ARDUINO PROJECTS

DIY Soil Ph Meter using Soil Ph Sensor & Arduino

By **Admin** — Updated: September 9, 2023 34 Comments 8 Mins Read

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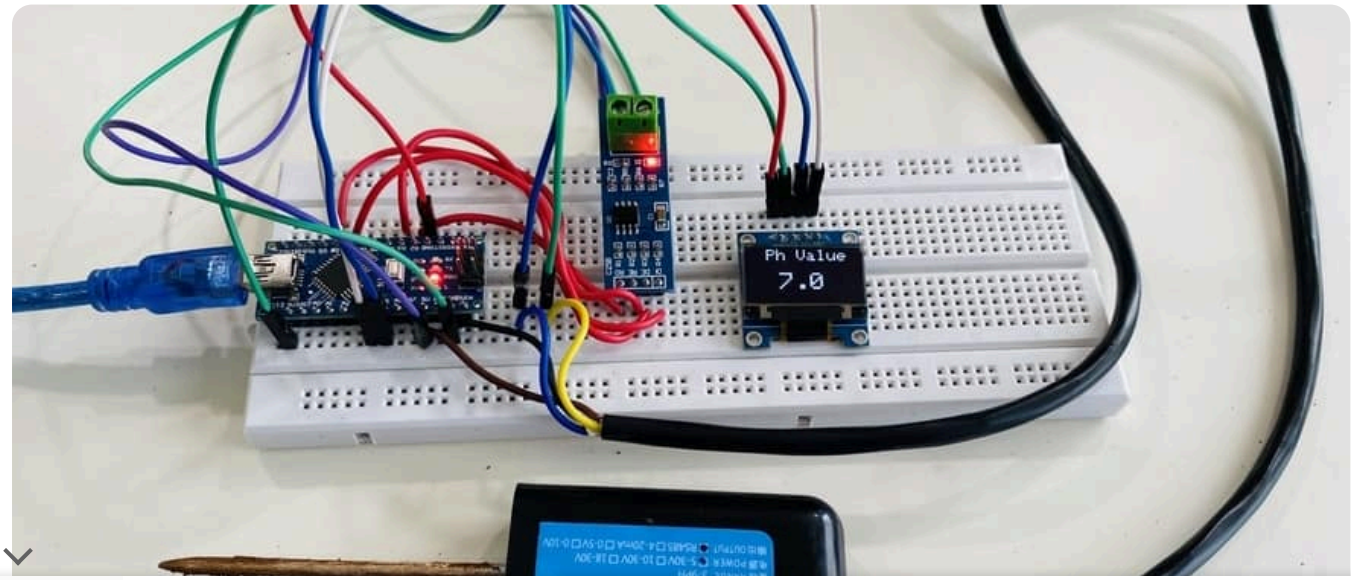


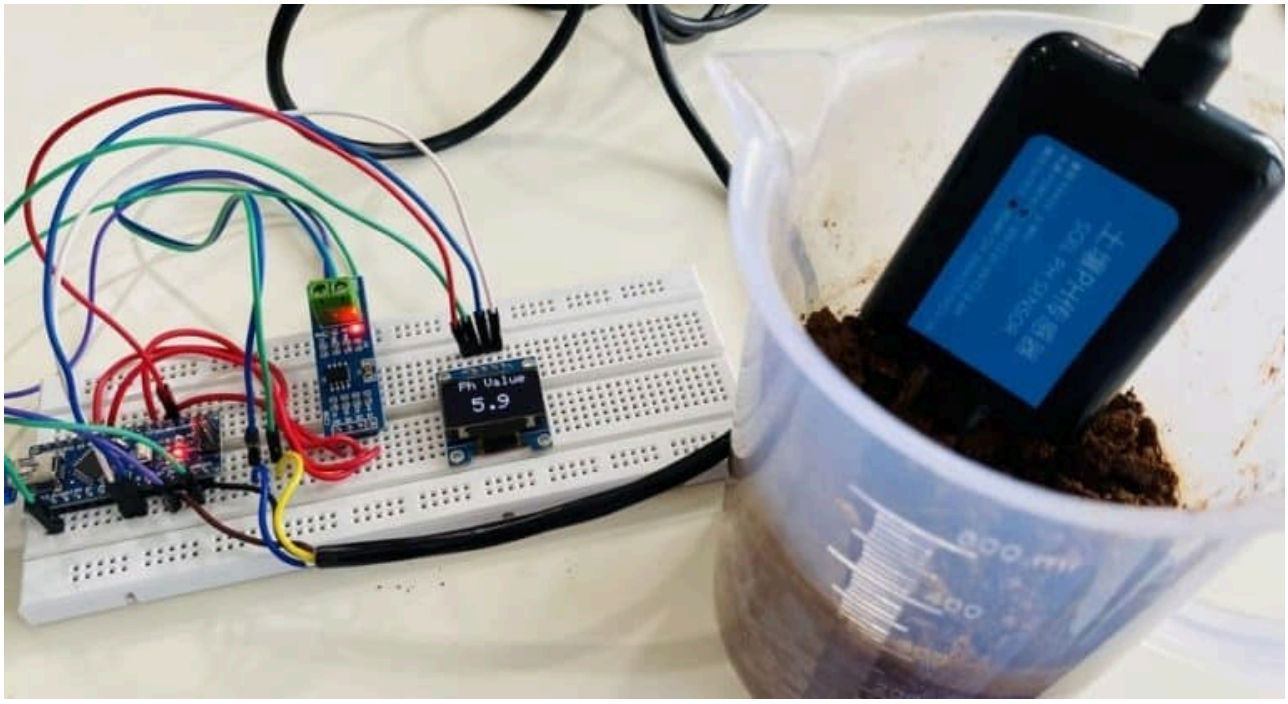
Overview

In this project, we will make our own **DIY Soil Ph Meter** using **Soil Ph Sensor** & Arduino for the measurement of **Soil Ph**. Soils can be naturally **acidic** or **alkaline** & can be measured by testing their **pH value**. Soil pH is a measure of the acidity or alkalinity of the soil.

Soil is considered a natural medium for plant growth & development. Much research is going on to determine the internal factors of farmers' crop production failure. One of the factors is the balance of nature in unstable or unfertile soil that inhibits plant growth and plant root development. The Ph is the **acidity or basicity** of material measured on a scale between **0 to 14**. The Ph value lesser than 7 is considered **acidic** and greater than 7 is considered **basic**. If the pH scale is 7 then the material is **neutral**. The most ideal soil conditions for the growth & development of plants are neutral soil. However, some types of plants are still tolerant of soils with slightly acidic Ph with a maximum pH of 5.

Apart from Soil Ph, the Soil **Nitrogen, Phosphorous, Potassium, EC & Salinity** content is also useful for plant growth. For the measurement of **NPK Content**, we can use **NPK Sensor**. For Soil EC & Salinity measurement, we can use **Soil EC Sensor** But Soil Ph is completey different factor compared to Soil NPK. We have already discussed about **Water Ph Sensor** in one of our

construction and limitations factor. This is why we need an special Soil Ph Sensor to measure the Ph of a Soil.



While browsing through the internet, I found a great Ph Sensor manufactured by some Chinese R&D Manufacturer. The sensor is manufacture by a company called **HONDETEC** and you can check it on **Alibaba**. The sensor works perfectly with **Modbus** RS485 and the result is highly impressive. So, in this post we will learn about **Soil Ph Sensor & Arduino Interfacing** and design our own **Arduino Soil Ph Meter**. We will display the Soil Ph value on a 0.96" **OLED Display**.

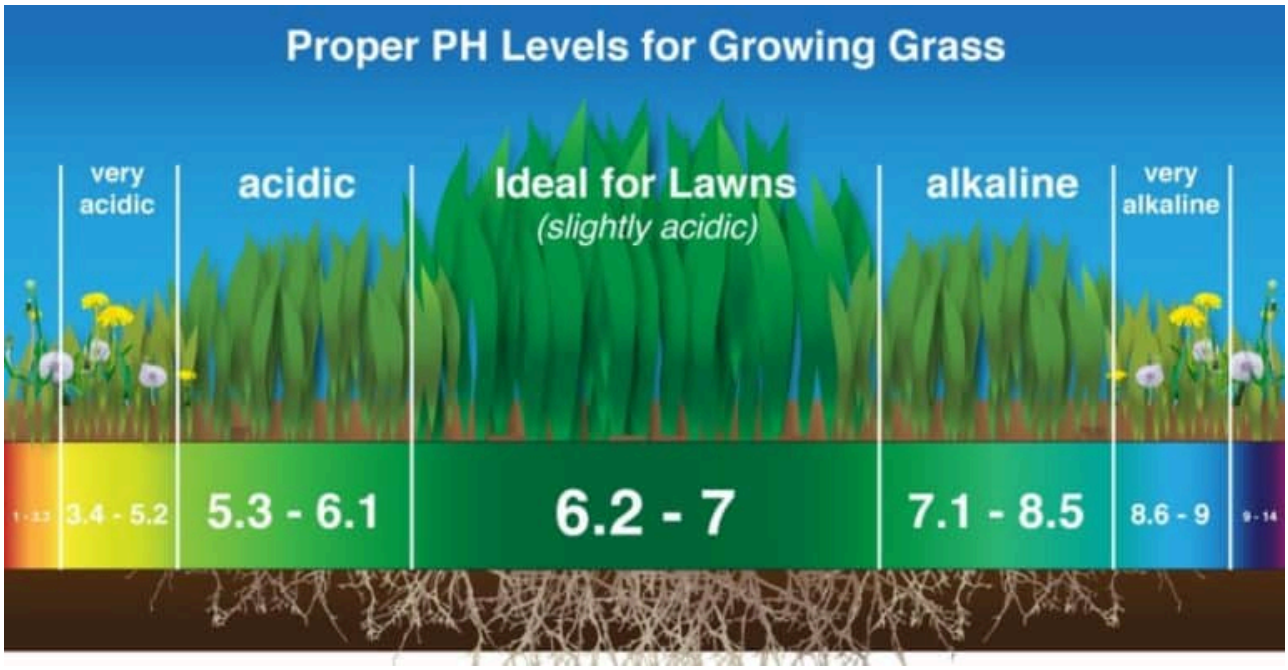
The bill of materials for making your own Soil Ph Meter is given below. All the components can be easily purchased from Amazon except the Soil Ph measurement sensor. You can get it from Amazon as well but may not be available every time.

S.N.	Components Name	Quantity	Purchase Links
1	Arduino Nano Board	1	**Amazon** | **AliExpress**
2	Soil Ph Sensor	1	**Amazon** | **AliExpress**
3	0.96" I2C OLED Display	1	**Amazon** | **AliExpress**
4	MAX485 Modbus Module	1	**Amazon** | **AliExpress**
5	9V Power Supply	1	**Amazon** | **AliExpress**
6	Connecting Wires	10	**Amazon** | **AliExpress**
7	Breadboard	1	**Amazon** | **AliExpress**

Soil Ph Measurement & its important

What is Soil Ph?

Soil pH is a measure of the **acidity** or **alkalinity** of the soil. A pH value is actually a measure of **hydrogen ion concentration**. Because hydrogen ion concentration varies over a wide range, a logarithmic scale (pH) is used



Most soils have pH values between **3.5** and **10**. In higher rainfall areas the natural pH of soils typically ranges from **5 to 7**, while in drier areas the range is **6.5 to 9**. Soils can be classified according to their pH value:

1. 6.5 to 7.5—neutral

2. over 7.5—alkaline

3. less than 6.5—acidic, and soils with pH less than 5.5 are considered strongly acidic

Origins

Natural soil pH depends on the rock from which the soil was formed and the **weathering processes** that acted on it, i.e. *climate, vegetation, topography & time*. These processes tend to cause a lowering of pH (**increase in acidity**) over time.

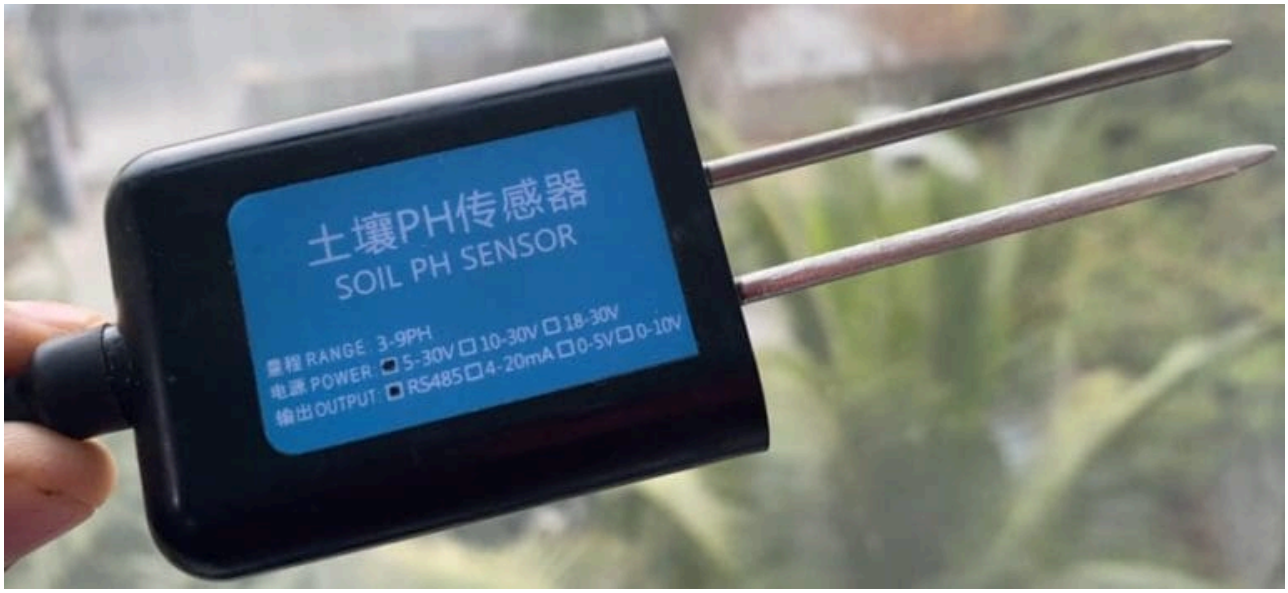
Rain is also considered as one of the significant factors for the increase in **acidity of the soil**. Some **fertilizers** can change soil pH and increase or reduce the number of **nutrients** available to plants.

Effects

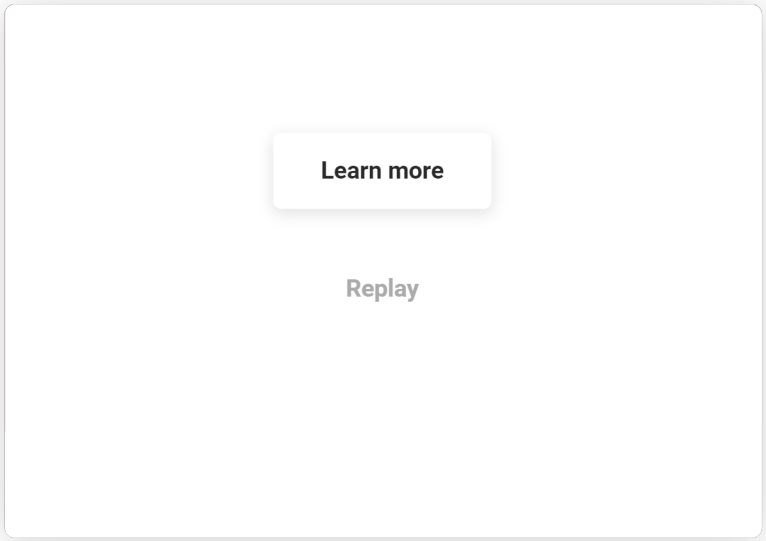
Soil pH affects the amount of **nutrients** and **chemicals** that are soluble in soil water. Some nutrients are more available under acid conditions while others are more available under alkaline conditions. However, most **mineral nutrients** are readily available to plants when soil

The development of strongly acidic soils can result in poor plant growth as a result of **Aluminum & Manganese** toxicity or **calcium & magnesium** deficiency. Alkaline soils may have problems with deficiencies of nutrients such as **zinc, copper, boron & manganese**.

Soil Ph Sensor



This is a **waterproof** and **dustproof** Soil Ph Sensor that can measure the Soil Ph value from **3** to **9** with high accuracy up to **±0.3PH**. The sensor has an **IP68 protective case** & is sealed with High-density **epoxy resin** which can prevent **moisture** from entering the body interior part. The sensor is suitable for Suitable for agricultural cultivation, industrial production, environmental monitoring, animal husbandry, and sewage treatment.



Specifications

1.Probe type: Probe electrode
2. Measuring range: **3 ~ 9 PH**
3. Measurement accuracy: ±0.3PH
4. Resolution: 0.1 PH
5. Outputsignal: **RS485/0-5V / 0-10V / 4-20mA output**
6. Supply voltage: **5V~30VDC**
7. Working temperature range: **-30 ° C ~ 70 ° C**
8. Stabilization time: **5-10 Minutes** after power on
9. Response Speed: **≤15S**
10. Standard **2 meters** Cable
11. Long-term Stability: **≤5%/y**

Pinout

The Soil Ph Sensor has **4 pins** as it need to be connected to RS485 or MAX485 Module. The four colored wires are **Yellow, Blue, Black & Brown**.

Communication Protocol & Register Address

The communication protocol that it uses is the **Modbus**. Thee device works as a **Slave** with the device address as shown below. You can send this instruction or **Inquiry frame** & Read soil PH at device address **0x01**.

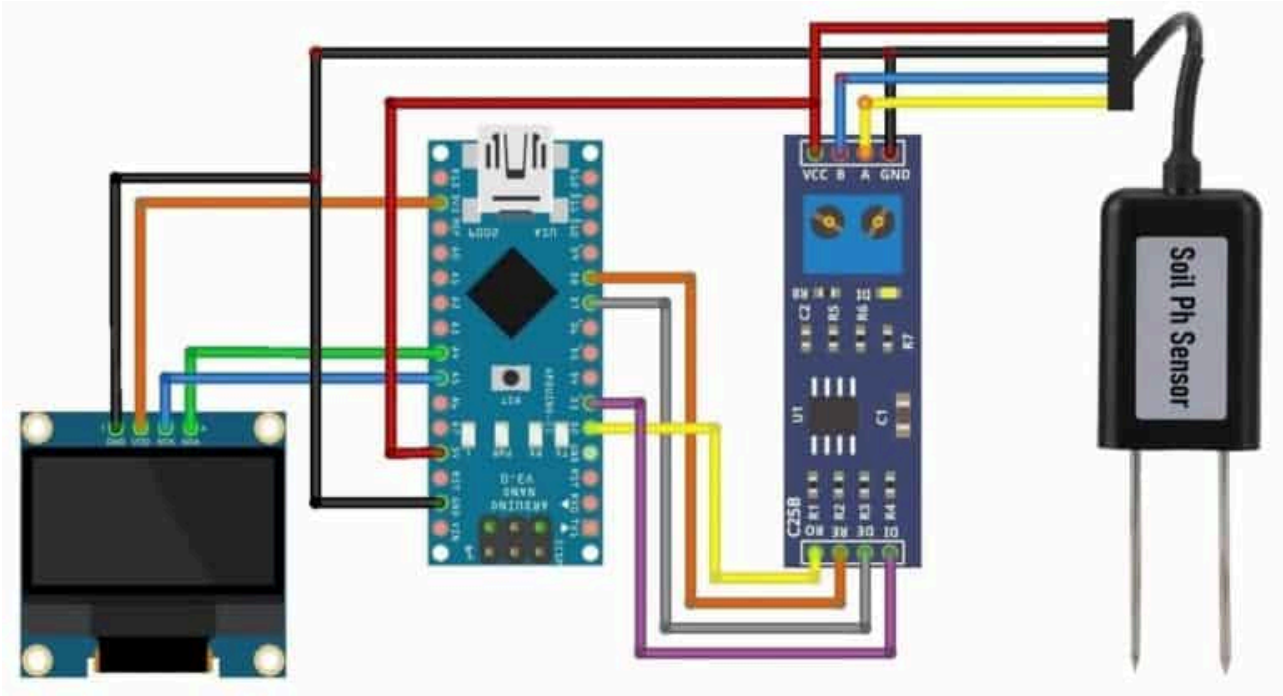
Address code	Function code	Register start address	Register length	Low check bit	Check code high
0X01	0X03	0X00 0X00	0X00 0X01	0X84	0X0A

You will get the **Response frame** as follows. From the response frame, you can calculate the Ph Value.

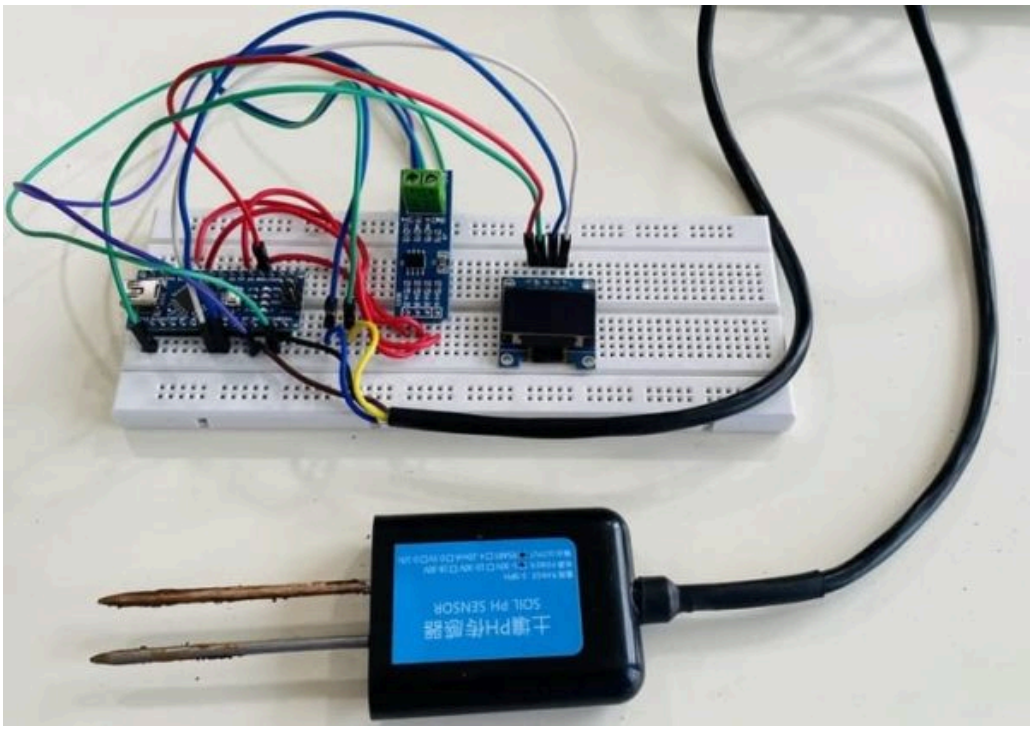
Address code	Function code	Number of valid bytes	Data area	Low check bit	High Check bit
0X01	0X03	0X02	0x00 0x47	0XD8	0x15

From the received response, you can calculate the **Ph Value**. The 4th bit (starting from the 0th bit) is the value of Ph. For example, we got **0047H (hexadecimal) = 71 Decimal => pH = 7.1pH**

Now, let us **interface the Soil Ph Sensor with the Arduino** Nano Board using the **MAX485 Modbus Module**. The connection diagram is given below.



The **R0 (Read Out) & DI (Data In)** pin of from the Modbus is connected to **D2 & D3** of Arduino using Software Serial. Similarly, we have to enable **DE & RE** high which is done by connecting them to the **D7 & D8** pin of Arduino. The NPK Sensor has 4 wires. The **brown** one is VCC which needs a **5V-30V Power Supply** & can be connected to 5V of Arduino. The GND pin which is **black** in color needs to be connected to the GND of Arduino. The **Blue wire** which is the B pin is connected to the B pin of MAX485 & the **Yellow Wire** which is the A pin is connected to the A pin of MAX485.



The **0.96" SSD1306 OLED Display** is an I2C Module. The OLED Display VCC & GND are connected to **3.3V** & GND of Arduino. Similarly, its **SDA & SCL** pins are connected to the A4 & A5 of Arduino. You can follow the circuit diagram & assemble the circuit on a breadboard or make a custom design PCB.

Source Code/Program

The source code for **interfacing Soil Ph Sensor with Arduino** & retrieving Soil Ph value from the Sensor via **Modbus command** is given below. You can send the command and retrieve the value in **HEX Code**. The HEX code needs to be converted into **Decimal** to get the Measured

Since we are using **OLED Display** to display, you will need OLED Library. Download the following **OLED Library** and add it to the Arduino IDE.

1. **Adafruit SSD1306 Library**: **Download**
2. **Adafruit GFX Library**: **Download**

Here is the complete source code. Compile & upload it to the Arduino Nano Board.

```
#include <SoftwareSerial.h>
#include <Wire.h>
#include <Adafruit_GFX.h>
#include <Adafruit_SSD1306.h>

#define RE 8
#define DE 7

const byte ph[] = {0x01, 0x03, 0x00, 0x00, 0x00, 0x01, 0x84, 0x0A};
byte values[11];
SoftwareSerial mod(2, 3);

#define SCREEN_WIDTH 128  // OLED display width, in pixels
#define SCREEN_HEIGHT 64  // OLED display height, in pixels
#define OLED_RESET    -1  // Reset pin # (or -1 if sharing reset pin)
Adafruit_SSD1306 display(SCREEN_WIDTH, SCREEN_HEIGHT, &Wire, OLED_RESET);


void setup()
{
  Serial.begin(9600);
  mod.begin(4800);
  pinMode(RE, OUTPUT);
  pinMode(DE, OUTPUT);
  if (!display.begin(SSD1306_SWITCHCAPVCC, 0x3C))
  {
    Serial.println(F("SSD1306 allocation failed"));
    for (;;); // Don't proceed, loop forever
  }
  display.display();
  delay(100);
  display.clearDisplay();

  display.clearDisplay();
```

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

void loop()
{
  byte val;
  digitalWrite(DE, HIGH);
  digitalWrite(RE, HIGH);
  delay(10);
  if (mod.write(ph, sizeof(ph)) == 8)
  {
    digitalWrite(DE, LOW);
    digitalWrite(RE, LOW);
    for (byte i = 0; i < 11; i++)
    {
      values[i] = mod.read();
      Serial.print(values[i], HEX);
    }
    Serial.println();
  }
  float soil_ph = float(values[4]) / 10;
  Serial.print("Soil Ph: ");
  Serial.println(soil_ph, 1);

  display.clearDisplay();
  display.setTextSize(2);
  display.setCursor(20,0);
  display.println("Ph Value");

  display.setTextSize(3);
  display.setCursor(35,30);
  display.print(soil_ph, 1);

  display.display();

  delay(3000);
}
```

Testing & Monitoring Soil Ph Data on OLED Display

Once the code is uploaded, the OLED will initialize along with the sensor. The sensor will take some time to get **stabilized** and the reading may be incorrect for a few seconds initially.

Once the sensor gets stabilized, you are ready to go. The sensor when exposed to air gives **7.0** as a Ph which can be observed on an OLED Display.

depending upon the type of soil. The value increased or decreases like an A**nalog Soil Ph Sensor** and can also be used as **IoT Soil Ph Sensor**.

Video Tutorial & Guide

Follow the following video to learn about the entire project & code information.

DIY Soil Ph Meter || Measure Soil Ph Value using Soil Ph Sensor & Arduino









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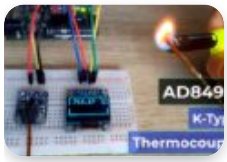

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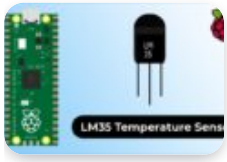

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