HOLY ANGEL UNIVERSITY
College of Engineering and Architecture
DEPARTMENT OF ELECTRONICS ENGINEERING

EXPERIMENT # 6.
EXPERIMENT TITLE: Bipolar Transistor Testing & Biasing

COURSE CODE: 4760
COURSE: ELECTRONIC DEVICES AND CIRCUIT THEORY LABORATORY

SCHEDULE (Day/Time/Room): M 1:20-4:20PM ECE LABORATORY
NAME: Alcantara, Jodi Moselle J. Sanchez, Helaena Irish D. To, Miah Angela M. De Jesus, John Michael P. Tan, Audrey Anne V.
GROUP No.: 6

DATE PERFORMED: February 19, 2024
DUE DATE: February 26, 2024

DATE SUBMITTED: February 26, 2024

INSTRUCTOR: Engr. Cherry Ann P. Navarro

SCORE SHEET

CRITERIA	SCORE
Participation (20%) [Ability to perform task in collaboration with teammates; well prepared in class; and time management skills] 1-4 Superficial 9-12 Satisfactory 17-20 Excellent 5-8 Ordinary 13-16 Very Good	20
Data and Results (40%)	35
Answers to Questions (15%)	15
Discussion of Findings (25%) [Ability to highlight the implications of the experimental results with respect to the theoretical foundations; Analytical skill; Communication skills] 1-5 Unsatisfactory 11-15 Satisfactory 21-25 Excellent 6-10 Deficient 16-20 Very Good	25
TOTAL	95

INSTRUCTOR'S SIGNATURE: ______

DATA AND RESULTS

Part 1

Table 7-1

Unit	Type Number	B neg E pos ohms	B pos E neg ohms	B pos C neg ohms	B neg C pos ohms	Is the transistor in good condition?	NPN or PNP
1	2N3904	0	∞	∞	0	Good	NPN
2	MPSA20	0	∞	∞	0	Good	NPN
3	2N3906	∞	0	0	∞	Good	PNP
4	2222A	0	∞	∞	0	Good	NPN
5							
6							

Part 2

Table 7-2

Step	Condition	Current mA		Voltage Vdc	
		I_E	I_C	V_{EB}	V_{CB}
3	Fig. 7-1 : R2 maximum	3.8mA	3.95mA	5.75V	0.6V
4	R2 minimum	1.16mA	1.22mA	5.9V	0.563V
5,6	Fig. 7-2: R2 maximum	0.79mA	0.73mA	5.9V	1.298V
	R2 minimum	2.5mA	2.4mA	5.99V	1.3V
7	I_{cbo} = 0A				

Table 7-3

Step	Condition	Current mA		Voltage Vdc	
		I_E	I_C	V_{EB}	V_{CB}
	Fig. 7-3: R2 maximum	3.21mA	3.42mA	0.76V	0.75V
9	R2 minimum	2.57mA	2.78mA	0.77V	0.76V
10	Fig.7-4: R2 maximum	2.18mA	2.65mA	0.78V	0.78V
	R2 minimum	2.02mA	2.54mA	0.77V	0.77V
11	I_{cbo} = 0A				

REVIEW QUESTIONS

1. How do you determine if a transistor is (a) shorted (b) open?
2. Can you check a transistor in circuit? Why or why not?
3. What are the effects on I_E of reversed bias on the emitter-base circuit?

Answers to Review Questions

1. To determine if a transistor is (a) shorted or (b) open, you can use a multimeter. For (a), check continuity between collector and emitter or collector and base; for (b) measure resistance between collector and emitter or collector and base

2. Checking a transistor in circuit may not provide accurate results because the other components in the circuit can affect readings. Removing the transistor from the circuit allows for more accurate reading

3. Reversed bias on the emitter-base circuit reduces the emitter current (I_E) as it inhibits the flow of majority carriers, leading to a decrease in transistor functionality.

DISCUSSION OF FINDINGS

In conclusion, an examination of transistor configurations reveals the subtle differences in dynamics of NPN & PNP configurations, highlighting the critical role of reverse bias in emmitter-base circuits. The collector-base circuit and bias in emmitter-base circuits. The collector-base circuit and leakage current of minority carriers emphasize the vulnerabity of the transistor to temperature changes and possible self-destructive tendencies. Careful handling is paramount, as live shorts present an immediate danger of destruction the practical go-no-go method using an ohmmeter excels in its reliability in judging transistor conditions, especially for accurate diode values. The bias experiments highlights the direct effect of temperature and bias control on the emmitter and collector currents and show the dynamic response of the transistor stand and control of the collector current through the emmitter base bias the PNP transistor which resembles two inverting diodes emphasizing the need to understand the nuances of biasing. In essence, the findings highlights the importance of understanding the complexity, careful handling, and experimental procedures of transistors to deepen our understanding of their behavior in electronic applications.

Theoretical analysis

1) BJT organization & function: three doped regions make up a BJT: the emitter (E), base (B), and collector (C). In a BJT with NPN: the strongly n-type emitter injects electrons, which are the majority carriers. Base serves a control region; it is a little doped p-type. Majority carriers from the emitter are collected by the collector (a lightly doped n-type). Conditions for biasing: forward biasing: majority carriers (electrons) can move from the emitter to the base because of the E-B junction. Reverse Bias: the C-B junction stops the majority carrier flow and forms a depletion zone. Current flow: Because of the reverse Bias, injected electrons from the emitter disperse as minority carriers (holes) in the base and are swept into the collector, resulting in a higher collector current (IC) than base current (IB).

2) Static (DC) characteristics: I-V characteristics: Each P-N junction (E-B and C-B) follows the shockley diode equation, relating current to voltage and temperature. BJT characteristic Combining individual junction characteristics and internal current relationships yeilds the overall BJT I-V characteristics, exhibiting different regions: Active Regions: Normal operation with forward-biased E-B and reverse biased C-B junctions. Saturation Region: Increased collector voltage minimally I_c due to pinch-off effect in the base. Cut-off Region: Both junctions reverse-biased, resulting in minimal leakage currents

3). Circuits for biasing: It is essential to have a steady operating point for a BJT in a circuit. Common methods of biasing: Fixed Bias: V_{BE} and I_c are set using resistors

Emitter Bias: To stabilize V_{BE} and enhance thermal stability, emitter resistors are used.

Utilizing a voltage divider to provide steady biasing voltages is known as voltage-divider bias.

Signal Model:
simplified hybrid model π represents the AC behavior of a BJT at low signal levels. this model consists of:

Resistors: represent the resistance of the base, collector and emitter regions.

Capacitors: modeling the internal capacitance between base, collector, and issuer.

Dependent current source: Relating the collector current to the base-emitter voltage.

5. Gain parameters:

Beta (β): the ratio of the change in collector current (ΔIC) to the change in base current (ΔIB) at a constant collector-emitter voltage (VCE) quantifies the current gain.

Alpha (α): The ratio of collector current to emitter current (IC / IE) indicating the collector part of the applied emitter current.

conductance (gm): the ratio of the change in collector current to the change in base-emitter voltage (ΔVBE) at constant collector-emitter voltage, which represents the BJT's ability to convert changes in voltage to changes in current.

This theoretical talk provides the foundation for understanding BJTs. Engineers can utilize BJTS in a variety of electrical applications by exploring these ideas further, examining their properties, and putting them to use in real-world circuit.

Book:

Boylestad, R.L., & Nashelsky, L. (2014). Electronic Devices and Circuit Theory, 11th ed.


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LABORATORY DC POWER SUPPLY
CURRENT
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CURRENT
VOLTAGE
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