Department of Computer Engineering
Digital Hardware Systems
CpEA 2202 – Electronic Circuits

Laboratory Report

Laboratory Exercise No.:	1	**Date Performed:**	31
Laboratory Exercise Title:	Diode Characteristics		
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Part I. Theory

A diode is a two-terminal semiconductor device, which permits the flow of current in one direction and prevents the flow of current in the opposite direction. A diode comprises a p-n junction, with p-type (positive) material joined with n-type (negative) material to create a rectifying characteristic. Diodes are basic building blocks in electronic circuits, widely applied for rectification, voltage regulation, signal demodulation, and protection circuits.

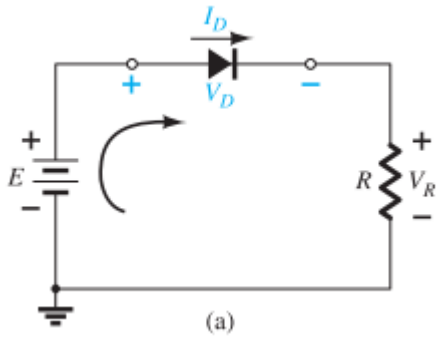
There are several classes of diodes, such as silicon (Si) and germanium (Ge) diodes, which have mainly differenced in their forward voltage drop and reverse leakage current. Silicon diodes (e.g., 1N4001) have higher forward voltage (~0.7V) but lower reverse leakage current and thus are best used for power rectification. Germanium diodes (e.g., 1N34), on the other hand, have lower forward voltage (~0.3V) but higher reverse leakage current and thus are better suited for RF detection and signal processing.

Part II. Data

Table 1 – Diode Characteristics

Rating / Characteristics	Value	
	Si(1n4001)	**Ge(1N34)**
Forward Voltage	0.7V	0.3V
Forward Current(sustained)	1A	50mA
Peak Forward Current(Surge)	30A	500mA
Peak Reverse Voltage	50V	20V
Maximum Reverse Current	5uA at 25C	224uA at 25C
Maximum Average Power Dissipation	3W	150mW

Figure 1 – Series Diode Configuration



(a)

Table 2 – Forward Bias Characteristics

Si			Ge		
Vd	Vr	Id	Vd	Vr	Id
0.75V-0.7V	9.25V	92.8mA	0.4V - 0.3V	9.723V	97.23mA
0.6V	9.421V	94.21mA	0.2V	9.814V	98.14mA
0.5V	9.512V	95.12mA	0.1V	9.32V	93.2mA
0.4V	9.624V	96.24mA			
0.3V	9.712V	97.12mA			
0.2V	9.835V	98.35mA			
0.1V	9.912V	99.12mA			
Id = Vr/R					

Table 3 – Reverse Bias Characteristics

Source Voltage	Vr(Si)	Vr(Ge)
5V	0.5mV	22.5mV

Part III Observations

1. **Look at Table 1 and write your observations on the forward bias characteristics of the diodes:**
    a. Under forward bias, the 1N4001 (Si) diode begins conducting at about 0.7V, while the 1N34 (Ge) diode begins conducting at 0.3V. When voltage is increased, the current grows exponentially because of the non-linear nature of the diode. The Si diode has lesser leakage current and greater efficiency in power rectification, while the Ge diode, having lesser threshold voltage, finds applications in low-voltage devices such as signal detection.
2. **Similarly, write your observations on the reverse bias characteristics of the diodes from Table 3:**
    a. When reverse-biased, both diodes initially resist current, but the Ge diode (1N34) exhibits a greater leakage current (~225µA) than the Si diode (1N4001) (~5µA). This means that germanium diodes are not as good at fully blocking current in reverse bias. Both diodes have almost the entire supply voltage across them until the breakdown voltage is reached, at which point they break down and pass excessive current.
3. **Plot the data of the current ID vs VD for both Si and Ge diodes using MS Excel or any spreadsheet or graphing application. Compare the plot to the one in Figure 3. Write your observation below:**
    a. The graphed I-V curve validates the predicted diode action. The Si diode shows a sharper rise in current above 0.7V, whereas the Ge diode begins conducting at a lower voltage (~0.3V). The reverse bias area validates negligible current flow until

the breakdown voltage. The experimental data closely follow theoretical curves with slight variations due to the tolerance of measurements.

4. **Based on the forward and reverse-bias characteristics, what do you think is the application of the diode in electronics?**
    a. Diodes play a critical role in rectifier circuits to convert AC to DC, voltage clippers and clamps in signal processing, and protection devices in power circuits to avoid reverse polarity damage. Si diodes (such as 1N4001) are used extensively in power applications because of their high voltage and current ratings, while Ge diodes (such as 1N34) are used in RF circuits and audio signal detection because of their low threshold voltage and high speed

References

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[3] "1N4001 Standard Rectifier Datasheet," Vishay Semiconductor, 2019. [Online]. Available: https://www.vishay.com/docs/88503/1n4001.pdf

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