

ROBOTICS AND AUTOMATION CENTER

# **PRESENTATION ON BASIC IDEA OF ROBOTICS**



**By:**

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Amod Amatya**

# RESISTOR

*“The resistor is a passive electrical component to create resistance in the flow of electric current.”*

*Resistors are used for many purposes.*

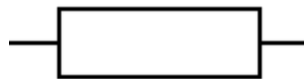
*For examples:*

➤ *To limit electric current*

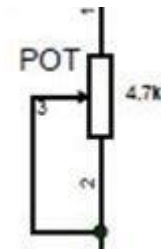
➤ *For voltage division*



*fixed resistor symbol  
symbol*



*fixed resistor symbol*

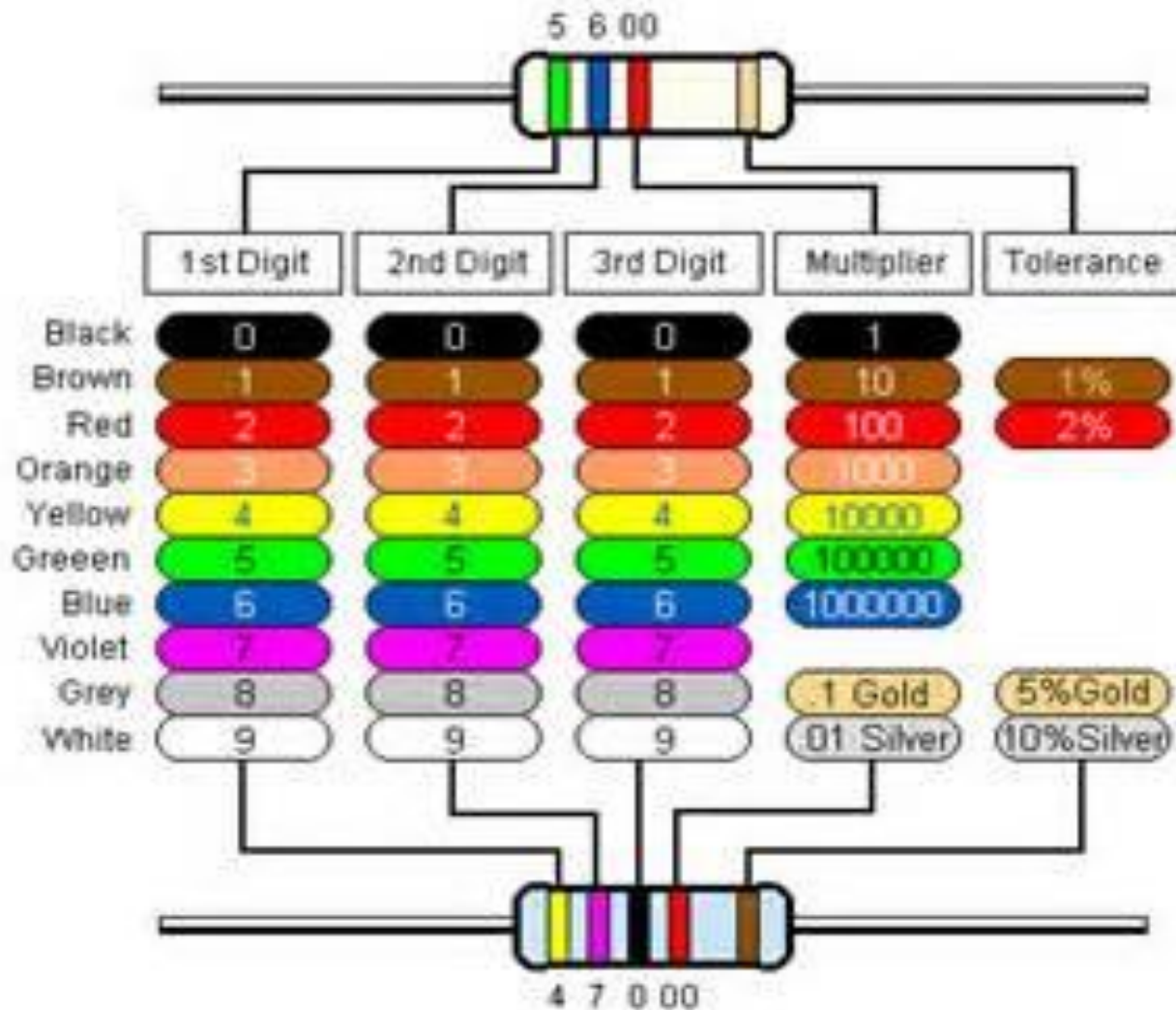


*Variable resistor*

*(ANSI standard)*



# COLOR CODING OF RESISTER



# USE OF DIODE AND TRANSISTOR

*Diodes are often used for the purpose of protection in our circuits. It allows current to flow in one direction while blocking in another. They are used for rectification, as switches also in performing digital logics and to drop fixed voltages.*

*Transistors are mainly used to amplify signals and in robotics we use them **as switch** and amplification purpose.*



# LOGIC GATES

- Not
- OR
- AND
- NOR
- NAND
- XOR
- XNOR

Symbol, Boolean expression and truth table.

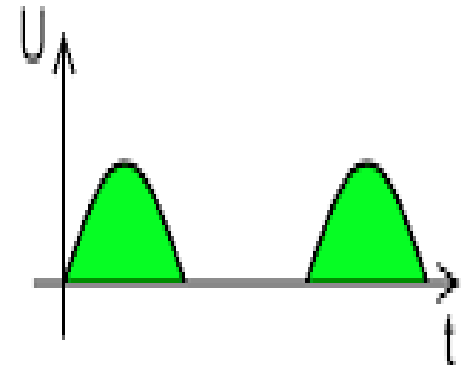
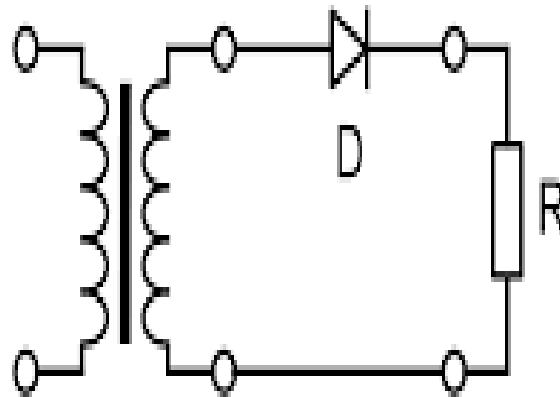
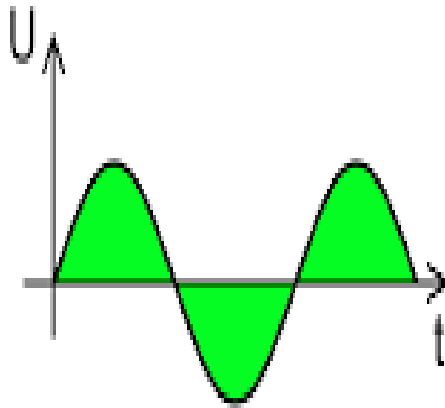


# USE OF RECTIFIER

*As the name says Rectifiers are used for the purpose of rectification of AC into DC.*

*There are different types of rectifiers:*

- *Single phase rectifiers*
- *Half wave rectifiers*



## ➤ Full Wave Bridge Rectifier

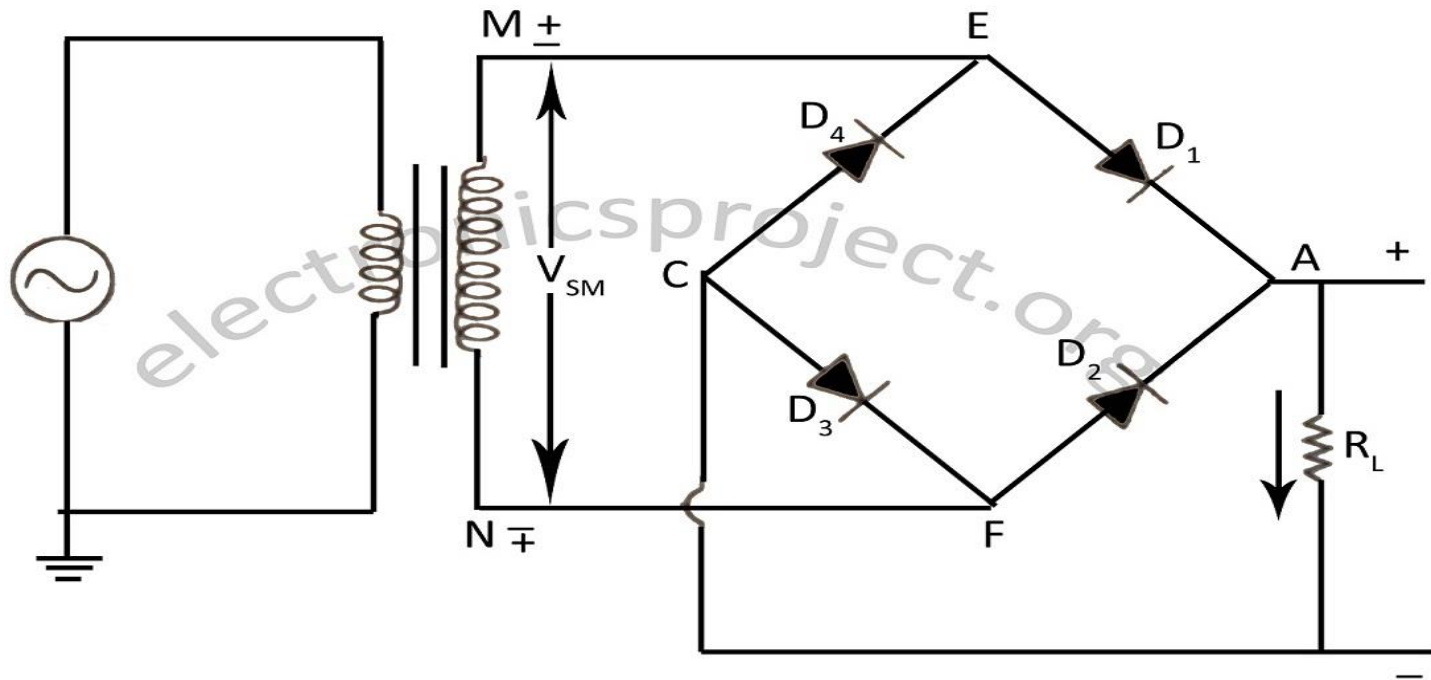


Figure 1: Single-Phase Bridge rectifier

*The output from rectifier is pulsating DC with high ripple factor.*

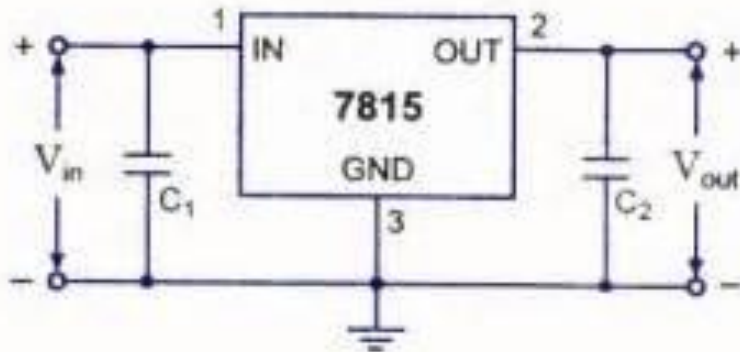
*Ripple factor is reduced by using high valued capacitor.*



# VOLTAGE REGULATOR(78XX AND 79XX)

*The 78XX series of voltage regulator are those which regulate the denoted positive voltage for instance 7805 regulates +5 voltage. Likewise 7815 regulate +15 voltage.*

*In similarly 79XX series denotes negative voltage regulation. 7905 is -5 voltage regulator. These are fixed voltage regulator.*



*Connection of 7815 Voltage Regulator*

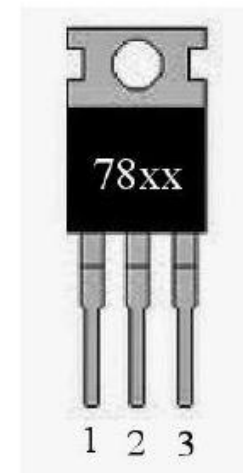


Fig: 78XX series voltage regulator

*For further details see the data sheets of 78XX series and 79XX series*

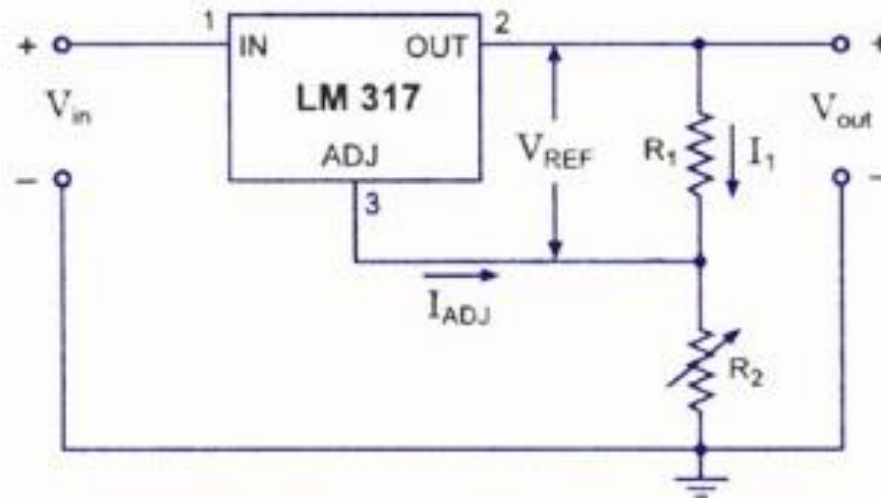




# VARIABLE VOLTAGE REGULATOR

*We need different voltages supply required for different components in the circuit. For instance we may need 12v for a fan and need 5v for processor and other different voltage levels for different component. So here comes the need of variable voltage regulator we can use it to regulate a range of voltage. They may have a feedback loop and can be automatically adjusted too.*

*A adjustable voltage we often use in our lab is LM317.*



*Connection of LM 317 Adjustable Voltage Regulator*



# CAPACITOR

*“Capacitors are passive electrical components to store electric energy.”*



*They are usually used to allow only AC current and block DC current, or to smooth power supply output.*

*The figure along side shows a electrolytic capacitor.*



# USE OF MULTIMETER

*Multimeter is a device used to measure current, voltage and other electrical parameters.*

*We need to know how to use Multimeter to check whether our circuits performs the desired task or not.*

*Mostly used for*

- *Continuity test(S/C Test)*
- *Voltage reading(voltmeter-high i/p resistance)*
- *Current reading(ammeter – low i/p resistance)*
- *Measuring Resistance*

*Sensitivity of multimeter is **KOhm/V***

*I hope all of you here know how to use a “Multimeter”.*



# TYPES OF CAPACITOR

## *Ceramic Capacitors or Disc Capacitors*

- *For very low capacitance values a ceramic disc is used.*
- *Ceramic capacitors have a high dielectric constant (High-K)*
- *They are available so that relatively high capacitance's can be obtained in a small physical size.*
- *They have values ranging from a few picofarads to one or two microfarads, ( $\mu F$ ) but low voltage ratings.*
- *Ceramic types of capacitors generally have a 3-digit code printed onto their body to identify their capacitance value in **pico-farads**.*
- *Generally, the first two digits indicate the capacitors value and the third digit indicates the number of zero's to be added*



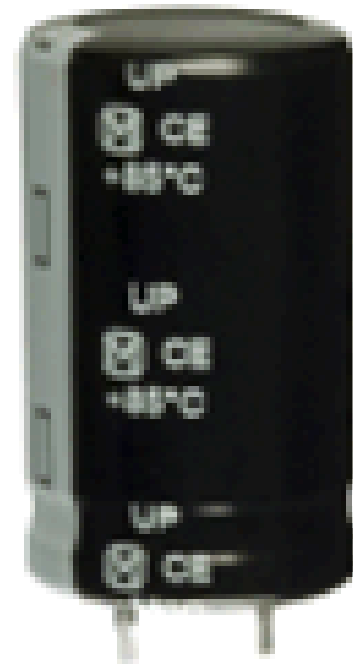
# TYPES OF CAPACITOR

- *Electrolytic Capacitors*
- *They are generally used when very large capacitance values are required.*
- *The majority of electrolytic types of capacitors are **Polarized***
- *An incorrect polarization will break down the insulating oxide layer and permanent damage may result.*
- *All polarized electrolytic capacitors have their polarity clearly marked with a negative sign to indicate the negative terminal and this polarity must be followed*
- *They are generally used in DC power supply circuits due to their large capacitance.*
- *They must not be used on AC supplies.*





Ceramic Capacitor

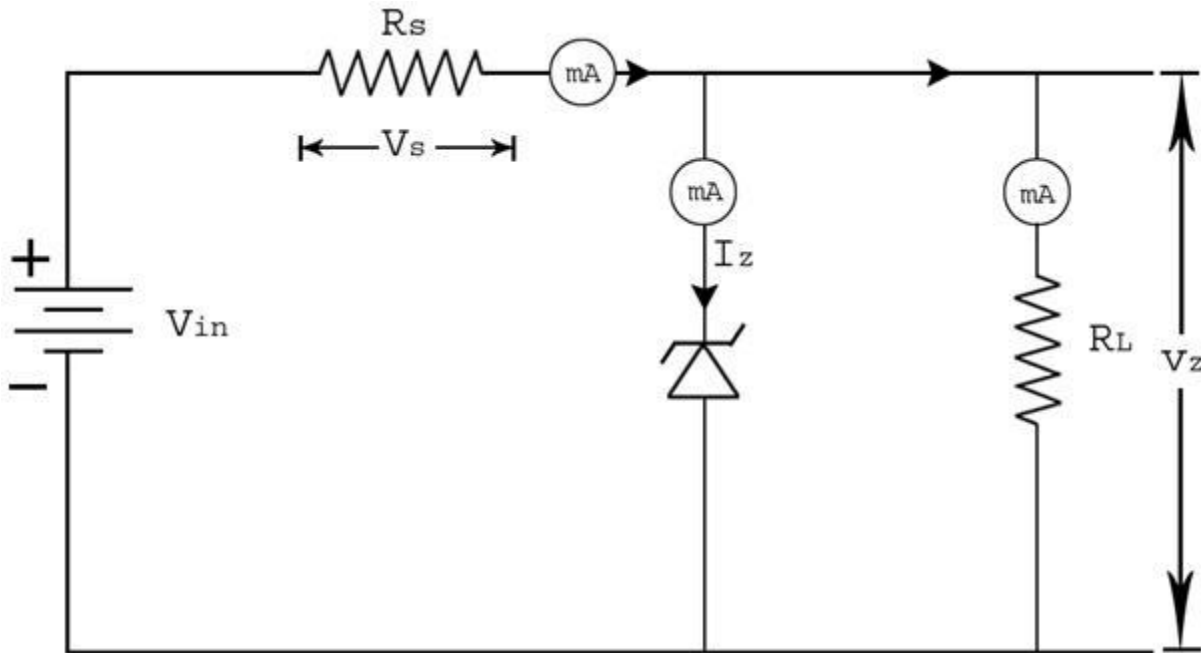


Electrolytic Capacitor



# USE OF ZENER DIODE IN VOLTAGE REGULATION

*Zener diode is like a general diode when forward biased, but when reverse voltage is applied the voltage remains constant for wide range of current.*



*fig: Zener diode shunt regulator*



# VOLTAGE AND CURRENT

*Voltage and Current are vital to understanding electronics, but they are quite hard to grasp.*

*Voltage attempts to make a current flow and current will flow if circuit is complete. It is actually measure of energy carried by the charge from one point to another.*

*Current is the rate of flow of charge.*

**Is it voltage or current that kills you ?**

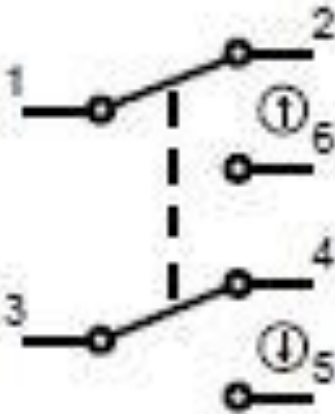
*We often listen “it’s not the volts that kills you, it’s the amps” and while that’s true in a way, but you cant have amps without volts and skin resistance plays a big part too.*



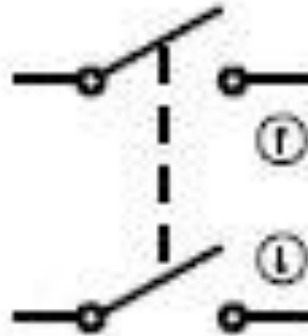


# SWITCHES

- ✓ *SPST (Single Pole Single Throw)*
- ✓ *SPDT (Single Pole Double Throw)*
- ✓ *DPST (Single Pole Single Throw)*
- ✓ *DPDT (Single Pole Single Throw)*



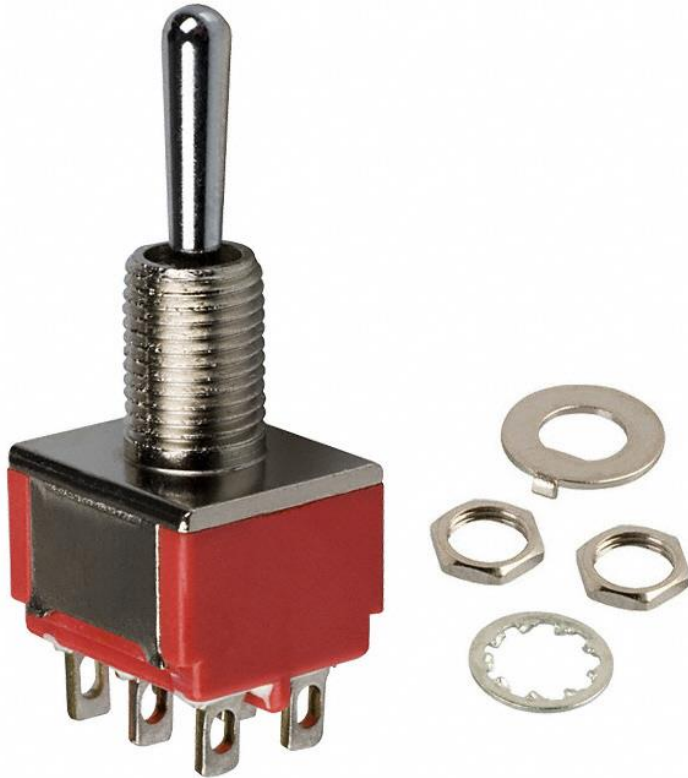
*DPDT*



*DPST*

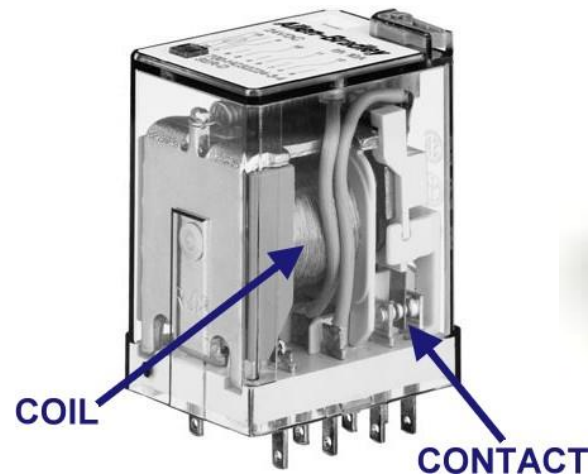
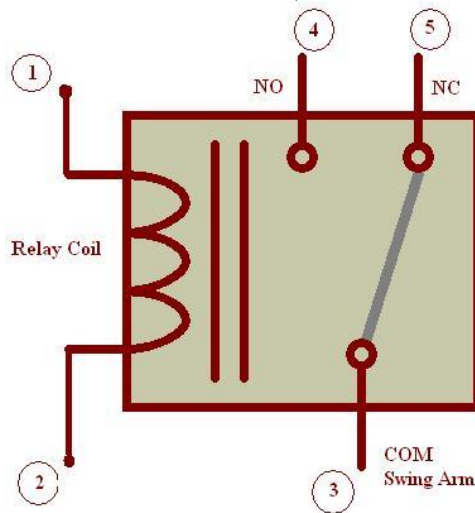


# SWITCHES



# RELAY

- *A **relay** is an electrically operated switch. Many relays use an electromagnet to mechanically operate a switch.*
- *Relays are used where it is necessary to control a circuit by a low-power signal (with complete electrical isolation between control and controlled circuits)*



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- *Current reading*
- *Measuring Resistance*

*I hope all of you here know how to use a “Multimeter”.*



# POWER SUPPLY (RECTIFIER OR BATTERY)

*There are mainly two types of power supply in electronic circuits:*

- 1. Battery for mobile circuits(eg automatic robot)*
- 2. Rectifier for fixed circuit (eg Home Security System)*

*Ah and voltage of battery should be declared.*

*No load voltage and load Voltage/current of rectifier should be declared*



# OPERATIONAL AMPLIFIER

*An Operational amplifier (op-amp) is a DC-coupled high-gain electronic voltage amplifier with a differential input and, usually, a single-ended output.*

*An operational amplifiers does the mathematical operations such as adding/subtracting inputs, integrating or differentiating them.*

*An ideal Op-amp has:*

- *Infinite input impedance*
- *Zero output impedance*
- *Infinite bandwidth*
- *Zero offset voltage*
- *Infinite slew rate*



# USE OF OP-AMP

- As a amplifier
- As a adder/subtractor
- As a differentiator /integrator
- As a comparator



# OP AMP AS A COMPARATOR(VVI)

Will be discussed with  
microcontroller





# IC, ITS PHYSICAL TYPES AND PIN CONFIGURATION

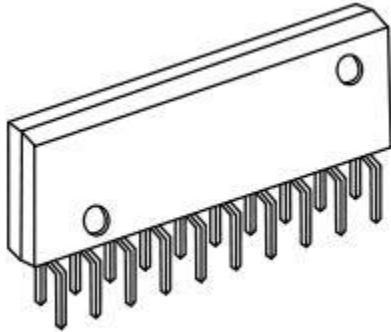
*IC's are present everywhere in today's world from a small calculator, cellular phone to Rocket launching systems.*

*Integrated circuit is an association (or) connection of various electronic devices such as resistors, capacitors, diode, transistors etched (or) fabricated to a semiconductor material such as silicon or germanium.*

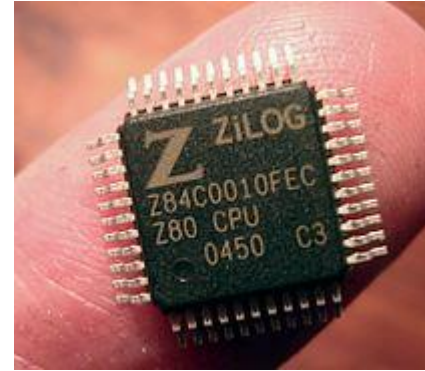
Conti....



*The physical types of IC's are:*



*Sil(Single In Line Package)*



*QFP(Quadra Flat Package)*



*Dil(Dual In Line Package)*



*ZZL(Zig Zag In Line Package)*



# MICROCONTROLLERS

*A microcontroller is a single chip device containing a processor core, memory and programmable input output peripherals.*

*Microcontrollers are used in automatically controllers products and devices, such as automobile engine control system, implantable medical devices, remote controls.*



# DIFFERENCE BETWEEN MICROCONTROLLER AND MICROPROCESSOR

## *MICROCONTROLLER*

- *Has processor as well as Memory.*
- *I/O interfacing pins are present*
- *Eg AVR(Atmega16, 32), 8051.*

## *MICROPROCESSOR*

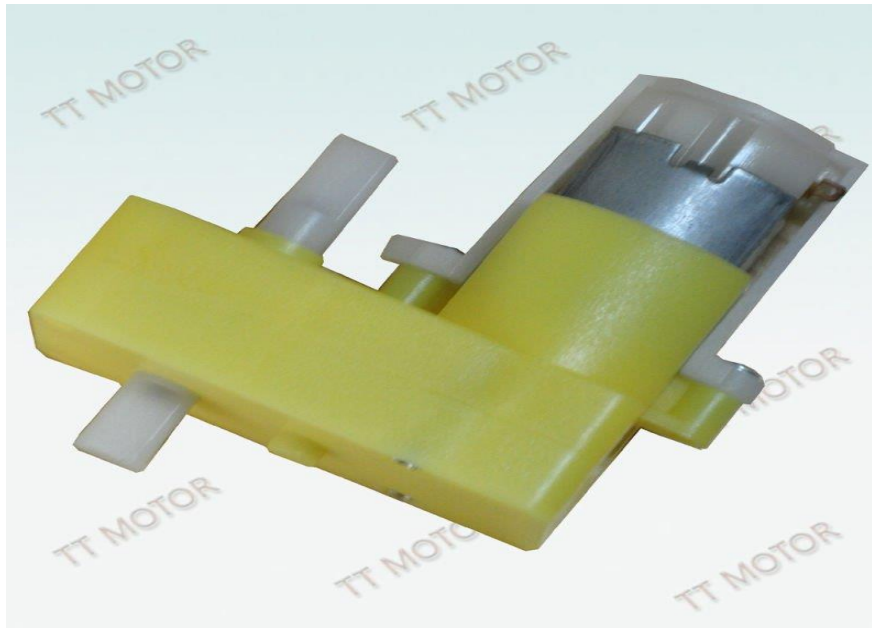
- *Memory is absent.*
- *No I/O pins.*
- *Eg 8085, 8086, Intel processor*



# MOTORS (DC, STEPPER, SERVO, WIPER)

## *DC Gear Motor:*

*. It consists of permanent magnets and a winding which rotates in the field when a dc current is fed into. Fast, continuous rotation motors – Used for anything that needs to spin at a high RPM e.g. car wheels, fans etc.*



- ***Stepper Motor:***

*A **stepper motor** (or **step motor**) is a brushless DC electric **motor** that divides a full rotation into a number of equal steps. The **motor's** position can then be commanded to move and hold at one of these steps.*



## ***Servo Motor:***

*Servos have integrated gears and a shaft that can be precisely controlled. Standard servos allow the shaft to be positioned at various angles, usually between 0 and 180 degrees. Servo motors are designed for more specific tasks where position needs to be defined accurately*



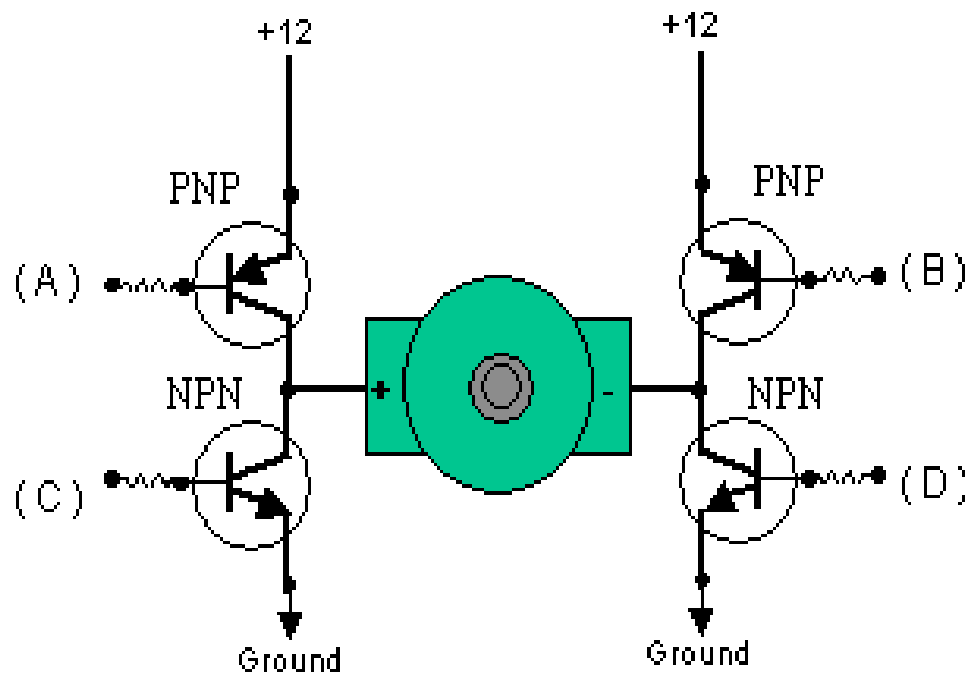
## ***Wiper Motor:***

*A wiper is a equipment in automobile used to navigate through hazardous condition, for maximum visibility in rain and a special kind of motor is needed to drive such arm which is wiper motor.*



# H-Bridge

H-bridge is a circuit which allows the voltage to be flow in either direction. As you know voltage need to change its direction for being able to rotate the motor in clockwise or anticlockwise direction, Hence H-bridge IC are ideal for driving a DC motor.



A	B	C	D	Function
-	-	-	-	-----
1	0	0	1	Forward
0	1	1	0	Reverse
1	1	0	0	Brake
0	0	1	1	Brake

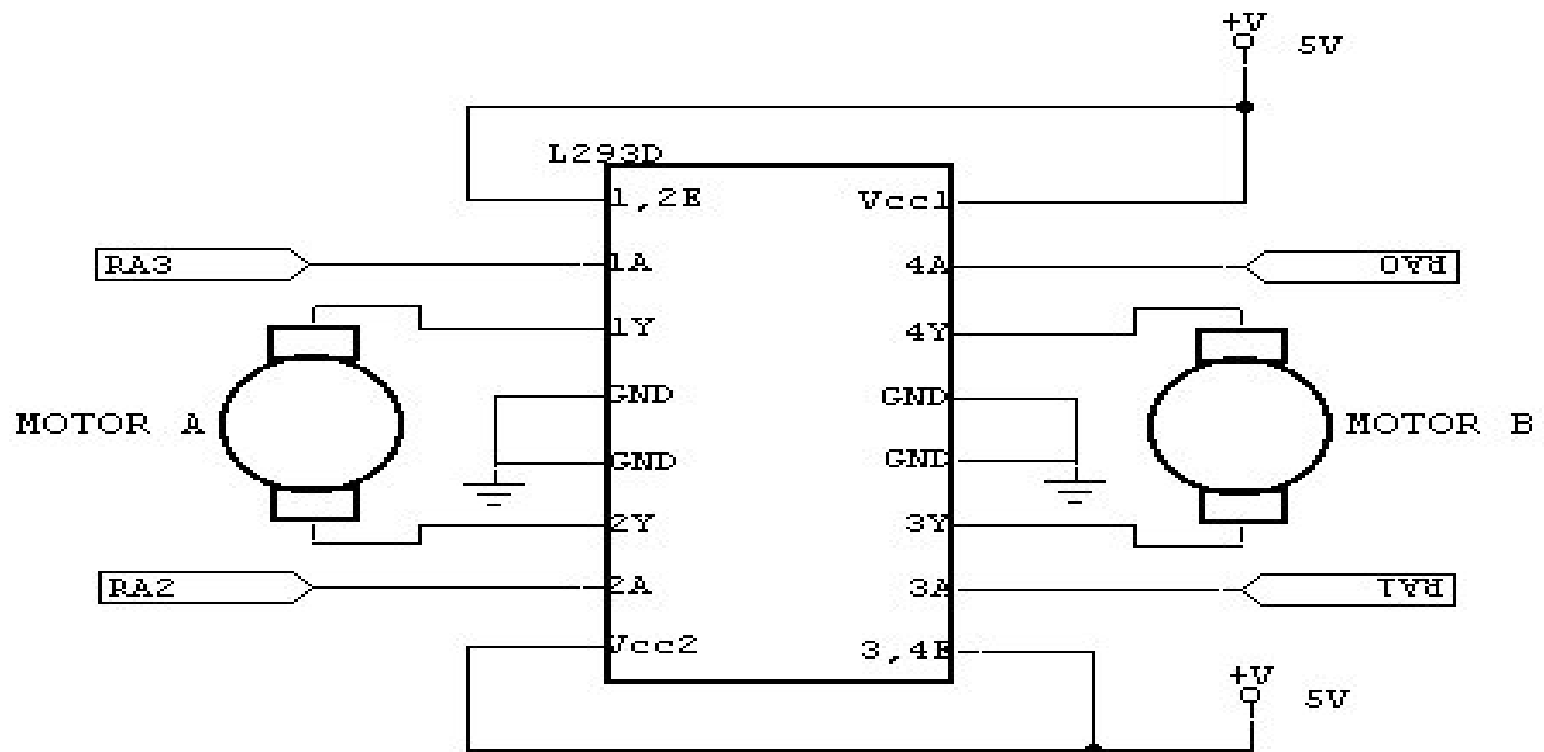




# MOTOR DRIVERS

## ■ L293D

L293D is a typical Motor driver or Motor Driver IC which allows DC motor to drive on either direction. L293D is a 16-pin IC which can control a set of two DC motors

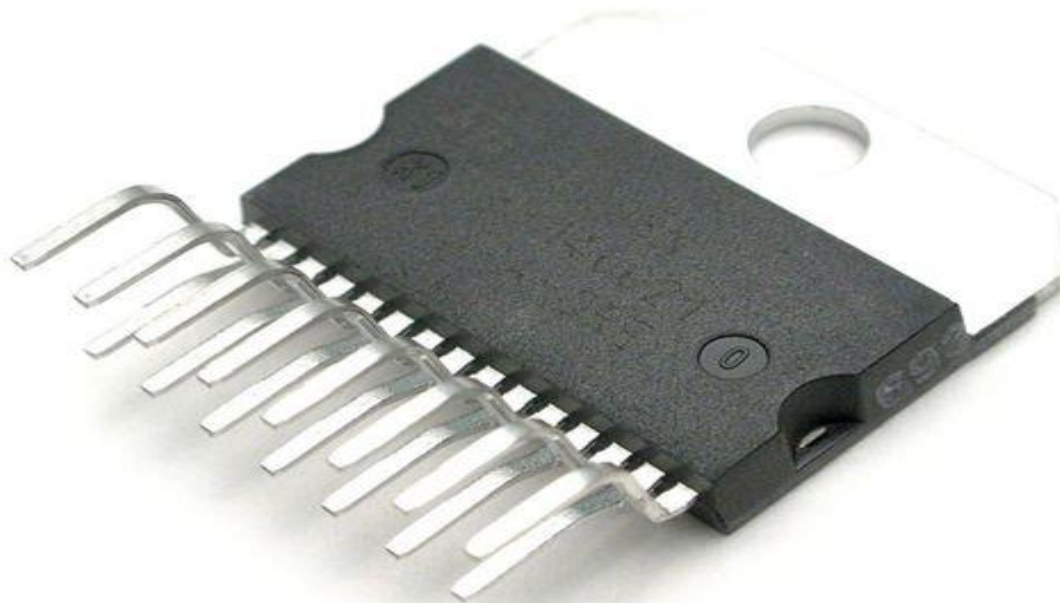


## H-Bridge

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(A

(C



# SPEED CONTROL OF MOTOR(PWM)

- PWM(Pulse Width Modulation)
- By changing Duty Cycle, voltage across motor can be changed.

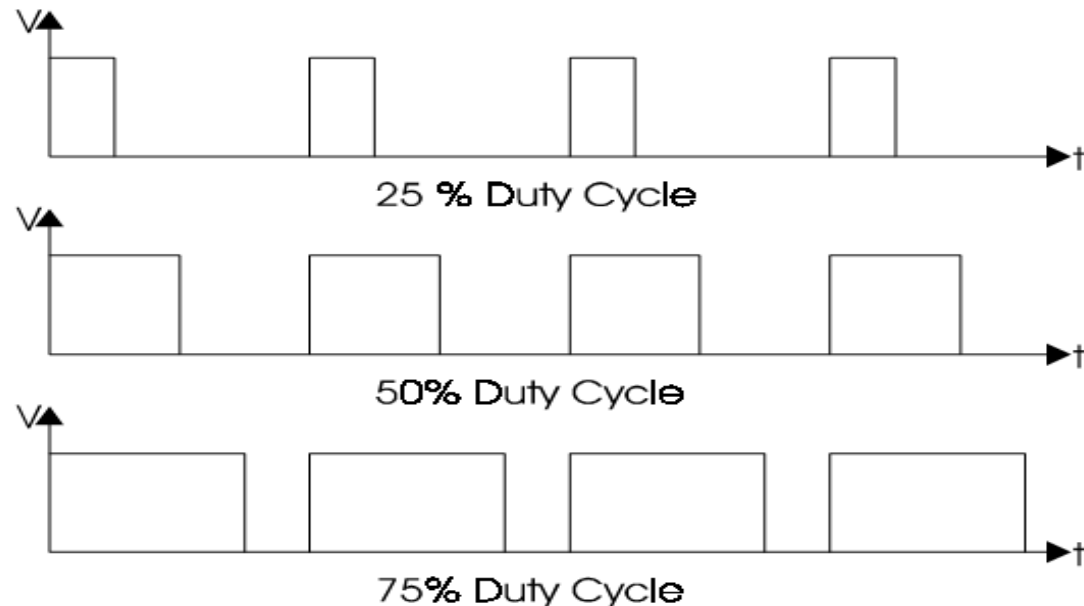


Figure 1 - Duty Cycles

- Mostly used in speed control of ROBOT and FAN



# SENSOR AND ITS INTERFACE WITH MICROCONTROLLER

*The Sensor needs to be interfaced with microcontroller so that the signal from the sensor are manipulated by a  $\mu\text{C}$ .*

*The sensor transforms a signal from a given energy domain (such as **thermal, magnetic, mechanical, chemical or radiant**) to the electrical domain by changing—for example—its electrical **resistance or capacitance**.*

*The signal conditioning circuit, which generally relies on operational amplifiers (Op-Amp), performs some or all of the following tasks in the analogue domain:*

***sensor output-to-voltage conversion,***

***amplification,***

***filtering,***

***linearization and/or demodulation.***



# CONT...

- *The resulting analogue signal is then digitized via an analogue-to-digital converter (ADC).*
- *A digital system (e.g., a  $\mu\text{C}$ ) **acquires, stores, processes, controls, communicates** (to other devices or systems) and/or displays the digital value with information about the measurand.*



# ADC AND DAC

- *Almost natural signals are analog in nature.*
- *Microcontroller only reads digital signal, so conversion is necessary.*
- *Different types of ADC are available for Analog to Digital Conversion.*
- *Successive Approximation ADC, Sigma-Delta A/D Converter are mainly used.*
- *DAC is used to convert digital signal to analog.*
- *ADC080X Series are mainly used.*
- *DAC080X series is mainly used.*



# NUMBERING SYSTEMS(BINARY AND HEXADECIMAL)

- The machine we operate only understand the 1 and 0 i.e high and low. So we need to know the binary system. In the microcontrollers we need to set the bits individually.*
- Binary number system is quietly lengthy and time consuming so we use hexadecimal numbering system in micro-controller programming(in both high level and low level programming).*
- Counting of binary and hex number.*
- Addition, Subtraction, Multiplication, Division of binary and hexadecimal Number.***
- Conversion from HEX to BINARY to DECIMAL*
- BCD Numbering System*



# ASSEMBLY PROGRAMMING

Not in use due  
to its Difficulty





# BASIC 'C' PROGRAMMING

*We often use C programming while writing codes for programming our microcontrollers.*

*C is the basic procedural oriented programming language*

## **❖Data Types:**

*Char(unsigned and signed), int(unsigned, signed, double, long), string, array(1-D,2-D),structure*

***Loop(infinite loop, one time execution loop):***

*For(),while(),do{}while(),*

***Switch-case, break-continue, goto-label***

***Funtions***



# CONDITIONAL AND LOGICAL OPERATOR

- Less than(<)
- Greater than(>)
- Greater than and equal to(>=)
- Less than and equal to(<=)
- Equal to(==)
- Not equal to(!=)
- **Exp1>exp2:exp3**
- Logical OR(||)
- Logical AND(&&)



# BITWISE OPERATOR IN MICROCONTROLLER PROGRAMMING

*They are very important in microcontroller programming as individual bits often have a significant meaning and need to be modified as needed.*

*The bitwise operators are, **AND**, **OR**, **XOR**, **NOT**, **Shift** etc.*

*For example: A bitwise XOR operator results in bits being set if, and only if, the same bit is set in one of the operands but not the other.*

	7	6	5	4	3	2	1	0
	1	0	1	0	1	0	1	0
XOR	0	0	0	0	1	1	1	1
=	1	0	1	0	0	1	0	1

*The character (^) caret is the bitwise XOR operator in C.*



# USE OF DIFFERENT OPERATOR

- Bitwise AND(&) and Bitwise OR(|) operator

For eg to check the bit '1' or '0'.

To make the bits '1' or '0'.

- Bitwise shift operator

Right shift(>>)

left shift(<<)

Note: 0x means hex, 0b means binary in programming.



# MEMORY PROBLEMS IN PROGRAMMING

*In programming with microcontrollers we are provided with little memory space. For example ATmega16 has 16KB of flash memory.*

*The modern day microcontrollers have different types of memory they are:*

- *ROM: it is preprogrammed memory*
- *FLASH: it can be programmed*
- *EEPROM: it can be reprogrammed hundred and thousands of time in same block*
- *RAM: its space is very low because its costly and needs power for operation. It can store data and program on same architecture. It losses its content during power loss.*

*So we should be careful about memory management while programming*



# OPTIMIZING THE MEMORY IN MICROCONTROLLER

- By using functions(minimize the code size)
- By using the data types as per requirements  
for eg: char instead of int
- By using advanced data types of variables  
for eg: array, structure
- By DMA
- And many more...(search yourself)



# PCB DEVELOPING PROCESS

*PCB Development includes following steps:*

- *PCB Layout designing and printing*
- *Attaching layout in the PCB board*
- *PCB etching*

*We use ferric chloride solution for etching we can use the epoxy board or the ordinary.*

*Once when board is prepared drilling, placing components and soldering are further steps.*

