

Overview

What will you have learned?

- Working with basic electronic components.
- Designing and debugging electronic circuits.
- Getting started with digital communication.
- Building electronics projects by teamwork.
- Visualizing a path for your future in electronics & communication field.

Course Outline

Project 1: Basic Remote Controlled Car

- Simple electronic components
 - Resistors
 - Push button
 - Dip switches
 - Diodes
- Encoder & Decoder
 - Introduction
 - Functions
 - Truth Table
 - HT12E & HT12D ICs

Course Outline

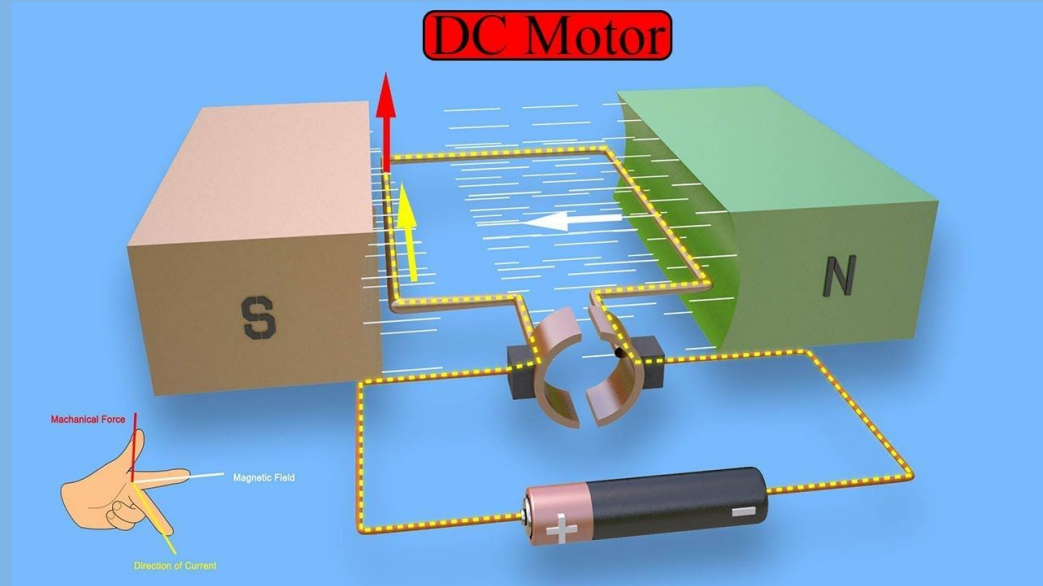
- Wireless Communication
 - Introduction with block diagram
 - Amplitude shift keying (Basic Ideas Only)
 - Introduction
 - Generation of ASK signal
 - Introduction
 - Op Amp as multiplier (product modulator)
 - Detection of ASK signal
 - Introduction
 - Band-pass Filter
 - Rectifier
 - Low-pass Filter
 - RF 433MHz module

- Diode based control logic
 - Working principle
 - Truth table
 - Circuit Diagram
- Power Supply
 - Battery
 - Voltage Regulator
- Relay H-bridge
 - H-bridge
 - Relay switching
- Motors
 - DC motors
 - Brushless DC motors
 - Stepper motors and servo-motors

- PCB design
 - Schematic Design
 - Footprints & component placement
 - Tracks & pads design
 - Printing

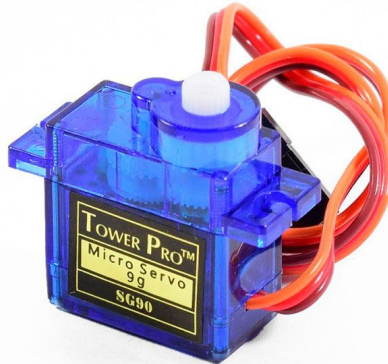
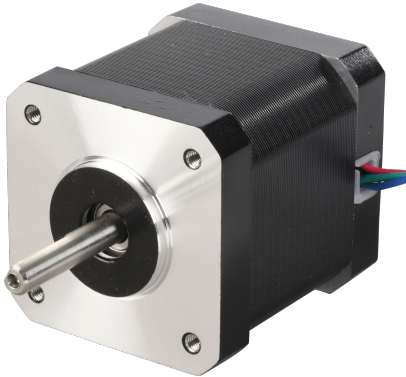
Motors

- An electrical machine that converts electrical energy into mechanical energy
- Works on the principle **a conductor carrying electrical current kept in a magnetic field experience mechanical force**



Types of Motors

1. DC motor
2. Servo Motor
3. Stepper Motor



Factors to consider when selecting a Motor

1. Voltage Rating
2. Current Rating
3. Torque
4. Velocity (RPM)

Voltage Rating

- Voltage Rating indicates the most efficient voltage while running.
- Using voltage below the recommended voltage will not turn the motor
- Using voltage above the recommended voltage short windings resulting in power loss or complete destruction.

Current Rating

- The maximum current specification of a motor is the maximum amount of current that a motor can withstand passing through it without being damaged or destroyed.
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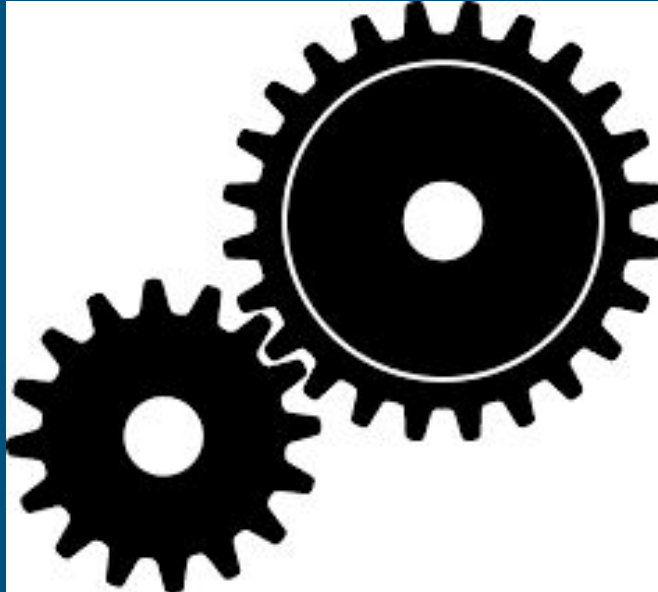
Torque

- Torque is a rotating force produced by a motor
- Rotational Speed(RPM) is inversely proportional to torque
- But high torque allows the application of high forces
- it provides faster responsiveness – meaning that motors can be accelerated rapidly to high speeds at rest if high torque can be maintained.
- So choose motors with high torque rather than high velocity when precise movements have to be realized like in the wiper of a vehicle , the cutters in textile industry

Velocity (RPM)

- amount of times the shaft of a DC motor completes a full spin cycle per minute.
- The higher the RPM , higher the rotational speed of the motor
- When speed is important, RPM is a crucial factor to look over when choosing a motor like in washing machines , treadmills
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RPM and Torque



Question 1

DC Motors

- Runs on DC
- The direction of motion changes when polarity is reversed

Battery

- A cell is a single unit of device that converts chemical energy into electrical energy.
- A battery is a collection of cells that converts chemical energy into electrical energy.

Factors to consider when buying a battery

1. Battery Voltage
2. Capacity / Milliampere-Hours (mAh)
3. Expected Cycle Life

Nominal Voltage

1. Most common way to refer a battery
2. A 9 volt battery has 9 volts of energy across its terminals and which gives out 9 volts when connected in a circuit.

Capacity/Milliampere-Hours (mAh)

1. shows how long the battery can last for in operation
2. a 1900mAh battery can supply 1900mA of current to a circuit for one hour, and then it will have used all of its charge.
3. Likewise : it can also mean
 - 3.1. 3800mA for 0.5hours($3800 \times 0.5 = 1900$)
 - 3.2. 1900mA for 1 hour($1900 \times 1 = 1900$)
 - 3.3. 950mA for 2 hours($950 \times 2 = 1900$)
 - 3.4. 475mA for 4 hours($475 \times 4 = 1900$)

Expected Cycle Life

1. Each round of full discharge and then full recharge is called battery cycle life.
2. So for a battery with 200 cycle life , after 200 full rounds of charge and discharge it would drop to 80% of its max capacity
3. After that it would start deteriorating faster and its capacity to be recharged fully decreases.

Question 2

Suppose you have a electric bike that consumes 10 amps on average. If your battery is of 60AH, how many hour you can run your bike?

Switch

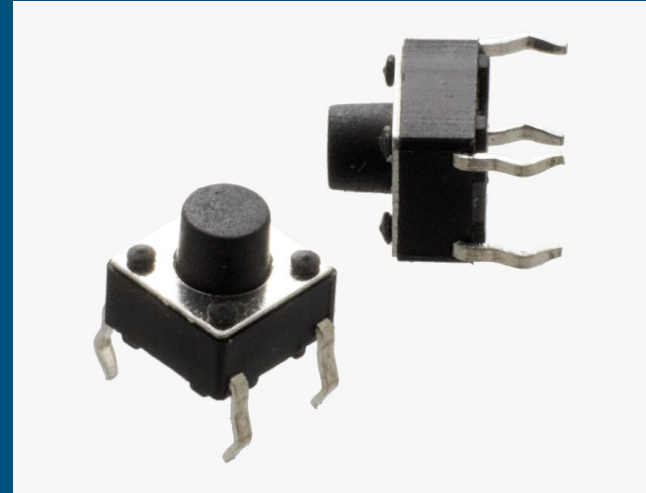
1. An electrical switch serves the purpose of controlling the flow of electrical current within a circuit.
2. It has two states
 - a. OFF : The circuit is open
 - b. On : The circuit is closed

Mechanical Switching

1. Such switches require the user to manually set the switch to ON or OFF
- 2.

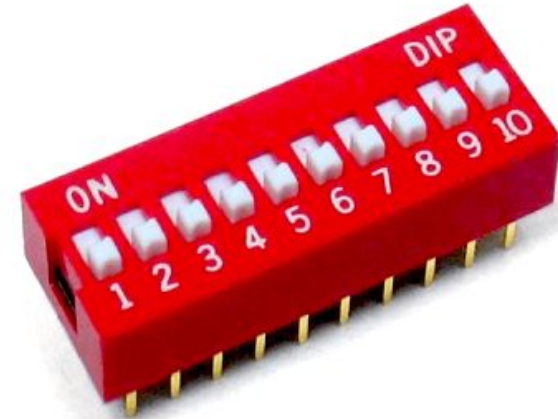
Push button switch

1. when you press the switch, contacts of switch is closed and make circuit close to flow the current
2. when you remove pressure from the button, contacts of switch is open and break the circuit.



DIP Switches

1. It consists of a series of switches in a single unit.



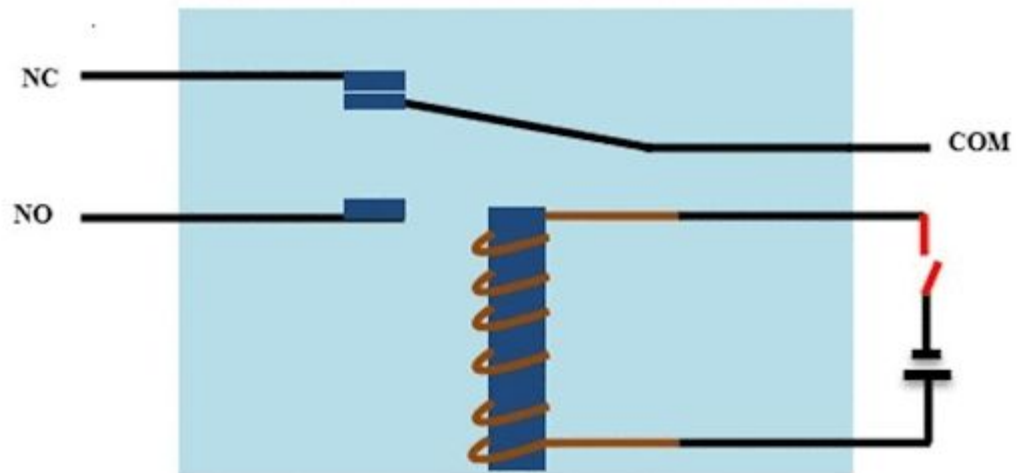
Electrical Switching

- The change of state from ON to OFF is initiated by a electrical signal

Relay

1. A relay is an electrically operated mechanical switch.
- 2.



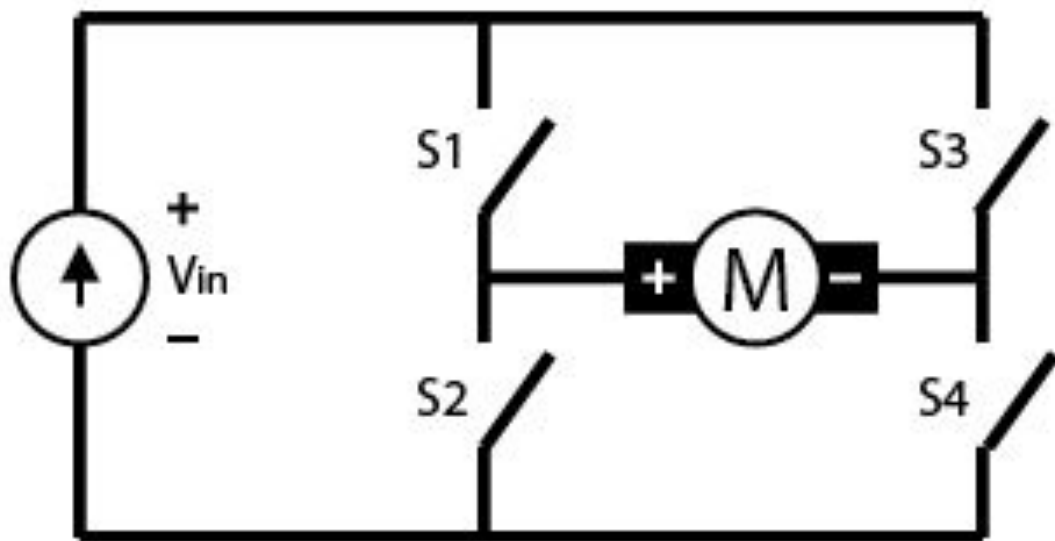


Types of Relay

- Single pole single throw
- Single pole double throw
- Double pole single throw
- Double pole double throw

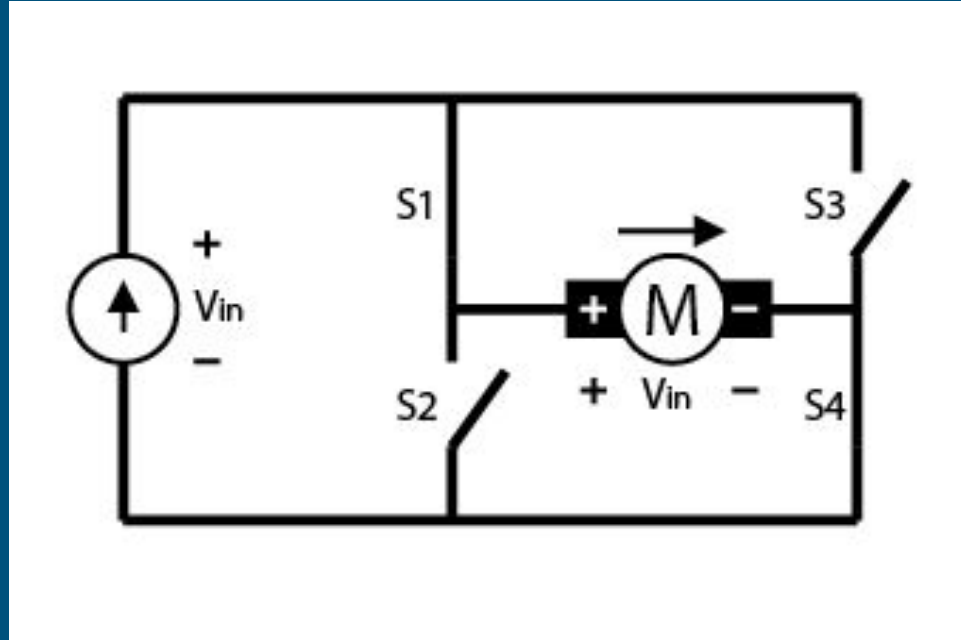
H bridge

1. A H-bridge is an electronic circuit that switches the polarity of a voltage applied to a load
2. It lets you control a DC motor to go backward or forward



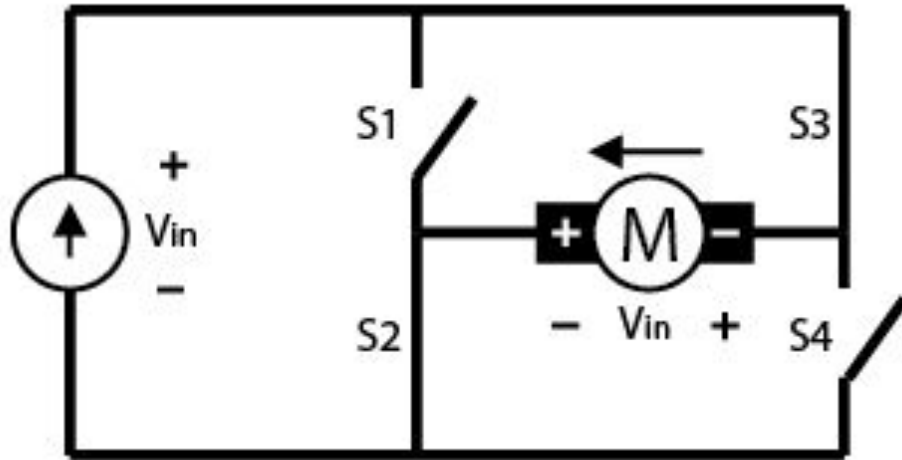
Working of an H-Bridge

- If Switch 1 and 4 are closed, then the current will flow from the left to right

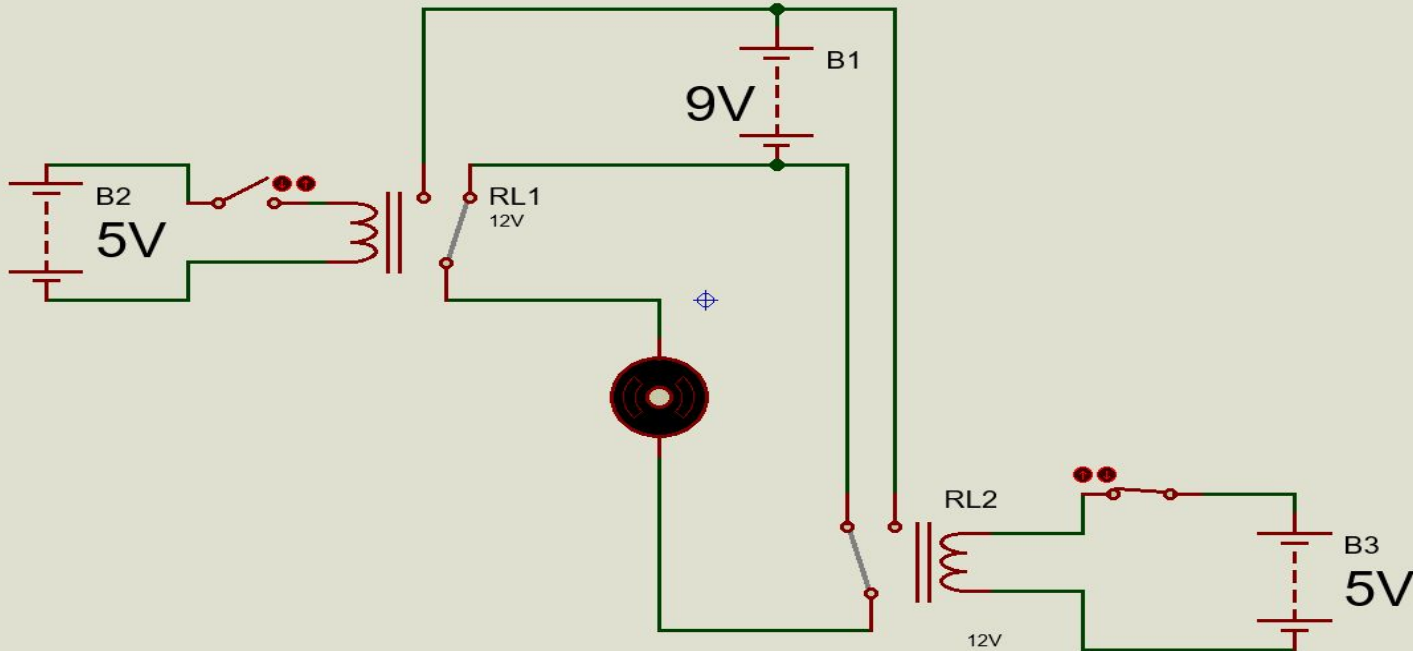


Working of an H Bridge

- If Switch 1 and 4 are closed, then the current will flow from the right to left

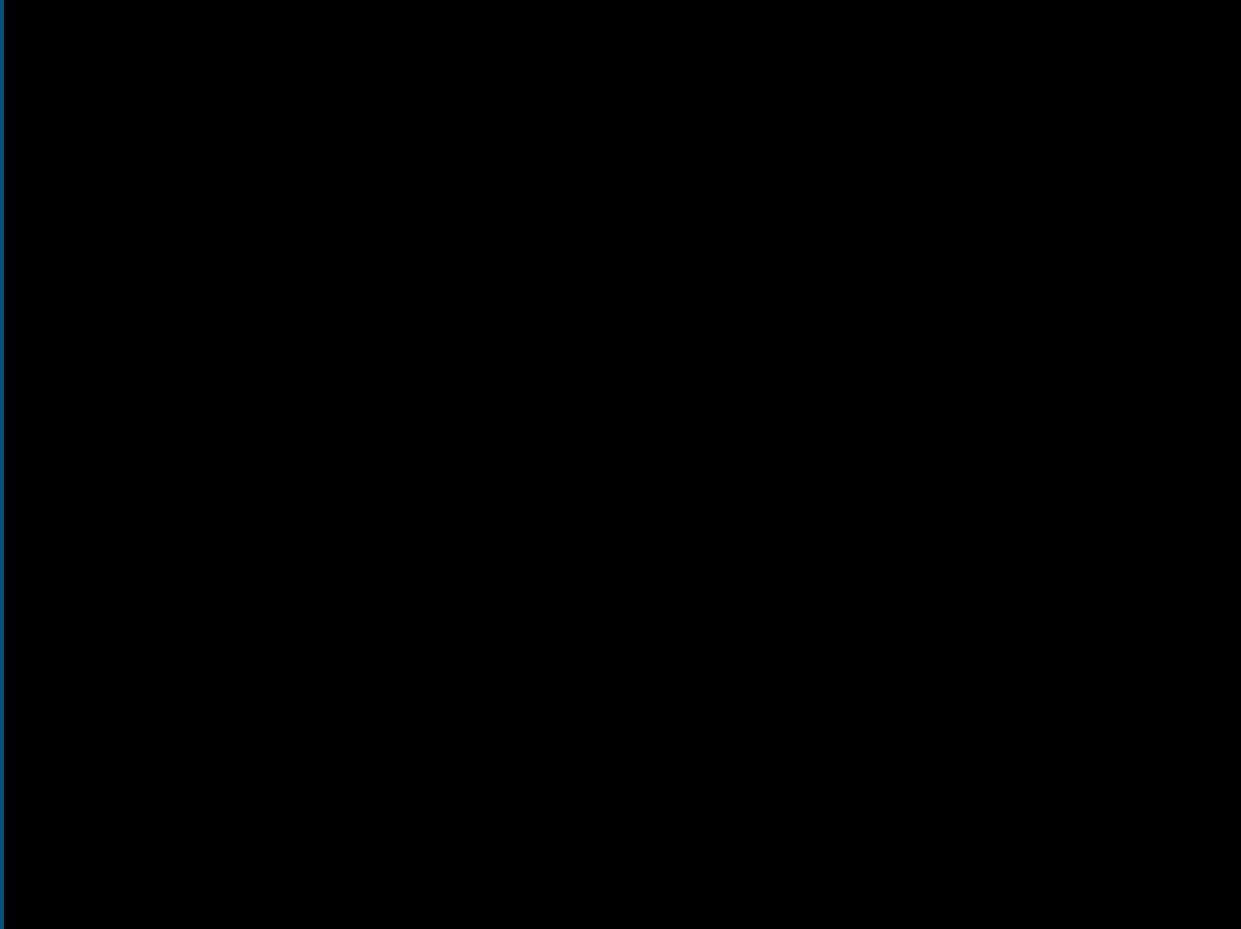


Relay H bridge



Simulation for relay H-bridge

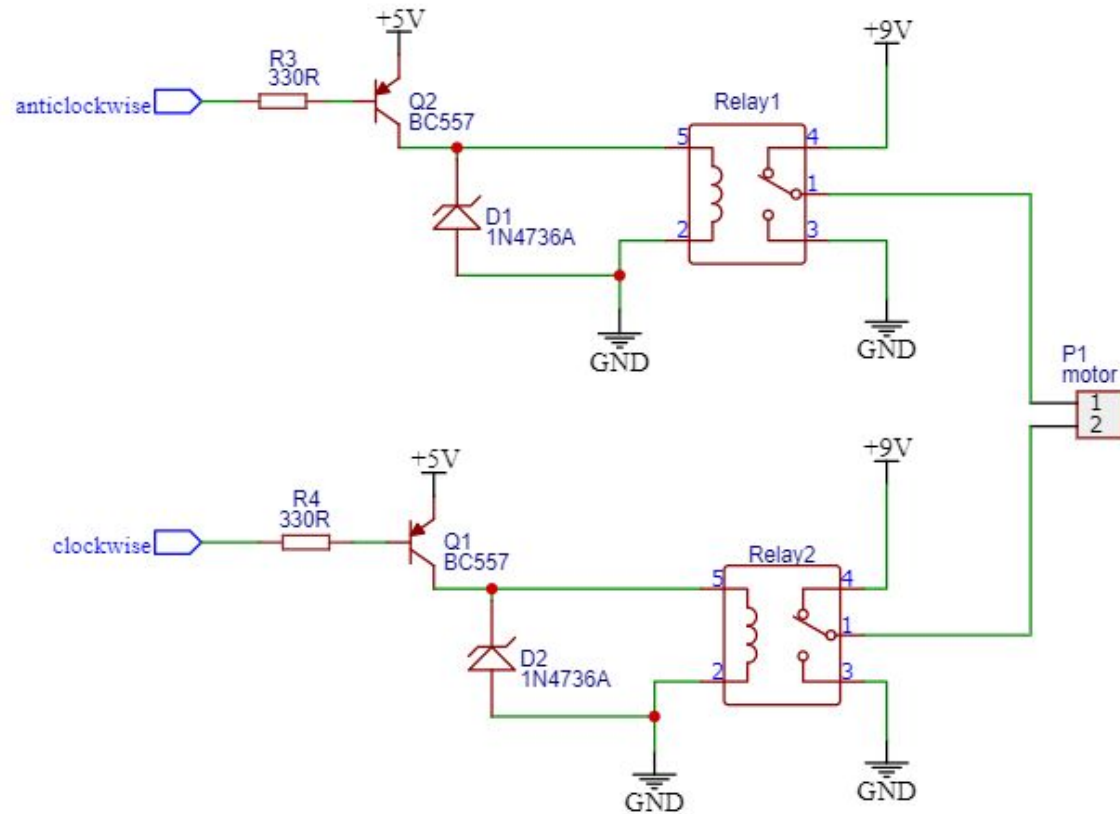
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Limitations of a relay H-bridge

1. Relay switches draw a huge volume of current and directly using Relay switching may cause the connected IC to burn when this happens
2. So it's recommended to control the switching of Relay using resistors ,diodes and transistors for prevention of such errors

Actual circuit for relay h bridge

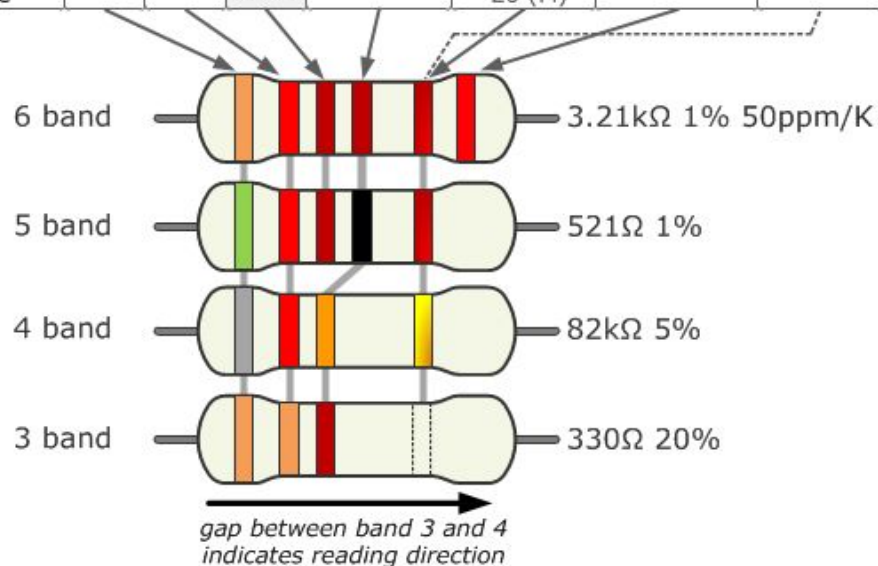


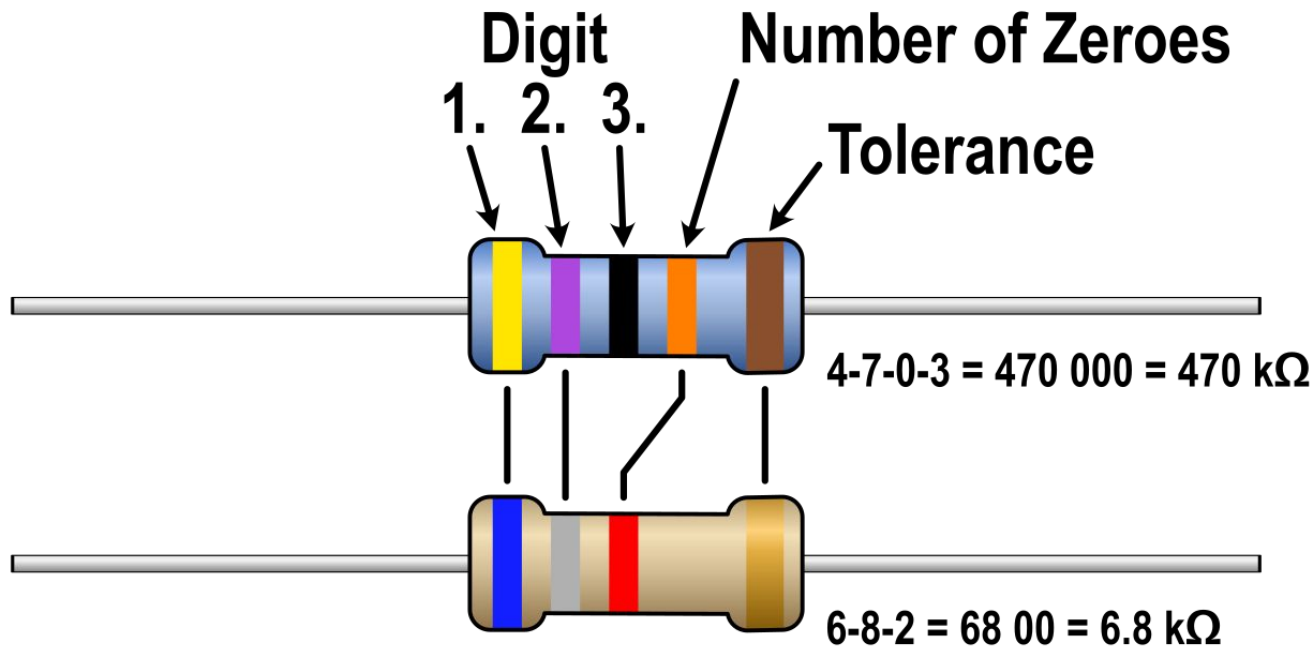
Resistor

1. Resistor limits or regulates the flow of electrical current in an electronic circuit.
2. Resistors can also be used to provide a specific voltage for an active device such as a transistor.



	Color	Significant figures			Multiply	Tolerance (%)	Temp. Coeff. (ppm/K)	Fail Rate (%)
Bad	black	0	0	0	x 1		250 (U)	
Beer	brown	1	1	1	x 10	1 (F)	100 (S)	1
Rots	red	2	2	2	x 100	2 (G)	50 (R)	0.1
Our	orange	3	3	3	x 1K		15 (P)	0.01
Young	yellow	4	4	4	x 10K		25 (Q)	0.001
Guts	green	5	5	5	x 100K	0.5 (D)	20 (Z)	
But	blue	6	6	6	x 1M	0.25 (C)	10 (Z)	
Vodka	violet	7	7	7	x 10M	0.1 (B)	5 (M)	
Goes	grey	8	8	8	x 100M	0.05 (A)	1(K)	
Well	white	9	9	9	x 1G			
Get	gold			3th digit only for 5 and 6 bands	x 0.1	5 (J)		
Some	silver				x 0.01	10 (K)		
Now!	none					20 (M)		



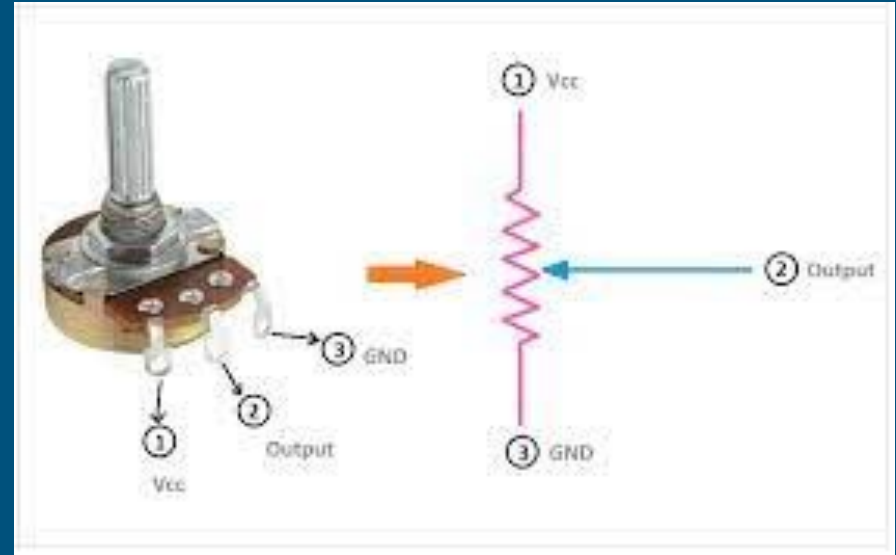


Digit	0	1	2	3	4	5	6	7	8	9
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Tolerance	Silver ±10 %	Gold ±5 %	±1 %	±0.5 %	±0.1 %
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What is a Potentiometer

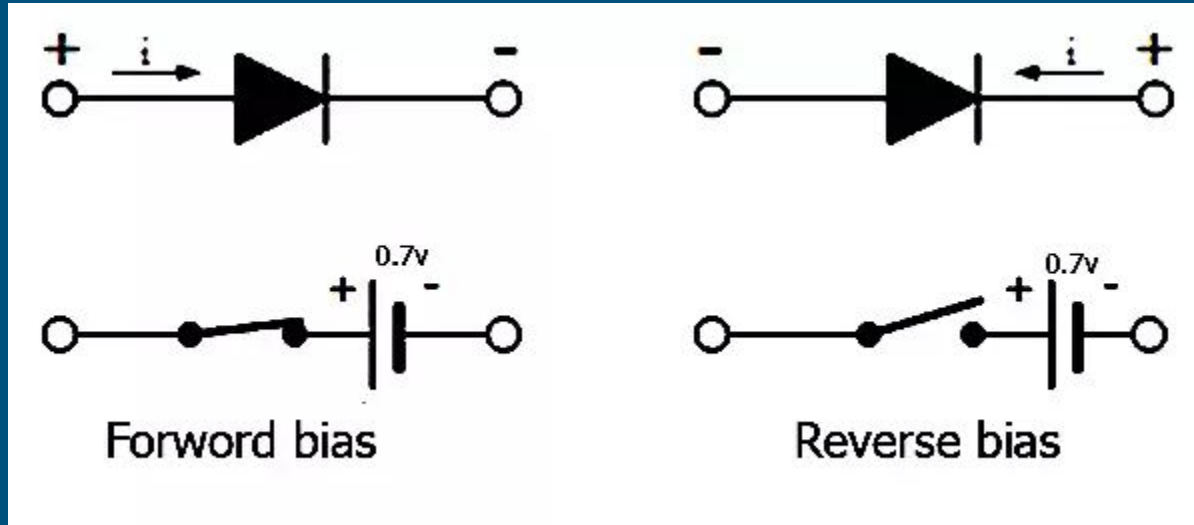
1. 3 terminal variable resistor in which the resistance is manually varied to control the flow of electric current.
2. A potentiometer acts as an adjustable voltage divider.



Diodes

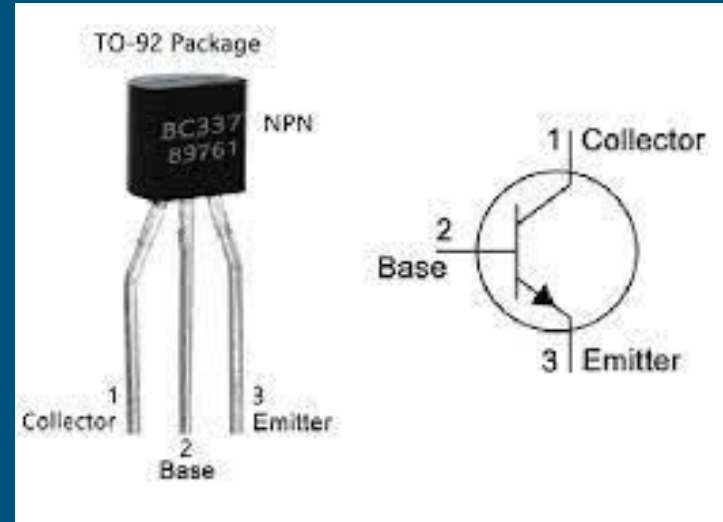
- A diode is used to block the electric current flow in one direction
- This principle of diode makes it work as a Rectifier.
- The output will be DC removing the AC components.

Diodes as Switches



Transistor

1. A transistor is a semiconductor device used to amplify or switch electrical signals and power.
2. It has 3 terminals
 - a. Emitter
 - b. Base
 - c. Collector



Working of a transistor

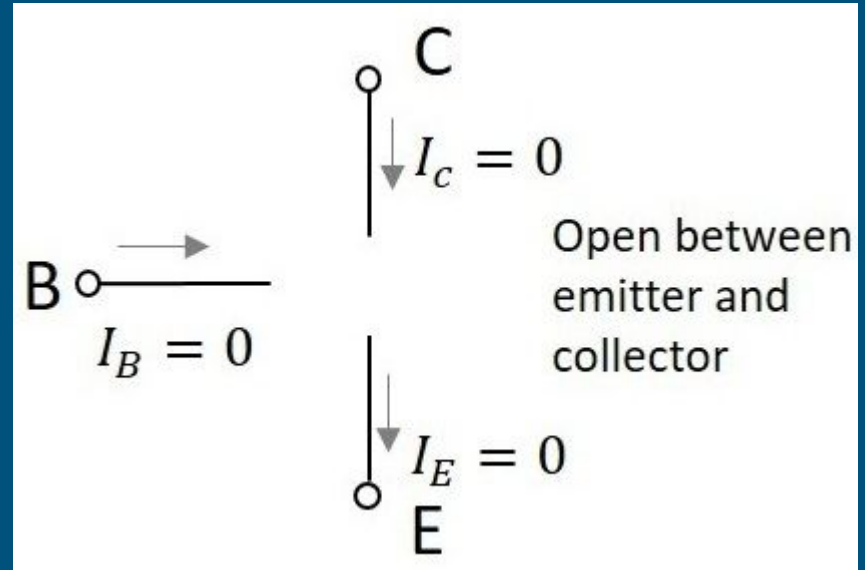
1. Transistor lets you control the flow of current through Collector by varying the intensity of a much smaller current that's flowing through the Base.
2. So when no current flows through the base , no current is obtained at the collector (output)

Transistor Junction

- transistor is a combination of two diodes
- junction is between the emitter and base, is called as **Emitter-Base junction**
- The junction between base and collector is **Collector-Base junction**

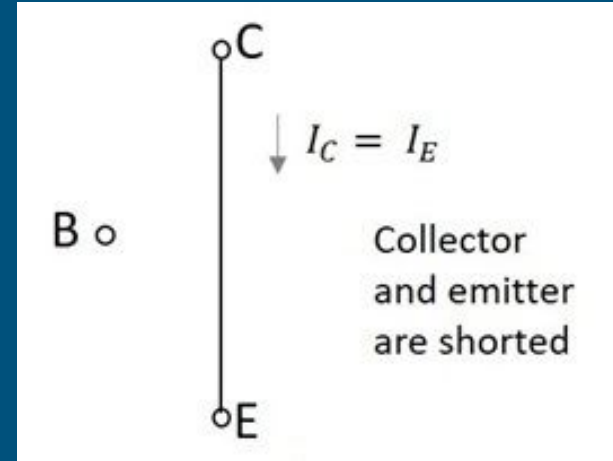
Transistor as Switch - (Switch OFF)

- Both the junctions of BJT are reverse biased
- Input base current (I_B) is equal zero, hence the zero output collector current (I_C)
- This results in a large depletion layer on the junctions of the transistor and no current can flow through the device

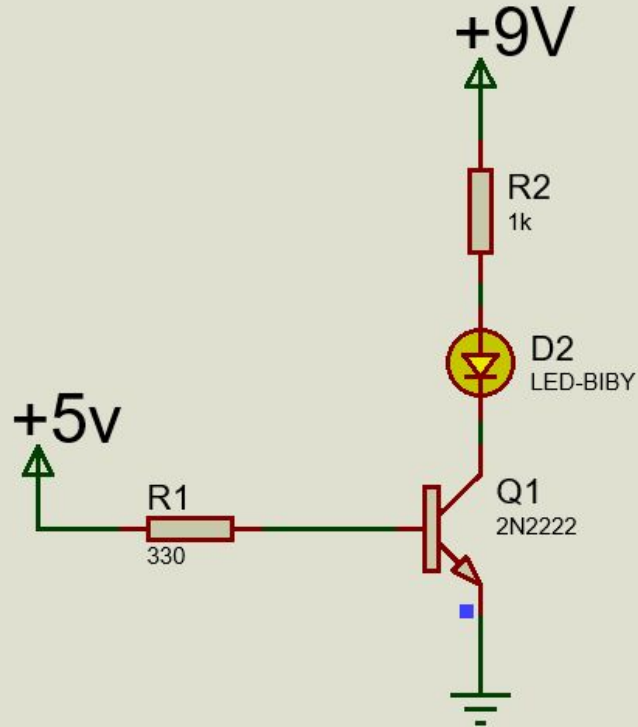


Transistor as a Switch -(Switch On)

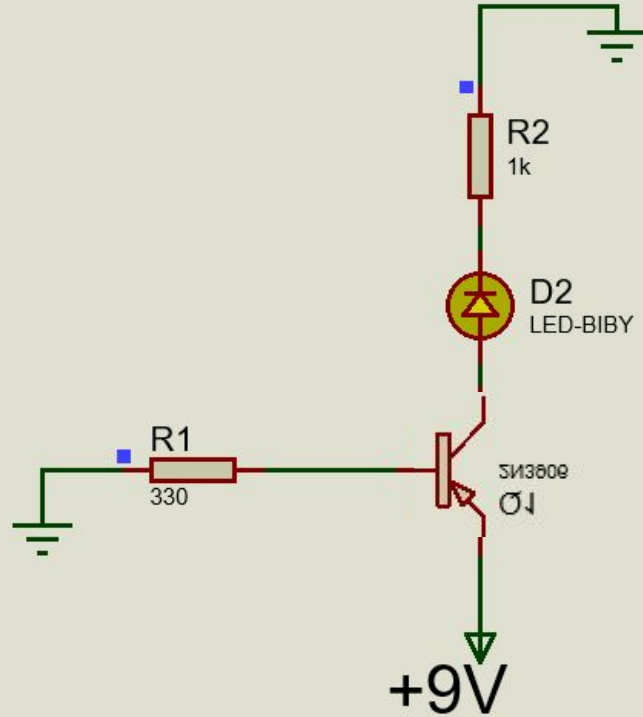
- Both the junctions of the BJT are forward biased
- The base current can be applied to its maximum value which results in maximum collector current
- Due to forward biased junctions the width of depletion layer is as small as possible causing minimum collector – emitter voltage drop
- Which leads to maximum current across collector



NPN transistor as switch

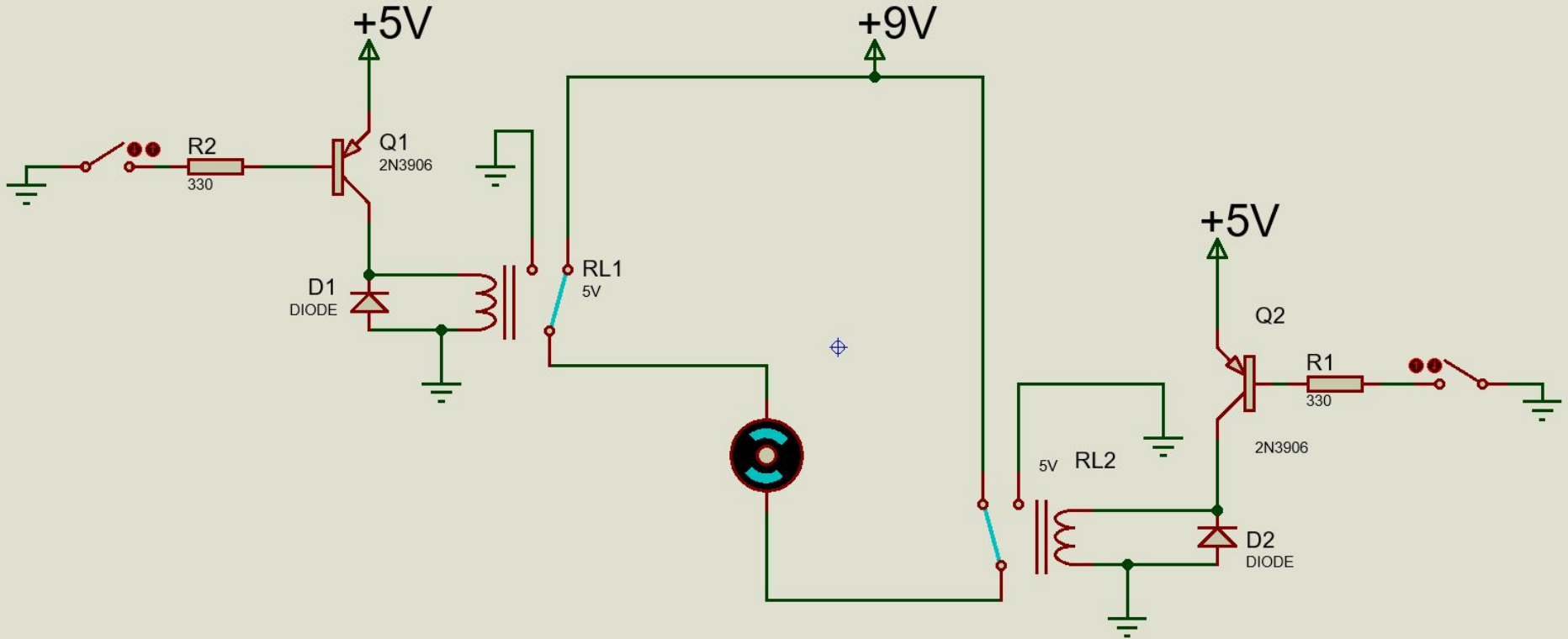


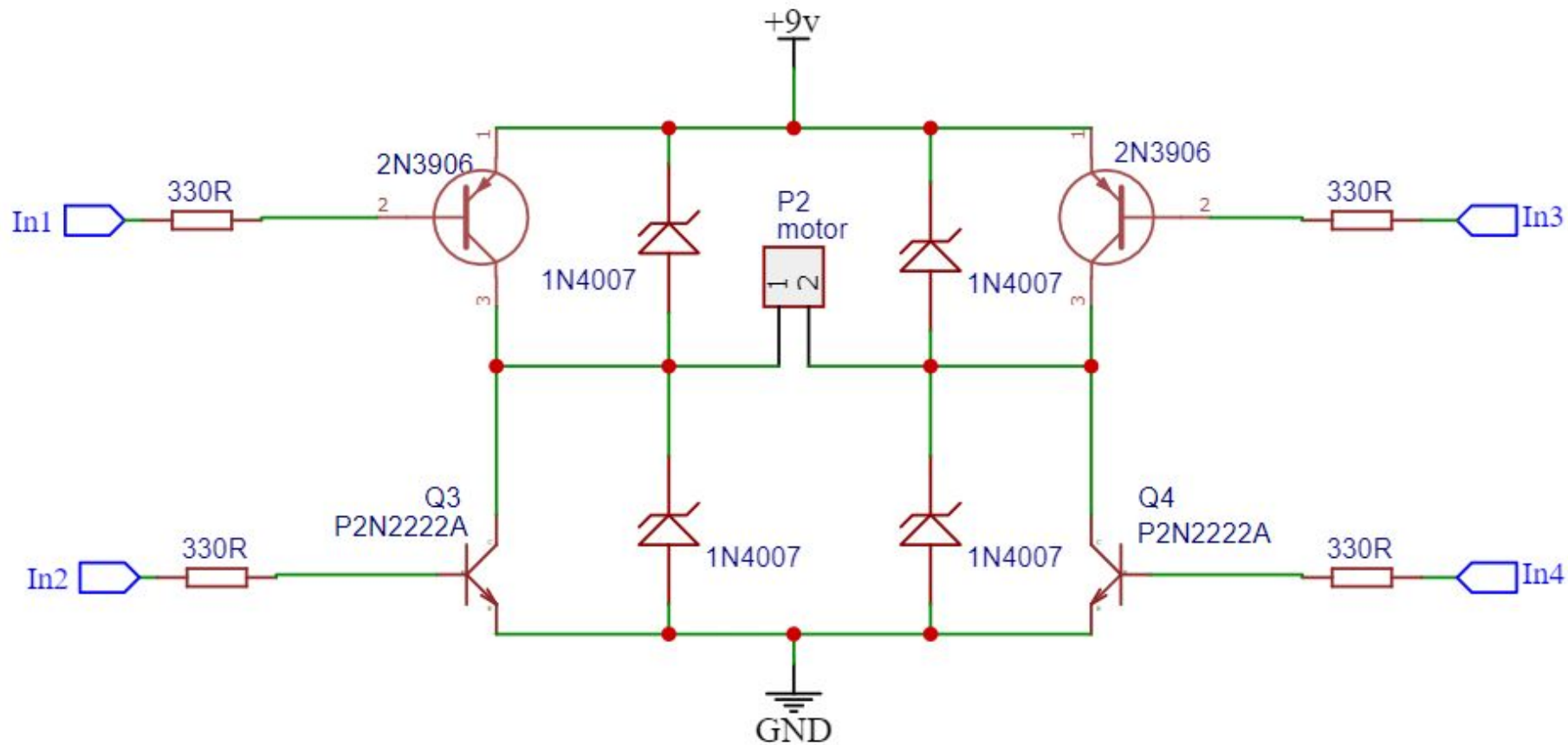
PNP transistor as switch



Simulation for PNP transistor as switch

Simulation of actual relay H bridge





Simulation for transistor H bridge
