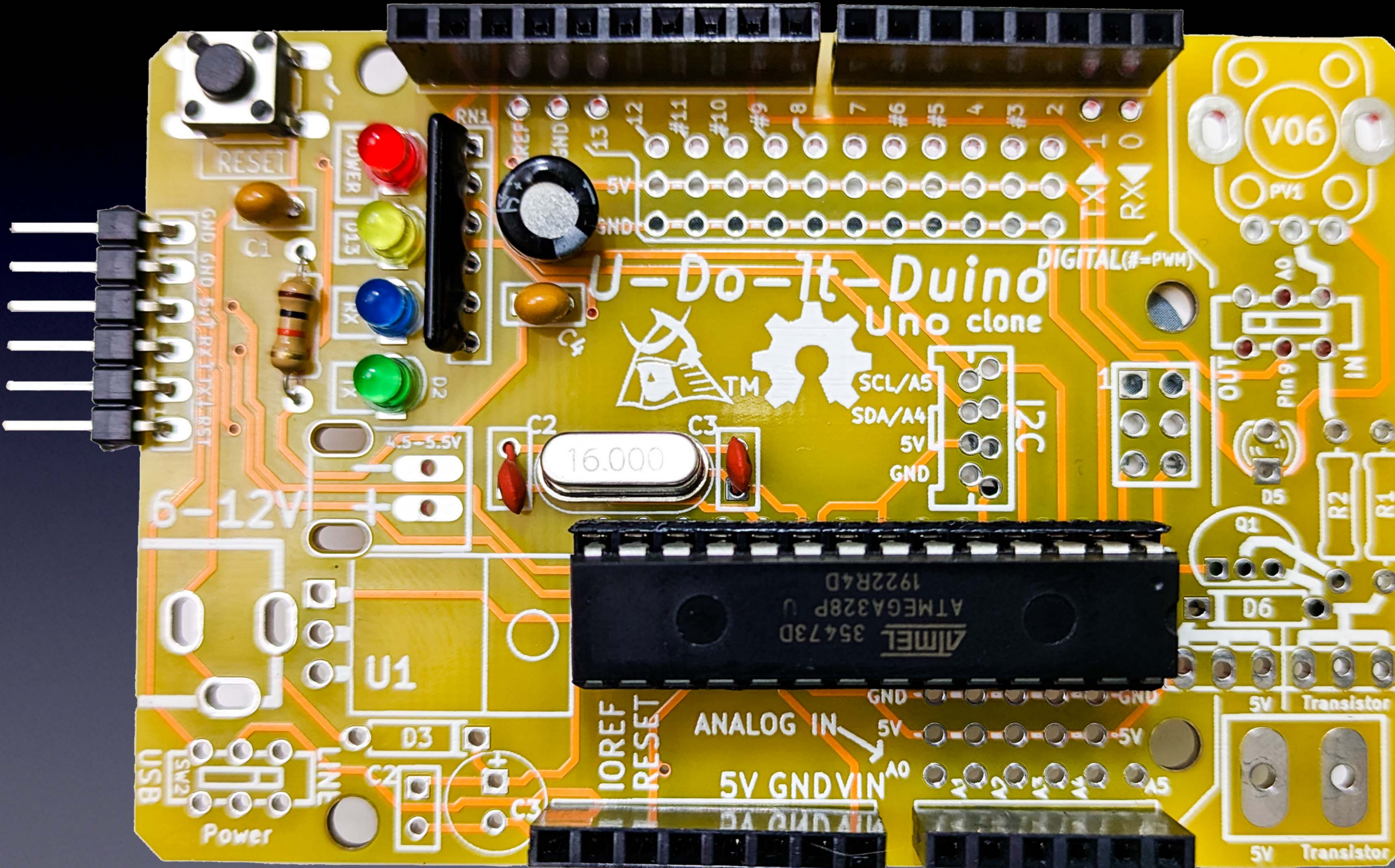
Microcontroller

Each pin in its hole, chip pushed down all the way.
Pin 1 is oriented correctly.



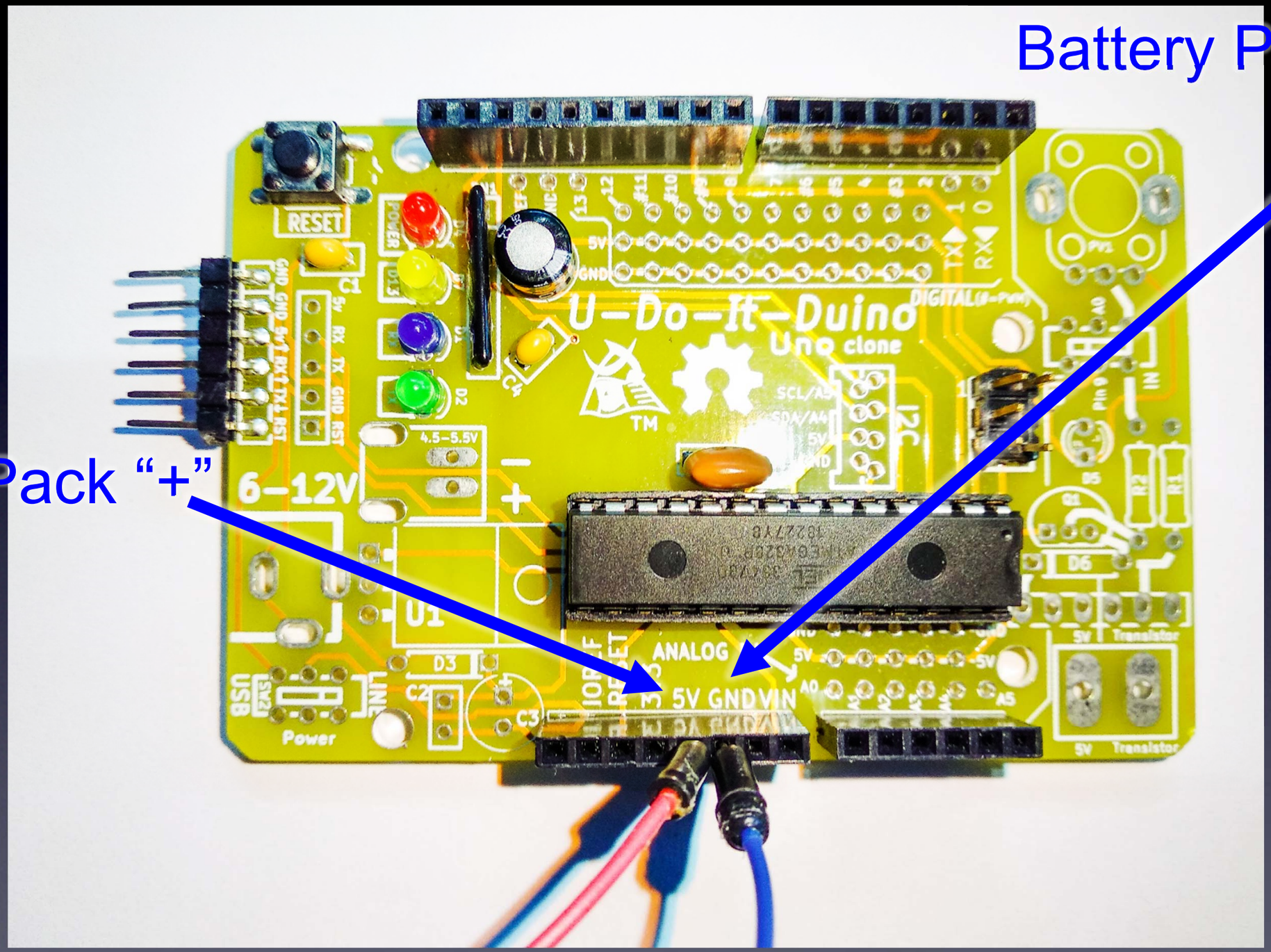
Microcontroller

We’re done!



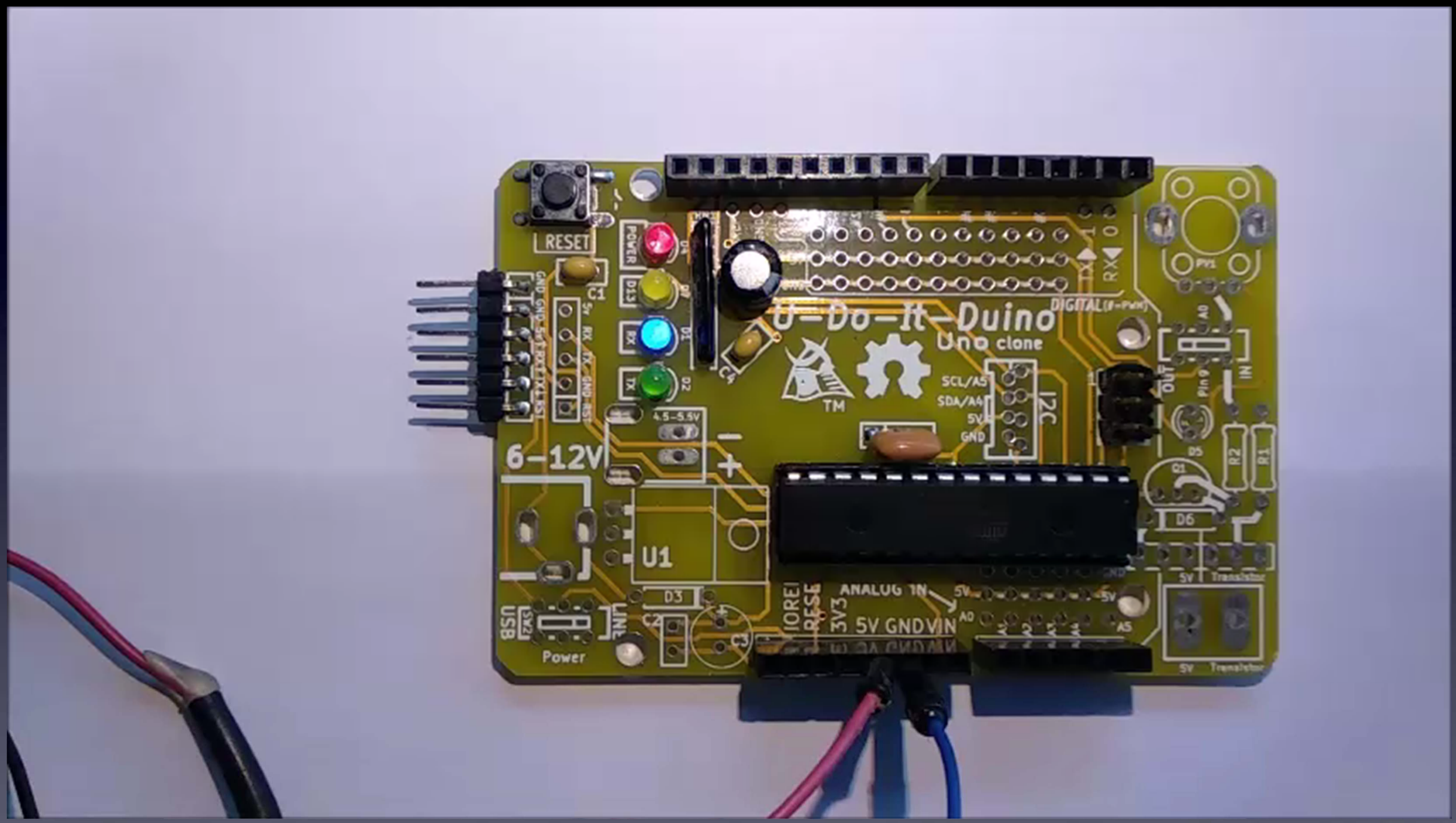
U-Do-It-Duino
Uno clone
DIGITAL(#=PWM)
RESET
16.000
ATMEGA328P
ANALOG IN
5V GNDVIN
IOREF
RESET
6-12V
4.5-5.5V
U1
D3
Power
SCL/A5
SDA/A4
5V
GND
I2C
V06
D6
Transistor

First test:



Connect power with a battery pack…

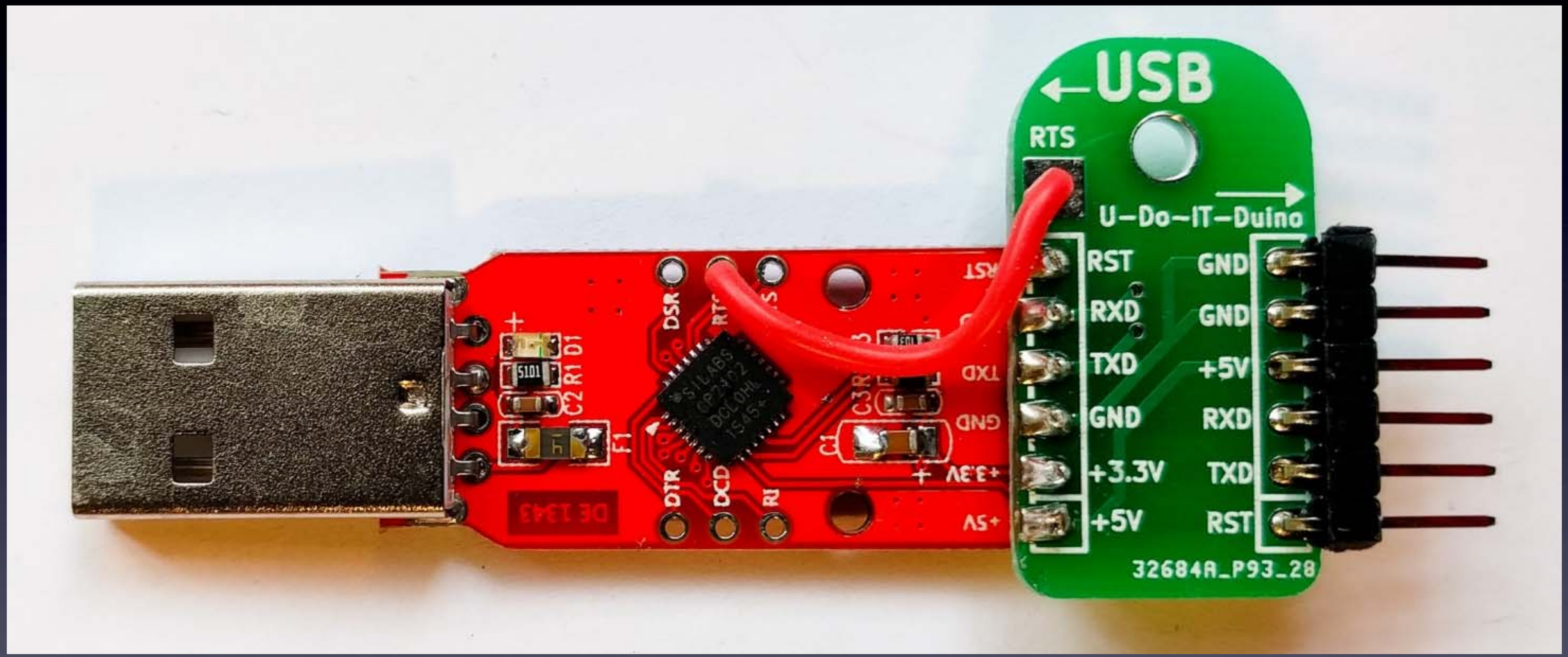
First test:



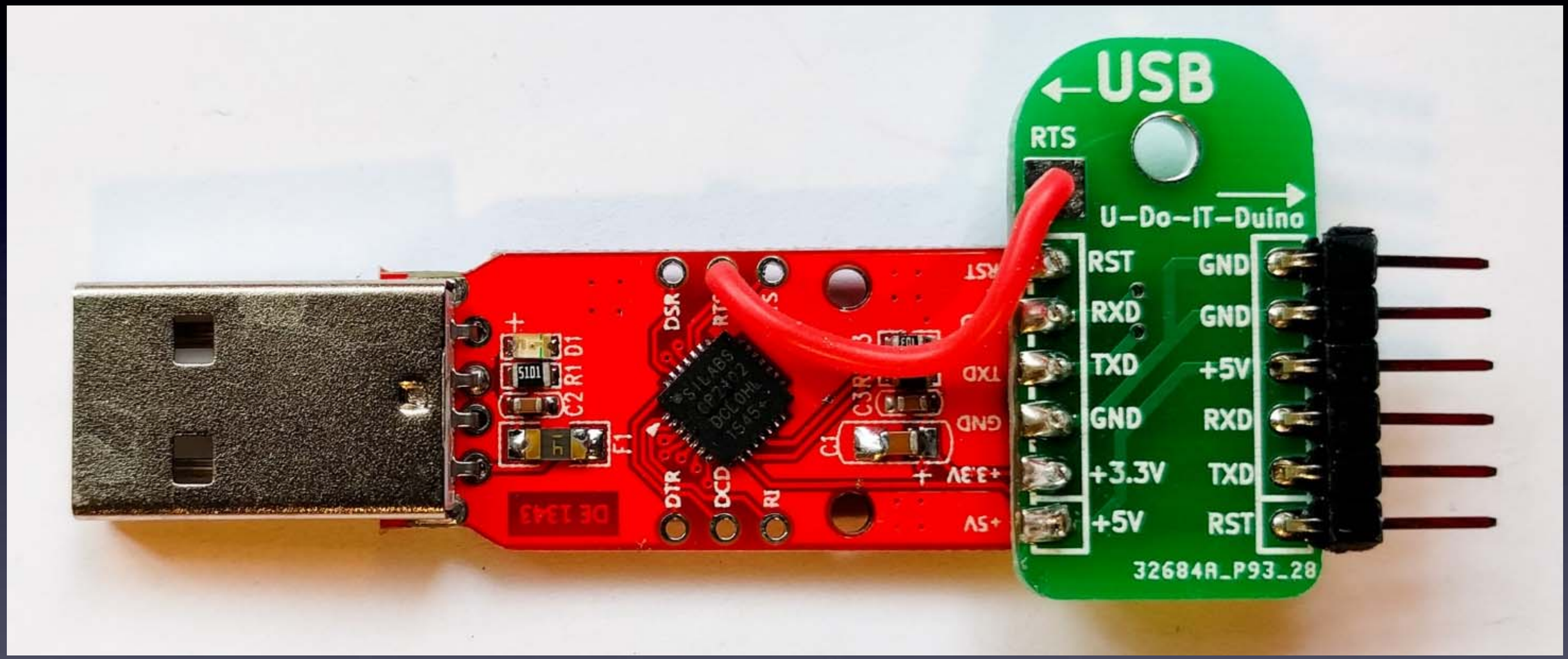
… and it blinks !

Now we can
connect parts to our Arduino,
and program it!

USB-Serial Cable



USB-Serial Cable Driver



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

<https://www.silabs.com/products/development-tools/software/usb-to-uart-bridge-vcp-drivers>

Helpful info
on the
Arduino for(4) Total Newbies

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workshop
web-page:

https://cornfieldelectronics.com/cfe/projects/tvbg_arduino/tvbg_arduino_workshop.php

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Take control

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.

DO-IT-YOURSELF PROJECTS

by Mitch Altman, and friends.
Last modified: 5-Oct-2022

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!

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.

Here is a really nice tutorial on how to solder -- for total beginners!
Soldering Tutorial for total beginners

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:
mitch AT CornfieldElectronics DOT com

open source hardware

Soldering!

Soldering is fun! And it is easy! Really, it is!
I have taught tens of thousands of people around the world how to solder.
Everyone can do it! All ages, all skill levels.
People who have never even sewn a button can easily learn to solder. Even you!
Once you learn how to make one good solder connection, you can make anything on this page.
And if you can make anything on this page, you can learn to make anything with electronics and microcontrollers.

scroll down

Project: Make your own open source TV-B-Gone Kit (developed with Ladayada)

The TV-B-Gone Kit was originally developed from a MiniPOV3 hack (see below)
(which, of course, I hacked from my original TV-B-Gone.)

For excellent **assembly instructions**, please go to the TV-B-Gone Kit page of the of the Adafruit.com website.

For **questions** about the TV-B-Gone Kit, please go to the TV-B-Gone Kit user forum.
To see the **schematic, firmware, and board layout**, please go to TV-B-Gone Kit downloads.

TV-B-Gone Kits are available for **purchase** from the TVBGone.com website.

Project: Arduino For Total Newbies workshop
-- Learn Arduino, and make your own TV-B-Gone!

This workshop covers lots of ground -- all you need to learn how to play with Arduinos.
As an example project, you can make your own TV-B-Gone using Arduino.
Many thanks to Ken Shirriff for the original TV-B-Gone for Arduino project!
For documentation on this workshop, please see the:
Arduino For Total Newbies Workshop page.

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Arduino For Total Newbies Workshop

last updated: 1-May-2023

Learn how to make your own way cool projects with Arduino,
using TV-B-Gone as an example project to learn from.

I've given this workshop at **Noisebridge** hackerspace in San Francisco (several times), at **27C3** and **28C3** in Berlin, and **29C3**, **30C3**, **31C3**, **32C3**, and **33C3** in Hamburg, and at **34C3**, **35C3**, **36C3** in Leipzig, and **RC3** online, at **CCCamp2011** **CCCamp2015** and **CCCamp2019** outside of Berlin, at **HeatSync Labs** hackerspace in Phoenix, AZ, at **Fabelier** hackerspace in Paris, at Unit One in **2012**, **2014**, **2016**, and **2018** as Hacker In Residence at the University of Illinois, in Urbana, IL, at Makerspace Urbana in Urbana, IL in **2012** and in **2016**, at **Workshop Weekend** in Oakland, CA (twice), at **XinCheJian** hackerspace in Shanghai, at **Maker Carnival** in Beijing (twice) at several conferences and hackerspaces on my **Hackers on a Train Workshop Tour 2012** including at **HOPE Number 9** in New York City, at **ToorCamp 2012** in Neah Bay, WA, at **OHM 2013** and **SHA 2017** outside of Amsterdam, at **RockIT CoLabs** in San Francisco, at **BalcCon2k14** in Novi Sad, Serbia, at **HOPE X**, **The Eleventh HOPE**, **The Circle of HOPE** **A New HOPE** in New York City, and **HOPE 2020** online, at **the iCenter** as Hacker In Residence at Tsingua Univeristy in Beijing, at **EMF Camp 2016**, **EMF Camp 2018**, and **EMF Camp 2022**, outside of London, at **Tami** hackerspace in Tel Aviv, at **Le Wagon** and **Zhongxi** in Chengdu, at **Astralship** hackerspace in North Wales (three times), at **Open Source Microfactory Build Camp** online, at **Newline** in Ghent, at **GPN20** in Karlsruhe, at **Fri3d Camp 2022** near Sint-Joris-Weert, Belgium, at **Maker Faire Brno 2022** in Brno, Czech Republic, at **HiP-Berlin** in Berlin, Germany,
and lots of other places.

Each time 10 to 50 people show up. (Folks seem to like it.)

Itinerary for Arduino For Total Newbies Workshop:

Here is what is available for downloading for the Arduino For Total Newbies Workshop:

1) If you don't already have **Arduino software** you need to download it for your computer (Windows, Mac OS, or Linux):
Arduino download page

2) You need a **driver for your USB communications/programming cable**. Several different ones are available. Choose the driver for the cable you have and the operating system for your computer.

Samurai Circuits board (SiLabs CP210x USB-to-Serial TTL) drivers:
The latest drivers from SiLabs' website
The SiLabs driver is installed by default on most Linux systems.

Adafruit FTDI Friend drivers:
The latest drivers from FTDI's website
The FTDI driver is installed by default on most Linux systems.

FTDI Cable drivers:
The latest drivers from FTDI's website
The FTDI driver is installed by default on most Linux systems.

3) You also need the **TV-B-Gone Arduino Sketch**
(download this, unzip it, and copy it to your computer in the "examples" folder inside your "arduino" folder that you downloaded):
TV-B-Gone Arduino sketch*(22KB)*

4) Schematic Diagram for Arduino TV-B-Gone remote control:
Schematic Diagram*(449KB)*

Parts List for Arduino TV-B-Gone remote control:
Parts List (Open Office)*(12KB)*
Parts List (MS Office)*(9KB)*

Schematics for the U-Do-It-Duino Arduino clone kit:
U-Do-It-Duino schematic *(110KB)*

Complete assembly instructions for the U-Do-It-Duino Arduino clone kit:
U-Do-It-Duino complete assembly instructions

The SiLabs driver is installed by default on most Linux systems.

Adafruit FTDI Friend drivers:

The latest drivers from FTDI's website

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Complete assembly instructions for the U-Do-It-Duino Arduino clone kit:

U-Do-It-Duino complete assembly instructions

Soldering Is Easy comic book:

Solder Comic (English) *(809KB)*
Many other languages are available!

Here are links to the slides I use in the workshop:

Arduino For Total Newbies workshop slides (with U-Do-It-Duino kit) *(69.2MB)*

Arduino For Total Newbies workshop slides (with Arduino Uno -- no soldering) (56.0MB)

scroll down

tvbg_arduino_workshop.php

https://cornfieldelectronics.com/cfe/projects/tvbg_arduino/tvbg_arduino_workshop.php

The SiLabs driver is installed by default on most Linux systems.

Adafruit FTDI Friend drivers:

The latest drivers from FTDI's website

The FTDI driver is installed by default on most Linux systems.

FTDI Cable drivers:

The latest drivers from FTDI's website

The FTDI driver is installed by default on most Linux systems.

3) You also need the **TV-B-Gone Arduino Sketch** (download this, unzip it, and copy it to your computer in the "examples" folder inside your "arduino" folder that you downloaded):

TV-B-Gone Arduino sketch*(22KB)*

4) Schematic Diagram for Arduino TV-B-Gone remote control:

Schematic Diagram*(449KB)*

Parts List for Arduino TV-B-Gone remote control:

Parts List (Open Office)*(12KB)*
Parts List (MS Office)*(9KB)*

Schematics for the U-Do-It-Duino Arduino clone kit:

U-Do-It-Duino schematic *(110KB)*

Complete assembly instructions for the U-Do-It-Duino Arduino clone kit:

U-Do-It-Duino complete assembly instructions

Soldering Is Easy comic book:

Solder Comic (English) *(809KB)*
Many other languages are available!

Here are links to the slides I use in the workshop:

Arduino For Total Newbies workshop slides (with U-Do-It-Duino kit) *(69.2MB)*

Arduino For Total Newbies workshop slides (with Arduino Uno -- no soldering) (56.0MB)

Slides for this workshop

scroll down

1) If you don't already have **Arduino software** you need to download it for your computer (Windows, Mac OS, or Linux):

Arduino download page

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Cornfield Electronics :: Projects | Cornfield Electronics :: Arduino | Arduino - Software

https://www.arduino.cc/en/Main/Software

ARDUINO

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SIGN IN

SOFTWARE

ENGLISH

ARDUINO WEB EDITOR

Start coding online with the Arduino Web Editor, save your sketches in the cloud, and always have the most up-to-date version of the IDE, including all the contributed libraries and support for new Arduino boards.

GETTING STARTED

CODE ONLINE

Download the Arduino IDE

Windows Installer, for Windows XP and up

Windows ZIP file for non admin install

2) You need a **driver for your USB communications/programming cable.** Several different ones are available. Choose the driver for the cable you have and the operating system for your computer.

Samurai Circuits board (SiLabs CP210x USB-to-Serial TTL) drivers:

The latest drivers from SiLabs' website

The SiLabs driver is installed by default on most Linux systems.

https://www.silabs.com/products/development-tools/software/usb-to-uart-bridge-

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Silicon Labs » Products » Development Tools » Software » USB to UART Bridge VCP Drivers

CP210x USB to UART Bridge VCP Drivers

The CP210x USB to UART Bridge Virtual COM Port (VCP) drivers are required for device operation as a Virtual COM Port to facilitate host communication with CP210x products. These devices can also interface to a host using the direct access driver. These drivers are static examples detailed in application note 197: The Serial Communications Guide for the CP210x, download an example below:

AN197: The Serial Communications Guide for the CP210x

Download Software

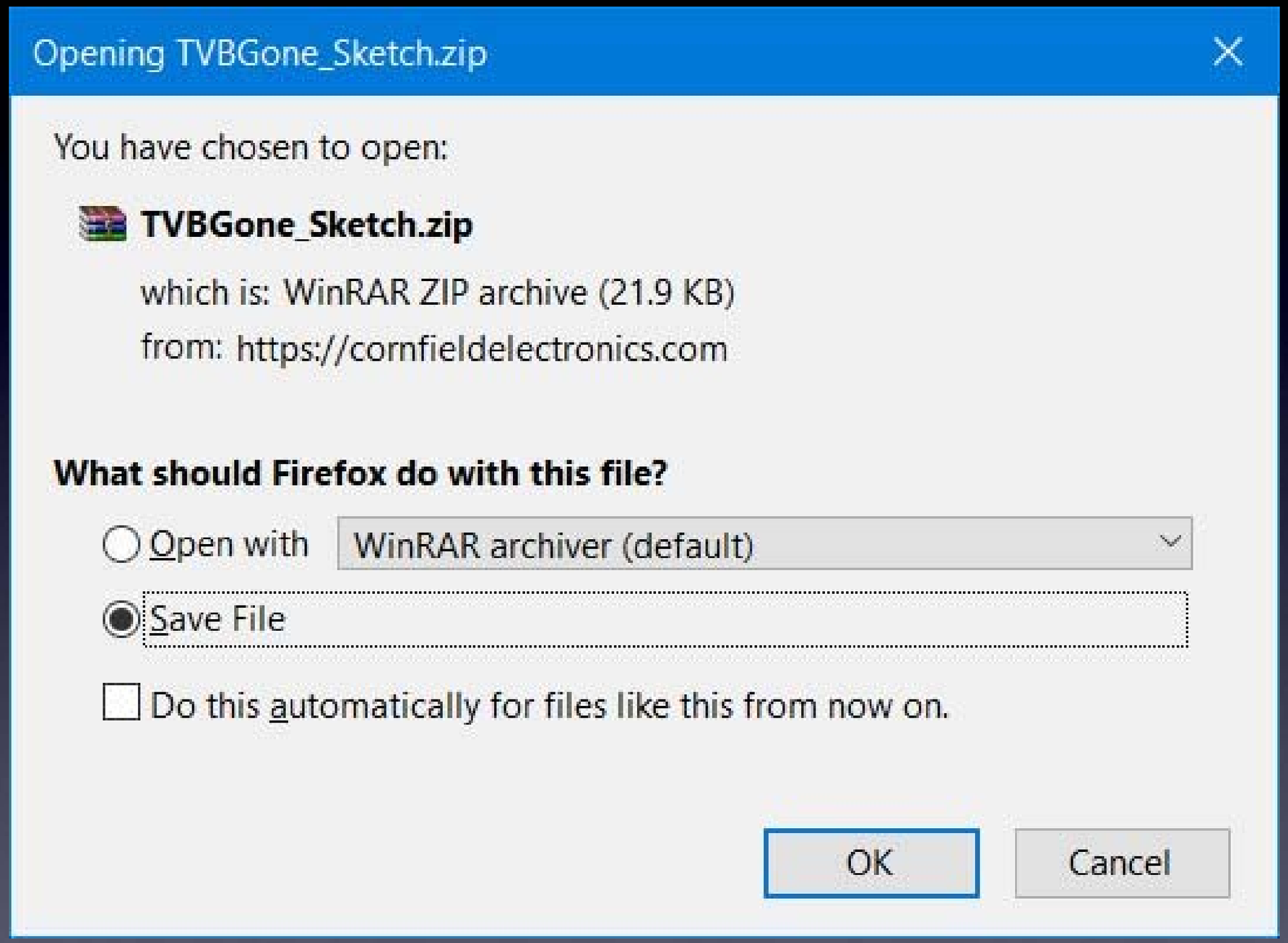
The CP210x Manufacturing DLL and Runtime DLL have been updated and must be used with v6.0 and later of the CP210x Windows VCP Driver. Application Note Software downloads affected are AN144SW.zip, AN205SW.zip and AN223SW.zip. If you are using a 5.x driver and need support you can download archived Application Note Software.

Legacy OS software and driver package download links and support information ›

Download for Windows 10 Universal (v10.1.4)

community.silabs.com/t5/Interface-Knowledge-Base/Legacy-OS-Software-and-Driver-Packages/ta-p/182585

3) You also need the **TV-B-Gone Arduino Sketch**
(download this, unzip it, and copy it to your computer in the "examples" folder inside your "arduino" folder that you downloaded):
TV-B-Gone Arduino sketch*(22KB)*



4) Schematic Diagram for Arduino TV-B-Gone remote control:

[Schematic Diagram(449KB)]

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Cornfield Electronics :: Projects | Cornfield Electronics :: Arduino | arduino_tvbgone_schematic.pd

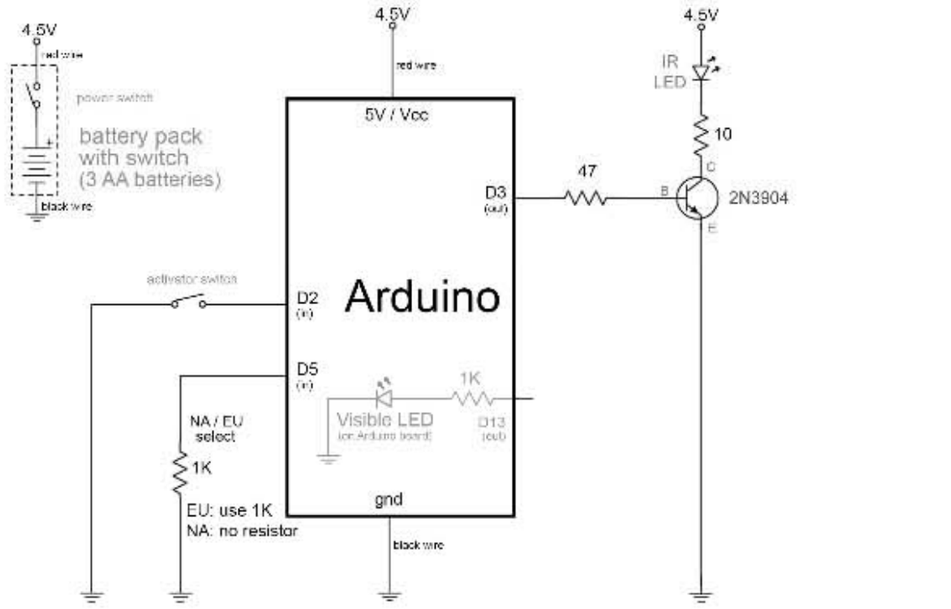
https://cornfieldelectronics.com/cfe/projects/tvbg_arduino/arduino_tvbgone_schematic.pd

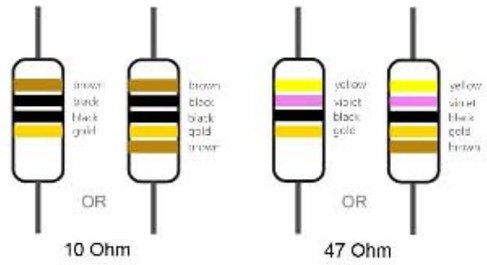
1 of 1 — 70%

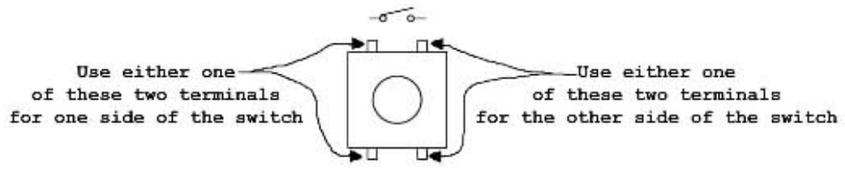
Arduino For Total Newbies

4-Sep-2015

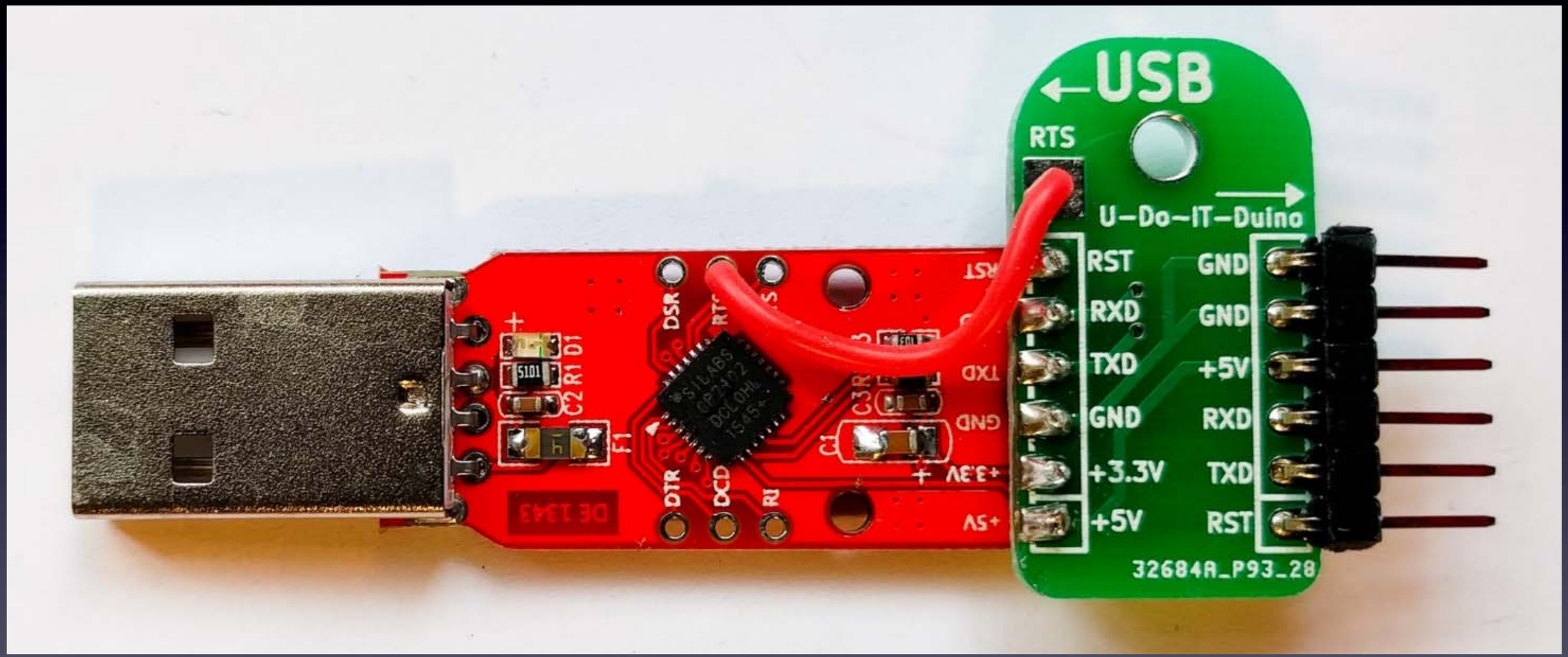
Mitch Altman (original TV-B-Gone hardware and firmware, modified TV-B-Gone Arduino design)
Limore Fried (firmware modifications, kit design)
Ken Shirriff (original modifications for Arduino)
Johannes Schneemann (documentation)



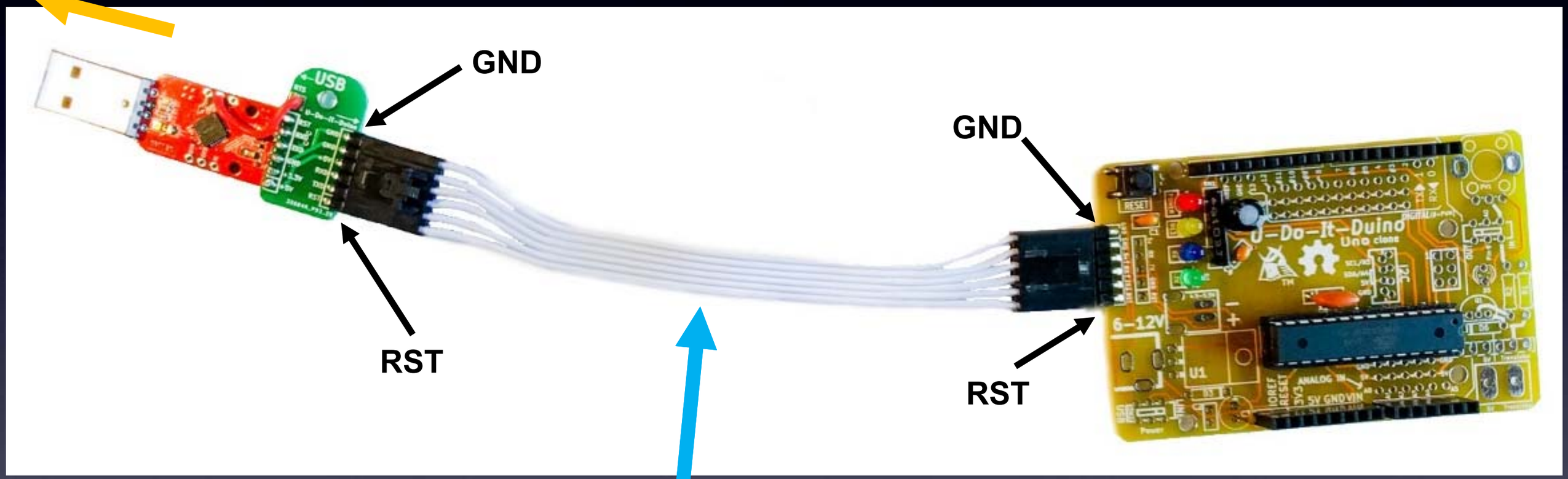




USB-Serial Cable



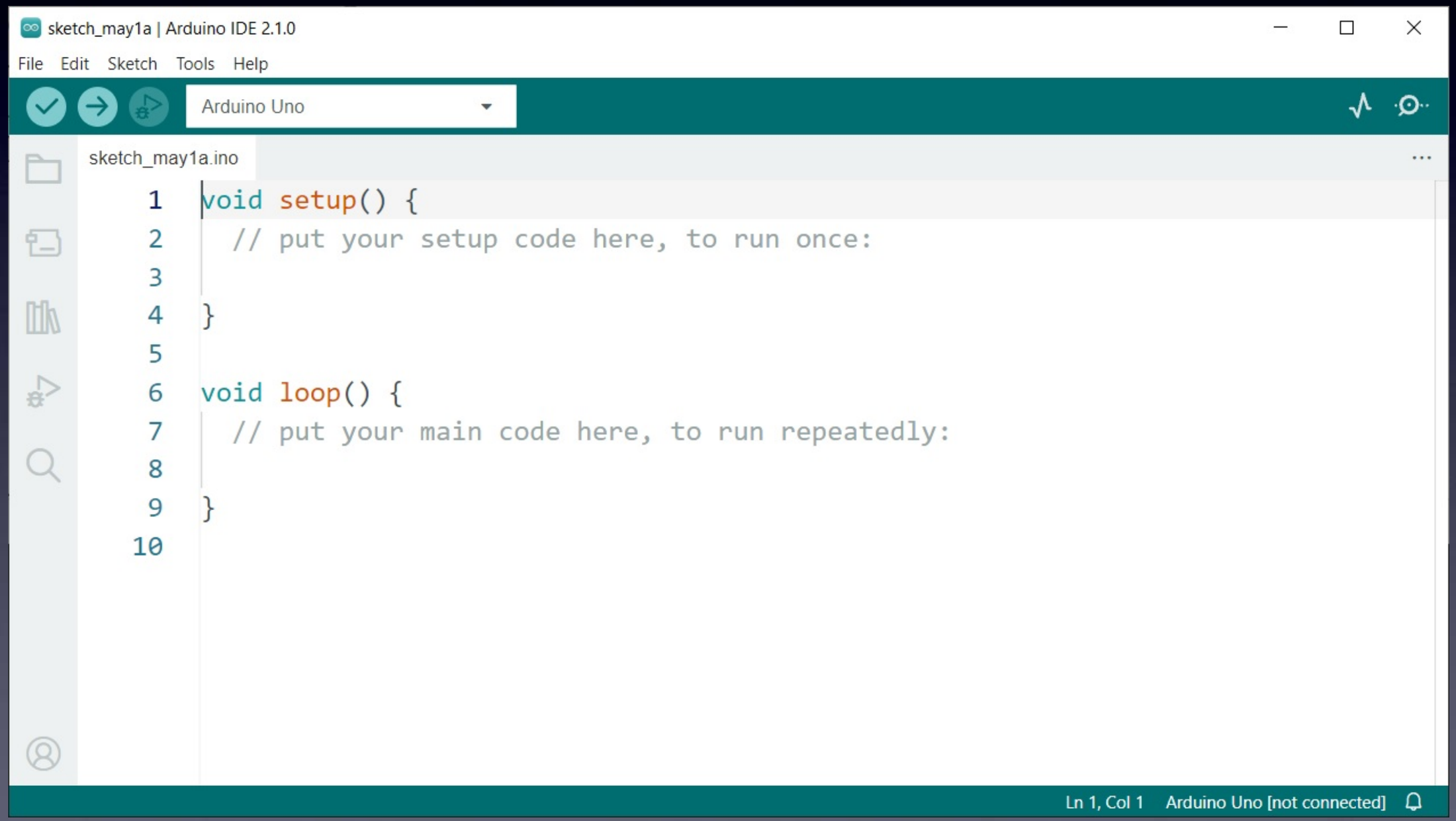
To computer's USB



no twists

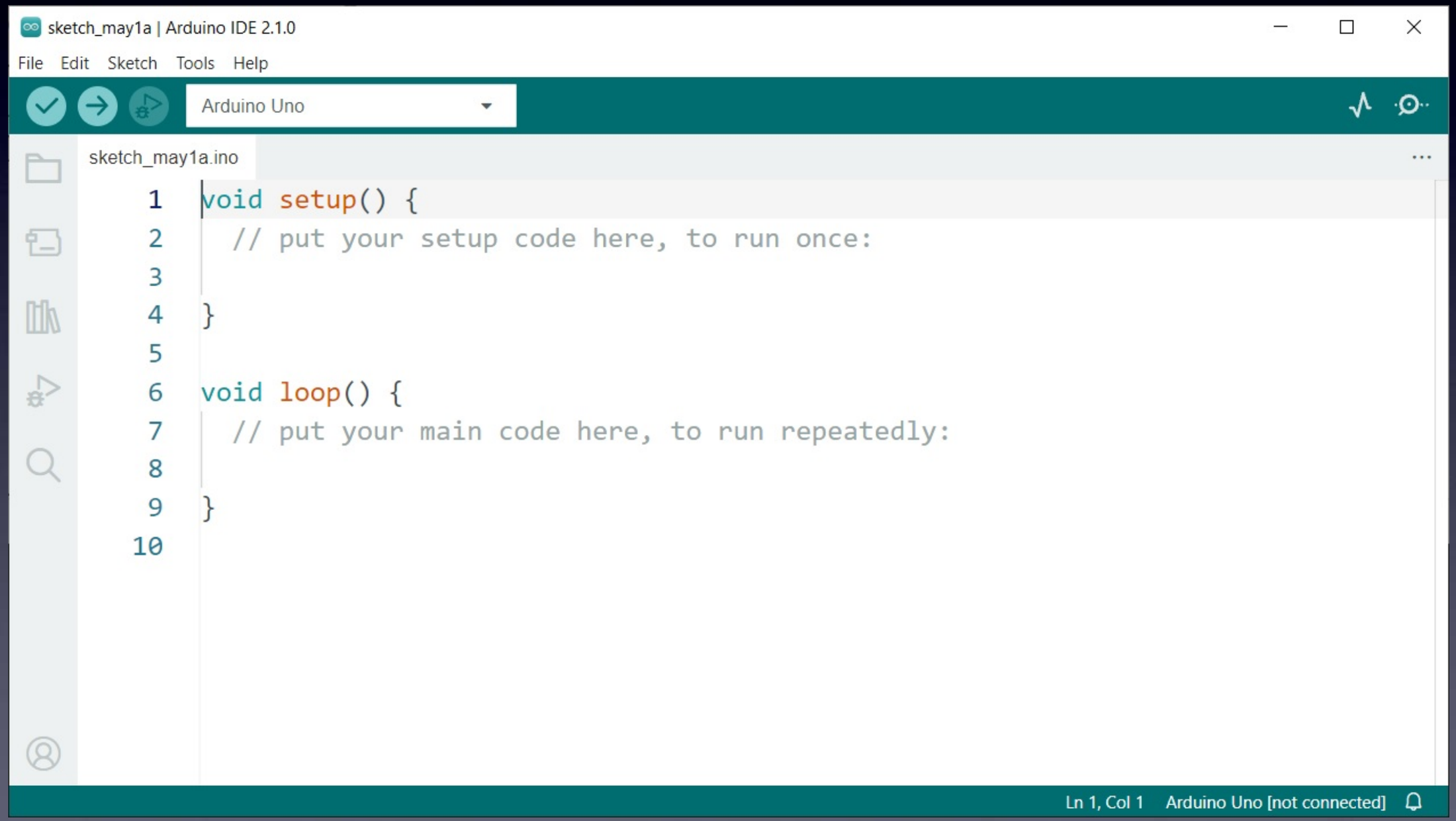
Arduino

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



Arduino

How to Set Up and Use the Arduino Software

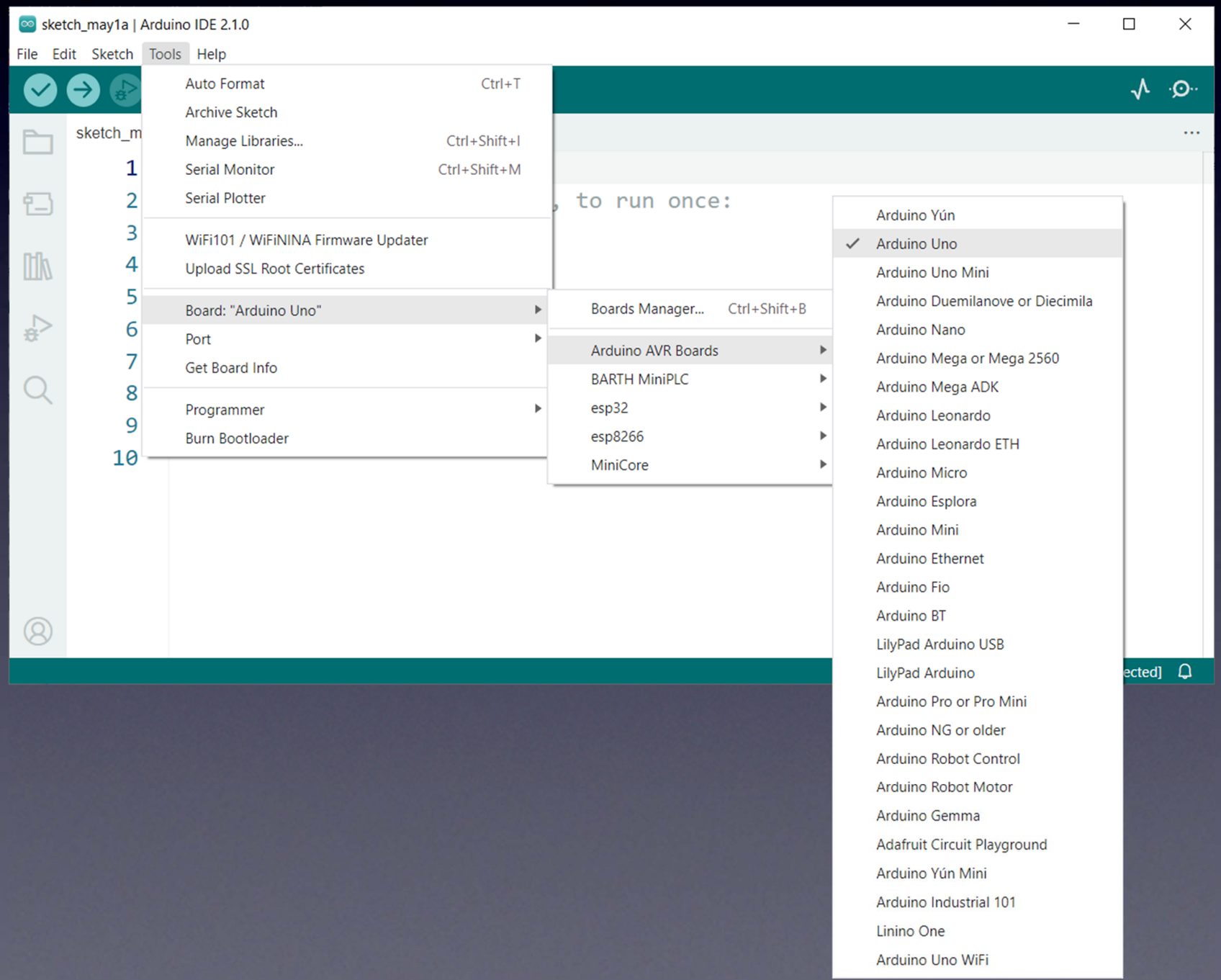


Arduino

The ***first time*** you start your Arduino software
you need to do ***two things*** to set things up:

(1)
Choose “Uno”
as the Board

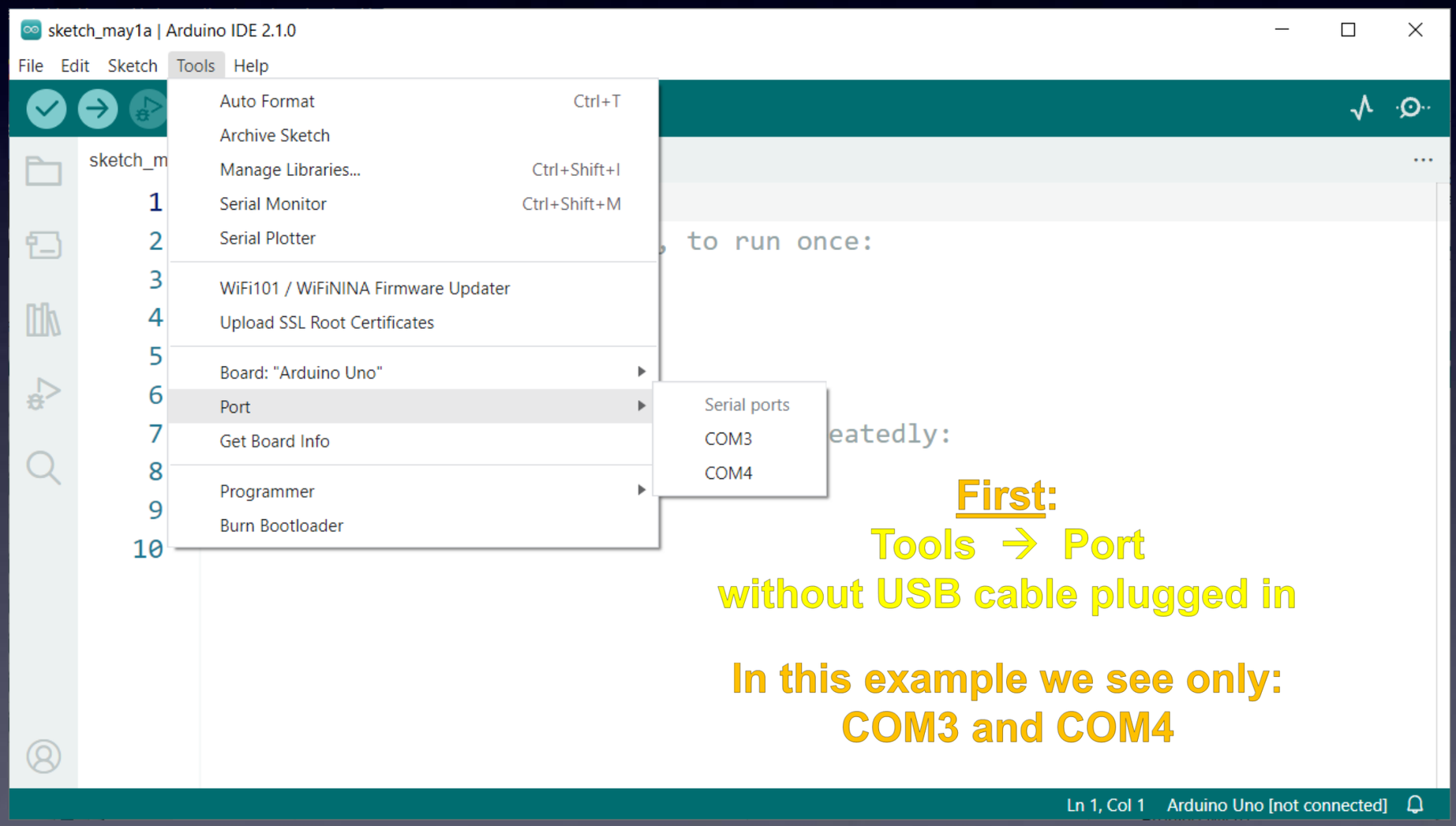
(Your
U-Do-It-Duino
acts
just like
an
Arduino Uno board)



Arduino

The ***first time*** you start your Arduino software
you need to do ***two things*** to set things up:

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

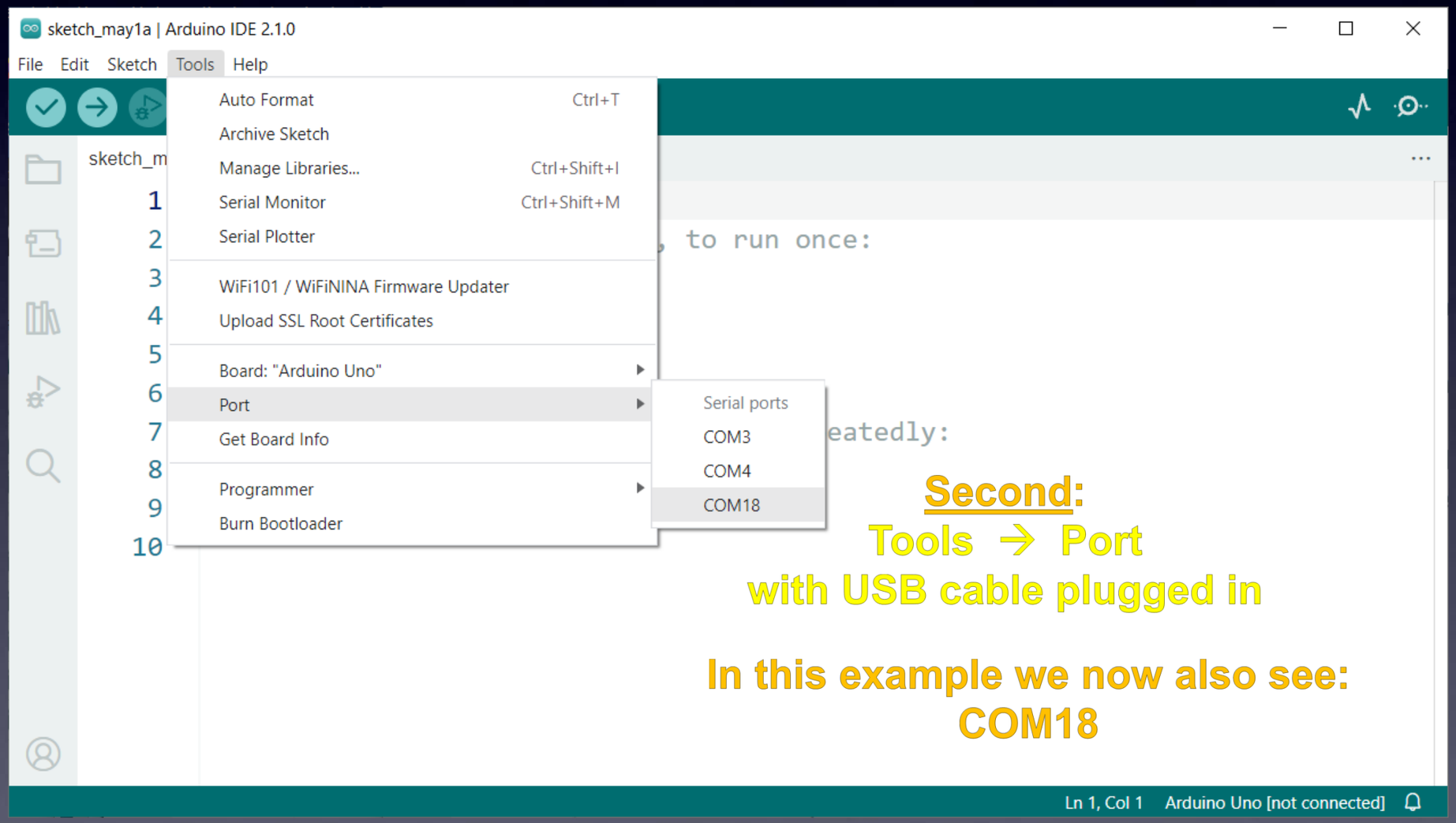


Arduino

The ***first time*** you start your Arduino software
you need to do ***two things*** to set things up:

(2)
Choose the Port (this will be different depending on your Operating System)

(After installing the driver for your USB-Serial cable and plugging it in your operating system will see a serial port and it appears here.)

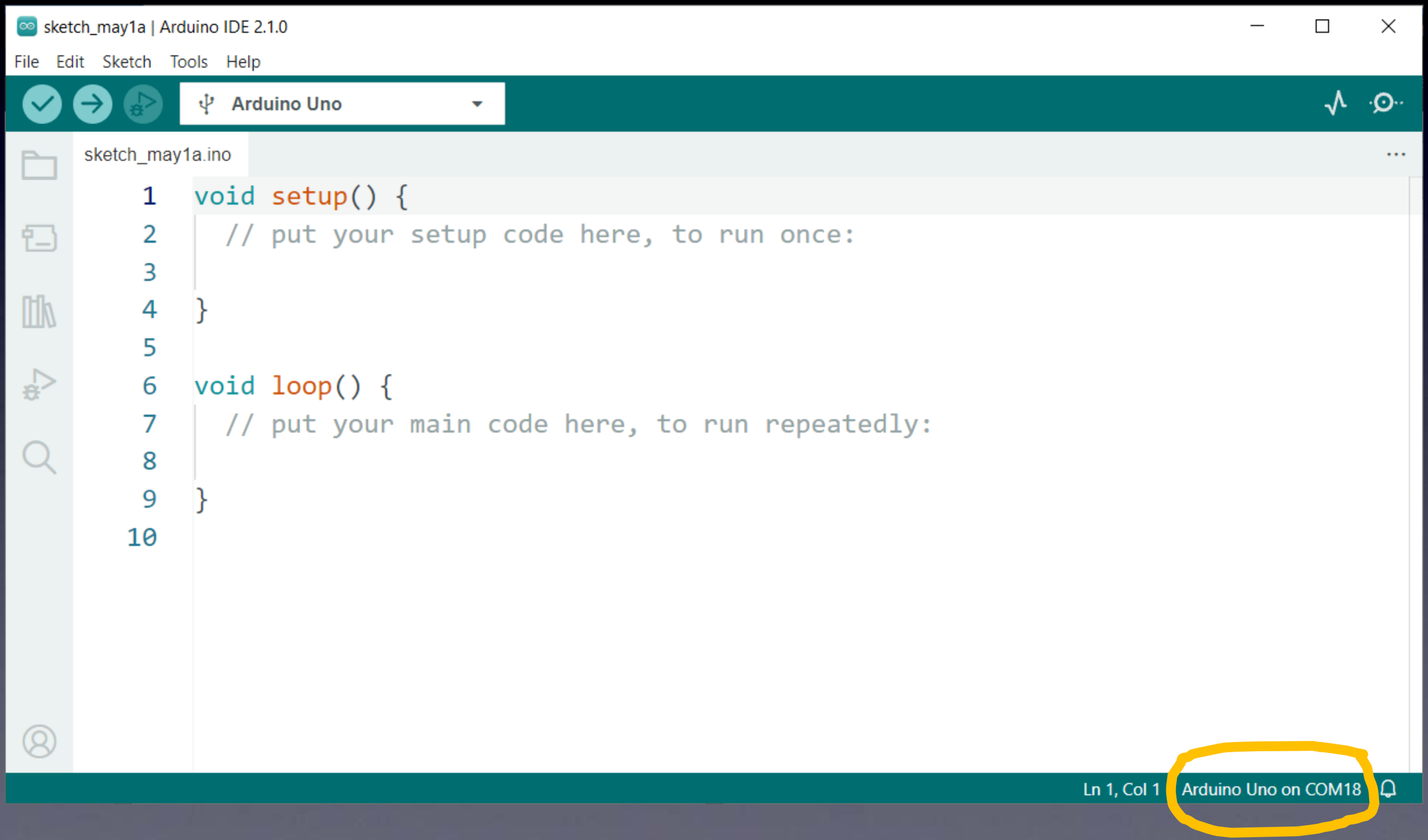


Second:
Tools → Port
with USB cable plugged in

In this example we now also see:
COM18

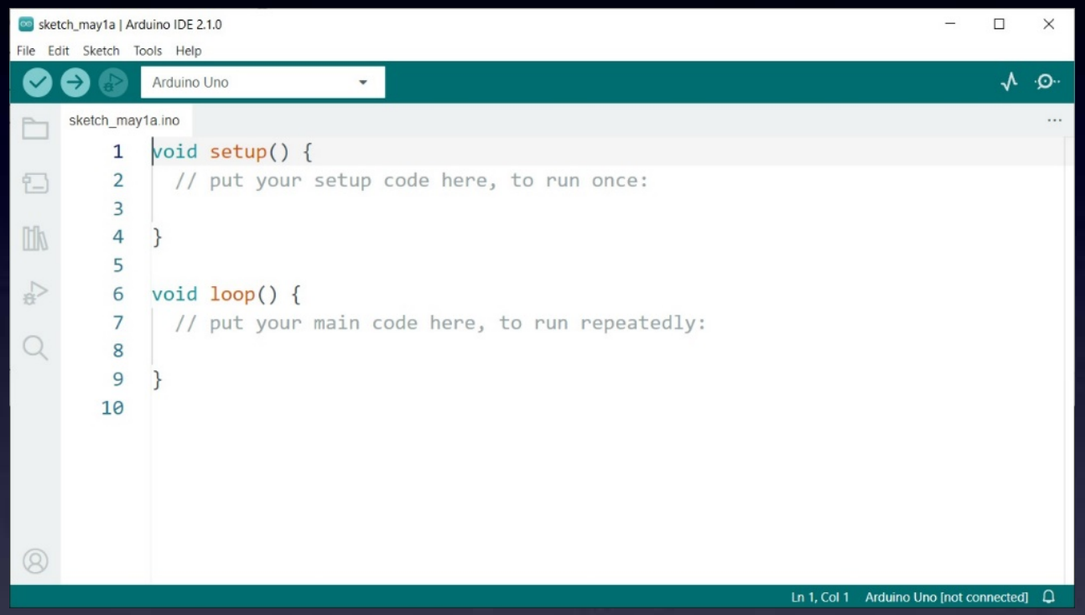
Arduino

Your Arduino software is now ready to program your U-Do-It-Duino !



Arduino

Designed for non-geeky artists

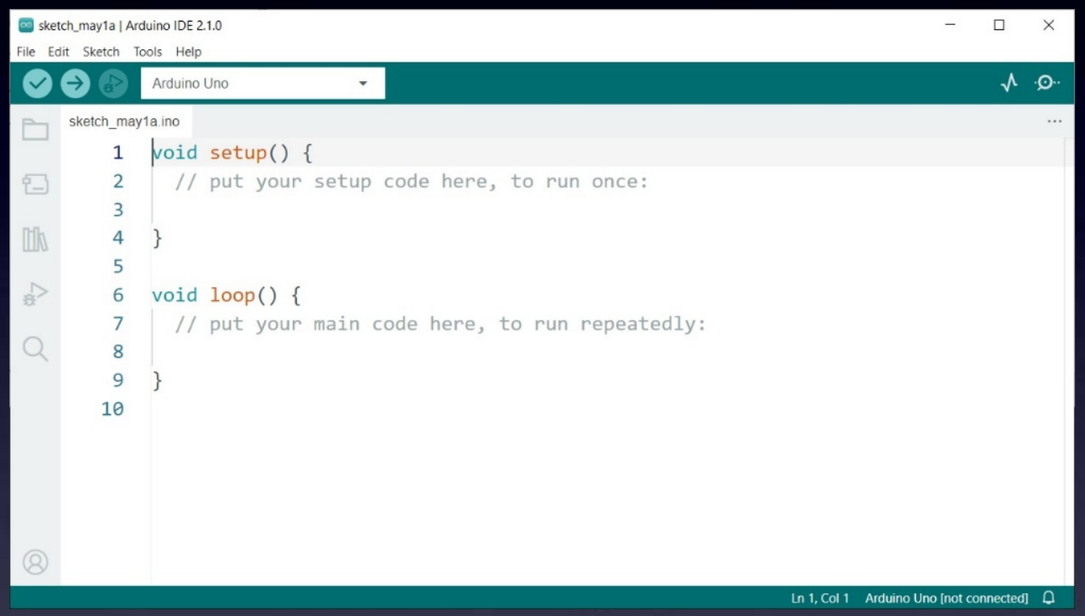


“Sketch” :

an Arduino program

Arduino

Designed for non-geeky artists



The Arduino language :

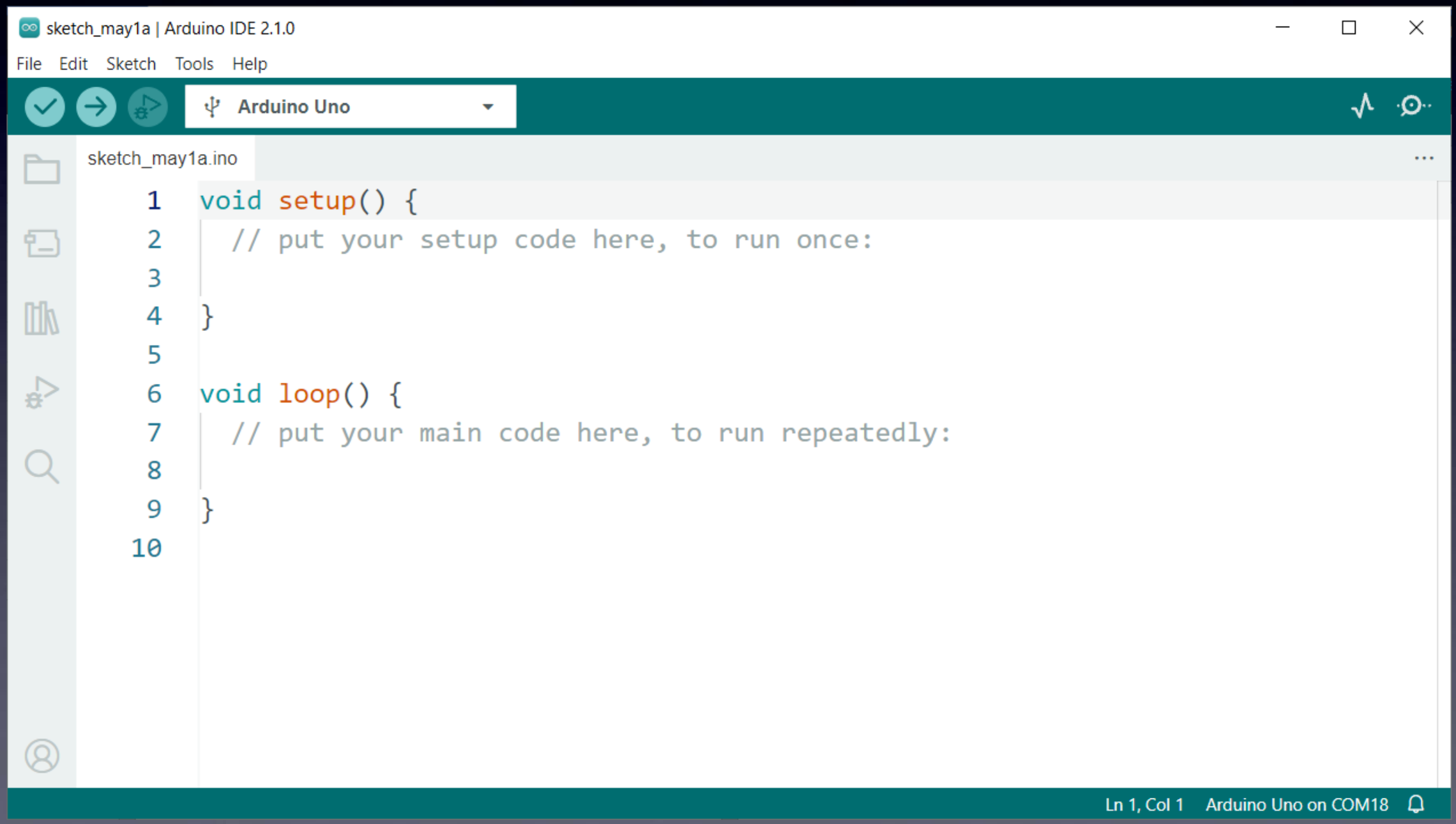
“Wiring”

(actually C/C++)

Arduino

Your Arduino software is now ready to program your U-Do-It-Duino !

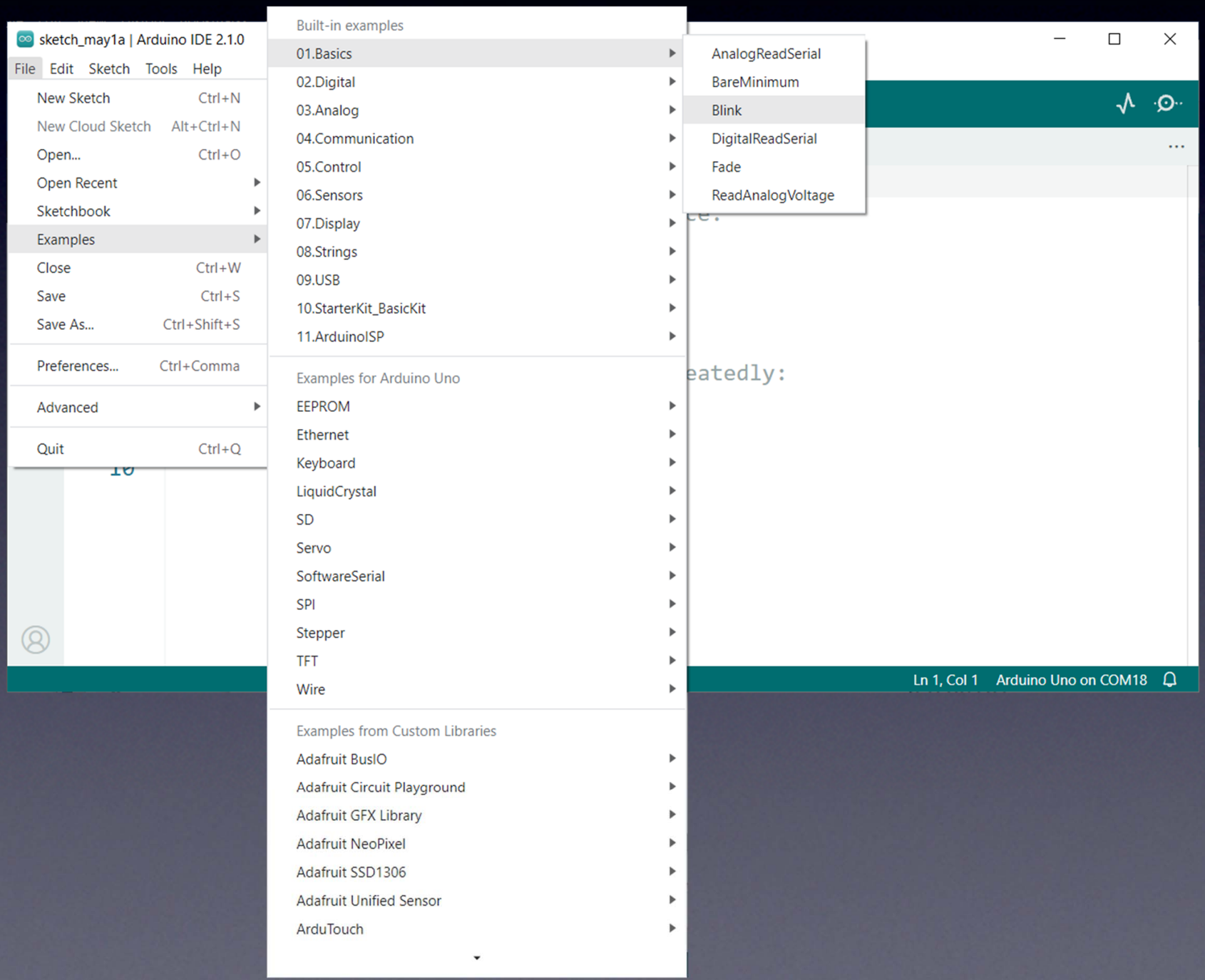
Let's make an LED blink! `Hello World`



Arduino

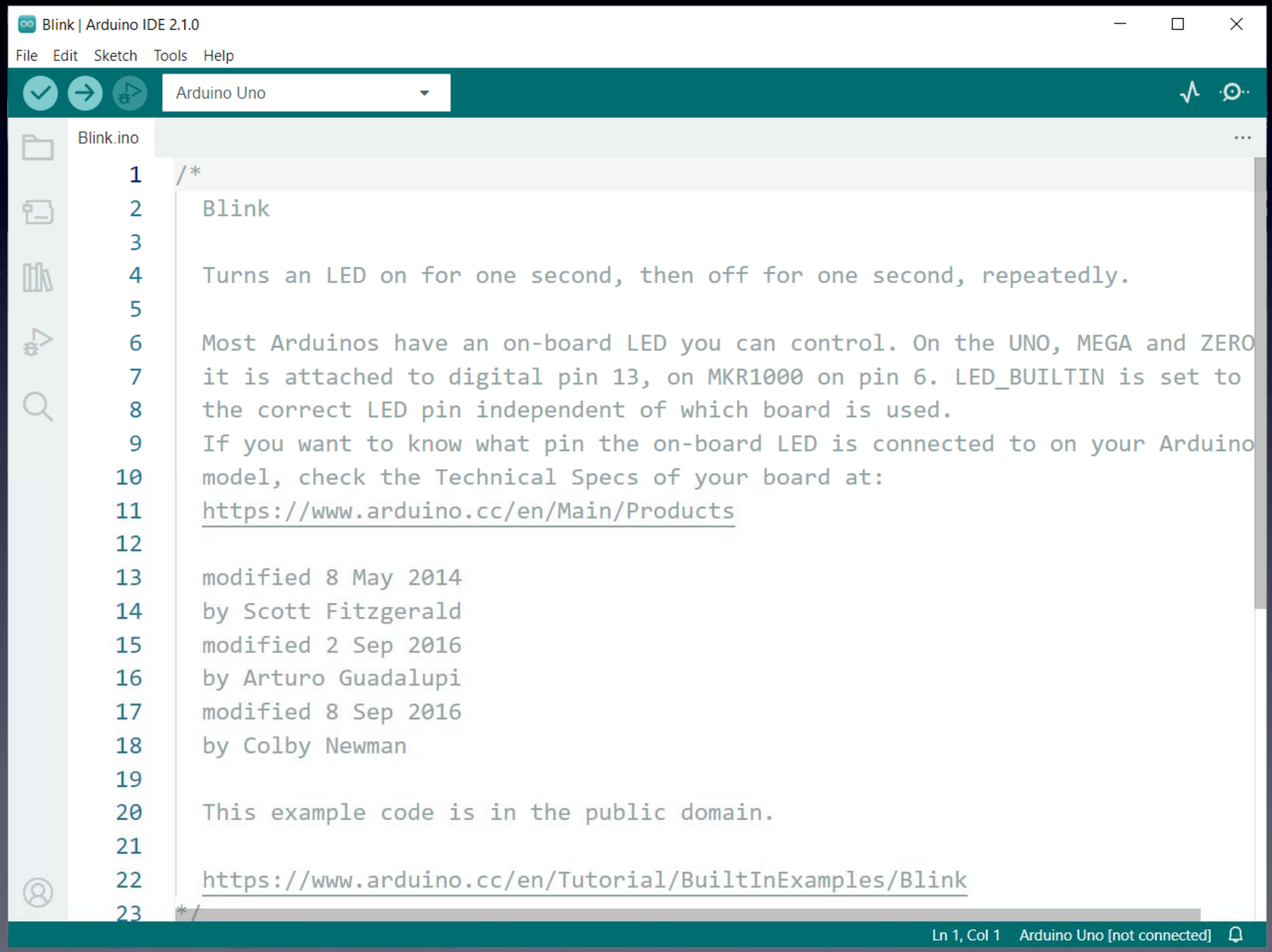
Your Arduino software is now ready to program your U-Do-It-Duino !

Let's make an LED blink! `Hello World`



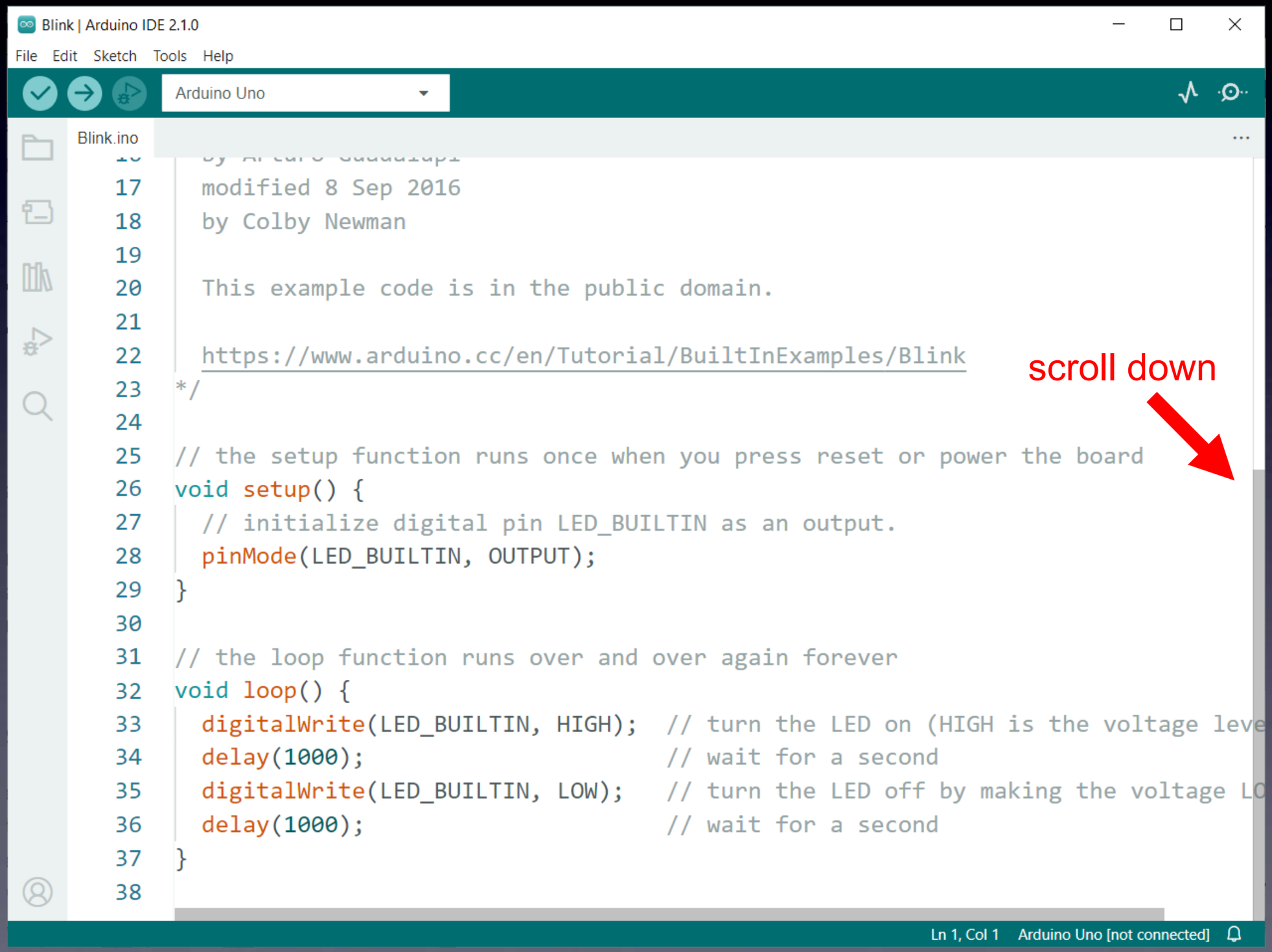
Arduino

Let's make an LED blink! `Hello World`

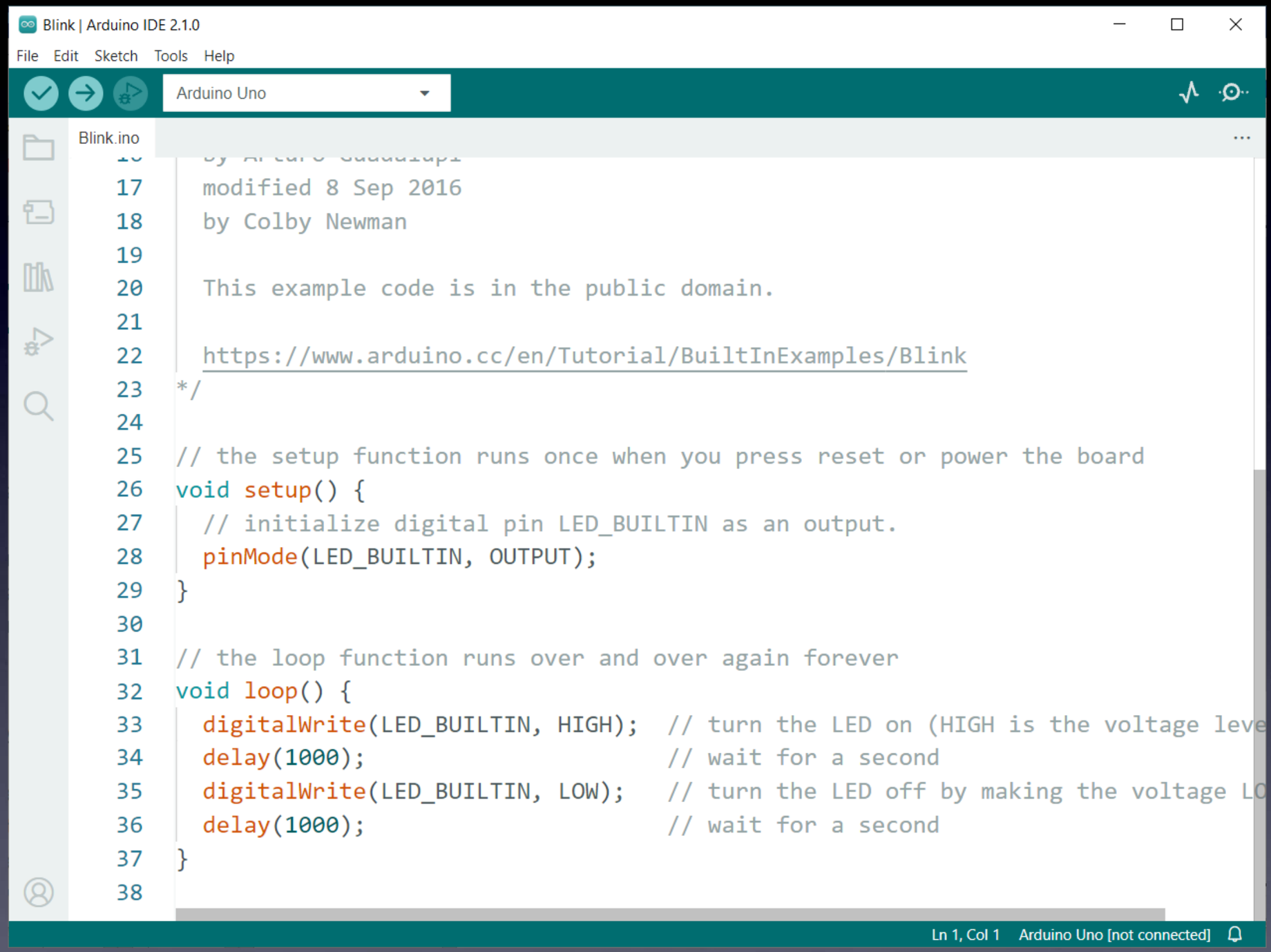


Arduino

Let's make an LED blink! Hello World



How to Hack Arduino Programs (“Sketches”)



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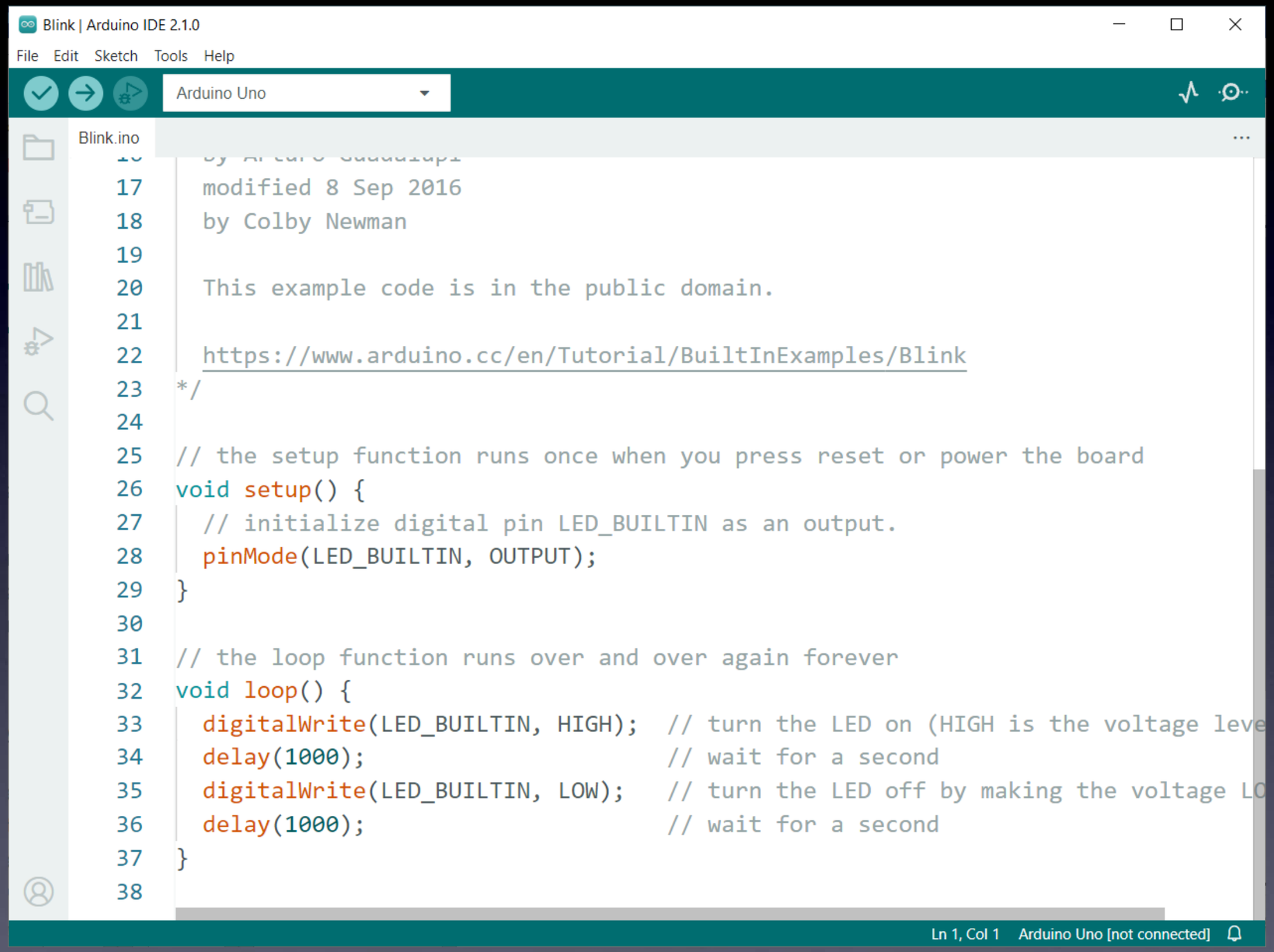
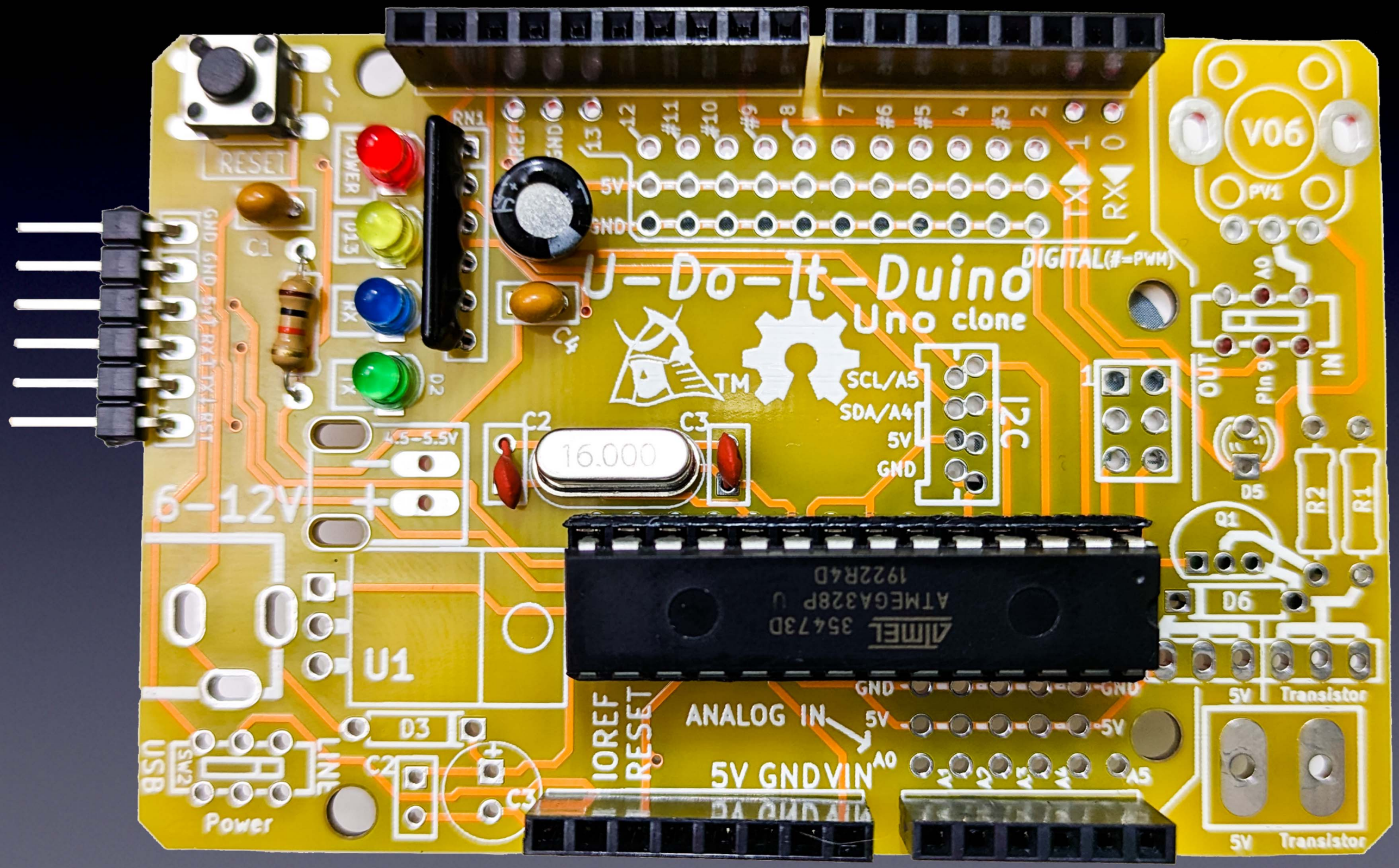


Many ways!

Here are just a few:

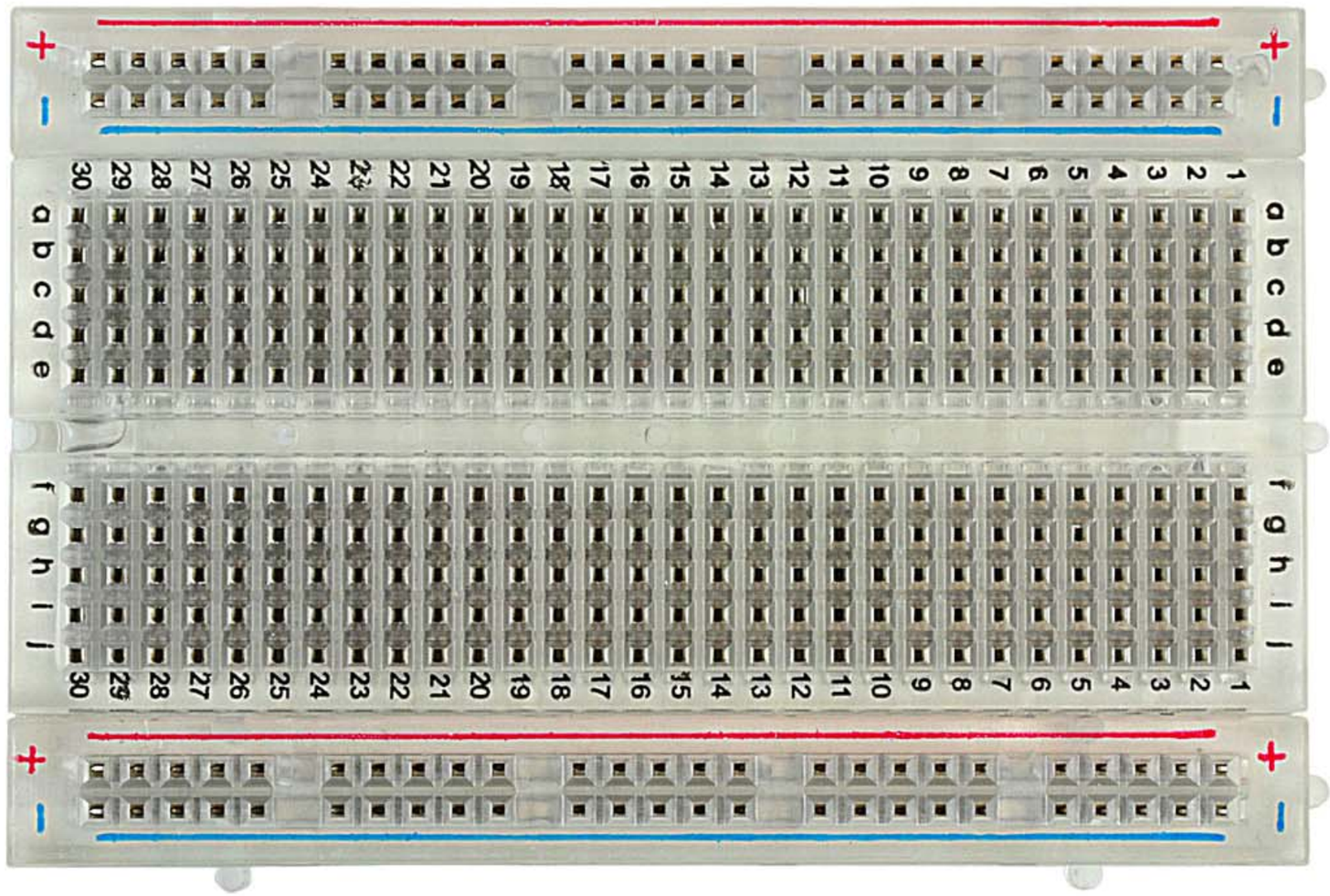
- Change blink rates
- External LED
- External motor
- External speaker
- External LED on Solderless breadboard
- More complex projects on Solderless breadboard

How to Hack Arduino Programs (“Sketches”)

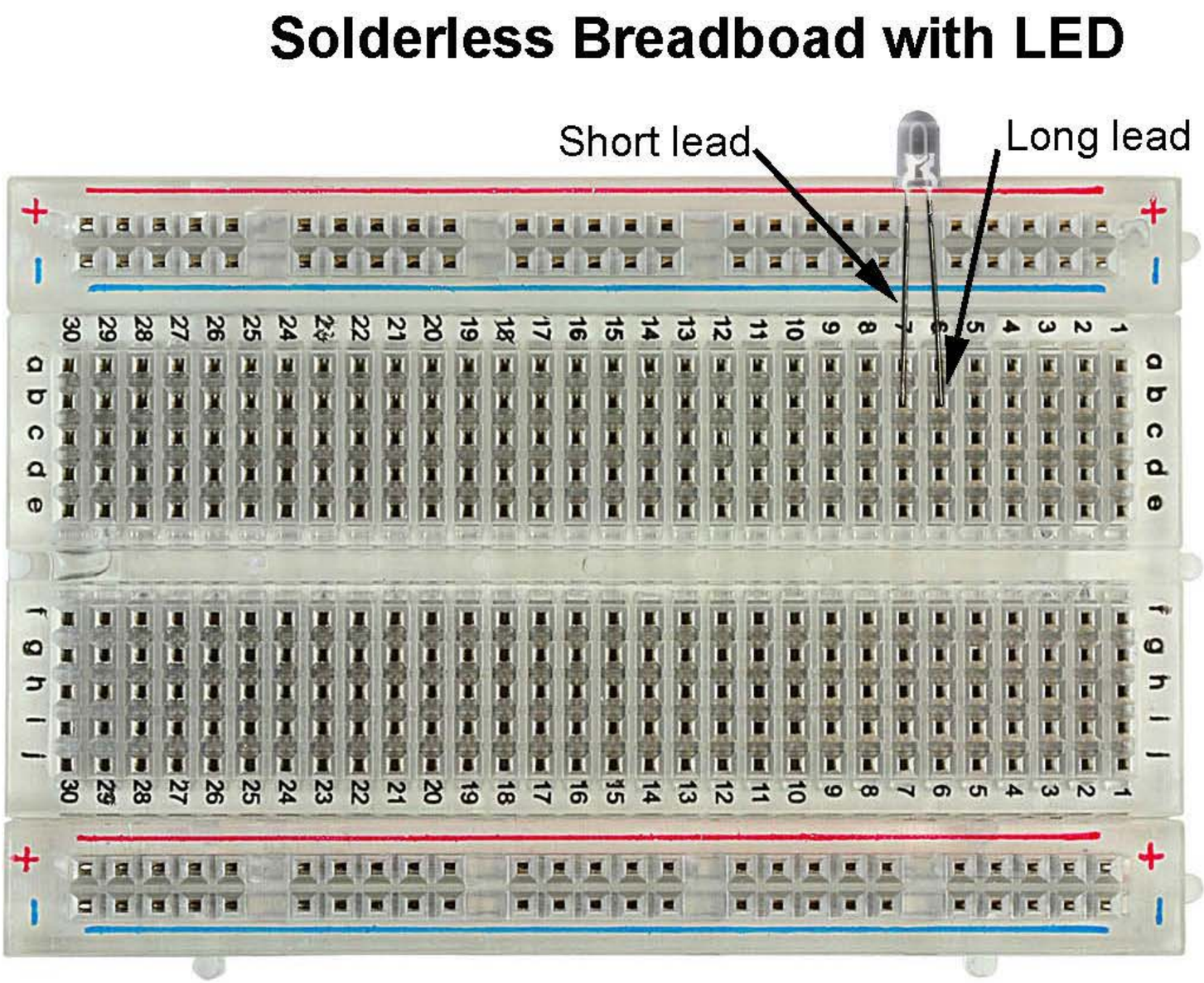


How to Use Solderless Breadboards

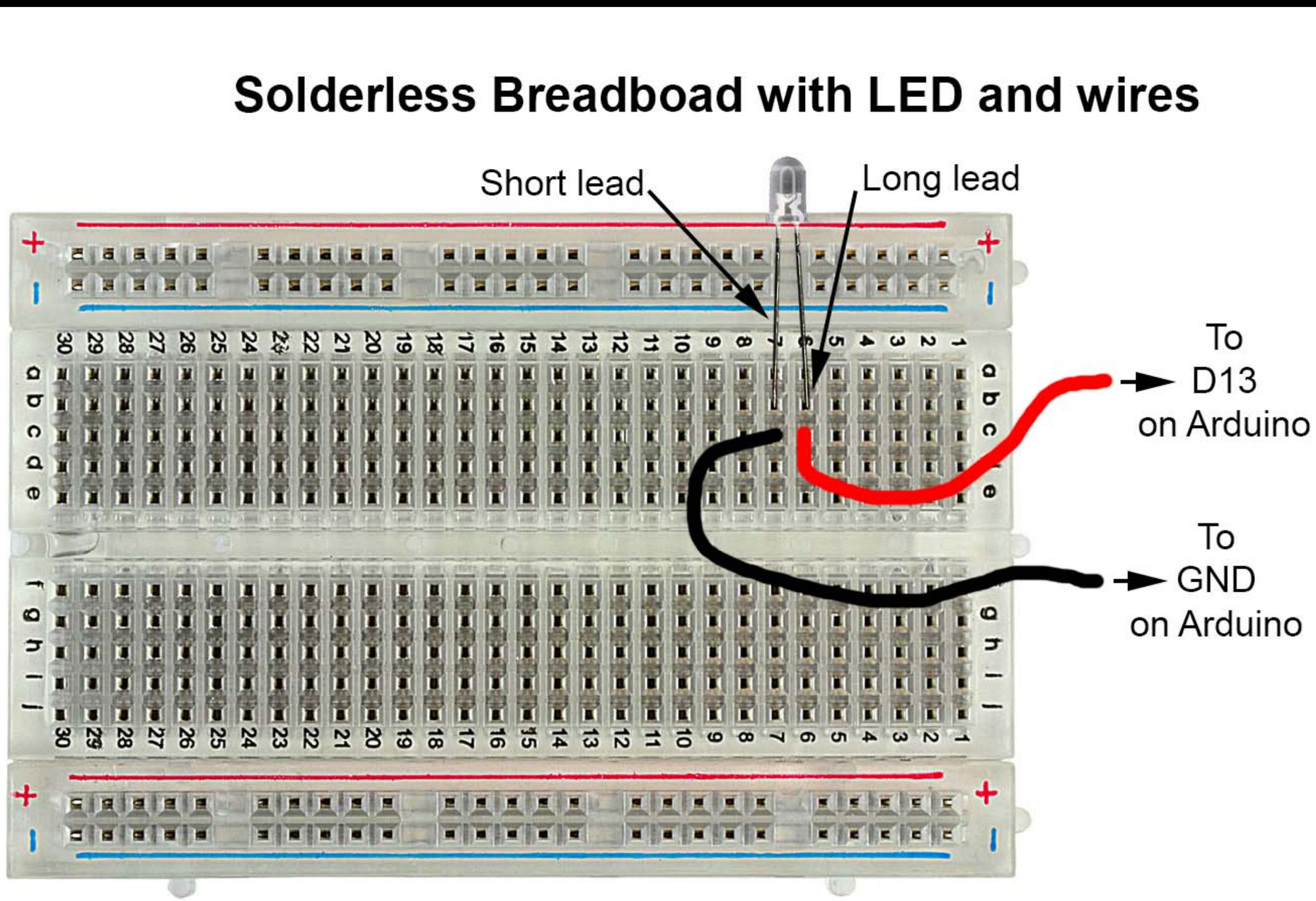
Solderless Breadboard



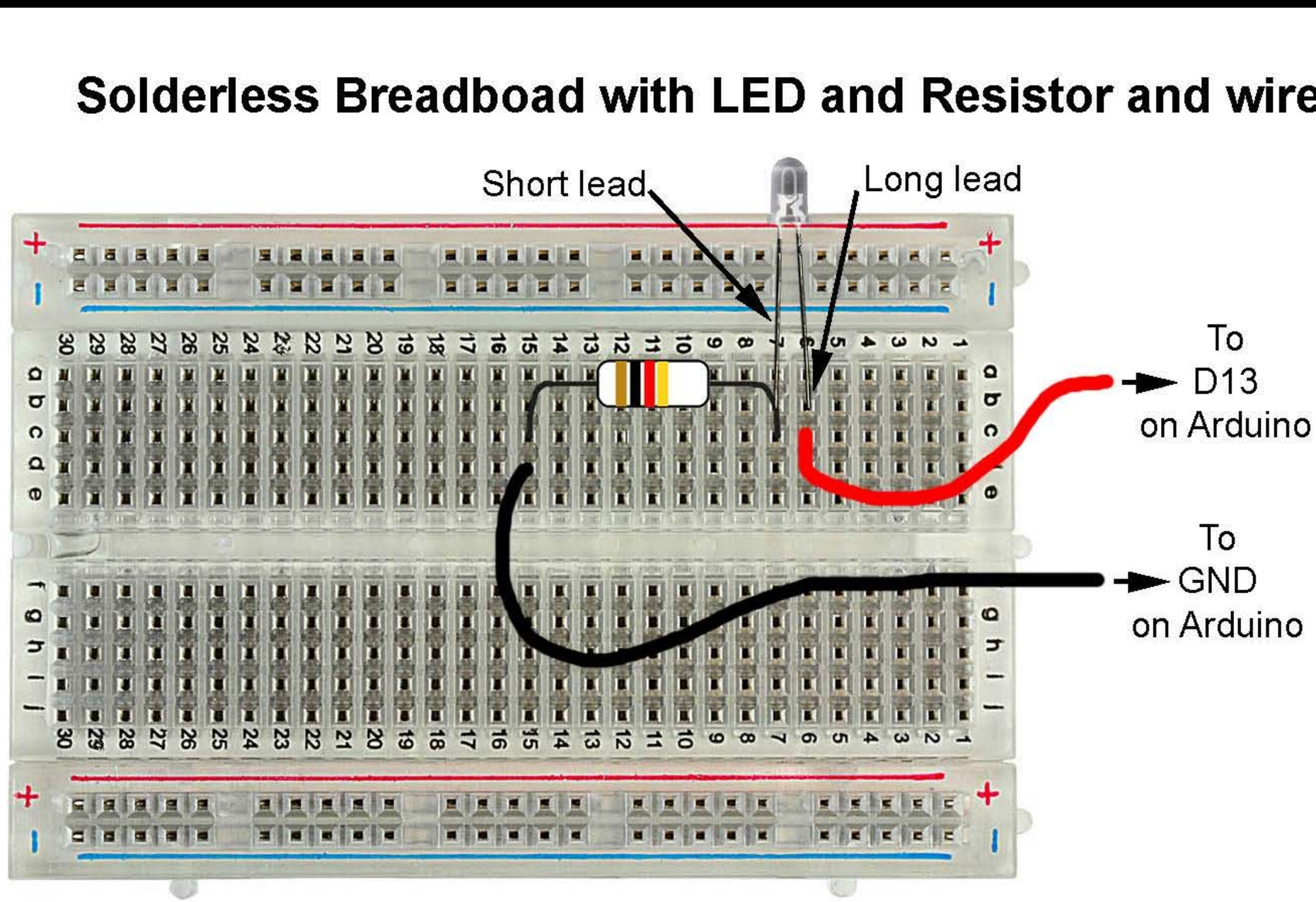
How to Use Solderless Breadboards



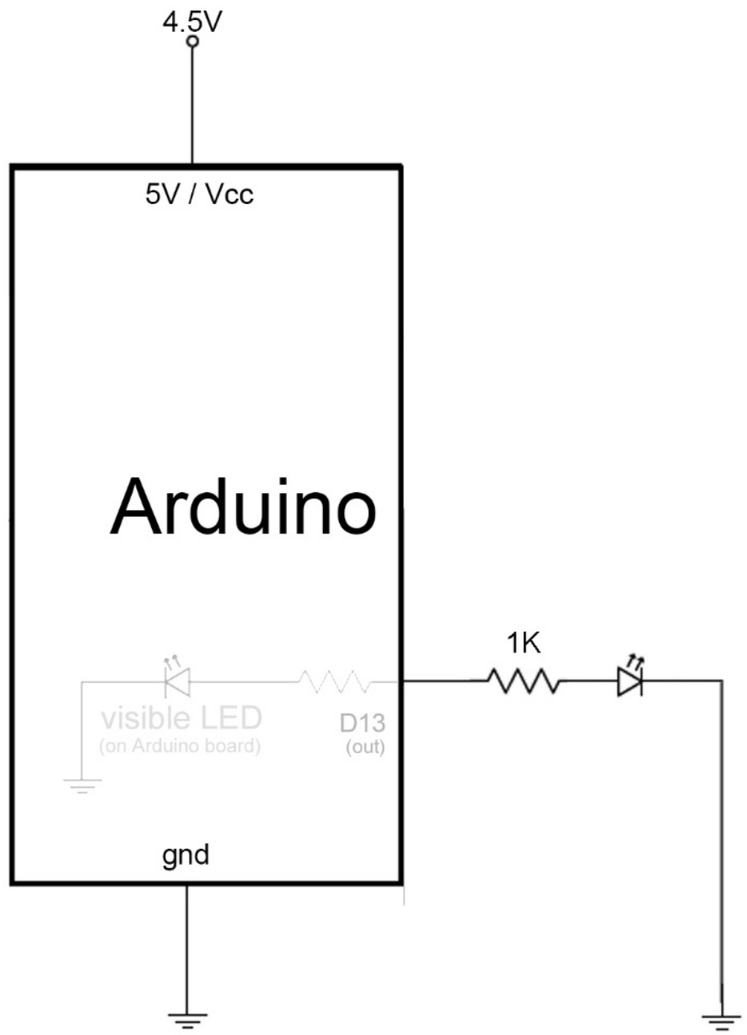
How to Use Solderless Breadboards



How to Use Solderless Breadboards



How to Read a Schematic



How to Read a Schematic

4-Sep-2015

Arduino For Total Newbies

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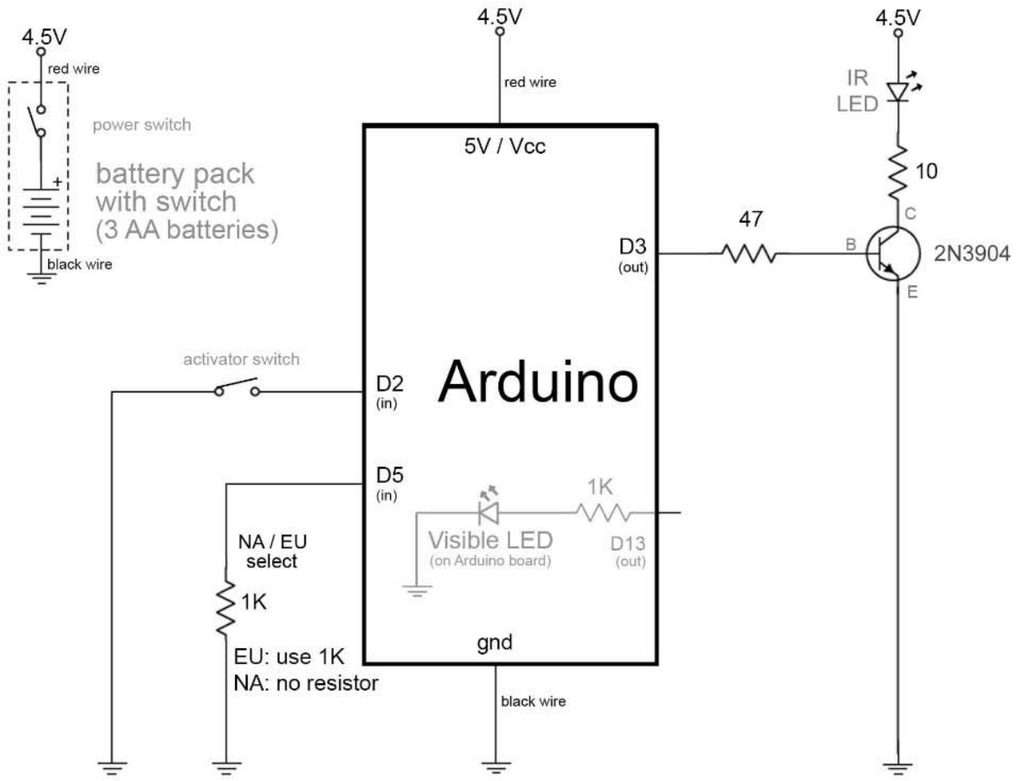
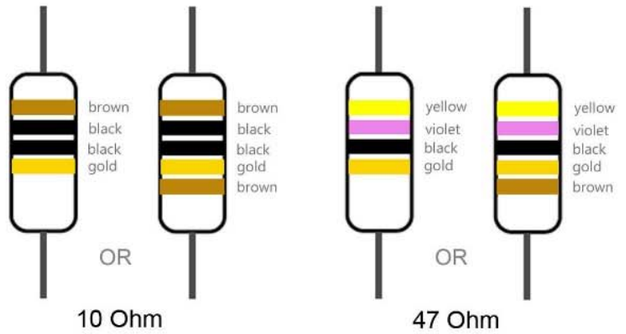
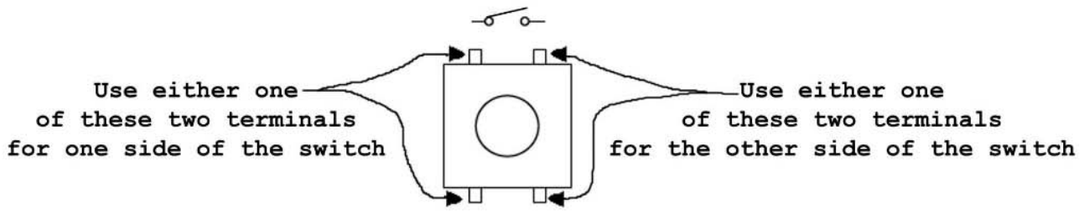
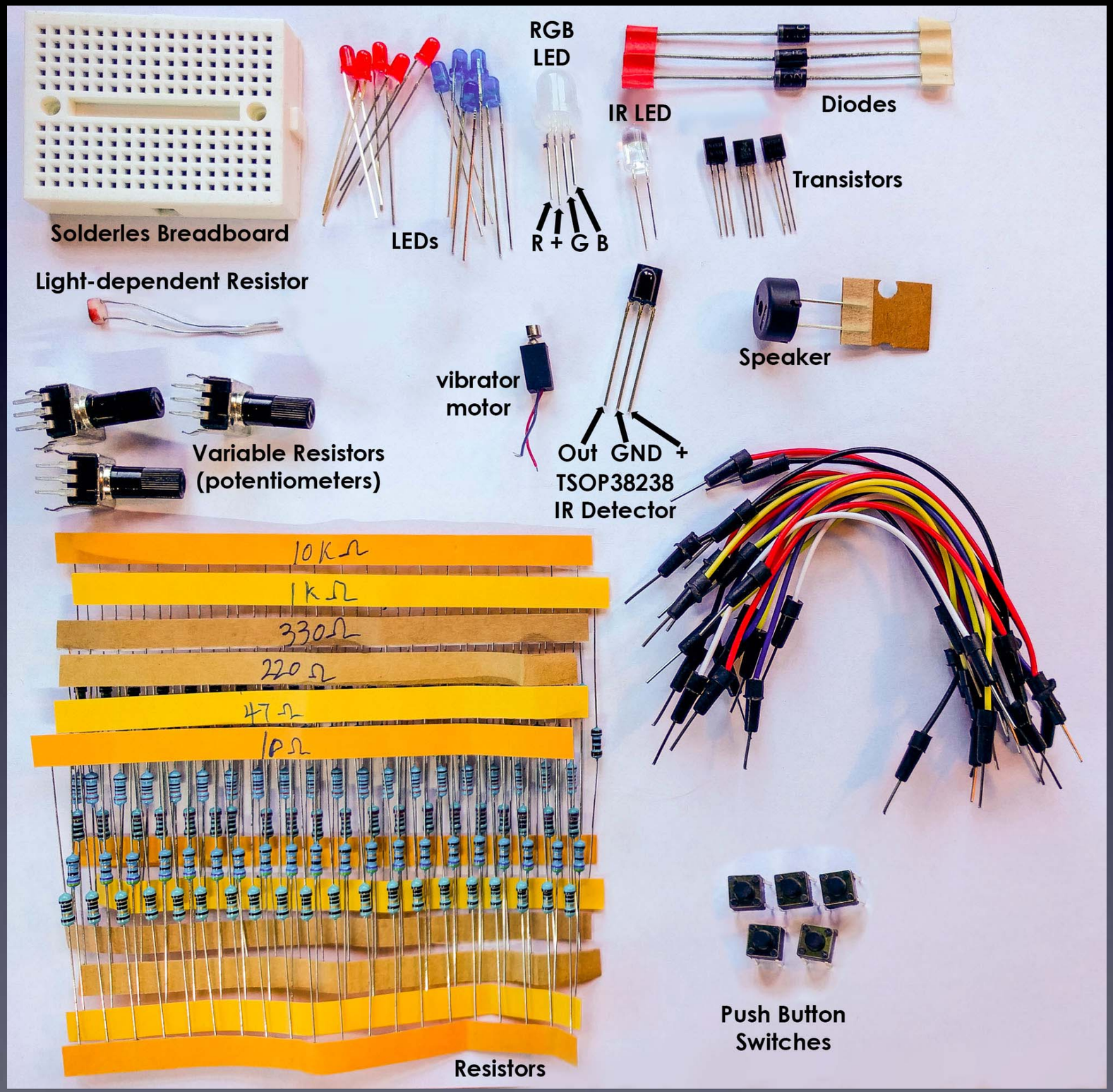


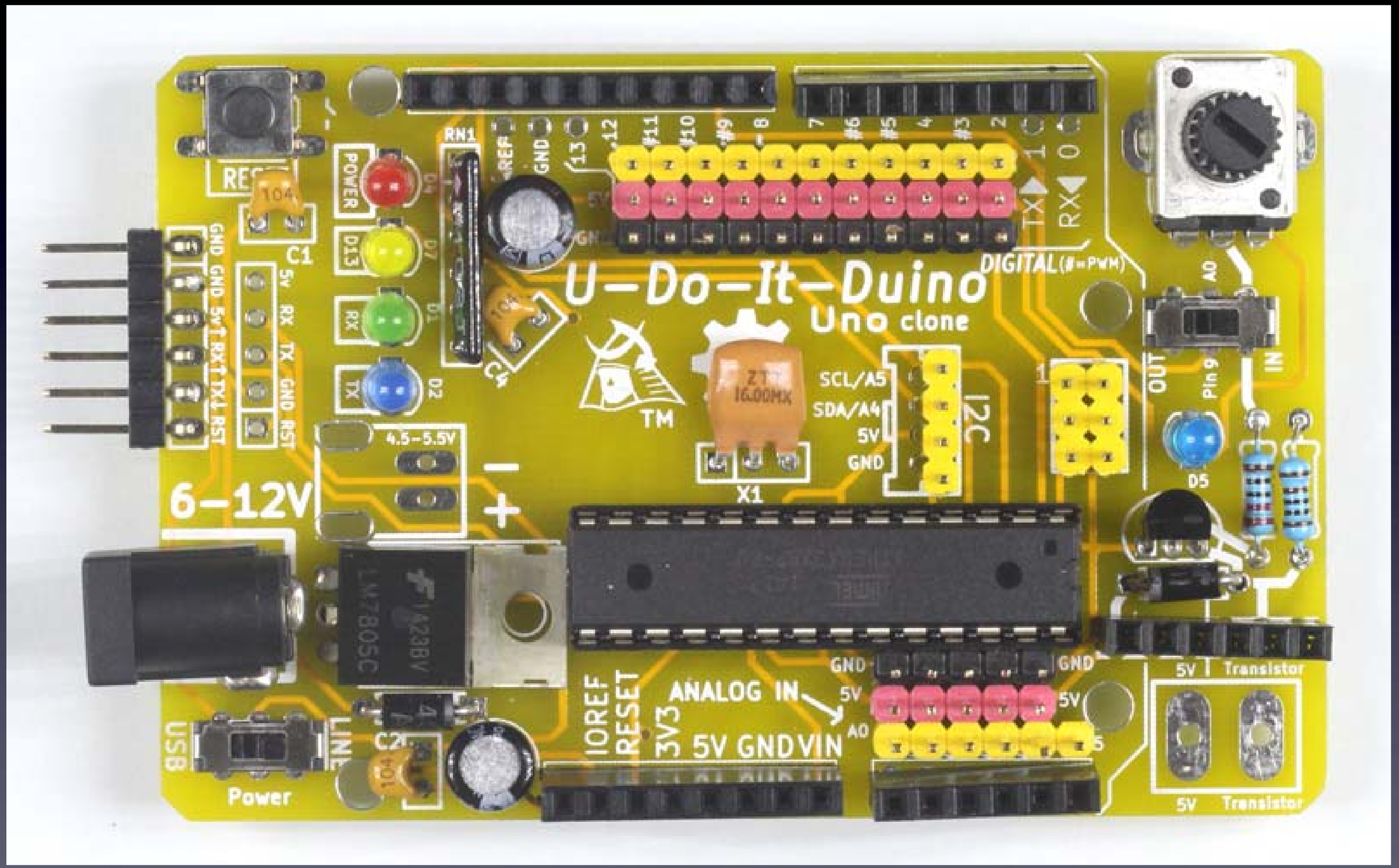




Parts Pack Contents



If you want to:



https://cornfieldelectronics.com/cfe/u_do_it_duino_complete.php

Please Remember:

to

Wash your hands

I have these Toolkits for sale

Tools

Rev 11c: 4-Jun-2024

Arduino For Total Newbies

w/ TV-B-Gone as example project

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)
email: **mitch@CornfieldElectronics.com**
site: **www.CornfieldElectronics.com**
facebook: **maltman23**
flickr: **maltman23**
WeChat: **mitchaltman**
Fediverse: **@maltman23@mastodon.social**
Patreon: mitchaltman