University of Washington

BEE331 Lab 1.1

2301991
Jason Truong

1900585
Henry Haight

supervised by
Prof. Joseph Decuir

July 15, 2024

Characterising Diodes; I-V Curve

Design Objective

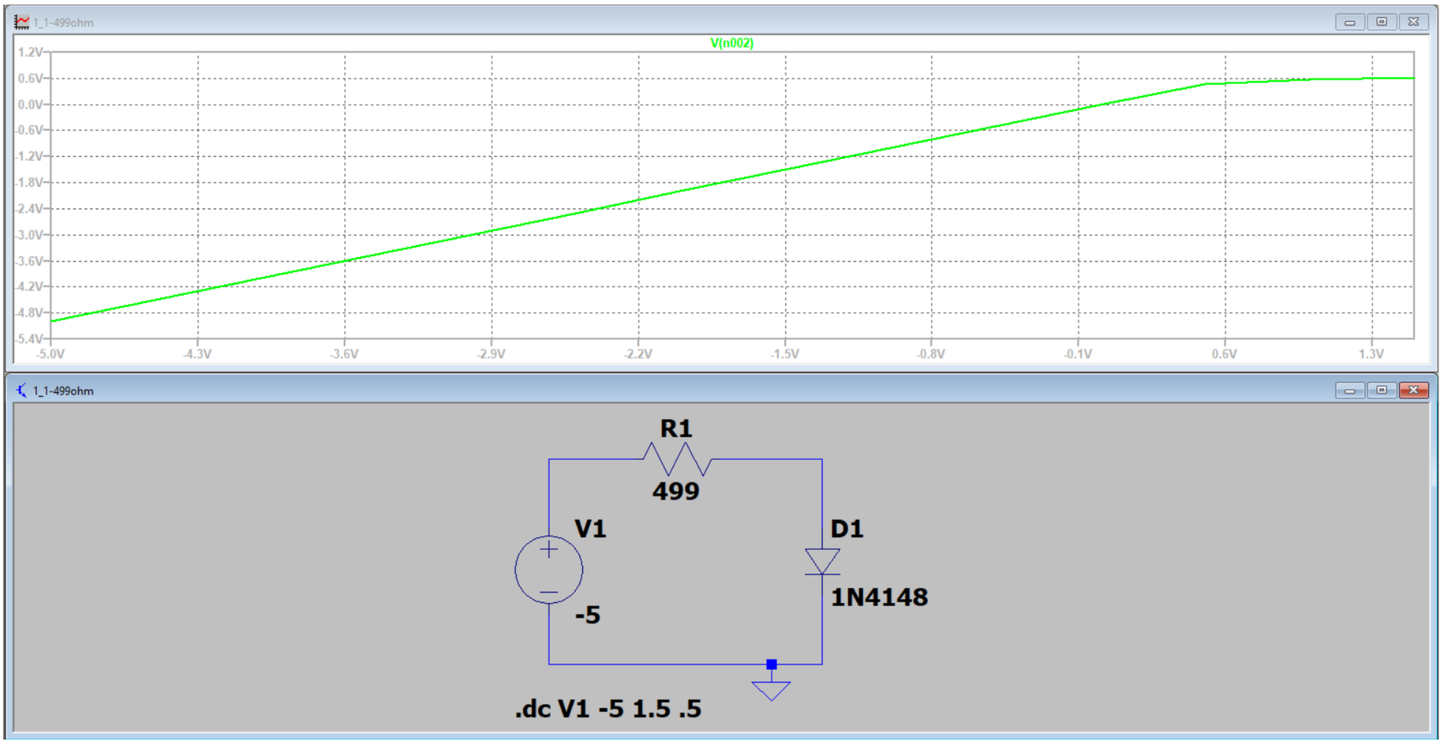
In this lab, we introduce ourselves to the diode, we characterise its function by the I-V curve.

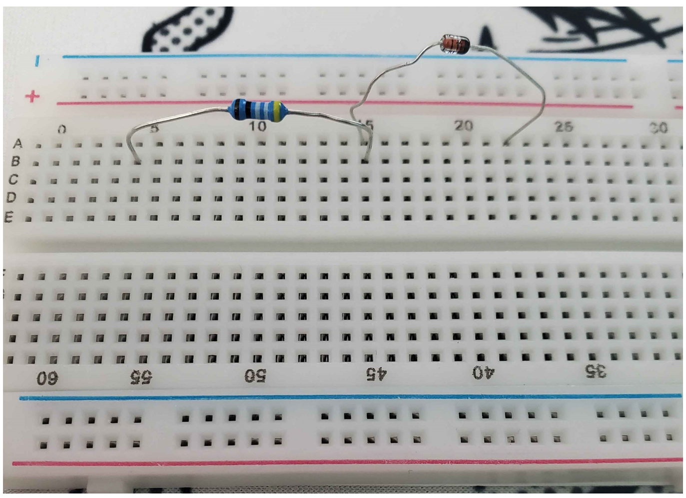
Circuit Design Outline

With a resistor of an arbitrary impedance greater than 50Ω ($R \geq 100\Omega$), and the natural impedance of the Function Generator in series ($R_{TOT} = R_{FG} + R \geq 150\Omega$), the (1N4148 silicon) diode is set in series to forward-bias from the function generator. Set the function generator @ f=1kHz and $V_P = 5V$.

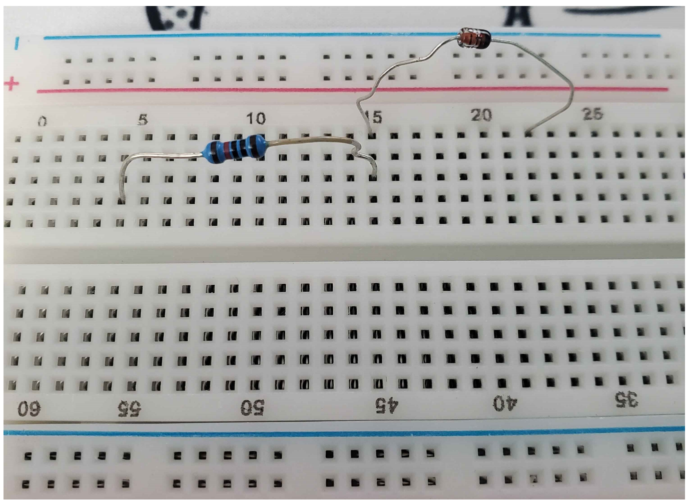
Figure 1: Series R + Diode

(a) LTSpice + Rudimentary Schematic Seris RD (499Ω) Circuit





(b) Series RD Circuit 499Ω



(c) Series RD Circuit 100Ω

Descriptions of Measurements & Calculations

Analysis

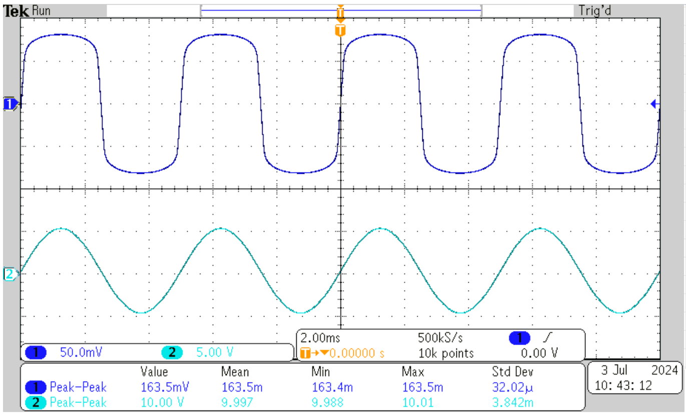
- **i. Describe how you measured I_D and V_D?**

  At the node where R; ($R > 100\Omega$) and the Diode; (D) meet, we denote this junction as V_{out}. We attach our Multimetre's positive lead (Red) to V_{out}, and attached our ground lead to the opposing node of the Diode; (D) - which should be grounded.

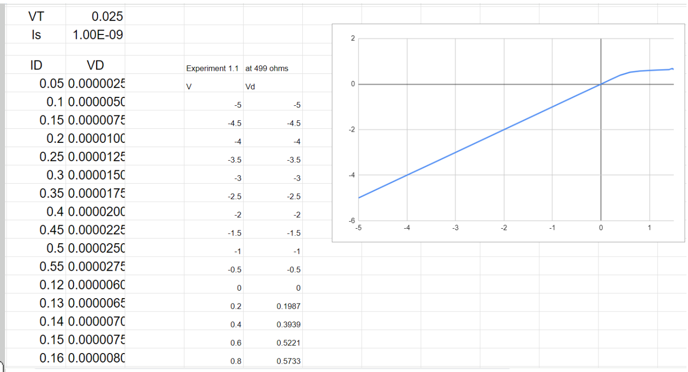
- **ii. In this experiment how would you determine the value of $I_{D,max}$**

Figure 1: RD Circuit

(a) RD Circuit Measurement



(b) S



VT	0.025			
Is	1.00E-09			
ID	VD		Experiment 1.1	at 499 ohms
0.05	0.0000025		V	Vd
0.1	0.0000050		-5	-5
0.15	0.0000075		-4.5	-4.5
0.2	0.0000100		-4	-4
0.25	0.0000125		-3.5	-3.5
0.3	0.0000150		-3	-3
0.35	0.0000175		-2.5	-2.5
0.4	0.0000200		-2	-2
0.45	0.0000225		-1.5	-1.5
0.5	0.0000250		-1	-1
0.55	0.0000275		-0.5	-0.5
0.12	0.0000060		0	0
0.13	0.0000065		0.2	0.1987
0.14	0.0000070		0.4	0.3939
0.15	0.0000075		0.6	0.5221
0.16	0.0000080		0.8	0.5733

Summary & Conclusions

Revealed in Figure 2(a-b), the primary components; the Inductor and Capacitor, overcompensate and overdamp the circuit, and grew to be greater than the voltage originally. The calculation and the measurements in actuality were very close in similar measurements.

Addendum Pages

Figure 2: Jason Truong Addendum

(a) Lab Design Calculations

$$I_D = I_S(e^{qV_D / NkT} - 1)$$

Where,

I_D = Diode current in amps

I_S = Saturation current in amps (typically 1×10^{-12} amps)

e = Euler's constant (~ 2.718281828)

q = charge of election (1.6×10^{-19} coulombs)

V_D = Voltage applied across diode in volts

N = "Nonideality" or "Emission" coefficient (typically between 1 and 2)

k = Boltzmann's constant (1.38×10^{-23})

T = Junction Temperature in Kelvins

Bibliography

Cited:

- Lab 1 Manual
- Sedra, Adel, and Kenneth Smith. Microelectronic Circuits. S.L., Oxford Univ Press Us, 2019.
- “How Do You Calculate, a Silicon Junction Diode with N = 1 Has v = 0.7 v al I = 1 MA. What Is the Voltage Drop at I=0.1 MA and I=10 MA.?” Quora, 2024, appliedmathematics.quora.com/How-to-calculate-A-silicon-junction-diode-with-n-1-has-v-0-7-V-al-I-1-mA-What-is-the-voltage-drop-at-I-0-1-mA-an?top_ans=223007030. Accessed 15 July 2024.

(a) Look at her, she’s perfect.