Department of Electrical Engineering
College of Engineering and Petroleum
Kuwait University

Lab Course Number and Section: 234/04A

Lab Course Title: ELECTRONICS LAB

Experiment Title: Diode Characteristics

Experiment Number: 3

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Introduction

This report focuses mainly on Diodes, their applications, characteristics and behaviour. A diode is a semiconductor device formed from a junction of n-type and p-type semiconductor materials. Its forward-biased state allows current to flow through the anode, while reverse-biased state blocks current flow. This report will explore the characteristics of forward and reverse-biased silicon, germanium, and Zener diodes, investigate their use in DC power supplies, and study Zener diodes as voltage regulators. Diodes, with their unidirectional property, are crucial for tasks like rectification, signal demodulation, and voltage regulation, making their understanding essential for electronics design [1][2].

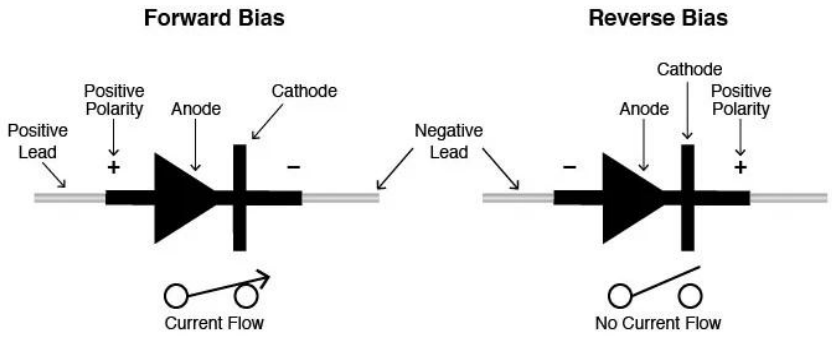

Figure 1 - Diode Digital Representation

Diode Structure:

1. **Anode**: The positive terminal through which current enters the diode.
2. **Cathode**: The negative terminal through which current exits the diode.
3. **PN Junction**: The boundary between the p-type and n-type semiconductor materials, essential for the diode's rectifying properties.

Diode Applications:

1. **Rectification**: Converting alternating current (AC) to direct current (DC).
2. **Voltage Regulation**: Using Zener diodes to maintain a constant voltage level.
3. **Voltage Clamping**: Preserve circuits from voltage spikes and reverse polarity.
4. **Light Emission**: In LEDs for lighting and display technologies.

i- The Silicon Diode:

A silicon diode is a type of semiconductor diode that uses silicon as its primary material. Silicon diodes are widely used in electronic circuits due to their reliable performance and favourable characteristics [3]. The most known characteristic of the silicon diode is that it maintains the highest breaking of the three types of diodes. Also, this diode ideally maintains a voltage drop of 0.7V this

is the voltage that is required for the diode to conduct current in the forward direction. Finally, this diode offers good performance over a wide temperature range.

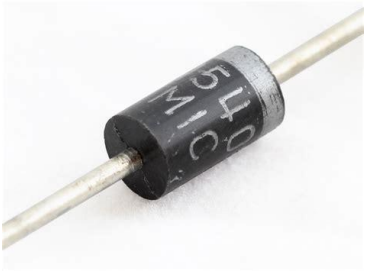

Figure 2 - Physical Silicon Diode

ii- The Germanium Diode:

Germanium diodes are semiconductor diodes made from germanium, similar to silicon diodes. They have a lower forward voltage drop of 0.3V, making them useful in low-voltage applications. However, they are more temperature-sensitive, affecting their performance in different environmental conditions. Germanium diodes were crucial in early transistor technology and radio applications. Although less commonly used in mainstream electronics, they still find niche applications in specialized circuits due to their unique electrical characteristics [4].

Figure 3 - Physical Germanium Diode

iii- The Zener Diode:

Zener diodes can operate in the reverse breakdown region of the voltage-current characteristic curve, allowing current to flow in reverse direction when the voltage across the diode exceeds its breakdown voltage (Zener voltage). This property makes Zener diodes useful in voltage regulation circuits, voltage reference circuits and surge protectors, where maintaining stable voltage or clamping voltage spikes is important [5].

Figure 4 - Physical Zener Diode

Objectives

1. To study the behaviour of the forward and reverse-biased silicon (Si), germanium (Ge) and Zener P-N junction diodes.
2. Apply the diodes in real life applications using simple lab experiments.
3. Examine the abilities of Zener diodes as voltage regulators.

List of Equipment and components

- Bread Board.
- Curve Tracer 571.
- DMM.
- Resistors.
- Diodes (3 types, Si, Ge and Ze)
- Decade resistance box (RL).
- Set of wires.
- Oscilloscope.
- Function Generator.

Observation and Results

PART (A): The Diode Static Characteristics

PART (B): The Silicon Diode Circuit

PART (C): The Zener Diode Circuit

Data and Results

PART (A): The Diode Static Characteristics

PART (B): The Silicon Diode Circuit

PART (C): The Zener Diode Circuit

Discussion of Results

Conclusion

The use of Zener diode regulators and the static properties of diodes are examined in the report. Diode circuits can be used in electronic devices and systems, they work as voltage regulators, voltage clampers and are a source of light emission (LED technology). The experiment also showed that diodes conduct significant current when voltage reaches a threshold, and that the Zener diode regulator maintains constant output voltage even with increased load resistance. The experiment results were as theoretically expected, and the objectives were met.

Questions & Problems

References

[1] Diode. (n.d.). In *Wikipedia*. Retrieved July 4, 2024, from https://en.wikipedia.org/wiki/Diode

[2] D. M. Alsaif, "EXPERIMENT # 4: Diode Characteristics" Kuwait, 2024

[3] Electronics Lesson. (n.d.). *What is a silicon diode?* Retrieved July 4, 2024, from https://electronicslesson.com/what-is-a-silicon-diode/

[4] Electricity & Magnetism. (n.d.). *Germanium diode*. Retrieved July 4, 2024, from https://www.electricity-magnetism.org/germanium-diode-2/

[5] Byju's. (n.d.). Zener Diode. Retrieved July 4, 2024, from https://byjus.com/physics/zener-diode/

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Lab Report Evaluation Form

Experiment: Diode Characteristics
Course Number and Title: EE 234 Electronics 1 Laboratory
Date: 9/7/2024
Student Name(s): Asmaa Alazmi

Assign a weight (W) for each criterion to be evaluated. Sum of weights is 20.
Rank each criterion by assigning a numerical grade (G) from lowest 1 to highest 5.

	Weight (W)	Grade (G)	W*G
1. Experiment Title page with student Name and Due date	1	0 1 2 3 4 5	
2. Table of Contents	0.5	0 1 2 3 4 5	
2. Design and setup experiments, conduct and data analysis.			
a. Objectives.	1.5	0 1 2 3 4 5	
b. Theory of Experiment.	*3*	0 1 2 3 4 5	
c. Equipment and Components Used.	*1*	0 1 2 3 4 5	
d. Experimental procedures.	*1*	0 1 2 3 4 5	
e. Experimental Data and Results.	*4*	0 1 2 3 4 5	
f. Solving Discussion	*4*	0 1 2 3 4 5	
g. *Conclusion and Comments*	2	0 1 2 3 4 5	
4. Written Communication.			
a. Structure/Organization/plots.	1	0 1 2 3 4 5	
b. Grammar/Rhetoric.	1	0 1 2 3 4 5	

GRADE = Σ (W* G) = _____ %

Comments:

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