

Basics of Electronics



Colour Code used on Welwyn Band-marked Resistors

Through-hole and MELF style resistors with colour band marking use the following colour code (reference IEC60062):

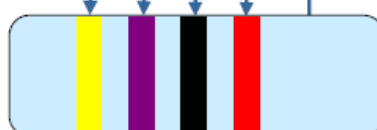
Colour	Value 1	Value 2	Value 3	Multiplier	Tolerance	
Silver				x 0.01	10%	K
Gold				x 0.1	5%	J
Black	0	0	0	x 1		
Brown	1	1	1	x 10	1%	F
Red	2	2	2	x 100	2%	G </td
Orange	3	3	3	x 1K		
Yellow	4	4	4	x 10K		
Green	5	5	5	x 100K	0.5%	D
Blue	6	6	6	x 1M	0.25%	C
Violet	7	7	7	x 10M	0.1%	B
Grey	8	8	8	x 100M	0.05%	A
White	9	9	9	x 1G		
Blank					20%	M

Example 1
5-Band Marking
E24/E96 values



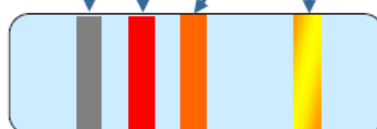
4 7 0 x100 1%
= 47K 1%
E.g. MFR4 E96

Example 2
4-Band Marking
E24/E96 values
without tolerance



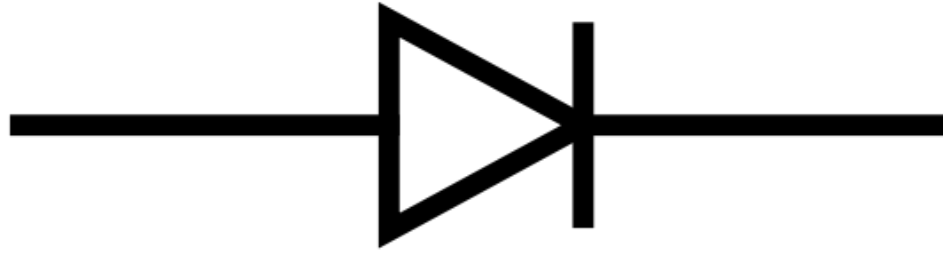
4 7 0 x100
= 47K
E.g. WRM0204 E96

Example 3
4-Band Marking
E24 values



8 2 x1K 5%
= 82K 5%
E.g. WMO3S E24

node
(+)



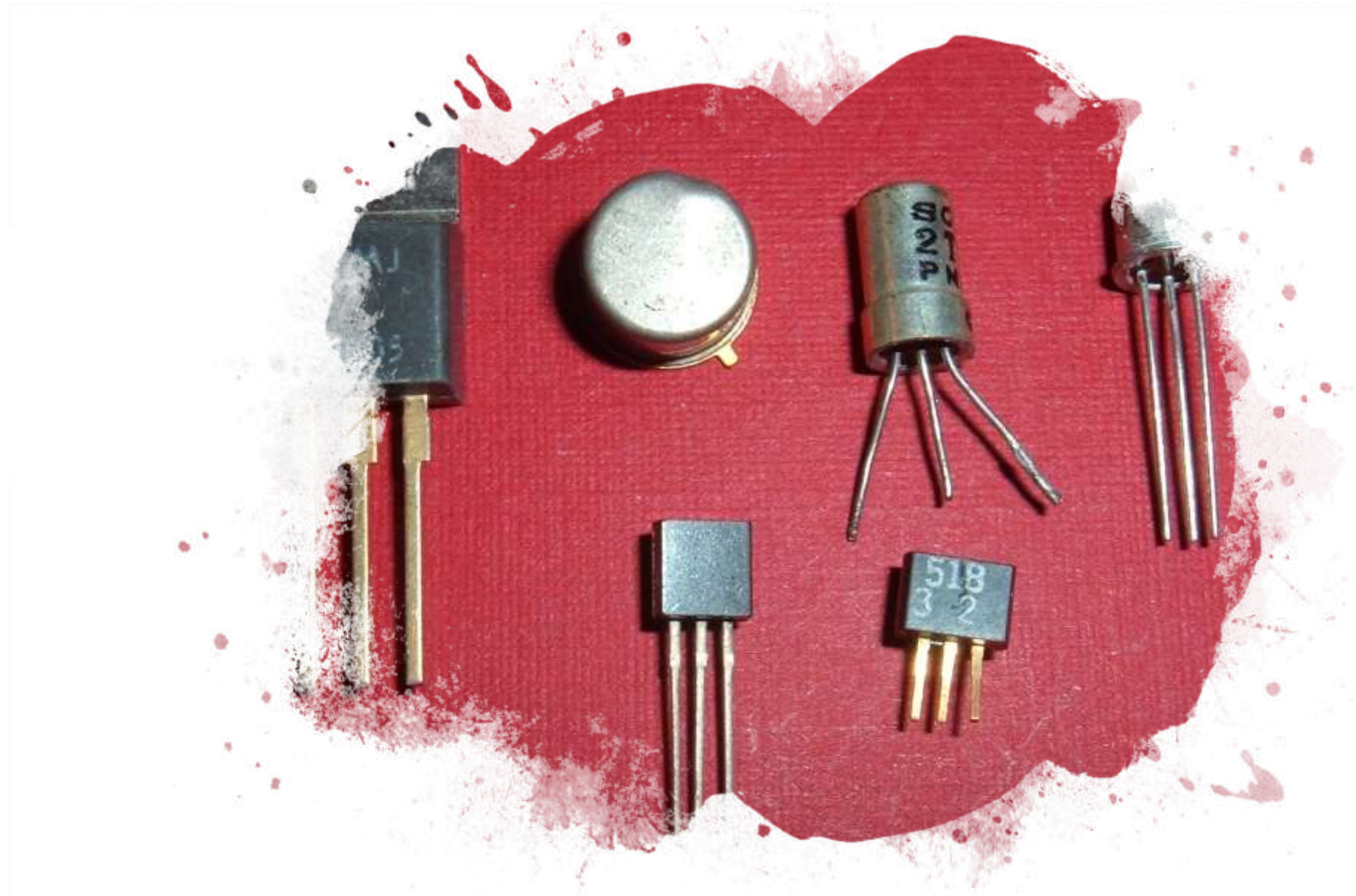
Ca

Diode

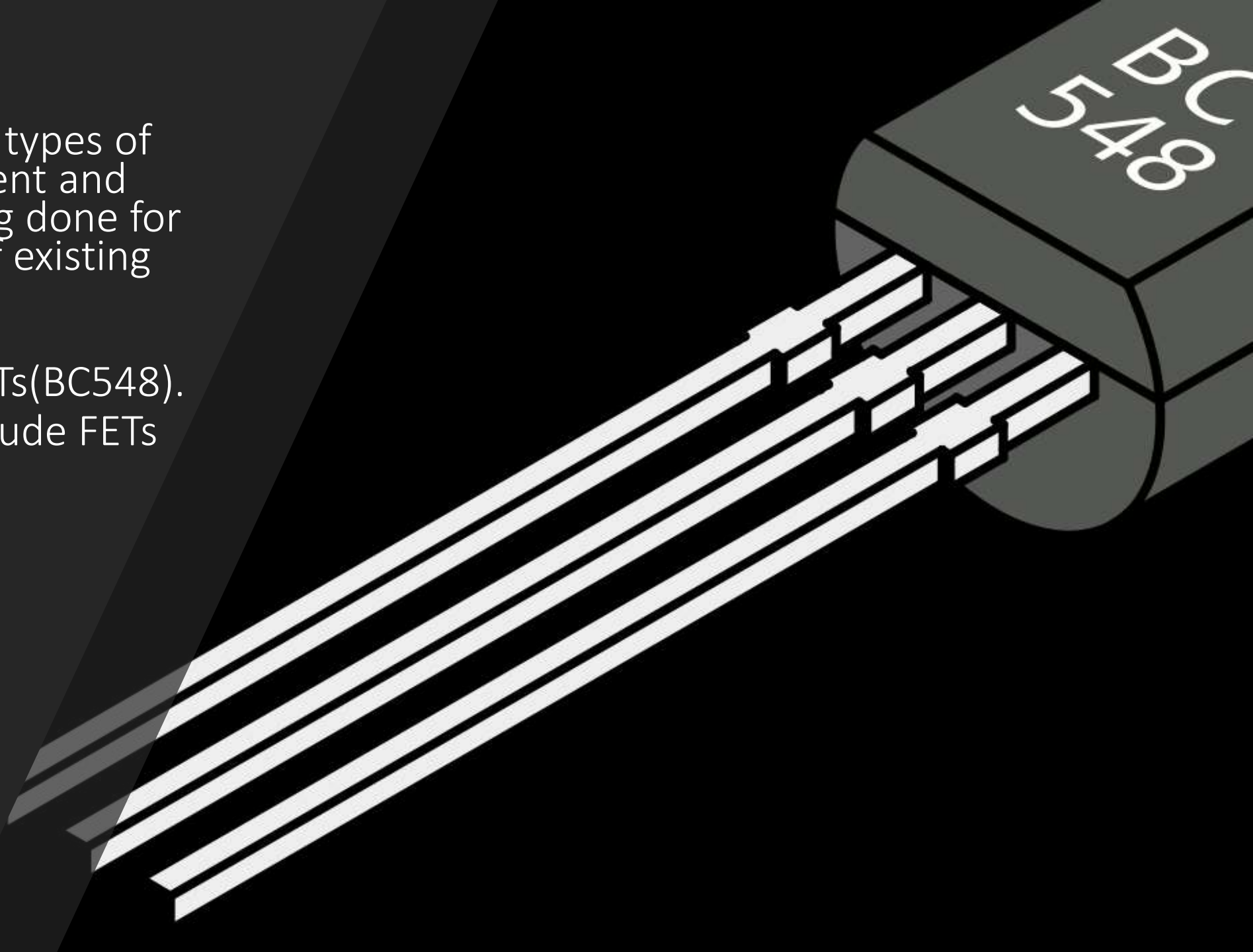
- In simple terms it allows Electric current only in one direction.



Transistors

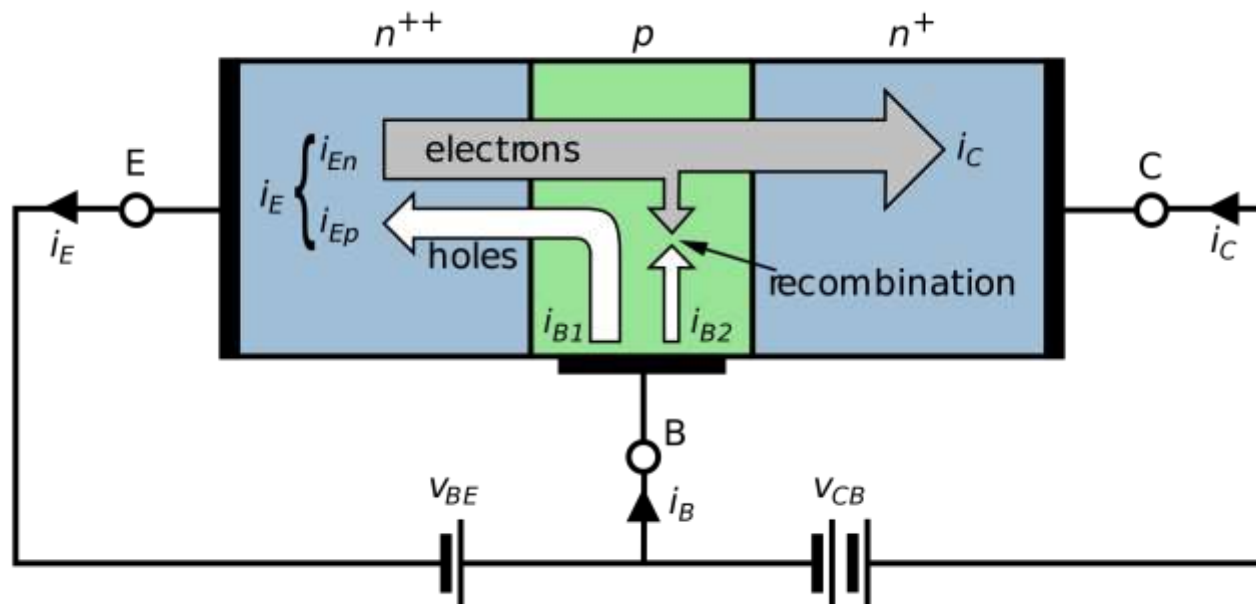
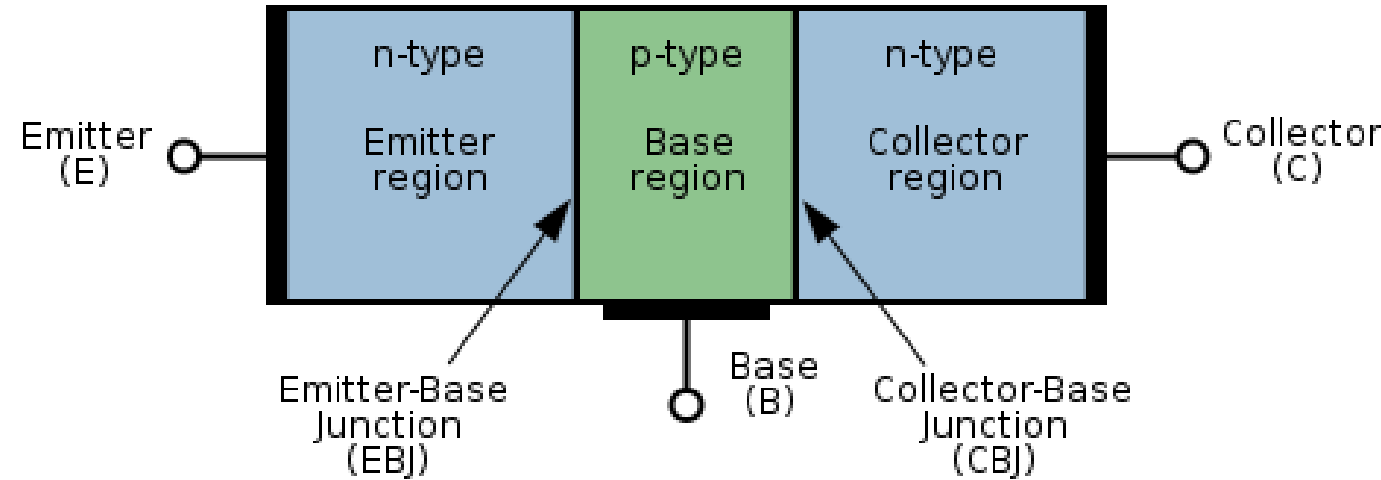


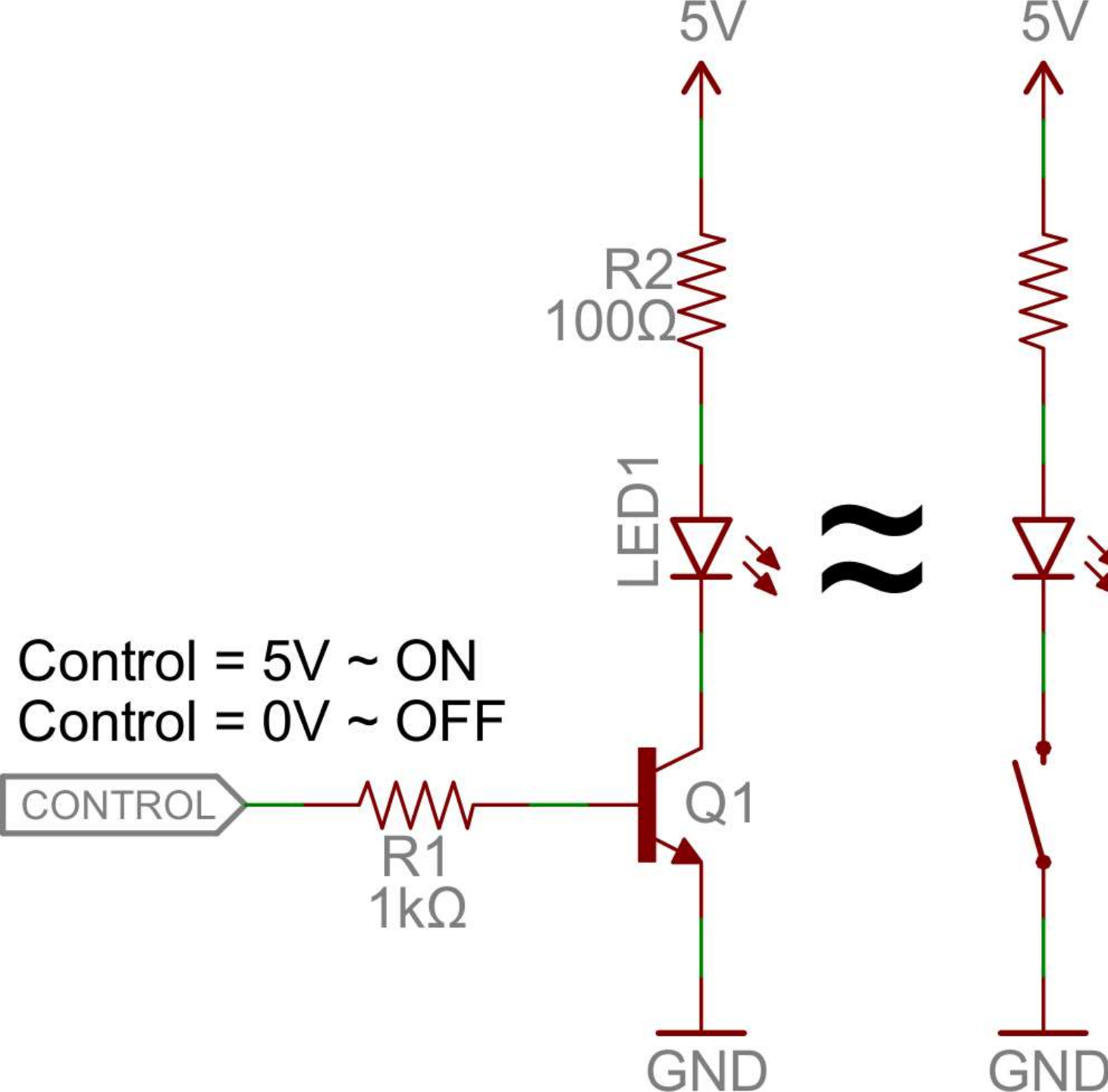
- There are many types of transistors present and research is being done for improvement of existing transistors.
- We limit our discussion to BJTs(BC548).
- Other types include FETs ,MOSFETs etc.



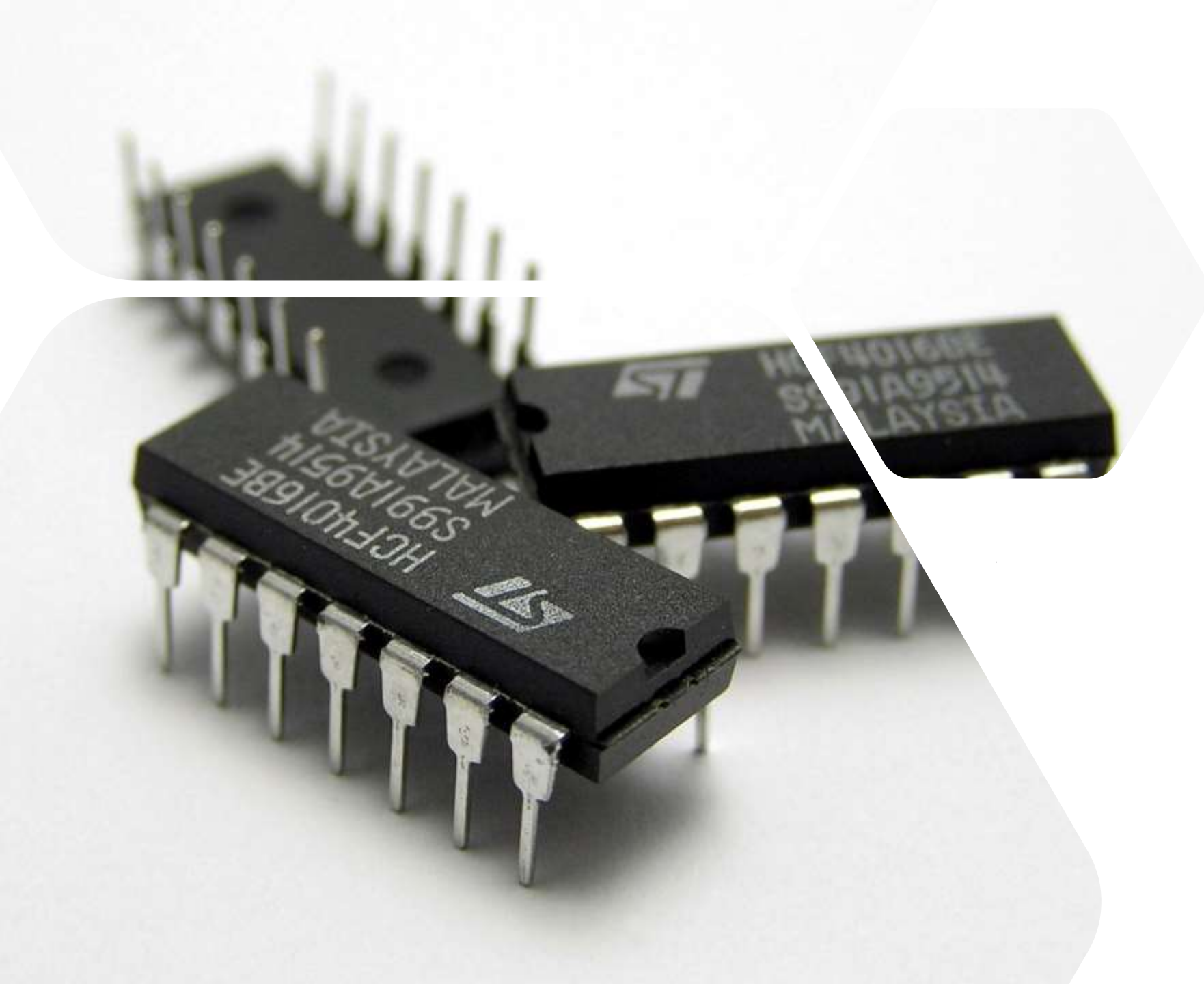
BJT(Bipolar Junction Transistor)

A three terminal device used for amplification purposes and as a switch normally..

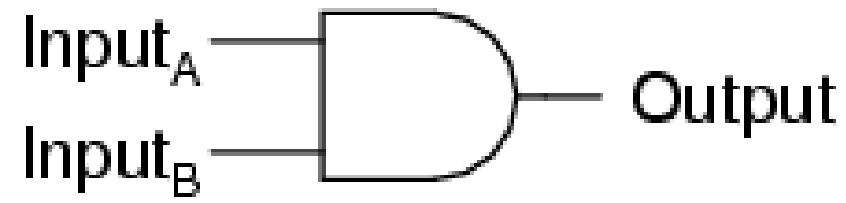




A simple
example



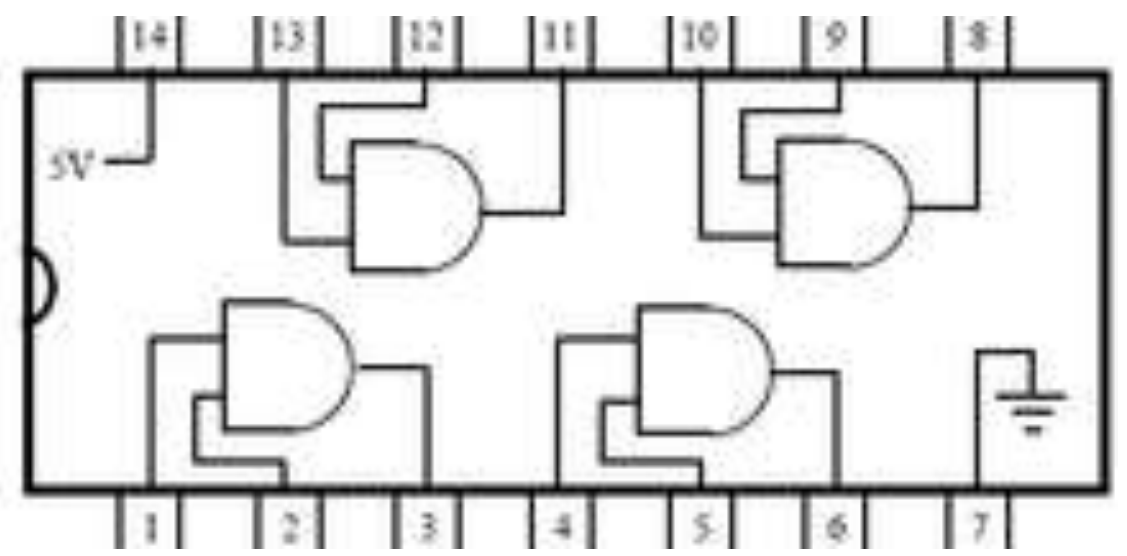
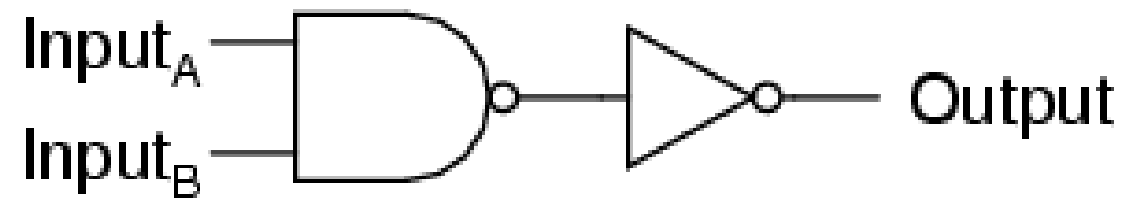
IC(Integrated
Circuits)



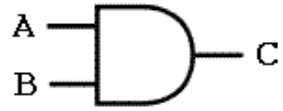
A	B	Output
0	0	0
0	1	0
1	0	0
1	1	1

AND gate IC

Equivalent circuit



AND



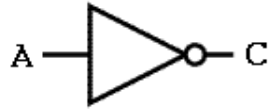
Inputs		Output
A	B	C
0	0	0
0	1	0
1	0	0
1	1	1

OR

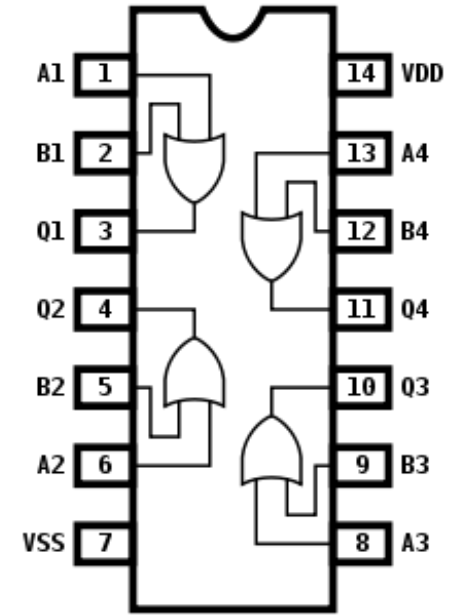
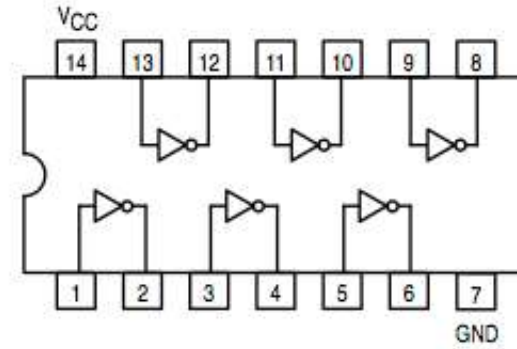


Inputs		Output
A	B	C
0	0	0
0	1	1
1	0	1
1	1	1

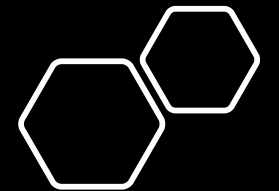
NOT



Input	Output
A	C
0	1
1	0

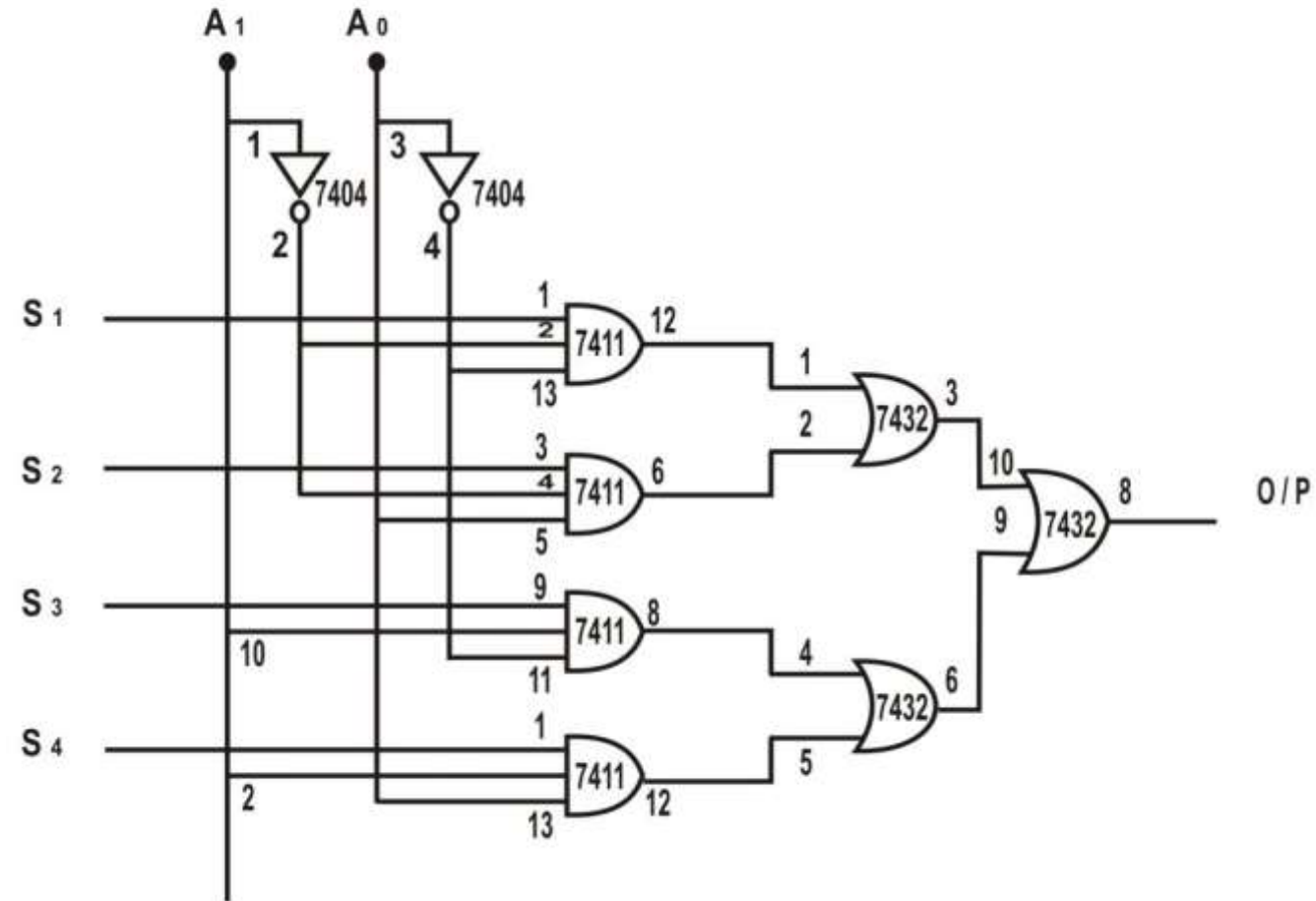


Or and not gates IC

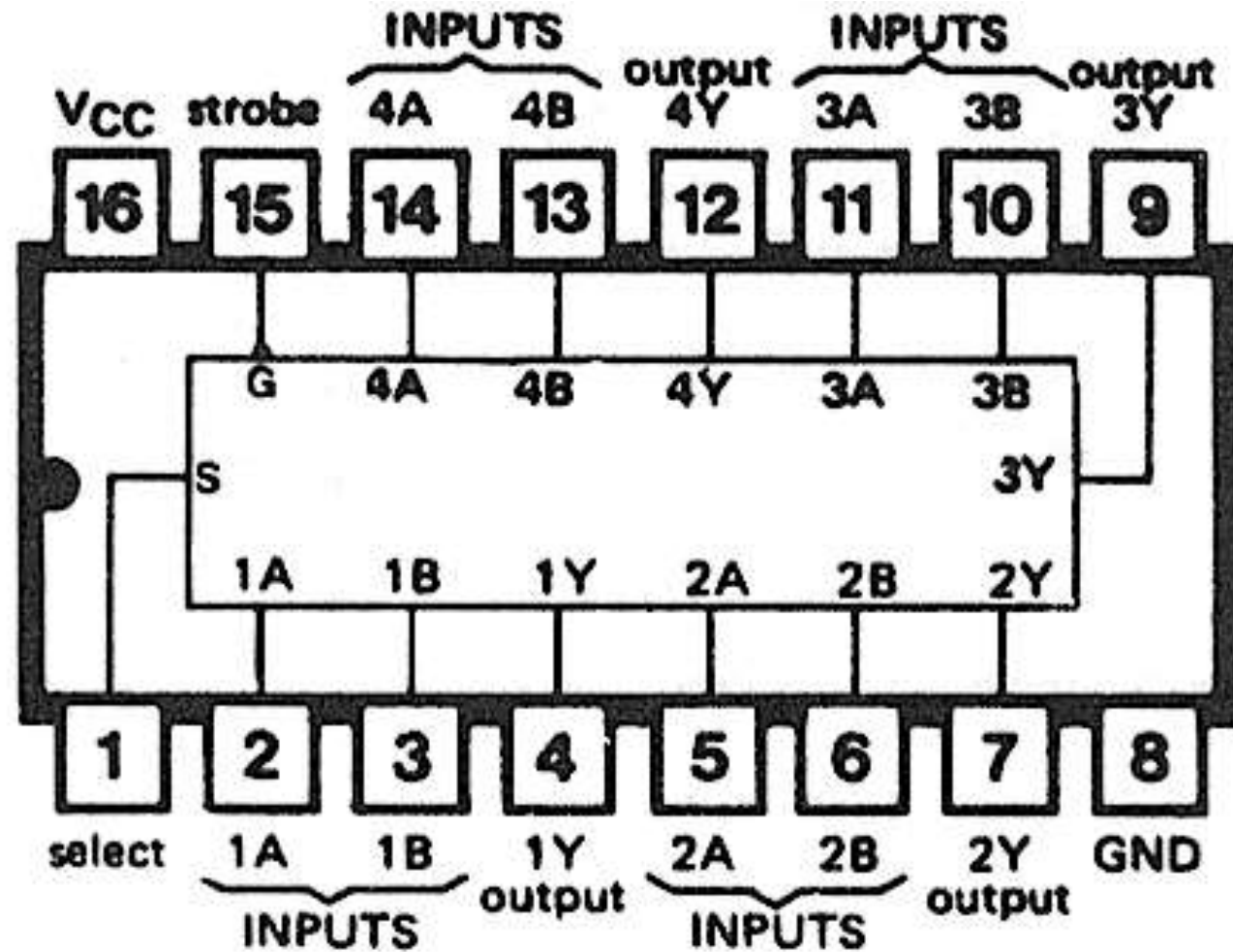


MULTIPLEXER

A multiplexer, also known as a data selector, is a device that selects between several analog or digital input signals and forwards it to a single output line.



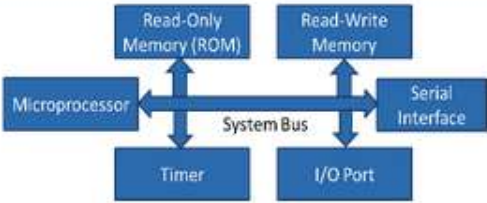

Multiplexer IC





- These are just simple ICs to get started with ,there are lot many more ICs present out there like adders , comparators ,encoders ,decoders etc.
- Which are simple to learn, still it's your responsibility to understand about the topics that are required for your project.

MP and MC

Microprocessor	Micro Controller
	
Microprocessor is heart of Computer system.	Micro Controller is a heart of embedded system.
It is just a processor. Memory and I/O components have to be connected externally	Micro controller has external processor along with internal memory and i/O components
Since memory and I/O has to be connected externally, the circuit becomes large.	Since memory and I/O are present internally, the circuit is small.
Cannot be used in compact systems and hence inefficient	Can be used in compact systems and hence it is an efficient technique
Cost of the entire system increases	Cost of the entire system is low
Due to external components, the entire power consumption is high. Hence it is not suitable to use with devices running on stored power like batteries.	Since external components are low, total power consumption is less and can be used with devices running on stored power like batteries.
Most of the microprocessors do not have power saving features.	Most of the micro controllers have power saving modes like idle mode and power saving mode. This helps to reduce power consumption even further.
Since memory and I/O components are all external, each instruction will need external operation, hence it is relatively slower.	Since components are internal, most of the operations are internal instruction, hence speed is fast.
Microprocessor have less number of registers, hence more operations are memory based.	Micro controller have more number of registers, hence the programs are easier to write.
Microprocessors are based on von Neumann model/architecture where program and data are stored in same memory module	Micro controllers are based on Harvard architecture where program memory and Data memory are separate
Mainly used in personal computers	Used mainly in washing machine, MP3 players

Let us start with regulators:(specifically voltage regulators)

A voltage regulator is a system designed to automatically maintain a constant voltage level.

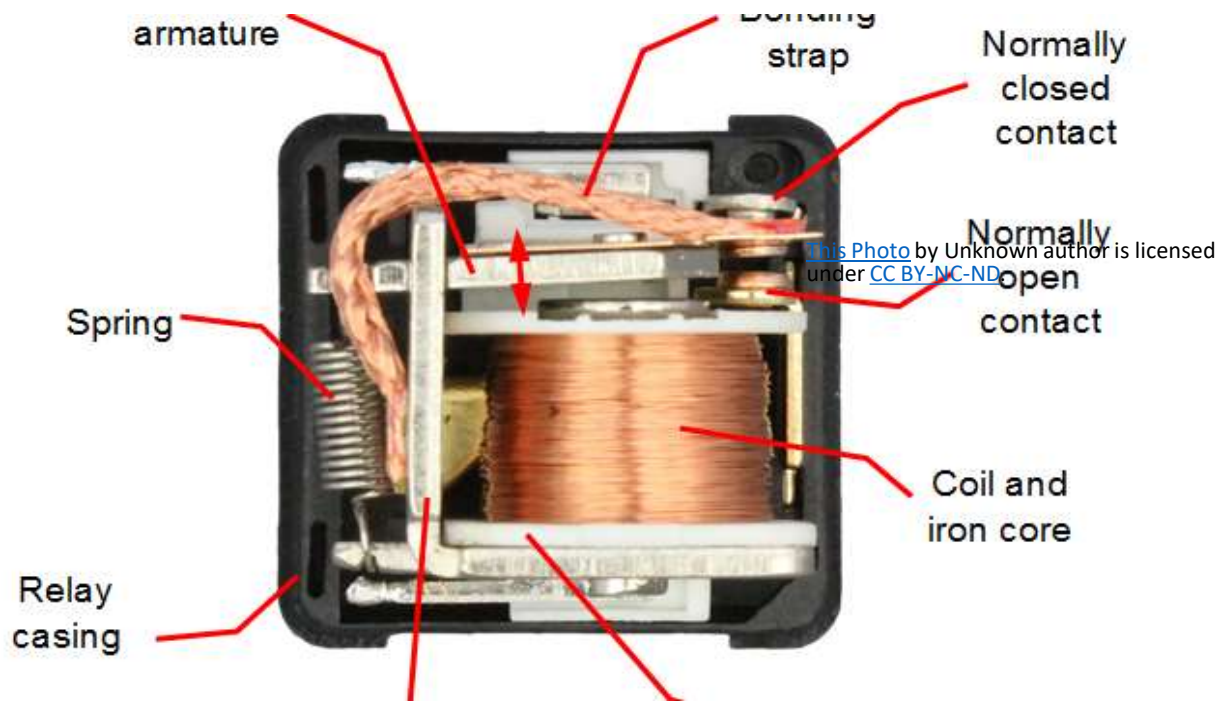
Examples:7805(max I/P voltage 35V \leftrightarrow 5V O/P and 2V dropout voltage), LM1117(max I/P voltage 13V \leftrightarrow 3.3V O/P and 1.2 dropout voltage), etc.

Where you can use them?

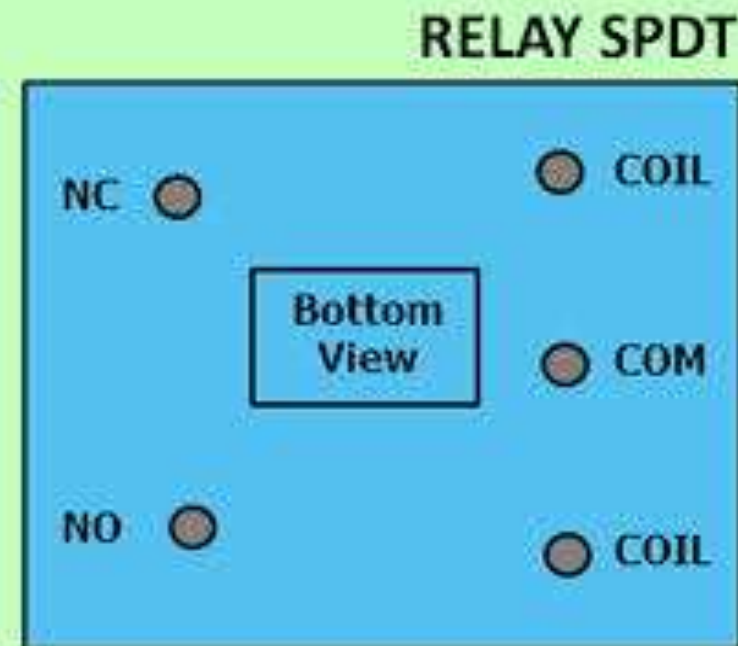
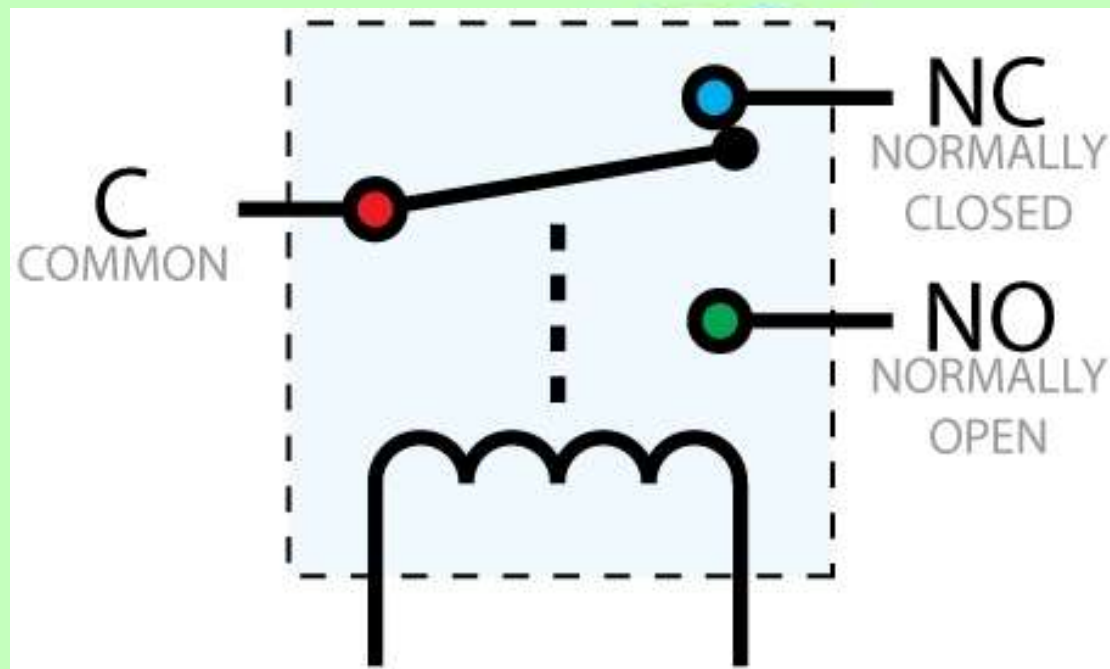
Solar panels ! When you want to charge the batteries through solar panels , supply of voltage to Modules in need of constant voltage and etc.

Relay(A Switch)

- A relay is an electrically operated switch
- Electromagnetic Relays. These relays are constructed with electrical, mechanical and magnetic components, and have operating coil and mechanical contacts
- Other types of relays include, Solid State uses solid state components to perform the switching operation without moving any parts.

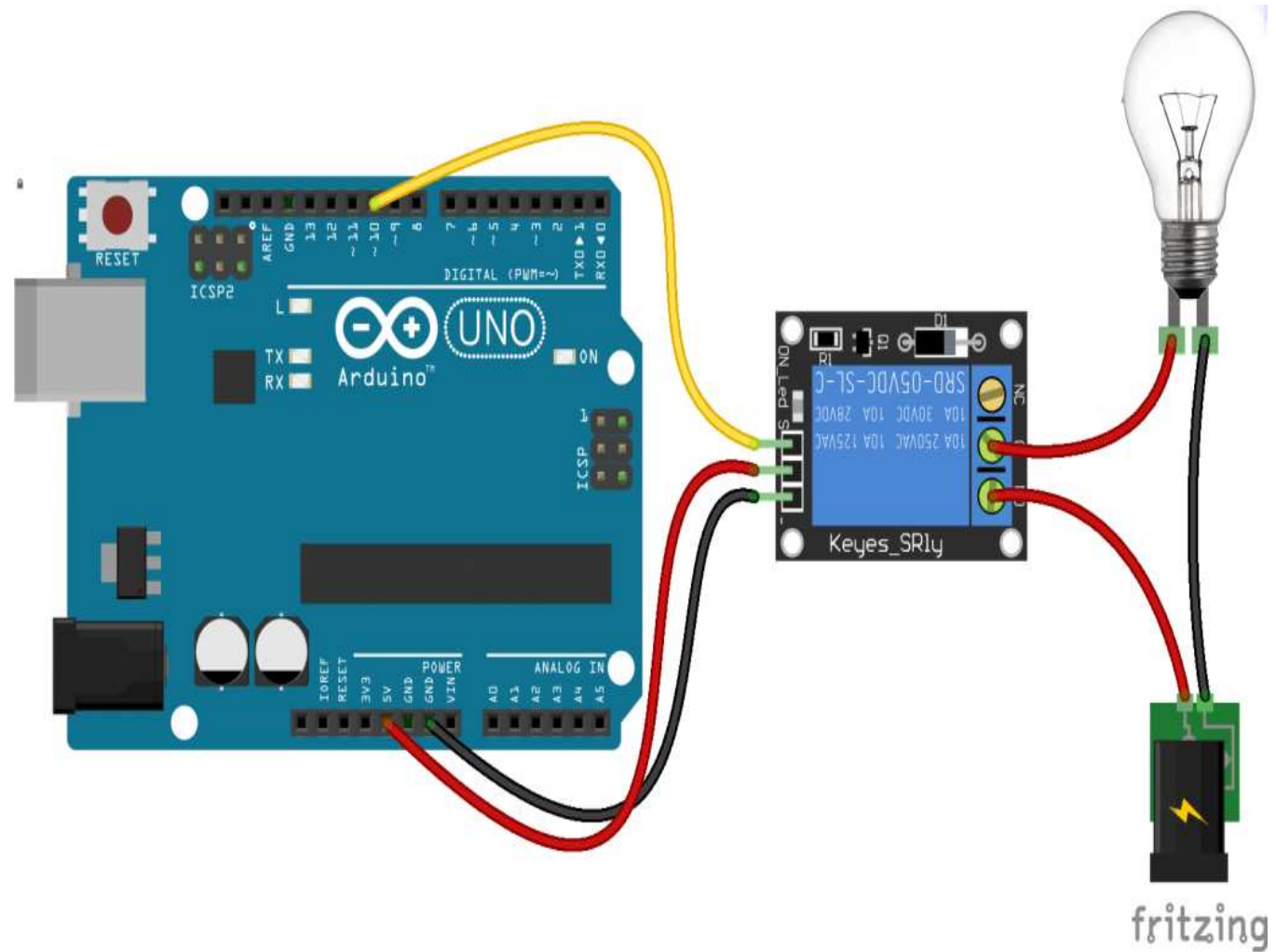


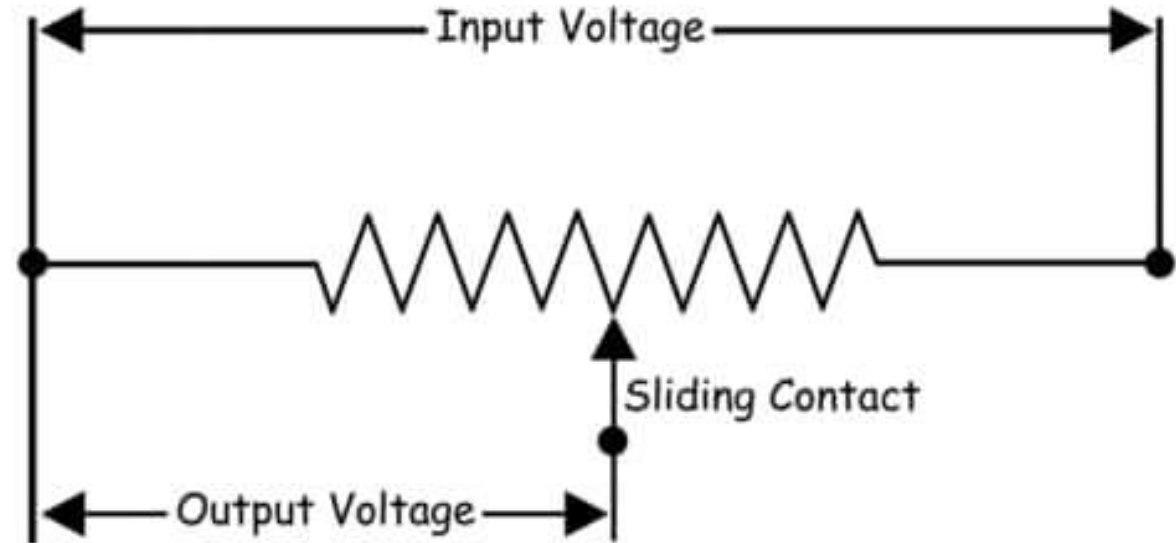
Relay Connections| Pin Details and Example



Usage in circuits

```
#define relay 10
#define interval 1000
void setup() {
  pinMode(relay, OUTPUT);
}
void loop()
{
  digitalWrite(relay, HIGH);
  delay(interval);
  digitalWrite(relay, LOW);
  delay(interval);
}
```





Potentiometer

- A potentiometer is a three-terminal resistor with a sliding or rotating contact that forms an adjustable voltage divider. If only two terminals are used, one end and the wiper, it acts as a variable resistor

Types of signals



Signals have become main means to transmit data across different origins and their respective destinations..

Broadly there are many types of signals :

- Continuous and Discontinuous(analog and digital comes under this category)
- Power and energy signals
- Deterministic and non-deterministic
- Even and odd signals
- Periodic and Aperiodic

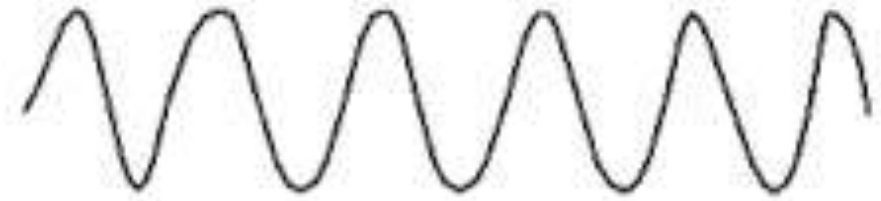
And many more but for now our concentration shall be on Analog and digital Signals

Digital Signals

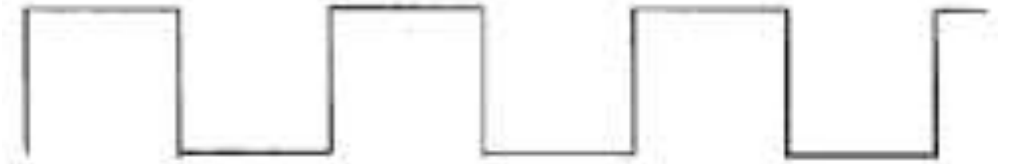
- A digital signal is a way of transmitting data that converts the data to discrete values, usually based on the binary code that computer systems work upon, which consists of packets of information coded as strings of ones and zeros.

A good example would be a digital signal in **Morse Code**

Function used in Arduino IDE
for generation of digital signal:
`digitalWrite(args);`
And to read:
`digitalRead(args);`



Analog Signal



Digital Signal

Analog signals

An analog signal is any continuous signal for which the time-varying feature (variable) of the signal is a representation of some other time-varying quantity, i.e., analogous to another time-varying signal.

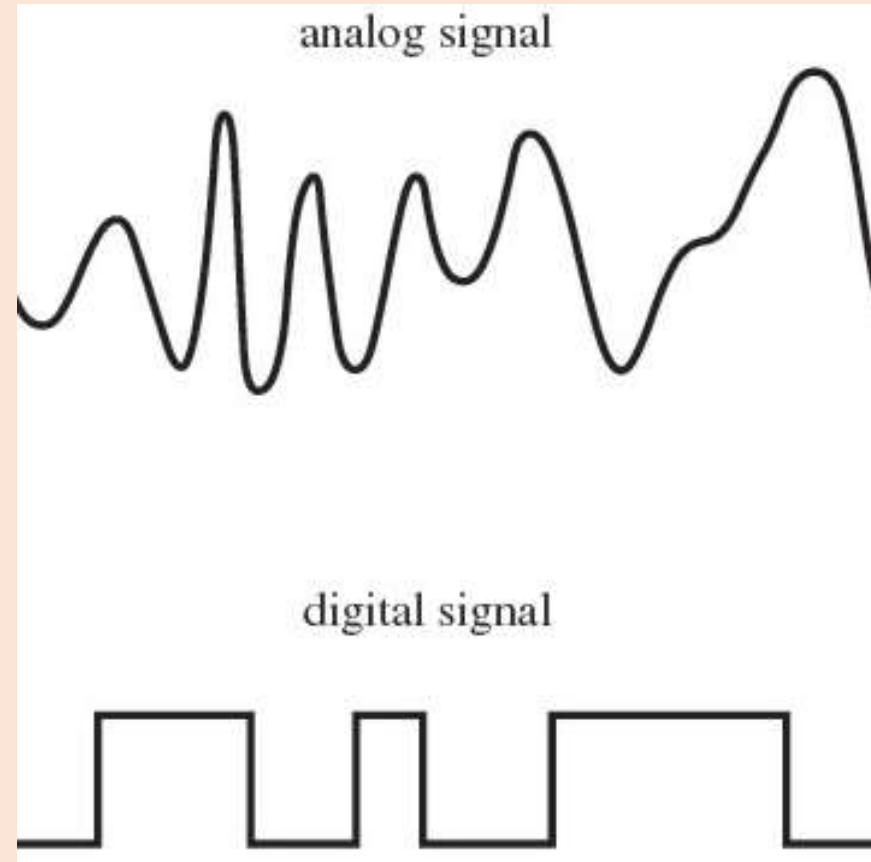
Example could be anything which is varying with time .. like temperature reading from a sensor over continuous period.

Function used in Arduino IDE for generation of analog signal:

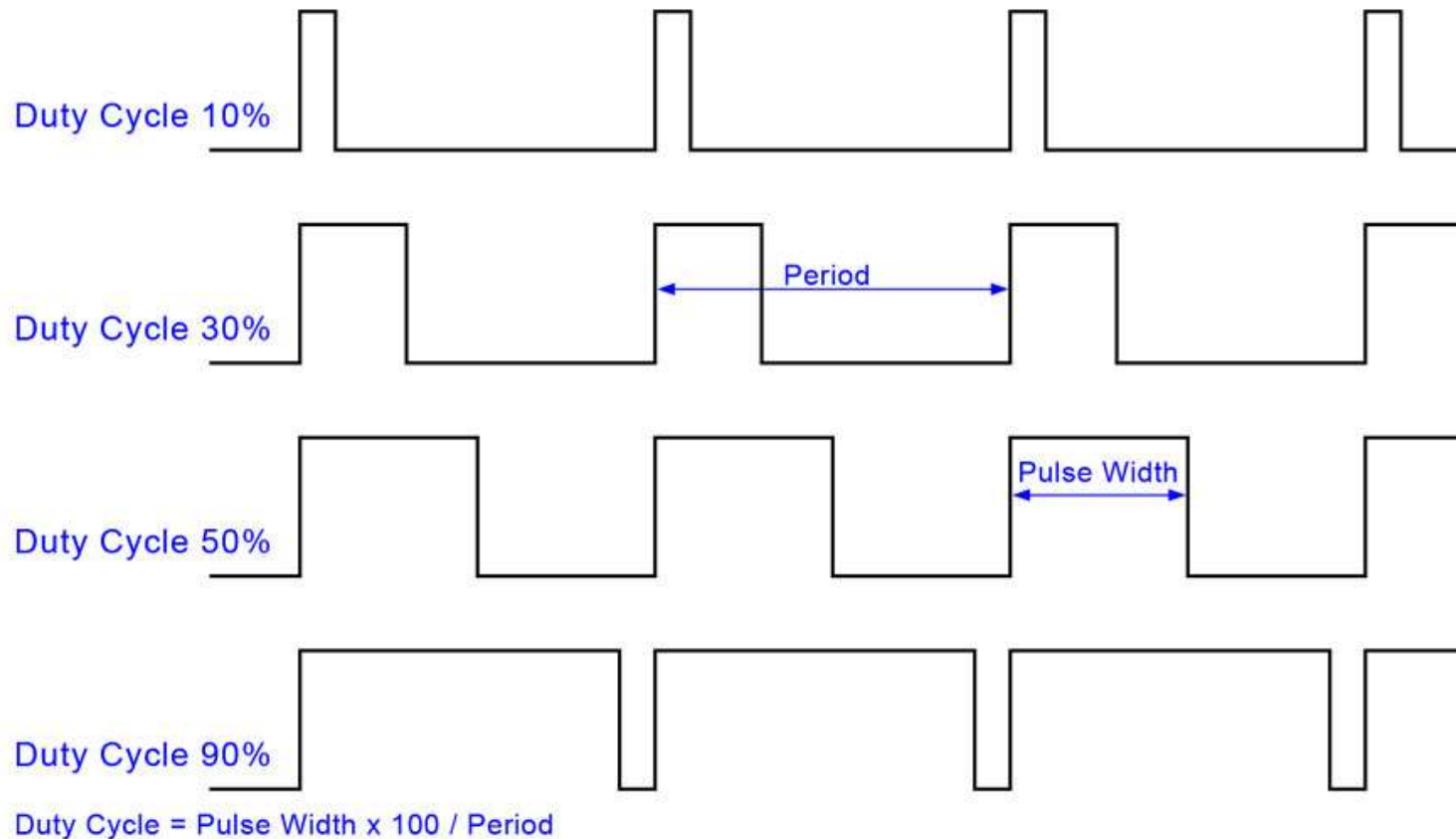
```
analogWrite(args);
```

And to read:

```
analogRead(args);
```



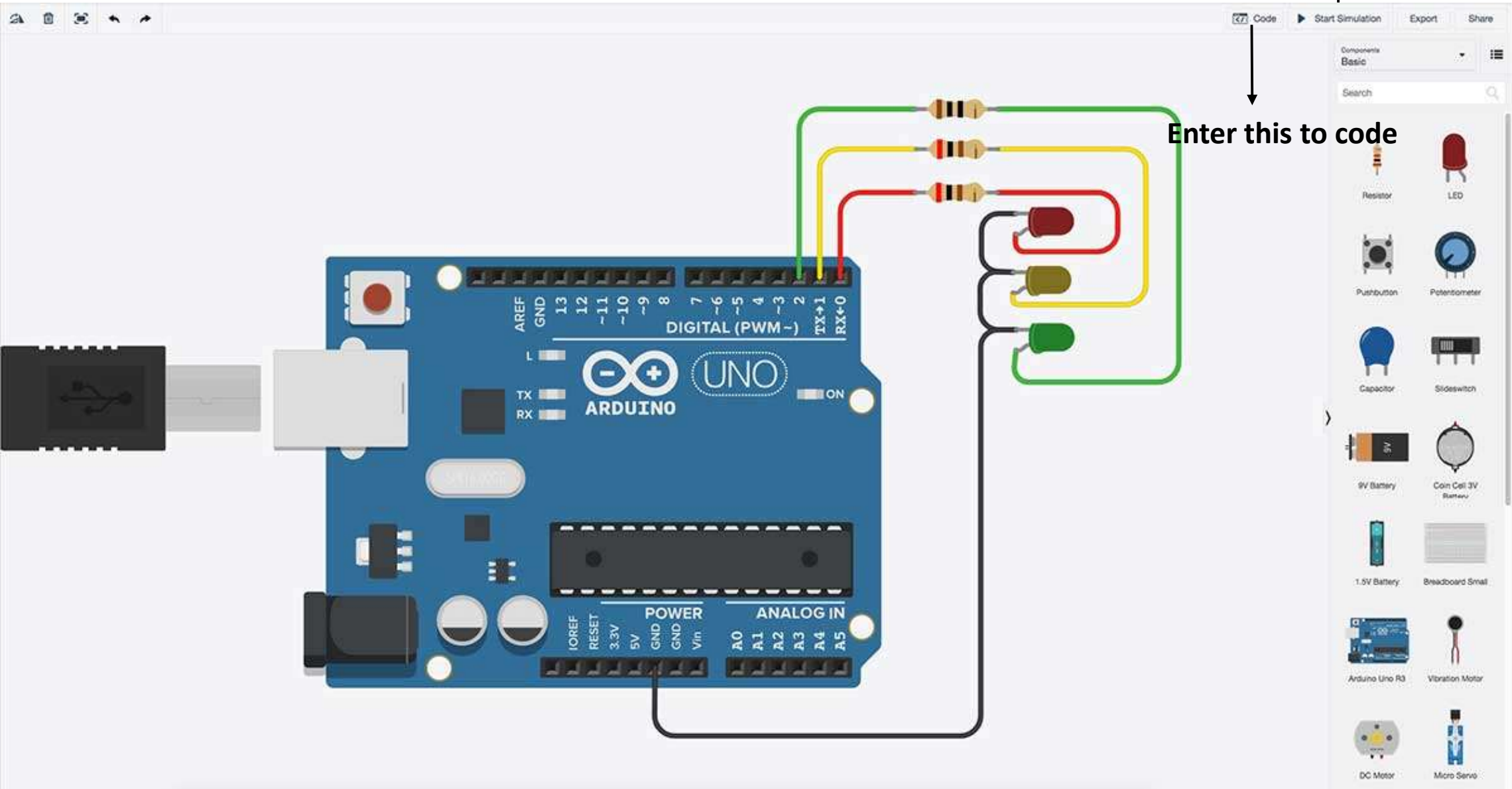
PWM(Pulse Width Modulation)



- PWM is a technique for getting analog results with digital means. Digital control is used to create a square wave, a signal switched between on and off.

1st Let us get familiar with tinkercad.

Click this to start simulation of circuit assembly



Usage

- //led brightness control

- //Initializing LED Pin

```
int led_pin = 6;
```

```
void setup() {
```

```
  //Declaring LED pin as output  
  pinMode(led_pin, OUTPUT);
```

```
}
```

```
void loop() {
```

```
  //Fading the LED
```

```
  for(int i=0; i<255; i++){  
    analogWrite(led_pin, i);  
    delay(5);
```

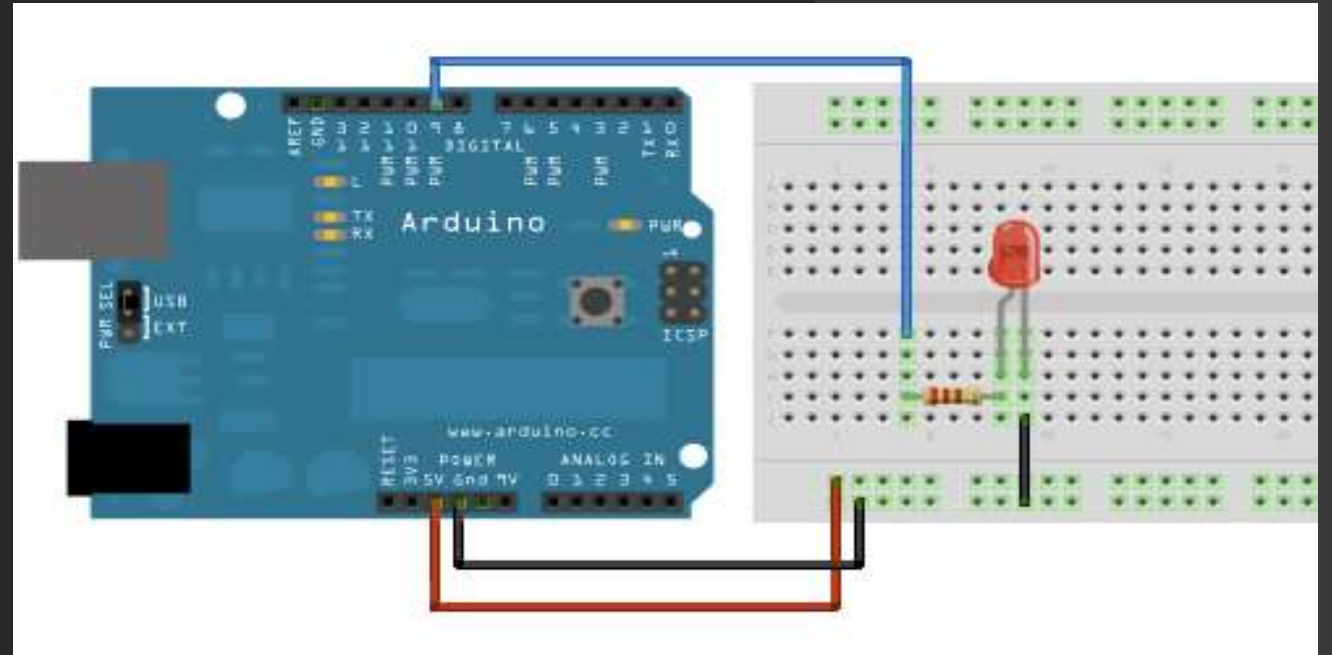
```
  }
```

```
  for(int i=255; i>0; i--){  
    analogWrite(led_pin, i);  
    delay(5);
```

```
  }
```

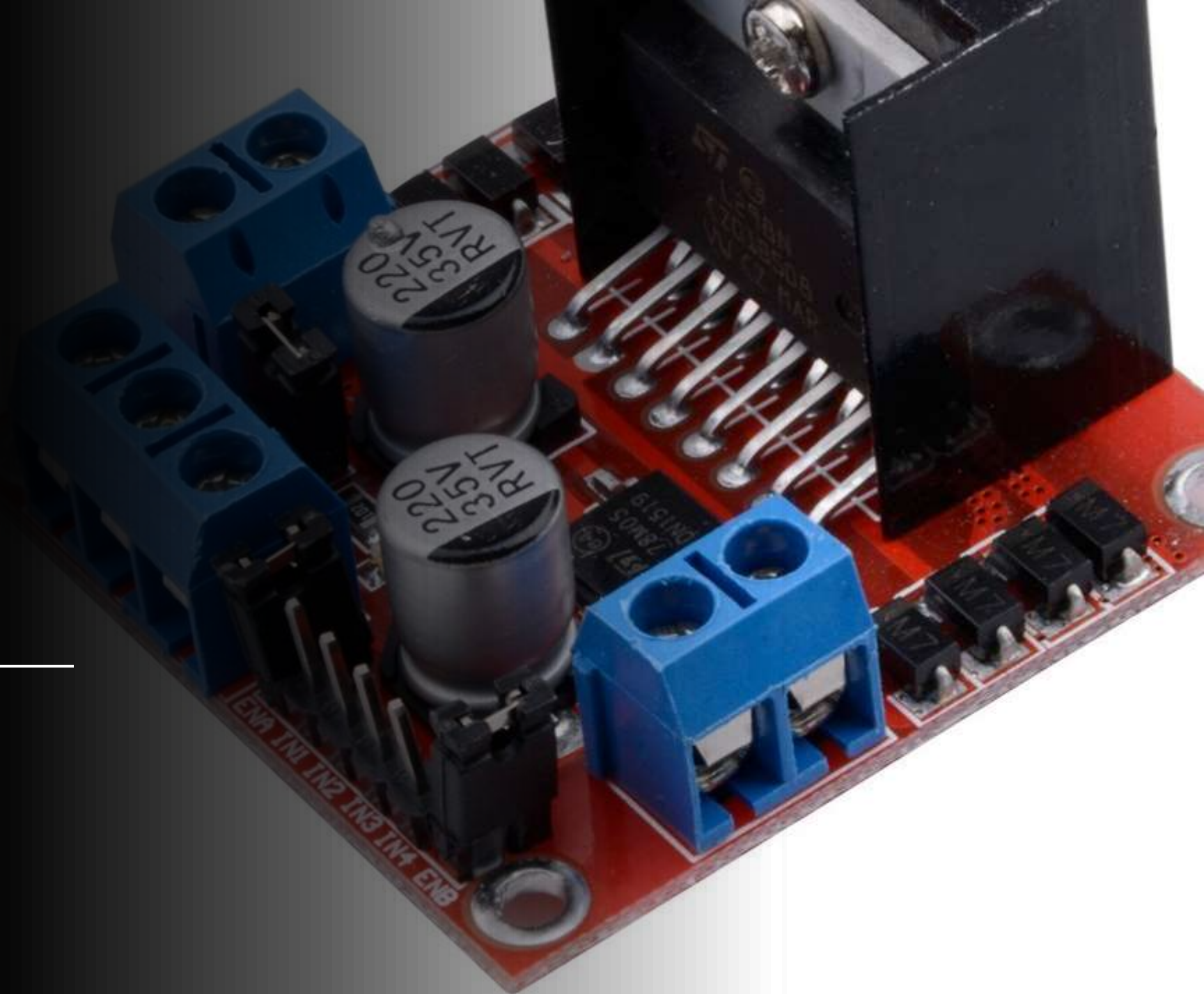
```
}
```

- // can be used for controlling speed of the motors as well.





Motor drivers

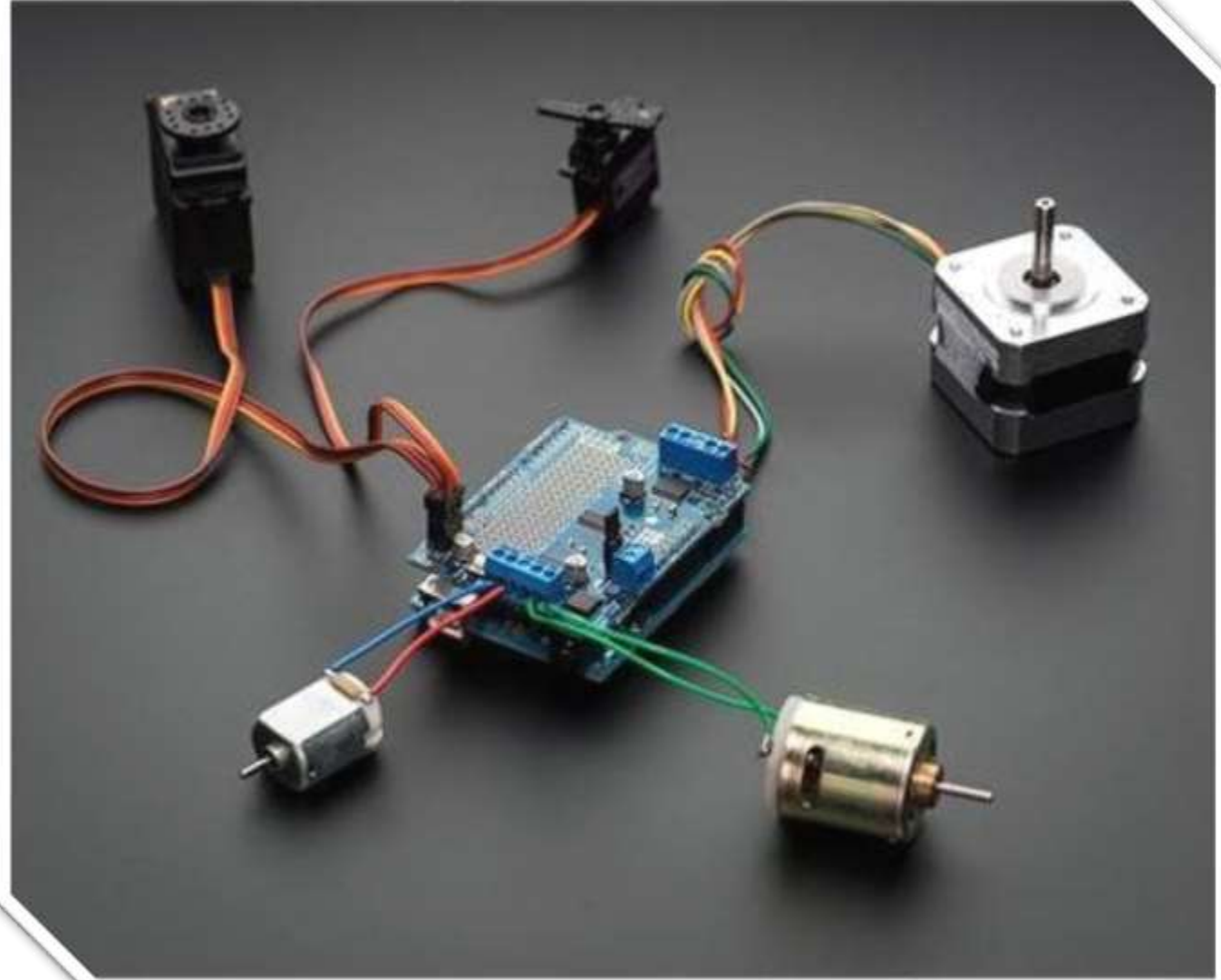


Usage

- Motor drivers acts as an interface between the motors and the control circuits.
- Motor require **high amount of current** where as the controller circuit works on low current signals.
- Function of motor drivers is to take a low-current control signal and then turn it into a higher-current signal that can drive a motor.

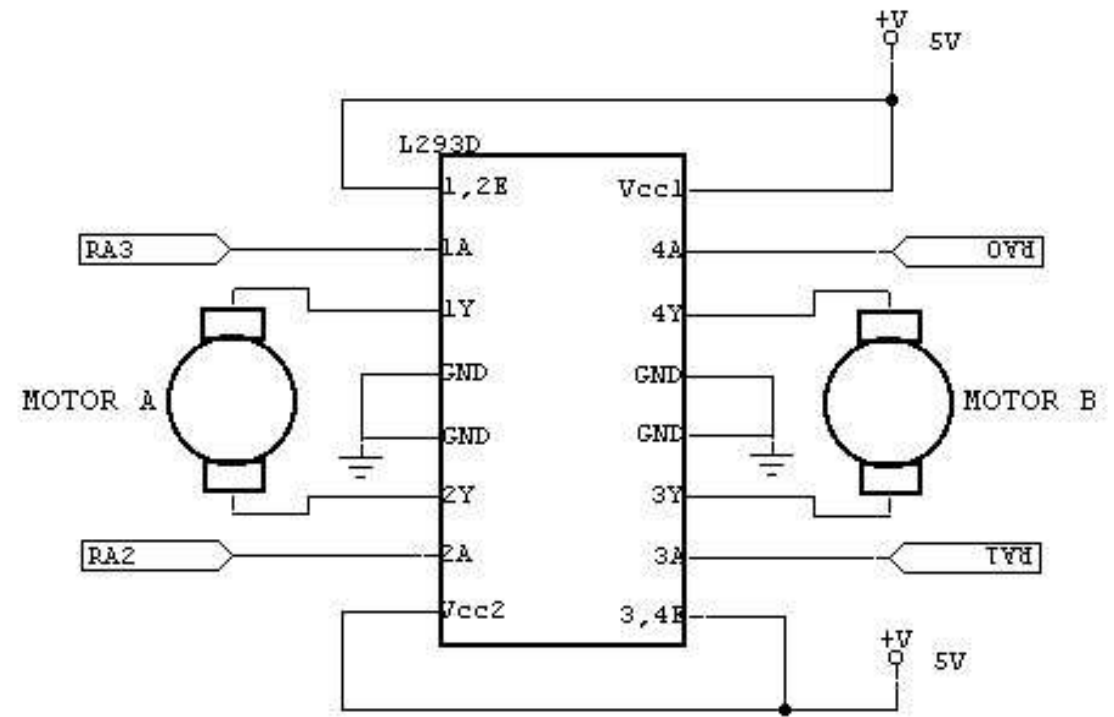
Popular Motor Drivers

- L293d
- L298n(has Heat sink)
- Adafruit Motor/Stepper/Servo Shield.(Only for Specific Purposes)
- Other popular drivers also present for various applications.
- **(Do Research !)**

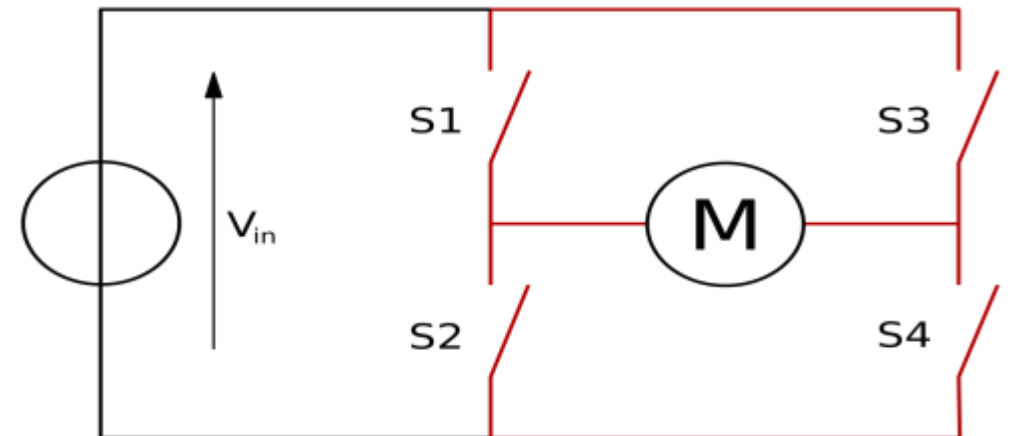


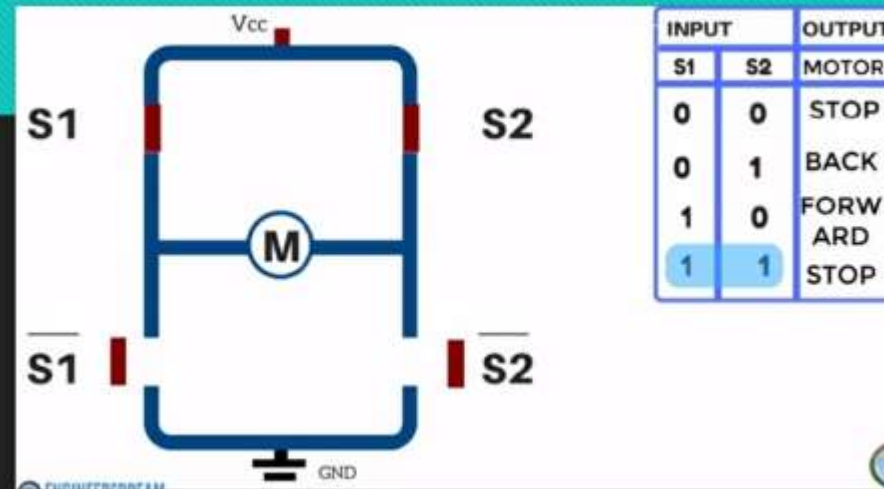
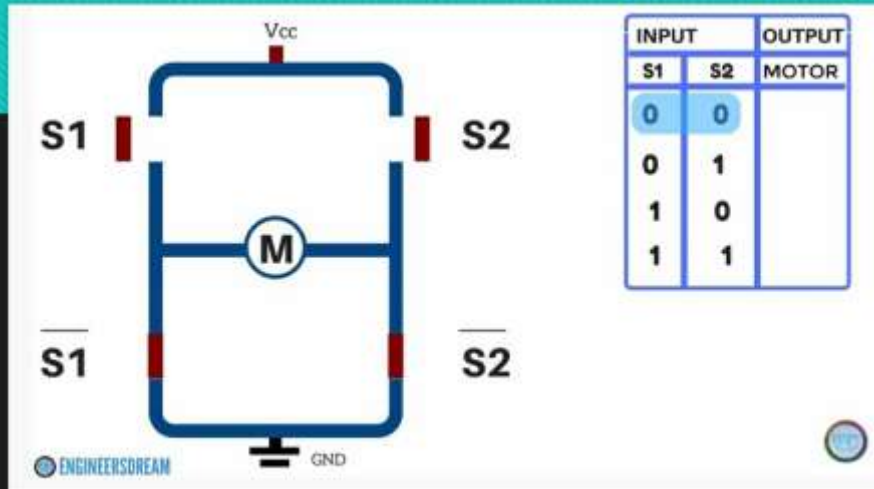
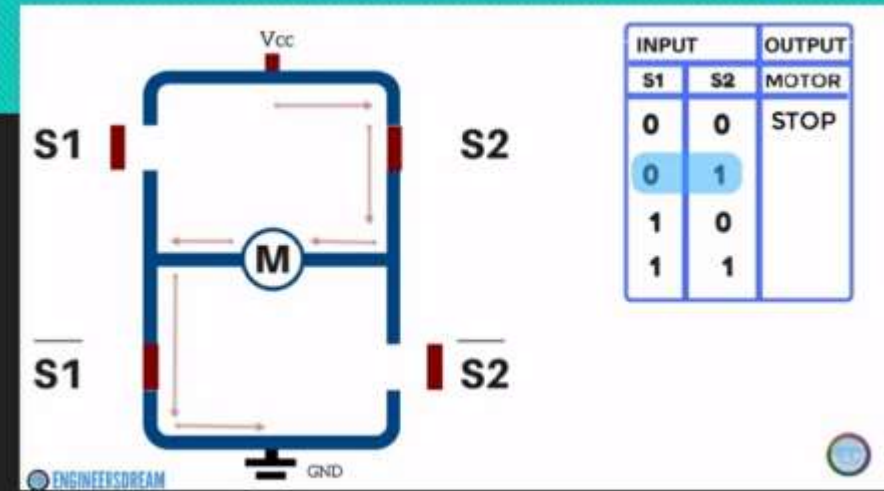
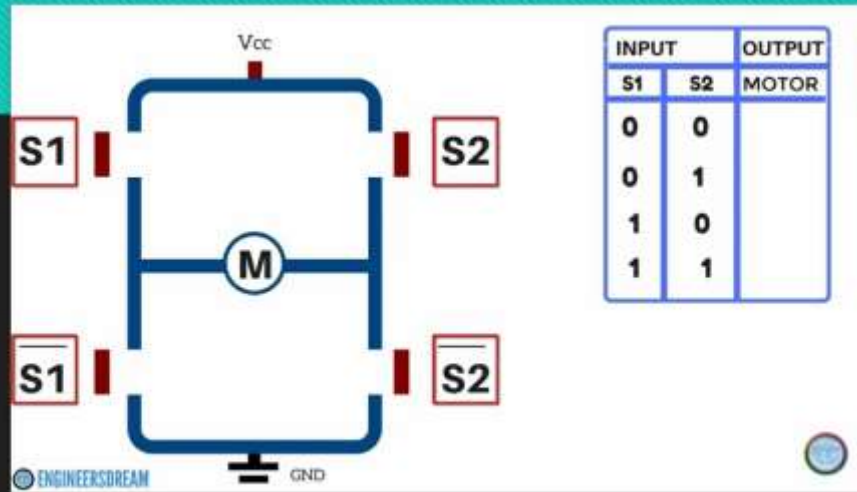
Difference between L298N and L293D

- The L298N supports higher currents (up to 4 A with proper heat sink)
- The L293D is limited to 600 mA. the L298N has a higher operating voltage (up to 46 V), the L293D is limited to 36 V.



!!Motor Drivers are simple electronic devices, and they are not limited for the usage of driving Motors only!!



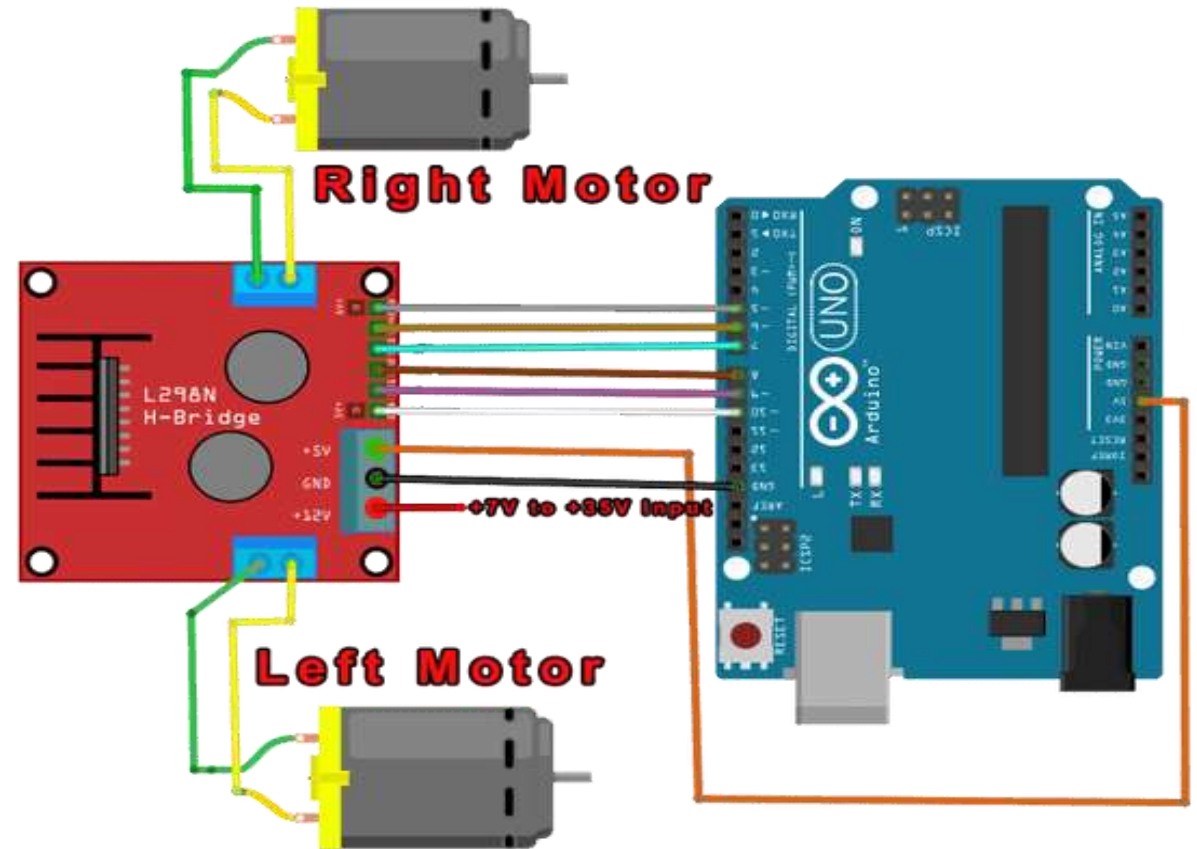


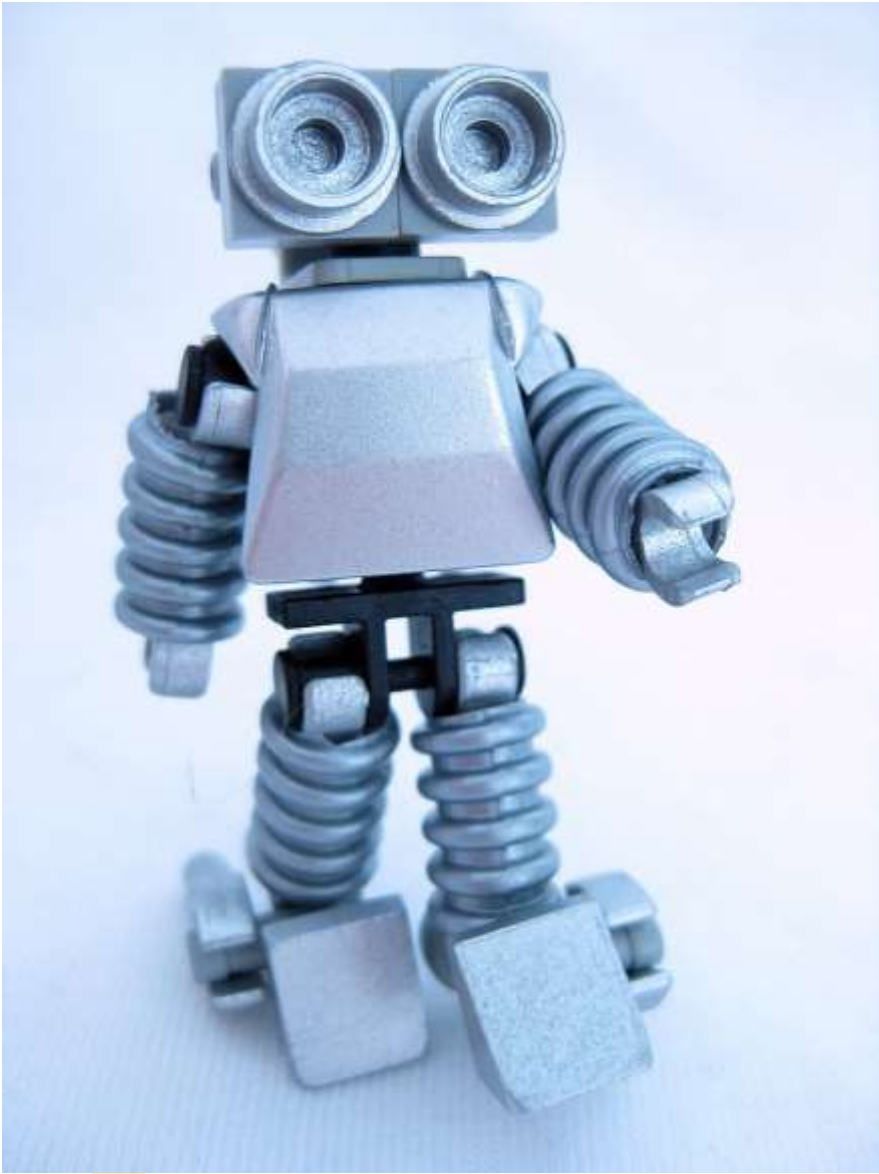
```
//MotorA
const int inputPin1 = 10; // Pin 15 of L293D IC
const int inputPin2 = 11; // Pin 10 of L293D IC
//Motor B
const int inputPin3 = 9; // Pin 7 of L293D IC
const int inputPin4 = 8; // Pin 2 of L293D IC
```

```
void setup()
{
  pinMode(inputPin1, OUTPUT);
  pinMode(inputPin2, OUTPUT);
  pinMode(inputPin3, OUTPUT);
  pinMode(inputPin4, OUTPUT);
}
```

```
void loop()
{
  digitalWrite(inputPin1, HIGH);
  digitalWrite(inputPin2, LOW);
  digitalWrite(inputPin3, HIGH);
  digitalWrite(inputPin4, LOW);
}
```

Simple Example to
Use Motor Driver





There are still so much
to learn in electronics .
Do your research
accordingly for your
robot!