



pH Sensor with temperature compensation sensor consist of pH probe and a signal conditioning board which gives an analog voltage output proportional to the pH Value of a solution. The linear output of analog voltage can be directly interfaced with any micro-controller with ADC feature like Arduino UNO. The pH Sensor components are usually combined into one device called a combination pH electrode. The measuring electrode is made of glass and is quite fragile. Recent developments have replaced the glass with more durable solid state sensors.

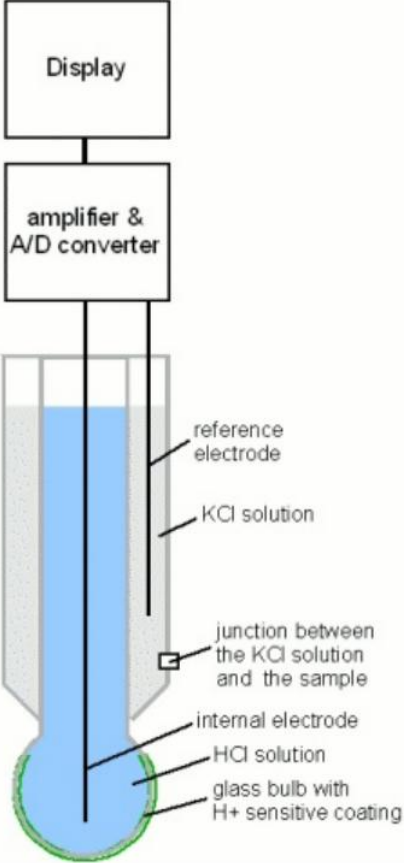
The signal conditioning board contains preamplifier which takes the high impedance pH electrode signal and changes it into a low impedance signal which the analyzer or transmitter can accept. The preamplifier also strengthens and stabilizes the signal, making it less susceptible to electrical noise.

There are two types of probes:

1. pH probe : measure the pH Value from 0 to 14.
2. ORP probe : Oxidation Reduction Potential probe which returns voltage proportional to the tendency of the solution to gain or lose electrons from the other substances.

## **Product Specification**

1. Operating Voltage =  $5V \pm 0.2V$
2. Operating Current : 5-10mA
3. pH Value Range: PH0-14
4. Ambient Temperature when taking pH measurement : 0-80 degree Celsius
5. Response Time : less than 5 second
6. Stabilizing Time : less than 60 seconds
7. Power Consumption : 0.5W
8. Operating Temperature : -10 to 50 degree Celsius (Optimum : 20 degree Celsius)
9. Relative Air Humidity : 95% RH (Optimum : 65%RH)
10. Lifespan : 3 years
11. Size : 42mm\*32mm\*20mm
12. Weight : 25gram
13. Output signal : Analogue Voltage

Diagram	Explanation
	<p>The pH indicates the concentration of hydrogen <math>[H]^+</math> ions present in certain solutions. It can accurately be quantified by a sensor that measures the potential difference between two electrodes: a reference electrode (silver / silver chloride) and a glass electrode that is sensitive to hydrogen ion. This is what forms the probe.</p>

pH Liquid	Values obtained from multimeter
	
	
	

pH Precision Liquid	Voltage Value (V)
4	3.071
7	2.535
10	2.0666



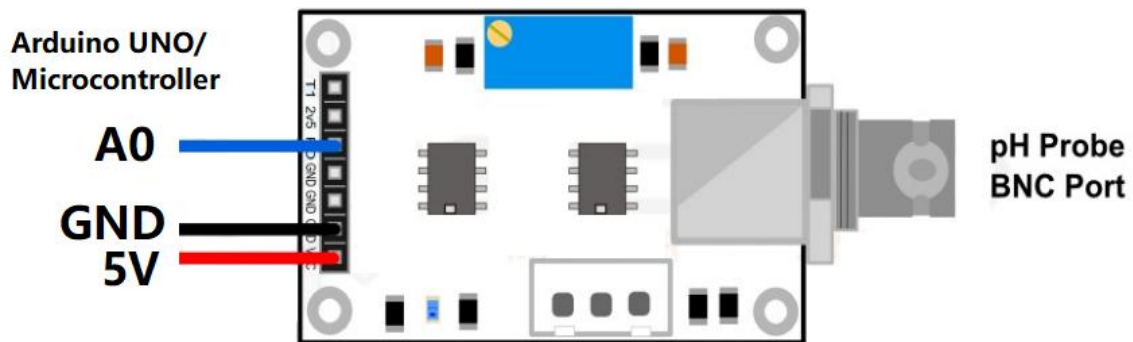
**The 3 packs of pH Substances should be made up to calibrate and test your pH sensor kits:**

1. Mix 250ml de-ionized water with Sodium Tetraborate powder at 25 degree Celsius to get solution rated at pH 9.18
2. Mix 250ml de-ionized water with Mixed Phosphate powder at 25 degree Celsius to get solution rated at pH 6.86
3. Mix 250ml de-ionized water with Potassium Hydrogen Phyhalate powder at 25 degree Celsius to get solution rated at pH 4.00

**Table 2. pH Value of the known substances.**

0	5% Sulphuric acid, H <sub>2</sub> SO <sub>4</sub> , battery acid.
1	0.1 N HCl, hydrochloric acid (1.1)
2	Lemon juice. Vinegar (2.4-3.4)
3	wine (3.5-3.7)
4	Orange juice. Apple juice (3.8). Beer. Tomatoes.
5	Cottage cheese. Black coffee. Rain water 5.6.
6	Milk. Fish (6.7-7). chicken (6.4-6.6).
7	Neutral: equal numbers of hydrogen and hydroxyl ions. Blood (7.3-7.4). Distilled water without CO <sub>2</sub> , after boiling.
8	Sea water (8.1). Egg white.
9	Borax. baking soda.
10	Milk of magnesia, Magnesium hydroxide Mg (OH) <sub>2</sub> .
11	Household ammonia
12	Photographic developer, household bleach
13	Oven cleaner
14	Sodium lye NaOH, 1 mol/litre.

### Sample Connections to microcontroller (A0 indicates analog pin of microcontroller)

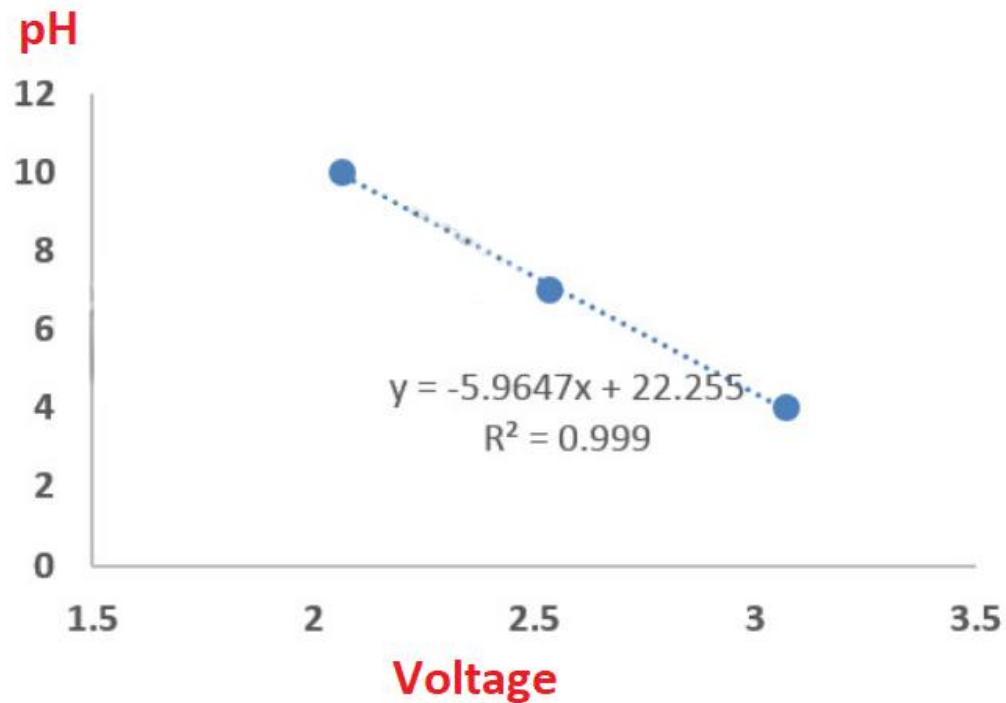


### Sample Code

```
1  const int analogInPin = A0;
2  int sensorValue = 0;
3  unsigned long int avgValue;
4  float b;
5  int buf[10],temp;
6  void setup() {
7    Serial.begin(9600);
8  }
9
10 void loop() {
11   for(int i=0;i<10;i++)
12   {
13     buf[i]=analogRead(analogInPin);
14     delay(10);
15   }
16   for(int i=0;i<9;i++)
17   {
18     for(int j=i+1;j<10;j++)
19     {
20       if(buf[i]>buf[j])
21       {
22         temp=buf[i];
23         buf[i]=buf[j];
24         buf[j]=temp;
25       }
26     }
27   }
28   avgValue=0;
29   for(int i=2;i<8;i++)
30   avgValue+=buf[i];
31   float pHVol=(float)avgValue*5.0/1024/6;
32   float pHValue = -5.70 * pHVol + 21.34;
33   Serial.print("sensor = ");
34   Serial.println(pHValue);
35
36   delay(20);
37 }
```

The following code will take 10 samples of analogue input from A0, and then calculate the average by discarding the highest and the lowest, leaving and using the 6 remaining samples. Then it will convert the values using a formula to pHValue. The final value will be displayed using a Serial monitor via com port of Arduino Uno.

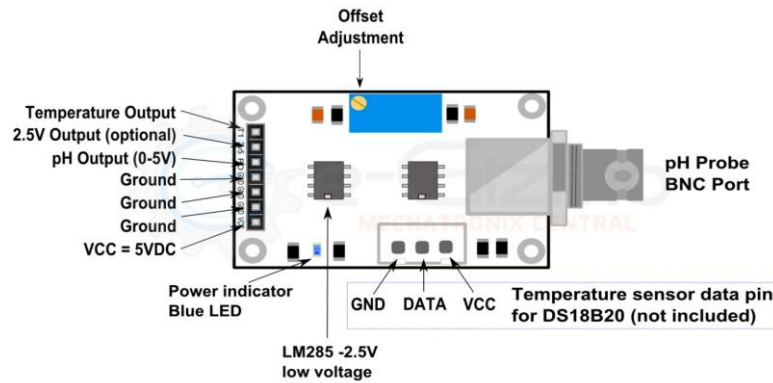
You may change the calibration factor -5.70 and +21.34 to calibrate your sensor. You may refer the following graph to get more ideas on the calibration factors. The equations below is the default factor obtained using  $y=mx+c$



**Connection of Sensor Module with Ds18b20 precision temperature sensor for temperature compensation**

Sensor Module	DS18B20 Temperature Sensor is not included in the sensor package





### How to use or calibrate sensor electrode

1. Do not “wipe” or rub the electrode
2. Turn open the protective plastic caps of the electrode at the end of the electrode, please follow the below steps to ensure that the electrode is in good condition.
3. Make sure the ball tip of electrode is facing downwards, hold firmly the cable end plastic holder, and then swirl the electrode a few times gently to make sure there is no air bubbles in the ball tip of electrode.
4. Gently rinse with deionized or distilled water
5. Plug in the pH Sensor to the BNC connector of the module.
6. You may dip the pH Sensor into pH Substance Solution, do not dip the entire electrode into pH Solution.
7. There are two steps in calibrating the sensor.
  - a. Offset regulation: The average range of the probe oscillates between negative and positive values. The 0 represents a pH of 7.0. In order to be able to use it with Arduino this circuit adds an offset value to the value measured by the probe, so the *ADC* will only have to take samples of positive voltage values. Therefore we will force a pH of 7.0 by disconnecting the probe from the circuit and short-circuiting the inside of the BNC connector with the outside. With a multimeter measure the value of *Po pin* and adjust the potentiometer to be 2.5V.
  - b. Calibration powder: We need to calculate the voltage conversion that gives us two pH reference value and measure the voltage returned by the sensor on the analogue output pin.

### **Maintenance and Precautions**

1. After finish using the electrode, use deionized water to wash the head of the electrode.
2. Then close the plastic cap by turning anti clockwise.
3. Make sure that the glass ball tip of the electrode is fully submerged with the solution, containing 3.0mol/L Potassium Chloride Solution.