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# arduino

- [Как настроить семисегментный дисплей на arduino](#)
- [Как взаимодействовать с OLED дисплеем через ESP32?](#)
- [Энкодер](#)

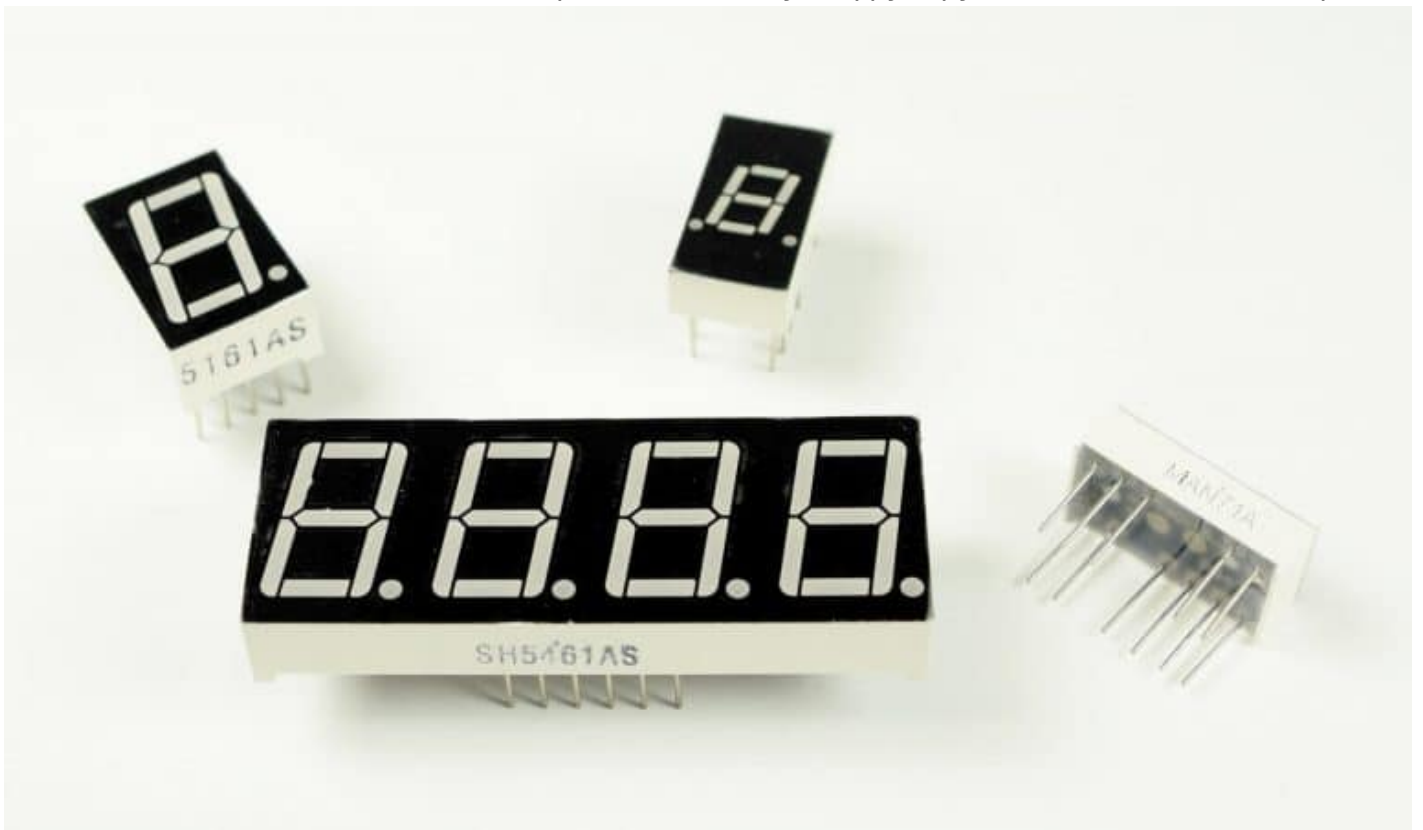
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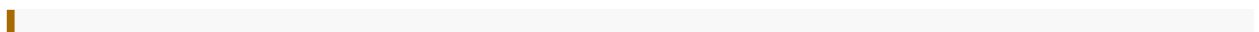
# arduino

Семисегментный дисплей часто используется для домашнего применения например в микроволновых печах, машинах для стирки и воздушных кондиционерах. Они достаточно просты и эффективны для отображения цифровой информации. В этой инструкции разберем как подключить и запрограммировать дисплей с одним или несколькими цифрами на базе ардуино.

Семи сегментный дисплей имеет больше разнообразие размеров и цветов. Красный, голубой и зеленый самые распространенный и их легко найти. Размеры могут варьироваться от 0.56 дюймов до 4 и даже 6.5. Некоторые имеют одну цифру, другие две или даже четыре.



Ардуино 7 сегментный дисплей - одна цифра и 4 цифры. Прежде чем приступим работать с 7 сегментным дисплеем, нужно понять: базовые вещи для LED и как с ними управляться.

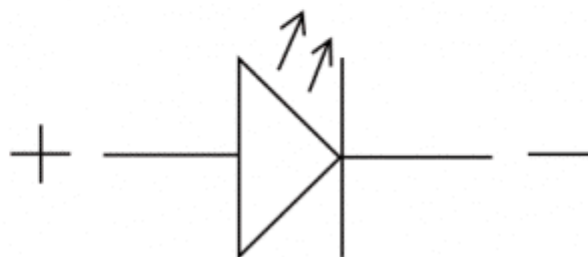
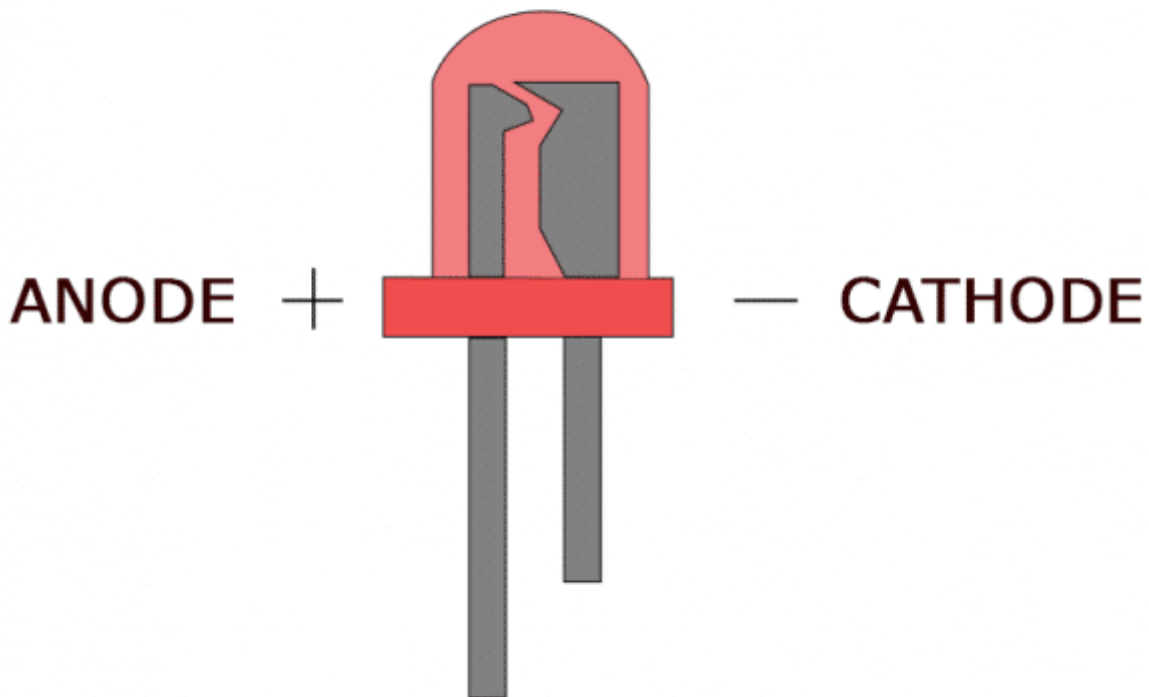
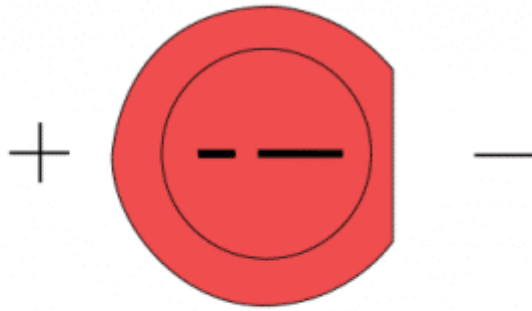


The 3-in-1 Smart Car and IOT Learning Kit from SunFounder has everything you need to learn how to master the Arduino. It includes all of the parts, wiring diagrams, code, and step-by-step instructions for 58 different robotics and internet of things projects that are super fun to build!

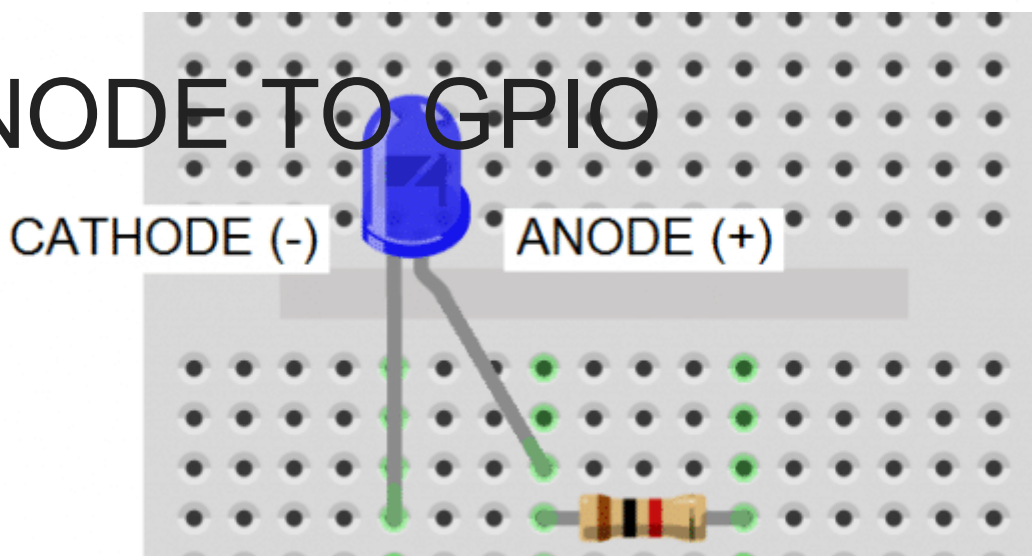
# LED ???????

Простой LED состоит из 2х частей: анод и катод. Анод позитивный конец, катод - негативный

Arduino 7 Segment Display Tutorial - LED Anode and Cathode To power the LED, you connect the cathode to ground and the anode to the voltage supply. The LED can be turned on or off by switching power at the anode or the cathode.



## ANODE TO GPIO



Segment Display Tutorial - Anode to GPIO Note: All LEDs need a current limiting resistor placed on either the anode side or cathode side to prevent the LED from burning out. The resistor value will determine how bright the LED shines. 1K ohms is a good place to start, but you can calculate the ideal value with an LED resistor calculator.

To light up an LED with the anode connected to a digital pin, you set the digital pin to HIGH:

```
void setup(){
  pinMode(7, OUTPUT);
  digitalWrite(7, HIGH);
}

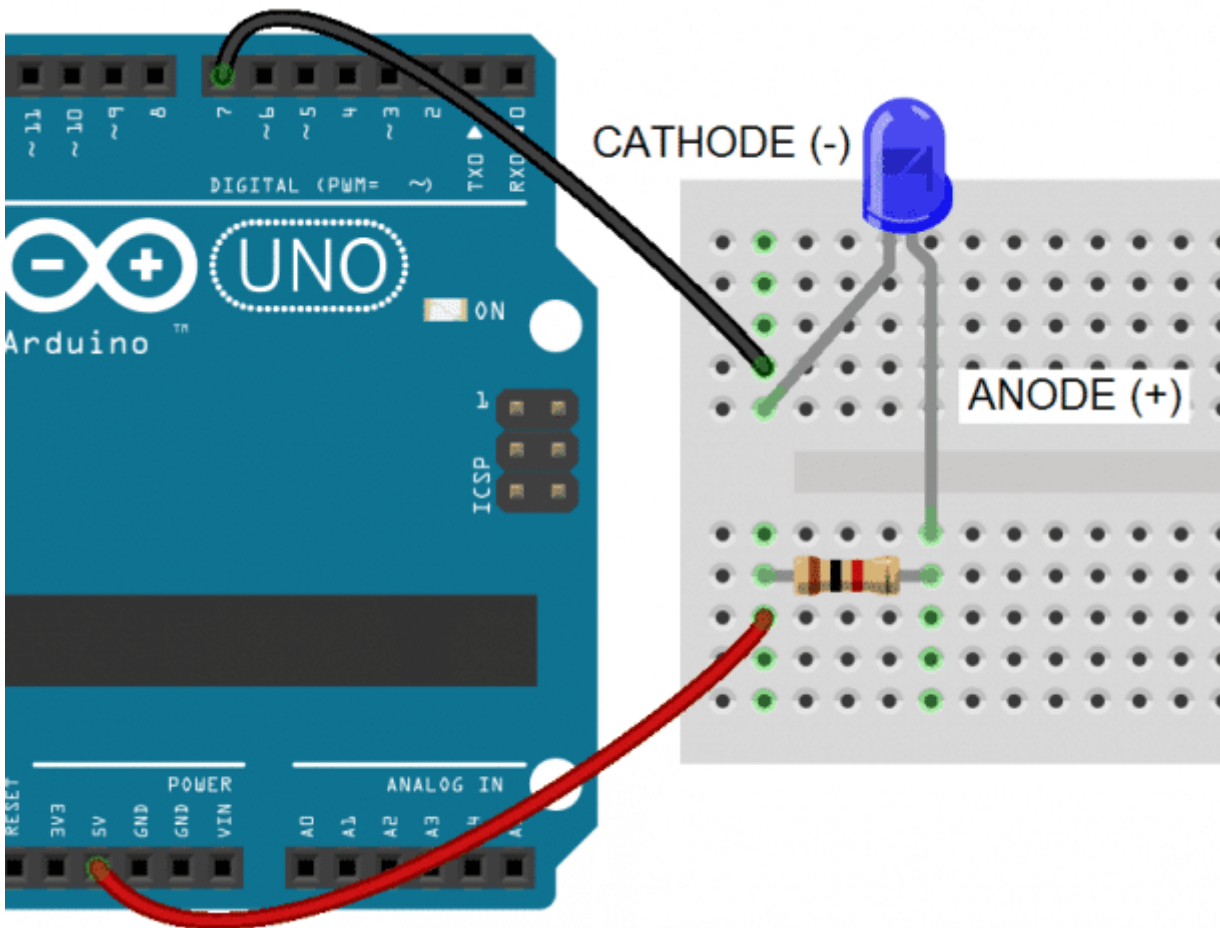
void loop(){
}
```

In the void setup() block, we configure GPIO pin 7 as an output with pinMode(7, OUTPUT) and drive it high with digitalWrite(7, HIGH).

## CATHODE TO GPIO

With an LED's cathode connected to a digital pin, the anode is connected to Vcc. To turn on the LED, the digital pin is switched LOW, which completes the circuit to ground:

Arduino 7-Segment Display Tutorial - Cathode to GPIO In this case we drive GPIO pin 7 LOW with digitalWrite(7, LOW). This closes the circuit and allows current to flow from Vcc to ground:

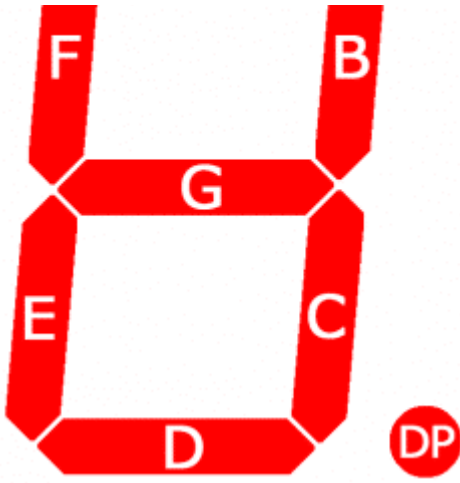


```
void setup(){
  pinMode(7, OUTPUT);
  digitalWrite(7, LOW);
}

void loop(){
}
```

# HOW 7-SEGMENT DISPLAYS WORK

Seven segment displays consist of 7 LEDs, called segments, arranged in the shape of an “8”. Most 7-segment displays actually have 8 segments, with a dot on the right side of the digit that serves as a decimal point. Each segment is named with a letter A to G, and DP for the decimal point:



Each segment on the display can be controlled individually, just

like a regular LED.

There are two types of 7-segment displays - common cathode and common anode.

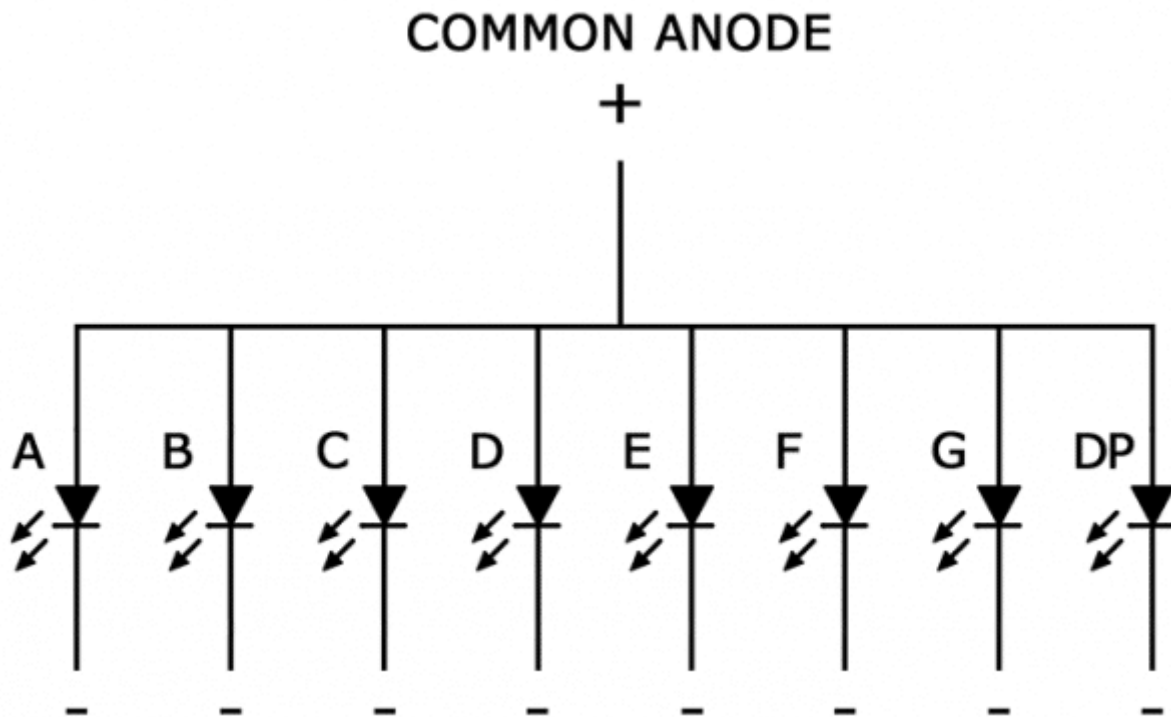
# COMMON CATHODE DISPLAYS

In common cathode displays, all of the cathodes are connected to ground and individual segments are turned on and off by switching power to the anodes:



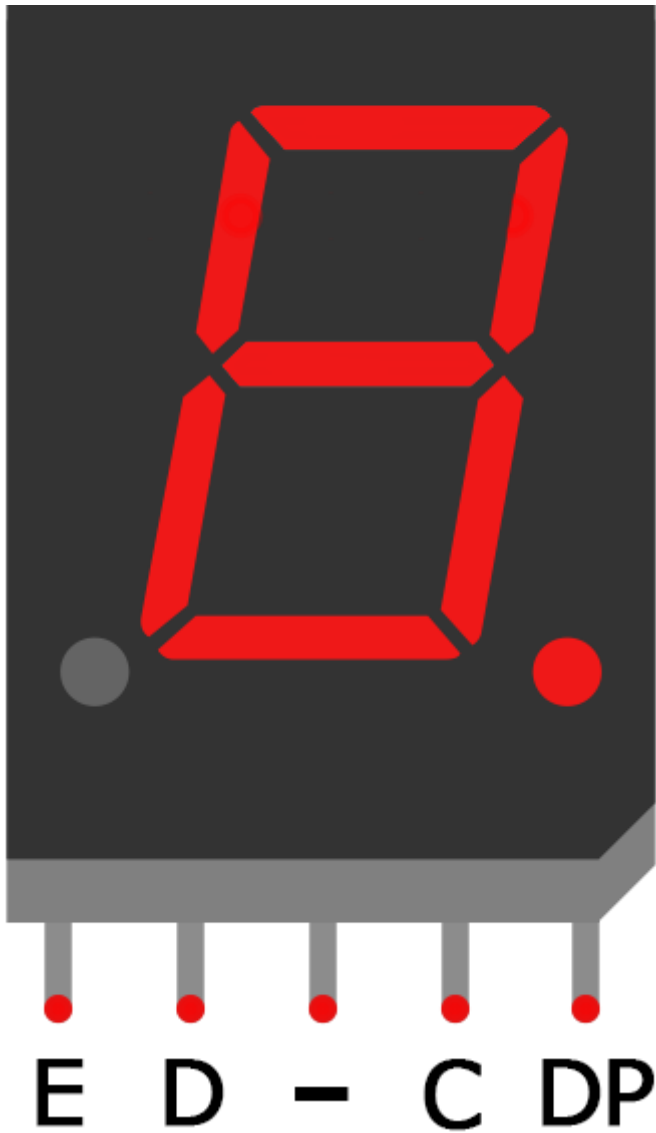
# COMMON ANODE DISPLAYS

In common anode displays, all of the anodes are connected to Vcc, and individual segments are turned on and off by switching power to the cathodes:



# CONNECTING 7-SEGMENT DISPLAYS TO THE ARDUINO

Single digit seven segment displays typically have 10 pins. Two pins connect to ground, and the other 8 connect to each of the segments. Here is a pin diagram of the popular 5161AS common cathode display:



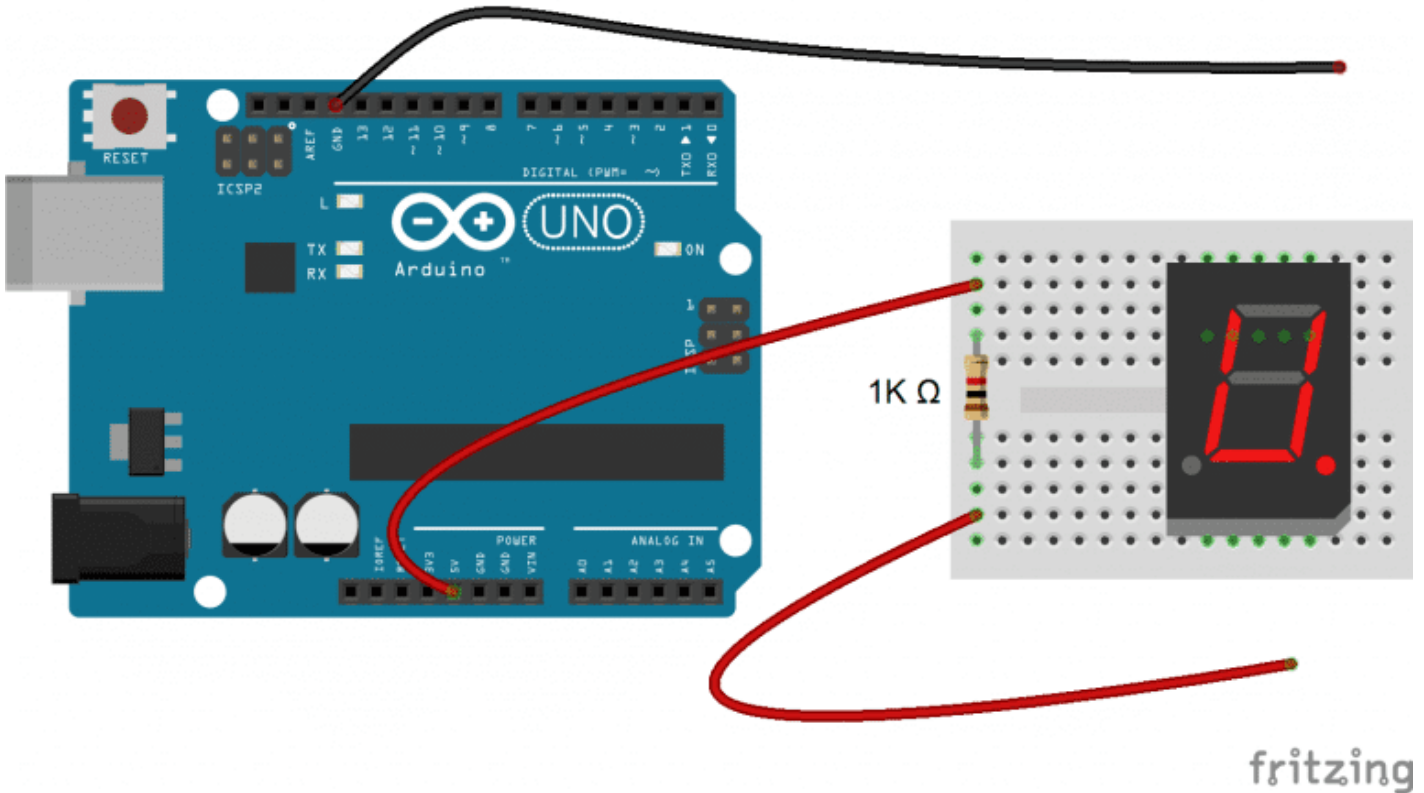
Before you can connect your display to the

Arduino, you need to know if it's common anode or common cathode, and which pins connect to each segment. This information should be in the datasheet, but if you can't find the datasheet or you don't know your display's part number, I'll show you how to figure this out below...

## HOW TO TELL IF YOU HAVE A COMMON ANODE OR

# COMMON CATHODE DISPLAY

To determine if a display is common anode or common cathode, you can probe the pins with a test circuit constructed like this:



Connect the ground (black) wire to any pin of the display. Then insert the positive (red) wire into each one of the other pins. If no segments light up, move the ground wire over to another pin and repeat the process. Do this until at least one segment lights up.

When the first segment lights up, leave the ground wire where it is, and connect the positive wire to each one of the other pins again. If a different segment lights up with each different pin, you have a common cathode display. The pin that's connected to the ground wire is one of the common pins. There should be two of these.

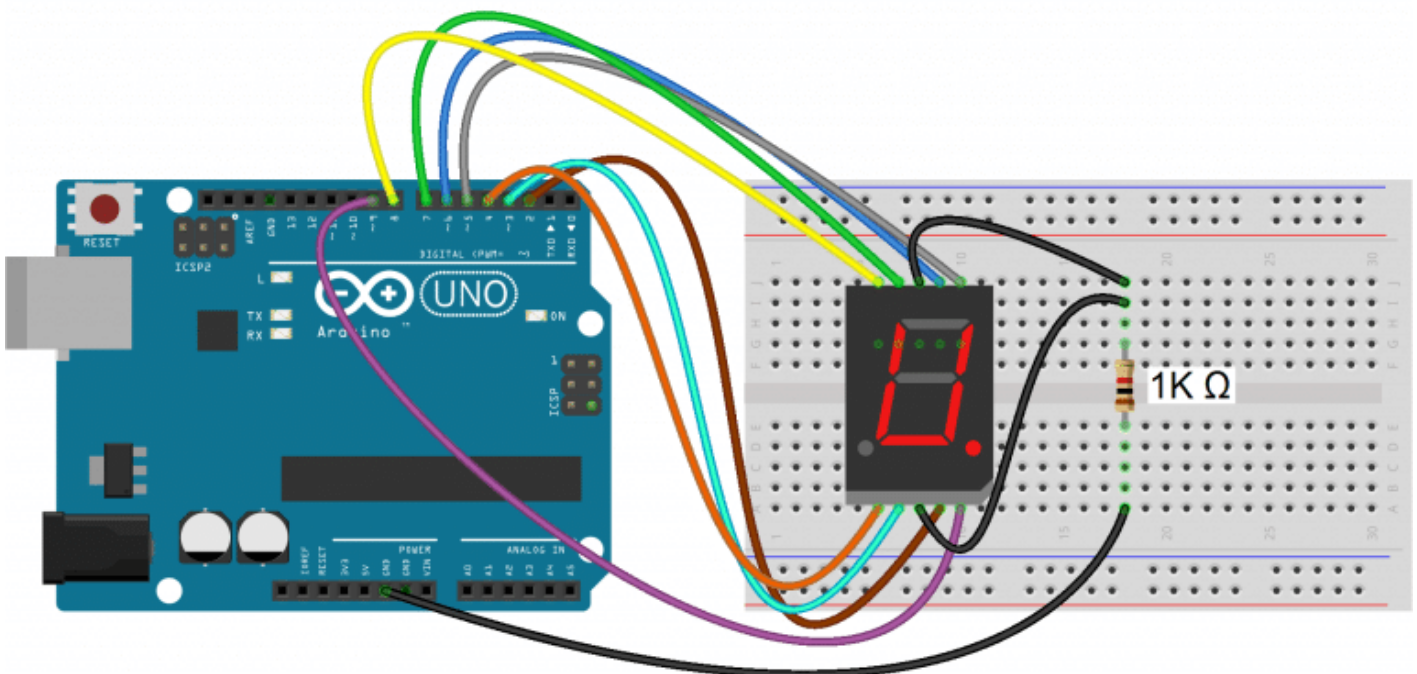
If two different pins light up the same segment, you have a common anode display. The pin that's connected to the positive wire is one of the common pins. Now if you connect the ground wire to each one of the other pins, you should see that a different segment lights up with each different pin.

# HOW TO DETERMINE THE PINOUT FOR YOUR DISPLAY

Now draw a diagram showing the pins on your display. With the common pin connected to the ground wire (common cathode) or positive wire (common anode), probe each pin with the other wire. When a segment lights up, write down the segment name (A-G, or DP) next to the corresponding pin on your diagram.

# CONNECTING SINGLE DIGIT DISPLAYS TO THE ARDUINO

Once you have the pin layout figured out, connecting the display to an Arduino is pretty easy. This diagram shows how to connect a single digit 5161AS display (notice the 1K ohm current limiting resistor connected in series with the common pins):



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In the example programs below, the segment pins connect to the Arduino according to this table:

<b>Segment Pin</b>	<b>Arduino Pin</b>
A	6
B	5
C	2
D	3
E	4
F	7
G	8
DP	9

# PROGRAMMING SINGLE DIGIT DISPLAYS

## INSTALL THE LIBRARY

We'll use a library called SevSeg to control the display. The SevSeg library works with single digit and multi-digit seven segment displays. You can download the library's ZIP file from GitHub or download it here:

Circuit Basics ZIP Icon SevSeg.zip

To install it, open the Arduino IDE, go to Sketch > Include Library > Add .ZIP Library, then select the SevSeg ZIP file that you downloaded.

# PRINTING NUMBERS TO THE DISPLAY

This program will print the number “4” to a single digit 7-segment display:

```
#include "SevSeg.h"
SevSeg sevseg;

void setup(){
    byte numDigits = 1;
    byte digitPins[] = {};
    byte segmentPins[] = {6, 5, 2, 3, 4, 7, 8, 9};
    bool resistorsOnSegments = true;

    byte hardwareConfig = COMMON_CATHODE;
    sevseg.begin(hardwareConfig, numDigits, digitPins, segmentPins, resistorsOnSegments);
    sevseg.setBrightness(90);
}

void loop(){
    sevseg.setNumber(4);
    sevseg.refreshDisplay();
}
```

In this program, we create a sevseg object on line 2. To use additional displays, you can create another object and call the relevant functions for that object. The display is initialized with the sevseg.begin() function on line 11. The other functions are explained below:

hardwareConfig = COMMON\_CATHODE - This sets the type of display. I’m using a common cathode, but if you’re using a common anode then use COMMON\_ANODE instead.

byte numDigits = 1 - This sets the number of digits on your display. I’m using a single digit display, so I set it to 1. If you’re using a 4 digit display, set this to 4.

byte digitPins[] = {} - Creates an array that defines the ground pins when using a 4 digit or multi-digit display. Leave it empty if you have a single digit display. For example, if you have a 4 digit display and want to use Arduino pins 10, 11, 12, and 13 as the digit ground pins, you would use

this: byte digitPins[] = {10, 11, 12, 13}. See the 4 digit display example below for more info.

byte segmentPins[] = {6, 5, 2, 3, 4, 7, 8, 9} - This declares an array that defines which Arduino pins are connected to each segment of the display. The order is alphabetical (A, B, C, D, E, F, G, DP where DP is the decimal point). So in this case, Arduino pin 6 connects to segment A, pin 5 connects to segment B, pin 2 connects to segment C, and so on.

resistorsOnSegments = true - This needs to be set to true if your current limiting resistors are in series with the segment pins. If the resistors are in series with the digit pins, set this to false. Set this to true when using multi-digit displays.

sevseg.setBrightness(90) - This function sets the brightness of the display. It can be adjusted from 0 to 100.

sevseg.setNumber() - This function prints the number to the display. For example, sevseg.setNumber(4) will print the number "4" to the display. You can also print numbers with decimal points. For example, to print the number "4.999", you would use sevseg.setNumber(4999, 3). The second parameter (the 3) defines where the decimal point is located. In this case it's 3 digits from the right most digit. On a single digit display, setting the second parameter to "0" turns on the decimal point, while setting it to "1" turns it off.

sevseg.refreshDisplay() - This function is required at the end of the loop section to continue displaying the number.

## COUNT UP TIMER

This simple program will count up from zero to 9 and then loop back to the start:

```
#include "SevSeg.h"
SevSeg sevseg;

void setup(){
  byte numDigits = 1;
  byte digitPins[] = {};
  byte segmentPins[] = {6, 5, 2, 3, 4, 7, 8, 9};
  bool resistorsOnSegments = true;
```

```
byte hardwareConfig = COMMON_CATHODE;
sevseg.begin(hardwareConfig, numDigits, digitPins, segmentPins, resistorsOnSegments);
sevseg.setBrightness(90);
}

void loop(){
  for(int i = 0; i < 10; i++){
    sevseg.setNumber(i, i%2);
    delay(1000);
    sevseg.refreshDisplay();
  }
}
```

The code is similar to the previous sketch. The only difference is that we create a count variable “i” in the for statement on line 16 and increment it one number at a time.

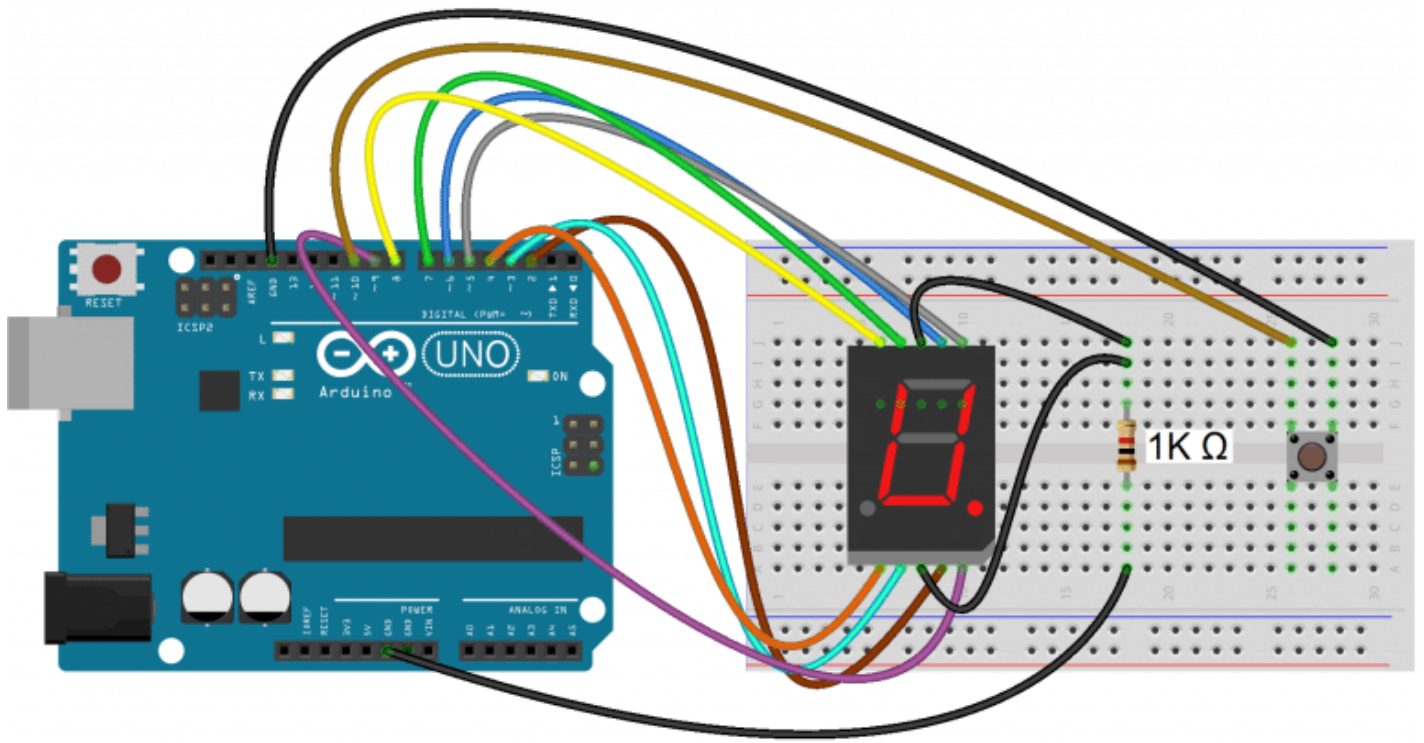
The `sevseg.setNumber(i, i%2)` function prints the value of `i`. The `i%2` argument divides `i` by 2 and returns the remainder, which causes the decimal point to turn on every other number.

The count up timer is a nice way to demonstrate the basics of how to program the display, but now let’s try to make something more interesting.

## ROLLING DICE

This example consists of a push button and a single 7 segment display. Every time the push button is pressed and held, the display loops through numbers 0-9 rapidly. Once the button is released, the display continues to loop for a period of time almost equal to the time the button was pressed, and then displays a number along with the decimal point to indicate the new number.

To build the circuit (with the 5161AS display), connect it like this:



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Then upload this program to the Arduino:

```
#include "SevSeg.h"
SevSeg sevseg;

const int buttonPin = 10; // the pin that the pushbutton is attached to
int buttonState = 0; // current state of the button
int lastButtonState = LOW; // previous state of the button
int buttonPushCounter = 0; // counter for the number of button presses
long counter = 0;
long max_long_val = 2147483647L;

void setup(){
  byte numDigits = 1;
  byte digitPins[] = {};
  byte segmentPins[] = {6, 5, 2, 3, 4, 7, 8, 9};
  bool resistorsOnSegments = true;

  byte hardwareConfig = COMMON_CATHODE;
  sevseg.begin(hardwareConfig, numDigits, digitPins, segmentPins, resistorsOnSegments);
  sevseg.setBrightness(90);

  pinMode(buttonPin, INPUT_PULLUP);
```

```

Serial.begin(9600);
lastButtonState = LOW;
}

void loop(){
  buttonState = digitalRead(buttonPin);
  if(buttonState == HIGH){
    buttonState = LOW;
  }

  else
    buttonState = HIGH;

  if(buttonState == HIGH){
    Serial.println("on");
    lastButtonState = HIGH;
    buttonPushCounter++;
    if(counter < max_long_val)
      counter++;
    buttonPushCounter %= 9;
    sevseg.setNumber(buttonPushCounter, 1);
    sevseg.refreshDisplay();
    delay(100 - (counter%99));
  }

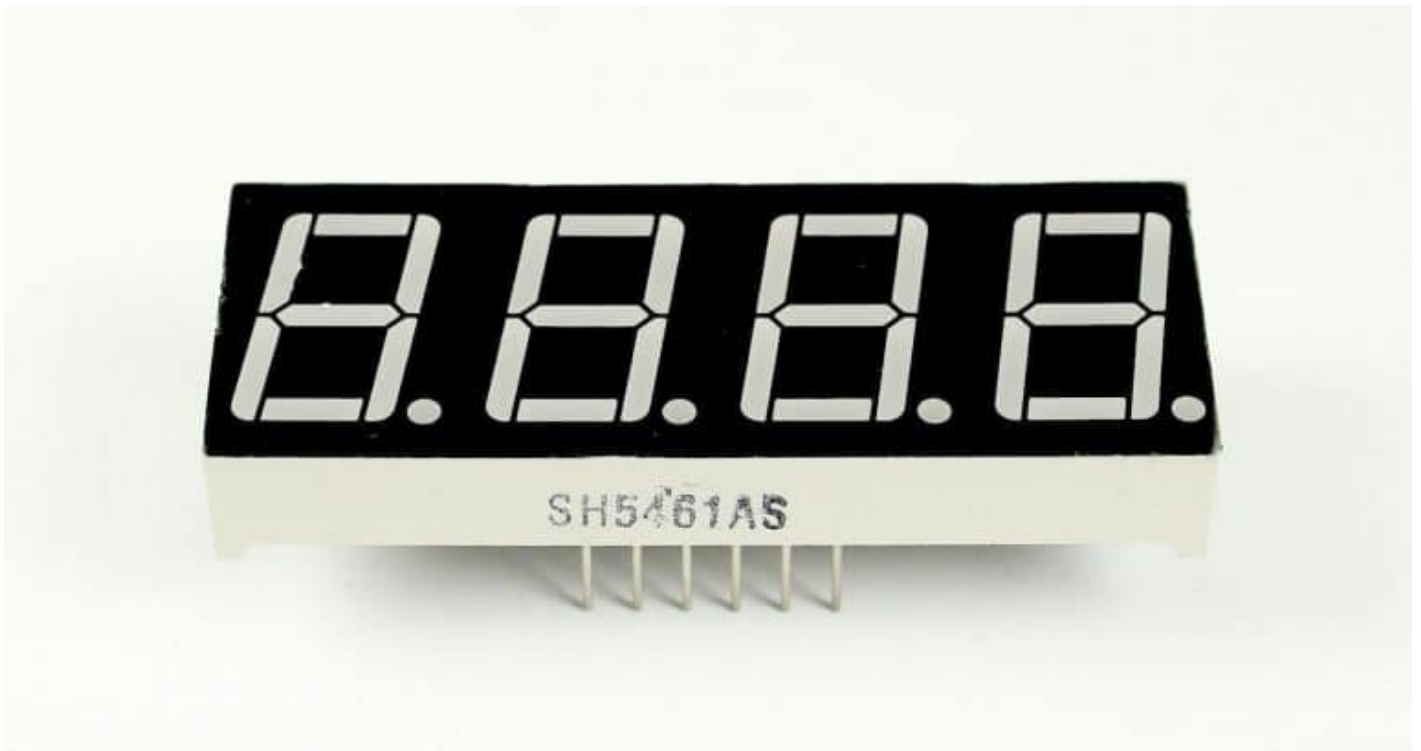
  else{
    Serial.println("off");
    if(lastButtonState == HIGH){
      Serial.println("in");
      buttonPushCounter++;
      buttonPushCounter %= 7;
      if(buttonPushCounter == 0)
        buttonPushCounter = 1;
      counter--;
      sevseg.setNumber(buttonPushCounter, 1);
      sevseg.refreshDisplay();
      delay(100 - (counter%99));
      if(counter == 0){
        lastButtonState = LOW;
        sevseg.setNumber(buttonPushCounter, 0);
      }
    }
  }
}

```

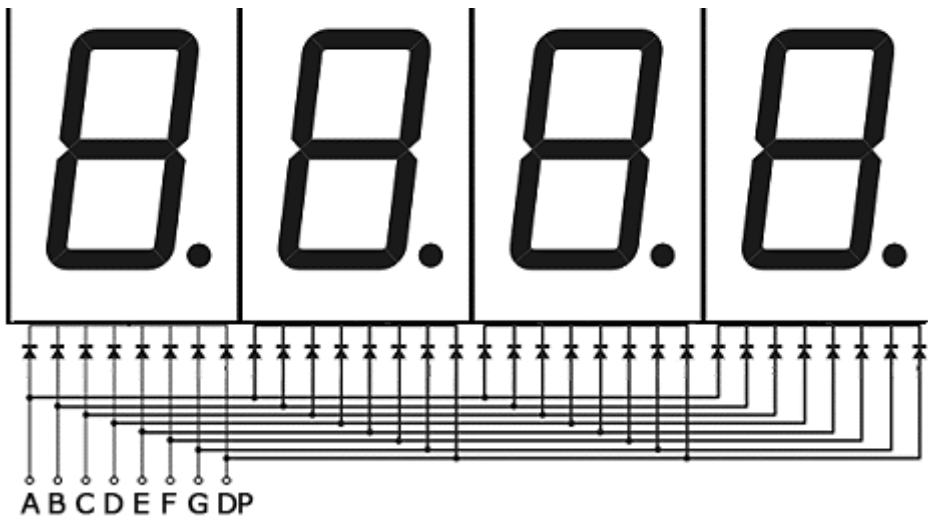
```
sevseg.refreshDisplay();  
    }  
}  
}
```

# 4 DIGIT 7-SEGMENT DISPLAYS

So far we have only worked with single digit 7-segment displays. To display information such as the time or temperature, you will want to use a 2 or 4 digit display, or connect multiple single digit displays side by side.

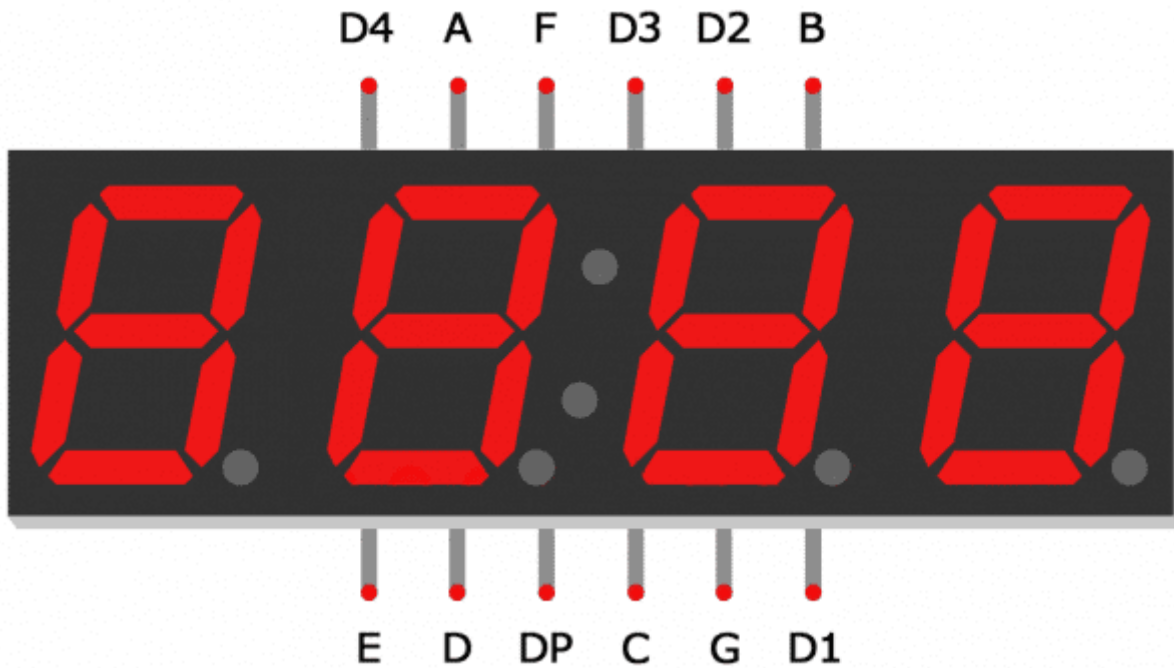


In multi-digit displays, one segment pin (A, B, C, D, E, F, G, and DP) controls the same segment on all of the digits. Multi-digit displays also have separate common pins for each digit - these are the digit pins. You can turn a digit on or off by switching the digit pin.



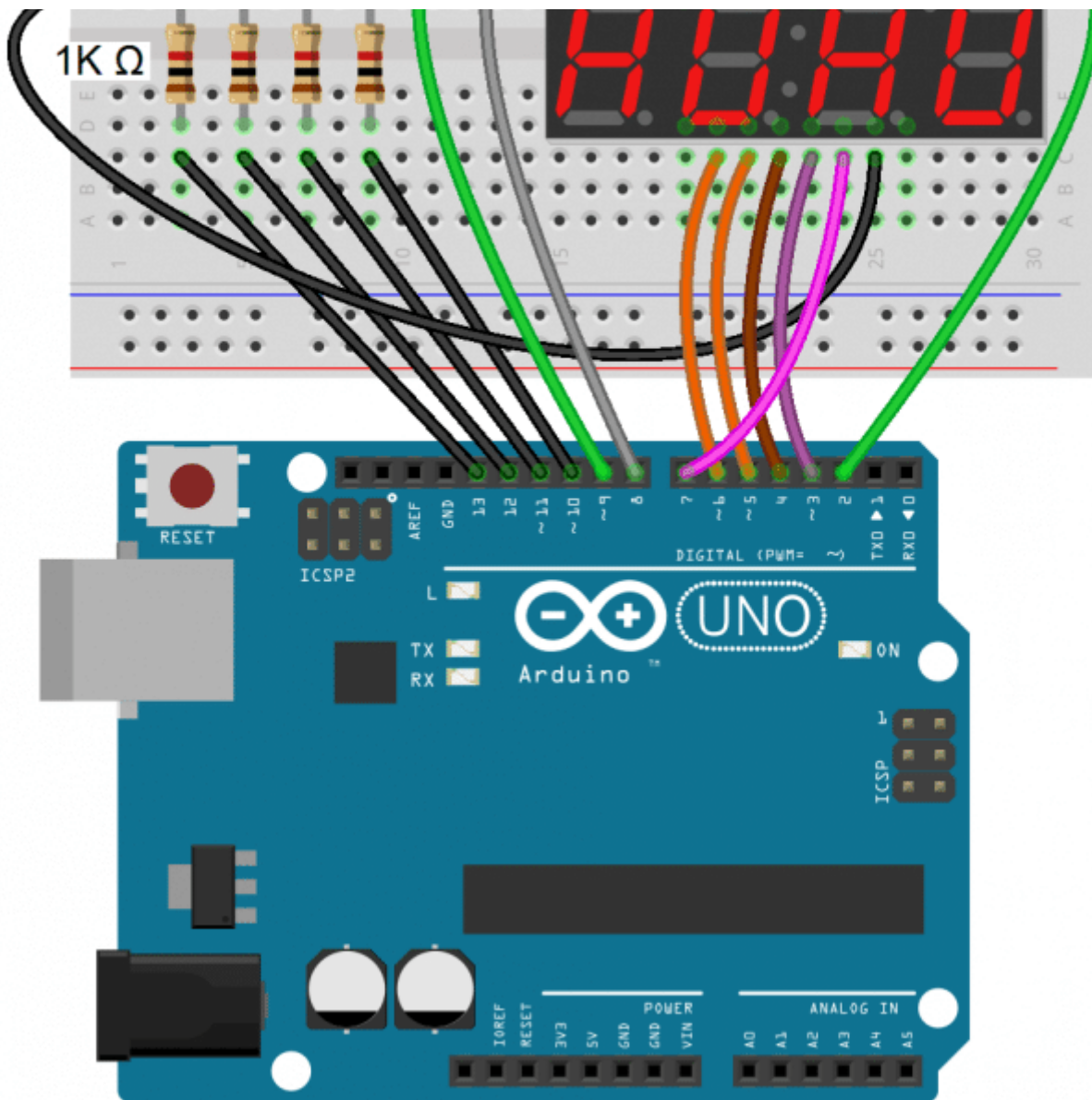
I'm using a 4 digit 7-segment

display with the model number 5641AH, but the wiring diagrams below will also work with the 5461AS.



The digit

pins D1, D2, D3 and D4 need to be connected to current limiting resistors, since they are the common terminals of the digits. The connections are shown below:



fritzing This simple

program will print the number "4.999" to the display:

```
#include "SevSeg.h"
SevSeg sevseg;

void setup(){
  byte numDigits = 4;
```

```
byte digitPins[] = {10, 11, 12, 13};
byte segmentPins[] = {9, 2, 3, 5, 6, 8, 7, 4};

bool resistorsOnSegments = true;
bool updateWithDelaysIn = true;
byte hardwareConfig = COMMON_CATHODE;
sevseg.begin(hardwareConfig, numDigits, digitPins, segmentPins, resistorsOnSegments);
sevseg.setBrightness(90);
}

void loop(){
    sevseg.setNumber(4999, 3);
    sevseg.refreshDisplay();
}
```

In the code above, we set the number of digits in line 5 with byte `numDigits = 4`.

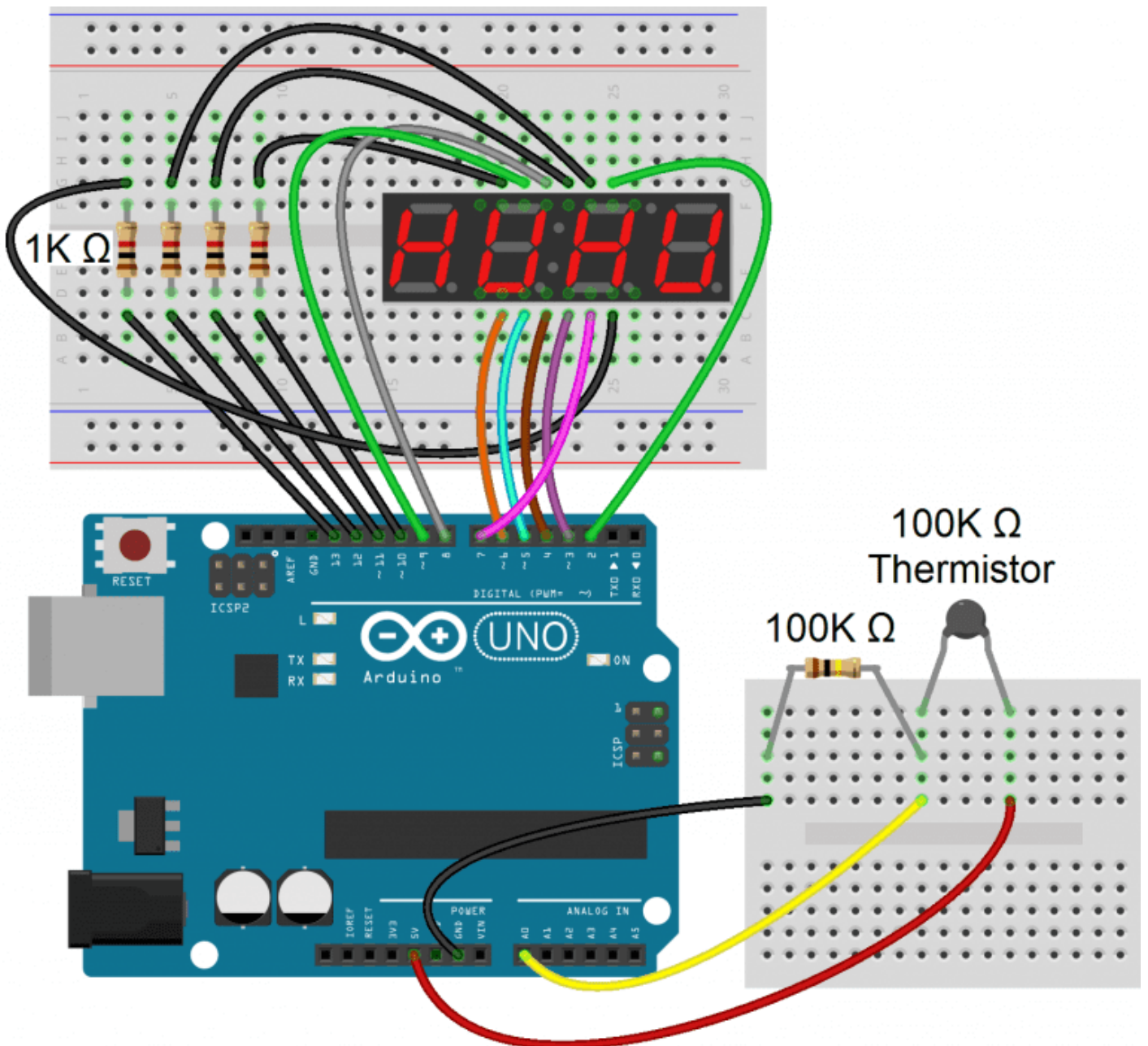
Since multi-digit displays use digit pins, we also need to define which Arduino pins will connect to the digit pins. Using byte `digitPins[] = {10, 11, 12, 13}` on line 6 sets Arduino pin 10 as the first digit pin, Arduino pin 11 to the second digit pin, and so on.

To print numbers with a decimal point, we set the second parameter in `sevseg.setNumber(4999, 3)` to three, which puts it three decimal places from the right most digit.

# DISPLAYING SENSOR DATA

Now let's read the temperature from a thermistor and display it on a 4 digit display.

Connect the circuit like this:



If you want to learn more about thermistors, check out our tutorial on using a thermistor with an Arduino.

Once everything is connected, upload this code to the Arduino:

```
#include "SevSeg.h"
SevSeg sevseg;

int ThermistorPin = 0;
int Vo;
float R1 = 10000;
float logR2, R2, T;
float c1 = 1.009249522e-03, c2 = 2.378405444e-04, c3 = 2.019202697e-07;
```

```

void setup() {
  byte numDigits = 4;
  byte digitPins[] = {10, 11, 12, 13};
  byte segmentPins[] = {9, 2, 3, 5, 6, 8, 7, 4};
  bool resistorsOnSegments = true;
  byte hardwareConfig = COMMON_CATHODE;

  sevseg.begin(hardwareConfig, numDigits, digitPins, segmentPins, resistorsOnSegments);
}

void loop() {
  Vo = analogRead(ThermistorPin);
  R2 = R1 * (1023.0 / (float)Vo - 1.0);
  logR2 = log(R2);
  T = (1.0 / (c1 + c2 * logR2 + c3 * logR2 * logR2 * logR2));
  T = T - 273.15;
  T = (T * 9.0) / 5.0 + 32.0; //Comment out for Celsius

  static unsigned long timer = millis();

  if (millis() >= timer) {
    timer += 300;
    sevseg.setNumber(T, 2);
  }

  sevseg.refreshDisplay();
}

```

This will display the temperature in Fahrenheit on the 7-segment display. To display the temperature in Celsius, comment out line 28.

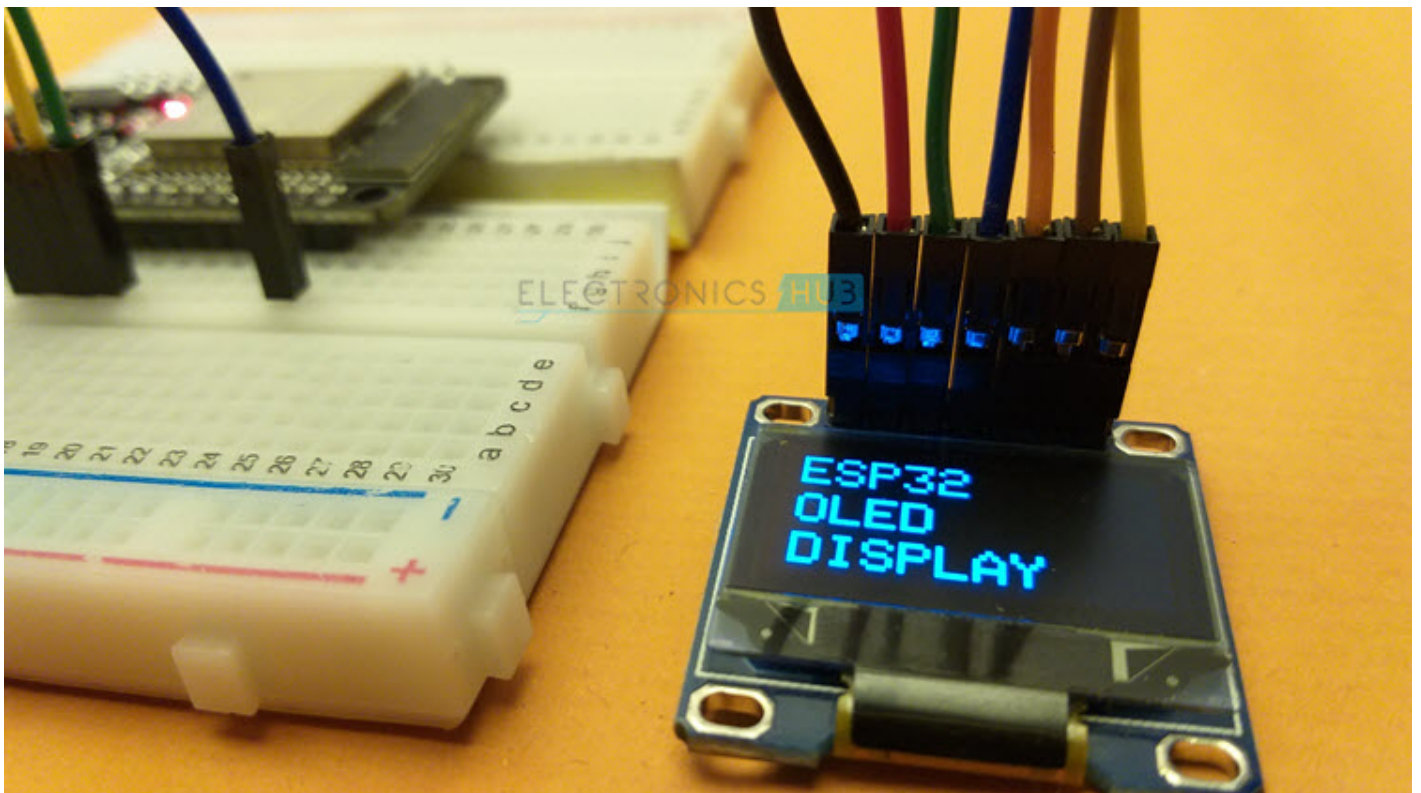
By itself, the display will update every time the temperature changes even slightly. This creates an annoying flickering. In order to deal with this, we introduce a timer mechanism, where we only read the value from the thermistor every 300 milliseconds (lines 30 to 34).

The temperature variable “T” is printed to the display on line 35 with `sevseg.setNumber(T, 2, false)`.

??? ?????????????????????? ?

# OLED ?????????? ?????? ESP32?

В этой инструкции, мы изучим как взаимодействовать с OLED дисплеем через ESP32 плату разработки. Графический OLED дисплей используемый в проекте основан на SSD1306 OLED драйвере IC и взаимодействует через SPI. Его можно использовать для отображения текста, картинки графики и так далее.



?????????????

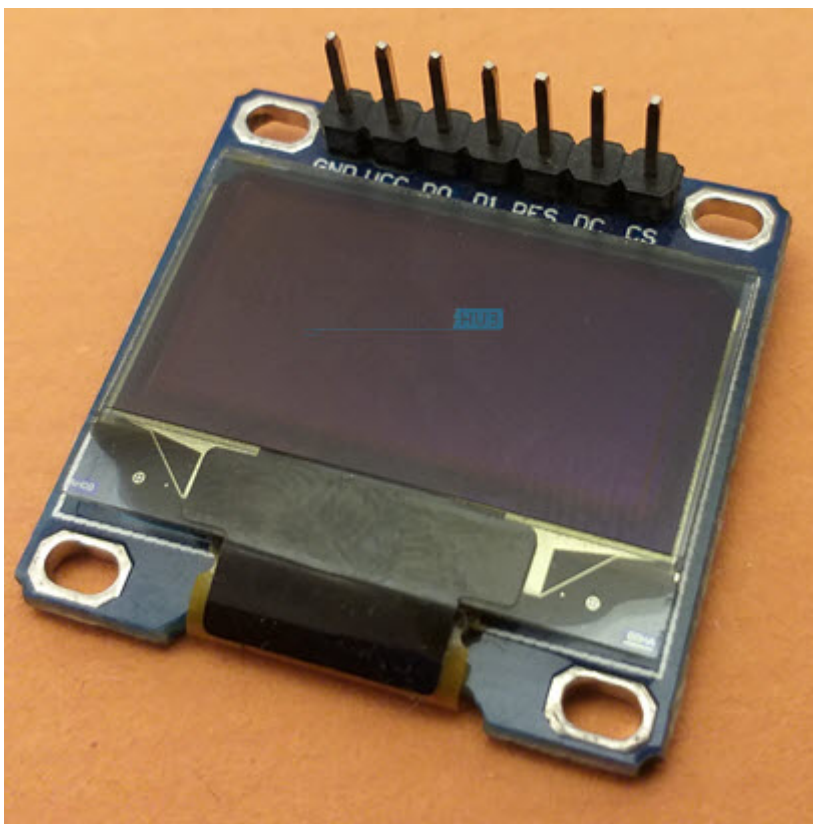
OLED или органический светодиод это улучшенная технология, которая использует пленку с органическим основанием между двумя электродами(анодом и катодом) и когда подается напряжение между электродами, органическая пленка испускает свет.

Главное преимущество OLED дисплея, в том, что она испускает свой собственный свет, и не требует другого источника подсветки. По этой причине OLED дисплеи часто имеют лучший контраст, яркость и углы обзора при сравнении с LCD дисплеями.

Другое важное свойство OLED дисплея это уровень черного цвета. Так как каждый пиксель испускает свой свет в OLED дисплее, чтобы получить черный свет, достаточно отключить пиксель.

# ???????? ?????????? SSD1306 OLED ??????????

Хотите использовать OLED дисплеи в ваших DIY проектах? Хотите отображать важную информацию, вроде IP адреса, Адреса Web сервера? Тогда модуль SSD1306 отличный выбор!



Этот модуль состоит из монохромного OLED дисплея с разрешением 128 на 64 пикселя. Диагональ такого дисплея 0.96. Этот дисплей использует SSD1306 OLED драйвер.

SSD1306 OLED Displays have three types of communication interfaces:

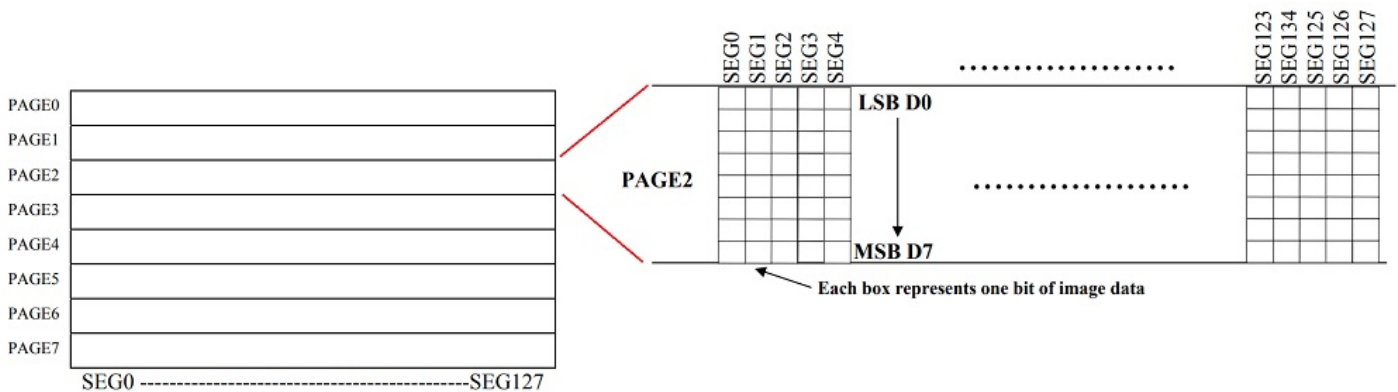
- 8-bit 6800 Parallel Interface
- 3 or 4 wire SPI

- I2C Of these, the I2C and SPI type OLEDs are very common. It is possible of change the configuration from SPI to I2C and vice-versa (you have solder / de-solder some SMD resistors). The model that I have is using 4-wire SPI Communication.



The SSD1306 OLED Driver IC has 128 x 64 bits Graphic Display Data RAM (GDDRAM). It is divided into eight pages (PAGE 0 to PAGE 7) and each page has 128 Segments. Again, each segment consists of 8-bits and each bit represents one pixel of the display.

So, 8 Pages \* 128 Segments \* 8 Bits = 8192 Bits (1024 Bytes).

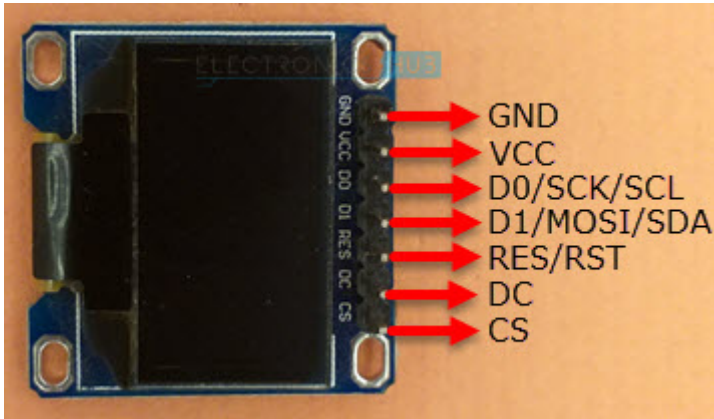


# Pinout of OLED Display Module

The following table shows the Pinout of 7-pin SPI based OLED Display Module.

Pin (Alternative Names)	Description
GND	Ground
VCC	Power Supply
D0 (SCK, SCL, CLK)	Clock

Pin (Alternative Names)	Description
D1 (MOSI, SDA)	Data
RES (RST)	Reset
DC (A0)	Data / Command Selection
CS	Chip Select



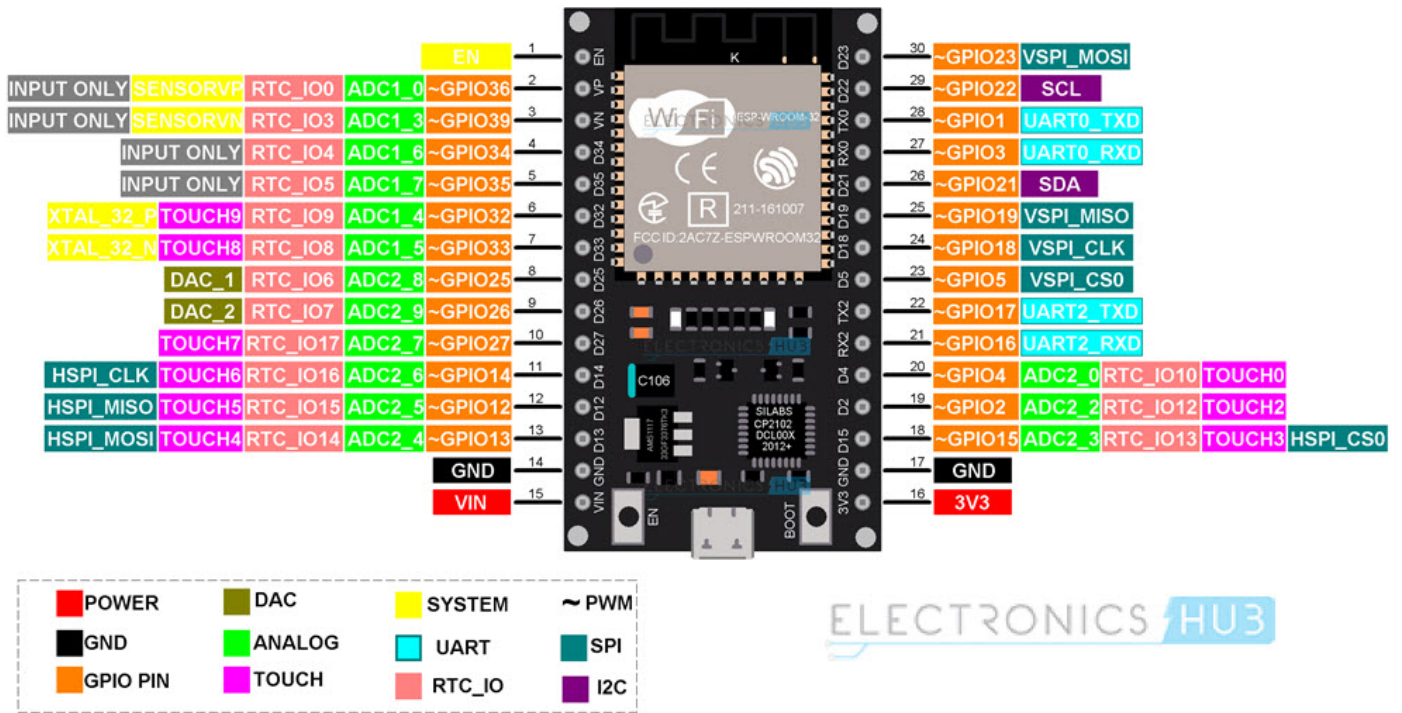
## Power Supply

The SSD1306 OLED Driver IC runs on  $VDD = 1.65V$  to  $3.3V$  and the actual OLED Panel runs on  $VCC = 7V$  to  $15V$ . The OLED Display Module takes care of these wide ranges of voltage requirements with a charge pump circuit (for Panel) and regulator (for Driver IC) from a single power supply (usually between  $3V$  and  $5V$ ).

This makes the OLED Display Module to be connected to different boards like Arduino (with  $5V$  logic) and ESP32 (with  $3.3V$  logic).

## ESP32 OLED Display Interface

Let us now see how to interface an OLED Display with ESP32. First thing to understand is that the communication interface is SPI. So, look at the Pinout of ESP32 and identify the SPI Pins.



From the above image, HSPI and VSPI are available on ESP32 Development Board for SPI Interface. Let us use the VSPI peripheral. The pins for VSPI in ESP32 are:

VSPI Pin	GPIO Pin
VSPI_MOSI	GPIO 23
VSPI_MISO	GPIO 19
VSPI_CLK	GPIO 18
VSPI_CS	GPIO 5

“ NOTE: ESP32 has totally 4 SPI Peripherals. (SPI0, SPI1, HSPI and VSPI). SPI0 is dedicated to SPI Flash IC. SPI1 shares the hardware with SPI0. This leaves HSPI and VSPI for interfacing SPI Devices.

The following table shows the connections between ESP32 and OLED Display Module. In total, we have to make seven connections as this is an SPI OLED Display.

OLED Display	ESP32
GND	GND

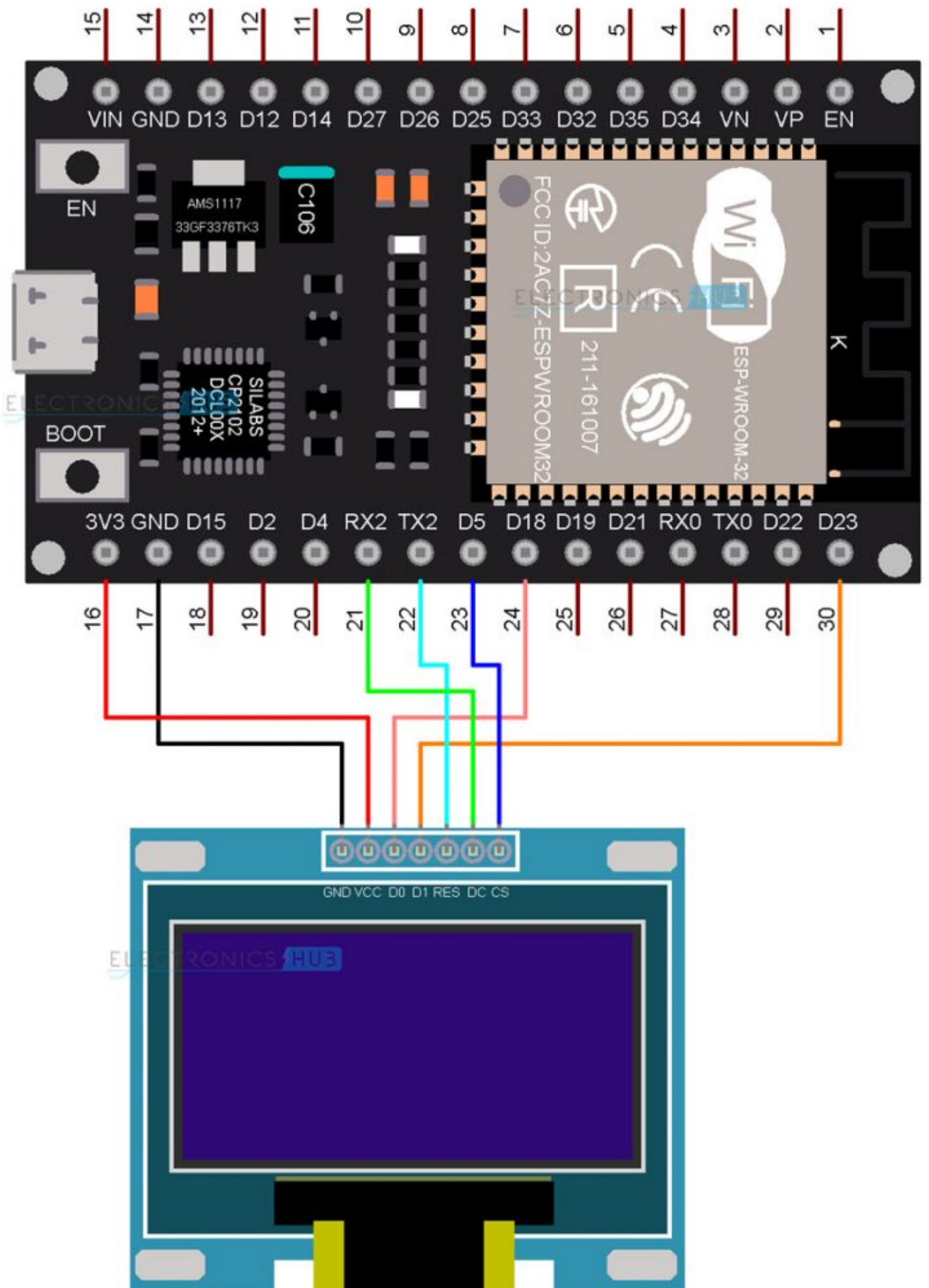
OLED Display	ESP32
VCC	3.3V
D0 (SCK)	GPIO 18
D1 (MOSI)	GPIO 23
RES	GPIO 17
DC	GPIO 16
CS	GPIO 5

## Components Required

- ESP32 DevKit Development Board
- OLED Display Module
- Breadboard
- Connecting Wires
- Micro USB Cable

## Circuit Diagram

The following image shows the circuit diagram for Interfacing SPI OLED Display with ESP32.



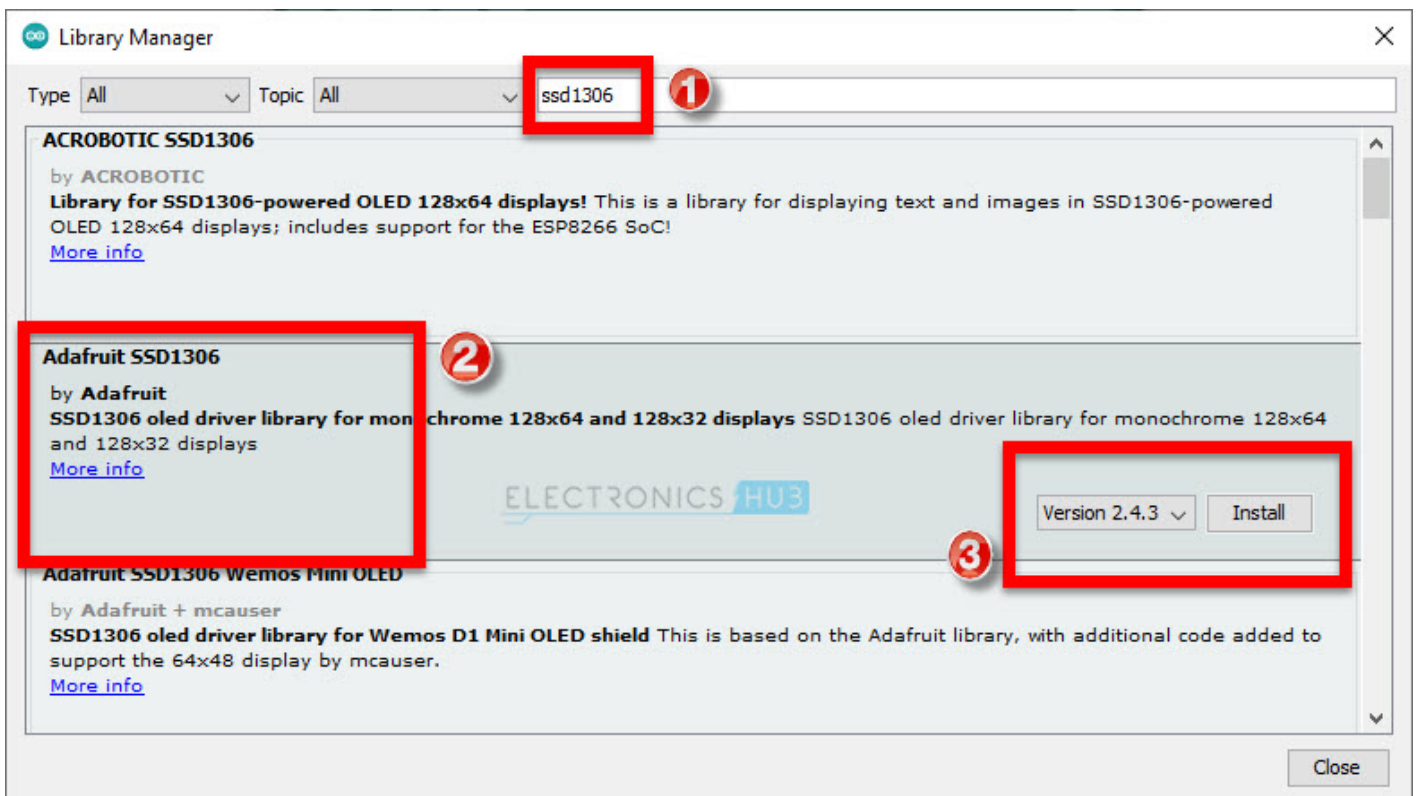
# Preparing Arduino IDE

Before writing the code, you need to download some libraries for Arduino IDE related to SSD1306 OLED Display.

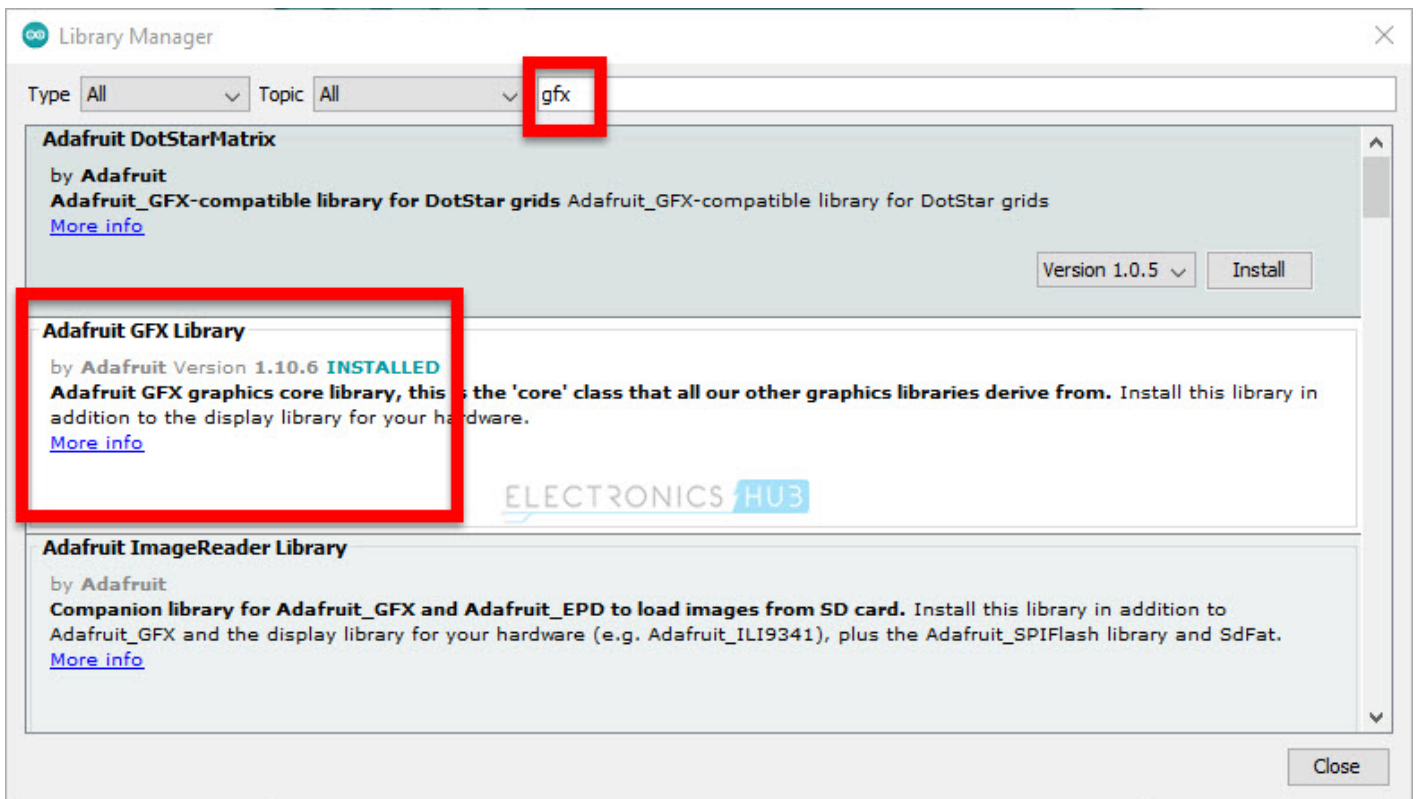
I made a dedicated tutorial on how to install ESP32 Board in Arduino IDE. You can check out that tutorial first. Now, open the Arduino IDE and go to Tools -> Manage Libraries. . .

Arduino-IDE-OLED-Library-1

A Library Manager window will pop-up. In the search bar, type “ssd1306” and from the results select the “Adafruit SSD1306” option and click on install. This library is written specifically for monochrome OLED Displays based on SSD1306 Driver IC. The supported resolutions are 128 x 32 and 128 x 64.



After installing SSD1306 Library, search for “gfx” and install “Adafruit GFX Library”. This is a graphics library by Adafruit for displaying basic graphics like lines, circles, rectangles etc.



Close the library manager window after downloading all the necessary libraries. Now, make sure that ESP32 Board is selected in Arduino IDE (Tools -> Board -> ESP32 Arduino -> ESP32 Dev Module).

# Testing ESP32 OLED Display

After making all the necessary connections, we will now proceed to write a test code for ESP32 to display some text and graphics on the OLED Display. In this code, I am testing various features of the OLED Display like displaying normal text, inverted text, scrolling text, displaying ASCII Characters, setting font size.

I also added the code for displaying graphics like rectangle, filled rectangle, rounded rectangle, filled rounded rectangle, circle, filled circle, triangle and filled triangle.

Finally, I took the "Electronics Hub" logo and converted it into a bitmap and displayed it on the OLED Display.

```
#include <SPI.h>
#include <Wire.h>
#include <Adafruit_GFX.h>
```



0x00,  
0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x0f, 0xff, 0xff, 0xff,  
0x80,  
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0x80,  
0x03, 0xe0, 0x07, 0xc3, 0x87, 0xcf, 0x03, 0x02, 0x11, 0x07, 0x04, 0x0f, 0xbd, 0xbd, 0xc7,  
0x80,  
0x03, 0xe4, 0x07, 0xc3, 0xc7, 0xcf, 0x07, 0x82, 0x11, 0x07, 0x8e, 0x0f, 0xbd, 0xbd, 0xc7,  
0x80,  
0x02, 0x04, 0x04, 0x06, 0xc1, 0x01, 0x84, 0xc2, 0x11, 0x0d, 0x8a, 0x0f, 0xbd, 0xbd, 0xf3,  
0x80,  
0x02, 0x04, 0x04, 0x04, 0x61, 0x00, 0x88, 0x42, 0x11, 0x08, 0x8a, 0x0f, 0xbd, 0xbd, 0xfb,  
0x80,  
0x02, 0x04, 0x04, 0x0c, 0x21, 0x00, 0x88, 0x43, 0x11, 0x10, 0x08, 0x0f, 0xbd, 0xbd, 0xfb,  
0x80,  
0x02, 0x04, 0x04, 0x08, 0x01, 0x00, 0x88, 0x23, 0x11, 0x10, 0x08, 0x0f, 0xbd, 0xbd, 0xfb,  
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0x02, 0x04, 0x04, 0x08, 0x01, 0x00, 0x88, 0x23, 0x11, 0x10, 0x08, 0x0f, 0xbd, 0xbd, 0xfb,  
0x80,  
0x02, 0x04, 0x04, 0x08, 0x01, 0x00, 0x90, 0x23, 0x11, 0x10, 0x08, 0x0f, 0xbd, 0xbd, 0xfb,  
0x80,  
0x02, 0x04, 0x04, 0x08, 0x01, 0x00, 0x90, 0x22, 0x91, 0x10, 0x08, 0x0f, 0xbd, 0xbd, 0xf7,  
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0x02, 0x04, 0x04, 0x08, 0x01, 0x00, 0x90, 0x22, 0x91, 0x10, 0x0e, 0x0f, 0xbd, 0xbd, 0xc7,  
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0x00,  
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```

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    0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00,
0x00,
};

void setup()
{
    Serial.begin(115200);
    if(!display.begin(SSD1306_SWITCHCAPVCC))
    {
        Serial.println(F("SSD1306 allocation failed"));
        for(;;);
    }

    display.clearDisplay();
    display.display();
    delay(1000);

    display.clearDisplay();
    display.drawBitmap(0, 0, electronicshub_logo, SCREEN_WIDTH, SCREEN_HEIGHT, SSD1306_WHITE);
}

```

```
display.display();
delay(1000);

}

void loop()
{
  AllPixels();
  TextDisplay();
  InvertedTextDisplay();
  ScrollText();
  DisplayChars();
  TextSize();
  DrawRectangle();
  DrawFilledRectangle();
  DrawRoundRectangle();
  DrawFilledRoundRectangle();
  DrawCircle();
  DrawFilledCircle();
  DrawTriangle();
  DrawFilledTriangle();
}

void AllPixels()
{
  int i;
  int j;
  display.clearDisplay();
  for(i=0;i<64;i++)
  {
    for(j=0;j<128;j++)
    {
      display.drawPixel(j, i, SSD1306_WHITE);
    }
    display.display();
    delay(30);
  }
}

for(i=0;i<64;i++)
```

```

{
  for(j=0;j<128;j++)
  {
    display.drawPixel(j, i, SSD1306_BLACK);

  }
  display.display();
  delay(30);
}

}

void TextDisplay()
{
  display.clearDisplay();
  display.setTextSize(1);
  display.setTextColor(SSD1306_WHITE);
  display.setCursor(5,28);
  display.println("Electronics Hub");
  display.display();
  delay(3000);
}

void InvertedTextDisplay()
{
  display.clearDisplay();
  display.setTextColor(SSD1306_BLACK, SSD1306_WHITE);
  display.setCursor(5,28);
  display.println("Electronics Hub");
  display.display();
  delay(3000);
}

void ScrollText()
{
  display.clearDisplay();
  display.setCursor(0,0);
  display.setTextSize(1);
  display.setTextColor(SSD1306_WHITE);
  display.println("This is a");
}

```

```
display.println("Scrolling");
display.println("Text!");
display.display();
delay(100);
display.startscrollright(0x00, 0x0F);
delay(2000);
//display.stopscroll();
//delay(1000);
display.startscrollleft(0x00, 0x0F);
delay(2000);
//display.stopscroll();
//delay(1000);
display.startscrollldiagright(0x00, 0x0F);
delay(2000);
display.startscrollldiagleft(0x00, 0x0F);
delay(2000);
display.stopscroll();
}
```

```
void DisplayChars()
{
    display.clearDisplay();

    display.setTextSize(1);
    display.setTextColor(SSD1306_WHITE);
    display.setCursor(0, 0);
    display.cp437(true);

    for(int16_t i=0; i<256; i++)
    {
        if(i == '\n')
        {
            display.write(' ');
        }
        else
        {
            display.write(i);
        }
    }
}
```

```
display.display();
delay(4000);
}
void TextSize()
{
display.clearDisplay();

display.setTextSize(1);
display.setTextColor(SSD1306_WHITE);
display.setCursor(0,0);
display.println(F("Size: 1"));
display.println(F("ABC"));

display.setTextSize(2);
display.setTextColor(SSD1306_WHITE);
display.println("Size: 2");
display.println(F("ABC"));

display.display();
delay(3000);
}

void DrawRectangle()
{
display.clearDisplay();
display.setTextSize(1);
display.setTextColor(WHITE);
display.setCursor(0,0);
display.println("Rectangle");
display.drawRect(0, 15, 90, 45, SSD1306_WHITE);
display.display();
delay(2000);
}

void DrawFilledRectangle()
{
display.clearDisplay();
display.setTextSize(1);
display.setTextColor(WHITE);
display.setCursor(0,0);
```

```
display.println("Filled Rectangle");
display.fillRect(0, 15, 90, 45, SSD1306_WHITE);
display.display();
delay(2000);

}

void DrawRoundRectangle()
{
display.clearDisplay();
display.setTextSize(1);
display.setTextColor(SSD1306_WHITE);
display.setCursor(0,0);
display.println("Round Rectangle");
display.drawRoundRect(0, 15, 90, 45, 10, SSD1306_WHITE);
display.display();
delay(2000);
}

void DrawFilledRoundRectangle()
{
display.clearDisplay();
display.setTextSize(1);
display.setTextColor(SSD1306_WHITE);
display.setCursor(0,0);
display.println("Filled Round Rect");
display.fillRoundRect(0, 15, 90, 45, 10, SSD1306_WHITE);
display.display();
delay(2000);
}

void DrawCircle()
{
display.clearDisplay();
display.setTextSize(1);
display.setTextColor(SSD1306_WHITE);
display.setCursor(0,0);
display.println("Circle");
display.drawCircle(30, 36, 25, SSD1306_WHITE);
```

```
    display.display();
    delay(2000);
}
void DrawFilledCircle()
{
    display.clearDisplay();
    display.setTextSize(1);
    display.setTextColor(SSD1306_WHITE);
    display.setCursor(0,0);
    display.println("Filled Circle");
    display.fillCircle(30, 36, 25, SSD1306_WHITE);
    display.display();
    delay(2000);

}

void DrawTriangle()
{
    display.clearDisplay();
    display.setTextSize(1);
    display.setTextColor(SSD1306_WHITE);
    display.setCursor(0,0);
    display.println("Triangle");
    display.drawTriangle(30, 15, 0, 60, 60, 60, SSD1306_WHITE);
    display.display();
    delay(2000);
}

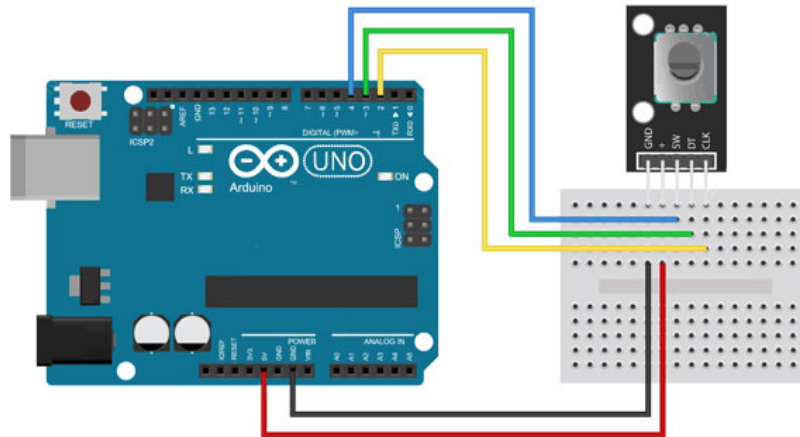
void DrawFilledTriangle()
{
    display.clearDisplay();
    display.setTextSize(1);
    display.setTextColor(SSD1306_WHITE);
    display.setCursor(0,0);
    display.println("Filled Triangle");
    display.fillTriangle(30, 15, 0, 60, 60, 60, SSD1306_WHITE);
    display.display();
    delay(2000);
}
```

# Conclusion

A simple tutorial on how to interface SPI OLED Display Module with ESP32 DevKit Board. You learned the pinout of SSD1306 OLED Display, necessary connections for SPI Interface with ESP32, download libraries for Arduino IDE and display some text, graphics and image on the OLED Display using ESP32.

???????

????? ????????????



???

```
#define CLK 2 // Указываем к какому выводу CLK энкодер подключен к
Arduino
#define DT 3 // Указываем к какому выводу DT энкодер подключен к
Arduino
#define SW 4 // Указываем к какому выводу SW энкодер подключен к
Arduino

int counter = 0; // Создаем переменную counter
int currentStateCLK; // Создаем переменную currentStateCLK
int lastStateCLK; // Создаем переменную lastStateCLK
String currentDir = ""; // Создаем
unsigned long lastButtonPress = 0; // Создаем переменную lastBut

void setup()
{
  pinMode(CLK, INPUT); // Указываем вывод CLK как вход
  pinMode(DT, INPUT); // Указываем вывод DT как вход
  pinMode(SW, INPUT_PULLUP); // Указываем вывод SW как вход и включаем подтягивающий
резистор
```

```

Serial.begin(9600);          // Создаем последовательную связь
lastStateCLK = digitalRead(CLK);
pinMode(13, OUTPUT);      // Считываем значение с CLK
}
void loop()
{
  currentStateCLK = digitalRead(CLK); // Считываем значение с CLK

// Проверяем изменилось ли состояние CLK
  if (currentStateCLK != lastStateCLK && currentStateCLK == 1){
    if (digitalRead(DT) != currentStateCLK) {
      counter --;
      currentDir ="CCW";
    } else {
      counter ++;
      currentDir ="CW";
    }
    Serial.print("Direction: ");
    Serial.print(currentDir);
    Serial.print(" | Counter: ");
    Serial.println(counter);
  }

  lastStateCLK = currentStateCLK;          // Запоследнее состояние CLK
  int btnState = digitalRead(SW);         // Считываем состояние вывода SW

  if (btnState == LOW){                   // Если состояние LOW, кнопка нажата
    if (millis() - lastButtonPress > 50){ // Если состояние LOW в течении 50 мкс, кнопка
нажата
      Serial.println("Button pressed!"); // Отправка сообщения
      switch (digitalRead(13)) { // переводим светодиод в противоположное состояние
        case HIGH:
          digitalWrite(13, LOW);
          break;
        case LOW:
          digitalWrite(13, HIGH);
          break;
      }
    }
  }
}

```

```
    lastButtonPress = millis();  
  }  
  delay(1);           // Пауза  
}
```