

ATL EQUIPMENT MANUAL



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A top-down view of various electronic components and a drone. In the center is a blue Arduino Uno R3 board. To its left is a custom-built robot with a green PCB, two ultrasonic sensors, and four wheels. Above the Arduino is a green PCB with various components and a ribbon cable. To the right is a black and white drone with red landing gear. Other items include a yellow LED, a black fan, a USB cable, and various jumpers and screws.

PACKAGE 1

Electronics Development, Robotics, Internet of Things, & Sensor

LED

LED (Light Emitting Diode) is a diode which when connected in forward bias generates light. The light generated depends on the colour for which the LED is designed.

A LED contains two leads - positive terminal (longer one) and negative terminal (shorter one). LED will glow when positive pin of LED is connected to +ve terminal of the battery and negative pin of LED is connected to -ve terminal of the battery. The operating voltage of an LED is between 1.8 and 3.3 volts



How to Use

To make a simple connection, we can connect the LED with a battery to make it glow. The positive lead of the LED needs to be connected to the positive terminal of the battery, and negative lead to the negative terminal. We need to make sure that the voltage rating matches the battery voltage. Otherwise, we can use resistors to provide the required voltage.



Common Applications

1. To provide light
2. As indicators



Some Example Tasks

1. Create a simple circuit to glow an LED
2. Connect LEDs in series with the battery and resistors and observe the dip in the intensity of light as the number of leds increase



Safety Measures

1. Don't put the LED close to the eyes.
2. Supplying a high voltage might damage the LED.



Important Links

1. All about LEDs
2. How does a LED work at the micro level YouTube Video



RGB LED

RGB LED is a single LED that can produce three colours:- Red, Green, Blue. The colour theory says that any colour can be made using red, green and blue. So, we can change the intensity of each of these colours in the LED to generate possibly any colour. The pixels used in screens of devices like mobiles, laptops and TVs are also rgb pixels. These kinds of LEDs are very common in decorative and indicative purposes as they work as one single unit to produce different colours based on specified conditions. An RGB LED contains 4 leads, one each for 3 different colours and the remaining one as a common anode or cathode.



How to Use

Project Tutorial



Common Applications

1. Displays
2. Decorative purposes



Some Example Tasks

1. Produce all colours using RGB LEDs and Arduino Tutorial
2. Design a 8x8x8 RGB LED cube



Safety Measures

1. Supplying a very high voltage might damage the LED.



Important Links

1. How does a RGB LED work YouTube Video



Breadboards and Mini Breadboard

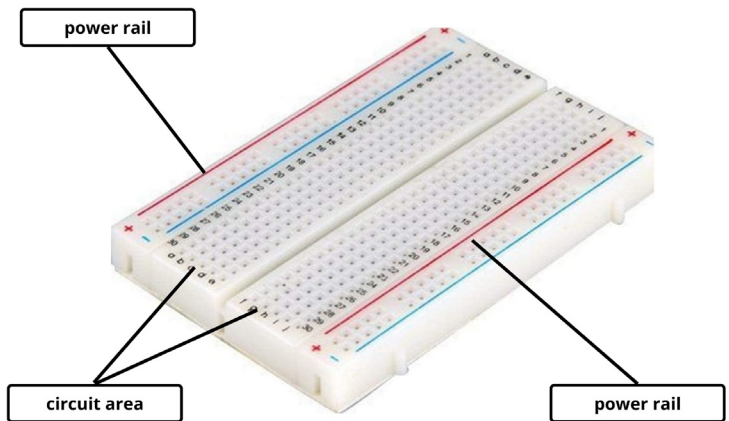
Breadboard is a thin plastic board which is used to hold components to test out the circuit temporarily before making the actual final circuit connections. A breadboard has internal connections which makes it very handy to connect different components based on the requirements. There are two major types of size in which breadboards are available:

Normal size

It has 800 pins in it to be used for making connections. It is suitable for making complex circuit prototypes.

Mini Breadboard size

It has 400 pins in it to be used for making connections. It is suitable for comparatively smaller and simpler circuit designs.



How to Use

To use a breadboard, one should first have an idea regarding which pins are short circuit and which are open circuit. In a breadboard, usually, when held horizontally, the upper two rows and lower two rows are divided into 4 short-circuited connections each. The other Rows have pins short-circuited vertically. Once identified, you can utilise pins of your choice to put components for making connections, and then test them accordingly. A very simple example could be to connect a LED light with a battery and switch.



Common Applications

1. Used to make temporary connections for testing the circuit.
2. Used to hold components together for connection and makes the work easier.



Some Example Tasks

1. Make a simple LDR connection on a breadboard using a LDR, battery, LED and switch.



Safety Measures

1. Make sure to not try to bend the breadboard as it might break.
2. Don't ever try to solder the ends of components on breadboards as they're not meant for that purpose.



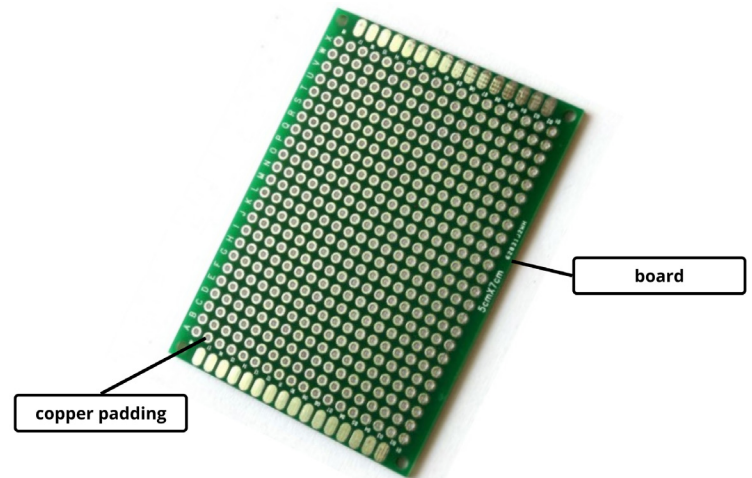
Important Links

1. Basics of a breadboard YouTube Video



General Purpose Solderable Board

A solderable board is a perf board which is used in prototyping electronic circuit designs. It is a kind of PCB (printed circuit board), also referred to as DOT PCB. One major advantage of using a solderable board lies in its name. That is, the board is solderable. This is very useful while making circuits, since soldering makes the connections semi permanent and ensure that there are no loose ties. Their boards are made of a material called phenolic, which is obtained and processed from a variety of plant based foods.



How to Use

Usually a solderable board has one side copper padding, but the copper padding could be on both sides as well. Put the component you need to join into the hole from the non-copper padding side, and then bend the wire a bit and cut the excess part of the other end. Then, take the soldering iron and solder the board from the back (the side with copper padding). Make the connections as required, and you're done!



Common Applications

1. Solderable boards are used for nice arrangement and circuit design prototypes of various types.



Some Example Tasks

Prototyping a simple electronic circuit of choice using solderable board.



Safety Measures

1. Avoid using excessive soldering wire as it might ruin the connection.
2. Don't put the soldering iron in contact with the board for a long time.



Important Links

Basics of a perf board YouTube Video



Battery

A battery is one of the most commonly used devices in electronics. A battery is a source of electrical power consisting of one or more electrochemical cells put together and provided with some sort of external connections to use the power. A battery basically works on the principle of conversion of chemical energy into electrical energy. A battery has two terminals, positive (+) and negative (-). Usually, there are 2 major types of batteries:-

Rechargeable

These batteries once exhausted can be recharged with help of chargers and be utilised again. The common mobile Li-ion batteries can be considered as a nice example.

Non-Rechargeable

These batteries, once used and exhausted, can't be recharged again and used. So, basically these batteries are only meant for one-time usage.



How to Use

To use a battery, attach the device to the terminals of the battery. Some devices might have a port where it can be directly plugged. Otherwise, wires can be used to make the connection. Make sure the terminals are connected with the right wires. As a convention, the red wire is positive and the black wire is negative. After a rechargeable battery is exhausted, which can be known when the battery isn't providing any voltage, it should be charged. For charging as well, it depends on different kinds of batteries. But most commonly, the charger has a holder where the battery needs to be put, and then turning on the power button would start charging the battery. The indicator light would give an idea if the battery is charged or being charged. After its done charging, the battery should be removed from the charger holder.



Common Applications

1. A battery is used to power almost every electronic device that we use.
2. Batteries are used in other appliances such as watches, remotes, etc.



Safety Measures

1. Don't overcharge a battery for too long.
2. Store the batteries away from heat and sunlight.



Some Example Tasks

1. Make a series LED connection using battery and see the difference in intensities YouTube Video (<https://www.youtube.com/watch?v=8CGEoHSHduc>)
2. Connect a small DC motor to the battery and try rotating it



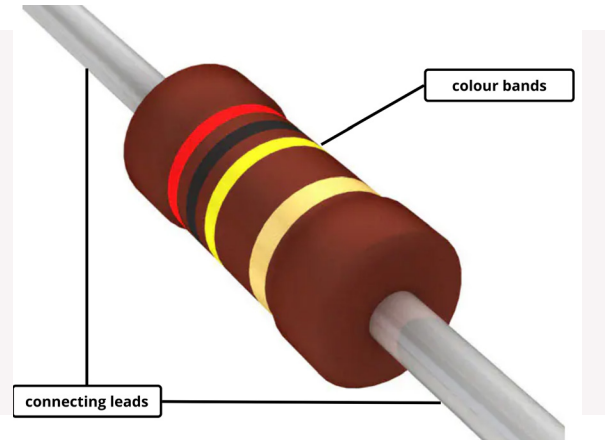
Important Links

1. Working principle of a battery YouTube Video



Resistor

A resistor is such a device which finds use in almost everything related to electronics. A resistor is used in lamps, fans, toaster, microwave, etc. Technically, a resistor is a two-terminal component that is used to obtain electrical resistance in circuits. In electronic circuits, resistors are used to reduce current flow, adjust signal levels, to divide voltages and more. Resistors are usually made of metals or other components that have a very high resistivity as compared to common connecting metals like copper and aluminium. These metals are then coated with an insulating material.



How to Use

To use a resistor, just select a resistor of appropriate ratings and put it in the circuit. Resistors don't have any polarity of terminals so they can be connected either way in the circuit and made to work. The connections once made can be soldered to keep them intact.



Common Applications

1. Used to restrict the flow of current in almost every circuit.



Some Example Tasks

1. Connect resistors in different arrangements with LED and battery and notice the difference in its intensity.



Safety Measures

1. Don't touch the open resistor leads while it's in use.
2. Don't twist or break the resistors.



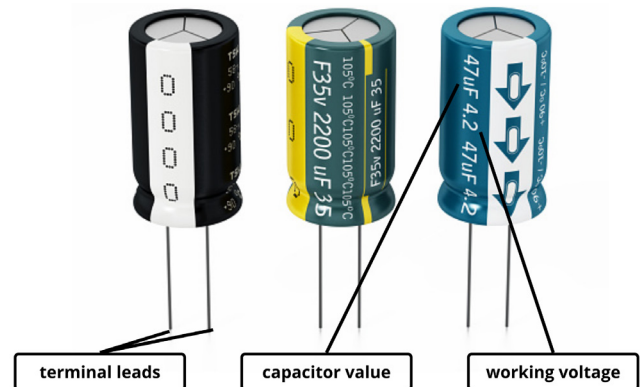
Important Links

1. How to read resistor values YouTube Video
2. Resistor basics and types YouTube Video



Capacitor

A capacitor is a device that stores energy in the form of an electric charge. Capacitors are found in a number of devices such as cameras, fans, speakers and sensors. The major job of a capacitor is to store the energy in itself, and then supply it in a go whenever required. The energy is stored between dielectric plates that are placed parallelly in the capacitor. The plates may have a dielectric material between them. A capacitor has two terminals, which are connected to dielectric plates, that are placed parallelly at a small distance from each other, like the image below:



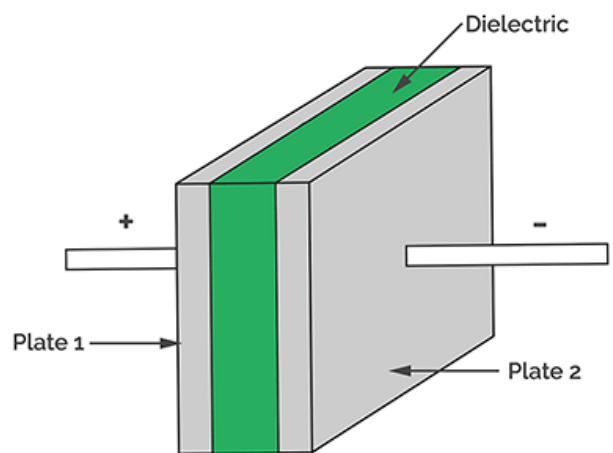
How to Use

A capacitor can be put in a circuit by connecting its both terminals to the circuit. One thing to notice is that unlike resistors, multiple capacitors connected in series constitute lesser equivalent capacitance as compared to when they're connected in parallel.



Common Applications

1. Used in appliances like fans, cameras, etc.
2. Used in many ICs like capacitive touch modules.
3. Providing stability to voltage regulators.



Some Example Tasks

1. Design a voltage regulator circuit of your own by using capacitors and diodes.



Safety Measures

1. Do not use capacitors on higher current or voltage value than specified
2. Do not discharge it by force.



Important Links

1. How does a capacitor work YouTube Video



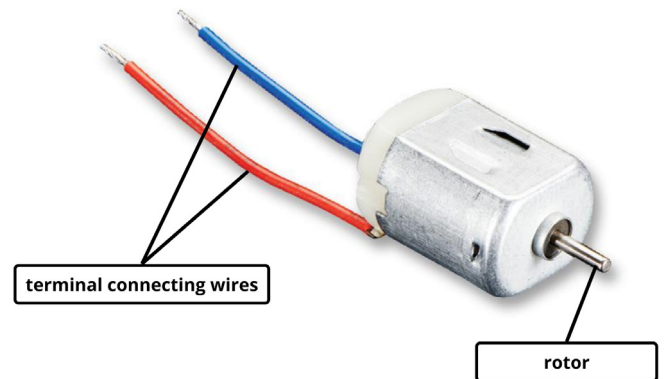
DC Motor

A DC motor is a machine that converts chemical or electrical energy into mechanical energy by making the rotors rotate either clockwise or anti-clockwise. The direction of rotation usually depends on the polarity they're connected in.

Components

A DC motor majorly has 3 components on the outside:

1. A rotor which rotates when power is supplied to the motor.
2. Connecting wires.
3. A motor body enclosing the functional parts of the motor.



How to Use

To use a motor, take its connecting wires and connect them to the terminals of a battery. That's all you need to do. If the connections are proper, the motor should start rotating. To rotate the motor in the opposite direction, just reverse the polarity of the battery connections.



Common Applications

A Dc motor is used in a lot of appliances such as fans, cars, drill machines, rotary tools, motor pumps, etc. A DC motor, as suggested through its name, functions on DC voltage.



Some Example Tasks

1. Make a small USB fan using a DC motor
2. Design a DIY Dishwasher using a DC Motor and a battery



Safety Measures

1. A motor may get heated up on prolonged use.



Important Links

How does a DC motor work YouTube Video



Servo Motor

Servo motors are a specific kind of motors that are used to push or rotate parts of machines with high precision. They are used at angular or linear positions to provide a specific acceleration and velocity to the rotor..



How to Use

Tutorial



Common Applications

1. In robotic arms
2. In industrial robots because of their smooth switching on and off and accurate positioning.
3. In the aerospace industry to maintain hydraulic fluid in their hydraulic systems.
4. Radio controlled toys.
5. In automobiles to maintain the speed of vehicles
6. Electronic devices such as DVDs or Blue ray Disc players to extend or replay the disc trays.



Some Example Tasks

1. Make a rotating robotic arm using a servo motor
2. Control position of servo motor using Potentiometer
3. Automatic Door Opener



Safety Measures

1. Don't manually rotate the rotor of the servo motor beyond its limit.
2. Always use compatible voltage with the servo motor.



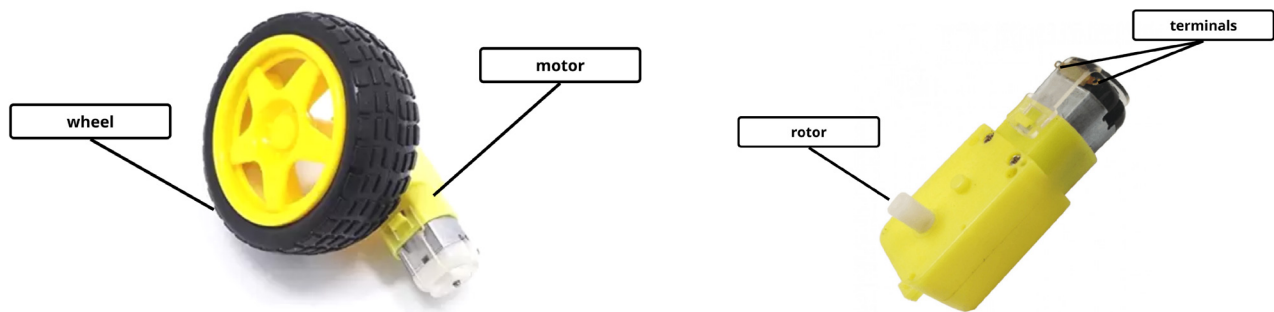
Important Links

How does a servo motor work YouTube Video



DC Plastic Gear Motor With Wheel

A DC Geared motor (BO) motor, called Battery Operated motor is a DC motor which works just like a normal DC motor, but the speed is a bit low and the torque is higher. It is great for lightweight battery operated robots since it is very compact and light. We also get a wheel which is detachable. We can use it accordingly when required.



Components

A BO motor has 3 major parts like all DC motors:-

1. Rotor, it is the part that rotates when applied with voltage
2. Terminals, these are connected to the battery to rotate the rotors
3. Motor body, it encloses the inner components of the motor.



How to Use

To use a BO motor, take its connecting wires and connect them to the terminals of a battery. That's all you need to do. If the connections are proper, the motor should start rotating. To rotate the motor in the opposite direction, just reverse the polarity of the battery connections. To use the wheel, just fit it into the rotor, and you're good to go!



Common Applications

Fans, robot cars, drill machines, rotary tools, motor pumps



Some Example Tasks

1. Build a Walking Robot
2. Make a robotic car using a BO motor to drive its wheels



Safety Measures

1. A motor may get heated up on prolonged use.



Important Links

1. How to Use a BO motor YouTube Video
2. What is inside a DC Geared Motor

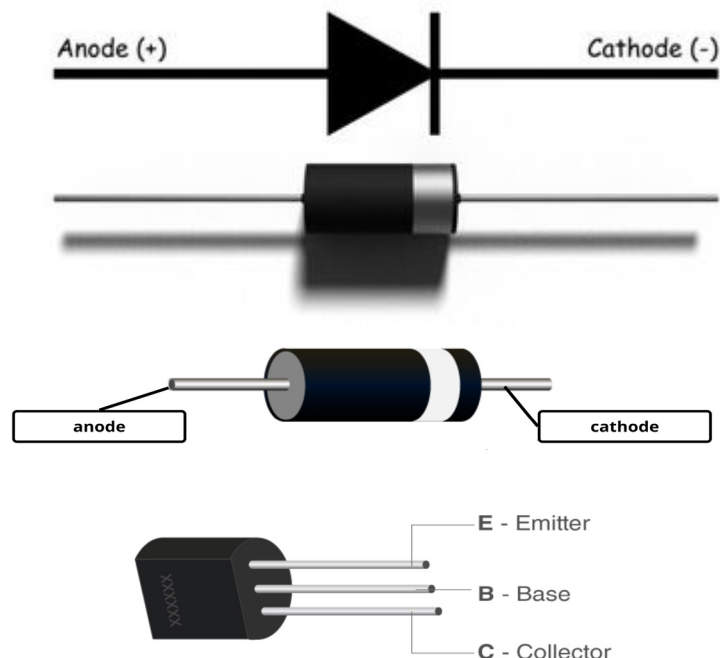


Diode

A diode is a semiconductor device that essentially acts as a one-way switch for current. It allows current to flow easily in one direction, but severely restricts current from flowing in the opposite direction. This property of a diode is very useful in certain scenarios where we only want the current to flow unidirectionally.

Components

A diode generally has two terminals, anode and cathode. It conducts electricity only in one direction, which means, it acts as an insulator if current is in a specific direction or as conductor if the direction of flow of current is reversed. So, it can be made to use by connecting to the circuit.



How to Use

A diode has 2 terminals, it can be made to use by connecting in series to the circuit. A LED is also a type of diode, which we know is connected along the circuit to work. Similarly, we shall connect other diodes too, to make them work.

Tutorial-https://www.youtube.com/watch?v=cO8_K3ytvGI



Common Applications

- Diodes are used in many appliances such as LED, rectifiers, switches, solar cells, etc
- Diodes are also used in rectifier, clipper and clamper circuits



Safety Measures

- Do not let the soldering touch the glass body of the diode directly while making connections.
- Don't use higher voltages on diodes more than the specified limits (0.60V-0.75 V).



Some Example Tasks

- Make a rectifier using diodes
- Create a Clipper using diodes



Important Links

- Overview of Diodes



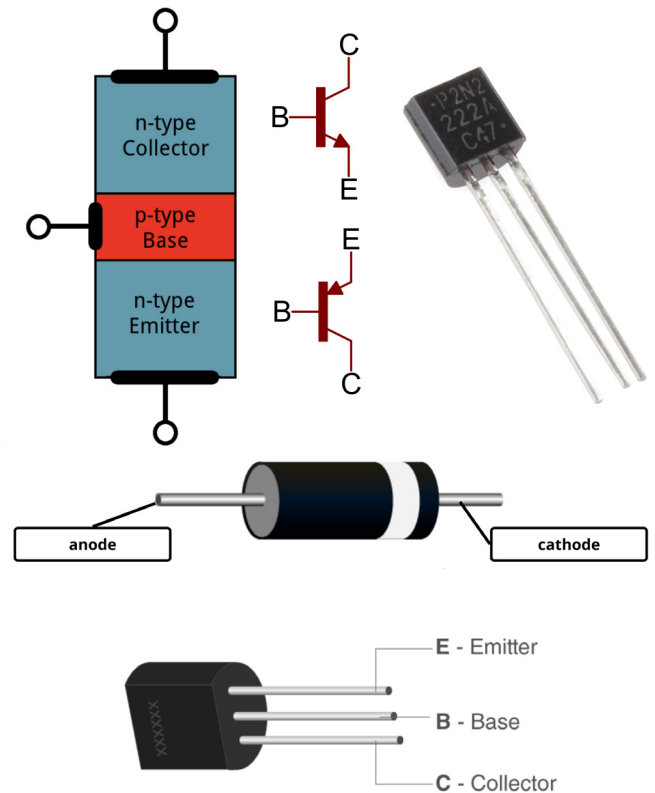
Transistor

A transistor is an electrical device which can amplify and boost an electrical current. A transistor basically acts as a switch and an amplifier. In simple words, we can say that a transistor is a miniature device that is used to control or regulate the flow of electronic signals. Transistors are one of the key components in most of the electronic devices that are present today. Developed in the year 1947 by three American physicists John Bardeen, Walter Brattain and William Shockley, the transistor is considered as one of the most important inventions in the history of science.

Components

A transistor has 3 terminals, namely emitter, base and collector. The configuration depends on the type of transistor in use.

- Base: This is used to activate the transistor.
- Collector: It is the positive lead of the transistor.
- Emitter: It is the negative lead of the transistor.



How to Use

Tutorial-Article



Common Applications

- Transistors are used as a simple switch to make a circuit open or close by controlling the base voltage
- Transistors are also used in a variety of appliances such as computer chips, microprocessors, mobile phones, etc.



Some Example Tasks

- Make a bridge rectifier using diodes and capacitors.

- ◉ Make a LED blinker using transistors Article



Safety Measures

- ◉ Don't use higher voltages on transistors more than the specified limits.



Important Links

1. How does transistors work YouTube Video
2. More about Transistors



Alligator Connectors

A crocodile connector, also known as alligator connector is a type of connecting cable which has crocodile mouth shaped jaws to make temporary connections by clipping the connector. It is used for making temporary connections, which makes it reusable. The cable has two ends. Some cables might have alligator connector jaws on both ends and some might have it on only one end.



How to Use

To use the alligator connector, we just need to squeeze it around its rubber tip, and then the connectors' jaws open up. Then, we can plug it with wires or pins to make the connection. It is as simple as that!



Common Applications

1. Making connections between two devices or wires.



Some Example Tasks

1. Make a circuit and measure the voltage using alligator connectors and a multimeter.



Safety Measures

1. Don't touch the metallic jaw of the connector when it is being used at a high voltage and is in ON state.
2. Don't put the jaws on relatively softer material if you want to avoid marks on it.



Important Links

1. How to crimp an alligator clip into a wire YouTube Video



Battery clips with DC Jack

Common batteries don't often have an output DC jack that could be plugged in to provide power. That is exactly why we use battery clips with DC jack. It is a very simple gadget with a cable, which is attached to common battery clips on one end and a DC jack on the other.



How to Use

To use a battery clip and DC jack connector, just fit the clip over the battery that is supposed to be used to provide power. The DC jack then can be plugged into the board or appliance that requires power.



Common Applications

1. To connect battery to the circuit



Safety Measures

1. Make sure that the voltage compatibility of the device matches with the battery.
2. Don't use damaged connectors. Disconnect the battery when the cable gets heated

Hook-up wires

Hook up wires, also called lead wires are single core wires with insulation that are used to make the internal wirings of electronic devices. They can be used to make all sorts of required connections, and are one of the fundamental units of any electrical circuit.



How to Use

It's very easy to use wires. Strip a small part of wire from one end by using a wire stripper plier. Connect it accordingly. Do the same with the other end of wire, and you're done with the connection.



Common Applications

1. To make electrical connections

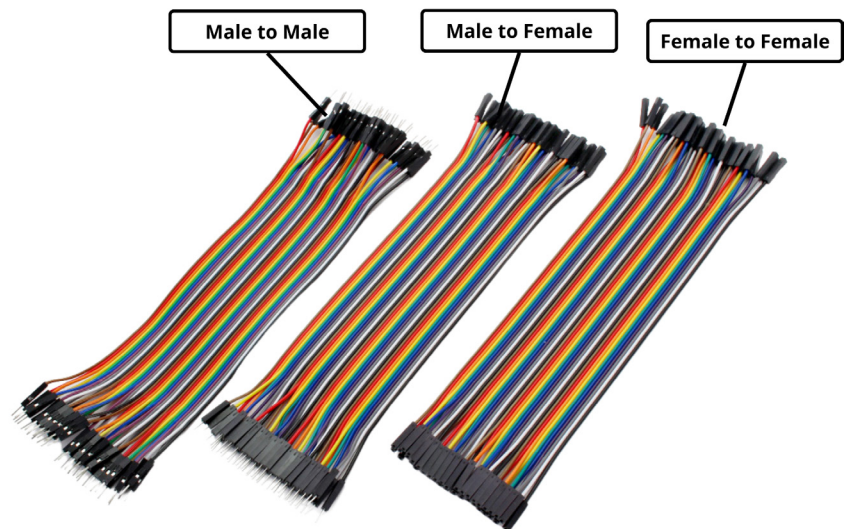


Safety Measures

1. Don't touch the open ends of wire when connected to power
2. Always check if the wires are properly insulated

Jumper Cable

Jumper cables are used very often in making connections. They're very simple to use as compared to normal wires, because you don't need to strip the wire, make connection and then twist it to make it intact. Just plugging in to the breadboard does the job in case of jumper wires. There are majorly two ends in a jumper wire:- male and female. These jumper cables can be of three types:- male-male, male-female, female-female. The usage totally depends on the purpose they're being used for.



How to Use

A jumper wire is used when a connection is being made. The male connector of jumper wire can fit into the breadboard easily by just plugging it in



Common Applications

1. Used to make connections between different components in a breadboard



Safety Measures

1. Don't poke the sharp ends of jumper cables.
2. Jumper cables do not provide a very high heat resistance, so don't use it in circuits producing a lot of heat.



Important Links

1. Basics of a jumper cable YouTube Video

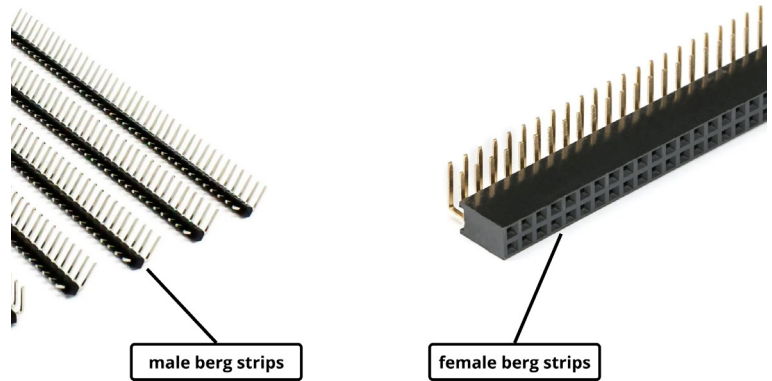


Berg strips

A berg strip, also known as a pin header is a connector strip which is used in various kinds of circuit boards. There are majorly two types of pin headers used:-

1. Male berg strips
2. Female berg strips

The usage of both depends on the kind of circuit needed. Mostly, whenever they're used on circuit boards, they're soldered to the board and then can be used to connect components to it or to connect multiple boards together. Arduino Uno boards have female berg strips present on it for making the connections.



How to Use

Take the required berg strip, either male or female, that you need to solder over the circuit board. The strips could be cut in required size with the use of pliers. Always make sure it is held intact while cutting, to avoid any sort of cracking. Once cut, place them on the board accordingly, and solder each pin's base to the board. Once done, it can then be used to make connections as per the requirement.



Common Applications

1. Making connections on a perf board
2. Connecting different boards with microcontroller boards like Arduino Uno or Raspberry Pi



Some Example Tasks

1. Create a small circuit board of choice using male pin headers and then connect it to the Arduino Uno board.



Safety Measures

1. Hold the strip intact with some plier while cutting it or else it could cause a slanting crack which would then damage the strip.
2. The base of pin headers is sharp so make sure it's not poked while using.



Important Links

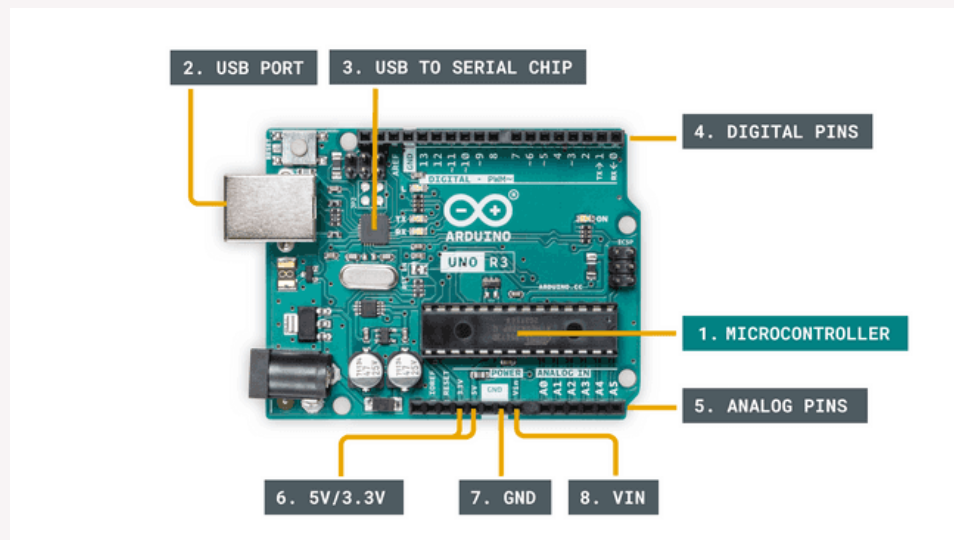
Types of pin headers and their basics YouTube Video



Arduino

Arduino is the perfect board to get familiar with electronics and coding. Arduino is an open-source electronics platform based on easy-to-use hardware and software. Arduino boards can read inputs—light on a sensor, a finger on a button, or a Twitter message—and turn them into an output—activating a motor, turning on an LED, publishing something online. We can tell the Arduino board what to do by sending a set of instructions to the microcontroller on the board. To do so, we need to use the Arduino programming language (based on Wiring) and the Arduino Software (IDE), based on Processing. While all Arduino boards differ from each other, several key components can be found on practically any Arduino.

Components of an Arduino board



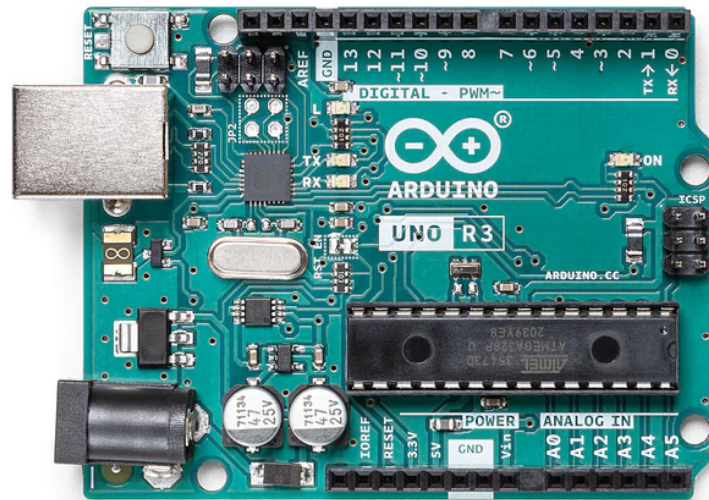
1. Microcontroller – This is the brain of an Arduino, and is the component that we load programs into. Think of it as a tiny computer, designed to execute only a specific number of things.
2. USB port – used to connect your Arduino board to a computer.
3. USB to Serial chip – the USB to Serial is an important component, as it helps translate data that comes from e.g. a computer to the onboard microcontroller. This is what makes it possible to program the Arduino board from your computer.
4. Digital pins – pins that use digital logic (0,1 or LOW/HIGH). Commonly used for switches and to turn on/off an LED.
5. Analog pins – pins that can read analog values in a 10-bit resolution (0-1023).
6. 5V / 3.3V pins- these pins are used to power external components.
7. GND-also known as ground, negative or simply -, is used to complete a circuit, where the electrical level is at 0 volts.
8. VIN-stands for Voltage In, where you can connect external power supplies.

Common Types of Arduino Boards

Arduino UNO

Arduino UNO is based on an ATmega328P microcontroller. The Arduino UNO includes 6 analog pin inputs, 14 digital pins, a USB connector, a power jack, and an ICSP (In-Circuit Serial Programming) header.

It is the most used and of standard form from the list of all available Arduino Boards. It is also recommended for beginners as it is easy to use.



Specifications

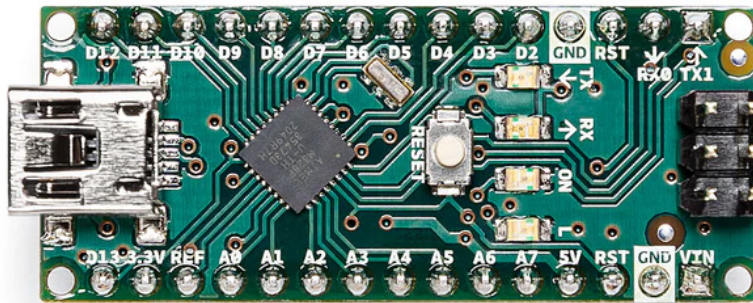
Microcontroller	ATmega328P – 8 bit AVR family microcontroller
Operating Voltage	5V
Recommended Input Voltage	7-12V
Input Voltage Limits	6-20V
Analog Input Pins	6 (A0 – A5)
Digital I/O Pins	14 (Out of which 6 provide PWM output)
DC Current on I/O Pins	40 mA
DC Current on 3.3V Pin	50 mA
Flash Memory	32 KB (0.5 KB is used for Bootloader)
SRAM	2 KB
EEPROM	1 KB
Frequency (Clock Speed)	16 MHz

Arduino Nano

The Arduino Nano is a small Arduino board based on the ATmega328P or ATmega628 Microcontroller. The connectivity is the same as the Arduino UNO board.

The Nano board is defined as a sustainable, small, consistent, and flexible microcontroller board. It is small in size compared to the UNO board. The devices required to start our projects using the Arduino Nano board are Arduino IDE and mini USB.

The Arduino Nano includes an I/O pin set of 14 digital pins and 8 analog pins. It also includes 6 Power pins and 2 Reset pins.



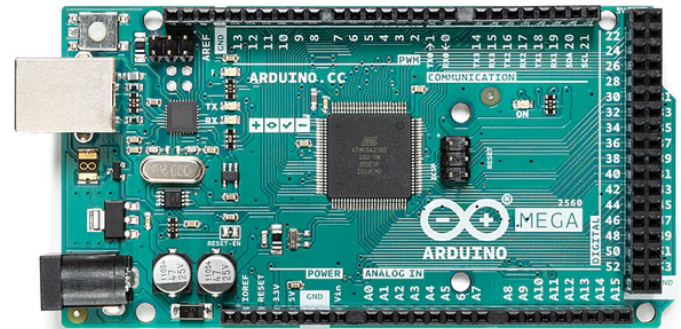
Specifications

Microcontroller	ATmega328P – 8-bit AVR family microcontroller
Operating Voltage	5V
Recommended Input Voltage for Vin pin	7-12V
Analog Input Pins	6 (A0 – A5)
Digital I/O Pins	14 (Out of which 6 provide PWM output)
DC Current on I/O Pins	40 mA
DC Current on 3.3V Pin	50 mA
Flash Memory	32 KB (2 KB is used for Bootloader)
SRAM	2 KB
EEPROM	1 KB
Frequency (Clock Speed)	16 MHz
Communication	IIC, SPI, USART

Arduino Mega

The Arduino Mega is based on the ATmega2560 Microcontroller. The ATmega2560 is an 8-bit microcontroller. We need a simple USB cable to connect to the computer and the AC to DC adapter or battery to get started with it. It has the advantage of working with more memory space.

The Arduino Mega includes 54 I/O digital pins and 16 Analog Input/Output (I/O), ICSP header, a reset button, 4 UART (Universal Asynchronous Receiver/Transmitter) ports, USB connection, and a power jack.



Specifications

Microcontroller	ATmega2650
Operating Voltage	5V
Recommended Input Voltage for Vin pin	7-12V
Analog Input Pins	16
Digital I/O Pins	54 (Out of which 6 provide PWM output)
DC Current on I/O Pins	40 mA
DC Current on 3.3V Pin	50 mA
Flash Memory	256 KB (8 KB is used for Bootloader)
SRAM	8 KB
EEPROM	4 KB
Frequency (Clock Speed)	16 MHz



How to Use

The Arduino Uno is programmed using the Arduino Software (IDE), an Integrated Development Environment common to all boards and running both online and offline. If you want to program your Arduino while offline, you need to install the Arduino Desktop IDE. You must have installed the Arduino Software (IDE) on your PC. Connect your Uno board with an A B USB cable; sometimes, this cable is called a USB printer cable.

The USB connection with the PC is necessary to program the board and not just to power it up. The Uno automatically draws power from either the USB or an external power supply. Connect the board to your computer using the USB cable. The green power LED (labelled PWR) should go on.

Install the board drivers

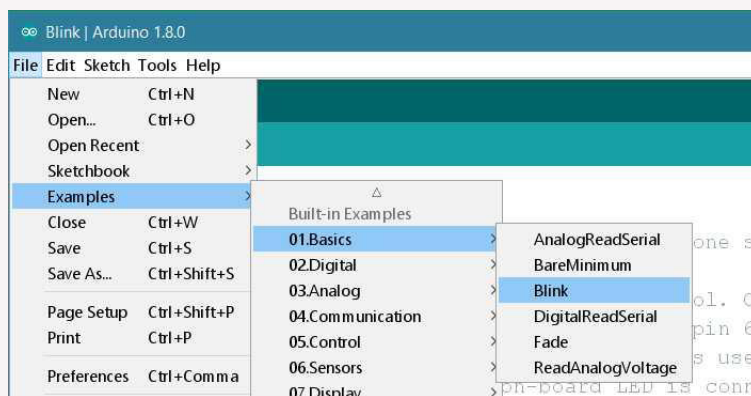
If you used the Installer, Windows—from XP up to 11—would install drivers automatically as soon as you connect your board.

If you had downloaded and expanded the Zip package or, for some reason, the board wasn't properly recognized, please follow the procedure below.

- Click on the Start Menu, and open up the Control Panel.
- While in the Control Panel, navigate to System and Security. Next, click on System. Once the System window is up, open the Device Manager.
- Look under Ports (COM & LPT). You should see an open port named "Arduino UNO (COMxx)". If there is no COM & LPT section, look under "Other Devices" for "Unknown Device".
- Right click on the "Arduino UNO (COMxx)" port and choose the "Update Driver Software" option.
- Next, choose the "Browse my computer for driver software" option.
- Finally, navigate to and select the driver file named "arduino.inf", located in the "Drivers" folder of the Arduino Software download (not the "FTDI USB Drivers" sub-directory). If you are using an old version of the IDE (1.0.3 or older), choose the Uno driver file named "Arduino UNO.inf"
- Windows will finish up the driver installation from there.

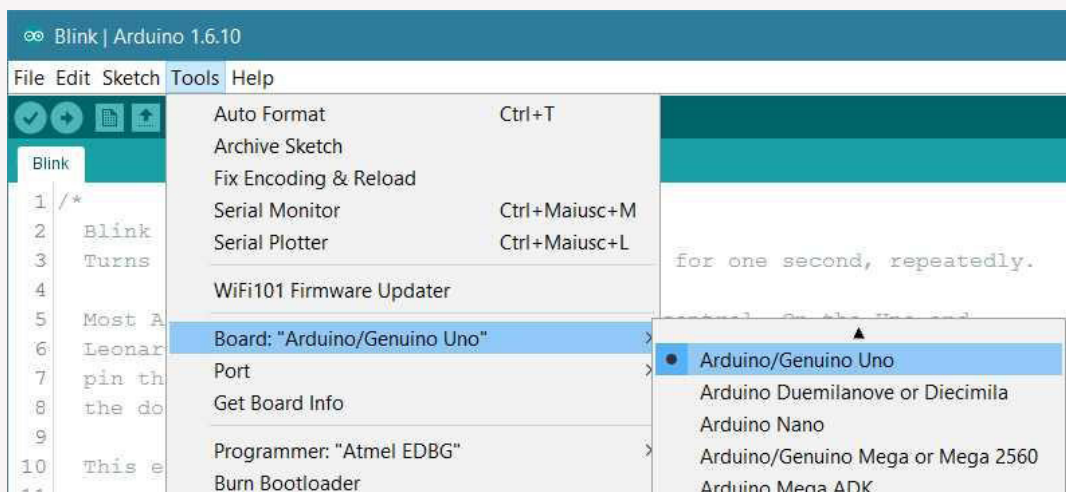
Open your first sketch

Open the LED blink example sketch: File > Examples > 01. Basics > Blink.

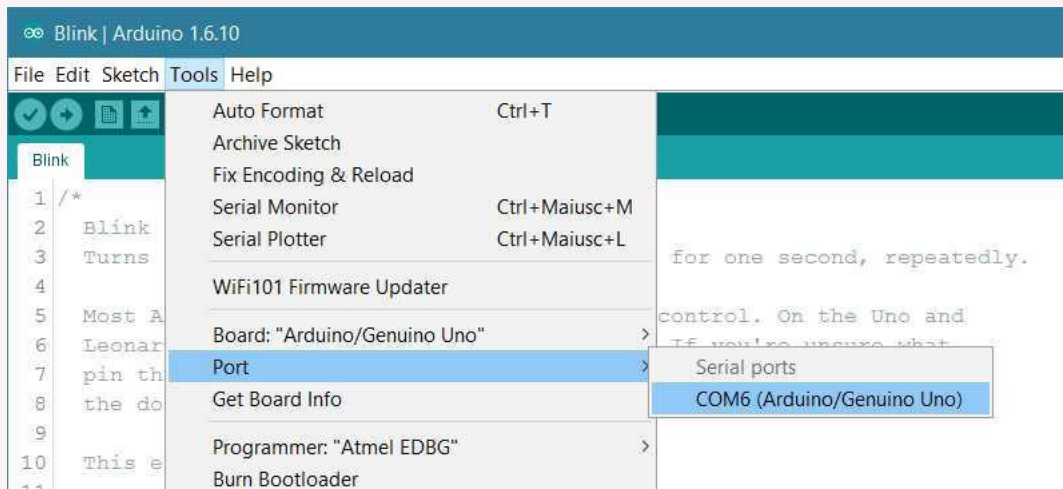


Select your board type and port

You'll need to select the entry in the Tools > Board menu that corresponds to your Arduino board.

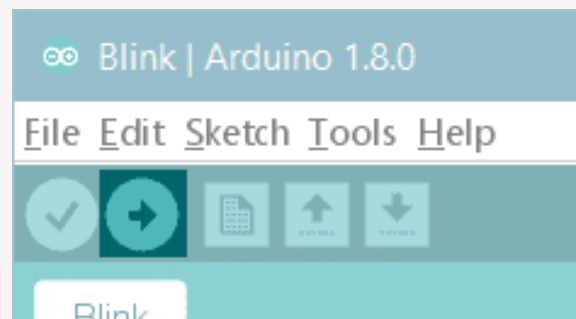


Select the serial device of the board from the Tools | Serial Port menu. This is likely to be COM3 or higher (COM1 and COM2 are usually reserved for hardware serial ports). To find out, you can disconnect your board and re-open the menu; the entry that disappears should be the Arduino board. Reconnect the board and select that serial port.



Upload the program

Now, add the code – <https://www.arduino.cc/en/Tutorial/BuiltInExamples/Blink> & simply click the “Upload” button in the environment. Wait a few seconds—you should see the RX and TX LEDs on the board flashing. If the upload is successful, the message “Done uploading.” will appear in the status bar.



A few seconds after the upload finishes, you should see the pin 13 (L) LED on the board start to blink (in orange). If it does, congratulations! You’ve gotten Arduino up and running.



Common Applications

Arduinos are excellent for beginner and intermediate robotics projects. They are powerful enough to be able to give the basic commands the robot needs to function while keeping their limited resources focused on the tasks at hand. This eliminates interference or resource drain from other programs running in the background. Teachers and students use it to build low-cost scientific instruments, to prove chemistry and physics principles, or to get started with programming and robotics. Designers and architects build interactive prototypes, and musicians and artists use it for installations and to experiment with new musical instruments.



Some Example Tasks

1. Blinking an LED
2. Fading an LED
3. Analog Read Serial
4. Analog In, Out Serial



Important Links

1. Learn the basics of Electronics & Arduino-Learn | Arduino Documentation | Arduino Documentation
2. How to install & use the Arduino IDE-Arduino IDE 2 Tutorials | Arduino Documentation | Arduino Documentation
3. Arduino Built in Examples-Built-in Examples | Arduino Documentation | Arduino Documentation
4. How to Use the Arduino Cloud-Arduino Cloud | Arduino Documentation | Arduino Documentation
5. Understanding the Arduino Programming Language
6. Exciting Projects that can be built using Arduino-Arduino Project Hub

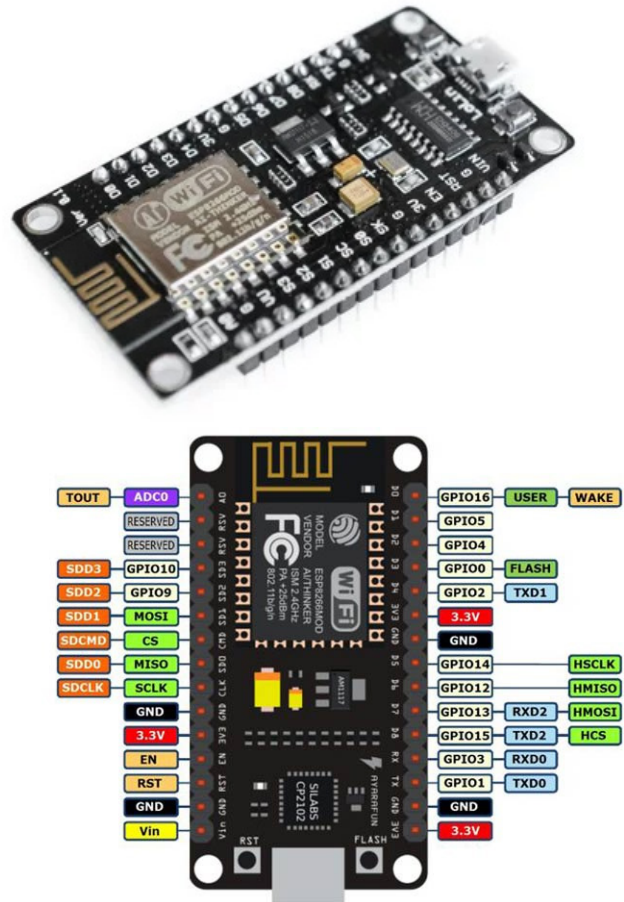


Node MCU

NodeMCU is a firmware based open source development board which can help you build many IoT projects . It can serve many features like an Arduino board or raspberry pi. A NodeMCU is originally programmed in a language called Lua, but since the Arduino programming language is very heavily used in the microcontroller programming, there evolved certain libraries to code a NodeMCU using the Arduino IDE as well. It is based around the ESP-8266 module which is a low cost WIFI enabled microchip that can serve a lot of purposes.

Components

Generally, a Node MCU contains 13 GPIO pins, 10 PWM channels, I2C, SPI, ADC, UART, and 1-Wire. The pinout and ports of the ESP8266 NodeMCU are listed down:



Power	Micro-USB, 3.3V, GND, Vin
Control Pins	EN, RST
Analog Pin	A0
GPIO Pins	GPIO1 to GPIO16
SPI Pins	SD1, CMD, SD0, CLK
UART Pins	TXD0, RXD0, TXD2, RXD2

Specifications

Microcontroller	Tensilica 32-bit RISC CPU Xtensa LX106
Operating Voltage	3.3V
Input Voltage	7-12V
Digital I/O Pins (DIO)	16
Analog Input Pins (ADC)	1
UARTs	1

Microcontroller	Tensilica 32-bit RISC CPU Xtensa LX106
SPIs	1
I2Cs	1
Flash Memory	4 MB
SRAM	64 KB
Clock Speed	80 MHz



How to Use3

Tutorial



Common Applications

1. It is used widely to connect objects and transfer data over the Wi-Fi protocol.
2. IoT Projects



Some Example Tasks

1. Home Automation System using NodeMCU
2. WiFi Controlled Car
3. 3. Smart home with Google Assistant and Alexa



Safety Measures

1. Do not expose to water or moisture, or place on a conductive surface whilst in operation
2. Do not expose to heat from any source.
3. Take care whilst handling to avoid mechanical or electrical damage to the printed circuit board and connectors.
4. Whilst it is powered, avoid handling the printed circuit board, or only handle it by the edges to minimise the risk of electrostatic discharge damage.



Important Links

1. An overview of the Node MCU board YouTube Video



2. Difference between Node MCU and Arduino Uno YouTube Video



3. Projects using Node MCU



Raspberry Pi 3 Model B+

It would be amazing if you could carry a computer in your pocket. Well Raspberry Pi makes it possible. The Raspberry Pi is a low cost, credit-card sized computer that plugs into a computer monitor or TV, and uses a standard keyboard and mouse. It is a capable little device that enables people of all ages to explore computing, and to learn how to program in languages like Scratch and Python.

Raspberry Pi can be used as a general purpose computer, by attaching a monitor to it, or can be used to make complex Robotics IoT and AI projects as well.

Components

The main components in a Raspberry Pi are:

1. PION
GPIO is arguably the most important feature of the Raspberry Pi and is the equivalent of GPIO pins on the Arduino. These pins can be used in programs to read electrical signals from circuits as well as provide electrical signals for controlling circuits.
2. DSI Display Port
The DSI display port allows the Raspberry Pi to connect to a serial display similar to those used in tablets.
3. CSI Camera Port
The CSI camera port is a connector that allows the Raspberry Pi to connect to a Raspberry Pi camera module.
4. MicroSD Slot
This slot is used to house the microSD card that holds the Raspberry Pi operating system.
5. HDMI / USB / Network
These slots are used to connect the Pi to an HDMI screen, USB devices such as mice and keyboards, and to an ethernet connection for internet access.
6. Micro USB Power
Power to the Raspberry Pi can be provided using either a micro USB lead to the micro USB connector (recommended) or 5V can be directly fed into the 5V GPIO pin.

Specifications

Processor	Broadcom BCM2837B0, Cortex-A53 64-bit SoC @ 1.4GHz
Memory	1GB LPDDR2 SDRAM
Connectivity	<ul style="list-style-type: none">• 2.4GHz and 5GHz IEEE 802.11.b/g/n/ac wireless LAN, Bluetooth 4.2, BLE• Gigabit Ethernet over USB 2.0 (maximum throughput 300Mbps)• 4 × USB 2.0 ports
Access	Extended 40-pin GPIO header

Video and Sound	<ul style="list-style-type: none"> • 1 × full size HDMI • MIPI DSI display port • MIPI CSI camera port • 4 pole stereo output and composite video port
Multimedia	H.264, MPEG-4 decode (1080p30); H.264 encode (1080p30); OpenGL ES 1.1, 2.0 graphics
SD card support	Micro SD format for loading operating system and data storage
Input power	<ul style="list-style-type: none"> • 5V/2.5A DC via micro USB connector • 5V DC via GPIO header • Power over Ethernet (PoE)-enabled (requires separate PoE HAT)
Environment	Operating temperature, 0-50°C



How to Use

The setting up and usage process for raspberry pi can be found on their official documentation page



Common Applications

1. Game development
2. Personal Computer
3. Security monitoring
4. Web camera
5. IoT applications
6. Can be used along with sensors to perform various tasks



Some Example Tasks

1. Make your own Personal Computer using Raspberry Pi
2. Build a line following robot using raspberry pi Tutorial Link
3. Make a remote control cart using raspberry pi
4. Build a wire loop game using raspberry pi





Safety Measures

1. Do not expose to water or moisture, or place on a conductive surface whilst in operation
2. Do not expose to heat from any source; the Raspberry Pi 3 Model B+ is designed for reliable operation at normal ambient temperatures.
3. Take care whilst handling to avoid mechanical or electrical damage to the printed circuit board and connectors.
4. Whilst it is powered, avoid handling the printed circuit board, or only handle it by the edges to minimise the risk of electrostatic discharge damage.



Important Links

1. Getting started with raspberry pi3 YouTube Video
2. Introduction to Raspberry Pi-Tutorial Guide
3. Install NOOBS operating system on raspberry pi YouTube Video
4. List of Projects you can try out using Raspberry Pi
5. Use Raspberry Pi with Scratch, Python and Unity
6. The official documentation for Raspberry Pi computers and microcontrollers



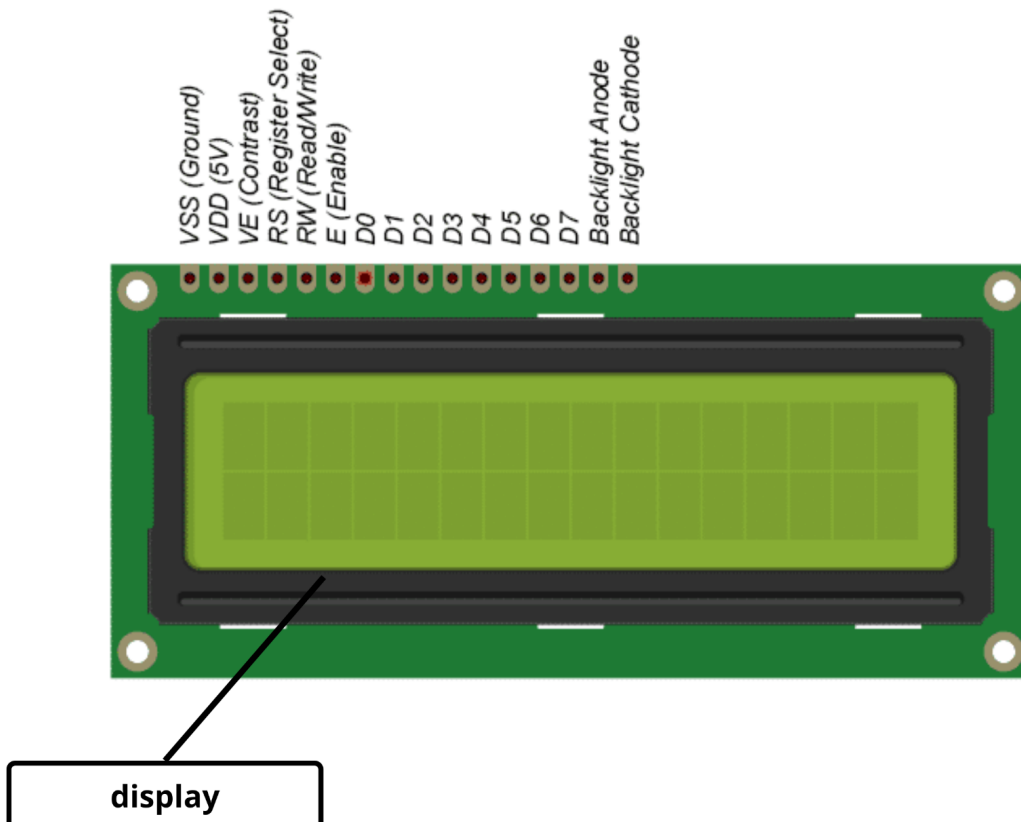
16x2 LCD display

LCD 16×2 is an electronic device that is used to display data and messages. As the name suggests, it includes 16 Columns & 2 Rows so it can display 32 characters ($16 \times 2 = 32$) in total & every character will be made with 5×8 (40) Pixel Dots. So the total pixels within this LCD can be calculated as 32×40 otherwise 1280 pixels. It is very useful in circuit specific circuit designs or projects where the data needs to be visible on the screen. Without having to use a monitor, it can show the required data on its display accordingly.

Components

A LCD display module has 16 pins:-

1. GND (the ground pin)
2. VCC (connected to 5v pin)
3. Vo (for attaching potentiometer)
4. RS (used for selecting if either commands or data is being sent)
5. R/W (toggle between read and write)
6. E (enable pin)
7. 7-14 D0-D7 (data pins)
8. Anode
9. Cathode





How to Use

Full Tutorial



Common Applications

1. For showing sensor data, for example, it's used to show the weather characteristics by using temperature and humidity sensors.
2. As a common display interface in complex devices.



Some Example Tasks

Display text on a LCD Arduino Tutorial



Safety Measures

1. Do not drop, bend or twist the LCD
2. Do not make extra holes on the printed PCB or modify its shape.



Important Links

Connect LCD to arduino boards YouTube Video



USB Cables

USB cables are used everywhere. Whether it is the task of transferring some sort of data (could be loading the program into the microcontroller boards), charging the devices or programming (USB debugging is a very common usage), USB cables come into play. A USB cable consists of two ends, both equipped with a connector (port) which is connected to the defined port size and then used for carrying our data transfer or charging tasks. There are various types of USB ports that we use from the electronics point of view:-

1. USB Type A
2. USB Type B
3. USB mini
4. USB micro
5. USB Type C



How to Use

Using a USB cable is just as simple as connecting both ends of the cable to the required devices' ports.



USB Type A

USB Type B

USB 3.0

USB Mini

USB Micro

USB Type C

USB Micro B

TechTerms.com



Common Applications

1. Used for charging devices when one end is connected to a power adapter.
2. Used for transferring data between devices or boards.



Safety Measures

1. Always make sure to not be in contact with the main supply.
2. Don't twist the cable beyond its limit



Important Links

Different types of USBs YouTube Video

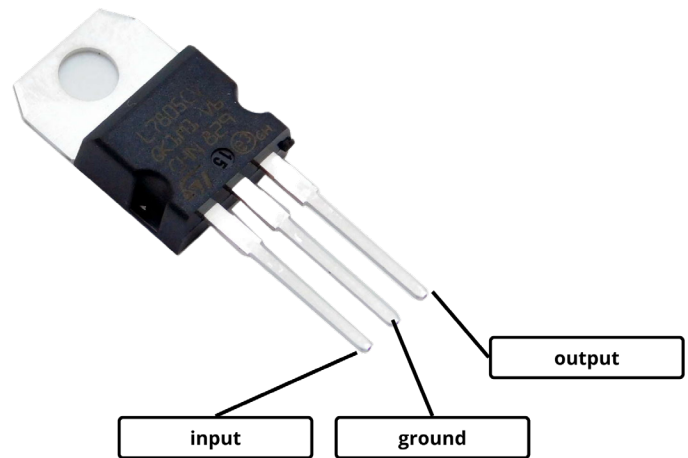


Linear Voltage Regulator

A linear voltage regulator is a small device which is used to supply a linear voltage (almost constant) in cases of fluctuations, to ensure the smooth functioning of other parts and prevent damage. It can be directly connected to the circuits and be used to make them safer and uniform.

Components

A voltage regulator contains 3 pins:- input, output and ground,



How to Use

Take a voltage regulator, connect its ground and connect the other pins in series with the circuit. A breadboard can be used to make temporary connections to first test them out.



Common Applications

1. One of the most common examples is the mobile charger. The adapter is supplied with an AC signal. However, the output voltage signal is a regulated DC signal.
2. Every power supply in the world uses a voltage regulator to provide the desired output voltage. Computers, televisions, laptops, and all sorts of devices are powered using this concept.
3. Small electronic circuits rely on regulators to operate. Even the slightest fluctuation in voltage signal can damage the components of a circuit such as ICs.
4. When it comes to power generation systems, voltage regulators play an essential part in their operation. A solar power plant generates electricity based on the intensity of sunlight. It needs a regulator to ensure a regulated constant output signal.



Some Example Tasks

1. Use linear voltage regulator in a circuit with capacitors and measure the input & output voltages using a multimeter.



Important Links

How to Use a voltage regulator YouTube Video



Safety Measures

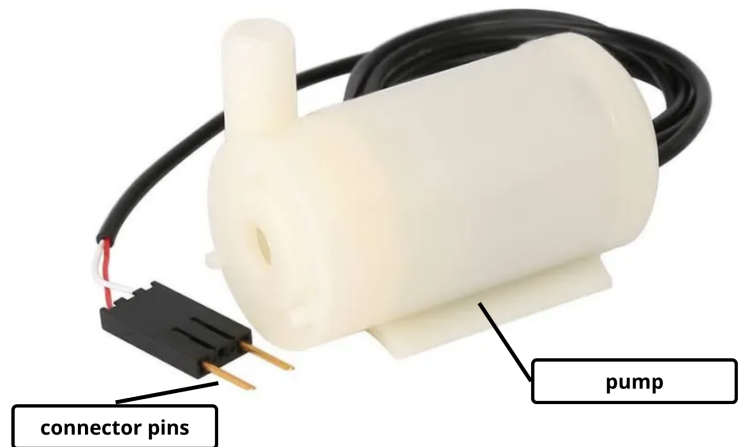
1. Don't use very high voltage on the regulator since it gets heated up very fast.

Water Pump Module

Water pump module is a mini water pump which is used to demonstrate and pump water for various use cases. It can be used to demonstrate something related to agriculture or to demonstrate some sort of cooling mechanism. The possibilities for putting it to use are endless.

Components

Usually, it has 2 connector pins that are connected to the circuit board, and a pump that takes the water through the inlet and then pumps it through the outlet.



How to Use

Full Tutorial



Common Applications

1. Used in smart agriculture processes
2. Can be used to automate plant watering.



Some Example Tasks

Make a moisture detector system with an automatic watering mechanism using a moisture sensor and water pump module



Safety Measures

1. Don't use it in the air for a long time since it would get heated up very quickly.



Important Links

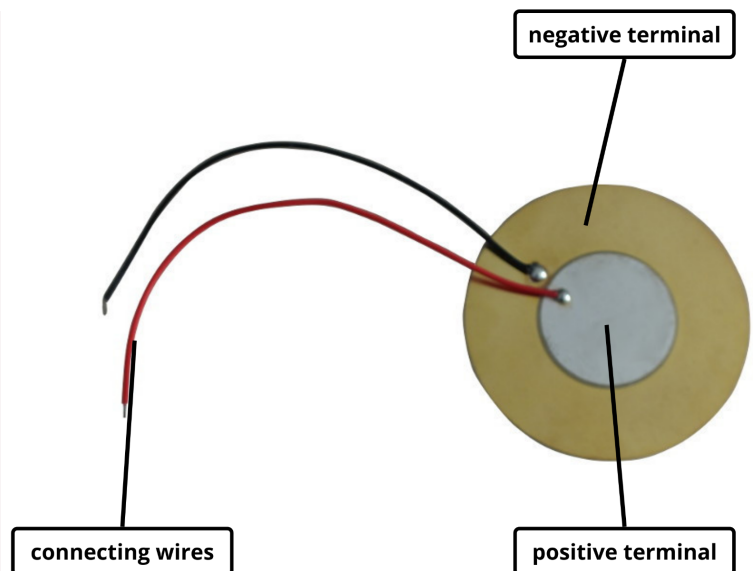
1. How submersible pumps work
2. How does a centrifugal pumps work YouTube Video



Piezoelectric plate

Piezoelectric plate converts mechanical energy into electrical energy. It converts the pressure that is applied to it, to electrical energy. Piezoelectric materials are the materials that can conduct electricity when put under force (example-quartz). Basically, when these materials are applied with force, their ions redistribute the arrangement and the material becomes polarised, which hence generates an electric field for a short period of time. These plates can be used to make a lot of projects and appliances.

A piezoelectric plate consists of two terminals, negative and positive, and connecting wires to each terminal.



How to Use

Take a piezoelectric plate, and connect its terminals in the circuit. Now, when the plate is applied with force, it'll generate voltage which can be noticed by putting a LED, motor or by measuring it through a multimeter.



Common Applications

1. Used in piezoelectric motors.
2. Used in piezoelectric buzzers.



Safety Measures

1. Don't use these plates with appliances that require constant voltage supply.



Some Example Tasks

1. Connect a LED with a piezoelectric plate and observe the effect after applying force to it.
2. Generate electricity using Piezoelectric Plate and light up an LED
3. Smart Shoes using Piezoelectric Plates



Important Links

Understanding piezoelectric effect
YouTube Video

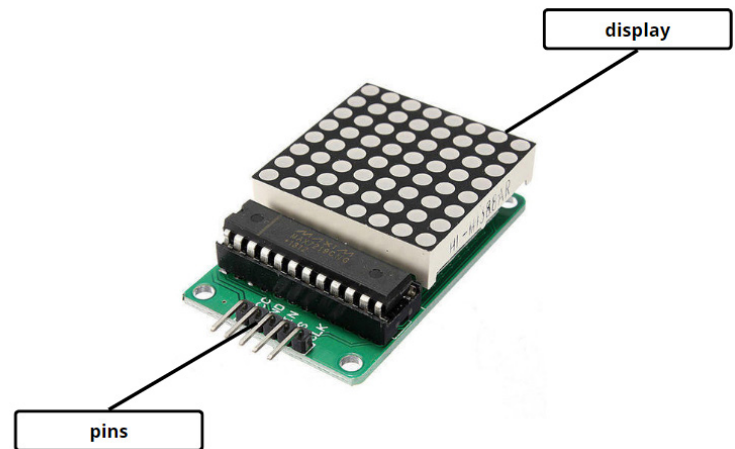


8x8 LED Matrix Module

LED Matrix Module (8×8) is an array of LEDs that you can display particular numbers, letters, and shapes on. Dot matrices are indicated by the number of rows and columns. The most popular type of Dot Matrix is its 8×8 type, which provides 64 LEDs in 8 rows and 8 columns.

Components

A LED matrix is just a grid arrangement of LEDs in the form of an IC with 4 digital pins required to make the connection.



How to Use

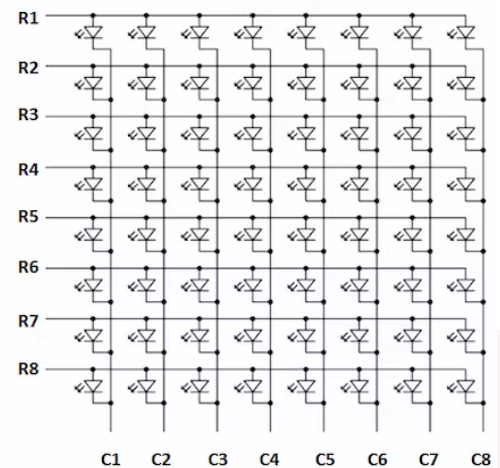
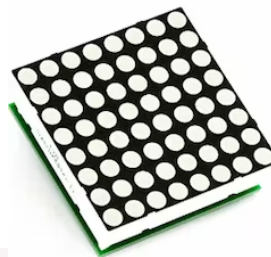
Full Tutorial



Common Applications

It is used in a lot of projects like:-

1. Pixel gaming
2. Bar graph displays
3. Character design



Some Example Tasks

Display Scrolling text in 8x8 LED matrix module



Safety Measures

1. Don't use it on a higher voltage rating than required.

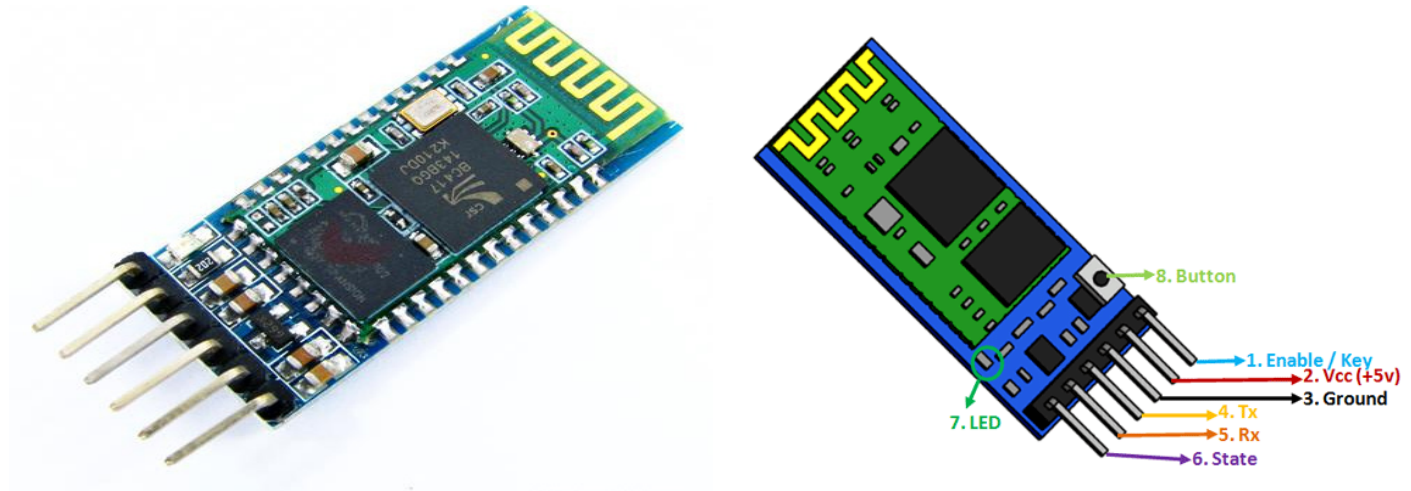
Important Links

1. How to connect a LED matrix module with arduino YouTube Video



Bluetooth Module

HC-05 is a Bluetooth device used for wireless communication with Bluetooth-enabled devices (like smartphones). This module can be used in a master or slave configuration. It communicates with microcontrollers using serial communication (USART). Default settings of the HC-05 Bluetooth module can be changed using certain AT commands.



HC-05 Pinout Configuration

Pin Number	Pin Name	Description
1	Enable / Key	This pin is used to toggle between Data Mode (set low) and AT command mode (set high). By default it is in Data mode
2	Vcc	Powers the module. Connect to +5V Supply voltage
3	Ground	Ground pin of module, connect to system ground.
4	TX - Transmitter	Transmits Serial Data. Everything received via Bluetooth will be given out by this pin as serial data.
5	RX - Receiver	Receive Serial Data. Every serial data given to this pin will be broadcasted via Bluetooth
6	State	The state pin is connected to on board LED, it can be used as feedback to check if Bluetooth is working properly.
7	LED	Indicates the status of Module <ul style="list-style-type: none">Blink once in 2 sec: Module has entered Command ModeRepeated Blinking: Waiting for connection in Data ModeBlink twice in 1 sec: Connection successful in Data Mode
8	Button	Used to control the Key/Enable pin to toggle between Data and command Mode



How to Use

The tutorial for interfacing HC-05 module with Arduino can be viewed using this link -
Getting Started with HC-05 Bluetooth Module & Arduino - Arduino Project Hub



Common Applications

- Microcontroller projects
- Communicate with Laptop, Desktops and mobile phones
- Data Logging application
- Consumer applications
- Wireless Robots
- Industrial control
- Home Automation



Some Example Tasks

1. Bluetooth Door Lock
2. Bluetooth Smart Fan
3. Talkative Home Automation
4. Bluetooth Controlled Car



Important Links

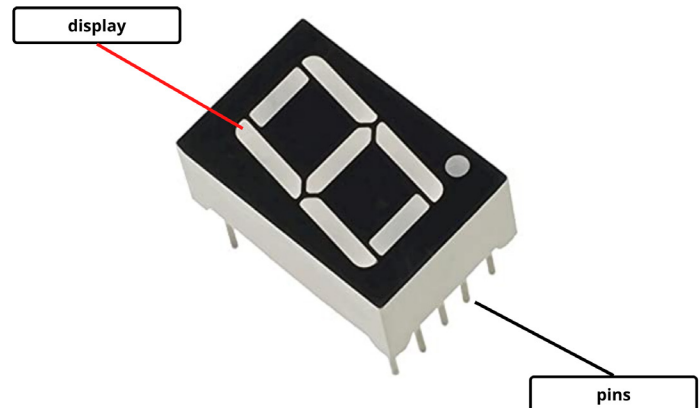
1. Additional Extensive Tutorial-Arduino and HC-05 Bluetooth Module Complete Tutorial
2. HC05 Datasheet
3. More Projects using Bluetooth Module



7 segment LED display

Many of us might have seen those arrangements of lights in many digital clocks and traditional calculators that light up in combinations to display different numbers. That display used to show decimal numerals is called a 7-segment display, 7-segment because it's an arrangement of 7 segments put into order to display the values.

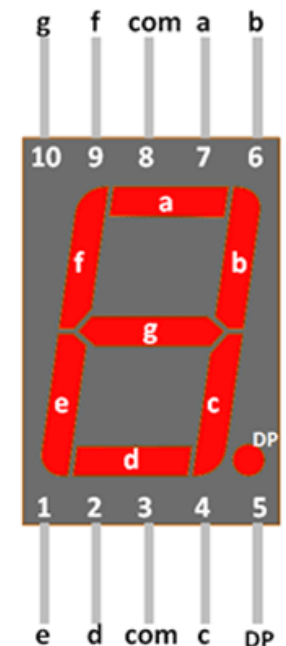
At its structural level, each of the segments is a LED which lights up or stays OFF based on what digit we're trying to show.



Pinout

A 7 segment display contains 10 pins in total. They're arranged as shown below:

1. Pin 1-e: The first pin1 connects with the left bottom LED of the display.
2. Pin 2-d: Pin2 helps to light up the bottom-most led.
3. Pin 3-com: This pin will be common with ground/power. It depends on the type of the 7-segment either it is the common cathode or anode.
4. Pin 4-c: Pin4 light up the bottom right led to the display
5. Pin 5-DP: There is a decimal point on the 7-segment which uses the pin5 to light up.
6. Pin 6-b: It controls the right top led light.
7. Pin 7-a: The top led of the 7-segments is at pin7.
8. Pin 8-com: Pin8 is a second common ground pin, works the same as pin3.
9. Pin 9-f: Top-left led lights up through pin9.
10. Pin 10-g: Power input on pin10 lights up the middle led.



How to Use

Tutorial



Common Applications

- Digital clocks
- Electronic metres
- Basic calculators



Some Example Tasks

1. Show digits on a 7 segment LED display using arduino
2. Create a counter using a button and 7 segment display



Safety Measures

1. The maximum current rating and the connections inside different 7-segment displays may be different, and not using the devices correctly can “burn out” an LED (it is unlikely that the 7-segment will actually become hot, but the LED inside the segment can become unusable)



Important Links

1. Know about 7 segment display YouTube Video

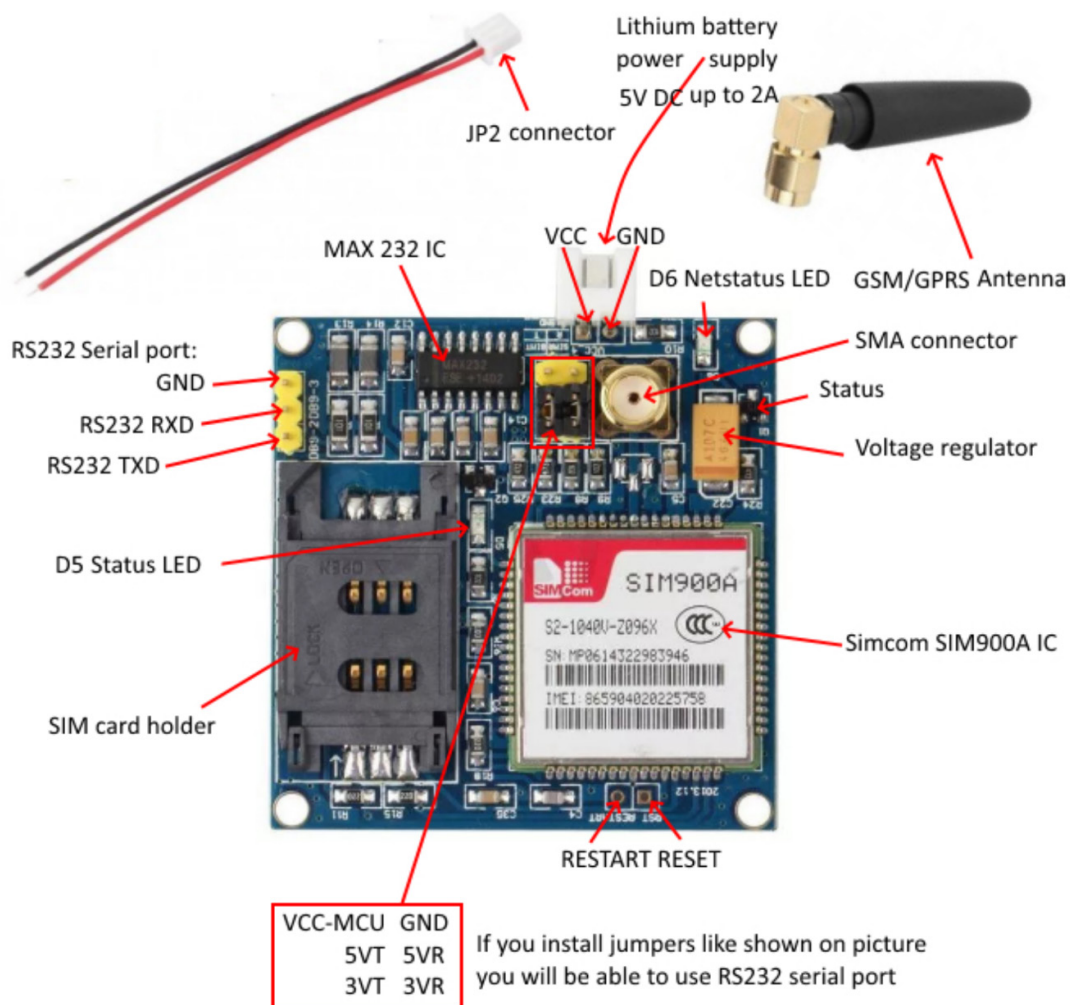


GSM Module

GSM is an international standard for mobile telephones. It is an acronym that stands for Global System for Mobile Communications. It is also sometimes referred to as 2G, as it is a second-generation cellular network. To use GPRS for internet access, and for the Arduino to request or serve web pages, you need to obtain the Access Point Name (APN) and a username/password from the network operator. We also require a SIM card to be used to facilitate the GSM for us.

Components

The module hardware consists of a GSM module, voltage level shifter, SIM circuit and Atmega328P microcontroller. Microcontroller provides control for sending, receiving and AT command processing to the GSM module. The firmware is responsible for handling tasks related to communication between device and host server. It processes all incoming SMS, extract, and store new configuration from Host, transmits alert/notification SMS when the radiation data reach/exceed threshold value, and transmits SMS data at every fixed interval according to configuration. Integration of this module with radiation survey/monitoring device will create mobile and wireless radiation monitoring systems with prompt emergency alert at high-level radiation.





How to Use

Tutorial



Common Applications

1. Connect onto any global GSM network with any 2G SIM
2. Make and receive voice calls using an external earphone & electret microphone
3. Send and receive SMS messages
4. Send and receive radio transmission data



Some Example Tasks

1. Making a call with arduino using GSM module
2. Send SMS using Arduino and GSM Module



Safety Measures

1. Only use compatible SIM card with GSM module.



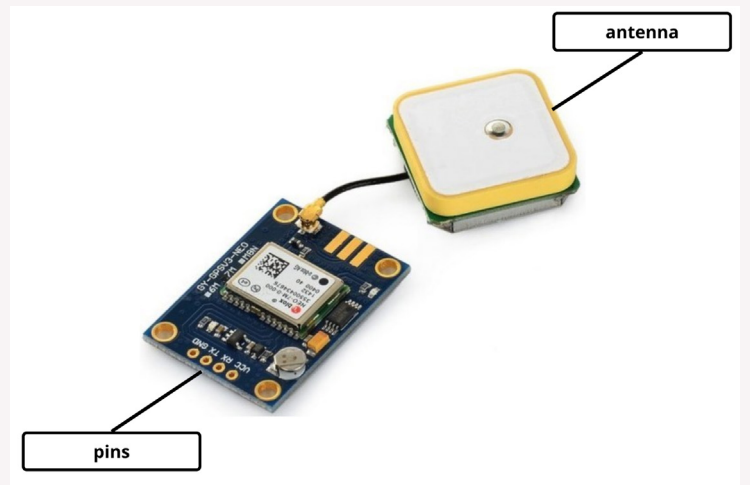
Important Links

1. Overview of SIM900 GSM module YouTube Video
2. What is GSM (Global System For Mobile Communication)



GPS Module

GPS (Global Position System) is a navigation system based on satellites, made up of at least 24 satellites. It is capable of working in any weather conditions, and from anywhere in the world. GPS satellites transmit at least 2 low-power radio signals. The signals travel by line of sight, meaning they will pass through clouds, glass and plastic but will not go through most solid objects, such as buildings and mountains. However, modern receivers are more sensitive and can usually track through houses. The NEO-6M module comes with an external antenna and does not come with header pins. So you will need to solder it. This module can be connected and mounted on Arduino and made to work accordingly.



Components

A GPS module consists of 4 pins:-

1. VCC: Positive power pin
2. RX: UART receive pin
3. TX: UART transmit pin
4. GND: Ground

Other than that, a GPS module has

1. NEO-6M GPS Chip
It is responsible for tracking satellites to get location.
2. 3.3V LDO Regulator
The operating voltage of the NEO-6M chip is from 2.7 to 3.6V. But, the module comes with MIC5205 ultra-low dropout 3V3 regulator from MICREL. The logic pins are also 5-volt tolerant, so we can easily connect it to an Arduino or any 5V logic microcontroller without using any logic level converter.
3. Position Fix LED Indicator
There is an LED on the NEO-6M GPS Module which indicates the status of Position Fix. It'll blink at various rates depending on what state it's in.
4. Battery & EEPROM
An EEPROM together with a battery helps retain the battery backed RAM (BBR).



How to Use

Tutorial





Common Applications

1. Location - determining a position.
2. Navigation - getting from one location to another.
3. Tracking - monitoring object or personal movement.



Some Example Tasks

1. Build a destination notifier using Arduino
2. Vehicle Tracking System



Safety Measures

1. Make sure that the connections are made right and wait for the LED to start blinking to ensure that it's working.

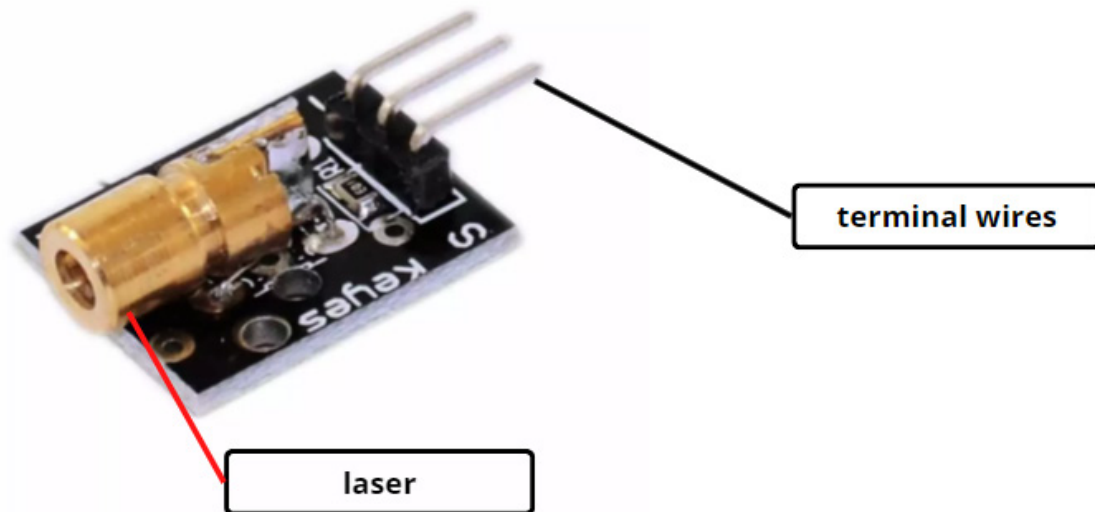


Important Links

1. How GPS works
2. How to Use a neo 6m module YouTube Video



Laser Diode Emitter



There are times when we want to use laser lights in our projects. These lights are theoretically perfectly parallel and the intensity remains concentrated in the axis of traversal of light. A laser module is very easy to use, you can use Arduino control, do controllable laser pointer, theft detection, etc. interesting application devices. The laser head is composed of a light-emitting tube, condenser lens and adjustable copper sleeve and it is assembled when delivered, the focal length of the lens is adjusted by a strong glue stick, which can work directly after connecting to a 5V DC power supply.



How to Use

Tutorial



Common Applications

1. Military and law enforcement devices.
2. Barcode scanners.
3. Anti-theft devices.
4. Fun games like dodging laser beams.



Some Example Tasks

1. Laser Light Security System Using Arduino with Alarm



2. Make a laser pointing tank using raspberry pi and laser diode module



Safety Measures

1. Never put eyes directly in the path of traverse of light.
2. Use appropriate protection devices to prevent exposure of high beam light.

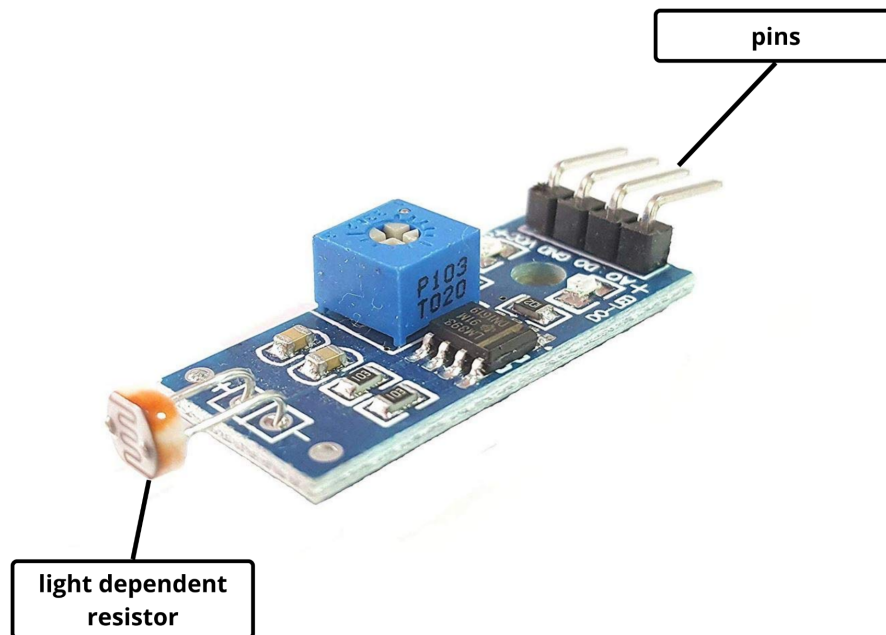


Important Links

1. Working principle of laser YouTube Video



LDR Module



LDR (light dependent resistor) module is a sensor module which is used to detect the presence of light or to measure its intensity. It is simply a resistor which potentiates with the intensity of light. The output of the module becomes higher and higher as the presence of light increases and vice versa. The sensitivity of the signal can be adjusted using a potentiometer.

Components

A LDR module has 4 pins:-

1. VCC: +5 v power supply Input Pin
2. GND: Ground (-) power supply Input Pin
3. DO: Digital Output Pin
4. AO: Analog Output Pin

Other than pins, it has the following components:-

1. Light Dependent Resistor
This is the part of the module which does the actual work of detecting the intensity of light and working as a resistor.
2. Variable Resistor (Trim pot)
This part is used to vary the sensitivity of the LDR.
3. Power LED
This indicates if the power is reaching the LDR module or not.
4. Output LED

When the LDR sensor detects the light, the output LED is turned on. When the LDR sensor detects darkness, the output LED is turned off.



How to Use

Detailed Project Tutorial



Common Applications

1. Used to detect the intensity of light.
2. Used to design automatic ON/OFF systems.



Some Example Tasks

1. Make an Automatic Street Light



Safety Measures

1. Do not use a Sensor in an environment where there are explosive or inflammable gases.
2. Do not use the Sensor in environments where the cables may become immersed in oil or other liquids or where liquids may penetrate the Sensor. Doing so may result in damage from burning and fire, particularly if the liquid is flammable.

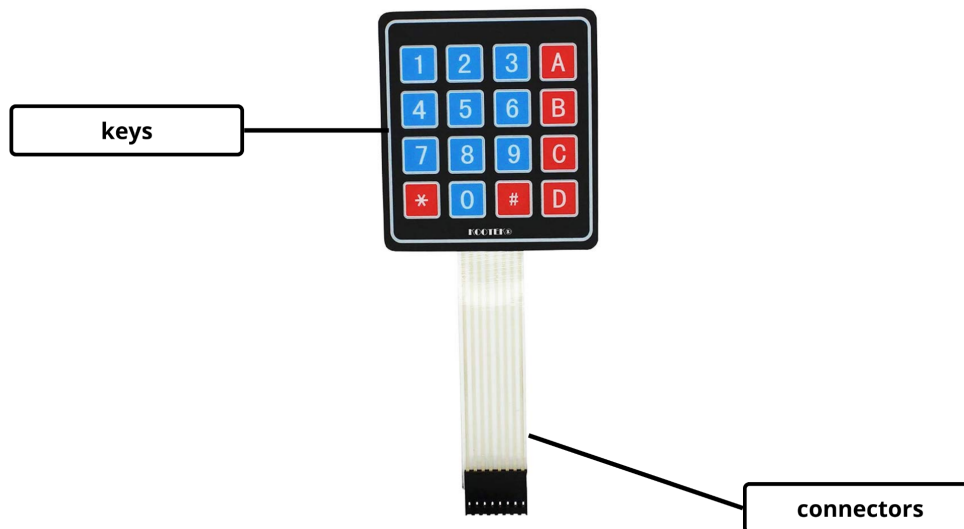


Important Links

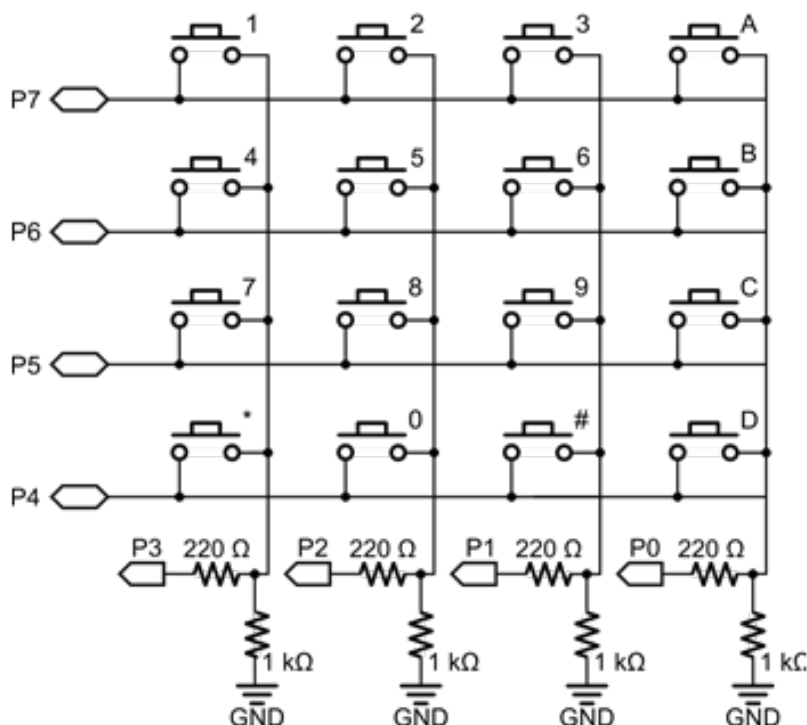
1. Overview of a Light Dependent Resistor YouTube Video



Keypad



Many times, we are required to put inputs to our microcontroller based projects, that is when a 4 x 4 matrix keypad comes into play. It has 16 keys in total that acts as input keys for specific characters/digits. Beneath each key is a membrane switch. Each switch in a row is connected to the other switches in the row by a conductive trace underneath the pad. Each switch in a column is connected the same way – one side of the switch is connected to all of the other switches in that column by a conductive trace. Each row and column is brought out to a single pin, for a total of 8 pins on a 4X4 keypad:





How to Use

Project Tutorial



Common Applications

1. To take inputs from users.



Some Example Tasks

1. Secure lock using keypad module
2. Tech-TicTacToe using Keypad and LED Matrix



Safety Measures

1. Don't press the keys on the keypad with excessive pressure.
2. Make sure that it is not placed in a circuit that's producing excess heat.



Important Links

1. How does a keypad module work YouTube Video



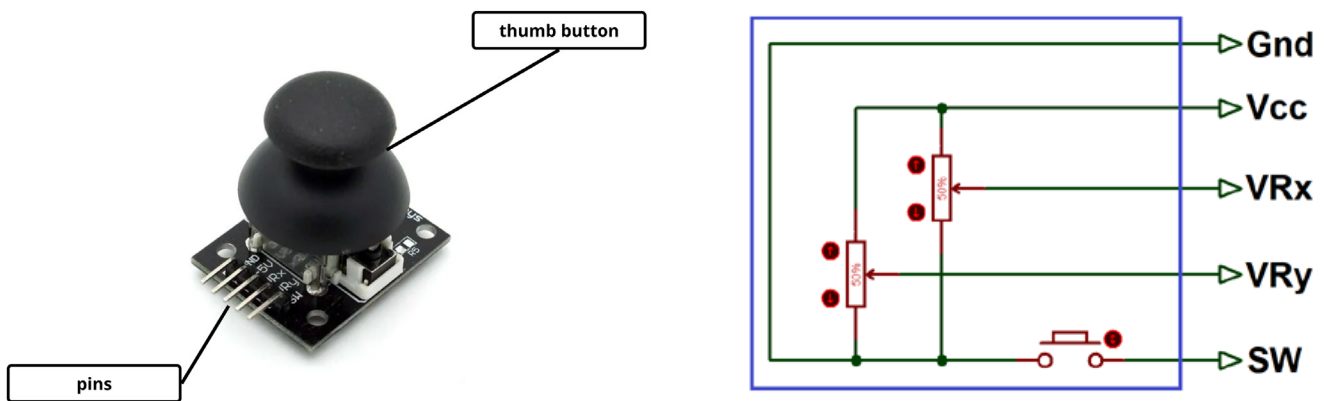
Joystick

Joysticks are very often related with games, present on console controllers and used to manage players movements. But, in actuality, it's used in a lot more places. Technically, a joystick is an input device consisting of a stick that pivots on a base and reports its angle or direction to the device it is controlling. The joystick is similar to two potentiometers connected together, one for the vertical movement (Y-axis) and other for the horizontal movement (X-axis).

Generally, a joystick module contains 5 pinouts. They're as follows:

1. GND: Ground terminal of Module
2. +5V: Positive supply terminal of Module
3. VRx: Voltage Proportional to X axis
4. VRy: Voltage Proportional to Y axis
5. SW; Switch

Internally, the arrangement of the circuit looks like the diagram below:



How to Use

Project Tutorial



Common Applications

1. Game controllers
2. Robot Controllers
3. Drones



Some Example Tasks

1. Make a mouse for PC using a joystick Tutorial
2. Arduino Marble Maze Labyrinth
3. Make a Laser Turret for Your Cat



Safety Measures

1. Don't try to move it beyond its limit, by excessive force.



Important Links

1. How Joysticks work
2. Connecting a joystick module with arduino uno YouTube Video
3. Evolution of controllers



Active Buzzer

A buzzer, also called a piezo buzzer, is basically a tiny speaker that you can connect directly to an Arduino or use directly to produce sound. You can make it sound like a tone at a frequency you set. Piezo buzzers are constructed by placing electrical contacts on the two faces of a disk of piezoelectric material and then supporting the disk at the edges in an enclosure. When a voltage is applied across the two electrodes, the piezoelectric material mechanically deforms due to the applied voltage. This movement of the piezo disk within the buzzer creates sound



How to Use

1. If your buzzer has a sticker on top of it, pull it off. Connect one pin (it doesn't matter which one) to the Arduino's ground (Gnd) and the other end to digital pin 10. From the Arduino, you can make sounds with a buzzer by using tone function of Arduino.
2. Tutorial



Common Applications

1. Siren in security locks
2. Alarm devices
3. Any project where sound needs to be produced



Safety Measures

1. Do not insert foreign objects into the sound-emitting hole or open hole.
2. Do not use this product in an atmosphere containing chlorine gas, sulfidizing gas, acid, or other corrosive substances.



Some Example Tasks

Make a door lock using a buzzer



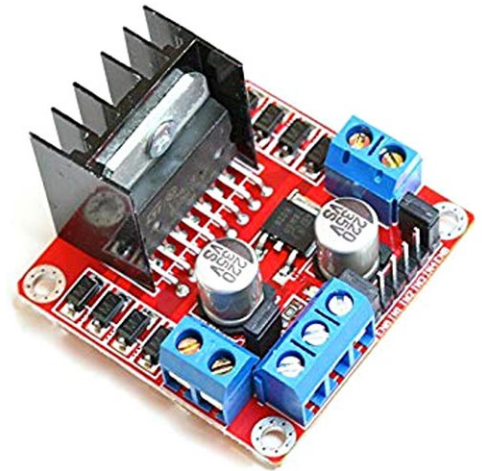
Important Links

1. How Buzzer works
2. Understand Piezoelectricity



Motor Driver Module

A motor driver module is a simple circuit used for controlling a DC motor. It is commonly used in autonomous robots and RC cars (L2938N and L293D are the most regularly utilized motor driver chips). A motor driver module takes the low voltage input from a controller like Arduino. This input logic controls the direction of DC motors connected to the driver. To put it in simple words, you can control the direction of DC motors by giving appropriate logic to the motor driver module. The motor driver module consists of a motor driver IC, which is the heart of the module. The IC alone can control the DC motor but using the module makes the interfacing with Arduino easy.



How to Use

Tutorial



Common Applications

A motor driver is necessary because the microcontroller requires lower-level voltage than the motors. Due to this, we cannot supply power directly from the microcontroller to the motor. We need a motor driver in between these electrical components at this point. The driver steps up the current from the microprocessor to match the motor current.



Some Example Tasks

1. Attach a motor driver to the arduino and run motors using it.



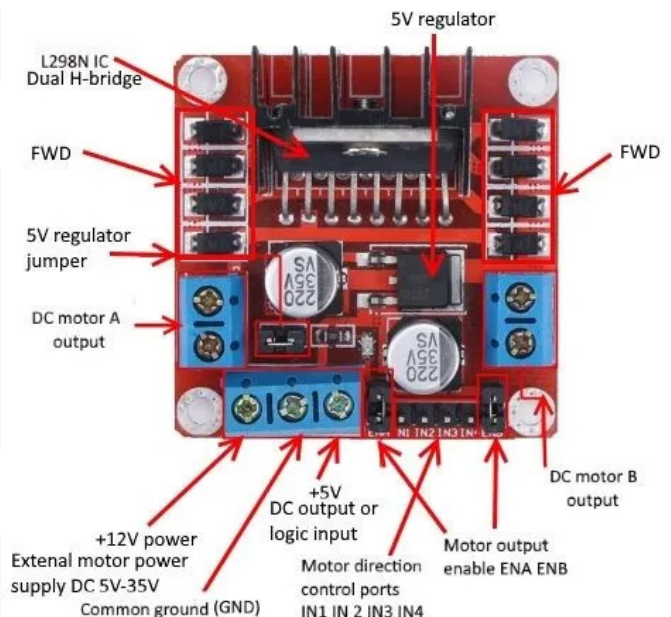
Safety Measures

1. Don't overload the motor driver with motors rated at higher voltages than the specified values.



Important Links

1. About Motor Drivers
2. Different types of motor drivers YouTube Video

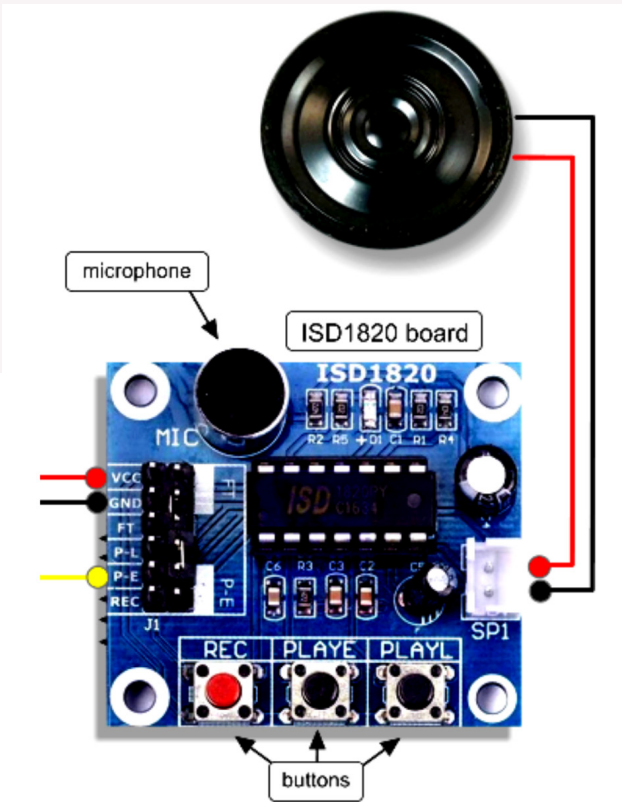


Sound playback module

Voice Recorder is a device that captures speech (or audio) in various situations like meetings, lectures, interviews, conferences, broadcasts etc. so that you can easily edit or play them back. The most common sound playback module is ISD 1820 Voice Recorder Module. It is based on ISD1820, which is a multiple-message record/playback device. It can offer true single-chip voice recording, no-volatile storage, and playback capability around 10-20 seconds. The module is very handy and easy to use with various microcontroller boards.

Pin	Function
VCC	DC 2.4-5.5V
GND	Ground
FT	FeedThrough: This mode enables the Microphone to drive the speaker directly.
REC/REC (Button)	The module starts recording whenever REC is HIGH.
MIC	microphone input

P-E/PLAY-E (Button)	Playback, Edge-activated
P-L/PLAY-L (Button)	Playback, Level-activated,
SPI	The SP+ and SP- pins provide a direct drive for loudspeakers with impedances as low as 8Ω.
Power Supply	3.3V



How to Use

Tutorial



Common Applications

1. Security Systems
2. Accident voice recordings
3. Record message during collisions



Some Example Tasks

1. Make a voice recording project using Arduino and sound playback module
2. Make a voice player project controlled by ultrasonic sensor



Safety Measures

1. The module contains delicate parts so it should be handled with care.



Important Links

1. The Science behind Sound
2. Video Tutorial



Vibrating Motor

Vibrating motors are small DC motors that are often used to send signals in form of vibrations, unlike sound. These motors are used in a lot of appliances and devices like cell phones, handsets, etc. It has two terminal wires that when connected through a battery produce the vibrations. A vibrating motor has a very simple design just like every common motor. It has two connecting wires, body and a rotor which rotates while in the connection. The operating voltage range of vibrating motors is generally. 2.4 V to 3.5 V



How to Use

To use the motor, connect the wires of the motor in a circuit with a battery. Attach some sort of a toggle switch to turn it ON or OFF. That is it, the motor should then rotate when ON and produce vibration.



Common Applications

1. Mobile Phones
2. Joysticks



Some Example Tasks

1. Connect a vibrating motor to the battery and check its vibrations
2. Turn on and off the vibration motor for one second each minute using Arduino



Safety Measures

1. The rotor of the motor shouldn't be put in contact with delicate materials as it can damage them.
2. Avoid using a vibrating motor for longer durations as it may get heated up.



Important Links

1. Video Tutorial



Timer IC-LM 555

A LM-555 Timer is a commonly used IC designed to produce a variety of output waveforms with the addition of an external RC network. The name 555 is derived from the fact that it has 3 resistors with values of 5Ω each. It is a highly stable device for generating accurate time delays or oscillation. Additional terminals are provided for triggering or resetting if desired. In the time delay mode of operation, the time is precisely controlled by one external resistor and capacitor. For a stable operation as an oscillator, the free running frequency and duty cycle are accurately controlled with two external resistors and one capacitor. The circuit may be triggered and reset on falling waveforms, and the output circuit can source or sink up to 200 mA or drive TTL circuits.

A 555 Timer IC has 8 pins for different purposes, as listed down:-

1. Ground
2. Trigger
3. Output
4. Reset
5. Control
6. Threshold
7. Discharge
8. VCC



How to Use

Tutorial





Common Applications

1. PWM (Pulse Width Modulation) & PPM (Pulse Position Modulation)
2. Duty Cycle Oscillator
3. To generate Pulse, Waveform, and square wave.



Some Example Tasks

1. Automatic Time Indicator for Telephone using IC 555
2. Latching Touch Sensitive Alarm Circuit Using 555 Timer IC



Safety Measures

1. Use the product within the ratings specified for ambient operating temperature and ambient operating humidity for each model.
2. Separate the input devices, input wiring, and product as far as possible from sources of noise and power lines carrying noise.



Important Links

1. How does 555 Timer IC work YouTube Video



Button Switch Set

A switch is an electronic component which is used to break connections between a circuit. It can be used to have two states, on or off. That is why it is also considered as a binary device. When an electronic switch is on, it is considered closed in a circuit. When the switch is classified as off, the switch is open in the circuit. When someone presses the button, it touches with the stationary contacts, causing the action to take place. In some cases, the user needs to keep holding the button or to press it repeatedly, for an action to take place. With other pushbuttons, a latch connects and keeps the switch on until the user presses the button again.

There are a number of types of buttons that should be used, namely:-

1. Push
2. Toggle
3. Rotary
4. Selector
5. Slide



How to Use

Tutorial



Common Applications

1. To turn ON and OFF the flow of current in a circuit
2. Buttons are used in calculators, push button phones, etc.



Some Example Tasks

1. Dim LEDs using a push button and Arduino using PWM
2. Design Dodge the Defenders Game using a push button and LCD



Safety Measures

1. Do not touch the terminals or other charged parts of the Switch while power is being supplied.
2. Do not use damaged switches.

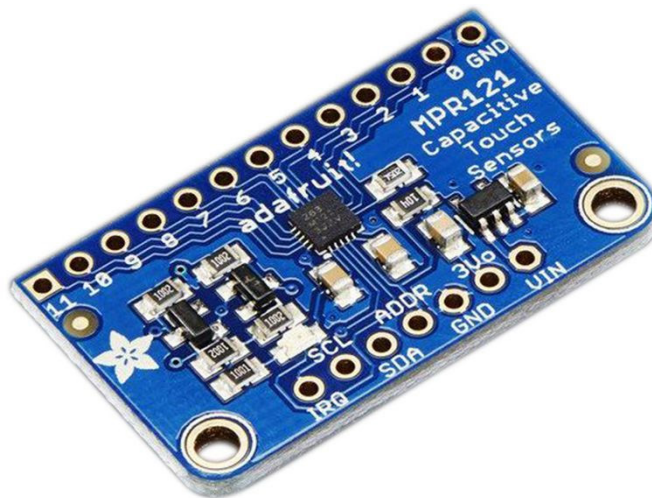


Important Links

1. How does a push button works YouTube Video
2. Different types of switch buttons used in industry YouTube Video



Capacitive Touch Module



Its amazing that we just touch our mobile screens and they work like magic and do things. Now it is very common so we might not feel very awed about it. But, if you think, that's a great invention and leap of technology, where a simple touch can be used as an input in devices to perform actions. The module which is responsible for carrying it out is the capacitive touch module.

A MPR121 module features 20 pins, as follows:

Pin	Function
IRQ	Open Collector Interrupt Output Pin, active low
SCL	I2C clock
SDA	I2C data
ADDR	I2C Address Select Input Pin. Connect the ADDR pin to the VSS, VDD, SDA or SCL line, the resulting I2C addresses are 0x5A, 0x5B, 0x5C and 0x5D respectively
VREG	Internal Regulator Node - Connect a 0.1 μ F bypass cap to VSS
VSS	Ground
REST	External Resistor - Connect a 75 k Ω 1% resistor to VSS to set internal reference current
ELE0-ELE11	Electrode 0 to Electrode 11
VDD	Connect a 0.1 μ F bypass cap to VSS



How to Use

A step-by-step tutorial



Common Applications

1. Mobile phones.
2. Touch pads, touch slide bars, etc.



Some Example Tasks

Make a music organ using capacitive touch module MPR 121



Safety Measures

- Do not put anything liquid with the interface of the module.
- Don't apply excess pressure to the sensor part as it may get damaged.

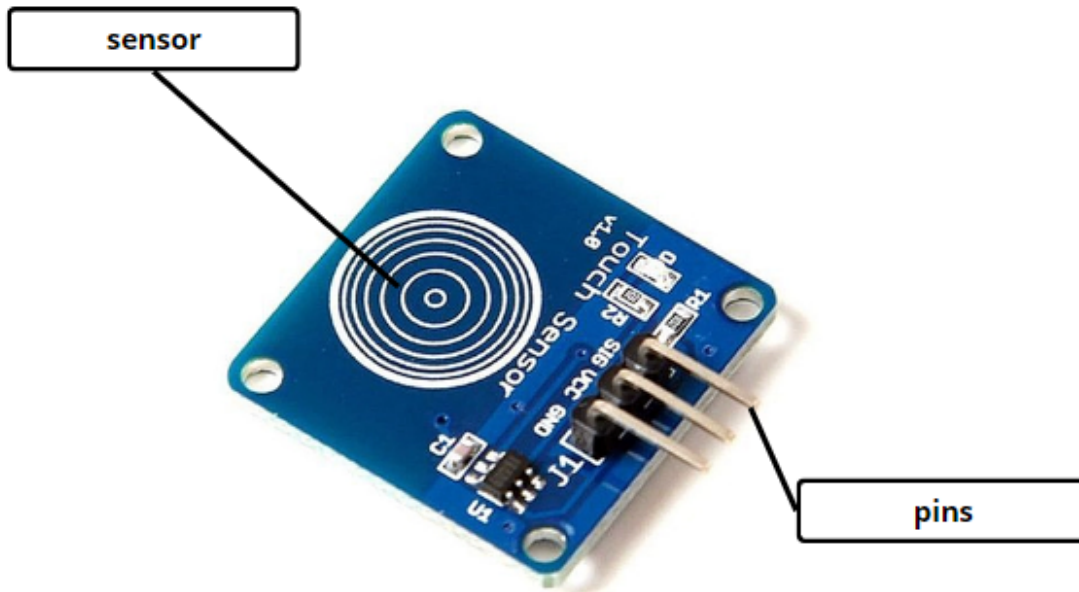


Important Links

1. How to Use MPR 121 module YouTube Video



Capacitive Touch Switch Module



A capacitive touch switch module (TTP223) is a touch pad detector integrated circuit which works as a single tactile button, which means, it can be used to sense touch inputs as switch buttons and do the work accordingly. This touch detection IC is designed for replacing traditional direct button keys with diverse pad sizes. The touch plate of the sensor is present in the opposite face of the pins.

There are two bridges in the TTP223 module. It has 3 modes, depending upon which bridge is soldered.

BRIDGE A	BRIDGE B	MODE
unsoldered	unsoldered	Touch to ON (initially low)
unsoldered	soldered	Touch to OFF (initially high)
soldered	soldered	Self locking switch (initially low)
soldered	unsoldered	Self locking switch (initially high)

Like many other modules, it also has 3 pins:-

1. GND-ground
2. I/O-input/output
3. VCC-power



How to Use

Tutorial



Common Applications

1. Used as an alternative to touch pad switches.



Some Example Tasks

1. Make a circuit and control its ON/OFF states using capacitive touch switch module



Safety Measures

- ⦿ Do not put anything liquid with the interface of the module.
- ⦿ Don't apply excess pressure to the sensor part as it may get damaged.



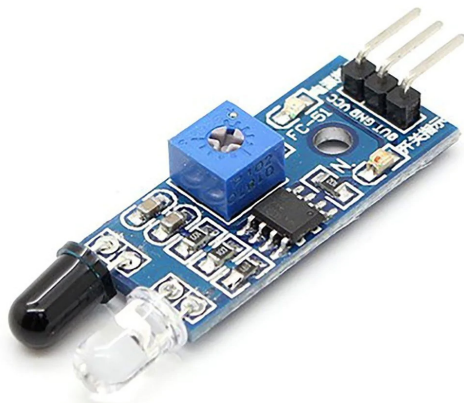
Important Links

1. How to Use a capacitive touch switch YouTube Video
2. Using a touch sensor switch without a microcontroller YouTube Video

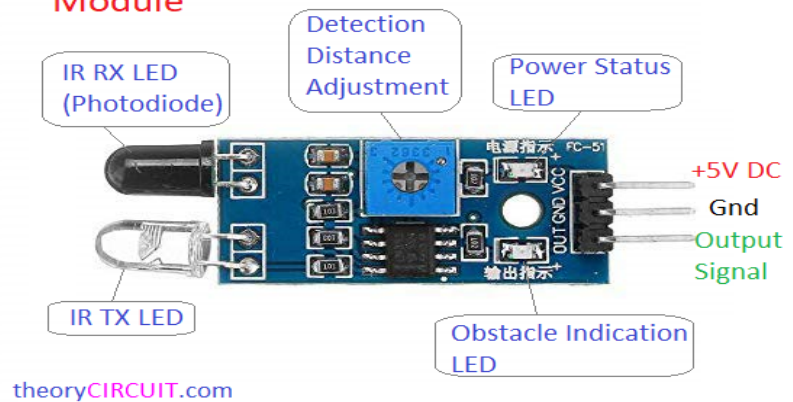


IR Sensors, obstacle avoider sensor module

The IR sensor is used to sense if there is some sort of obstacle in its line of sight. It does that by sending an IR (infrared) light from the transmitter end, which isn't visible to the normal eyes, and then, if there's some sort of obstacle, then the light is reflected back and is detected by the receiver. The sending process is continuous and as soon as the obstacle is detected, we can use it to perform our required output. The Detection Range of an IR sensor is 2 to 20cm & the Detection Angle is 30° to 40°



IR Infrared Obstacle Avoidance Sensor Module



A IR obstacle avoider sensor contains:-

1. Transmitter LED
2. Receiver LED
3. Detection distance adjuster
4. Power LED
5. Obstacle detection LED
6. Pins (power, ground, output)



How to Use

Tutorial



Common Applications

1. In obstacle avoider robots.
2. In aids for visually impaired.



Some Example Tasks

1. How to use a capacitive touch switch
2. Using a touch sensor switch without a microcontroller



Safety Measures

1. Avoid using or storing the sensor under direct sunlight.
2. Avoid using it in regions with chemical or gaseous exposures.



Important Links

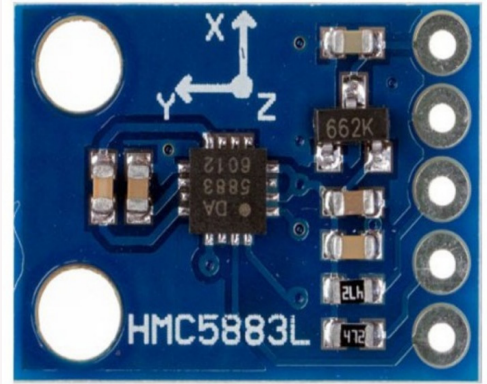
1. How to Use a IR sensor with Arduino
2. Working of an IR sensor



Triple axis magnetometer

A magnetometer is used to find directions, by aligning itself with the earth's magnetic field. There are many types of magnetometers such as fluxgate, magnetoresistive, magneto-inductive and others.

Earth's magnetic field is present in space which points towards the magnetic north. Current carrying conductor also generates a magnetic field around itself. Hence, whenever a current carrying conductor is placed in space, it experiences the effect of the earth's magnetic field affecting the flow of the electrons through that conductor. These changes in the flow of the electrons are used for identifying the heading or direction of the magnetic field. This is the basic working principle of the magnetometer. The HMC5883L uses a magnetoresistive sensor arranged in a bridge circuit, which is made of nickel-iron (Ni-Fe magnetic film) material. A HMC5883L module has 5 pins:- VCC, GND, SCL, SDA, and DRDY



How to Use

Tutorial



Common Applications

1. Used to detect orientation of mobile phones.
2. Used in digital compasses.



Some Example Tasks

1. Make a compass using magnetometer



Safety Measures

1. Any sort of external magnetic force would distort the readings of the magnetometer.

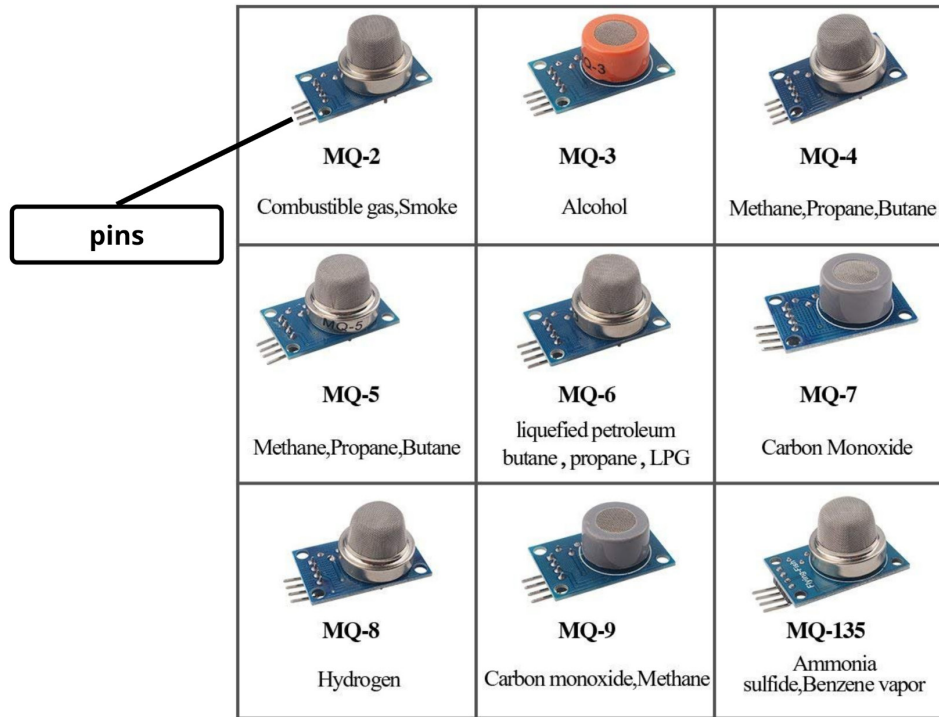


Important Links

1. How does a magnetometer work YouTube Video



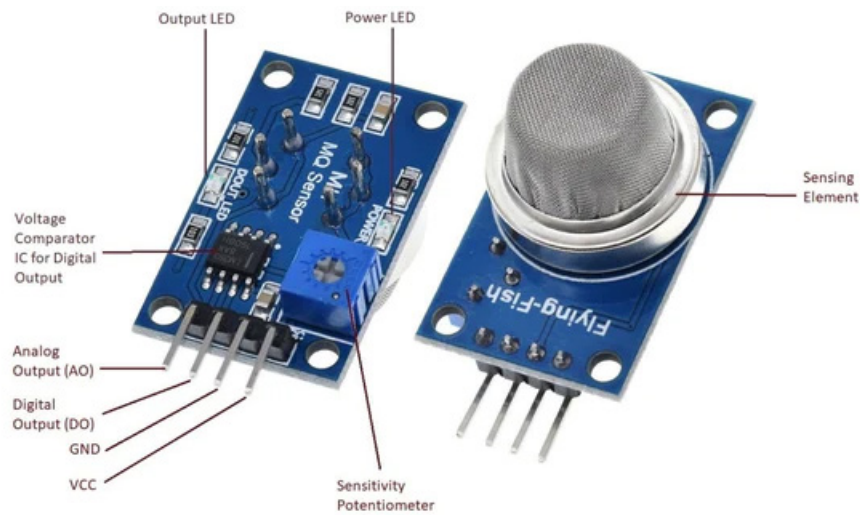
MQ Series Sensors



MQ Series are a set of gas sensors that are used to identify different types of gases. They are very useful in measuring the gas concentration and can be used in sensitive areas such as chemical industries. Each type of MQ sensor is designed to detect specific gases. We've a lot of MQ sensors. Some most commonly used ones are:

Sensor	Used in the detection of
MQ-2	Combustible gas, smoke
MQ-3	Alcohol
MQ-4	Methane, propane, butane
MQ-5	Natural gas, LPG
MQ-6	Propane, LPG
MQ-7	Carbon monoxide
MQ-8	Hydrogen
MQ-9	Carbon monoxide, methane
MQ-135	Ammonia sulfide, benzene vapour

A MQ sensor has 4 pins and many other components, depicted in the image below:



How to Use

Tutorial



Common Applications

1. Used in factories to monitor chemical exposure level.
2. Used in smoke detectors.
3. Used to check alcohol levels.



Safety Measures

1. Don't release poisonous gases in excess just for the sake of testing them.



Important Links

1. A brief intro on MQ sensors YouTube Video
2. How to make a smoke detector alarm YouTube Video



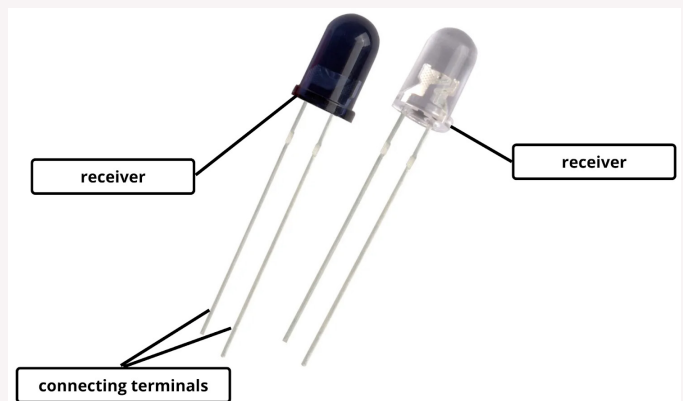
Some Example Tasks

1. Checking alcohol level using MQ-2 and Arduino



IR Transmitter/Receiver

IR transmitter and Receiver are commonly used in devices which can be controlled with the help of remote. TV remotes are the best example for IR transmitters. IR Led emits infrared rays which cannot be seen with normal open eyes as its wavelength is very low (700nm – 1mm) as compared to visible light. The transmitted light then can be detected with a receiver. There's a very cool trick if you want to observe IR lights. Although our eyes can't see them, cameras of many mobile phones can. All you have to do is open the camera, and then light up the IR light, you can use a TV or AC's remote for that. And then, you shall be able to see how it lights up on button press.



How to Use

Tutorial



Common Applications

1. In Tv remote and Ac remotes.
2. For simple remote controlling applications & small data transfers.



Some Example Tasks

1. How to Use IR Receiver Module with Arduino Raspberry Pi (Youtube link)
2. Lighting a Led with the help of IR transmitter and Receiver (Youtube link)



Safety Measures

1. The module contains delicate parts so it should be handled with care. Be careful to not bend the LEDs

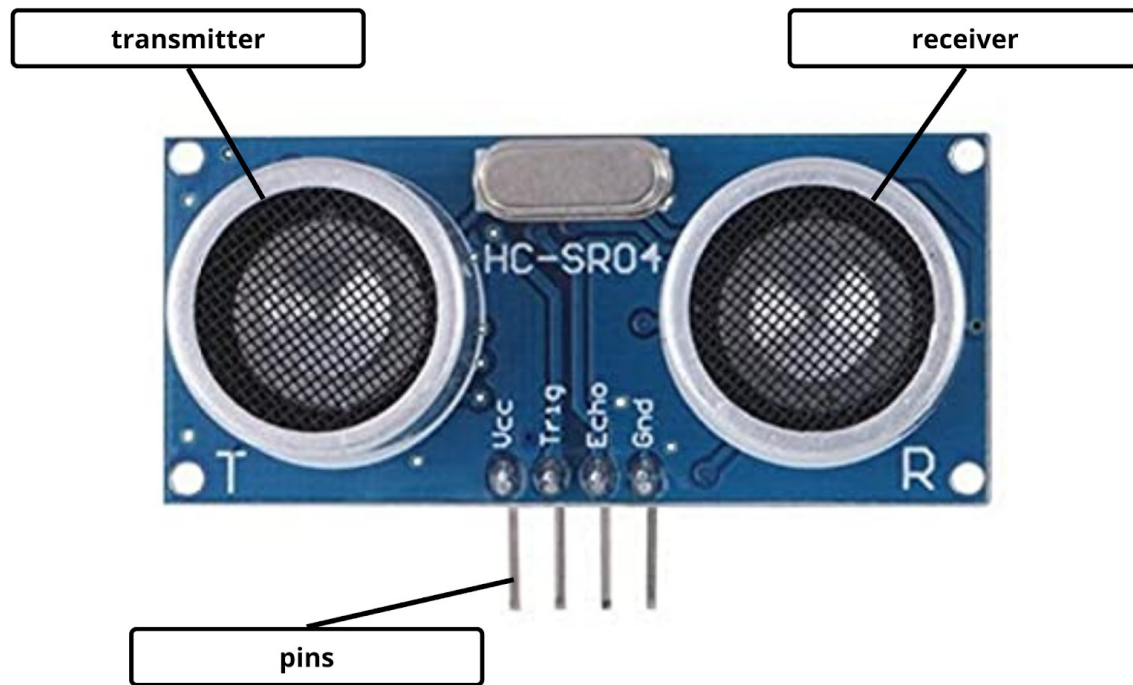


Important Links

1. IR transmitter and receiver circuits
2. Guide to Infrared Communication



Ultrasonic sensor module HC-SR04



This is the HC-SR04 ultrasonic distance sensor. This economical sensor provides 2cm to 400cm of non-contact measurement functionality with a ranging accuracy that can reach up to 3mm. Each HC-SR04 module includes an ultrasonic transmitter, a receiver and a control circuit. It is used to measure the distance of the obstacle in front of it. An ultrasonic wave is sent from the transmitter of the module, and then the wave is reflected back and received at the receiver.

The module consists of 4 pins:-

1. VCC-Power
VCC supplies power to the HC-SR04 ultrasonic sensor. You can connect it to the 5V output from your Arduino.
2. Trigger
Trig (Trigger) pin is used to trigger ultrasonic sound pulses. By setting this pin to HIGH for 10's, the sensor initiates an ultrasonic burst.
3. Echo
Echo pin goes high when the ultrasonic burst is transmitted and remains high until the sensor receives an echo, after which it goes low. By measuring the time the Echo pin stays high, the distance can be calculated.
4. GND-Ground
It is the ground pin.



How to Use

Tutorial



Common Applications

1. To measure speed as well as the direction between two objects
2. Depth measurement



Some Example Tasks

1. Make an automatic motion sensor dustbin using ultrasonic sensor
2. Ultrasonic glasses for visually impaired



Safety Measures

1. The module contains delicate parts so it should be handled with care
2. Do not use a voltage in excess of the operation voltage range.



Important Links

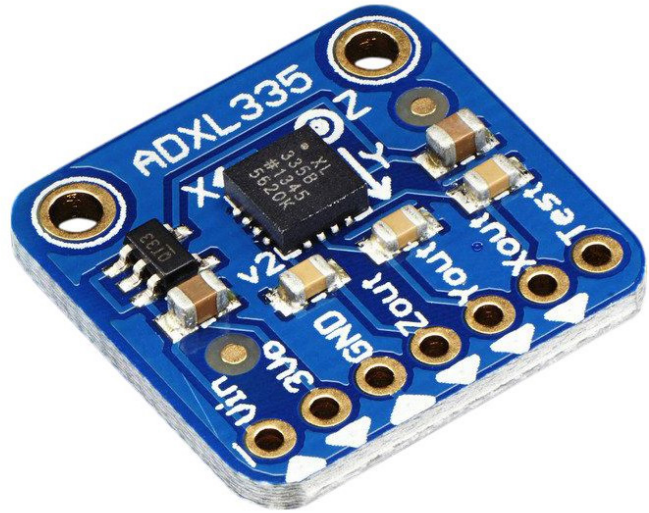
1. Basics of Ultrasonic sensor module HC-SR-04 Article Link



Triple Axis Accelerometer

Have you ever wondered how your smartphone knows which way is up? It's one of the most innovative features of today's smartphones. They all have a tiny device called an accelerometer built into the circuitry that detects when you tilt the device from side to side. That's how your smartphone knows when to switch from portrait to landscape mode. An accelerometer is a tool which is used to measure proper acceleration of anything it is fit into.

Accelerometers are widely used in low-power, low-cost motion and tilt sensing applications such as mobile devices, gaming systems, disk drive protection, image stabilization, and sports and health devices. Few commonly used accelerometer modules are ADXL335, ADXL 345 and MPU 6050 (accelerometer and gyroscope sensor)



How to Use

Full Tutorial



Common Applications

1. To measure vehicle acceleration.
2. To measure vibration on cars, machines, buildings, and etc.
3. Smartphones and Gaming Consoles



Some Example Tasks

1. Accident Alert System Project Using ADXL335 Accelerometer Arduino SIM800L and GPS Module
2. Make a virtual tennis game using an accelerometer Tutorial Link



3. Make a gesture control robot using accelerometer Tutorial Link



Safety Measures

1. The module contains delicate parts so it should be handled with care and overheating needs to be avoided
2. The module should be properly calibrated before use

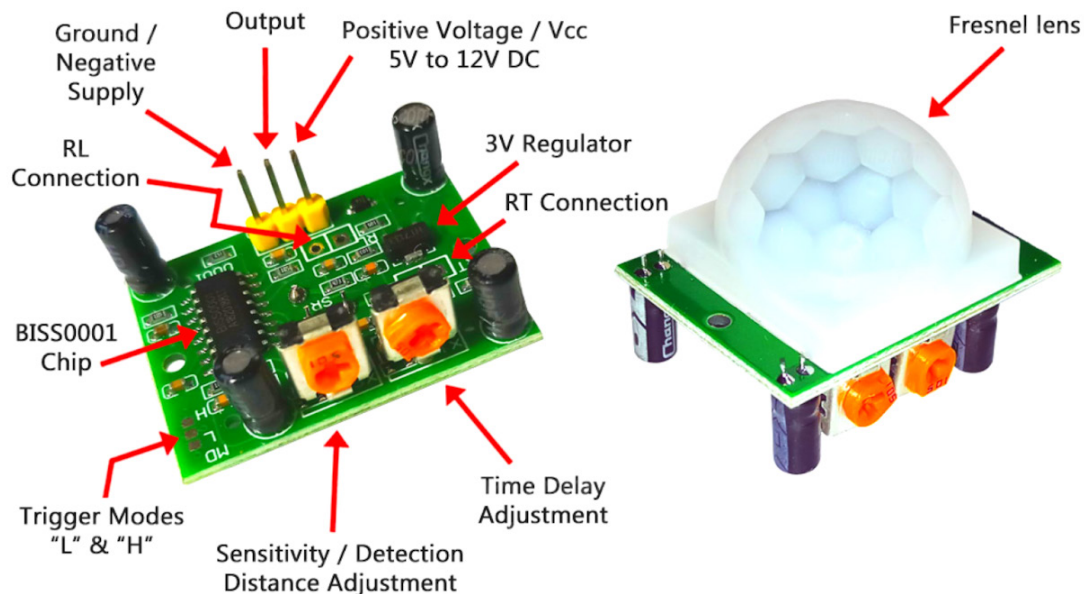


Important Links

1. How Accelerometers work
2. How to track object orientation using accelerometer sensor and arduino YouTube Video



PIR Motion Detector Module



PIR sensors allow you to sense motion & to detect whether a human has moved in or out of the sensor's range. They are small, inexpensive, low-power, easy to use and don't wear out. PIRs are basically made of a pyroelectric sensor, which can detect levels of infrared radiation. PIR sensors use a pair of pyroelectric sensors to detect heat energy in the surrounding environment. These two sensors sit beside each other, and when the signal differential between the two sensors changes (if a person enters the room, for example), the sensor will engage. That may mean it triggers an alarm, notifies authorities, or maybe turns on a floodlight. IR radiation focuses on each of the two pyroelectric sensors using a series of lenses constructed as the sensor's housing. The detection range is generally between 5 meters and 12 meters.



How to Use

Tutorial



Common Applications

1. Lighting Controls.
2. Thermostats And HVAC Systems.
3. Smart Home And IoT.
4. IP Cameras And Surveillance Systems.



Some Example Tasks

1. Make a LED buzzer system using PIR motion detector module YouTube Video
2. Advanced Home Security System using PIR Sensor, Arduino and GSM Module



Safety Measures

1. The module contains delicate parts so it should be handled with care
2. The module should be properly calibrated before use



Important Links

1. How PIR sensor works
2. More about PIR sensor



Pulse Rate Heart Sensor

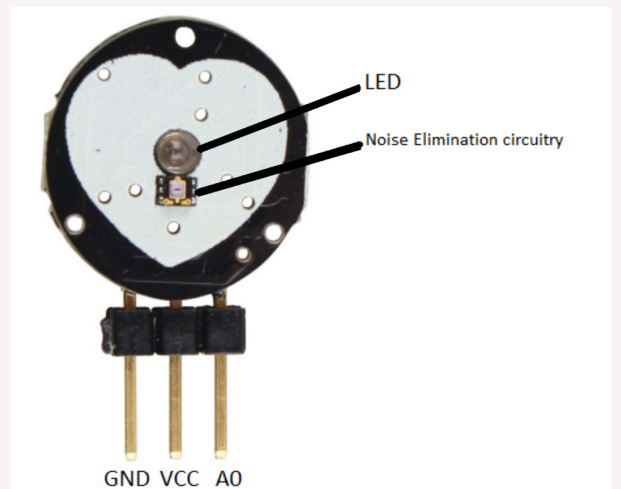
Almost all of us know about those fancy and cool smartwatches that can measure our heart rates. There's this sensor which is solely responsible for making them work. It's the pulse rate heart sensor. An optical heart rate sensor measures pulse waves, which are changes in the volume of a blood vessel that occur when the heart pumps blood. Pulse waves are detected by measuring the change in volume using an optical sensor and green LED.

A pulse sensor or any optical heart-rate sensor, for that matter, works by shining a green light (~ 550 nm) on the finger and measuring the amount of reflected light using a photosensor. This method of pulse detection through light is called Photoplethysmogram.

The oxygenated haemoglobin in the arterial blood has the characteristic of absorbing green light. The redder the blood (the higher the haemoglobin), the more green light is absorbed. As the blood is pumped through the finger with each heartbeat, the amount of reflected light changes, creating a changing waveform at the output of the photosensor. As you continue to shine light and take photo sensor readings, you quickly start to get a heart-beat pulse reading.

The pulse rate heart sensor has 3 pins, namely:

1. (Signal) is the signal output. It is connected to analog input of an Arduino.
2. (VCC) is the VCC pin. It is connected to 3.3 or 5V.
3. (GND) is the Ground pin.



How to Use

Tutorial



Safety Measures

1. The module contains delicate parts so it should be handled with care



Common Applications

1. Smart watches, wristbands to read the pulse and heart rate of the human.



Important Links

1. For more Info you can read this article [Article Link](#)



Some Example Tasks

1. Make a heart rate sensor using Pulse Heart Rate Sensor module



Relay Module

A relay almost works like a switch, which can be electrically controlled. It can be turned on or off, letting the current go through or not, and can be controlled with low voltages, like the 5V provided by the Arduino pins. This relay module has two channels (those blue cubes). There are other models with one, four and eight channels. This module should be powered with 5V, which is appropriate to use with an Arduino. There are other relay modules that are powered using 3.3V, which is ideal for ESP32, ESP8266, and other microcontrollers.

There are two different types of relays that are usually available, based on the number of channels present:-

1. Single channel

This type of relay module can only be connected to one schematic at a time.

2. Double channel

This type of relay is just like a collection of two single channel relays put together, and can be connected to two schematics at a time.

A relay has 3 pins like a lot of other modules, namely:-

1. VCC
2. Ground
3. Signal

On the other side, it has a connector with 3 sockets, common (COM), normally closed (NC), and normally open (NO).





How to Use

Tutorial



Common Applications

1. To control circuits such as a lamp.
2. In complex appliances such as refrigerators and air conditioners.



Some Example Tasks

1. Use 5V Relay with Arduino to turn ON and OFF AC bulb or DC load



Safety Measures

1. Do not touch the terminal section (charged section) of the Relay while power is being supplied.
2. Do not drop or disassemble Relays. Doing so may reduce Relay characteristics and may result in damage, electric shock, or burning.
3. Working with relay should be done under expert supervision.



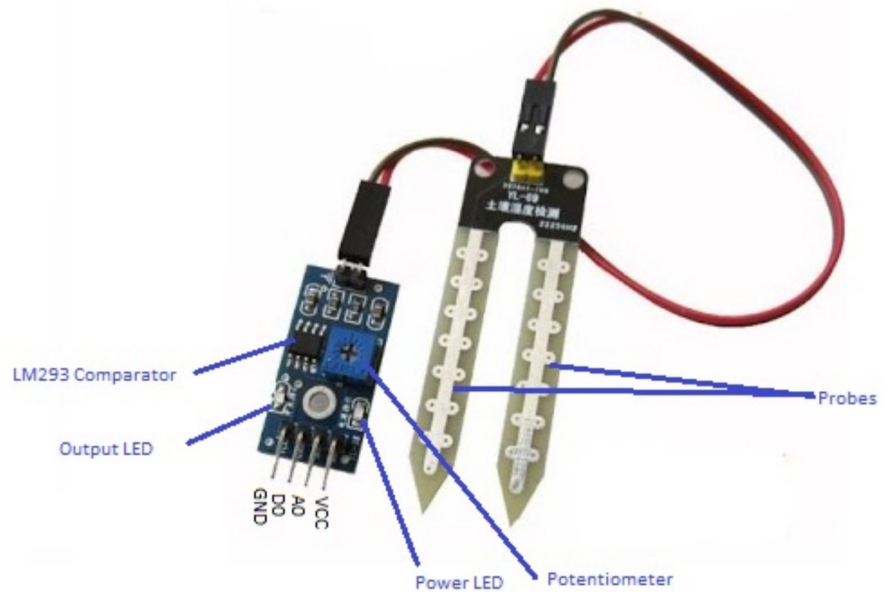
Important Links

1. What is a relay module, in detail YouTube Video
2. How relays work



Soil Moisture Sensor Module

A soil moisture sensor is used to measure the moisture content in soil and send it as output, so that the required steps can be taken after that accordingly. It is used widely in today's world and serves its purpose pretty well. A soil moisture sensor module has 2 probes, a cable connecting them to the board, a comparator, an output LED, a power LED, potentiometer and 4 pins



How to Use

A step-by-step
tutorial -
YouTube Video



Common Applications

1. Used in smart agriculture.
2. Can be used to automate the plant watering process.



Some Example Tasks

1. Design an Automatic Plant watering system using Arduino



Safety Measures

1. Ensure that the probes are put correctly into the soil.
2. Try to avoid exposure to water for prolonged periods of time.



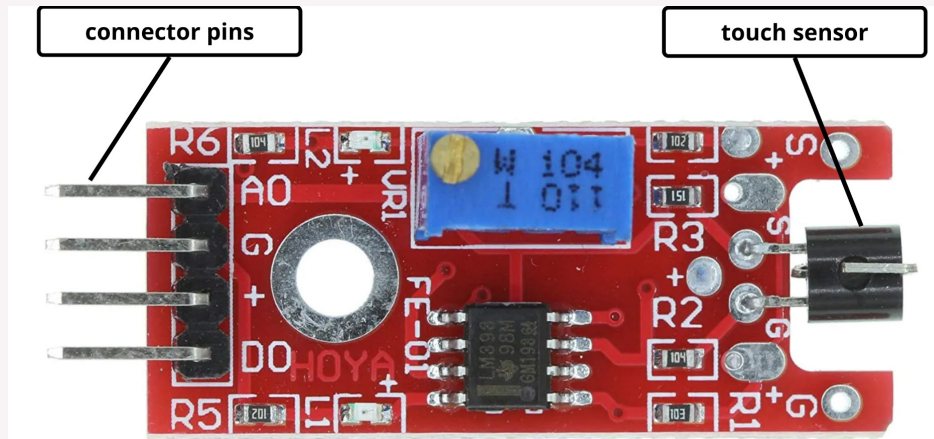
Important Links

1. How does a soil moisture sensor work YouTube Video



Metal Touch Sensor Module

This sensor is used to detect touches. It emits a signal if the front metal tip of the sensor is touched. The sensitivity of the sensor can be adjusted by means of a controller. It is ideally suited for threshold measurement. This means that the sensor emits a digital high signal as soon as a threshold value set by the user is exceeded. However, this also means that the analog measured values are not suitable for conversions, as the analog signal is also influenced by the rotary potentiometer.



The KY-036 sensor module has a power LED, a touch detection LED, touch sensor plate, and 4 pins. The pins are as follows:

1. GND
2. VCC
3. AO (analog output)
4. DO (digital output)



How to Use

Tutorial



Common Applications

1. Alarm Devices



Some Example Tasks

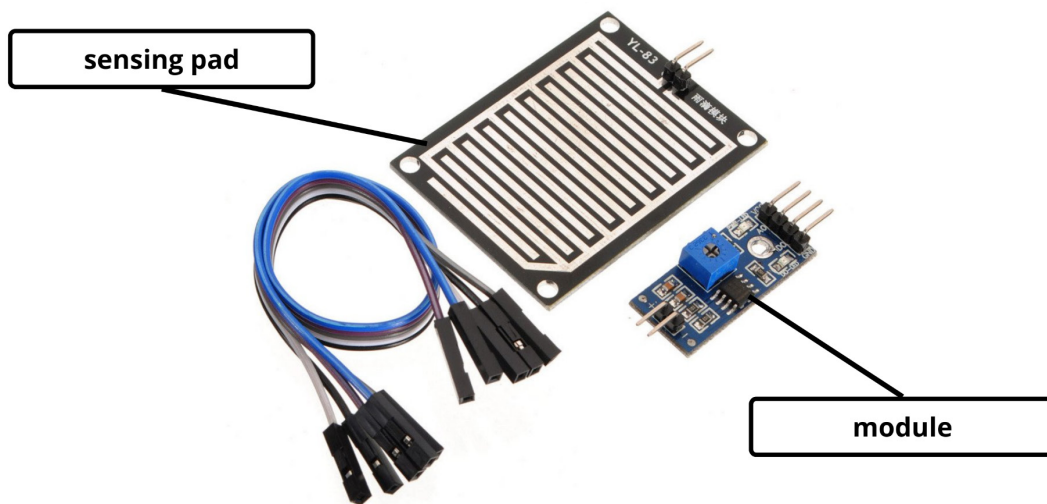
1. Alarm Device Using a Human Touch Sensor



Safety Measures

1. Do not put excessive or sharp force on the sensor part as it may get damaged.

Rain Drop Sensor



Raindrop sensor is a board on which nickel is coated in the form of lines. It works on the principle of resistance. The rain Sensor module allows measuring moisture via analog output pins and it provides a digital output when a threshold of moisture exceeds.

A rain drop sensor has 4 pins, a sensing pad and connectors. The pins are as follows:-

1. VCC: Connects supply voltage- 5V
2. GND: Connected to ground
3. D0: Digital pin to get digital output
4. A0: Analog pin to get analog output



How to Use

Tutorial



Common Applications

1. Automobile sectors to control the windshield wipers automatically.
2. Smart agriculture systems.



Some Example Tasks

1. Create a raindrop sensing system Tutorial Link



2. Automatic Rain Sensing Car Wiper System Using Arduino



Safety Measures

1. Do not use a Sensor in an environment where there are explosive or inflammable gases
2. The sensor should be checked regularly to remove dust, mud and other material that may get stuck on it.



Important Links

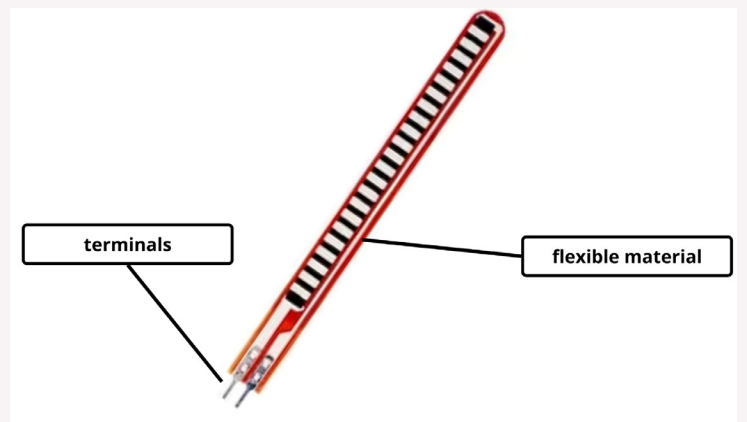
1. Introduction to the rain drop sensor module YouTube Video



Flex Sensor

A flex sensor or bend sensor is a sensor that measures the amount of deflection or bending. Usually, the sensor is stuck to the surface, and resistance of the sensor element is varied by bending the surface. It is very useful when we're required to measure the extent of bending in anything. As the sensor bends, its resistance increases and that is how it measures the amount of bend applied.

A flex sensor has a flexible material which is bent to find out the extent of bending, and two terminals that are connected to the circuit.



How to Use

A flex sensor basically works with varying resistance as the flexible material is bent. Tutorial



Common Applications

1. Gaming gloves.
2. Security systems.



Some Example Tasks

1. Arduino Flex Sensor controlled Robot Hand
2. Sign Language to Speech Conversion using Arduino With Flex Sensor



Safety Measures

1. Do not bend the sensor beyond its limit and along different axes.
2. Do not connect it to very high current as it may get damaged.



Important Links

1. Basics & working of a flex sensor YouTube Video



Temperature Sensor

A temperature sensor is a very useful sensor and has many uses in the real world. It works on a basic principle. The output voltage of the pin is proportional to the temperature that the sensor detects. It is used to measure the temperature of the surrounding area using this property of proportionality.



How to Use

Tutorial



Common Applications

1. To measure the temperature of the surroundings.



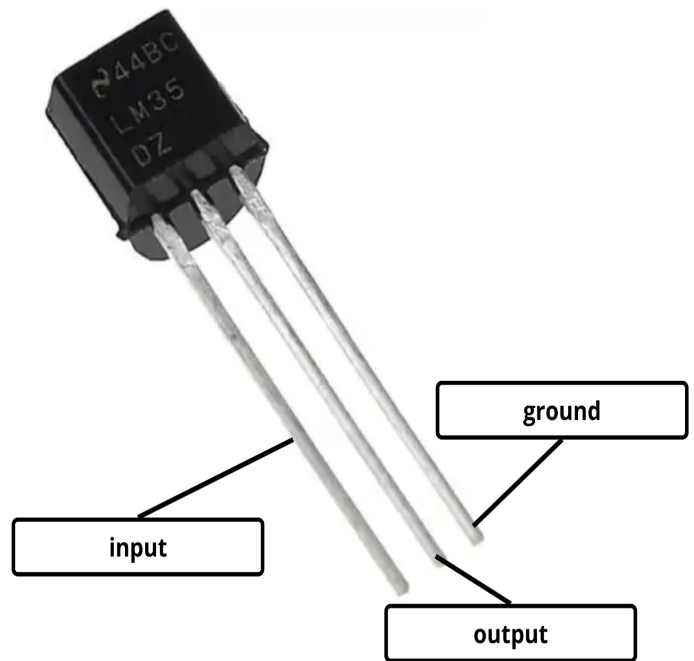
Some Example Tasks

1. Test the room temperature using the temperature sensor.
2. Study the variation of temperature using a temperature sensor on supplying heat.



Safety Measures

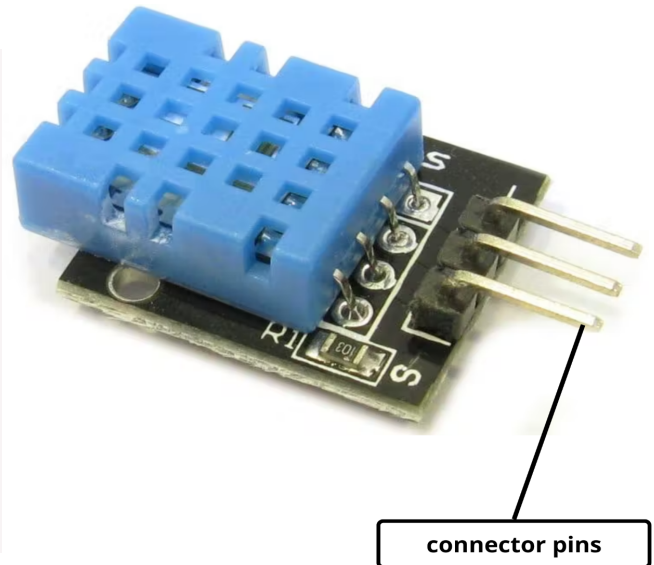
1. Do not test the sensor in an environment beyond its limits.



Temperature and Humidity Sensor Module

The DHT11 sensor is a very economical, simple temperature and humidity sensor available in the market. It uses a capacitive humidity sensor and a thermistor to detect the values and show them in digital output. Its compact size and sampling rate made this sensor popular among hobbyists. Some of the sensors which can be used as an alternative to DHT11 sensor are DHT22, AM2302, SHT71.

The DHT11 also measures relative humidity. The relative humidity is the amount of water vapour in air vs. the saturation point of water vapour in the air. At the saturation point, water vapour starts to condense and accumulate on surfaces forming dew.



How to Use

Tutorial



Common Applications

1. To measure the humidity of surroundings.
2. To measure the temperature.



Some Example Tasks

1. Measure Temperature and Humidity using Arduino Tutorial Link
2. Arduino Weather Station



Safety Measures

1. Consider Time Drift and Temperature Drift errors while measuring the values.



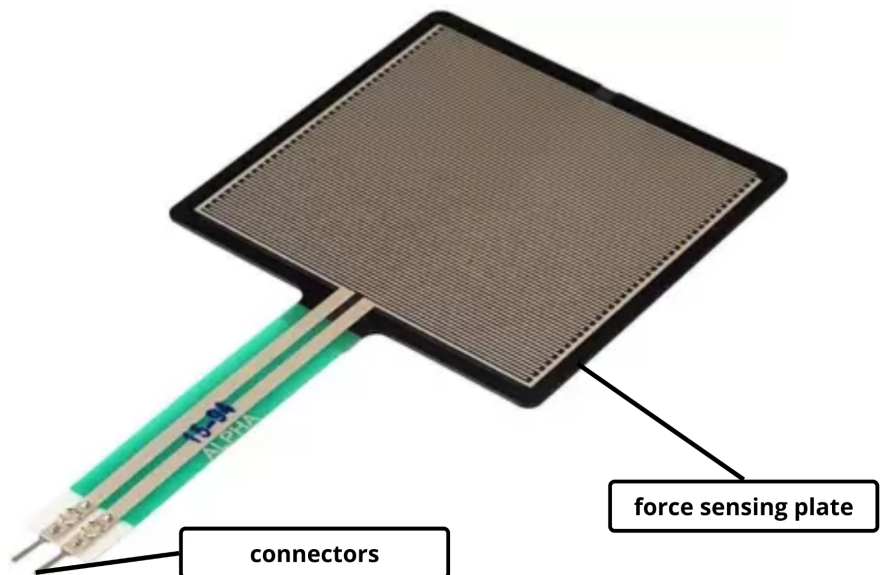
Important Links

1. Introduction to DHT11 temperature and humidity sensor YouTube Video



Force Pressure Sensor

Force pressure sensors, also called force sensitive resistors are sensors that are used to detect physical pressure, squeezing and weight. FSRs are basically resistors that change their values when they're subjected to pressure. The amount of pressure can be shown as an output to the user by measuring its instantaneous resistance. A force pressure sensor consists of a force sensing plate where the pressure is applied, and connectors that are connected to the circuit.



How to Use

Tutorial



Common Applications

1. To measure frictional forces between surfaces.
2. For fluid monitoring applications, dialysis machines, etc.



Some Example Tasks

1. Measure force and pressure and display it on Arduino Serial Monitor
2. Glow pillow project using force pressure sensor



Safety Measures

1. Verify that the supply voltage variation is within the rating.
2. Make sure that stress by forcible bend or pulling is not applied directly to the sensor cable joint.



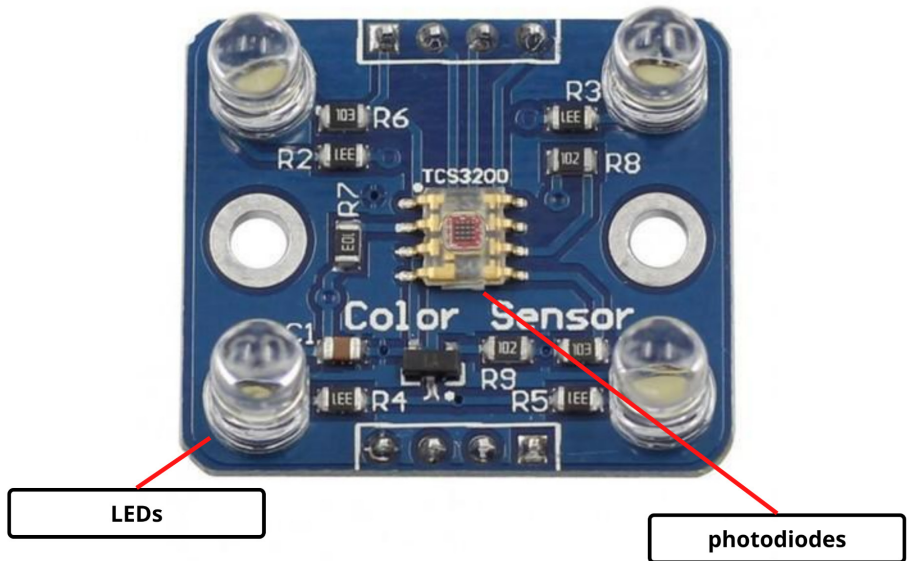
Important Links

1. Basics of force pressure sensors YouTube Video

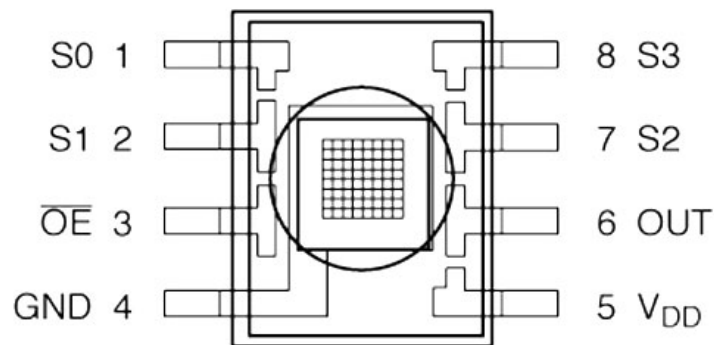


Colour Recognition Sensor

A colour recognition sensor works by emitting light through a transmitter, and then detecting the reflected light by using a receiver. It is used to detect the received light intensity for red, blue and green respectively, making it possible to determine the colour of the target object, since most of the colours can be devised through a combination of red, blue and green. The sensor is designed in such a way that 4 bright LEDs light the object and then the light reflecting from that is used by the sensor to detect the colour.



It has 4 LEDs, photodiodes and 8 pins as described in the image below:



TCS3200 Color Sensor Pinout



How to Use

Tutorial-YouTube Video



Common Applications

1. In scanners to distinguish coded markings
2. In manufacturing industries.



Some Example Tasks

1. Make a colour detection project Tutorial Link



2. Colour Sorting Machine



Safety Measures

1. Avoid the interference of external light during colour recognition, otherwise it will affect the result of colour.



Important Links

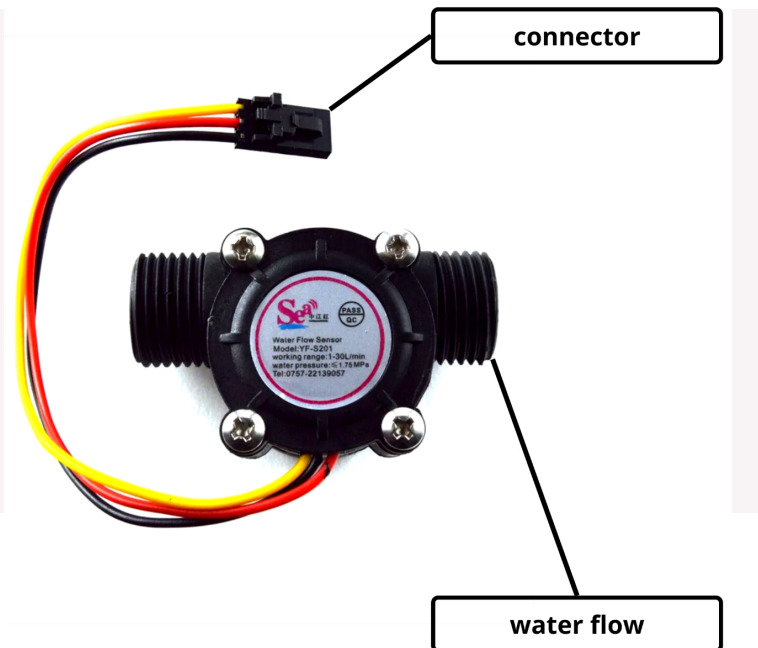
1. Introduction to colour sensor-YouTube Video



Water Flow Sensor

Monitoring the water supply is very essential in places like industries or schools/universities. To monitor the amount of water being supplied and used, the rate of flow of water has to be measured. Water flow sensors are used for this purpose. Water flow sensors are installed at the water source or pipes to measure the rate of flow of water and calculate the amount of water flowing through the pipe. Rate of flow of water is measured as litres per hour or cubic metres.

A water flow sensor has a connector with pins, and a tube through which the water may flow, of whose pressure and flow rate we'll calculate.



How to Use

Here is a step-by-step tutorial of How to Use a water flow sensor to detect flow rate YouTube Video



Common Applications

1. Agriculture sector systems.
2. Food processing.
3. Water management.



Safety Measures

1. Do not use a voltage that exceeds the power supply voltage range.
2. Mount the Sensor appropriately.



Some Example Tasks

1. Measure the water flow rate using water flow sensor and arduino
2. DIY Water, Juice & Milk Filling Machine

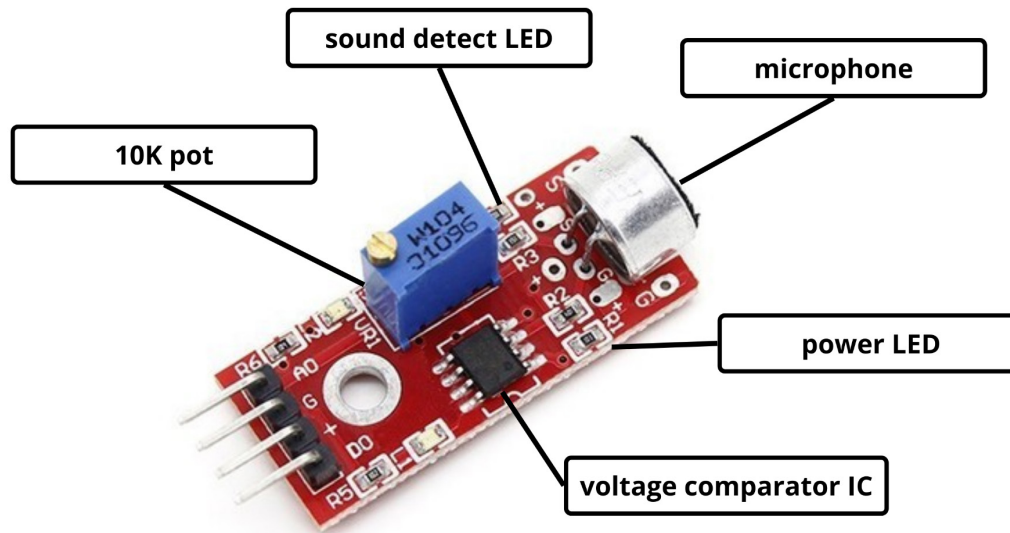


Important Links

1. Basic principle and usage of water flow sensors YouTube Video



Sound Sensor



Ever wanted to make something that could be controlled with sound? Like, controlling the ON/OFF state of a LED by clapping, or changing the turn direction of a remote controlled car by producing sound. Well, all of this is possible through this amazing sensor. A sound detector module is used to detect sounds and use them as inputs to carry out specific functionalities. This module consists of a sensitive capacitance microphone for detecting sound and an amplifier circuit. The output of this module is both analog and digital. The digital output acts as a key, and it activates when sound intensity has reached a certain threshold. The sensitivity threshold can be adjusted via the potentiometer on the sensor. The analog output voltage changes with the intensity of sound received by the microphone. You can connect this output to Arduino analog pins and process the output voltage.

A sound sensor consists of a voltage comparator IC, power LED, sound detect LED, microphone and a 10k pot. It has 4 pins, namely:-

1. VCC-Power
2. GND-Ground
3. D0-Digital Output
4. A0-Analog Output

Specifications

1. Operating voltage: 3.5V
2. Operating current: 4~5 mA
3. voltage gain: 26 dB
4. sensitivity of the microphone: 52 to 48 dB
5. impedance of the microphone: 2.2k Ohm



How to Use

Tutorial



Common Applications

1. Used in sound control remote control cars.
2. Used in home automation.
3. Used in general sound detection.



Some Example Tasks

1. Make a system to detect sound using arduino and sound sensor



Safety Measures

1. The sensor might not work properly in noisy areas. For that, selective sound proofing can be done depending on the environment.



Important Links

1. Controlling an LED using sound sensor

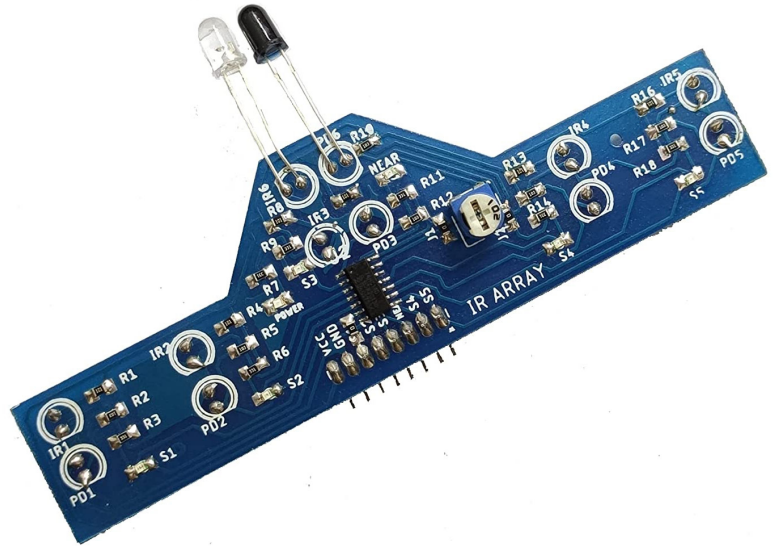


IR Sensors Array module for line following robot

Many of us might have seen those robotic cars that are able to follow a colored line on the track, which means they can take turns accordingly and stay on the defined line. That behaviour of those cars is achieved through IR sensors array module for line following.

A line follower IR sensor array module consists of 8 different proximity sensors arranged in a row, and 4 pins, as named below:-

1. VCC-power
2. GND-ground
3. AO-Analog output
4. DO-Digital output



How to Use

Tutorial



Common Applications

- To build line following robots.



Some Example Tasks

1. Line follower robot using IR sensor Array



Safety Measures

1. Do not use a Sensor in an environment where there are explosive or inflammable gases.
2. Do not use the Sensor in environments where the cables may become immersed in oil or other liquids or where liquids may penetrate the Sensor.



Important Links

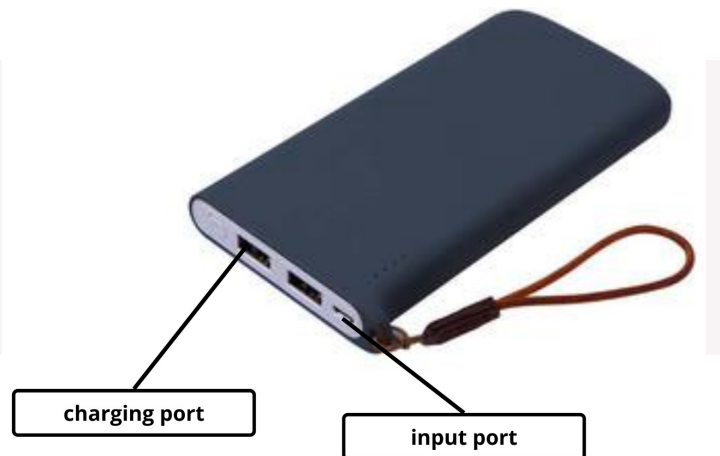
1. Overview of IR sensor Array module



Power Bank

A power bank helps to charge devices in absence of any power source. It is a very handy and useful tool which acts as a life saver in situations where the power sockets are not in proximity or there is any sort of power cut.

A power bank of minimum 10,000 mAh and 5 volts is preferred in the ATL lab.



How to Use

To use a power bank, just connect a USB connector to the charging port of the power bank and the other end to the device that needs to be powered. To a power bank, use a DC power adapter with a USB cable and connect it with the input port of the power bank.



Common Applications

1. For charging devices such as mobile phones.
2. Powering Raspberry Pi , Arduino boards and other projects



Safety Measures

1. Don't overcharge the powerbank
2. Don't try to charge it with undefined ways.
3. Power banks are electronic devices, and therefore they do not like water, or even moisture. One key piece of advice when using power banks is to keep them dry at all times.



Important Links

1. How does a power bank works YouTube Video

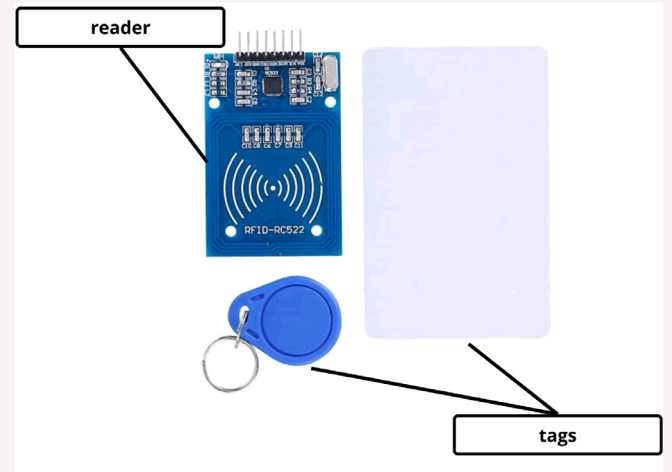


RFID Reader & Tags

For most of the RFID based Arduino projects, the RC522 RFID reader/writer module is a great choice. It is low power, low cost, very rugged, easy to interface and extremely popular among hobbyists.

An RFID or radio frequency identification system consists of two main components, a tag attached to the object to be identified, and a reader that reads the tag.

A reader consists of a radio frequency module and an antenna that generates a high frequency electromagnetic field. Whereas the tag is usually a passive device (it does not have a battery). It consists of a microchip that stores and processes information, and an antenna for receiving and transmitting a signal.



How to Use

Tutorial



Common Applications

- Inventory management.
- Asset tracking and equipment tracking.
- Inventory control.
- Cargo and supply chain logistics.
- <https://www.youtube.com/watch?v=Gtu-kZ24O0e> vehicle tracking.



Safety Measures

1. There shouldn't be a very high exposure to radio frequencies.
2. The module is delicate and should be handled with care.



Important Links

1. Different types of RF modules YouTube Video
2. How does RF modules work YouTube Video

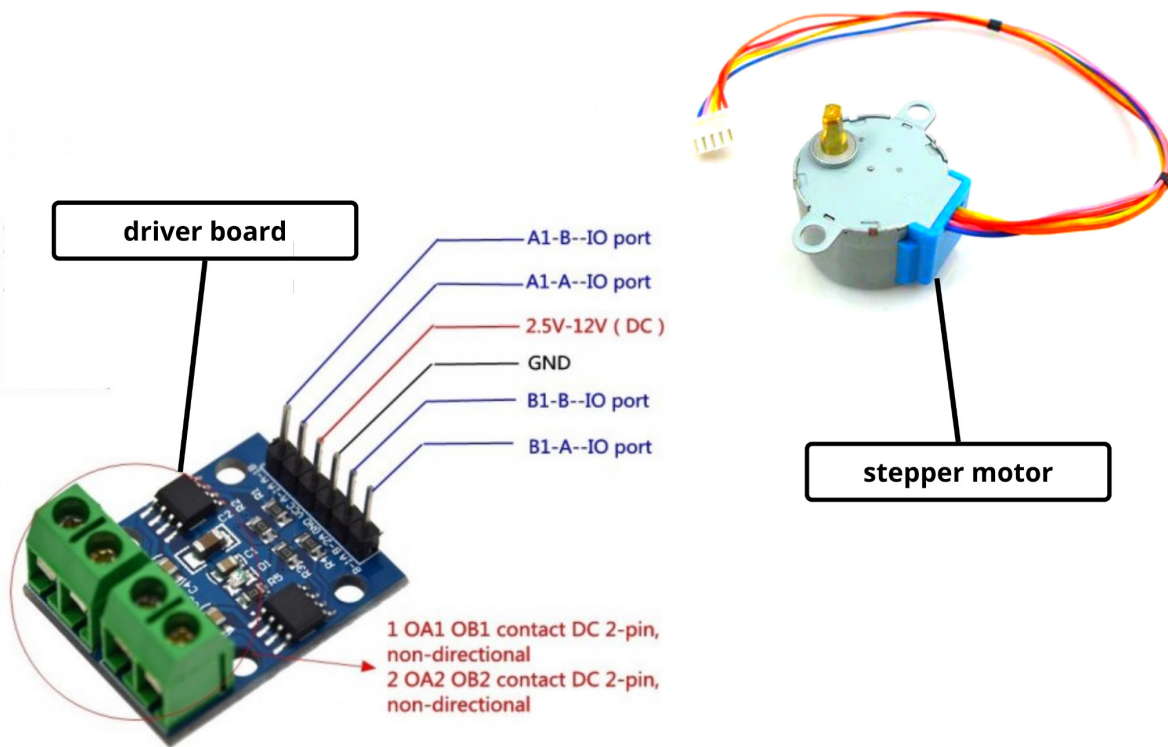


Some Example Tasks

1. RFID Attendance system
2. RFID based Smart Door Lock



Stepper Motor with Driver Board



There are many places where we need to perform rotary work but with very high precision, like in manufacturing units, the robotic arms need to work very precisely in order to achieve the goal. That is when a stepper motor comes into play, which got its name from the fact that it rotates in steps.

We also use a motor board while using the stepper motor. The board has a connector that mates the motor wires perfectly which makes it very easy to connect the motor to the board. There are also connections for four control inputs as well as power supply connections.

The motor board for 2 channels consists of 6 pins, namely:-

1. A1
2. A2
3. VCC
4. GND
5. B1
6. B2

The stepper motor has a motor with connector pins to make the connections.



How to Use

Tutorial



Common Applications

1. Most commonly motors in 3D printers
2. Devices like Disk drives, scanners, computer printers, plotters, slot machines, image scanners, etc



Some Example Tasks

1. Control the rotational speed of a stepper motor
2. CNC Plotter



Safety Measures

1. Do not use the driver or the motor under conditions that exceed the specification values.
2. Make all connections as small as possible

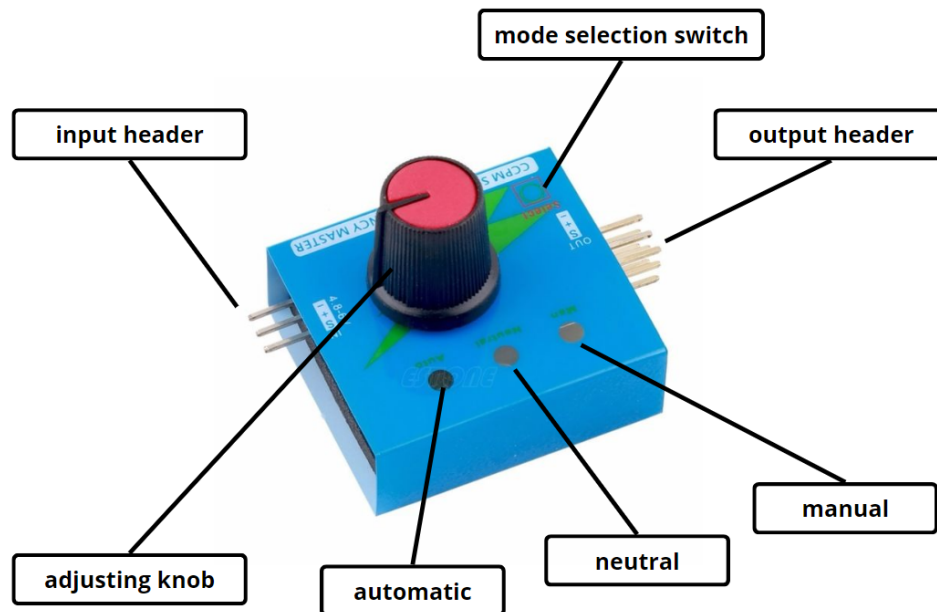


Important Links

1. How does a stepper motor work YouTube Video



Servo Motor Tester



A servo motor tester, as the name suggests, is used to test servo motors. It is a small device with input and output pins, a knob for adjusting the values and light indicators. Although, servos can be tested through arduino boards, but its not always feasible. That is when servo motor testers come in play.



How to Use

The servo tester first needs to be connected to the DC voltage source through the pin in its input header. Once done, the light indicator of one of the modes would be ON. Then, you can connect at most 3 servo motors together. The motors should be connected to the horizontally lined up pins. Then, there are three modes of testing that could be toggled by pressing the mode selection switch. The modes are as follows:

1. Automatic

This mode makes the motor rotate to and fro on its own. It can be used to check if the motor is rotating to its complete potential or not.

2. Manual

In this mode, the user can rotate the motor according to their choice by adjusting the knob. This also serves the same purpose as the automatic mode, except the fact that this is manual

3. Neutral

This mode brings the servo motor to its neutral position, which can be used to determine if its alignment is proper in neutral position.

Tutorial on how to test servo motors YouTube Video





Common Applications

The major application of servo motor testers is to test servo motors to see if they're working desirably.



Some Example Tasks

Take two or three servo motors and test them using the servo motor tester.



Safety Measures

1. Only use compatible voltage supply with the tester.



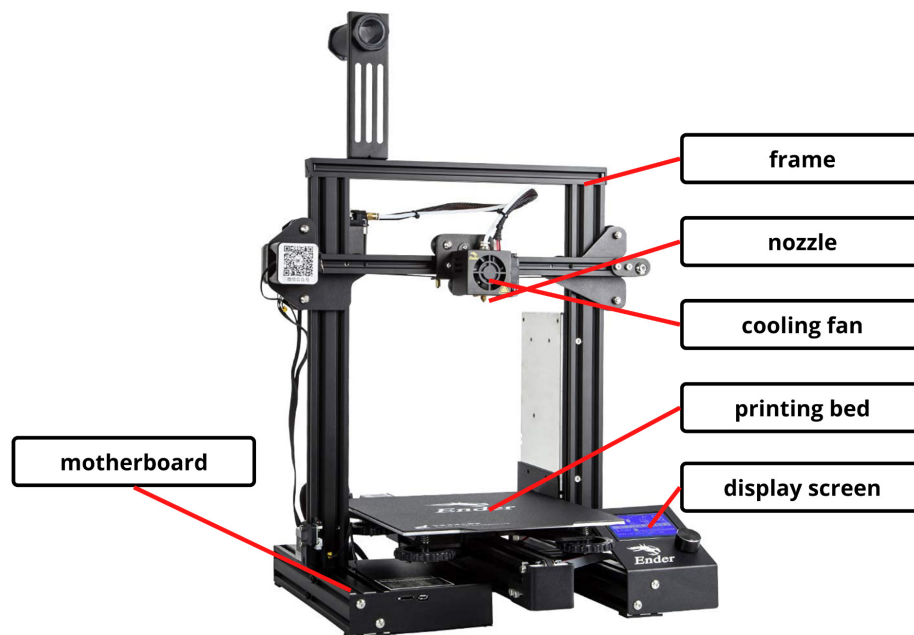
PACKAGE 2

Rapid Prototyping Tools

3D Printer Kit and tools

3D Printing is a process for making a physical object from a three-dimensional digital model, typically by laying down many successive thin layers of material. It brings a digital object (its CAD representation) into its physical form by adding materials layer by layer. The input is the model design of whatever you want to make, and the output is its real life 3D model, present in the 3D space. 3D Printing can be done using different types of 3D Printers. 3D printing allows students to experience their projects from the model stage to the actual model creation. This creates both excitement and a better understanding of the design process as they gain hands-on experience from conception to creation.

The individual features are seen more clearly as the student builds the project layer by layer. Excitement also stems from the ability to explore real details, not just on a screen or in a textbook. 3D printing also brings the world of theory to the physical world where students can see and touch, opening up new possibilities for learning and activities. Apart from fun activities, 3D printers are very useful for making components of devices, in organ synthesis, and recently even a whole house was built using huge 3D printers.



Let's now look at some components of a 3D Printer and learn in detail about them

Components

A common printer has these major parts:-

Printer frame

A printer frame is essential to provide support to all the components that carry out the printing process.

Nozzle

It is the part of the 3D printer which extrudes the filament. It heats the cartridge and melts the filament, which is then used to start the printing process.

Cooling fan

The fan used in the 3D printer is directed towards the plastic that comes out from the hot end, to cool it down and solidify it properly. It is essential to make sure that the model isn't deformed.

Printing bed

A 3D printer bed is a flat surface on which a 3D printer builds the model. It is required to keep the surface flat and on horizontal level for printing the model successfully.

Display screen

A small display screen is a multipurpose screen present in 3D printers to show all the relevant information that might be required to be shown to the users

Motherboard

The motherboard on 3D printer, just like on every electronic device serves as the brain of the device, and all the components of the 3D printer are connected with the motherboard to coordinate the task

Material Specifications for a suggested FDM (Fused Deposition Modeling) 3D printer

Minimum dimensions	160mm *160mm *160mm Build Size or 4 litre Build Volume
Nozzle	0.3mm to 0.4mm nozzle diameter
Slicing Software	Free or open source
Material compatibility	PLA, ABS, and derivatives of PLA
Repair Kit	Common repair kit with spare springs, screws, keys, tweezers, etc



How to Use

1. Prepare your design for 3D printing

First of all, to get a 3D model printed, you'll need to have a 3D model. There are two ways to get it. You can either use some free model available on the internet and print it, or you can make your model. Some free models can be found on websites such as Thingiverse, Free3D (<https://free3d.com/>) and Sketchfab (<https://sketchfab.com/features/free-3d-models>). Or, if you want to make your own models, there are many cool software and websites such as Tinkercad (<https://www.tinkercad.com/>) and Blender (<https://www.blender.org/>).

2. Getting the design ready to print

Once you have the 3D model ready, it's time to get it printed with the use of a 3D printer. One thing to observe is that the printer doesn't work with the common .stl or .obj model files. Instead, the model needs a slicer to convert it to g-code which can then be used by the printer to print the model. Cura is preferred for those purposes, which can be installed on computers from their website-<https://ultimaker.com/software/ultimaker-cura>.

3. Send your file to the printer

Once downloaded, load your model file into it and edit the profile of your model accordingly. Then, using the given options, the file can be stored on the laptop storage or the SD card. If you prefer

an SD card, make sure to insert it into the computer slot before transferring. Once done, it's time to print it. Plug the SD card into the printer in the slot near the motherboard. Select the option to print from an SD card and start the print. Alternatively, you can plug in your laptop directly with the printer and transfer the file that way. But in this case, make sure that the laptop doesn't go to sleep as it will probably interrupt the printing process.

4. Start 3D Printing

Now you can sit back, relax and watch your creation come to life. Printing times vary depending on your printed object's size, detail level and 3D printer type. On some 3D printers, a small component or rough prototype may only take a few hours. Most parts will be ready the next day if you leave the printer running overnight. And if you need a very large, detailed print, you may have to wait a couple of days.

5. Final Steps

When the print is finished, remove it from the printer. Depending on your chosen material and printing process, some final manual steps may be needed before it's ready to use. In most 3D printers, this 'post-processing' is just peeling off a small brim of material around the 3D printed part.



Common Applications

1. Printing 3D models for education and research
2. Printing synthesised organs and micro equipment for medical sciences
3. Automotive industry
4. Construction, home development
5. Art and Jewellery
6. Printing designs for decorative purposes.



Some Example Tasks

1. Create your own imaginary 3D model on Tinkercad and print it.
2. Design a keychain for yourself with your name written in 3D
3. Print out historical artefacts and 3D models of molecules



Safety Measures

1. Never obstruct the flow of printing with mechanical force.
2. Ensure that there is a constant power supply throughout the printer's usage.
3. Ensure that the environment in which you're using the printer isn't very hot.



Important Links

1. How to use a 3D printer
2. How does a 3D printer work
3. Tutorial - Learn 3D Design using TinkerCAD
4. Tutorial - Learn 3D Design using Blender
5. Lesson Plans for teachers
6. Sites to get free 3D Designs - Thingiverse
7. Free3D
8. Sketchfab

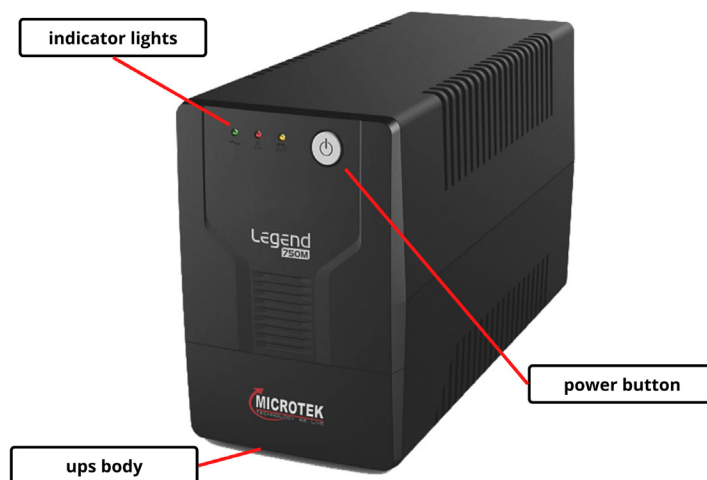


Dedicated UPS/Power Backup

3D printing is a very complex and time taking process. Even printing a simple 3D model through a 3D printer might take hours to complete. It is so important to ensure that the power supply is uniform and available all the time to carry out the printing process, or else it gets aborted in between. That is where a backup supply or UPS comes into play. A UPS (Uninterrupted Power Supply) when connected with a 3D printer ensures the regular power supply to the printer for carrying out the 3D printing process.

Indicator lights and their significance:-

1. Green: Normal operation
2. Orange/Yellow: Operating on battery power.
3. Red: Power low, requires charging



How to Use

Plug in the 3D printer to the UPS and the UPS to power supply and you're done!



Common Applications

UPS are used for power backup purposes in case of power cuts.



Important Links

1. How to connect a UPS to 3D printer

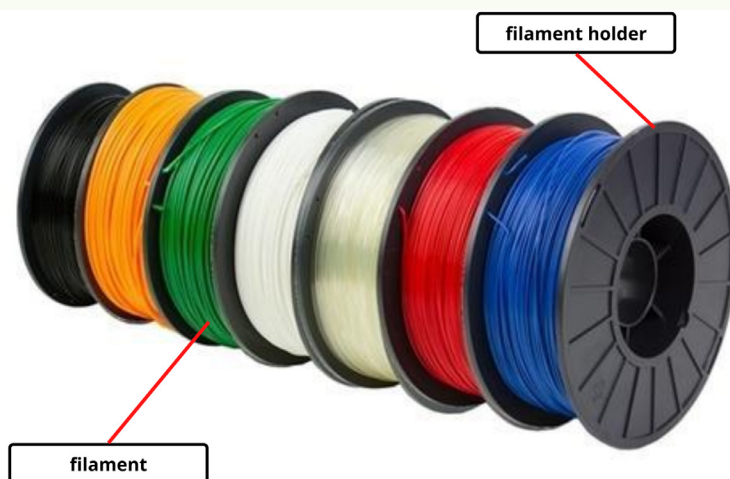


Filament for 3D Printer

Filament is an important requirement for 3D printing. Filaments used in 3D printing are thermoplastics, which are plastics that melt rather than burn when heated, can be shaped and moulded, and solidify when cooled.

The filament is fed into a heating chamber in the printer's extruder assembly, where it is heated to its melting point and then extruded (squirted) through a metal nozzle as the extruder assembly moves, tracing a path programmed into a 3D object file to create, layer by layer, the printed object.

The two most common filaments are standard diameters of 2.85 mm and 1.75 mm. They usually look like wire and are fitted such that they can be fed to the printer while in use.



How to Use

Open the loose end of the filament, and cut a very small part to make sure that the end is plain and angled. Then, push the filament straightly into the hole that takes it towards the nozzle. Once the filament reaches the nozzle, it'll start oozing out a bit. Pull off the extra part of the filament and done, the filament is now loaded into the printer.



Safety Measures

1. Keep the filament away from hot or humid environments.
2. Make sure that the filament is not twisted to ensure smooth flow.



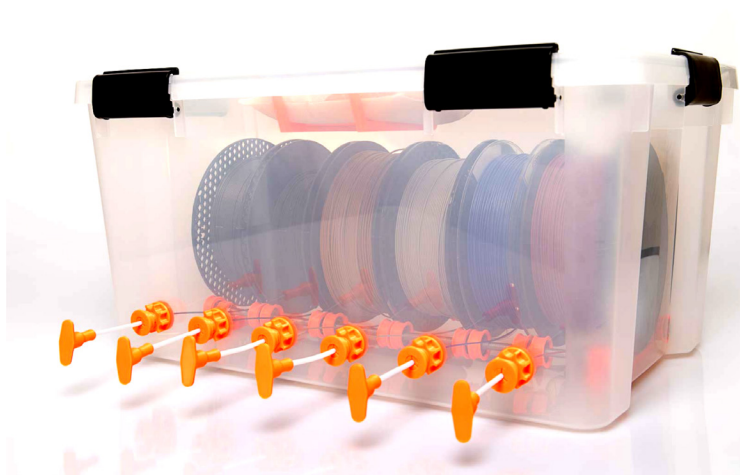
Important Links

1. Different types of filaments
2. How to load filament in a 3D printer



Filament Storage Box

A filament storage box is a simple plastic box which can be used to store the filaments for a 3D printer. It can also have an opening from where the filament can be fed to the printer for usage. Ideally, such a box is preferred with a place for fitting the filament holder. Moisture in the filament can lead to its degradation. If the lab is set up in a humid area, then it is very much suggested to use the filament storage box.



How to Use

The usage is very simple. Just put the filament holder with the filament inside the storage box. If the storage box has an opening for filament, it can directly be used to feed the printer. Take a small part out from the opening and use it whenever required.



Important Links

1. Types of filament storage boxes and relevance





PACKAGE 3

Mechanical, Electrical, and Measurement tools

HACKSAW

Hacksaw is a very useful tool used for cutting materials like wood, plastic and steel. The tool is derived from the traditionally used hand saws that were primarily used by craftsmen to cut pieces of wood. Hacksaw is very handy in ATL labs to cut and craft pieces accordingly for the purpose of making models and prototypes. Majorly, there are 2 parts that are present in all Hacksaws:-

Hacksaw Frame

The part of the hacksaw which had a handle to be held by the craftsperson and a frame to hold the blade is called the Hacksaw frame.

Hacksaw Blade

The other part is what serves the main purpose of cutting materials. It's a specialised blade which can be fit onto the Hacksaw frame and once done, make sure that the fittings are tight enough, and you're good to go!

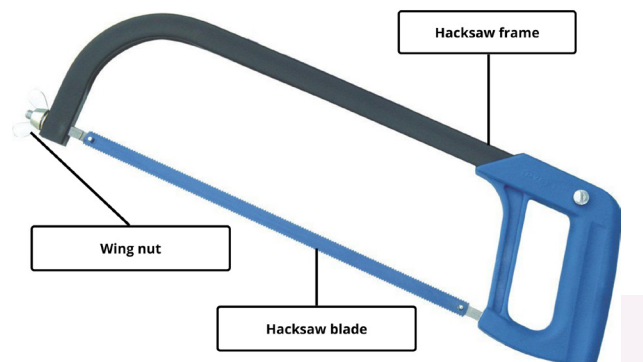
Then again, there are two different kinds of Hacksaws, used for different tasks and purposes:-

Normal Hacksaw

It is designed in a way such that the length of the blade is 12 inches, or 300 mm. It provides a greater cutting edge.

Mini Hacksaw

It is designed in a way such that the length of the blade is 6 inches, or 150 mm. It is mostly useful if you need to carry out lighter operations and if the space is compact.



How to Use

Using a hacksaw is very straightforward, just make sure that the usage is safe and correct. First of all, it is important to attach the blade to the frame. To do this, first loosen the wing nut a little bit by rotating it counter-clockwise such that the blade is easily insertable. Make sure that the sharp teeth side of the blade is facing outwards to deliver the proper desired impact. After that, put in the blade and attach it to the hooks on both sides, and tighten it by rotating the wing nut in clockwise direction. Ensure that the connection is tight enough. After enough usage, the blade will become blunt and would need to be replaced. The procedure is the same. First loosen the wing nut, remove the old blade, put the new blade, tighten the wing nut, and yay, you're done! While using the hacksaw to cut any material, the handle should be held with the dominant hand. The other hand should hold the surface or the material to make sure it doesn't slip while applying force. Thereafter, start cutting the material by applying almost horizontal push and pull force. Make sure to use the maximum length of the blade to cut the material for feasibility. Once done, wipe off the filings from the blade if any.



Safety Measures

1. Do not apply excessive pressure while cutting as it might break the blade.
2. Do not use it when the blade becomes loose on the frame.



Common Applications

1. To cut and shape their prototypes properly.
2. To cut PVC pipes of right length if the project is utilising them

Basically, anything related with cutting pieces of plastic, metal or wood, Hacksaw comes into play



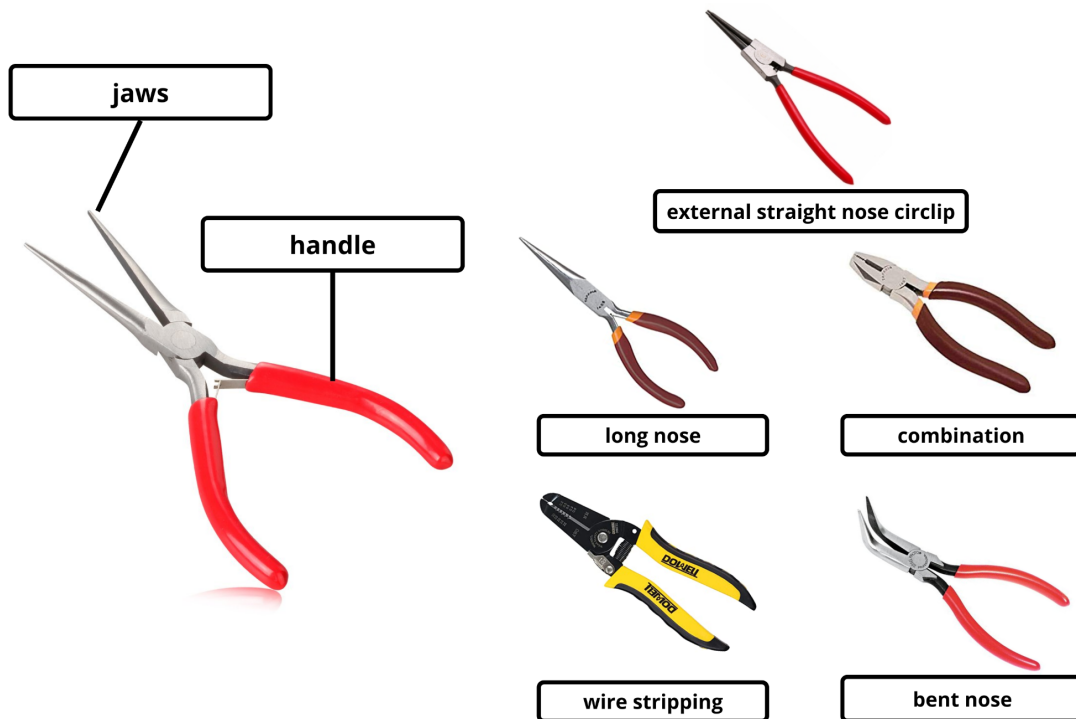
Important Links

1. How to use a Hacksaw
2. Basics of Force



PLIERS: 4.5 INCH SIZE

While crafting things and sorting out electrical connections, pliers come in very handy. Pliers can serve a huge number of purposes, but it is mostly used for holding grip or cutting small pieces of wire and similar material. A plier is generally made of sturdy steel alloys that are used for making the body of it. The handle side is usually covered with thick plastic or rubber, to provide insulation and also to provide a better grip. There are many kinds of pliers, each of them for specific functions, but there are 5 most common ones that we'll usually deal with. They are:-



External straight nose circlip plier

These pliers are used for installing or removing circlips on shafts and boards. A circlip is a small locking device which has two holes where a plier needs to be put and then made to work.

Long nose plier

These pliers have elongated jaws and are used to grip small objects and reach tough places easily.

Combination mini plier

These pliers are a combination of pliers and can be used to carry out multiple tasks such as stripping wires, cutting wires and materials, gripping objects and more.

Wire stripping pliers

As the name suggests, these pliers are used to strip wires and then make connections with the open ends of wires.

Bent nose pliers

The main reason bent nose pliers are used is that they don't come in the line of sight and are very useful in some situations where it needs to access hard-to-reach places. These kinds of pliers are also used for opening and closing circlip.



How to Use

All types of pliers are used in a similar fashion. They are meant to be used with one hand, your dominant hand preferably. Hold the plier handles with your hand, and grip it tightly. Put the jaws in between the material that you want to twist/cut/flatten out, and then hold it tightly. Now, depending on the type of plier, you can perform various operations.



Safety Measures

While using pliers with some electrical components, always make sure that you're not touching the metal part.

Hold a strong grip on the plier so that it doesn't slip which might be hazardous.



Common Applications

There are potentially a lot of things that pliers can be used for:-

To strip wires for making connections

To tighten nut bolts.

For cutting wires, as well as for twisting them together.



Important Links

1. Types of pliers in detail

2. Theory about circlips



Tweezer Set

Tweezers are small tools that are used to grab very small things that are usually tough to grab through hands. They are used for tasks such as PCB repair and microelectronics, where a lot of precision is required. The material of the tweezer could be magnetic or anti-magnetic. It is always preferred to use anti magnetic tweezers such that they won't interfere with the properties of the material they're being worked on. One more thing to notice is that even anti-magnetic tweezers gain some amount of magnetism over time, so it should be made sure to replace them once it happens.



Types

The tweezer set should have at least these 6 types of tweezers in it:-

1. ESD 10-120 mm ESD safe straight tip single
2. ESD 11-140 mm straight tip single
3. ESD 12-135 mm straight tip single
4. ESD 13-120 mm spade tip single
5. ESD 14-120 mm super fine straight single
6. ESD 15-120 mm curved tweezers



How to Use

Hold the tweezer frame with fingers on each side, applying a very small pressure to keep it in grip, then use its tip to hold small pieces, apply further pressure to just hold it enough, and then use it to transfer pieces and do whatever is needed to be done.



Common Applications

To take out small pcb and microcontroller parts that are difficult to be handled by hand. For makeup purposes and also in medical procedures.



Safety Measures

Avoid using tweezers that have gained magnetic properties.
Handle tweezers with care and make sure you don't poke it on your skin.



Important Links

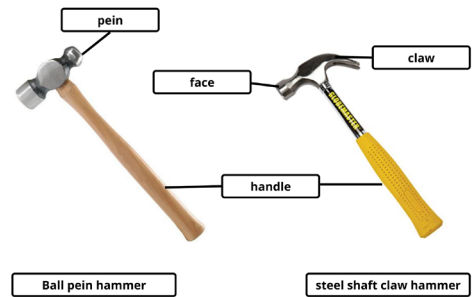
1. Learn more about tweezers



Hammer

Hammers are very common tools that are used for a variety of purposes such as carpentry, framing, nail pulling, finishing, bending or shaping metal and more. The material is made of hard metals or alloys such as steel or cast iron. The handle of the hammer could be of different materials like wood, metal or metal with rubber grip.

There are many types of hammers, out of which 2 of them are essential for ATL labs, they are:



Ball Pein Hammer

This kind of hammer is generally used in metalworking. It has two heads, one is the flat one and the other is rounded, also called the ball pein part. The pein head is used in surface peening, which means to deform the surface by applying force.

Steel Shaft Claw Hammer

This hammer has a claw on one head which is very useful while picking out the nails that are struck into walls, metal or wood pieces.



How to Use

The hammer should be held tightly with one hand on its handle, gripping the handle firmly. Then, the head part is used for putting the impact. For striking purposes, the head of the hammer should be struck upon the material that needs to be struck. It can also be used with a chisel to care for shapes by striking the chisel which is held over the material. For putting nails, The opening of the claw should be put on the nail through its neck, and then the hammer should be pulled and twisted with power to get the nail out from the surface.



Common Applications

- Strike nails to fit them on surfaces.
- Taking out nails from the surfaces.
- Deforming the surface through peening.



Some Example Tasks

- Putting the nail on a wooden board through a hammer and then taking it out.



Safety Measures

- Always strike normally (90°) on the surface.
- Always wear safety goggles while using a hammer as the small chips that come out while hammering could put damage to your eyes.
- Wear gloves if required and make sure that you don't strike on your hand.



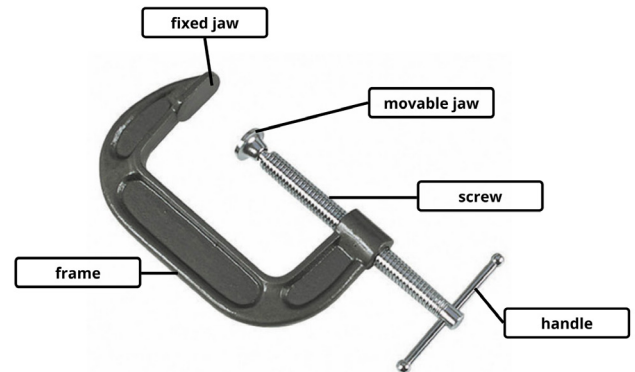
Important Links

- Types of hammers and their uses
- How to use a claw hammer
- Use a ball pein hammer with a chisel



C-Clamp

A C-clamp, also known as G-clamp is a device which is used as a clamp to hold metal and wood pieces, especially for welding and carpentry purposes. It takes a firm grip on the material so that it won't slip while doing the carpentry and welding work. They are generally made of steel or cast iron. C clamp consists of a fixed jaw which is attached to the clamp frame, and a movable jaw which is attached to a screw that is tightened into the clamp frame through a handle present over its top edge.



How to Use

Put the material (wood/metal pieces) between the jaws. A small piece of wood can be used as a buffer to protect the main wood piece from getting marks of the C-Clamp. After putting them, tighten the jaws to make sure that the grip is firm and it is tightened well. After that, the material can be cut or welded accordingly with other tools such as a hacksaw and welding machine.



Common Applications

For holding metal for cutting/welding
To hold wood materials for carpentry



Safety Measures

Remove clamps as soon as the job is finished. Clamps serve only as temporary devices for holding work securely in place.
Keep all moving parts of clamps lightly oiled and keep tools clean to prevent slippage.
Store C-clamps by clamping them in a rack, not in a drawer.



Some Example Tasks

Take a wood piece, hold it with a C-clamp and cut it.



Important Links

1. How to use a clamp



Allen key set

Allen key, also known as allen wrench is a basic driver which is used to tighten or loosen bolts and screws that have internal hexagonal recesses (sockets).

Hex Size	Length of long arm	Length of short arm
1/16 inch	91 mm	15 mm
3/32 inch	112 mm	19 mm
7/64 inch	119 mm	20 mm
1/8 inch	123 mm	21 mm
9/64 inch	130 mm	22 mm
5/32 inch	137 mm	27 mm
3/16 inch	154 mm	34 mm
1/4 inch	185 mm	34 mm
5/16 inch	195 mm	37 mm
3/8 inch	224 mm	42 mm



How to Use

Take the allen key, and put its face into the screw that needs to be tightened or loosened. To tighten it, rotate the allen key clockwise till the point it becomes tight, and similarly to loosen it, rotate the allen key counter clockwise till it becomes loose and comes out.



Common Applications

Tightening and loosening internal hex bolts.



Some Example Tasks

Take some device with internal hexagonal socket, loosen the screw and then tighten it back using allen keys



Important Links

1. <https://youtu.be/sGu-eFH02Go>

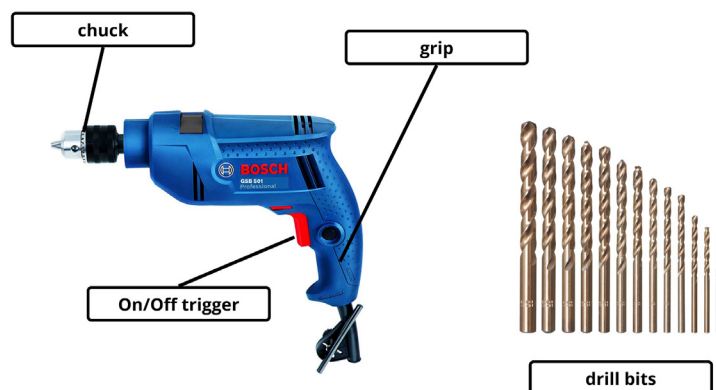


Drill Machine

Drill machine is a very useful machine which is used when we need to make holes in materials and surfaces such as bench, wood, wall and more. They come with different attachments of bits (the metal rod) which is used to make the hole. It is a gun-like machine which is handy and can be used anywhere. It has a power button, a speed regulator and a chuck to fit the drill bits. It is used to make holes in materials such as wood and walls.

Drill bits are metal rods that have twists on them and are attached to drill machines to carry out the drilling process. There are different types of drill bits for different target materials.

A drill machine set may also consist of other accessories like hammer, key and screws.



How to Use

A drill machine usually has two modes to select from, one for drilling into wood/metal and other for concrete materials. Select a drill bit of required size and tightened it using the key. Once done, make sure the fitting is tight enough. Then take the material you need to drill into. Point the bit towards it and press the red button. The rotational speed of the bit would depend on the strength with which the button is pressed. Slowly, put the drill bit into the surface of the material, don't put a lot of force, just enough force to keep the drill bit intact.



Common Applications

To make holes in walls for screws.

To make holes in other materials such as metal and wood.



Some Example Tasks

Drill a hole into a wood piece.



Important Links

1. How to use a drill machine
2. Parts of a drill machine



Drilling Workstation

A drilling workstation refers to the whole setup where the process of drilling can be carried out. An ideal workstation should have a drill press setup, a drill holder for holding drill machines/multitools over it, and a rotary tool.



How to Use

The Drilling workstation has a drill press which takes the drill holder downwards to easily carry out the drilling process without having to exert much pressure. The rotary tool or drill machine can be attached to the setup, with their drilling points facing downwards. Once done, a drill bit can be attached to it and can be used to get it to work.



Common Applications

Making holes in comparatively small and mobile materials like a block of wood.



Safety Measures

- It uses very high power devices, so a socket with appropriate voltage and current ratings should be used.
- Don't put your hands near the drill bit while it's in use.

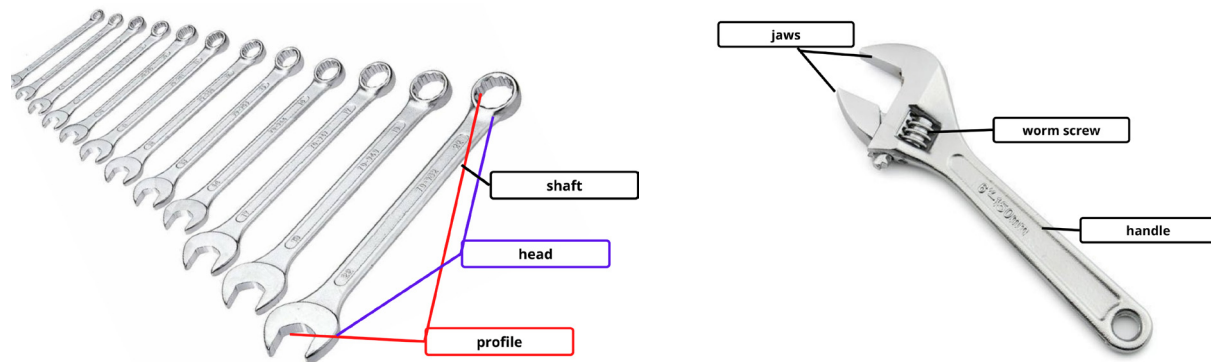


Important Links

- Installing and using a dremel workstation



Spanner set and Wrench



Many times we require to tighten or loosen nuts and bolts for opening or closing the parts of devices for various purposes such as repairing, modification and more. This is where spanners come in handy. A spanner is a tool made of hard metal or alloys such as steel which has a shaped jaw designed to tighten or loosen nuts and bolts. A spanner set contains spanners with different sizes of jaws to use on different nuts and bolts.

A universal wrench is a tool, pretty much like the spanner, but with movable jaws, to avoid using multiple different tools for different bolt sizes. It is used to loosen or tighten bolts and to hold grip over them. The space between the jaws can be changed by using the worm screw.



How to Use

To use the spanner, find the correct size of spanner required for the specific bolt. Put the spanner's jaw over the bolt, making sure that it fits well and is interlocked. Then, to fasten it, rotate the spanner clockwise, and to loosen it, rotate the spanner in counter clockwise direction.

To use a wrench effectively, loosen its jaws a bit by rotating the worm screw, put the wrench over the bolt, and then tighten the jaws to make them fit. Once fit, rotate the wrench in the clockwise direction for tightening it, and in the counter clockwise direction for loosening it.



Common Applications

Tightening or loosening bolts.



Safety Measures

- Do not use a bent or damaged spanner.
- Don't apply excessive force as it might break the material on which the bolt is tied.



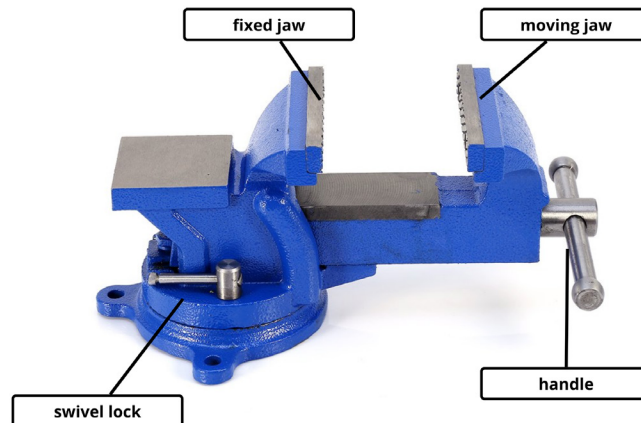
Important Links

- How is a spanner manufactured



Vice normal

Vice, also spelled as vise, is a device which consists of two jaws, one fixed and one movable, which is used for holding a workpiece. It is usually permanently attached to a bench to carry out the work. The length of the workspace jaw is varied by using the movable jaw, and ranges between 4 to 12 inches generally.



How to Use

To use a vice, it is advised to first install it on a bench with enough space around it. For installation, the screws need to be tightened into the bench. Once done, the vice is ready to be used. For using it, take the workpiece, wood or metal, and put it between the jaws. Then, tighten the jaws and make sure that the workpiece is held firmly. Now, you can go ahead and perform the task on the wood.



Common Applications

Used for holding wood pieces for cutting with hacksaws.
Used for holding metal for performing welding.



Safety Measures

- Do not use a bent or damaged spanner.
- Don't apply excessive force as it might break the material on which the bolt is tied.



Some Example Tasks

Cutting a piece of wood by putting it on vice by using a hacksaw.



Important Links

- How to install a vice



Screw driver set

Screw drivers are an amazing tool that are used to tighten or loosen screws of different head patterns. A screwdriver usually has 2 major parts, a handle which is held by the person using it, and a shaft with a tip. A multipurpose screwdriver set has so many types of screw drivers that vary in their size and the shape of head. Generally, we use 3 major types of screwdrivers:-

Simple manual screwdriver

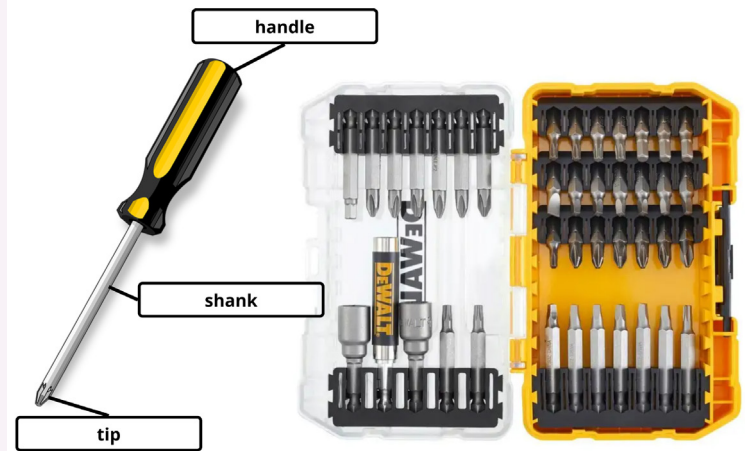
These screwdrivers are used with manual mechanical force and have a simple design

Electric screwdriver

It is an electric tool which is used when power is required to loosen or tighten the screws. It looks like a drill machine and makes the process of screwing/unscrewing almost effortless.

Precision screwdriver set

These screwdrivers are used to tighten or loosen relatively small fasteners that require more precision to be used.



How to Use

For using a screwdriver, it should be held with the handle. Choose a screwdriver with the desired shaft tip based on the screw that needs to be tightened or loosened. Then, fit the tip into the screw, and rotate it clockwise to fasten it, and anti-clockwise to loosen it. Electric screw works in the same way, just that it has a button which needs to be pressed for rotating the shaft.



Common Applications

Dismantling some electronic devices for repair purposes.
Changing old rusted screws.



Safety Measures

- Do not use a bent or damaged screwdriver.
- Don't apply excessive pressure while turning the screws.



Important Links

- How to crimp an alligator clip into a wire YouTube Video



Cordless rotary multitool set

A rotary tool is a versatile, handheld power tool with a fast-spinning motor tip that is used for grinding, sanding, honing and polishing a variety of materials. Rotary tools have a large assortment of attachments designed for different tasks, making them a staple in many toolboxes.



Specification

A rotary tool with adjustable rotation speed till 30,000 and voltage/current range of 8-10V, 0-2A is preferred.



How to Use

Attach the bit that you would need to use for your purpose. Put the plug into the socket and turn it on. Set the speed at which you want the rotation through the regulator present in the multitool. Once done, you can switch the button and start working with it. The rotational speed is very high so only a small impact should be made while using it.



Common Applications

To make the surfaces polished.

A grinding blade attached to a rotary tool makes it work like a grinder for cutting wood, metal pieces.



Important Links

1. <https://youtu.be/xx9h9hfirtw>



Air blower

Air blowers are devices used to blow air. The main purpose is to replace the contaminated air with clean air. Almost every industry uses air blowers for different purposes such as drying, reducing heat levels, reducing smoke and odours, processing and controlling gaseous fumes. The primary purpose of an air blower is to ensure the provision of a steady air flow when needed.

Some blowers can also work as vacuum cleaners by putting the blower nozzle in the fitting from where the air is sucked.



How to Use

Plug in the air blower into the socket and power it on. There's a speed regulator attached to blowers which controls the amount of air that should come out from the blower. Then, there's a push button which is used to blow the air. It should be pressed and held to blow air out of the machine. There's also a small lock which when pressed would keep the blower button ON and would supply air continuously. Once done with the blowing, turn the button off, and turn off the power supply as well.



Common Applications

1. Cleaning hard to reach places at home.
2. Cleaning dust from surfaces.



Safety Measures

1. Never point the blower over anyone or near the face.
2. Wear proper safety equipment such as goggles and safety mask before using it in dusty areas.
3. Make sure that the cable of the blower is not damaged.



Important Links

How to use an air blower

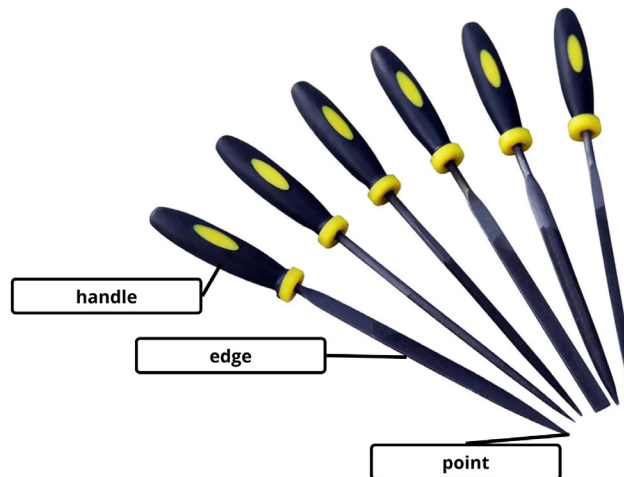


File set

Files are crafting tools that are used for various purposes such as making the surface of a metal smooth, making the corners round, putting impact for creating depth on glass, metal or wood. There are a variety of files for different purposes. Generally, there are two types of files that we'll be using:-

Mini file set (working length-3 inches)

File set (working length-6 inches)



How to Use

A file is usually used with both hands. Put one hand on the handle, and the other one softly on the edge. Then, push and pull it across the surface horizontally, creating maximum friction. Do this repeatedly and you'll start seeing the desired result.



Common Applications

- To make corners of materials rounded for safety.
- To make the surface smoother and shinier.



Safety Measures

- Hold the file properly and securely while using.
- Don't use a file if its teeth become dull.



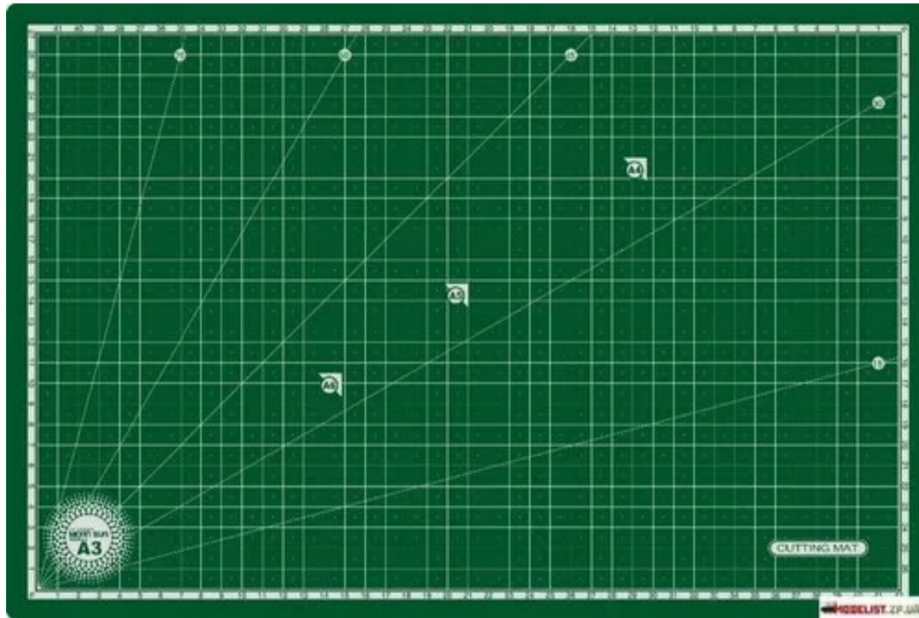
Important Links

[How to use files for metalworking](#)



Flexible cutting mat

A cutting mat is a hard mat that protects your work surface so that it does not receive any marks from the rotary cutter's blade. It also prolongs the life of the blade by keeping it from becoming dull. Many cutting mats also have grid lines or rulers, which helps you to measure as you cut.



Specification

A A3 size mat (18 inches x 12 inches) with markings is preferred to be used.



How to Use

Whenever doing some work with a rotary multitool, use this flexible mat beneath to protect the flooring surface.



Safety Measures

Don't roll the mat even when not in use.
Clean the mat periodically to ensure it's longevity.



Important Links

[How to clean a cutting mat](#)



Pegboard

A pegboard is a very useful board used to hold and hang objects on it. Generally, we use it to hang mechanical tools such as pliers, hammers, spanners and more. The advantage of using it over a normal board is that its customizable and can hold a lot more things as compared to common boards. A pegboard also has hooks that can be put in the holes and then can be used to hold things.



Specification

The pegboard should at least be 24x24 inches to accommodate all the required materials.



How to Use

Just hang the pegboard on a wall using screws and you're good to go! Attach the hooks in the holes you want to and then you can start putting tools over it.



Common Applications

Storing and organising tools.



Safety Measures

Make sure to install the pegboard on the wall safely.

Don't overload the pegboard with tools exceeding its holding capacity.



Important Links

[How to install pegboards](#)



Hot glue gun

A hot gun is a very useful tool which is used to stick things together through the adhesive in its stick which is used in molten form. The gun requires electricity and melts down the glue stick from the nozzle of the gun which is then used to stick materials. The adhesive of the glue stick solidifies in a few minutes, ensuring that the materials are stuck together. It is used in small craftings and attachments, as the method is very cheap, fast and easy to use, and also reliable.

Specification

Glue guns compatible with standard 0.5 inch glue sticks and with a temperature range of around 230-280 degree celsius is preferred.



How to Use

Insert glue stick into the glue gun and make sure that it's properly fit inside. Then, turn on the glue gun power supply and let it run for about a minute. Then, take the glue gun and press its trigger to get the hot glue out for usage. Once the adhesive comes out, it can be put on any surface that needs to be stuck. After putting, put another material over it and press for a while. After a few minutes, the adhesive would solidify and provide a hard bond.



Common Applications

Sticking materials together while making prototype projects



Some Example Tasks

Create a DIY design using icecream sticks or any other material and use a glue gun to stick its components together.



Safety Measures

Ensure that you don't touch the hot part of the gun while it's ON.

Don't put hot glue adhesive on things that are fragile and might deform due to heat.



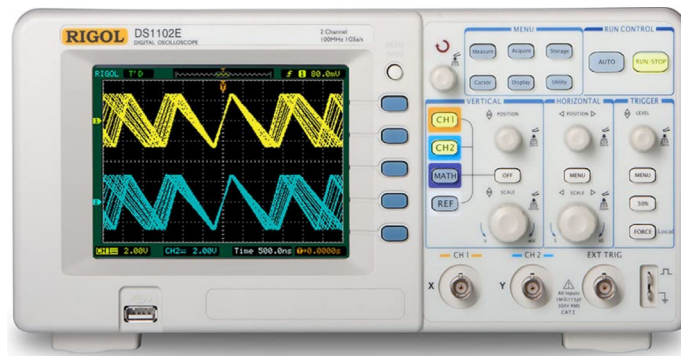
Important Links

How to use a glue gun



Digital oscilloscope

An oscilloscope is a type of electronic test instrument that allows observation of constantly varying current or voltage signals, usually as a two-dimensional plot of one or more signals as a function of time. Other signals (such as sound or vibration) can be converted to voltages and displayed. It has a display which can be controlled with a number of controllers present in the panel.



How to Use

Tutorial-YouTube Video



Common Applications

Analysing the nature of electronic waveforms.
See visual representation of the variation of voltage over time.



Safety Measures

Use only shielded probes and never touch the metal part of the probes while in use.
Avoid operating an oscilloscope in an environment with a significant magnetic field as it can distort the results.



Some Example Tasks

Design any circuit on a breadboard and find its voltage through a digital oscilloscope.



Important Links

Working principle of an oscilloscope



Soldering kit

Soldering is a joining process used to join different types of metals together by melting solder. Solder is a metal alloy usually made of tin and lead which is melted using a hot iron. It is used a lot in making connections on microcontroller boards. Precision is highly required while working with soldering iron. The iron is heated to temperatures above 300 degrees celsius which then cools to create a strong electrical bond.

A soldering kit contains multiple tools to achieve the process of soldering, It contains:-

1. Soldering Iron
2. Desoldering pump
3. Soldering Tip
4. Soldering wire



How to Use

Take the soldering iron, turn it ON. Then take it near the metal that needs to be soldered. Put it on the tip, and put the soldering wire's tip at the point as well. As soon as it melts a bit, take off the soldering iron quickly. This is the best way to do soldering as it makes the soldering wire material stick the best. Rosin core soldering wire is most famously used for electronics.



Common Applications

Making connections on microcontroller boards.



Safety Measures

Never touch the element or tip of soldering iron when in use.

Always return the soldering iron to its stand when not in use. Never put it down on the workbench.



Some Example Tasks

Solder the pins on the arduino board.



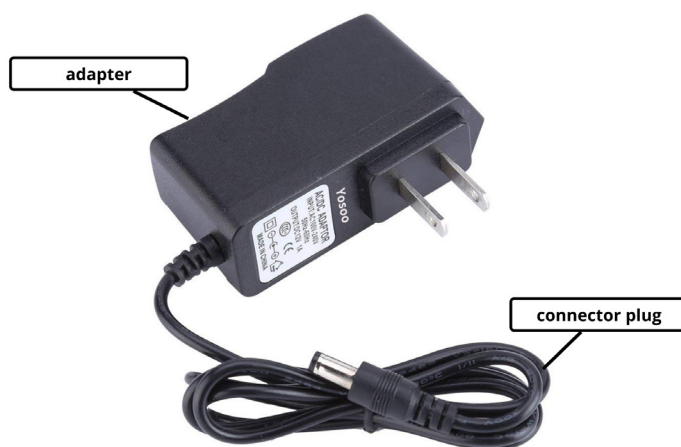
Important Links

1. Basics of soldering



Adapters

A DC adapter is used to power a device which has a DC power jack connector to power it. It is used for such devices that can't use the voltage that comes from the main, which is AC voltage. So, a DC adapter converts AC to DC accordingly and helps to charge such devices.



How to Use

1. Plug in the adapter into the power socket.
2. Plug in the DC connector into the device that requires the power
3. Turn ON the switch from main power.



Safety Measures

1. Don't touch the DC jack connector while the main power is ON.
2. Don't put the adapters in devices that are not rated to be used with the specifications of that adapter.



Important Links

1. Learn about adapters in detail



Dual temperature heat gun

A heat gun is a machine that blows heated air. It is used to mould things, soften materials and provide heat. It can be used to remove oil paint from the walls, melt down the water in frozen pipes during winters in extremely cold places, or repair furniture. In dual temperature heat guns, they've two modes. One is more powerful and blows more heat, and the other mode is a bit subtle in comparison.



How to Use

To use a heat gun, put the plug into the socket and turn it on. Now, on the switch, you'll see two modes, higher power and lower power, switch to any mode based on needs and then the heated air would start blowing. Point the air towards whatever material you need to use it, and rotate the material to provide equal heat on all sides if required.



Common Applications

1. A much less powerful version of heat guns is what we call hair dryers, used to make hair dry after shower.
2. It can be used to mould PVC pipes.
3. Heat guns can also be used to mould glass materials.



Safety Measures

1. Never put your hand or any part of your body in front of a heat gun while it's on.
2. Never point it to objects that are not intended to be heated, as it can prove hazardous.



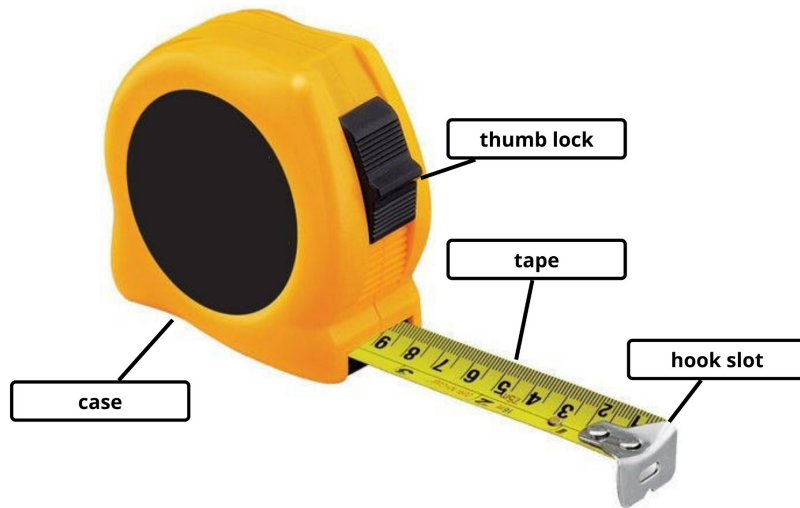
Important Links

1. How to use a heat gun



Return measuring tape

A measuring tape is a very handy and useful tool which can be used for measurement purposes and for longer measurements that are generally not possible through rulers. A tape measure or measuring tape is a flexible ruler used to measure size or distance. It consists of a ribbon of cloth, plastic, fibreglass, or metal strip with linear measurement markings. It is a common measuring tool.



How to Use

Using a measuring tape is simple. It has a hook slot which can be pulled to get the required amount of measuring tape out. The ideal way is to place the hook slot at one end of whatever material needs to be measured, and then pull the tape in the opposite direction. The thumb lock can be used to lock the tape position, which otherwise goes into the case if left as it is.



Common Applications

1. It is used to measure materials such as bench, plywood, pvc pipes and more.



Safety Measures

1. Don't pull the tape further after it has reached its limit,
2. Don't abruptly lose its grip as its hook can hit you and cause harm.

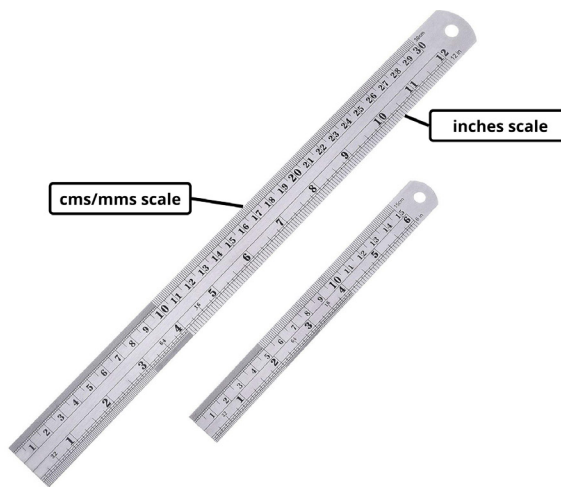


Important Links

1. How to use a measuring tape



Stainless steel ruler



A ruler is a very common stationary and industrial essential which is used for taking measurements and drawing lines along them. A common stainless steel ruler has two measurements written on it, in inches and centimetres. On one side you can find the measurements in inches, and on the other side they're in centimetres.



How to Use

Using a ruler is very easy. Just put it on the surface of whose length you want to measure or create lines, and then just go on with your task.



Common Applications

1. Drawing straight lines
2. Measuring exact lengths and mark points accordingly.

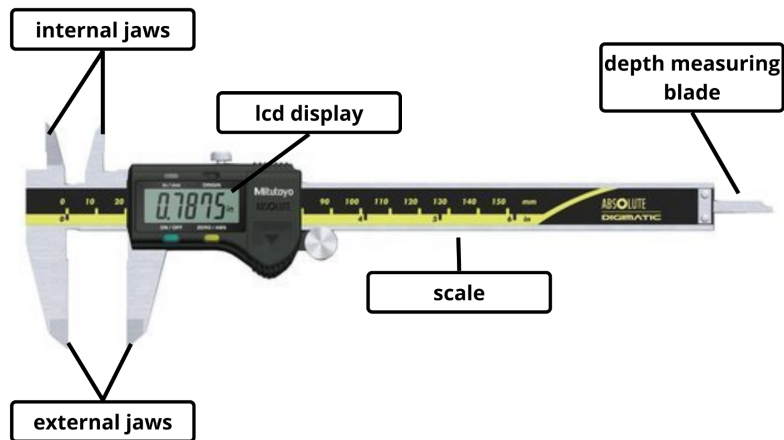


Safety Measures

1. The ruler is pointed at edges, so carry and use it safely.
2. Make sure you're watching the scale normally to avoid parallax errors in measurements.

Digital vernier Calliper

Vernier calliper is a measuring device which is used to reach much more accuracy and precision as compared to a normal ruler. It is very useful for measuring small materials where the measurement needs to be accurate. It can also be used to measure the depth and breadth of materials. Earlier the callipers required to be measured through 2 different graduating scales and then get the actual measurement by using the formula. But the digital vernier calliper eases out the whole process. It shows the exact values digitally on the LCD display.



How to Use

There are 3 ways you can measure things using vernier callipers, it depends on what you are measuring. Let's take a simple example of a beaker. First of all, turn on the button to start measuring and put the calliper to zero. If it shows a non zero value, then press the absolute zero button to correct zero error, and now it's set to be used. If the internal diameter of the beaker is to be measured, the vernier calliper would be put into it with the internal jaws touching the ends of the beaker, and then the value can be read. Now, suppose if you want to measure its outer diameter, you can use the external jaws and put the beaker between it and then read the LCD display values. Thirdly, If the depth of the beaker needs to be measured, you can just put the depth measuring blade inside and then read the values.



Common Applications

1. To measure the diameter of a pendulum bob.
2. To measure the dimensions of the beaker.



Safety Measures

1. Make sure that you don't put excess pressure on the calliper while measuring.
2. Make sure that you eradicate the zero error in final readings.



Some Example Tasks

Measure the dimensions (outer diameter, inner diameter and depth) of the beaker using a digital vernier calliper.



Important Links

3. How to use a digital vernier calliper

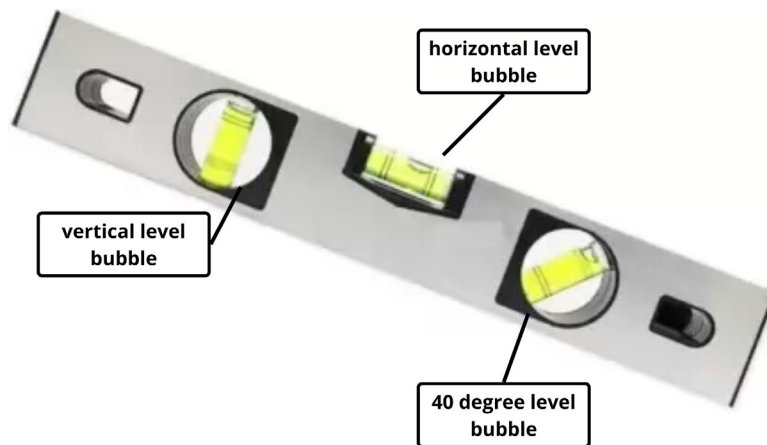


4. Working principle of a simple vernier calliper



Spirit level

A spirit level is a device consisting of a sealed glass tube partially filled with alcohol or other liquid, containing an air bubble whose position reveals whether a surface is perfectly level. The level is found to be exactly vertical or exactly horizontal if and only if the relevant tube bubble is in the centre and opposite to the direction of gravitational force.



How to Use

Put the spirit level on the surface for checking. If the bubble is not in the centre, that means that the level isn't perfectly horizontal or vertical. Thereafter, relevant changes can be made to make the surface levelled.



Common Applications

1. To check if a surface is levelled



Safety Measures

1. Make sure that the tube isn't broken.
2. Ensure that you're viewing it in such a way that parallax is negligible.



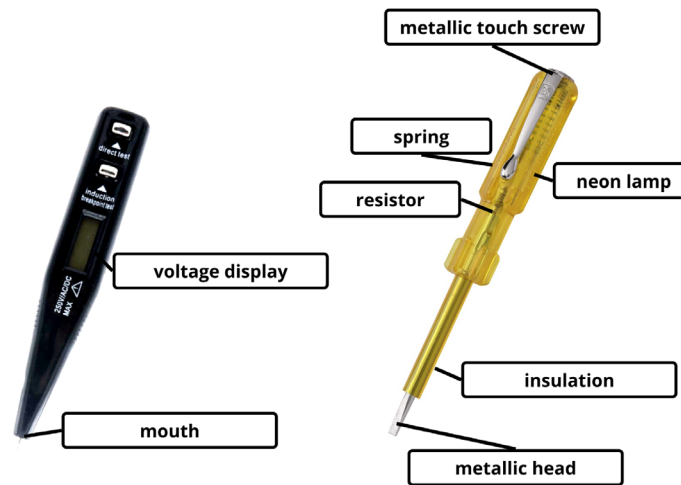
Important Links

How to use a spirit level



Digital pen electric tester

Many times, it is required to check if there's voltage coming in a line or not, mostly while making electrical connections or repairing electrical appliances. That is where a tester comes into play. Looking like a screwdriver, it is used to determine if there is any sort of voltage or not. There are two types of testers, a manual one and an electric one. Both work in the same way, but the electric one has an edge, as it shows the voltage in the voltage LCD display present on it.



How to Use

To use a tester, it should be held in hand. Then, the tip should be touched with the wire line or socket or any other thing you're testing it on. If it's an electric tester, it'll display the voltage of the display if any. Otherwise, if it's a manual one, you once need to touch the metal touch screw on the top, and then if the light glows, it indicates the presence of voltage. One thing to make sure is that one should never touch the metal part of the head which is in contact with the testing material.



Common Applications

1. Repairing electronic devices.
2. Testing the voltage on devices.



Safety Measures

1. Never touch the head part of the tester which is in contact with the voltage line.



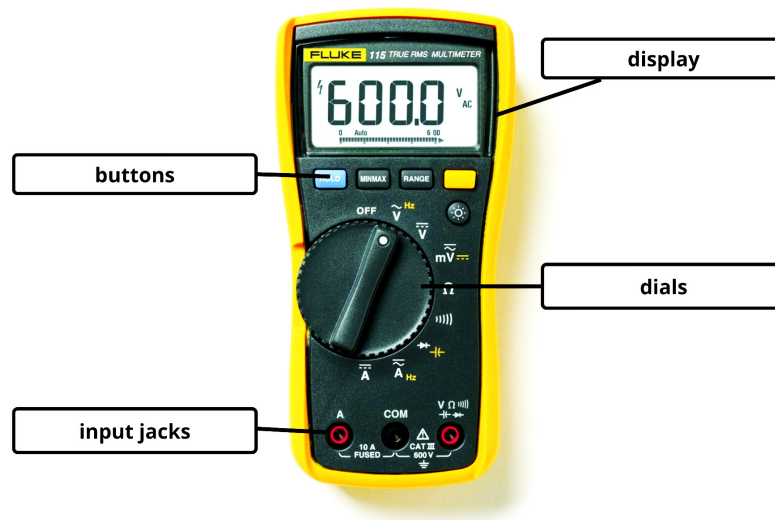
Important Links

How does an electric tester work



Digital Multimeter

A multimeter is a device which can be used to measure multiple properties of an electrical setup such as voltage, resistance and current. It serves as a single device which can be used as a voltmeter, ammeter and ohmmeter, which is why it is also referred to as volt-ohm-milliammeter (VOM). There are few multimeters that are even more advanced and can measure more properties such as temperature and inductance.



How to Use

First of all, put one probe into the jack named COM. After that, you need to point the dial on the property that you are measuring. If you are measuring direct current for example, point the dial towards the A label. After that, put another probe into the jack with label A. The other ends of the probes should be connected to the wire. If all the setup is correct, you should see the readings on the LCD display.



Common Applications

1. to measure the electrical properties of appliances.



Safety Measures

1. Put the probes correctly in the multimeter input jacks.
2. Don't touch any open ends while measuring values..



Important Links

How to use a multimeter

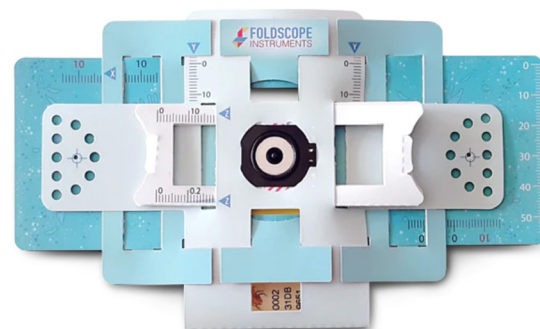


DIY paper microscope

A microscope is an optical instrument used for viewing very small objects, such as mineral samples or animal or plant cells, typically magnified several hundred times. For ATL purposes, we'll use a simple DIY paper microscope, which can be assembled by the user itself.

Specifications

Magnification	140X
Resolution	~2 micron
Back focal length	~0.5 mm
Depth of field	~0.01 mm
Field of view	~0.5 mm (diagonal radius)



How to Use

The setup of the microscope will be mentioned in their manual.



Common Applications

To observe microcomponents with much clarity and zoom to understand and study them better.



Some Example Tasks

1. Students can collect a very small amount of soil and then see its composition using the paper microscope.
2. Observe water droplets collected from different taps in school and home



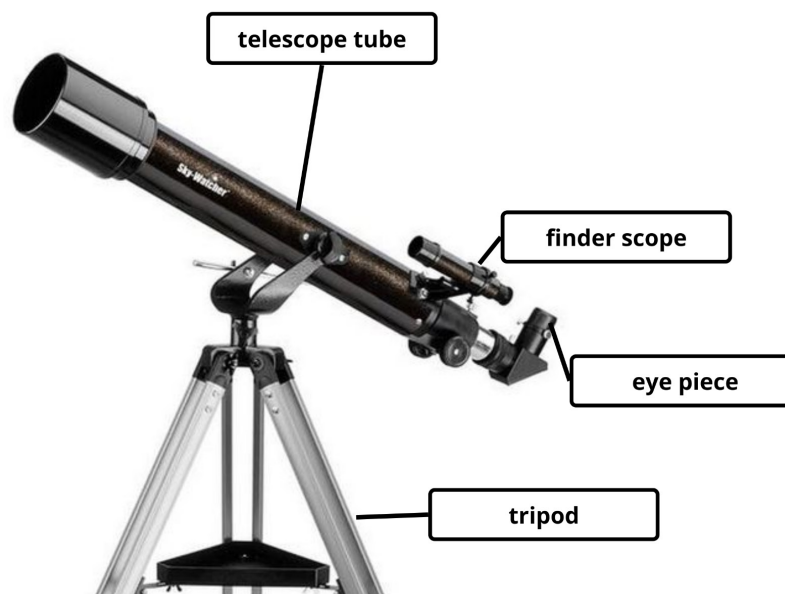
Important Links

How does a microscope work



Telescope

A telescope is a tool that astronomers use to see faraway objects. They work by using curved mirrors to gather and focus light from the night sky. Earlier lenses were preferred for this purpose, but nowadays, mirrors are preferred more. It's because mirrors are lighter, and they are easier than lenses to make perfectly smooth. The mirrors or lenses in a telescope are called the "optics." Really powerful telescopes can see very dim things and things that are really far away. The bigger the mirrors or lenses, the more light the telescope can gather. Light is then concentrated by the shape of the optics. That light is what we see when we look into the telescope. The optics of a telescope must be almost perfect. That means the mirrors and lenses have to be just the right shape to concentrate the light. They can't have any spots, scratches or other flaws. If they do have such problems, the image gets warped or blurry and is difficult to see. It's hard to make a perfect mirror, but it's even harder to make a perfect lens.



How to Use

Tutorial-<https://optcorp.com/blogs/telescopes-101/how-to-use-a-telescope>



Common Applications

1. To see far off things
2. In astronomy



Some Example Tasks

1. Observe the surface of the moon using a telescope.
2. Try to observe planets using the telescope



Safety Measures

1. Don't try to look at the sun or any bright material through a telescope as it can even lead to blindness.
2. Carry the telescope with care as it has many delicate parts.



Important Links

How does a telescope work



How to set up and align telescope



Observing moon through a telescope



Sewing kit



A sewing kit is a kit which contains devices and materials to carry out the sewing process. The kit should have one semi automatic sewing machine, few sets of assorted needles and few colour spools. Sewing machine is the most complex part of the kit. It has many components such as:-

1. Feed dog
2. Pattern selector
3. Machine body
4. Bobbin winder stopper

It requires a work of precision and aesthetics to make beautiful things.



How to Use

Different types of sewing machines



Common Applications

1. Sewing clothes
2. Sewing covers for Air-Conditioners or microwaves.



Some Example Tasks

1. Sew a small handkerchief kind of cloth with multiple folds, one on top of another to make it appear like a flower.



Important Links

Different types of sewing machines





PACKAGE 4

Power Supply, Accessories and Safety equipment

Glue Sticks



While using a hot glue gun for sticking materials, glue sticks are an essential component. They serve as a refill and should always be there attached while using hot glue guns. Glue sticks are made of polymers such as ethylene-vinyl acetate (EVA), polyolefins and polyamides.



How to Use

Insert the glue stick into the glue gun and make sure that it's properly fit inside. Then, turn on the glue gun power supply and let it run for about a minute. Then, take the glue gun and press its trigger to get the hot glue out for usage.



Important Links

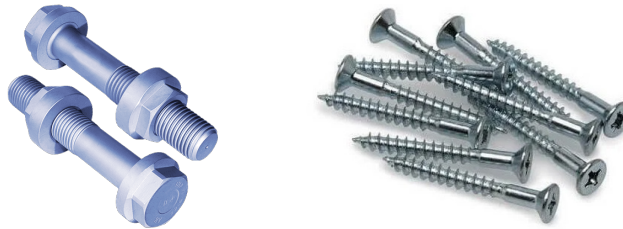
1. How to refill glue stick



Nuts, Bolts and Screws

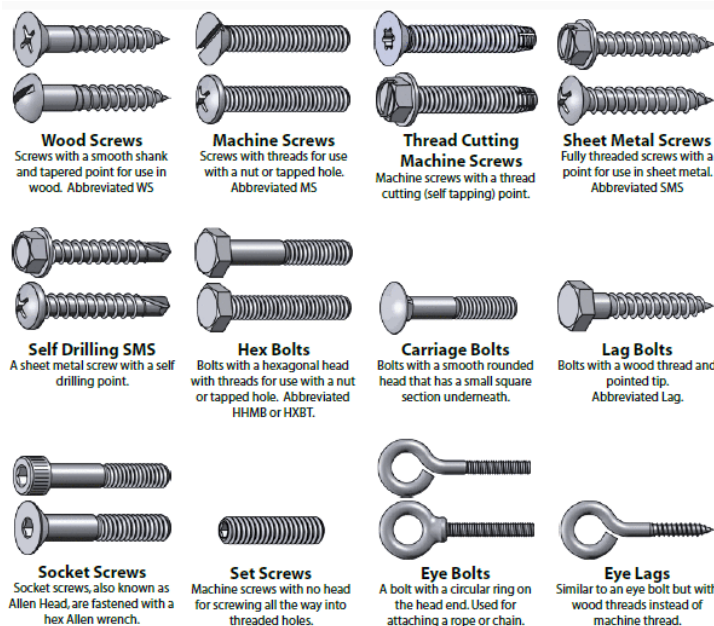
A nut is a small metal object with a hole in the middle that has a corrugated hole. These curved holes are known as threads. Nuts are used as a fastening device. It is important to note that even though nuts are used as a fastening device, they cannot be used without bolts. Nuts and Bolts are usually used together to fasten multiple parts together. They are put together on the opposite ends of the material that needs to be fastened, and then tightened through tools such as screwdrivers and allen keys. Screws are a bit different in that sense. They are only single pieces and are used to hold things together. The screw is usually tightened into materials and makes them hold the surface.

Types of screws



How to Use

Nuts and bolts are held together by a combination of friction of their thread, a slight stretch of the bolt, & compression of the part to join together. For nuts and bolts, they should be kept apart first, then the bolt should be inserted into the materials that need to be fastened. Thereafter, the bolt should be inserted from the other end and should be tightened with the bolt. The nuts come with a separate locking mechanism that prevents machine parts from loosening due to the vibration of the parts or parts that they joined. The nut has internal threads so that it can be tightened easily on the bolt. Screws can directly be impacted upon a surface and then tightened enough to ensure they're fixed properly. The parts connected with the screw have less strength than the bolt.





Common Applications

1. All types of industrial equipment
2. Solar thermal plant & Nuclear power plant
3. Sewage Treatment plant
4. Pumps and valves
5. Transportation and storage, pressure vessels, tanks, piping, & heat exchangers



Some Example Tasks

1. Tightening the screw on a ply
2. Fasten two plies together with nut and bolt



Important Links

1. How to use nut and bolts
2. Difference between Bolts and screws

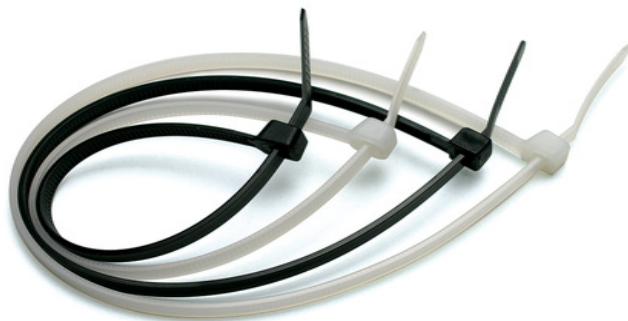


Safety Tips and Precautions

- ⦿ Tighten Bolts For Maximum Strength - The users see the tensile force only, not the comprehensive force. The bolt has an internal reaction force for which it is itself in the tension, which is equal to the amplitude of compression force.
- ⦿ Avoid Over-Tightening - It is difficult to determine the load that a fastener is bearing during clamping, but it is necessary to stay away from the point of over-tightening. It is important to manage the right balance for the perfect clamping.
- ⦿ Change The Melted Head Screws - At the time of sudden uncertainties, removing the melted screws is nothing but calling the fires for your own. Therefore, it's better to be prepared; replacing these with new ones can save you from blunders.

Cable Tie

Cable ties are used for fastening and holding items together, mostly electrical components like wires. It is used to properly organise the components, keeping the setup tidy. They are also known by other names such as hose, zip, or tie wrap. They come in different sizes, lengths, materials and even colours. The different uses of cable ties vary across industries, but they all have in common that they're the most effective way to manage your cables.



How to Use

Take a cable tie, wind it around the materials you want to wrap together, and then fasten the cable tie. Once fastened, you can cut the excess part if required.



Common Applications

1. Locking food items bag
2. Fastening group of cables in servers
3. Group together things in an organiser



Important Links

1. Types of Cable ties and their applications - A guide to cable ties
2. Video Tutorial to use a Cable Tie - How To Use A Zip Tie-With A Bonus Zip Tie Trick



Sand Paper

Sandpaper is a kind of hard paper with sand or another abrasive stuck to it, which is helpful in polishing surfaces. In ATL labs, it can be used to polish surfaces of 3D models generated through 3D printers or ply or wood materials after cutting them.



How to Use

Hold the sandpaper from the plain side, and then run the other side on the material that you want to make smooth. Rub and change its position accordingly to give the shape and smoothness as required.



Some Example Tasks

1. Create a 3D model and smoothen it out using sandpaper.
2. Get some plywood and smoothen it out using sandpaper.



Common Applications

1. Polish rough surfaces
2. Smoothen the finish of a 3D printed objects



Important Links

1. Video Tutorial - How to use sandpaper



Power Strip Adapters

Power strip adapters come in very handy if you want to use multiple sockets for different devices but don't have enough sockets available. Also known as an extension or multiplier, it creates multiple sockets from one socket that can be used as single sockets. It has a cable, a power plug, and multiple sockets on its strip. The minimum number of suggested sockets is 5, but it can differ slightly.



How to Use

Using a Power strip adapter is very easy. Just plug in the power plug to the socket, power it on and there you go! Now you have multiple sockets to utilise.

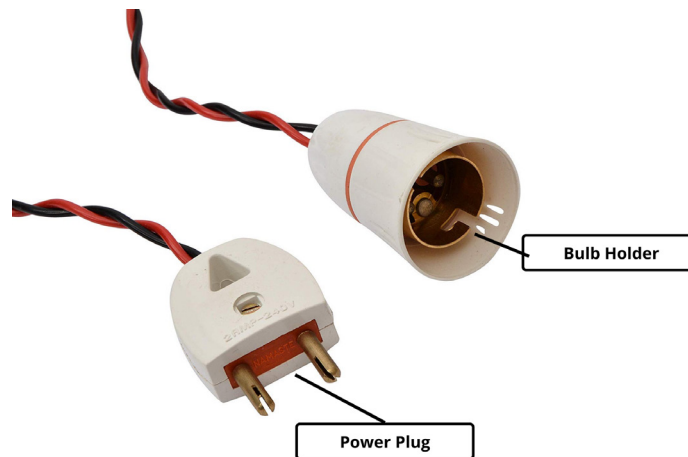


Safety Tips and Precautions

1. Don't put fingers around the socket when the switch is turned on.
2. Don't overload the power strip with heavy usage devices as it might fuse out.

Bulb Holders

Bulb holders, as the name indicates, are used to hold bulbs and are usually connected with a power source to light them up. They are used everywhere around us. The power source could be a dedicated switch with internal connections to the holder, or it can be as simple as a power plug which is portable and can be attached to a socket for power. The kind of bulb holders we'll need for ATL purposes are regular hanging bulb holders.



How to Use

The holder should be placed in the right spot, ensuring that the wires are not getting twisted and that they're insulated throughout. If they are not insulated at some parts, make sure to provide insulation first and then move on to the next step. Thereafter, take the bulb and place it in the holder. For doing so, find the entry points in the holder on the edge, push the bulb barely, and then rotate it to lock it there. After doing this, you can put the plug in the socket and turn on the power. The bulb should start glowing!

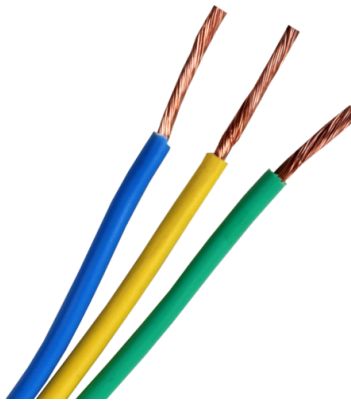


Safety Tips and Precautions

1. Don't put in the bulb when the holder power is on.
2. Avoid using rusted bulbs as they're not safe and the rust filings can cause short circuits.

Electric Wires

Electric wires are one of the most used components in the electrical and electronics domain. Wires are present all around us, and they power up almost everything in one way or the other. Electric wires can be used to make electrical connections between devices, in cables that are used to send information or for charging purposes, in internal machinery connections, and more. Many conducting materials are used to make wires such as copper, aluminium, steel, nickel alloys and more. Generally, we use the twisted red-black wires. In DC, the positive pole is mostly connected to the red wire and the negative pole with black wire. It's not compulsory to do so, but it is nice to follow the standard conventions.



How to Use

Connect the ends of wires to components/wires. Twist or solder them as required, and ensure that nothing carrying high voltage should be open. If there is anything with high voltage, it should be adequately insulated. Once the connections are made, ensure they're strong enough, and yay, you're done!



Some Example Tasks

Making a series bulb connection



Important Links

1. Types, components, features, tutorials) Understanding Wires



Safety Tips and Precautions

1. Don't touch the open part of the wire if it's connected to some sort of power supply.
2. Always insulate open wires properly

USB to DC Jack Cable



A USB to DC jack cable is very useful as it enables powering DC devices through the standard USB 2.0 ports present in laptops or power adapters. On one end, the cable has a USB 2.0 type connector; on the other, it has a DC jack.



How to Use

Plug the USB connector of the wire into your laptop or power adapter. Plug the DC Jack into your device that you want to power through the cable, and you're done!

First Aid Kit

First aid kit is a box which has all the necessary equipment needed to give immediate medical care to someone in case of an emergency. The emergency could be of any sort, such as a cut, fire burn or shock. It is very important to have first aid boxes in ATL labs. Some equipment should be present in all first aid kits:-

1. Plasters
2. Gauze dressings
3. Sterile eye dressings
4. Bandages
5. Safety Pins
6. Sterile gloves
7. Tweezers
8. Antiseptic wipes
9. Antiseptic liquid
10. Latex gloves



How to Use

The most important part is to identify what equipment from the first aid kits should be used to treat and provide medical care in case of emergencies. Then, make sure that the usage is correct and safe and always try to do that in a safe and secure place.



Safety Tips and Precautions

1. Any used disposable item such as bandages shouldn't be used again.
2. Antiseptic wipes and liquid should be applied in right amounts.



Important Links

1. How to use a First aid kit
2. First aid kit contents



Fire Extinguisher

Fire extinguisher is a fire protection device which is very useful to control or diffuse small level fires that may be caused due to several reasons. It is a very essential item that should be present in all sorts of labs or places that have chances of catching fire. There are different kinds of fire extinguishers for different kinds of fires. Fires are classified into 5 categories, with the top 3 being the most common ones:-

1. Type A fire
Fires in ordinary combustible materials, such as wood, cloth, paper, rubber, and many plastics.
2. Type B fire
Fires in flammable liquids, combustible liquids, petroleum greases, tars, oils, oil-based paints, solvents, lacquers, alcohols, and flammable gases.
3. Type C fire
Fires that involve energised electrical equipment.
4. Type D fire
Fires in combustible metals, such as magnesium, titanium, zirconium, sodium, lithium, and potassium.
5. Type K fire
Fires in cooking appliances that involve combustible cooking media (vegetable or animal oils and fats).



How to Use

Fire extinguisher should be used if and only if there's a case of fire. Always follow the acronym P.A.S.S (Pull, Aim, Squeeze, Sweep):-

1. Pull the pin to unlock the fire extinguisher to be used.
2. Aim the extinguisher discharge nozzle towards the fire from at least 6-8 feet away.
3. Squeeze the discharging lever to discharge the content of the extinguisher.
4. Sweep the nozzle back and forth to cover a larger area until the extinguisher empties out.



Safety Tips and Precautions

1. The nozzle shouldn't be pointed towards any human as it is toxic.
2. Once opened, an extinguisher should be completely used.



Important Links

1. How to use a fire extinguisher
2. How fire extinguishers work



Safety Goggles



While cutting pieces of ply, plastic, PVC and similar things, dust is released in the air that might enter in your eyes causing irritations and in some cases permanent damage. But with the proper care, it can be easily avoided using safety goggles. Wearing them before performing any sort of cutting, grinding or filing protects the eyes from dust.



How to Use

Before starting the cutting/grinding process, the goggles should be worn such that the eyes are completely covered. Ensure that the visibility is proper and you can see things correctly. In case of any uneasiness, the task should be aborted.



Important Links

1. How to put on safety goggles and use them



Safety Gloves Pair

Safety gloves are used to protect hands while working with things that might be corrosive, abrasive or chemicals.



How to Use

The gloves should be worn on hand like normal gloves. Always ensure that you wear gloves before coming in contact with abrasive or corrosive materials. Also, some people might have a latex allergy. It is strictly advised not to use gloves if you're allergic to latex, and ask your teammate or teacher to help you out with your work.



Important Links

1. [Learn more about latex allergy](#)



Safety Mask

While cutting pieces of ply, plastic, pvc and similar things, a lot of dust is released into the air, which could be in the breathing range of the people doing it. It is essential to ensure the dust isn't being inhaled as it can prove hazardous. That is the reason why we've safety masks in ATL. We should always ensure that we wear them before doing some work that might release dust.



How to Use

Before starting the cutting/grinding process, the mask should be worn such that the nose and mouth portion is totally covered. Ensure that you are not running short of breath while wearing it. In case of uneasiness, the task should be aborted.



Important Links

1. How to wear a mask





NITI Aayog



ATAL INNOVATION MISSION