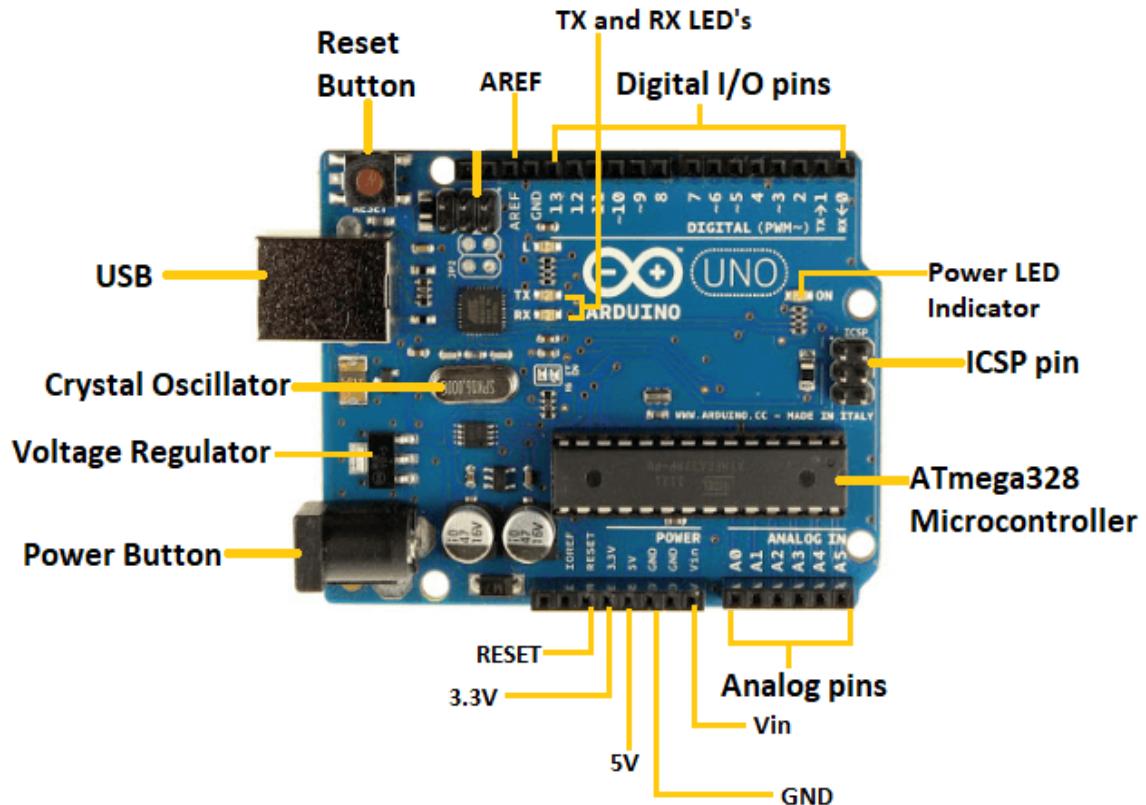


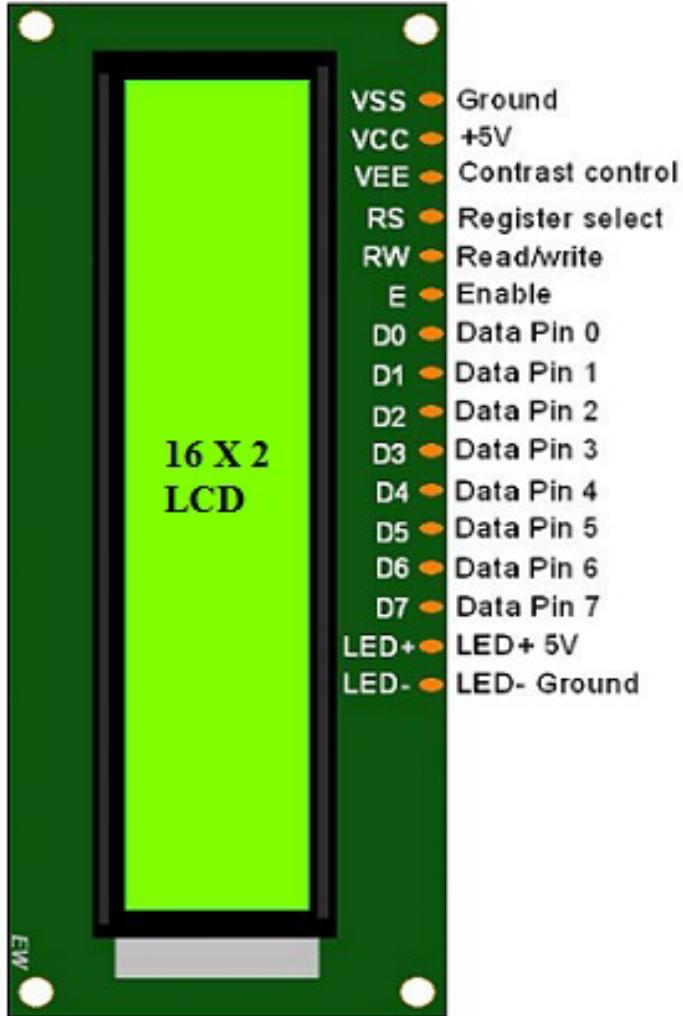
# ***COMPONENTS DETAILS***

# Arduino UNO



- **ATmega328 Microcontroller**- It is a single chip Microcontroller of the Atmel family. The processor code inside it is of 8-bit. It combines Memory (SRAM, EEPROM, and Flash), Analog to Digital Converter, SPI serial ports, I/O lines, registers, timer, external and internal interrupts, and oscillator.
- **ICSP pin** - The In-Circuit Serial Programming pin allows the user to program using the firmware of the Arduino board.
- **Power LED Indicator**- The ON status of LED shows the power is activated. When the power is OFF, the LED will not light up.
- **Digital I/O pins**- The digital pins have the value HIGH or LOW. The pins numbered from D0 to D13 are digital pins.
- **TX and RX LED's**- The successful flow of data is represented by the lighting of these LED's.
- **AREF**- The Analog Reference (AREF) pin is used to feed a reference voltage to the Arduino UNO board from the external power supply.
- **Reset button**- It is used to add a Reset button to the connection.
- **USB**- It allows the board to connect to the computer. It is essential for the programming of the Arduino UNO board.
- **Crystal Oscillator**- The Crystal oscillator has a frequency of 16MHz, which makes the Arduino UNO a powerful board.
- **Voltage Regulator**- The voltage regulator converts the input voltage to 5V.
- **GND**- Ground pins. The ground pin acts as a pin with zero voltage.
- **Vin**- It is the input voltage.
- **Analog Pins**- The pins numbered from A0 to A5 are analog pins. The function of Analog pins is to read the analog sensor used in the connection. It can also act as GPIO (General Purpose Input Output) pins.

# Lcd display



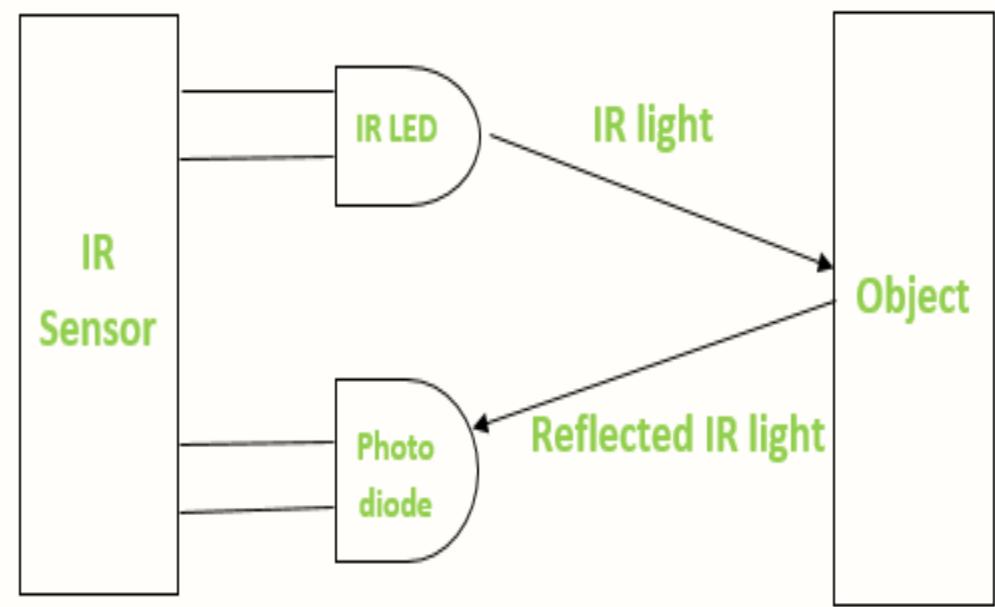
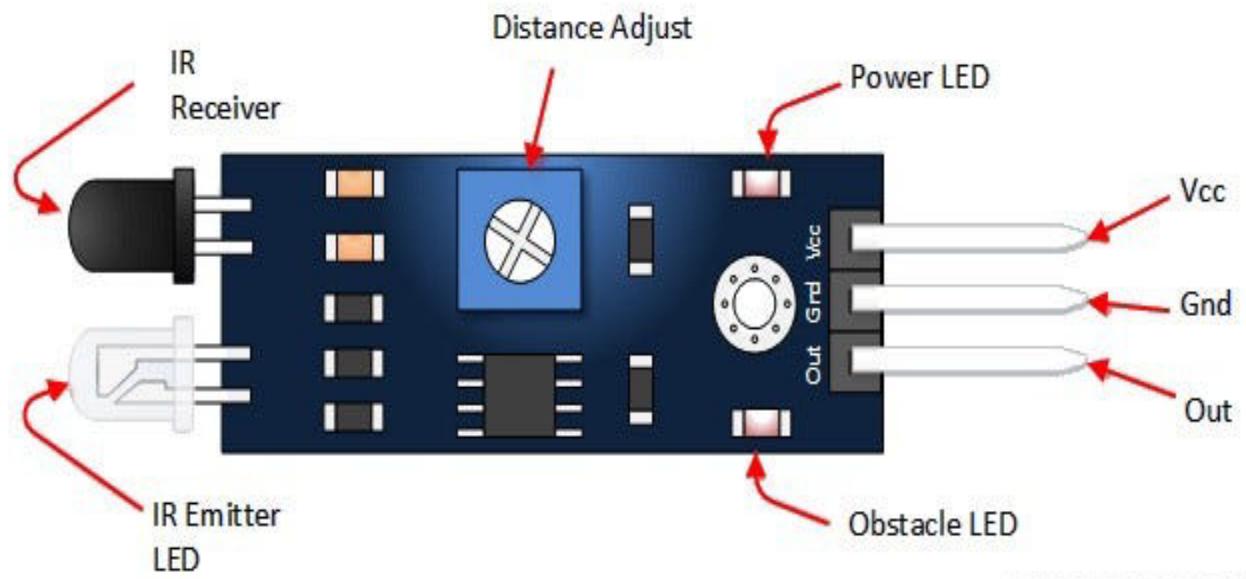
- The term LCD stands for liquid crystal display. It is one kind of electronic display module used in an extensive range of applications like various circuits & devices like mobile phones, calculators, computers, TV sets, etc. These displays are mainly preferred for multi-segment light-emitting diodes and seven segments. The main benefits of using this module are inexpensive; simply programmable, animations, and there are no limitations for displaying custom characters, special and even animations, etc.

## PIN DESCRIPTION:

- Pin1 (Ground/Source Pin): This is a GND pin of display, used to connect the GND terminal of the microcontroller unit or power source.
- Pin2 (VCC/Source Pin): This is the voltage supply pin of the display, used to connect the supply pin of the power source.
- Pin3 (V0/VEE/Control Pin): This pin regulates the difference of the display, used to connect a changeable POT that can supply 0 to 5V.
- Pin4 (Register Select/Control Pin): This pin toggles among command or data register, used to connect a microcontroller unit pin and obtains either 0 or 1(0 = data mode, and 1 = command mode).
- Pin5 (Read/Write/Control Pin): This pin toggles the display among the read or writes operation, and it is connected to a microcontroller unit pin to get either 0 or 1 (0 = Write Operation, and 1 = Read Operation).
- Pin 6 (Enable/Control Pin): This pin should be held high to execute Read/Write process, and it is connected to the microcontroller unit & constantly held high.
- Pins 7-14 (Data Pins): These pins are used to send data to the display. These pins are connected in two-wire modes like 4-wire mode and 8-wire mode. In 4-wire mode, only four pins are connected to the microcontroller unit like 0 to 3, whereas in 8-wire mode, 8-pins are connected to microcontroller unit like 0 to 7.
- Pin15 (+ve pin of the LED): This pin is connected to +5V
- Pin 16 (-ve pin of the LED): This pin is connected to GND.

# IR SENSOR

- IR sensor is an electronic device, that emits the light in order to sense some object of the surroundings. An IR sensor can measure the heat of an object as well as detects the motion. Usually, in the infrared spectrum, all the objects radiate some form of thermal radiation. These types of radiations are invisible to our eyes, but infrared sensor can detect these radiations.
- The emitter is simply an IR LED (**Light Emitting Diode**) and the detector is simply an IR photodiode . Photodiode is sensitive to IR light of the same wavelength which is emitted by the IR LED. When IR light falls on the photodiode, the resistances and the output voltages will change in proportion to the magnitude of the IR light received.
- Infrared Transmitter is a light emitting diode (LED) which emits infrared radiations called as IR LED's. Even though an IR LED looks like a normal LED, the radiation emitted by it is invisible to the human eye.
- Infrared receivers or infrared sensors detect the radiation from an IR transmitter. IR receivers come in the form of photodiodes and phototransistors. Infrared Photodiodes are different from normal photo diodes as they detect only infrared radiation.



# WATER PUMP



- This DC 12V Mini Submersible Noiseless Water Pump is a low cost, small size Submersible Pump Motor which can be operated from a 12V power supply. It can take up to 120 liters per hour with a very low current consumption of 220mA. Just connect the tube pipe to the motor outlet, submerge it in water, and power it.
- Make sure that the water level is always higher than the motor. The dry run may damage the motor due to heating and it will also produce noise.

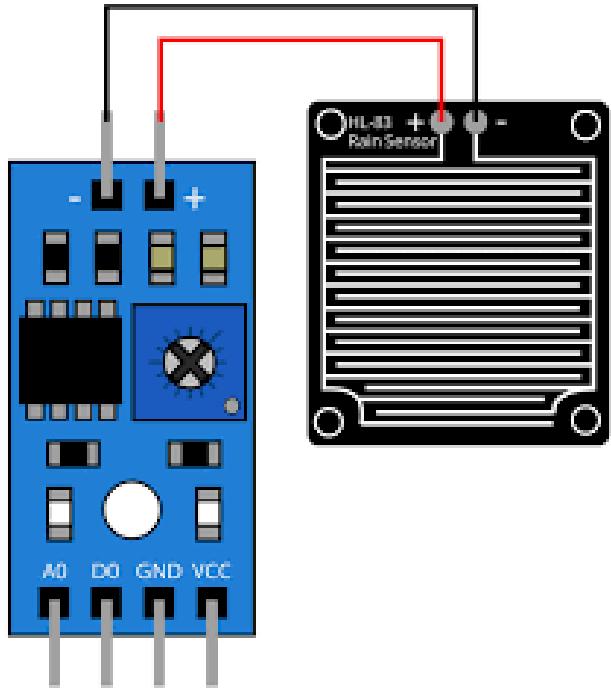
## Features :

1. DC 12V submersible pump
2. Mini submersible water pump 12V
3. DC water pump for DIY
4. DC pump for HOBBY kit.

# Rain sensor:

- A rain sensor is one kind of switching device which is used to detect the rainfall. It works like a switch and the working principle of this sensor is, whenever there is rain, the switch will be normally closed.
- The rain sensor module/board is shown below. Basically, this board includes nickel coated lines and it works on the resistance principle. This sensor module permits to gauge moisture through analog output pins & it gives a digital output while moisture threshold surpasses.
- This module is similar to the LM393 IC because it includes the electronic module as well as a PCB. Here PCB is used to collect the raindrops. When the rain falls on the board, then it creates a parallel resistance path to calculate through the operational amplifier.
- This sensor is a resistive dipole, and based on the moisture only it shows the resistance. For example, it shows more resistance when it is dry and shows less resistance when it is wet.

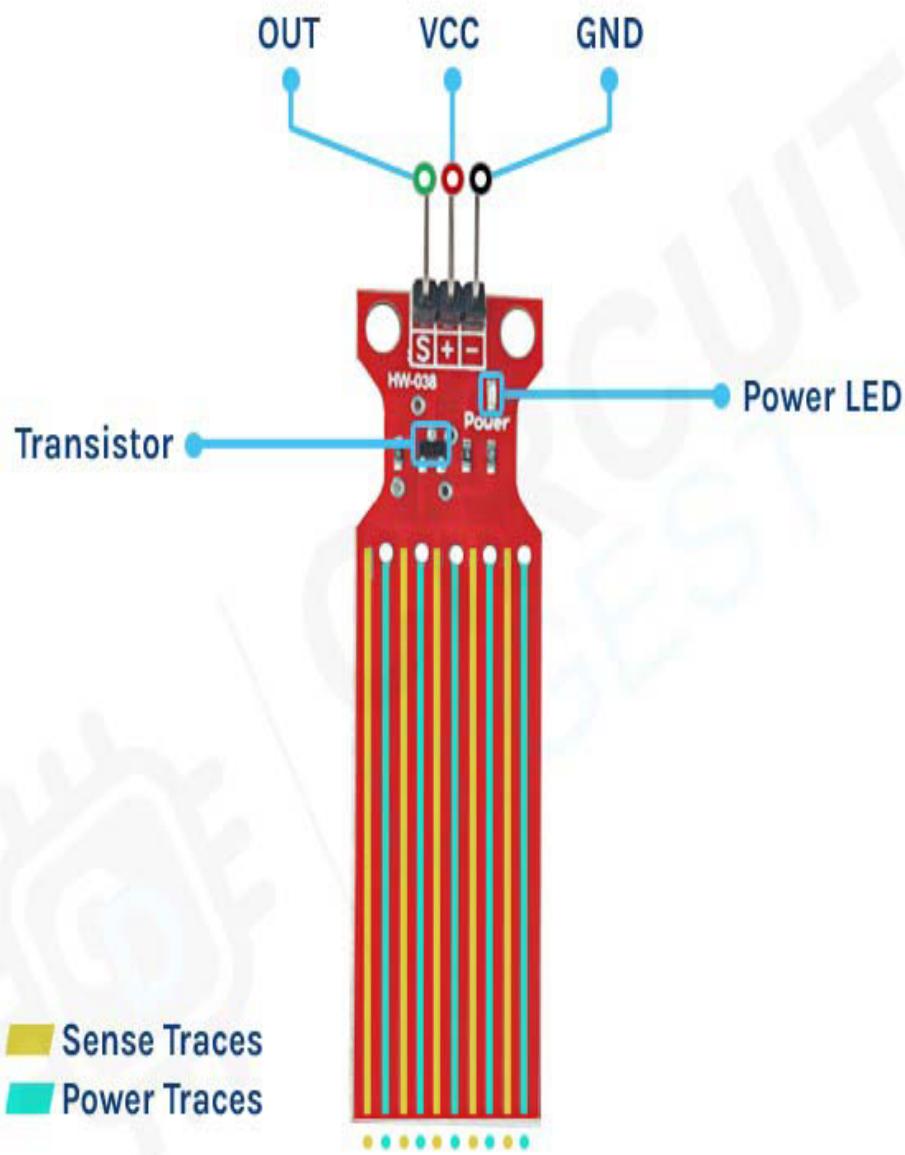
# Sensor module and pin details:



- Pin1 (VCC): It is a 5V DC pin
- Pin2 (GND): it is a GND (ground) pin
- Pin3 (DO): It is a low/high output pin
- Pin4 (AO): It is an analog output pin

# Water level sensor

- This sensor is used to measure the water level in container. The sensor has ten exposed copper traces, five of which are power traces and the remaining five are sense traces. These traces are interlaced so that there is one sense trace between every two power traces.
- Normally, power and sense traces are not connected, but when immersed in water, they are bridged.
- The power and sense traces form a variable resistor (much like a potentiometer) whose resistance varies based on how much they are exposed to water. This resistance varies inversely with the depth of immersion of the sensor in water.
- The more water the sensor is immersed in, the better the conductivity and the lower the resistance.
- The less water the sensor is immersed in, the poorer the conductivity and the higher the resistance.
- The sensor generates an output voltage proportional to the resistance by measuring this voltage, the water level can be determined.



# Dc motor

- A DC motor is defined as a class of electrical motors that convert direct current electrical energy into mechanical energy.
- we can conclude that any electric motor that is operated using direct current or DC is called a DC motor. We will understand the DC motor construction and how a DC motor converts the supplied DC electrical energy into mechanical energy in the next few sections.
- DC motor is any of a class of rotary electrical machines that converts direct current electrical energy into mechanical energy. The most common types rely on the forces produced by magnetic fields. Nearly all types of DC motors have some internal mechanism, either electromechanical or electronic, to periodically change the direction of current in part of the motor.

# Dc motor specification:

- RPM: 30
- Operating Voltage: 12V DC
- Gearbox: Attached Plastic (spur)Gearbox
- Shaft diameter: 6mm with internal hole
- Torque: 2 kg-cm
- No-load current = 60 mA(Max)
- Load current = 300 mA(Max).

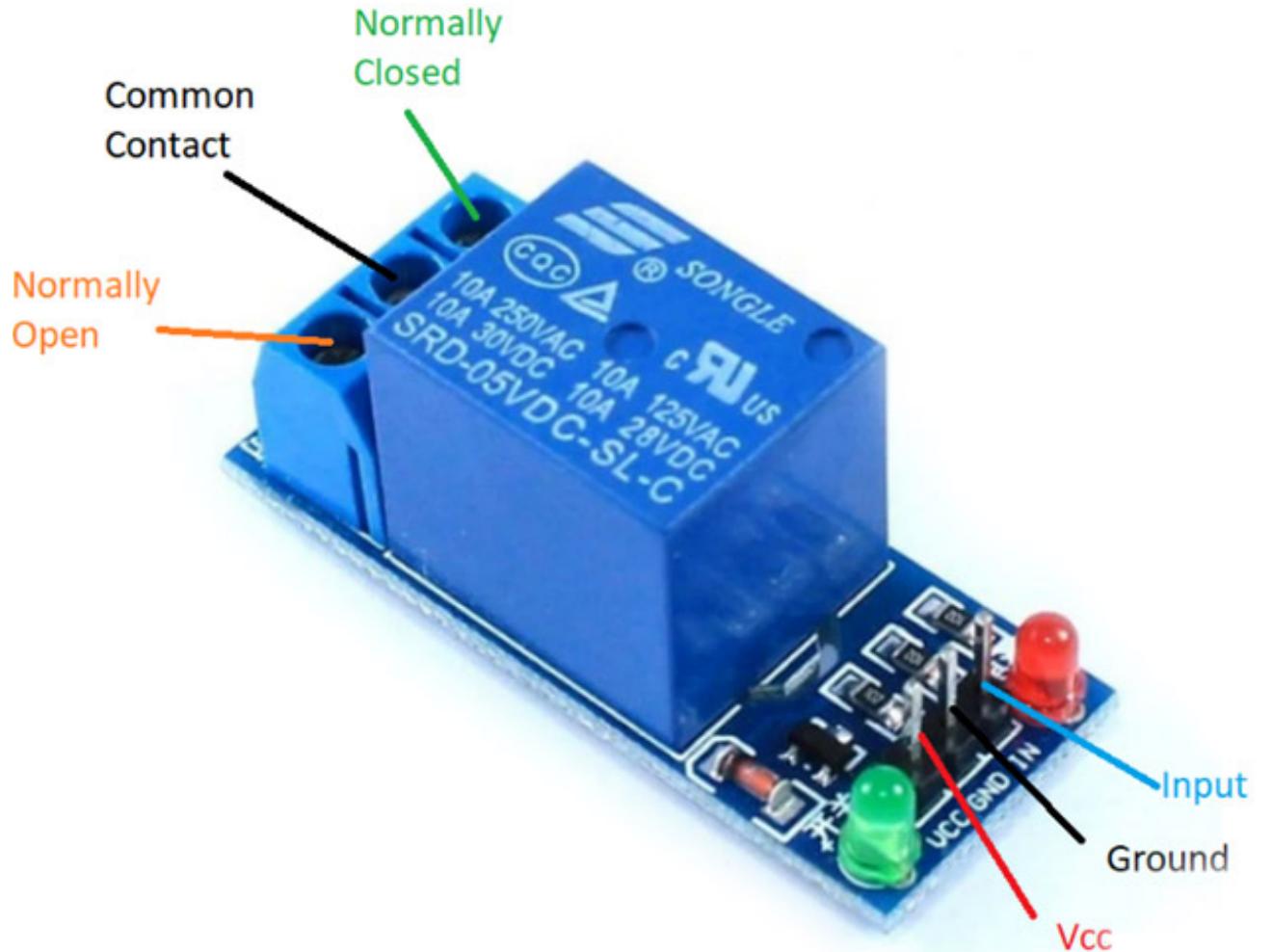


# Relay

- The Single Channel Relay Module is a convenient board which can be used to control high voltage, high current load such as motor, solenoid valves, lamps and AC load. It is designed to interface with microcontroller such as Arduino, NodeMCU, etc. The relay's terminal (COM, NO and NC) is being brought out with screw terminal. It also comes with a LED to indicate the status of relay.
- The relay is the device that opens or closes the contacts to switch ON/OFF other appliances operating at high voltages. It is also used in safety circuits where it detects the undesirable condition with an assigned area and gives the commands to the circuit breaker to disconnect the affected area through ON or OFF.
- Every electromechanical relay consists of:
  1. Electromagnet
  2. Mechanically movable contact
  3. Switching points
  4. Spring
- **COM:** Common Pin
- **NO:** Normally Open – There is no contact between the common pin and the normally open pin. So, when you trigger the relay, it connects to the COM pin and power is provided to the load.
- **NC:** Normally Closed – There is contact between the common pin and the normally closed pin. There is always connection between the COM and NC pins, even when the relay is turned off. When you trigger the relay, the circuit is opened and there is no supply provided to the load.

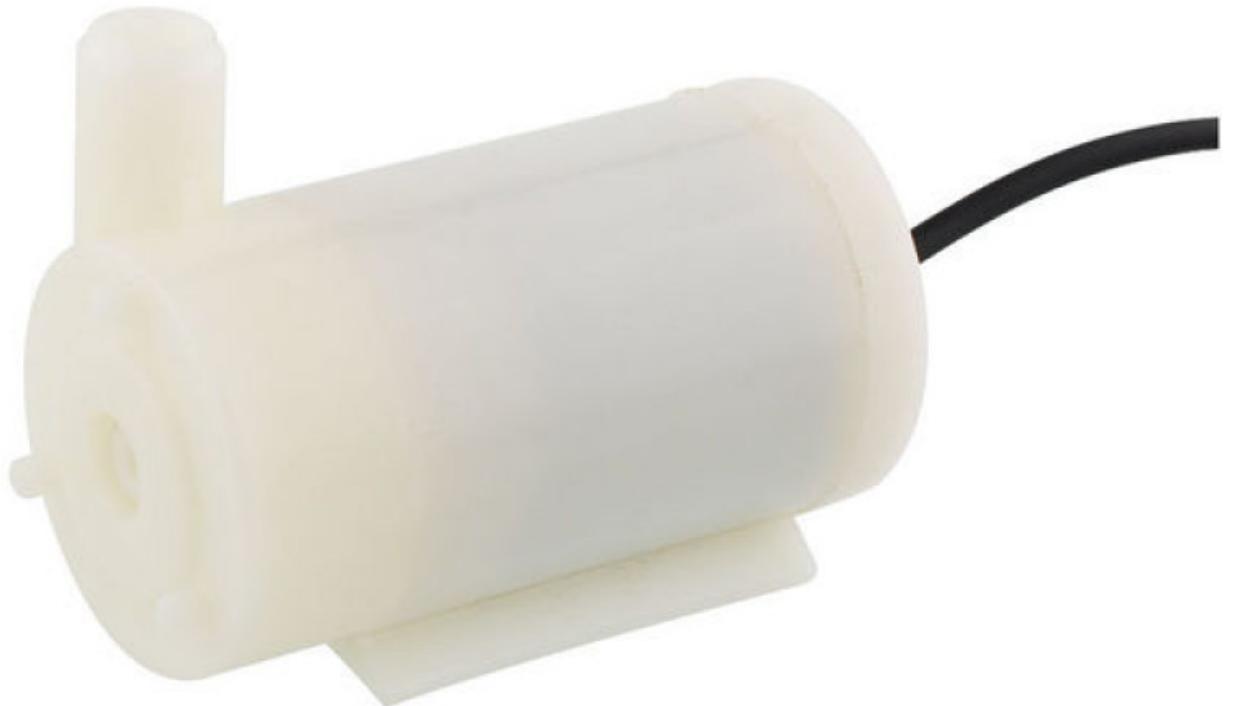
# Specification:

- Digital output controllable
- Compatible with any 5V microcontroller such as Arduino.
- Rated through-current: 10A (NO) 5A (NC)
- Control signal: TTL level
- switching voltage : 250VAC/30VDC
- switching current : 10A



# Water pump

Micro DC 3-6V Micro Submersible Pump  
Mini water pump For Fountain Garden Mini  
water circulation System DIY project. This is  
a low cost, small size Submersible Pump  
Motor which can be operated from a 3 ~ 6V  
power supply. It can take up to 120 liters per  
hour with very low current consumption of  
220mA. Just connect tube pipe to the motor  
outlet, submerge it in water and power it.  
Make sure that the water level is always  
higher than the motor. Dry run may damage  
the motor due to heating and it will also  
produce noise.



# Power supply module

It is used to provide power to all components. It will take 12v input voltage and convert it in three voltages of 3.3,5,12v.

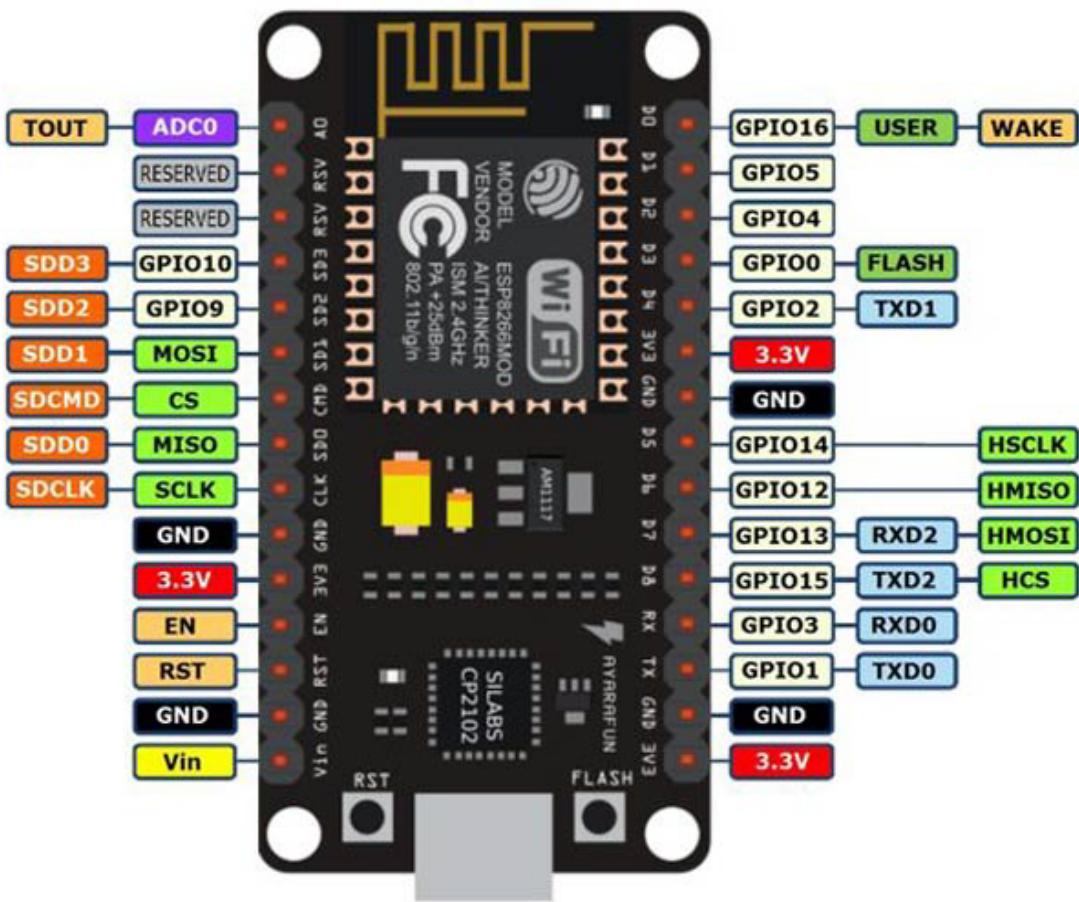
## Power supply specification

- Input voltage: 12v
- Output voltage: +3.3v, +5v, +12v
- Maximum load: 0.5amp
- Frequency: 16MHz



# Node MCU

- The NodeMCU (**N**ode **M**icro**C**ontroller **U**nit) is an open-source software and hardware development environment built around an inexpensive System-on-a-Chip (SoC) called the ESP8266. The ESP8266, designed and manufactured by Espressif Systems, contains the crucial elements of a computer: CPU, RAM, networking (WiFi), and even a modern operating system and SDK. That makes it an excellent choice for Internet of Things (IoT) projects of all kinds.
- However, as a chip, the ESP8266 is also hard to access and use. You must solder wires, with the appropriate analog voltage, to its pins for the simplest tasks such as powering it on or sending a keystroke to the “computer” on the chip. You also have to program it in low-level machine instructions that can be interpreted by the chip hardware. This level of integration is not a problem using the ESP8266 as an embedded controller chip in mass-produced electronics. It is a huge burden for hobbyists, hackers, or students who want to experiment with it in their own IoT projects.

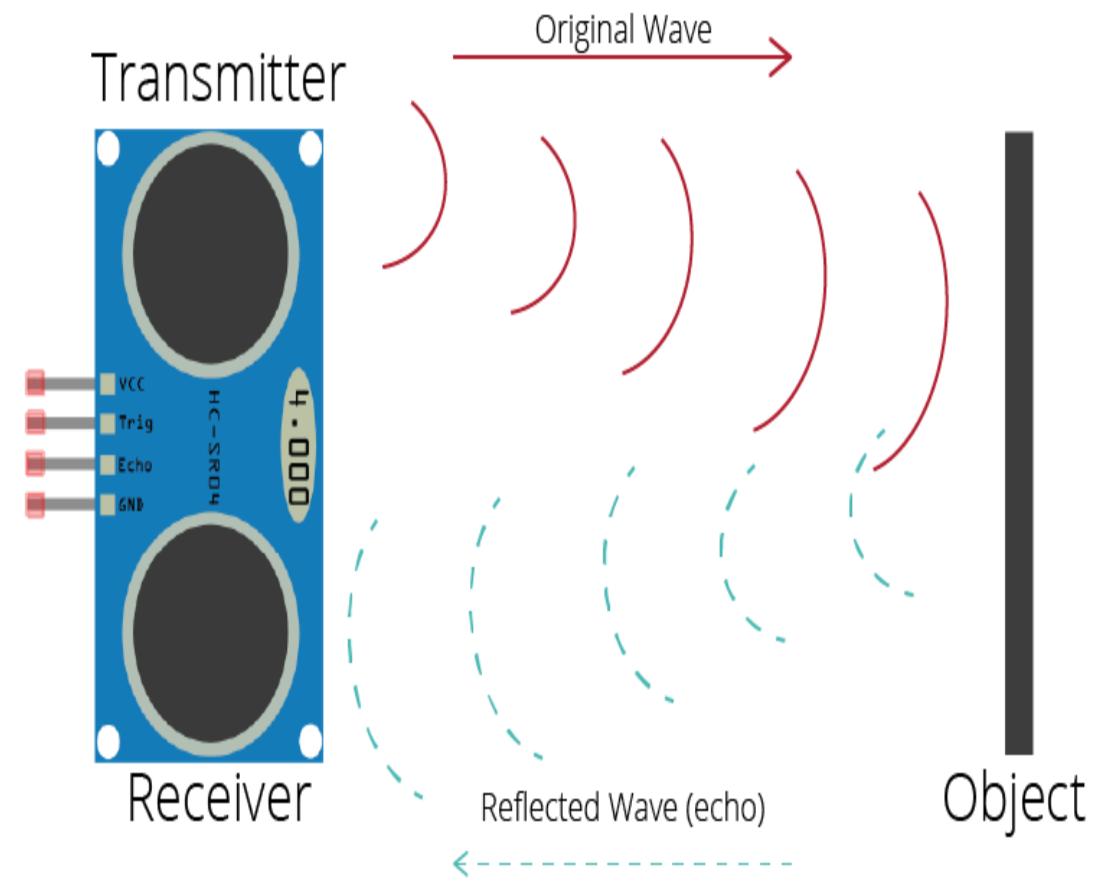
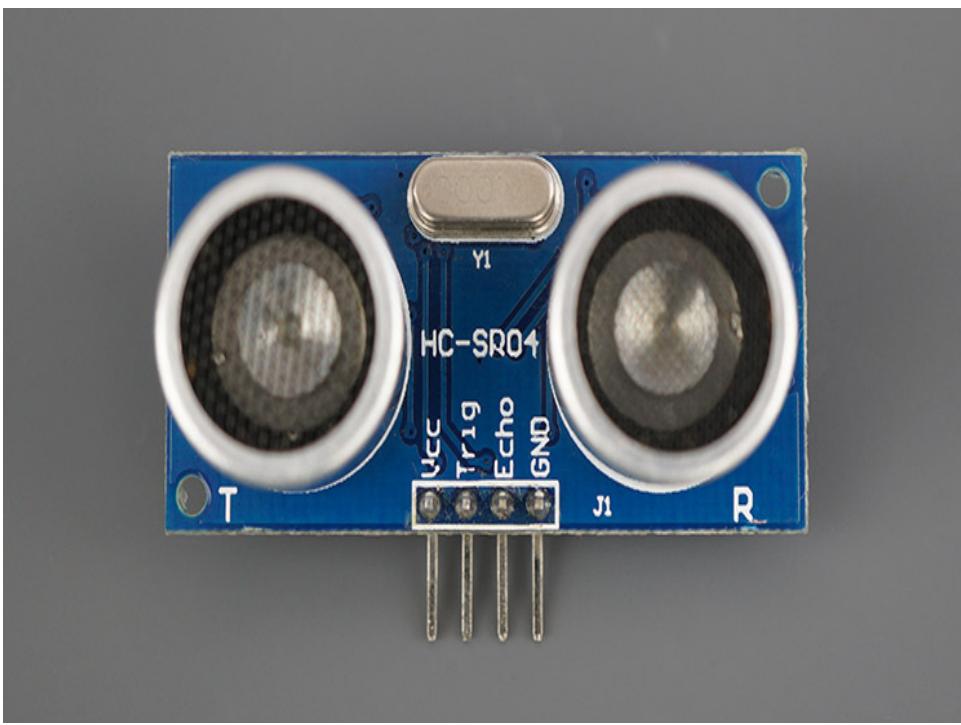


# Specifications:

- Model: ESP8266-12E
- Wireless Standard: 802.11 b/g/n
- Frequency range: 2.4 GHz - 2.5 GHz (2400M-2483.5M)
- Wi-Fi mode: Station / SoftAP / SoftAP+station
- Stack: Integrated TCP/IP
- Output power: 19.5dBm in 802.11b mode
- Data interface: UART / HSPI / I2C / I2S / Ir
- Remote Control GPIO / PWM
- Supports protection mode: WPA / WPA2
- Encryption: WEP / TKIP / AES
- Power supply: from 4.5 VDC to 9 VDC (VIN) or via micro USB connector
- Consumption: with continuous Wi-Fi transmission about 70 mA (200 mA MAX) - in standby < 200µA
- Operating temperature: from -40°C to +125°C
- Dimensions (mm): 58×31.20×13
- Weight: 10 grams

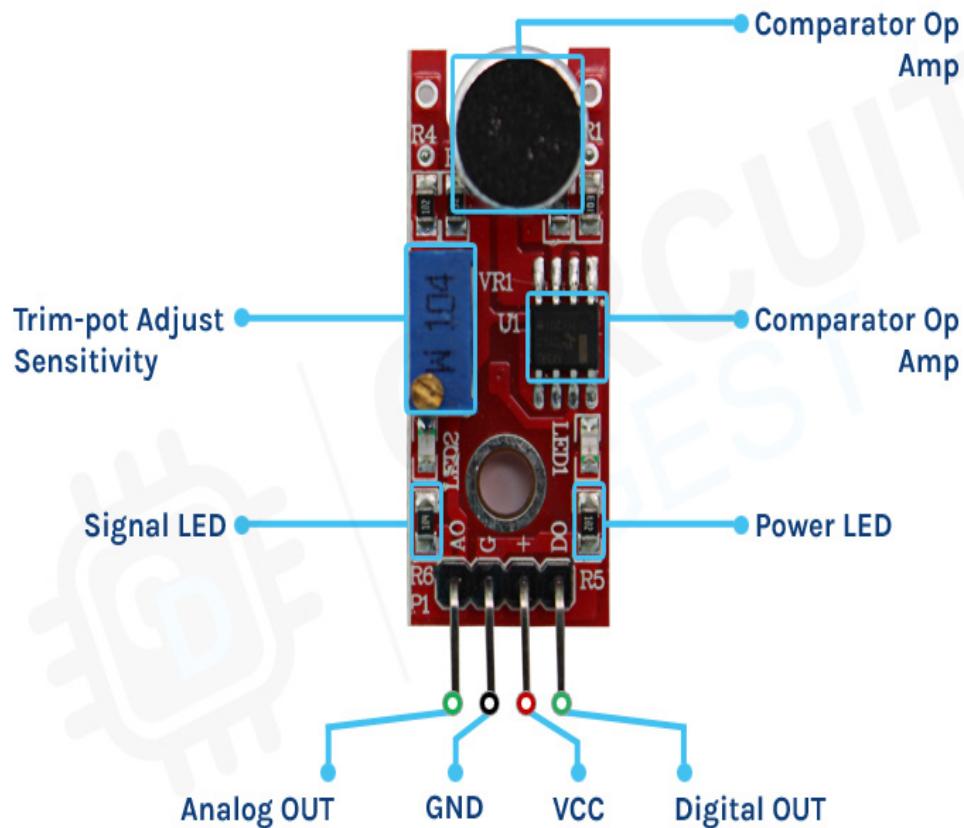
# Ultrasonic sensor

- An ultrasonic sensor is an instrument that measures the distance to an object using ultrasonic sound waves.
- An ultrasonic sensor uses a transducer to send and receive ultrasonic pulses that relay back information about an object's proximity.
- Ultrasonic sensors work by sending out a sound wave at a frequency above the range of human hearing. The transducer of the sensor acts as a microphone to receive and send the ultrasonic sound. Our ultrasonic sensors, like many others, use a single transducer to send a pulse and to receive the echo. The sensor determines the distance to a target by measuring time lapses between the sending and receiving of the ultrasonic pulse.
- The working principle of this module is simple. It sends an ultrasonic pulse out at 40 kHz, which travels through the air, and if there is an obstacle or object, it will bounce back to the sensor. By calculating the travel time and the speed of sound, the distance can be calculated.
- Ultrasonic sensors are a great solution for the detection of clear objects. For liquid level measurement, applications that use infrared sensors, for instance, struggle with this particular use case because of target translucence.
- For presence detection, ultrasonic sensors detect objects regardless of color, surface, or material (unless the material is very soft, like wool, as it would absorb sound).



# Sound sensor:

- The sound sensor is a module that monitors and detects the sound signals like voice, claps, snaps, knocks, etc. It is also known as an acoustic sensor or sound detector. Used in various applications such as security systems, monitoring systems, radios, telephones, mobile phones, computers, home automation systems, consumer electronic appliances, etc.
- It contains a microphone, power amplifier, and output actuator. The microphone that acts as an input sensor receives the sound signal and converts it into an electrical signal. Then this signal is amplified by the power amplifier and its amplitude is detected by the peak detector. The output actuator, like a loudspeaker, converts this amplified electrical signal into a sound signal for listening.
- The sound sensors can detect sound signals in the frequency range of 3kHz to 6kHz and it operates at a DC voltage of 3.3V to 6V. It is a small and cost-effective sensor.

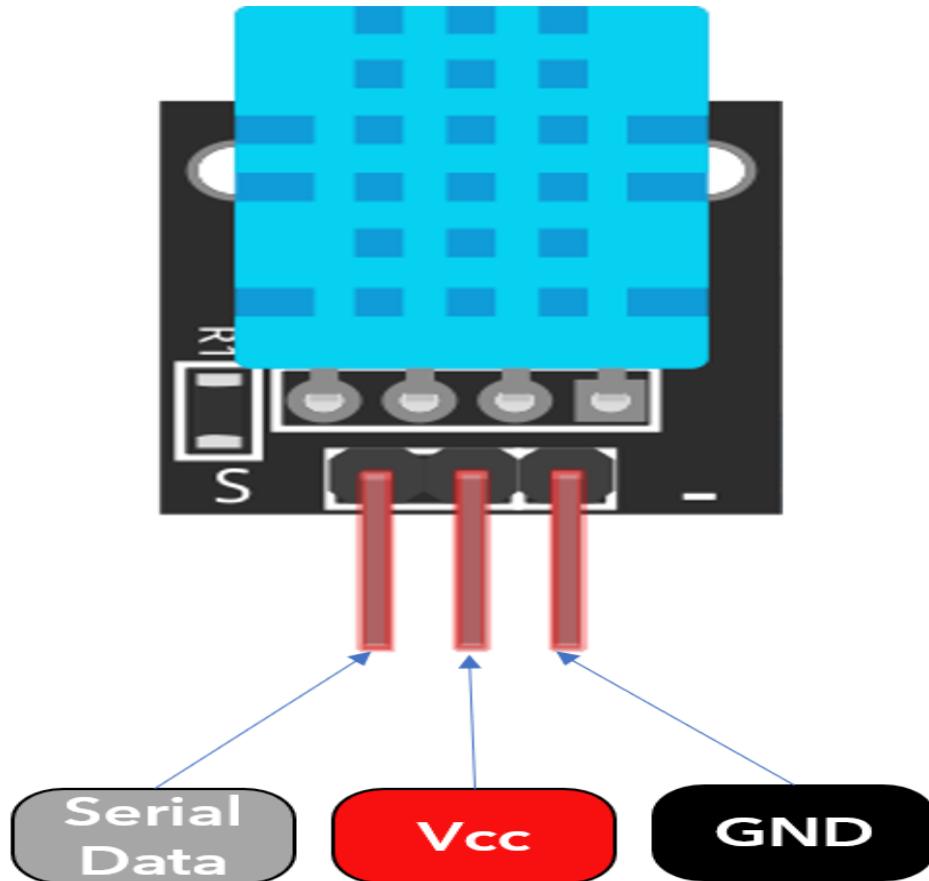


## Specifications:

- Wide operating voltage of 3.3V to 5V DC.
- Operating current of 4mA to 5mA.
- The voltage gain of 26dB.
- The high sensitivity of 1KHz.
- Microphone's dB level of 52 to 48dB.
- The impedance of the microphone is 2.2-kilo ohms.
- The frequency of the microphone is 16KHz to 20Khz.
- The signal-to-noise ratio is 54dB.
- LM393N comparator with threshold present is used.
- The induction distance is 0.5 meters.

# HUMIDITY AND TEMPERATURE SENSOR:

- DHT11 is a low-cost digital sensor for sensing temperature and humidity. This sensor can be easily interfaced with any micro-controller such as Arduino, Raspberry Pi etc... to measure humidity and temperature instantaneously.
- DHT11 sensor consists of a capacitive humidity sensing element and a thermistor for sensing temperature. The humidity sensing capacitor has two electrodes with a moisture holding substrate as a dielectric between them. Change in the capacitance value occurs with the change in humidity levels. The IC measure, process this changed resistance values and change them into digital form.
- For measuring temperature this sensor uses a Negative Temperature coefficient thermistor, which causes a decrease in its resistance value with increase in temperature. To get larger resistance value even for the smallest change in temperature, this sensor is usually made up of semiconductor ceramics or polymers.
- The temperature range of DHT11 is from 0 to 50 degree Celsius with a 2-degree accuracy. Humidity range of this sensor is from 20 to 80% with 5% accuracy. The sampling rate of this sensor is 1Hz .i.e. it gives one reading for every second. DHT11 is small in size with operating voltage from 3 to 5 volts. The maximum current used while measuring is 2.5mA.

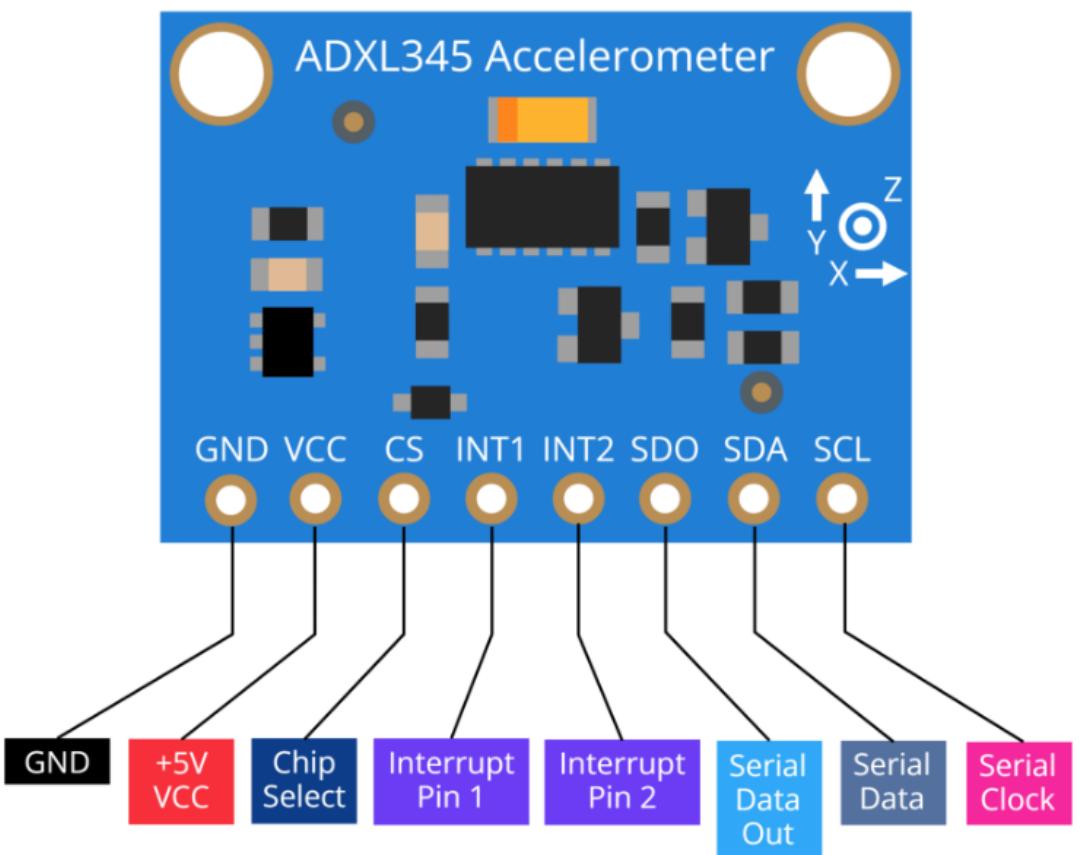


## SPECIFICATIONS:

- 3 to 5V power and I/O
- 2.5mA max current use during conversion (while requesting data)
- Good for 20-80% humidity readings with 5% accuracy
- Good for 0-50 °C temperature readings +/- 2 °C accuracy
- No more than 1 Hz sampling rate (once every second)
- Body size 15.5mm x 12mm x 5.5mm
- 4 pins with 0.1" spacing

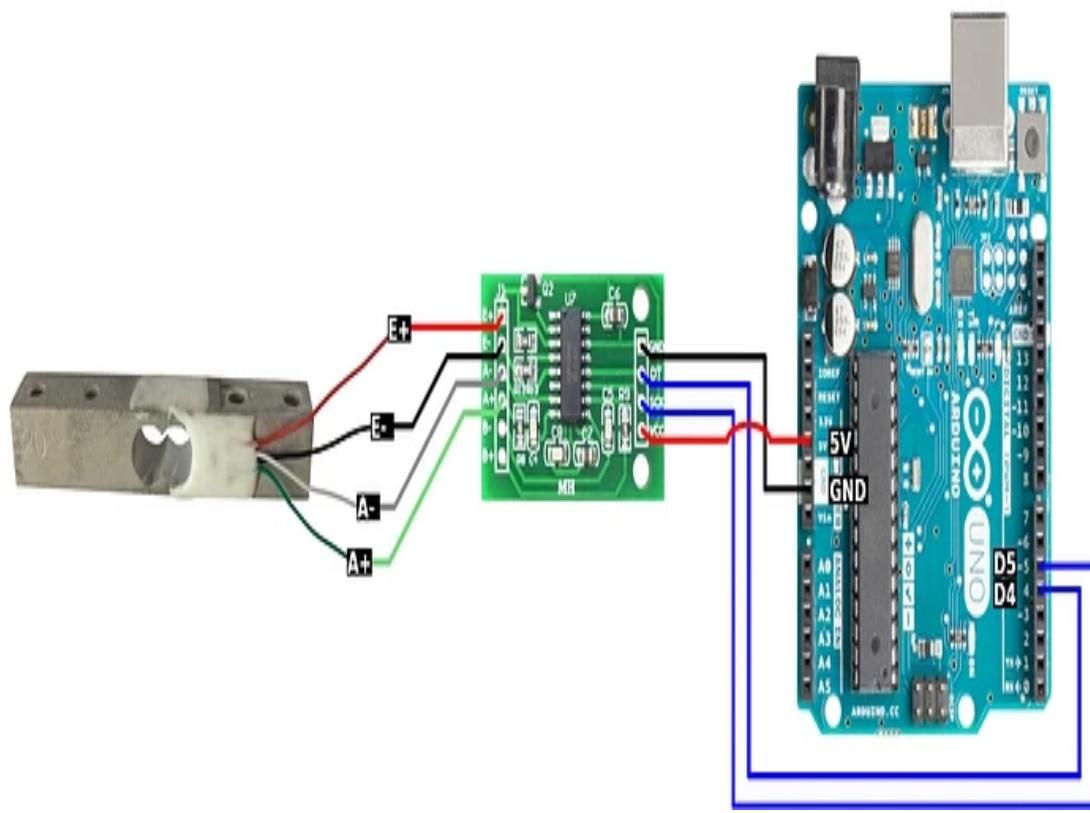
# ADXL SENSOR:

- An accelerometer is an electromechanical device that measures both static (gravity) and dynamic (motion or vibration) accelerations. The earth gravitational force is a typical example of static force, while dynamic forces can be caused by vibrations, movements and so on.
- if we have an accelerometer positioned flat, with its Z-axis pointing upwards, opposite to the gravitational force, the Z-axis output of the sensor will be 1g. On the other hand, the X and Y outputs will be zero, because the gravitational force is perpendicular to these axes and doesn't affect them at all.
- If we flip the sensor upside down, then the Z-axis output will be -1 g. This means that the outputs of the sensor due to its orientation to gravity can vary from -1g to +1g.

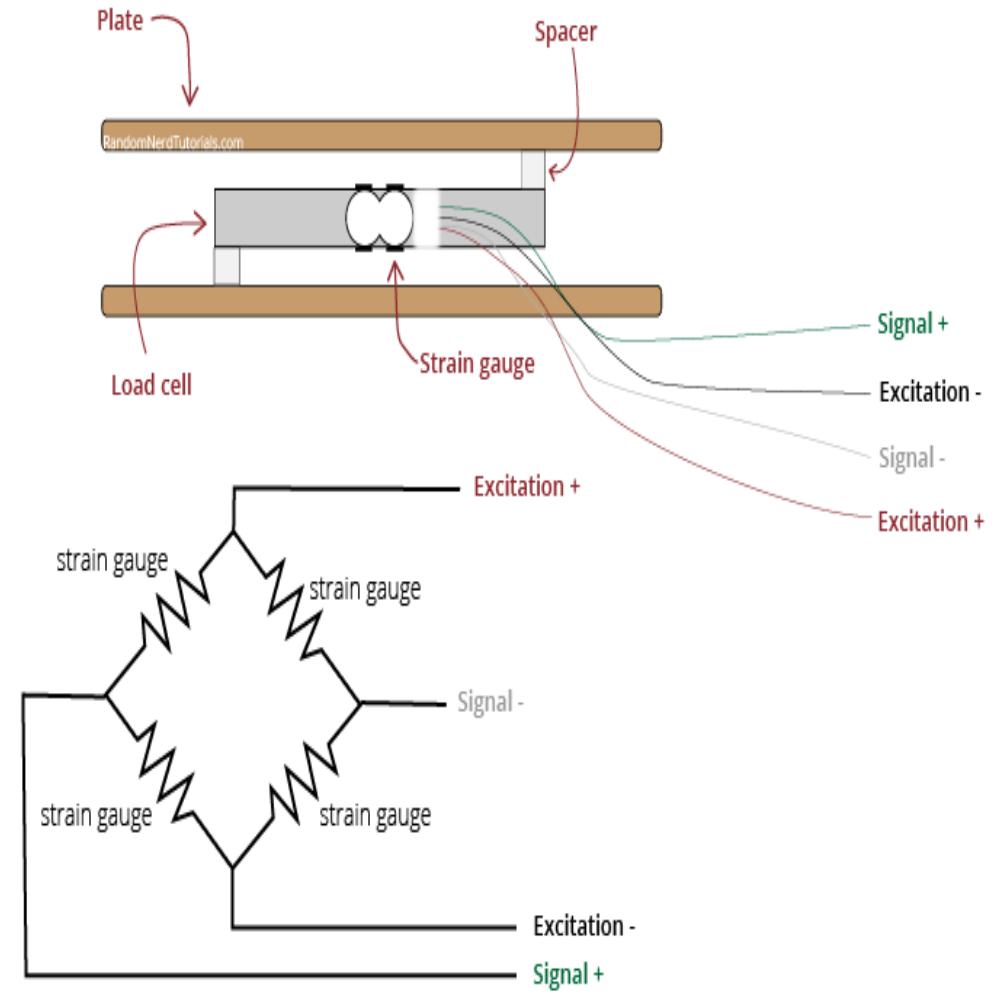


# LOAD CELL:

- A load cell converts a force into an electrical signal that can be measured. The electrical signal changes proportionally to the force applied. There are different types of load cells: strain gauges, pneumatic, and hydraulic. In this tutorial, we'll cover strain gauge load cells.
- Strain gauge load cells are composed of a metal bar with attached strain gauges . A strain gauge is an electrical sensor that measures force or strain on an object. The resistance of the strain gauges varies when an external force is applied to an object, which results in a deformation of the object's shape . The strain gauge resistance is proportional to the load applied, which allows us to calculate the weight of objects.
- Usually, load cells have four strain gauges hooked up in a Wheatstone bridge that allow us to get accurate resistance measurements. For a more detailed explanation of how strain gauges work,

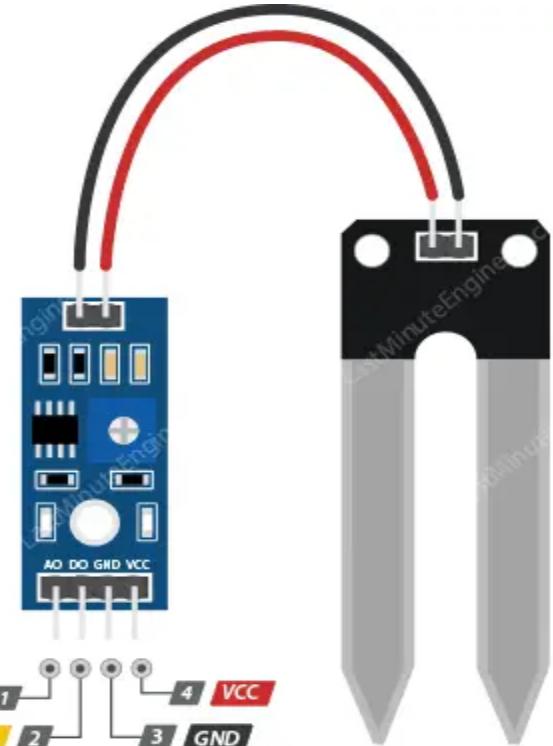


circuitjournal.com



# WET SENSOR:

- The moisture of the soil plays an essential role in the irrigation field as well as in gardens for plants. As nutrients in the soil provide the food to the plants for their growth. Supplying water to the plants is also essential to change the temperature of the plants. The temperature of the plant can be changed with water using the method like transpiration. And plant root systems are also developed better when rising within moist soil.
- The soil moisture sensor is one kind of sensor used to gauge the volumetric content of water within the soil. As the straight gravimetric dimension of soil moisture needs eliminating, drying, as well as sample weighting. These sensors measure the volumetric water content not directly with the help of some other rules of soil like dielectric constant, electrical resistance, otherwise interaction with neutrons, and replacement of the moisture content.



#### PIN DETAILS:

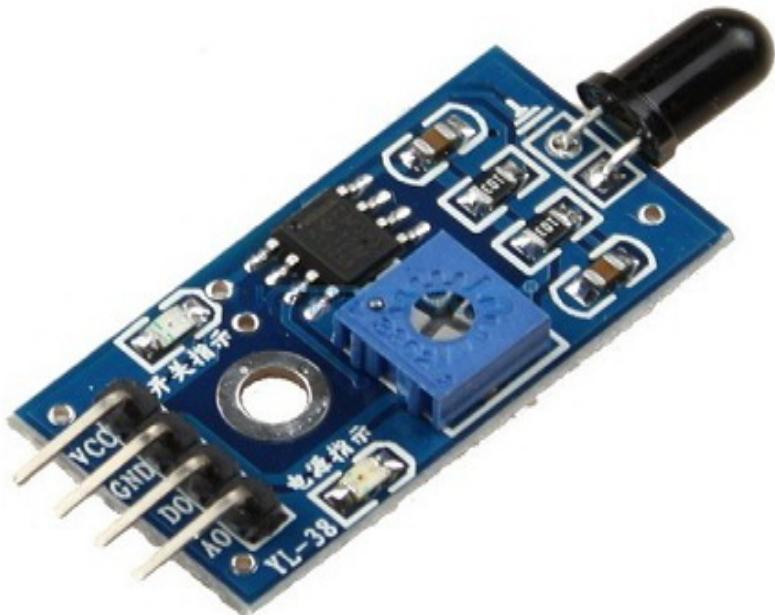
- VCC pin is used for power
- A0 pin is an analog output
- D0 pin is a digital output
- GND pin is a Ground

#### SPECIFICATION:

- The required voltage for working is 5V
- The required current for working is <20mA
- Type of interface is analog
- The required working temperature of this sensor is 10°C~30°C

# FIRE SENSOR:

- A sensor which is most sensitive to a normal light is known as a flame sensor. That's why this sensor module is used in flame alarms. This sensor detects flame otherwise wavelength within the range of 760 nm – 1100 nm from the light source. This sensor can be easily damaged to high temperature. So this sensor can be placed at a certain distance from the flame. The output of this sensor is an analog signal or digital signal. These sensors are used in fire fighting robots like as a flame alarm.
- A flame-sensor is one kind of detector which is mainly designed for detecting as well as responding to the occurrence of a fire or flame. The flame detection response can depend on its fitting. It includes an alarm system, a natural gas line, propane & a fire suppression system. This sensor is used in industrial boilers. The main function of this is to give authentication whether the boiler is properly working or not. The response of these sensors is faster as well as more accurate compare with a heat/ smoke detector because of its mechanism while detecting the flame.

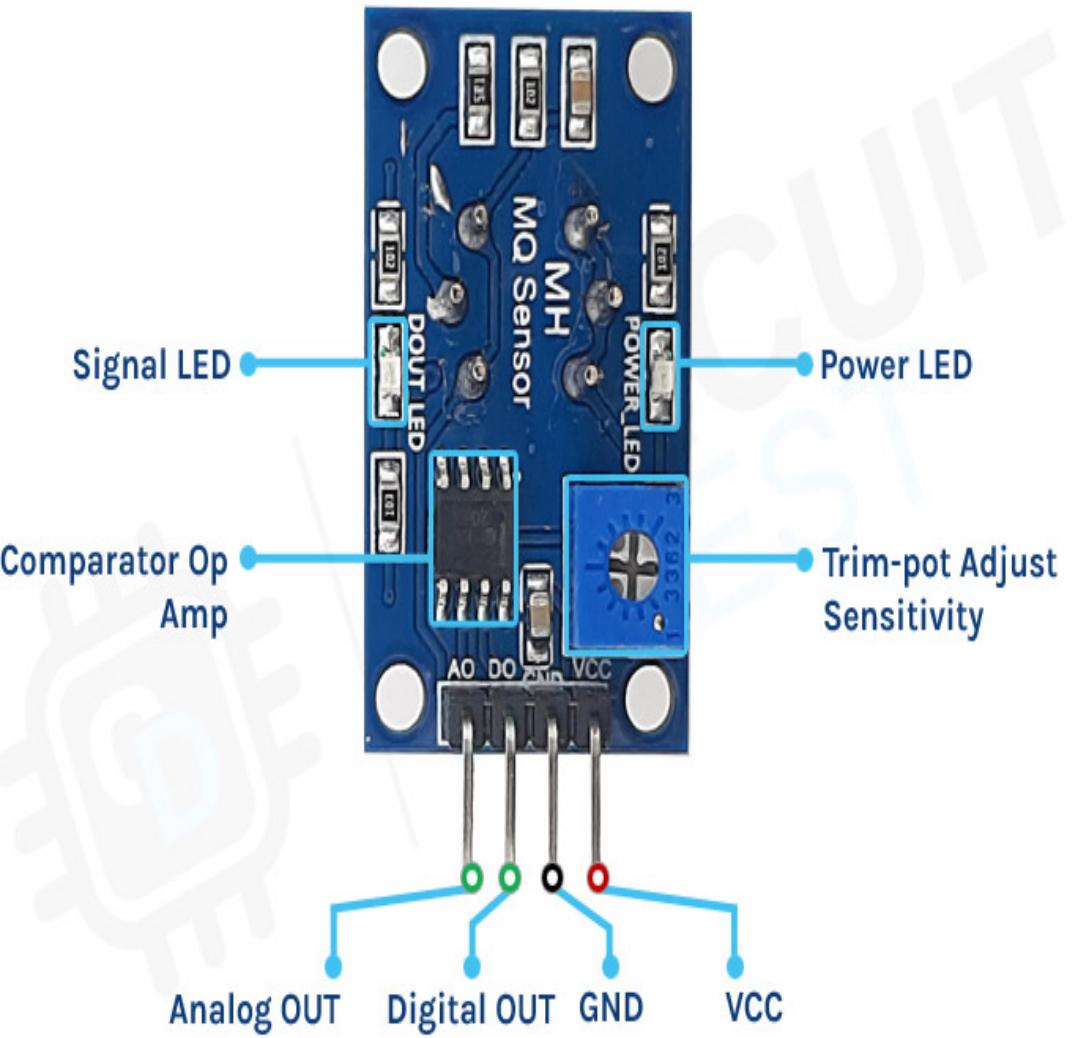


#### Specifications:

- Photosensitivity is high
- Response time is fast
- Simple to use
- Sensitivity is adjustable
- It is responsive to the flame range.
- Accuracy can be adjustable
- Operating voltage of this sensor is 3.3V to 5V
- Output is in both analog and digital form
- Power indicator & digital switch o/p indicator

# Gas sensor:

- A **gas sensor** is a device which detects the presence or concentration of gases in the atmosphere. Based on the concentration of the gas the sensor produces a corresponding potential difference by changing the resistance of the material inside the sensor, which can be measured as output voltage. Based on this voltage value the type and concentration of the gas can be estimated.
- The type of gas the sensor could detect depends on the **sensing material** present inside the sensor. Normally these sensors are available as modules with comparators as shown above. These comparators can be set for a particular threshold value of gas concentration. When the concentration of the gas exceeds this threshold the digital pin goes high. The analog pin can be used to measure the concentration of the gas.

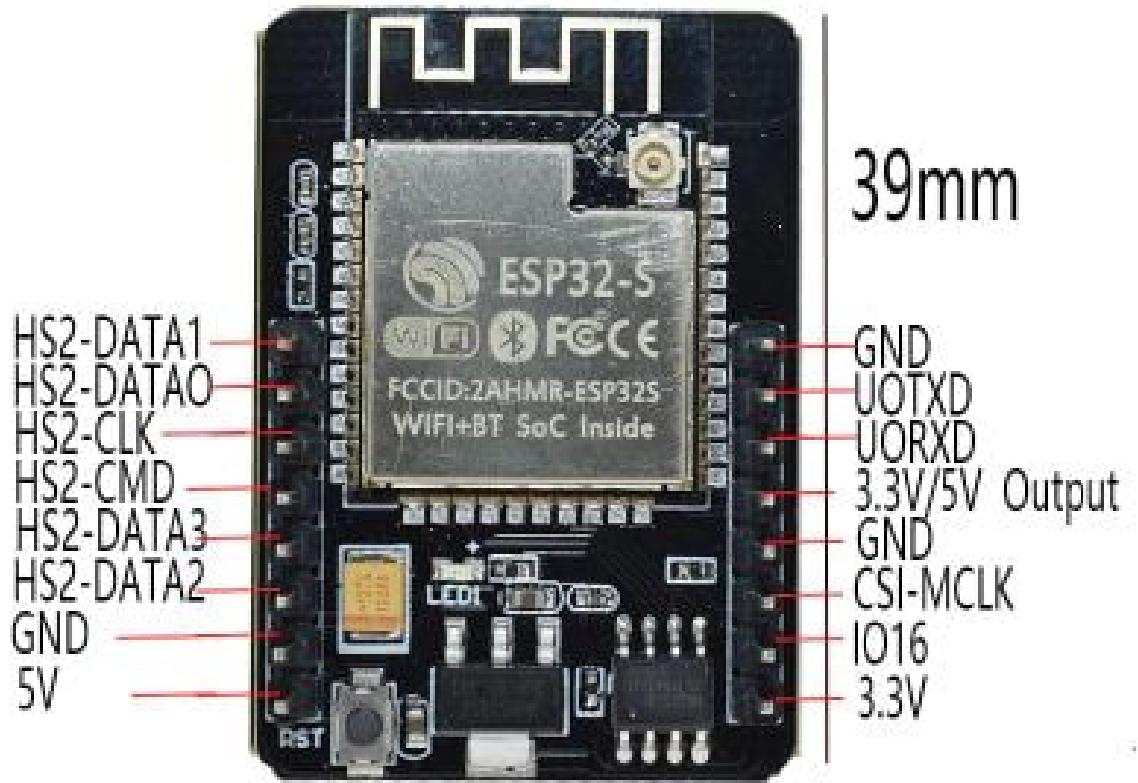


# ESP32 CAMERA

The ESP32 CAM WiFi Module Bluetooth with OV2640 Camera Module 2MP For Face Recognition has a very competitive small-size camera module that can operate independently as a minimum system with a footprint of only 40 x 27 mm; a deep sleep current of up to 6mA and is widely used in various IoT applications.

It is suitable for home smart devices, industrial wireless control, wireless monitoring, and other IoT applications.

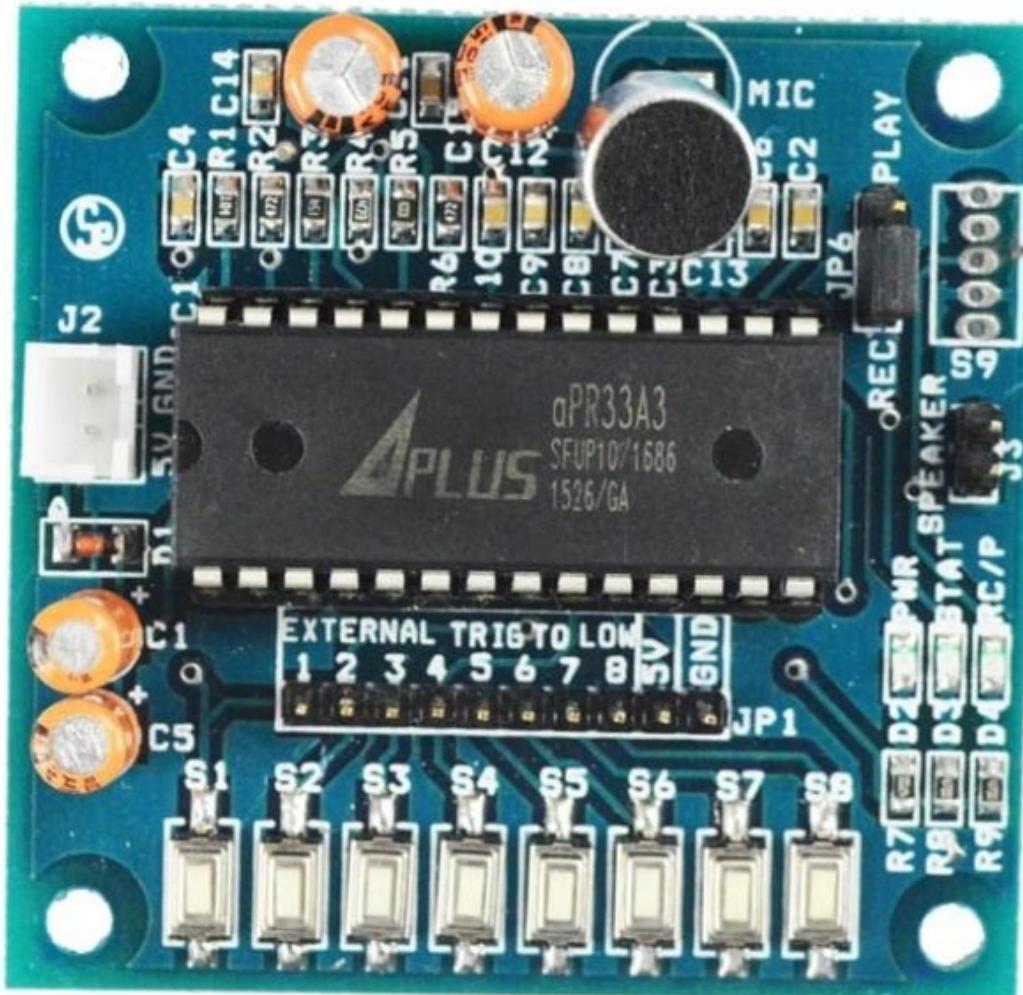
27mm



- **Features :**
- **ESP32-CAM :**
  1. The smallest 802.11b/g/n Wi-Fi BT SoC module.
  2. Low power 32-bit CPU, can also serve the application processor.
  3. Up to 160MHz clock speed, summary computing power up to 600 DMIPS.
  4. Built-in 520 KB SRAM, external 4MPSRAM.
  5. Supports UART/SPI/I2C/PWM/ADC/DAC.
  6. Support OV2640 and OV7670 cameras, built-in flash lamp.
  7. Support image WiFi upload.
  8. Supports TF card.
  9. Supports multiple sleep modes.
  10. Embedded Lwip and FreeRTOS.
  11. Supports STA/AP/STA+AP operation mode.
  12. Support Smart Config/AirKiss technology.
  13. Support for serial port local and remote firmware upgrades (FOTA).
- **Specifications :**
  1. Wireless Module: ESP32-S WiFi 802.11 b/g/n + Bluetooth 4.2 LE module with PCB antenna, u.FL connector, 32Mbit SPI flash, 4MBit PSRAM.
  2. External Storage: micro SD card slot up to 4GB.
  3. Camera
    1. FPC connector.
    2. Support for OV2640 (sold with a board) or OV7670 cameras.
    3. Image Format: JPEG( OV2640 support only ), BMP, grayscale.
    4. LED flashlight.
  4. Expansion: 16x through-holes with UART, SPI, I2C, PWM.
  5. Misc: Reset button.
  6. Power Supply: 5V via pin header.
  7. Power Consumption.
    1. Flash LED off: 180mA @ 5V.
    2. Flash LED on to maximum brightness: 310mA @ 5V.
    3. Deep-sleep: 6mA @ 5V min.
    4. Modem-sleep: 20mA @ 5V min.
    5. Light-sleep: 6.7mA @ 5V min.
  8. Dimensions (ESP32): 40 x 27 x 12 (LxWxH) mm.
  9. Temperature Range: Operating: -20 °C ~ 85 °C; storage: -40 °C ~ 90 °C @ < 90%RH.

# APR MODULE

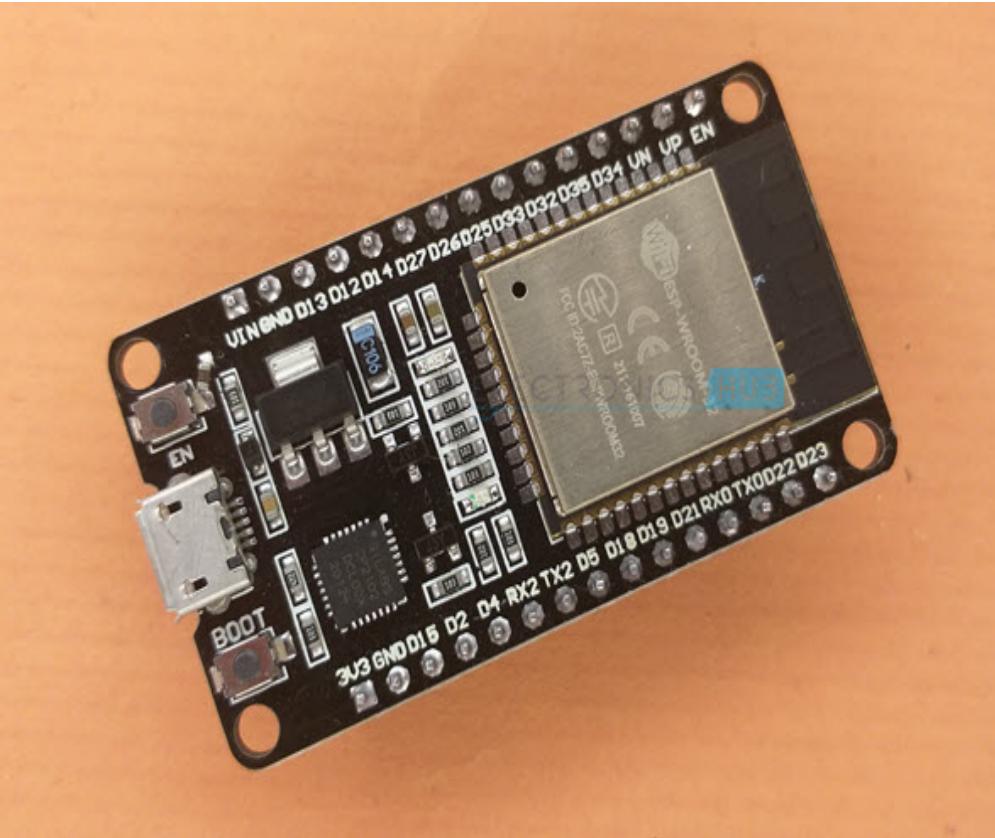
- The **APR33A** series is a powerful audio processor along with high-performance audio analog-to-digital converters (ADCs) and digital-to-analog converters (DACs). The IC is a fully integrated solution offering high performance and unparalleled integration with analog input, digital processing, and analog output functionality.
- The APR33A series is specially designed for the simple key trigger. The user can record & play the message averagely for 1, 2, 4, or 8 voice message(s) by a switch and be adjusted the sample rate by using different values of resistors. It is suitable in a simple interface or needs to limit the length of a single message, e.g. toys, leave messages system, answering machine, etc.



- **APR33A3 Features**

1. Operating Voltage Range: 3V ~ 6.5V
2. Single-Chip, High-Quality Audio/Voice Recording & Playback Solution
3. No External ICs Required
4. Minimum External Components
5. User Friendly, Easy to Use Operation
6. Programming & Development Systems Not Required
7. 680 sec.(11 Minutes) Voice Recording Length in APR33A3-C2
8. Nonvolatile Flash Memory Technology
9. No Battery Backup Required
10. External Reset pin
11. Powerful Power Management Unit
12. Very Low Standby Current: 1uA
13. Low Power-Down Current: 15uA
14. Supports Power-Down Mode for Power Saving
15. Built-in Audio-Recording Microphone Amplifier
16. No External OPAMP or BJT Required
17. Easy to PCB layout
18. Configurable analog interface
19. Differential-ended MIC pre-amp for Low Noise
20. High-Quality Line Receiver
21. High-Quality Analog to Digital and PWM module
22. Simple And Direct User Interface
23. Averagely 1,2,4 or 8 voice messages record & playback

# ESP32



- ESP32 is a low-cost System on Chip (SoC) Microcontroller from Espressif Systems, the developers of the famous ESP8266 SoC. It is a successor to ESP8266 SoC and comes in both single-core and dual-core variations of the Tensilica's 32-bit Xtensa LX6 Microprocessor with integrated Wi-Fi and Bluetooth.
- The good thing about ESP32, like ESP8266 is its integrated RF components like Power Amplifier, Low-Noise Receive Amplifier, Antenna Switch, Filters and RF Balun. This makes designing hardware around ESP32 very easy as you require very few external components.
-

- **Specifications of ESP32**
- ESP32 has a lot more features than ESP8266 and it is difficult to include all the specifications in this Getting Started with ESP32 guide. So, I made a list of some of the important specifications of ESP32 here. But for complete set of specifications, I strongly suggest you to refer to the Datasheet.
- Single or Dual-Core 32-bit LX6 Microprocessor with clock frequency up to 240 MHz.
- 520 KB of SRAM, 448 KB of ROM and 16 KB of RTC SRAM.
- Supports 802.11 b/g/n Wi-Fi connectivity with speeds up to 150 Mbps.
- Support for both Classic Bluetooth v4.2 and BLE specifications.
- 34 Programmable GPIOs.
- Up to 18 channels of 12-bit SAR ADC and 2 channels of 8-bit DAC
- Serial Connectivity include 4 x SPI, 2 x I<sup>2</sup>C, 2 x I<sup>2</sup>S, 3 x UART.
- Ethernet MAC for physical LAN Communication (requires external PHY).
- 1 Host controller for SD/SDIO/MMC and 1 Slave controller for SDIO/SPI.
- Motor PWM and up to 16-channels of LED PWM.
- Secure Boot and Flash Encryption.
- Cryptographic Hardware Acceleration for AES, Hash (SHA-2), RSA, ECC

# ZigBee



ZigBee is a wireless communication technology designed based on IEEE 802.15.4 specification. One of the most economical, low-power-consuming data transfer technologies operates with a simple networking protocol. Let's see what the ZigBee standard is, the specifications, and its applications.

ZigBee has been developed to power Wireless Personal Area Networks (WPANs) like home automation and Internet of Things applications. ZigBee Alliance is the monitoring organization for developing, standardizing, and certifying ZigBee standards.

ZigBee has been developed for use under mesh networking topology. In a mesh network, every device or node can interact with every other device within the network.

In practice, each device acts as a router, increasing the entire network's reliability. Each device may have different roles, like configuring the communication path, connecting to other active devices to initiate routing, and talking to end devices.

- **Specifications:**
  - Baud rate setting command module supports different baud rates to suit different applications 2400 -4800-9600-19200- 38400-57600- 115200
  - Works on ISM band (2.4 GHz)
  - Designed to be as easy to use as cables.
  - No external Antenna required.
  - Plug and play device.
  - Works on 5 DC supply.
  - Range 100 Mtrs

# MAX 30100/SPO<sub>2</sub> Sensor



- MAX30100 is a multipurpose sensor used for multiple applications. It is a **heart rate monitoring** sensor along with a **pulse oximeter**. The sensor comprises two [Light Emitting Diodes](#), a photodetector, and a series of low noise signal processing devices to detect heart rate and to perform pulse oximetry.

## Working of an oximeter:

- The sensor consists of a pair of Light-emitting diode which emits monochromatic red light at a wavelength of 660nm and infrared light at a wavelength of 940 nm. These wavelengths are particularly chosen as at this wavelength oxygenated and deoxygenated hemoglobin have very different absorption properties. As shown in the graph below, it can be seen that there is a difference between HbO<sub>2</sub>(oxygenated Hb) and Hb(deoxygenated Hb) when subjected to these specific wavelengths.
- There are two parts to the sensor, an emitting diode, and a photoreceiver. As the [photodiode](#) emits the light, it falls over the finger which has to be placed steadily. The light emitted gets absorbed by the oxygenated blood and the rest of the light is reflected through the finger and falls over the detector whose output data is then processed and read through a microcontroller.

- **Features of MAX03100**
  - Here are some of the features and specifications of the MAX03100 Heart Rate Oxygen pulse sensor.
1. Operating Voltage - 1.8V to 3.3V
  2. Input Current - 20mA
  3. Integrated Ambient Light Cancellation
  4. High Sample Rate Capability
  5. Fast Data Output Capability

# HEARTBEAT SENSOR



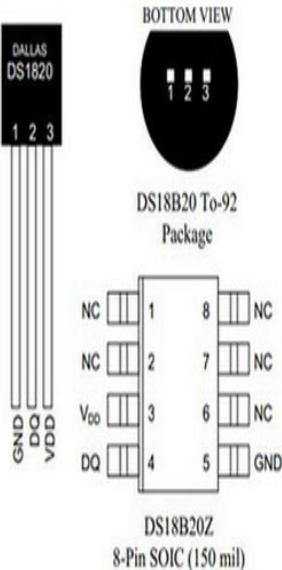
- Monitoring heart rate is very important for athletes, patients as it determines the condition of the heart (just heart rate). There are many ways to measure heart rate and the most precise one is using an **Electrocardiography**
- But the more easy way to monitor the heart rate is to use a Heartbeat Sensor. It comes in different shapes and sizes and allows an instant way to measure the heartbeat.
- The principle behind the working of the Heartbeat Sensor is Photoplethysmograph. According to this principle, the changes in the volume of blood in an organ is measured by the changes in the intensity of the light passing through that organ.
- Usually, the source of light in a heartbeat sensor would be an IR LED and the detector would be any Photo Detector like a Photo Diode, an LDR (Light Dependent Resistor) or a [Photo Transistor](#).
- With these two i.e. a light source and a detector, we can arrange them in two ways: A Transmissive Sensor and a Reflective Sensor.
- In a Transmissive Sensor, the light source and the detector are place facing each other and the finger of the person must be placed in between the transmitter and receiver.
- Reflective Sensor, on the other hand, has the light source and the detector adjacent to each other and the finger of the person must be placed in front of the sensor.

- A simple Heartbeat Sensor consists of a sensor and a [control circuit](#). The sensor part of the Heartbeat Sensor consists of an IR LED and a Photo Diode placed in a clip.
- The Control Circuit consists of an Op-Amp IC and few other components that help in connecting the signal to a Microcontroller. The working of the Heartbeat Sensor can be understood better if we take a look at its circuit diagram.
- The above circuit shows the finger type heartbeat sensor, which works by detecting the pulses. Every heartbeat will alter the amount of blood in the finger and the light from the IR LED passing through the finger and thus detected by the Photo Diode will also vary.
- The output of the photo diode is given to the non – inverting input of the first op – amp through a capacitor, which blocks the DC Components of the signal. The first op – amp acts as a non – inverting amplifier with an amplification factor of 1001.
- The output of the first op – amp is given as one of the inputs to the second op – amp, which acts as a comparator. The output of the second op – amp triggers a transistor, from which, the signal is given to a Microcontroller like Arduino.
- The Op – amp used in this circuit is LM358. It has two op – amps on the same chip. Also, the transistor used is a BC547. An LED, which is connected to transistor, will blink when the pulse is detected.

# 1-WIRE TEMPERATURE SENSOR



## PIN ASSIGNMENT



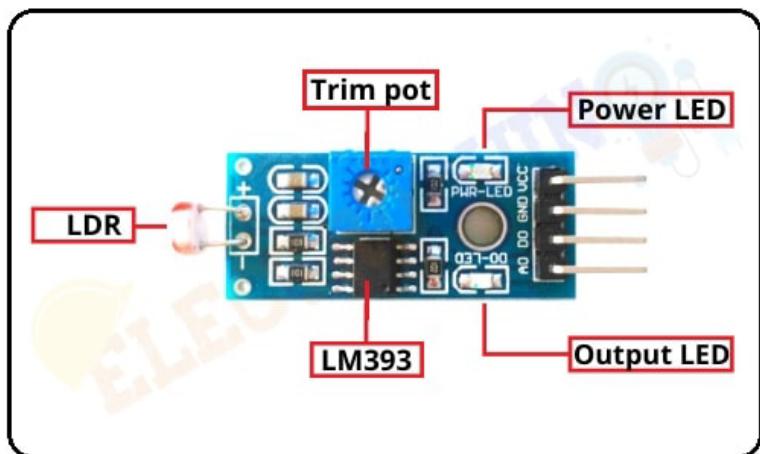
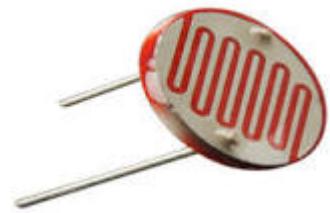
## PIN DESCRIPTION

|                 |                        |
|-----------------|------------------------|
| GND             | - Ground               |
| DQ              | - Data In/Out          |
| V <sub>DD</sub> | - Power Supply Voltage |
| NC              | - No Connect           |

- This is a pre-wired and waterproofed version of the DS18B20 sensor. Handy for when you need to measure something far away, or in wet conditions.
- While the sensor is good up to 125°C the cable is jacketed in PVC so we suggest keeping it under 100°C. Because they are digital, you don't get any signal degradation even over long distances!
- **DS18B20 Sensor Technical specs:**
  - Usable temperature range: -55 to 125°C (-67°F to +257°F)
  - 9 to 12 bit selectable resolution
  - Uses 1-Wire interface- requires only one digital pin for communication
  - Unique 64 bit ID burned into chip
  - Multiple sensors can share one pin
  - ±0.5°C Accuracy from -10°C to +85°C
  - Temperature-limit alarm system
  - Query time is less than 750ms
  - Usable with 3.0V to 5.5V power/data

- **Cable specs:**
- Stainless steel tube 6mm diameter by 30mm long
- Cable is 36" long / 91cm, 4mm diameter (1 Meter Long)
- Contains DS18B20 temperature sensor
- Three wires - **Red** connects to 3-5V, **Black** connects to ground and **White** is data.
- These 1-wire digital temperature sensors are fairly precise ( $\pm 0.5^{\circ}\text{C}$  over much of the range) and can give up to 12 bits of precision from the onboard digital-to-analog converter.
- They work great with any microcontroller using a single digital pin, and you can even connect multiple ones to the same pin, each one has a unique 64-bit ID burned in at the factory to differentiate them.
- Usable with 3.0-5.0V systems.
- The only downside is they use the Dallas 1-Wire protocol, which is somewhat complex, and requires a bunch of code to parse out the communication. When using with microcontroller put a 4.7k resistor to sensing pin, which is required as a pullup from the DATA to VCC line.

# LDR



LDR sensor module is a low-cost **digital sensor** as well as **analog sensor** module, which is capable to measure and detect light intensity. This sensor also is known as the **Photoresistor sensor**. This sensor has an onboard LDR(Light Dependent Resistor), that helps it to detect light.

## SPECIFICATIONS:

|                     |                                |
|---------------------|--------------------------------|
| Operating voltage   | 5V or 3.3V DC                  |
| Comparator chip     | LM393                          |
| Module Pins         | 3 pins                         |
| Output type         | Digital outputs (D0)           |
| Sensitivity         | Adjustable                     |
| Indicator LED       | Output and power LED indicator |
| PCB size            | 3cm * 1.6cm                    |
| Fixed Hole Diameter | 3mm                            |

- **WORKING**

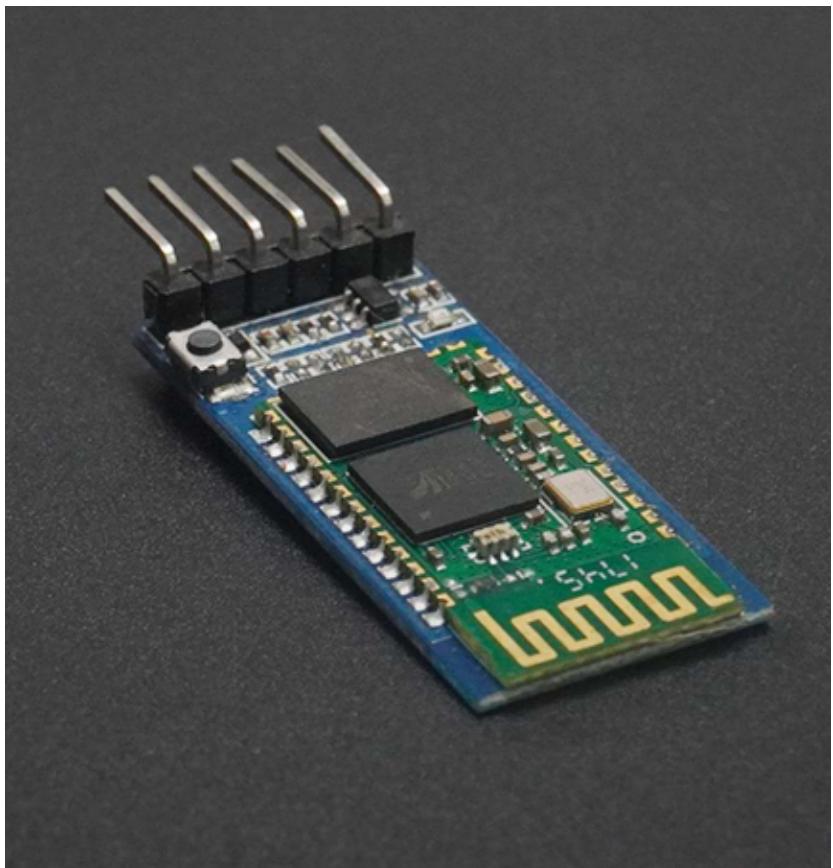


- When **light intensity increase** on the surface of the LDR then the resistance of the LDR decreases. Then the **maximum amount of voltage** will be allocated across the **resistor(R3)**. So, a **Low amount** of voltage from the LDR is given to the **Inverting input (2)** of the IC. Then the Comparator IC compares this voltage with the threshold voltage. In this condition, this input voltage is **less than** the threshold voltage, so the sensor output goes **LOW (0)**.
- In contrast, When **light intensity decrease (low/dark)** on the surface of the LDR then the resistance of the LDR increases. Then the **maximum amount of voltage** will be allocated across the **LDR (R2)**. So, a **High amount** of voltage from the LDR is given to the **Inverting input (2)** of the IC. Then the Comparator IC compares this voltage with the threshold voltage. In this condition, this input voltage is **greater than** the threshold voltage, so the sensor output goes **High (1)**.

- **APPLICATIONS**

- Detecting the darkness and light.
- Automatic light on/off system

# BLUETOOTH-HC05



- It is used for many applications like wireless headset, game controllers, wireless mouse, wireless keyboard, and many more consumer applications.
- It has range up to <100m which depends upon transmitter and receiver, atmosphere, geographic & urban conditions.
- It is IEEE 802.15.1 standardized protocol, through which one can build wireless Personal Area Network ([PAN](#)). It uses frequency-hopping spread spectrum ([FHSS](#)) radio technology to send data over air.
- It uses serial communication to communicate with devices. It communicates with microcontroller using serial port (USART).
- HC-05 is a Bluetooth module which is designed for wireless communication. This module can be used in a master or slave configuration.  
HC-05 module has two modes,
  1. **Data mode:** Exchange of data between devices.
  2. **Command mode:** It uses AT commands which are used to change setting of HC-05. To send these commands to module serial (USART) port is used.
- **Key/EN:** It is used to bring Bluetooth module in AT commands mode. If Key/EN pin is set to high, then this module will work in command mode. Otherwise by default it is in data mode. The default baud rate of HC-05 in command mode is 38400bps and 9600 in data mode.

- **Specification of HC-05 Bluetooth Module**
- Bluetooth version: 2.0 + EDR (Enhanced Data Rate)
- Frequency: 2.4 GHz ISM band
- Modulation: GFSK (Gaussian Frequency Shift Keying)
- Transmit power: Class 2 (up to 4 dBm)
- Sensitivity: -80 dBm typical
- Range: approximately 10 meters (or 33 feet) in open air
- Profiles supported: SPP (Serial Port Profile), HID (Human Interface Device) and others
- Operating voltage: 3.3V to 5V DC
- Operating current: less than 50mA
- Standby current: less than 2.5mA
- Sleep current: less than 1mA
- Interface: UART (Universal Asynchronous Receiver/Transmitter)
- Baud rates: 1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200, 230400, and 460800
- Operating temperature: -20°C to 75°C (-4°F to 167°F)

# SERVO MOTOR



## Specifications

- Product: SG90 Servo
- Torque: 2.0kg/cm(4.8V), 2.2kg/cm(6V)
- Speed: 0.09s/60°(4.8V), 0.08s/60°(6V)
- Rotate angle: 180°
- Operating voltage: 4.8 ~ 6V
- Gear: plastic
- Dead band: 7us
- Weight: 10.5g
- Dimension: 22.8mm × 12.2mm × 28.5mm

- Servo motors are high torque motors which are commonly used in robotics and several other applications due to the fact that it's easy to control their rotation.
- Servo motors have a geared output shaft which can be electrically controlled to turn one (1) degree at a time. For the sake of control, unlike normal DC motors, servo motors usually have an additional pin aside the two power pins (Vcc and GND) which is the signal pin.
- The signal pin is used to control the servo motor, turning its shaft to any desired angle.
- Servo's have high current requirement so when using more than one servo motor with the Arduino, it is important to connect their power connections to an external power supply as the Arduino may not be able to source the current needed for the servo.
- Since we will be using just one servo in this tutorial its fine to power it with an Arduino.

### **Features :**

1. High resolution
2. Accurate positioning
3. Fast control response
4. Constant torque throughout the servo travel range
5. Excellent holding power

# GPS MODULE



The GPS QUESTAR TTL is a compact all-in-one GPS module solution intended for a broad range of Original Equipment Manufacturer (OEM) products, where fast and easy system integration and minimal development risk is required. The receiver continuously tracks all satellites in view and provides accurate satellite positioning data. The GPS QUESTAR TTL is optimized for applications requiring good performance, low cost, and maximum flexibility; suitable for a wide range of OEM configurations, including Handhelds, sensors, asset tracking, PDA-centric personal navigation system, and vehicle navigation products. Its 56 parallel channels and 4100 search bins provide fast satellite signal acquisition and short startup time. Acquisition sensitivity of  $-140\text{dBm}$  and tracking sensitivity of  $-162\text{dBm}$  offers good navigation performance even in urban canyons having limited sky view. Satellite-based augmentation systems, such as WAAS and EGNOS, are supported to yield improved accuracy. USB-level serial interface is provided on the interface connector. Supply voltage of  $3.8\text{V}\sim 5.0\text{V}$  is supported.

- **FEATURES**

- Model : QUESTAR
- Based on u-Blox chip : UBX-G6010-ST
- C / A code 1.023MHz code stream
- Receive bands : L1 [1575.42 MHz]
- Tracking channels : 50
- Support DGPS [WAAS, EGNOS and MSAS]
- Positioning, performance
  - 2D plane : 5m [average]
  - 2D plane : 3.5m [average], DGPS auxiliary.
- Drift : <0.02m / s
- Timing accuracy : 1us
- Reference coordinate system: WGS-84
- Maximum Altitude : 18,000 m
- Maximum speed : 500 m / s
- Acceleration : <4g
- Electrical properties:

# Dc fan

12V DC Cooling Fan 2 inch 50mm, The direct current fans, or DC fans, are powered with a potential of fixed value such as the voltage of a battery. It features maintenance-free double ball bearings, long service life, sufficient heat dissipation air volume, and air pressure. It is suitable for heat dissipation of chassis, CPU radiator, power fan modification, water-cooled heat dissipation assistance, game machine heat dissipation, high reliable server application place.

## **Features:-**

- Perfectly fit on the extruder
- Noiseless Performance
- Very low Current consumption
- Long Connecting Wire

# specifications

Operating Voltage : 12V DC

Type : DC

Operating Current : 0.08 Amp $\pm$ 10%

Rated speed : 5200 RPM  $\pm$ 10%

Air volume : 15.5 CFM

Noise : 18dBA

Length : 50mm

Width : 50mm

Height : 10mm

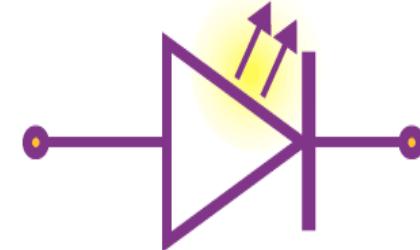
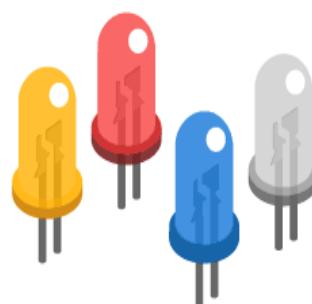
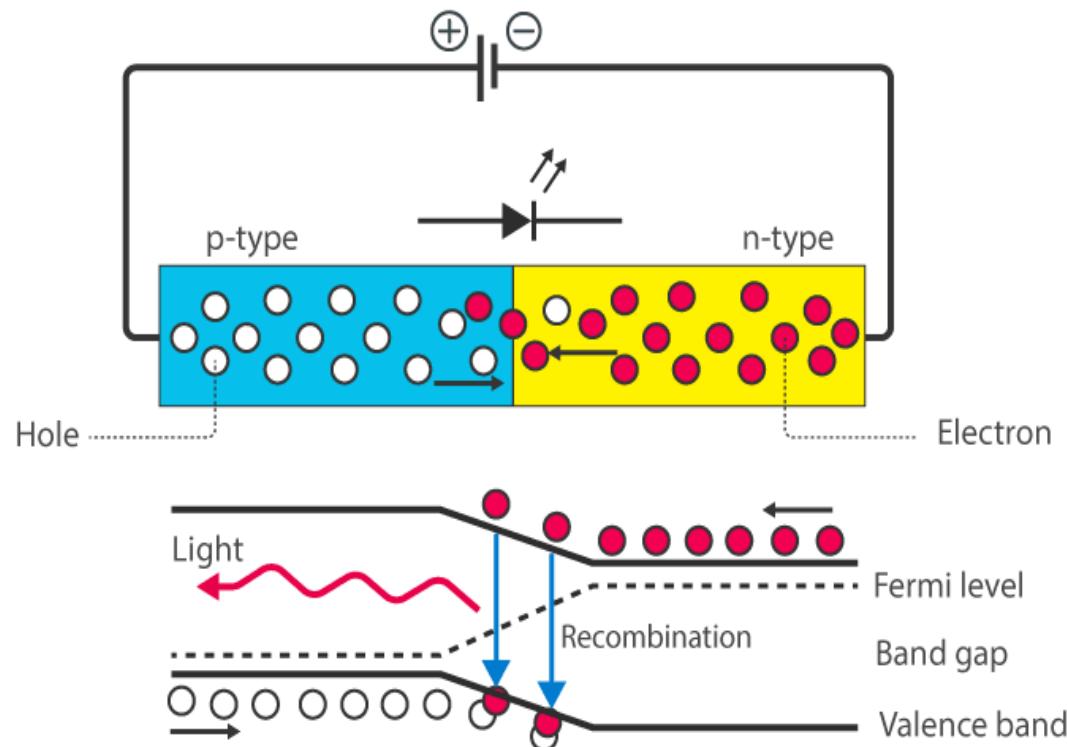
Weight : 20gm



# Led

- Light-emitting diodes are heavily doped p-n junctions. Based on the semiconductor material used and the amount of doping, an LED will emit coloured light at a particular spectral wavelength when forward biased.
- When the diode is forward biased, the minority electrons are sent from p to n while the minority holes are sent from n to p. At the junction boundary, the concentration of minority carriers increases. The excess minority carriers at the junction recombine with the majority charges carriers.
- The energy is released in the form of photons on recombination. In standard diodes, the energy is released in the form of heat. But in light-emitting diodes, the energy is released in the form of photons. We call this phenomenon electroluminescence. Electroluminescence is an optical phenomenon, and electrical phenomenon where a material emits light in response to an electric current passed through it. As the forward voltage increases, the intensity of the light increases and reaches a maximum.

# Working and symbol of led diagrams



# Motor driver IC

- L293D motor Driver IC is an integrated circuit that can drive two motors simultaneously and is usually used to control the motors in an autonomous system. This motor driver IC enables us to drive a DC motor in either direction and also control the speed of the motor.
- L293D is a dual H-bridge motor driver IC. H-bridge is the simplest circuit for controlling a low current-rated motor. One H-bridge is capable to drive a DC motor bidirectional. L293D is a current enhancing IC. It can also act as a switching device.
- The L293D is a 16-pin Integrated circuit, with eight pins, on each side, dedicated to the controlling of a motor. There are 2 input pins, 2 output pins and 1 enable pin for each motor. The L293D IC is designed to provide bidirectional drive currents of up to 600-mA at voltages from 4.5 V to 36 V. It is designed to drive inductive loads such as relays, solenoids, DC & bipolar stepping motors, as well as other high-current/high-voltage loads in positive-supply applications.
- L293D motor Driver IC is one of the most popular drivers in the market. Because of several reasons such as cheap price (compared to other drivers), easy control, proper shape and size, no need for protective circuit and diodes, no need for heat sinks, and good resistance to temperature and high-speed variations, L293D motor driver is mostly preferred driver to the user.

# specifications

Wide supply voltage range: 4.5V to 36V

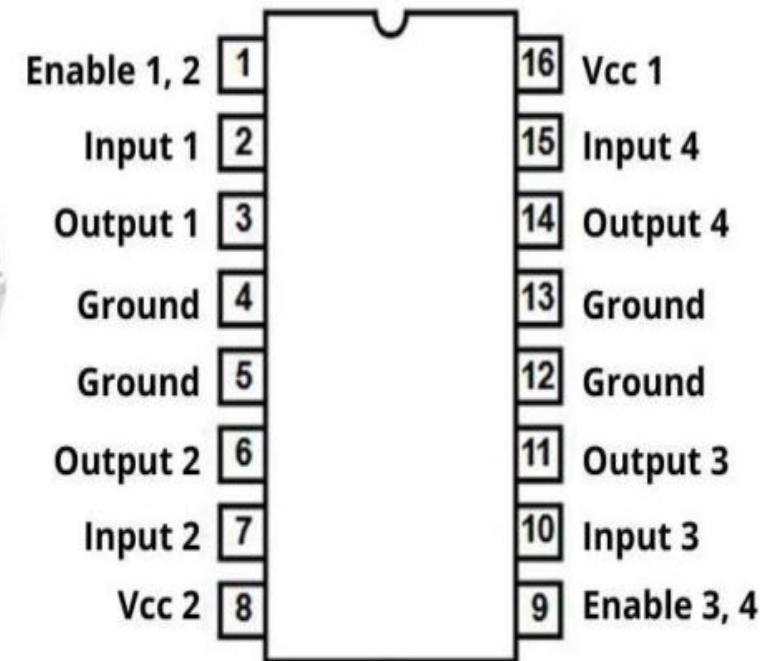
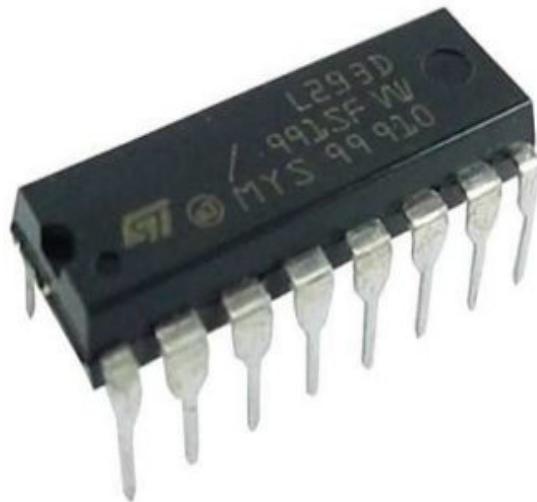
Output current 600mA per channel

Peak Output Current 1.2A per channel

High-Noise-Immunity Inputs

Separate Input-Logic Supply

Internal Electrostatic Discharge (ESD)  
Protection



# RFID module

- RFID is an acronym for “**Radio-Frequency Identification**” and refers to a technology whereby digital data encoded in RFID tags or smart labels (defined below) are captured by a reader via radio waves. RFID is similar to barcoding in that data from a tag or label are captured by a device that stores the data in a database. RFID, however, has several advantages over systems that use barcode asset tracking software. The most notable is that RFID tag data can be read outside the line-of-sight, whereas barcodes must be aligned with an optical scanner.

# tags

An RFID tag consists of an integrated circuit and an antenna. This tag carries 12 unique numbers. The tag is also composed of a protective material that holds the pieces together and shields them from various environmental conditions. The protective material depends on the application. For example, employee ID badges containing RFID tags are typically made from durable plastic, and the tag is embedded between the layers of plastic. RFID tags come in a variety of shapes and sizes. Tags can be attached to almost anything like Animals, Employee ID Card, vehicles, assets, Shoes, etc. There are two types of RFID tags.

- **Passive Tags**

Passive tags are the most widely used, as they are smaller and less expensive to implement. Passive tags must be “powered up” by the RFID reader before they can transmit data.

- **Active Tags**

Unlike passive tags, active RFID tags have an onboard power supply (e.g., a battery), thereby enabling them to transmit data at all times.

- **RFID Readers**

- It is used to read unique IDs from RFID tags. Whenever RFID tags come in range, the RFID reader reads its unique ID and transmits it serially to the microcontroller or PC. The RFID reader has a transceiver and an antenna mounted on it. It is mostly fixed in a stationary position.

# Specifications

5VDC through USB (External 5V supply will boost the range of the module)

Current: <50mA

Operating Frequency: 125Khz

Read Distance: 10cm

Size of RFID reader module: 32mm(length) \*  
32mm(width) \* 8mm(height)



# PH sensor:

- the Three-Way Soil Meter For Moisture, Light Intensity and pH Testing , you can easily check the condition of your plants. The moisture meter will quickly tell whether your plants are doing well. Firstly, let you know that dry and needs water or wet and could use a day to dry out, you will never over/under water your plants again. Secondly, it helps you to control pH level in soil, acidic or alkaline is suitable for your plants. Thirdly, testing whether plants getting adequate sunlight. Above all, equipped with this meter, you can give the best care to your plants and keep the soil and lawn healthy and happy.
- 
- Soil pH is one of the most important factors that can be overlooked in the garden. pH has impacts on the availability of nutrients and of the plant's ability to take them up. If the pH of your garden soil is not in the optimal range for the plants you are trying to grow you may end up having issues. Often plants grown in a soil that does not have the optimal pH don't produce or if they do their harvests are low while the plant may look stressed. pH is measured on a 14 point scale with 0 being the most acidic 7 neutral and 14 the most basic.
- 
- Three Way Soil Meter With PH Detector is a Perfect tool to test the soil conditions (Moisture/Light/ PH) of fruits, flowers, vegetables, shrubs, etc. Its an Ideal and necessary tool for gardeners, vegetable and fruit growers, and all those who plant trees and grass. The meter can be Simply inserted into the soil and switch to the setting you want to measure and read the scale.

# Specifications

**Moisture readings range: 0 DRY - 10 WET**

**Light readings range: 0 DARK - 2000 LUMEN**

**PH readings range: 8 ALKALINE - 3.5 ACIDIC**

**Moist value (1-10RH): 1 - 3 (Red) need to water, 4 - 7 (Green) favorable moisture, 8-10 (Blue) too wet**

**pH value (8-3.5): Neutral solution : =7, Acid reaction : <7, Alkaline reaction : >7**

**Length: 250 mm**

**Probe Length: 170 mm**

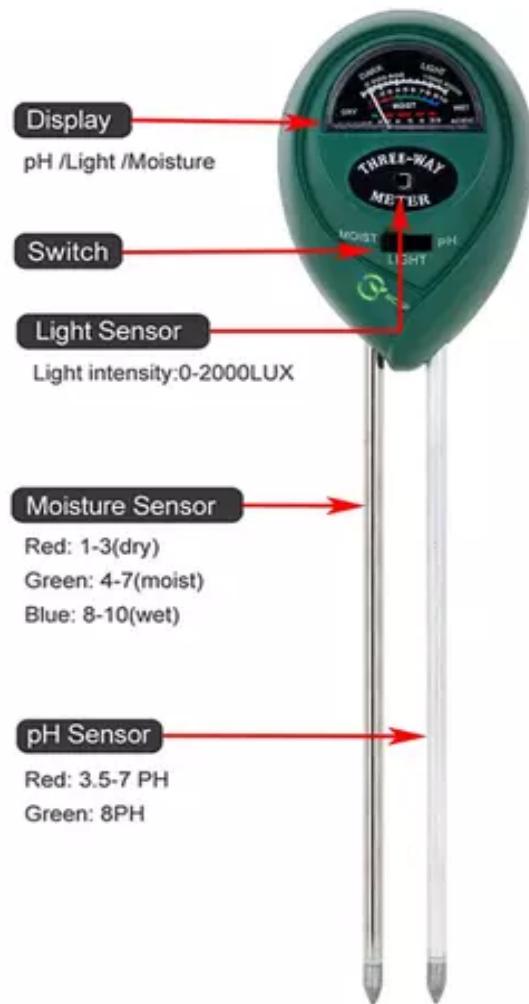
**Probe Diameter: 5 mm**

**Material: Body (Plastic), Probe (Stainless Steel & Aluminium)**

**Color: Green**

**Dimensions in mm (LxWxH): 260 x 58 x 36 ( Meter Console )**

**Weight (gm): 100**



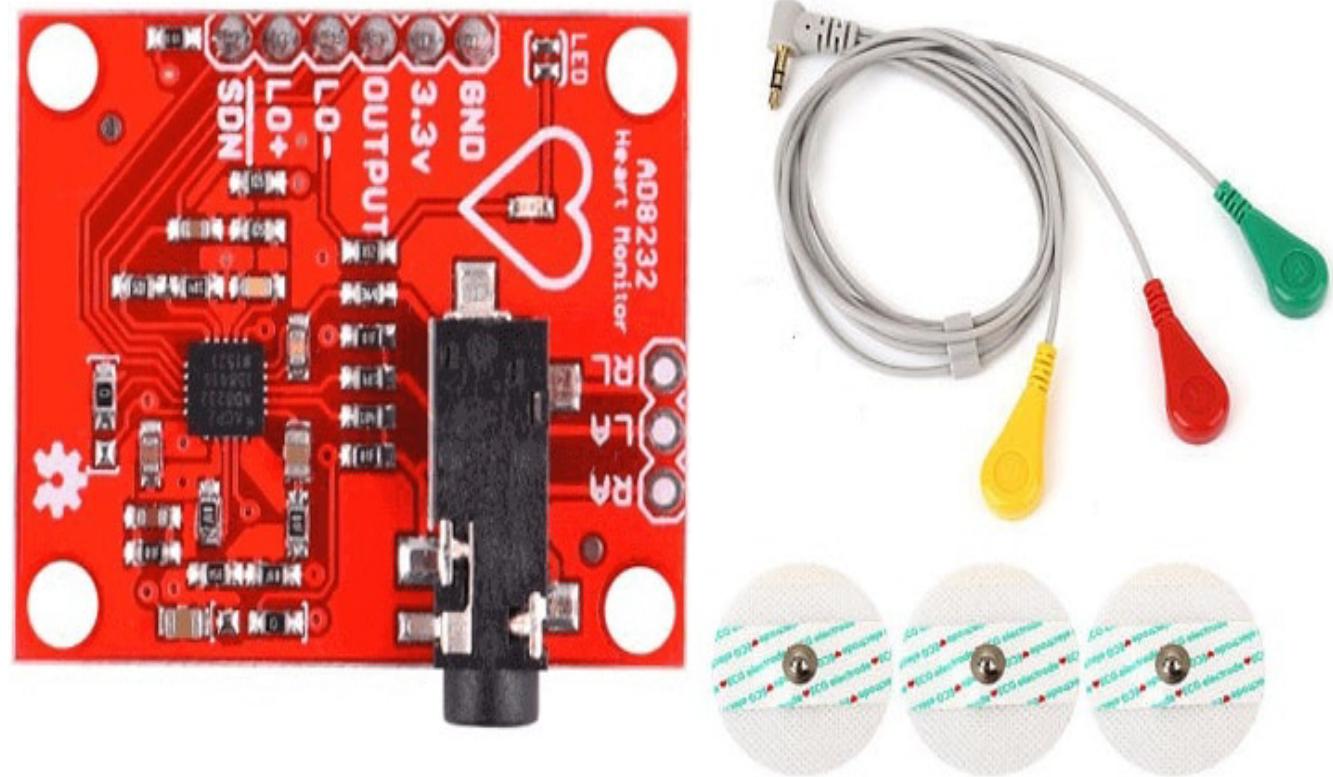
S-56412493

# ECG sensor

- An ECG is a paper or digital recording of the electrical signals in the heart. It is also called an electrocardiogram or an EKG. The ECG is used to determine heart rate, heart rhythm, and other information regarding the heart's condition. ECGs are used to help diagnose heart arrhythmias, heart attacks, pacemaker function, and heart failure.
- This sensor is a cost-effective board used to measure the electrical activity of the heart. This electrical activity can be charted as an ECG or Electrocardiogram and output as an analog reading. ECGs can be extremely noisy, the AD8232 Single Lead Heart Rate Monitor acts as an op-amp to help obtain a clear signal from the PR and QT Intervals easily.
- The AD8232 is an integrated signal conditioning block for ECG and other biopotential measurement applications. It is designed to extract, amplify, and filter small biopotential signals in the presence of noisy conditions, such as those created by motion or remote electrode placement.
- The AD8232 module breaks out nine connections from the IC that you can solder pins, wires, or other connectors to. SDN, LO+, LO-, OUTPUT, 3.3V, GND provide essential pins for operating this monitor with an Arduino or other development board. Also provided on this board are RA (Right Arm), LA (Left Arm), and RL (Right Leg) pins to attach and use your own custom sensors. Additionally, there is an LED indicator light that will pulsate to the rhythm of a heartbeat.

# Specifications

- Operating Voltage - 3.3V
- Analog Output
- Leads-Off Detection
- Shutdown Pin
- LED Indicator
- 3.5mm Jack for Biomedical Pad Connection



# Turbidity sensor

- Turbidity is the cloudiness or haziness of a fluid caused by large numbers of individual particles that are generally invisible to the naked eye, similar to smoke in the air. The measurement of turbidity is a key test of water quality.
- Turbidity is caused by particles suspended or dissolved in water that scatter light making the water appear cloudy or murky. Particulate matter can include sediment, especially clay and silt, fine organic and inorganic matter, soluble colored organic compounds, algae, and other microscopic organisms.
- High turbidity can significantly reduce the aesthetic quality of lakes and streams. It can increase the cost of water treatment for drinking and food processing. It can harm fish and other aquatic life by reducing food supplies, degrading spawning beds, and affecting gill function.
- Turbidity is measured using specialized optical equipment in a laboratory or in the field. Light is directed through a water sample, and the amount of light scattered is measured.
- The unit of measurement is called a Nephelometric Turbidity Unit (NTU), which comes in several variations. The greater the scattering of light, the higher the turbidity. Low turbidity values indicate high water clarity; high values indicate low water clarity.

# Specification

1. *Operating Voltage: 5V DC*
2. *Operating Current: 40mA (MAX)*
3. *Response Time: <500ms*
4. *Insulation Resistance: 100M (Min)*
5. *Output Method: Analog*
6. *Analog output: 0-4.5V*

