Rev 7: 8-Jun-2019

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**
twitter: **@maltman23**
flickr: **maltman23**
WeChat: **mitchaltman**

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

Stuff!

Bring all of this home with you!

DO NOT open this bag yet!

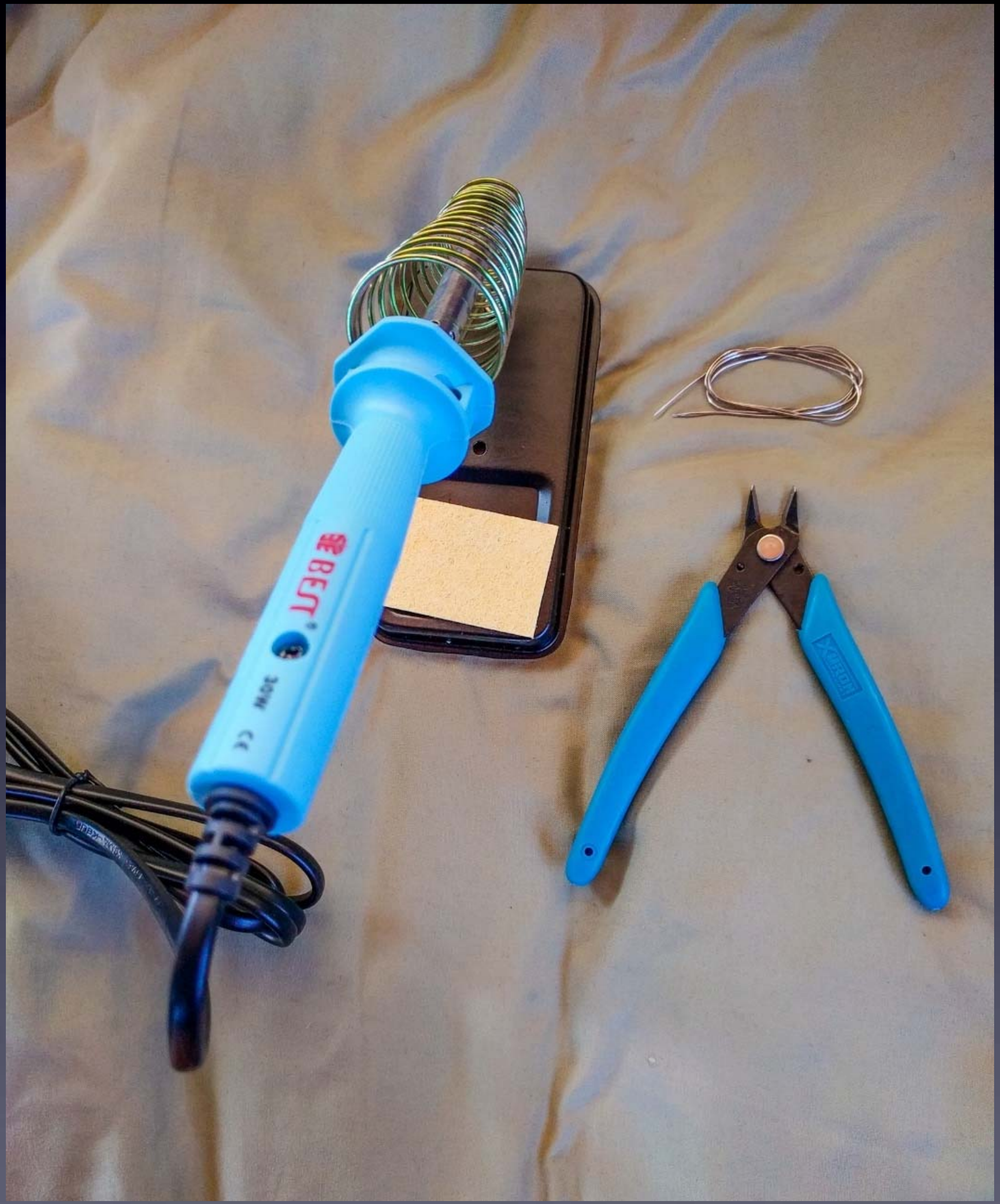
U-Do-It-Duino kit

Parts Pack

USB-Serial cable

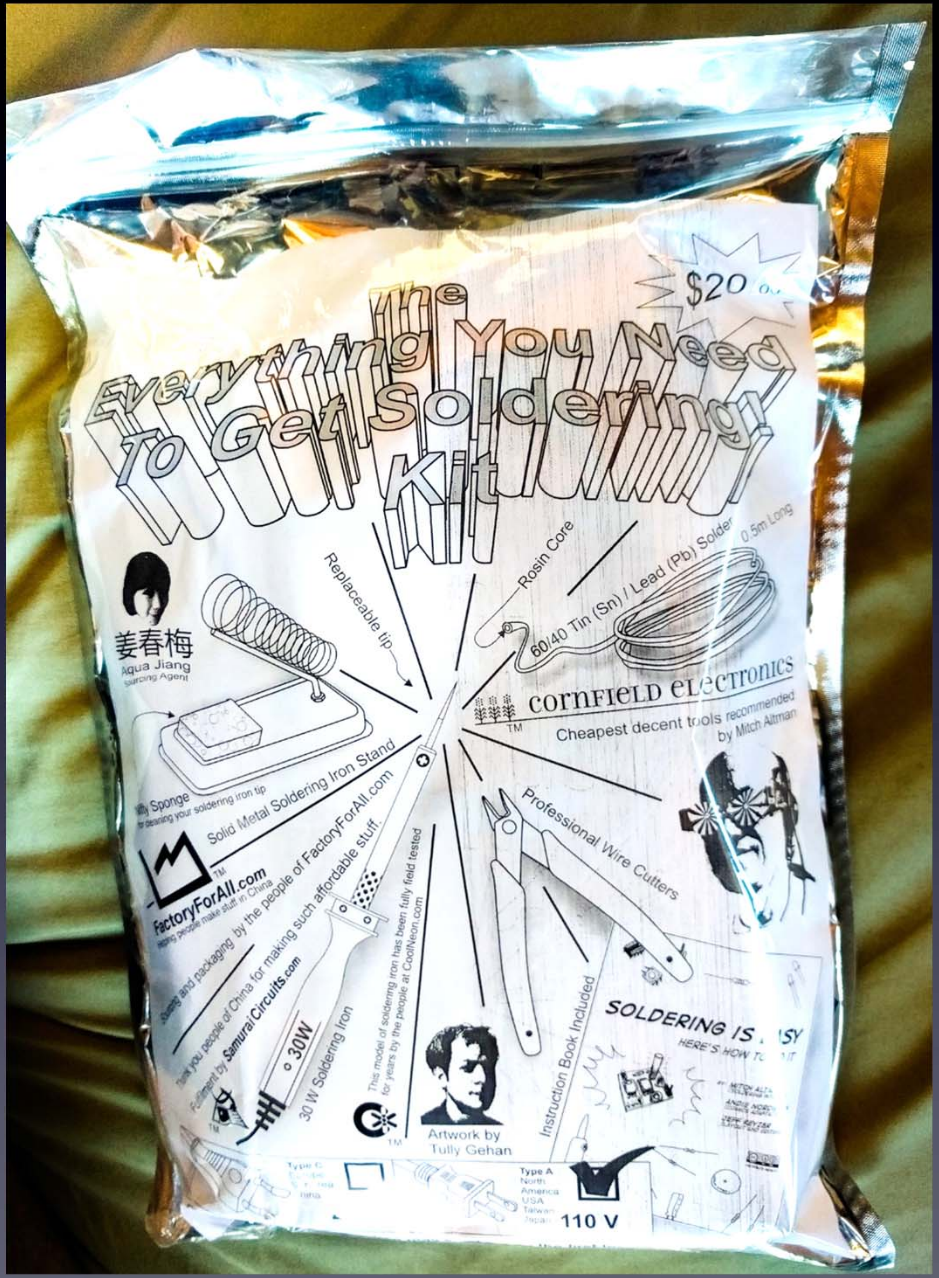
Tools

(Don’t bring these home)

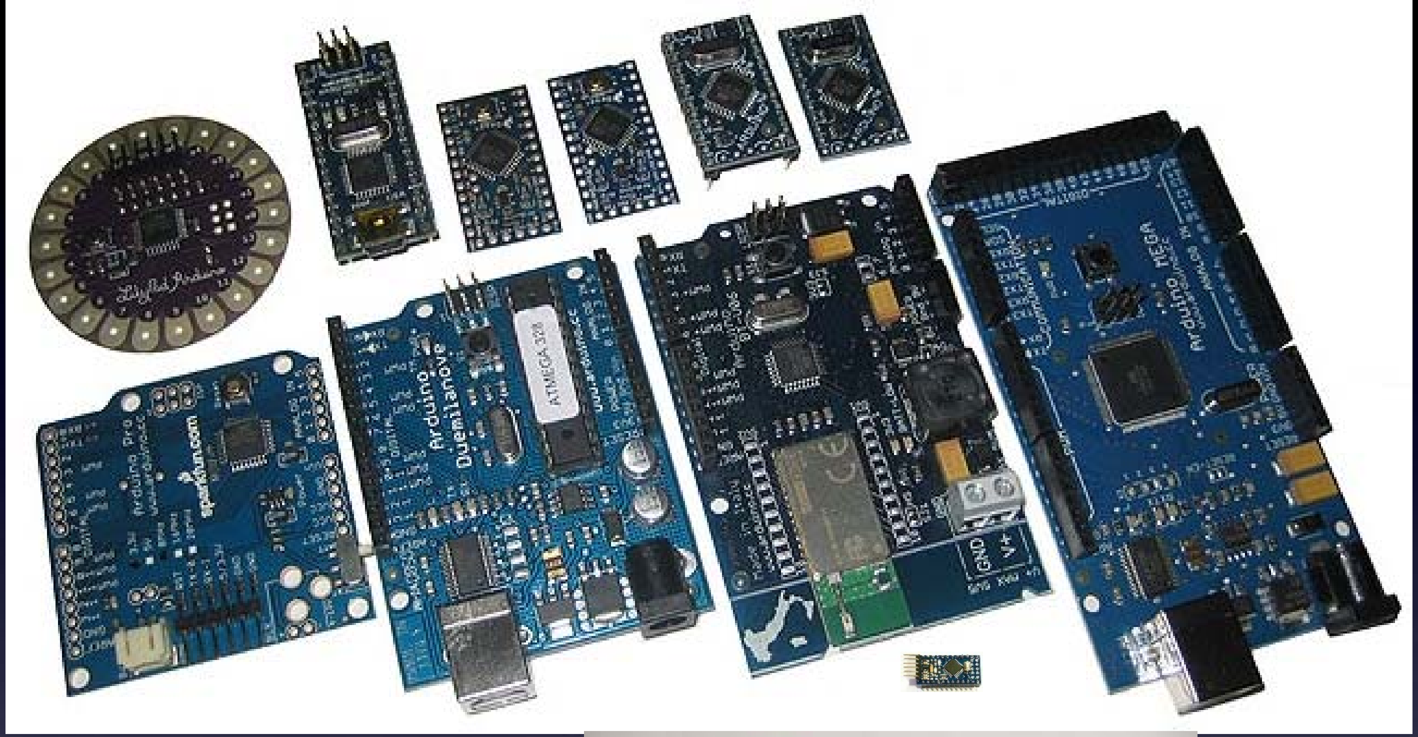


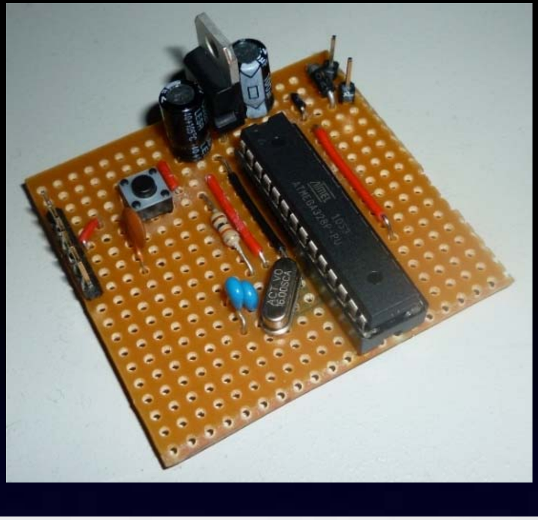
Tools

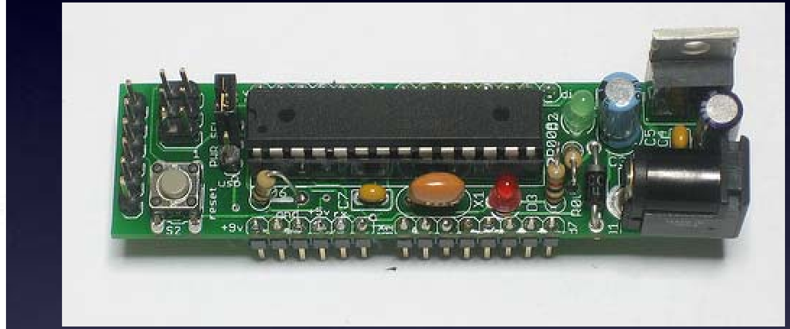
I have these Toolkits for sale

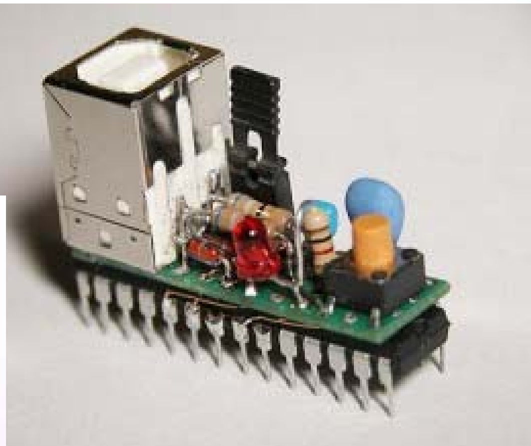

$20
The Everything You Need To Get Soldering! Kit
Replaceable tip
Rosin Core
60/40 Tin (Sn) / Lead (Pb) Solder
0.5m Long
姜春梅
Aqua Jiang
Sourcing Agent
Sponge
for cleaning your soldering iron tip
Solid Metal Soldering Iron Stand
cornfield electronics
Cheapest decent tools recommended by Mitch Altman
FactoryForAll.com
helping people make stuff in China
Sourcing and packaging by the people of FactoryForAll.com
Thank you people of China for making such affordable stuff.
Fulfillment by SamuraiCircuits.com
30W
30 W Soldering Iron
This model of soldering iron has been fully field tested for years by the people at CoolNeon.com
Professional Wire Cutters
Artwork by Tully Gehan
Instruction Book Included
SOLDERING IS EASY
HERE'S HOW TO DO IT
Type C
Type A
North America
USA
Taiwan
Japan
110 V

Intro

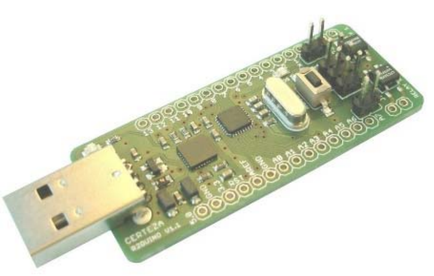

LilyPad Arduino
Arduino Pro
sparkfun.com
Arduino Duemilanove
ATMEGA 328
Arduino MEGA

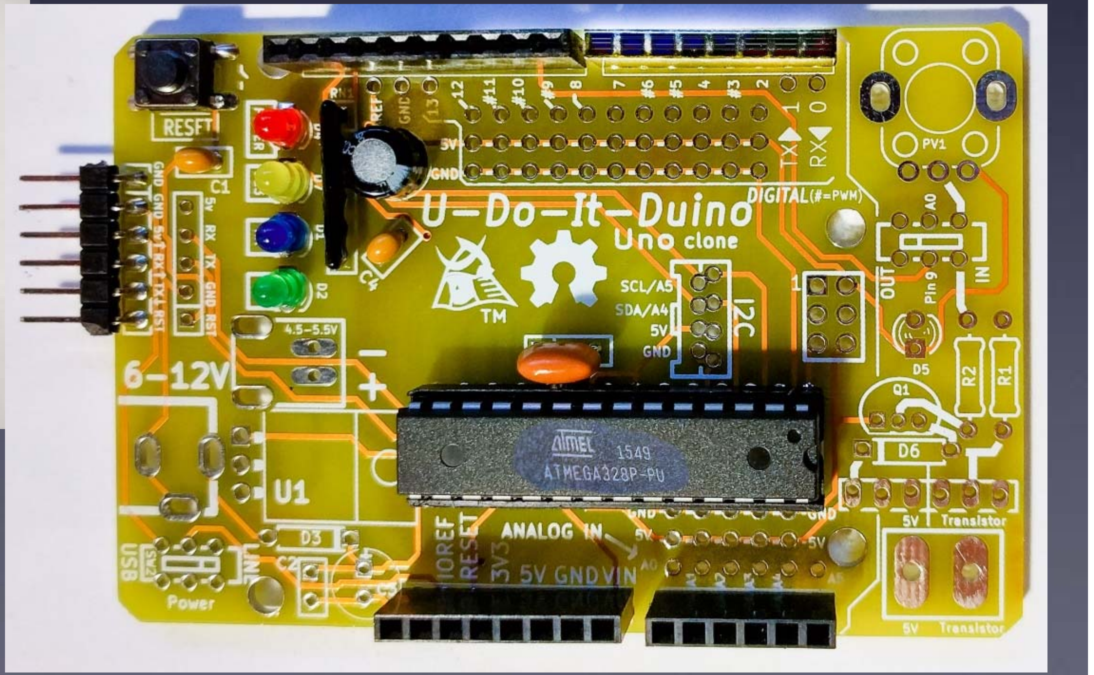




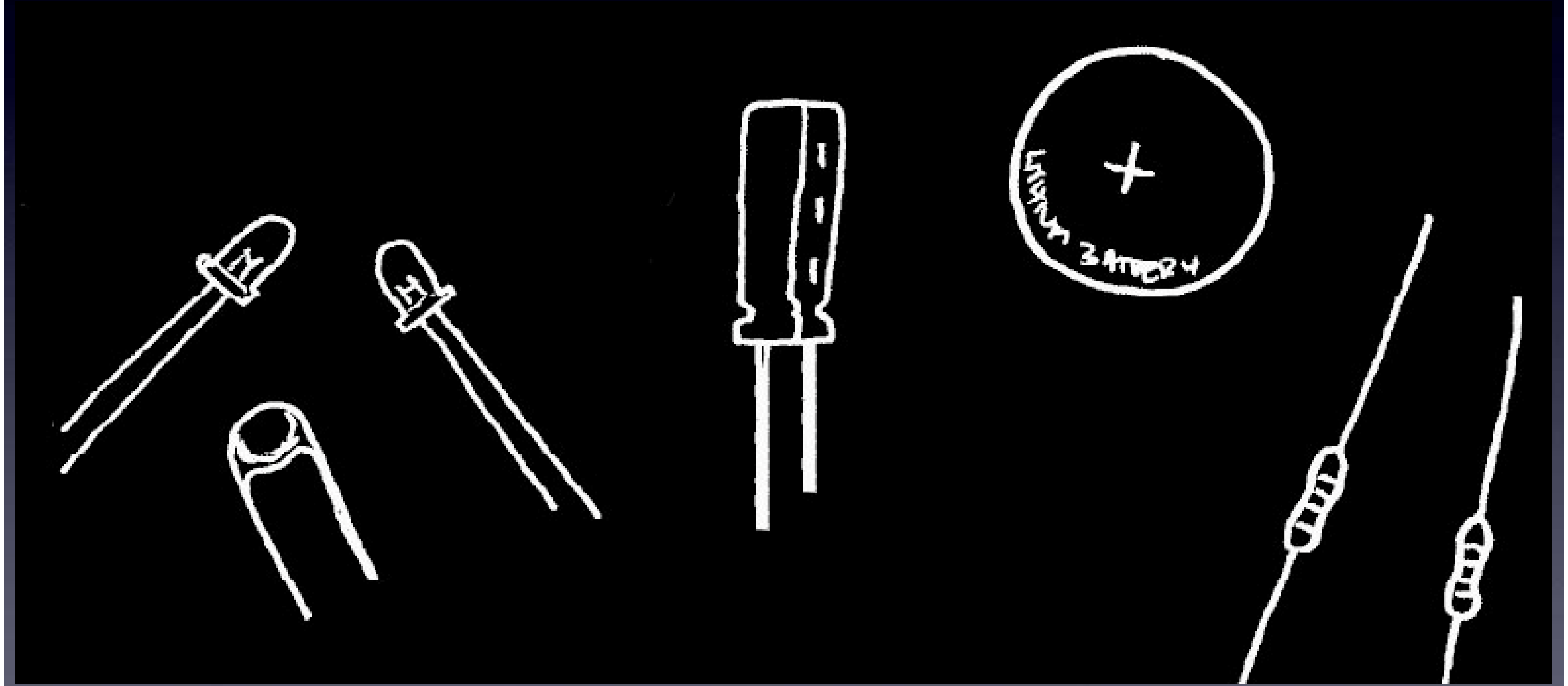


Diavolino
by Evil Mad Science

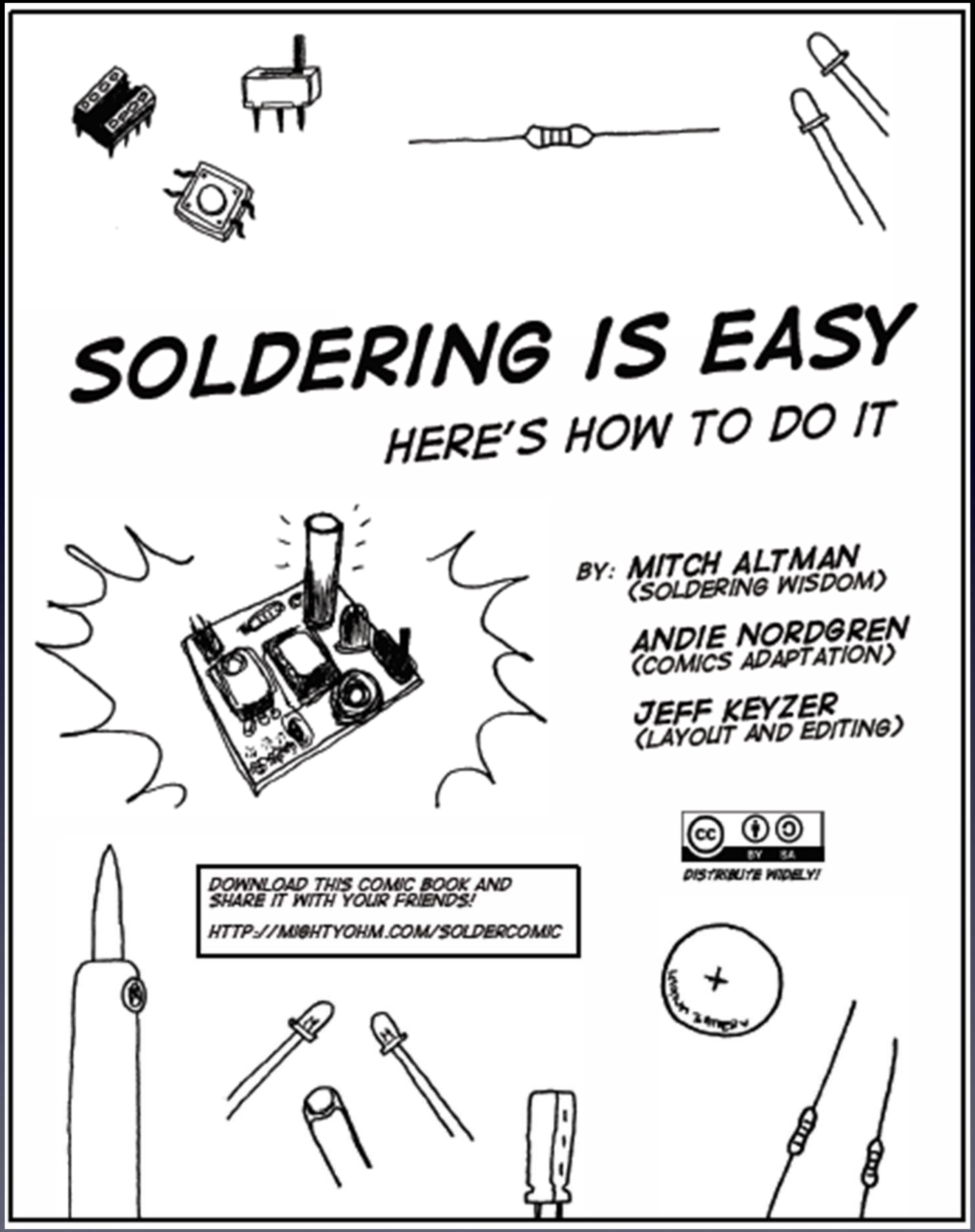



RESET
U-Do-It-Duino
Uno clone
DIGITAL (#=PWM)
6-12V
ATMEGA328P-PU
ANALOG IN
Power
Transistor

Everything You Need to Know About ***Electronics***



Learn To Solder



SOLDERING IS EASY

HERE'S HOW TO DO IT

BY: MITCH ALTMAN
(SOLDERING WISDOM)

ANDIE NORDGREN
(COMICS ADAPTATION)

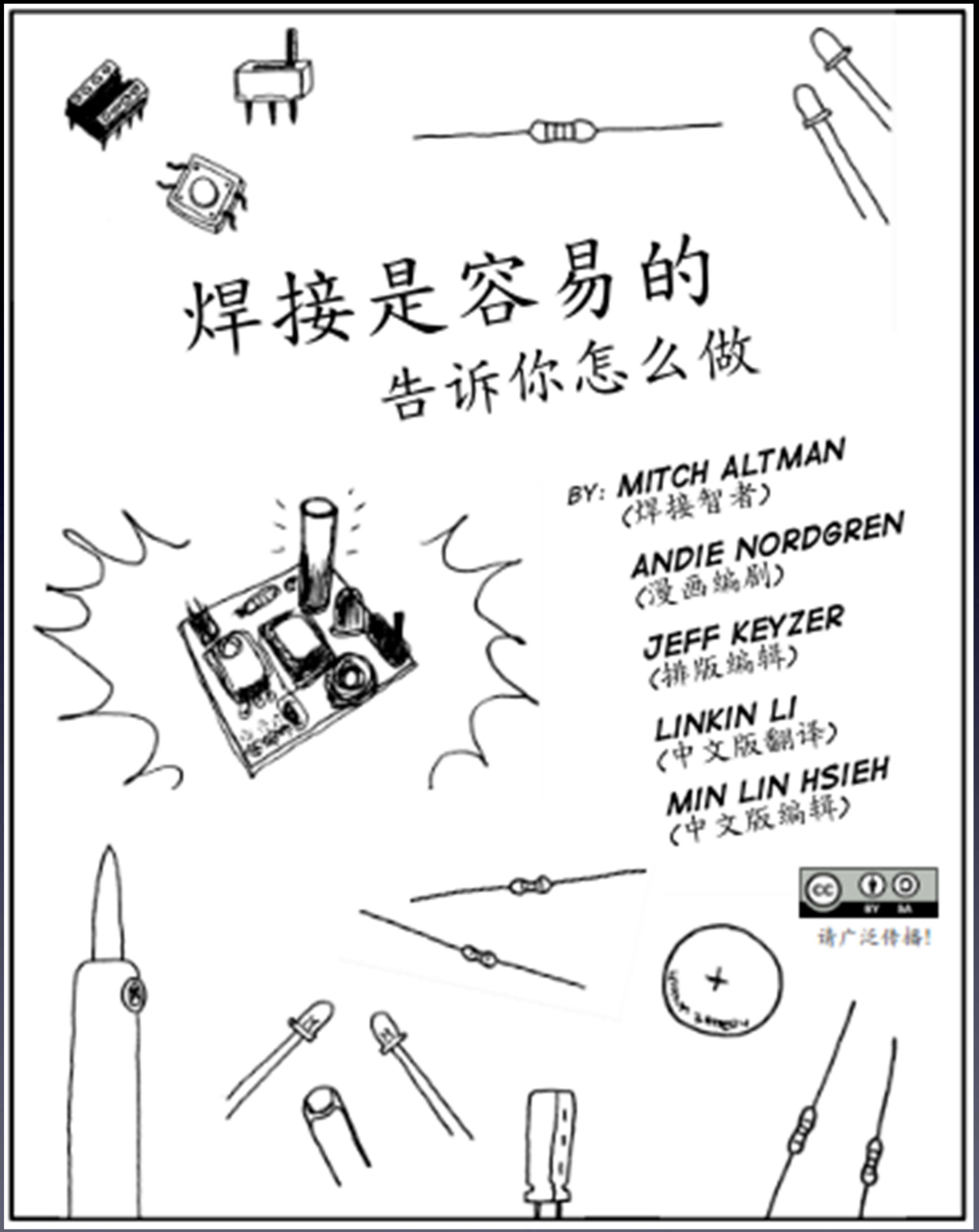
JEFF KEYZER
(LAYOUT AND EDITING)

DOWNLOAD THIS COMIC BOOK AND SHARE IT WITH YOUR FRIENDS!

HTTP://MIGHTYOHM.COM/SOLDERCOMIC

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

Learn To Solder



焊接是容易的

告诉你怎么做

BY: MITCH ALTMAN
（焊接智者）

ANDIE NORDGREN
（漫画编剧）

JEFF KEYZER
（排版编辑）

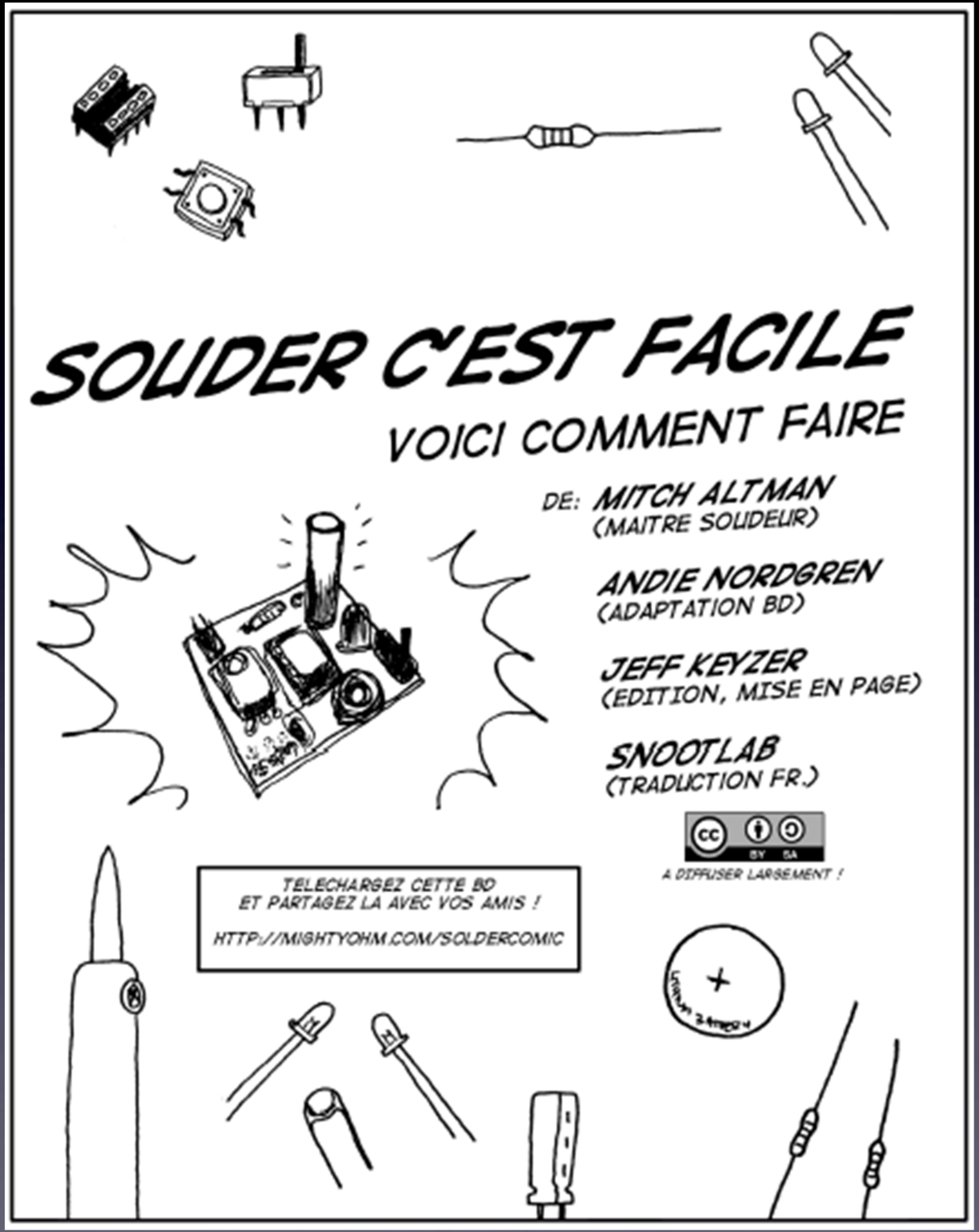
LINKIN LI
（中文版翻译）

MIN LIN HSIEH
（中文版编辑）

请广泛传播!

Download in the language of your choice for free at:
http://mightyohm.com/soldercomic

Learn To Solder



SOUDER C'EST FACILE

VOICI COMMENT FAIRE

DE: MITCH ALTMAN
(MAITRE SOUDEUR)

ANDIE NORDGREN
(ADAPTATION BD)

JEFF KEYZER
(EDITION, MISE EN PAGE)

SNOOTLAB
(TRADUCTION FR.)

cc BY SA

A DIFFUSER LARGEMENT !

TELECHARGEZ CETTE BD
ET PARTAGEZ LA AVEC VOS AMIS !

HTTP://MIGHTYOHM.COM/SOLDERCOMIC

Download in the language of your choice for free at:
http://mightyohm.com/soldercomic

Learn To Solder

SOLDAR ES FÁCIL!

APRENDE CÓMO HACERLO

POR: MITCH ALTMAN
(SABIDURÍA EN SOLDADO)

ANDIE NORDGREN
(ADAPTACIÓN A COMIC)

JEFF KEYZER
(DISEÑO Y EDICIÓN)

Download in the language of your choice for free at:
http://mightyohm.com/soldercomic

Learn To Solder

LÖTEN IST EINFACH

SO WIRD ES GEMACHT

VON: MITCH ALTMAN
(LÖTWEISHEITEN)

ANDIE NORDGREN
(KOMIK-UMSETZUNG)

JEFF KEYZER
(LAYOUT UND BEARBEITUNG)

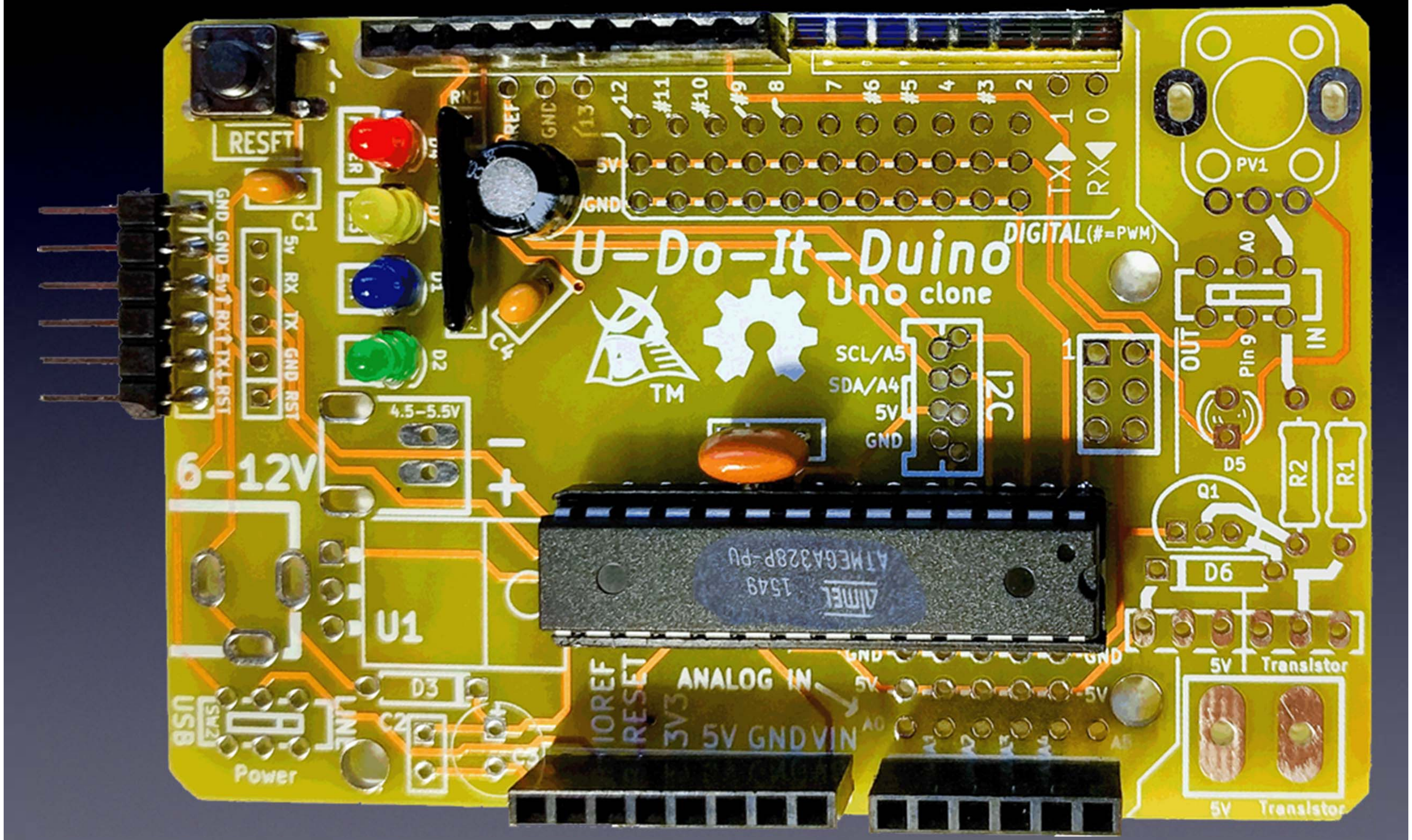
ALEXANDER BODORA
(ÜBERSETZUNG UND BEARBEITUNG)

RICHARD MEINSEN
(ÜBERARBEITUNG UND KORREKTUR)

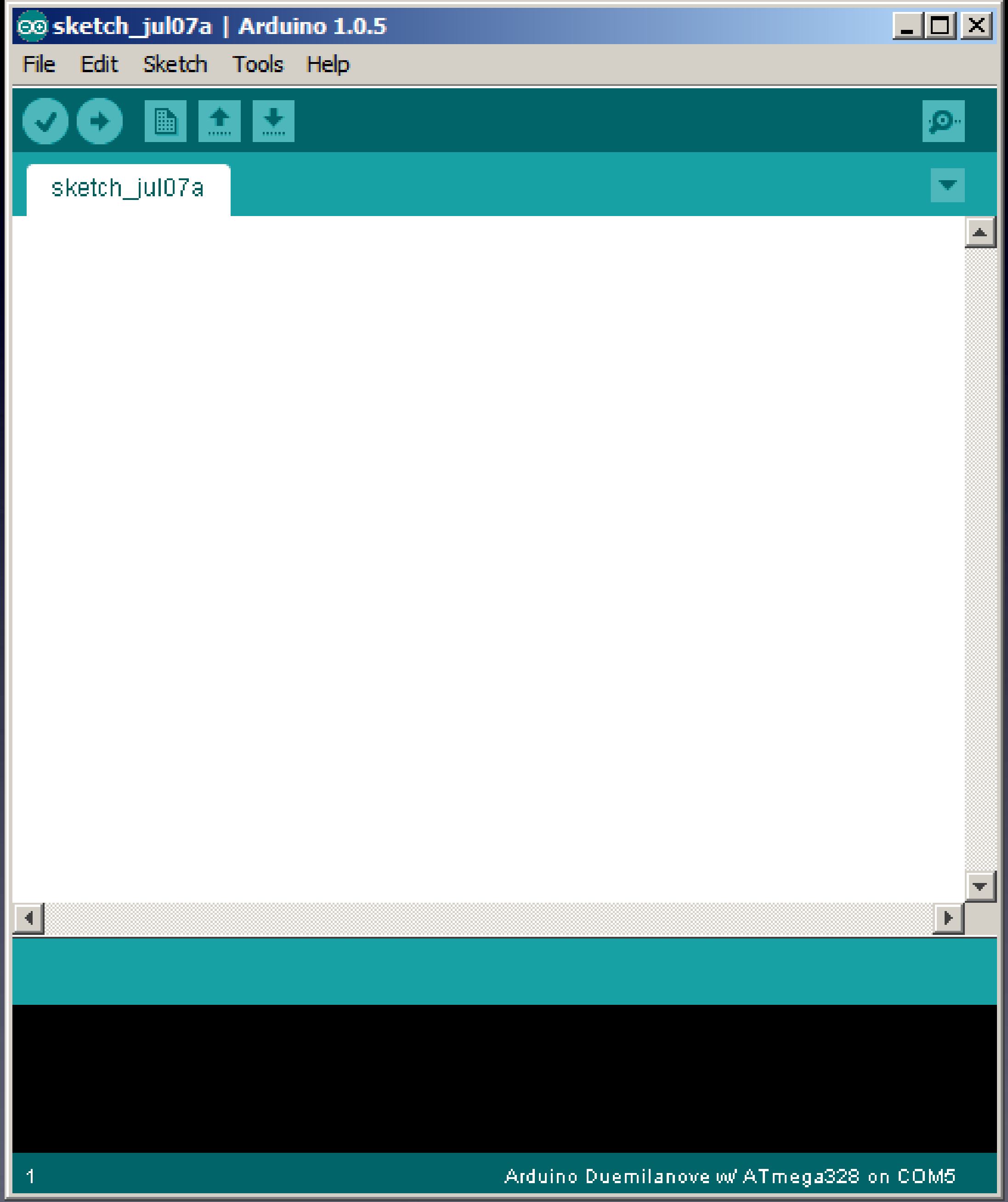
WEITER VERTEILEN!

Download in the language of your choice for free at:
http://mightyohm.com/soldercomic

Solder Your Aruino Clone

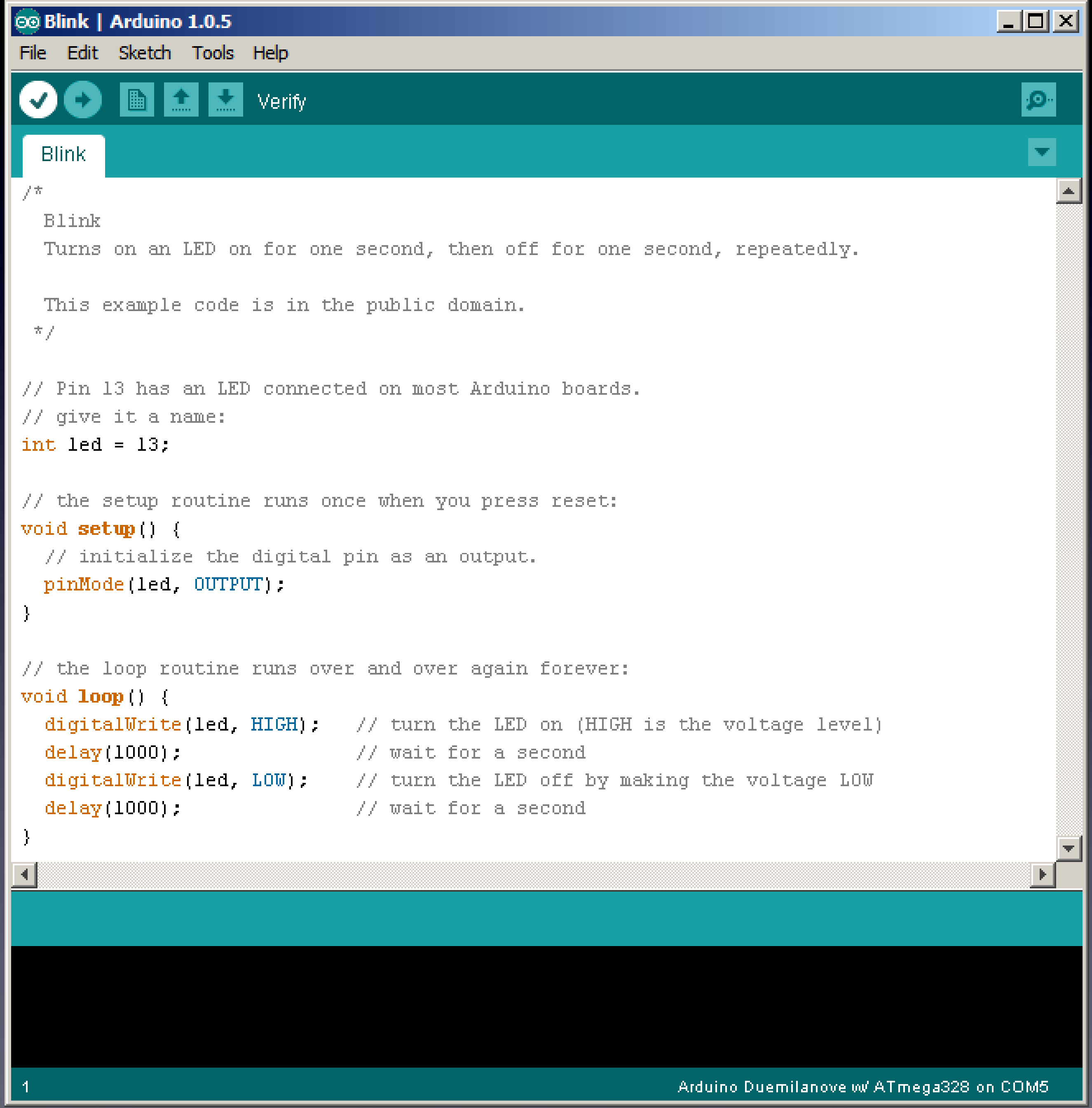


How to Set Up and Use the Arduino Software



sketch_jul07a | Arduino 1.0.5
File
Edit
Sketch
Tools
Help
sketch_jul07a
1
Arduino Duemilanove w/ ATmega328 on COM5

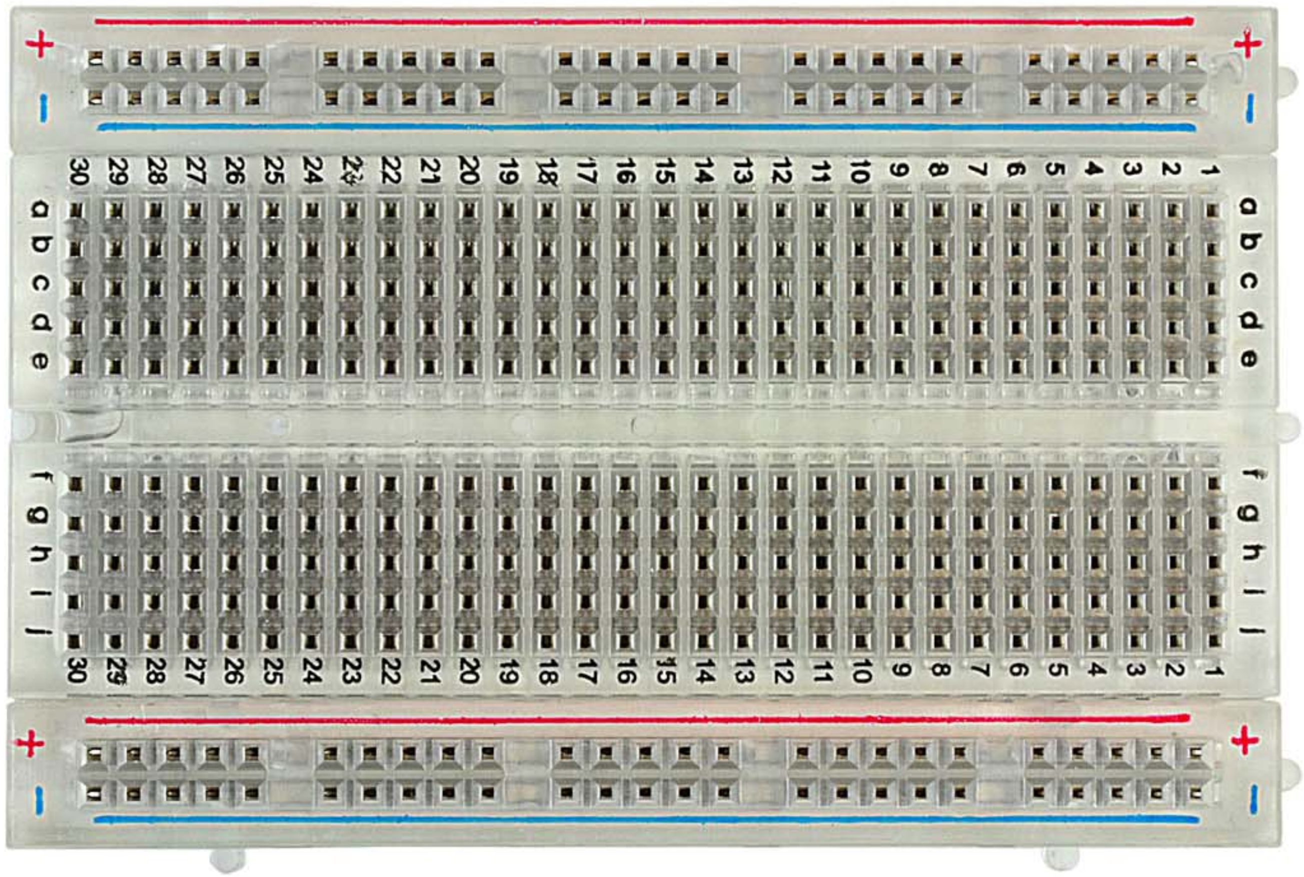
How to Hack Arduino Programs ("Sketches")



```
/*
  Blink
  Turns on an LED on for one second, then off for one second, repeatedly.

  This example code is in the public domain.
 */

// Pin 13 has an LED connected on most Arduino boards.
// give it a name:
int led = 13;

// the setup routine runs once when you press reset:
void setup() {
  // initialize the digital pin as an output.
  pinMode(led, OUTPUT);
}

// the loop routine runs over and over again forever:
void loop() {
  digitalWrite(led, HIGH);   // turn the LED on (HIGH is the voltage level)
  delay(1000);               // wait for a second
  digitalWrite(led, LOW);    // turn the LED off by making the voltage LOW
  delay(1000);               // wait for a second
}
```

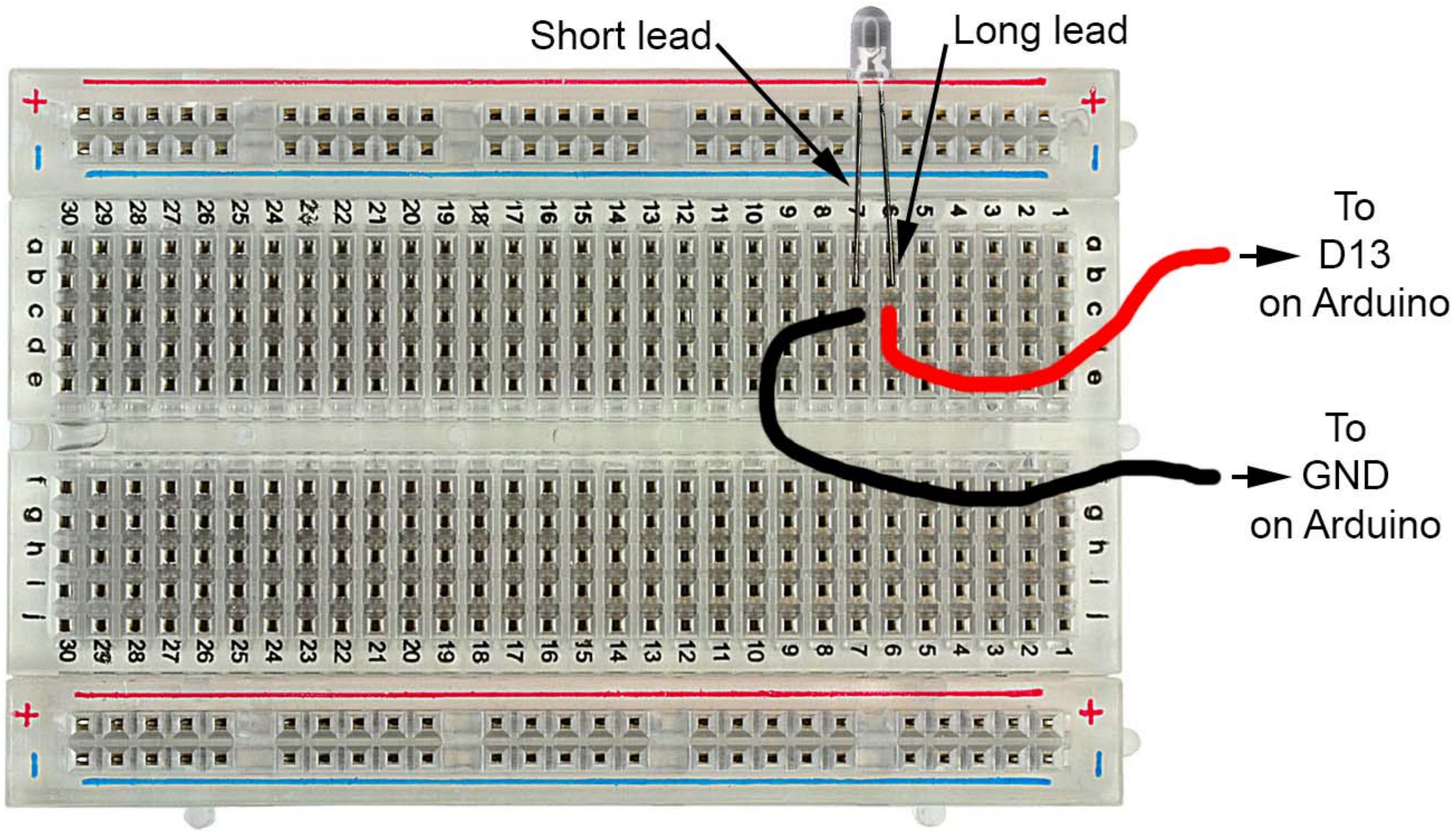
How to Use Solderless Breadboards

Solderless Breadboard

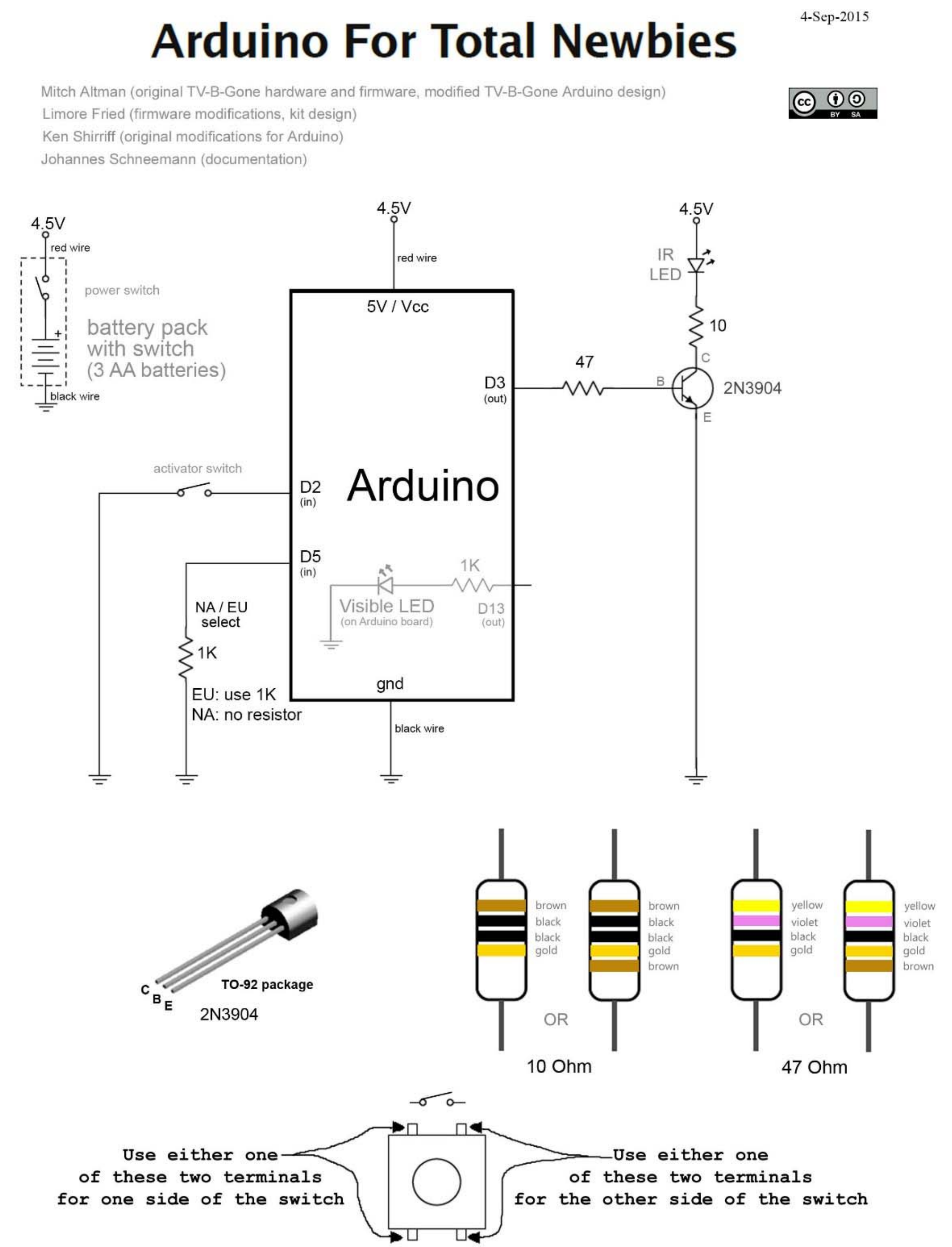


How to Use Solderless Breadboards

Solderless Breadboad with LED and wires



How to Read a Schematic



4-Sep-2015

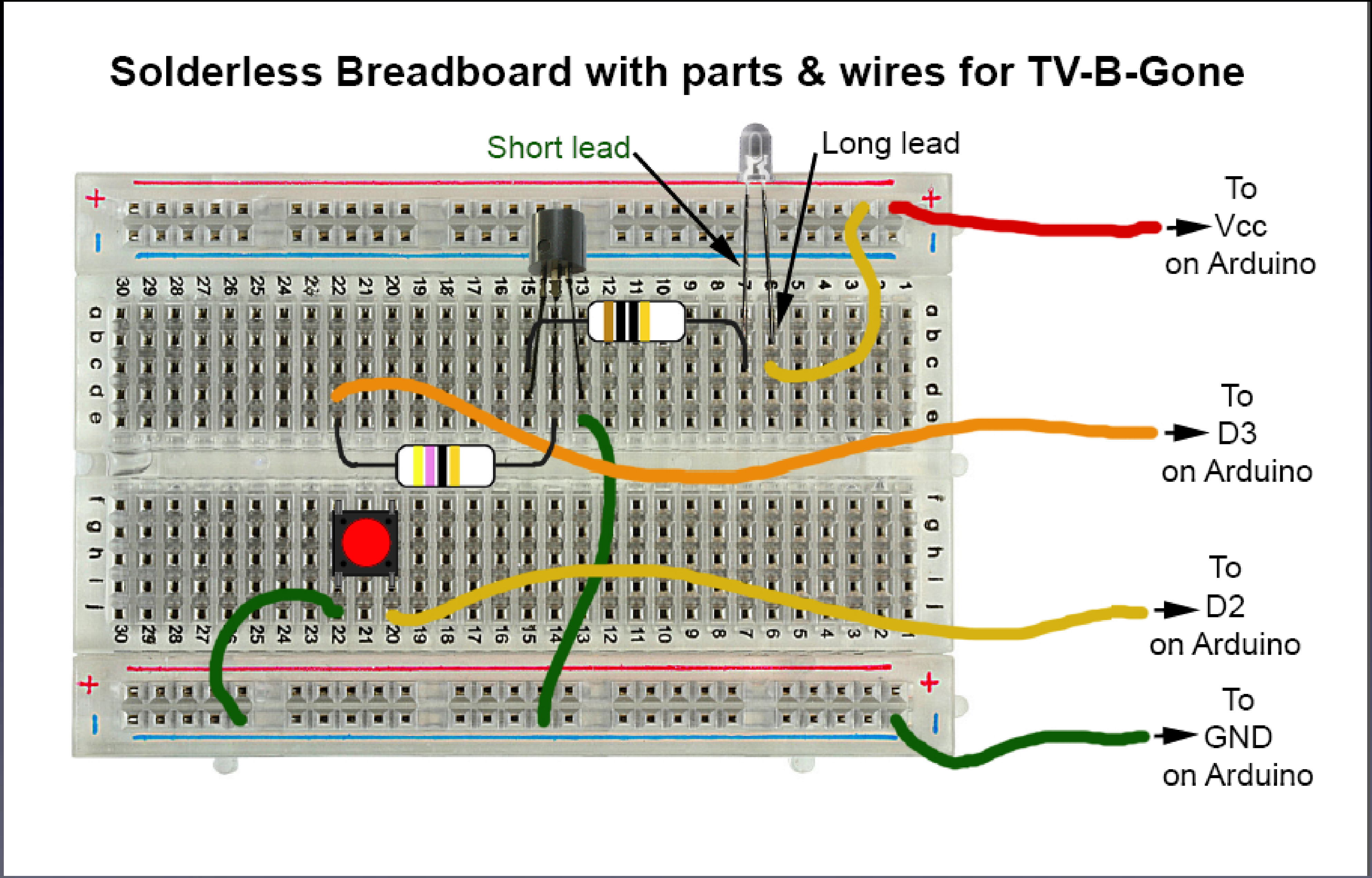
Arduino For Total Newbies

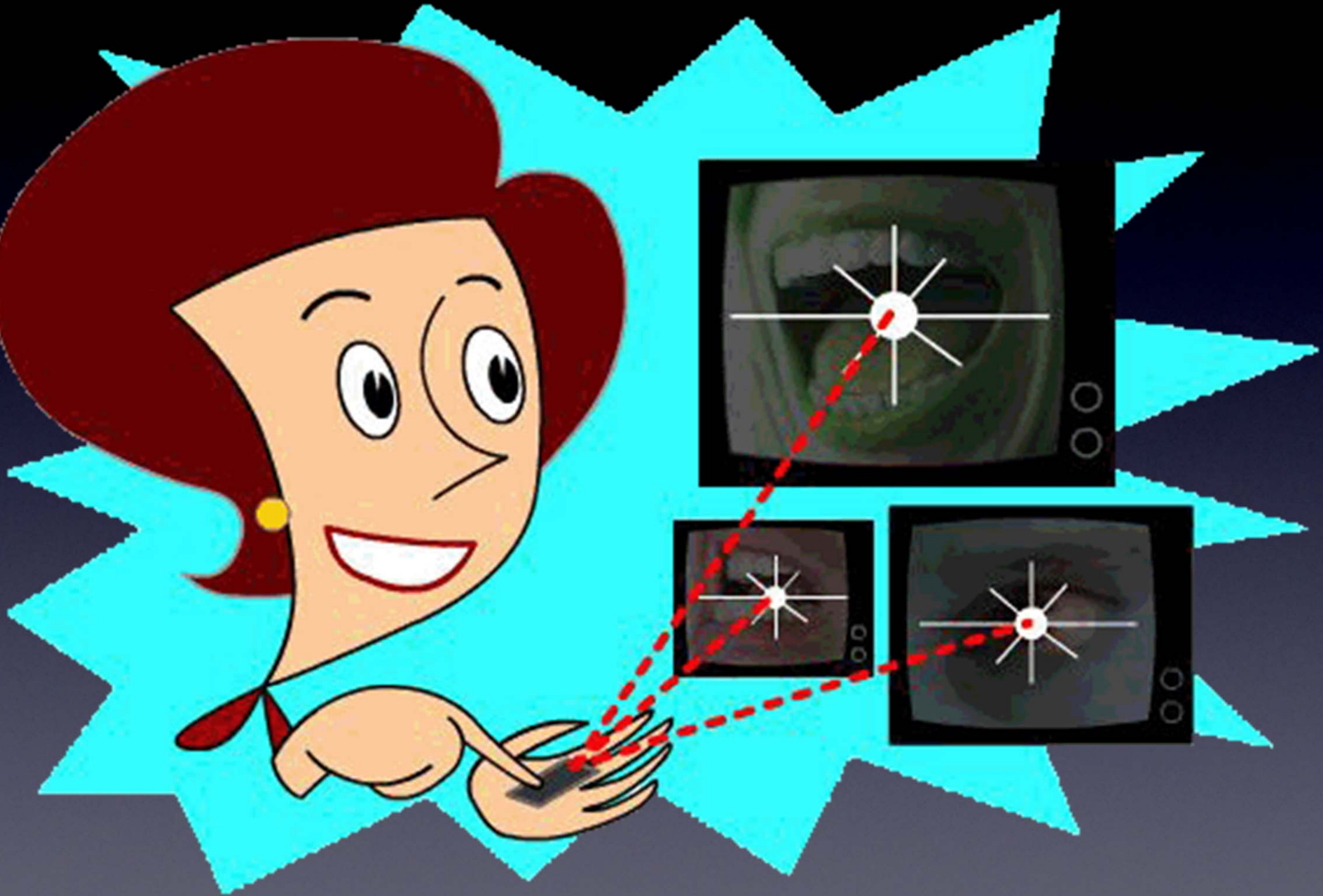
Mitch Altman (original TV-B-Gone hardware and firmware, modified TV-B-Gone Arduino design)
Limore Fried (firmware modifications, kit design)
Ken Shirriff (original modifications for Arduino)
Johannes Schneemann (documentation)

Use either one of these two terminals for one side of the switch

Use either one of these two terminals for the other side of the switch

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


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



Questions?

Intro

TV B-Gone™
Universal Remote Control
www.tvbgone.com

BUDDY L

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

RIO
TOKYO
PARIS
ROME
WASHINGTON
TORONTO
VIENNA
LONDON
FRANKFURT

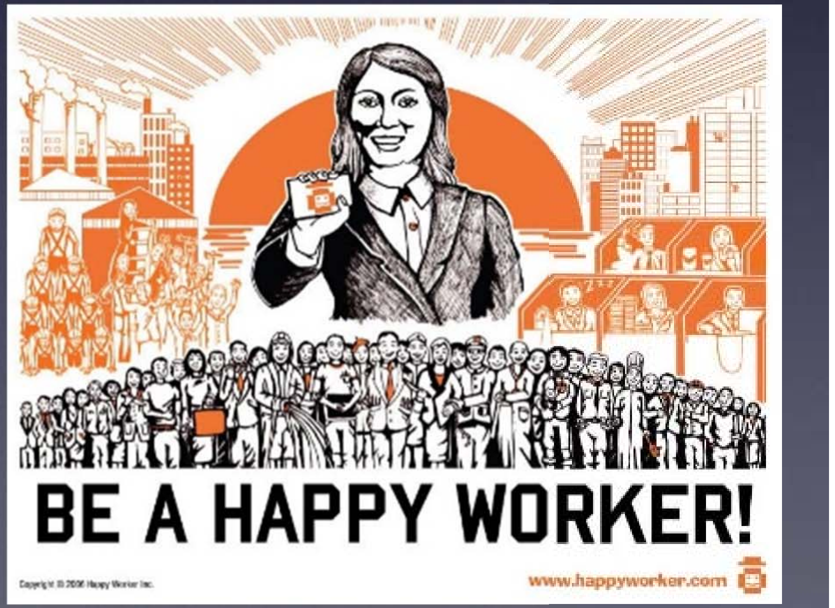
TEDx Brussels

WEST WALL

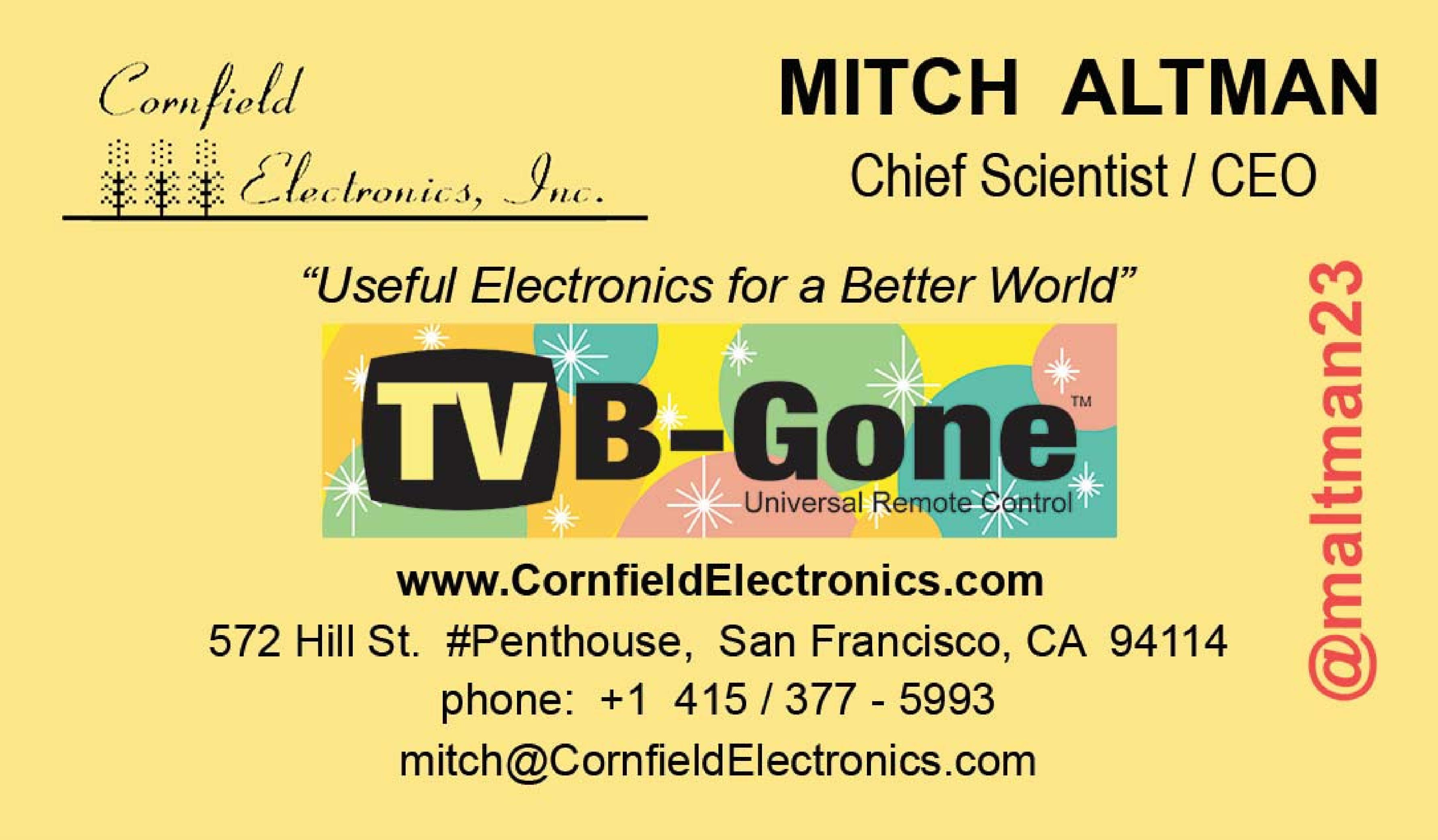
Intro

TV B-Gone™
Universal Remote Control
www.tvbgone.com

BUDDY L
.01 .10 .50 $10
.01 .10 .25 .75
.05 .20 .50 $100


BE A HAPPY WORKER!
Copyright © 2006 Happy Worker Inc.
www.happyworker.com

Intro



Cornfield Electronics, Inc.

MITCH ALTMAN

Chief Scientist / CEO

“Useful Electronics for a Better World”

TV B-Gone™
Universal Remote Control

www.CornfieldElectronics.com

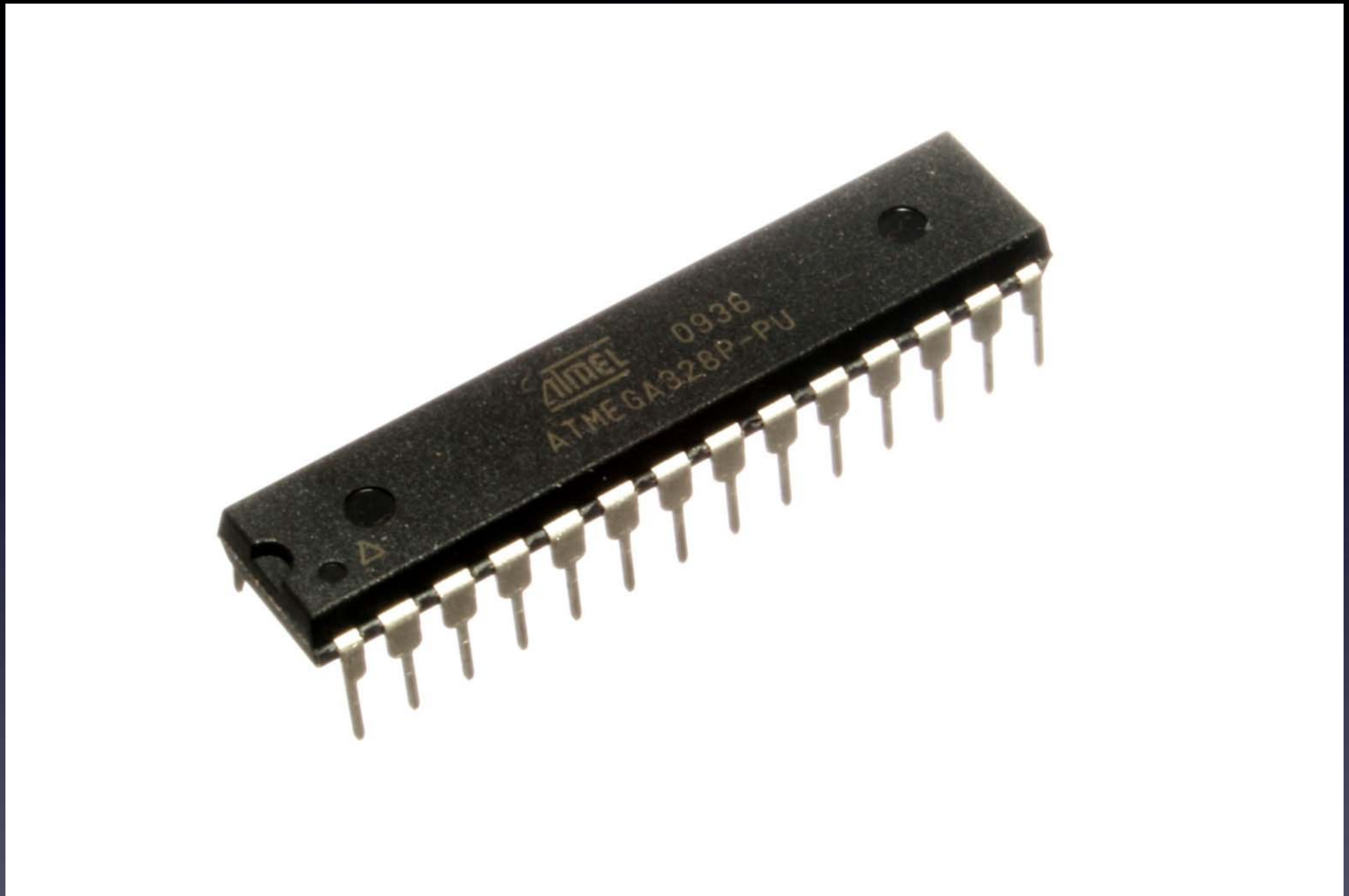
572 Hill St. #Penthouse, San Francisco, CA 94114
phone: +1 415 / 377 - 5993
mitch@CornfieldElectronics.com

@maltman23

Intro

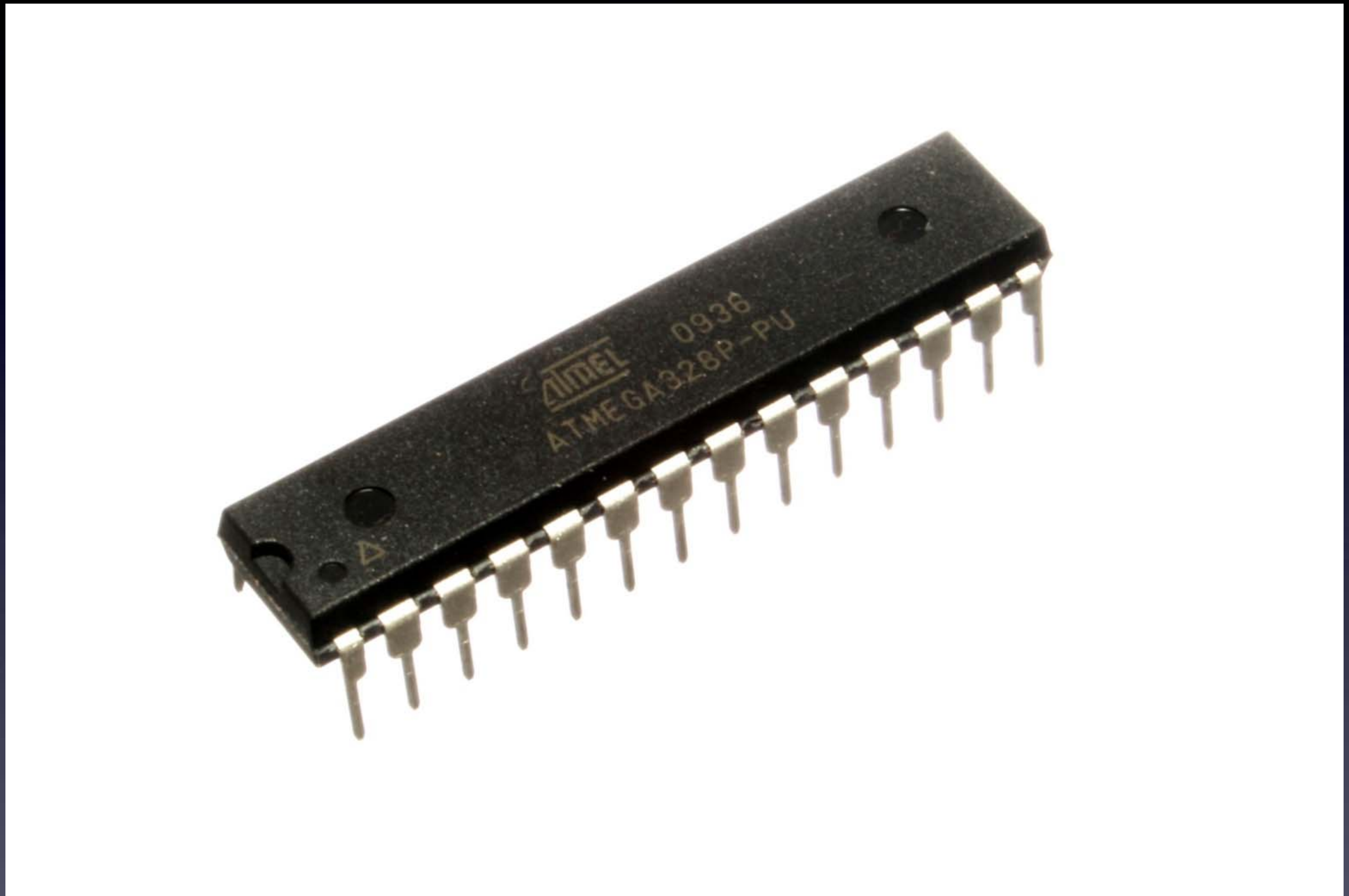
Arduino For Total Newbies Workshop at 30C3, Hamburg Germany

Intro to Arduino: microcontrollers



A complete computer on a chip

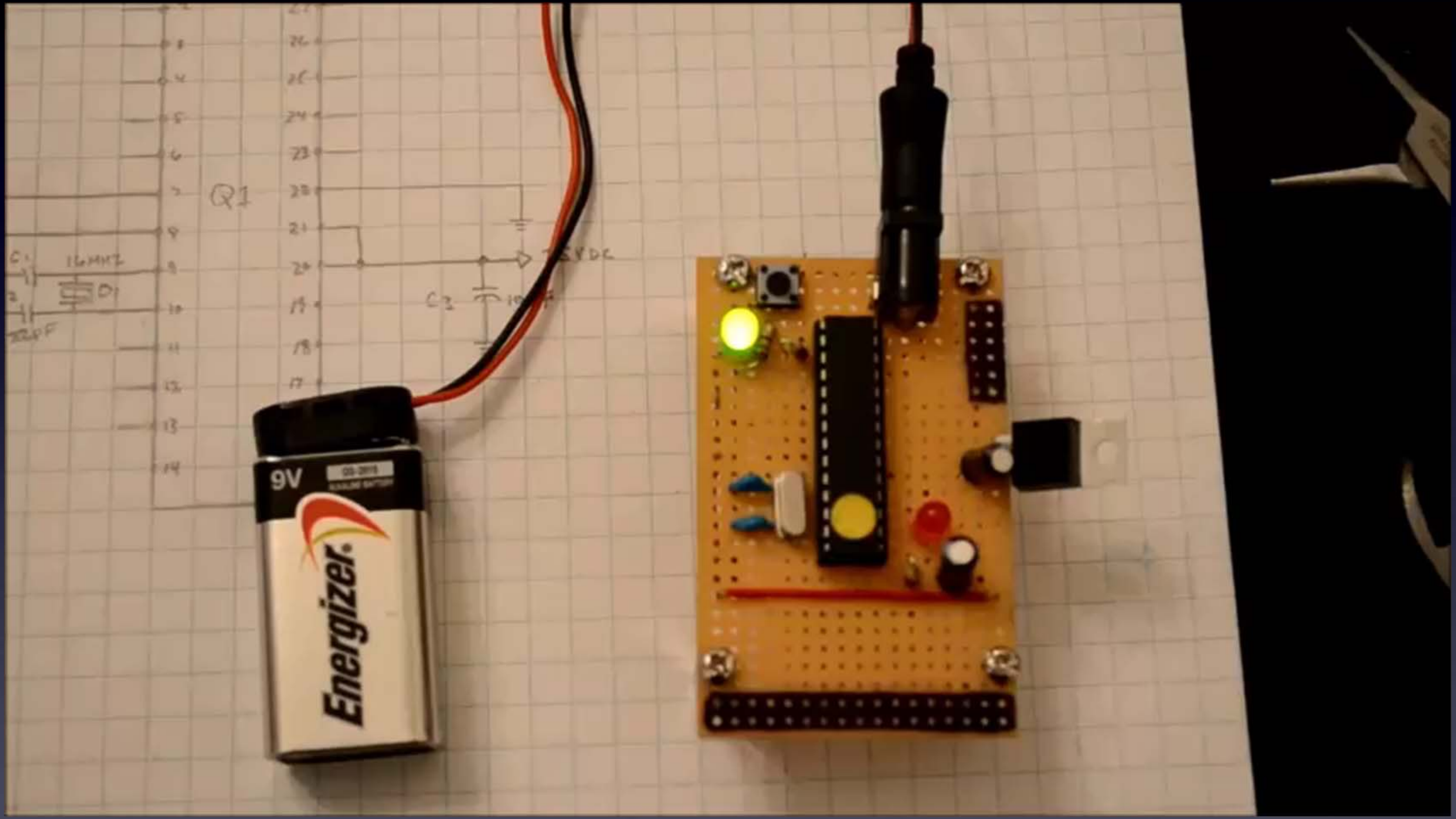
Intro to Arduino: microcontrollers



A complete computer on a chip:

they control parts connected to their pins

Intro to Arduino: microcontrollers



Intro to Arduino: microcontrollers

-- some of Mitch's projects --

***Trippy RGB Waves** kit*

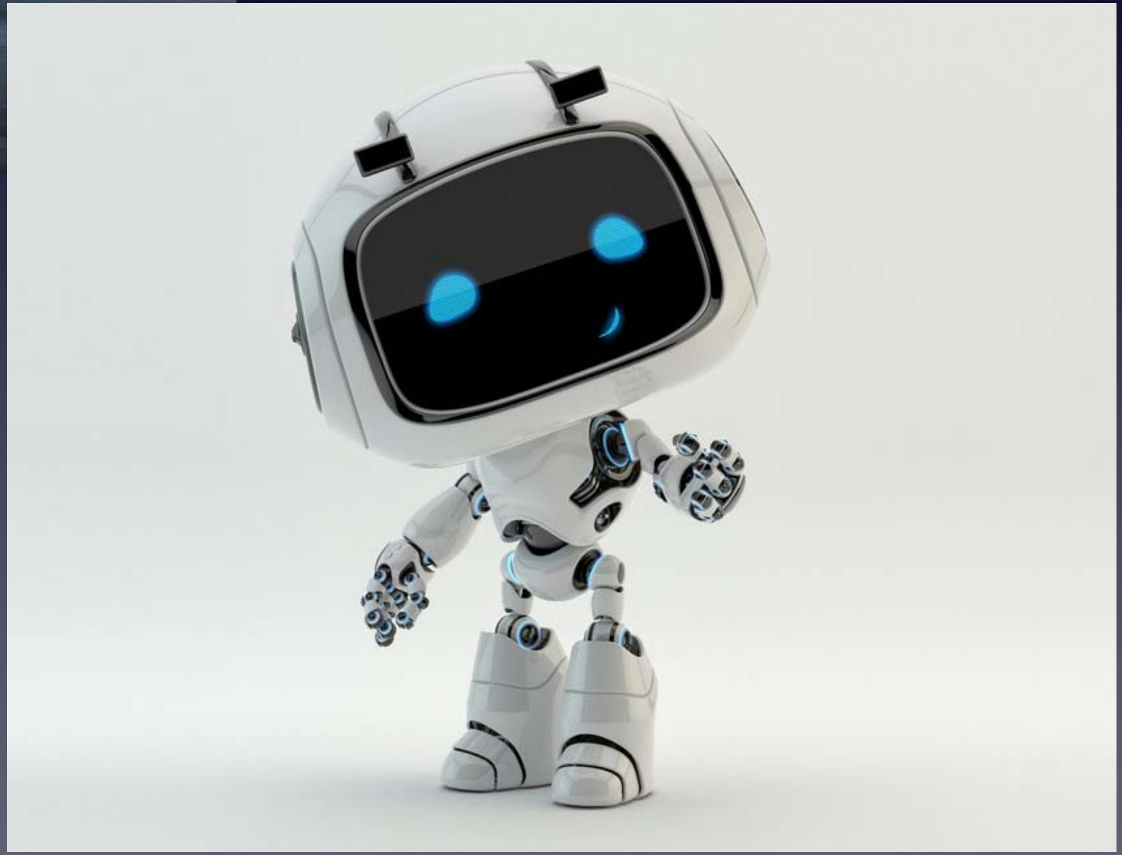
Intro to Arduino: microcontrollers

-- some of Mitch's projects --

ArduTouch
music
synthesizer
kit

Intro to Arduino: microcontrollers

Intro to Arduino: microcontrollers



Intro to Arduino: microcontrollers

Intro to Arduino: microcontrollers

Intro to Arduino: microcontrollers

-- some of Mitch's projects --

TV-B-Gone

HIGH POWER UNIVERSAL REMOTE CONTROL
Just Point & Click...
TURN ANY TV
On or Off! AMAZING!
BATTERIES INCLUDED! READY TO GO!

Intro to Arduino: microcontrollers

-- some of Mitch's projects --

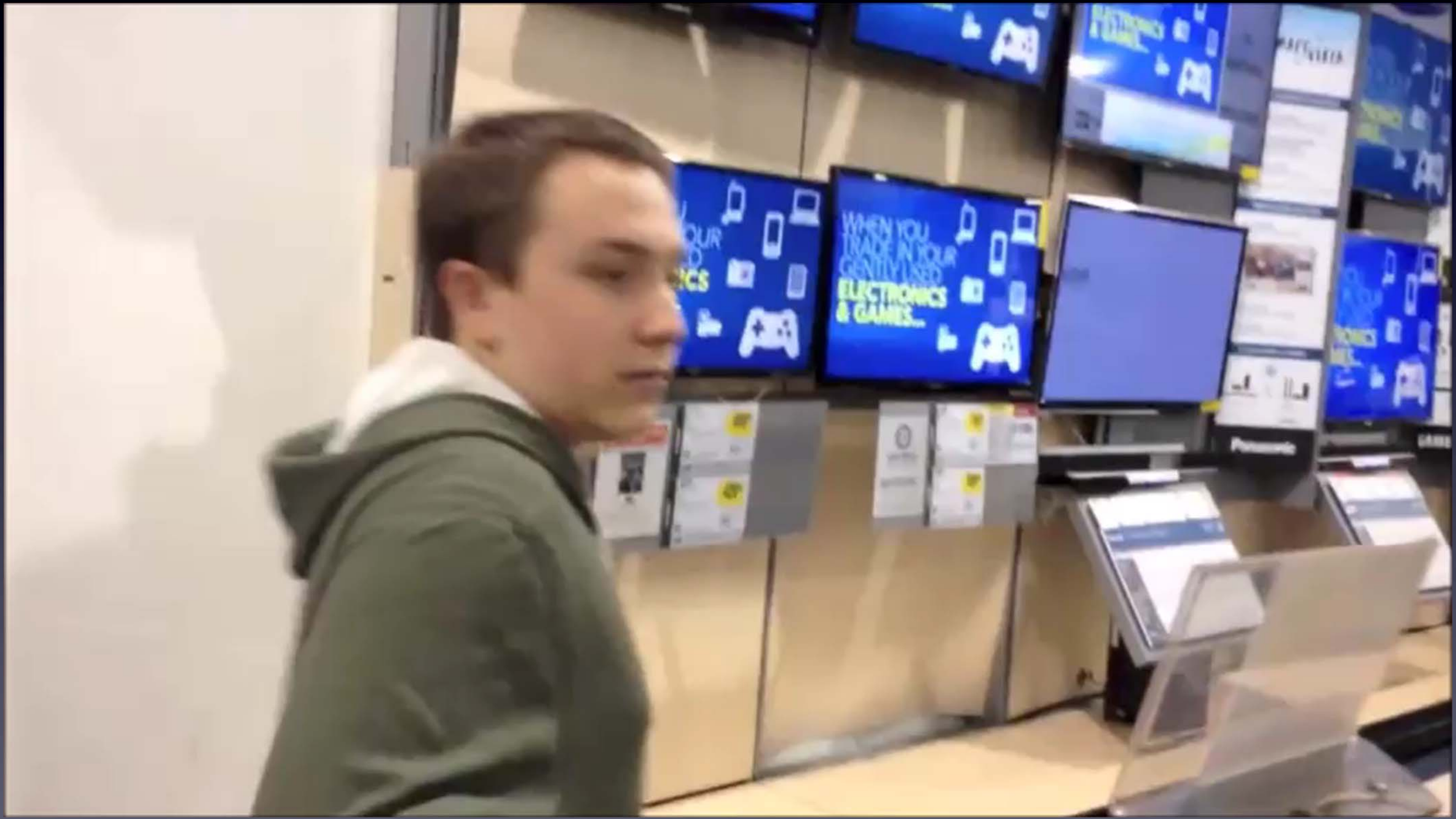
HIGH POWER UNIVERSAL REMOTE CONTROL
Just Point & Click...
TURN ANY TV
On or Off! AMAZING!
BATTERIES INCLUDED! READY TO GO!

TV-B-Gone

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

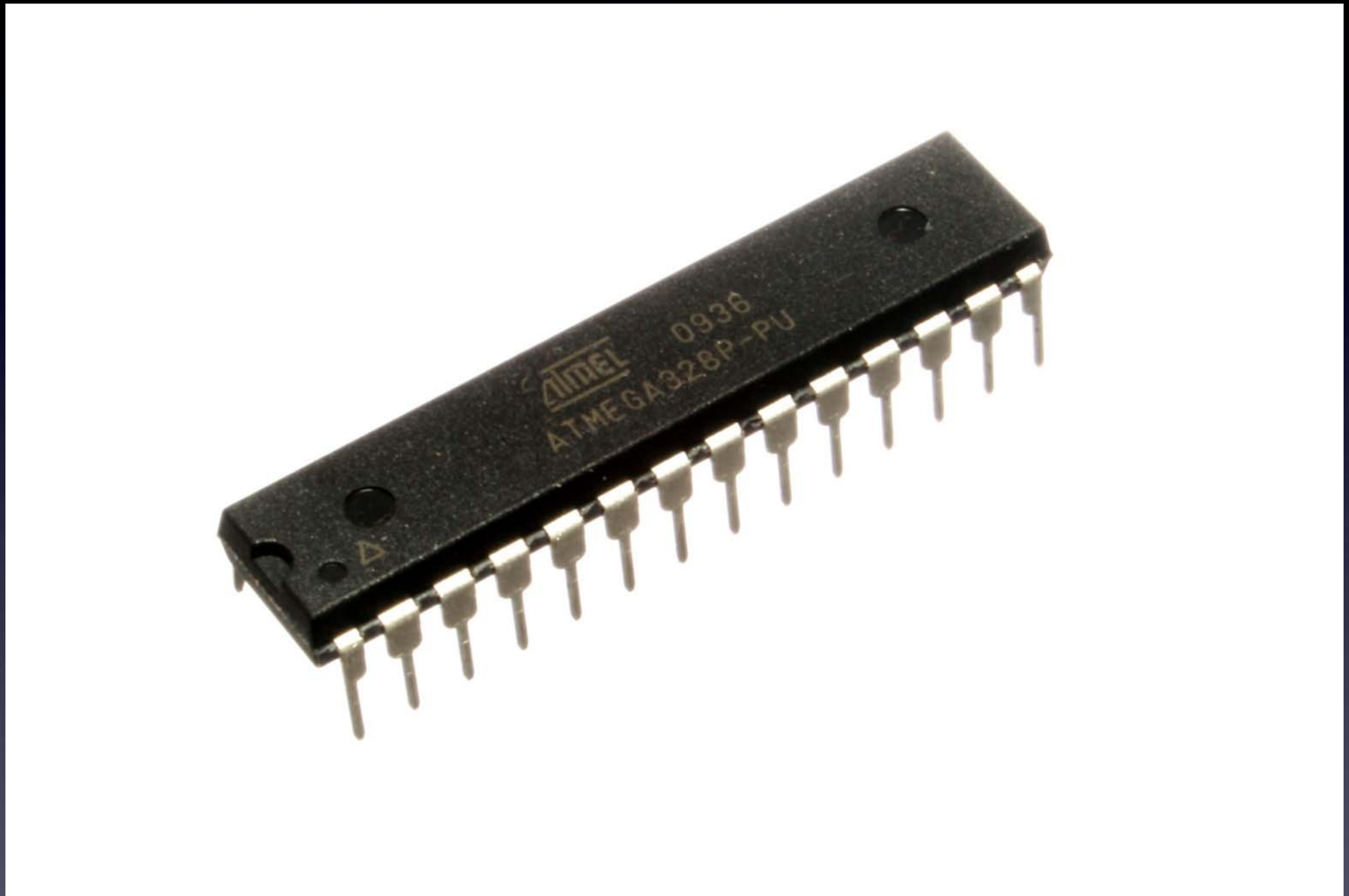
Intro to Arduino: microcontrollers

-- some of Mitch's projects --



TV-B-Gone

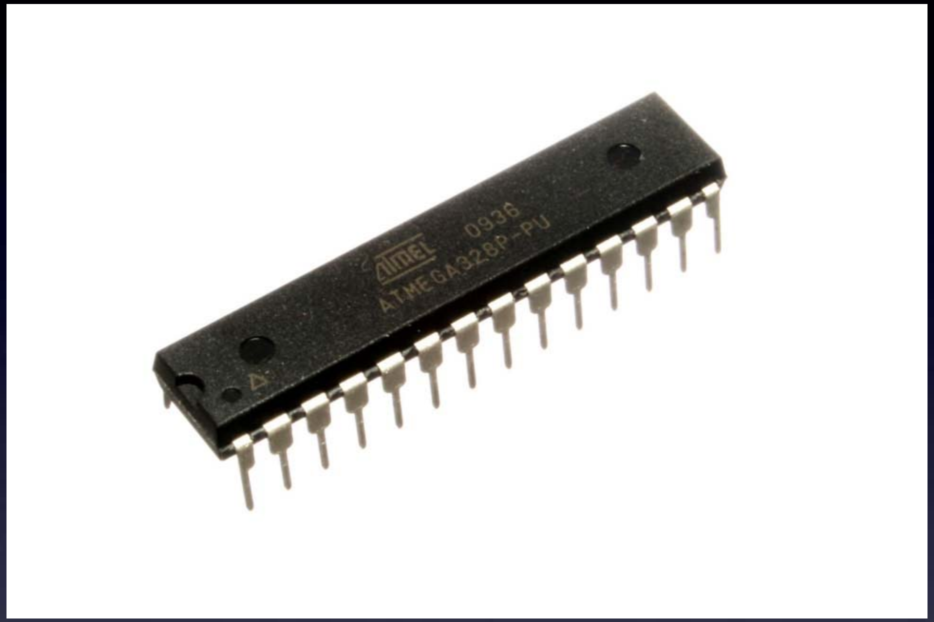
Intro to Arduino: microcontrollers



A complete computer on a chip:

they control parts connected to their pins

Intro to Arduino: microcontrollers



A complete computer on a chip:

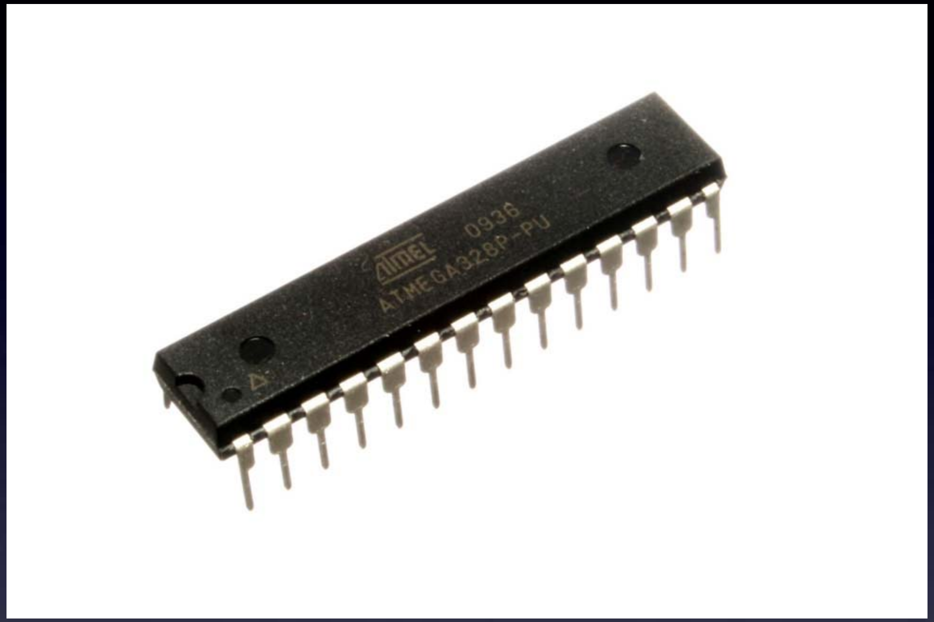
they control parts connected to their pins

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,

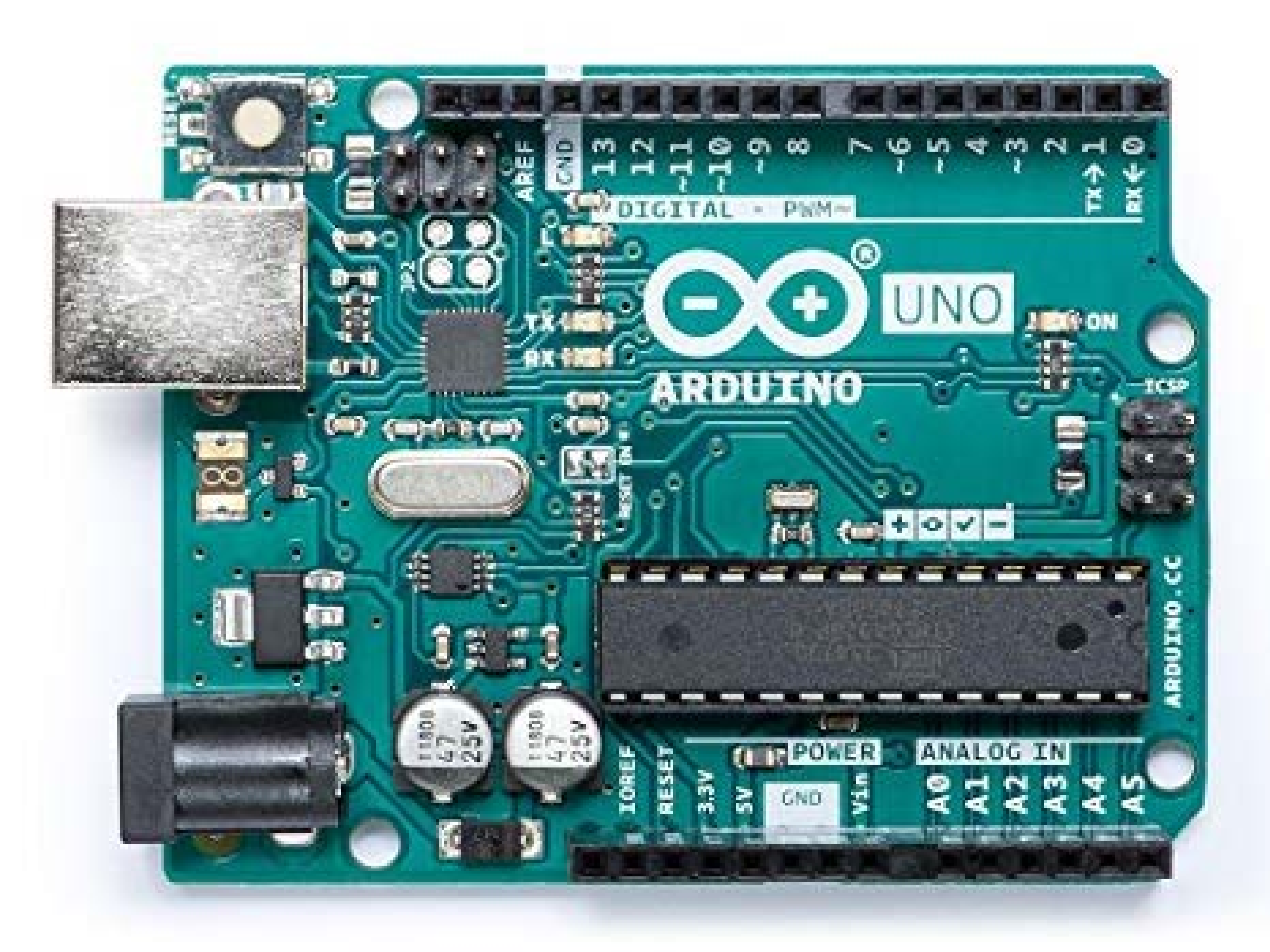
How do you
connect parts to its pins?

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

Answer: Be a geek, and learn how!

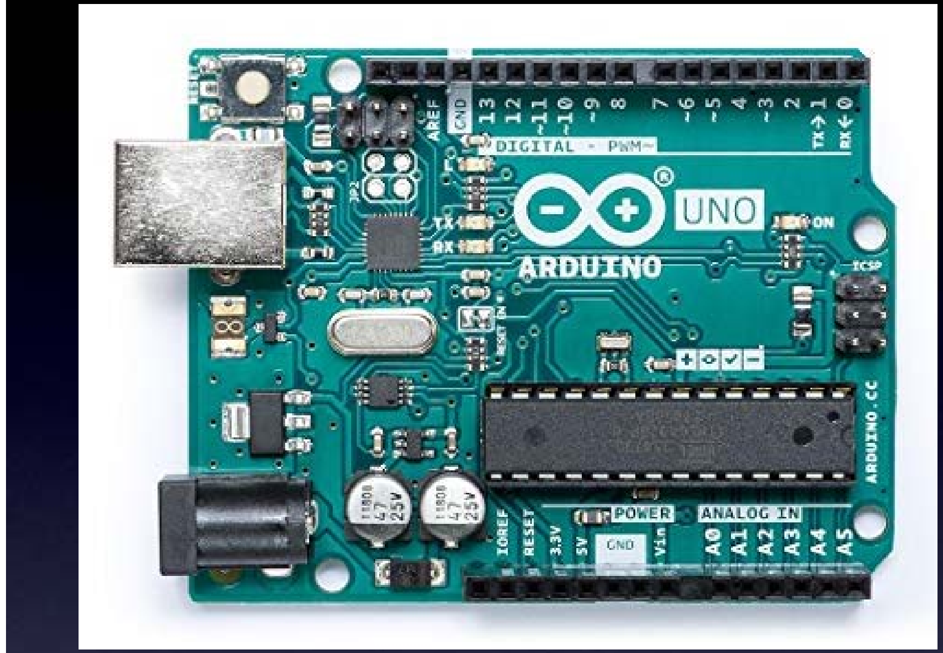
Or

Intro to Arduino



Use an Arduino board

Intro to Arduino

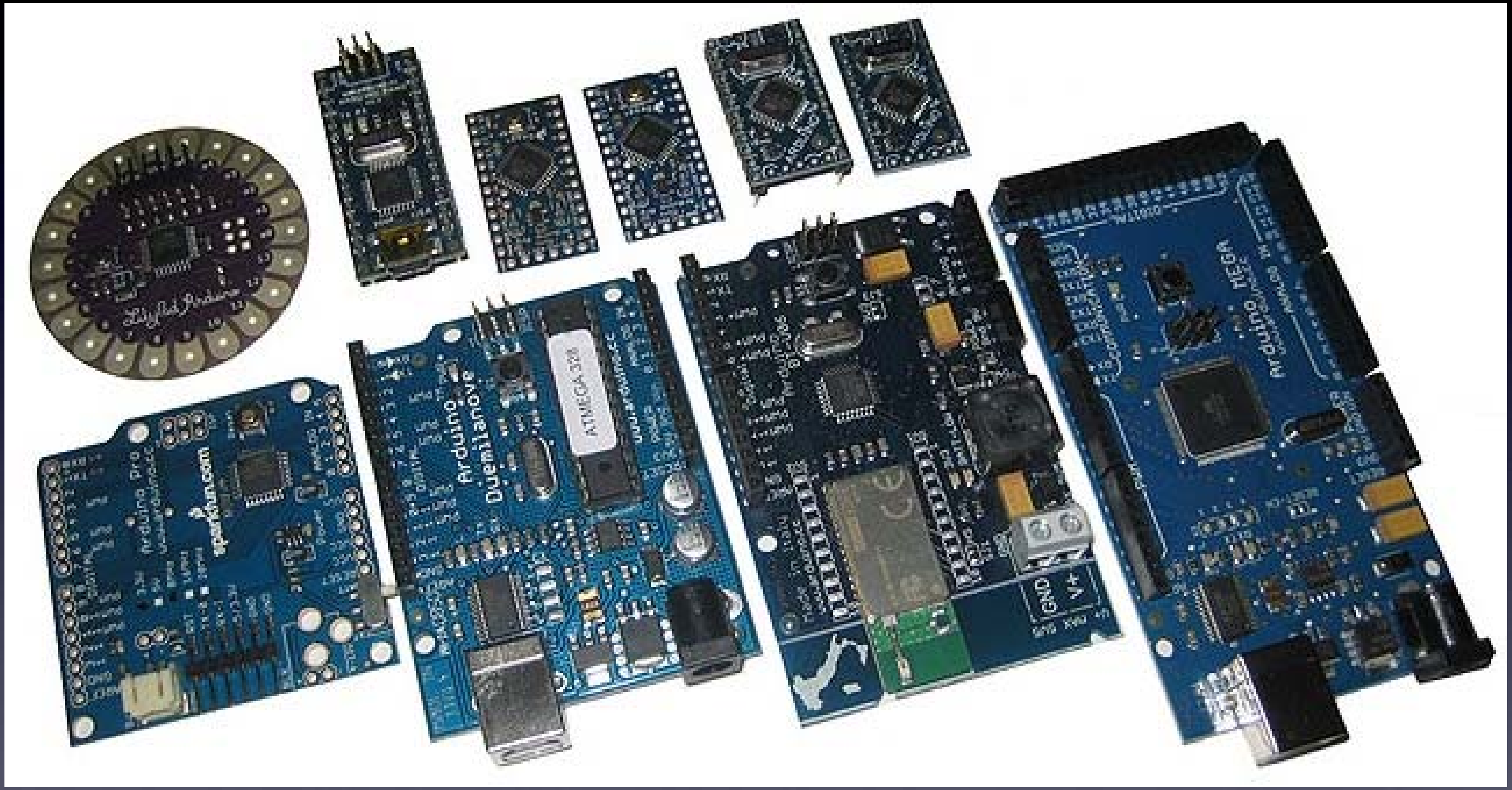


Use an Arduino board

Super easy to
connect parts
to its microcontroller’s pins

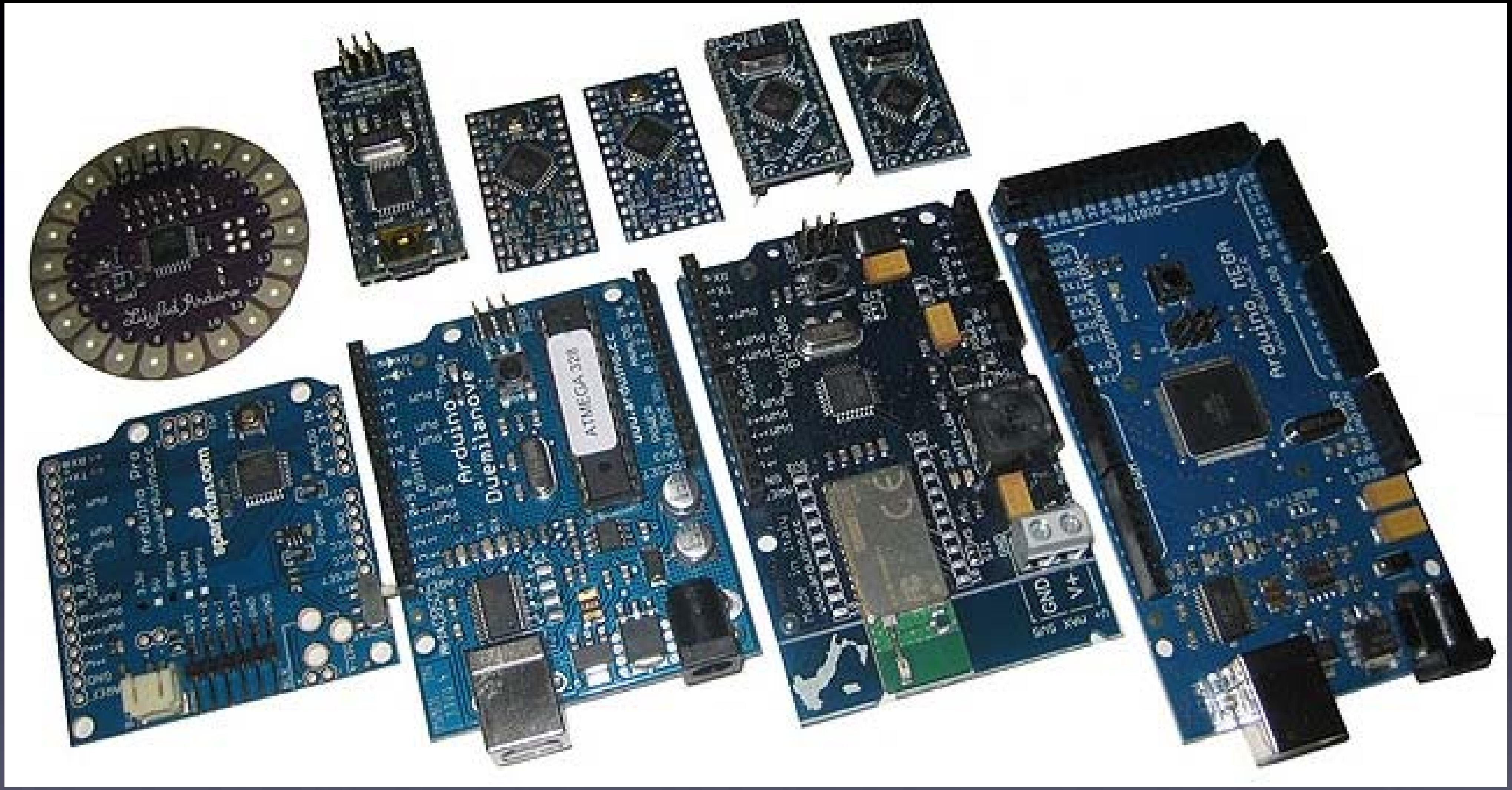
Super easy to
create and upload a program
to control the parts

Intro to Arduino



Many Arduino boards to choose from

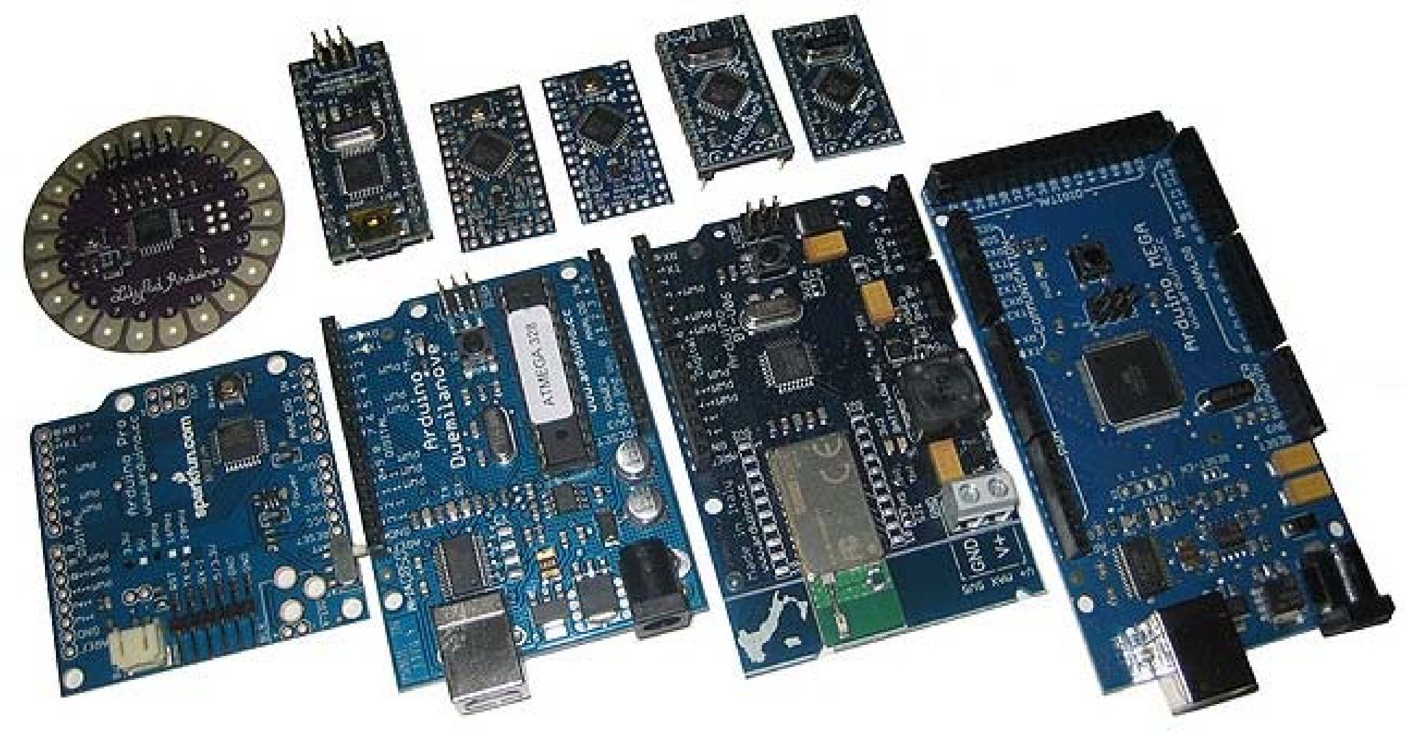
Intro to Arduino

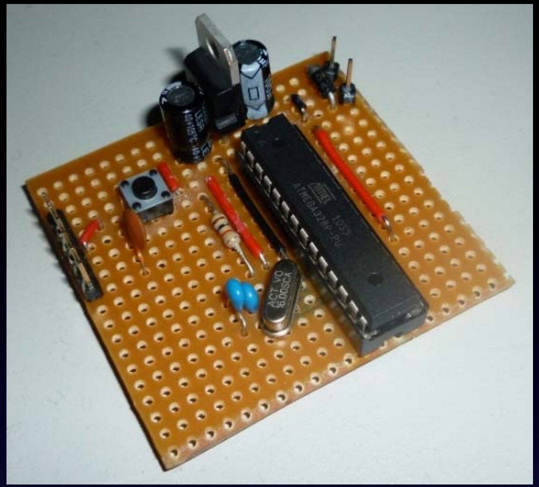


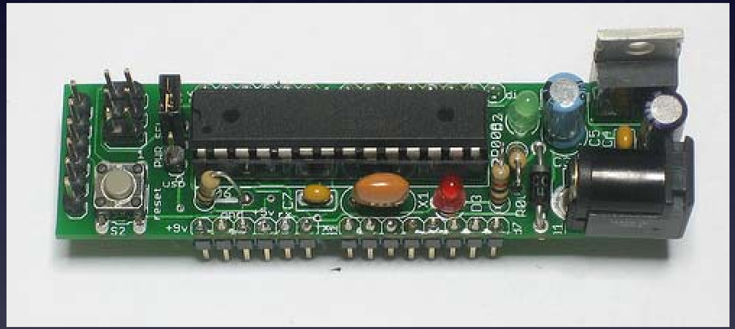
open hardware

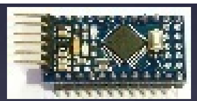
Open Source

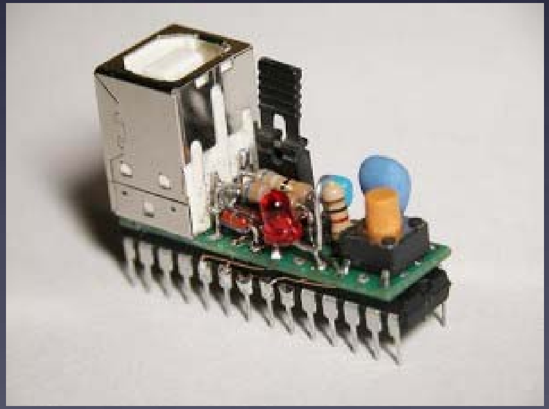
Intro to Arduino

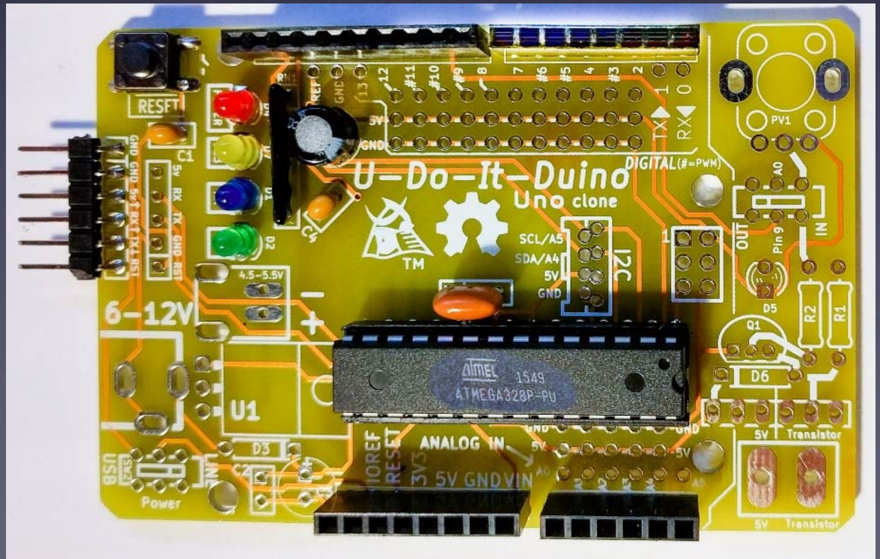


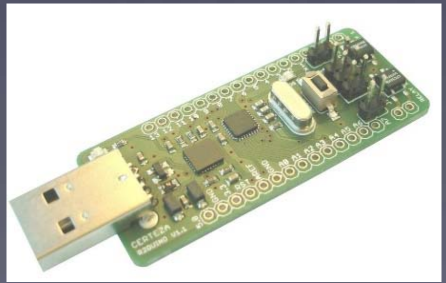






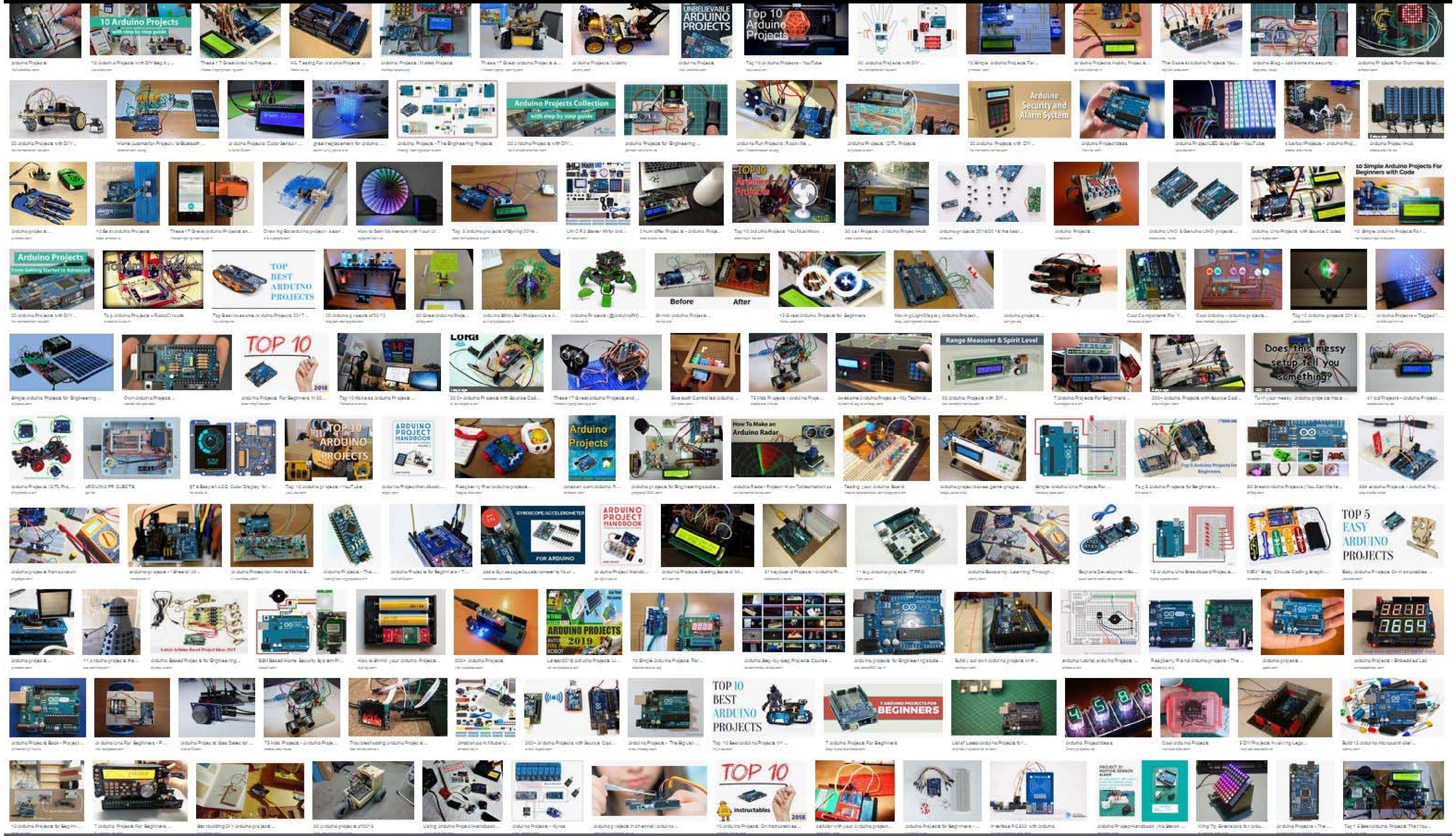






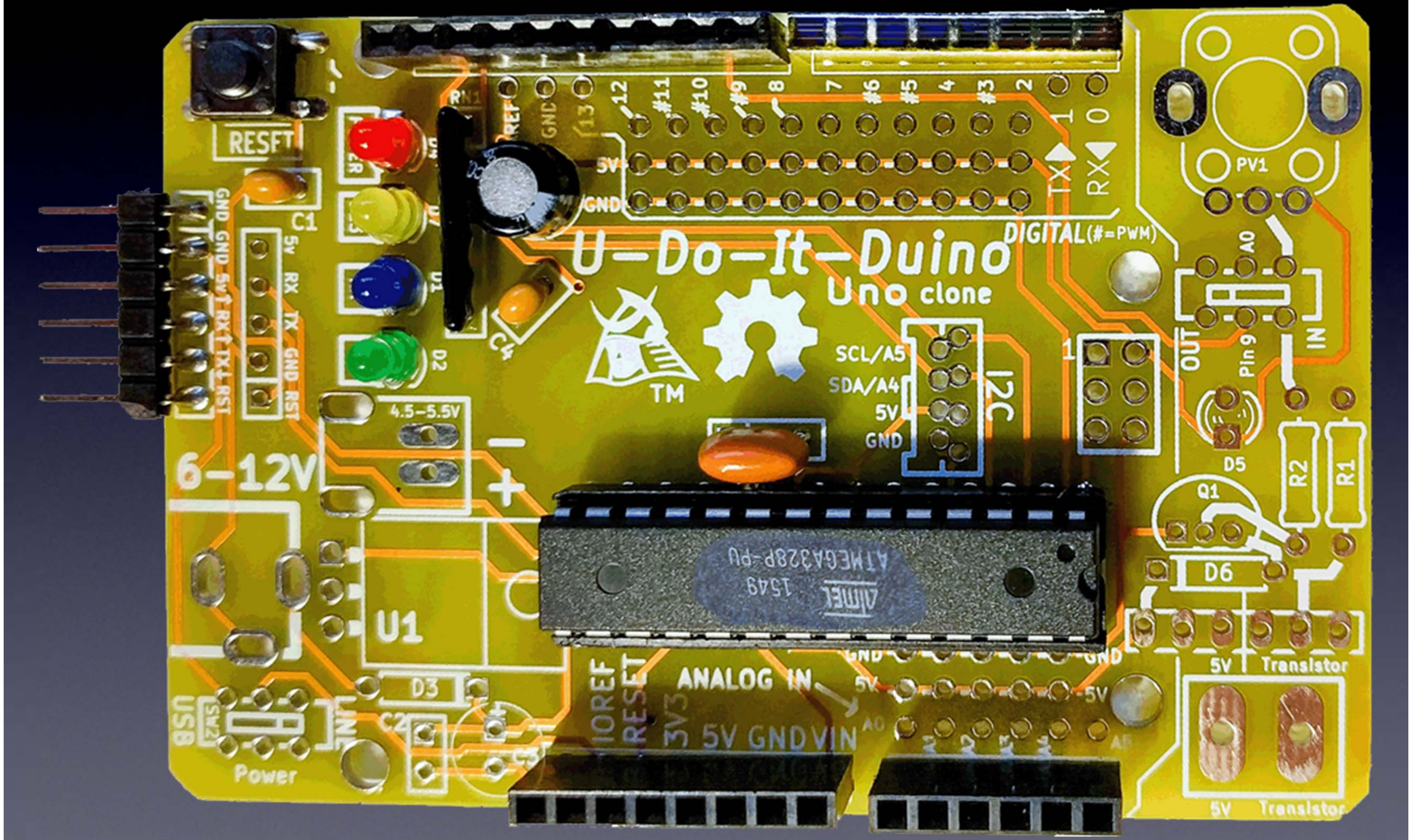
Open Source

Intro to Arduino


10 Arduino Projects
with step by step guide
UNBELIEVABLE ARDUINO PROJECTS
Top 10 Arduino Projects
Arduino Projects Collection
with step by step guide
Arduino Security and Alarm System
TOP 10 Arduino Projects
10 Simple Arduino Projects For Beginners with Code
Arduino Projects
From Getting Started to Advanced
TOP BEST ARDUINO PROJECTS
Before
After
Range Measurer & Spirit Level
TOP 10
2018
Does this messy setup tell you something?
TOP 10 ARDUINO PROJECTS
ARDUINO PROJECT HANDBOOK
Arduino Projects
How To Make an Arduino Radar
GYROSCOPE/ACCELEROMETER
FOR ARDUINO
ARDUINO PROJECT HANDBOOK
TOP 5 EASY ARDUINO PROJECTS
ARDUINO PROJECTS 2019
TOP 10 BEST ARDUINO PROJECTS
7 ARDUINO PROJECTS FOR BEGINNERS
TOP 10
instructables
2018

hundreds of thousands of projects online!

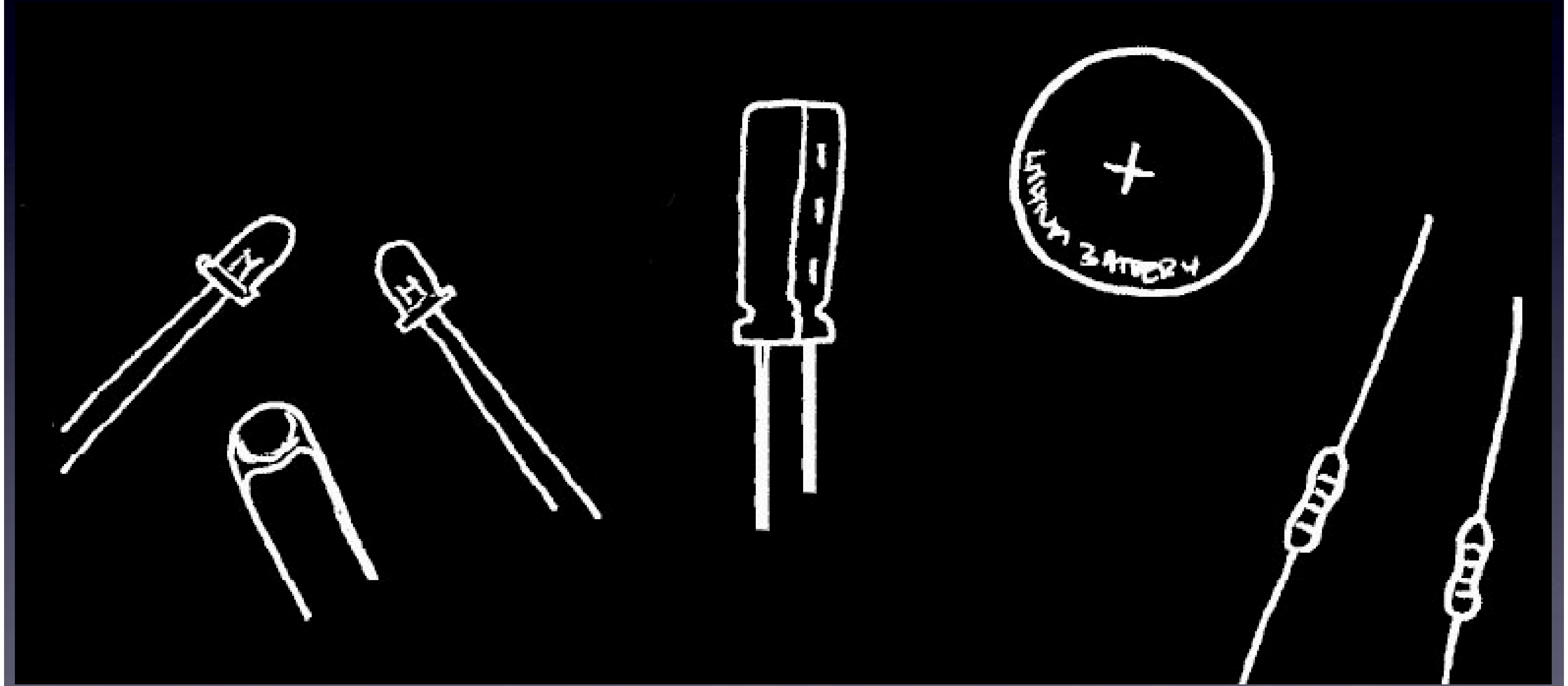
Intro


RESET
C1
6-12V
4.5-5.5V
U1
D3
C2
USB
Power
U-Do-It-Duino
Uno clone
TM
DIGITAL(#=PWM)
SCL/A5
SDA/A4
5V
GND
I2C
ANALOG IN
IOREF
RESET
3V3
5V
GND
VIN
PV1
OUT
IN
Pin 9
D5
Q1
R2
R1
D6
5V
Transistor
ATMEGA328P-PU
1549
D1
D2
C4
TX
RX

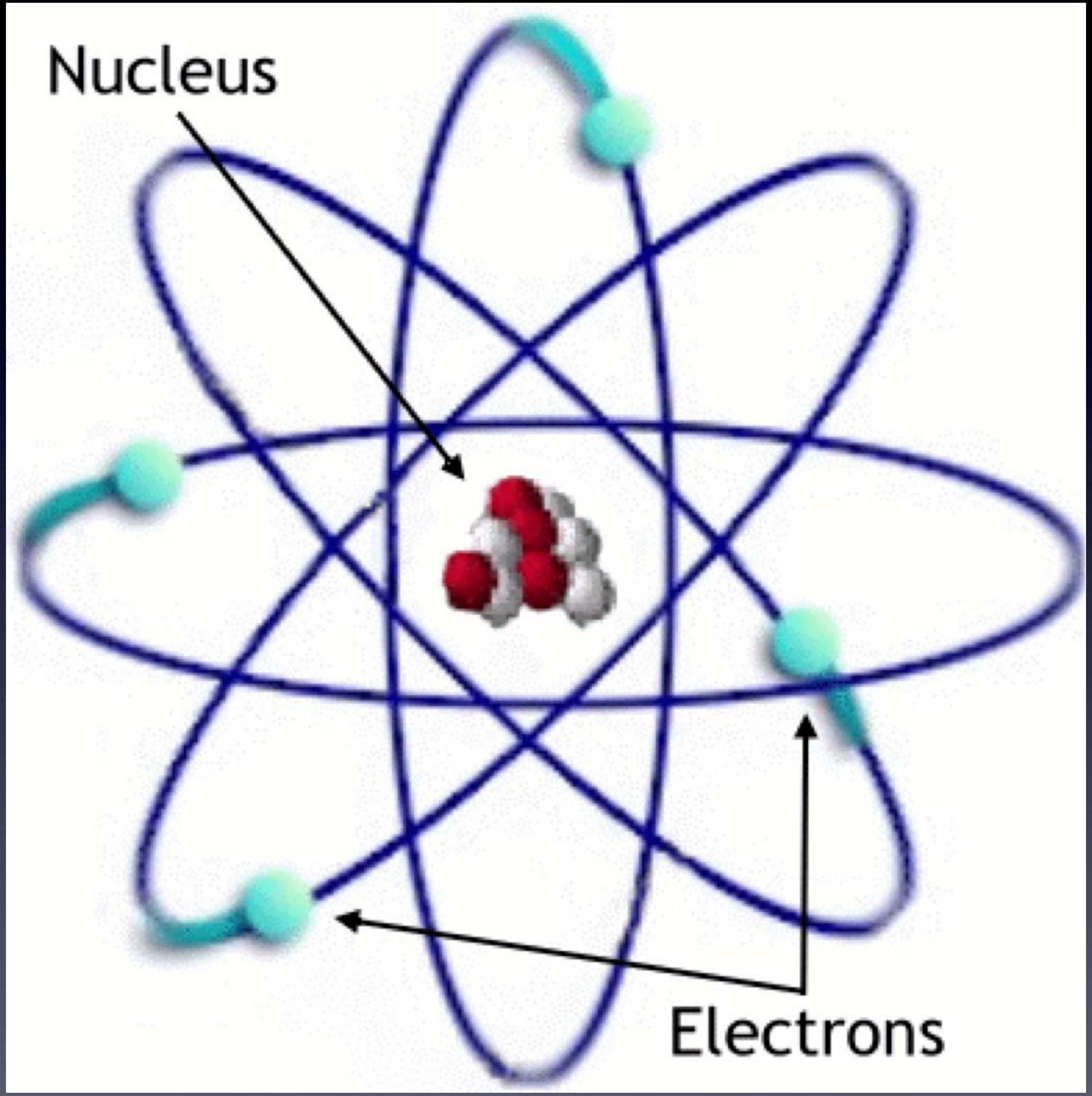
Intro

Questions?

Everything You Need to Know About ***Electronics***

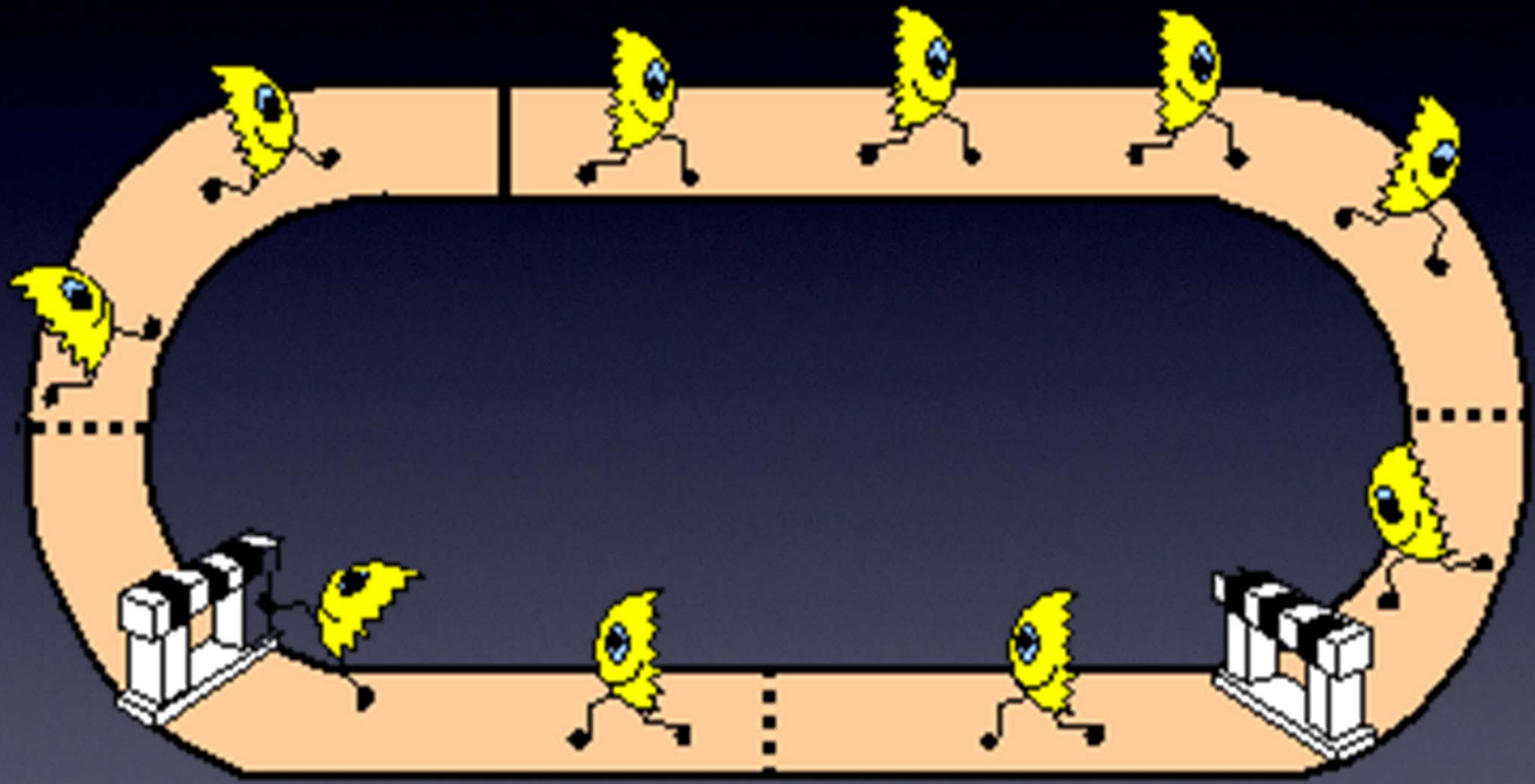


Everything You Need to Know About Electronics



Electrons

Everything You Need to Know About Electronics



Circuit = Electrons going in complete circle = Magic!

Everything You Need to Know About Electronics

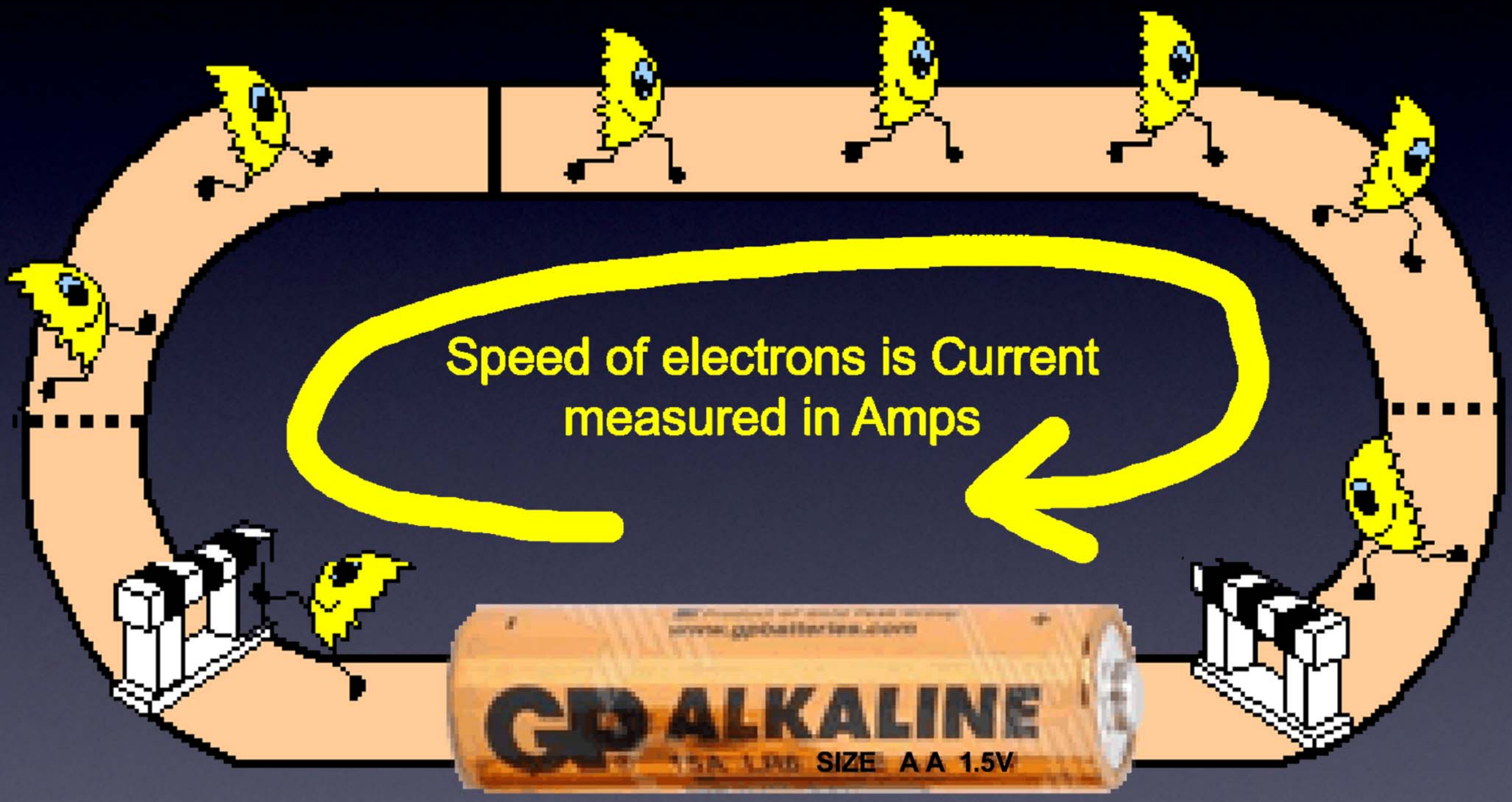
GP ALKALINE
15A LR6 SIZE AA 1.5V
www.gpbatteries.com
WARNING MAY EXPLODE OR LEAK IF RECHARGED, DISPOSED OF IN FIRE OR DISSECTED.
Made in China

Power Supplies

Everything You Need to Know About Electronics

Volts / Voltage

Everything You Need to Know About Electronics

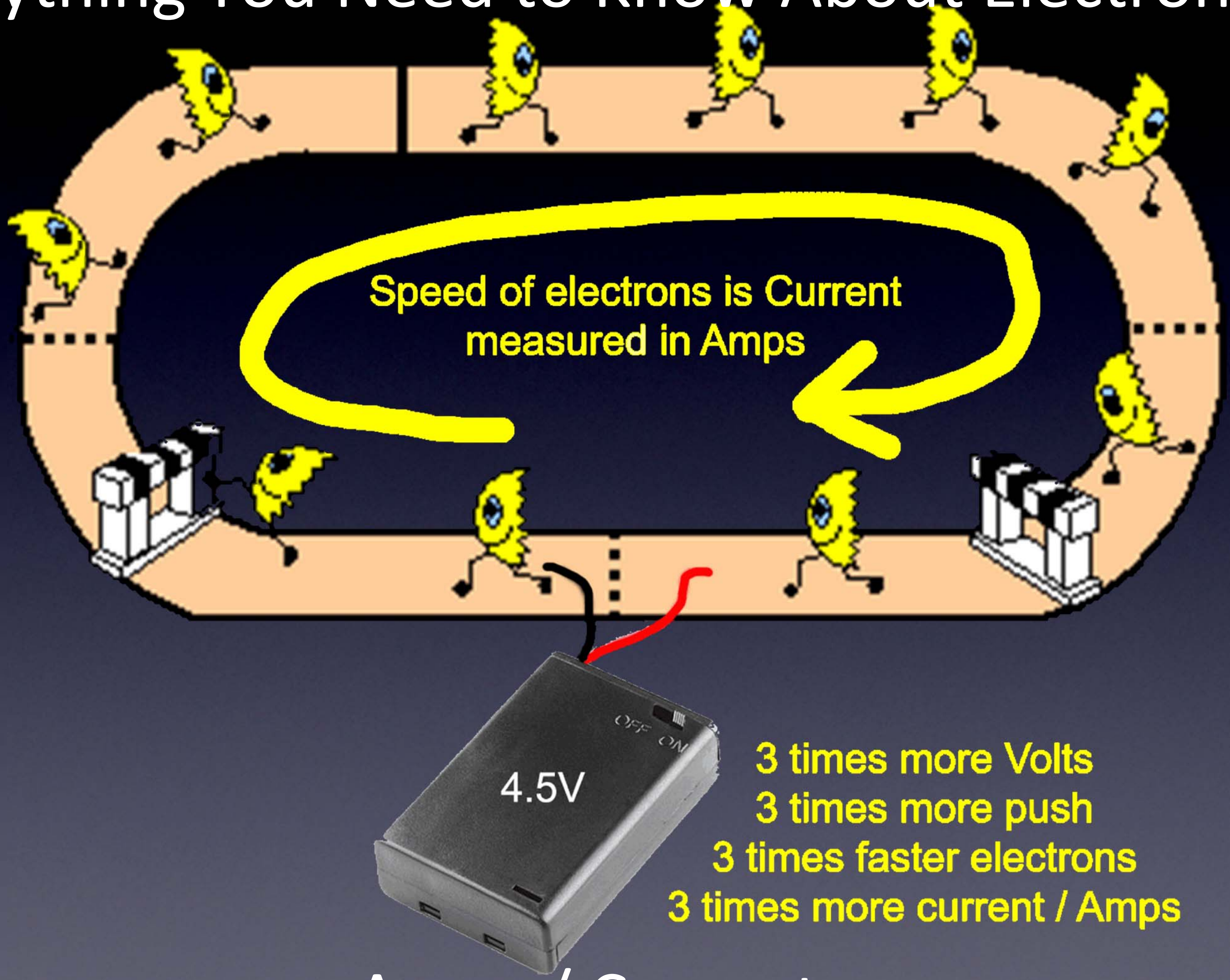


Speed of electrons is Current
measured in Amps

Electrons pushed with 1.5V.
So, they move!

Amps / Current

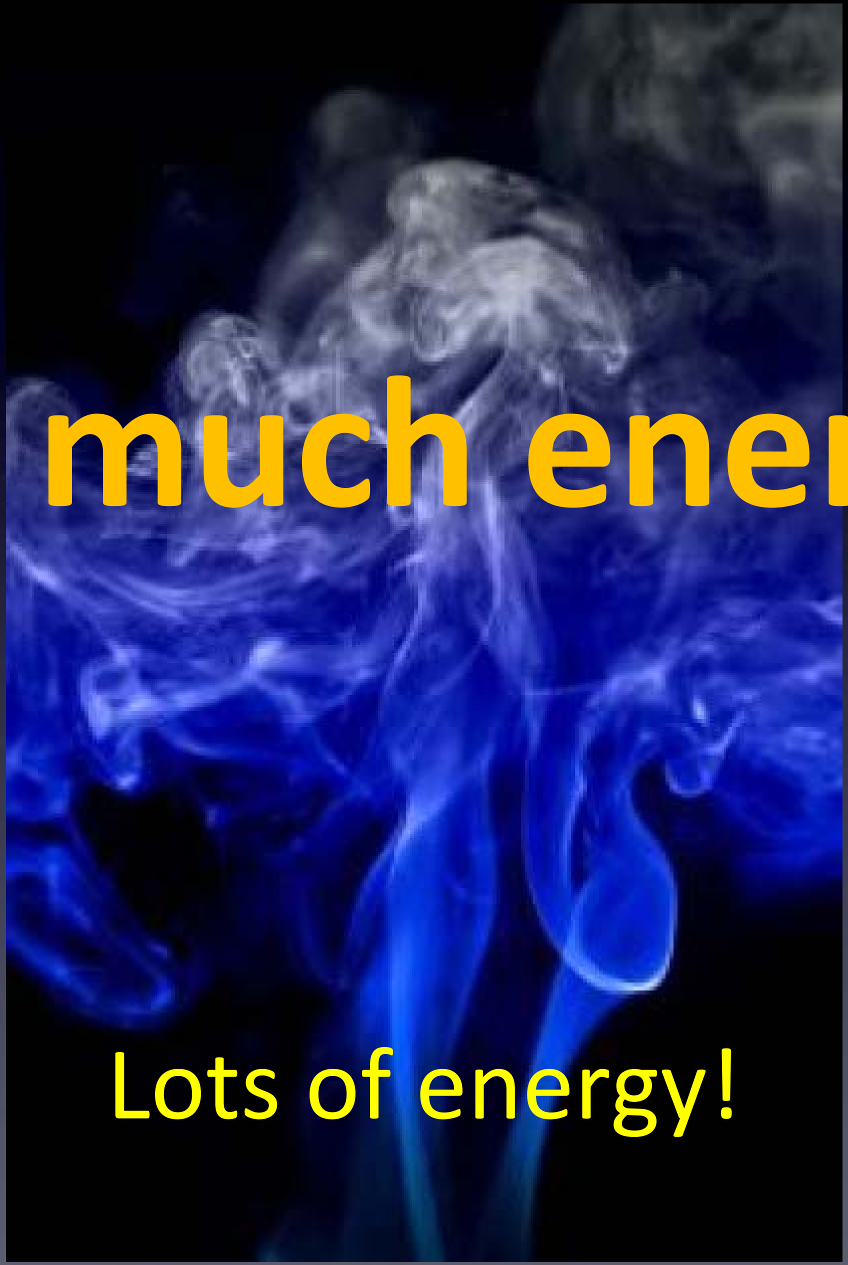
Everything You Need to Know About Electronics



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

Amps / Current

Everything You Need to Know About Electronics

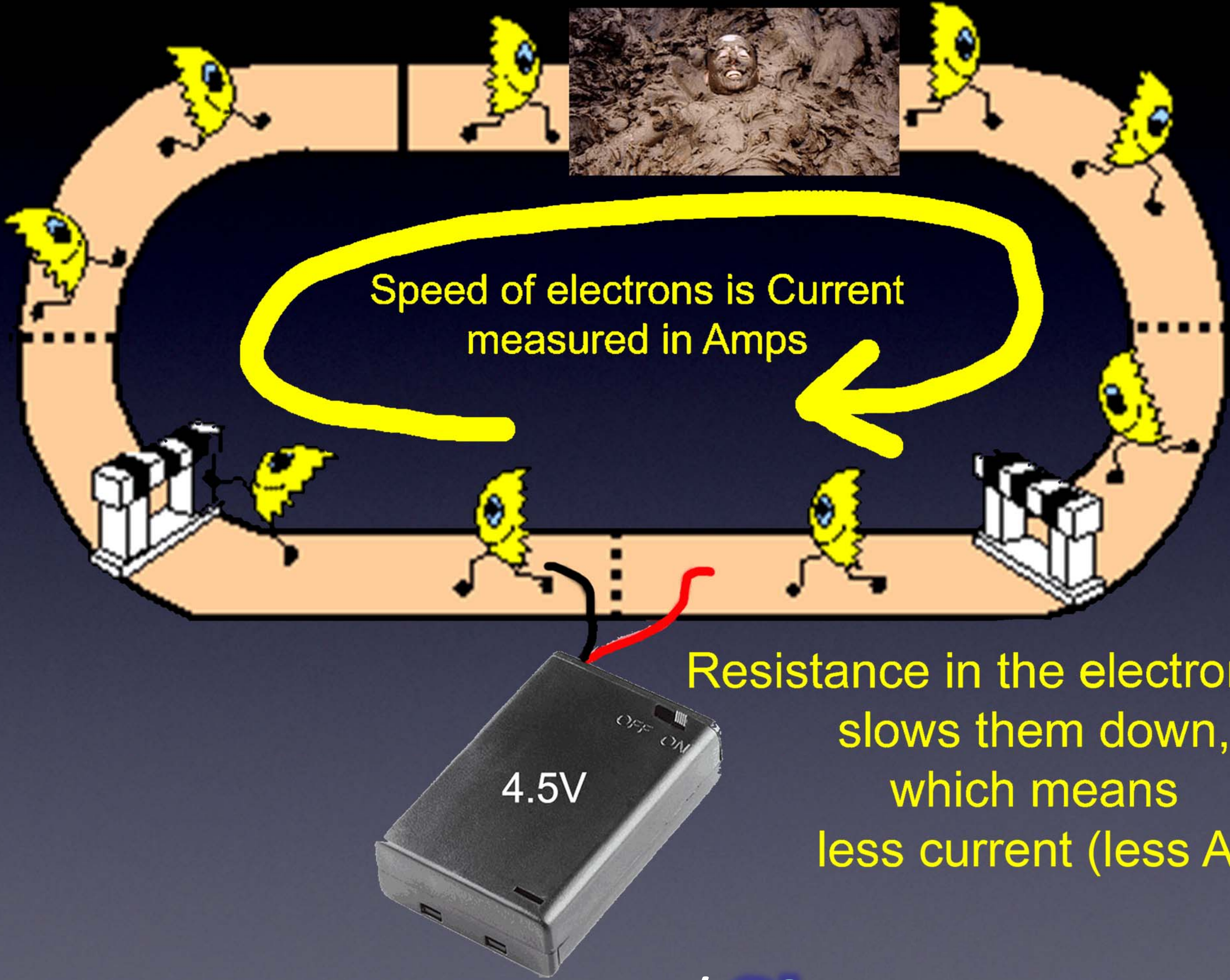


Too much energy?

Lots of energy!

Amps / Current

Everything You Need to Know About Electronics

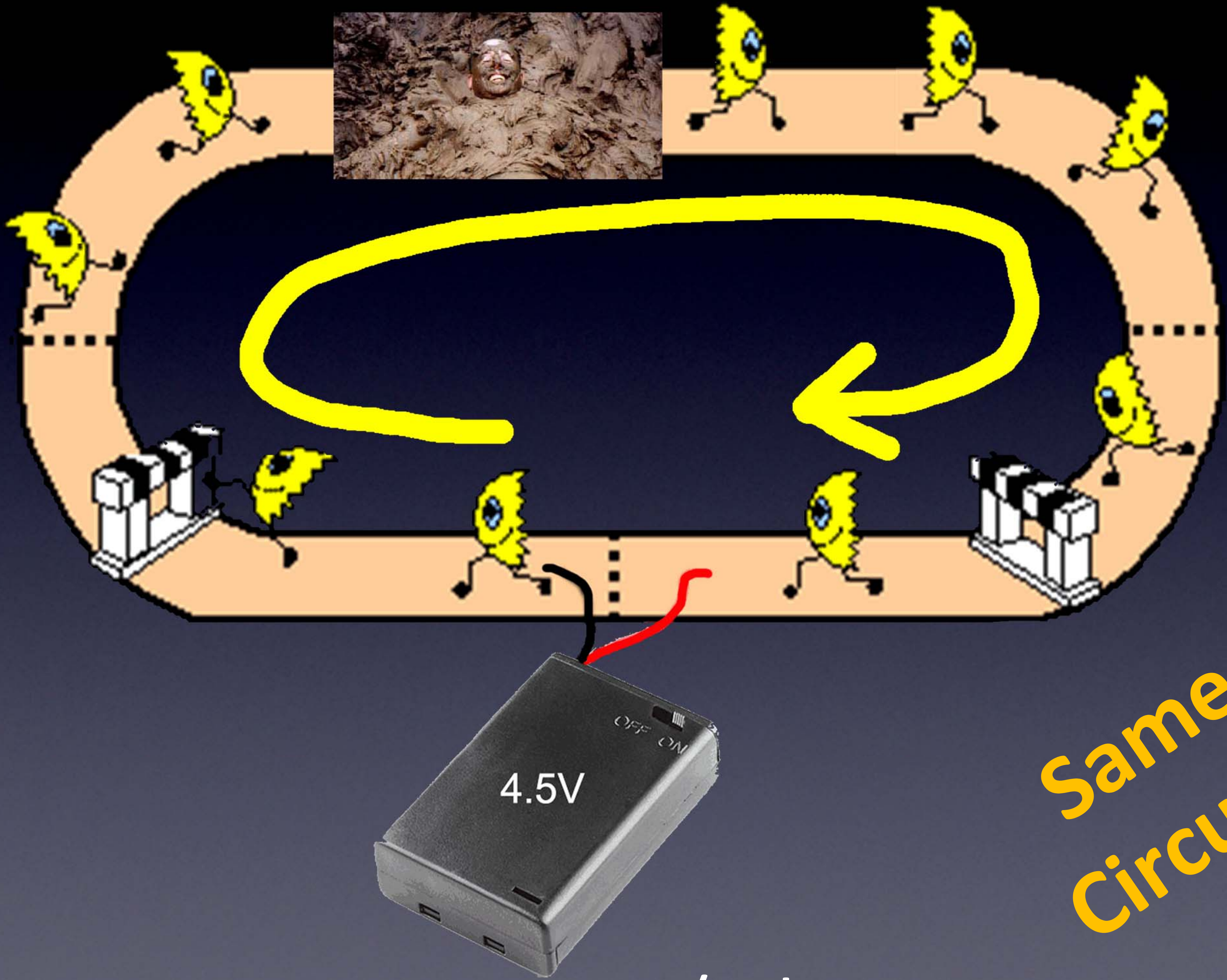


Speed of electrons is Current measured in Amps

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

Resistance / **Ohms**

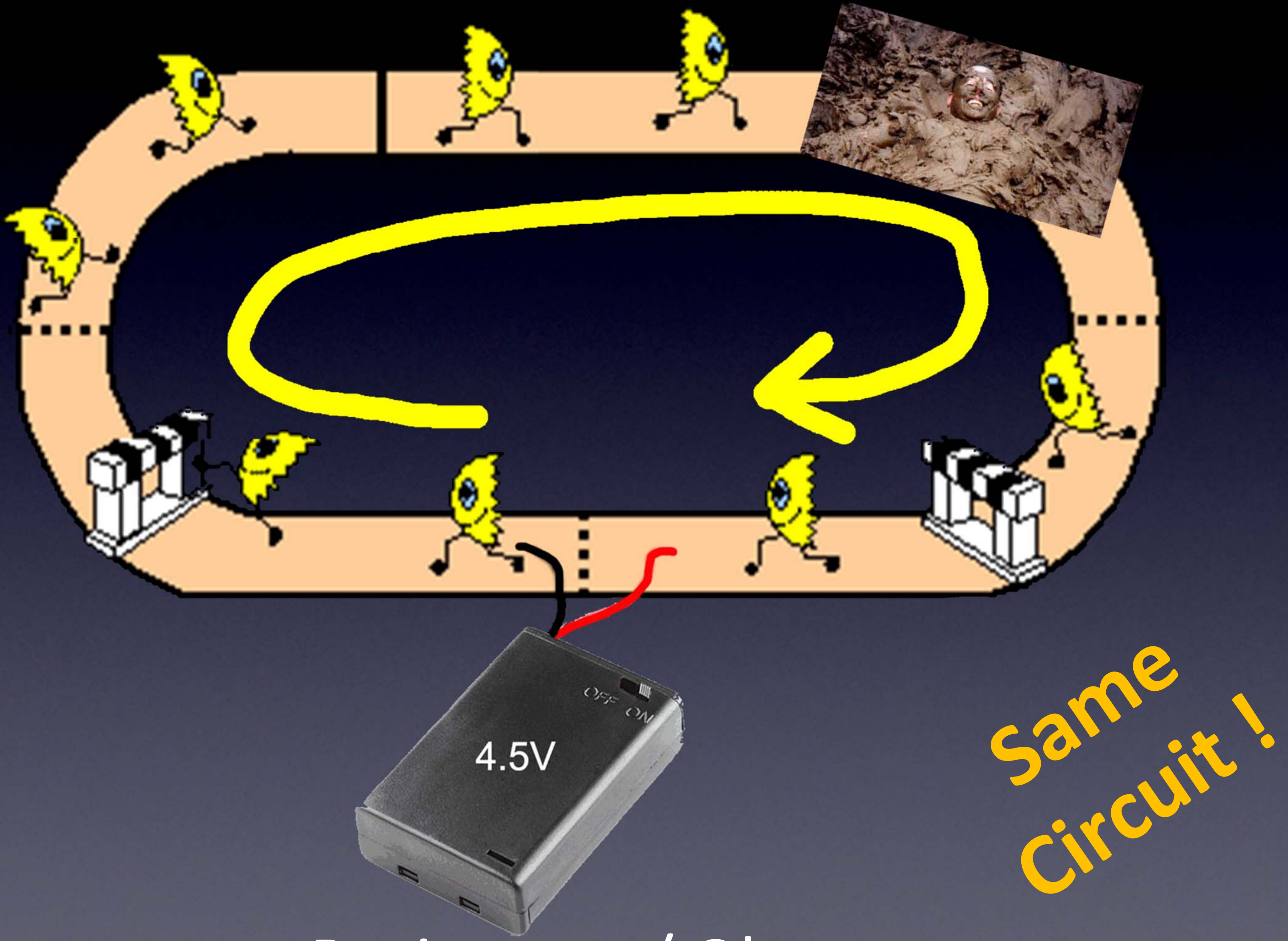
Everything You Need to Know About Electronics



Same Circuit !

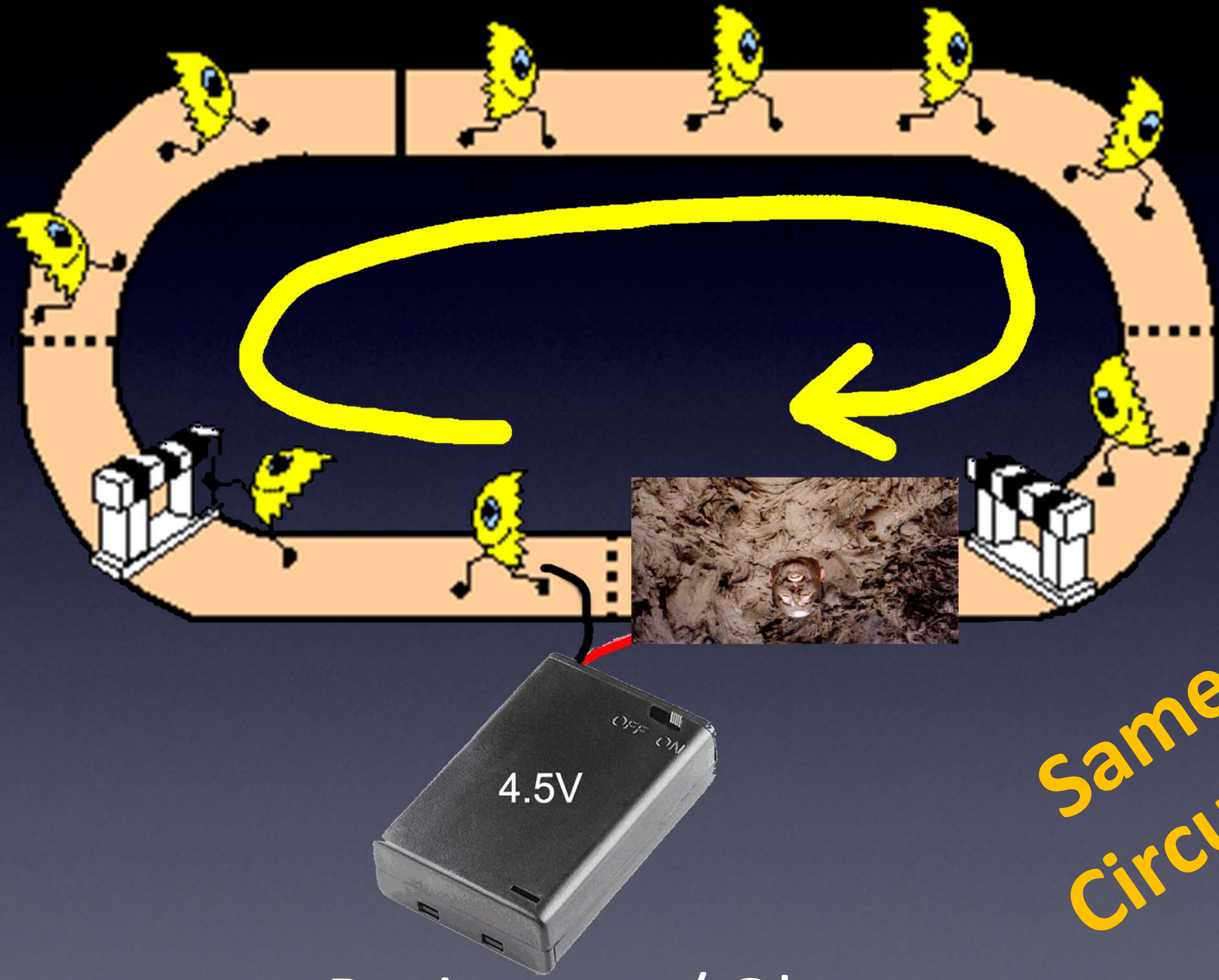
Resistance / Ohms

Everything You Need to Know About Electronics



Resistance / Ohms

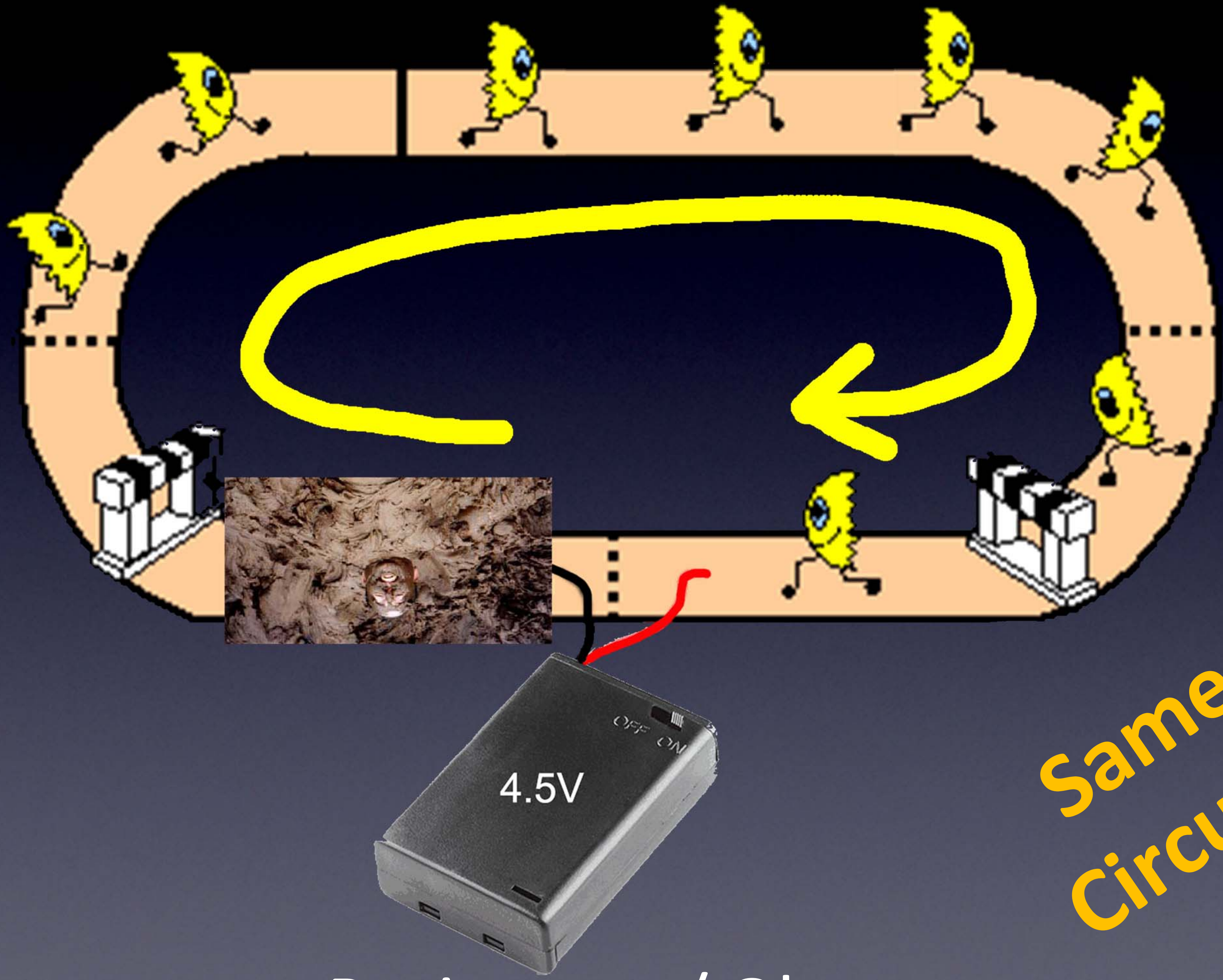
Everything You Need to Know About Electronics



Resistance / Ohms

Same Circuit !

Everything You Need to Know About Electronics



Same Circuit !

Resistance / Ohms

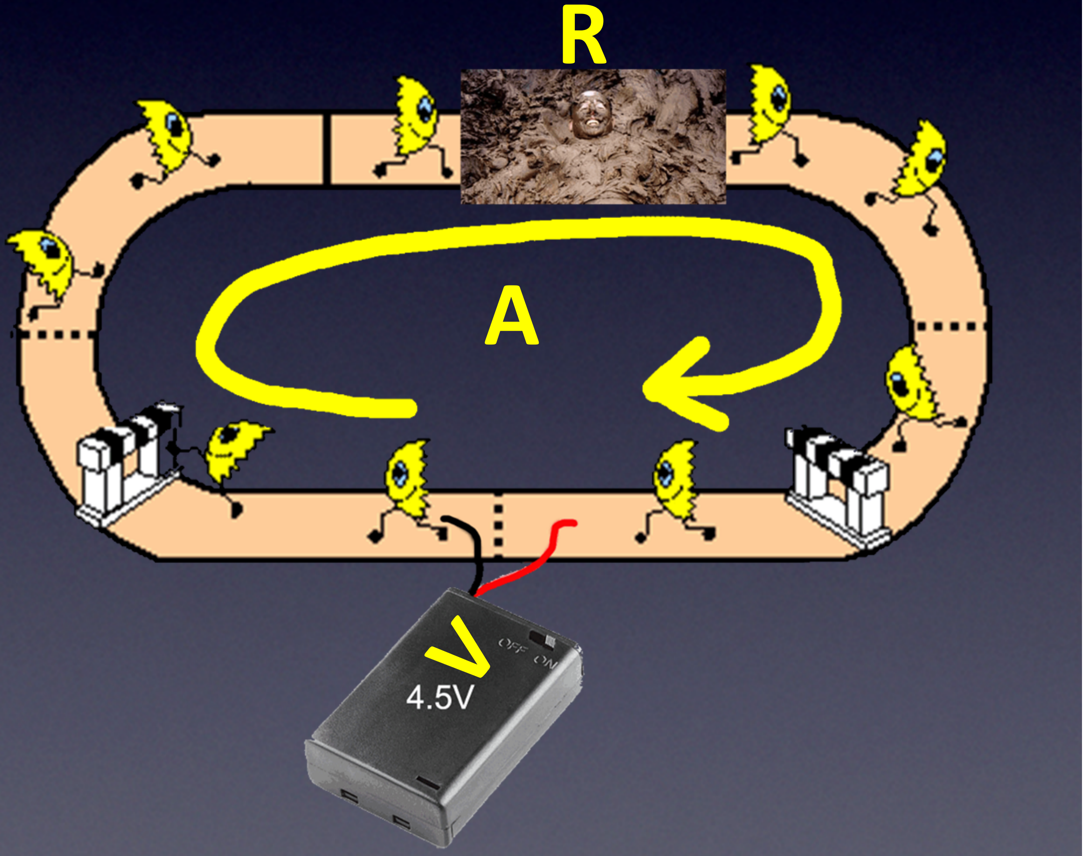
Everything You Need to Know About Electronics

Ohm's Law

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

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

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



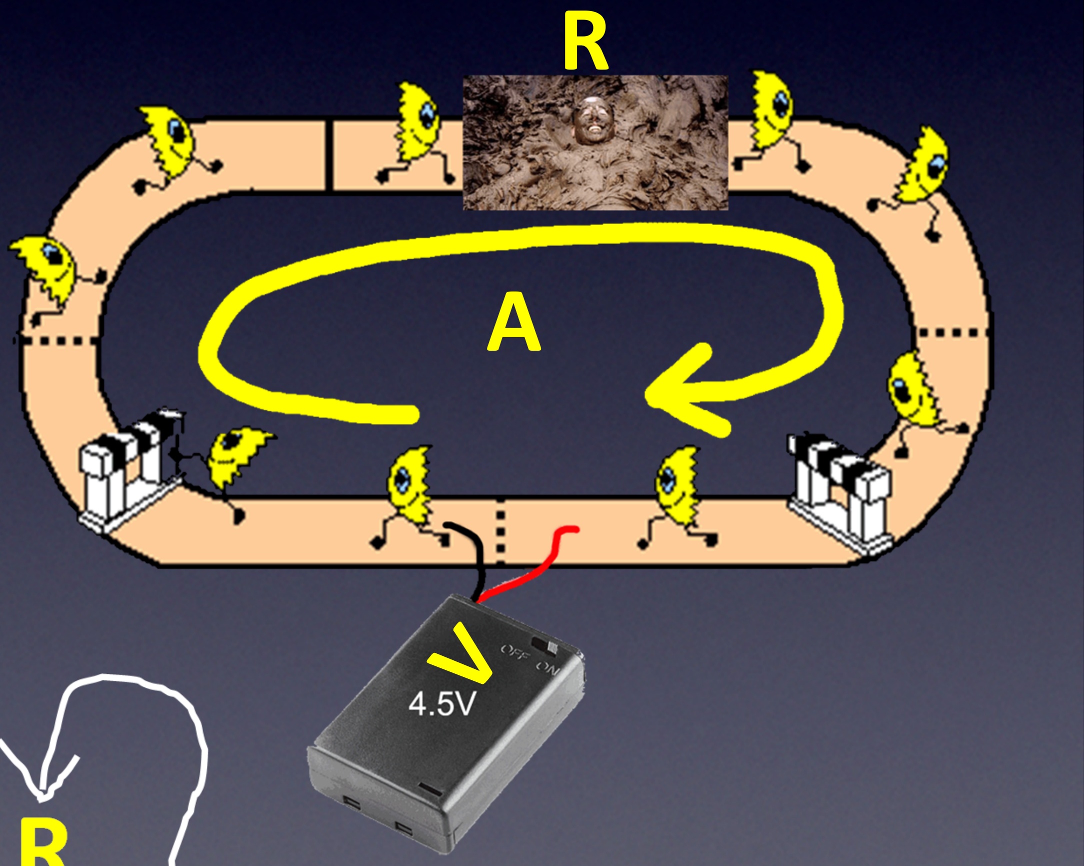
Everything You Need to Know About Electronics

Ohm's Law

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

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

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



Volts = Amps x R

(Ohms)

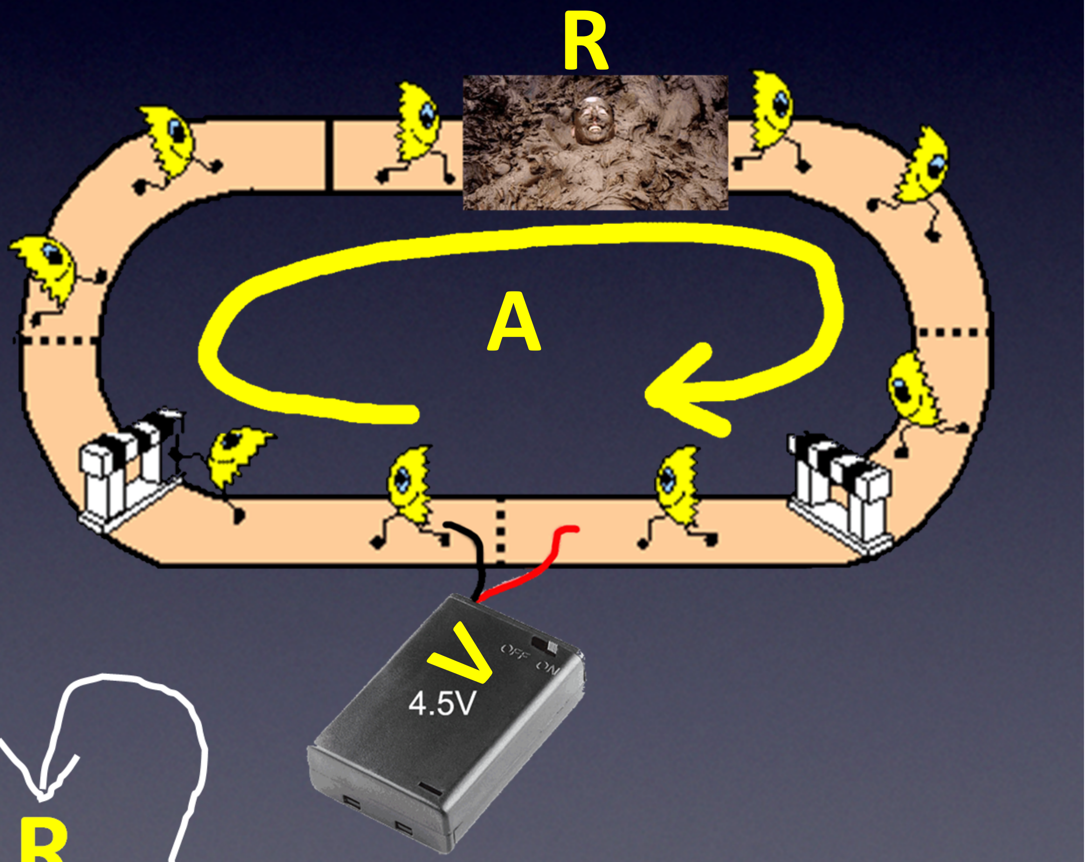
Everything You Need to Know About Electronics

Ohm's Law

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

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

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



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

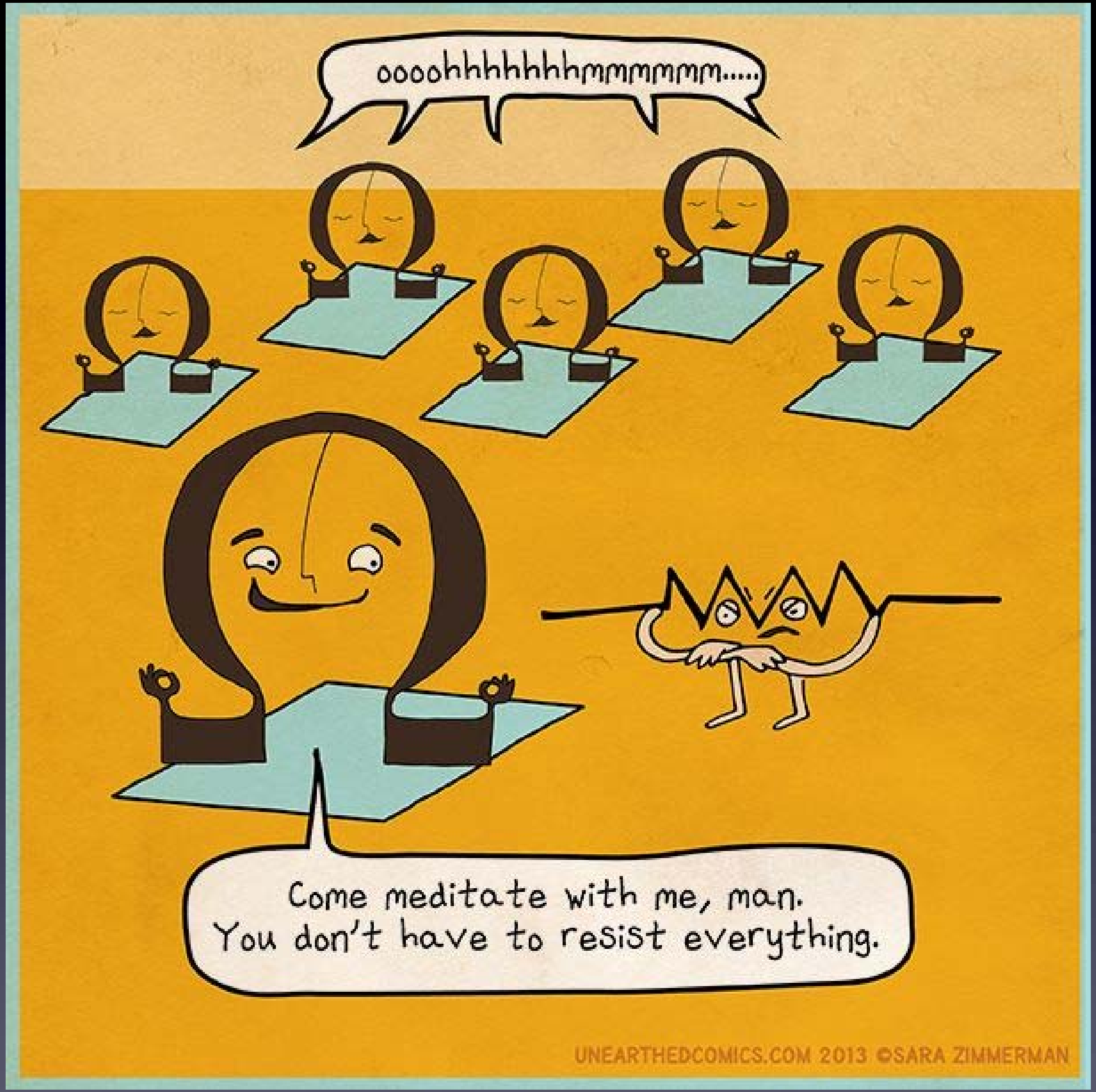
(Ohms)

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

Everything You Need to Know About Electronics

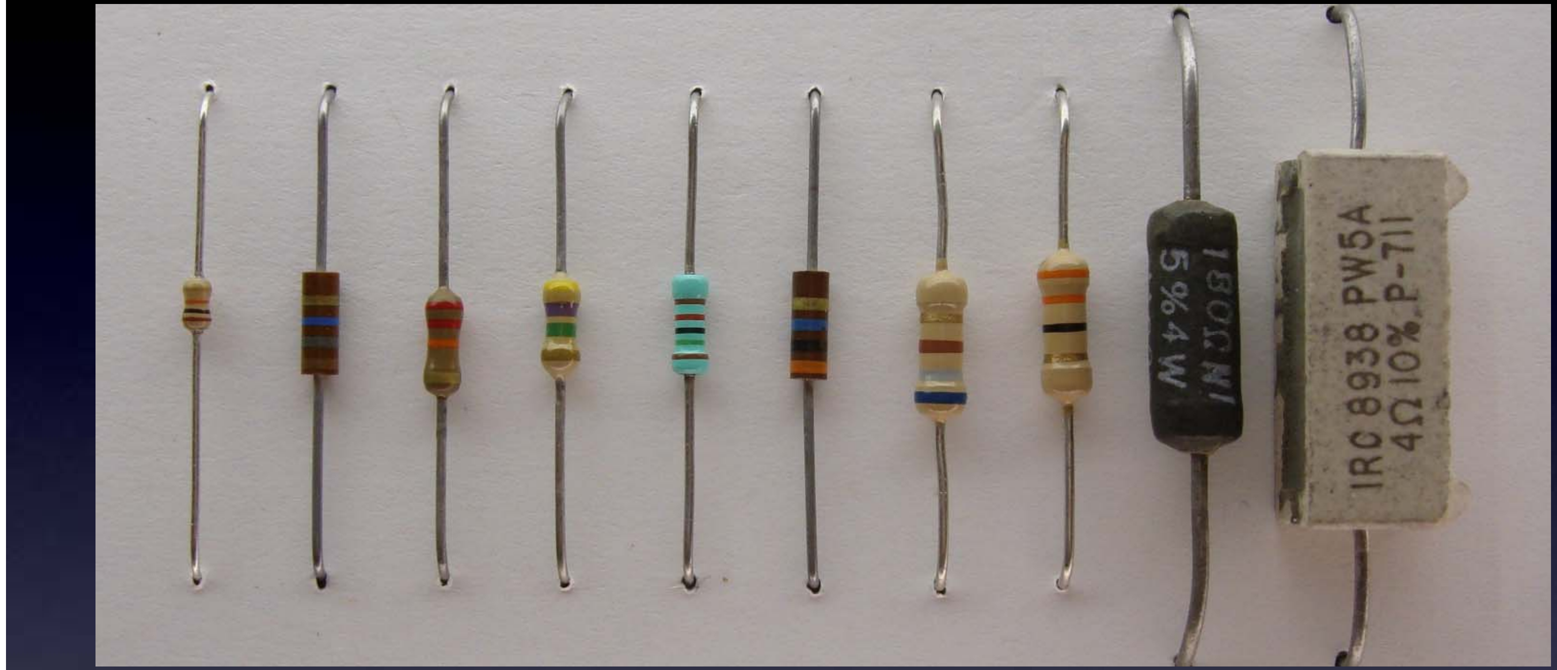
The symbol for **Resistance**:

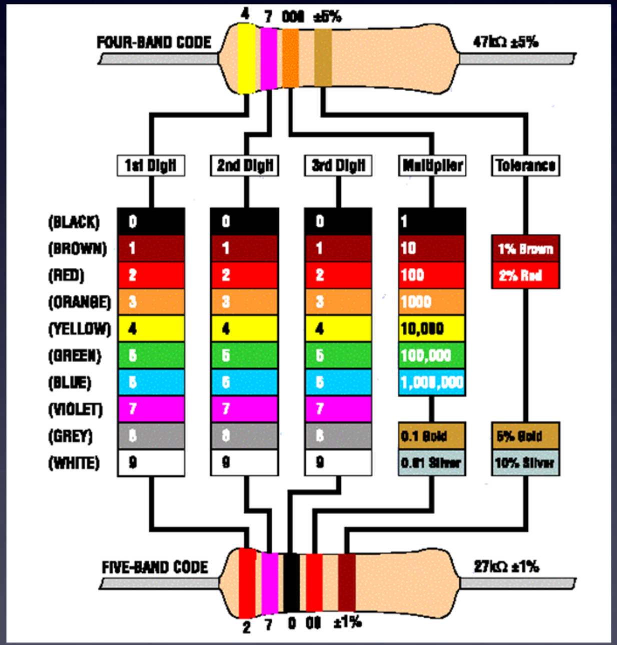
Ω


oooohhhhhhhmmmmm.....
Come meditate with me, man. You don't have to resist everything.
UNEARTHEDCOMICS.COM 2013 ©SARA ZIMMERMAN

Resistors / Ohms

Everything You Need to Know About Electronics





	1st Digit	2nd Digit	3rd Digit	Multiplier	Tolerance
(BLACK)	0	0	0	1	
(BROWN)	1	1	1	10	1% Brown
(RED)	2	2	2	100	2% Red
(ORANGE)	3	3	3	1000	
(YELLOW)	4	4	4	10,000	
(GREEN)	5	5	5	100,000	
(BLUE)	6	6	6	1,000,000	
(VIOLET)	7	7	7		
(GREY)	8	8	8	0.1 Gold	5% Gold
(WHITE)	9	9	9	0.01 Silver	10% Silver

Resistors / Ohms

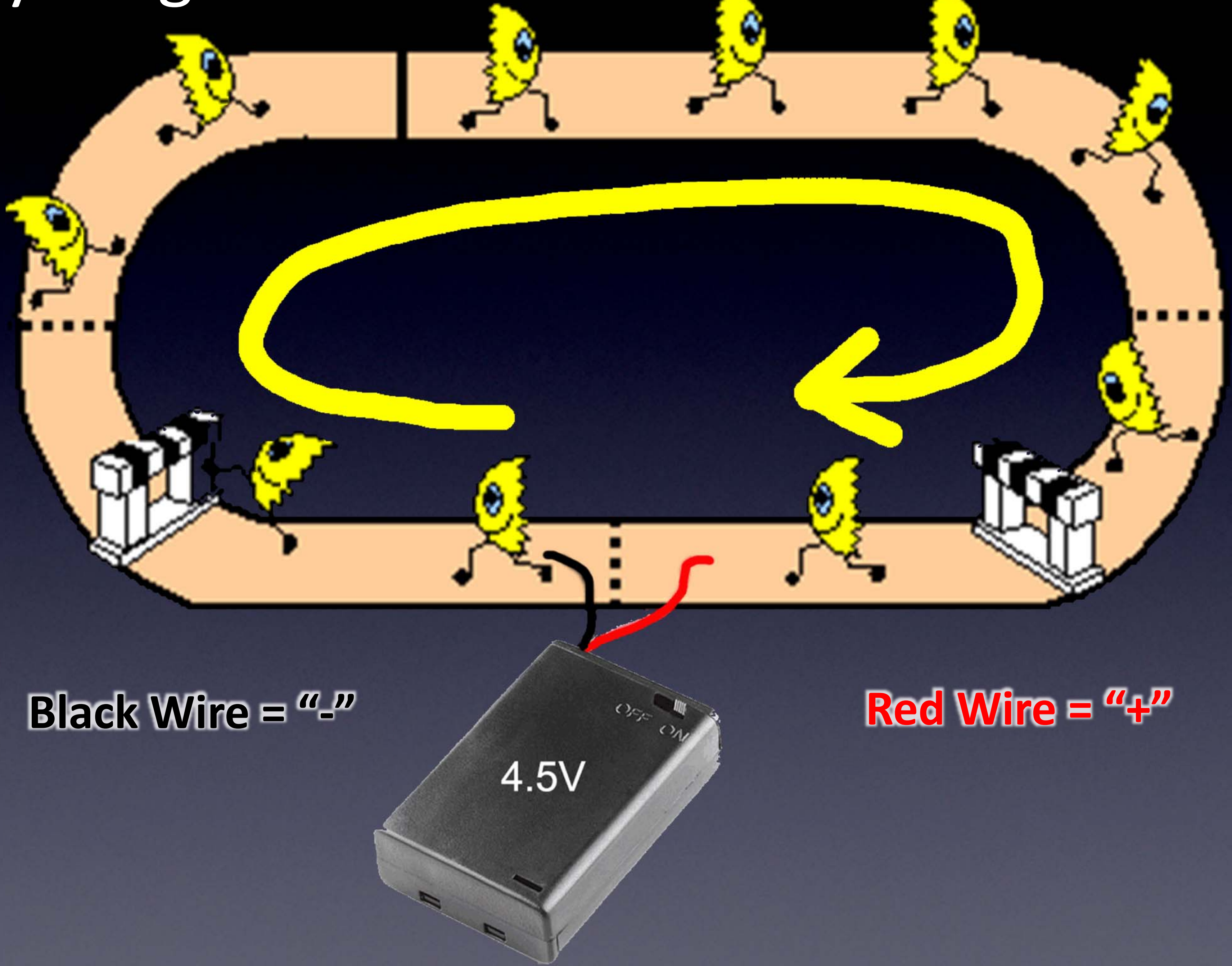
Everything You Need to Know About Electronics

What happens?

Polarity

Power Supply – it matters how you connect it!

Everything You Need to Know About Electronics

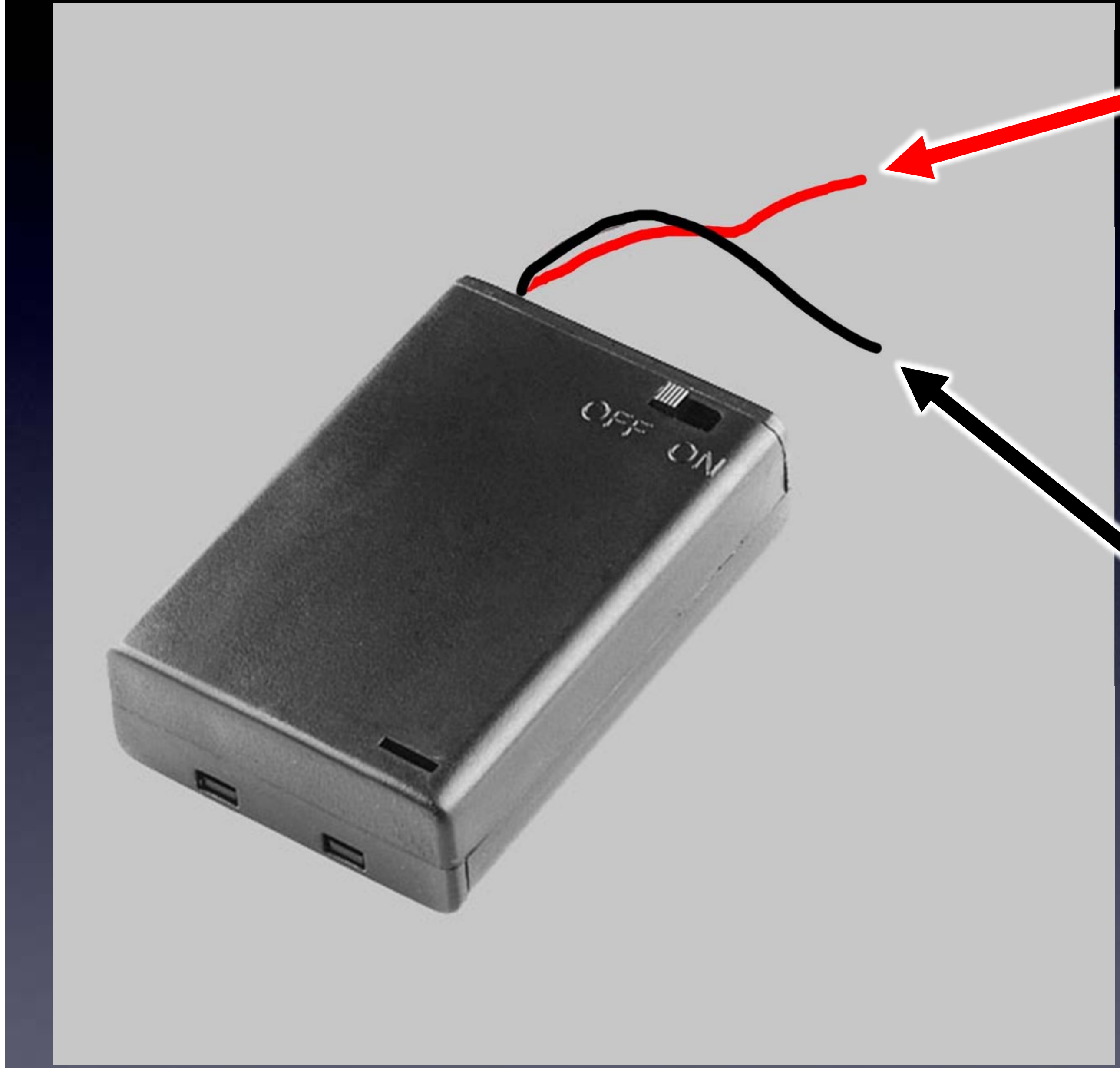


Black Wire = “-”

Red Wire = “+”

Power Supply – it matters how you connect it!

Everything You Need to Know About Electronics



Red wire:
Power,
Plus, Positive,
4.5V,
Vcc

Black wire:
Minus, Negative,
0V,
Ground (GND)

Power Supply – it matters how you connect it!

Everything You Need to Know About Electronics

or

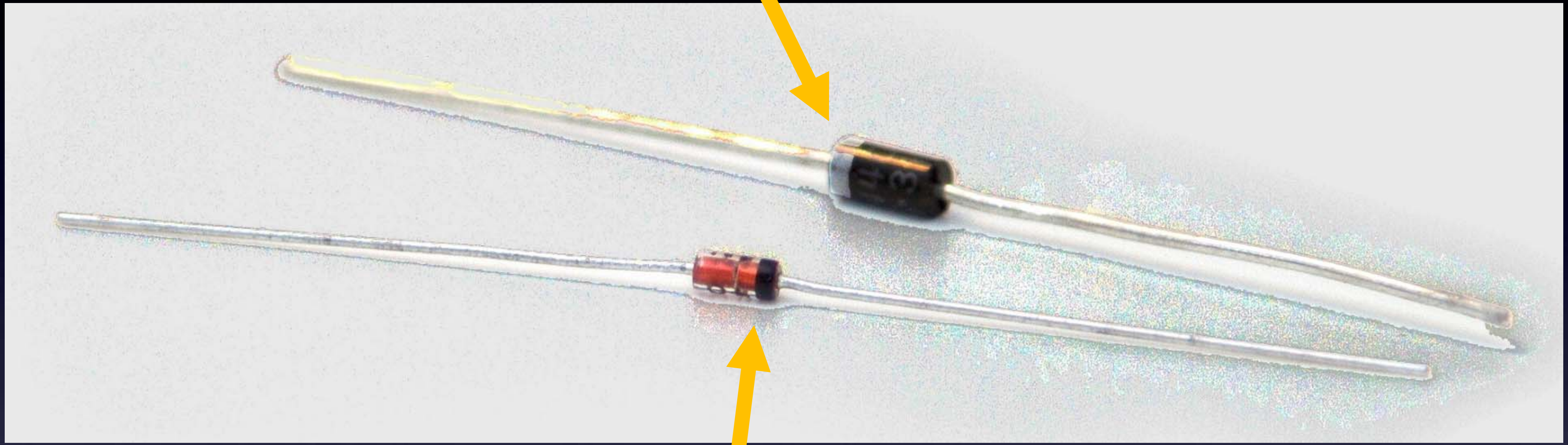
or

(electrons slowed down the same either way)

Resistors – it doesn't matter which way

Everything You Need to Know About Electronics

Minus / Negative side

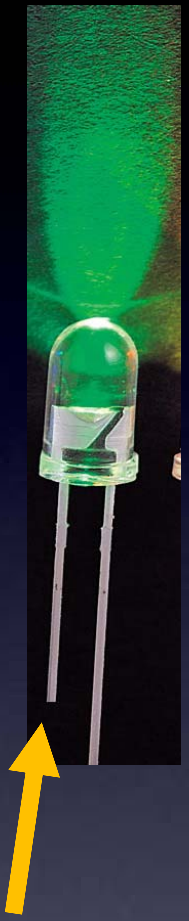


Minus / Negative side

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!

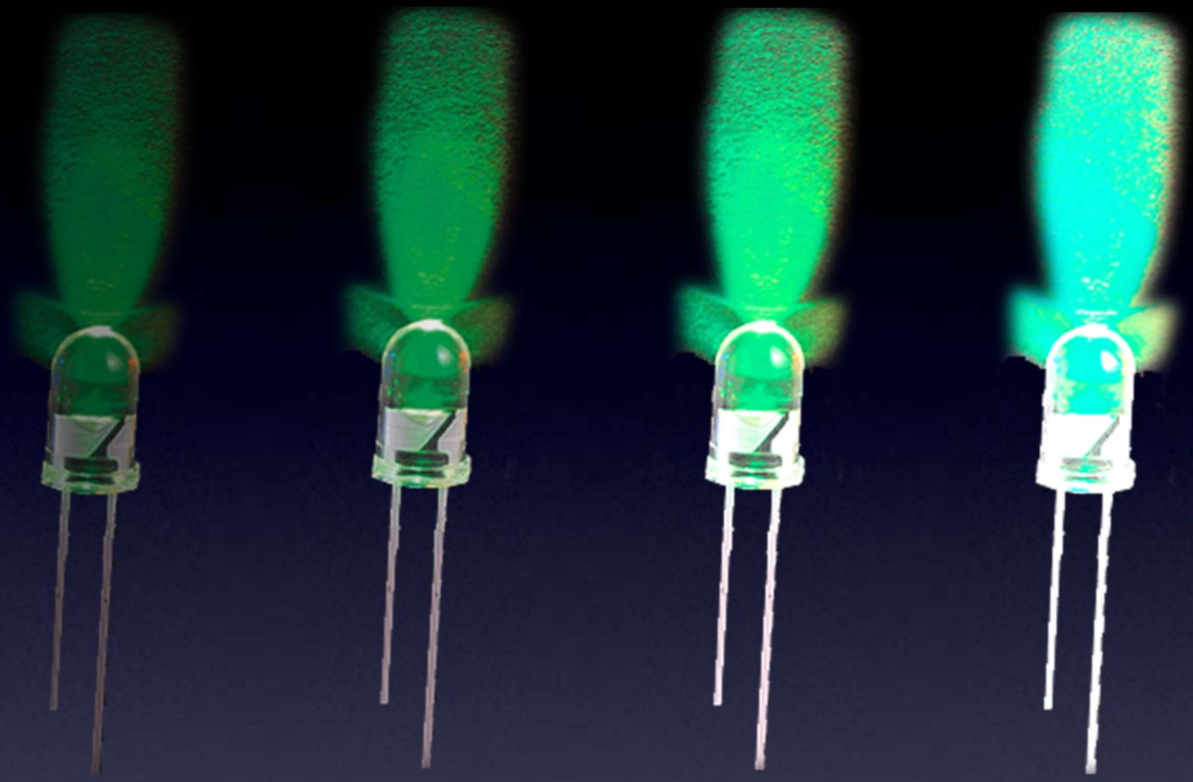
LED – it matters which way!

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…)

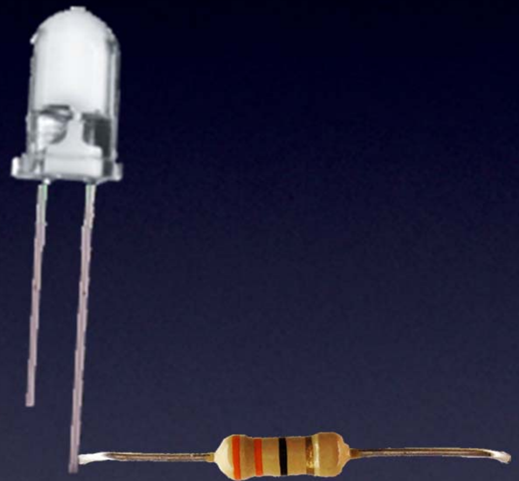
LED

Everything You Need to Know About Electronics

More current → More brightness! (until…)

LED

Everything You Need to Know About Electronics



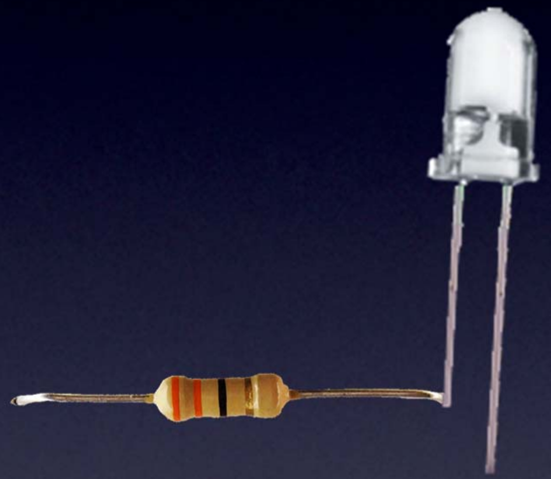
(with a resistor

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

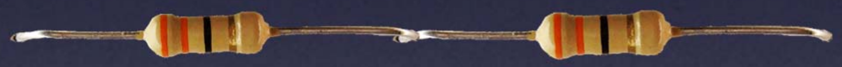


(the resistor can go on either side)

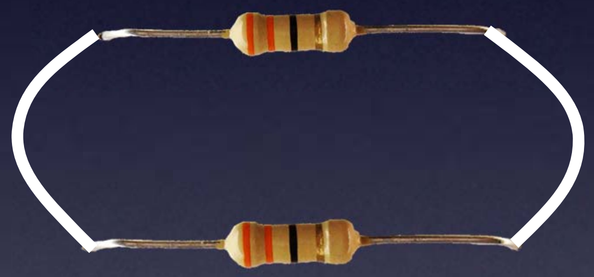
This is why we put a resistor in line with an LED

LED

Everything You Need to Know About Electronics

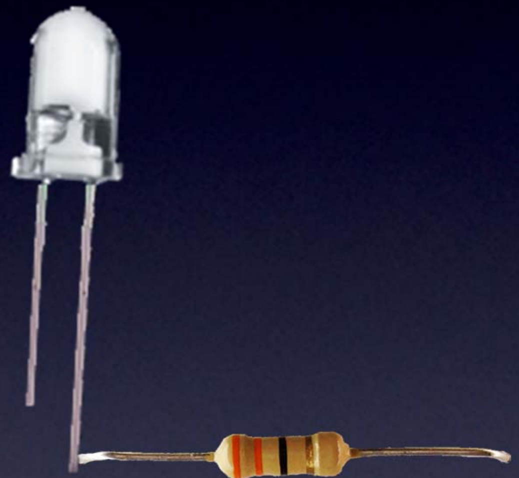


Series = in line



Parallel = across

Everything You Need to Know About Electronics

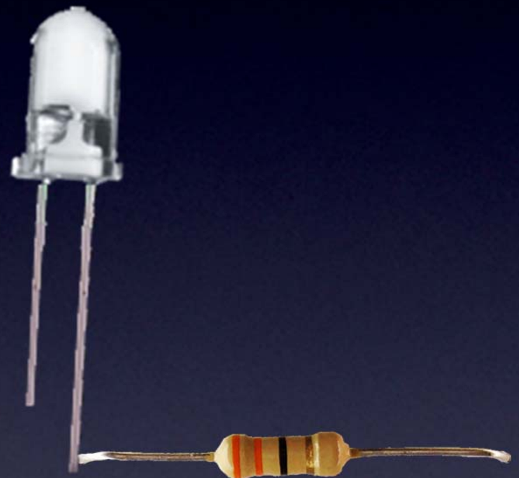


Let’s make this light up!

LED

Everything You Need to Know About Electronics

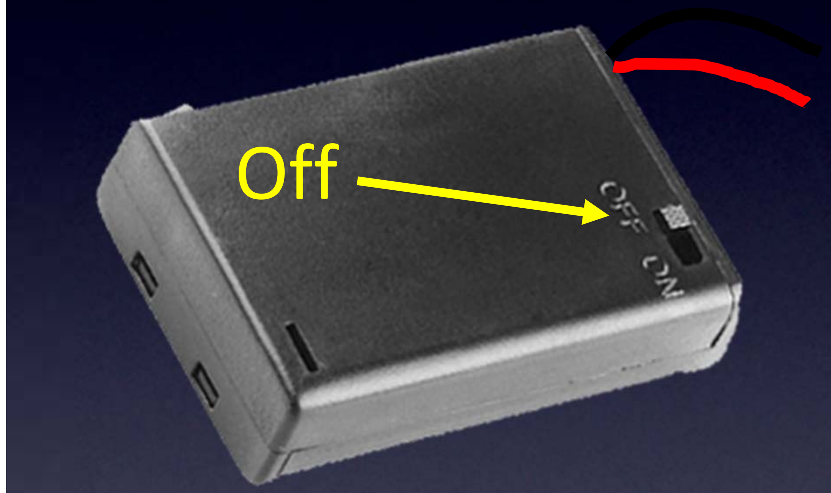
(add a power supply)

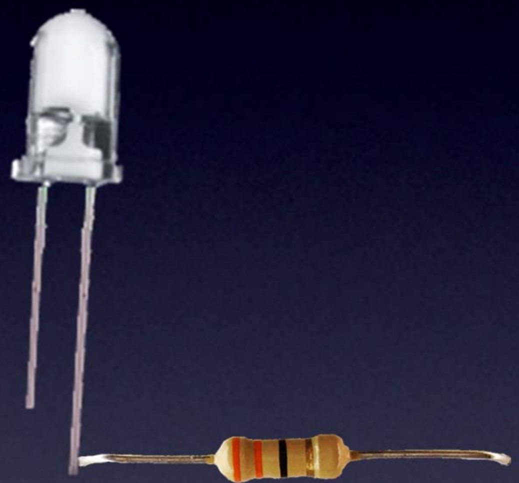


Let’s make this light up!

LED

Everything You Need to Know About Electronics





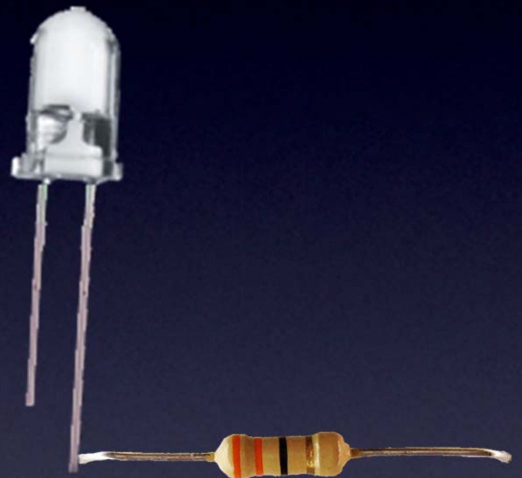
Let’s make this light up!

LED

Everything You Need to Know About Electronics

Black wire: “-” (ground)

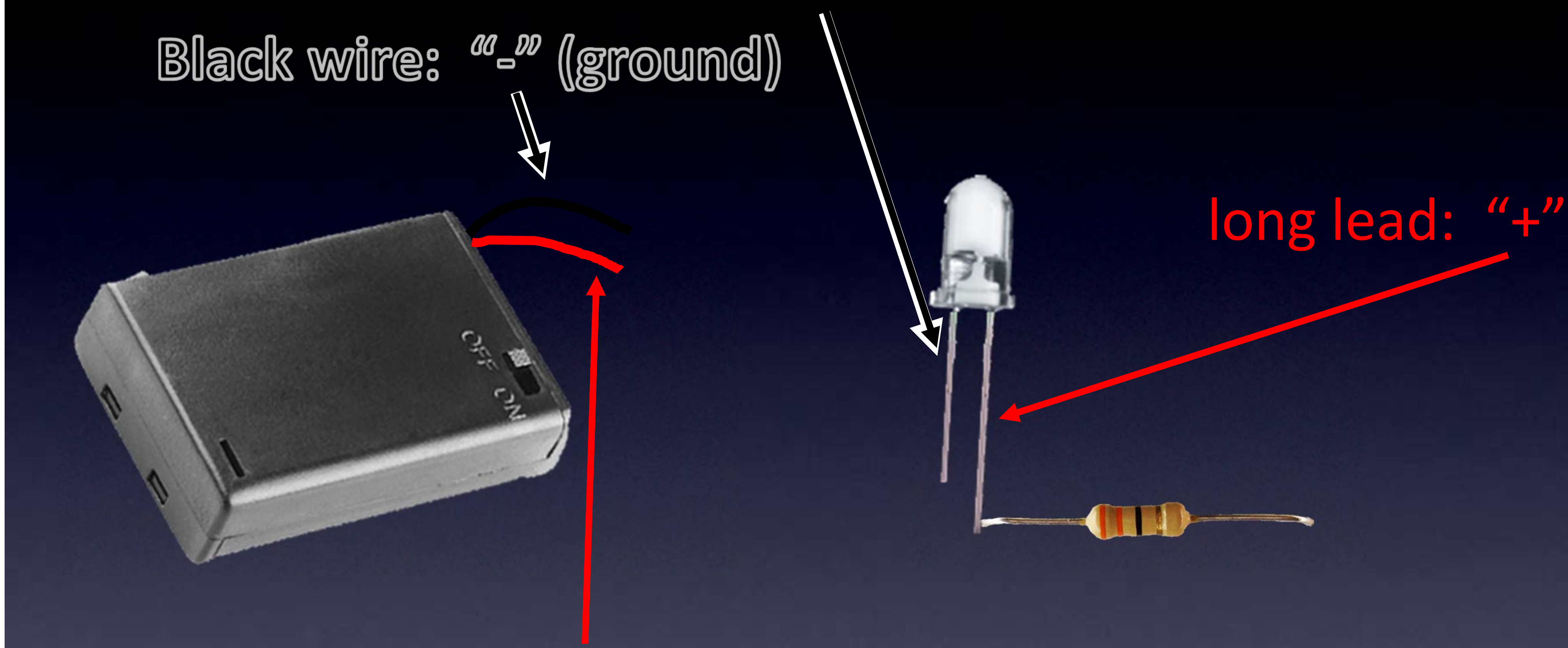
Red wire: “+” power)



Let’s make this light up!

LED

Everything You Need to Know About Electronics



short lead: “-”

Black wire: “-” (ground)

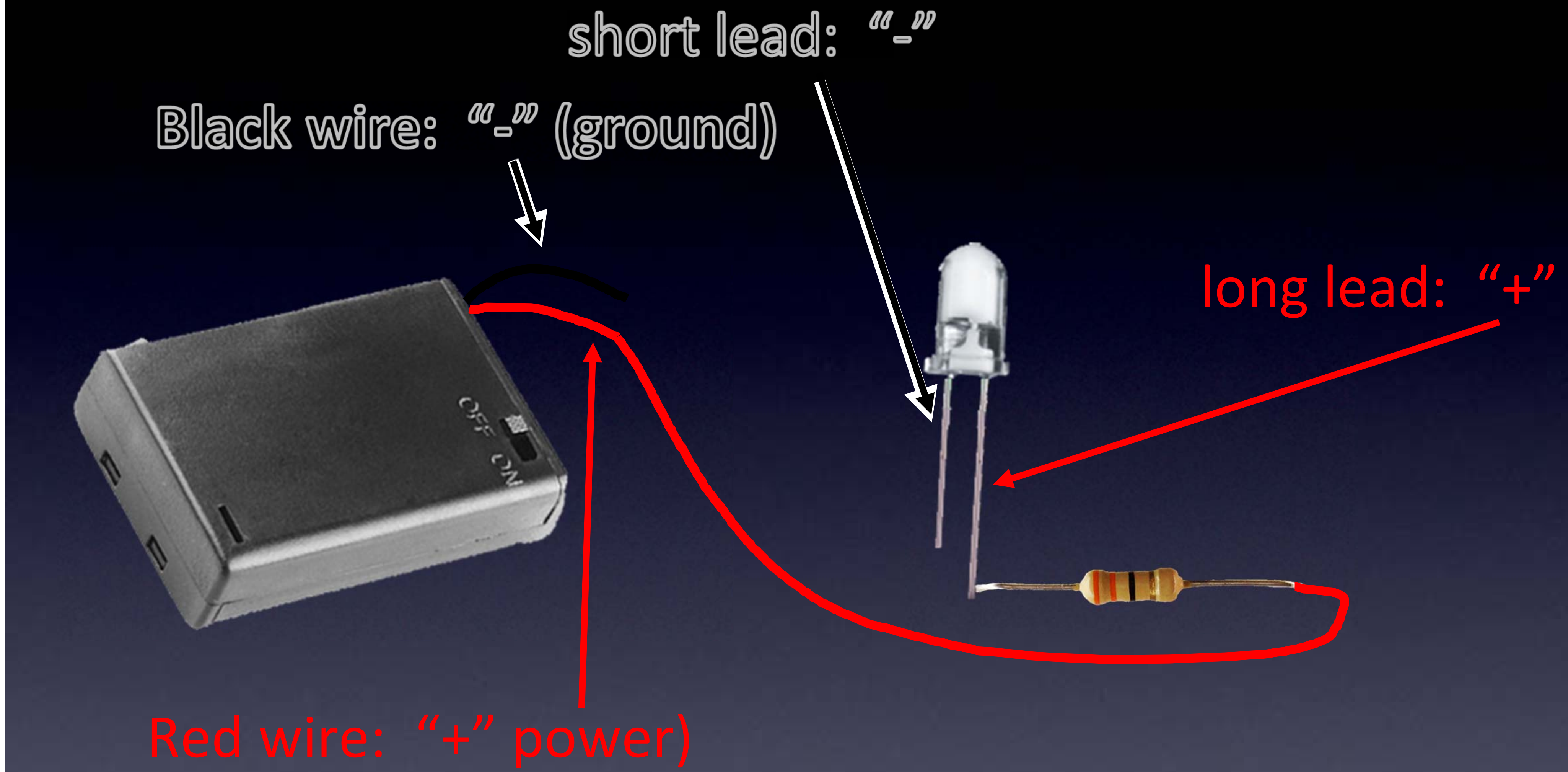
long lead: “+”

Red wire: “+” power)

Let’s make this light up!

LED

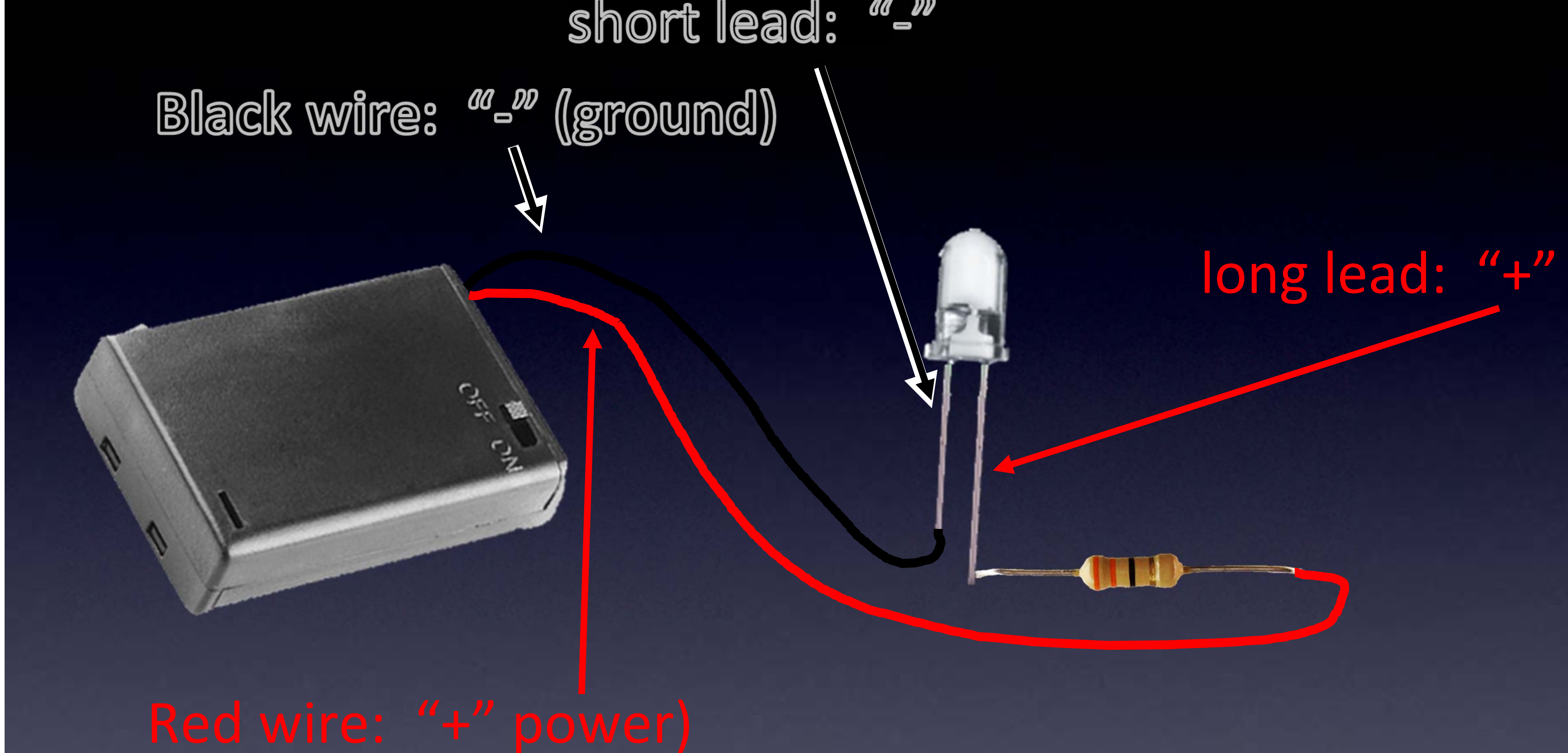
Everything You Need to Know About Electronics



Let’s make this light up!

LED

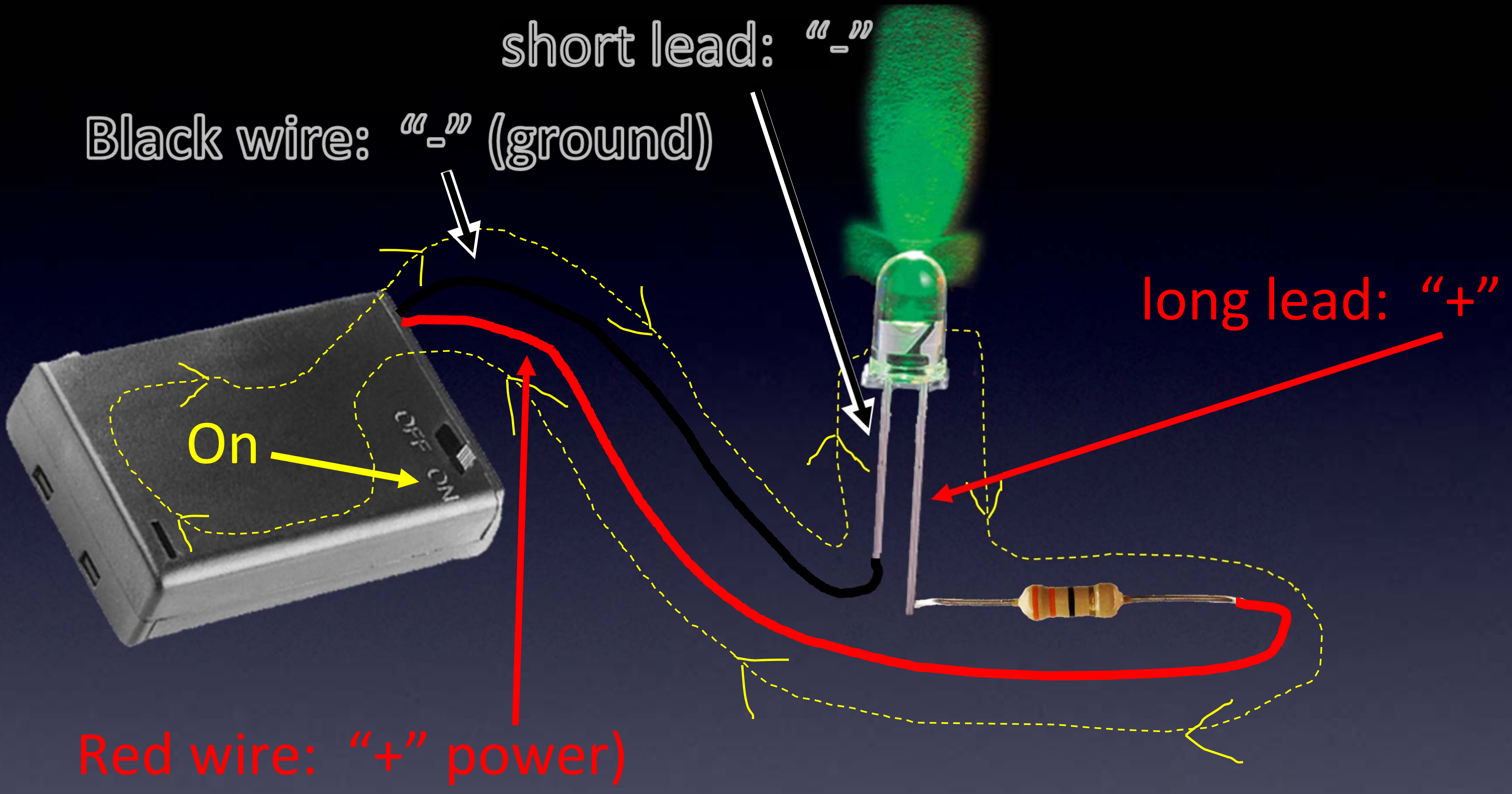
Everything You Need to Know About Electronics



Let's make this light up!

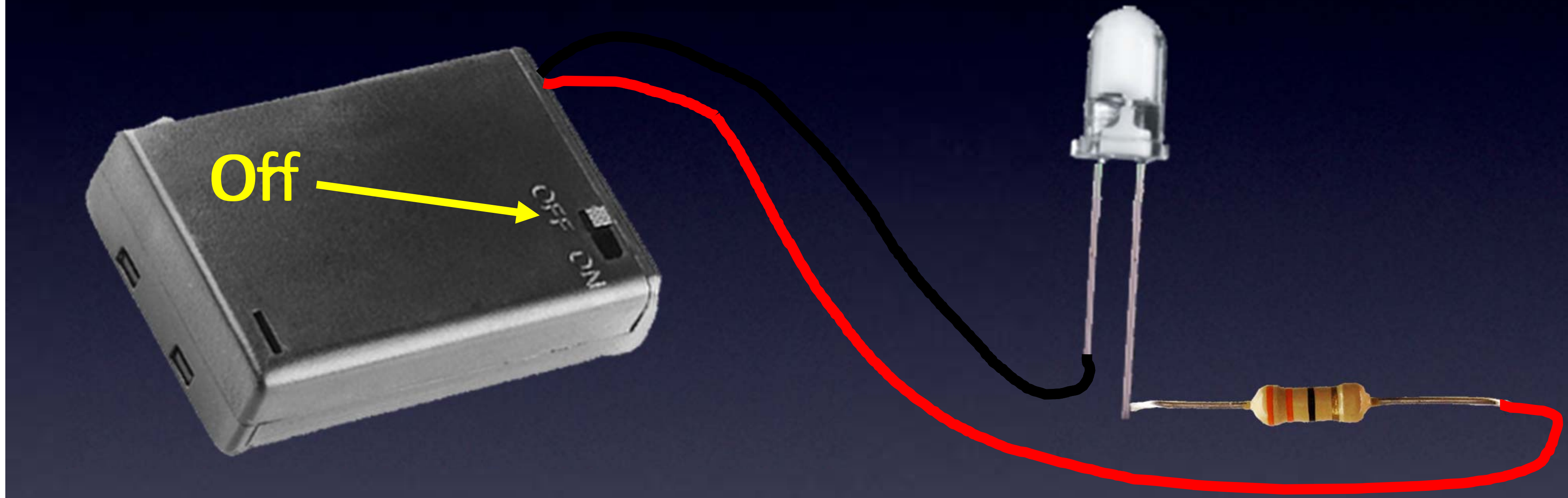
LED

Everything You Need to Know About Electronics



It lights!

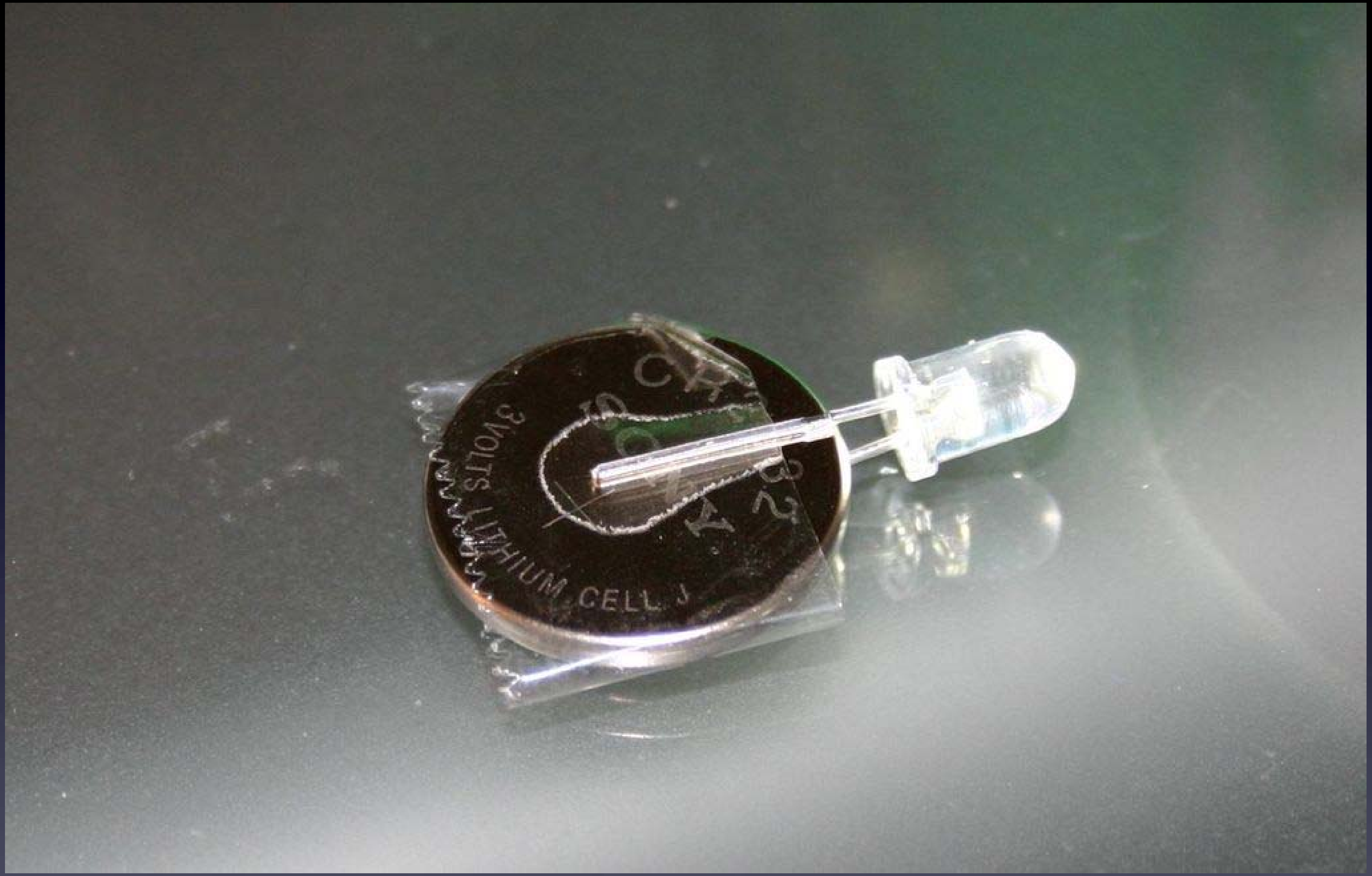
LED



It’s off

LED

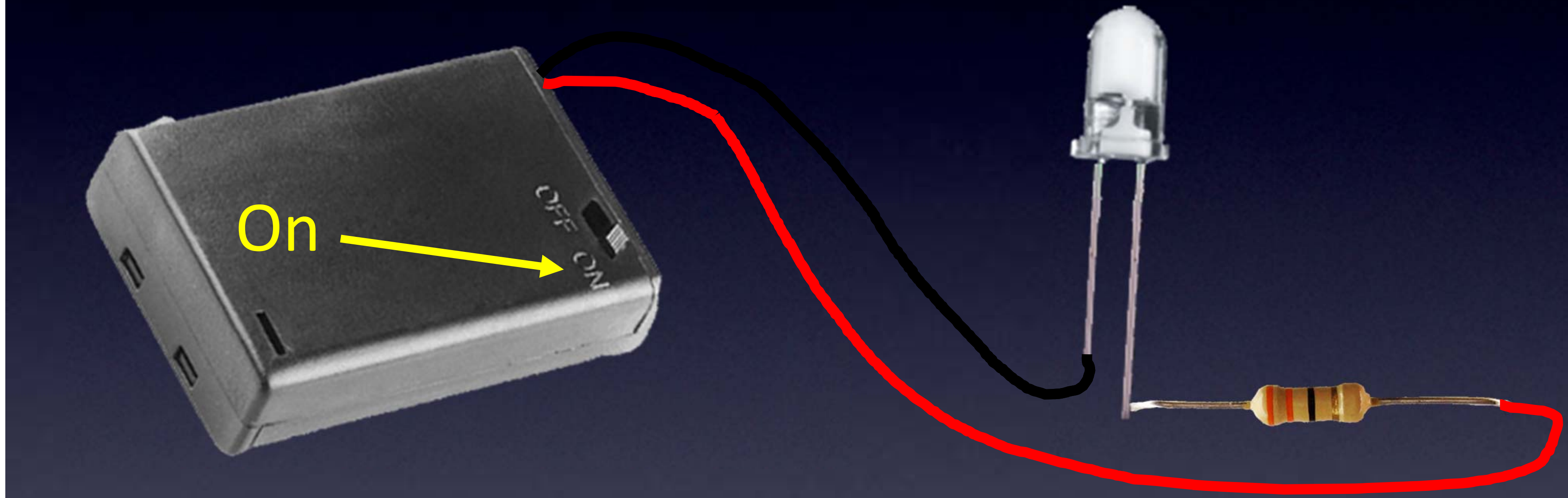
Everything You Need to Know About Electronics



LED & battery

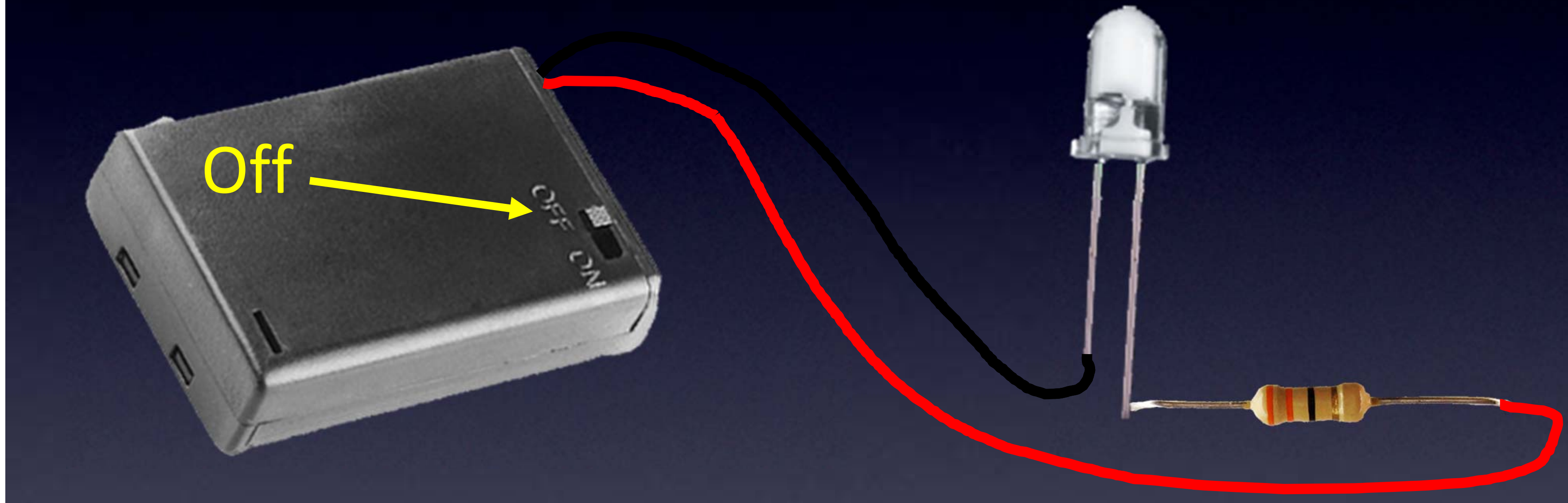
Our first circuit

Everything You Need to Know About Electronics


On

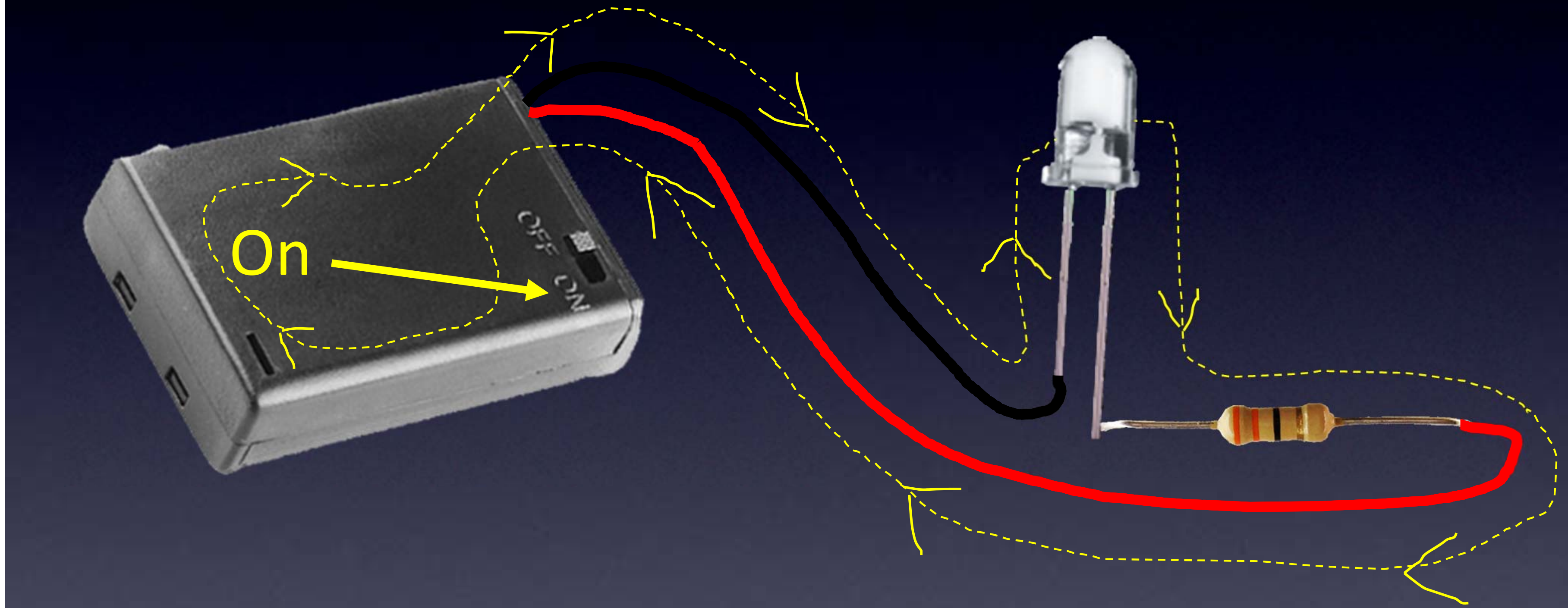
IR LED

Everything You Need to Know About Electronics



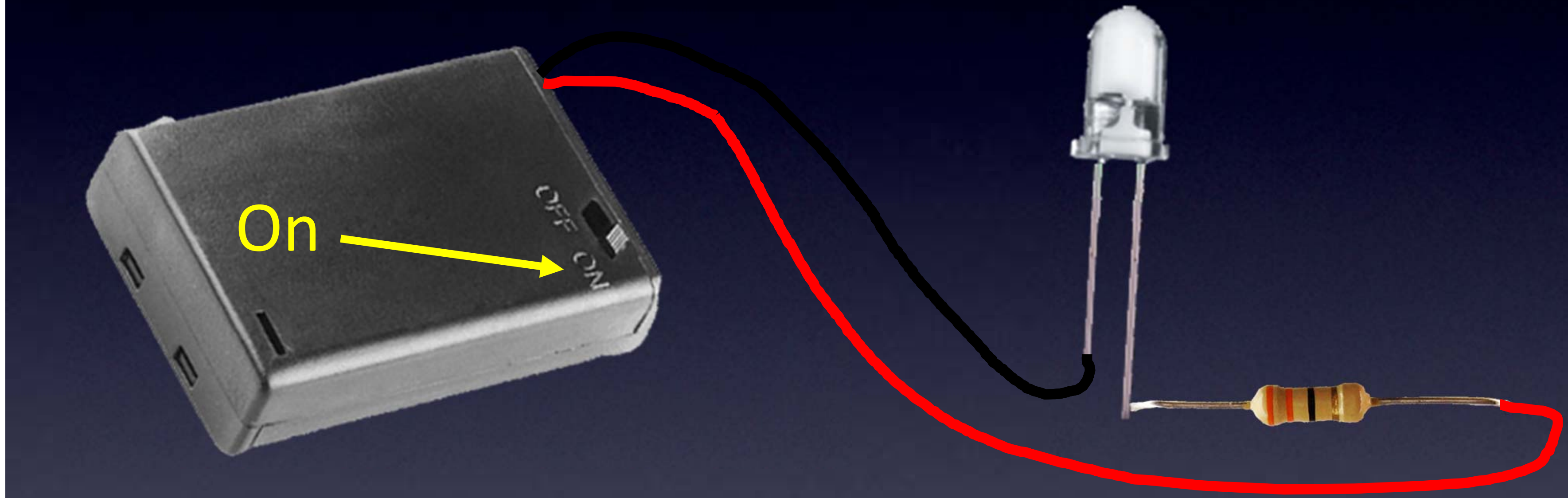
IR LED

Everything You Need to Know About Electronics



IR LED

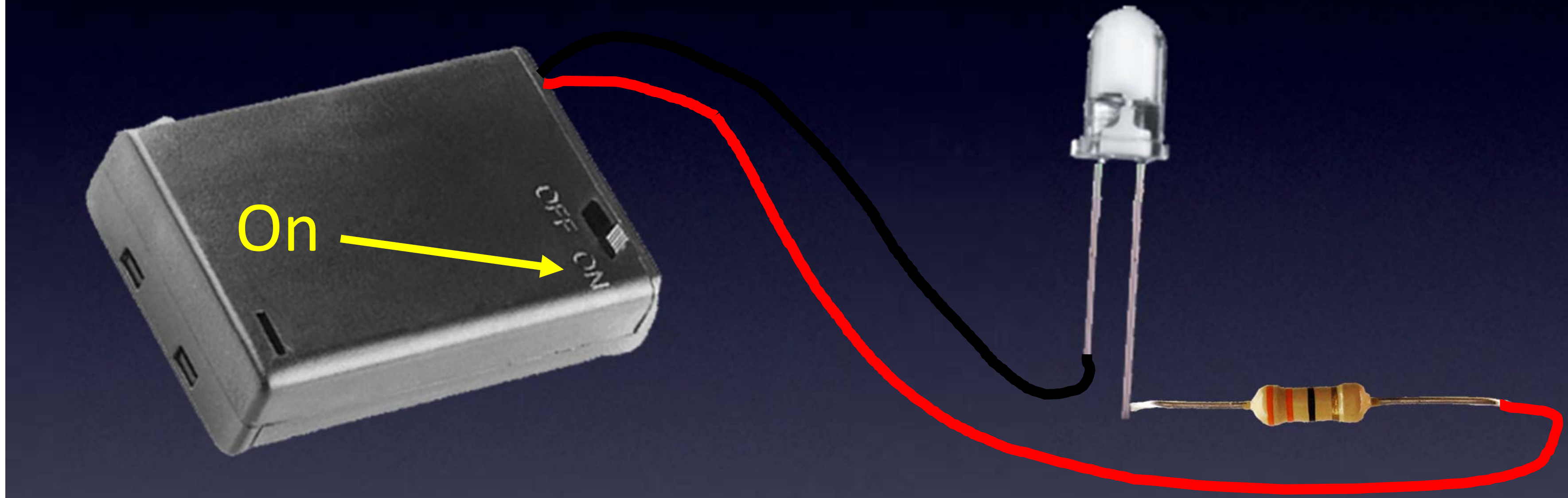
Everything You Need to Know About Electronics



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

IR Remote Control

Everything You Need to Know About Electronics



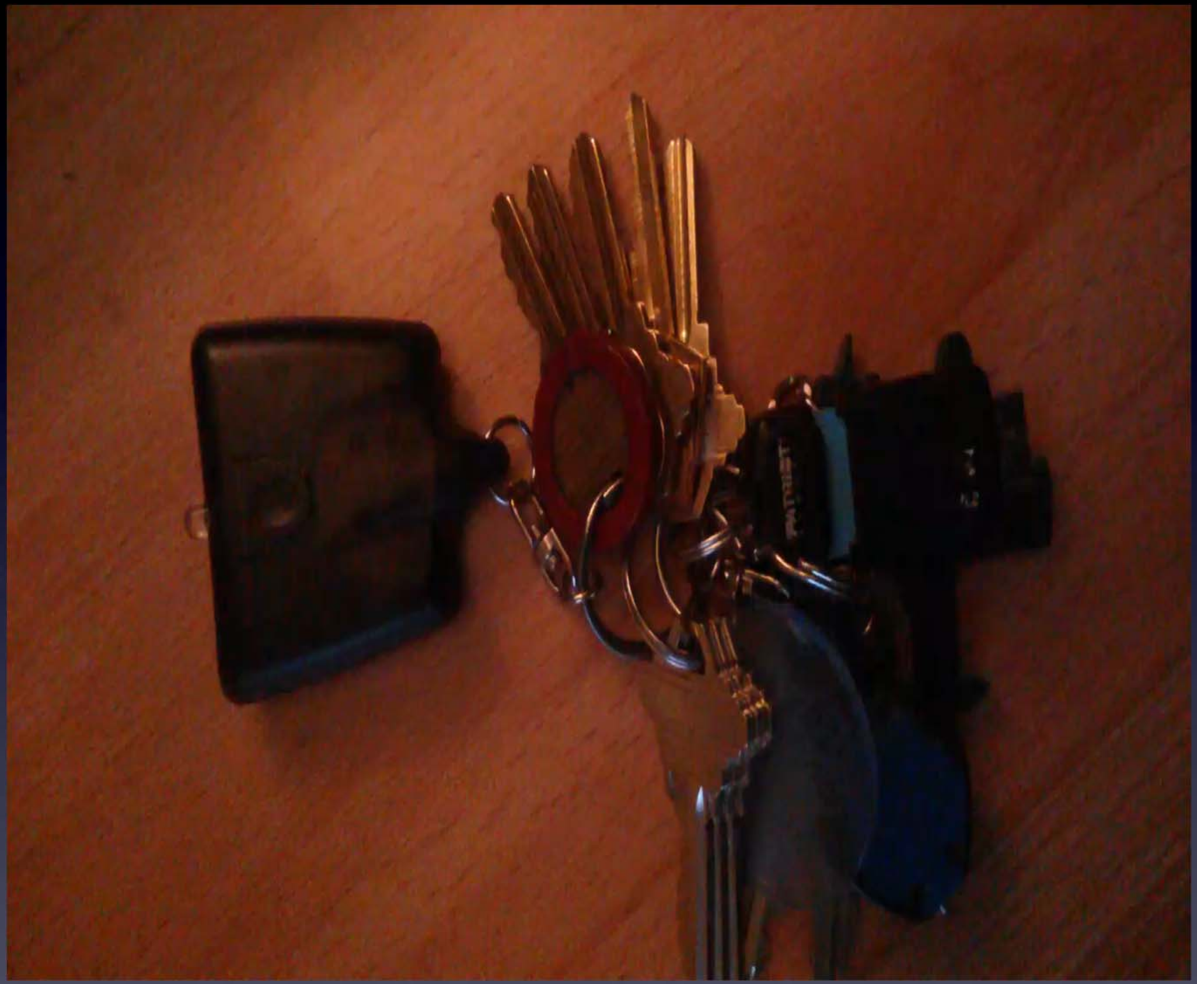
A “code” is IR light blinking on-off-on-off…

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

IR Remote Control

Everything You Need to Know About Electronics

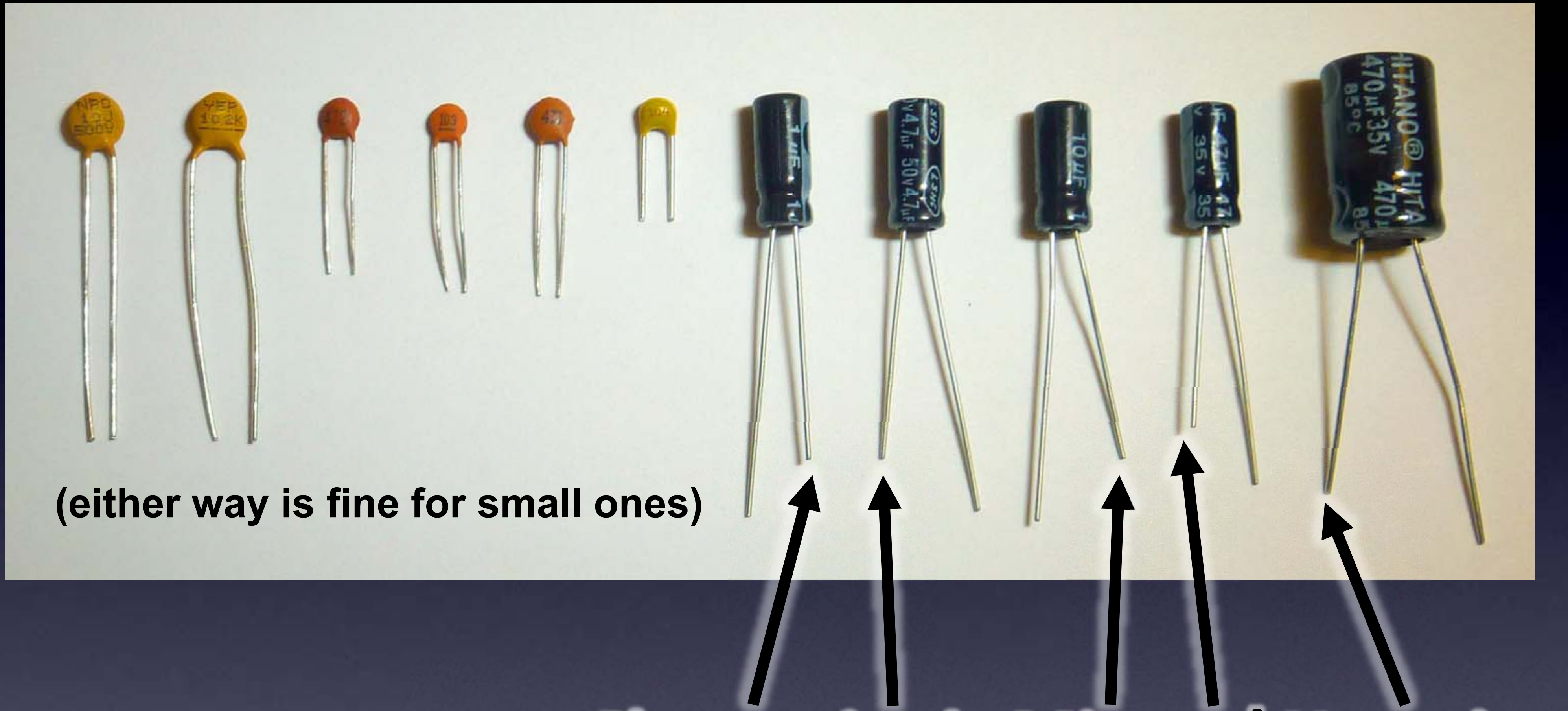
Takes about 60 seconds



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

TV-B-Gone universal remote control

Everything You Need to Know About Electronics



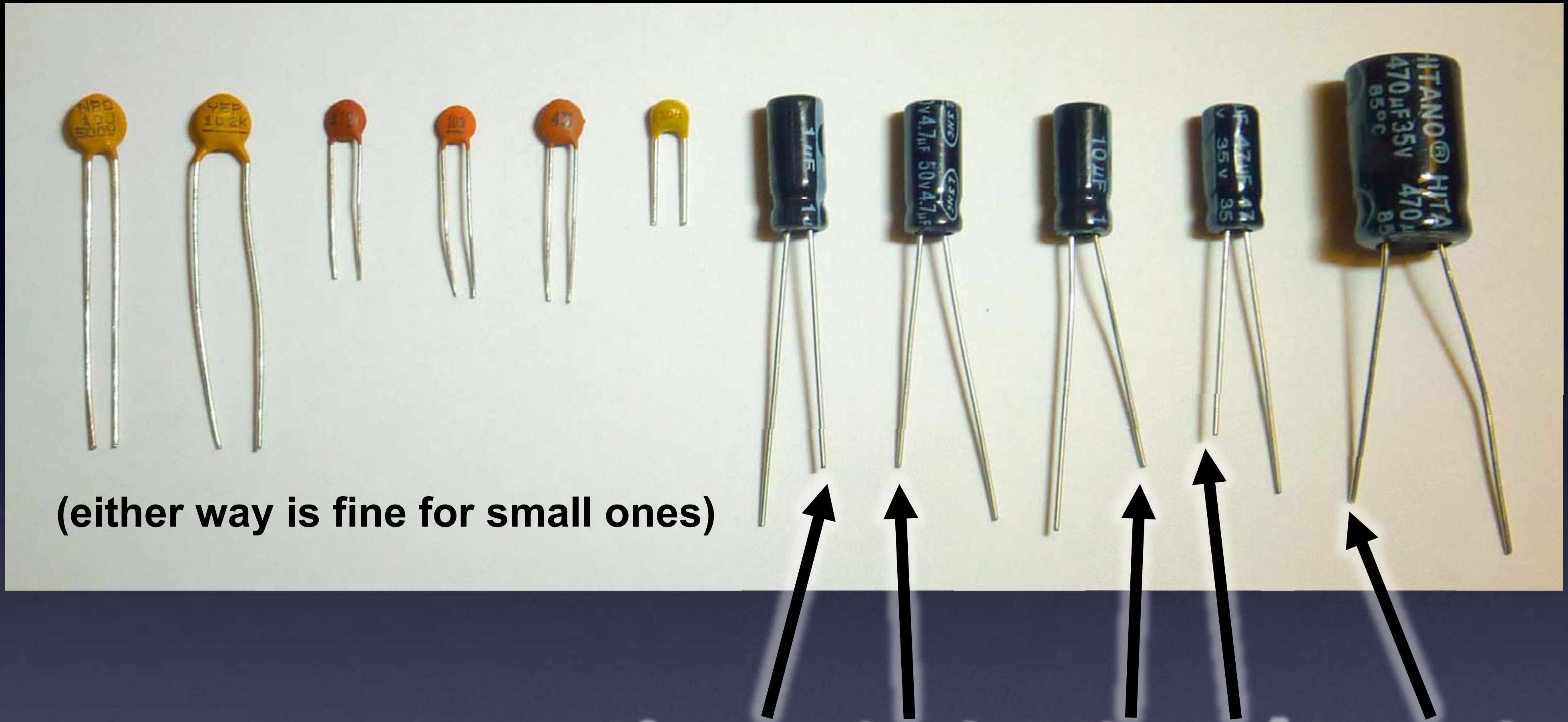
(either way is fine for small ones)

Short wire is Minus / Negative

Little buckets for electrons

Capacitor / Farads

Everything You Need to Know About Electronics



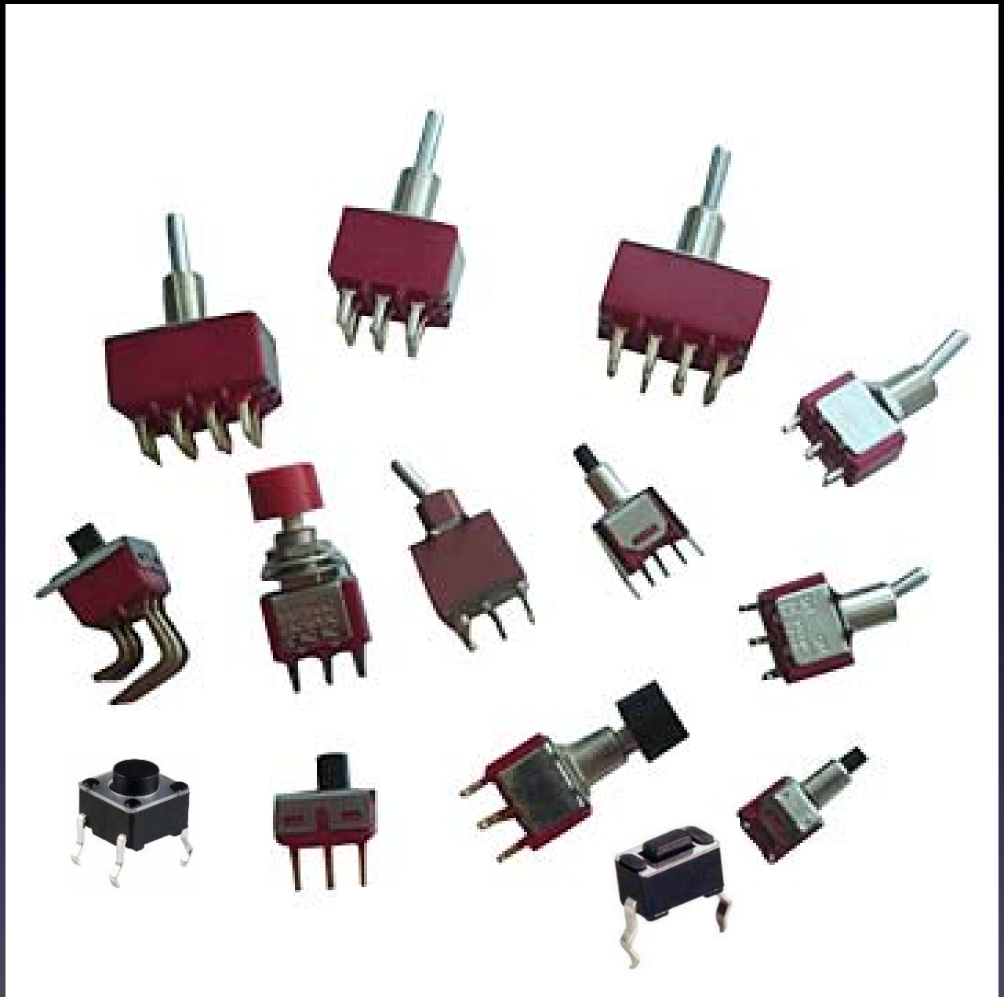
(either way is fine for small ones)

Short wire is Minus / Negative

Little buckets for electrons

Capacitor / **Farads**

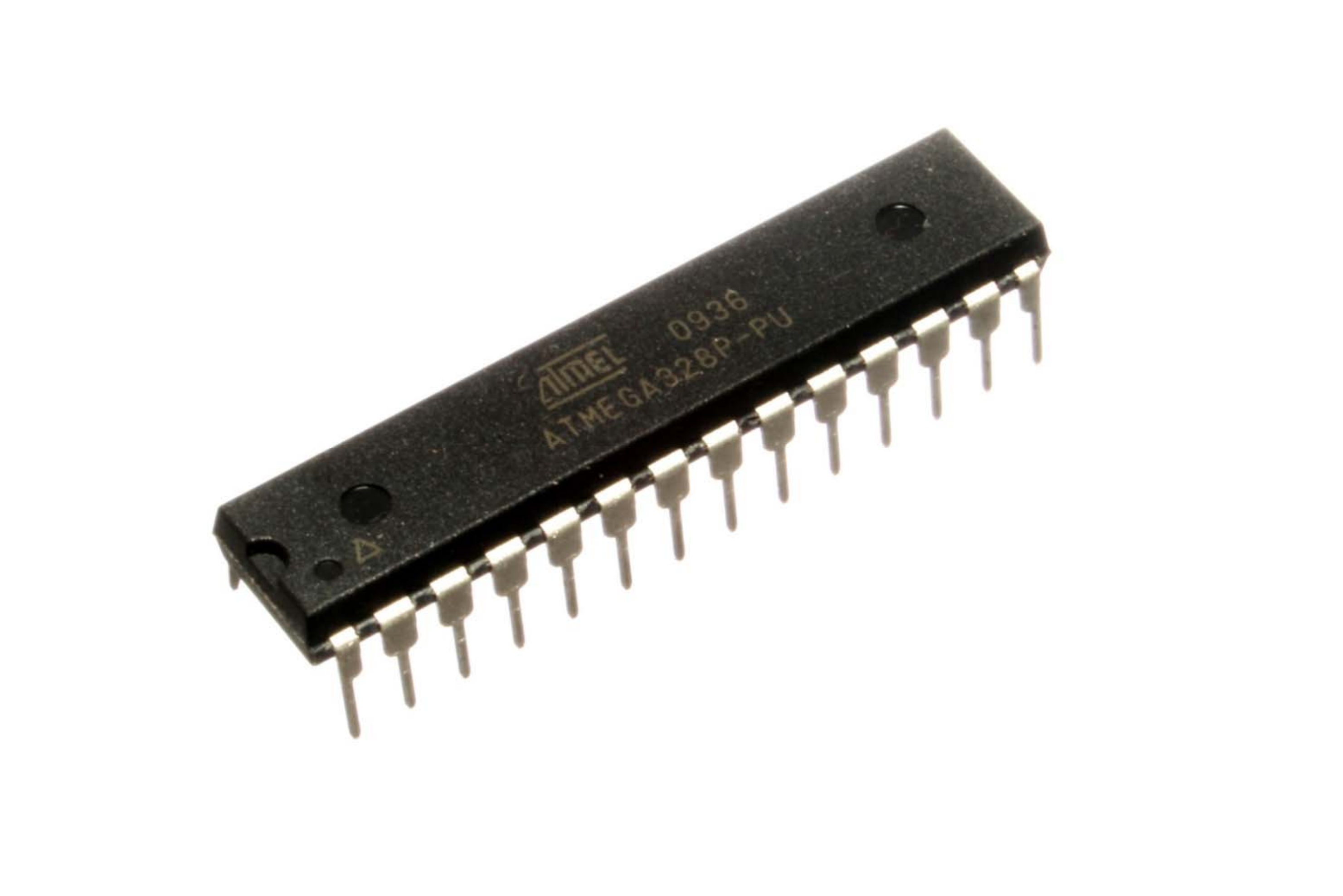
Everything You Need to Know About Electronics



Strips of metal connected together – or not

Switch

Everything You Need to Know About Electronics



A complete computer on a chip

Microcontroller

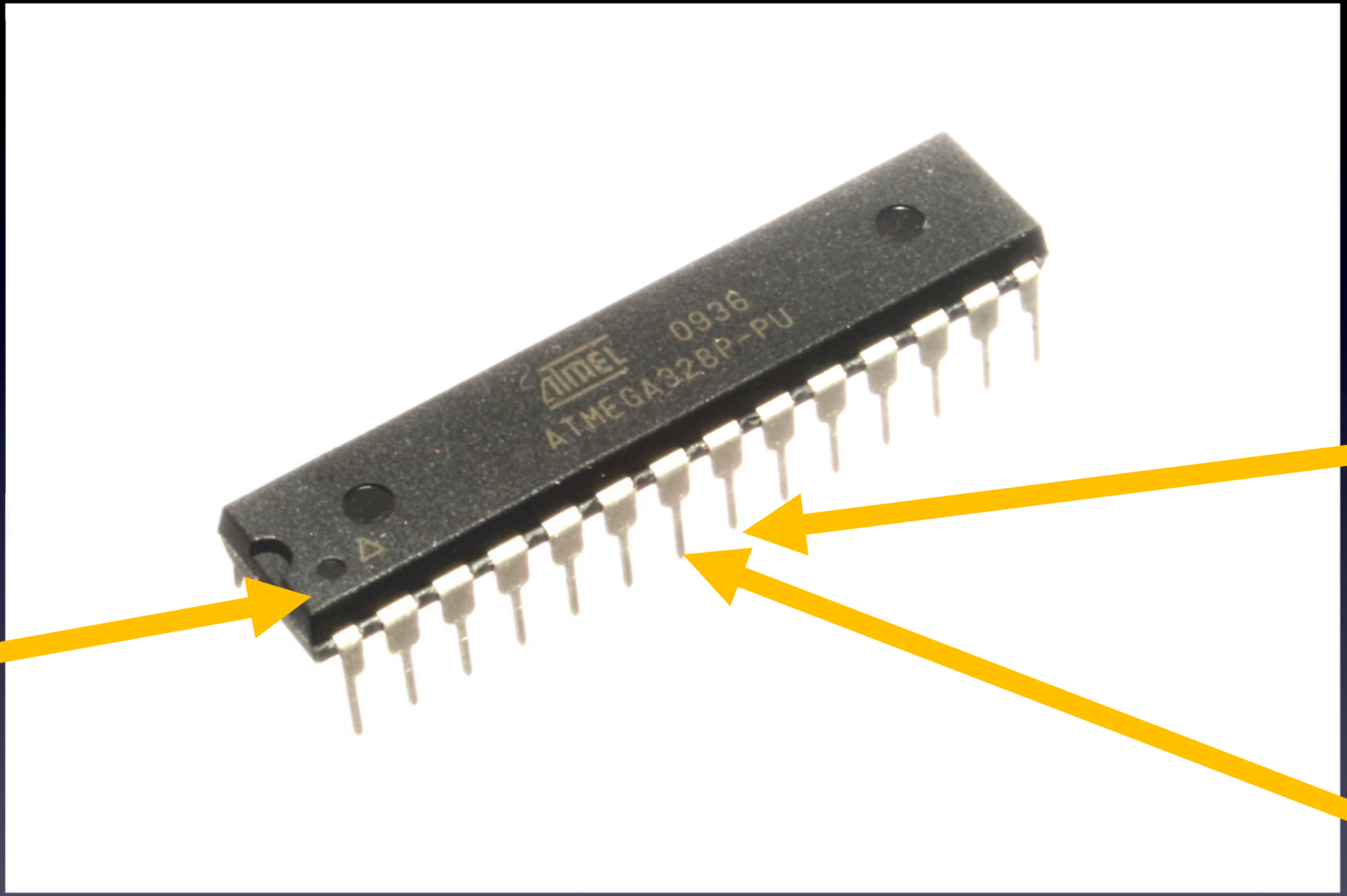
Everything You Need to Know About Electronics

It runs programs

that control electronic parts connected to its pins.

Microcontroller

Everything You Need to Know About Electronics



2 special pins:

Pin 1

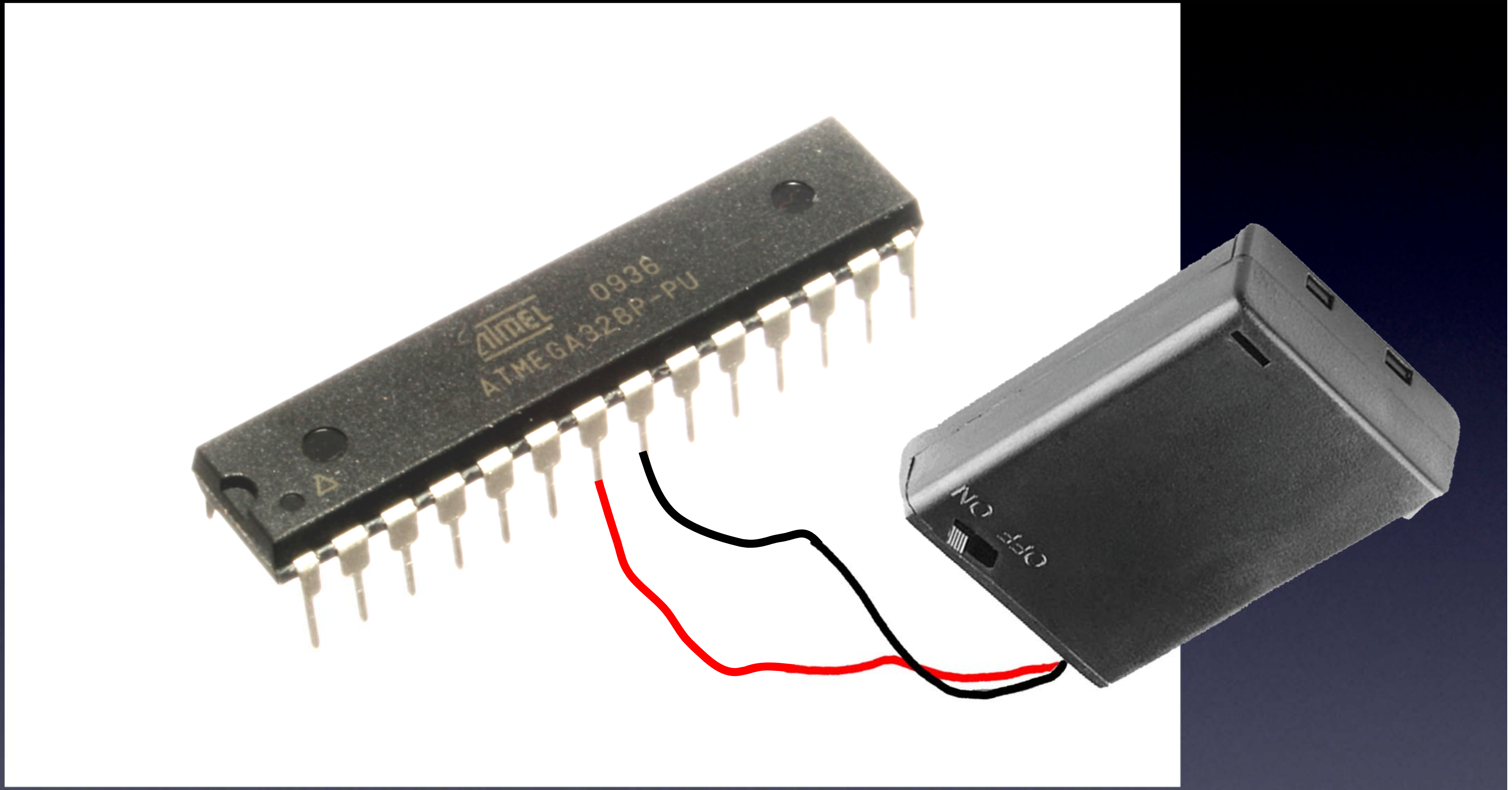
Pin 8 = Ground

Pin 7 = Vcc

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!

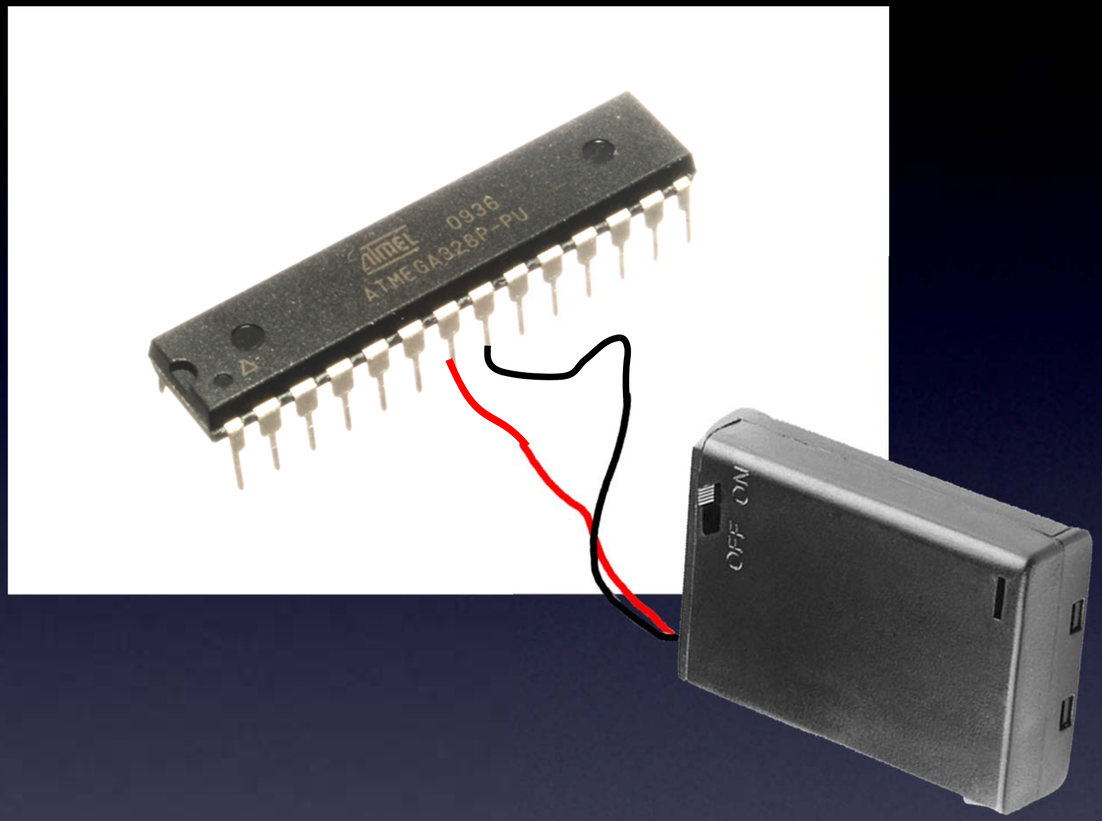
Everything You Need to Know About Electronics

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)

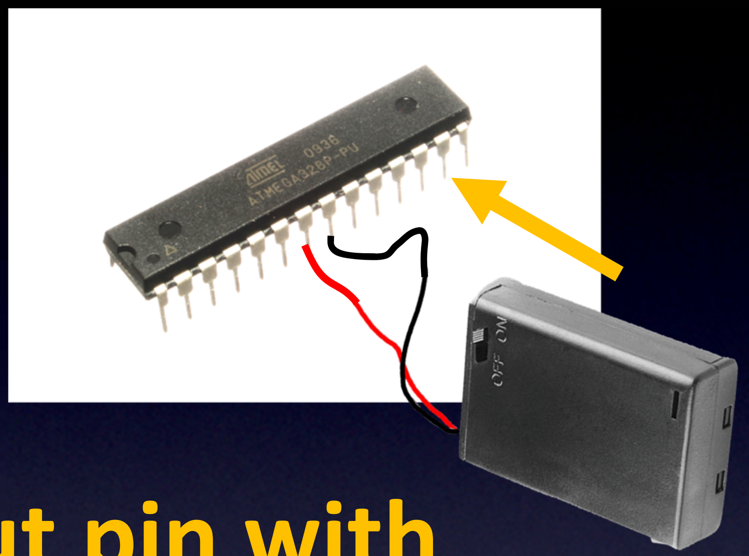
(without current / with current)

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

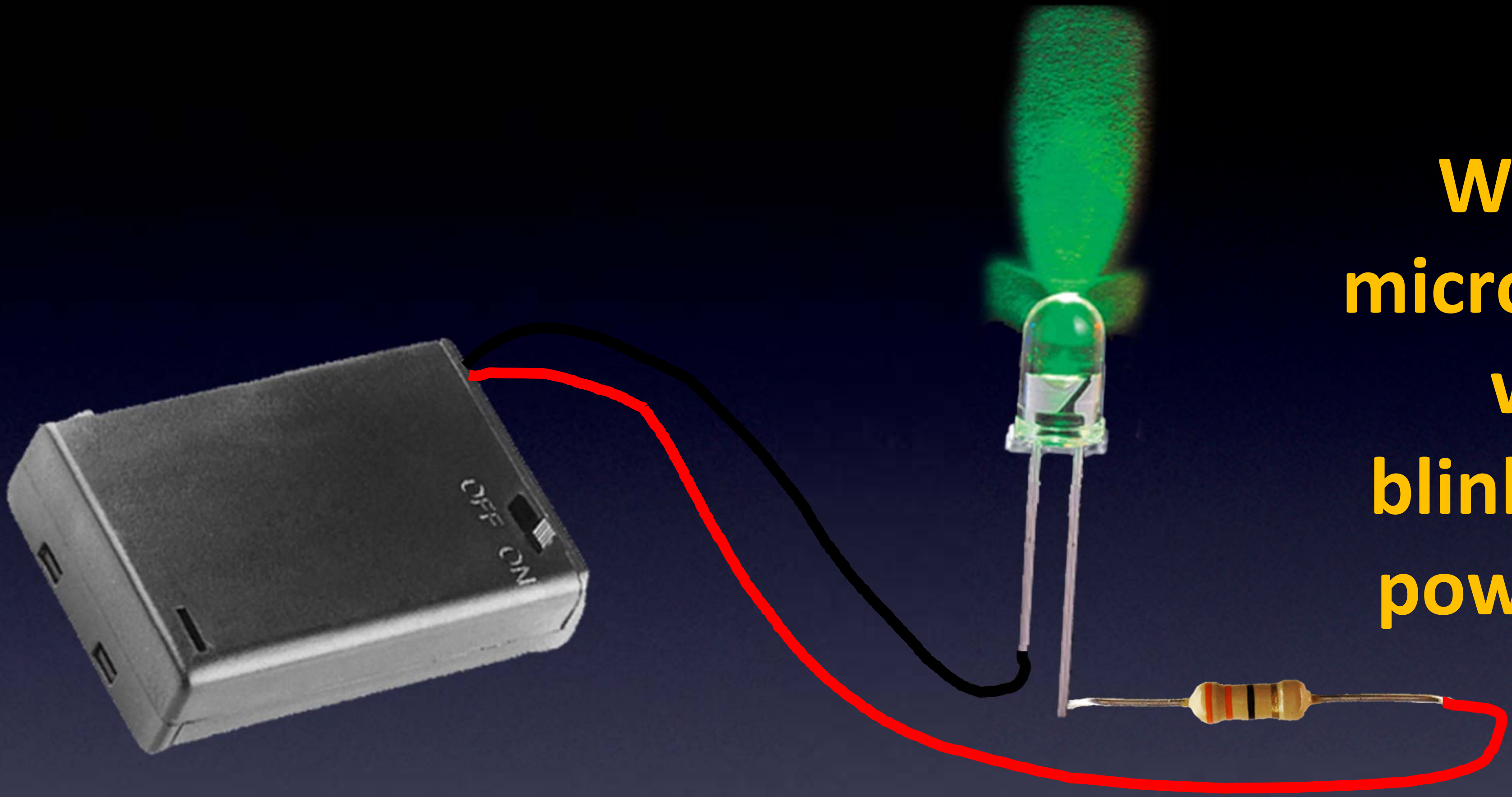
Microcontrollers

make an LED blink

`Hello World`

Microcontroller

Everything You Need to Know About Electronics



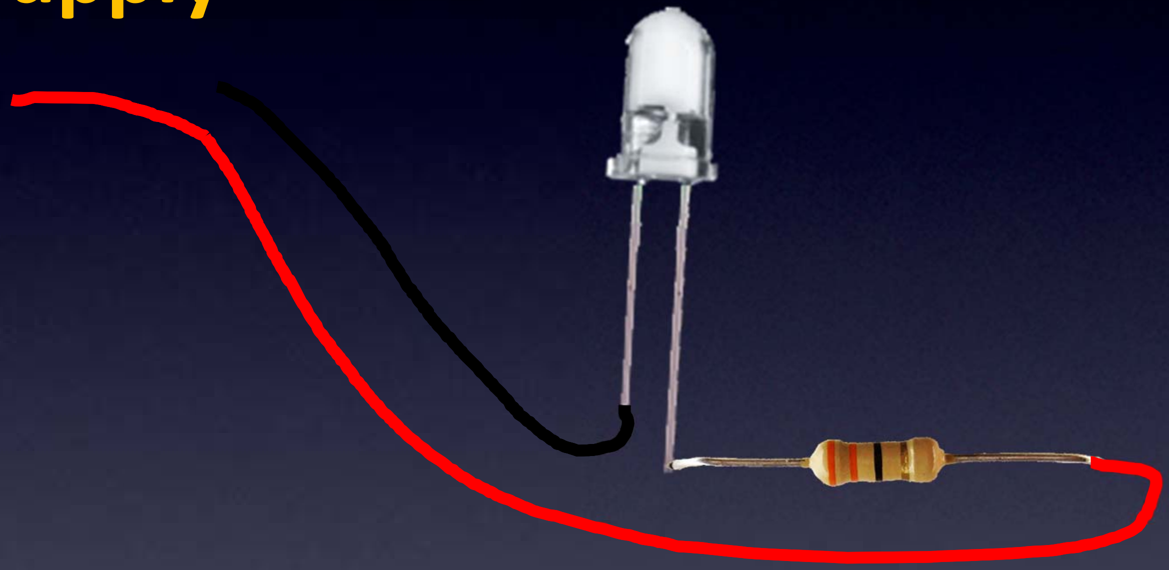
Without a microcontroller we can blink with our power supply

Turning an LED on and off

(Leading up to `Hello World`)

Everything You Need to Know About Electronics

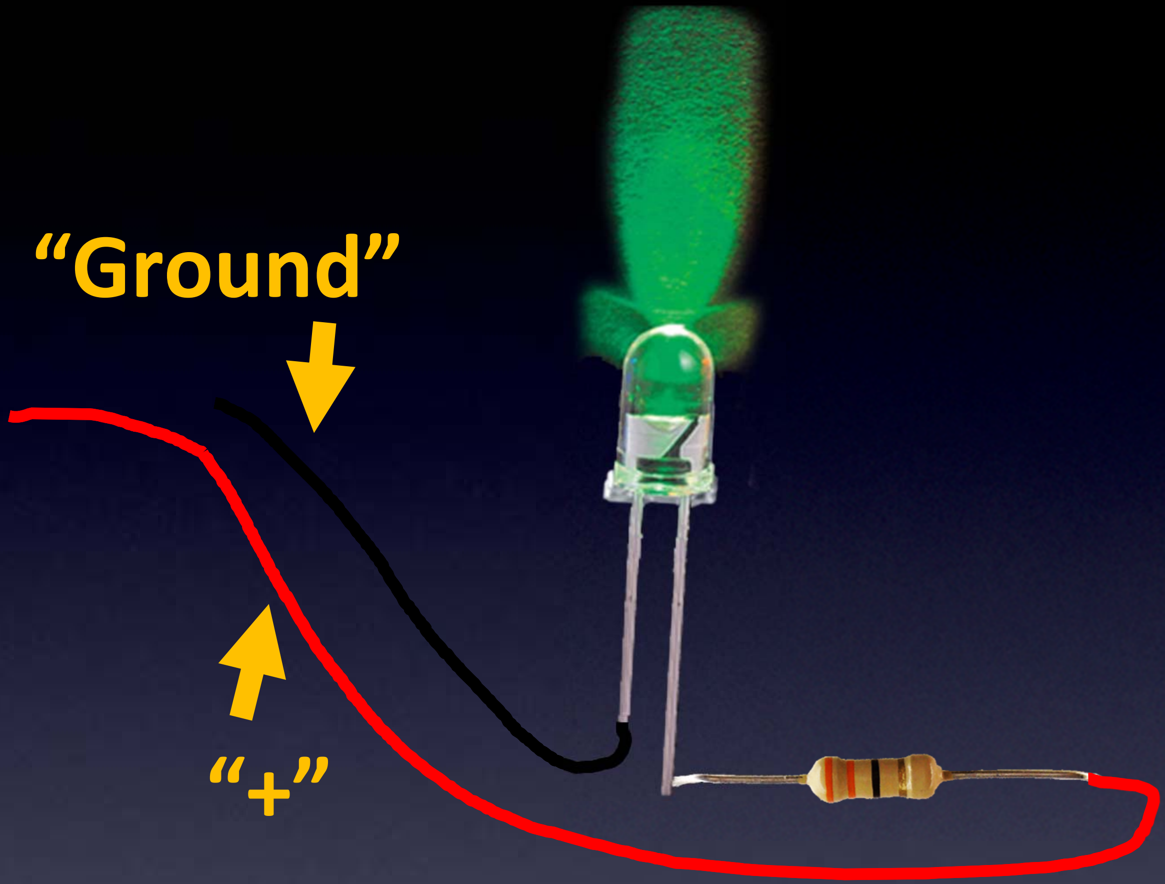
Let's replace
the power supply



Turning an LED on and off

(Leading up to `Hello World`)

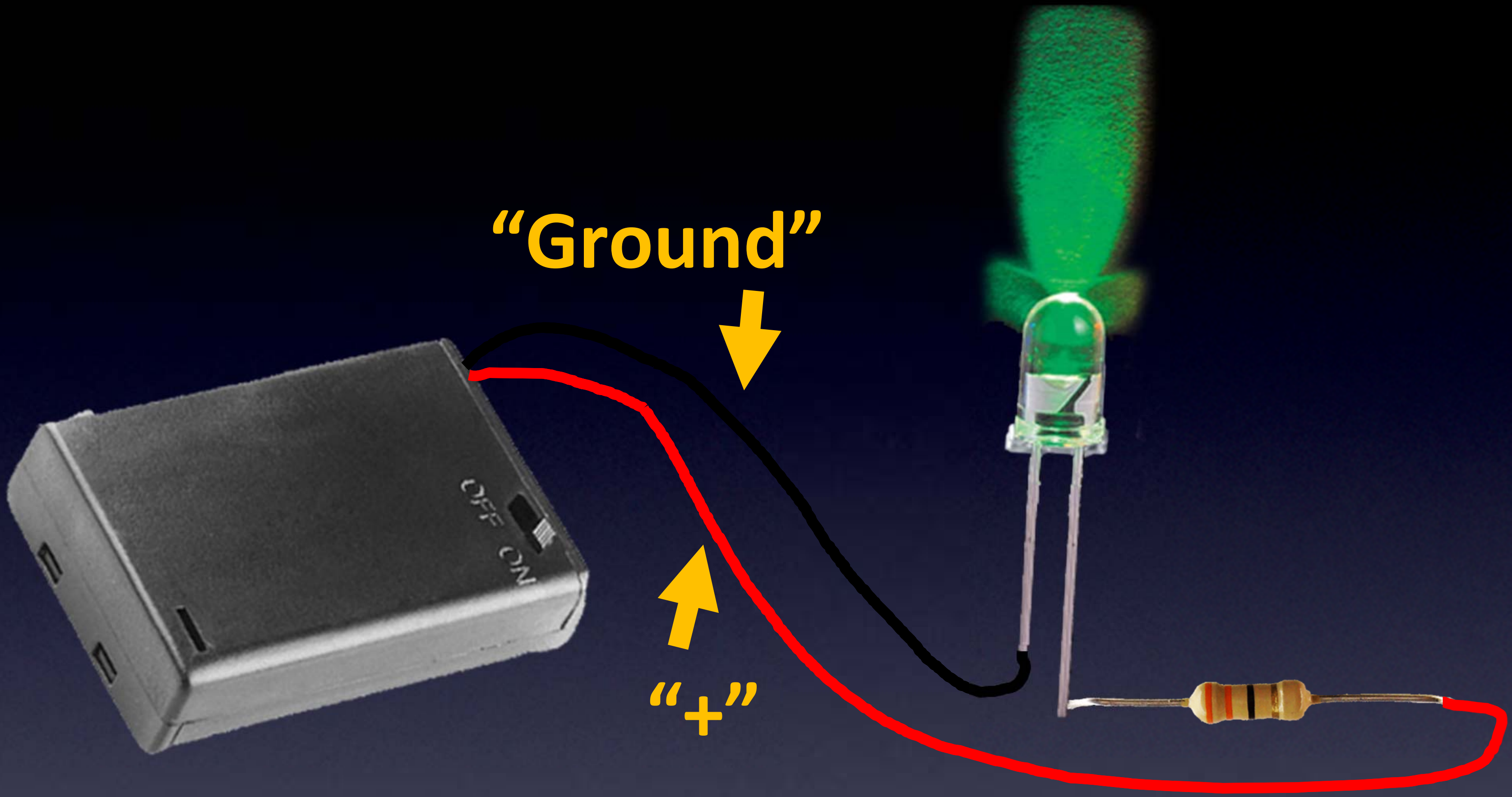
Everything You Need to Know About Electronics



Turning an LED on and off

(Leading up to `Hello World`)

Everything You Need to Know About Electronics



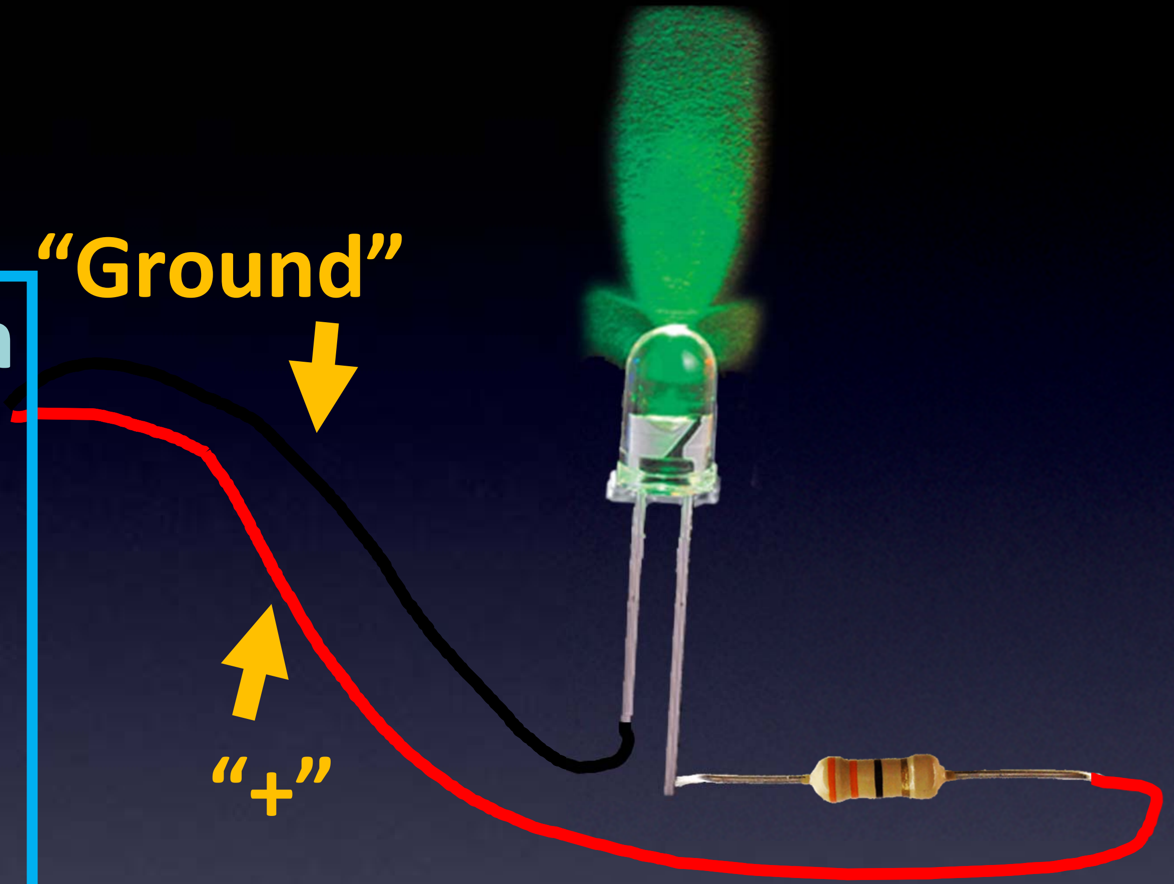
Turning an LED on and off

(Leading up to `Hello World`)

Everything You Need to Know About Electronics

We can use an Output pin (and Ground)

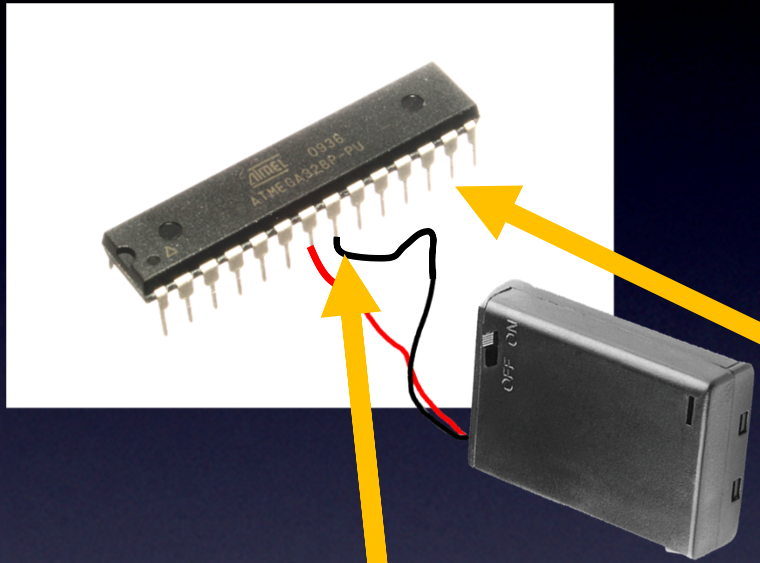
as our power supply



Turning an LED on and off

(Leading up to `Hello World`)

Everything You Need to Know About Electronics



Ground

Let's use Pin 13

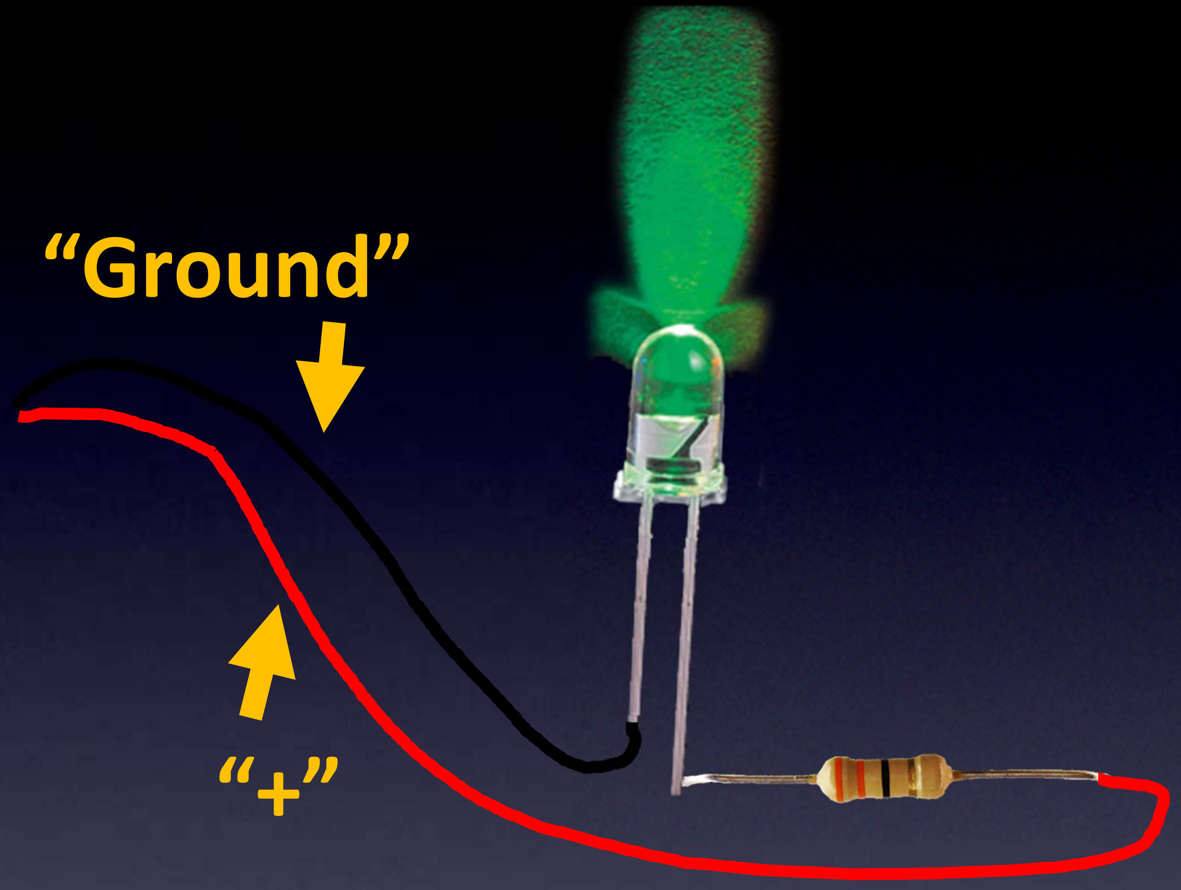
as our Output pin

(it can be High or Low)

Turning an LED on and off

(Leading up to `Hello World`)

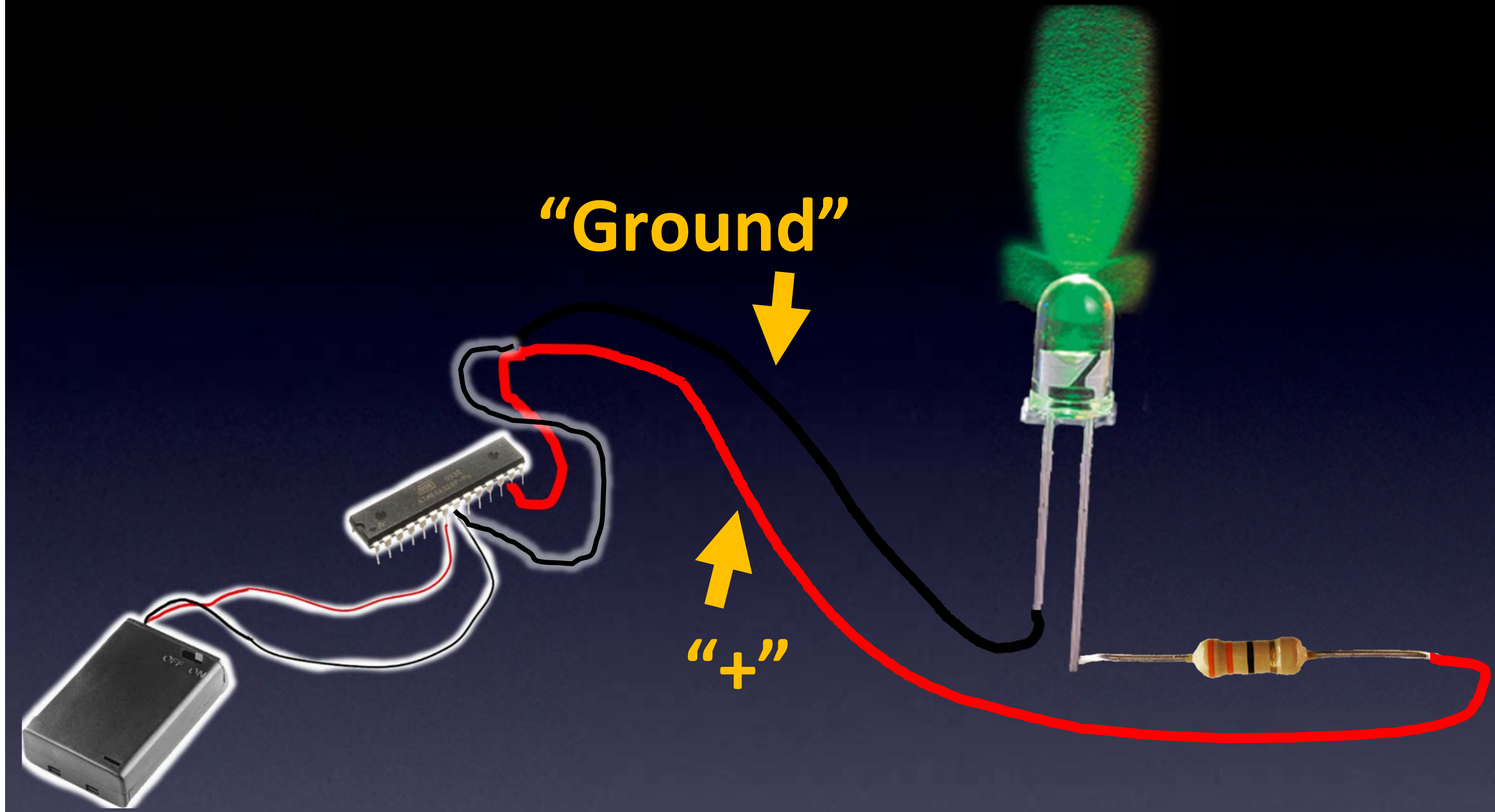
Everything You Need to Know About Electronics



Turning an LED on and off

(Leading up to `Hello World`)

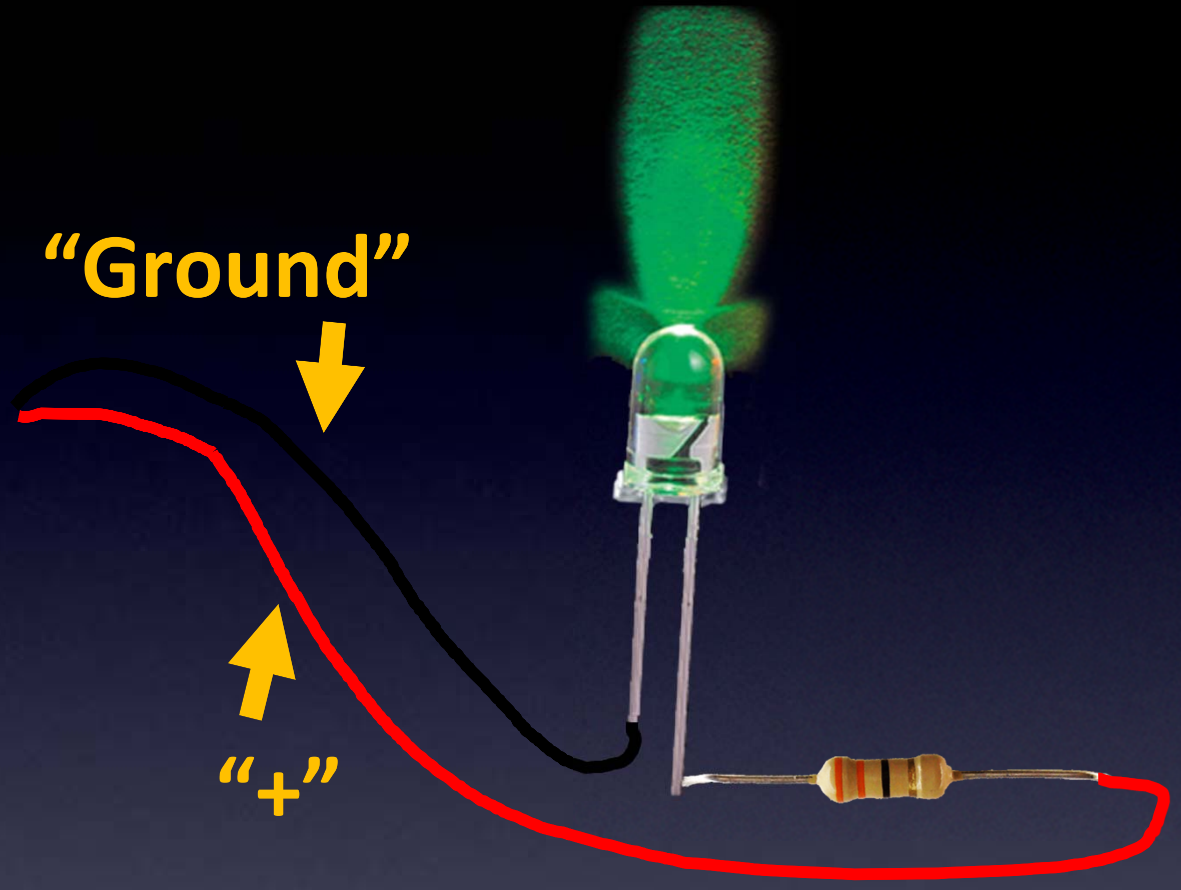
Everything You Need to Know About Electronics



Turning an LED on and off

(Leading up to `Hello World`)

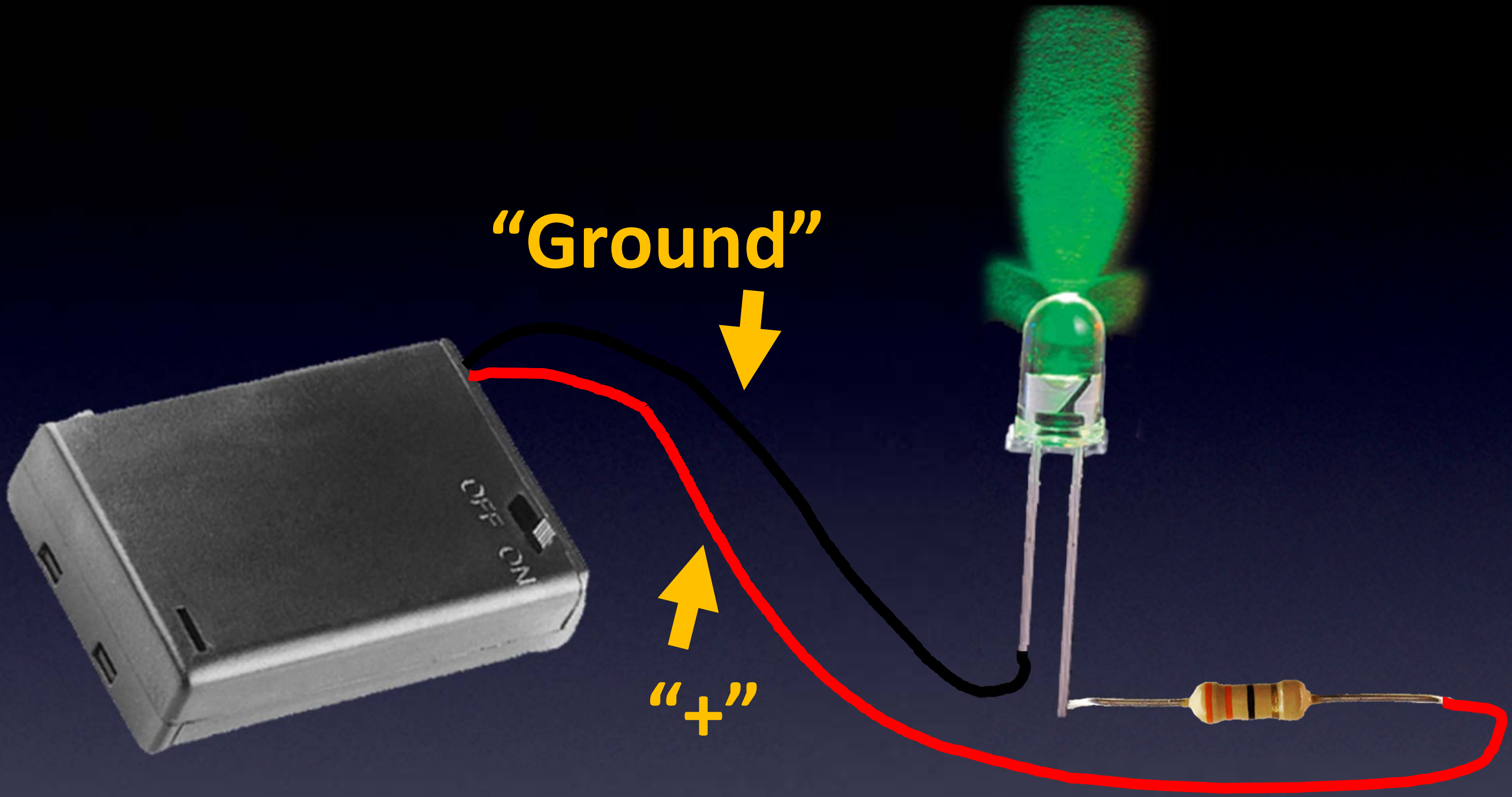
Everything You Need to Know About Electronics



Turning an LED on and off

(Leading up to `Hello World`)

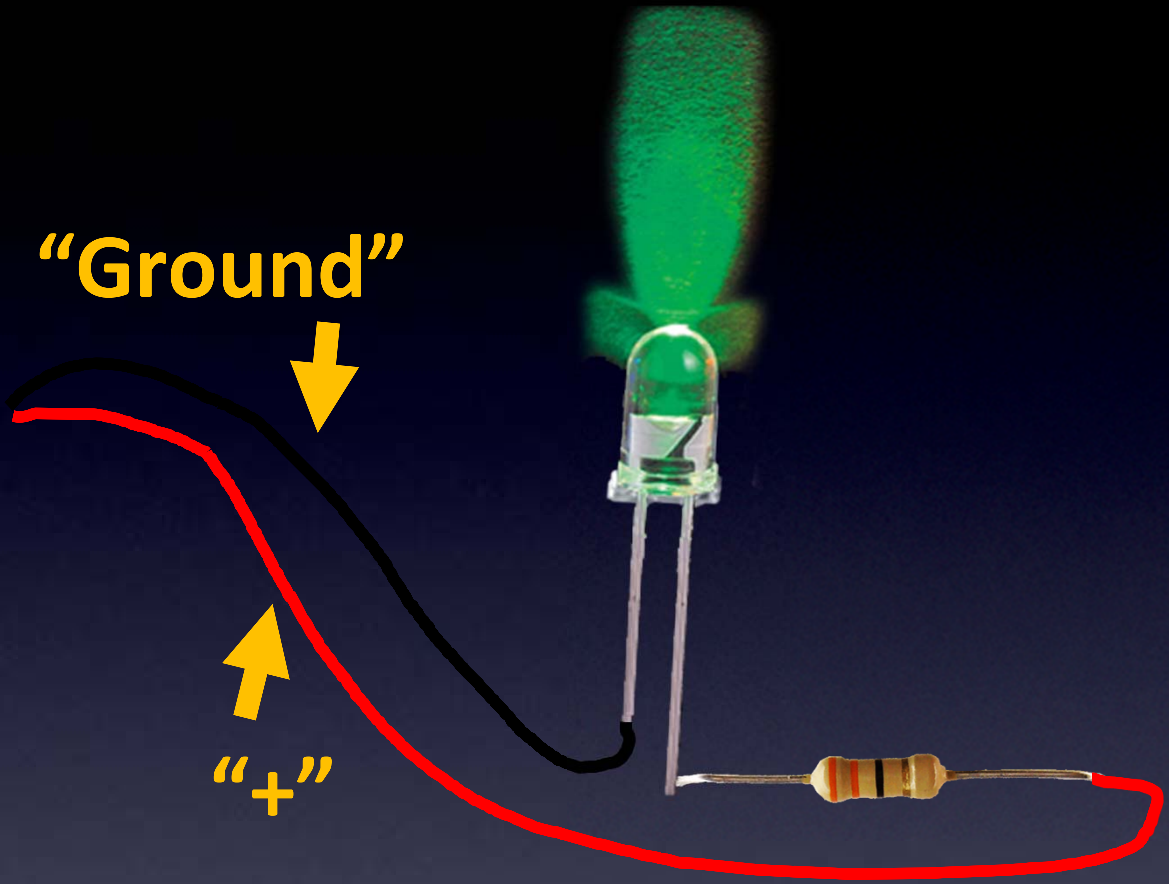
Everything You Need to Know About Electronics



Turning an LED on and off

(Leading up to `Hello World`)

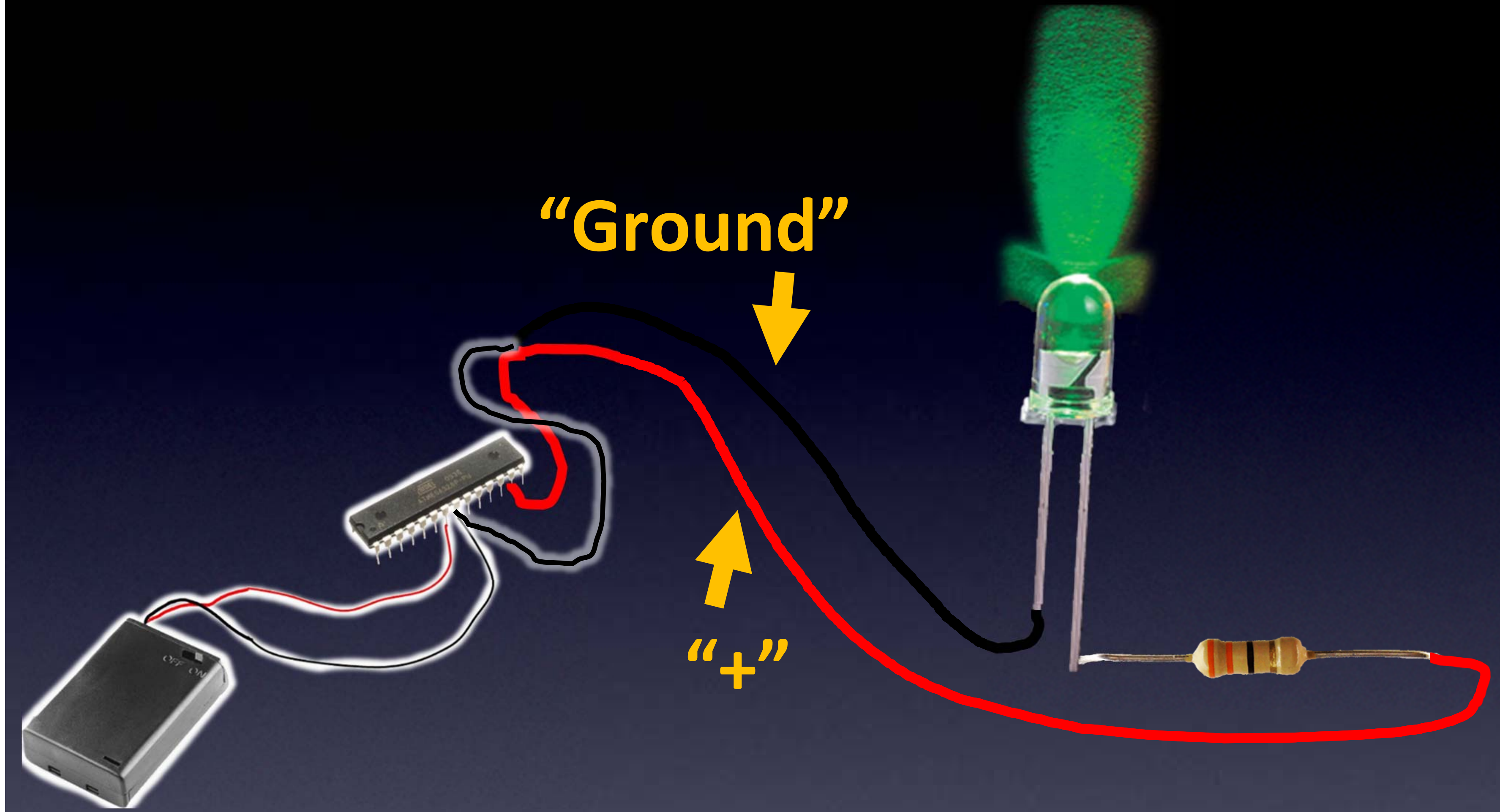
Everything You Need to Know About Electronics



Turning an LED on and off

(Leading up to `Hello World`)

Everything You Need to Know About Electronics

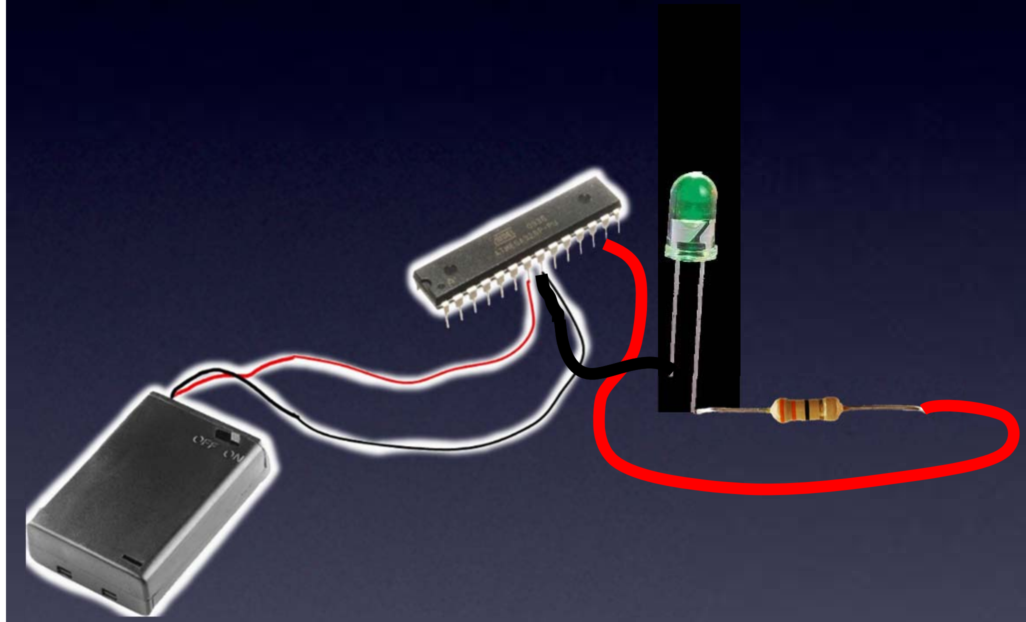


Turning an LED on and off

(Leading up to `Hello World`)

Everything You Need to Know About Electronics

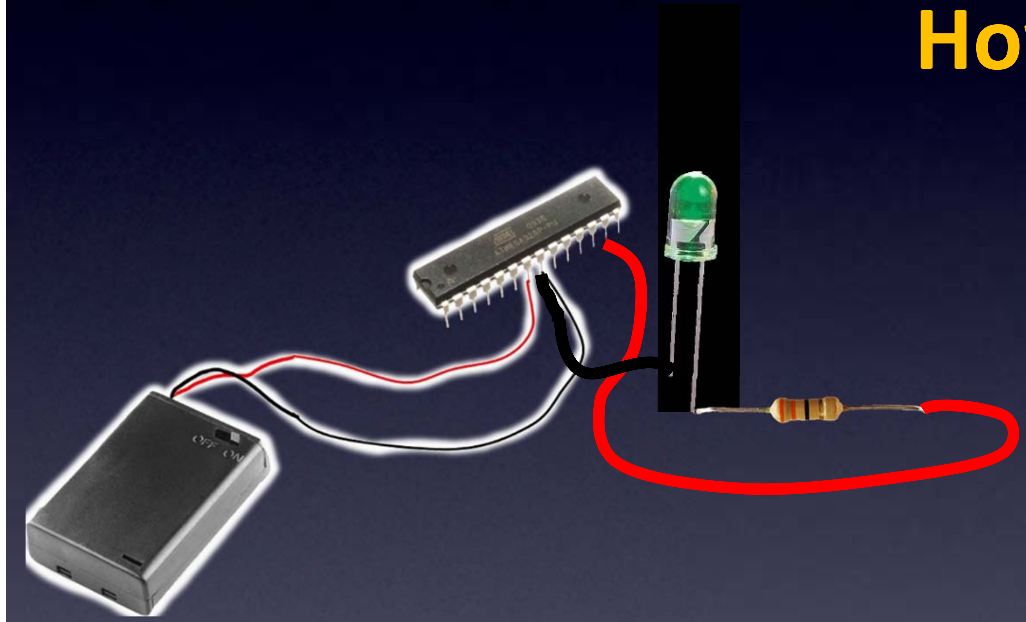
This is our <u>Hardware</u> for `Hello World!`



Turning an LED on and off

`Hello World`

Everything You Need to Know About Electronics



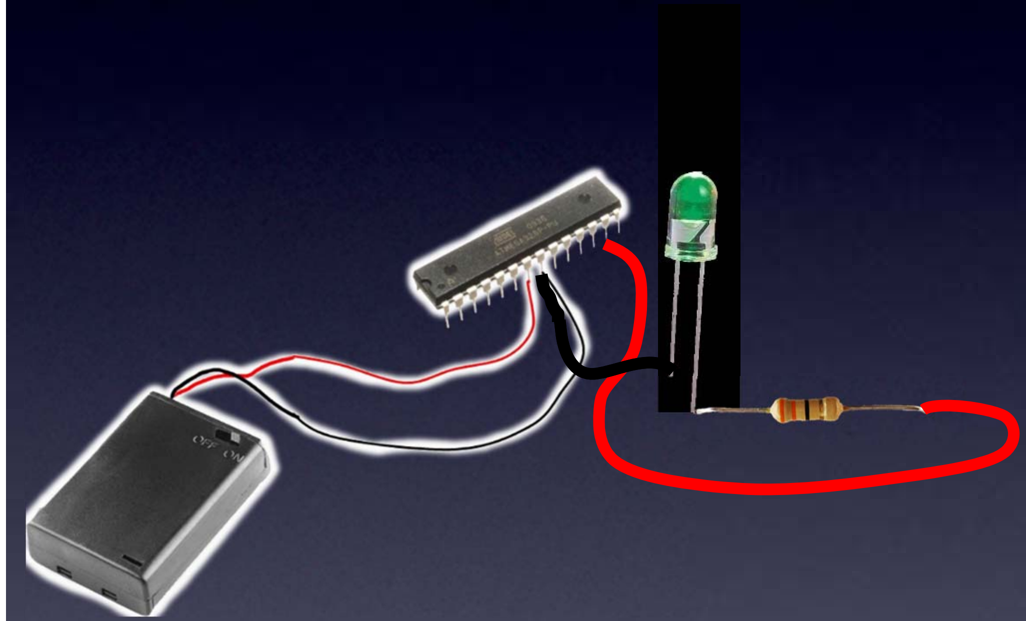
How about our program?

Turning an LED on and off

`Hello World`

Everything You Need to Know About Electronics

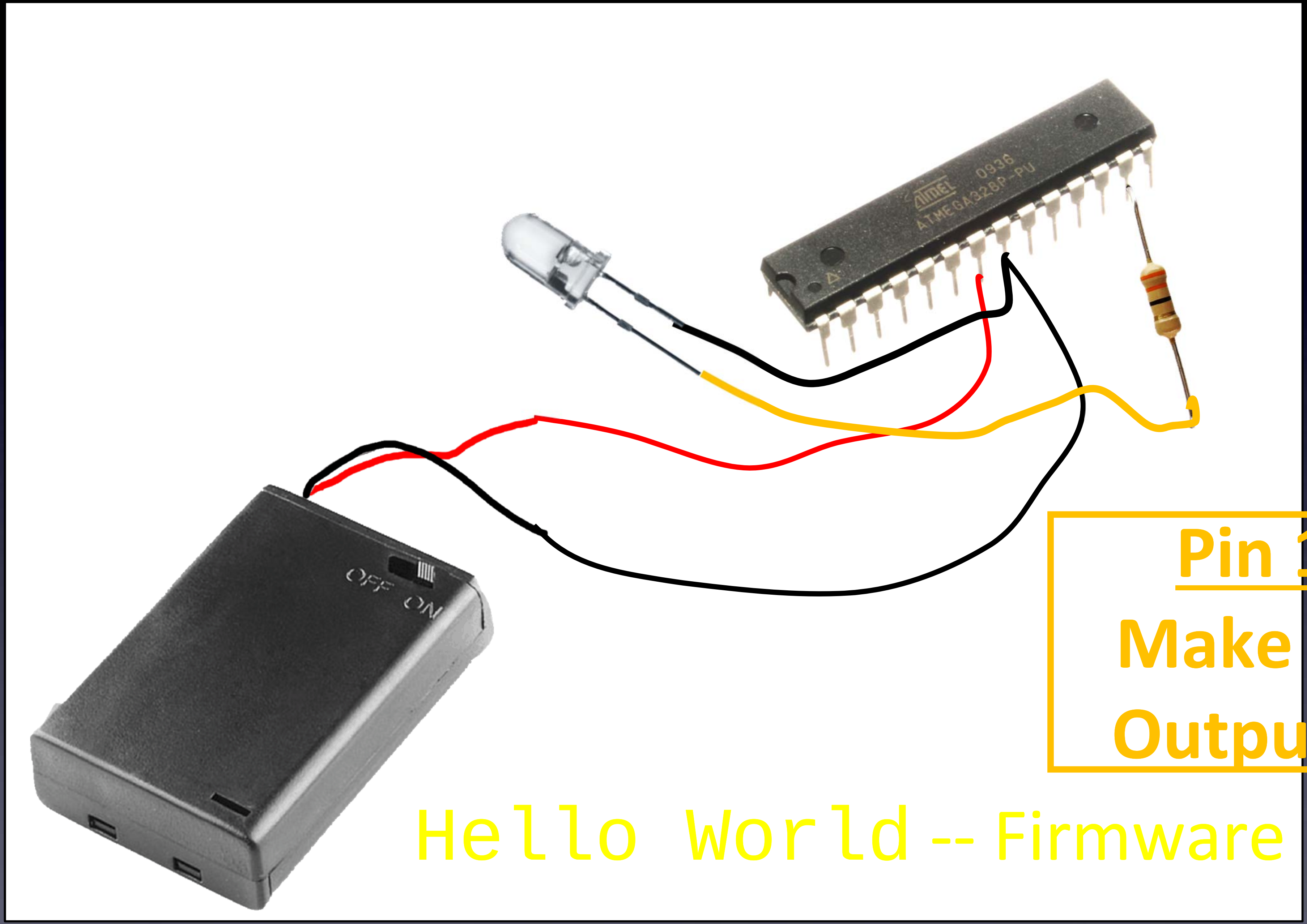
Programs on microcontrollers are called “Firmware”



Turning an LED on and off

`Hello World`

Everything You Need to Know About Electronics

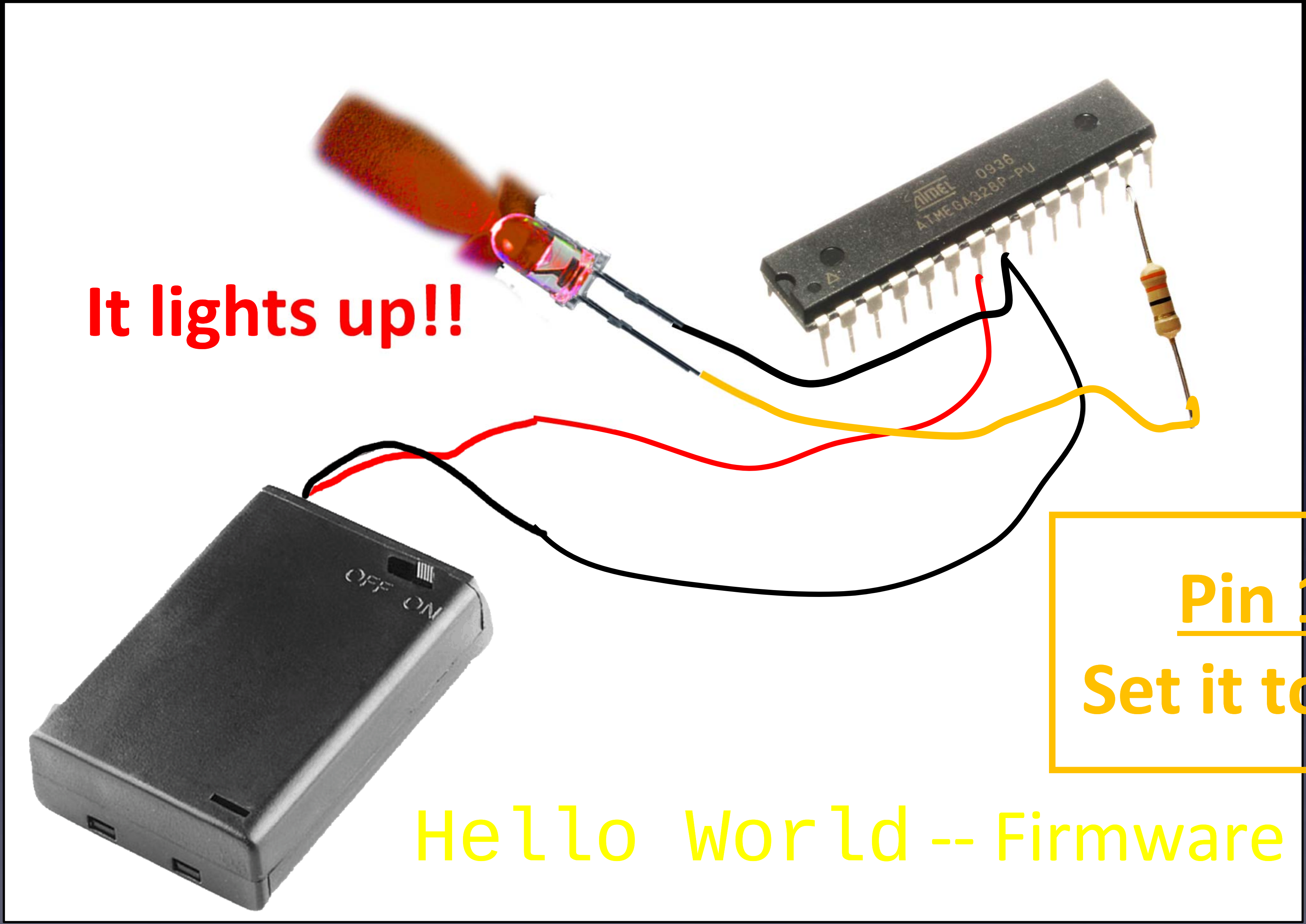


Pin 13: Make it an Output pin

Hello World -- Firmware

Microcontroller

Everything You Need to Know About Electronics



It lights up!!

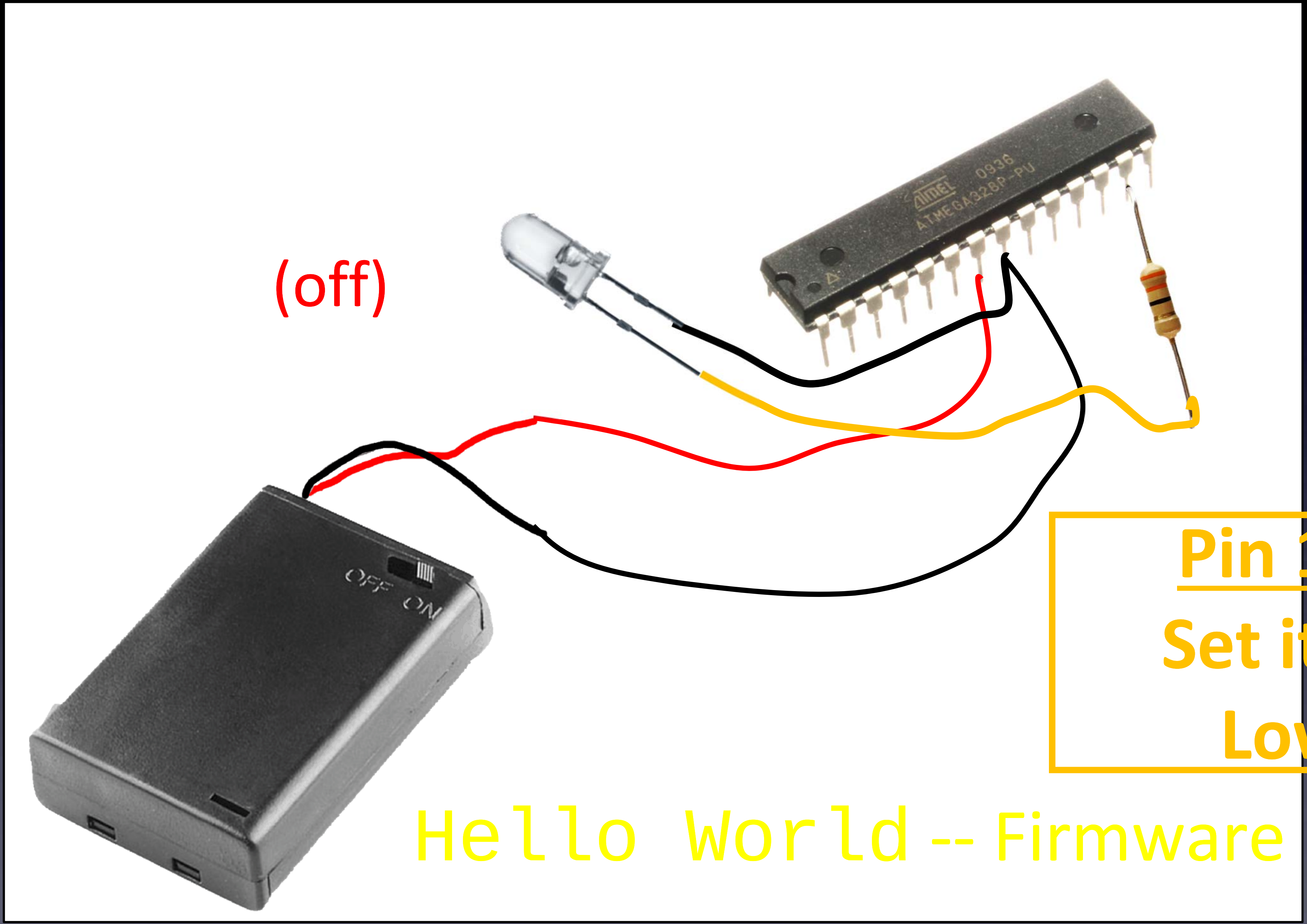
Pin 13:

Set it to High

Hello World -- Firmware

Microcontroller

Everything You Need to Know About Electronics

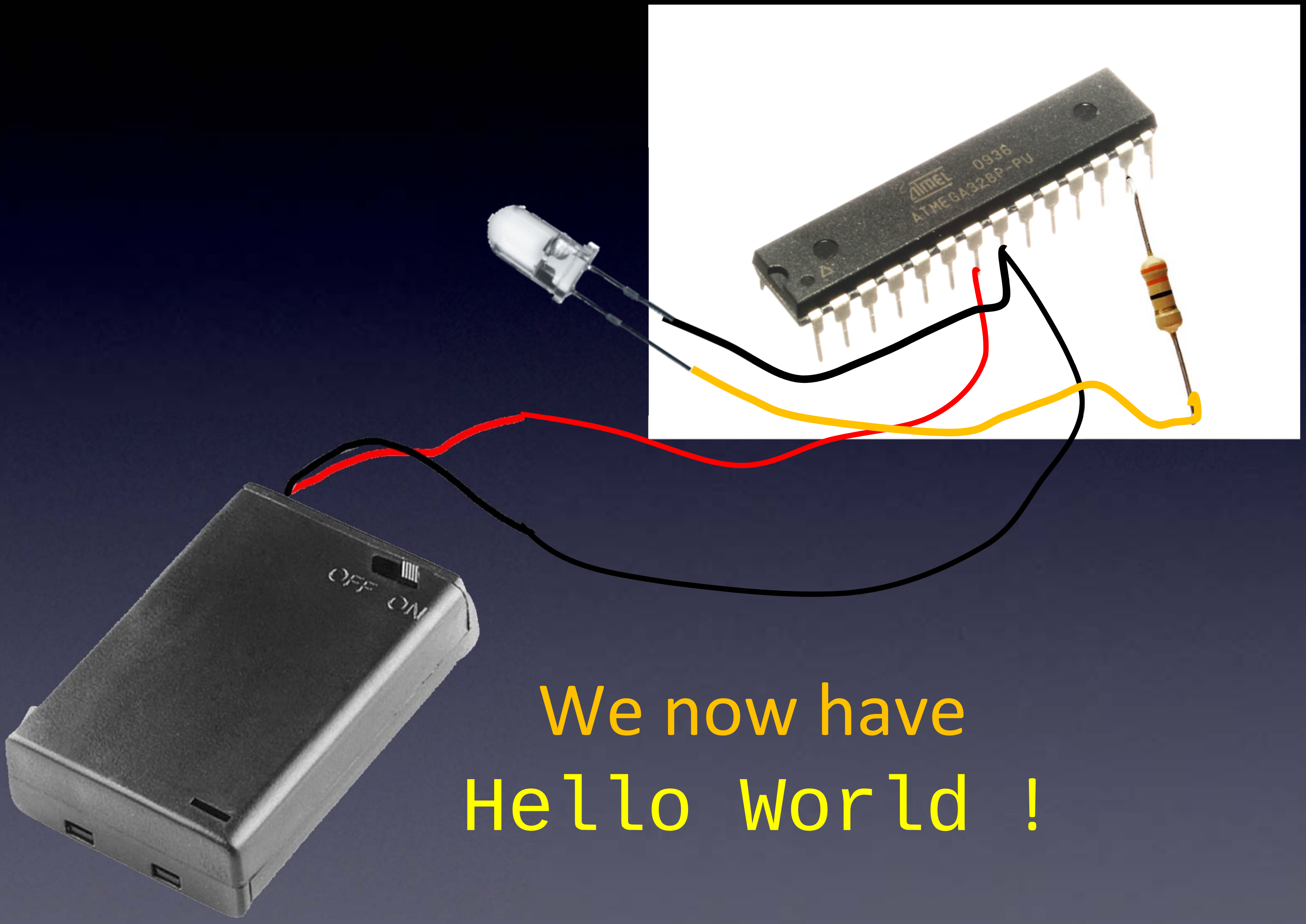


Pin 13:
Set it to Low

Hello World -- Firmware

Microcontroller

Everything You Need to Know About Electronics

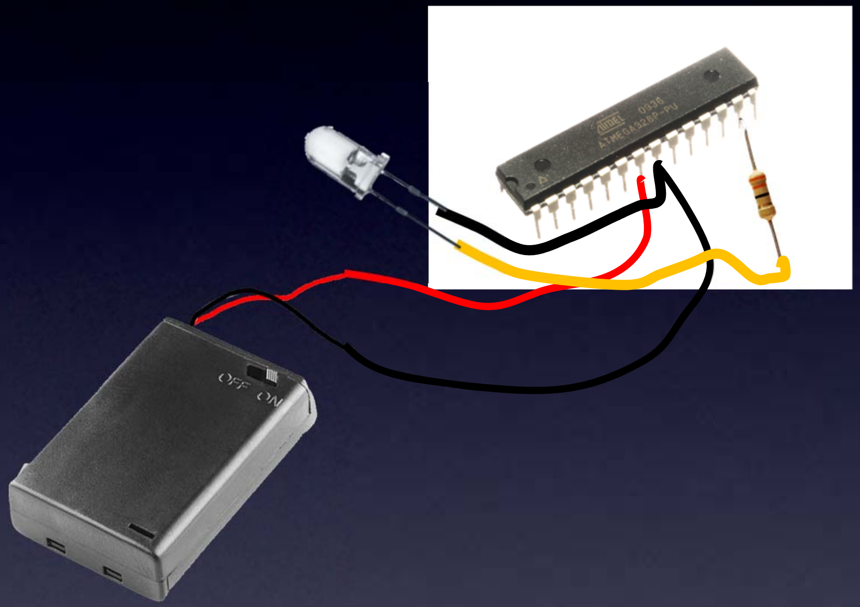


We now have

`Hello World !`

Microcontroller

Everything You Need to Know About Electronics



We now have

Hello World !

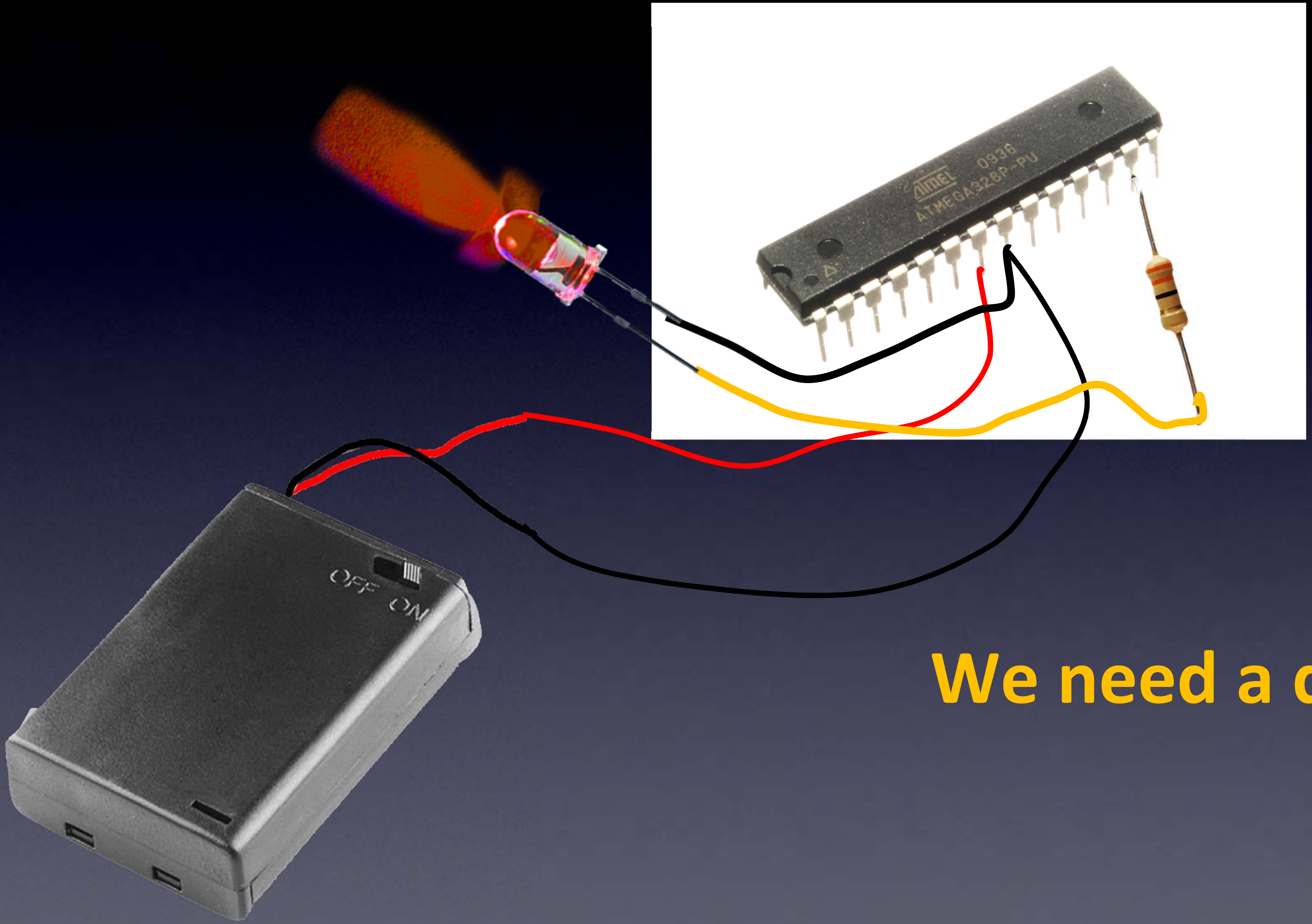
Except

We won’t see it

☹

Microcontroller

Everything You Need to Know About Electronics

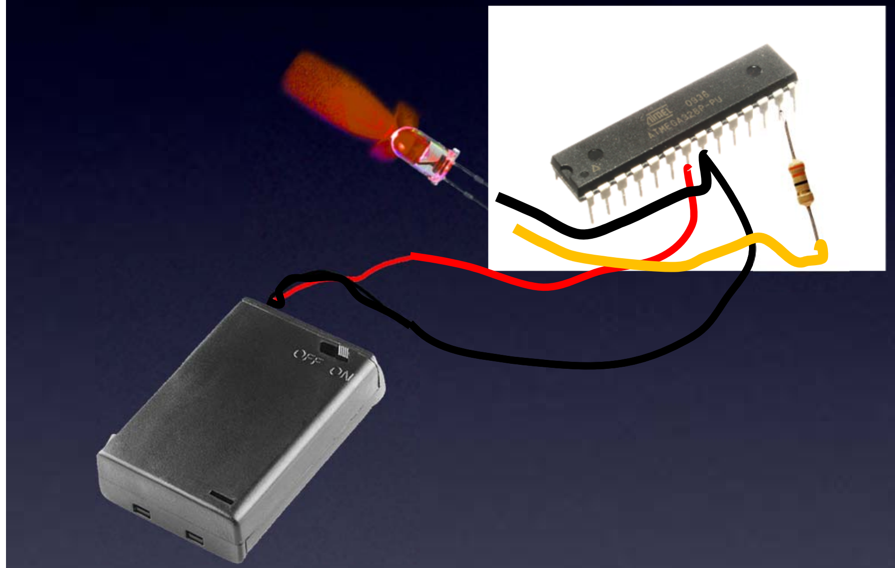


We need a delay

Microcontrollers – they go really fast!

Everything You Need to Know About Electronics

Hardware



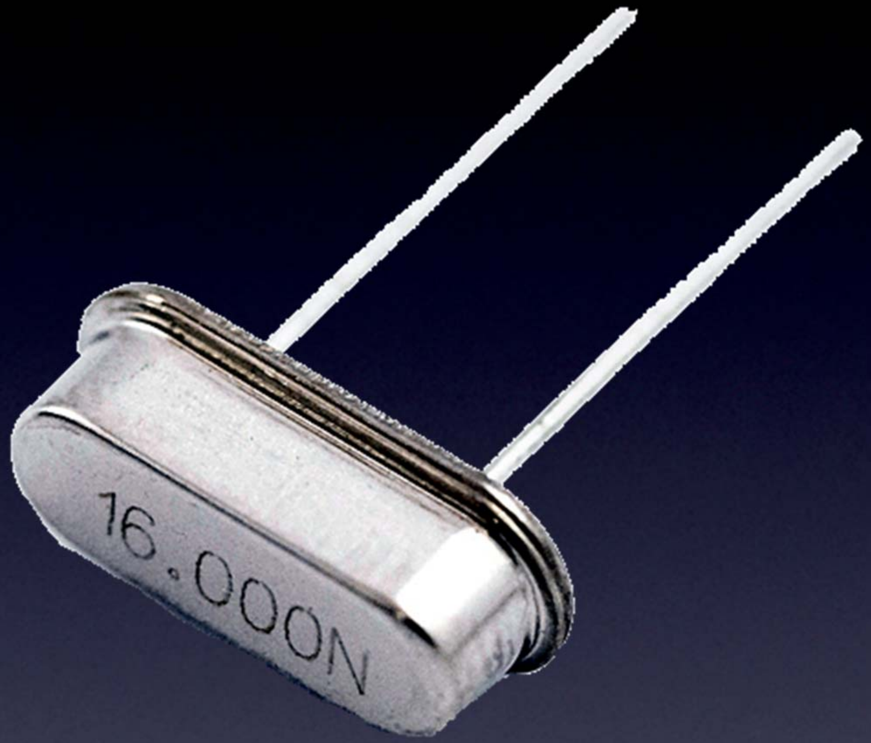
Firmware

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

`Hello World` – for real now!

Microcontroller – Firmware

Everything You Need to Know About Electronics

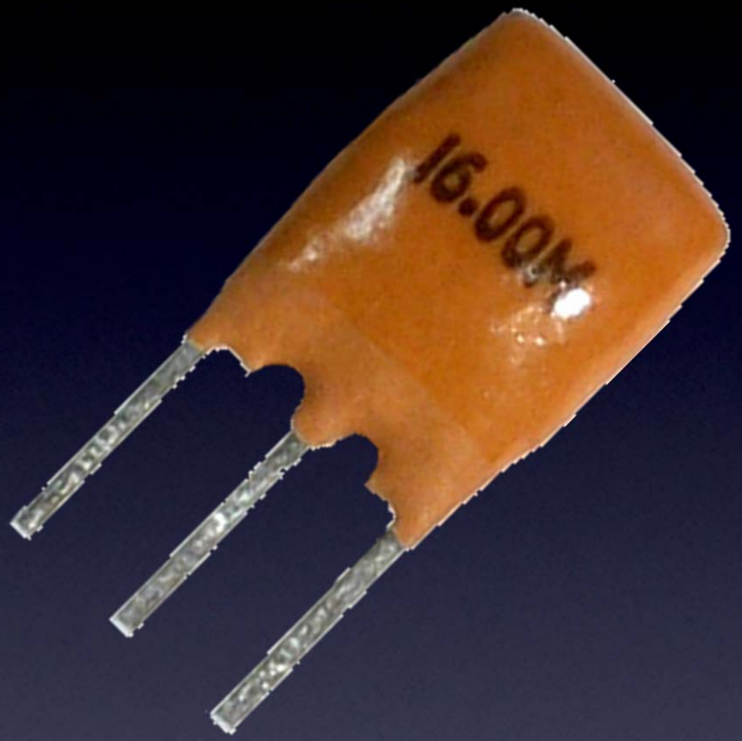


A precision cut piece of quartz crystal

For precise timing

Crystal

Everything You Need to Know About Electronics

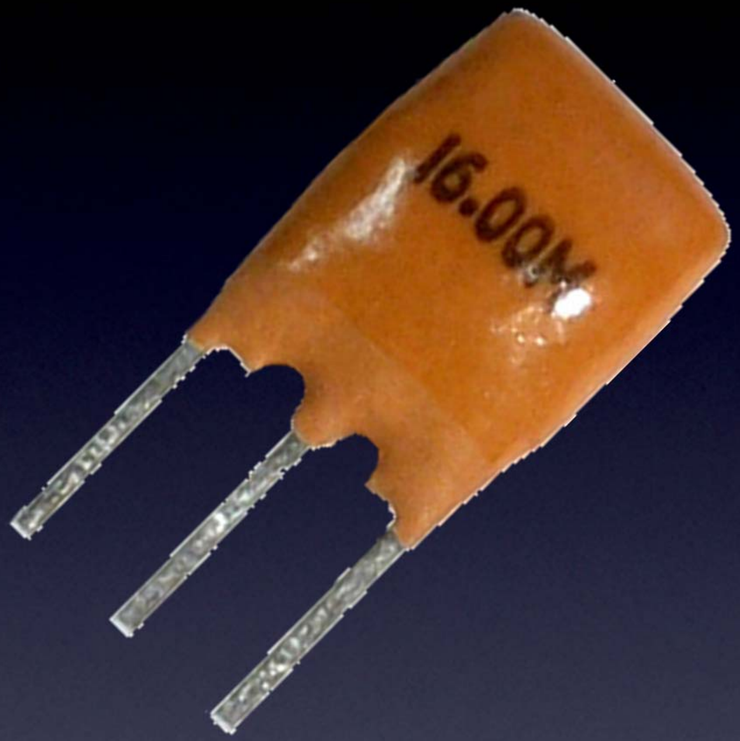


A bunch of resistors and capacitors

For precise timing (but less than a crystal)

Ceramic Resonator

Everything You Need to Know About Electronics



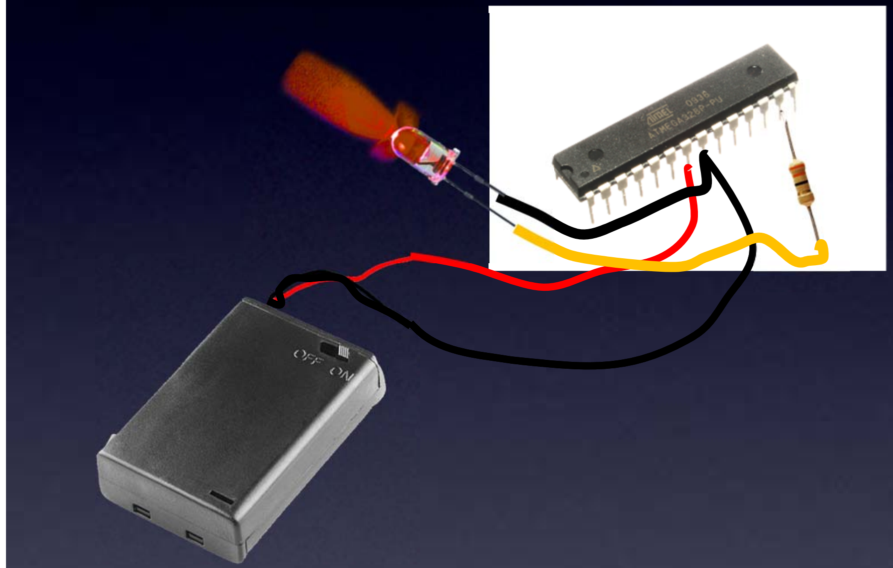
Frequency, measured in **Hertz**

For precise timing (but less than a crystal)

Ceramic Resonator / **Hertz**

Everything You Need to Know About Electronics

Hardware



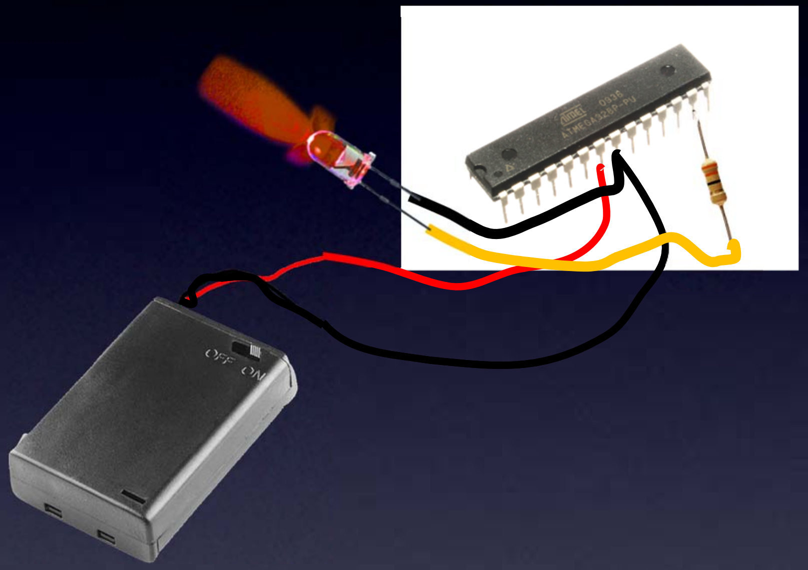
Firmware

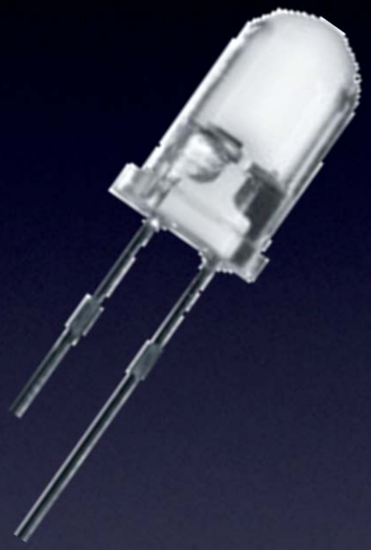
- pin 13 is Output pin
- set pin 13 High
- delay
- set pin 13 Low

Let's hack `Hello World!`

Microcontroller

Everything You Need to Know About Electronics



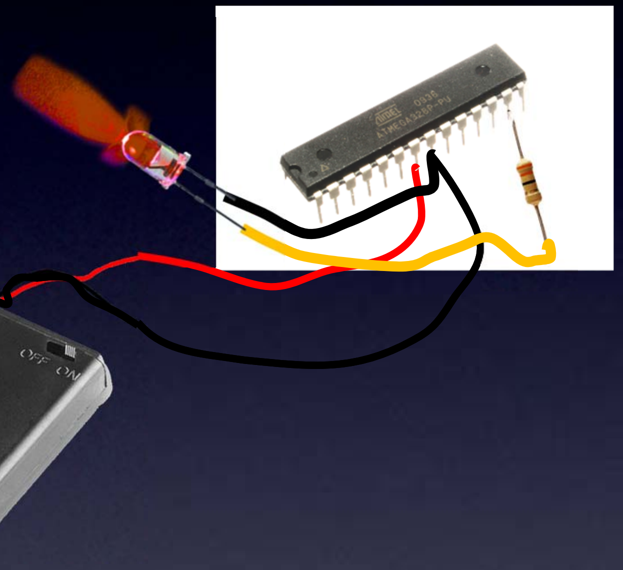


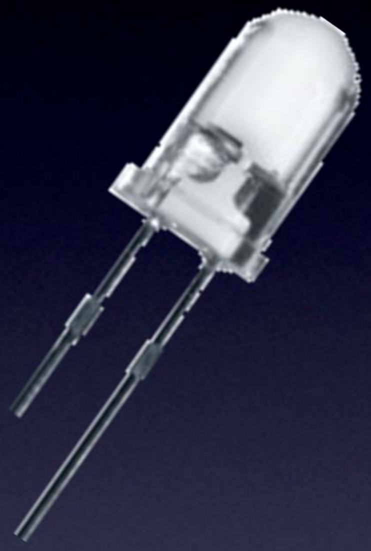
Add an IR LED to another pin

IR “OFF” codes

Microcontroller

Everything You Need to Know About Electronics



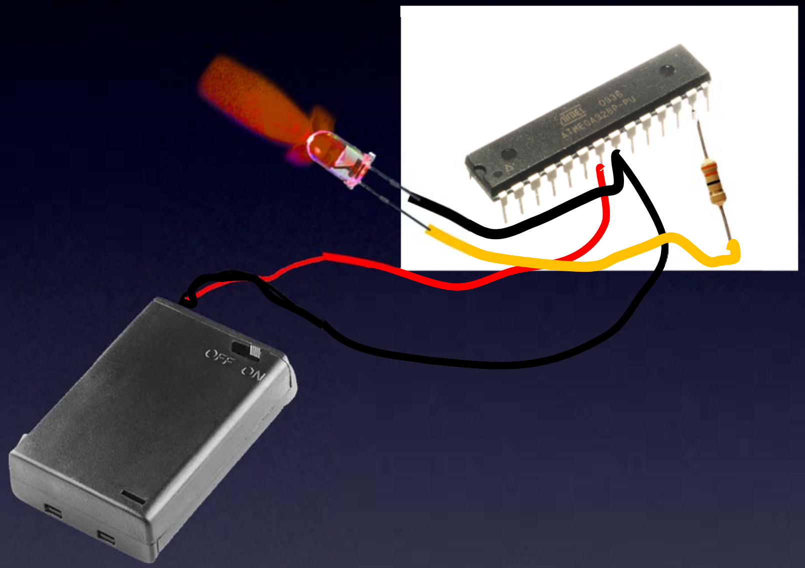


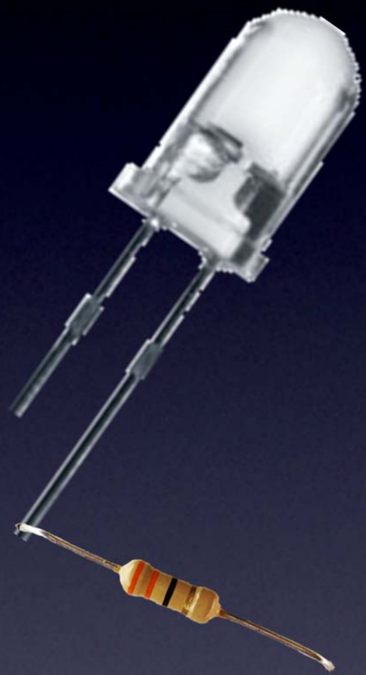
Add an IR LED to another pin (say, pin3)

IR “OFF” codes

Microcontroller

Everything You Need to Know About Electronics





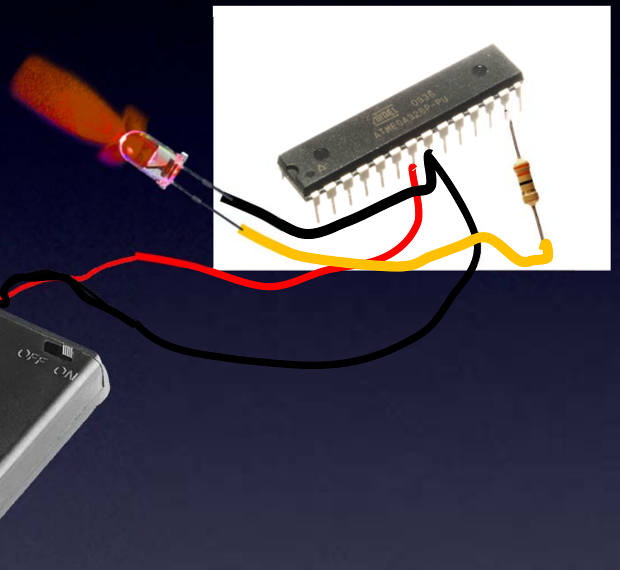
Add an IR LED to another pin (say, pin3)

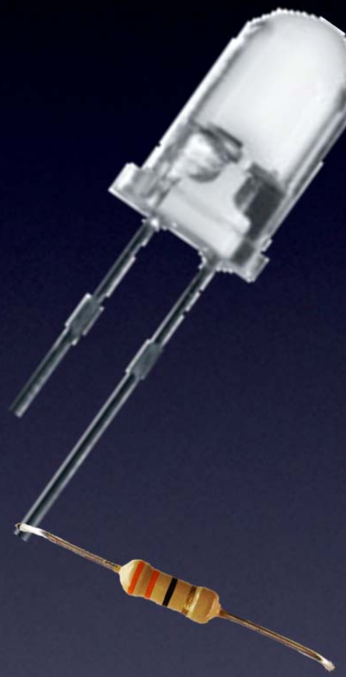
and a resistor so no magic smoke goes away

IR “OFF” codes

Microcontroller

Everything You Need to Know About Electronics



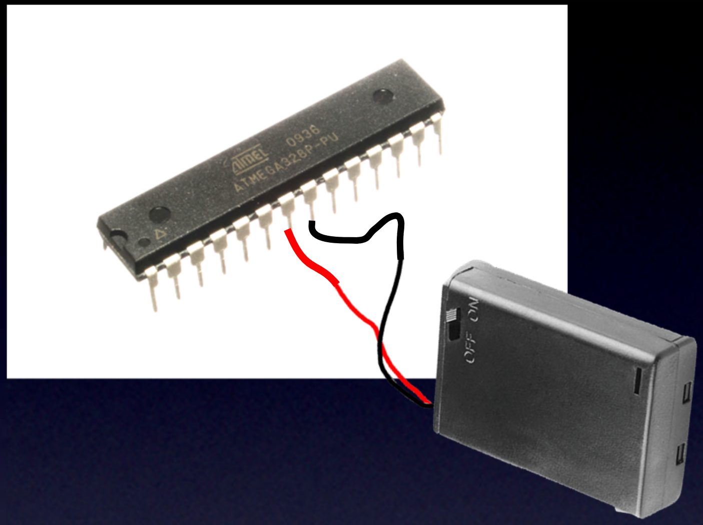


But, *When*?

IR “OFF” codes

Microcontroller

Everything You Need to Know About Electronics



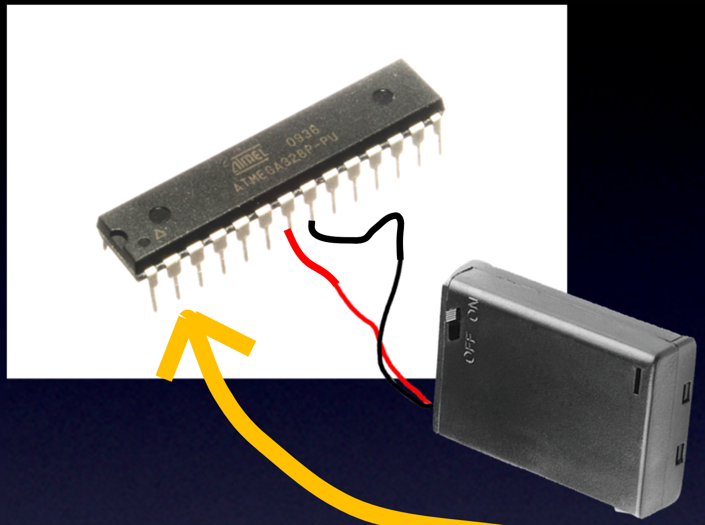
Let’s add an Input pin!

and

We can add a Start button

Microcontroller

Everything You Need to Know About Electronics



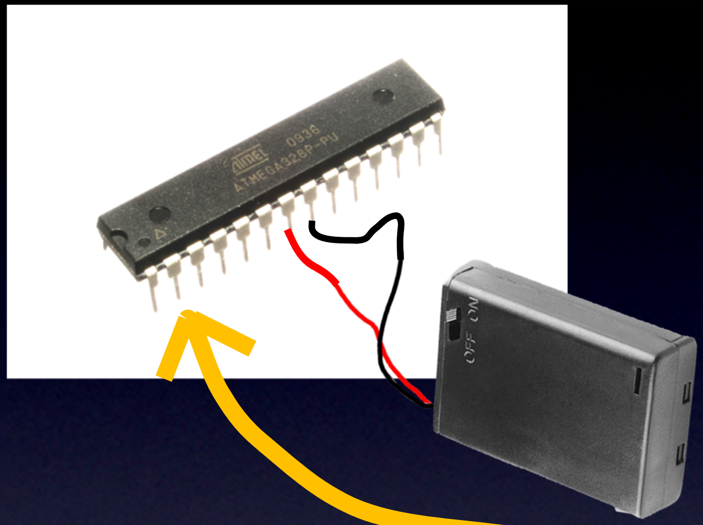
How do we make a pin an Input pin?

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

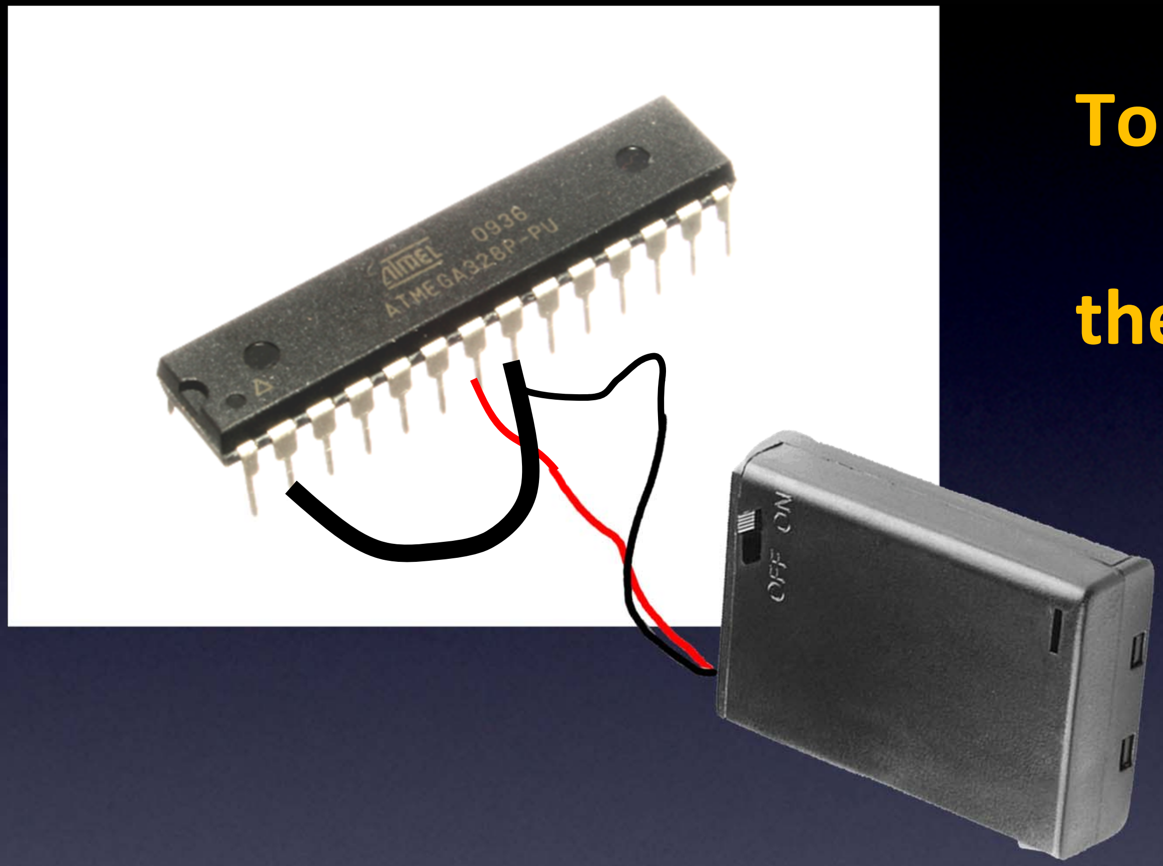


Once we have an **Input pin** (like, pin 2):

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

Microcontroller – Input pins

Everything You Need to Know About Electronics

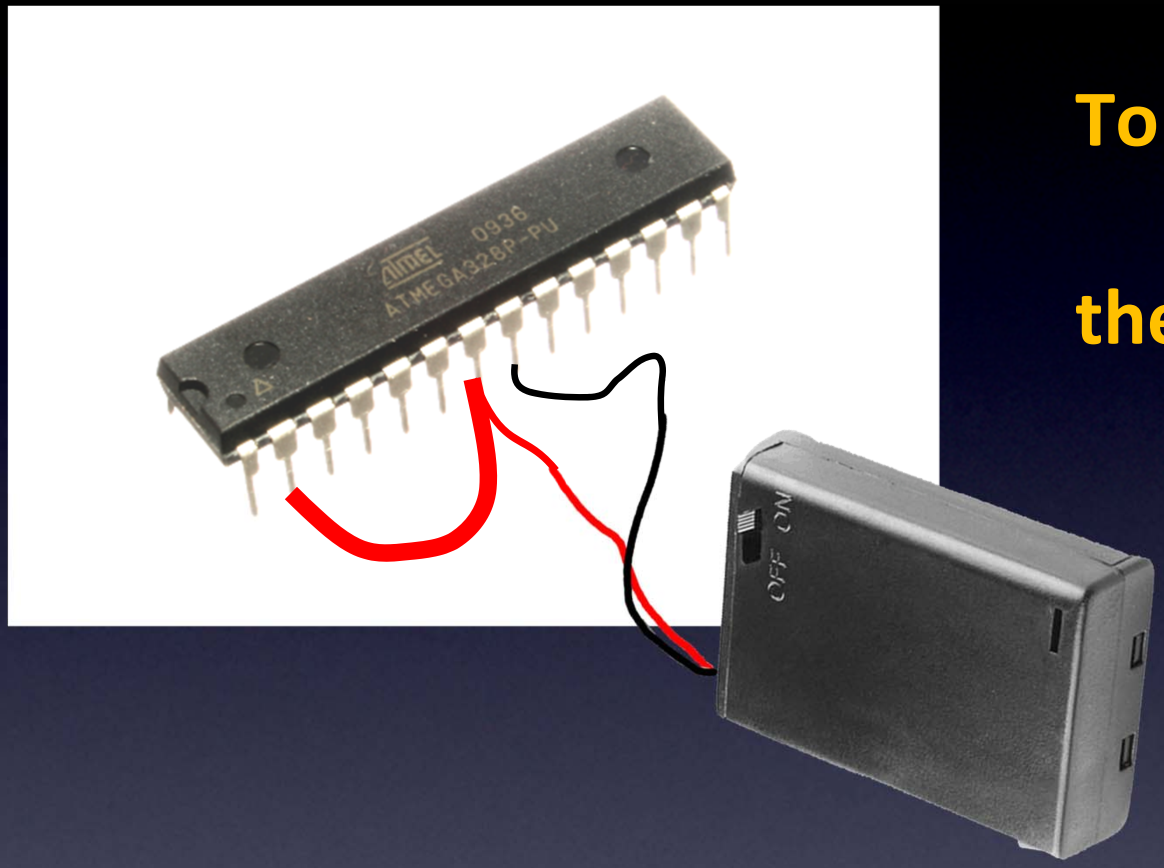


To make the Input pin **Low**, connect it to the Black wire of our power supply **(Ground)**.

Low

Microcontroller – Input pins

Everything You Need to Know About Electronics

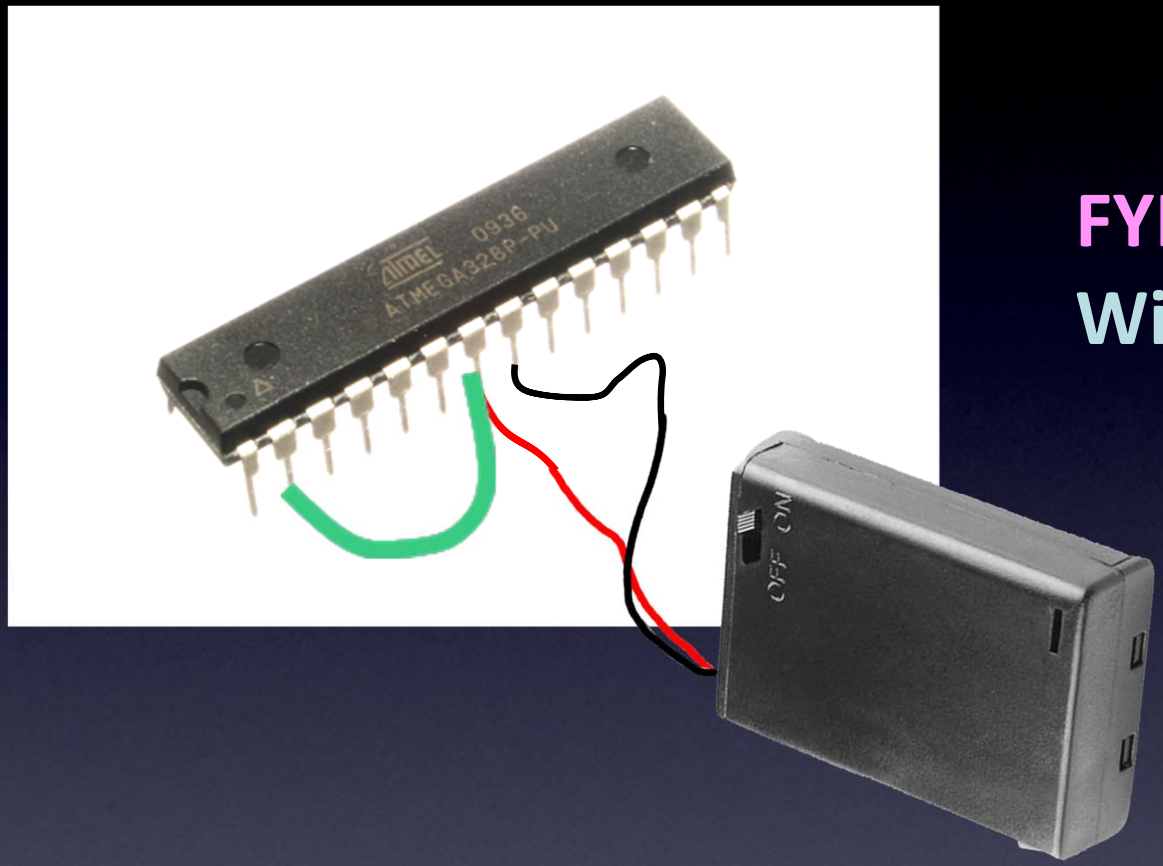


To make the Input pin High, connect it to the Red wire of our power supply (Vcc).

High

Microcontroller – Input pins

Everything You Need to Know About Electronics



FYI:

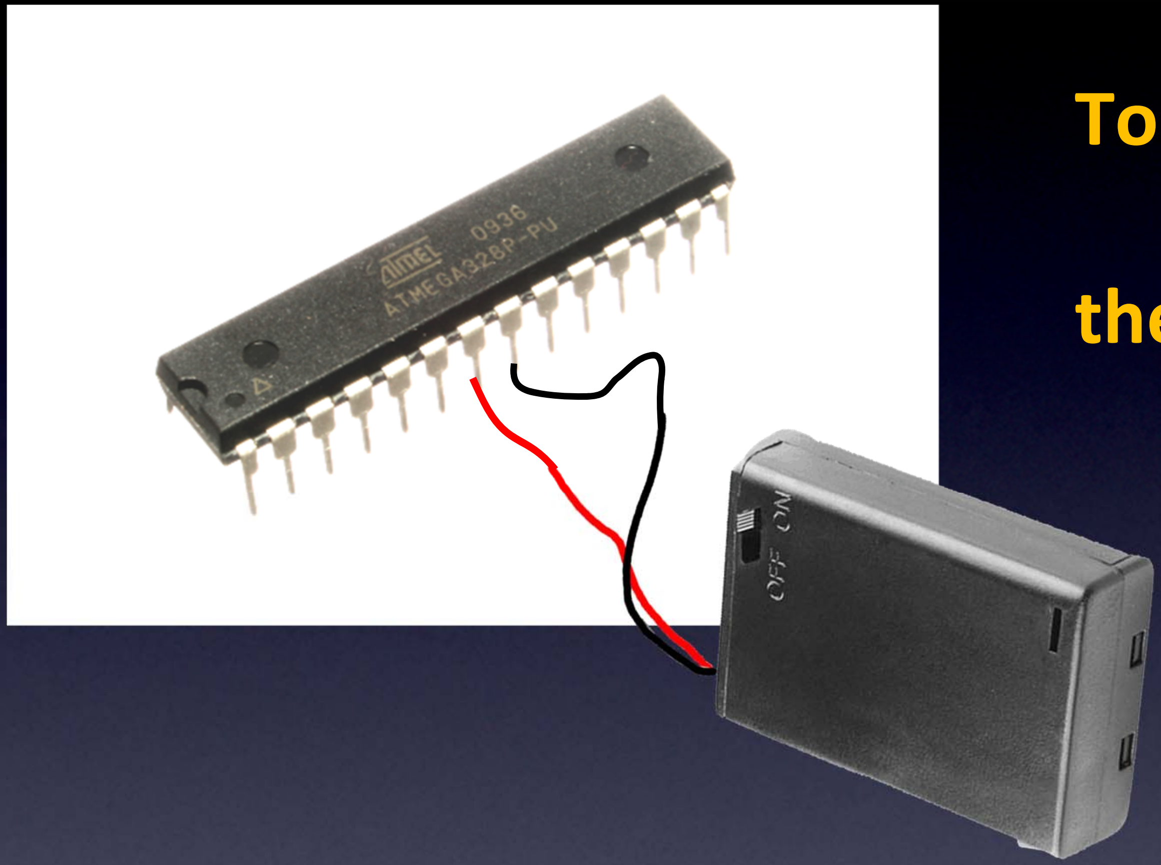
Wire color does not matter !

(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:

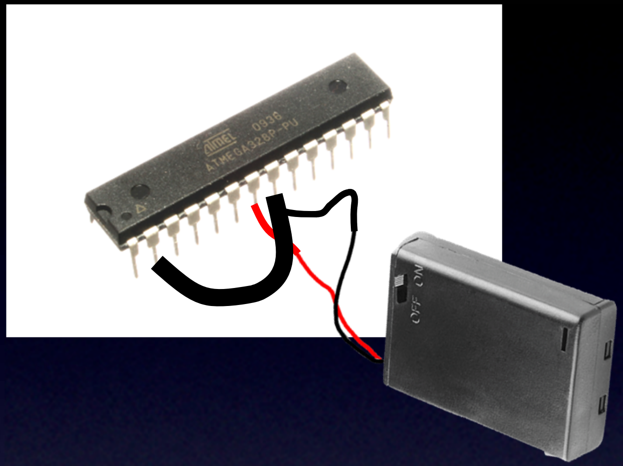
just leave it blank

(built-in resistors on each pin)

High

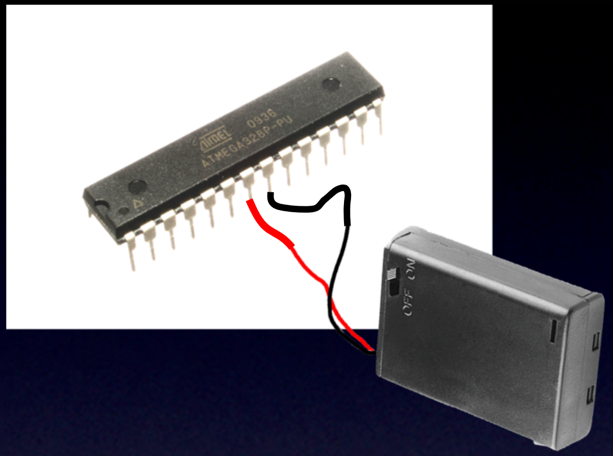
Microcontroller – Input pins

Everything You Need to Know About Electronics



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

Low



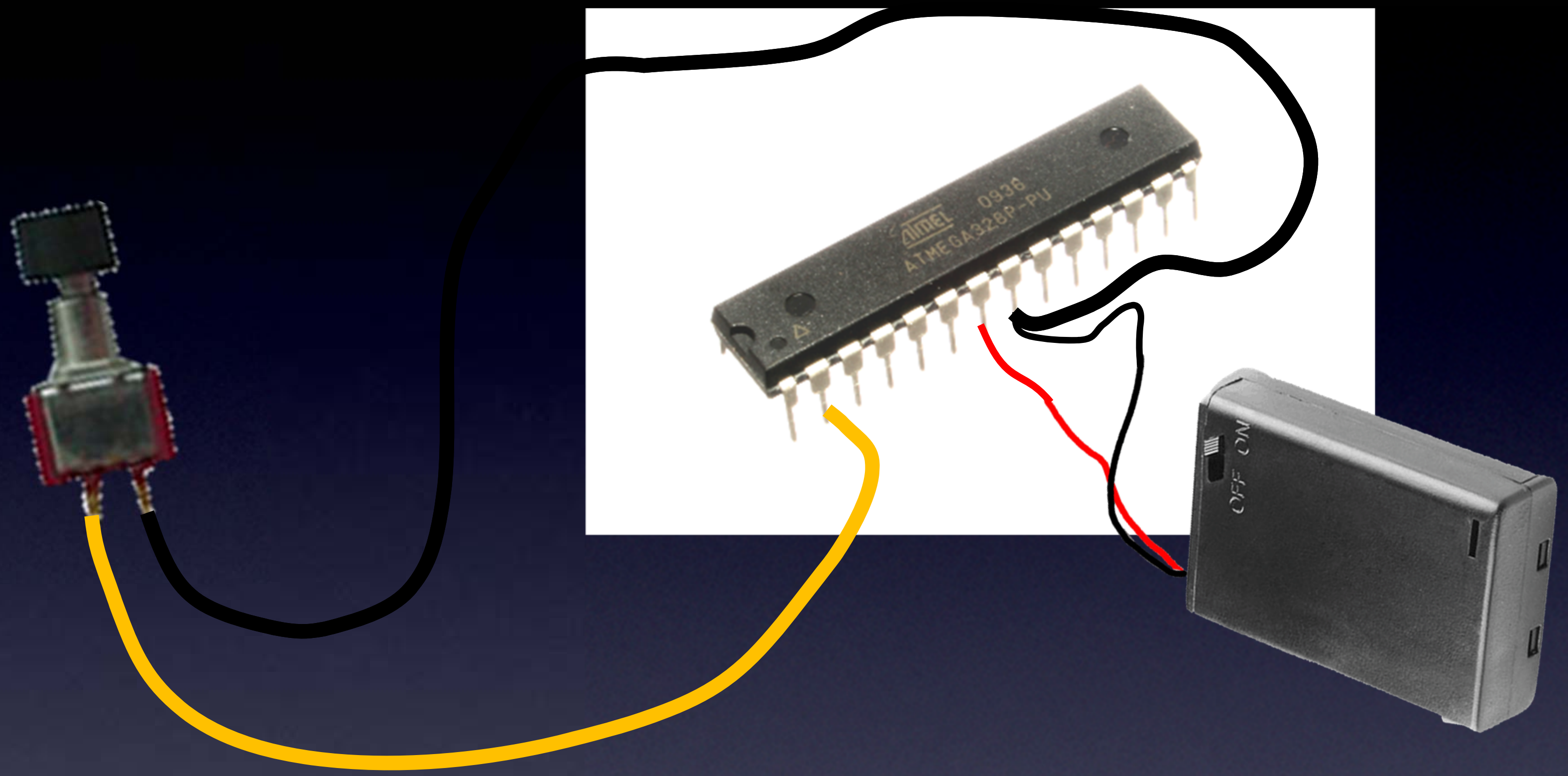
If firmware looks at
Pin 2 when it's like this,
it reports back:

High

Reading the Input pin

Microcontroller – Input pins

Everything You Need to Know About Electronics



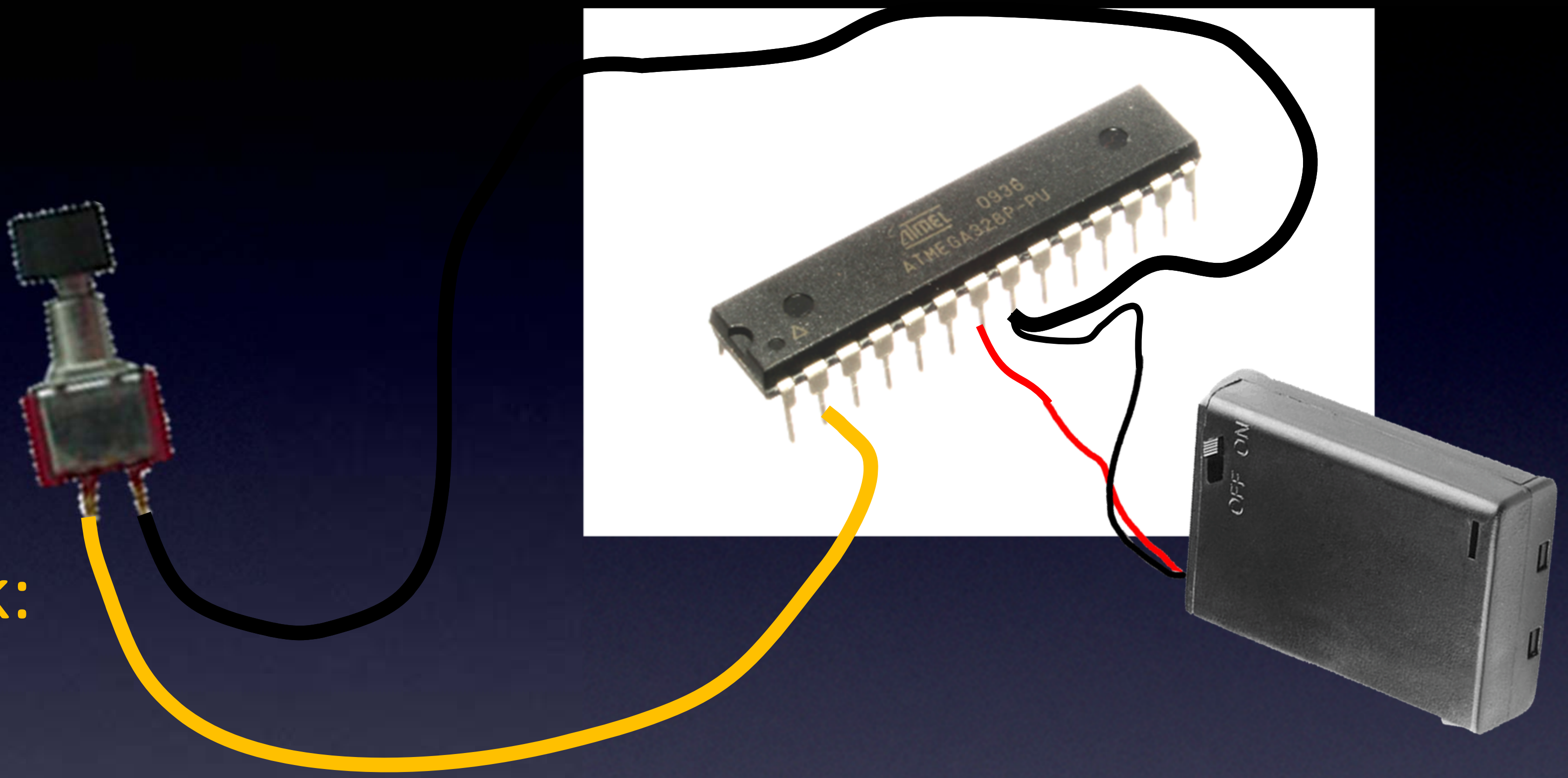
Reading the Input pin, with Switch

Microcontroller – Input pins

If firmware
looks at Pin 2
when switch
NOT pushed,

it reports back:

Low



Reading the Input pin, with Switch

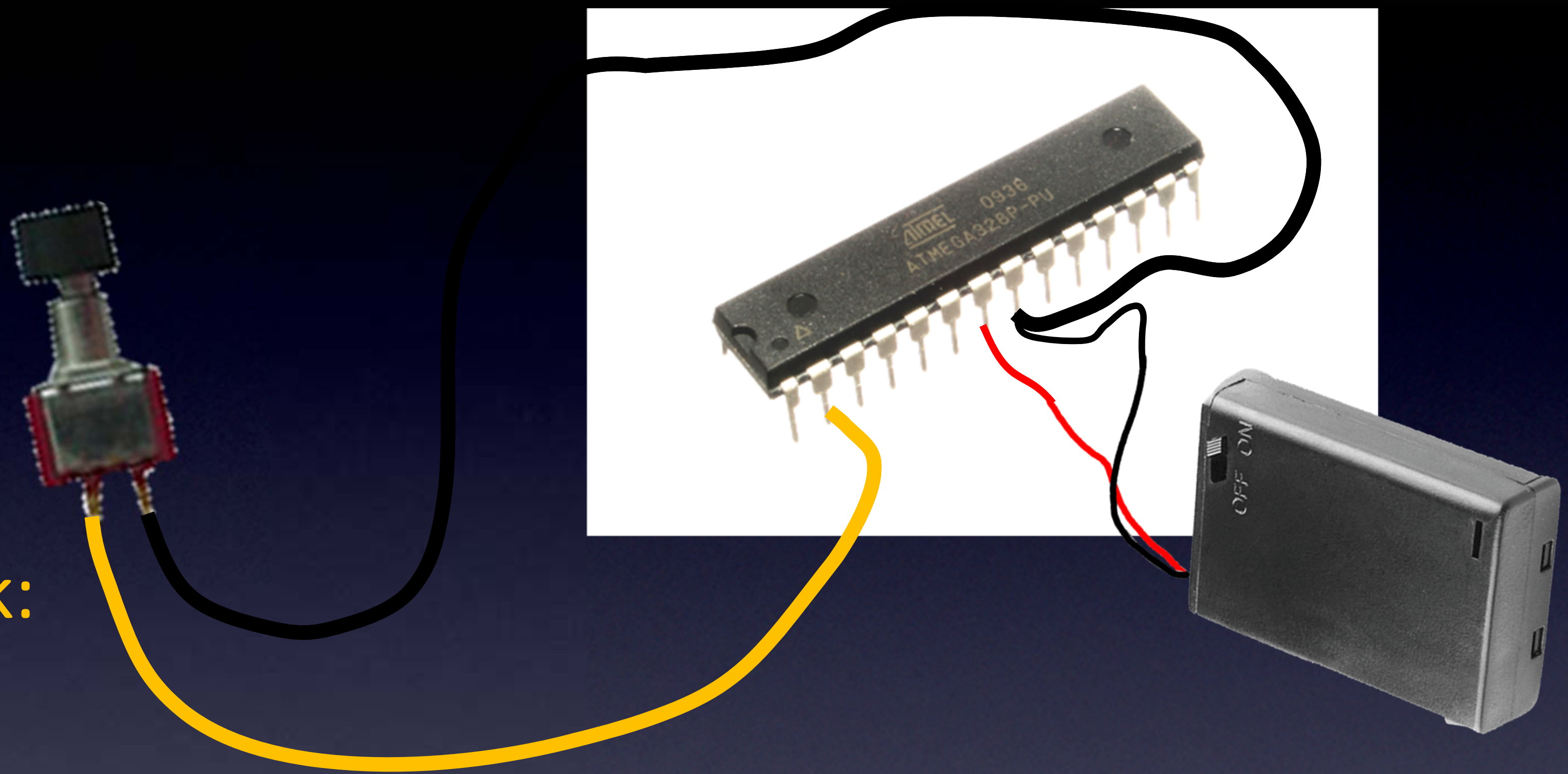
Microcontroller – Input pins

Everything You Need to Know About Electronics

If firmware looks at Pin 2 when switch pushed,

it reports back:

High

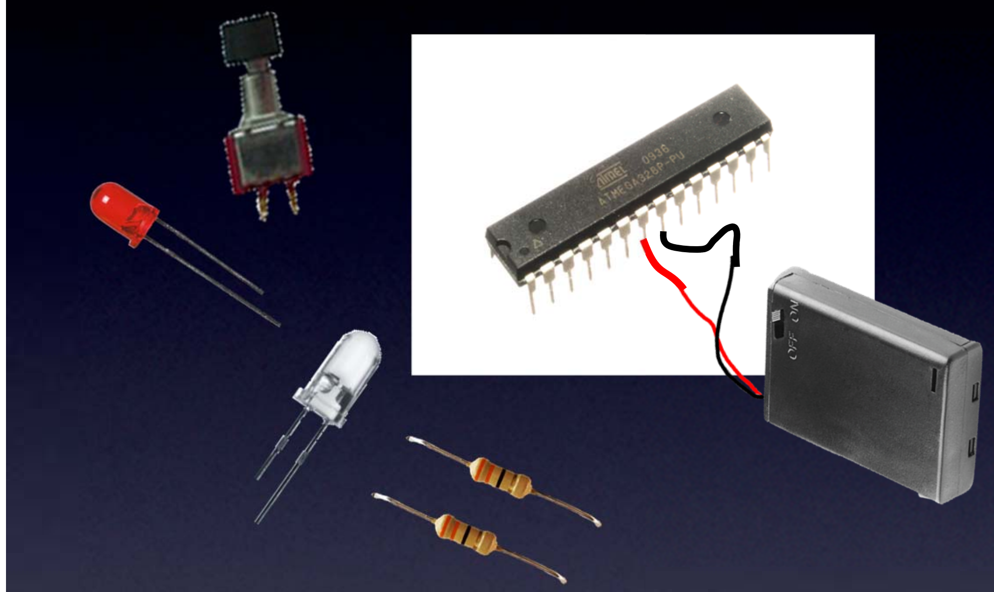


Reading the Input pin, with Switch

Microcontroller – Input pins

Everything You Need to Know About Electronics

Hardware



Firmware

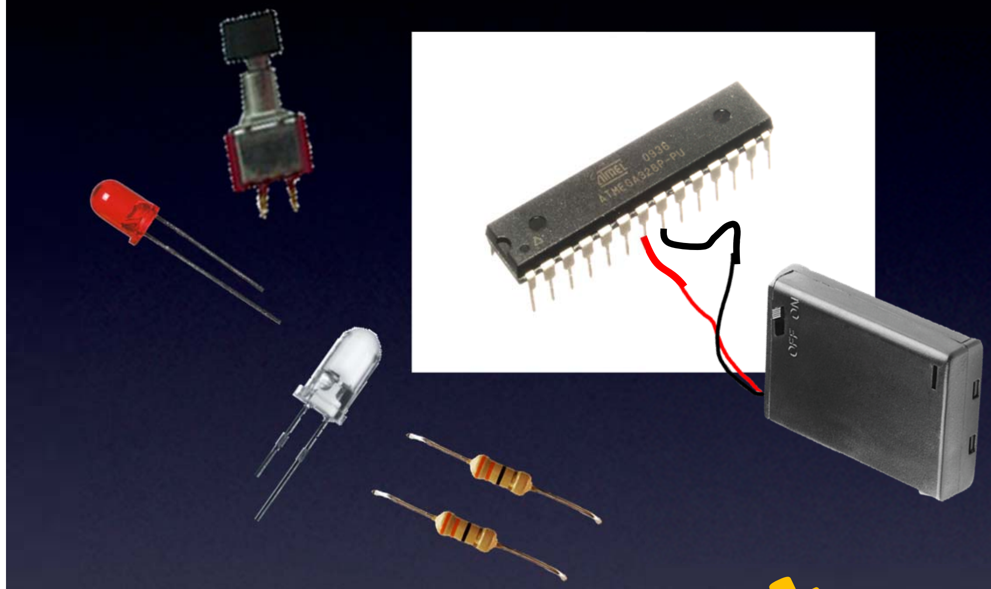
```
Pin 13 Output – visible LED pin
Pin 3 Output – IR LED pin
Pin 2 Input – Push Button

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

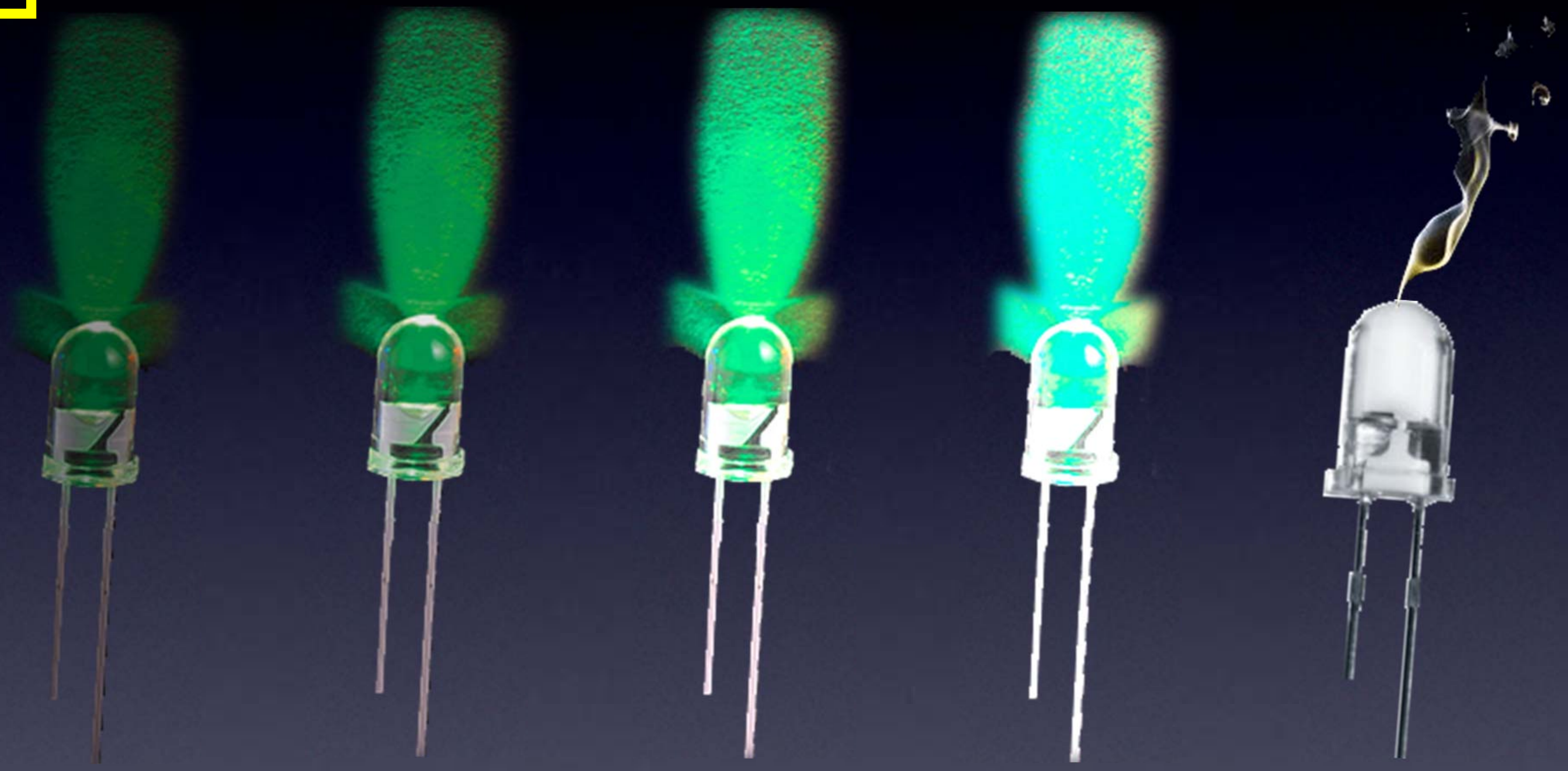
```
Pin 13 Output – visible LED pin
Pin 3 Output – IR LED pin
Pin 2 Input – Push Button

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	**High**
Off	**On**
(0V)	(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

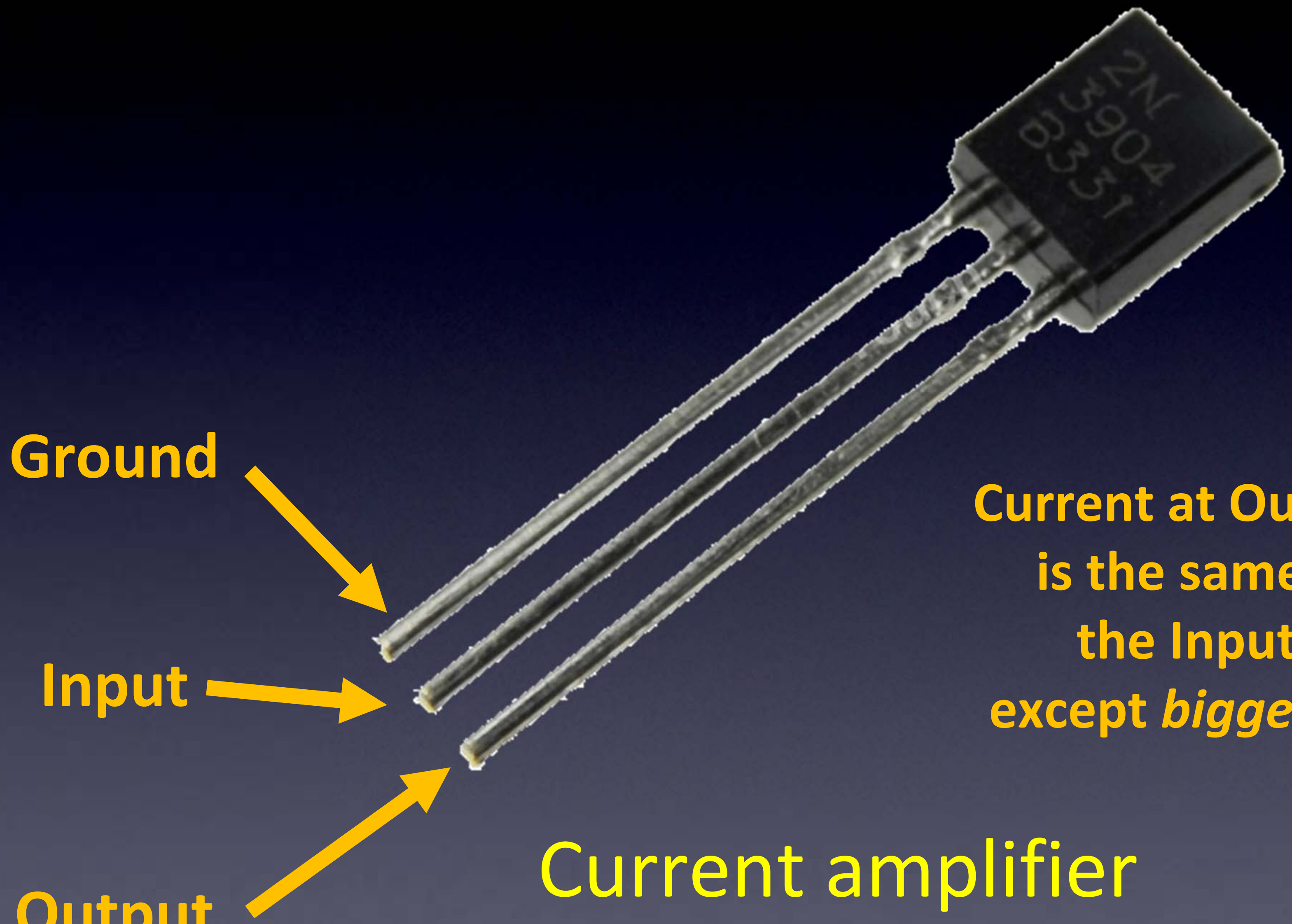
from the Output pin

with

a

Current amplifier !

Everything You Need to Know About Electronics



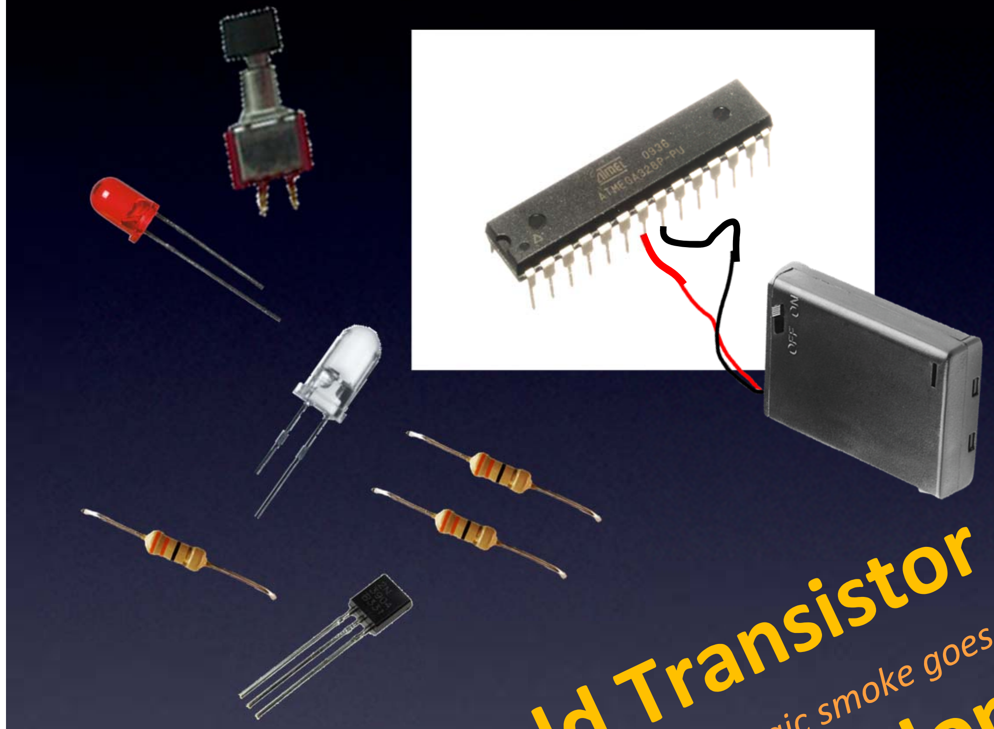
Current at Output lead
is the same as for
the Input lead
except *bigger current*

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

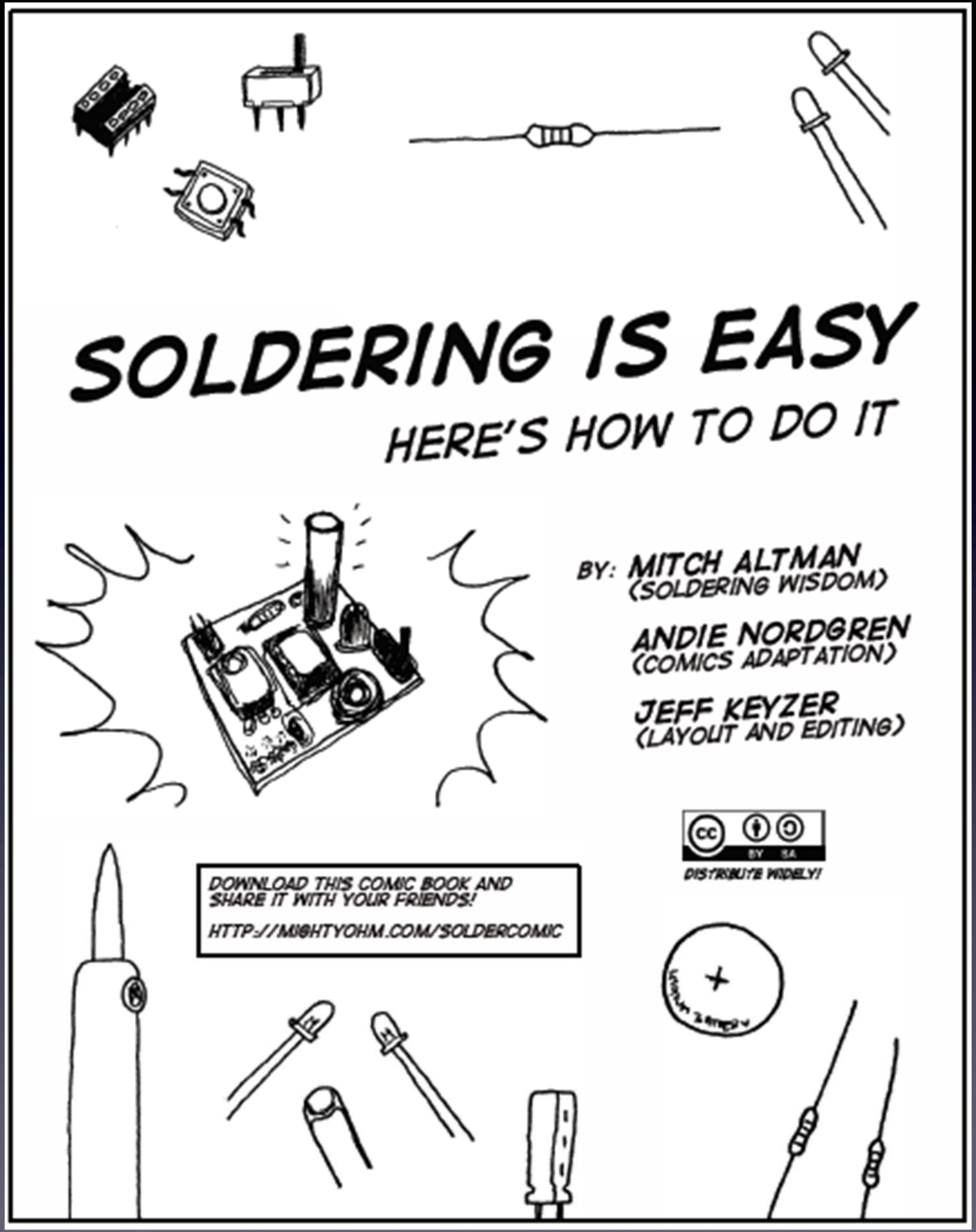
And, that is

Everything You Need to Know About

Electronics

Questions?

Learn To Solder



SOLDERING IS EASY

HERE'S HOW TO DO IT

BY: MITCH ALTMAN
(SOLDERING WISDOM)

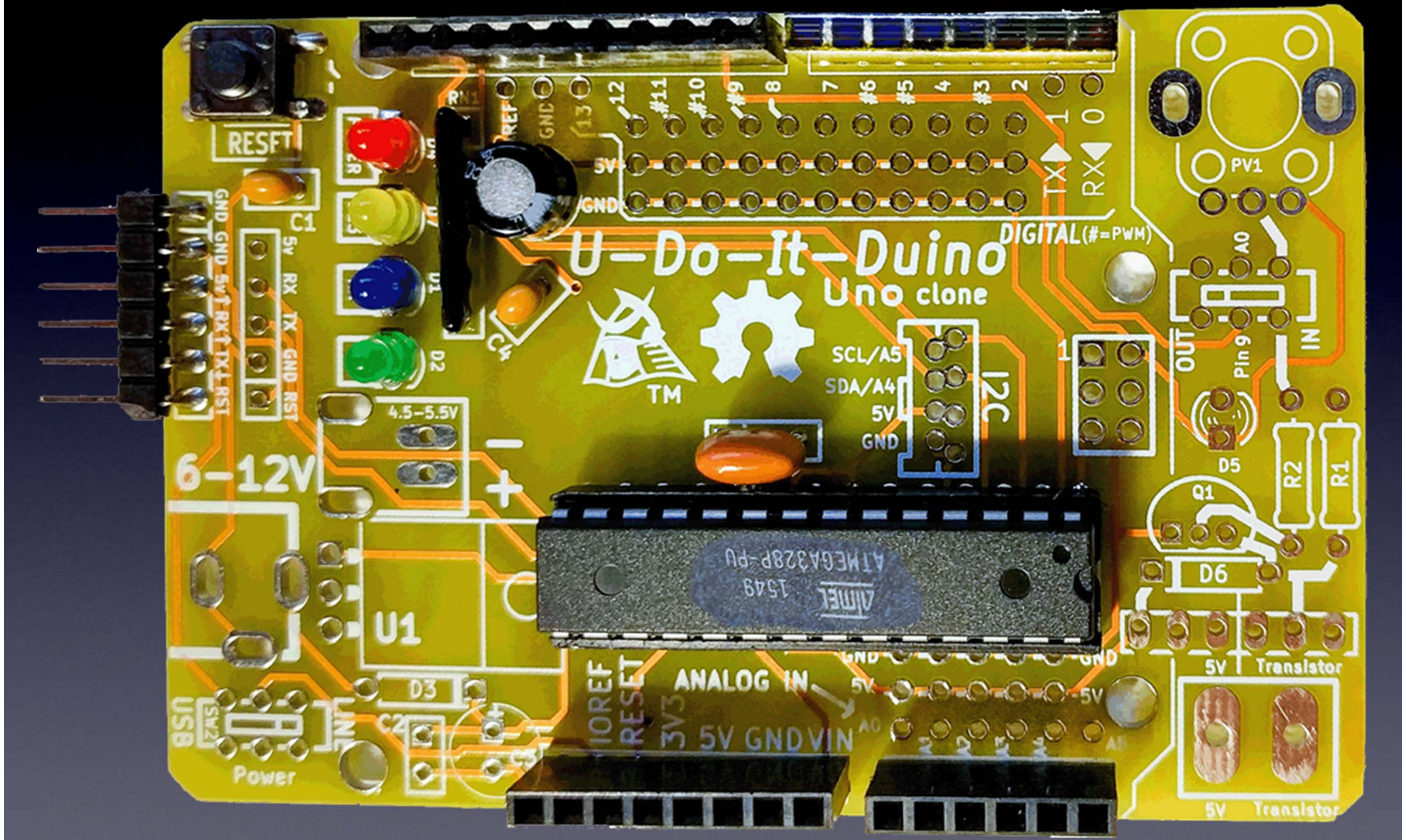
ANDIE NORDGREN
(COMICS ADAPTATION)

JEFF KEYZER
(LAYOUT AND EDITING)

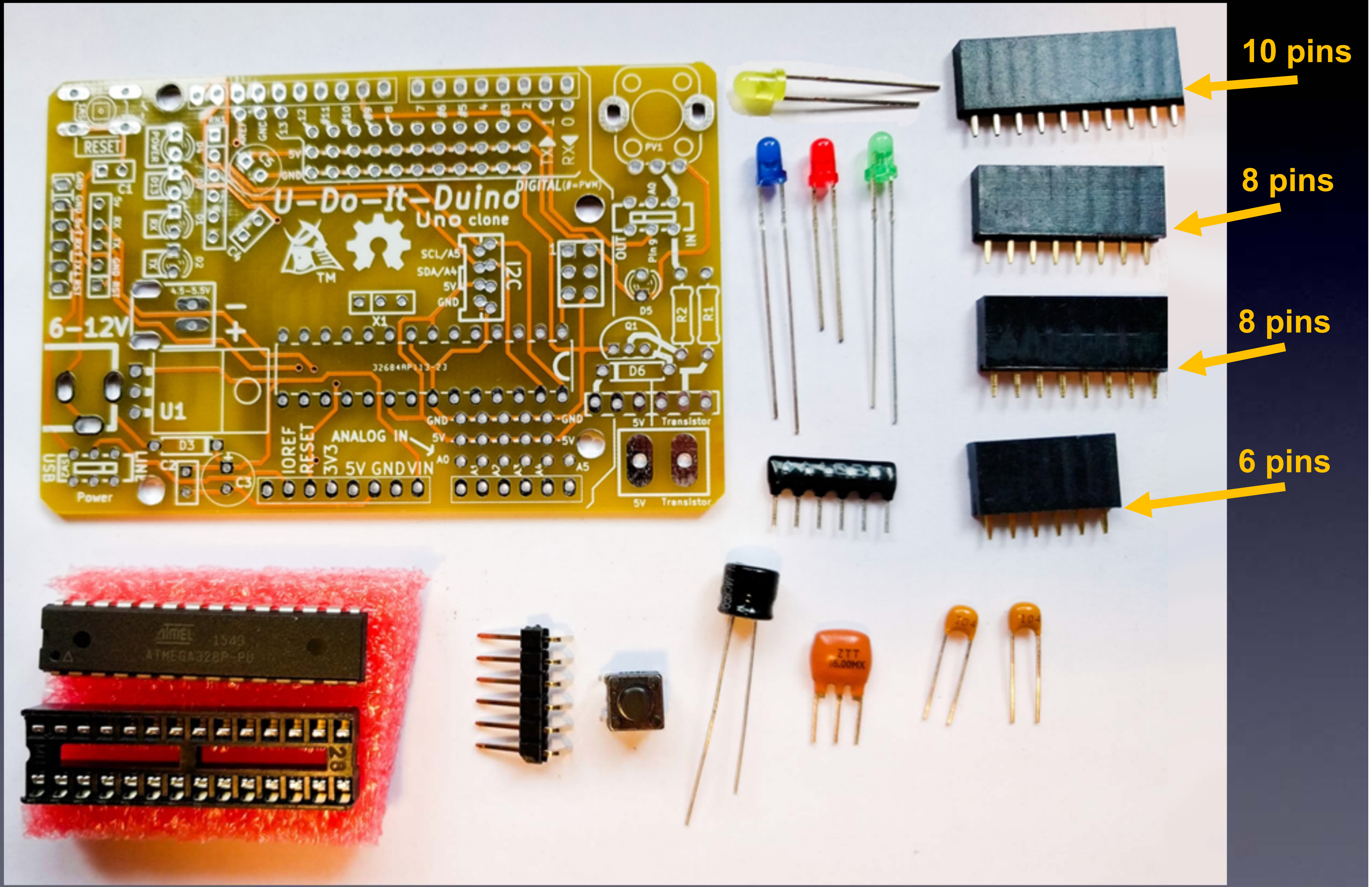
DOWNLOAD THIS COMIC BOOK AND SHARE IT WITH YOUR FRIENDS!

HTTP://MIGHTYOHM.COM/SOLDERCOMIC

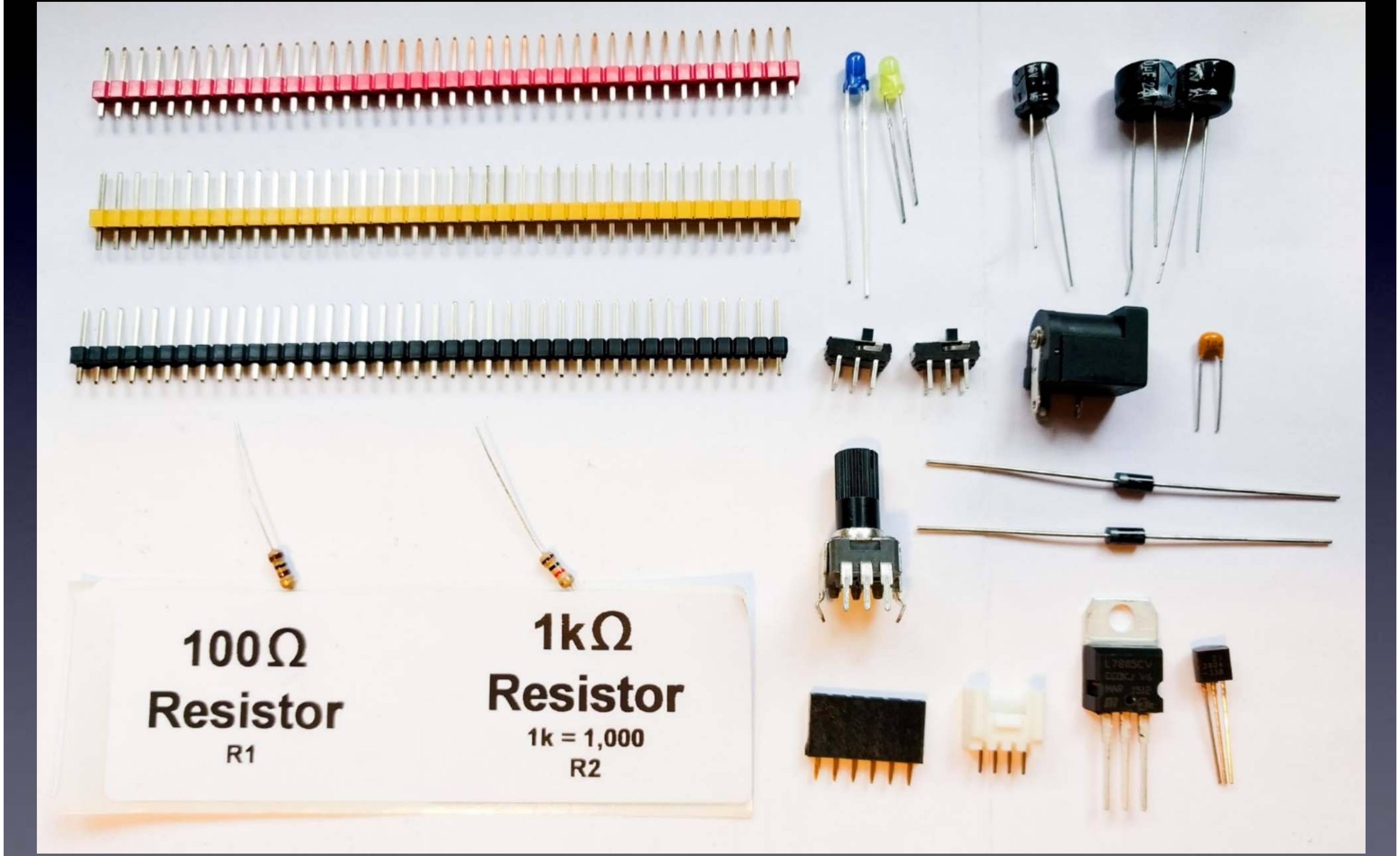
download for free at:
http://mightyohm.com/soldercomic


U-Do-It-Duino
Uno clone
RESET
DIGITAL (#=PWM)
ANALOG IN
6-12V
4.5-5.5V
U1
D3
D2
D5
D6
Q1
R1
R2
PV1
C1
C2
I2C
SCL/A5
SDA/A4
5V
GND
IOREF
RESET
3V3
5V
GND
VIN
OUT
IN
Pin9
Transistor
Power
USB
ATMEGA328P-PU
1549
TM

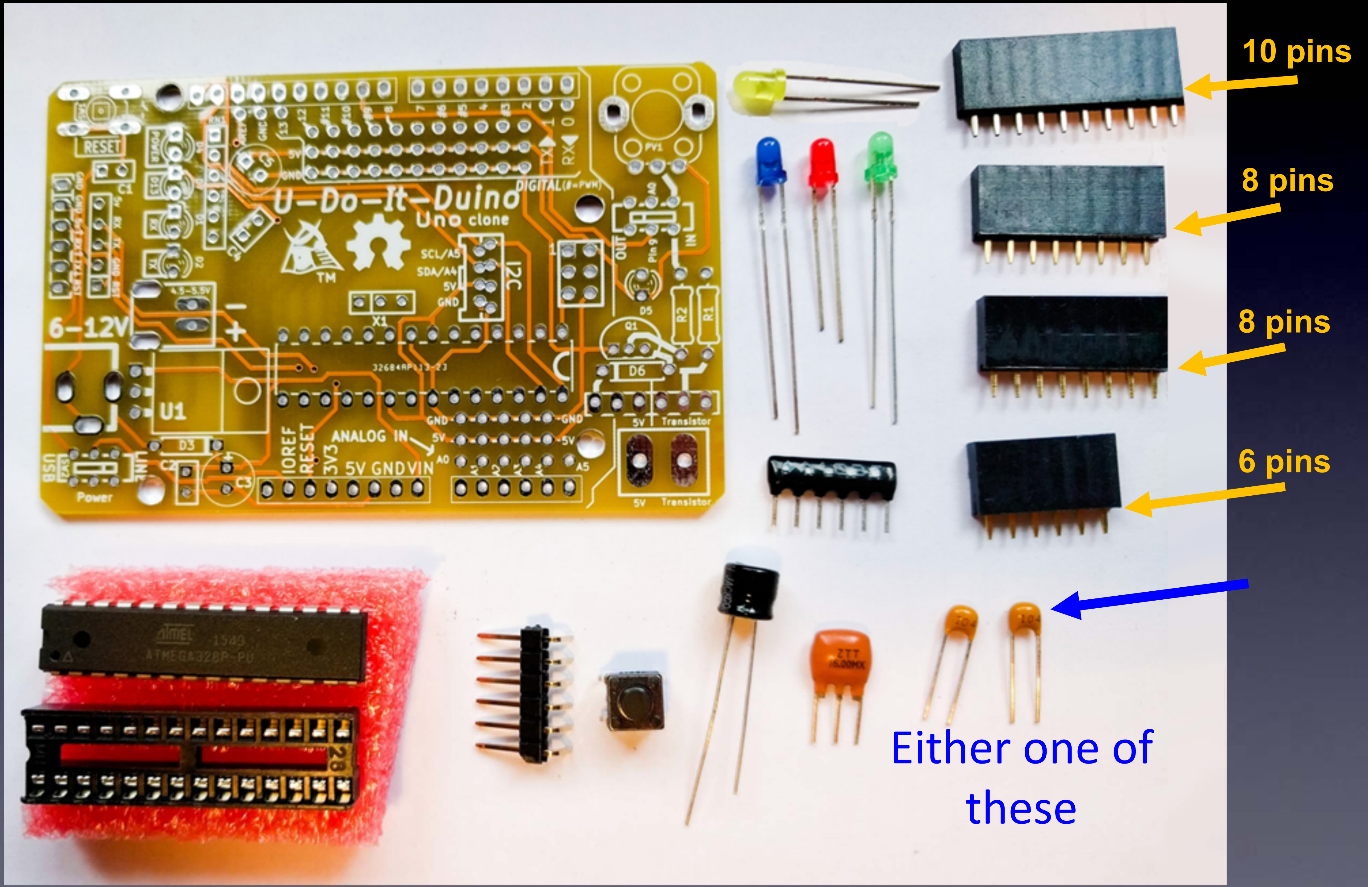
Parts to use



Unused parts



Our first part to solder: C1



10 pins

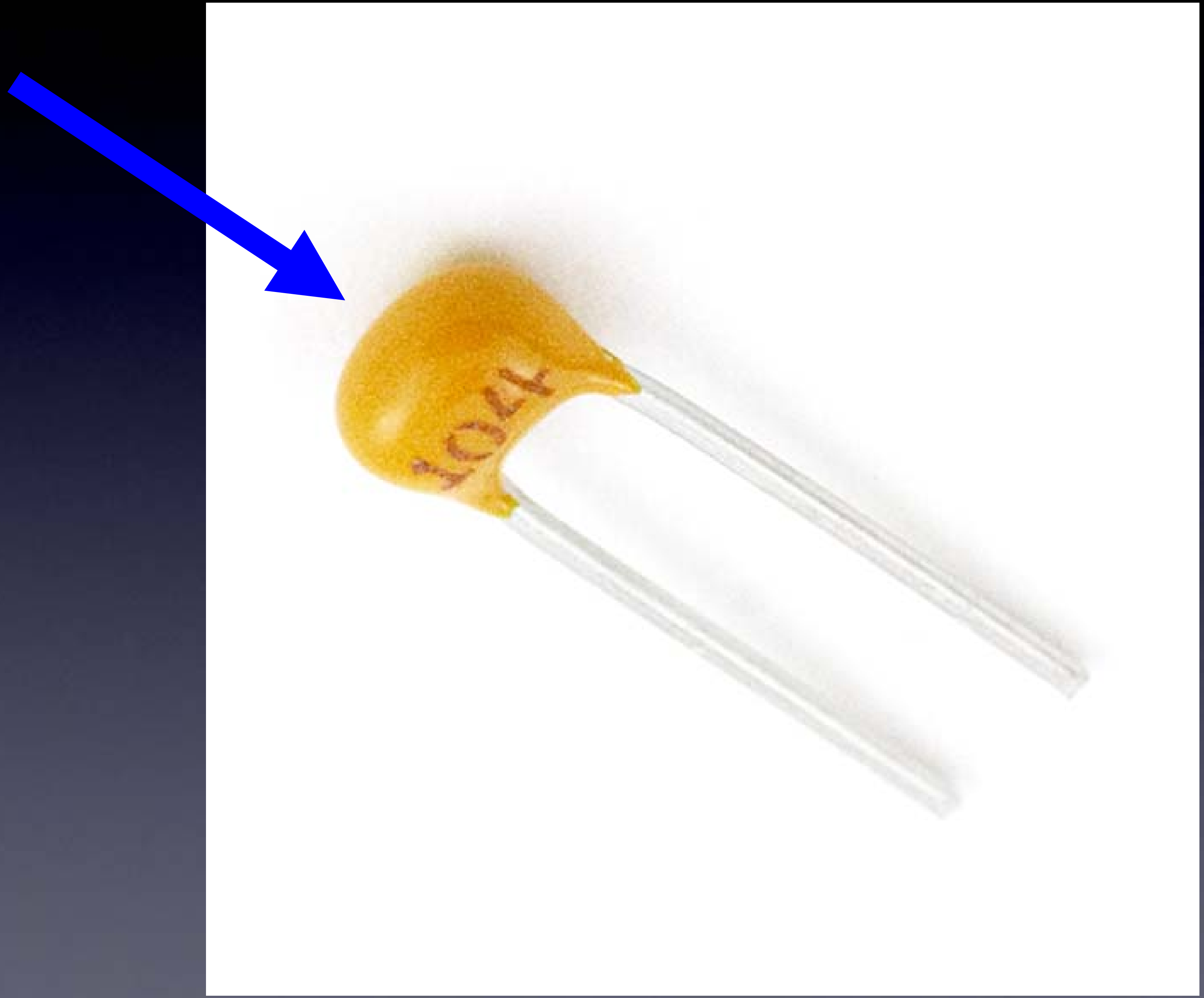
8 pins

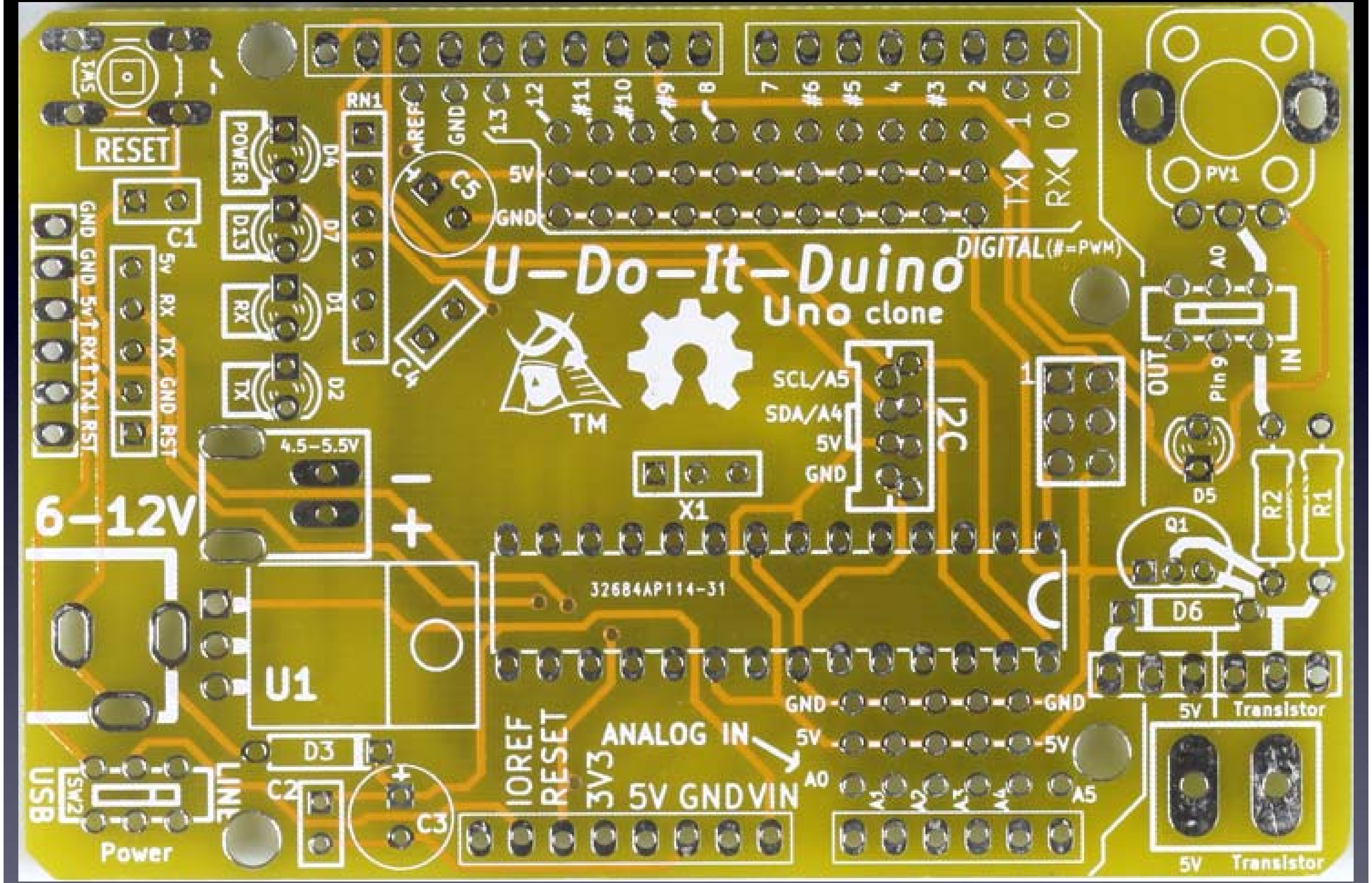
8 pins

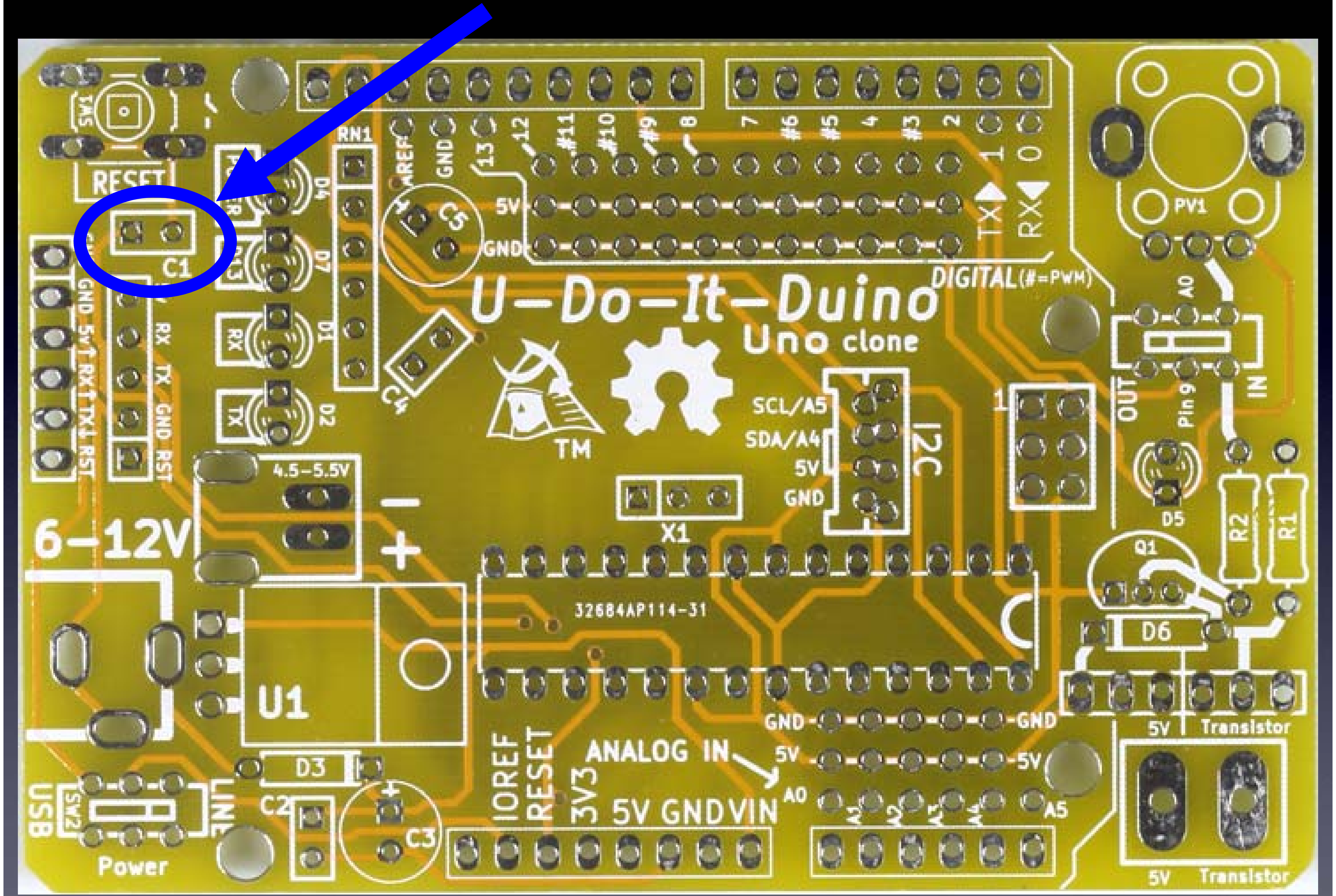
6 pins

Either one of these

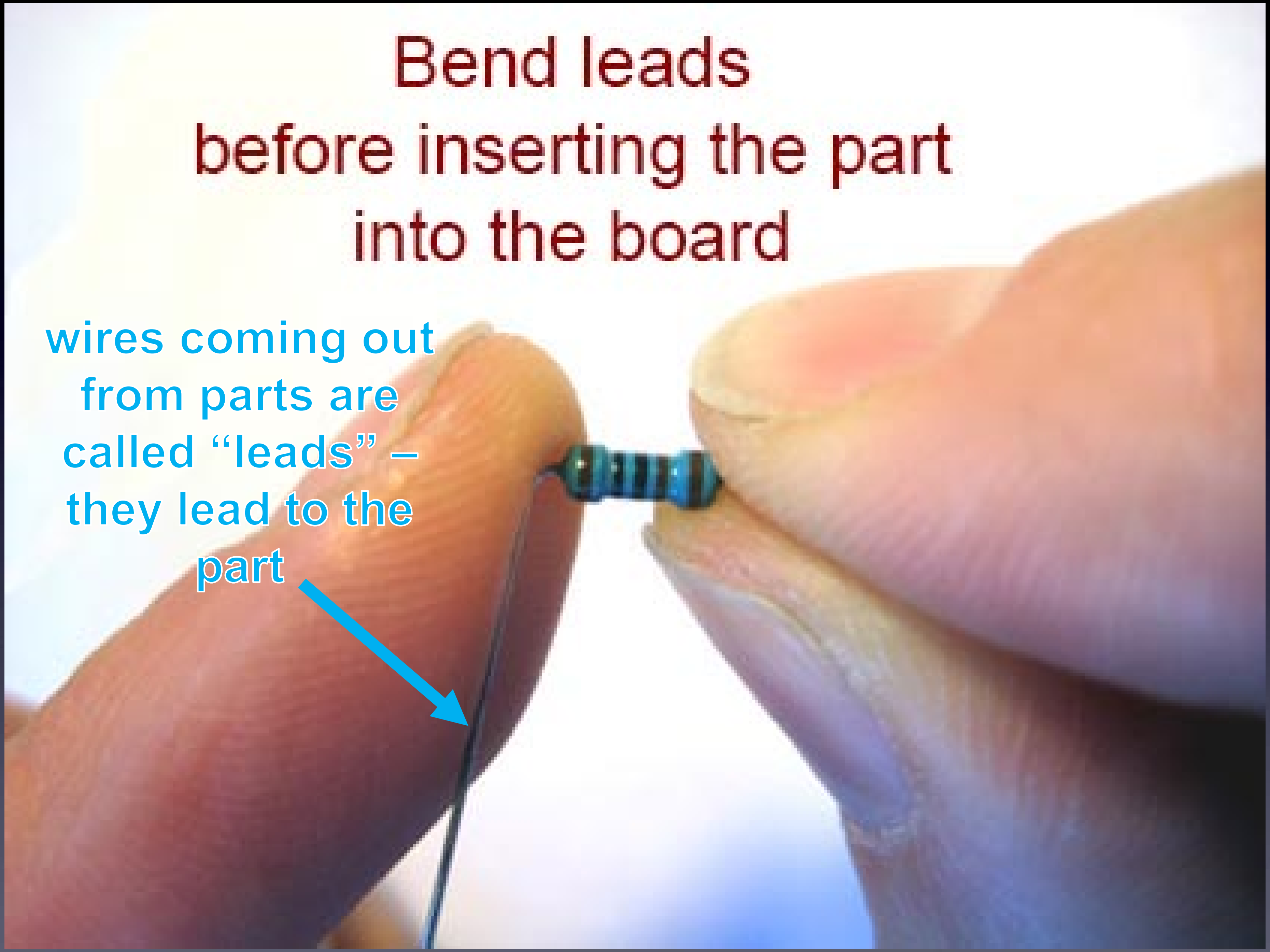
C1: Look down at the shape of this part




U-Do-It-Duino
Uno clone
TM
RESET
SW1
POWER
D4
D13
D7
RX
D1
TX
D2
RN1
C1
C4
C5
AREF
GND
13
12
#11
#10
#9
8
7
#6
#5
4
#3
2
1
0
TX▶
RX◀
5V
GND
DIGITAL(#=PWM)
GND GND 5V RX TX RST
5V RX TX GND RST
SCL/A5
SDA/A4
5V
GND
I2C
X1
32684AP114-31
4.5-5.5V
–
+
6-12V
U1
D3
C2
C3
USB
SW2
LINE
Power
IOREF
RESET
3V3
5V GND VIN
ANALOG IN
A0
A1
A2
A3
A4
A5
GND
5V
PV1
A0
OUT
Pin 9
IN
D5
R2
R1
Q1
D6
5V
Transistor
5V
Transistor

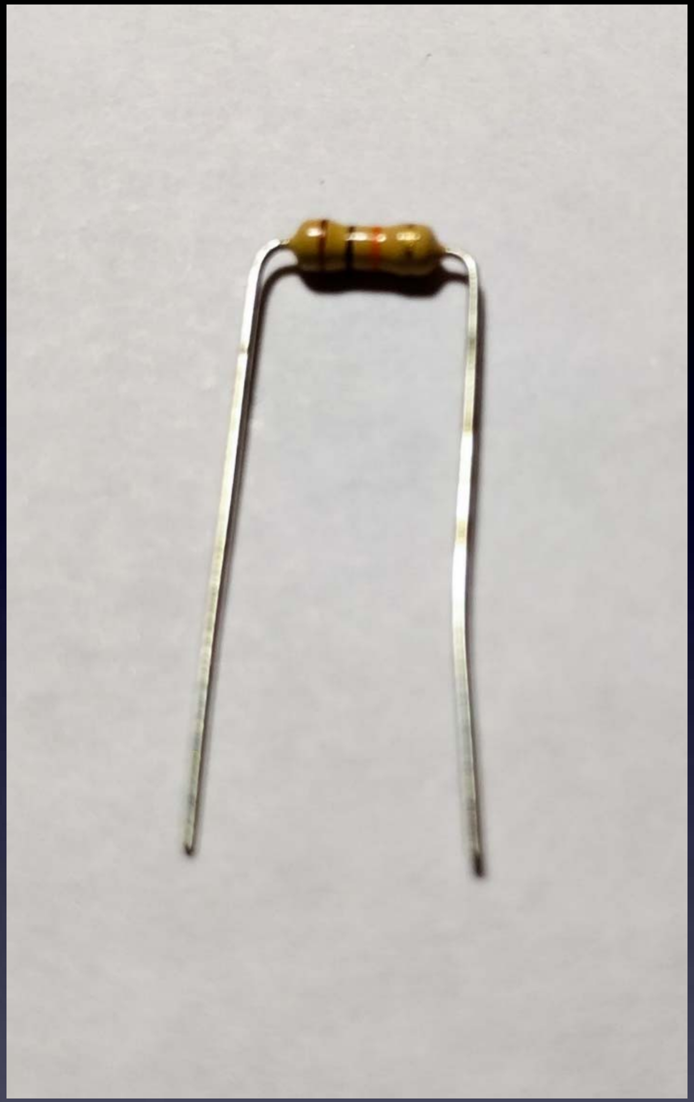

RESET
SW1
C1
RN1
AREF
GND
13
12
#11
#10
#9
8
7
#6
#5
4
#3
2
1
0
TX
RX
5V
GND
C5
D4
D7
D1
D2
RX
TX
GND 5V RX TX RST
U-Do-It-Duino
Uno clone
DIGITAL(#=PWM)
C4
TM
SCL/A5
SDA/A4
5V
GND
I2C
PV1
A0
OUT
Pin 9
IN
D5
R2
R1
Q1
D6
4.5-5.5V
-
+
6-12V
X1
32684AP114-31
U1
D3
C2
C3
USB
SW2
LINE
Power
IOREF
RESET
3V3
5V GND VIN
ANALOG IN
GND
5V
A0
A1
A2
A3
A4
A5
5V
Transistor

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



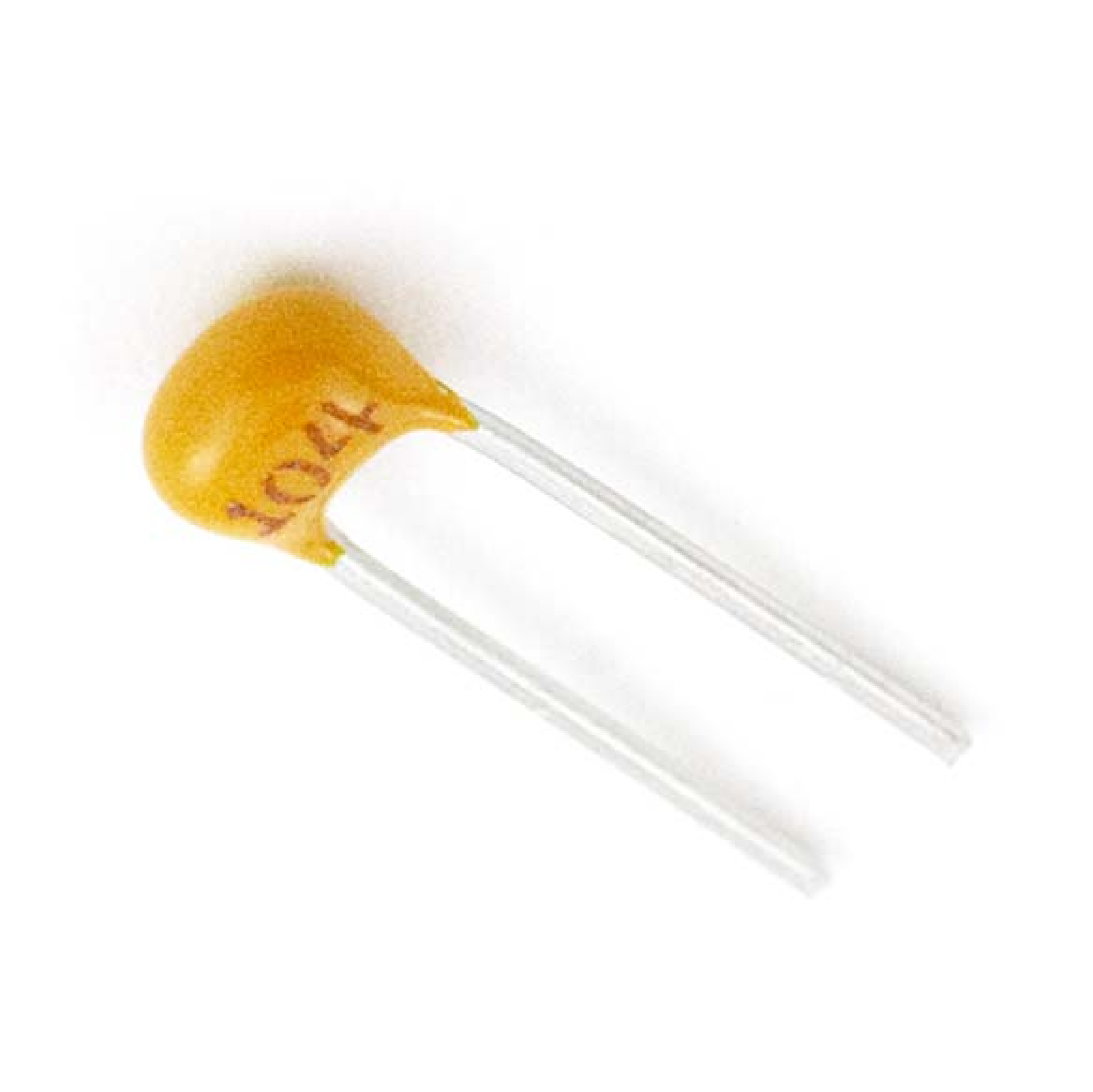
Bend leads
before inserting the part
into the board

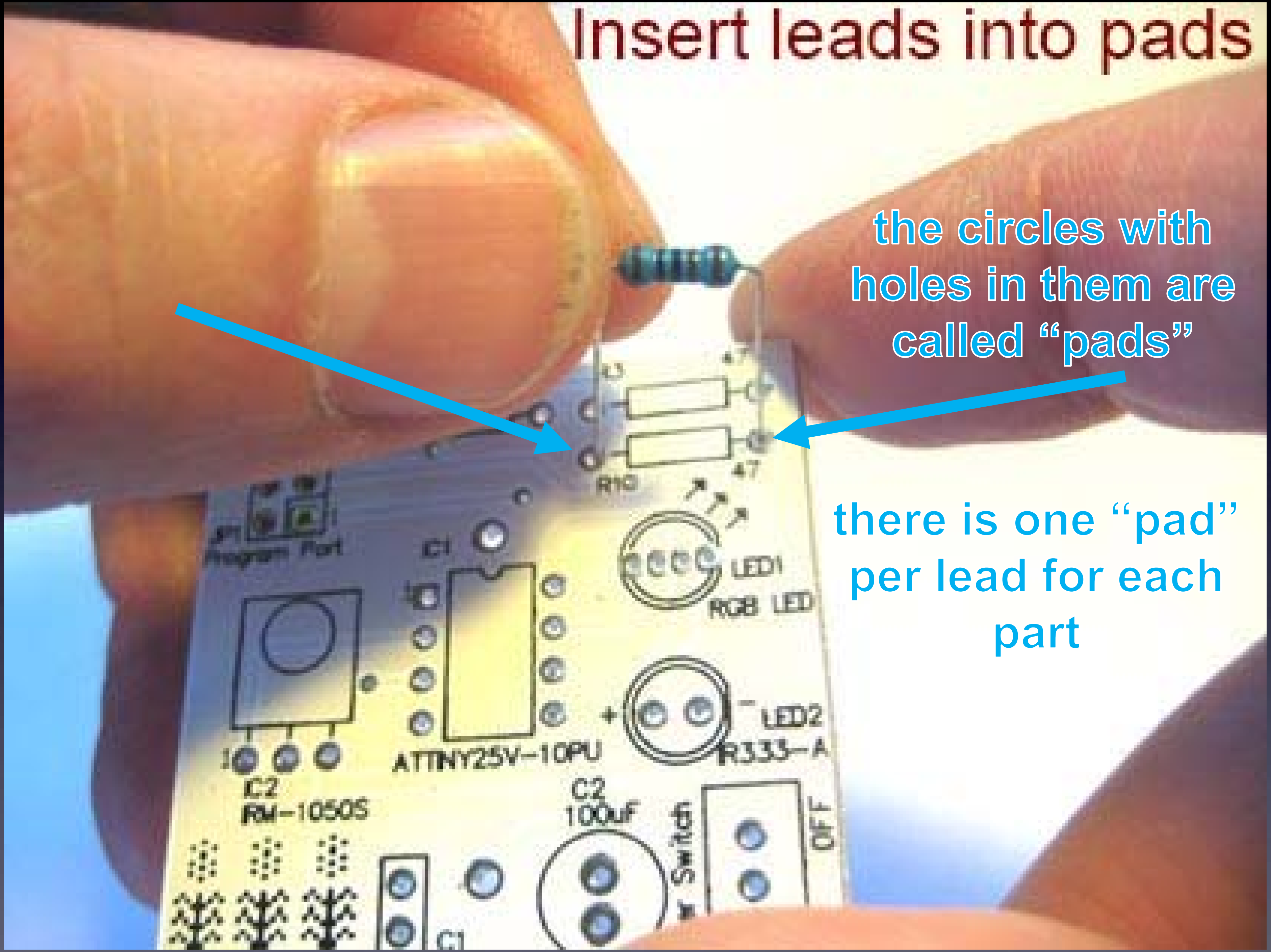
wires coming out from parts are called "leads" – they lead to the part



This is how a resistor look *before* inserting it into the board

C1: No need to bend leads first



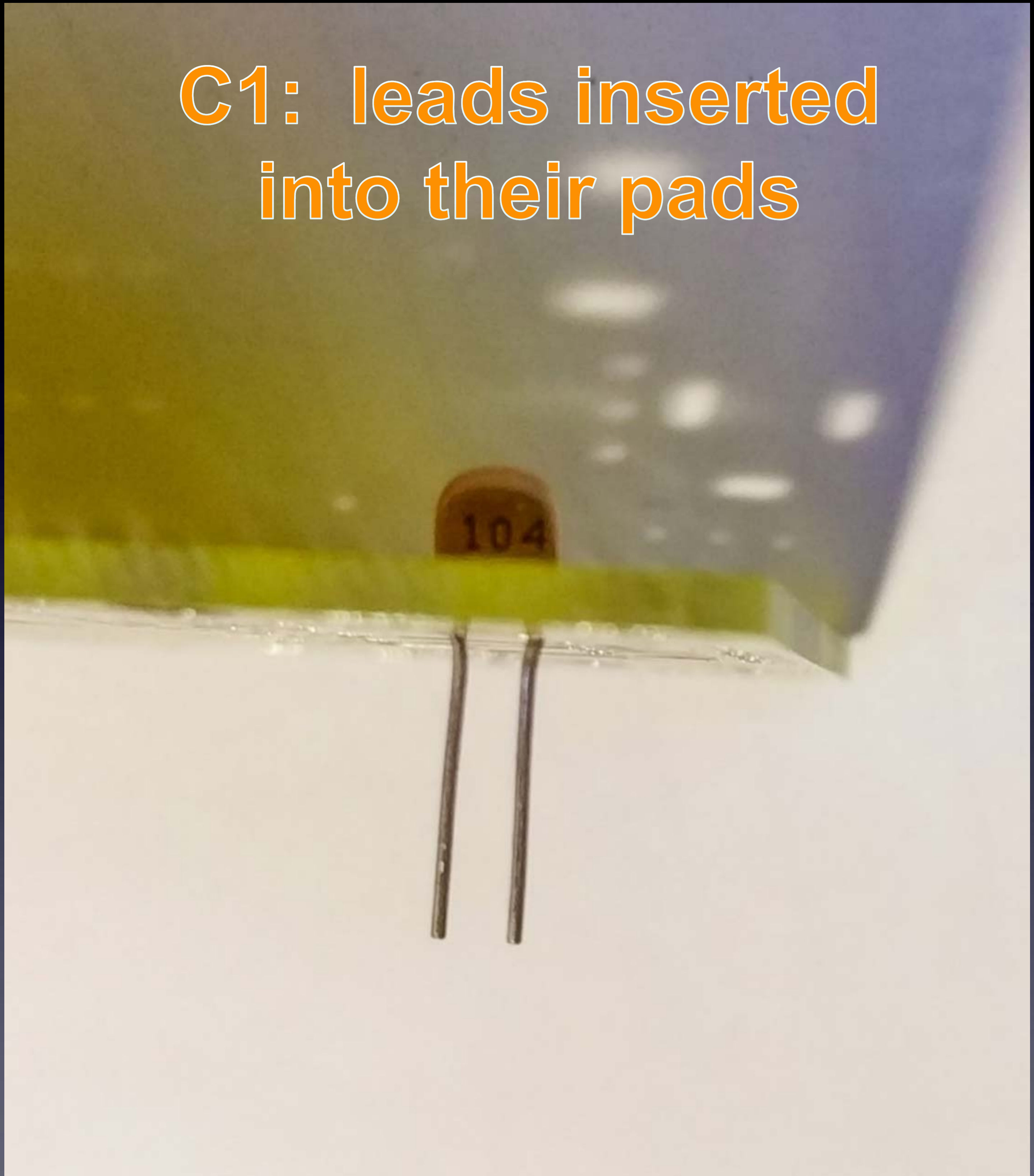


Insert leads into pads

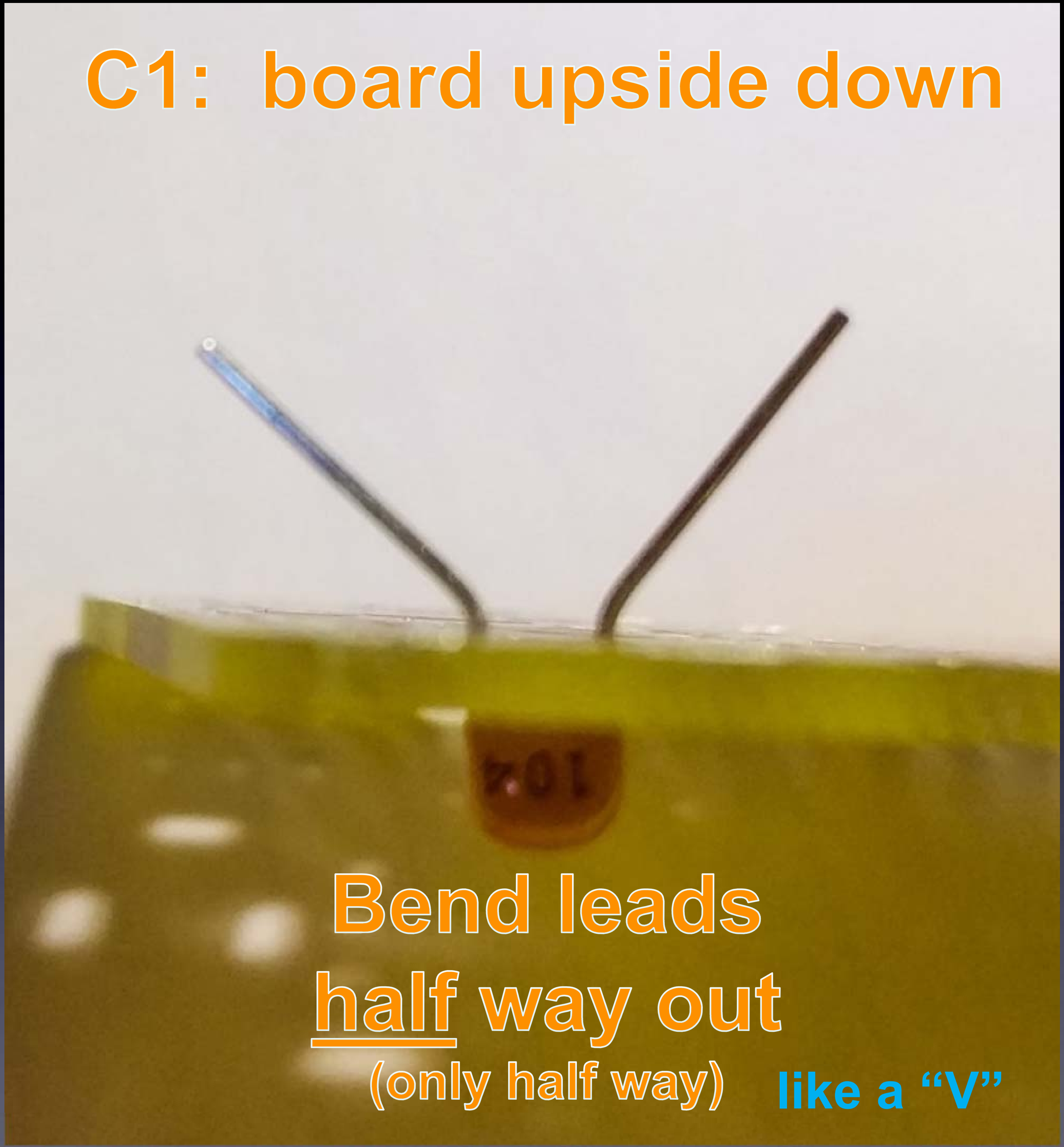
the circles with holes in them are called "pads"

there is one "pad" per lead for each part

C1: leads inserted into their pads



C1: board upside down

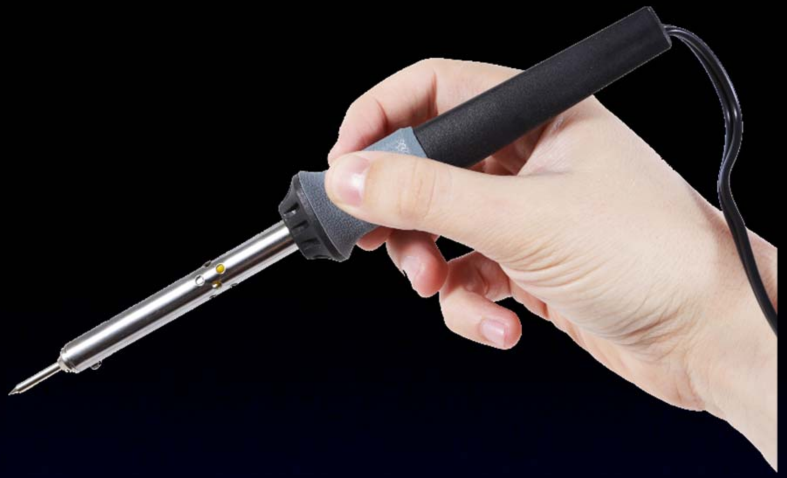


Bend leads

half way out

(only half way) like a "V"

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



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)

Important:

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

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!

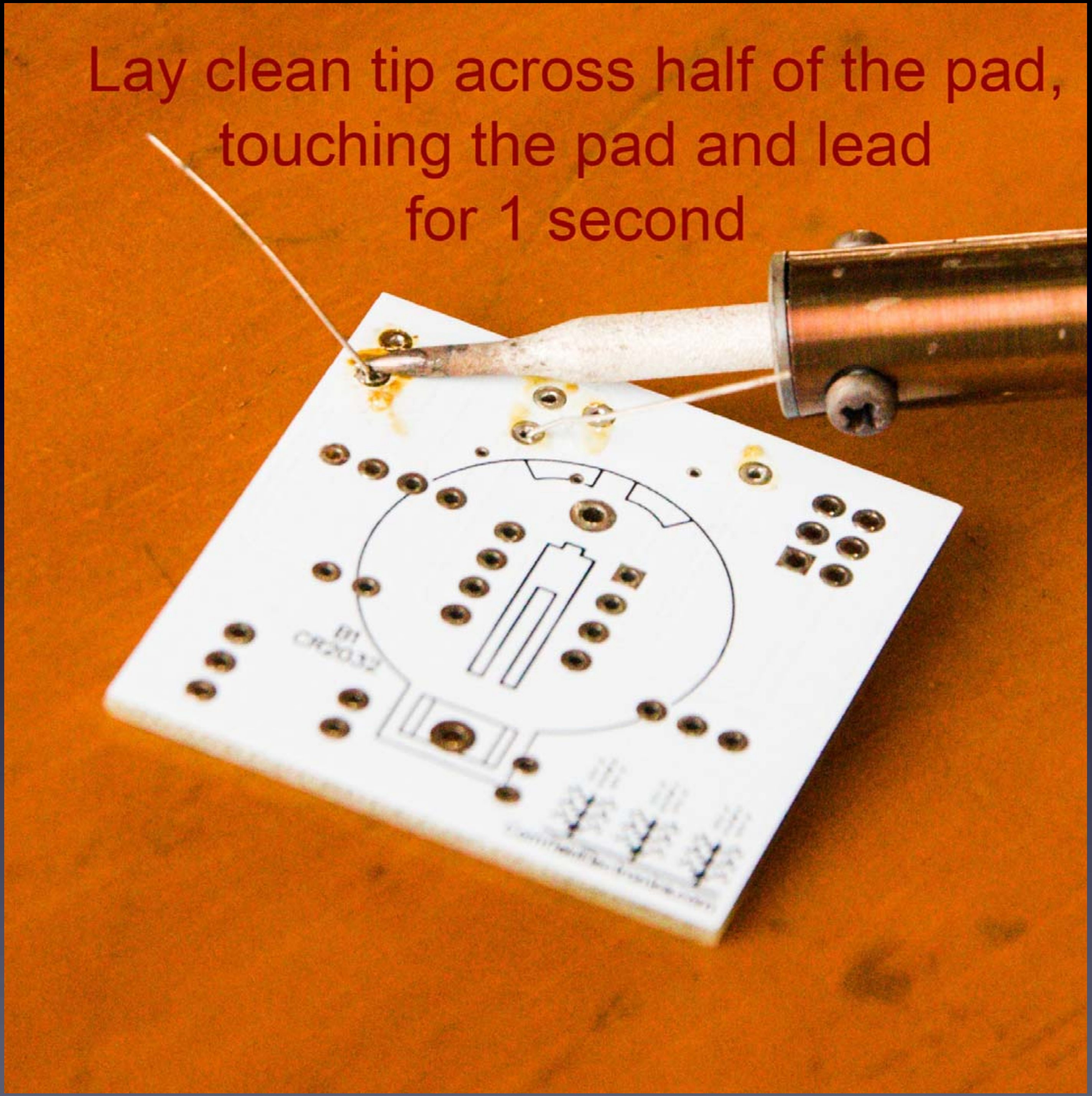
(before every solder connection)

Bang (lightly) 3 times,

knock solder off the tip

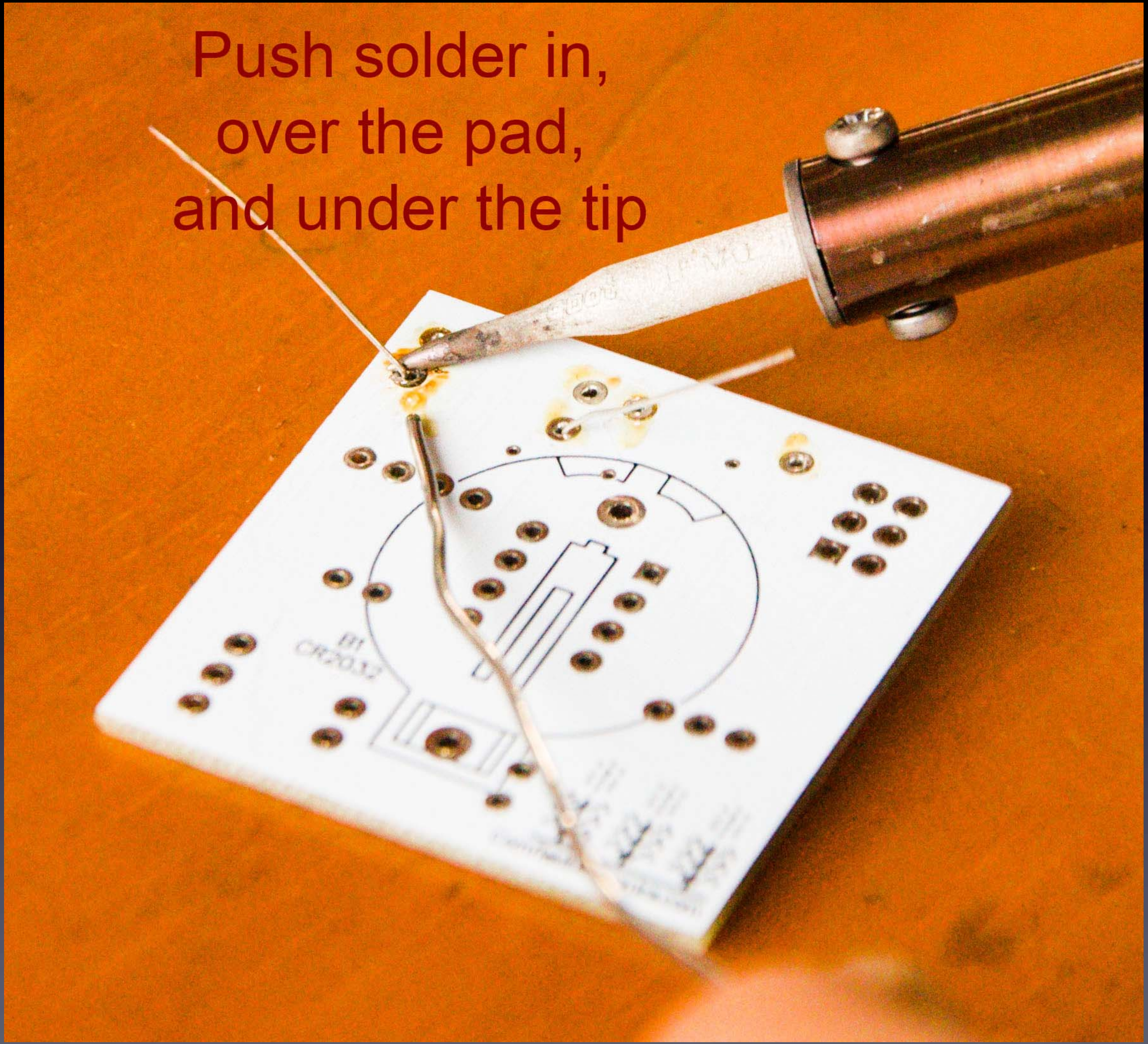
Swipe, Rotate, Swipe (on the sponge):

Keep the tip shiny silver!



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

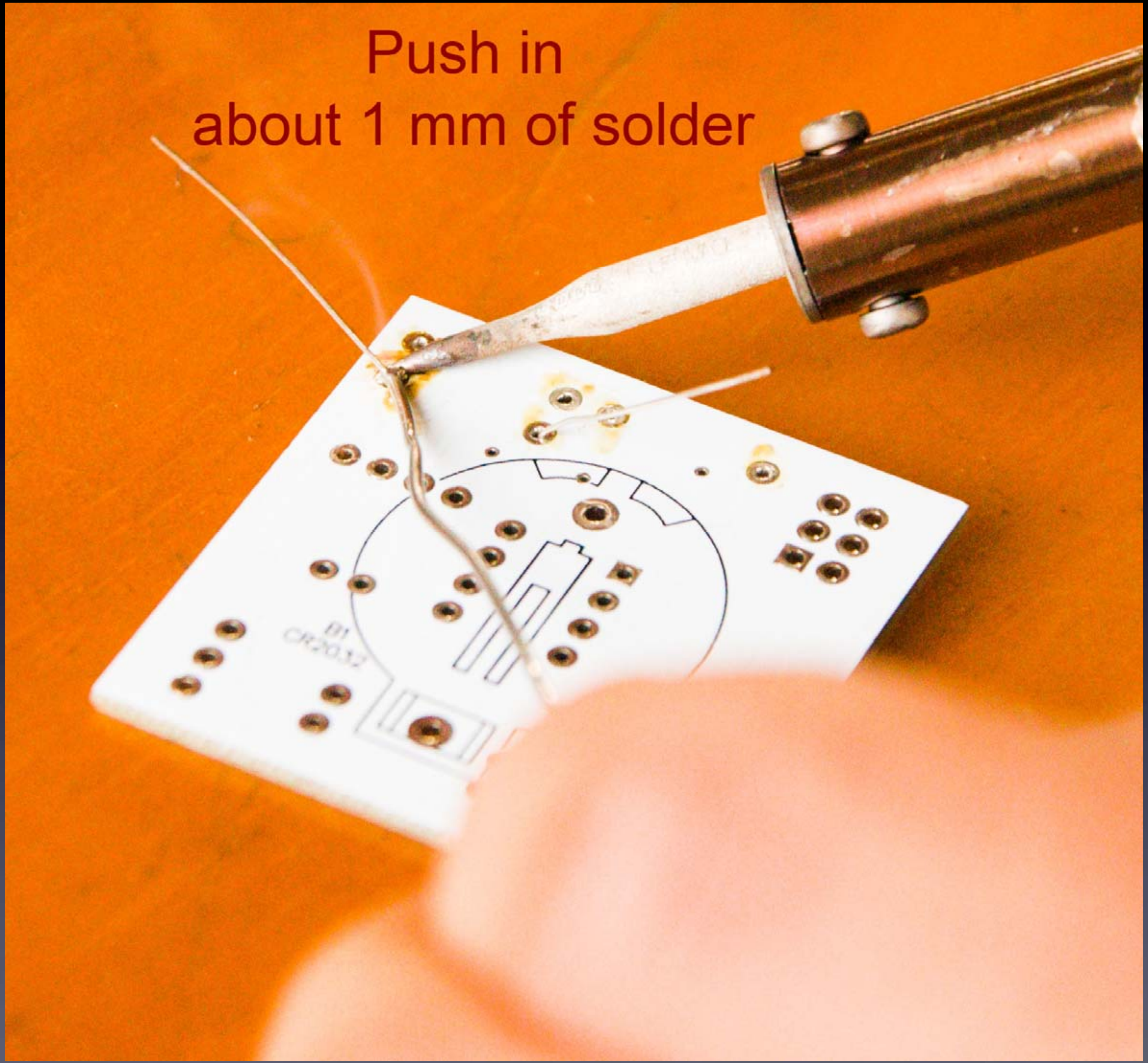
Do this quickly (slowly doesn't work well) – solder in & out in about 1 second



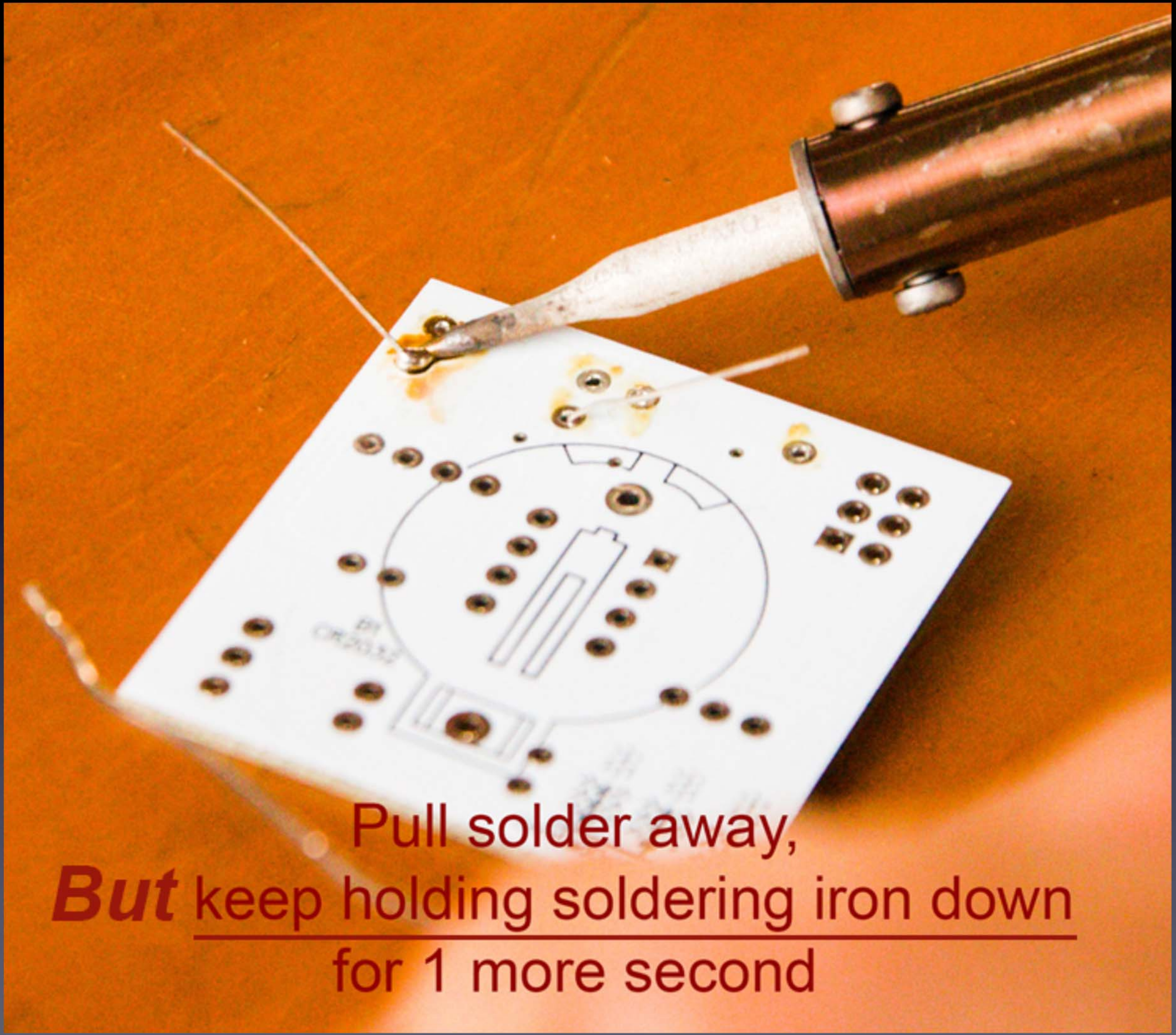
Push solder in,
over the pad,
and under the tip

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

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



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



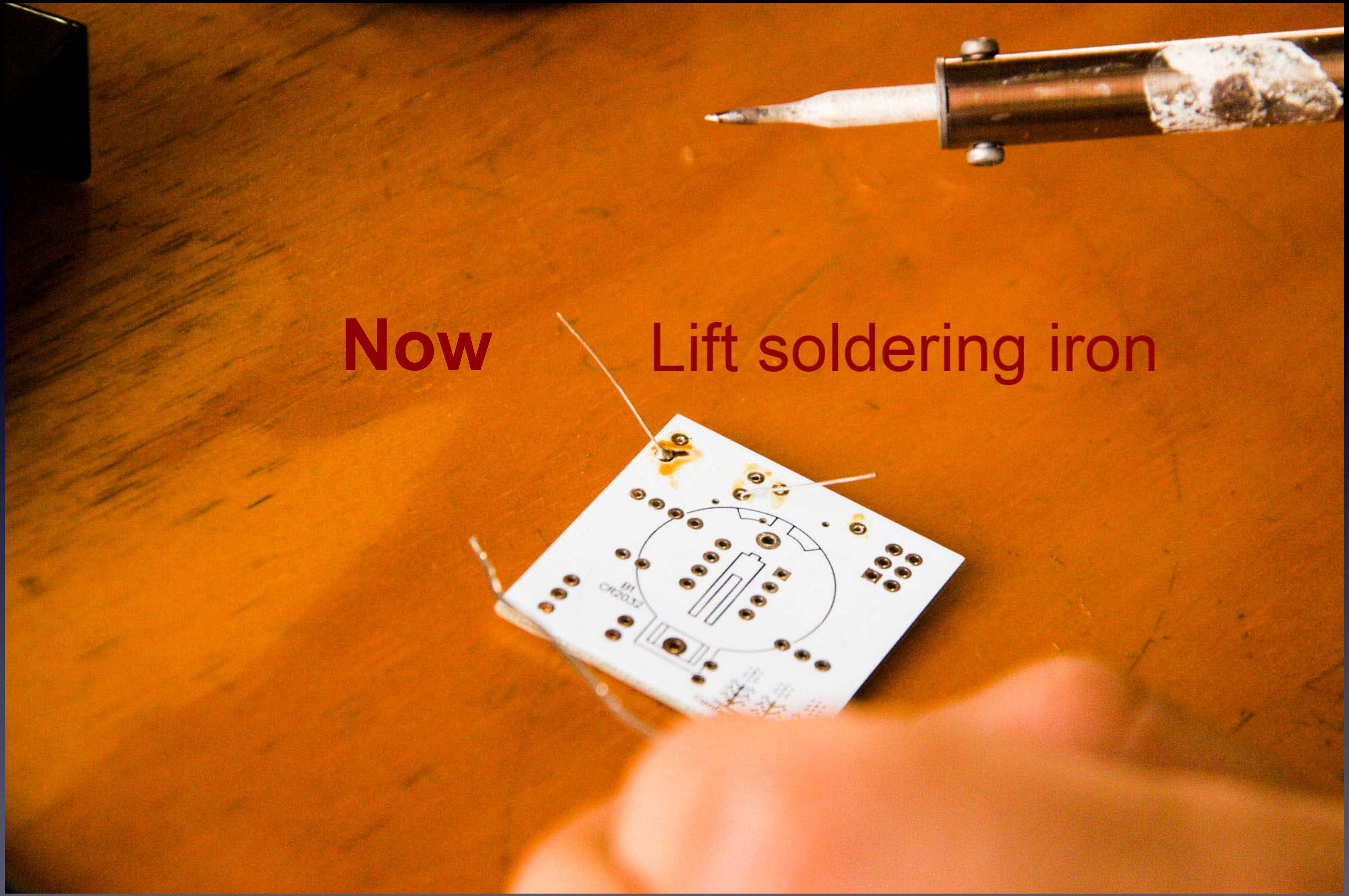
Pull solder away,

But keep holding soldering iron down

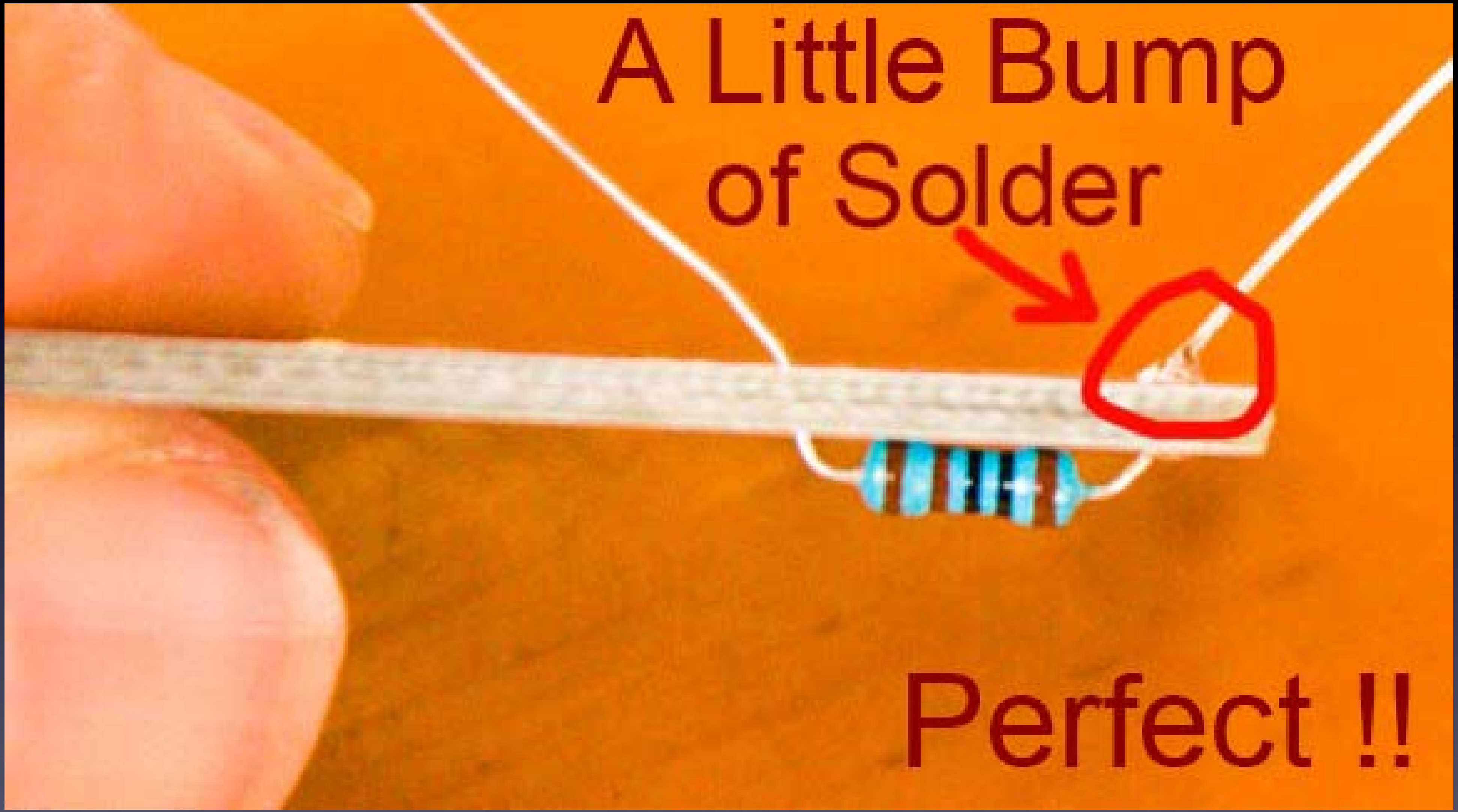
for 1 more second

Secret #2:

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

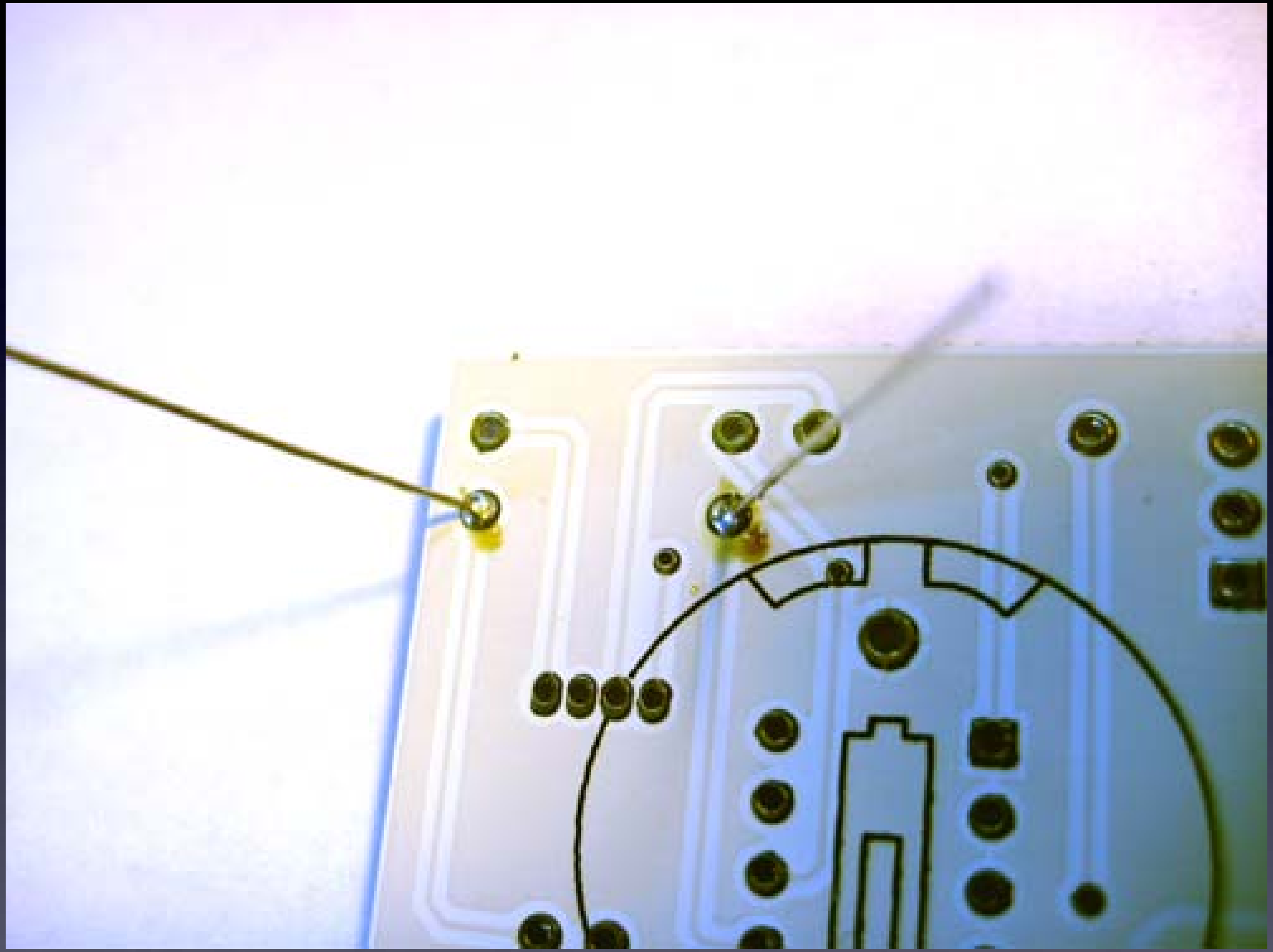


Now Lift soldering iron



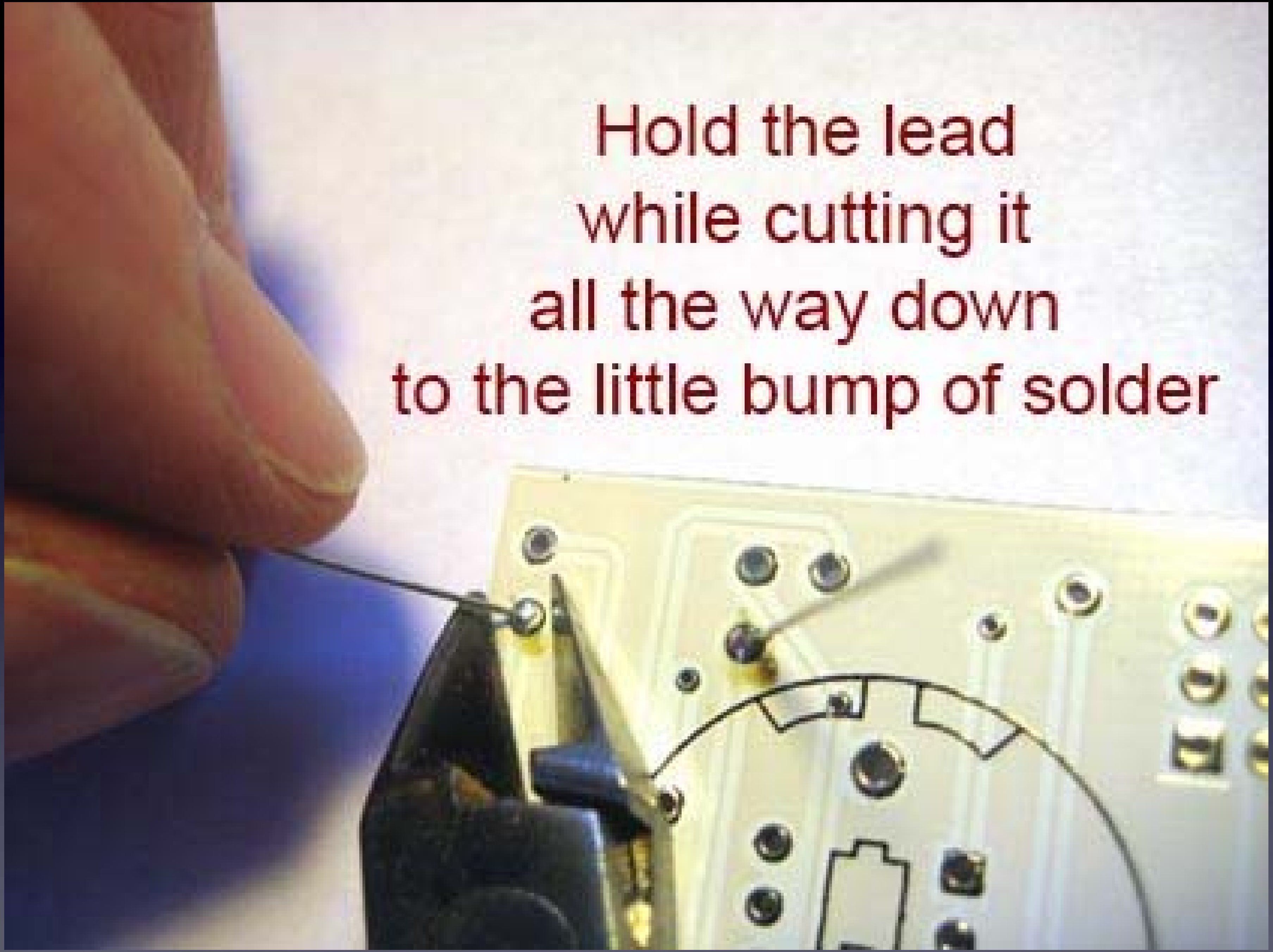
If you can see any of the pad, or the hole, you need more solder – so, just do all the steps again to make it perfect.

Solder all of the leads of the part to the board



For this part, there are two leads

Now cut the leads short



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

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

Safety Tip #3:

Hold or cover the lead !

(or it will fly into your eye!)

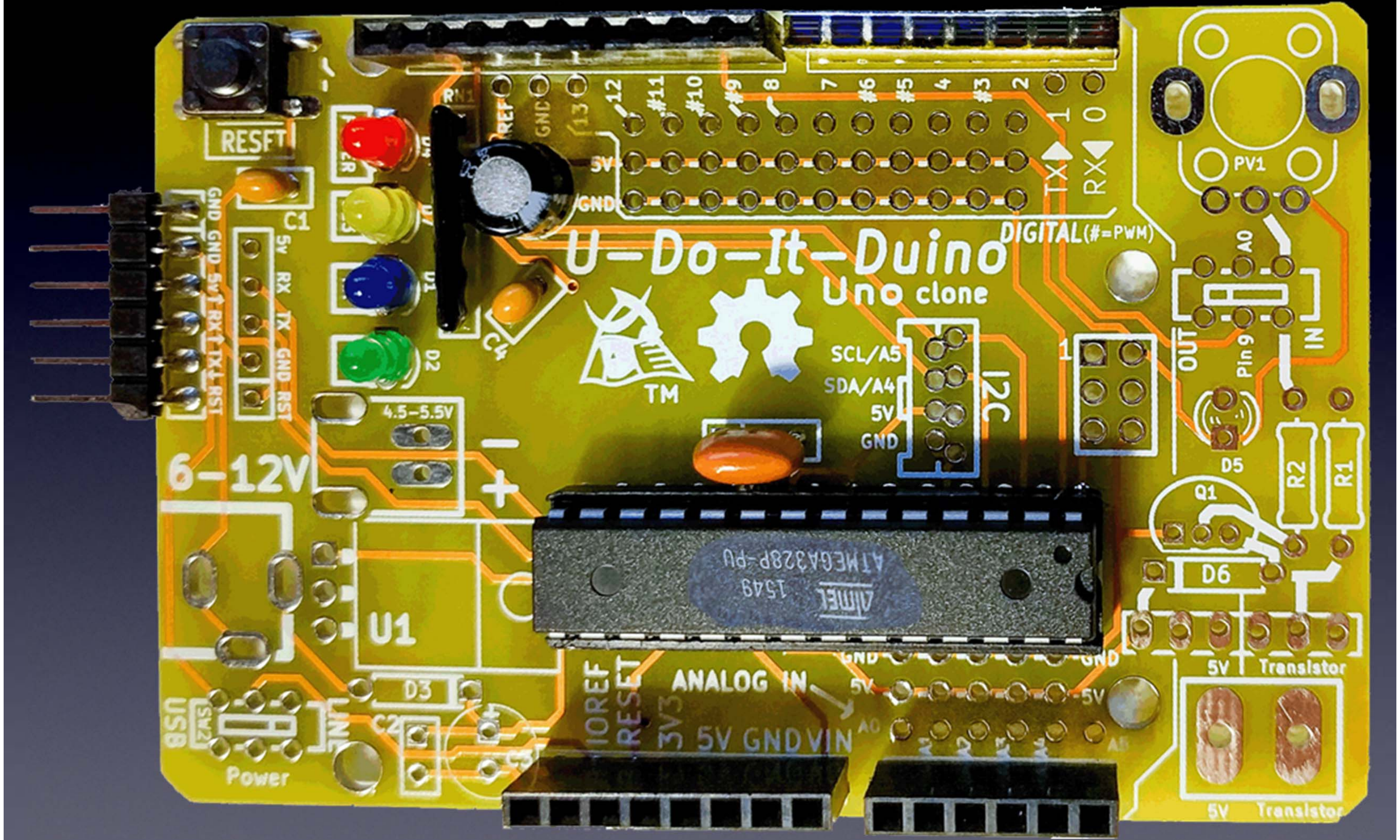
No wires sticking out

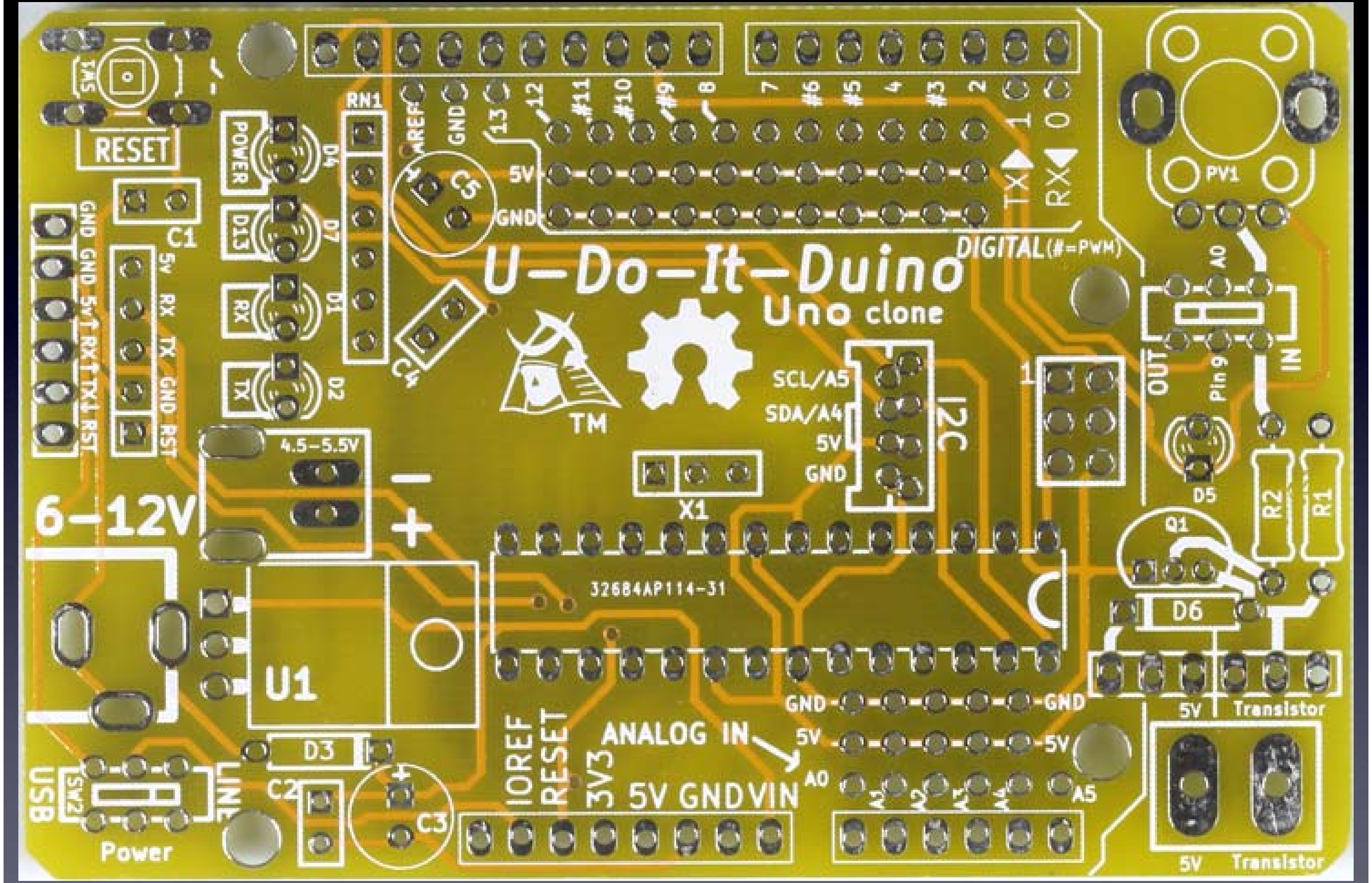
C1: All done !

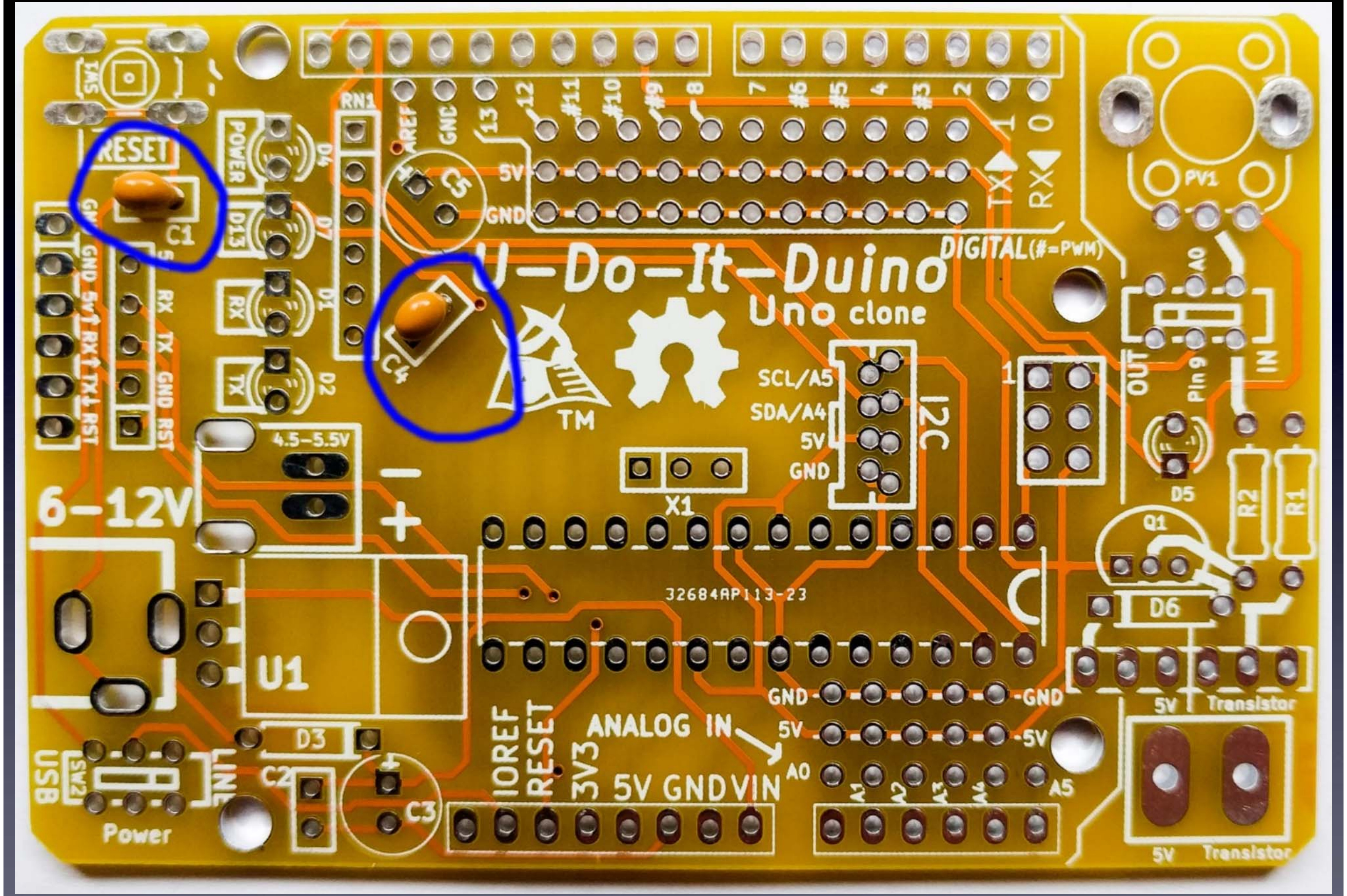
No wires sticking out

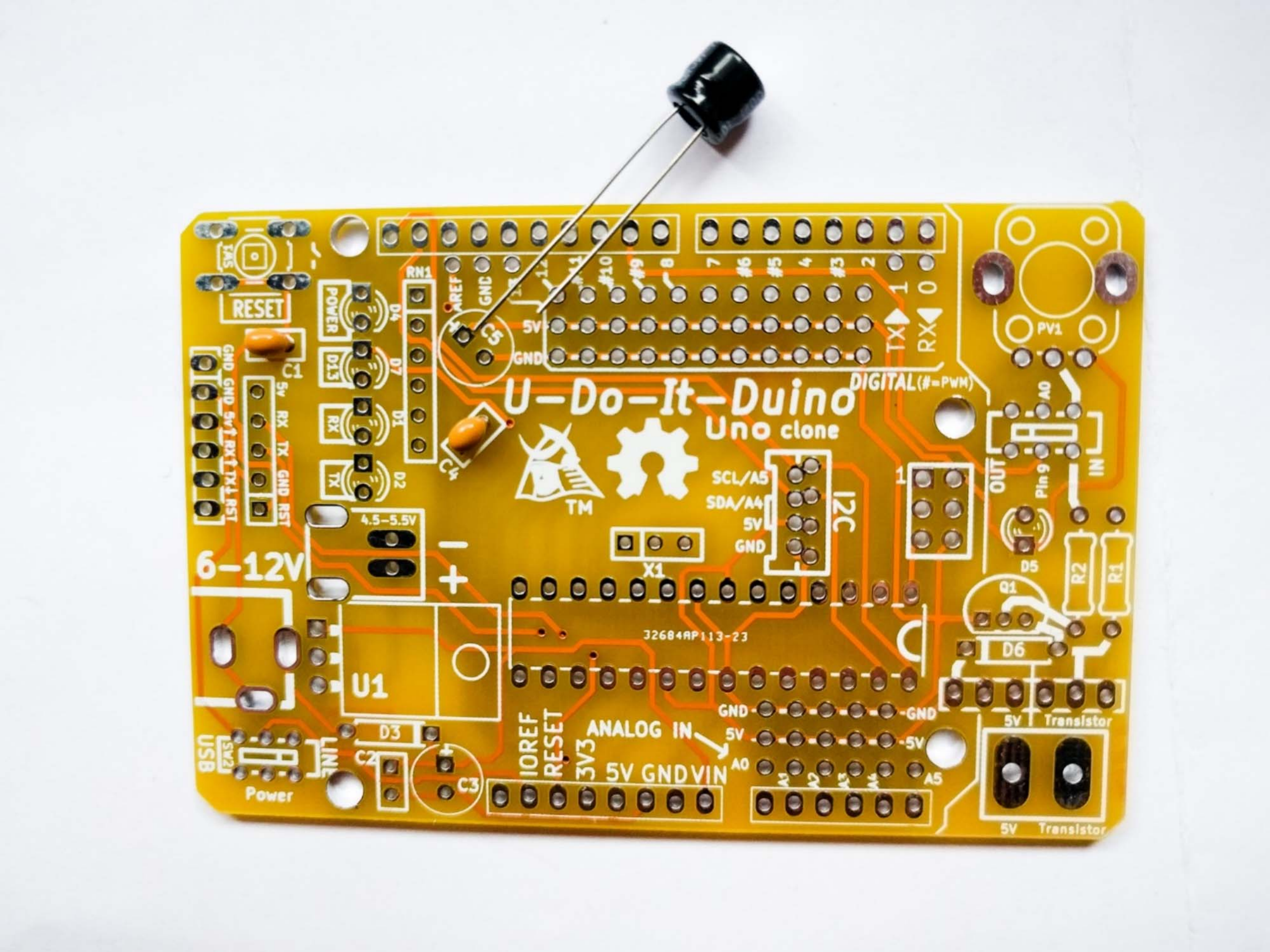
One part at a time

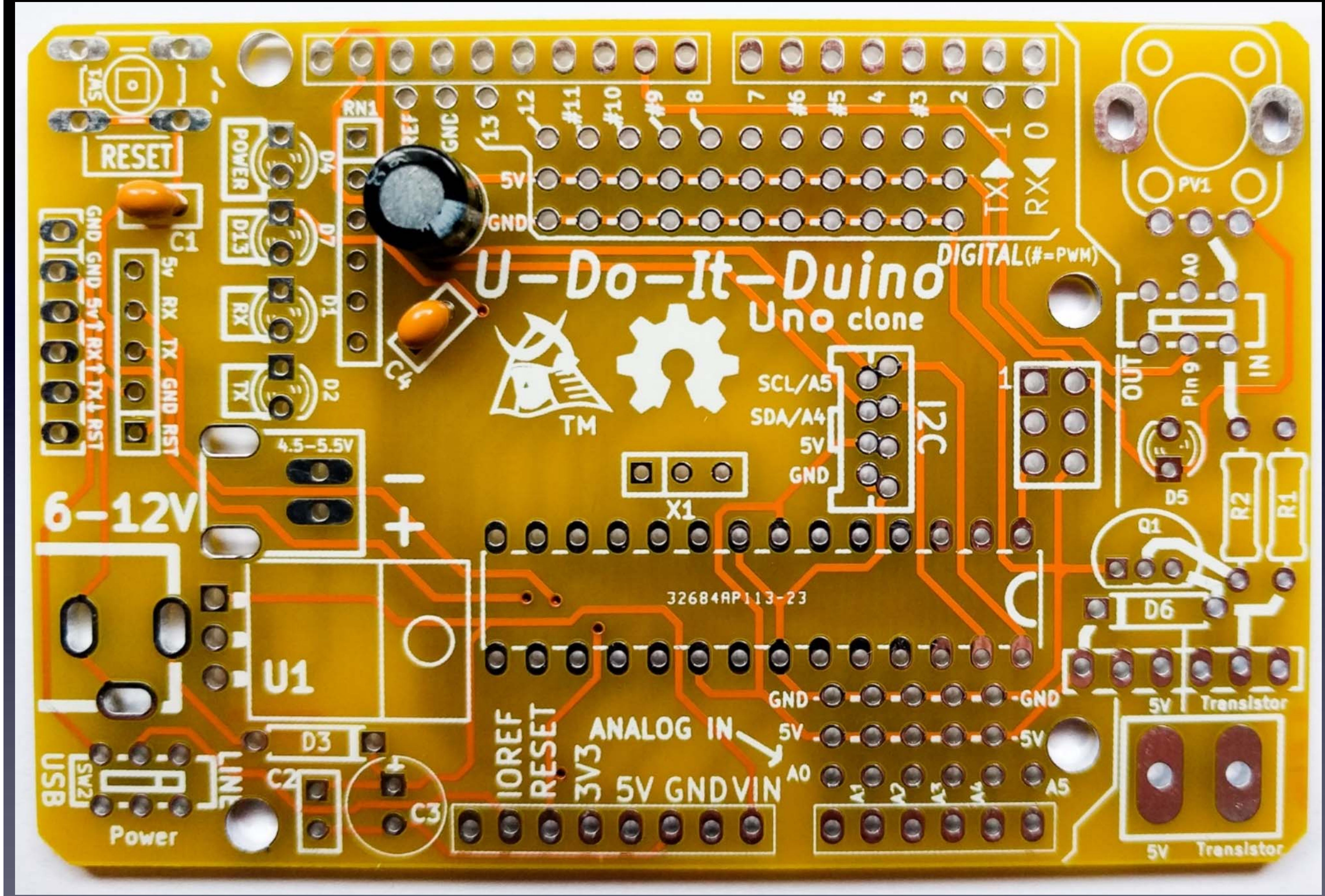
Till all the parts are soldered

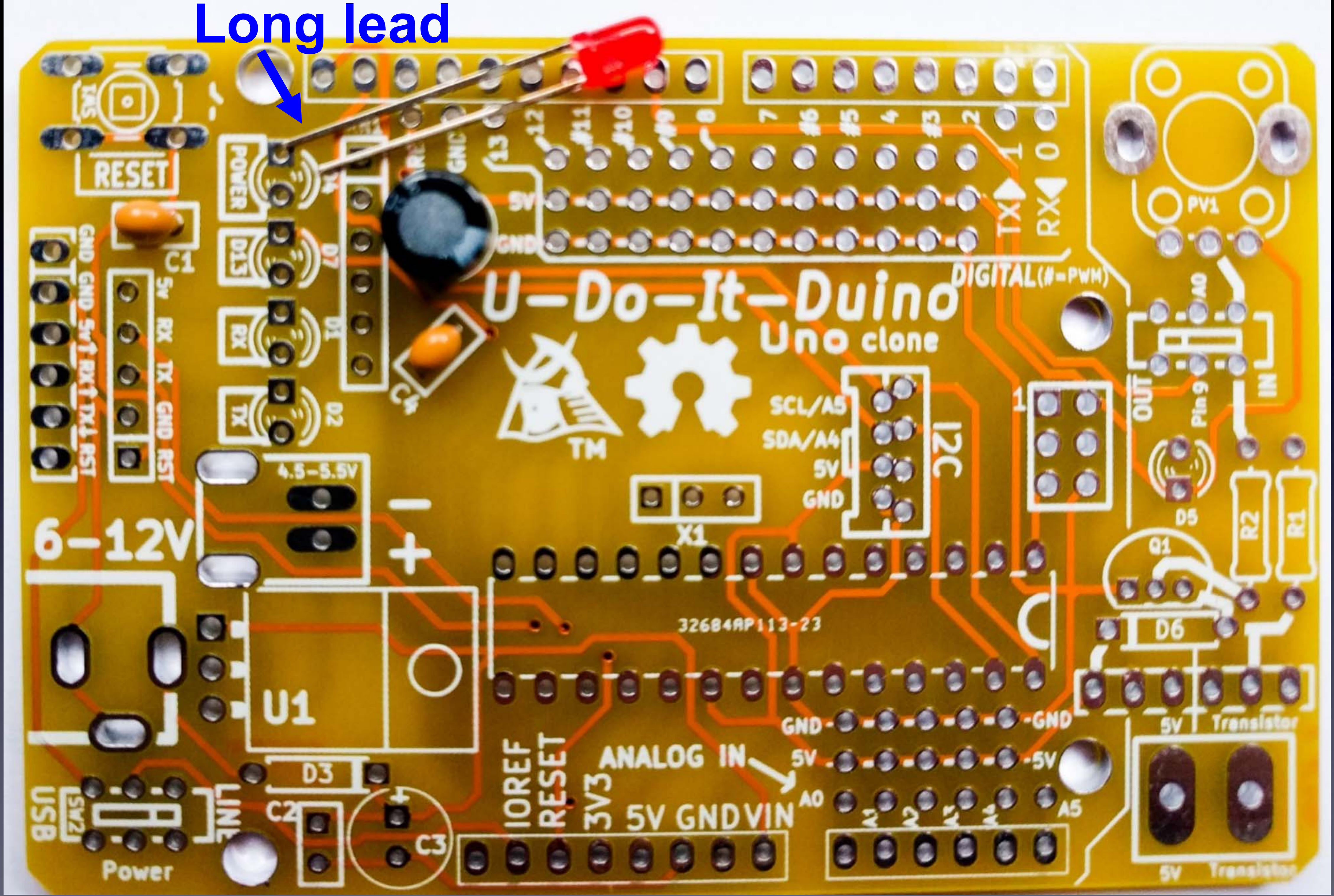

U-Do-It-Duino
Uno clone
RESET
DIGITAL(#=PWM)
ANALOG IN
6-12V
4.5-5.5V
U1
D3
Power
USB
TX
RX
SCL/A5
SDA/A4
5V
GND
I2C
PV1
A0
OUT
Pin9
IN
D5
Q1
R2
R1
D6
5V
Transistor
ATMEGA328P-PU
1549
Atmel
IOREF
RESET
3V3
5V
GND
VIN
C1
C2
C4
D2
TM


U-Do-It-Duino
Uno clone
DIGITAL(#=PWM)
RESET
SW1
POWER
D13
RX
TX
D4
D7
D1
D2
RN1
C1
C4
C5
AREF
GND
13
12
#11
#10
#9
8
7
#6
#5
4
#3
2
1
0
TX▶
RX◀
5V
GND
GND GND 5V RX TX RST
5V RX TX GND RST
6-12V
4.5-5.5V
−
+
TM
SCL/A5
SDA/A4
5V
GND
I2C
X1
32684AP114-31
PV1
A0
OUT
Pin 9
IN
D5
R2
R1
Q1
D6
5V
Transistor
U1
D3
C2
C3
USB
SW2
LINE
Power
IOREF
RESET
3V3
5V GND VIN
ANALOG IN
GND
5V
A0
A1
A2
A3
A4
A5
5V
Transistor

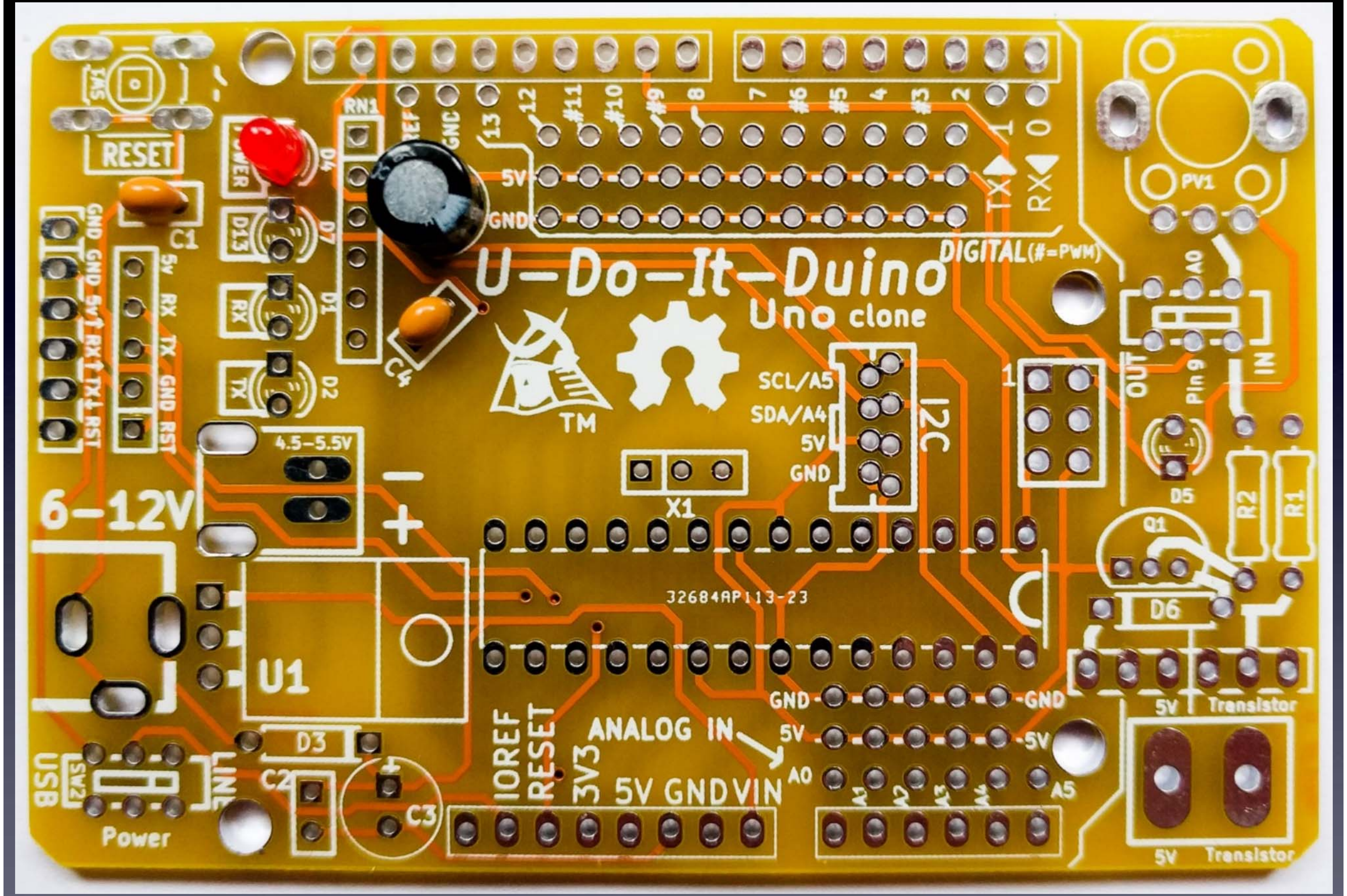

U-Do-It-Duino
Uno clone
TM
DIGITAL(#=PWM)
RESET
SW1
C1
C4
C5
RN1
POWER
D13
RX
TX
D4
D7
D1
D2
AREF
GND
13
12
#11
#10
#9
8
7
#6
#5
4
#3
2
1
0
TX◀
RX◀
5V
GND
PV1
A0
OUT
Pin9
IN
SCL/A5
SDA/A4
5V
GND
I2C
X1
D5
R2
R1
Q1
D6
32684AP113-23
4.5-5.5V
-
+
6-12V
U1
D3
C2
C3
USB
SW2
LINE
Power
IOREF
RESET
3V3
5V
GND
VIN
ANALOG IN
GND
5V
A0
A1
A2
A3
A4
A5
5V
Transistor

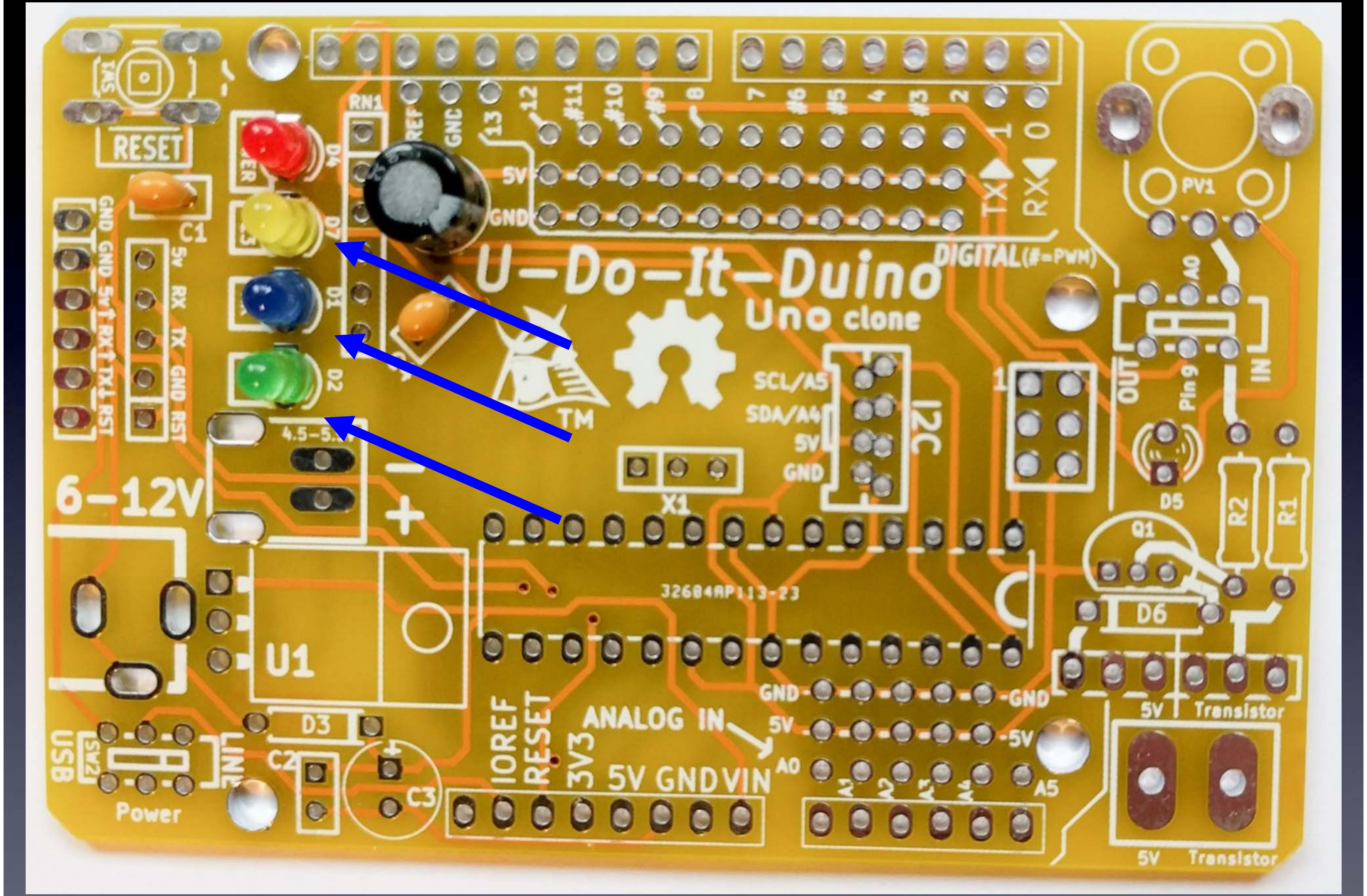

U-Do-It-Duino
Uno clone
TM
DIGITAL(#=PWM)
RESET
POWER
D13
RX
TX
6-12V
4.5-5.5V
U1
D3
C1
C2
C3
C4
C5
RN1
AREF
GND
5V
X1
I2C
SCL/A5
SDA/A4
PV1
A0
Pin 9
OUT
IN
D5
D6
Q1
R1
R2
IOREF
RESET
3V3
5V
GND
VIN
ANALOG IN
A0
A1
A2
A3
A4
A5
USB
Power
5V
Transistor
32684AP113-23

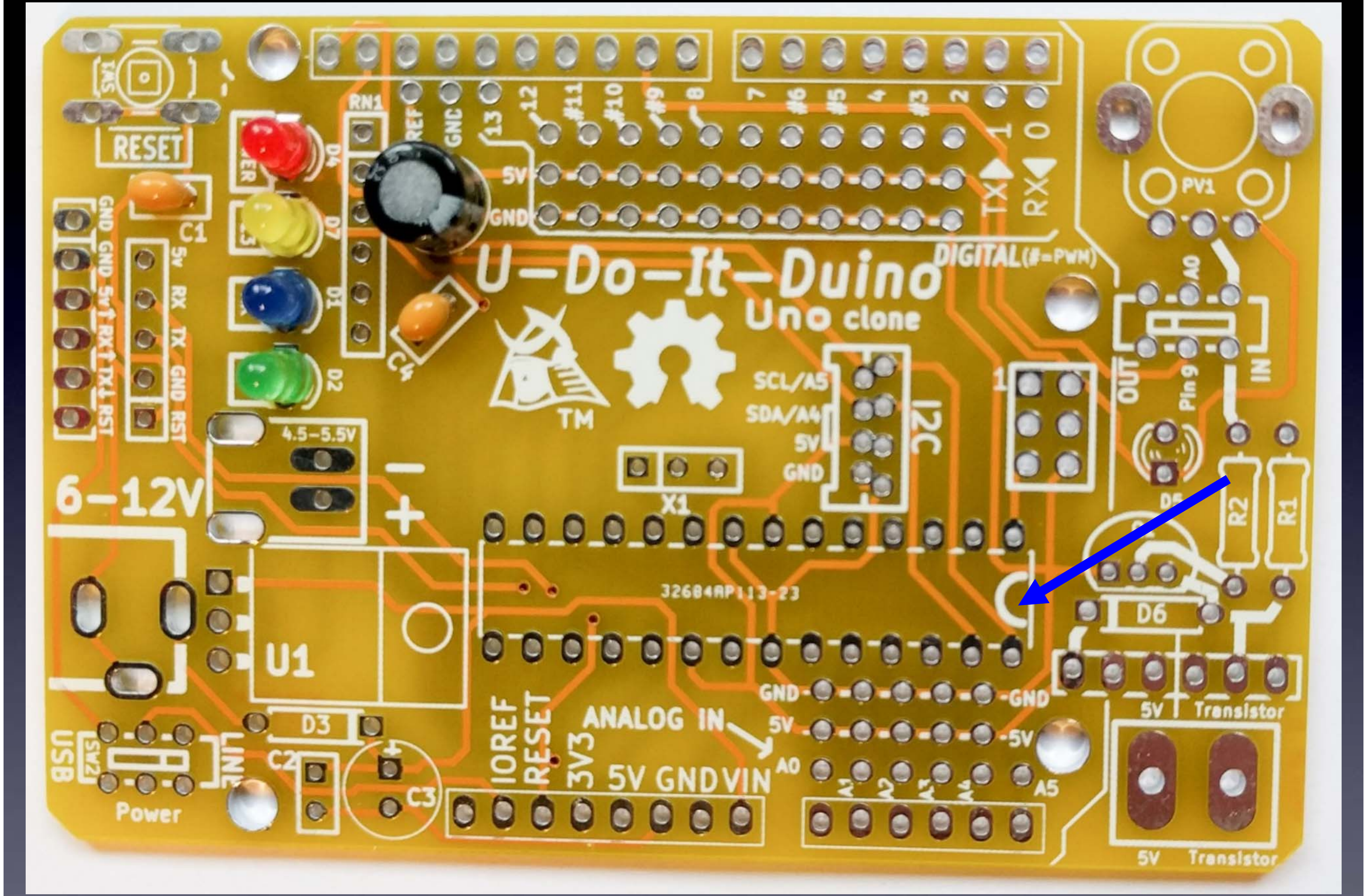

U-Do-It-Duino
Uno clone
TM
RESET
SW1
POWER
D13
RX
TX
D4
D7
D1
D2
RN1
C1
C4
GND GND 5V RX TX RST
5V RX TX GND RST
REF
GND
13
12
#11
#10
#9
8
7
#6
#5
4
#3
2
1
0
5V
GND
TX
RX
DIGITAL(#=PWM)
PV1
A0
OUT
IN
Pin 9
SCL/A5
SDA/A4
5V
GND
I2C
1
D5
R2
R1
Q1
D6
X1
4.5-5.5V
−
+
6-12V
U1
32684AP113-23
D3
C2
C3
USB
SW2
LiN
Power
IOREF
RESET
3V3
5V
GND
VIN
ANALOG IN
A0
A1
A2
A3
A4
A5
GND
5V
Transistor

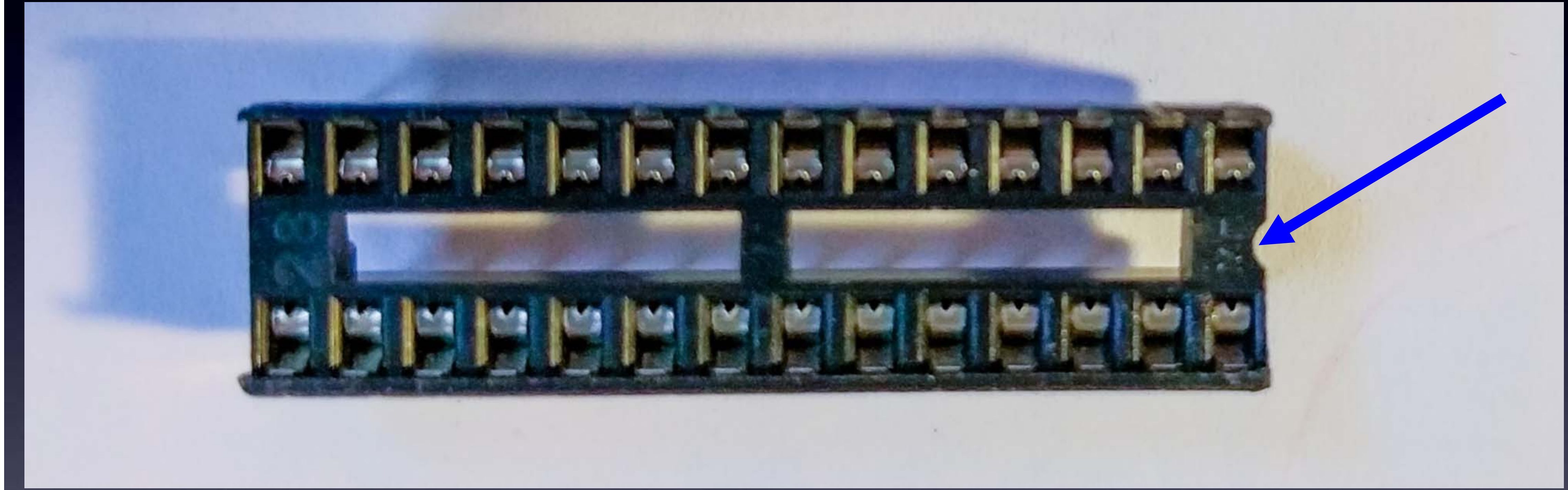

Long lead

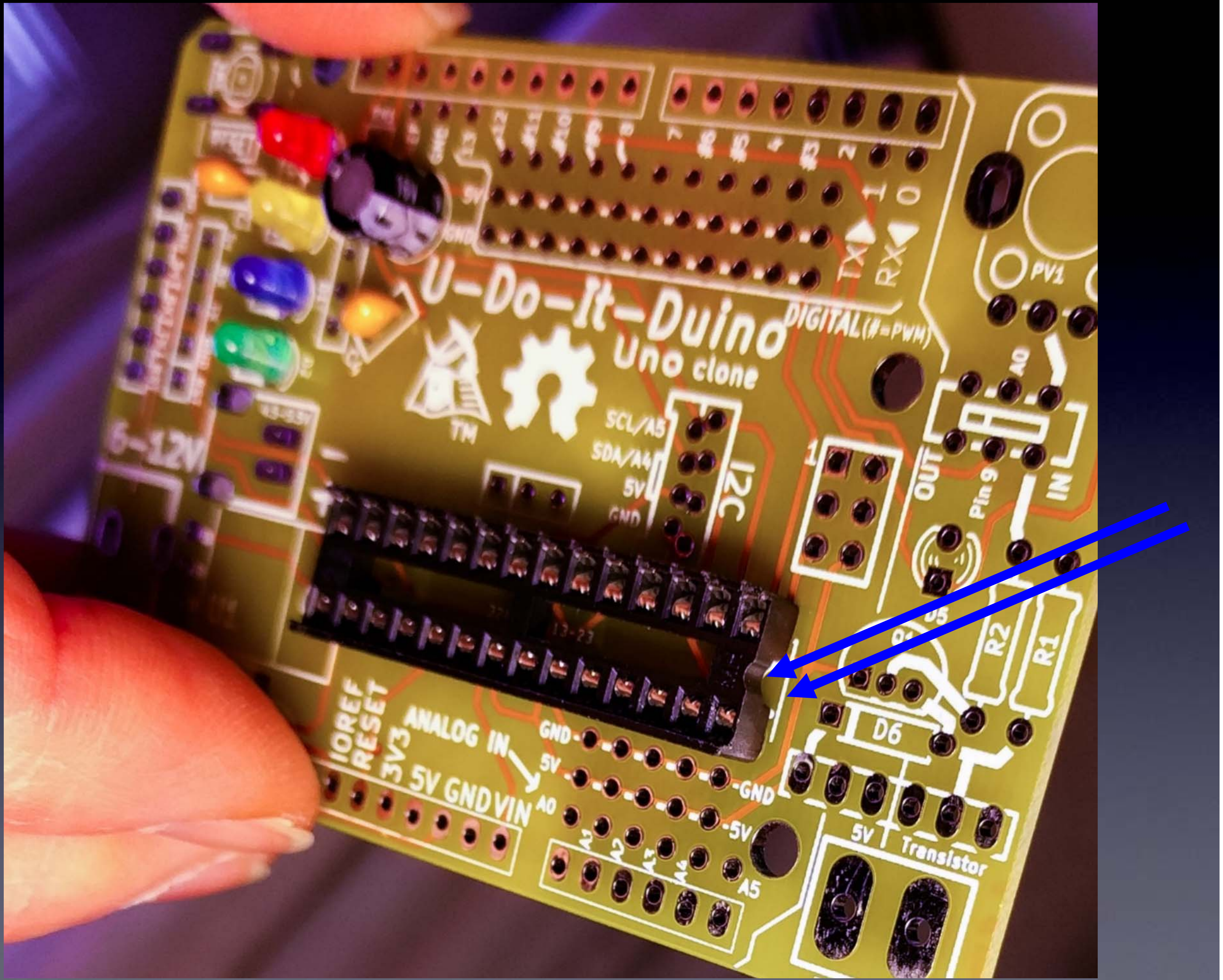
RESET
POWER
D13
RX
TX
D7
D1
D2
C1
C4
5V
GND
13
12
#11
#10
#9
8
7
#6
#5
4
#3
2
1
0
TX
RX
DIGITAL(#=PWM)
U-Do-It-Duino
Uno clone
TM
PV1
A0
OUT
Pin 9
IN
SCL/A5
SDA/A4
I2C
X1
D5
R2
R1
Q1
D6
4.5-5.5V
6-12V
U1
32684AP113-23
D3
C2
C3
USB
SW2
Power
LINE
IOREF
RESET
3V3
5V
GND
VIN
ANALOG IN
A0
A1
A2
A3
A4
A5
Transistor


RESET
SW1
POWER
D4
D13
D7
RX
D1
TX
D2
C1
C4
RN1
GND
5V
RX
TX
RST
6-12V
4.5-5.5V
−
+
U1
D3
C2
C3
USB
SW2
LINE
Power
U-Do-It-Duino
Uno clone
TM
DIGITAL(#=PWM)
13
12
#11
#10
#9
8
7
#6
#5
4
#3
2
TX 1
RX 0
SCL/A5
SDA/A4
5V
GND
I2C
X1
32684AP113-23
IOREF
RESET
3V3
5V
GND
VIN
ANALOG IN
A0
A1
A2
A3
A4
A5
PV1
A0
OUT
Pin 9
IN
D5
Q1
R2
R1
D6
5V
Transistor

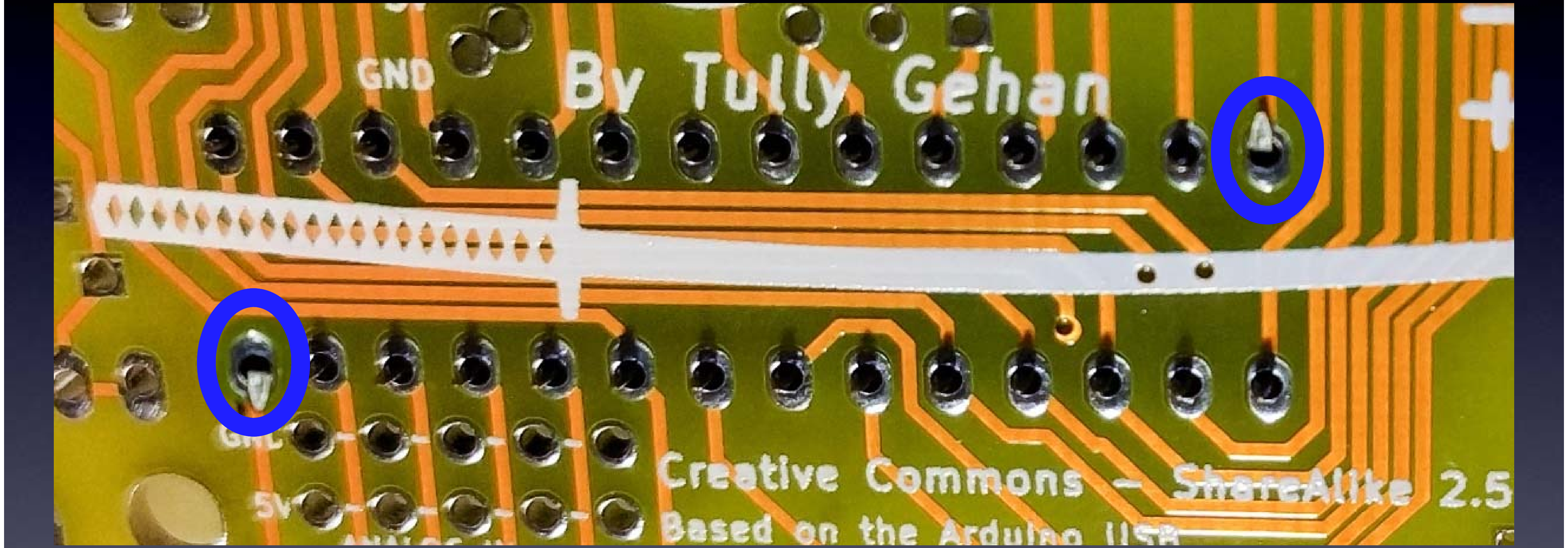

RESET
U-Do-It-Duino
Uno clone
DIGITAL(#=PWM)
D4
D7
D1
D2
RN1
C1
6-12V
4.5-5.5V
U1
D3
C2
C3
Power
USB
X1
I2C
SCL/A5
SDA/A4
5V
GND
TX
RX
PV1
Q1
D5
D6
R1
R2
ANALOG IN
IOREF
RESET
3V3
5V GND VIN
Transistor
TM
3268AP113-23


U-Do-It-Duino
Uno clone
TM
RESET
C1
C4
RN1
6-12V
4.5-5.5V
U1
D3
C2
C3
USB
Power
X1
SCL/A5
SDA/A4
5V
GND
I2C
DIGITAL(#=PWM)
TX
RX
PV1
A0
OUT
Pin 9
IN
D5
R2
R1
D6
32684AP113-23
IOREF
RESET
3V3
5V
GND
VIN
ANALOG IN
A0
A1
A2
A3
A4
A5
5V
Transistor

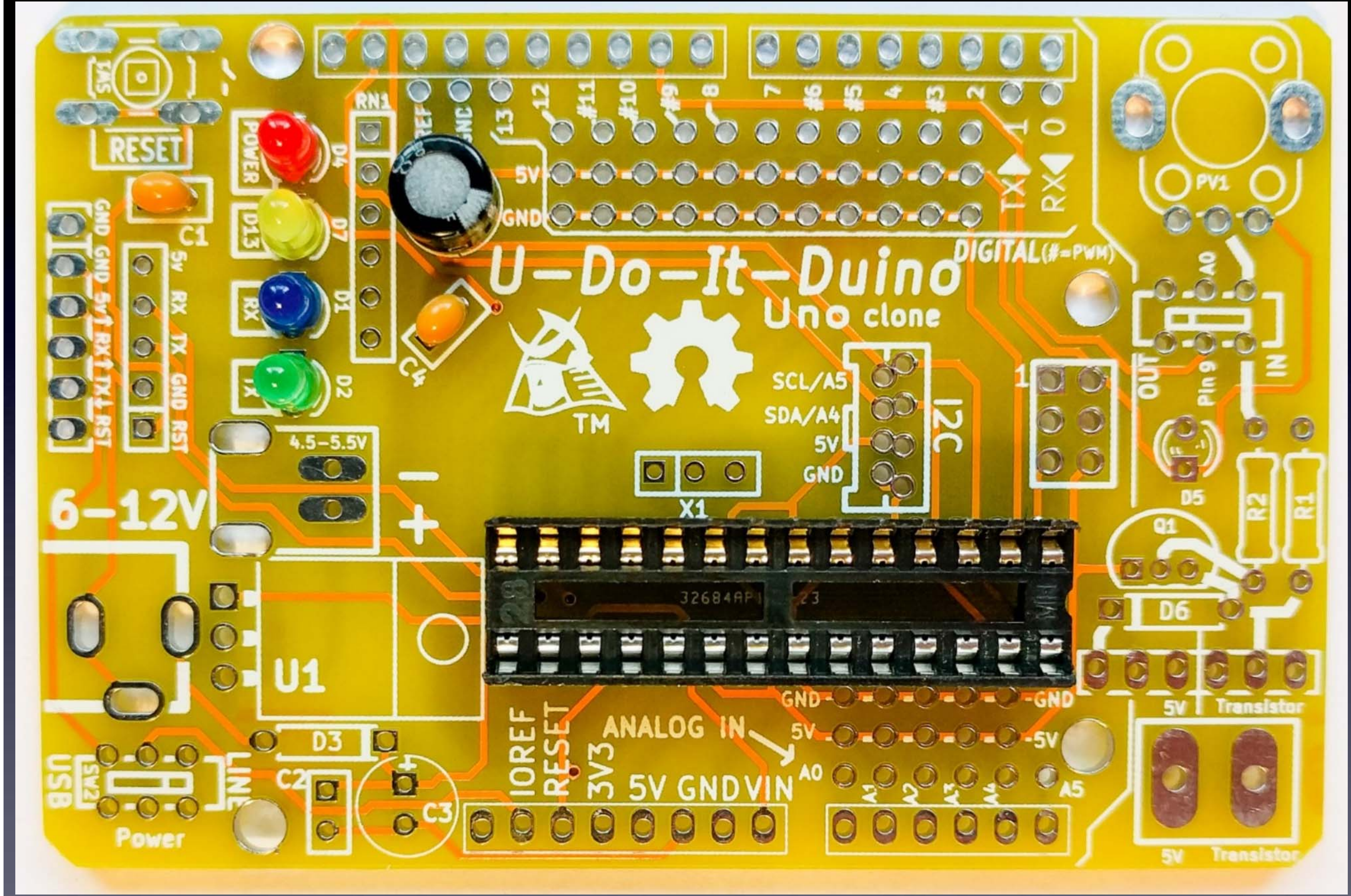

28

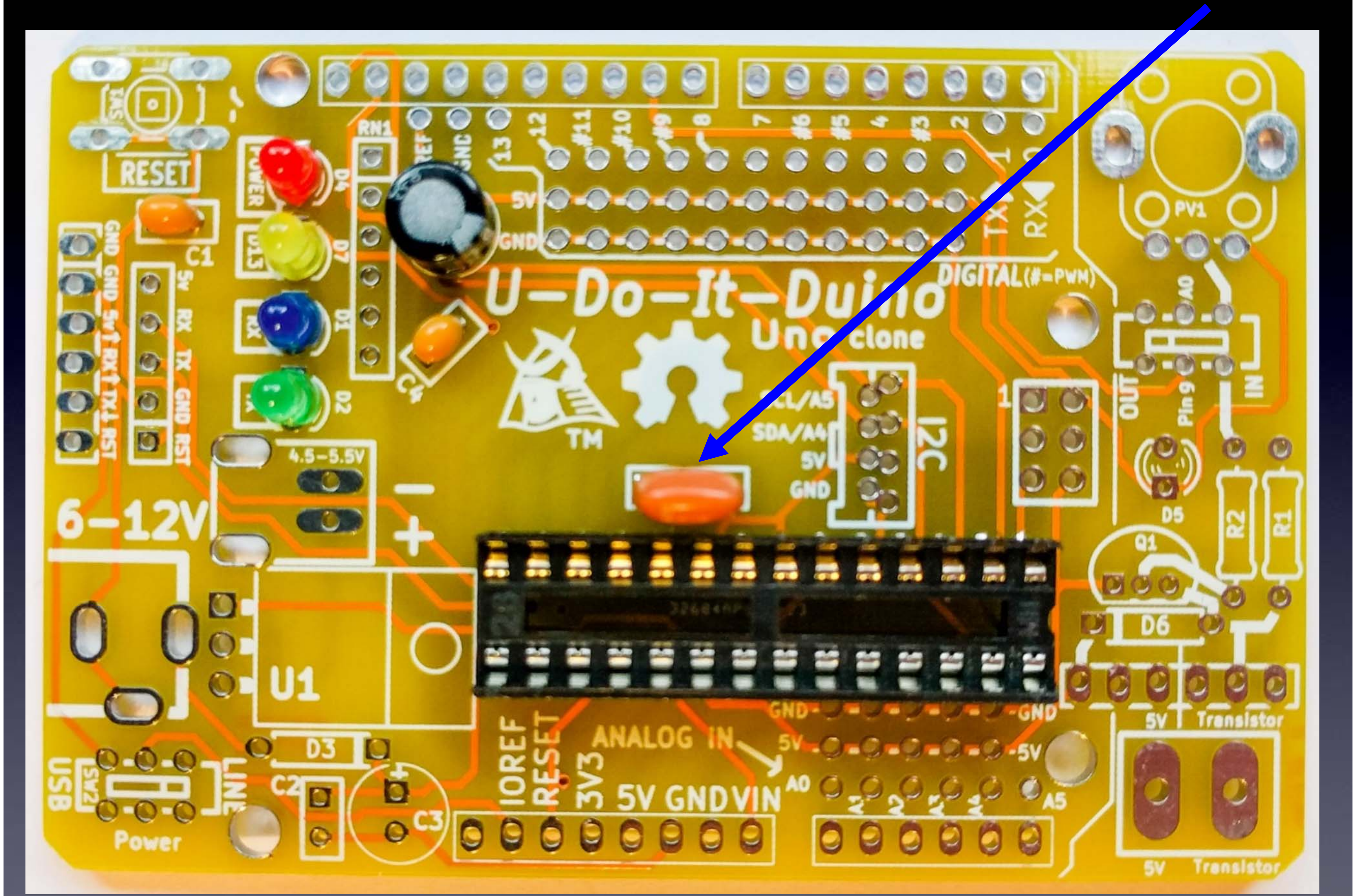

U-Do-It-Duino
Uno clone
TM
DIGITAL (#=PWM)
TX
RX
PV1
SCL/A5
SDA/A4
5V
GND
I2C
OUT
Pin 9
IN
A0
D5
R1
R2
D6
6-12V
IOREF
RESET
3V3
5V
GND
VIN
ANALOG IN
A0
A1
A2
A3
A4
A5
Transistor

Bend pins down on two opposite corners

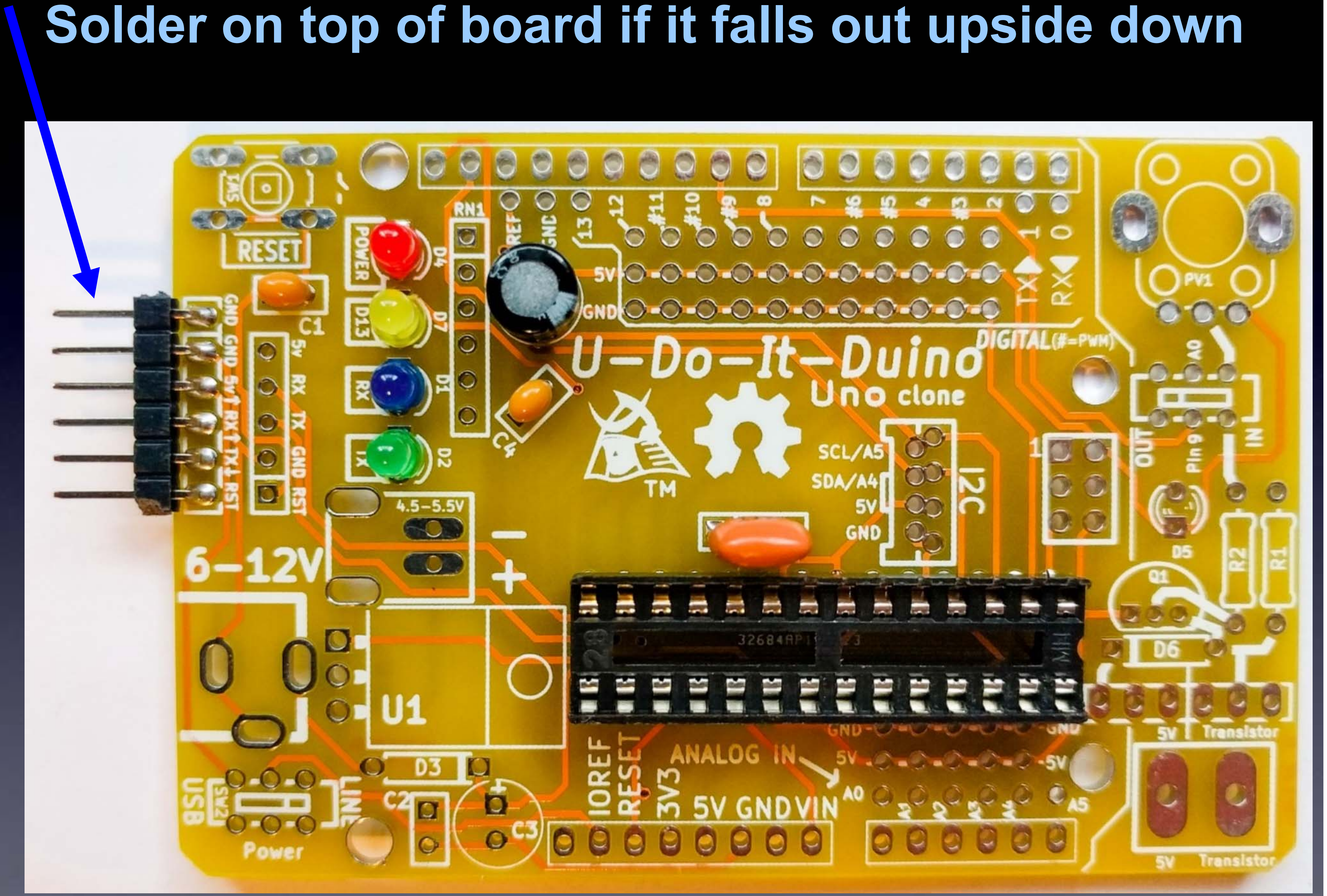


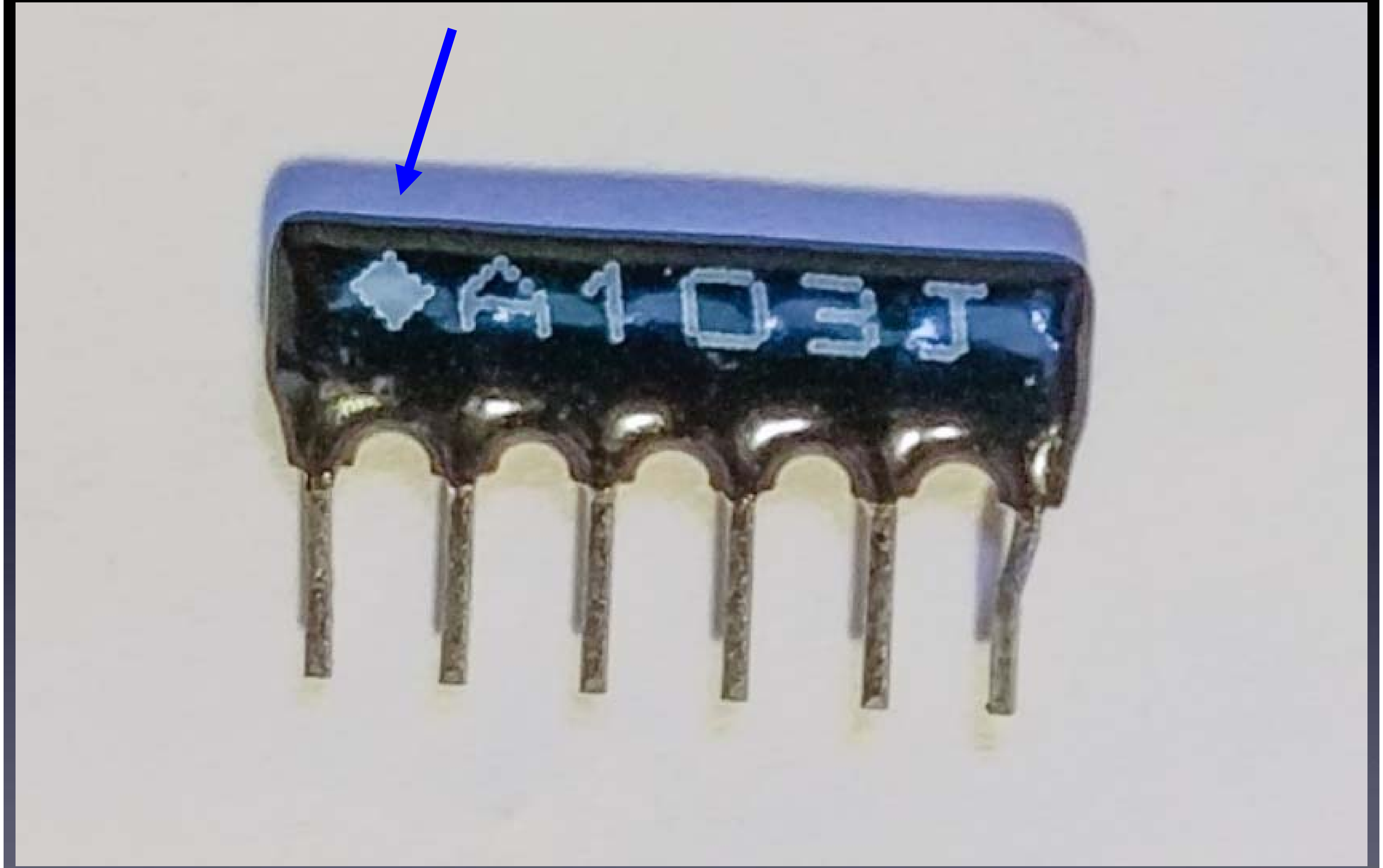
- Solder all 28 pins.
- Only need to clean the tip after it gets dirty.
- No need to cut the pins short after soldering.

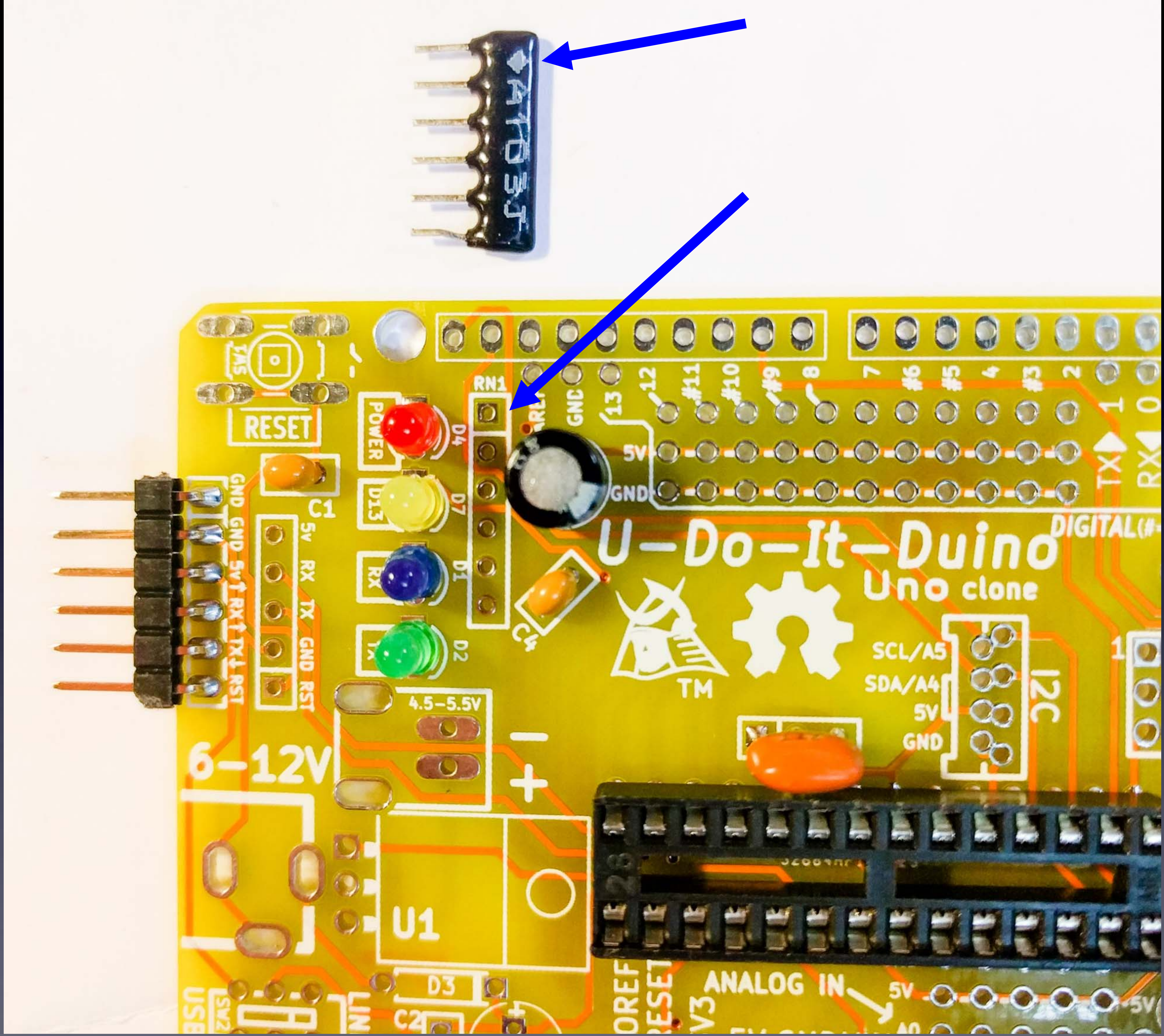

U-Do-It-Duino
Uno clone
RESET
SW1
C1
C4
RN1
POWER
D13
RX
TX
D4
D7
D1
D2
GND GND 5V RX TX RST
5V RX TX GND RST
13
12
#11
#10
#9
8
7
#6
#5
4
#3
2
1
0
TX
RX
5V
GND
DIGITAL(#=PWM)
TM
SCL/A5
SDA/A4
5V
GND
I2C
X1
PV1
A0
OUT
Pin 9
IN
D5
R2
R1
Q1
D6
5V
Transistor
4.5-5.5V
6-12V
U1
D3
C2
C3
USB
SW2
LINE
Power
IOREF
RESET
3V3
5V
GND
VIN
ANALOG IN
GND
-GND
5V
-5V
A0
A1
A2
A3
A4
A5
32684AP
23
28

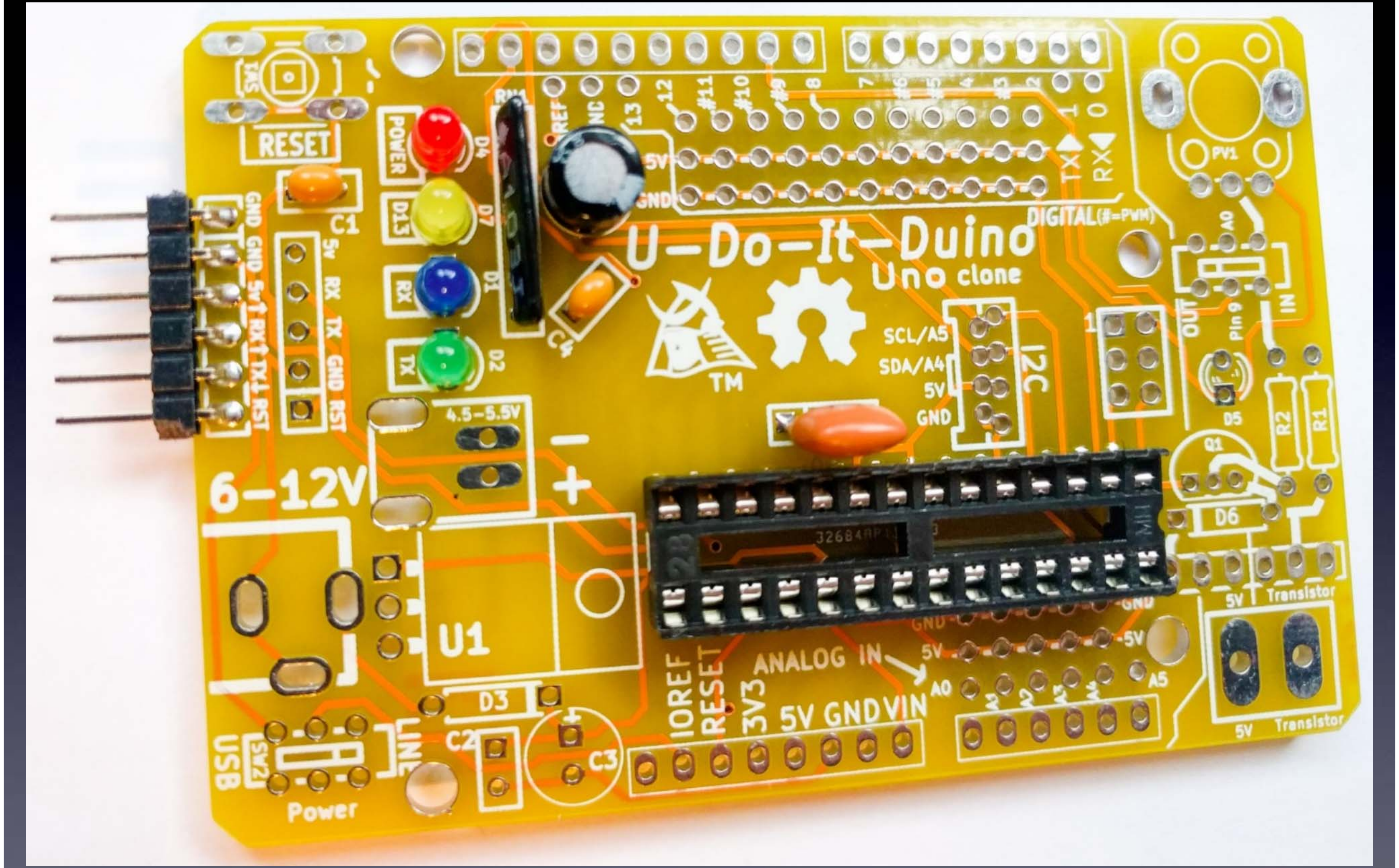

RESET
SW1
POWER
D4
D13
D7
RX
D1
TX
D2
RN1
C1
C4
5V
GND
GND
GND
5V
RX
TX
RST
5V
RX
TX
GND
RST
REF
GNC
13
12
#11
#10
#9
8
7
#6
#5
4
#3
2
1
0
TX
RX
DIGITAL (#=PWM)
U-Do-It-Duino
Uno clone
TM
SCL/A5
SDA/A4
5V
GND
I2C
1
PV1
A0
OUT
Pin 9
IN
D5
Q1
R2
R1
D6
4.5-5.5V
6-12V
U1
D3
C2
C3
USB
SW2
LINE
Power
IOREF
RESET
3V3
5V
GND
VIN
ANALOG IN
GND
5V
A0
A1
A2
A3
A4
A5
5V
Transistor
5V
Transistor

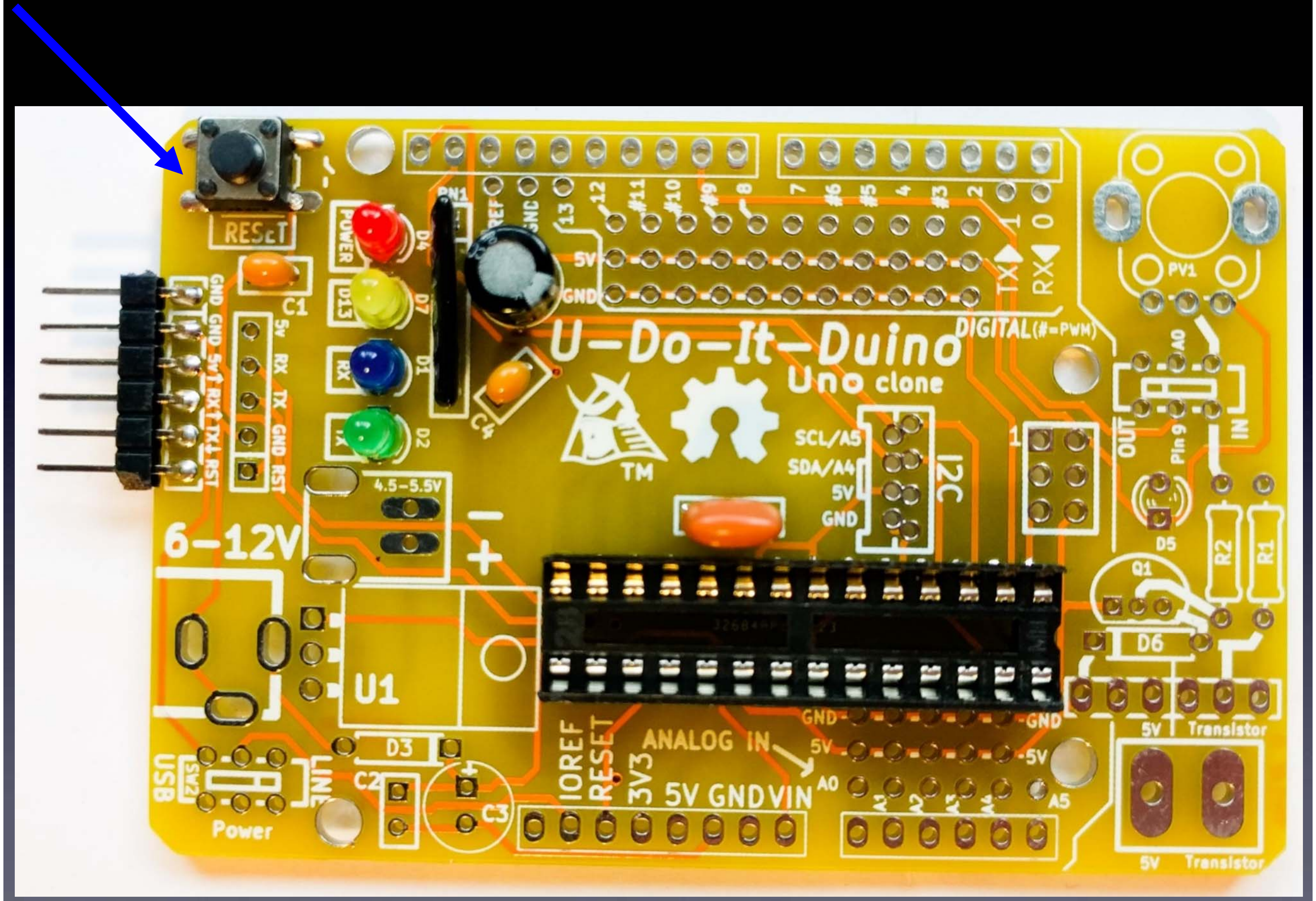
Solder on top of board if it falls out upside down



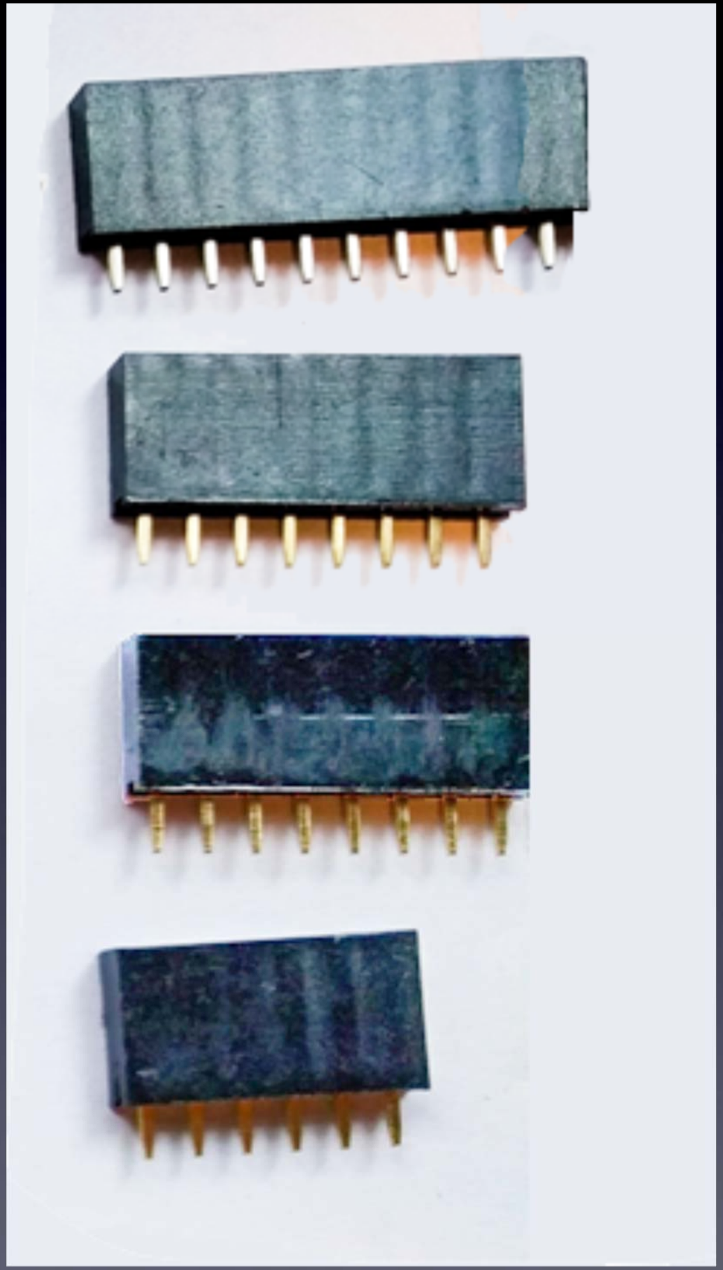

◆A103J


A103J
RN1
RESET
POWER
D4
D13
D7
RX
D1
TX
D2
C1
C4
GND
5V
U-Do-It-Duino
Uno clone
TM
SCL/A5
SDA/A4
5V
GND
I2C
DIGITAL
4.5-5.5V
6-12V
U1
D3
C2
ANALOG IN
IOREF
RESET
3V3
USB

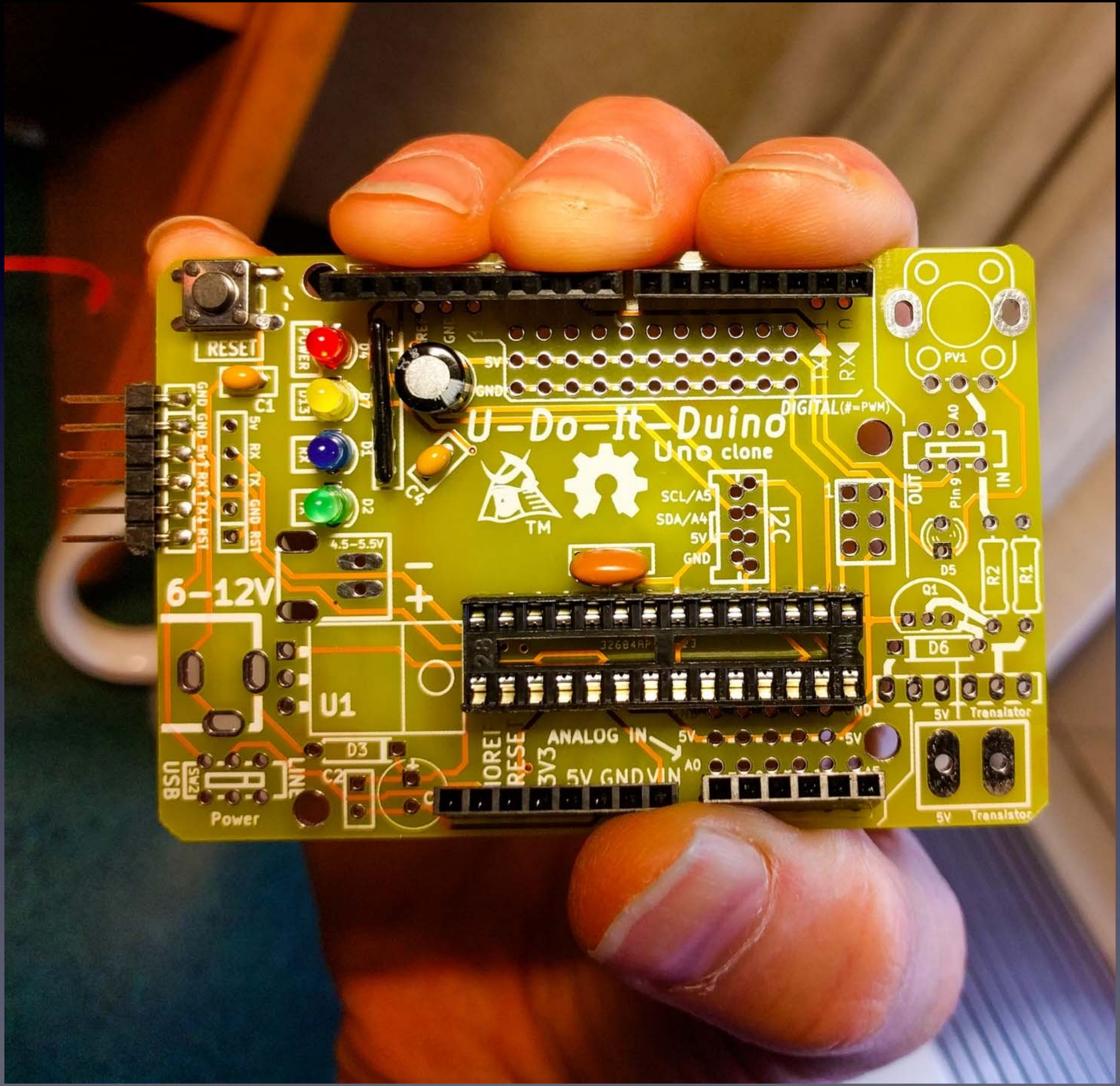

U-Do-It-Duino
Uno clone
TM
RESET
POWER
D13
RX
TX
D4
D7
D1
D2
C1
C4
RN1
GND GND 5V RX1 TX1 RST
5v RX TX GND RST
4.5-5.5V
6-12V
U1
D3
C2
C3
USB
SW2
Power
LINE
IOREF RESET 3V3 5V GND VIN
ANALOG IN
A0 A1 A2 A3 A4 A5
DIGITAL(#=PWM)
REF NC 13 12 #11 #10 #9 8 7 #6 #5 4 #3 2 1 0
TX RX
5V
GND
SCL/A5
SDA/A4
5V
GND
I2C
PV1
OUT
Pin 9
IN
D5
D6
Q1
R1
R2
5V
Transistor
32684AP


RESET
POWER
D4
D13
D7
RX
D1
TX
D2
C1
C4
PN1
REF
GND
13
12
#11
#10
#9
8
7
#6
#5
4
#3
2
1
0
TX
RX
5V
GND
DIGITAL(#=PWM)
U-Do-It-Duino
Uno clone
TM
PV1
A0
OUT
Pin 9
IN
SCL/A5
SDA/A4
5V
GND
I2C
D5
R2
R1
Q1
D6
GND 5V RX TX RST
GND 5V RX TX GND RST
4.5-5.5V
6-12V
U1
D3
C2
C3
USB
SW2
LINE
Power
IOREF
RESET
3V3
5V
GND
VIN
ANALOG IN
GND
5V
A0
A1
A2
A3
A4
A5
5V
Transistor

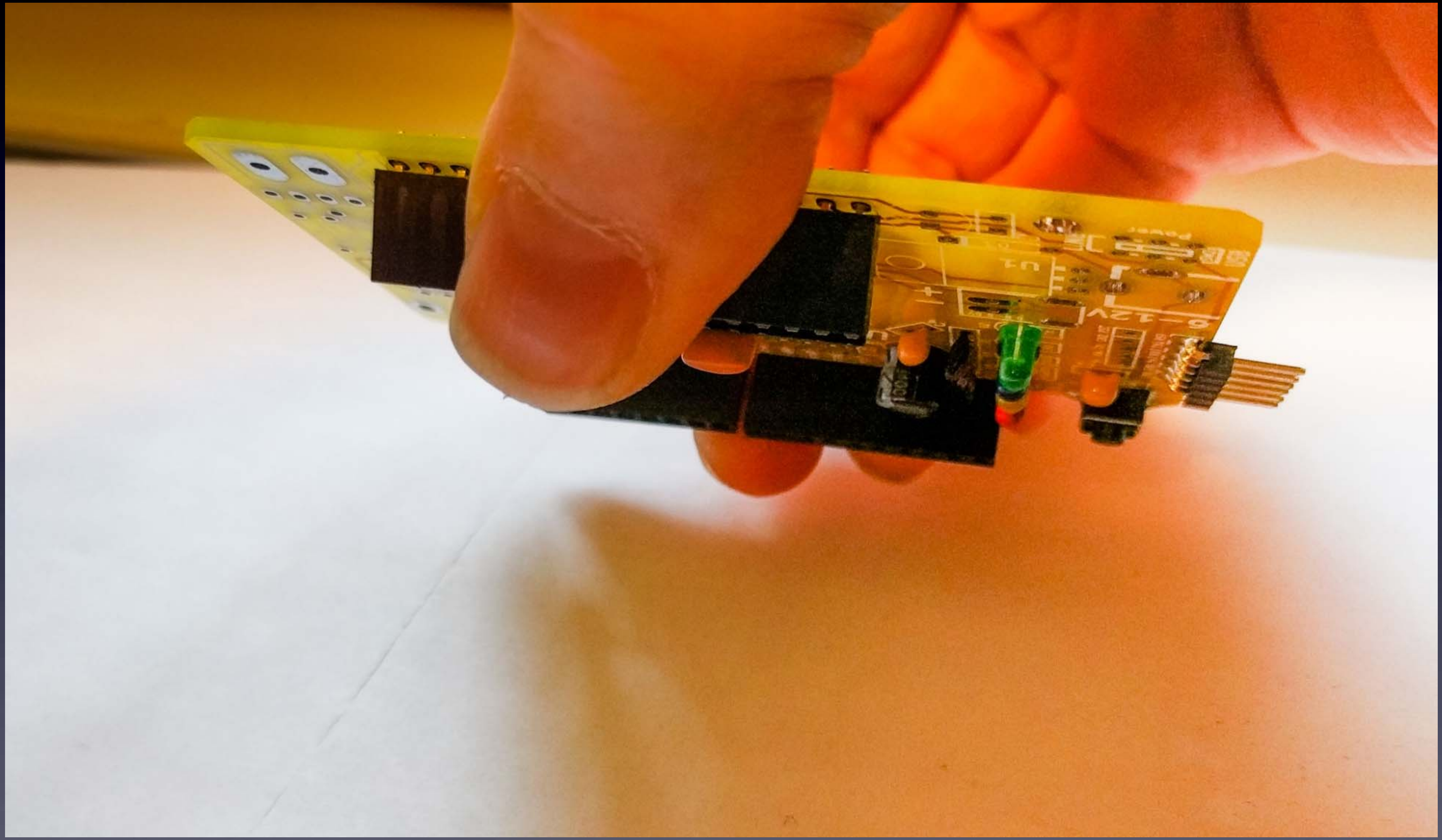
Headers



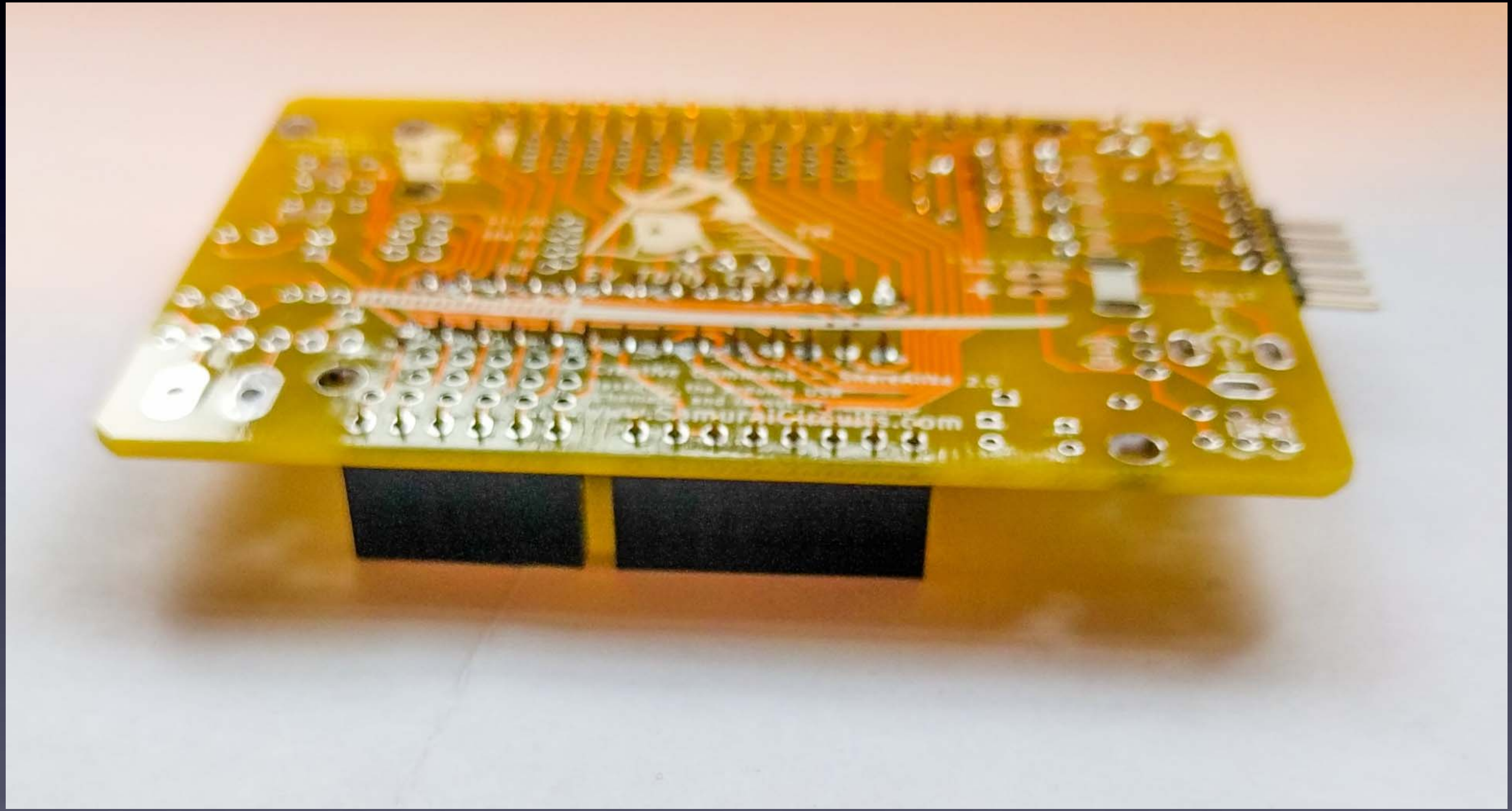
Headers

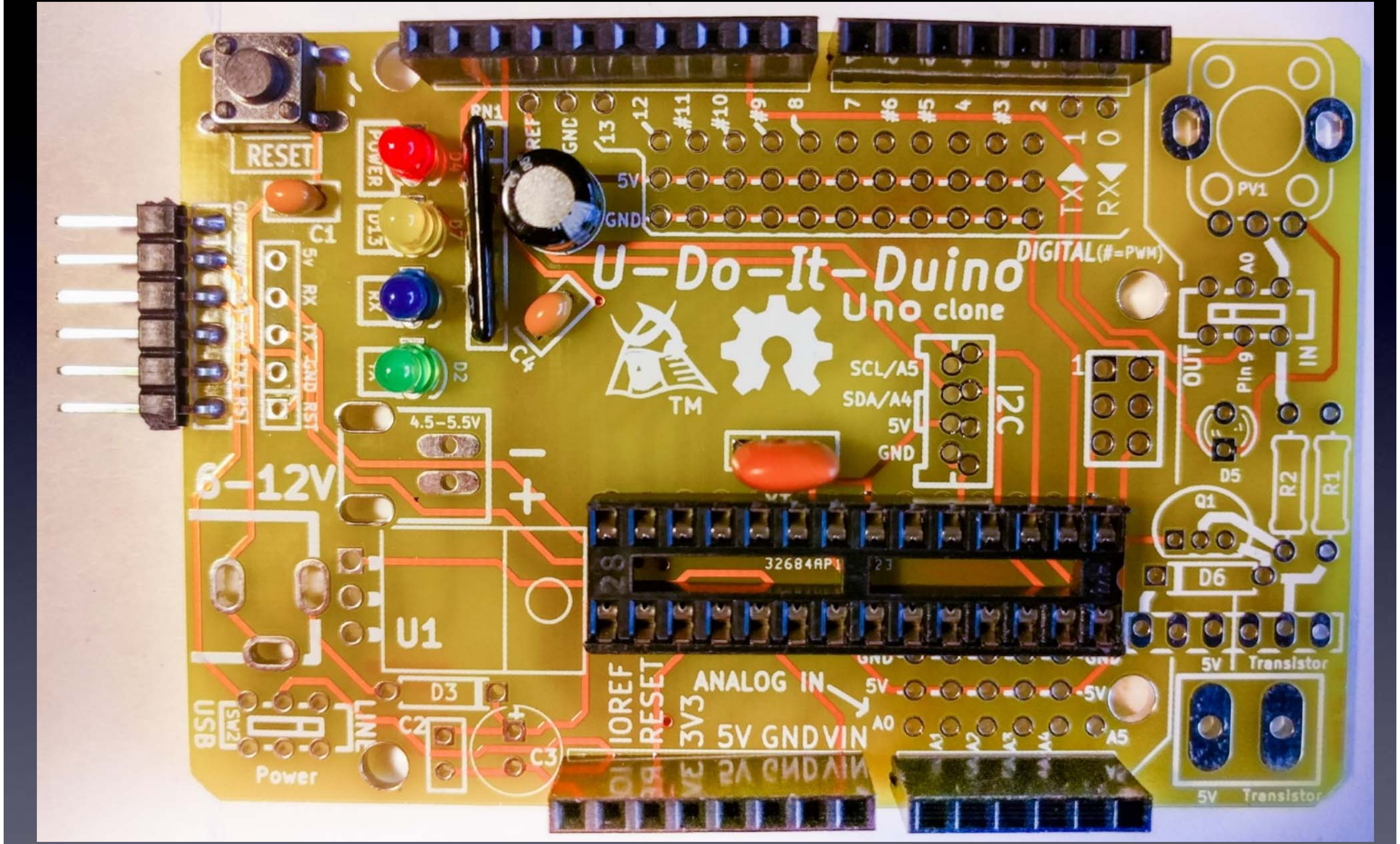

RESET
U-Do-It-Duino
Uno clone
DIGITAL(#=PWM)
SCL/A5
SDA/A4
5V
GND
I2C
6-12V
4.5-5.5V
U1
D3
C2
USB
Power
ANALOG IN
IOREF
RESET
3V3
5V GND VIN
5V
Transistor
PV1
A0
OUT
IN
Pin 9
D5
D6
Q1
R2
R1
TM

Headers

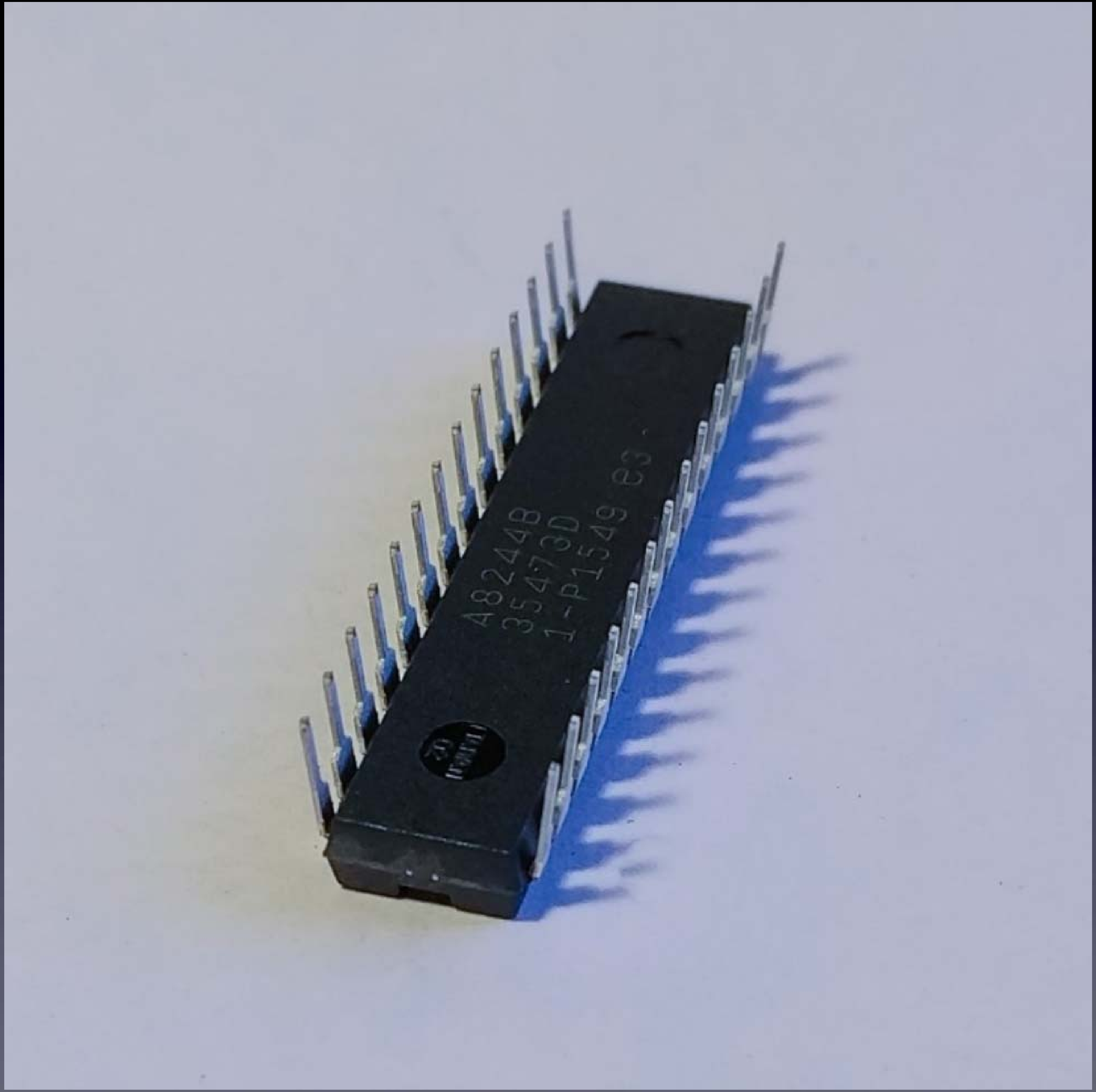


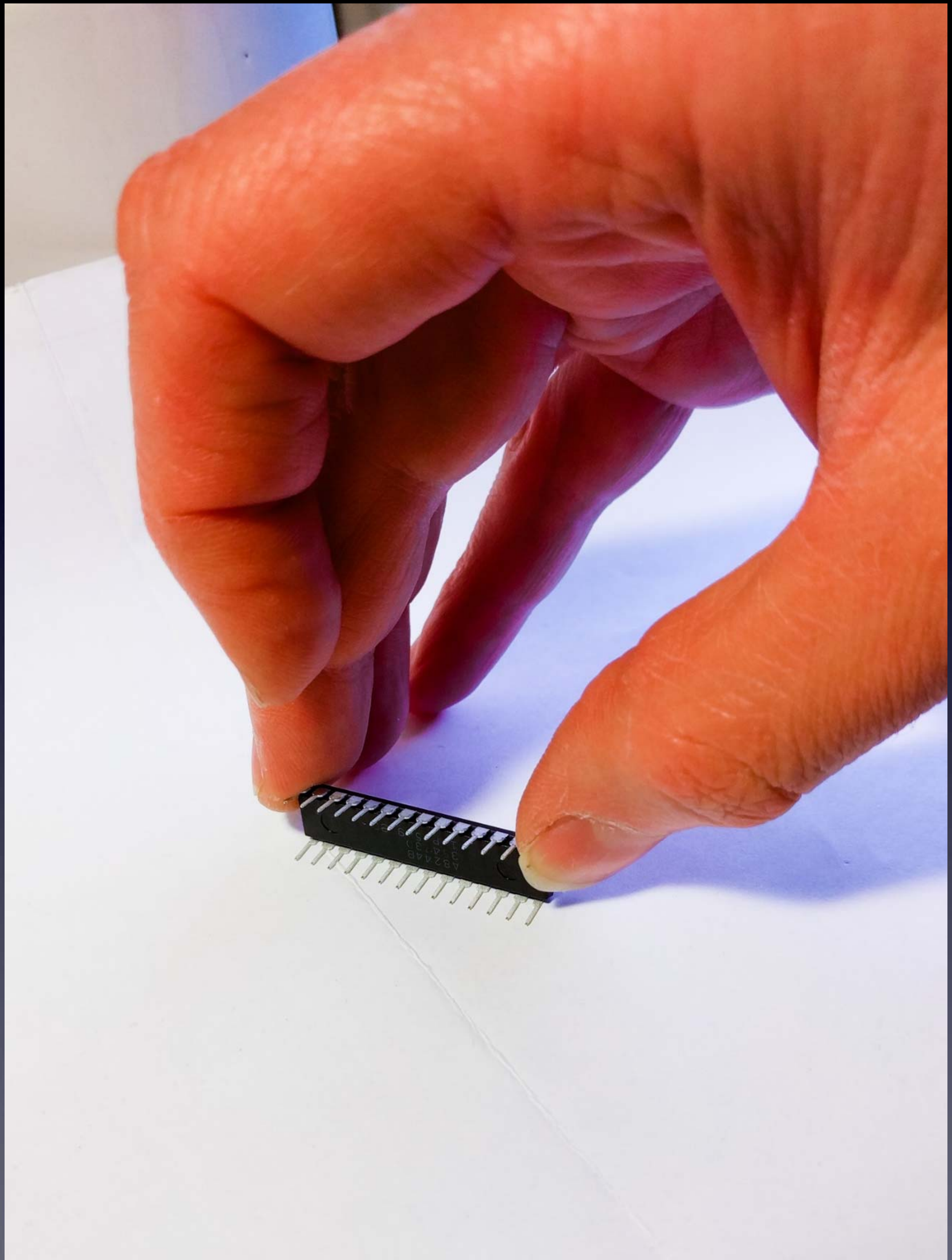
Headers

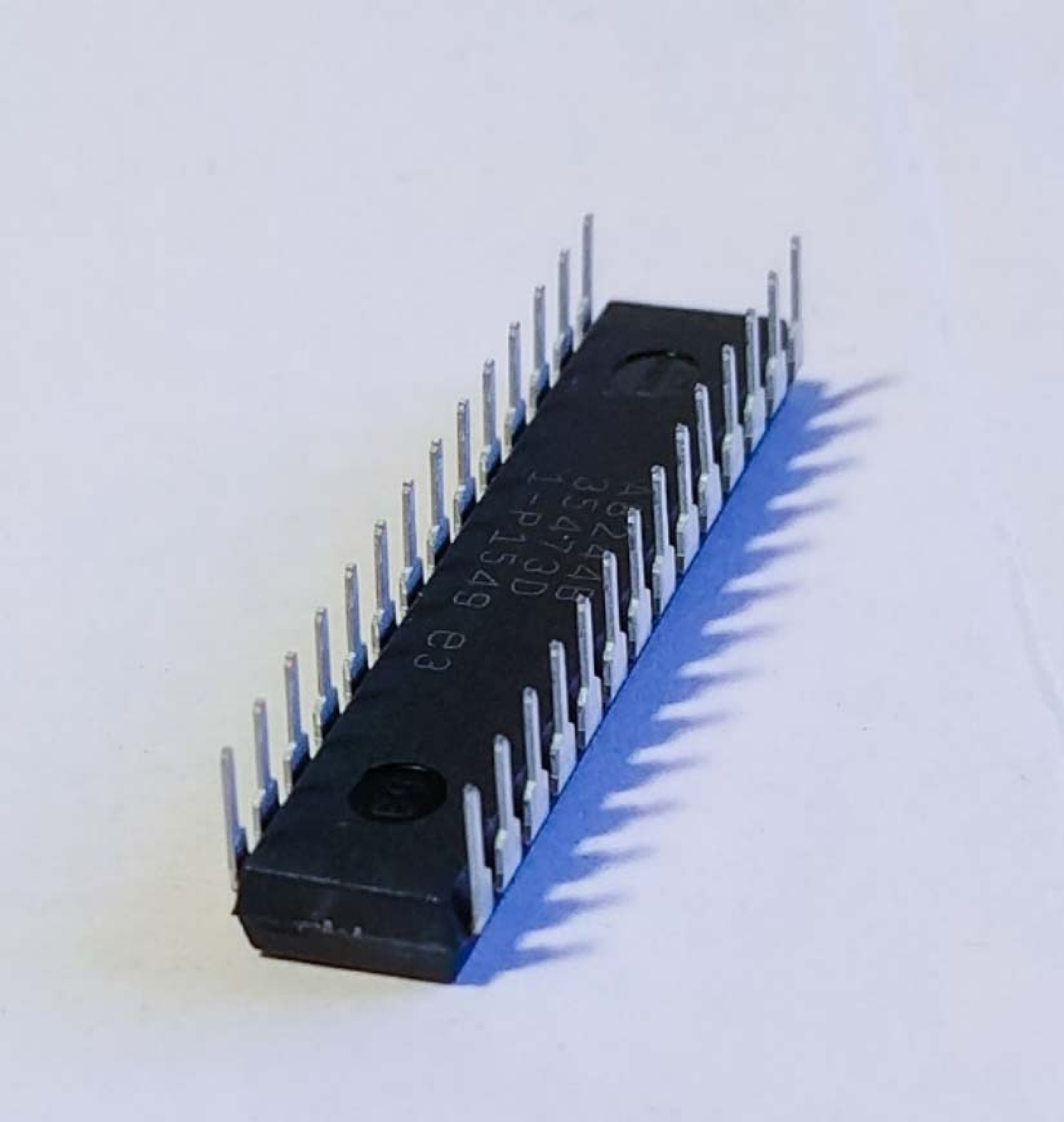


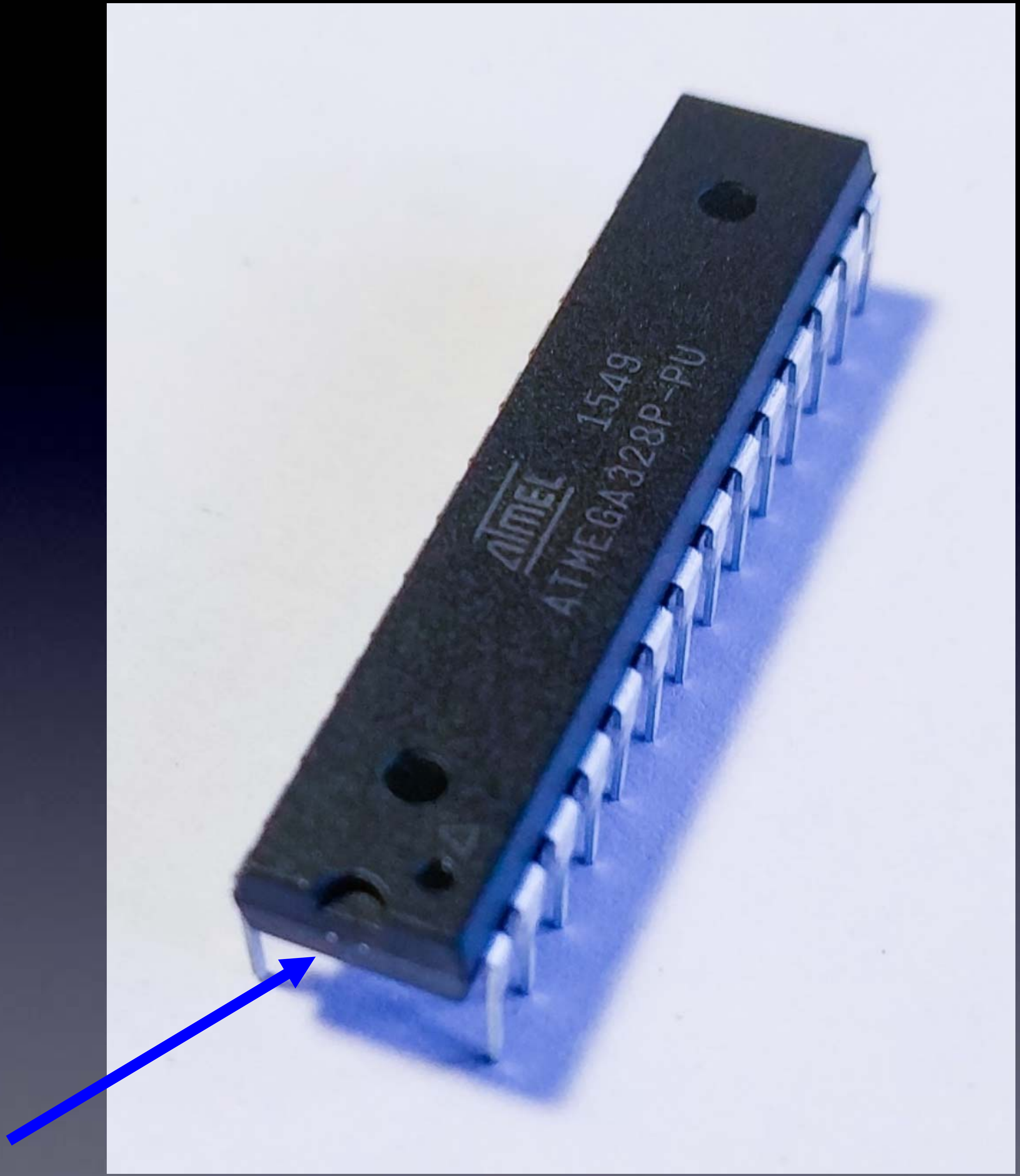


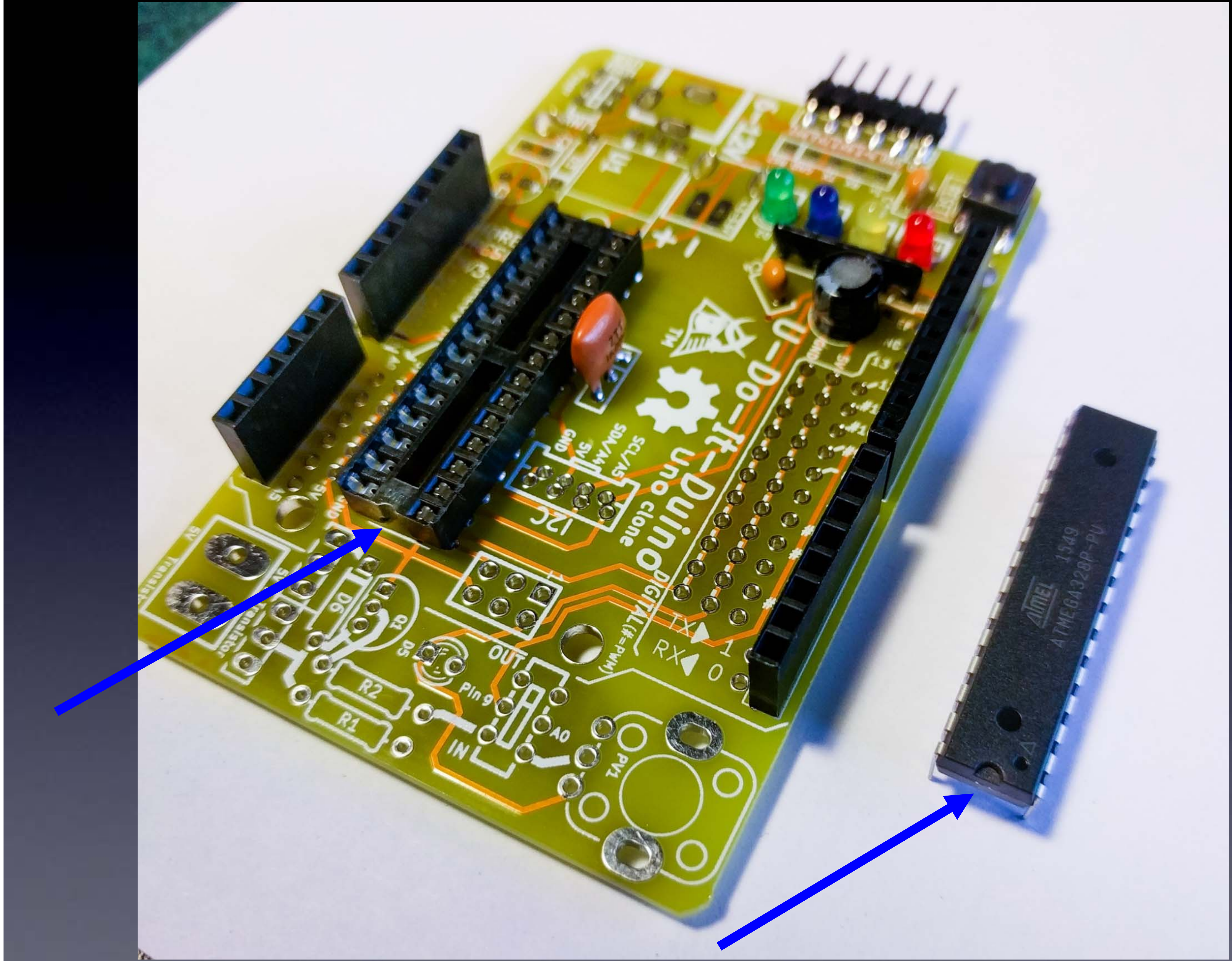
RESET
C1
POWER
D13
RX
TX
D4
D7
D2
RN1
REF
GND
13
12
#11
#10
#9
8
7
#6
#5
4
#3
2
1
0
5V
GND
TX
RX
DIGITAL(#=PWM)
U-Do-It-Duino
Uno clone
TM
C4
SCL/A5
SDA/A4
5V
GND
I2C
1
PV1
A0
OUT
Pin 9
IN
D5
R2
R1
Q1
D6
5V
Transistor
4.5–5.5V
−
+
6–12V
U1
28
32684AP1
D3
C2
C3
USB
SW2
LINE
Power
IOREF
RESET
3V3
5V
GND
VIN
ANALOG IN
GND
5V
A0
A1
A2
A3
A4
A5
5V
Transistor

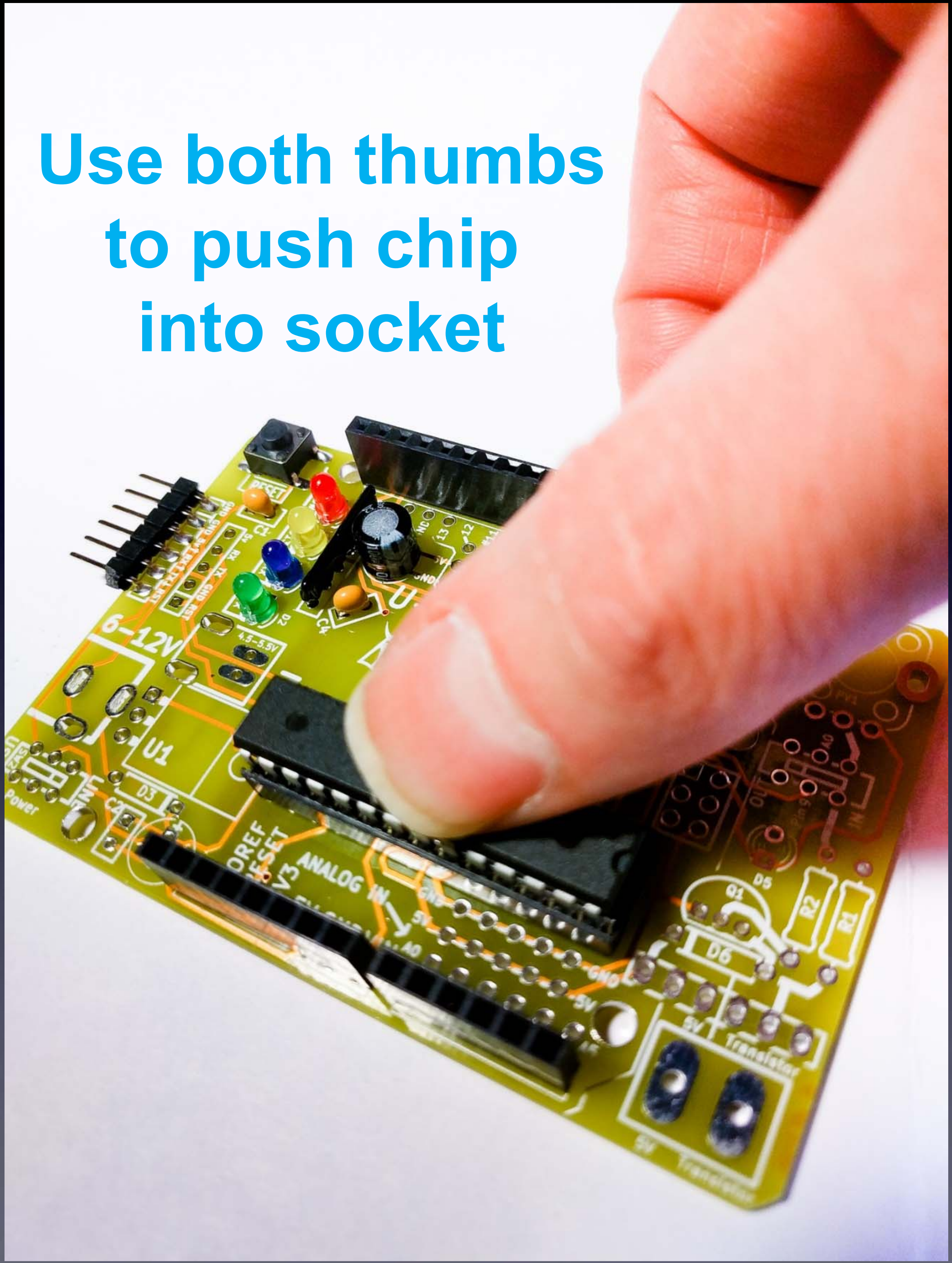

A82448
35473D
1-P1549 e3



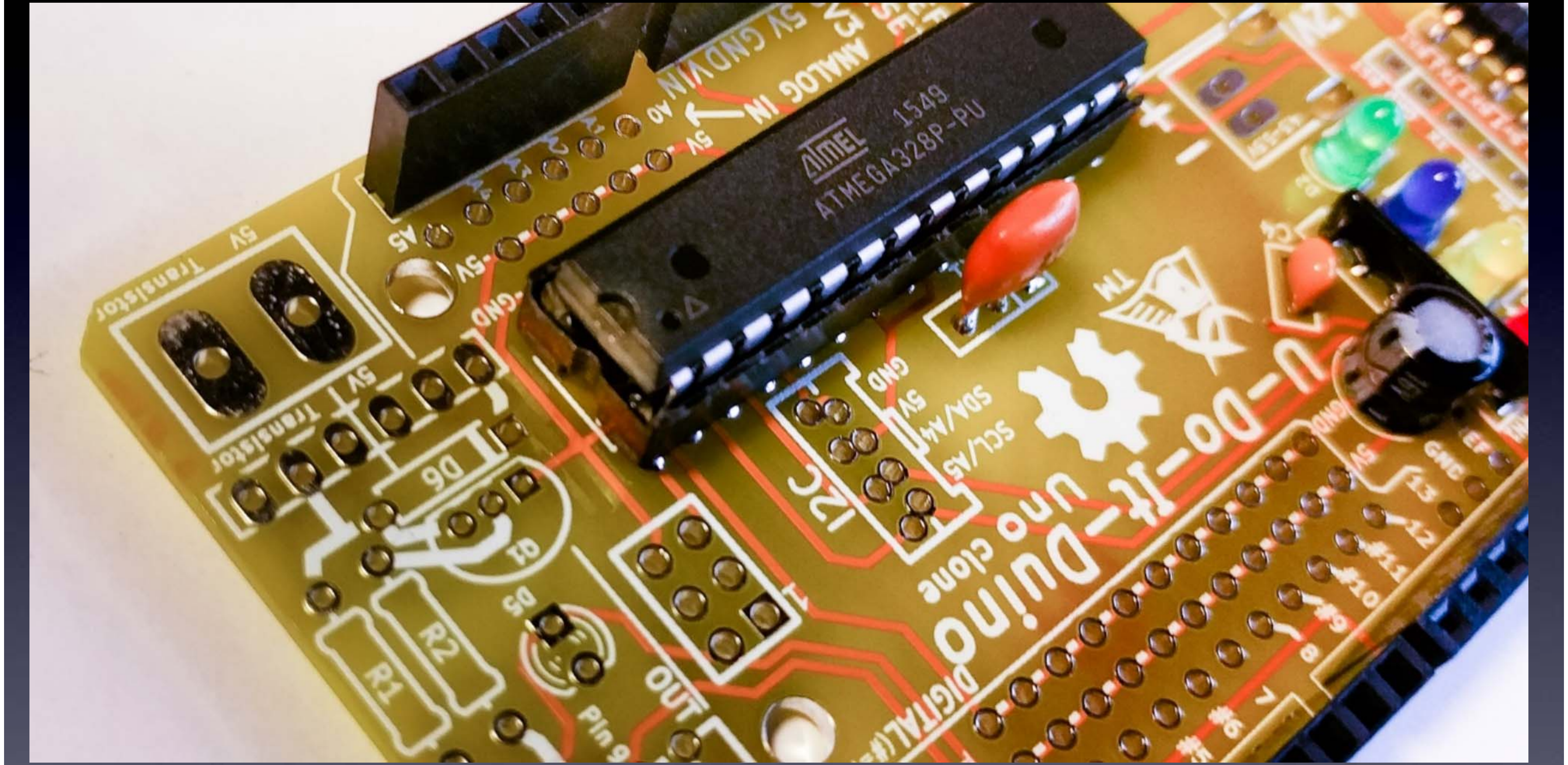

35473D
1-P1549
e3


Atmel
1549
ATMEGA328P-PU

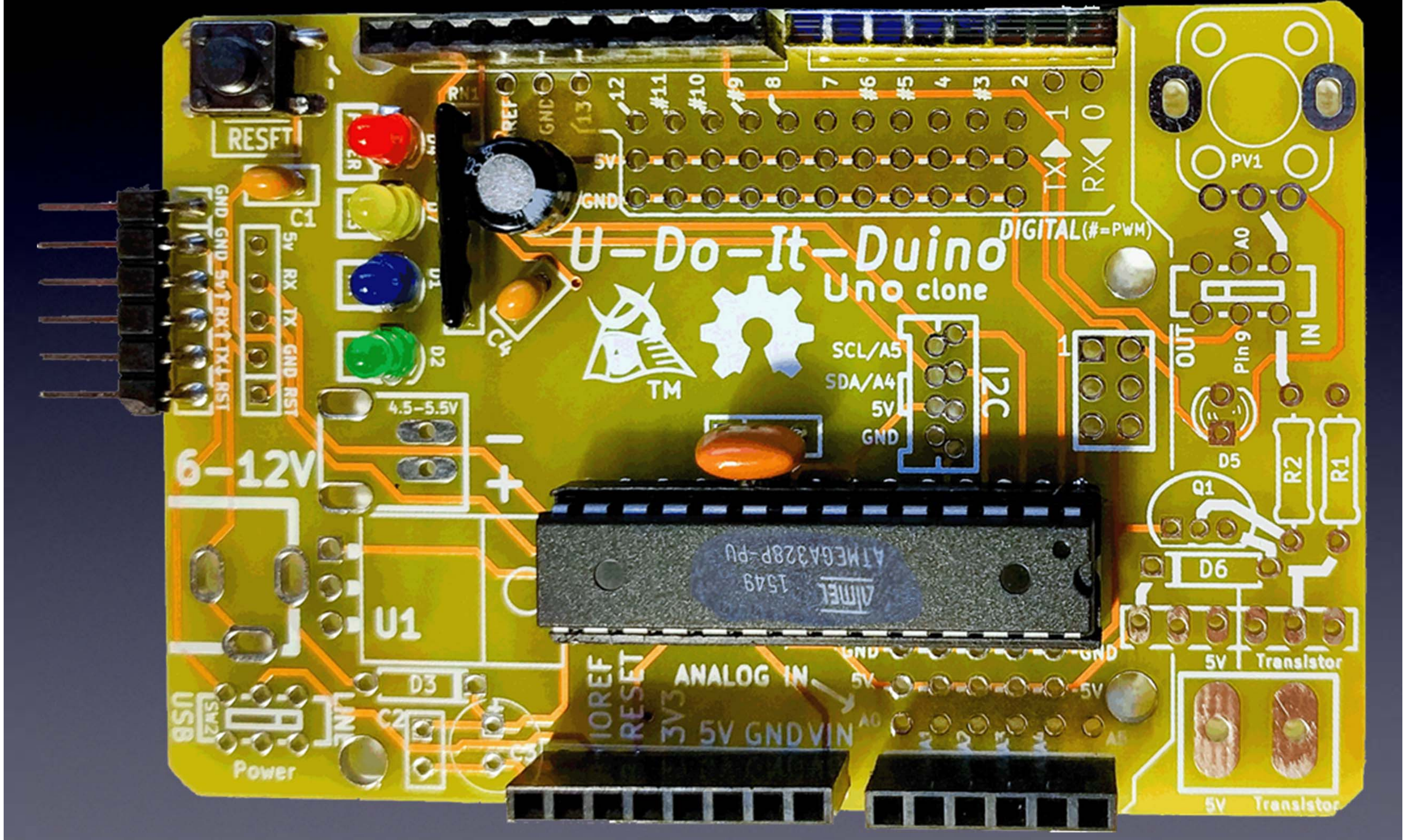

U-Do-It-Duino
Uno clone
DIGITAL (#=PWM)
TX 1
RX 0
I2C
SCL/A5
SDA/A4
5V
GND
R1
R2
D5
D6
Q1
PV1
IN
OUT
A0
Pin 9
+
-
ATMEL
1549
ATMEGA328P-PU



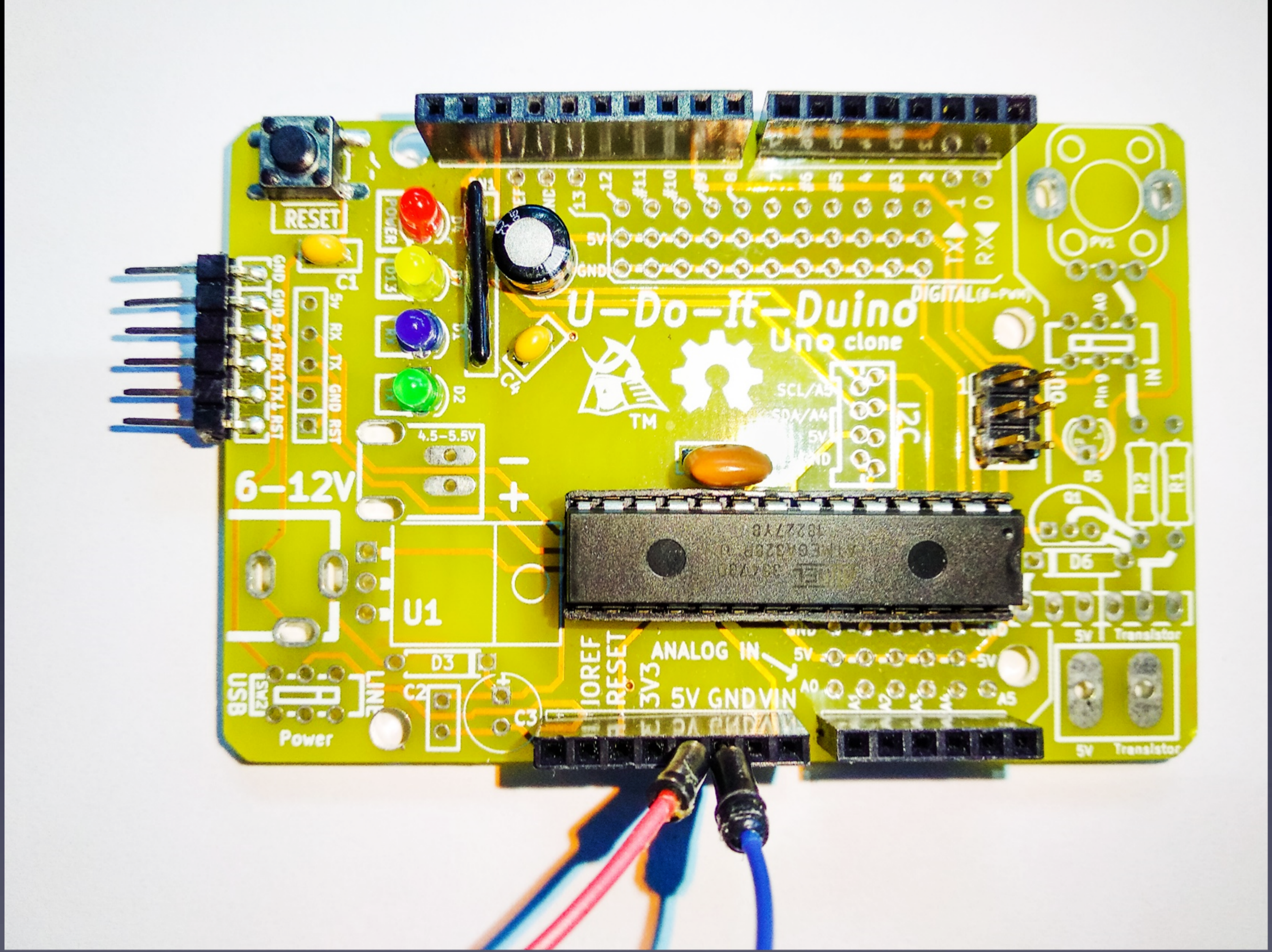
Use both thumbs to push chip into socket


ATMEL
1549
ATMEGA328P-PU
U-Do-It-Duino
uno clone
I2C
GND
5V
SDA/A4
SCL/A5
ANALOG IN
A0
A5
5V GND VIN
Transistor
5V
D6
Q1
D5
R1
R2
OUT
Pin 9
DIGITAL
TM
GND
13
12
~11
~10
~9
8
7
~6

We're done!

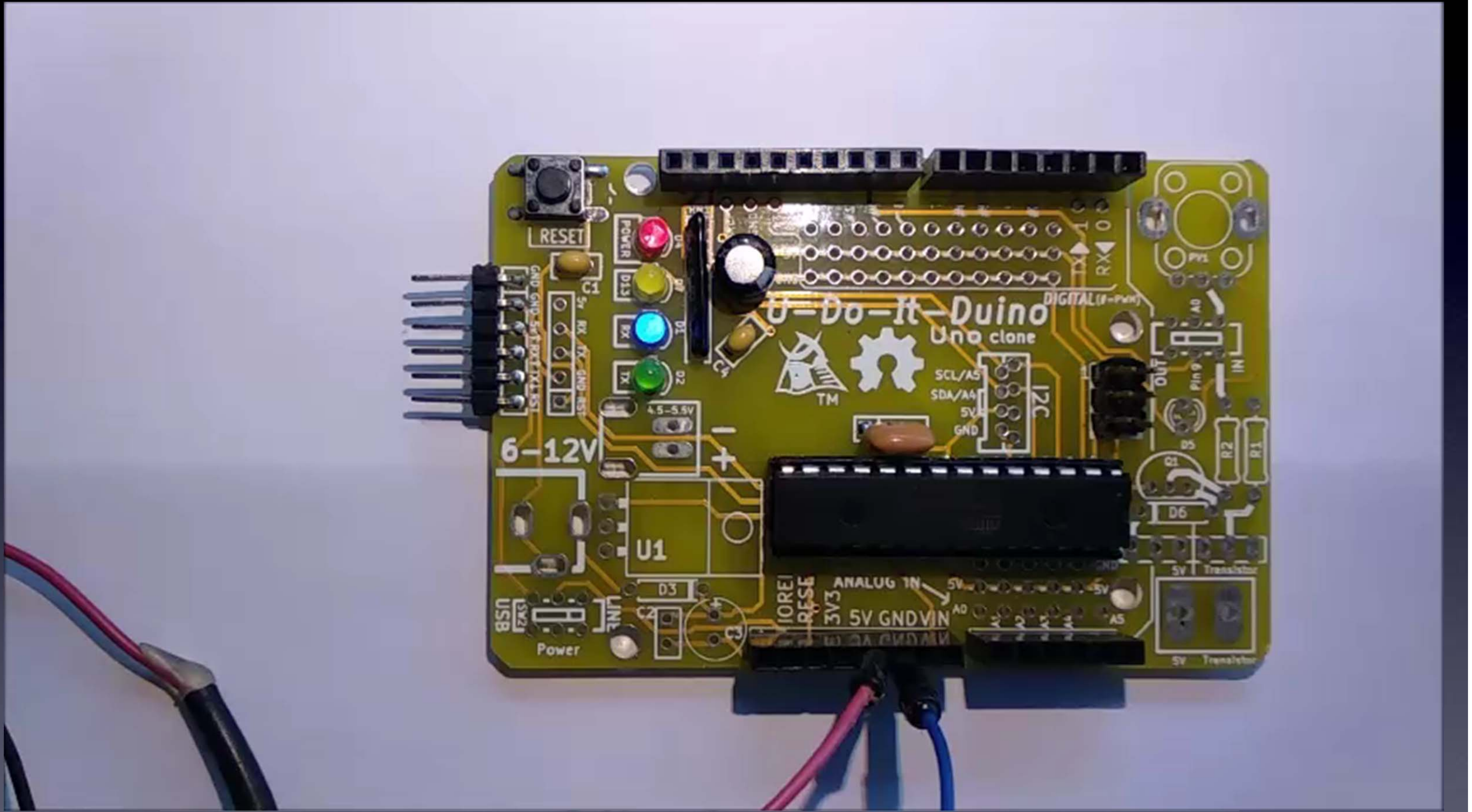

U-Do-It-Duino
Uno clone
TM
RESET
C1
C4
D2
D3
D5
D6
U1
Q1
R1
R2
PV1
6-12V
4.5-5.5V
USB
Power
DIGITAL(#=PWM)
TX
RX
ANALOG IN
IOREF
RESET
3V3
5V
GND
VIN
SCL/A5
SDA/A4
I2C
OUT
IN
Pin 9
A0
5V
Transistor
ATMEGA328P-PU
1549

First test:



Connect power with a battery pack…

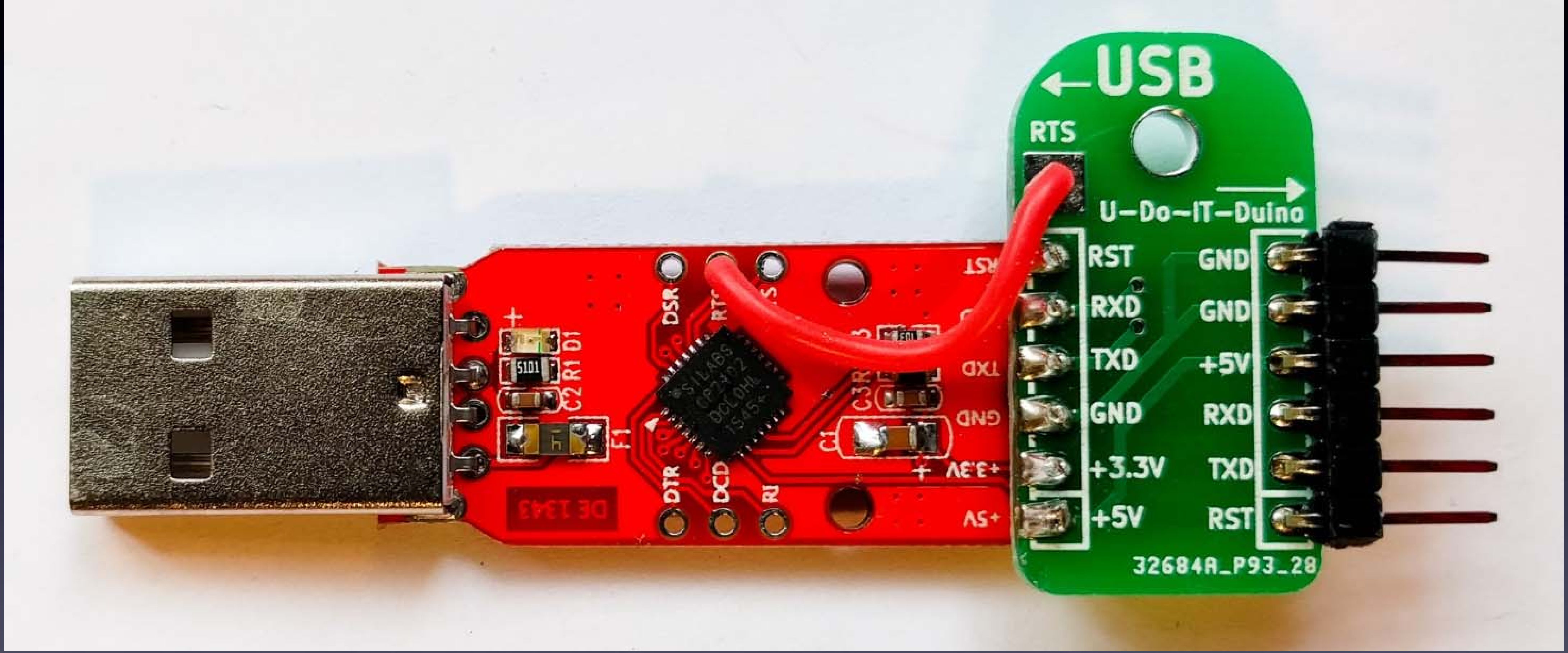
First test:



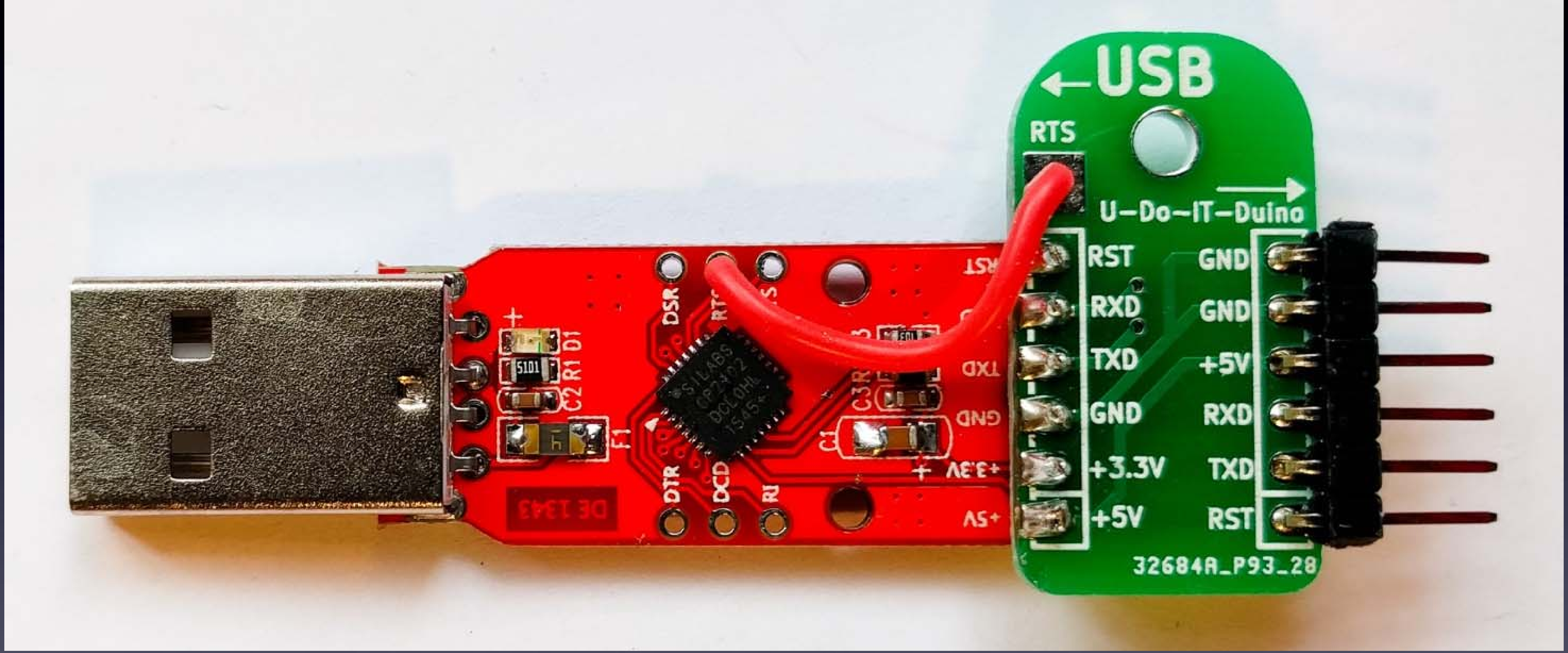
… and it blinks !

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

USB-Serial Cable



USB-Serial Cable Driver



You will 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>

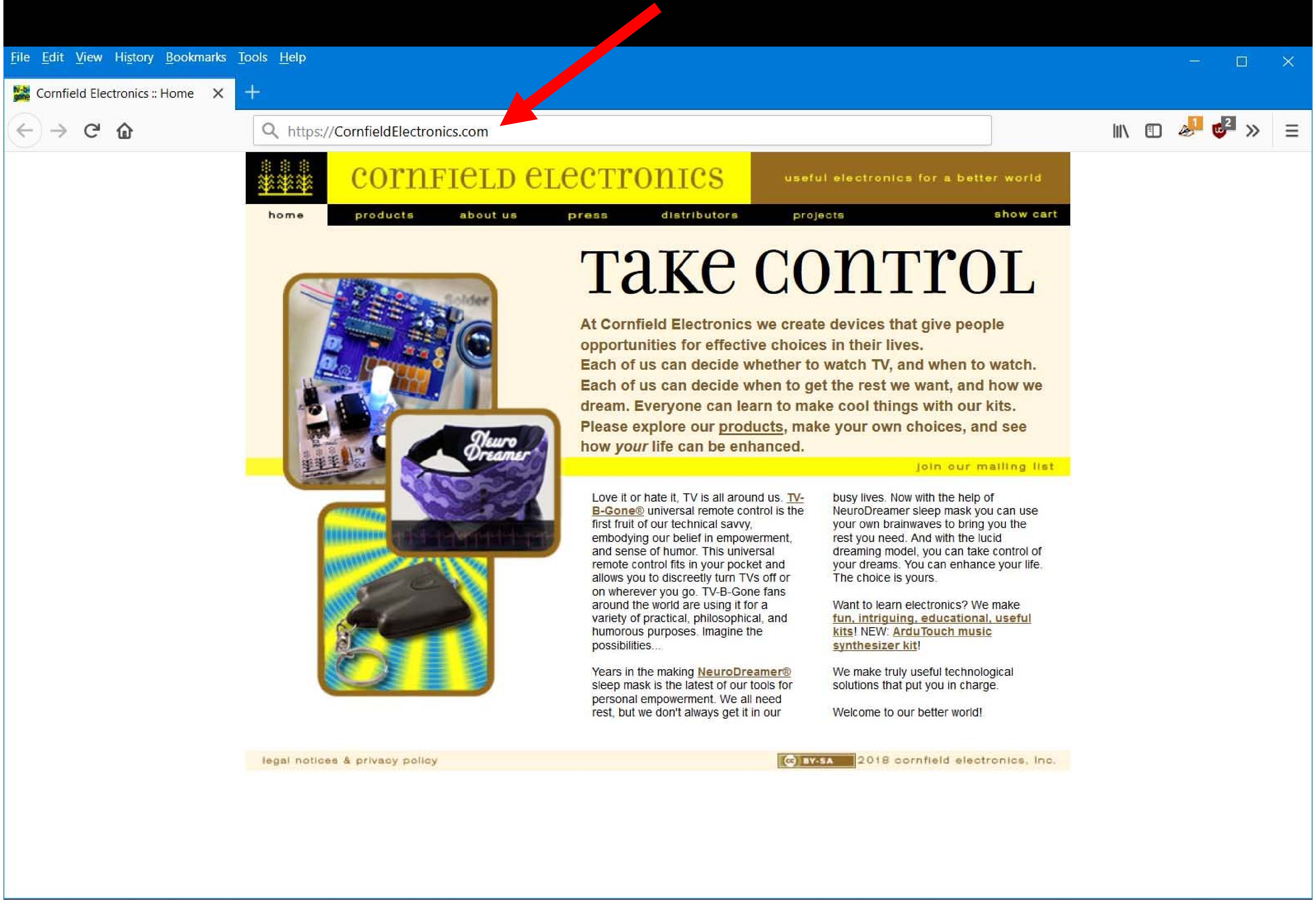
Helpful info
on the

Arduino for(4) Total Newbies

---

workshop
web-page:

http://tiny.cc/A4TN


File Edit View History Bookmarks Tools Help
Cornfield Electronics :: Home
https://CornfieldElectronics.com
cornfield electronics
useful electronics for a better world
home
products
about us
press
distributors
projects
show cart
Solder
NeuroDreamer
join our mailing list
legal notices & privacy policy
BY-SA
2018 cornfield electronics, inc.

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, 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.

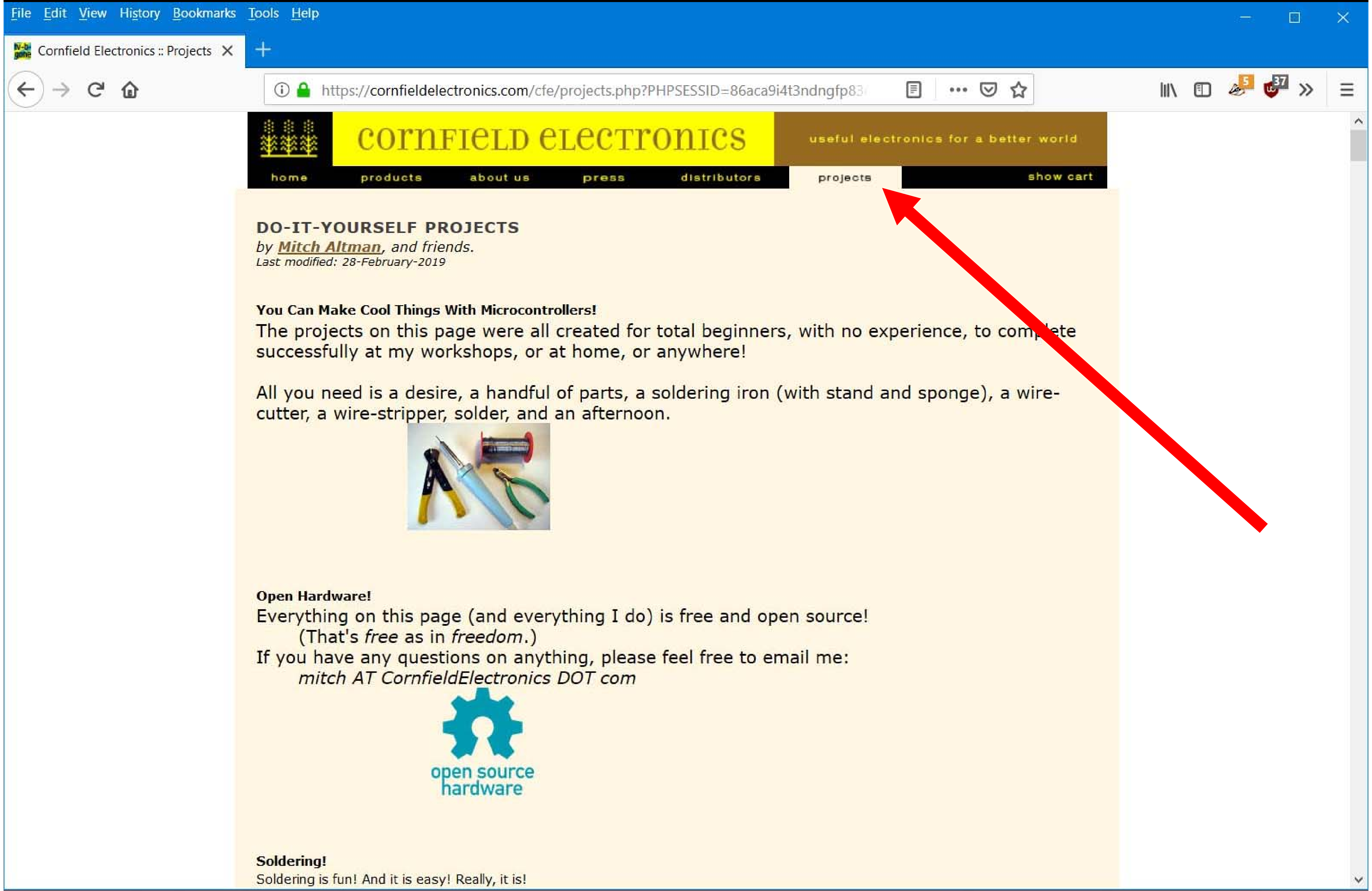
Love it or hate it, TV is all around us. TV-B-Gone® universal remote control is the first fruit of our technical savvy, embodying our belief in empowerment, and sense of humor. This universal remote control fits in your pocket and allows you to discreetly turn TVs off or on wherever you go. TV-B-Gone 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 the latest of our tools for personal empowerment. We all need rest, but we don't always get it in our busy lives. Now with the help of NeuroDreamer sleep mask you can use your own brainwaves to bring you the rest you need. And with the lucid dreaming model, you can take control of your dreams. You can enhance your life. The choice is yours.

Want to learn electronics? We make fun, intriguing, educational, useful kits! NEW: ArduTouch music synthesizer kit!

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

Welcome to our better world!


File Edit View History Bookmarks Tools Help
Cornfield Electronics :: Projects
https://cornfieldelectronics.com/cfe/projects.php?PHPSESSID=86aca9i4t3ndngfp83
cornfield electronics
useful electronics for a better world
home
products
about us
press
distributors
projects
show cart
open source hardware

DO-IT-YOURSELF PROJECTS

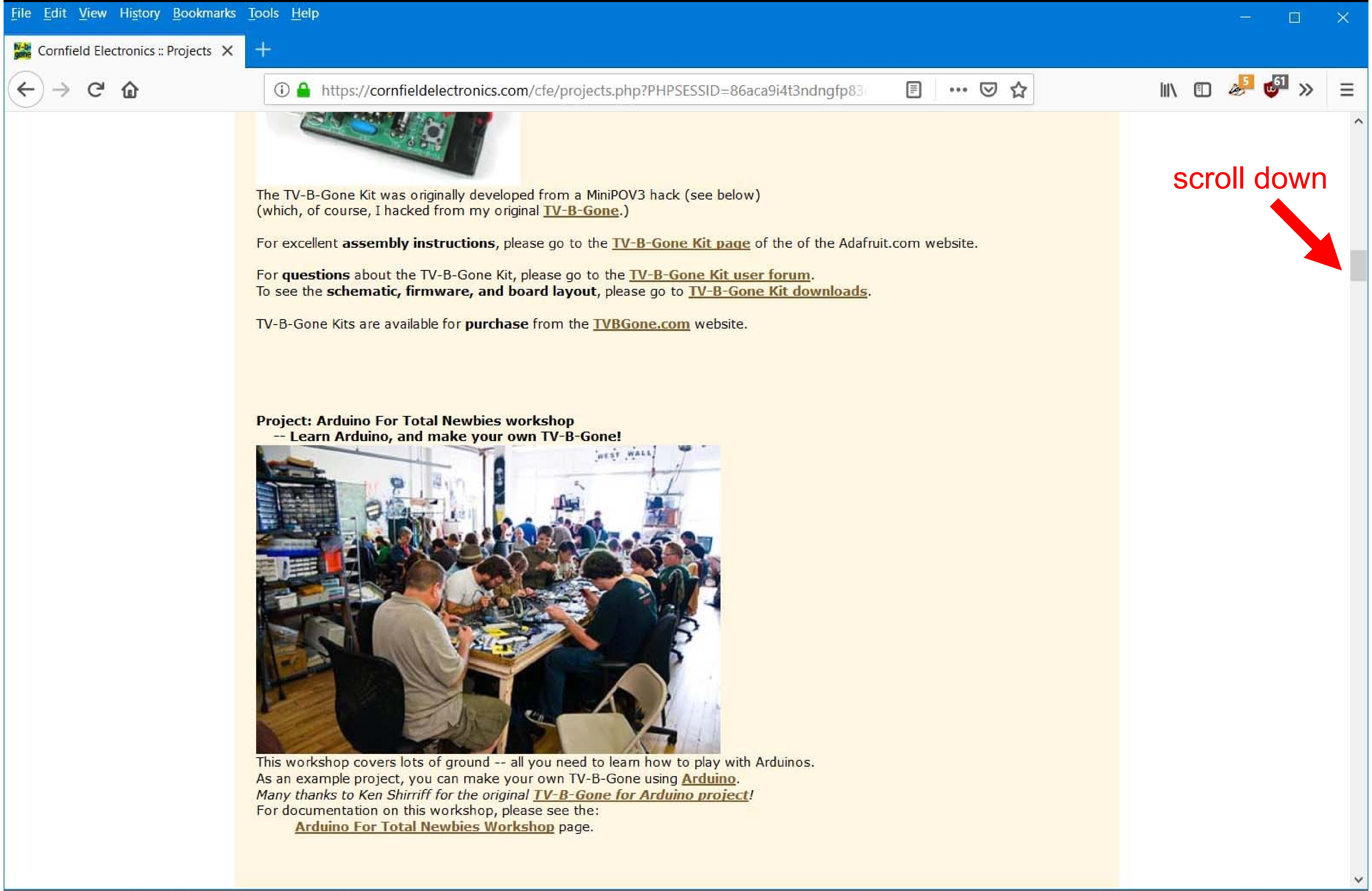
by Mitch Altman, and friends.
Last modified: 28-February-2019

You Can Make Cool Things With Microcontrollers!
The projects on this page were all created for total beginners, with no experience, to complete 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.

Open Hardware!
Everything on this page (and everything I do) is free and open source!
(That's *free* as in *freedom*.)
If you have any questions on anything, please feel free to email me:
mitch AT CornfieldElectronics DOT com

Soldering!
Soldering is fun! And it is easy! Really, it is!


File Edit View History Bookmarks Tools Help
Cornfield Electronics :: Projects
https://cornfieldelectronics.com/cfe/projects.php?PHPSESSID=86aca9i4t3ndngfp83

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.

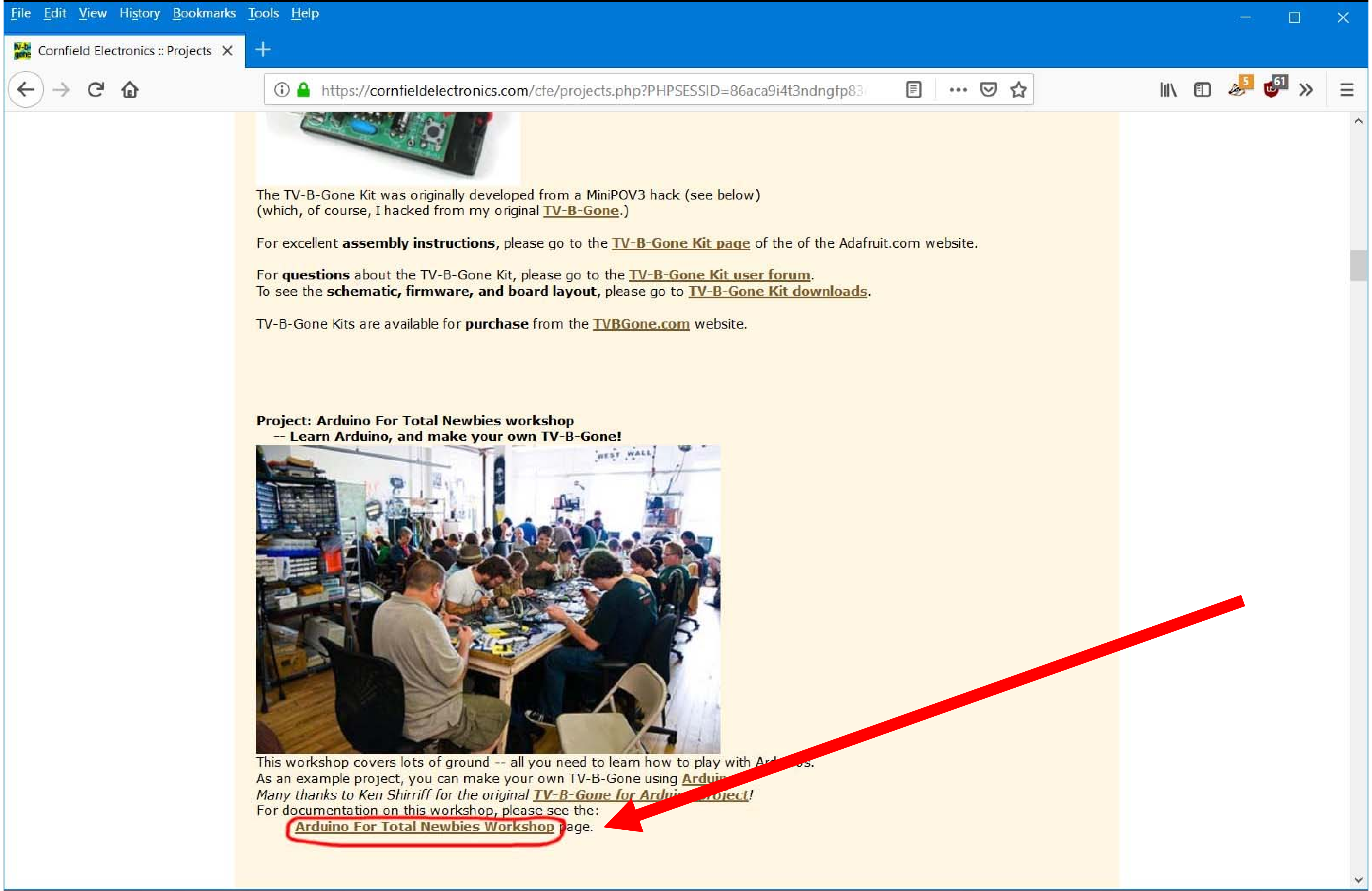
For **questions** about the TV-B-Gone Kit, please go to the TV-B-Gone Kit user forum.
To see the **schematic, firmware, and board layout**, please go to TV-B-Gone Kit downloads.

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.

scroll down


File Edit View History Bookmarks Tools Help
Cornfield Electronics :: Projects
https://cornfieldelectronics.com/cfe/projects.php?PHPSESSID=86aca9i4t3ndngfp83

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.)

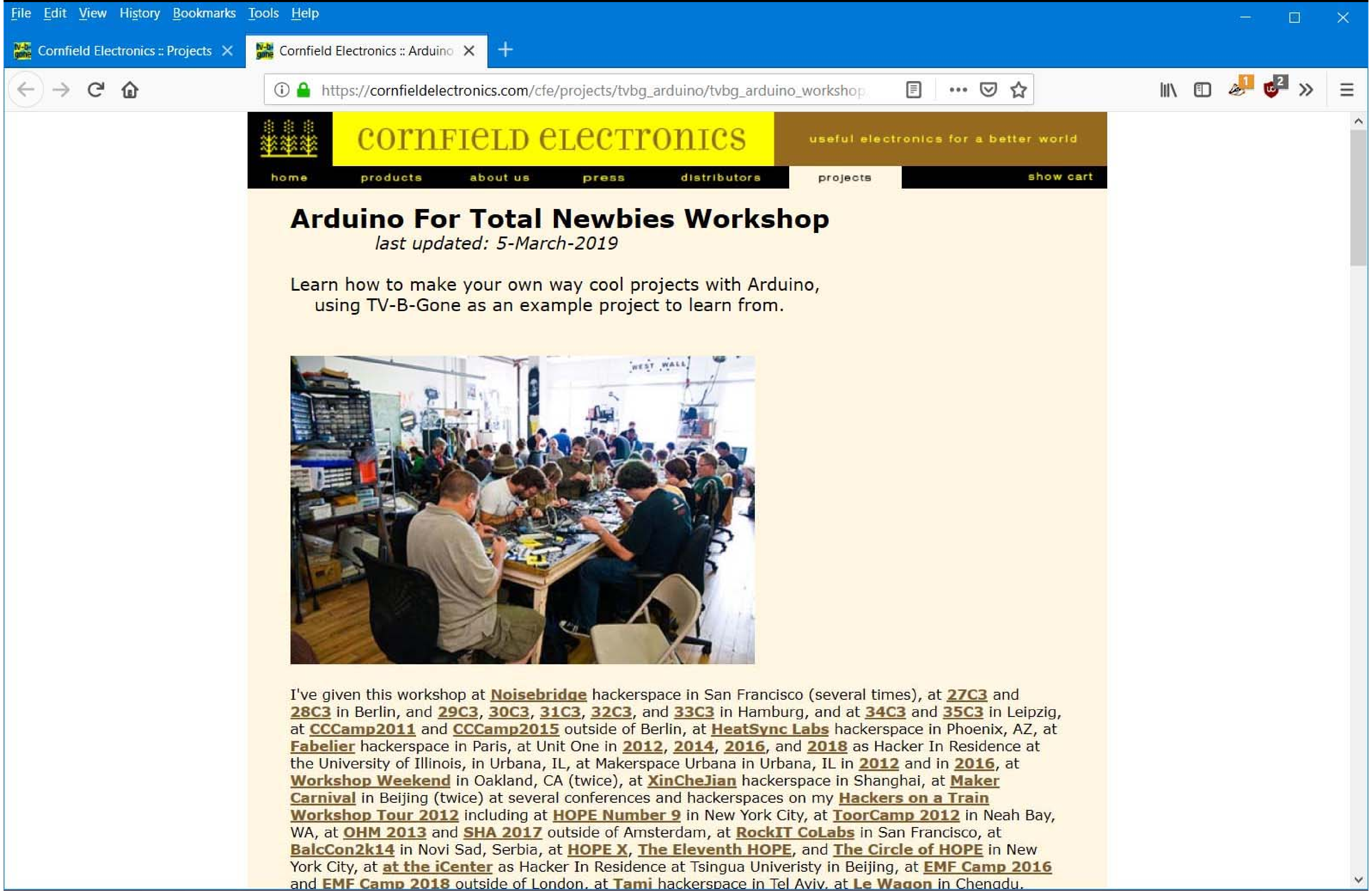
For excellent **assembly instructions**, please go to the TV-B-Gone Kit page of the of the Adafruit.com website.

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.

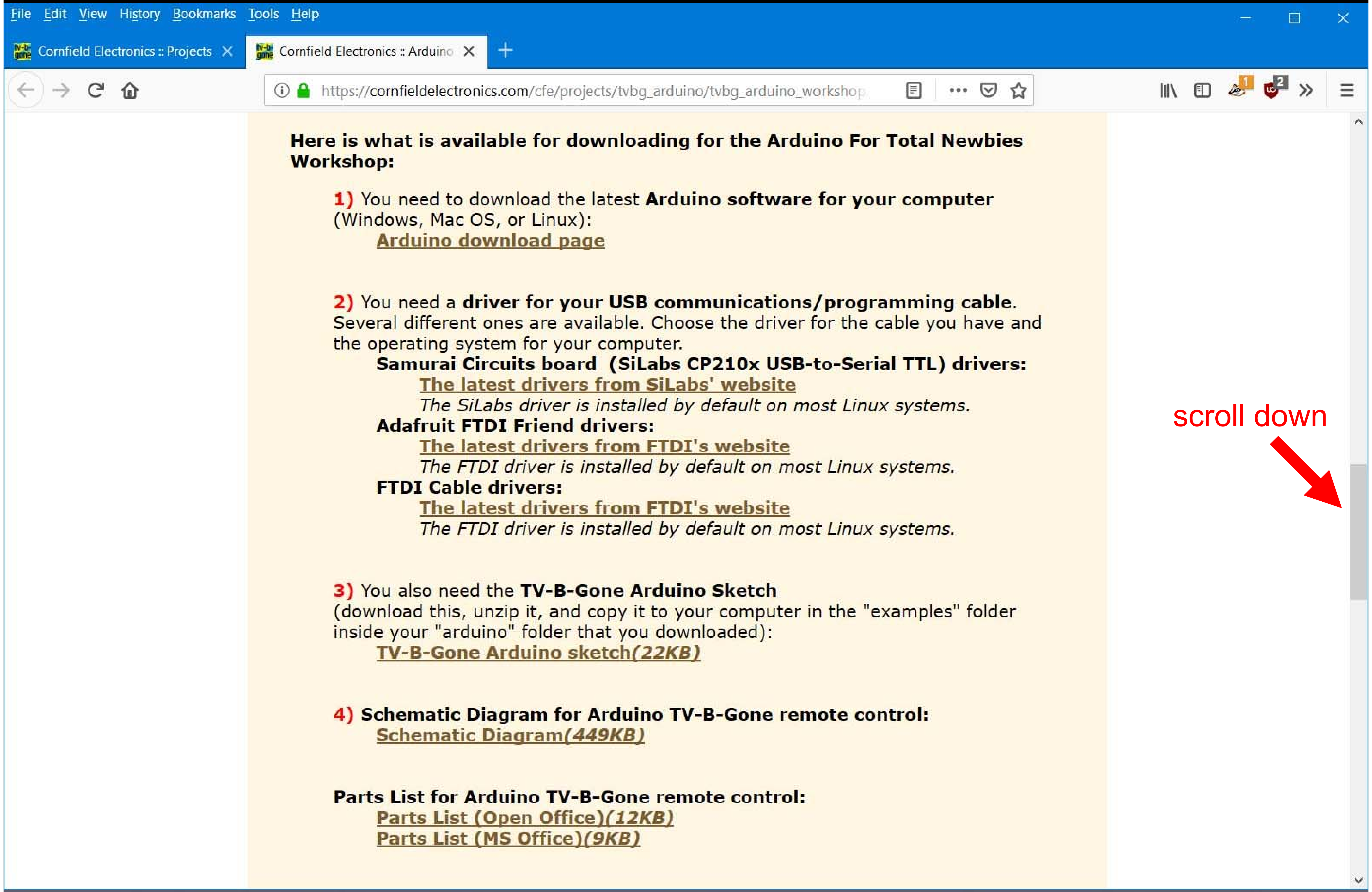

File Edit View History Bookmarks Tools Help
Cornfield Electronics :: Projects
Cornfield Electronics :: Arduino
https://cornfieldelectronics.com/cfe/projects/tvbg_arduino/tvbg_arduino_worksho
cornfield electronics
useful electronics for a better world
home
products
about us
press
distributors
projects
show cart
WEST WALL

Arduino For Total Newbies Workshop

last updated: 5-March-2019

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** and **35C3** in Leipzig, at **CCCamp2011** and **CCCamp2015** 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**, and **The Circle of HOPE** in New York City, at **at the iCenter** as Hacker In Residence at Tsingua Univeristy in Beijing, at **EMF Camp 2016** and **EMF Camp 2018** outside of London, at **Tami** hackerspace in Tel Aviv, at **Le Wagon** in Chengdu,



File Edit View History Bookmarks Tools Help
Cornfield Electronics :: Projects
Cornfield Electronics :: Arduino
https://cornfieldelectronics.com/cfe/projects/tvbg_arduino/tvbg_arduino_workshop

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

1) You need to download the latest **Arduino software 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.

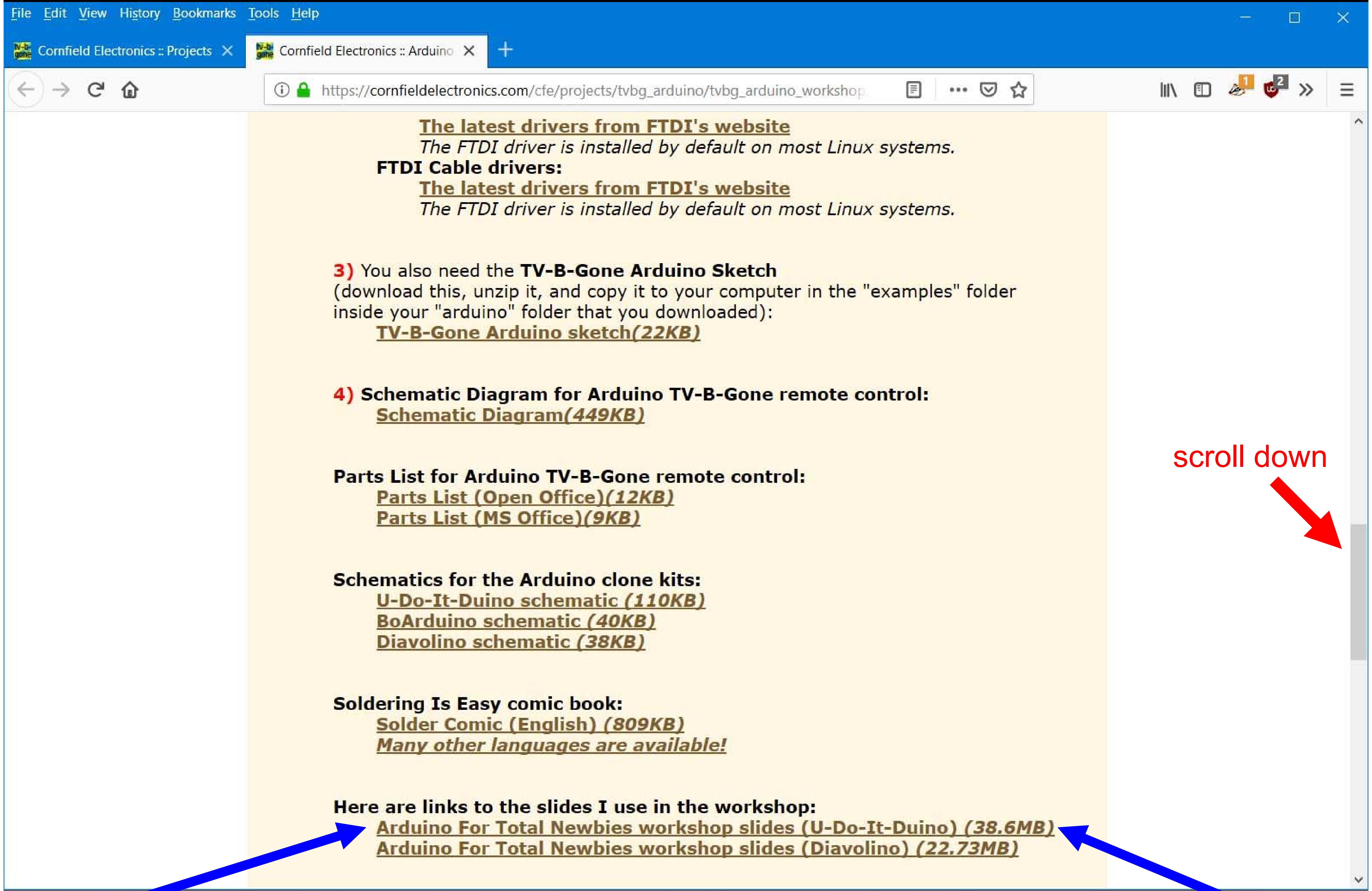
FTDI Cable drivers:
The latest drivers from FTDI's website
The FTDI driver is installed by default on most Linux systems.

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)*

scroll down


File Edit View History Bookmarks Tools Help
Cornfield Electronics :: Projects
Cornfield Electronics :: Arduino
https://cornfieldelectronics.com/cfe/projects/tvbg_arduino/tvbg_arduino_workshop

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 Arduino clone kits:
U-Do-It-Duino schematic *(110KB)*
BoArduino schematic *(40KB)*
Diavolino schematic *(38KB)*

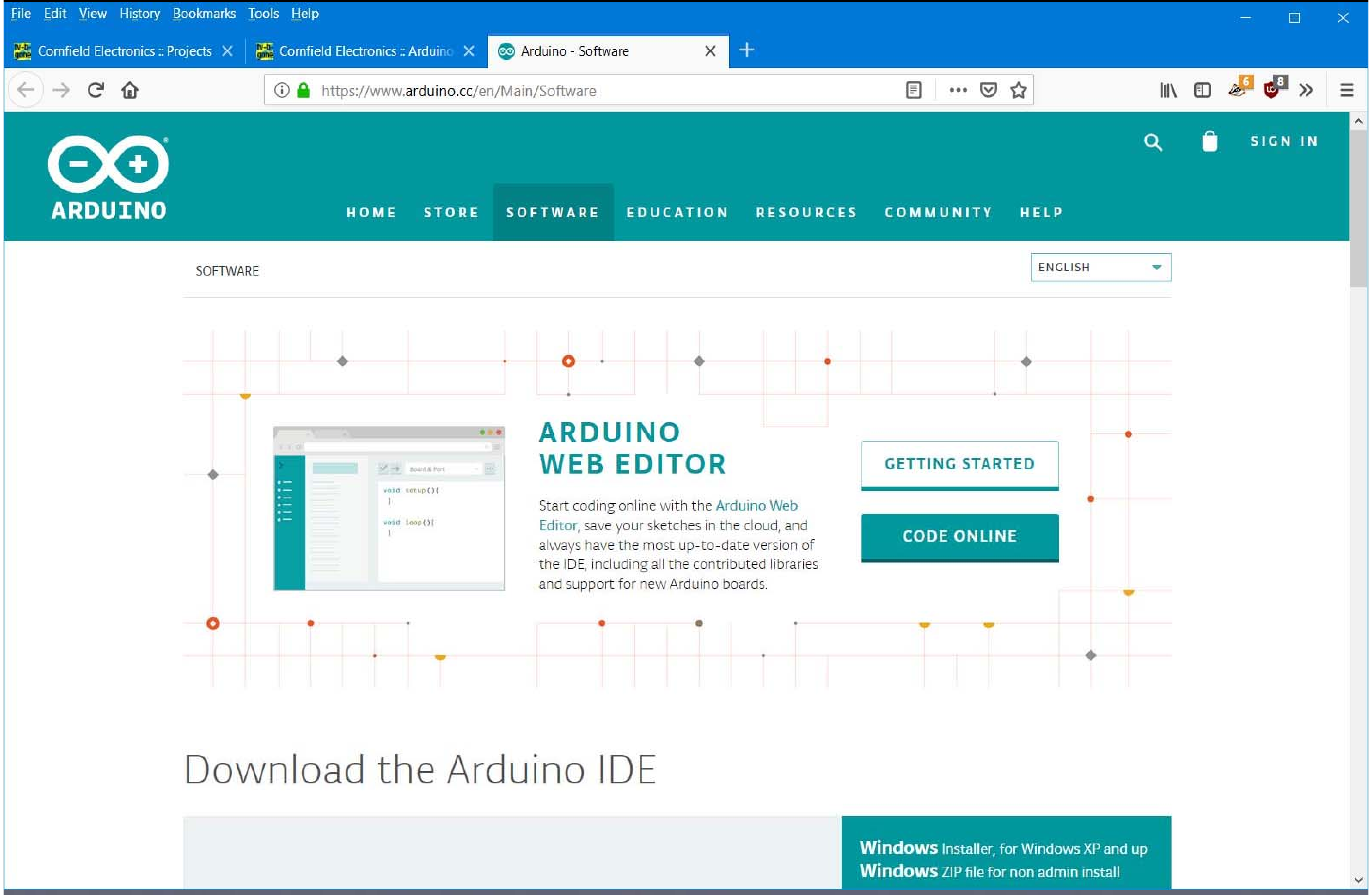
Soldering Is Easy comic book:
Solder Comic (English) *(809KB)*
Many other languages are available!

Here are links to the slides I use in the workshop:
Arduino For Total Newbies workshop slides (U-Do-It-Duino) *(38.6MB)*
Arduino For Total Newbies workshop slides (Diavolino) *(22.73MB)*

scroll down

1) You need to download the latest **Arduino software for your computer** (Windows, Mac OS, or Linux):

Arduino download page


File Edit View History Bookmarks Tools Help
Cornfield Electronics :: Projects
Cornfield Electronics :: Arduino
Arduino - Software
https://www.arduino.cc/en/Main/Software
SIGN IN
ARDUINO
HOME
STORE
SOFTWARE
EDUCATION
RESOURCES
COMMUNITY
HELP
SOFTWARE
ENGLISH
GETTING STARTED
CODE ONLINE

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.

Download the Arduino IDE

Windows Installer, for Windows XP and up

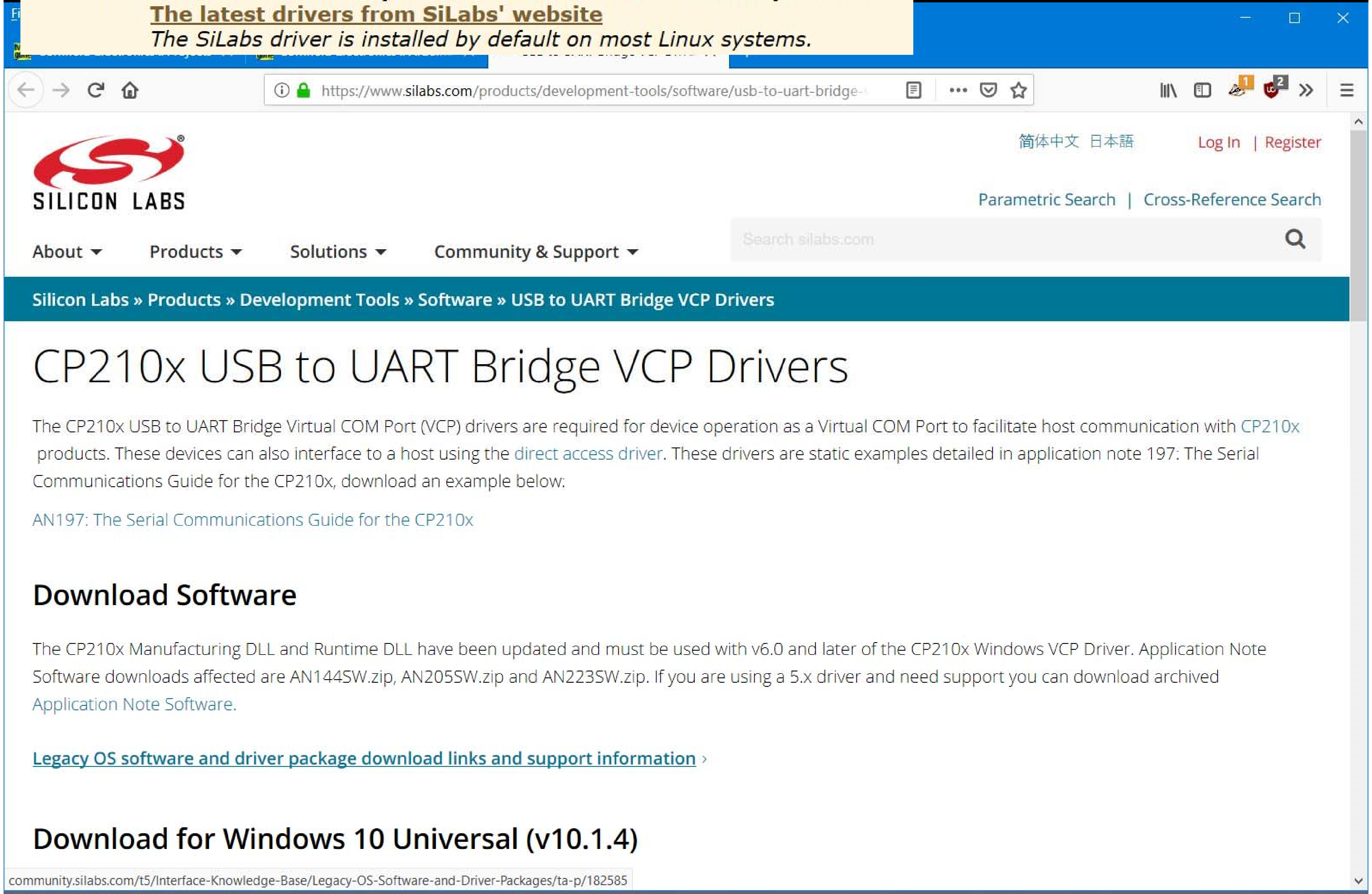
Windows ZIP file for non admin install

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-
SILICON LABS
简体中文 日本語
Log In | Register
Parametric Search | Cross-Reference Search
Search silabs.com
About
Products
Solutions
Community & Support

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

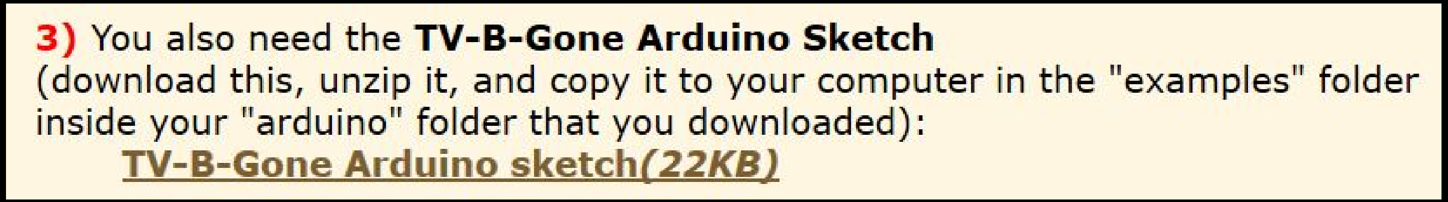
Download Software

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 ›

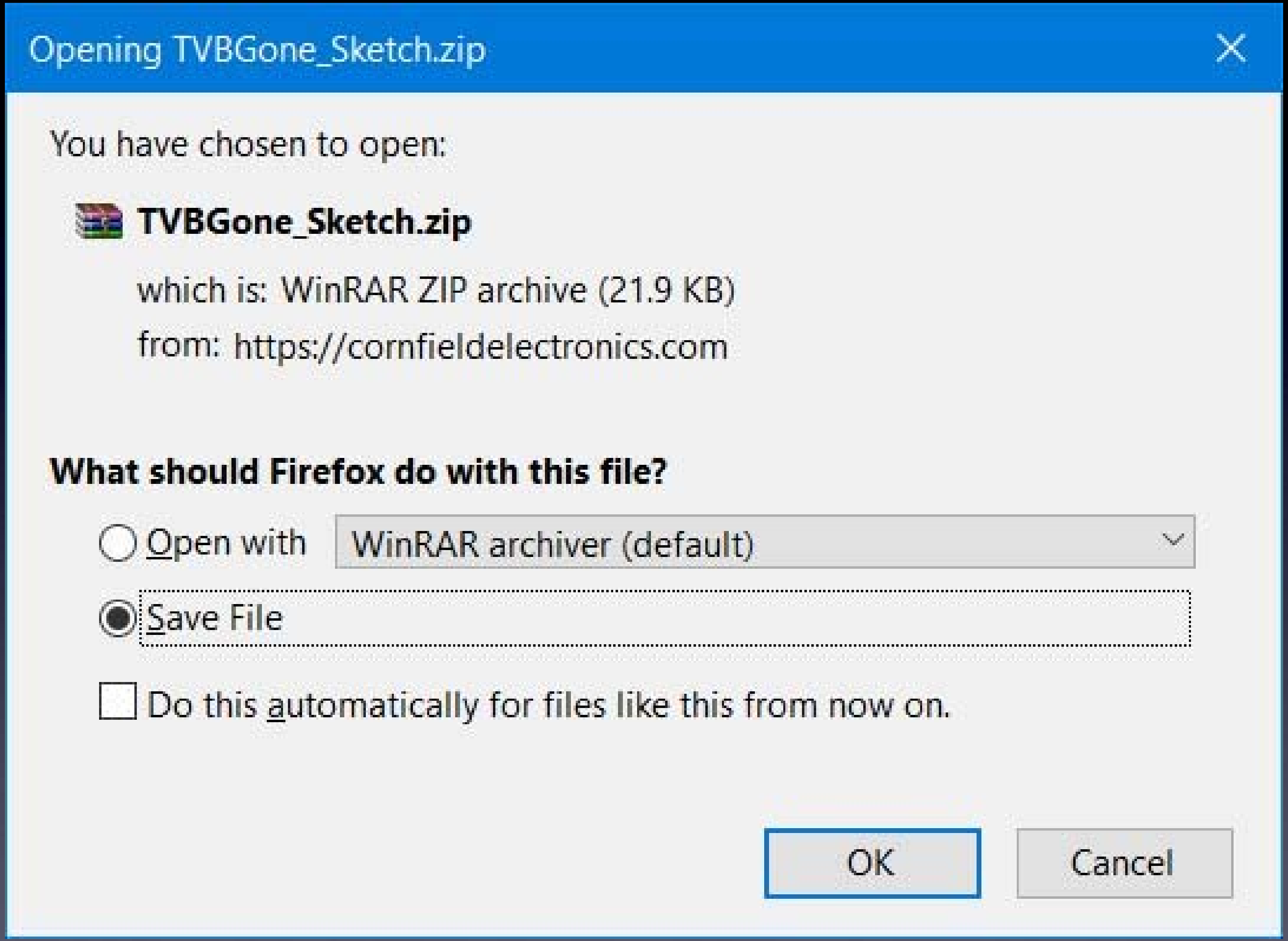
Download for Windows 10 Universal (v10.1.4)

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)*



Opening TVBGone_Sketch.zip

You have chosen to open:

TVBGone_Sketch.zip

which is: WinRAR ZIP archive (21.9 KB)

from: https://cornfieldelectronics.com

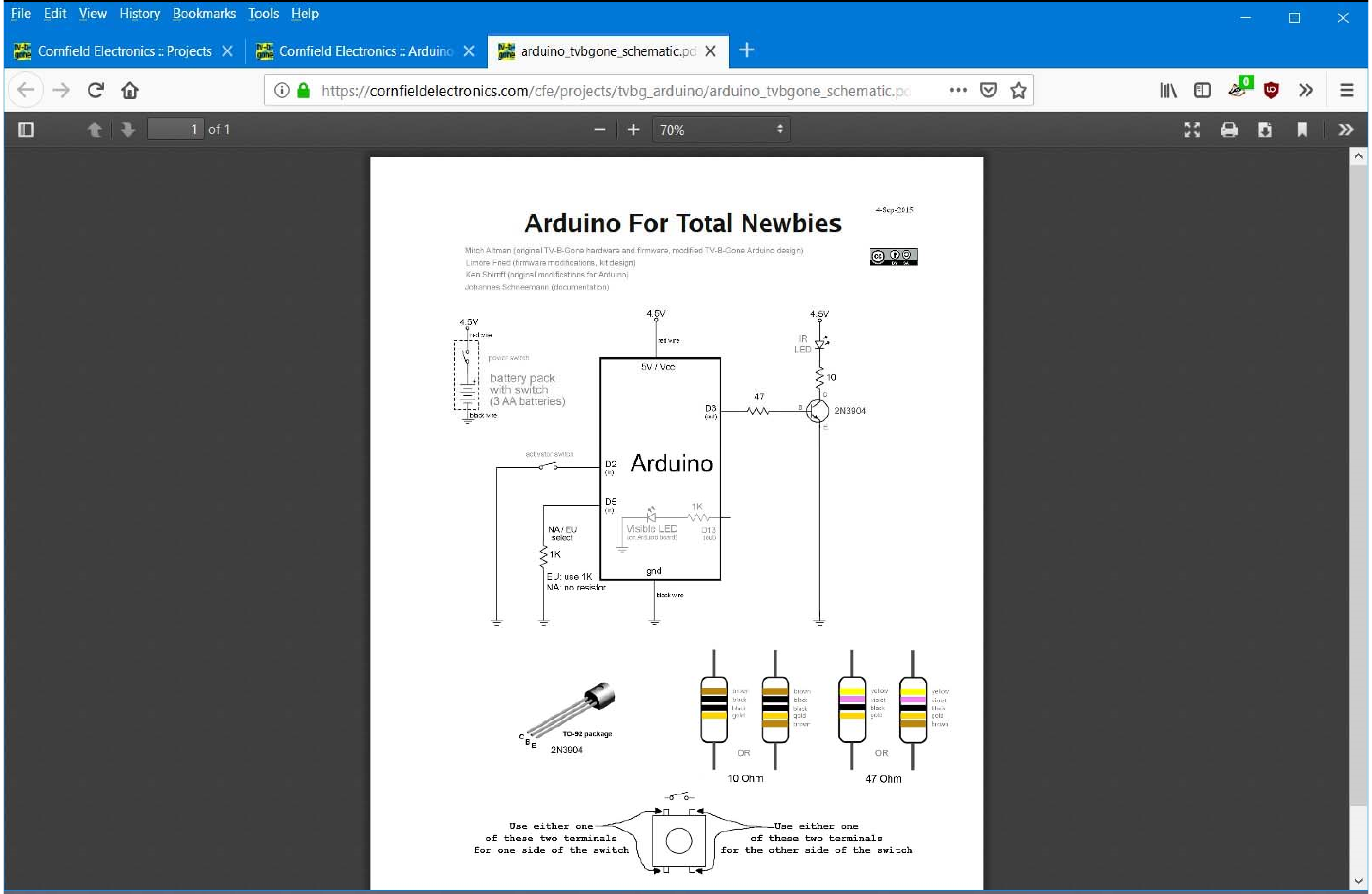
What should Firefox do with this file?

○ Open with WinRAR archiver (default)

● Save File

□ Do this automatically for files like this from now on.

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


File Edit View History Bookmarks Tools Help
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

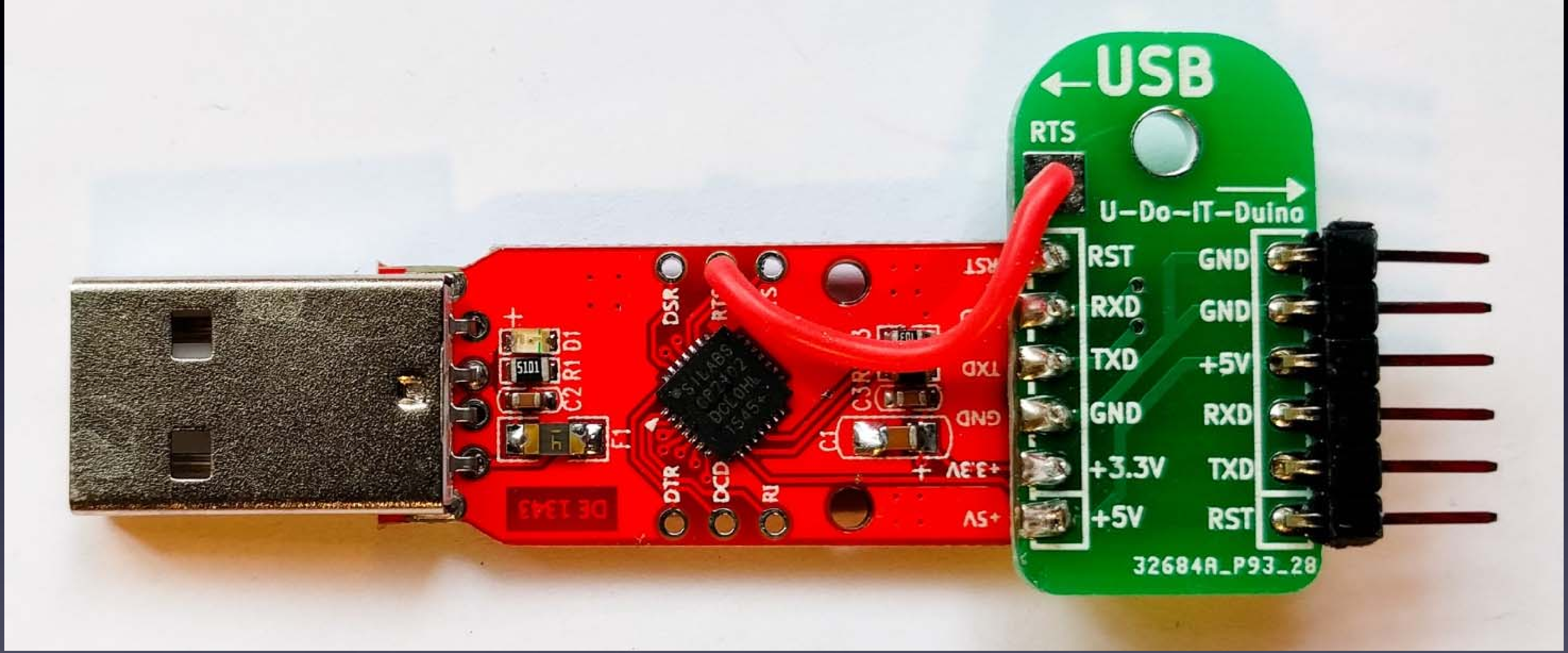
4-Sep-2015

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)

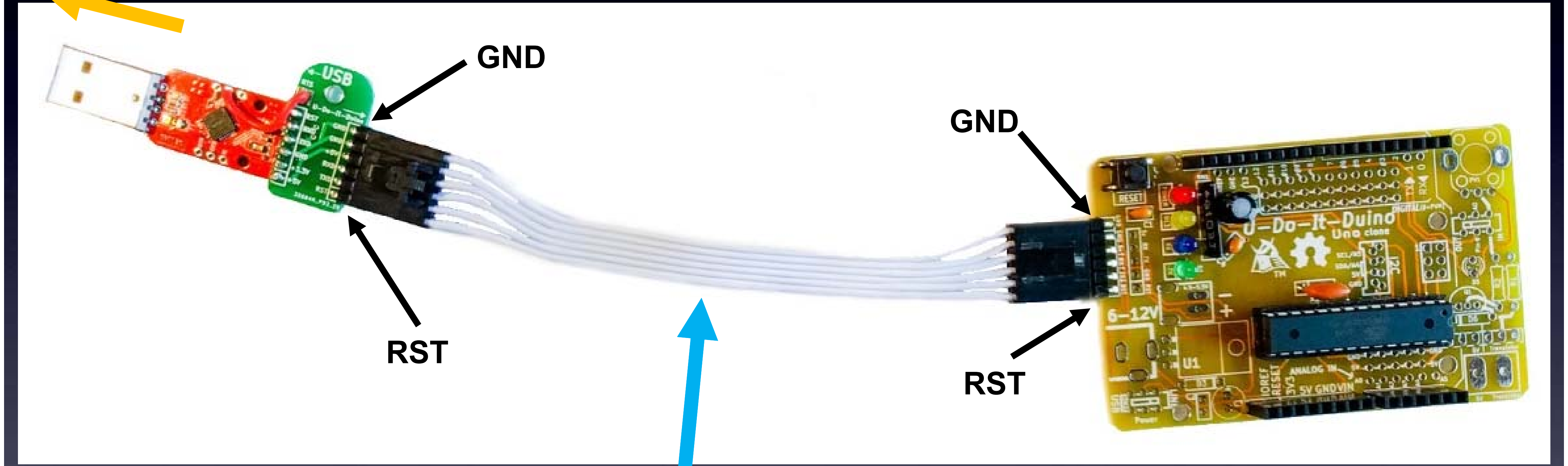
Use either one
of these two terminals
for one side of the switch

Use either one
of these two terminals
for the other side of the switch

USB-Serial Cable



To computer's USB



GND

RST

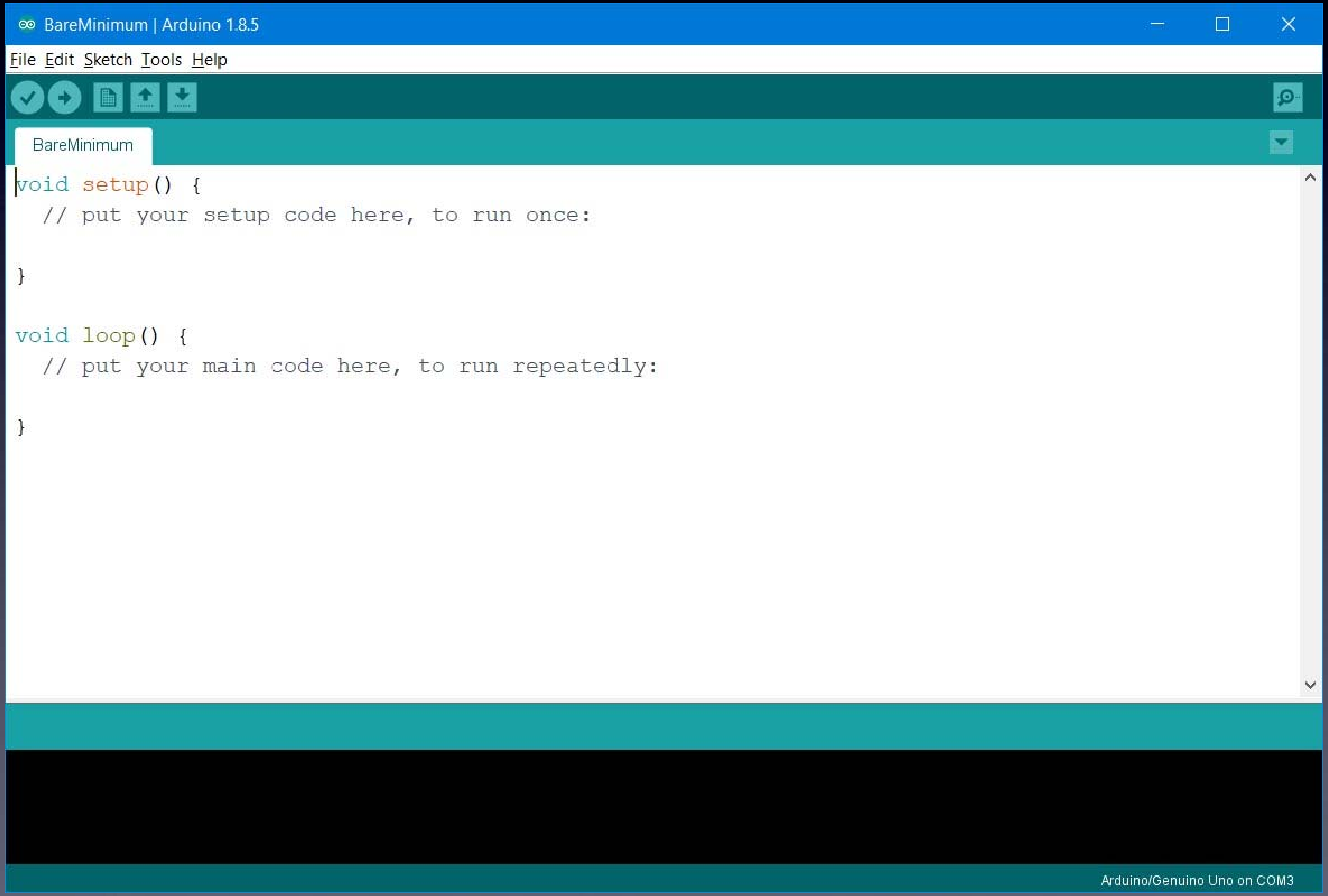
GND

RST

no twists

Arduino

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

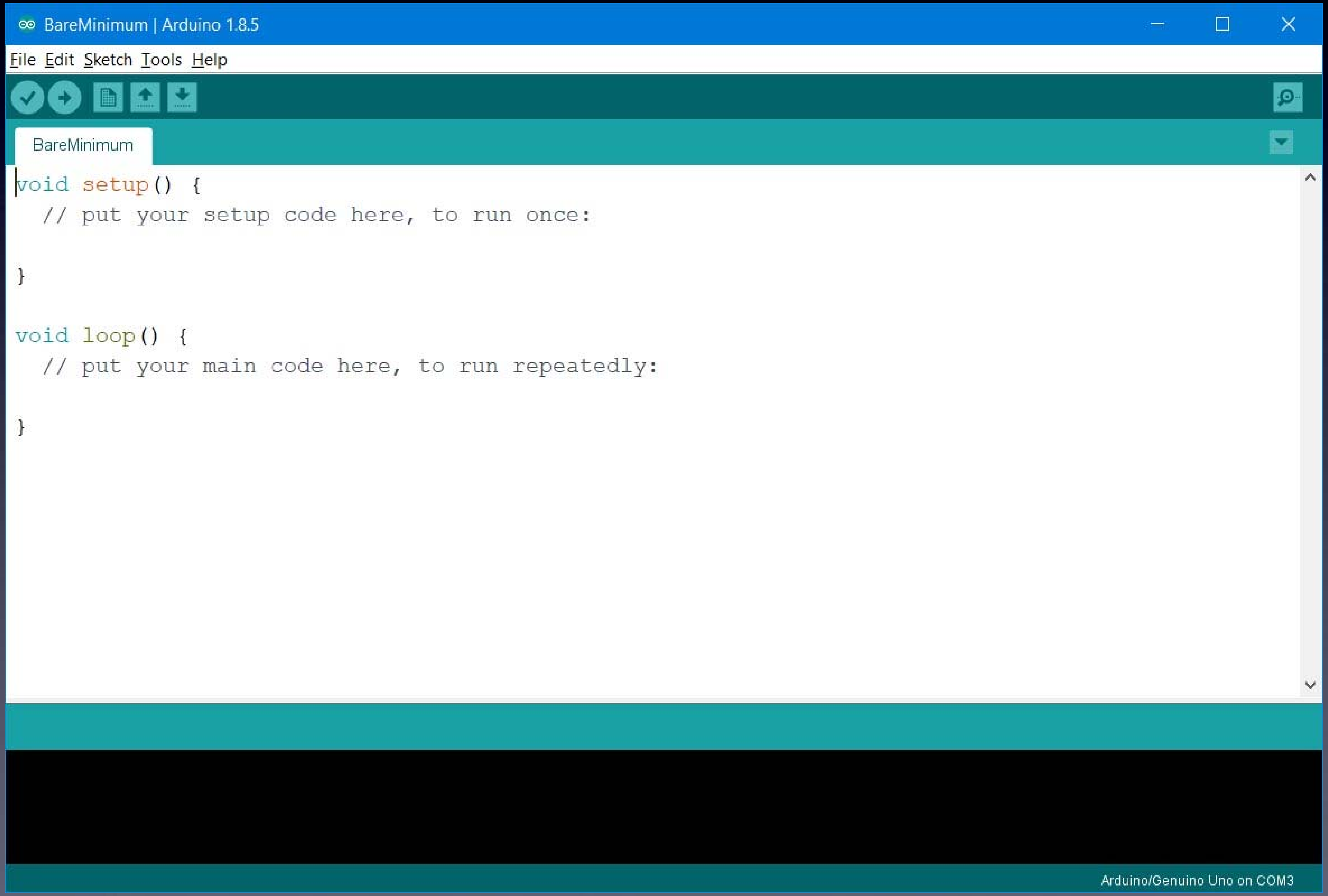


BareMinimum | Arduino 1.8.5
File Edit Sketch Tools Help
BareMinimum
Arduino/Genuino Uno on COM3

```
void setup() {
  // put your setup code here, to run once:

}

void loop() {
  // put your main code here, to run repeatedly:

}
```

Arduino

How to Set Up and Use the Arduino Software



BareMinimum | Arduino 1.8.5
File Edit Sketch Tools Help
BareMinimum
Arduino/Genuino Uno on COM3

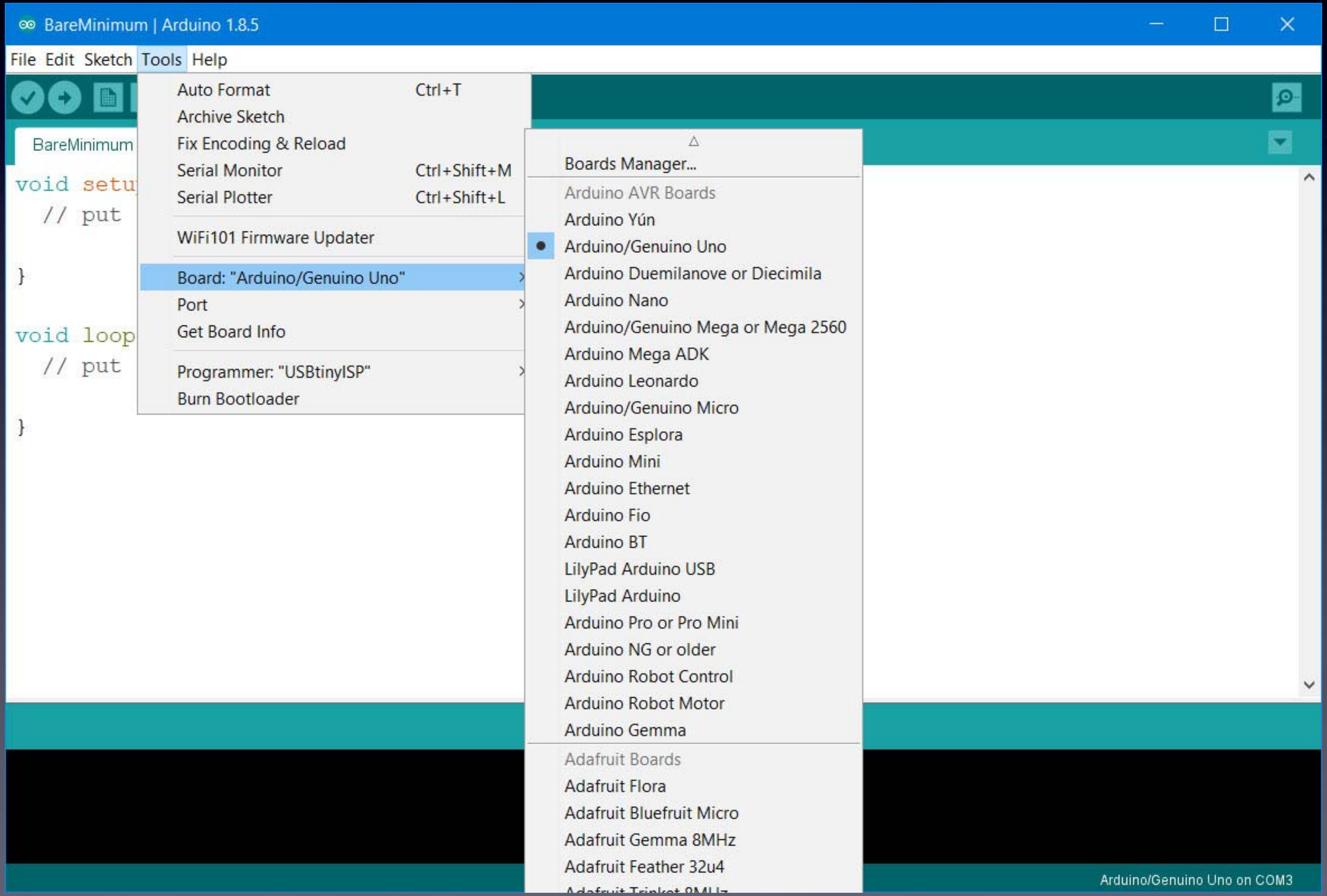
```
void setup() {
  // put your setup code here, to run once:

}

void loop() {
  // put your main code here, to run repeatedly:

}
```

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)



```
void setu
  // put

}

void loop
  // put

}
```

Board: "Arduino/Genuino Uno"

Programmer: "USBtinyISP"

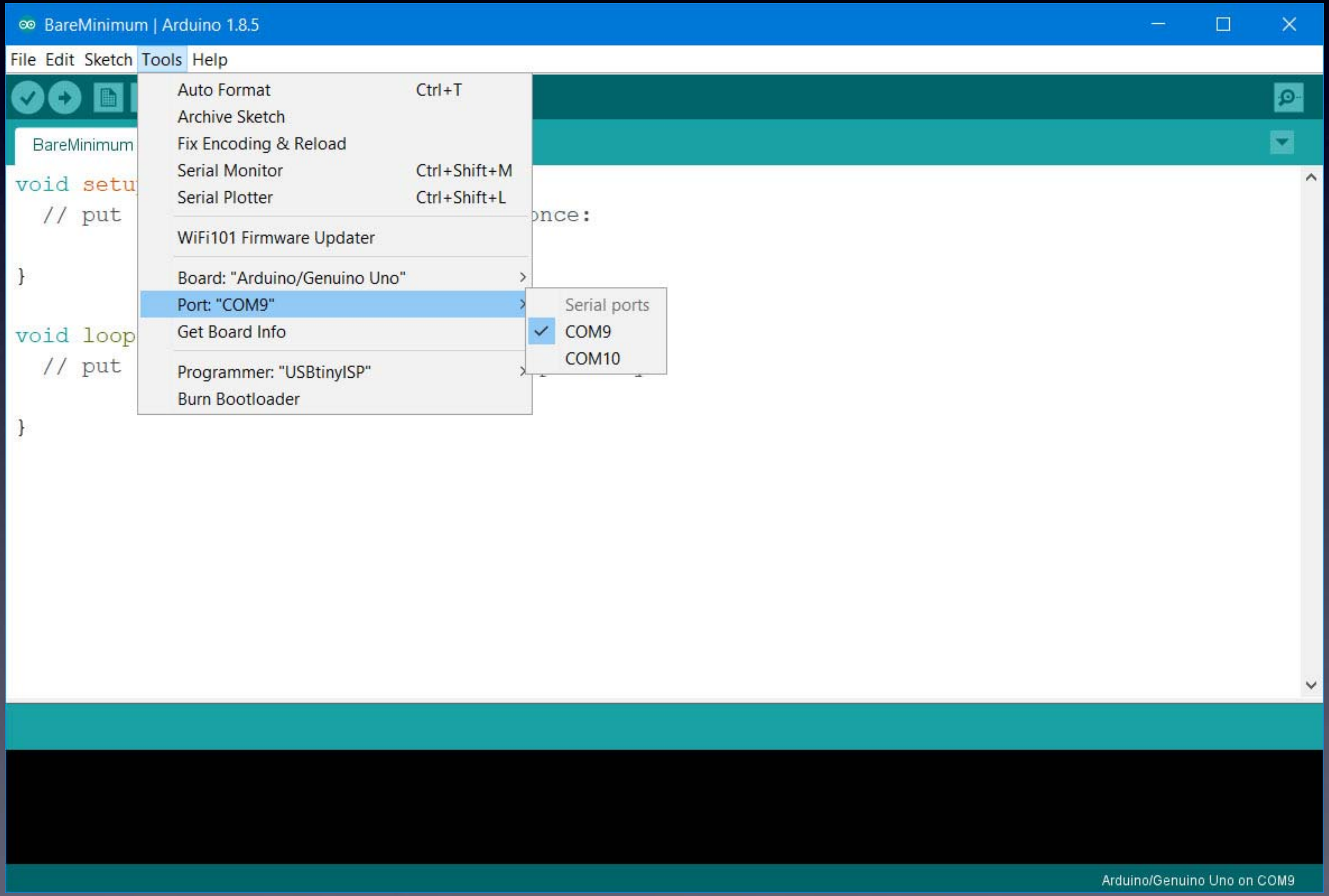
Arduino/Genuino Uno on COM3

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)**

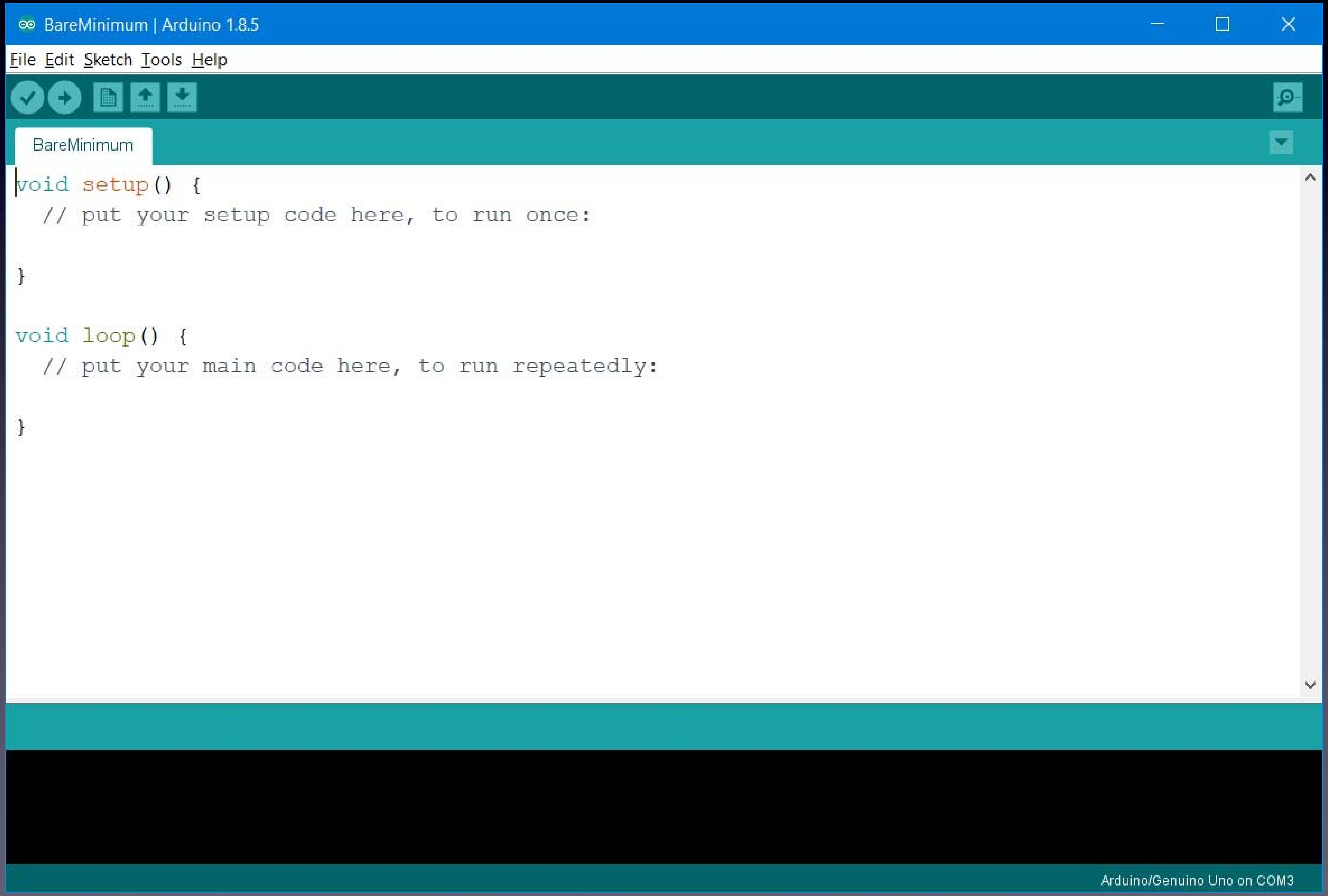
**(After installing
the driver for
your USB-Serial cable
and plugging it in
your operating system
will see a serial port
and it appears here.)**



```
void setu
  // put
                                    once:
}

void loop
  // put
}
```

Arduino

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



BareMinimum | Arduino 1.8.5
File Edit Sketch Tools Help
BareMinimum

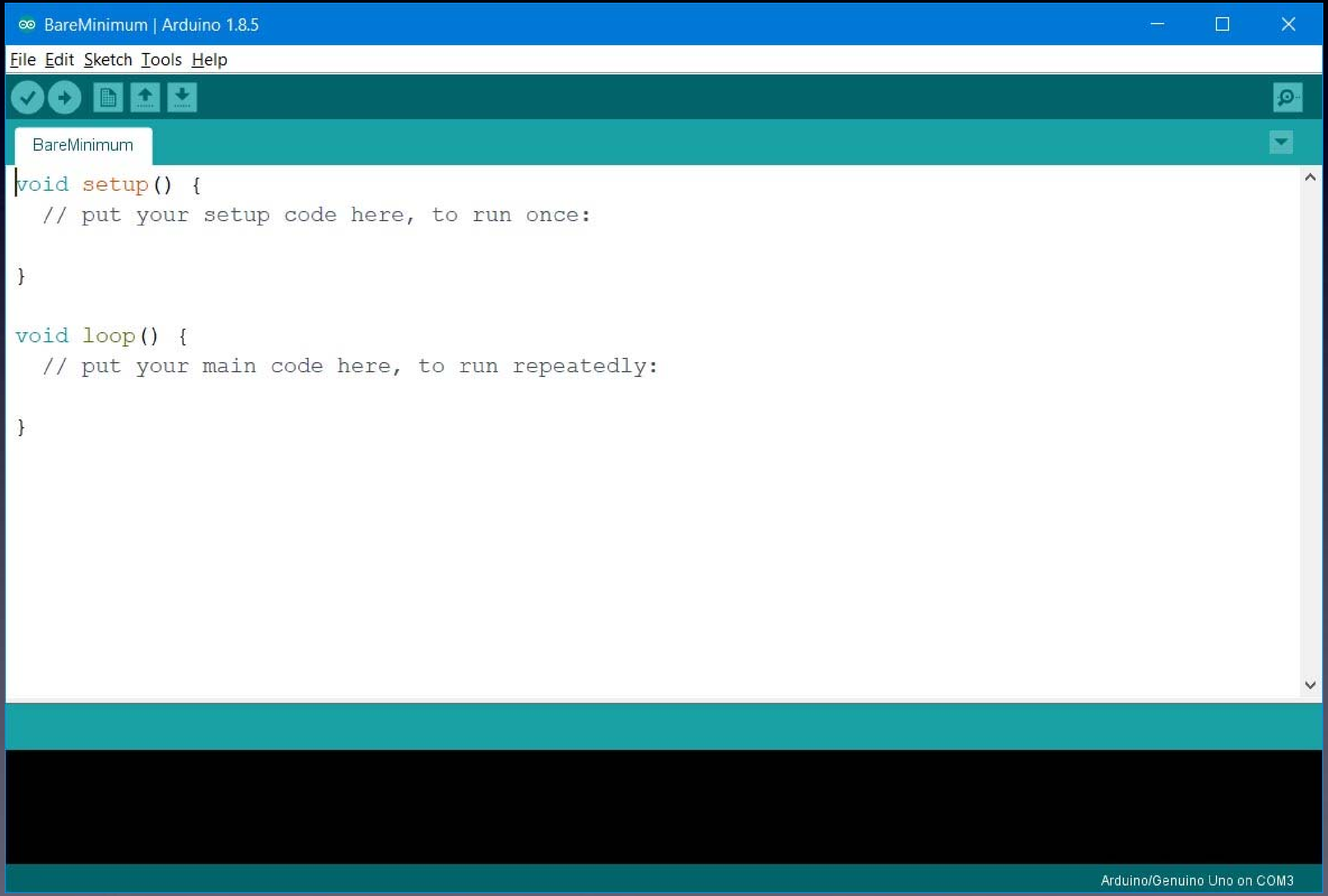
```
void setup() {
  // put your setup code here, to run once:

}

void loop() {
  // put your main code here, to run repeatedly:

}
```

Arduino/Genuino Uno on COM3

Arduino

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

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



BareMinimum | Arduino 1.8.5
File Edit Sketch Tools Help
BareMinimum

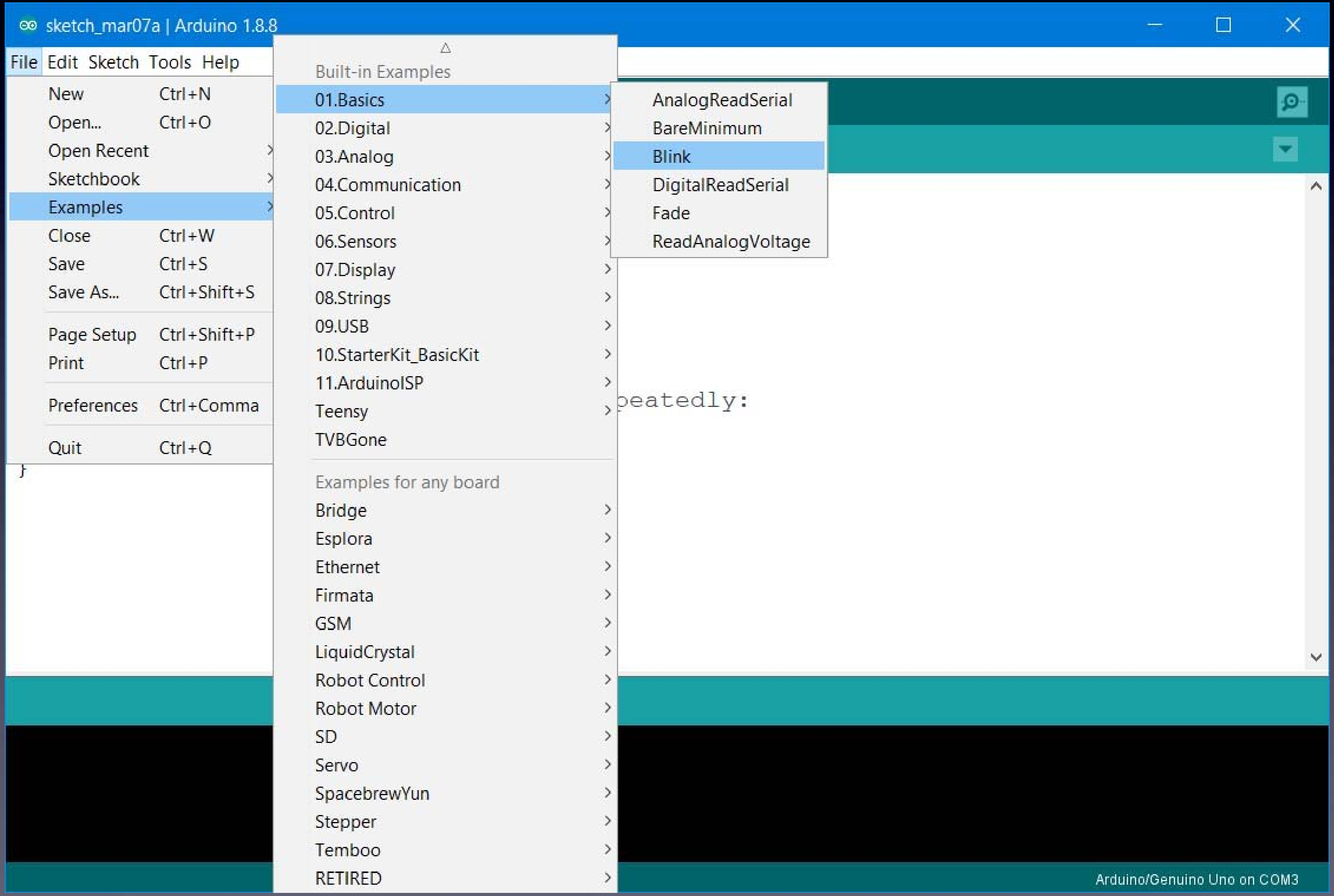
```
void setup() {
  // put your setup code here, to run once:

}

void loop() {
  // put your main code here, to run repeatedly:

}
```

Arduino/Genuino Uno on COM3

Arduino

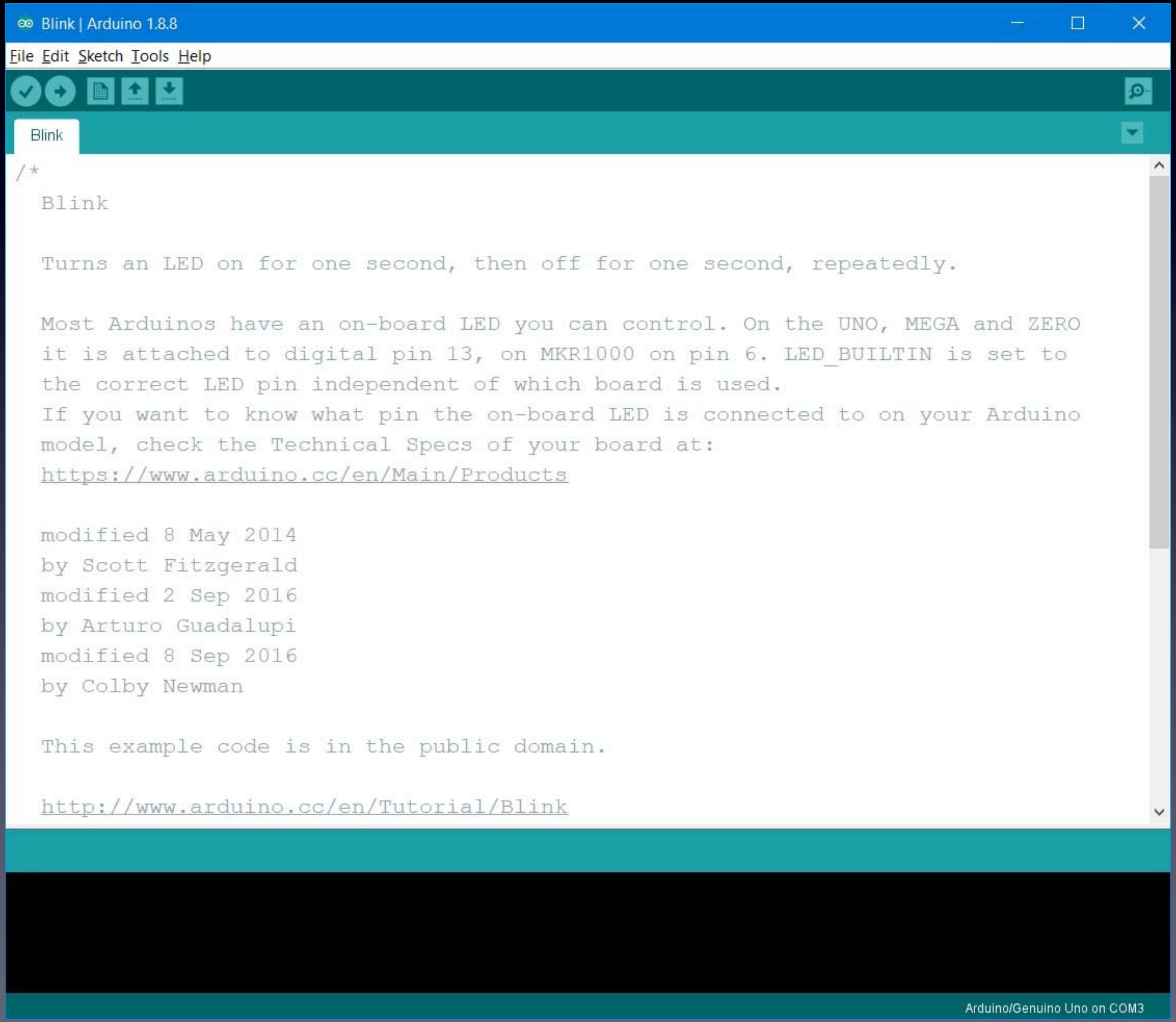
Your Arduino software is now ready to program your U-Do-It-Duino !

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



Arduino

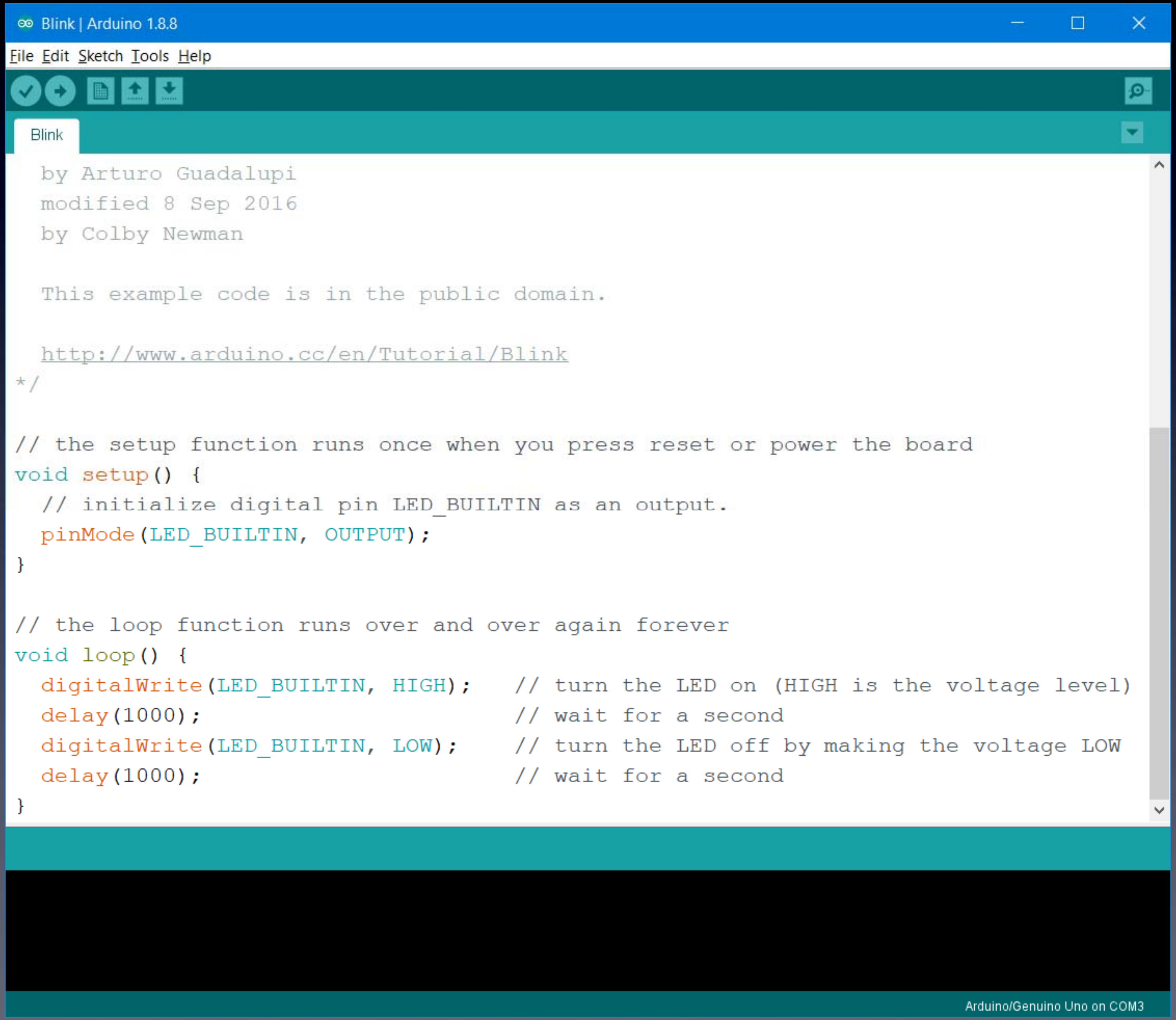
Let's make an LED blink! `Hello World`



```
/*
  Blink

  Turns an LED on for one second, then off for one second, repeatedly.

  Most Arduinos have an on-board LED you can control. On the UNO, MEGA and ZERO
  it is attached to digital pin 13, on MKR1000 on pin 6. LED_BUILTIN is set to
  the correct LED pin independent of which board is used.
  If you want to know what pin the on-board LED is connected to on your Arduino
  model, check the Technical Specs of your board at:
  https://www.arduino.cc/en/Main/Products

  modified 8 May 2014
  by Scott Fitzgerald
  modified 2 Sep 2016
  by Arturo Guadalupi
  modified 8 Sep 2016
  by Colby Newman

  This example code is in the public domain.

  http://www.arduino.cc/en/Tutorial/Blink
```

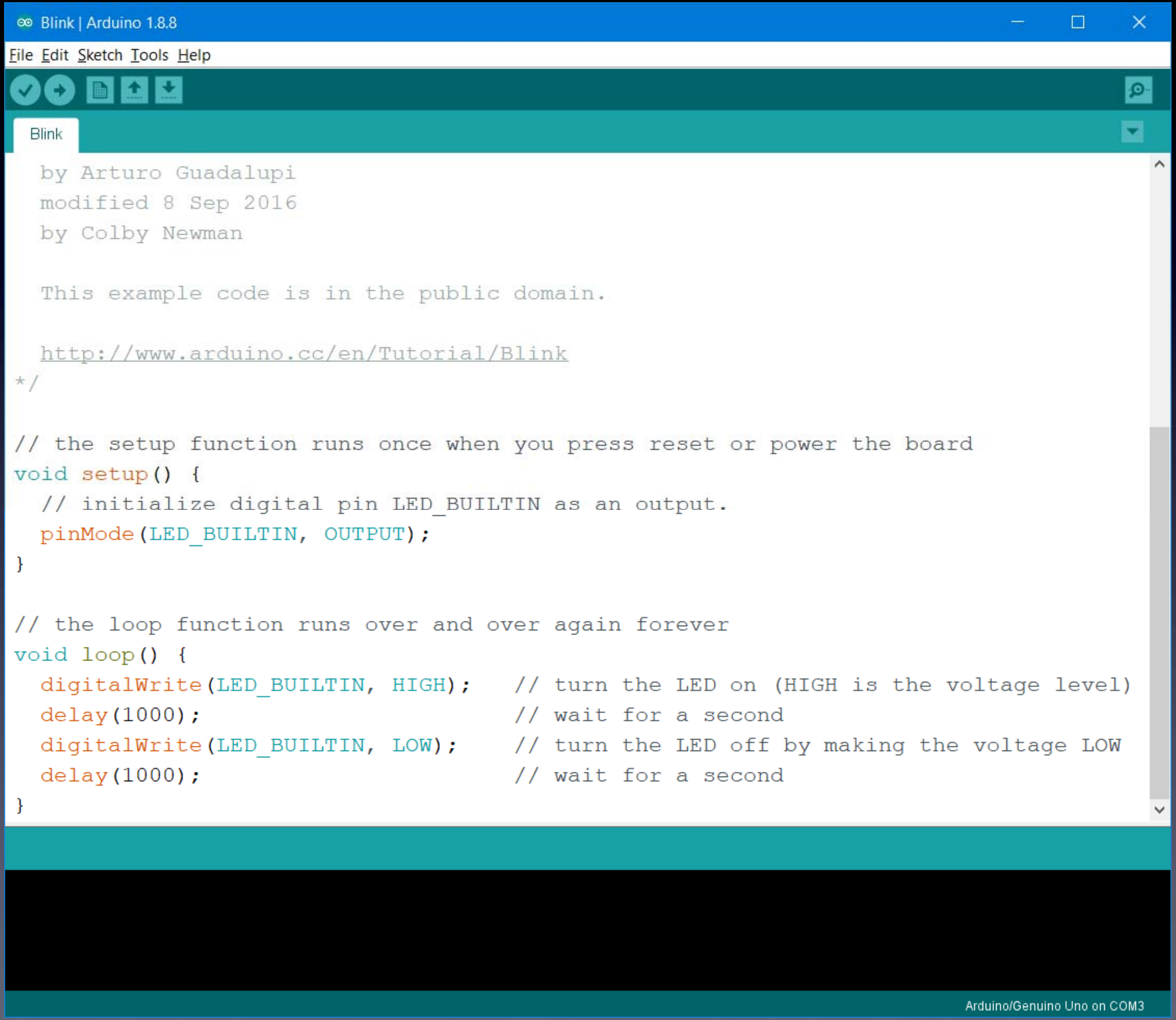
Arduino

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



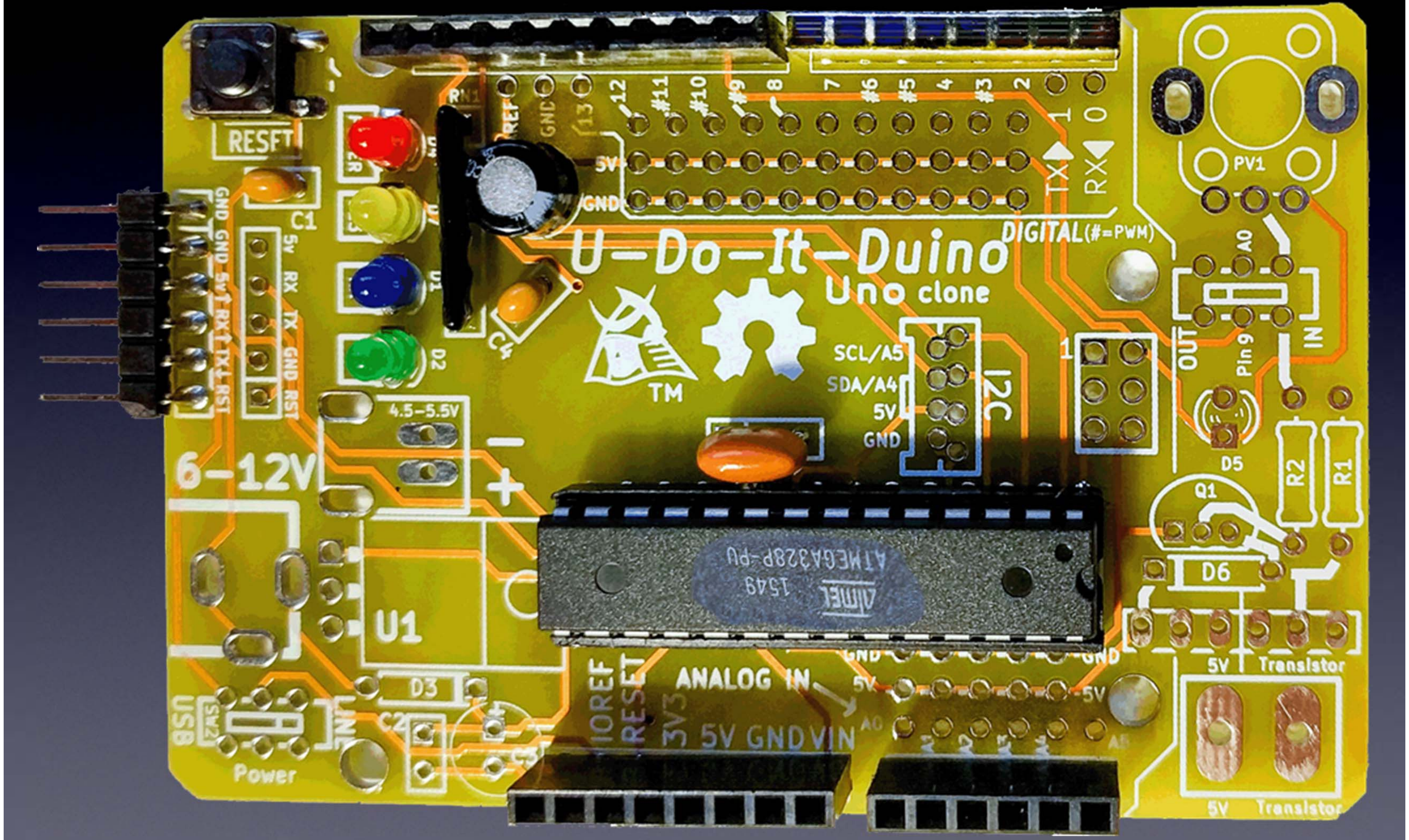
```
  by Arturo Guadalupi
  modified 8 Sep 2016
  by Colby Newman

  This example code is in the public domain.

  http://www.arduino.cc/en/Tutorial/Blink
*/

// the setup function runs once when you press reset or power the board
void setup() {
  // initialize digital pin LED_BUILTIN as an output.
  pinMode(LED_BUILTIN, OUTPUT);
}

// the loop function runs over and over again forever
void loop() {
  digitalWrite(LED_BUILTIN, HIGH);   // turn the LED on (HIGH is the voltage level)
  delay(1000);                       // wait for a second
  digitalWrite(LED_BUILTIN, LOW);    // turn the LED off by making the voltage LOW
  delay(1000);                       // wait for a second
}
```

How to Hack Arduino Programs (“Sketches”)



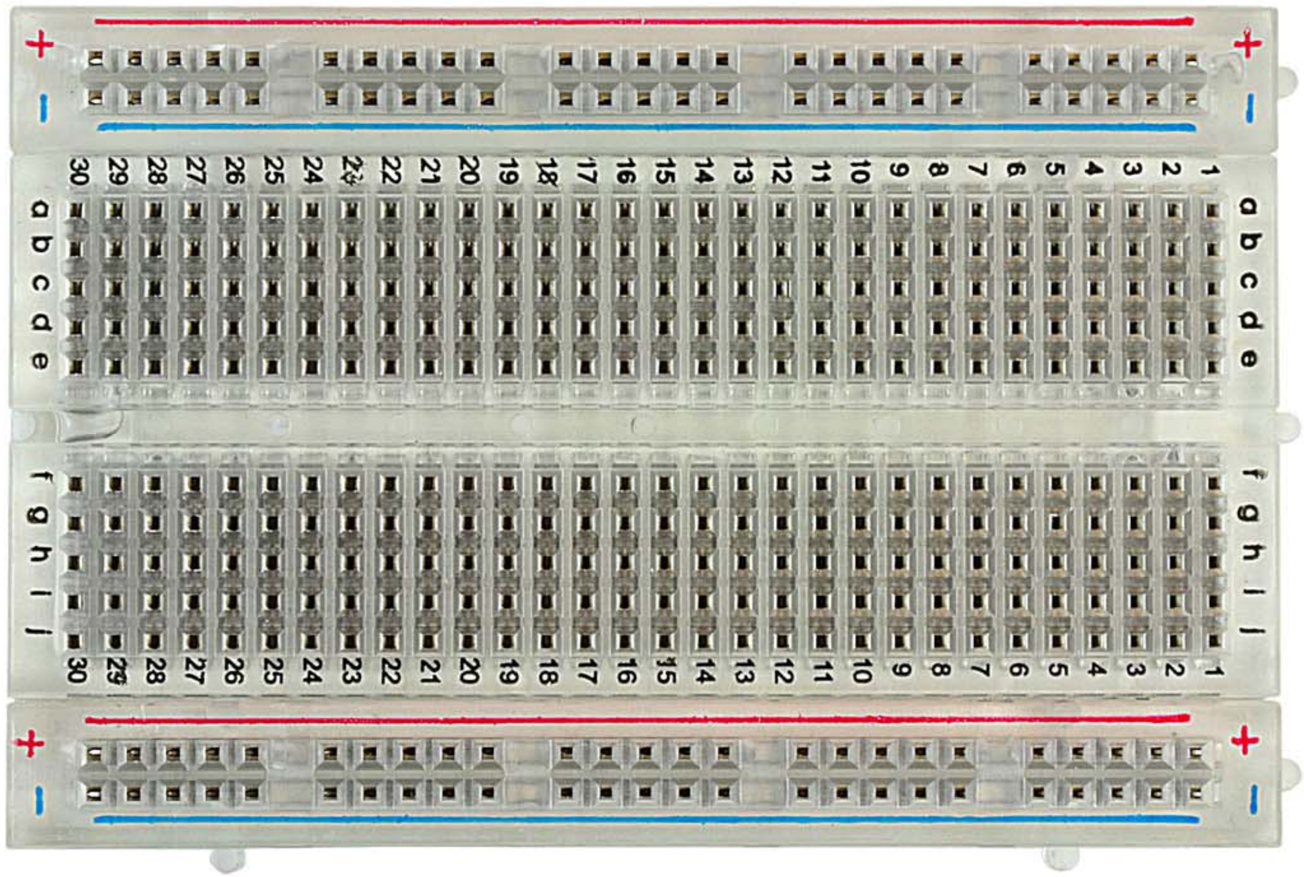
```
  by Arturo Guadalupi
  modified 8 Sep 2016
  by Colby Newman

  This example code is in the public domain.

  http://www.arduino.cc/en/Tutorial/Blink
*/

// the setup function runs once when you press reset or power the board
void setup() {
  // initialize digital pin LED_BUILTIN as an output.
  pinMode(LED_BUILTIN, OUTPUT);
}

// the loop function runs over and over again forever
void loop() {
  digitalWrite(LED_BUILTIN, HIGH);   // turn the LED on (HIGH is the voltage level)
  delay(1000);                       // wait for a second
  digitalWrite(LED_BUILTIN, LOW);    // turn the LED off by making the voltage LOW
  delay(1000);                       // wait for a second
}
```

How to Hack Arduino Programs ("Sketches")



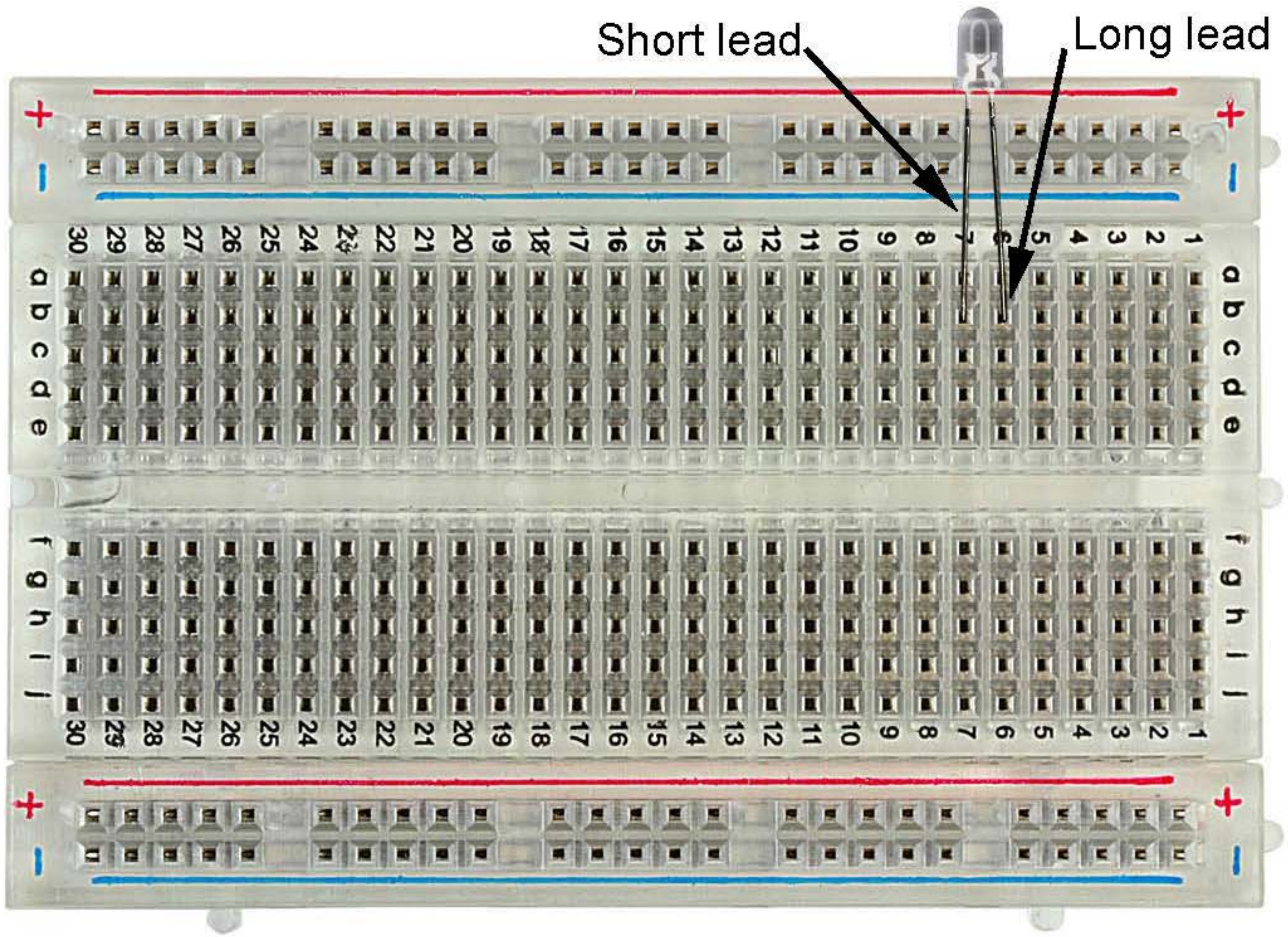
How to Use Solderless Breadboards

Solderless Breadboard



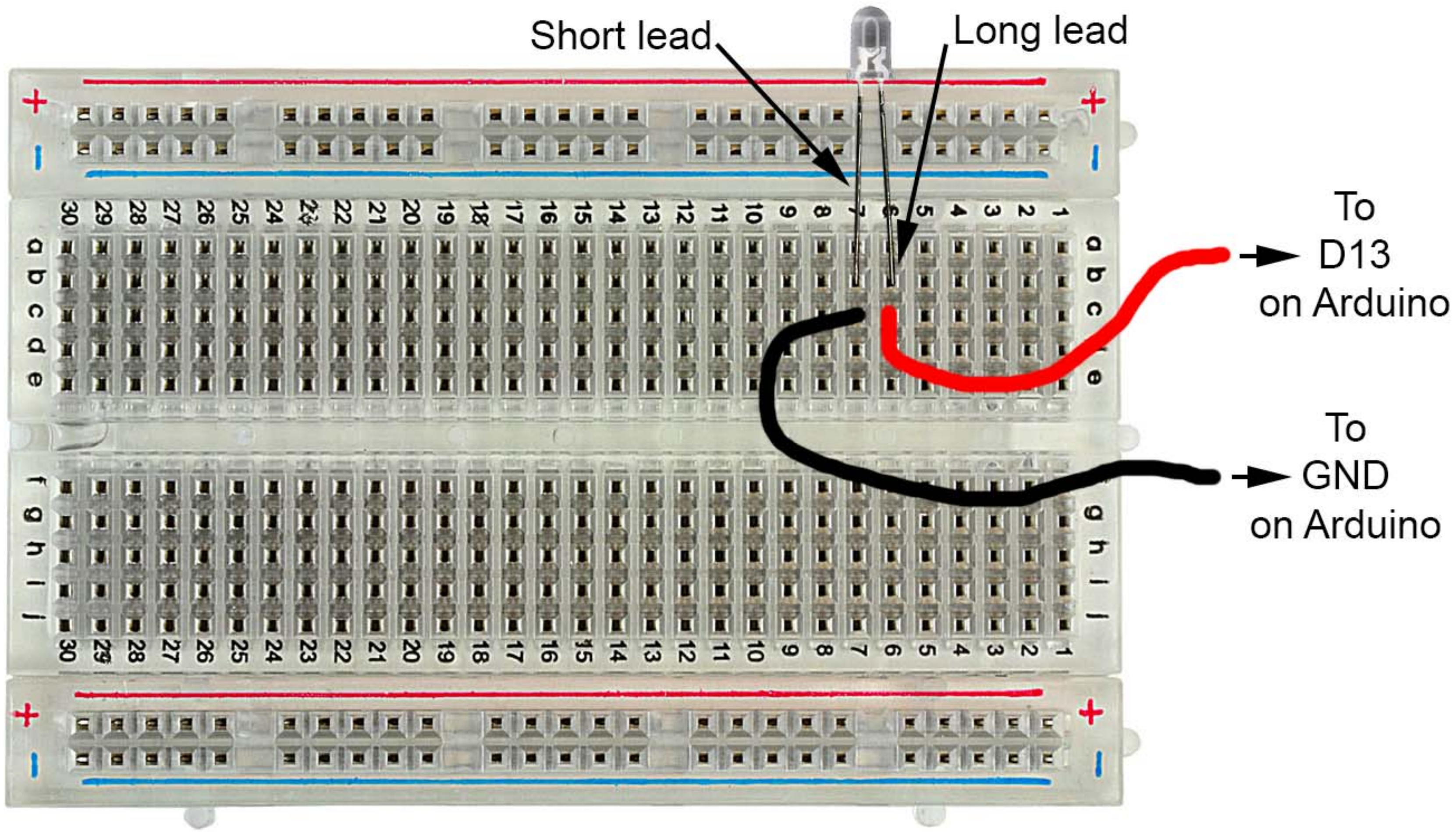
How to Use Solderless Breadboards

Solderless Breadboad with LED



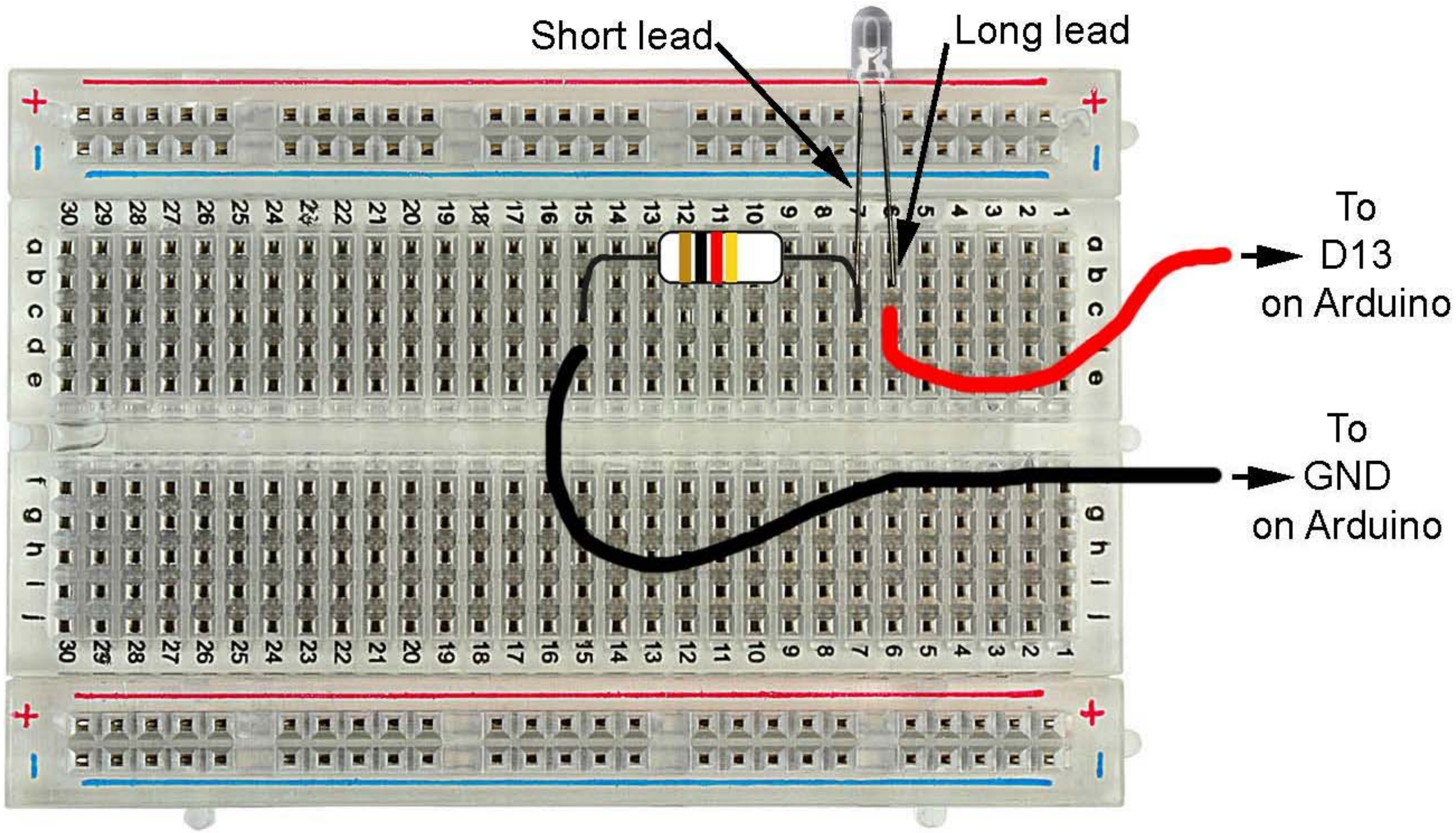
How to Use Solderless Breadboards

Solderless Breadboad with LED and wires

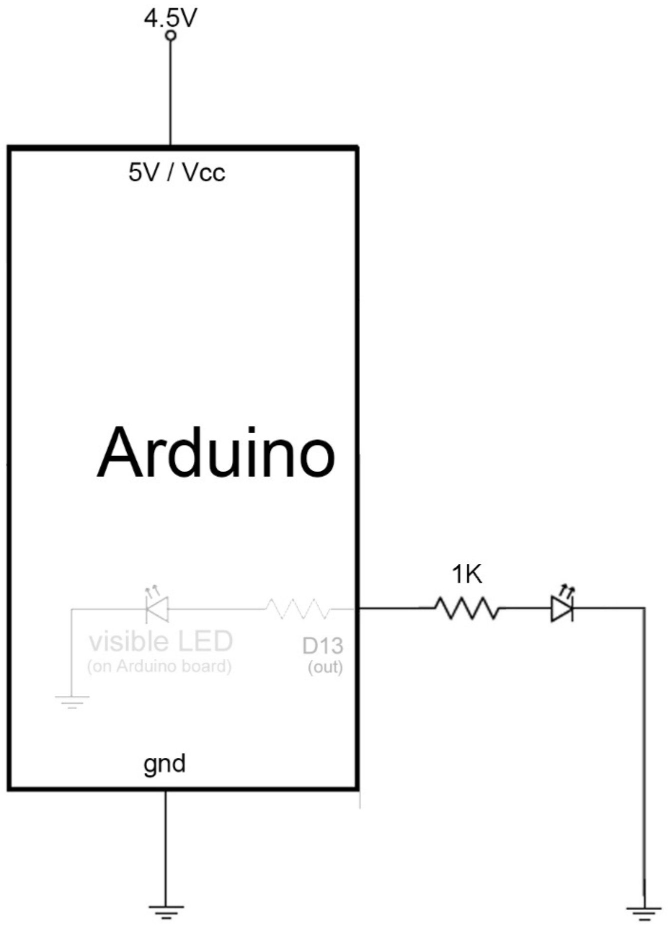


How to Use Solderless Breadboards

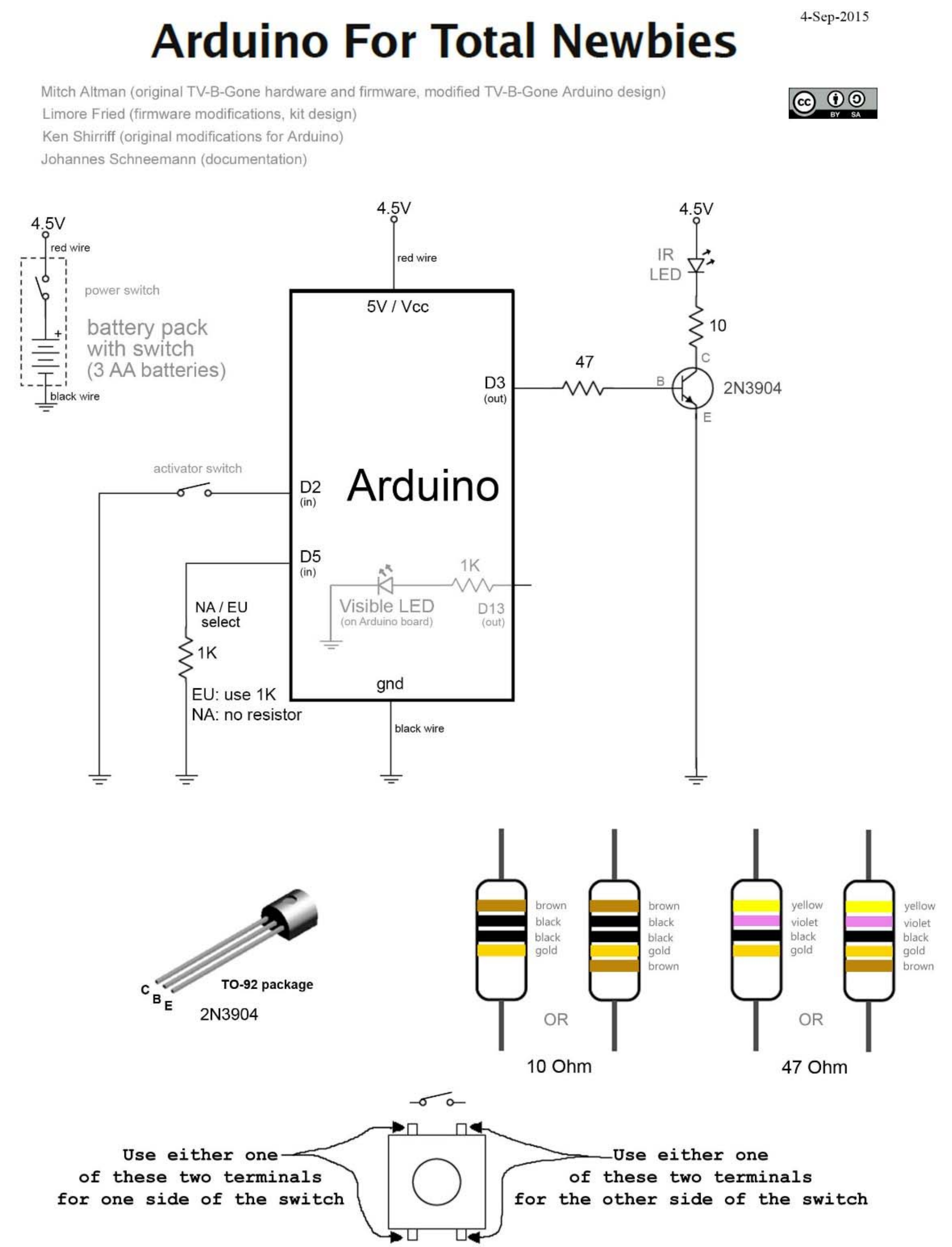
Solderless Breadboad with LED and Resistor and wires



How to Read a Schematic



How to Read a Schematic



4-Sep-2015

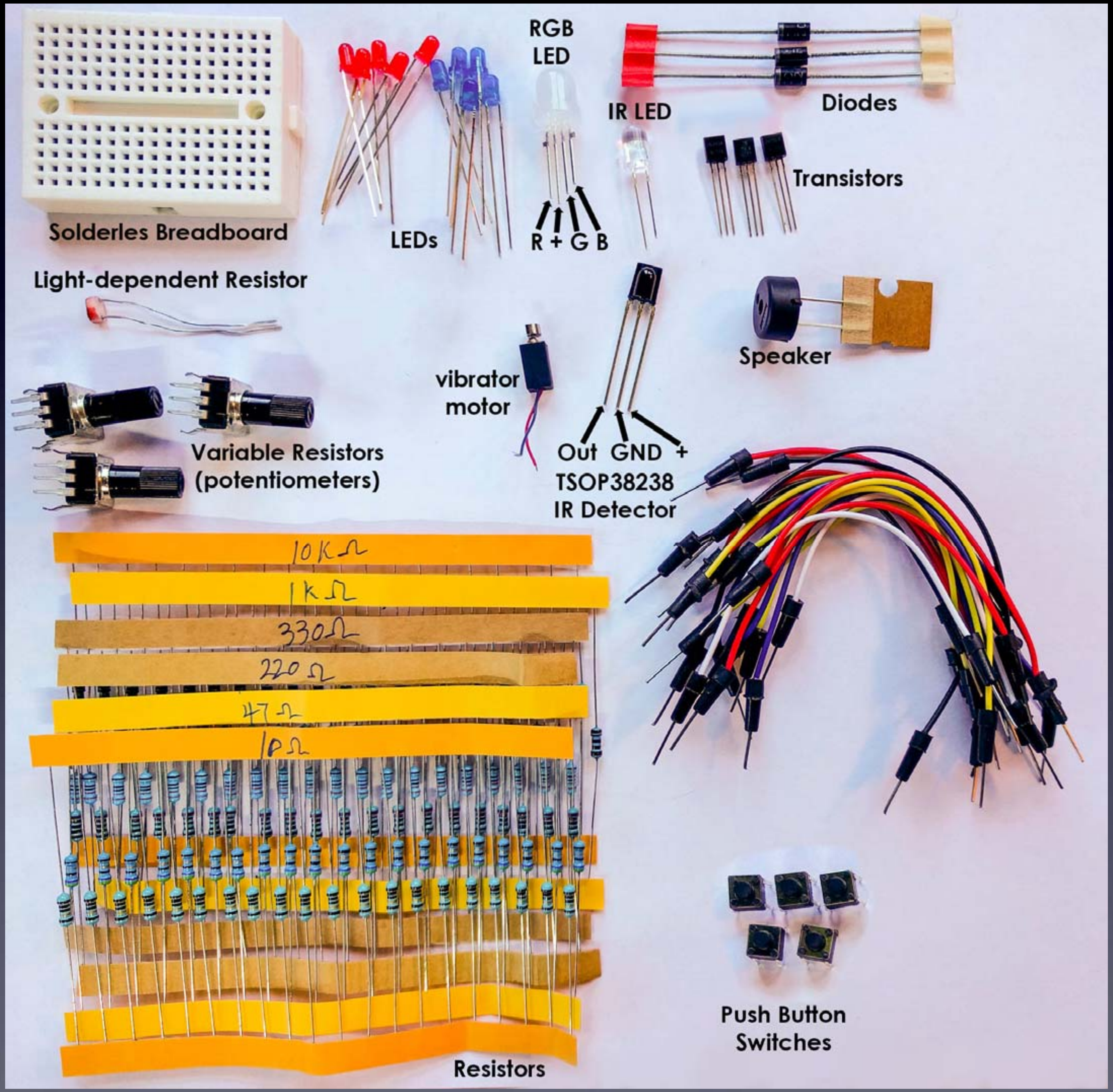
Arduino For Total Newbies

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)

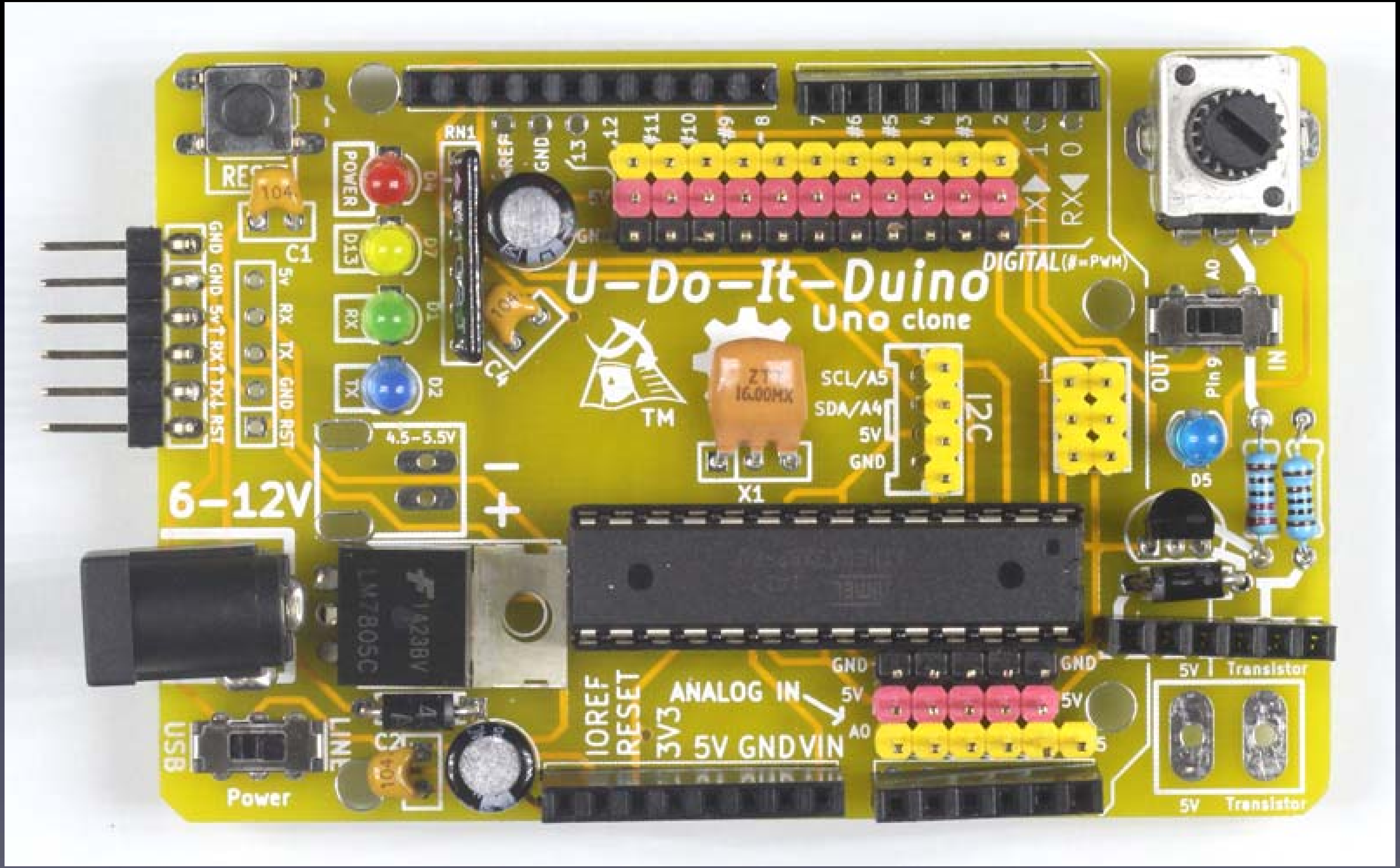
Use either one of these two terminals for one side of the switch

Use either one of these two terminals for the other side of the switch

Parts Pack Contents



If you want to:



(or just search for: U-Do-It-Duino online)

http://www.samuraicircuits.com/MediaWiki/index.php?title=U-Do-It-Duino

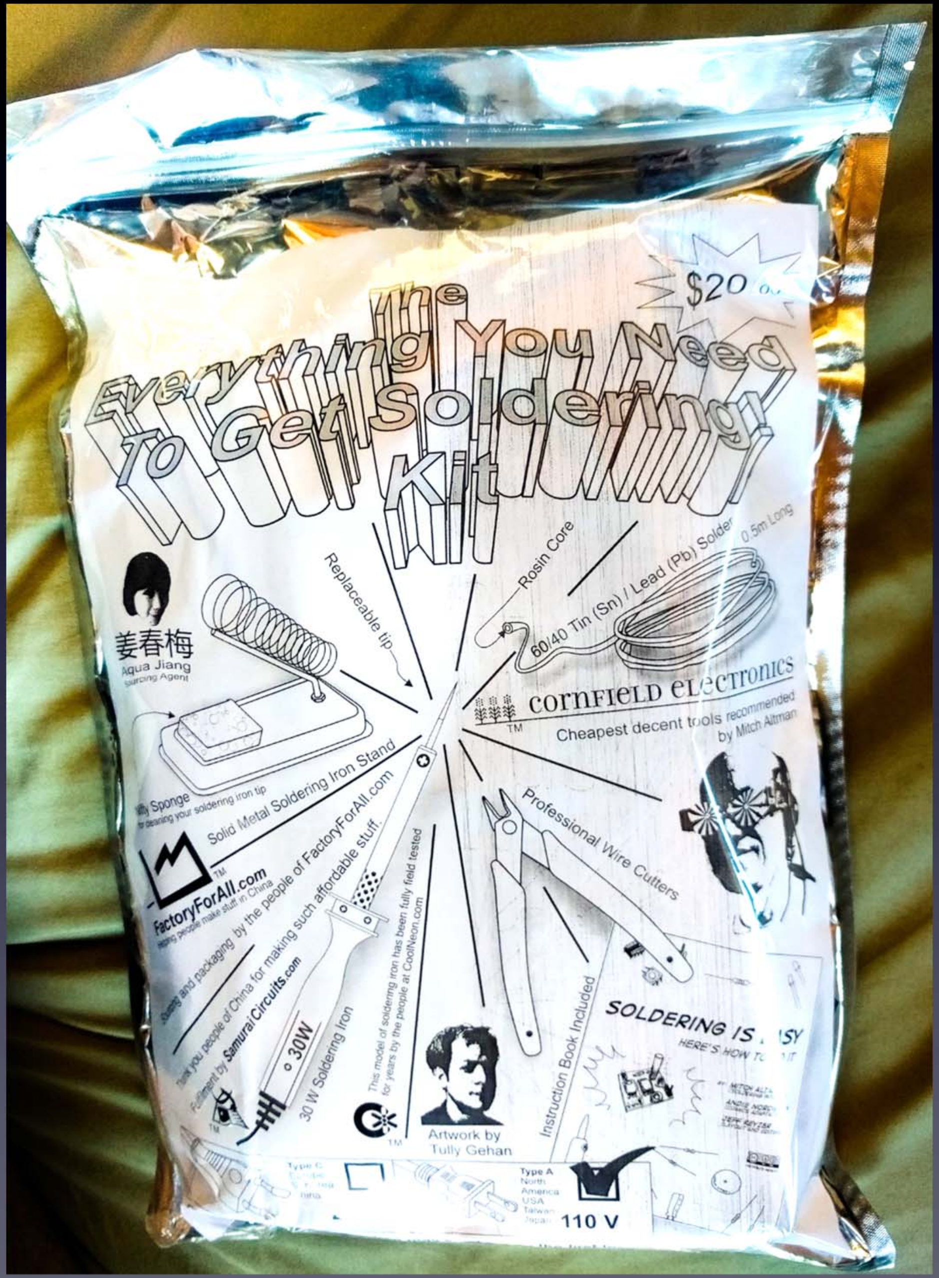
Please Remember:

to

Wash your hands

Tools

I have these Toolkits for sale


$20.00
The Everything You Need To Get Soldering! Kit
Replaceable tip
Rosin Core
60/40 Tin (Sn) / Lead (Pb) Solder
0.5m Long
姜春梅
Aqua Jiang
Sourcing Agent
Sponge
for cleaning your soldering iron tip
Solid Metal Soldering Iron Stand
cornfield electronics
Cheapest decent tools recommended by Mitch Altman
FactoryForAll.com
helping people make stuff in China
Sourcing and packaging by the people of FactoryForAll.com
Thank you people of China for making such affordable stuff.
Fulfillment by SamuraiCircuits.com
30W
30 W Soldering Iron
This model of soldering iron has been fully field tested for years by the people at CoolNeon.com
Artwork by Tully Gehan
Professional Wire Cutters
Instruction Book Included
SOLDERING IS EASY
HERE'S HOW TO DO IT
Type C
Type A
North America
USA
Taiwan
Japan
110 V