

# LAB #09

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## Objectives

To study the Basic Transistor Applications.

## Theory

Transistors can be used to

1. Switch currents, voltages and power.
2. Perform digital logic functions.
3. Time varying signals.

## Preparatory Exercise

Q1) What happens when the transistor is in cut off state?

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## Requirement

### Instruments

1. DC power supply
2. Function Generator
3. Digital Multimeter (DMM)

### Components

1. Six Resistors of different values.

## Procedure

### Switch

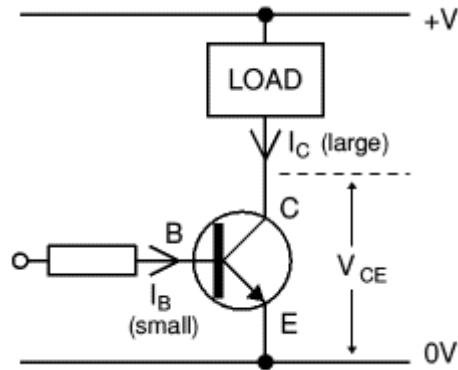


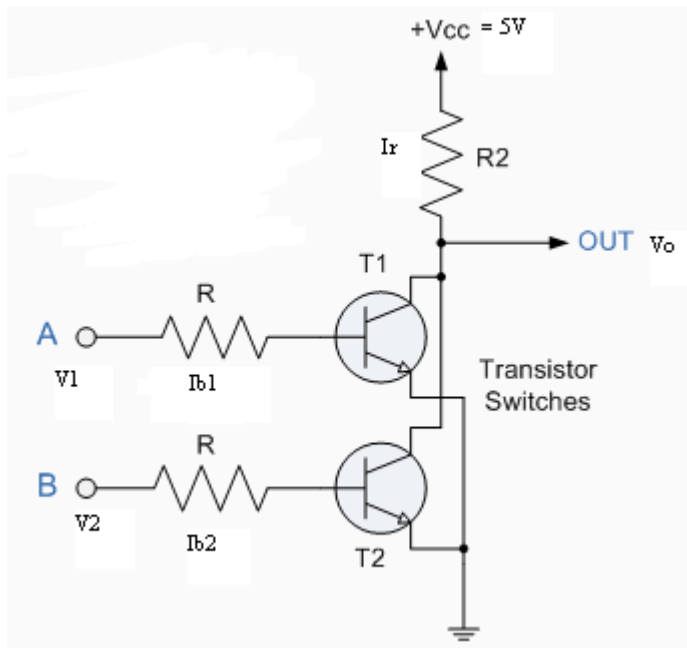
Figure 11.1 shows a bipolar circuit called an inverter. If  $V_1 < V_{BE(ON)}$ , then  $I_B = I_C = 0$  and the transistor is cut off. Since  $I_C = 0$ , the voltage drop across  $RC$  is zero, so output voltage is  $V_o = V_{CC}$ . Also, since the currents in the transistor are zero, the power dissipation in the transistor is zero. If we let  $V_1 = V_{CC}$  and if the ratio of  $R_B$  to  $R_C$  is less than beta, then the transistor is usually driven into saturation, which means that

$$I_B = (V_1 - V_{BE(ON)}) / R_B$$

$$I_C = I_{C(sat)} = (V_{CC} - V_{CE(sat)}) / R_C$$

And  $V_o = V_{CE(sat)}$

**Digital Logic**



When a second transistor is connected in parallel as shown in figure 11.2. When the two inputs are zero, both transistors  $Q_1$  and  $Q_2$  are in cut off and  $V_o = 5V$ . when  $V_1 = 5V$  and  $V_2 = 0$ ,

transistors Q1 can be driven into saturation, and Q2 remains in cut off. With Q1 in saturation the output voltage is  $V_0 = V_{CE(sat)} = 0.2 \text{ V}$ . If we reverse the input voltages so that  $V_1 = 0$  and  $V_2 = 5\text{V}$ , then Q1 is in cutoff, Q2 can be driven into saturation and  $V_0 = V_{CE(sat)} = 0.2 \text{ V}$ .

**Observations:****Switch**

1. Calculate  $I_B$

$$I_B = (V_1 - V_{BE(on)}) / R_B$$

2. Calculate  $I_C$

$$I_C = I_{C(sat)} = (V_{CC} - V_{CE(sat)}) / R_C$$

**Digital Logic**

A bipolar NOR Logic circuit response

V1	V2	V <sub>o</sub>
0	0	
5	0	
0	5	
5	5	