الجامعة الألمانية الأردنية
German Jordanian University

# Electronics 1 Lab (CME 2410)

School of Informatics & Computing
German Jordanian University

Laboratory Experiment (7)

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## The Bipolar Junction Transistor (BJT)
## DC Bias Stabilization

## *1. Objective*:

1. To be familiar with BJT transistors and to learn how they works.
2. To study the concept of biasing a Bipolar Junction Transistor (BJT).

## *2. Equipment & Instruments*

Module No. : DL 3155E14

2 Digital Multimeters

# Experiment Part 1 (Common Collector Bias)

## 1. Components List:

R1 = 120 kΩ, R2 = 120 kΩ, R3 = 6.8 kΩ.

## 2. Procedure

1) connect the circuit as shown in Fig. 10.5 ;

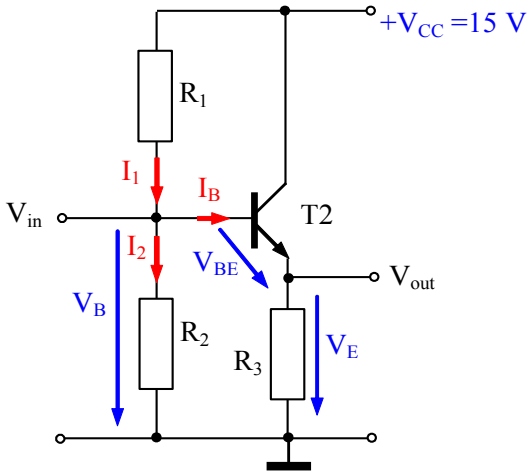



Fig. 10.5: Common collector circuit (emitter follower)

2) measure the voltages $V_B$, $V_E$ and $V_C$, determine the emitter current $I_E = V_E / R_3$ by using the measured value of $V_E$ ;
create a Tab. 10.4 (similar to Tab.10.1) and put these value in;

3) calculate the voltages $V_B$ and $V_E$, considering the voltage $V_{BE}$ = 0.6V;
calculate the value of the emitter current $I_E$ by using the calculated value of $V_E$;
put them all as "calculated" values in a second row of Tab. 10.4;

4) measure the voltages between the 3 terminals of the transistor and write these 3 values in a new Tab. 10.5 (similar to Tab.10.2);

5) measure the voltage drops on R1 and R2 and write them in further columns of Tab. 10.5 ;

6) calculate the base current $I_B$ and the DC-current gain $\beta_{DC}$ and write them in further columns of Tab. 10.5 ;

7) observe and comment the carried out measures (transistor currents and bias voltage) and verify that the transistor works in the **active** zone.

## Modification insertion

**Modification M8**

1) remove the cover of the Modifications/Faults simulator and set the eighth dip-switch M8 to ON position (covered dot);
2) measure and record in Tab. 10.6 the collector, base and emitter voltages with reference to ground;
3) **determine if the transistor T2 works:**
   a. at the saturation point
   b. in the active region
   c. at the cut-off point
   d. at an optimum Q point
4) set the dip-switch M8 back to the initial upwards position;

**Modification M9**

5) set the dip-switch M9 to ON position (covered dot);
6) measure and record in Tab. 10.6 the collector, base and emitter voltages with reference to ground;
7) **determine if the transistor T2 is:**
   a. at the saturation point
   b. at the cut-off point
   c. in the active region
   d. with the base-emitter junction in reverse bias;
8) set the dip-switch M9 back to the initial upwards position;

Tab. 10.6

| | $V_C$ / V | $V_B$ / V | $V_E$ / V |
|---|---|---|---|
| Modification M8 | | | |
| Modification M9 | | | |

NOTE !!! :
In your conclusions specify what the effect of each modification above is.

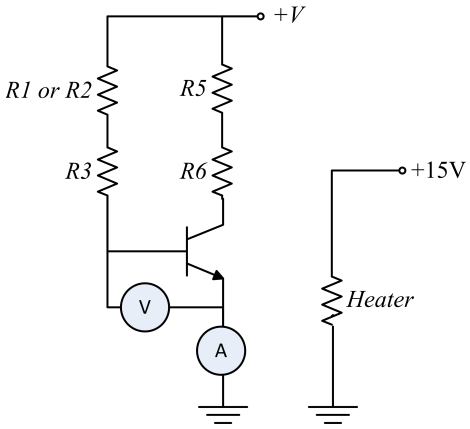
# Experiment Part 2 (Stability of Fixed Bias Circuit)

## *1. Components List:*

R1 = 3.3kΩ, R2=470Ω, R3=1MΩ, R4=1kΩ, R5=100Ω, R6=1.5kΩ, R7=390Ω, Heater=270Ω

## *2. Procedure*

1) Connect the circuit as shown with R1 (Make sure to turn R3 completely counter-clockwise – full resistance). **Do not connect the heater to +15V for now.**




2) Adjust the supply voltage +V to 6V

3) Measure the base-emitter voltage and the emitter (collector) current.

4) Connect the heater to +15V and observer the effect of temperature on the fixed bias circuit.

5) After about 5 minutes, record again the base-emitter voltage and the emitter (collector) current.

6) Disconnect the heater and let the transistor cool down.

7) Write down your conclusions related to:
   - Temperature effect on voltages and currents.
   - Temperature effect on bias stability.

8) Repeat previous steps with resistor R2 instead of R1.

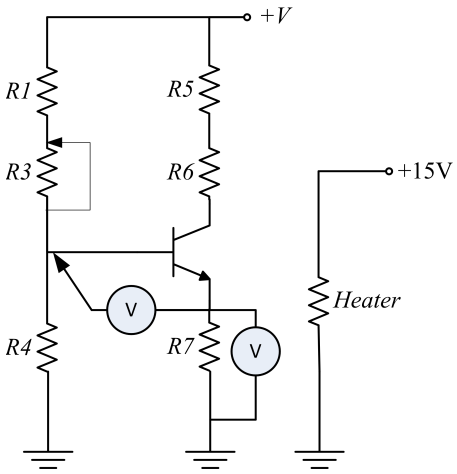
# Experiment Part 3 (Stability of Voltage Divider Bias)

## *1. Components List:*

R1 = 3.3kΩ, R2=470Ω, R3=1MΩ, R4=1kΩ, R5=100Ω, R6=1.5kΩ, R7=390Ω, Heater=270Ω

## *2. Procedure*

1) Connect the circuit as shown with (Make sure to turn R3 completely clockwise – zero resistance). **Do not connect the heater to +15V for now.**




2) Adjust the supply voltage +V to 6V

3) Measure the base-emitter voltage and the emitter voltage. Calculate the collector current.

4) Connect the heater to +15V and observer the effect of temperature on the fixed bias circuit.

5) After about 5 minutes, record again the base-emitter voltage and the emitter voltage and calculate the new collector current.

6) Disconnect the heater.

7) Calculate the stability factors $\Delta I_C\%$ of both types of bias circuits.

8) Write down your conclusions related to:

- Temperature effect on voltages and currents.
- Temperature effect on bias stability.
- Benefit of having the emitter resistor
- Comparison of stability factors.