MOTOR

Stepper Motor

- Stepper motor is a brushless, synchronous electric motor that converts digital pulses into mechanical shaft rotation.
- It rotates in steps and step size is 0.90 to 300
- Stepper motor is stepped from one position to the next by changing the currents through the fields in the motor.
- Two common field connections are
  - Two phase
  - Four phase

Types of Stepper Motor

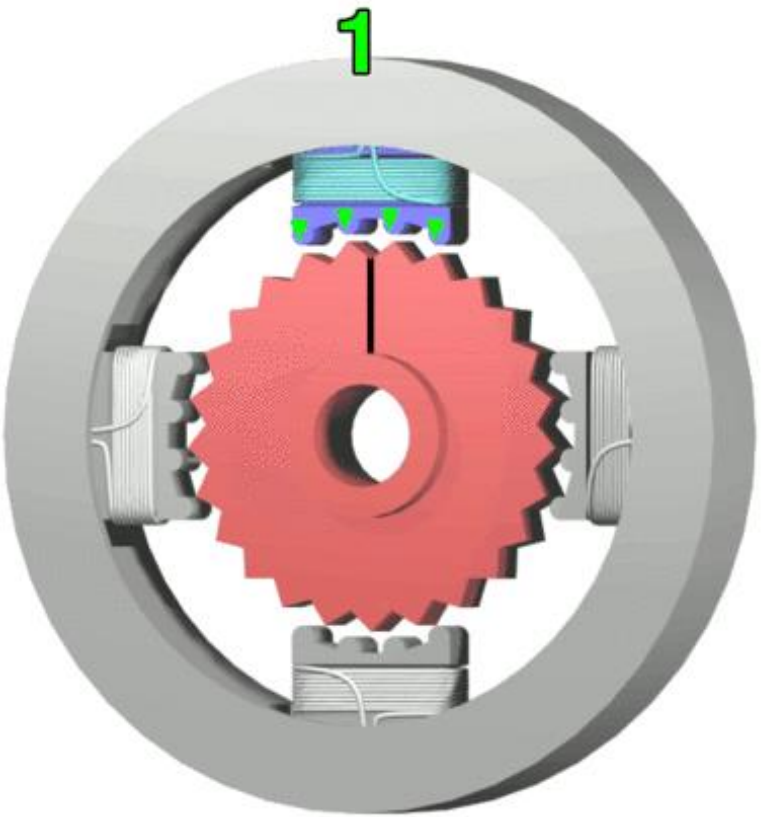
- Permanent Magnet Stepper Motor:
  - It has a magnet for a rotor but no teeth.
  - Use a permanent magnet (PM) in the rotor and operate on the attraction or repulsion between the rotor PM and the stator electromagnets.

- Variable Reluctance Stepper Motor:
  - It has teeth on the rotor and stator, but no magnet.
  - It has a plain iron rotor and operate based on the principle that minimum reluctance occurs with minimum gap, hence the rotor points are attracted toward the stator magnet poles.

- Hybrid Stepper Motor:
  - Hybrid stepper motors are named because they use a combination of permanent magnet (PM) and variable reluctance (VR) techniques to achieve maximum power in a small package size.
  - Hybrid stepper motors combine the magnet from the permanent magnet and the teeth from the variable reluctance motors.

How does stepper motor works?

- The stepper motor consists a permanent magnetic rotating shaft called the rotor and stationary electromagnets surrounding the rotor is called stator.
- Stepper motors have typically 50 to 100 electromagnetic poles (pairs of north and south poles) generated either by permanent magnet or an electric current
- The basic operation of a stepper motor allows the shaft to move a precise number of degrees each time a pulse of electricity is sent to the motor.
- To make the motor shaft turn
  - First one electromagnet is given power, which makes the gear's teeth magnetically attracted to the electromagnet's teeth.
  - The point when the gear's teeth are thus aligned to the first electromagnet, they are slightly offset from the next electromagnet.
  - So when the next electromagnet is turned ON and the first is turned OFF, the gear rotates slightly to align with the next one and from there the process is repeated.
  - Each of those slight rotations is called a step, with an integer number of steps making a full rotation. In that way, the motor can be turned by a precise.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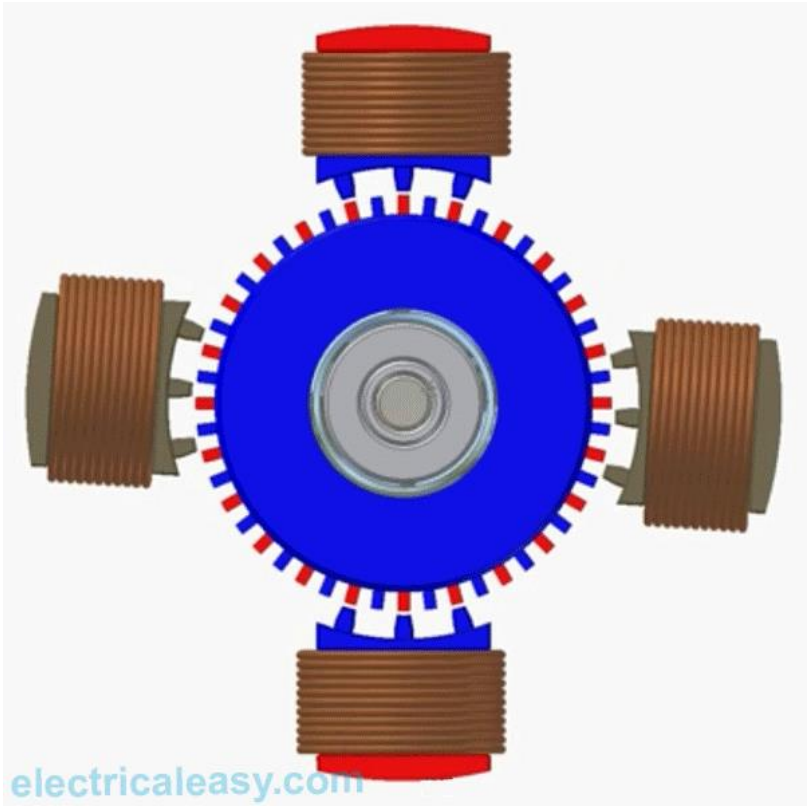
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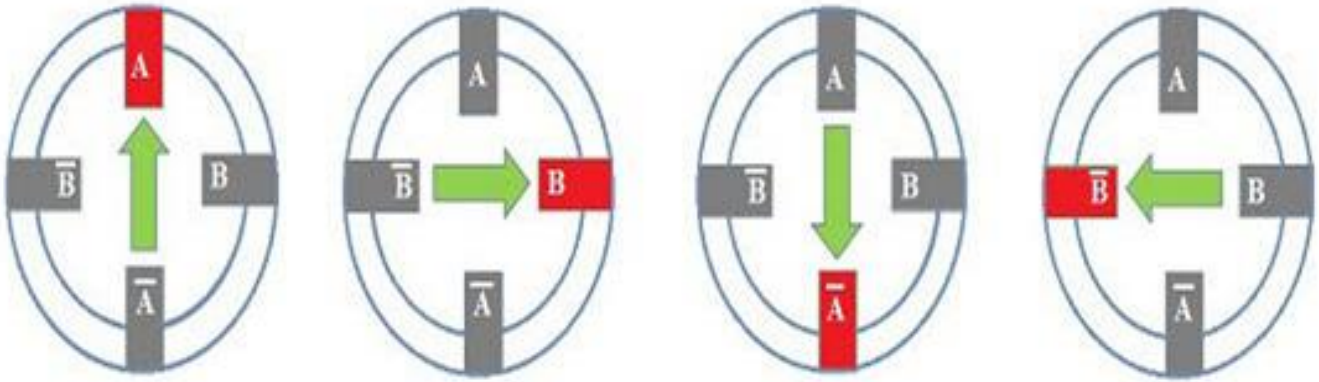
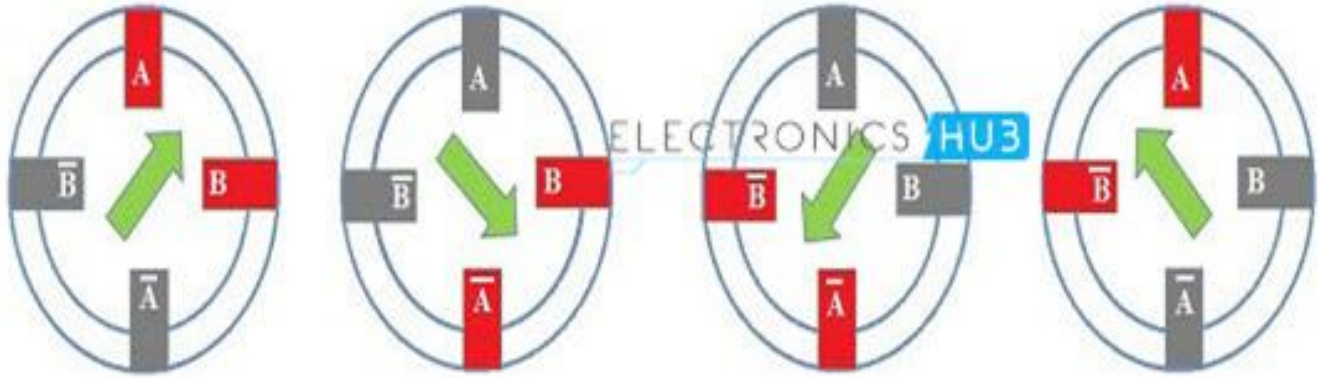
Two Phase Stepper Motor

Full Step - One Phase ON



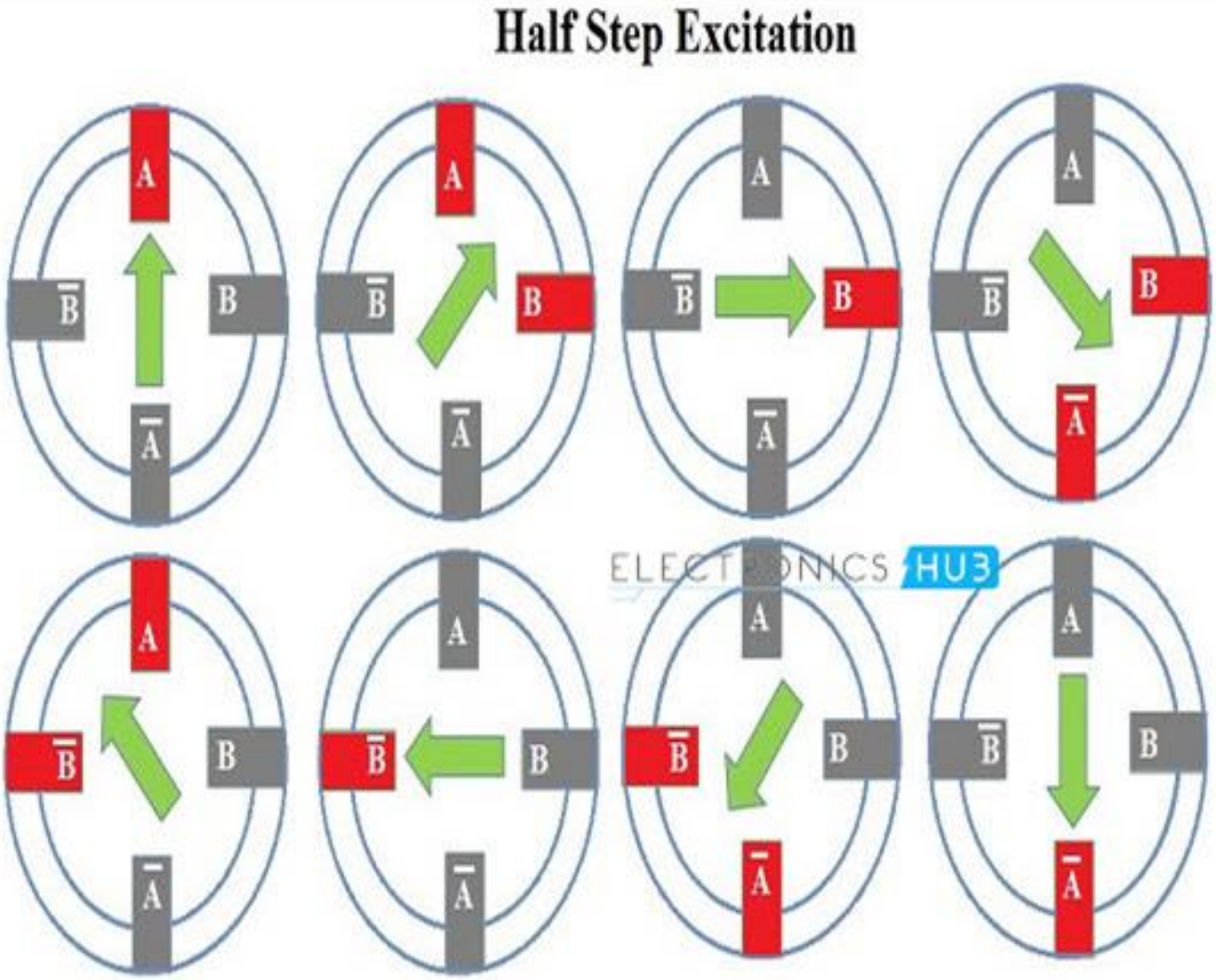
Step	Phase			
	A	B	$\overline{A}$	$\overline{B}$
1	1	0	0	0
2	0	1	0	0
3	0	0	1	0
4	0	0	0	1

Full Step - Two Phase ON



Step	Phase			
	A	B	$\overline{A}$	$\overline{B}$
1	1	1	0	0
2	0	1	1	0
3	0	0	1	1
4	1	0	0	1

Two Phase Stepper Motor



Step	Phase			
	A	B	$\overline{A}$	$\overline{B}$
1	1	0	0	0
2	1	1	0	0
3	0	1	0	0
4	0	1	1	0
5	0	0	1	0
6	0	0	1	1
7	0	0	0	1
8	1	0	0	1

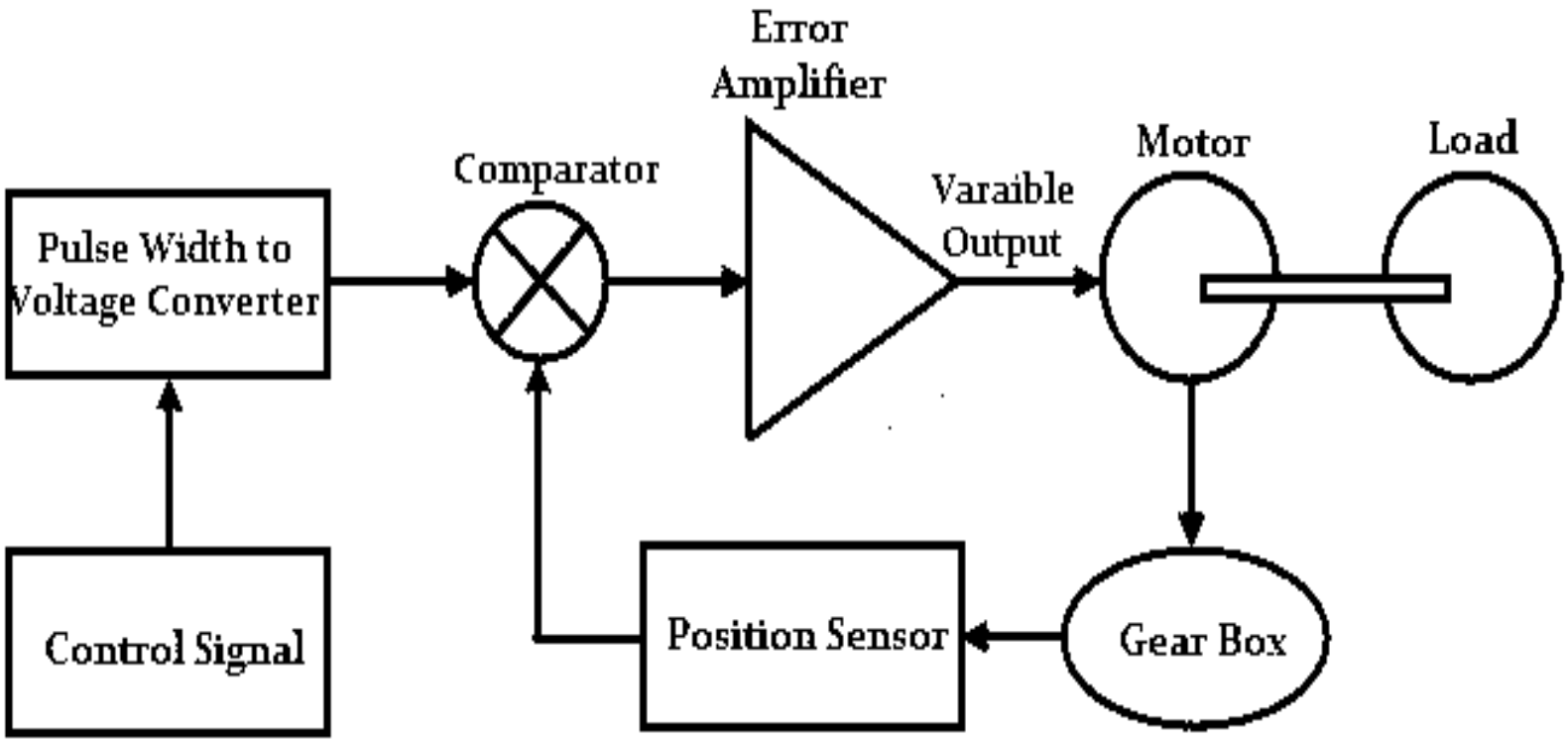
Servo Motor

- A **servo motor** is an electrical device which can push or rotate an object with great precision.

- 2 basic types of servo motor:
  - AC Servo Motor
  - DC Servo Motor

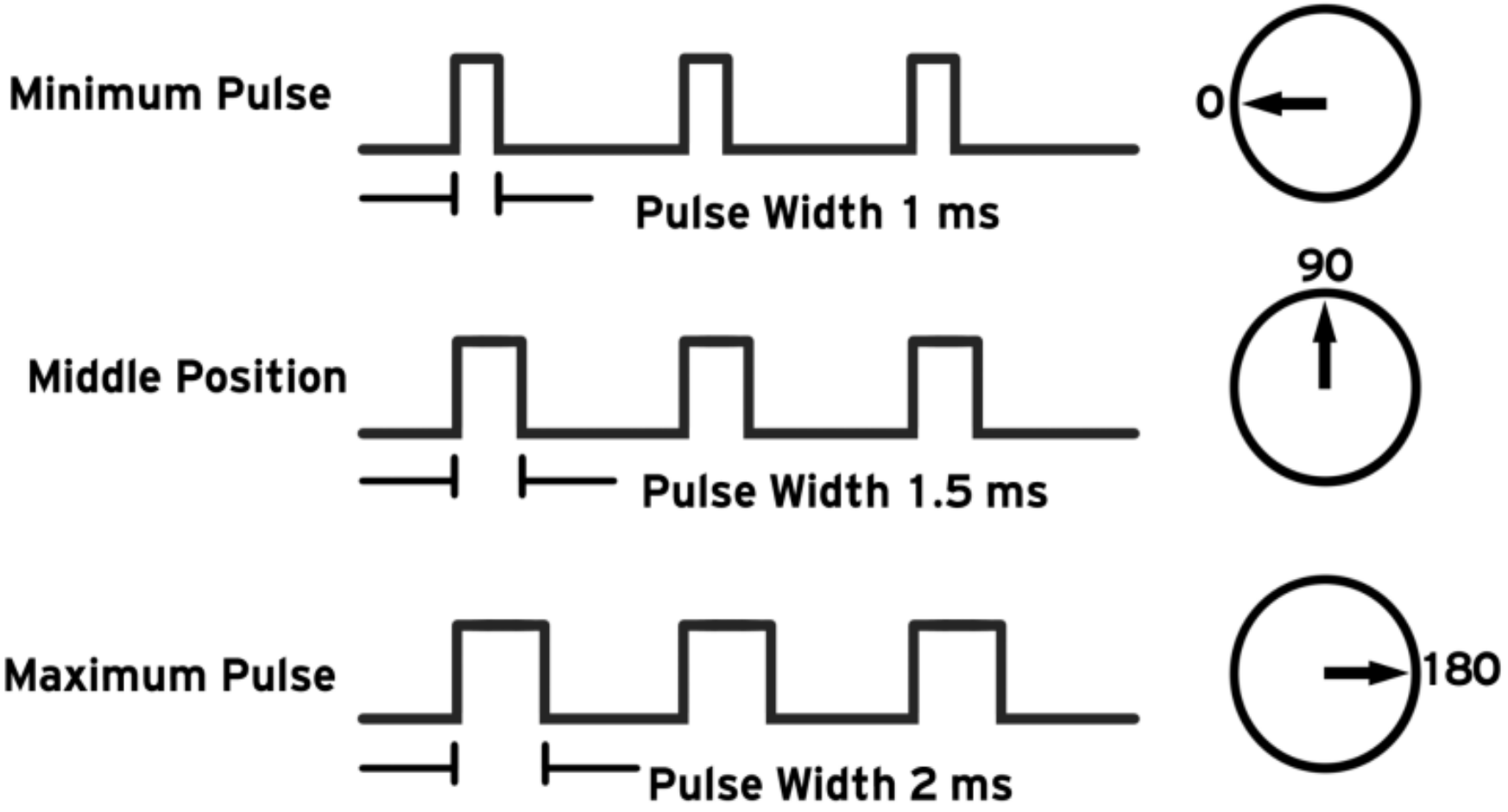
Working principle of DC Servo Motor

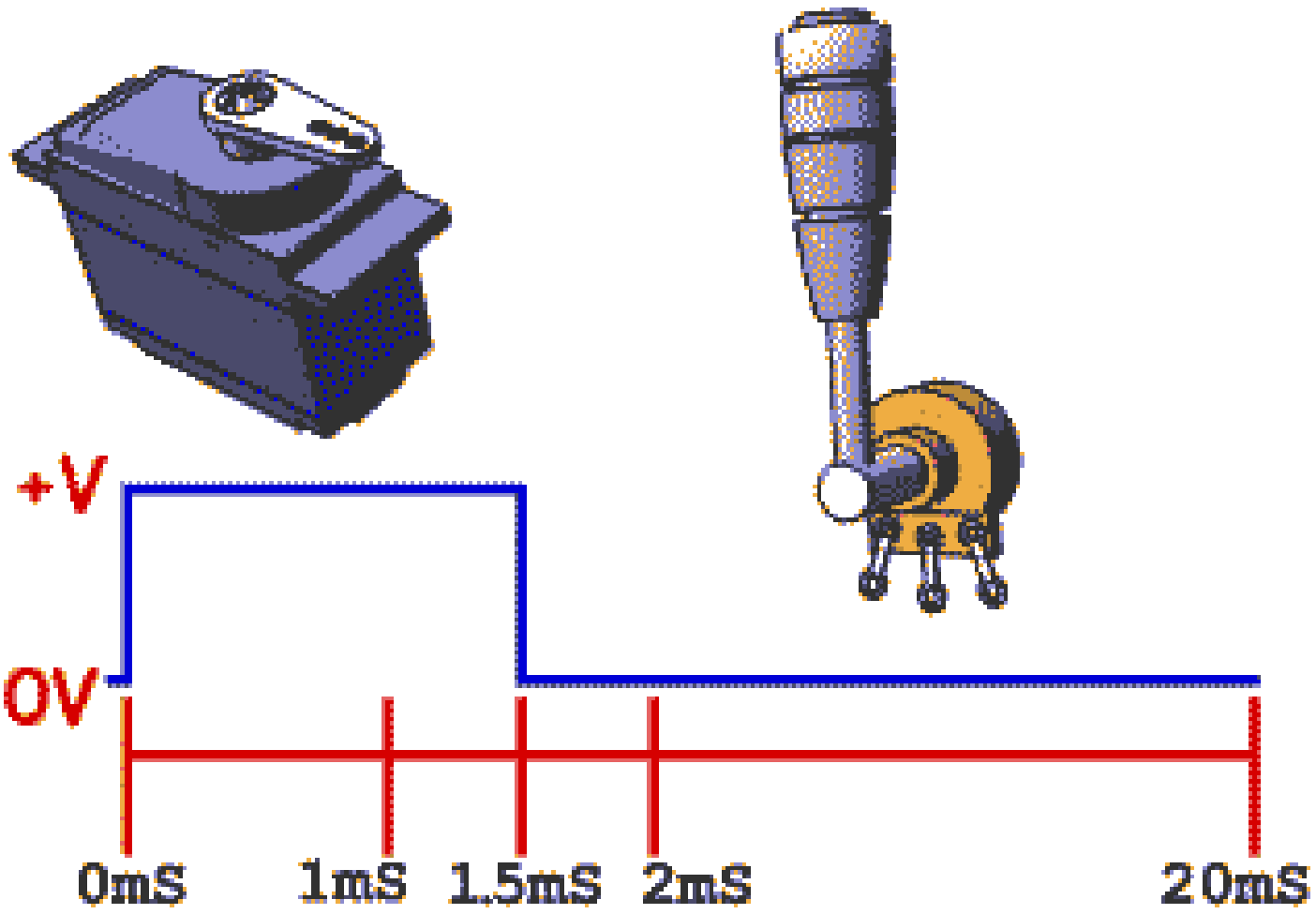
- The Servo Motor basically consists of a DC Motor, a Gear system, a position sensor and a control circuit.
- The DC motors get powered from a battery and run at high speed and low torque.
- The Gear and shaft assembly connected to the DC motors lower this speed into sufficient speed and higher torque.
- The position sensor senses the position of the shaft from its definite position and feeds the information to the control circuit.
- The control circuit accordingly decodes the signals from the position sensor and compares the actual position of the motors with the desired position and accordingly controls the direction of rotation of the DC motor to get the required position.
- The Servo Motor generally requires DC supply of 4.8V to 6 V.


Error
Amplifier
Comparator
Motor
Load
Varaible
Output
Pulse Width to
Voltage Converter
Control Signal
Position Sensor
Gear Box

Controlling Servo Motor

- A servo motor is controlled by controlling its position using Pulse Width Modulation Technique. The width of the pulse applied to the motor is varied and send for a fixed amount of time.
- The pulse width determines the angular position of the servo motor. For example a pulse width of 1 ms causes a angular position of 0 degrees, 1.5ms will move the shaft 90 degree whereas a pulse width of 2 ms causes a angular width of 180 degrees.


Minimum Pulse
Pulse Width 1 ms
0
Middle Position
Pulse Width 1.5 ms
90
Maximum Pulse
Pulse Width 2 ms
180


+V
0V
0mS
1mS
1.5mS
2mS
20mS

"Be healthy and stay safe"