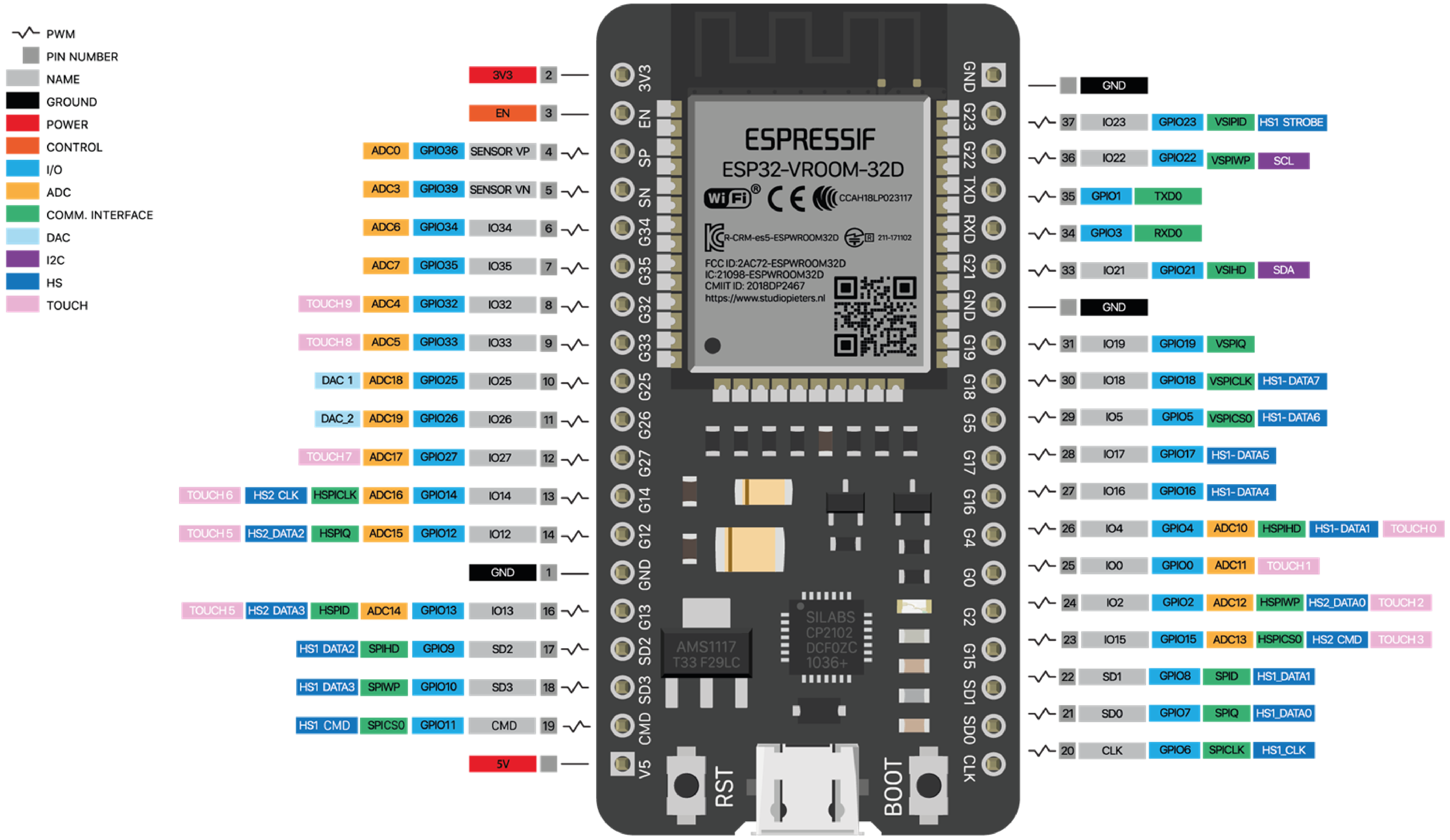
# DigitalOutput

Huaishu Peng | UMD CS | Fall 2023


PWM
PIN NUMBER
NAME
GROUND
POWER
CONTROL
I/O
ADC
COMM. INTERFACE
DAC
I2C
HS
TOUCH
3V3 2
EN 3
ADC0 GPIO36 SENSOR VP 4
ADC3 GPIO39 SENSOR VN 5
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GND 1
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HS1 CMD SPICS0 GPIO11 CMD 19
5V
GND
37 IO23 GPIO23 VSIPID HS1 STROBE
36 IO22 GPIO22 VSPIWP SCL
35 GPIO1 TXD0
34 GPIO3 RXD0
33 IO21 GPIO21 VSIHD SDA
GND
31 IO19 GPIO19 VSPIQ
30 IO18 GPIO18 VSPICLK HS1-DATA7
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20 CLK GPIO6 SPICLK HS1_CLK
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GND G23 G22 TXD RXD G21 GND G19 G18 G5 G17 G16 G4 G0 G2 G15 SD1 SD0 CLK
ESPRESSIF
ESP32-VROOM-32D
CCAH18LP023117
R-CRM-es5-ESPWROOM32D
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FCC ID:2AC72-ESPWROOM32D
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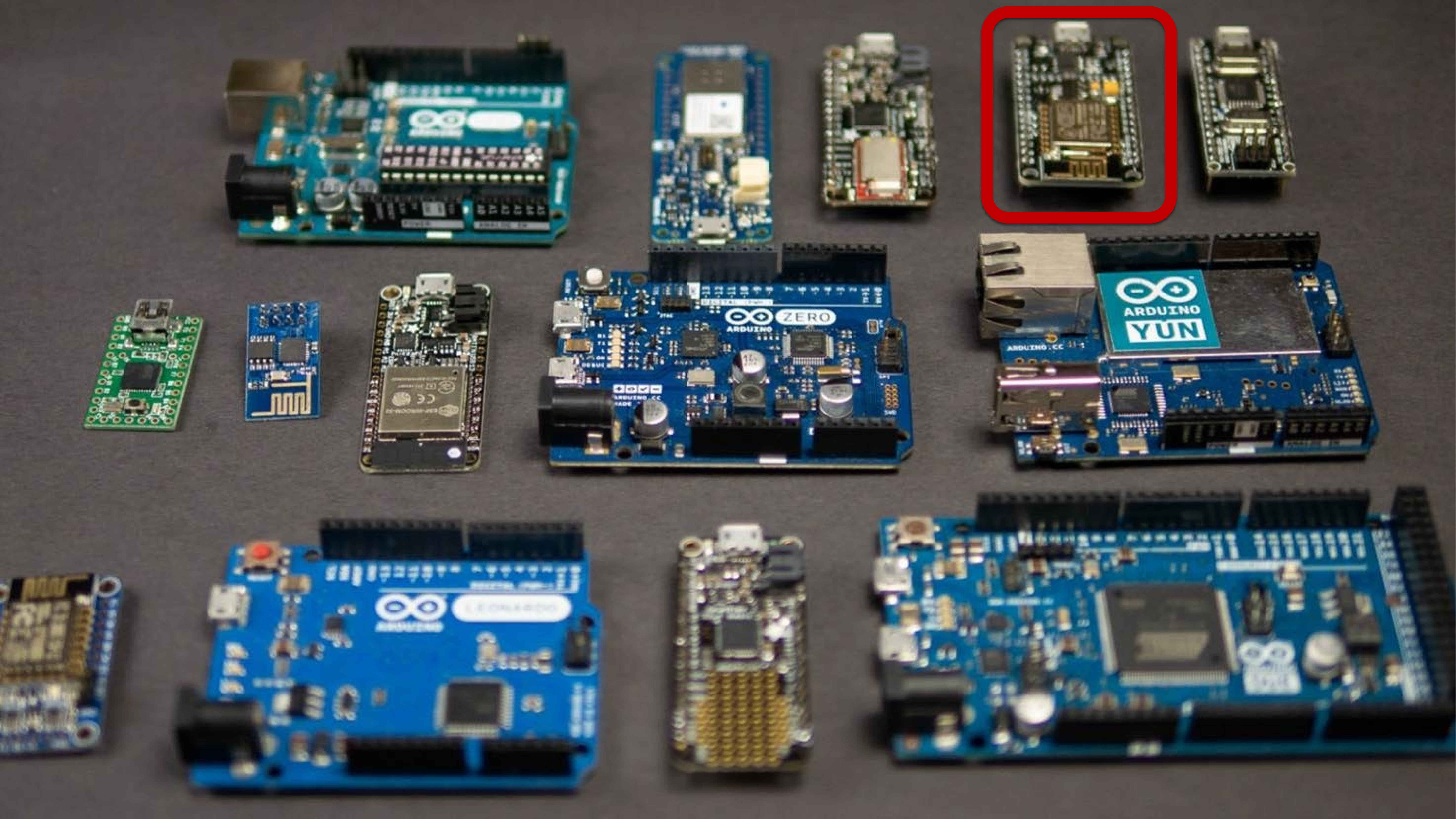
https://www.studiopieters.nl
AMS1117 T33 F29LC
SILABS CP2102 DCF0ZC 1036+
RST
BOOT

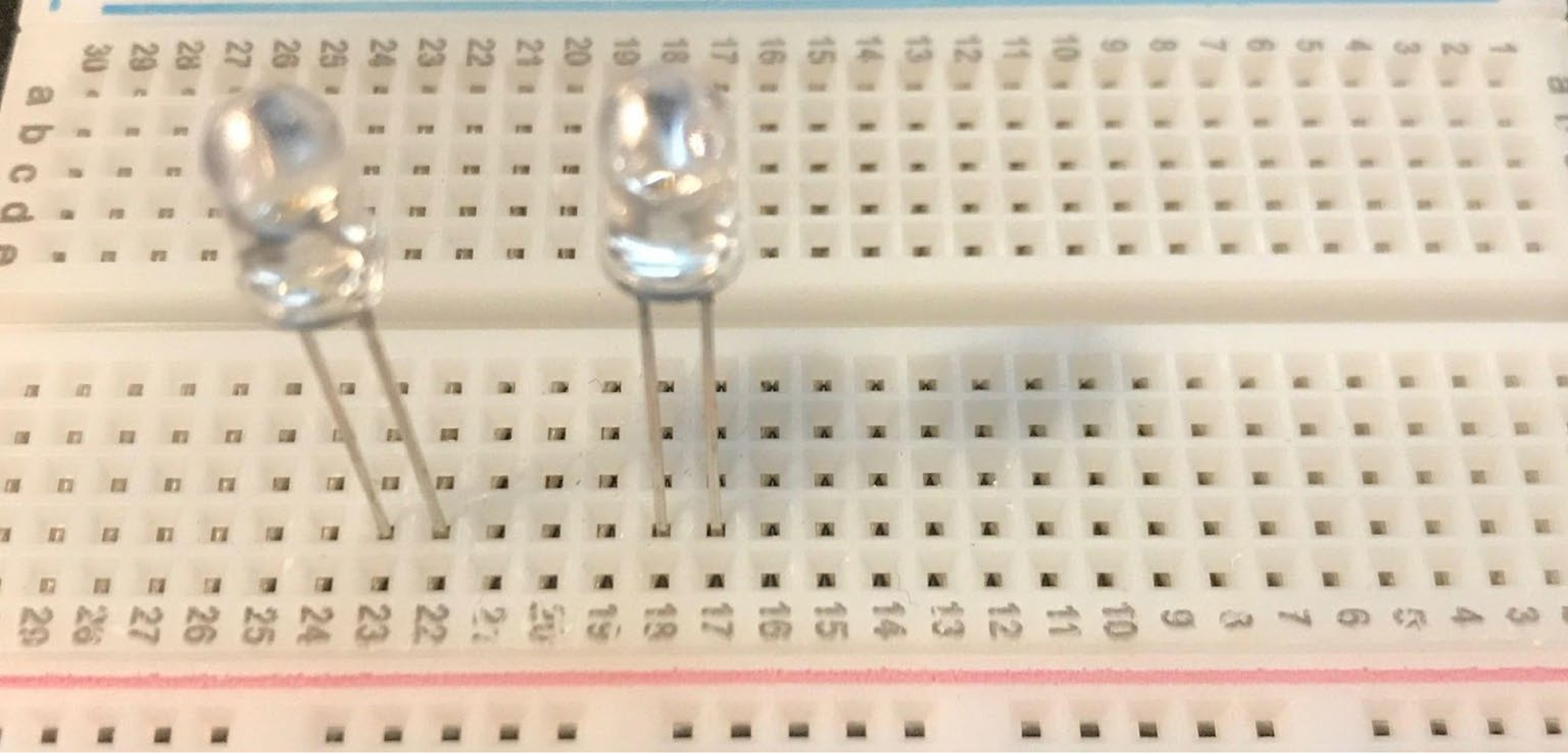
https://www.studiopieters.nl/esp32-pinout/


ARDUINO ZERO
ARDUINO YUN
ARDUINO.CC
ARDUINO LEONARDO

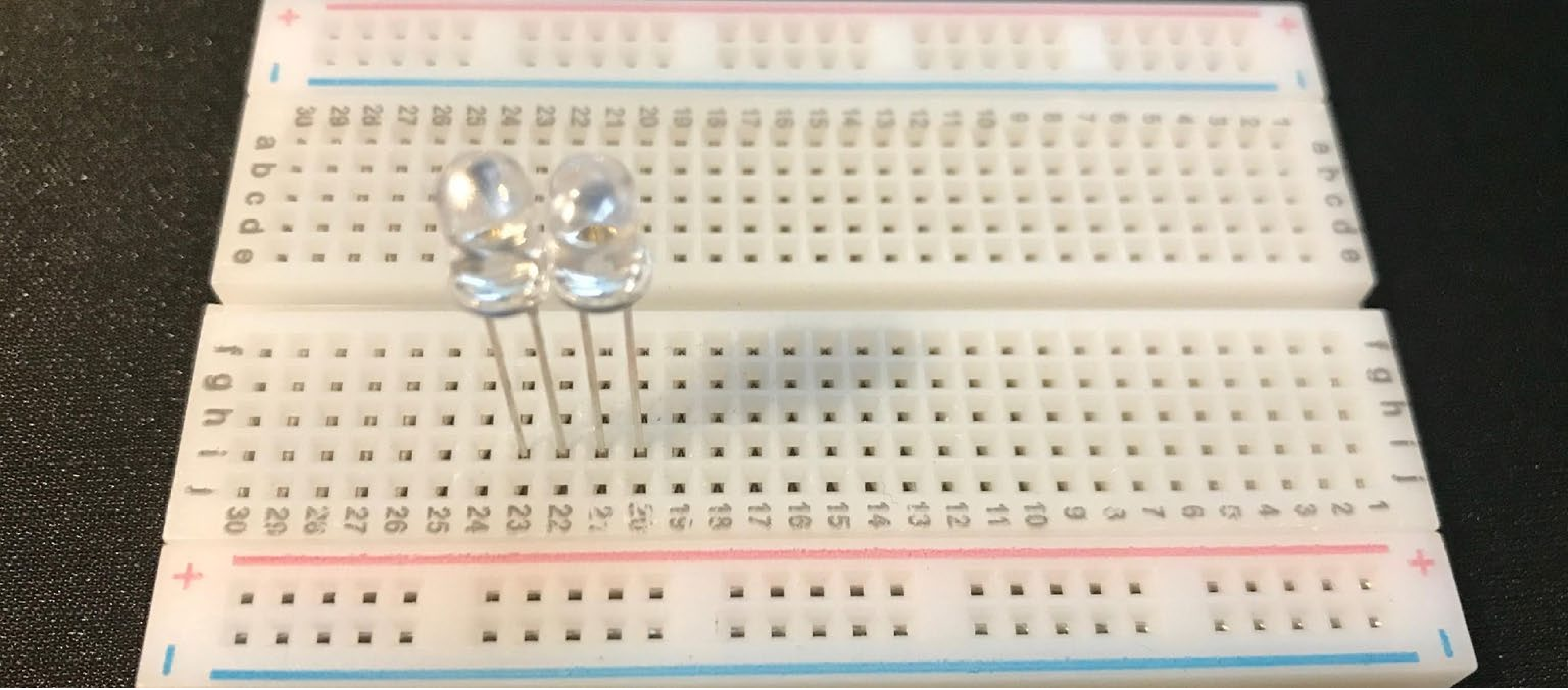
## ESP32 (38Pin version)

18 Analog-to-Digital Converter (ADC) channels
3 SPI interfaces
3 UART interfaces
2 I2C interfaces
16 PWM output channels
2 Digital-to-Analog Converters (DAC)
2 I2S interfaces
10 Capacitive sensing GPIO’s

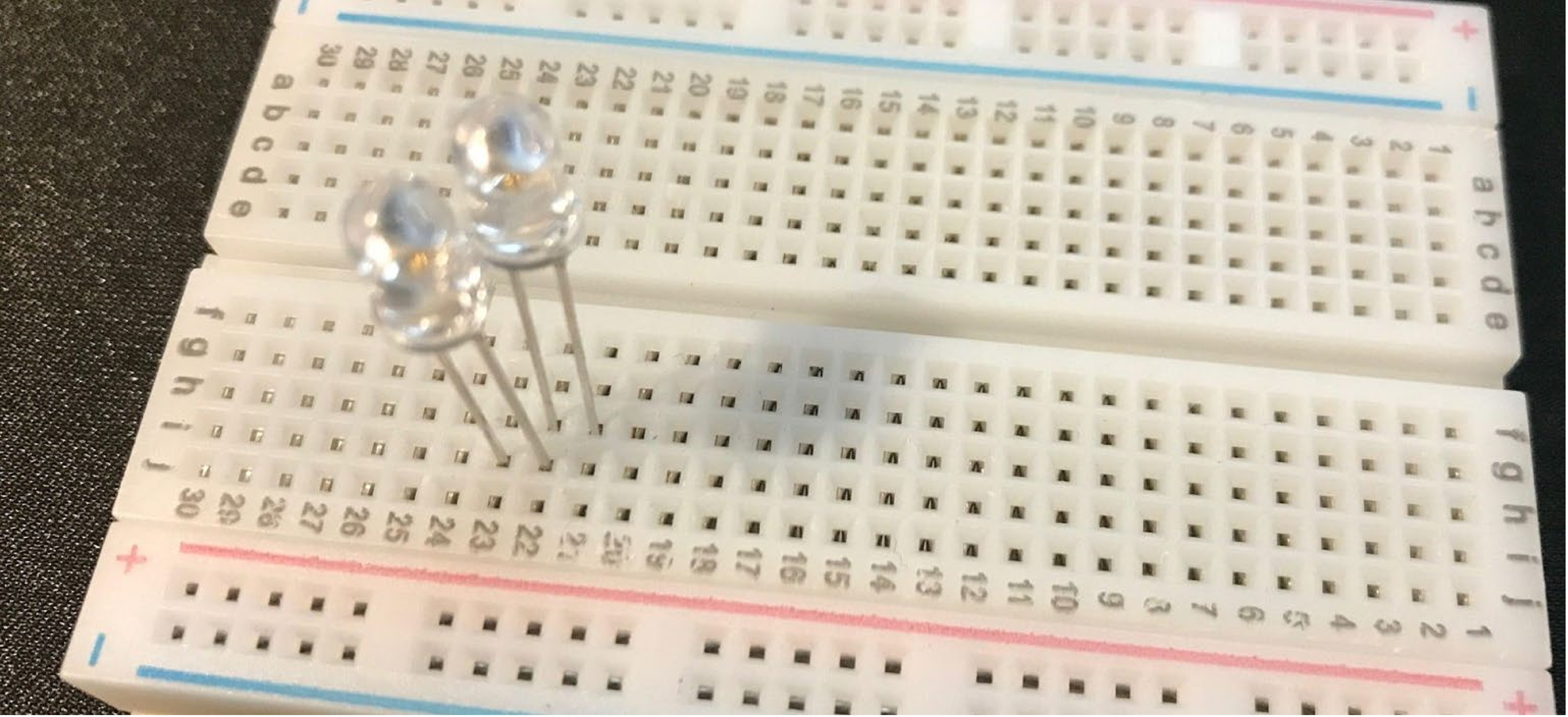
+ − a b c d e f g h i j + −
+ − a b c d e f g h i j + −



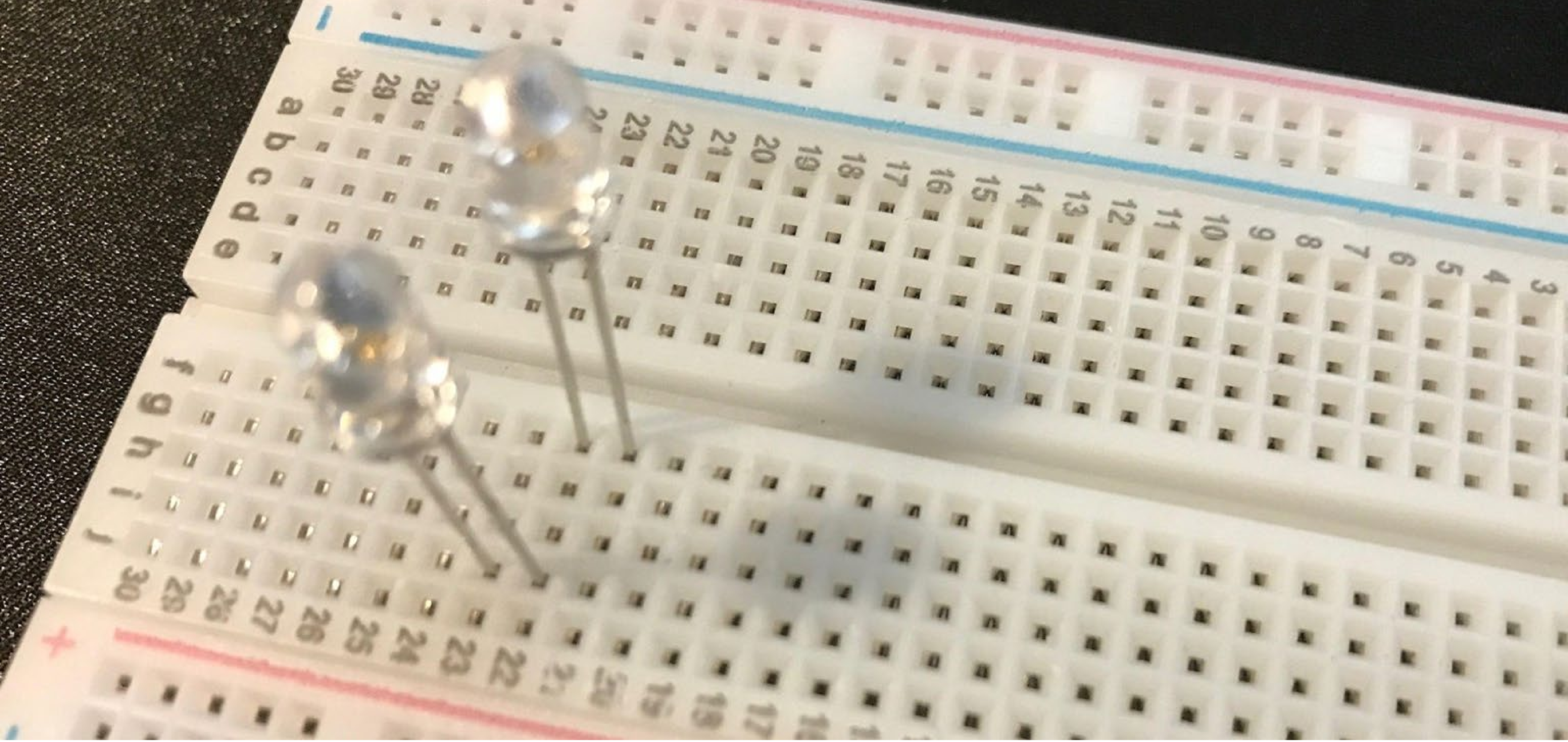
are the LEDs connected with each other?



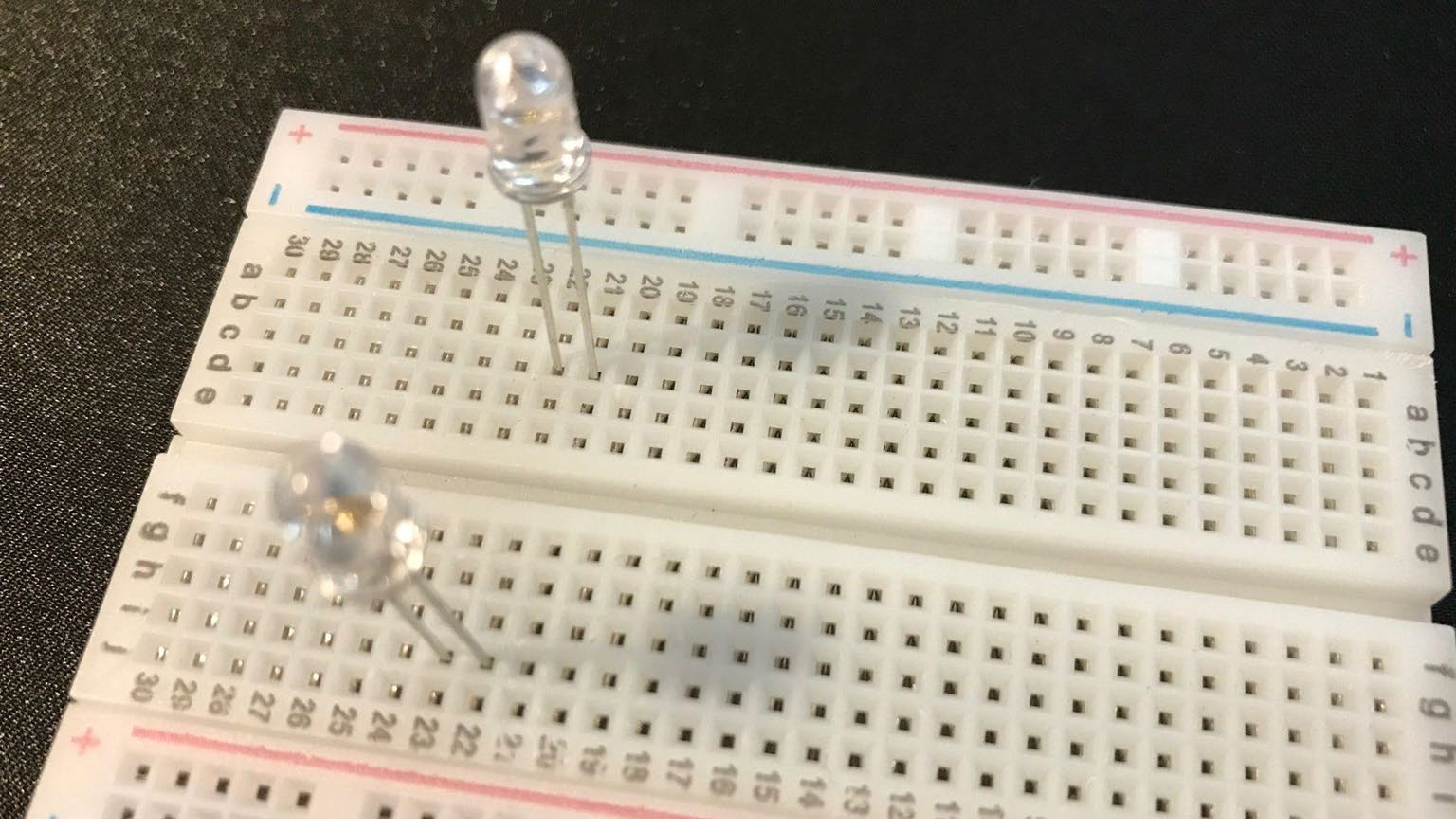
Now?

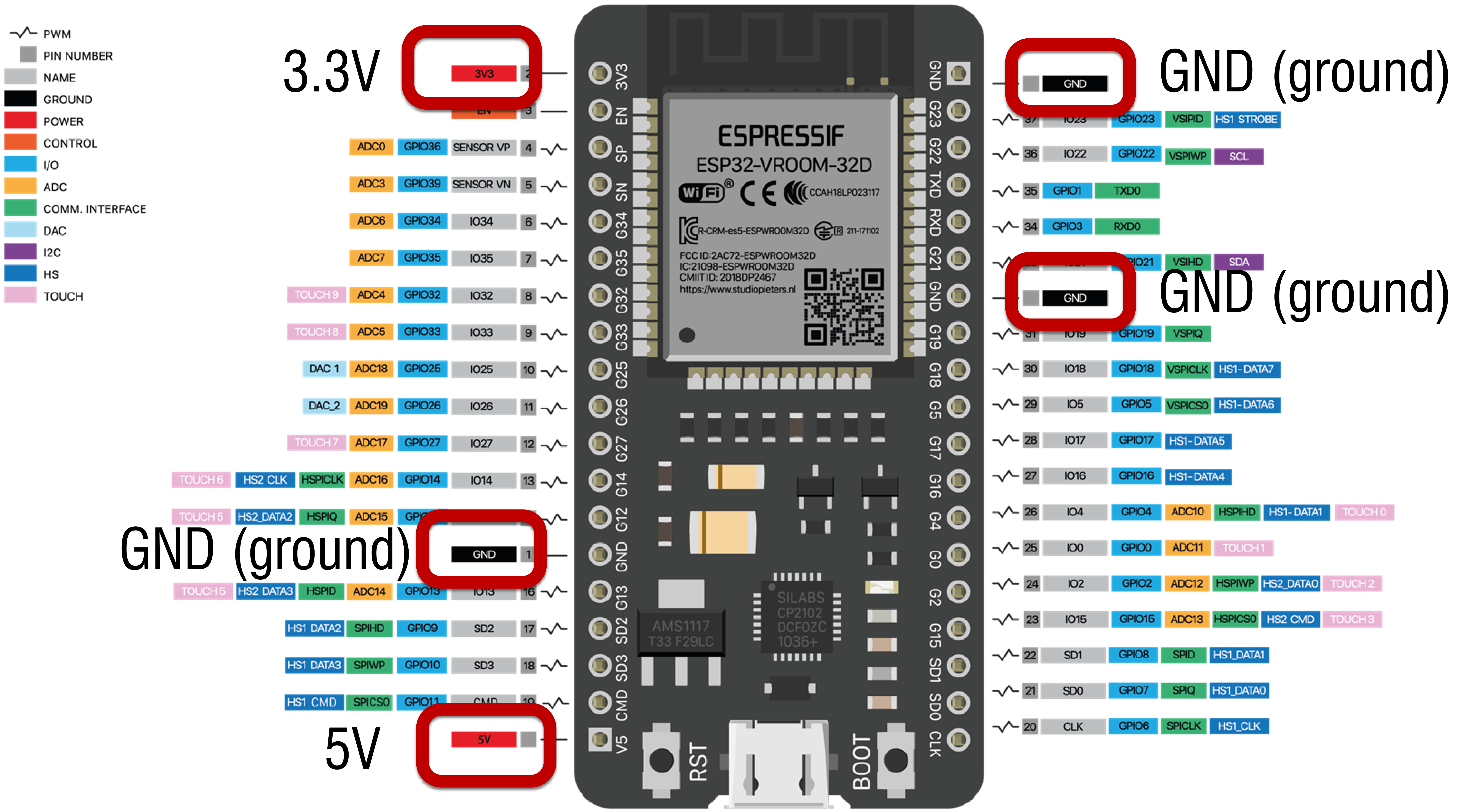


Now?



Now?

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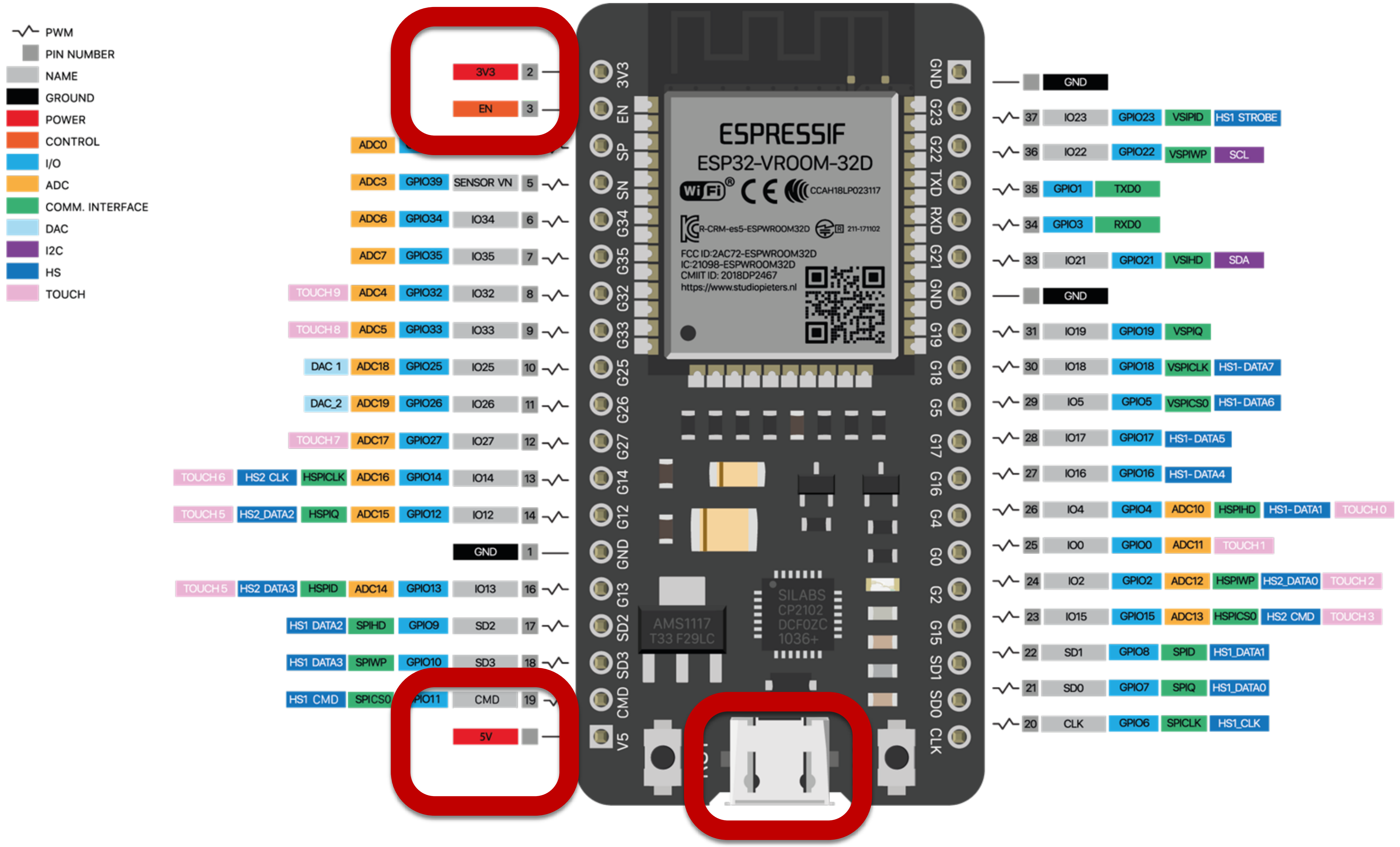
https://www.studiopieters.nl
AMS1117 T33 F29LC
SILABS CP2102 DCF0ZC 1036+
RST
BOOT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ESPRESSIF
ESP32-VROOM-32D
AMS1117
SILABS CP2102

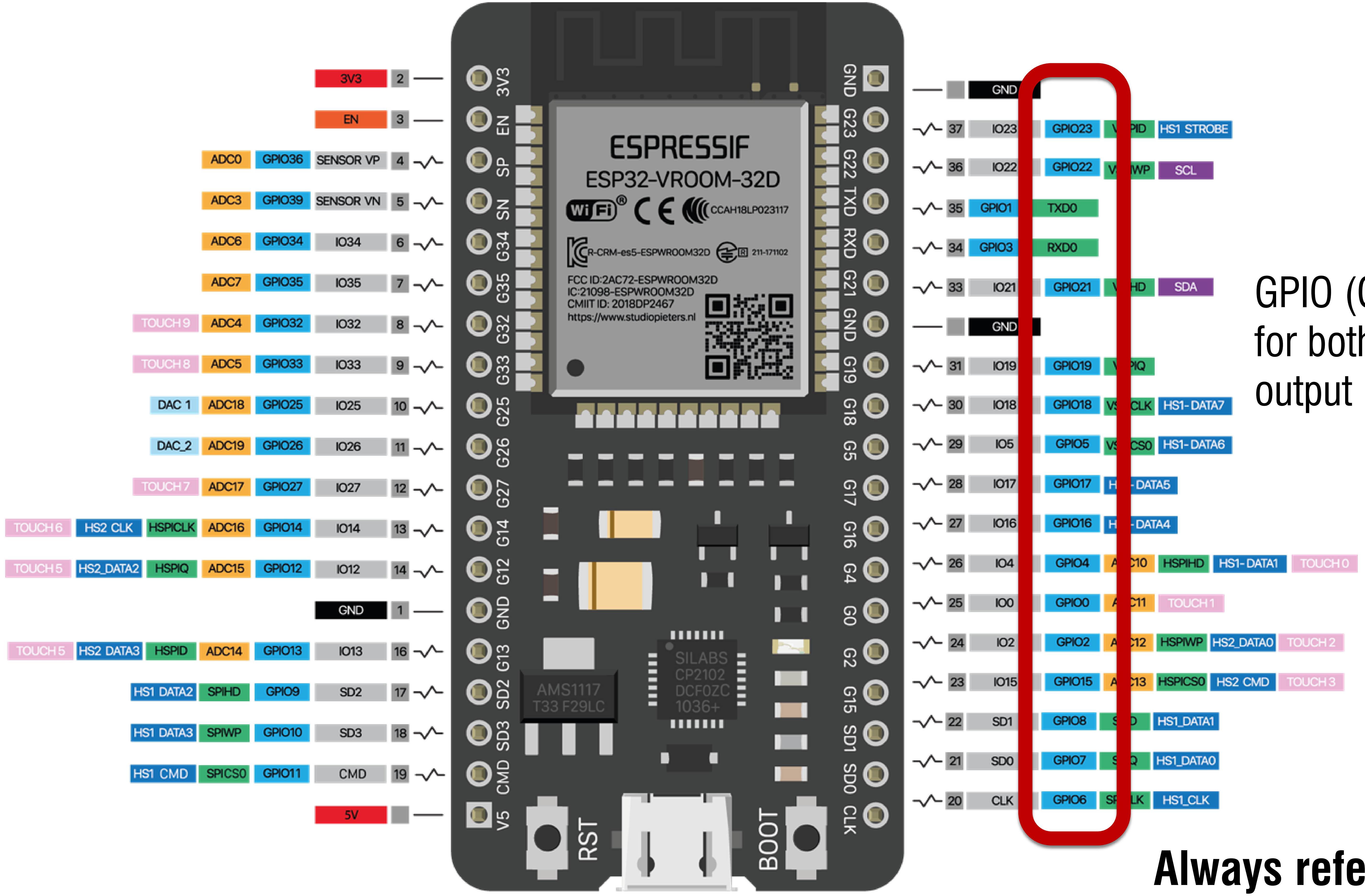
3 options to power up ESP32.

1. Directly via micro-USB port.

2. Unregulated power to GND and 5V pins (Between 5 to 12 v)

3. Regulated power to GND and 3.3V pins (ONLY 3.3v!)

Always only power the microcontroller with one option



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ESPRESSIF
ESP32-VROOM-32D
Wi Fi
CE
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33 IO21 GPIO21 V HD SDA
GND
31 IO19 GPIO19 V PIQ
30 IO18 GPIO18 VS CLK HS1-DATA7
29 IO5 GPIO5 VS CS0 HS1-DATA6
28 IO17 GPIO17 H DATA5
27 IO16 GPIO16 H DATA4
26 IO4 GPIO4 A 10 HSPIHD HS1-DATA1 TOUCH0
25 IO0 GPIO0 A 11 TOUCH1
24 IO2 GPIO2 A 12 HSPIWP HS2_DATA0 TOUCH2
23 IO15 GPIO15 A 13 HSPICS0 HS2 CMD TOUCH3
22 SD1 GPIO8 S D HS1_DATA1
21 SD0 GPIO7 S Q HS1_DATA0
20 CLK GPIO6 SF LK HS1_CLK

GPIO (General Purpose IO) for both digital input and output

**Always refer to the pin layout**

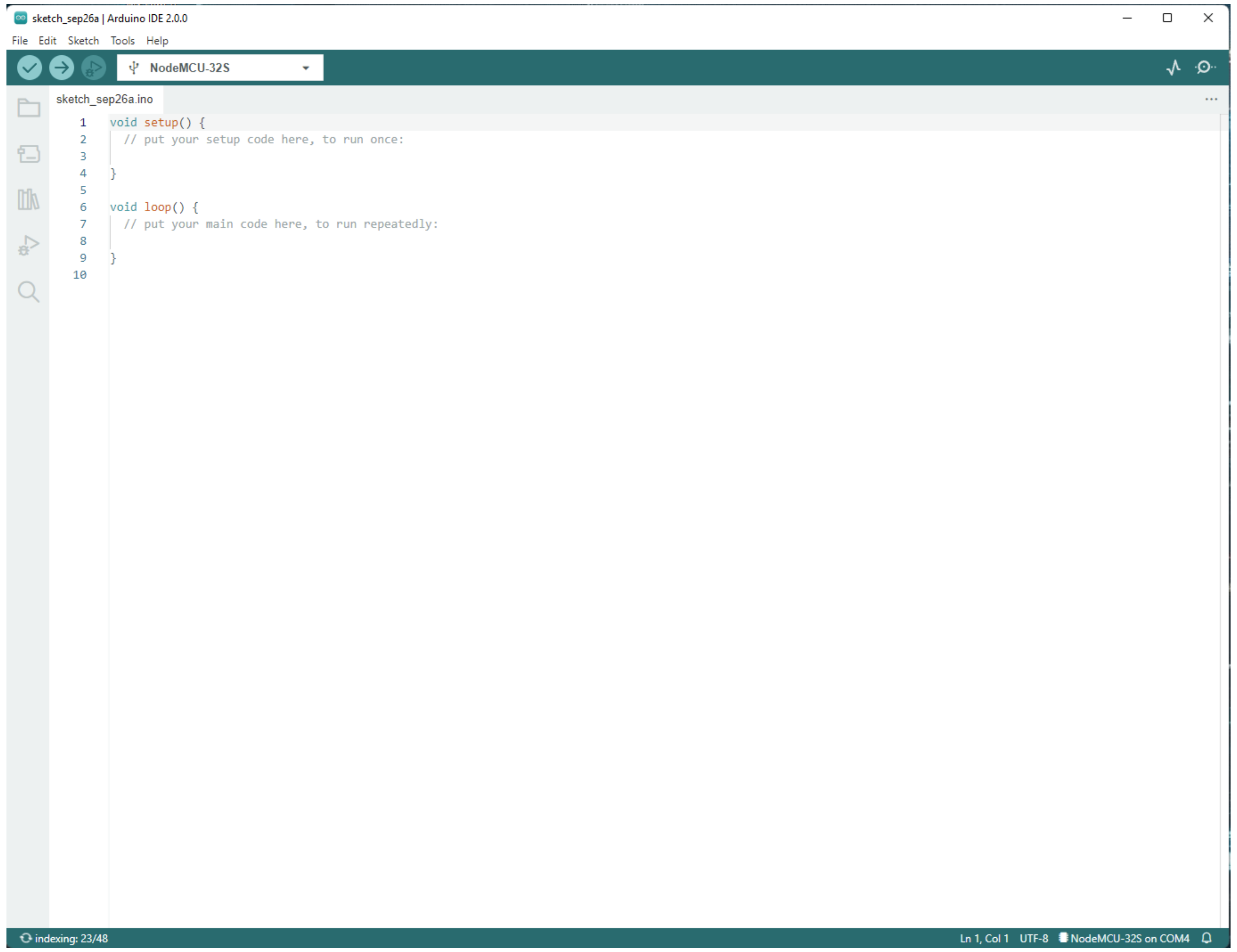
## Digital Output – Blink an LED

# Digital Output

Set the logic value of a pin
– **LOW** (0V) or **HIGH** (3.3V)

Arduino functions
– **pinMode(pin, OUTPUT)** to set the pin direction
*Often in the **setup()** function*
– **digitalWrite(pin, value)** to write the current value of a pin

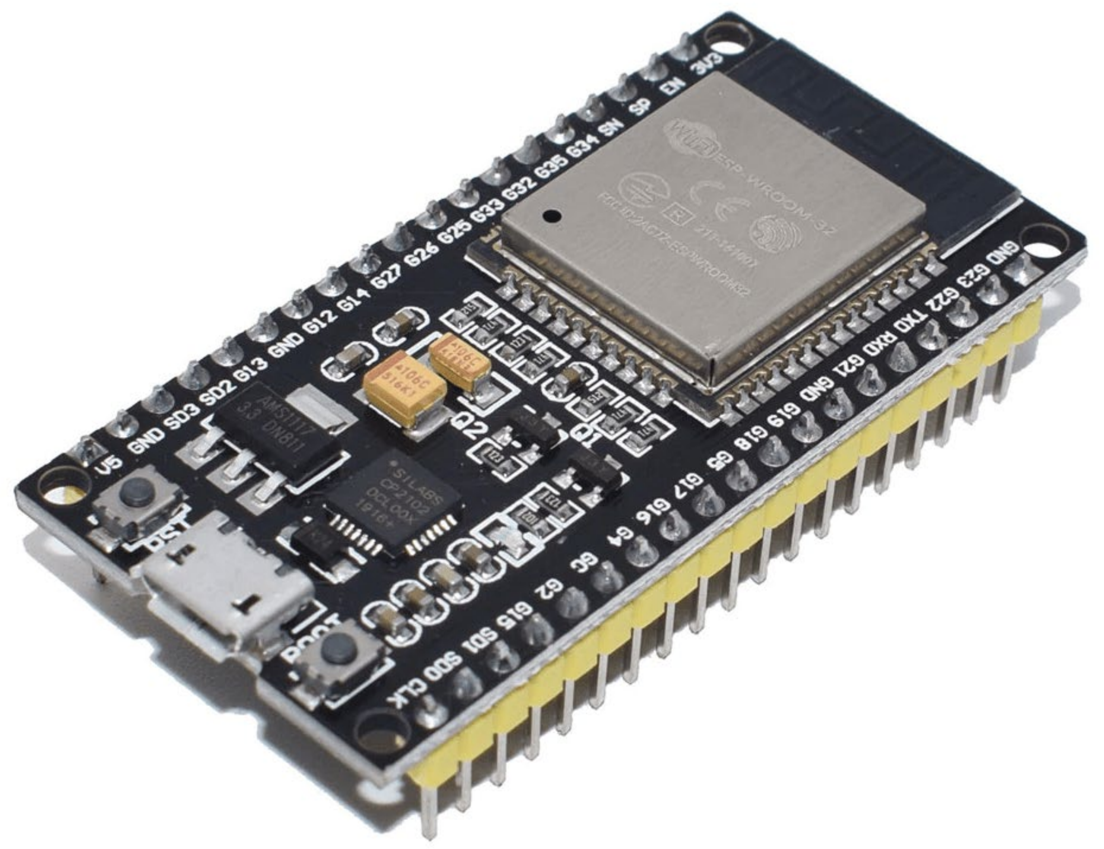
Limitations
– Only 0 or 3.3 V with limited current;


sketch_sep26a | Arduino IDE 2.0.0
File Edit Sketch Tools Help
NodeMCU-32S
sketch_sep26a.ino
indexing: 23/48
Ln 1, Col 1 UTF-8 NodeMCU-32S on COM4

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

}

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

}
```

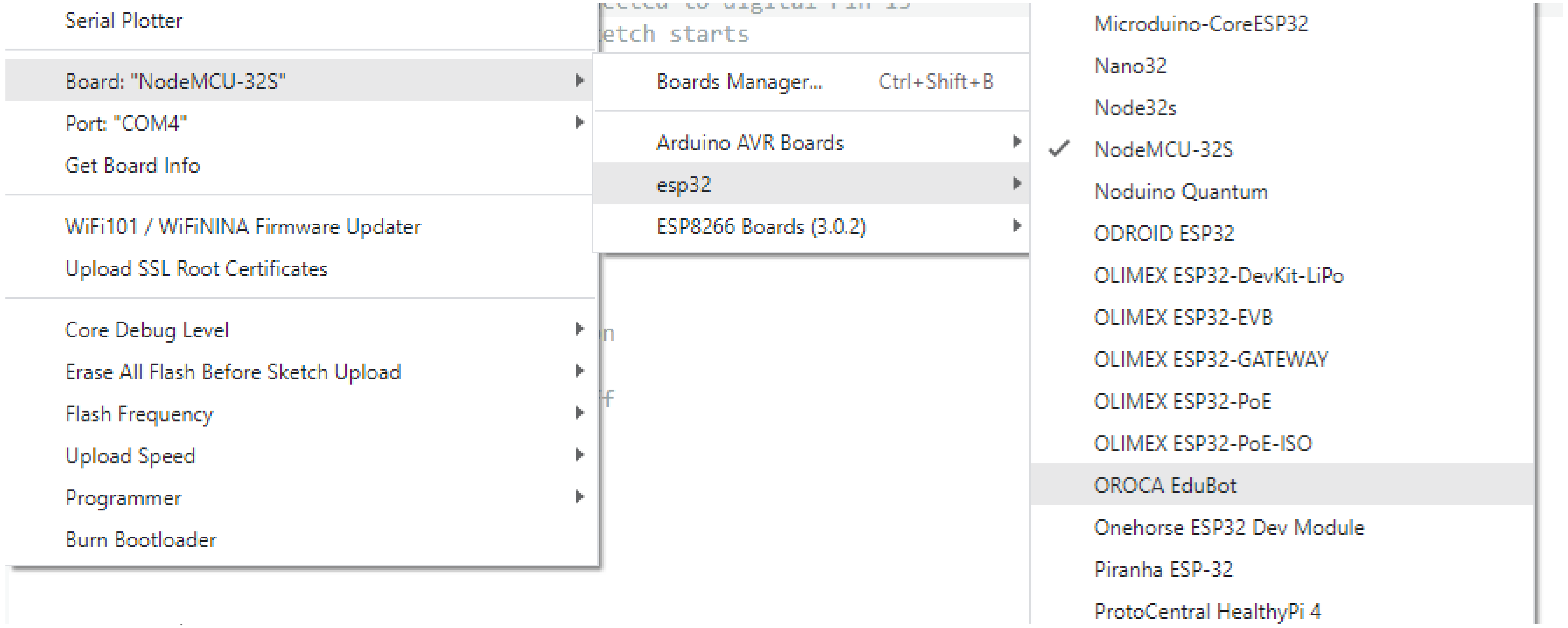
## Blink the built-in LED

```
// constants definition
const int ledPin = 2; // Default LED is connected to GPIO 2
// The setup() method runs once, when the sketch starts
void setup() {
  // initialize the digital pin as an output:
  pinMode(ledPin, OUTPUT);
}
// the loop() method runs over and over again,
// as long as the Arduino has power
void loop()
{
  digitalWrite(ledPin, HIGH); // set the LED on
  delay(5000); // wait for 5 second
  digitalWrite(ledPin, LOW); // set the LED off
  delay(5000); // wait for 5 second
}
```



Select
**Board: -> esp32 -> NodeMCU-32S**

Hit **Upload**



Serial Plotter

Board: "NodeMCU-32S"
Port: "COM4"
Get Board Info

WiFi101 / WiFiNINA Firmware Updater
Upload SSL Root Certificates

Core Debug Level
Erase All Flash Before Sketch Upload
Flash Frequency
Upload Speed
Programmer
Burn Bootloader

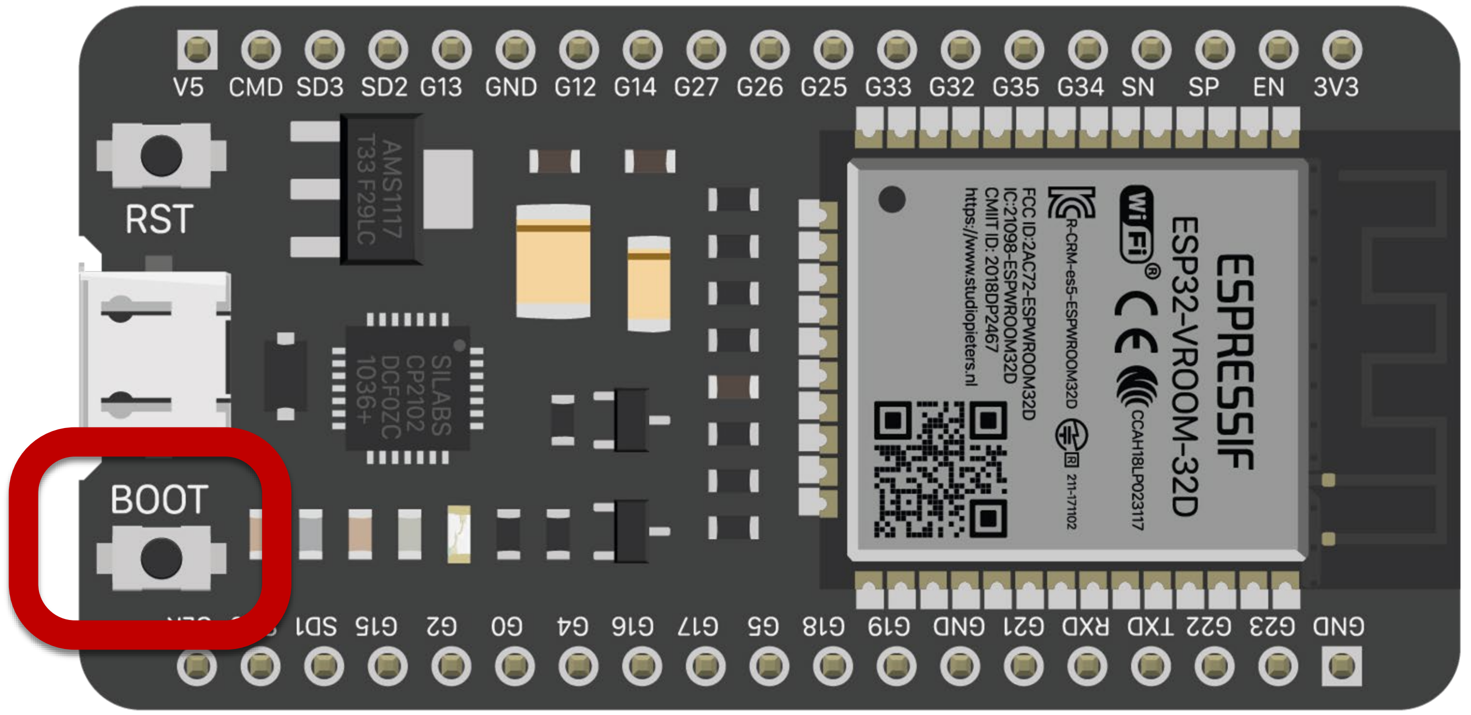
Boards Manager... Ctrl+Shift+B

Arduino AVR Boards
esp32
ESP8266 Boards (3.0.2)

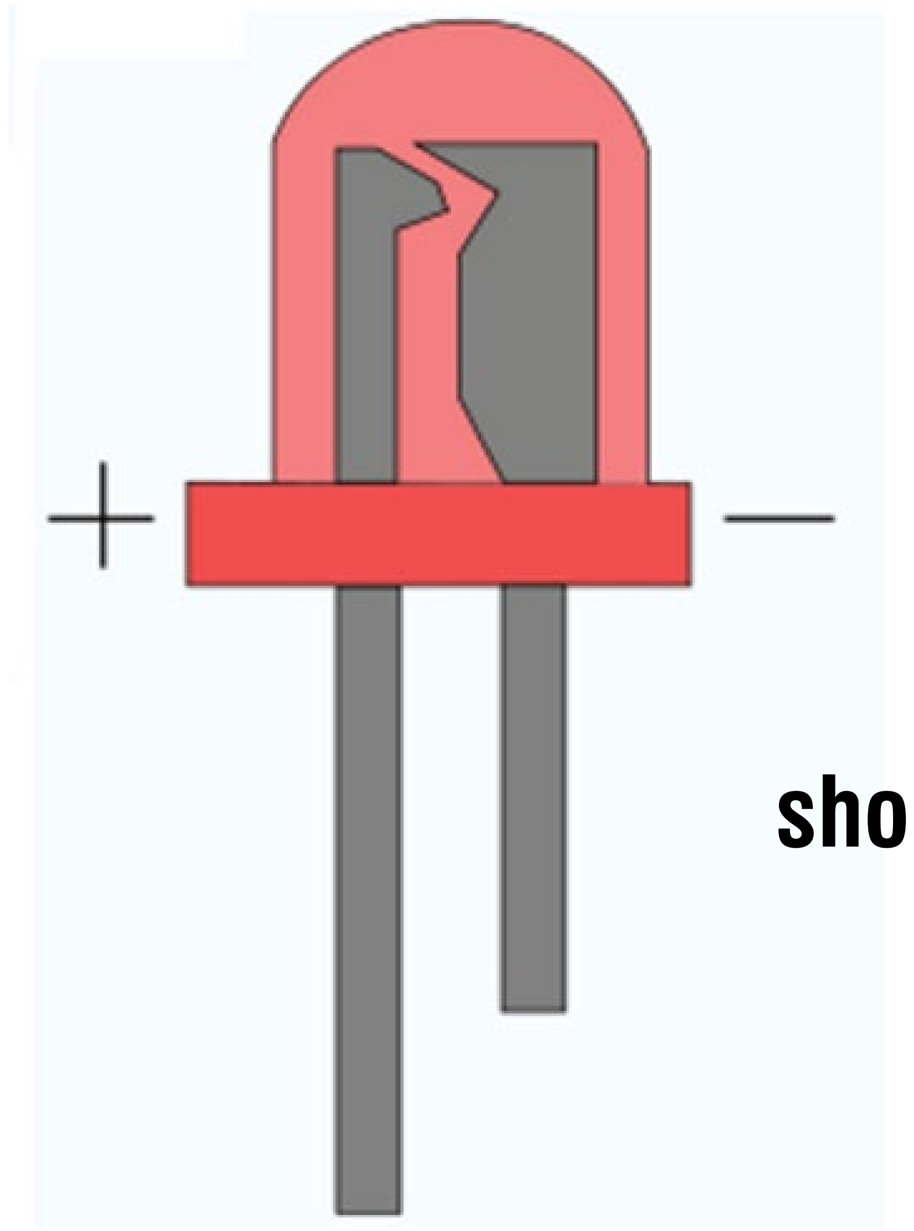
Microduino-CoreESP32
Nano32
Node32s
✓ NodeMCU-32S
Noduino Quantum
ODROID ESP32
OLIMEX ESP32-DevKit-LiPo
OLIMEX ESP32-EVB
OLIMEX ESP32-GATEWAY
OLIMEX ESP32-PoE
OLIMEX ESP32-PoE-ISO
OROCA EduBot
Onehorse ESP32 Dev Module
Piranha ESP-32
ProtoCentral HealthyPi 4

On the ESP32,

Press and hold the BOOT button until you see the code starts uploading


V5 CMD SD3 SD2 G13 GND G12 G14 G27 G26 G25 G33 G32 G35 G34 SN SP EN 3V3
RST
BOOT
ESPRESSIF
ESP32-VROOM-32D
GND G23 G22 TXD RXD G21 GND G19 G18 G5 G17 G16 G4 G0 G2 G15 SD1

## Practice: Light up the RED Led

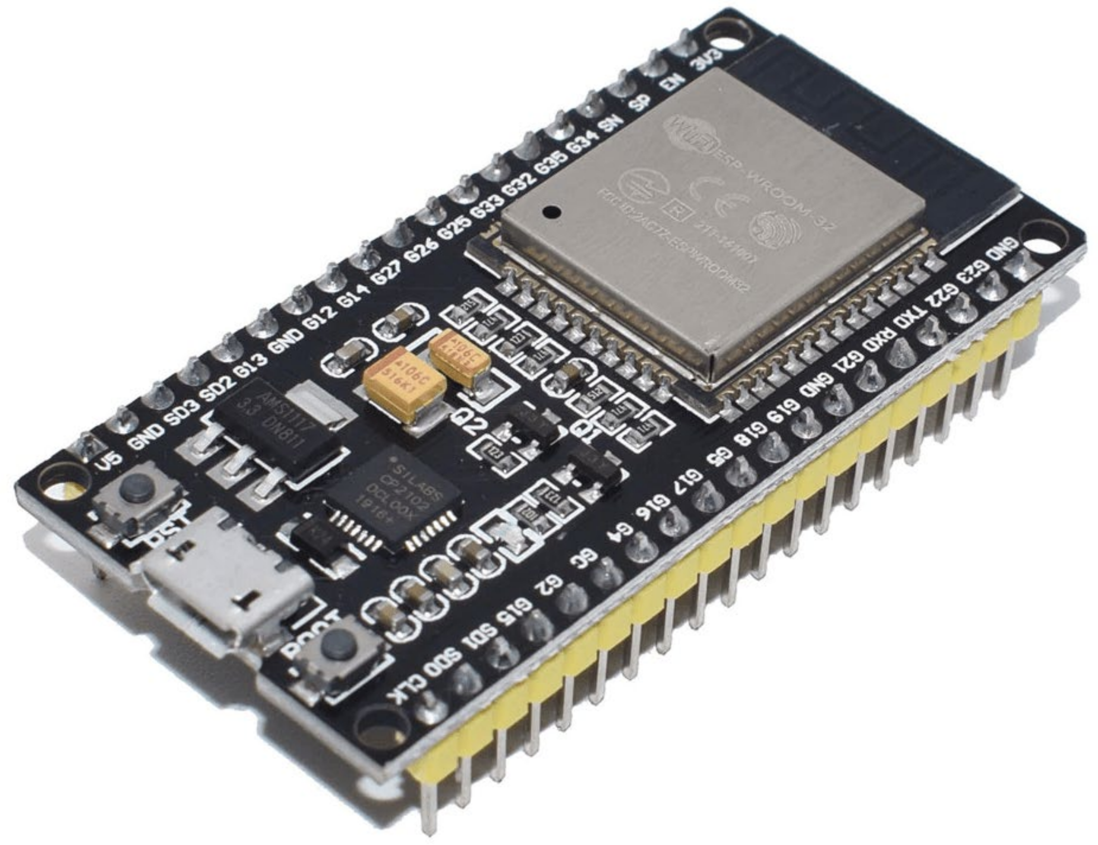


**short** leg

**long** leg

## Blink an external LED

```
// constants definition
const int ledPin = 23; // Default LED is connected to GPIO 23
// The setup() method runs once, when the sketch starts
void setup() {
  // initialize the digital pin as an output:
  pinMode(ledPin, OUTPUT);
}
// the loop() method runs over and over again,
// as long as the Arduino has power
void loop()
{
  digitalWrite(ledPin, HIGH); // set the LED on
  delay(5000); // wait for 5 second
  digitalWrite(ledPin, LOW); // set the LED off
  delay(5000); // wait for 5 second
}
```



## Serial Communication – talk to PC

# Serial Communication

Setup
– **Serial.begin(<baud_speed>)**//9600

Receiving information
– Test is data is available
    **Serial.available()**
– Read one byte
    **Serial.read()**

Sending information
– Raw data transfer
    **Serial.write(val) or Serial.write(buf, len)**

Other commands -> https://www.arduino.cc/reference/en

– Formatted output
    **Serial.print (x,{BIN,OCT,DEC,HEX})**
– Read formatted data
    **Serial.parseFloat()**
    **Serial.parseInt()**

## Echo program

```
// setup performs initializations
void setup()
{
  // initialize the serial port setting its speed to 9600 Baud:
  Serial.begin(9600);
}
// the loop() method runs over and over again,
// as long as the Arduino has power
void loop()
{
  // Temporary buffer
  byte incoming_byte;
  // check if the something is pending
  if (Serial.available() > 0)
  {
    // read the pending byte;
    incoming_byte = Serial.read();
    // Sending it back;
    Serial.write(incoming_byte);
  }
}
```

## Assignment

### Morse code

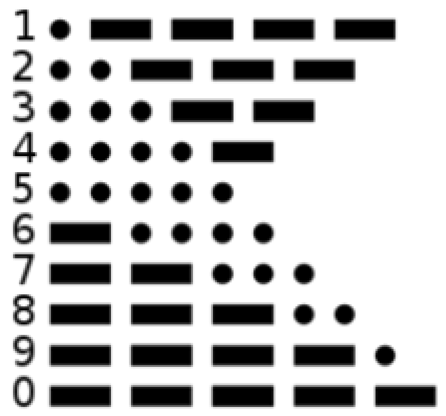
– Input:

*__3451__* from the Serial Terminal Monitor

– Output:

Blink the LED accordingly

### International Morse code



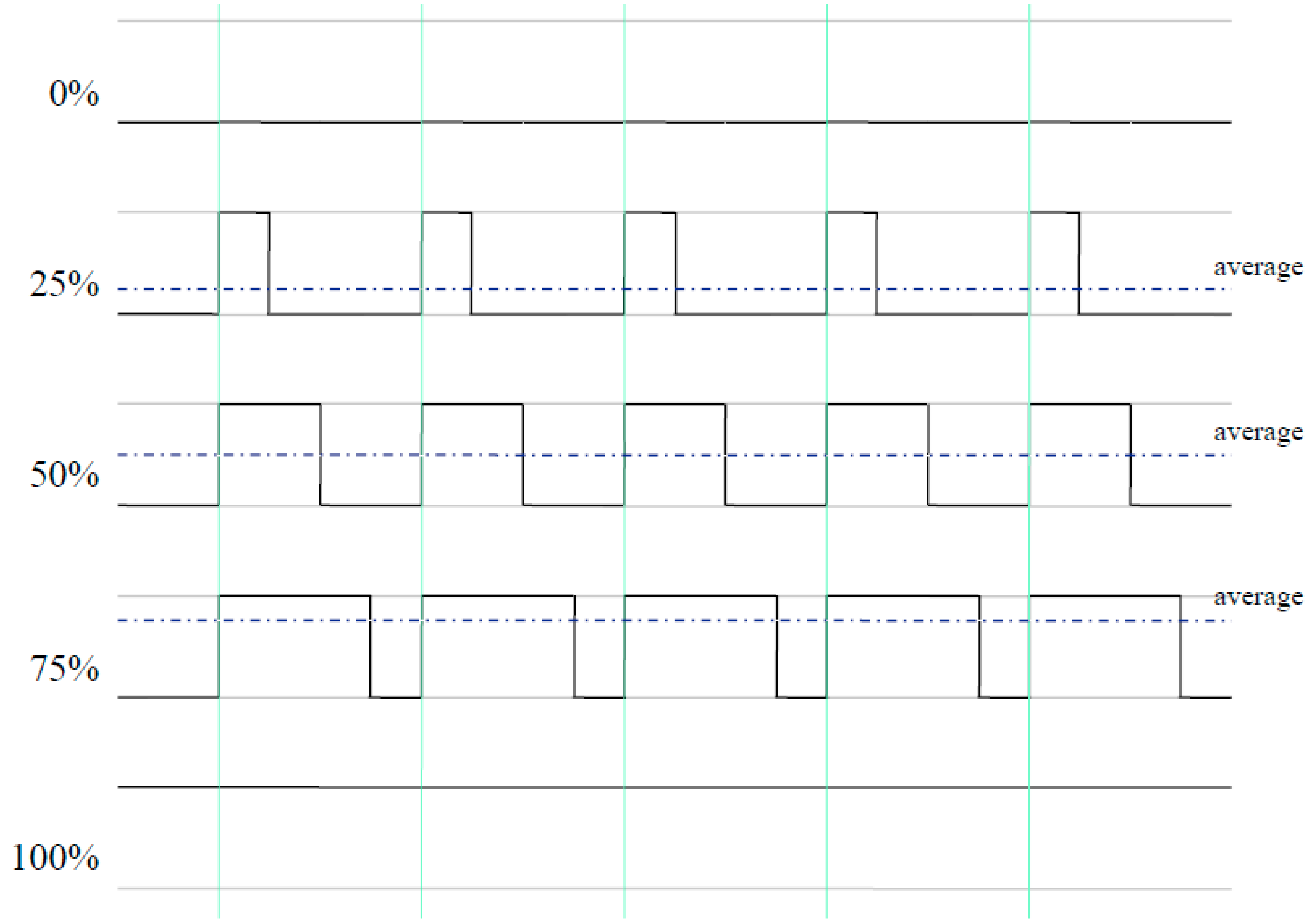
### For this assignment:

A **dot** is **100ms** long
A **dash** is equal to **3 dots**
A space between **parts** of the same letter is equal to **one dot**
The space between two **letters** is equal to **three dots**

### Submission:

Unlisted youtube video link for the blinking LED
Upload the Arduino code

## Pulse Width Modulation (PWM)



analogWrite() is on a scale of 0 - 255

**Now modify your program to**

**blink the LED with 100% light intensity when type ‘1’ from the PC**

**turn it off when type ‘0’**

**light up with 50% light intensity when type ‘2’**