AMERICAN INTERNATIONAL UNIVERSITY–BANGLADESH (AIUB)

FACULTY OF ENGINEERING

DEPARTMENT OF ELECTRICAL & ELECTRONICS ENGINEERING (EEE)

EXPERIMENT NO.	**:**	**05**
NAME OF THE EXPERIMENT	**:**	**STUDY OF TRANSISTOR CHARACTERISTICS IN COMMON EMITTER AMPLIFIER**
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ID	**:**	**22-46013-1**
COURSE TITLE	**:**	**ELECTRONIC DEVICES LABORATORY**
SECTION	**:**	**Q**
GROUP NO.	**:**	**05**
DATE OF PERFORMANCE	**:**	**MARCH 14, 2023**
DATE OF SUBMISSION	**:**	**APRIL 01, 2023**

Objectives of this Experiment:

The objective of this experiment to develop a comprehensive understanding of bipolar junction transistor (BJTs) and their behaviour in a common emitter (CE) amplifier circuit. This include gaining familiarity with the principles of biasing, as well as obtaining input and output characteristic of the circuit.

List of Components:

1. Trainer Board
2. Transistor (n-p-n) : C828 [1 PC]
3. Resistor : 1 KΩ [1 PC]
   : 10 KΩ [1 PC]
4. DC Power Supply
5. Multimeter
6. Power Supply Cable : [2 PC]

Diagrams:

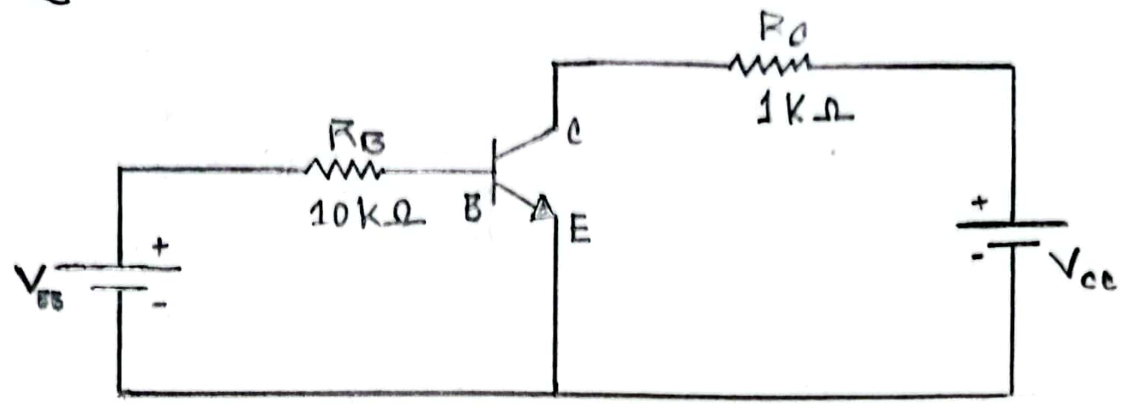

Figure: Transistor characteristic in CE configuration.

Working Principle of the Circuit.

The most frequently encountered transistor configuration appears in the figure. It is called common emitter configuration because emitter is common to both input and output tarminal. Two sets of characteristics are again necessary to descrive fully the behaviour of the common emitter configuration.

The emitter collector, and base current are shown in their actual conventional current direction. Even though the transistor configuration has changed.

For common emitter configuration the output characteristic are a plot of the output current (I_C) verses output voltages (V_{CE}) for a range of values of input current. (I_B). [1]

Data and Calculation:

Data Table-1: Input Characteristic

$V_{cc} = 8V$			$V_{cc} = 16V$		
V_{BB}(V)	V_{BE} (V)	I_B (mA)	V_{BB}(V)	V_{BE} (V)	I_B (mA)
0V	0	0	0V	0	0
0.5V	0.5	0	0.5V	0.488	0
1V	0.729	0.0271	1V	0.718	0.0282
1.5V	0.762	0.0738	1.5V	0.756	0.0744
2V	0.777	0.1229	2V	0.773	0.1227
2.5V	0.783	0.1717	2.5V	0.786	0.1714

Data Table-2: Output Characteristic

$I_B = 0\mu A$			$I_B = 50\mu A$			$I_B = 100\mu A$		
V_{cc}(V)	V_{CE} (V)	I_c (mA)	V_{cc}(V)	V_{CE} (mV)	I_c (mA)	V_{cc}(V)	V_{CE} (mV)	I_c (mA)
0V	52.2mV	0.0525	0V	12	0.012	0V	12.9	0.0129
4V	3.91	1.2539	4V	20.2	3.9798	4V	17.8	3.9822
8V	7.88	1.015	8V	27.2	7.9728	8V	22	7.978
12V	11.9	1.008	12V	33.6	11.9664	12V	26.2	11.9738
16V	15.88	1.007	16V	39.3	15.9607	16V	38.2	15.9618

Calculation for Input characteristic:

When, $V_{cc} = 8\,V$

$$I_B = \frac{V_{BB} - V_{BE}}{10K} \quad [\text{When, } V_{BE} = 0 \text{ and } V_{BB} = 0V]$$

$$= \frac{0-0}{10} = 0\ mA$$

when, $V_{BB} = 0.5V$ and $V_{BE} = 0.5V$

$$I_B = \frac{0.5 - 0.5}{10} = 0 \, mA$$

when, $V_{BB} = 1V$ and $V_{BE} = 0.729V$

$$I_B = \frac{1 - 0.729}{10} = 0.0271 \, mA$$

When, $V_{BB} = 1.5V$ and $V_{BE} = 0.762V$

$$I_B = \frac{1.5 - 0.762}{10} = 0.0738 \, mA$$

when, $V_{BB} = 2V$ and $V_{BE} = 0.777V$

$$I_B = \frac{2 - 0.777}{10} = 0.1223 \, mA$$

When, $V_{BB} = 2.5V$ and $V_{BE} = 0.783V$

$$I_B = \frac{2.5 - 0.783}{10} = 0.1717 \, mA$$

When, $V_{CC} = 16V$

when, $V_{BB} = 0V$ and $V_{BE} = 0V$

$$I_B = \frac{0 - 0}{10} = 0 \, mA$$

when, $V_{BB} = 0.5V$ and $V_{BE} = 0.488V$

$$I_B = \frac{0.5 - 0.488}{10} = 0.0012$$
$$\simeq 0 \, mA$$

when, $V_{BB} = 1V$ and $V_{BE} = 0.718V$

$$I_B = \frac{1 - 0.718}{10} = 0.0282\,mA$$

when, $V_{BB} = 1.5V$ and $V_{BE} = 0.756V$

$$I_B = \frac{1.5 - 0.756}{10} = 0.0744\,mA$$

when, $V_{BB} = 2V$ and $V_{BE} = 0.773V$

$$I_B = \frac{2 - 0.773}{10} = 0.1227\,mA$$

when, $V_{BB} = 2.5V$ and $V_{BE} = 0.786V$

$$I_B = \frac{2.5 - 0.786}{10} = 0.1714\,mA$$

Calculation for output Characteristic:

when $I_B = 0\,\mu A$,

$V_{cc} = 0V$ and $V_{CE} = 52.2\,mV$,

$$I_C = \frac{V_{cc} - V_{CE}}{1} = \frac{0 - 52.2}{1} = -0.0525\,mA$$

$V_{cc} = 4V$ and $V_{CE} = 3.91V$

$$\therefore I_C = \frac{4 - 3.91}{1} = 1.2539\,mA$$

$V_{cc} = 8V$ and $V_{CE} = 7.88V$

$$I_C = \frac{8 - 7.88}{1} = 1.015\,mA$$

$V_{CC} = 12V$ and $V_{CE} = 11.9V$

$$I_C = \frac{12 - 11.9}{1} = 1.008\ mA$$

$V_{CC} = 16V$ and $V_{CE} = 15.88V$ $\therefore I_C = \frac{16 - 15.88}{1} = 1.007\ mA$

When $I_B = 50\mu A$

$V_{CC} = 0V$ and $V_{CE} = 12mV$ $\therefore I_C = \frac{0 - 0.012}{1} = -0.012\ mA$

$V_{CC} = 4V$ and $V_{CE} = 20.2mV$ $\therefore I_C = \frac{4 - 0.0202}{1} = 3.9798\ mA$

$V_{CC} = 8V$ and $V_{CE} = 27.2mV$ $\therefore I_C = \frac{8 - 0.0272}{1} = 7.9728\ mA$

$V_{CC} = 12V$ and $V_{CE} = 33.6mV$ $\therefore I_C = \frac{12 - 0.0336}{1} = 11.9664\ mA$

$V_{CC} = 16V$ and $V_{CE} = 39.3mV$ $\therefore I_C = \frac{16 - 0.0393}{1} = 15.9607\ mA$

When, $I_B = 100\mu A$

$V_{CC} = 0V$ and $V_{CE} = 12.9mV$ $\therefore I_C = \frac{0 - 0.0129}{1} = -0.0129\ mA$

$V_{CC} = 4V$ and $V_{CE} = 17.8mV$ $\therefore I_C = \frac{4 - 0.0178}{1} = 3.9822\ mA$

$V_{CC} = 8V$ and $V_{CE} = 22mV$ $\therefore I_C = \frac{8 - 0.022}{1} = 7.978\ mA$

$V_{CC} = 12V$ and $V_{CE} = 26.2mV$ $\therefore I_C = \frac{12 - 0.0262}{1} = 11.9738\ mA$

$V_{CC} = 16V$ and $V_{CE} = 38.2mV$ $\therefore I_C = \frac{16 - 0.0382}{1} = 15.9618\ mA$

Discussion:

In this experiment, we learned about the common emitter topology of amplification. The circuit configuration is more widely as it provides the highest current amplification due to its high and low output impedance charachteristic. It was extablished that as V_{CC} was increased, V_{BE} is measured in Table-1. When we increased V_{BE} the gain input I_B current increased which resulted the output to be inverted. When a forward voltage V_{BB} was introduced into the circuit, The I_B current is constant than we increased V_{CC} result to V_{CE} voltage and I_C current increase respectively which can be seen in Table-2.

Most of our theoretical resemble the experimental values expect in a few cases. This difference could be explained by experimental errors in the performing the lab. This error could be associated with the circuit which are the low dynamic range imposed by the small signal ~~input~~ limit.

We can solve this or reduce the rate by construct the proper circuit and taking the values carefull when we run the experiment.

Conclusion:

By conducting this experiment, we gain practical experience analyzing and interpeting the the behavior of BJT Circuit and will be able to apply this knowledge in future projects or studies.

Remarks:

The study of transistor characteristic in a CE amplifier experiment is a fundamental experiment for us. This experiment allow us to become familar with the working principle of BJTs and study the biasing of CE amplifier circuit. It is also essential for understanding the amplification of signal using, which is a critical component of modern electronic device. Overall, this experiment is a valuable learning experience for us in electronic and electrical engineering.

List of References:

[1] Electronic Devices and Circuit Theory, 11th Edition. Page: 136-137

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Input characterstic

$V_{CC} = 8V$			$V_{CC} = 16$		
V_{BB} V	V_{BE} V	I_B mA	V_{BB}	V_{BE}	I_B
0V	.0	0	0	0	0
0.5V	.500	0	0.5	0.488	0
1V	.729	0.0271	1	0.718	0.0282
1.5V	.762	0.0738	1.5	0.756	0.0744
2V	.777	0.1223	2	0.773	0.1227
2.5V	.787	0.1717	2.5	0.786	0.1714

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$I_B = 0 \mu A$			$I_B = 50 \mu A$			$I_B = 100 \mu A$		
V_{CC}	V_{CE}	I_C	V_{CC}	V_{CE}(mV)	I_C	V_{CC}	V_{CE}(mV)	I_C
0V	52.2mV	0.025	0	12	0.012	0	12.9	0.0129
4V	3.91	1.2539	4	20.2	0.9798	4	17.8	3.9822
8V	7.88	1.015	8	27.2	7.9728	8	22	7.918
12V	11.9	1.008	12	33.6	11.9664	12	26.2	11.9738
16V	15.88	1.007	16	39.3	15.9607	16	38.2	15.9618