Practical No.17: Test the performance parameters of BJT as Switch

I Practical Significance

BJT can be operated in three regions: cut-off region, active region and saturation region. When BJT is used as a switch, only two regions cut- off and saturation are used. In saturation region transistor acts as ON state switch. In cut-off region, transistor acts as OFF state switch. In this practical only two points of DC load line while using BJT as a switch.

II Industry / Employer Expected Outcome

This practical is expected to develop the following skill: **'Use electronic components and circuits in electrical equipment and systems'.**

III Course Level Learning Outcome

Use semiconductor transistors in different applications.

IV Laboratory Learning Outcomes

Test BJT as switch on Breadboard:

1. Test the performance parameters of BJT as Switch.
2. Identify Cutoff and saturation regions.

V Relevant Affective Domain related Outcomes

1. Handle components and equipment carefully.
2. Follow all safety precautions

VI Minimum Theoretical Background

If the circuit uses the BJT transistor as a switch, then the biasing of the transistor, NPN or PNP is arranged to operate the transistor at the both sides of the V-I characteristics curves shown in figure 17.1

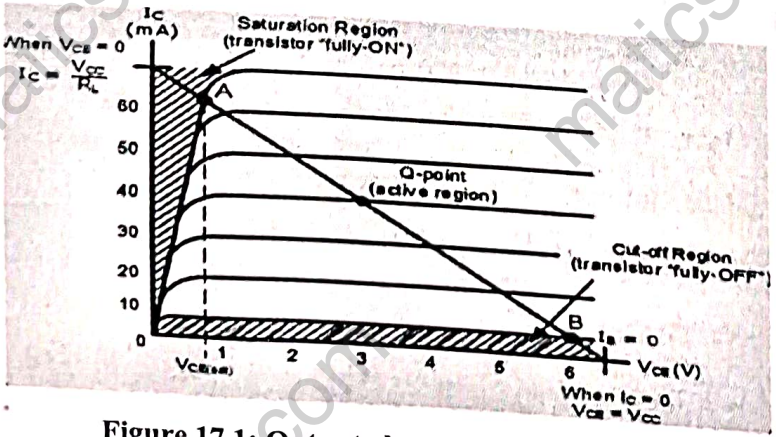


Figure 17.1: Output characteristics of BJT

From the above characteristics it is found that, the shaded area at the bottom of the curves represents the Cut-off region and the shaded area to the left represent the Saturation region of the transistor.

Cut-off Region: The operating conditions of the transistor are zero input base current (I_B=0), zero output collector current (I_C=0), and maximum collector voltage (V_{CE}) which results in a large depletion layer and no current flowing through the device. Therefore, the transistor is switched to "Fully-OFF State".

Saturation Region: In this region, the transistor will be biased so that the maximum amount of base current (I_B) is applied, resulting in maximum collector current (I_C=V_{CC}/R_L) and then resulting in the minimum collector-emitter voltage (V_{CE} ~ 0) drop. At this condition, the depletion layer becomes as small as the possible and maximum current flowing through the transistor. Therefore, the transistor is switched "Fully-ON State".

VII Practical setup in Laboratory

(a) Sample

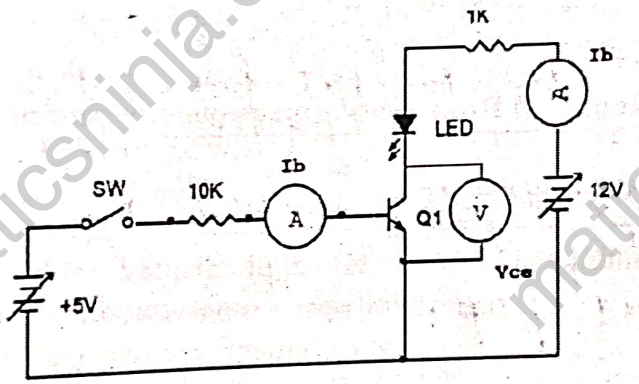
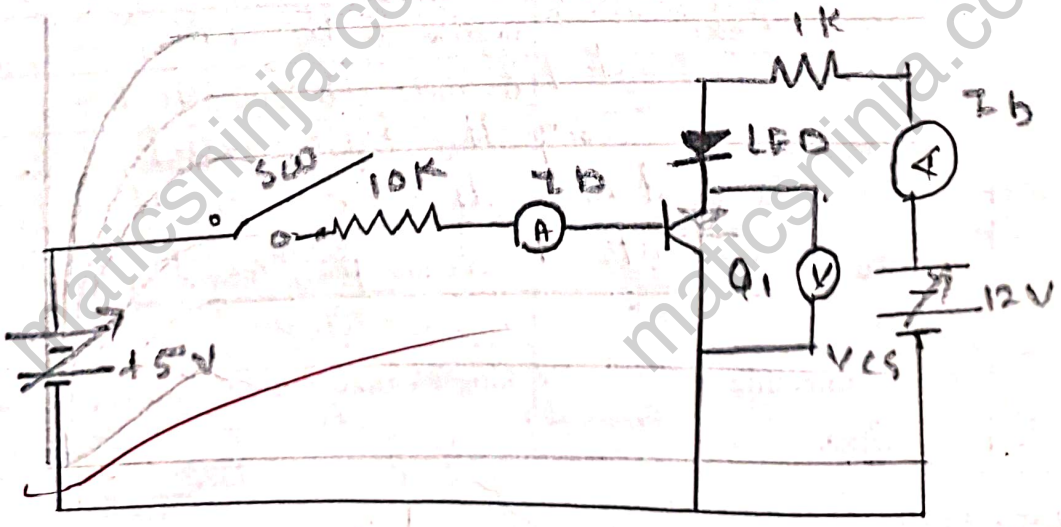


Figure 17.2: Circuit diagram of BJT as a switch

(b) Actual Circuit Diagram used in Laboratory



(c) Actual practical set up used in Laboratory

VIII Required Resources/apparatus/equipment with specifications

Sr. No	Instruments/Components	Specification	Quantity
1	Digital Multimeter	3 ½ -digit display with AC and DC voltage measurement and Current measurement facility and Diode testing facility.	1
2.	DC Regulated power supply	Variable DC power supply 0- 30V, 2A, SC protection, display for voltage and current.	2
3.	DC Voltmeter	0-20 V	1
4.	DC Ammeter	0 - 200 mA, 0 - 200 μA	1 each
5.	Transistor	BC107 or any other equivalent	1
6.	Resistor	1KΩ and 10KΩ (0.5watts/0.25watts)	1 each
7.	Bread board	5.5 CM X 17CM	1
8.	Connecting wires	Single strand Teflon coating (0.6mm)	As per requirement

IX Precautions to be followed

1. Care should be taken while handling the terminals of components.
2. Select proper range and mode of Ammeter and voltmeter.
3. Connect wire tightly while building circuits.
4. Do not switch ON the power supply unless you have checked the circuit connections as per the circuit diagram.

X Procedure

1. Connect circuit as shown in figure 17.2
2. Adjust collector supply Vcc = +12V and base supply V_{BB}=+5V.
3. Use base voltage supply switch instead of switch shown in the circuit diagram.
4. Measure I_B, I_C and V_{CE} when switch is OFF (It will be zero).
5. Now apply base voltage +5V.
6. Measure I_B, I_C and V_{CE}.

XI Observation Table

Table 1

Switch Condition	V_{BB}	I_B	V_{CE}	I_C
Switch OFF	V_{BB}= 0V	0 reverse bais	0	0
Switch ON	V_{BB}=+5V	02 forward bais	02	03

XII Results

In this practical we have perform bjt as a switch princiales.

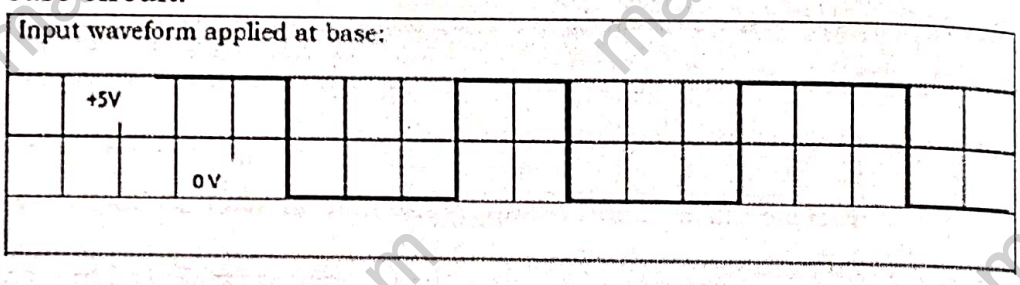
XIII Interpretation of results

In this practical we have learned about switching of bjt.

XIV Conclusions and Recommendation

XV Practical related Questions

1. List types of BJT available in your laboratory.
2. Find out the ratio of collector resistance to base resistance while designing transistor switch. State the effect of saturation on transistor operation.
3. Draw output waveform when following waveform is applied at the base circuit.



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→ The bipolar transistor (bipolar junction transistor BJT) consists of three semiconductors region forming two junction they are two types of structure npn and pnp.

② - - - - - - - ?

→ The transistor need sufficient base drive to structure i.e. turn hard on a general rule of thumb is the base current should be about 1/10 of the collector current, hence why the base resistor is around ten times the value of the LED's current limiting resistor.

XVII References / Suggestions for further Reading

1. https://www.electronics-tutorials.ws/transistor/tran_4.html
2. https://www.build-electronic-circuits.com/transistor-as-a-switch/
3. https://www.youtube.com/watch?v=oXY9zUSulkg