



UNIVERSITY OF WASHINGTON

BEE331 LAB 1.1

<i>2301991</i>	<i>1900585</i>
<i>Jason Truong</i>	<i>Henry Haight</i>

supervised by
Prof. Joseph DECUIR

July 15, 2024

Characterising Diodes; I-V Curve

Design Objective

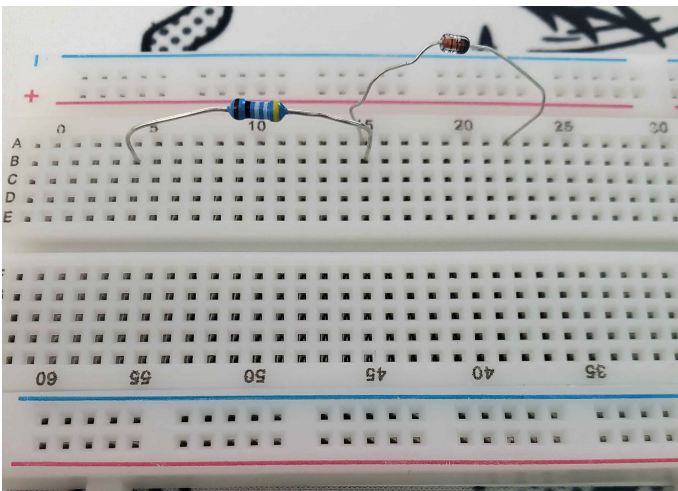
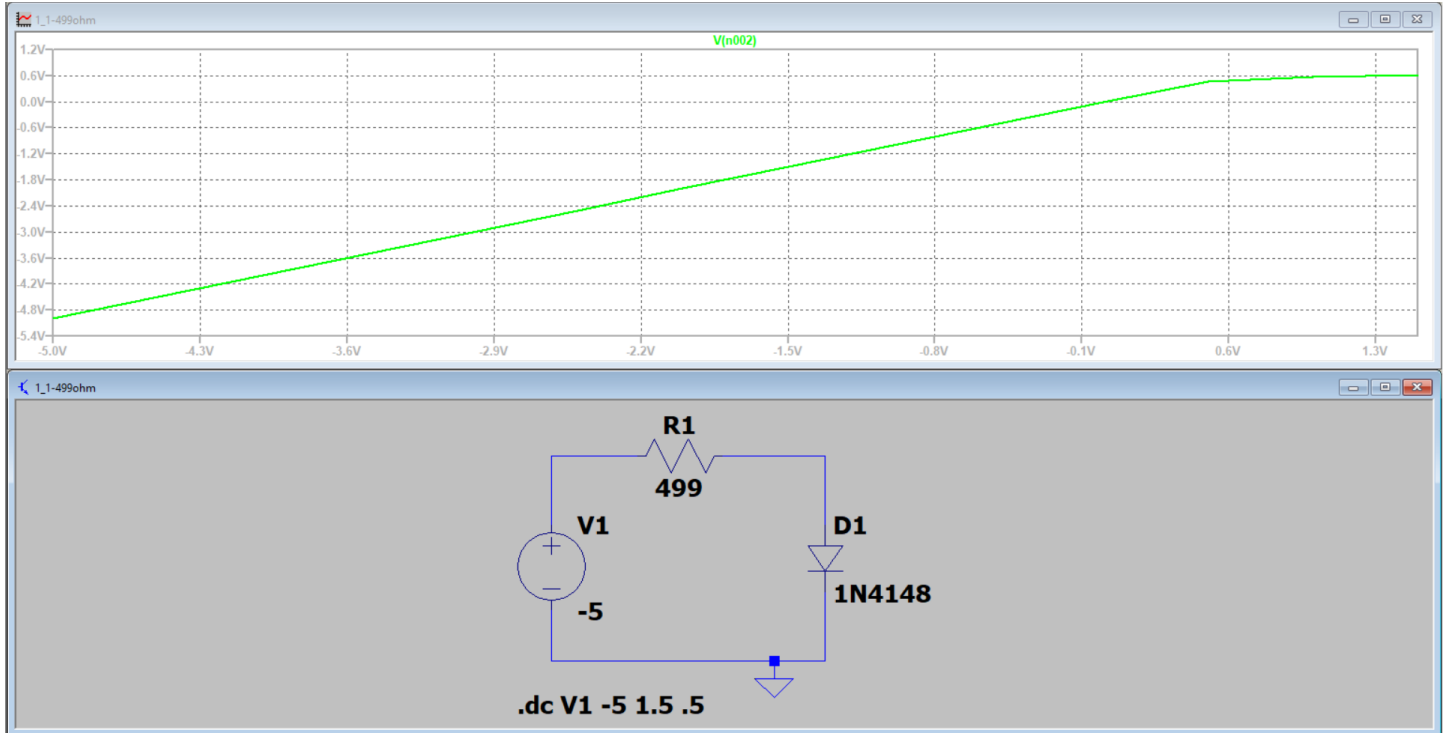
In this lab, we introduce ourselves to the diode, we characterise its function by the I-V curve.

Circuit Design Outline

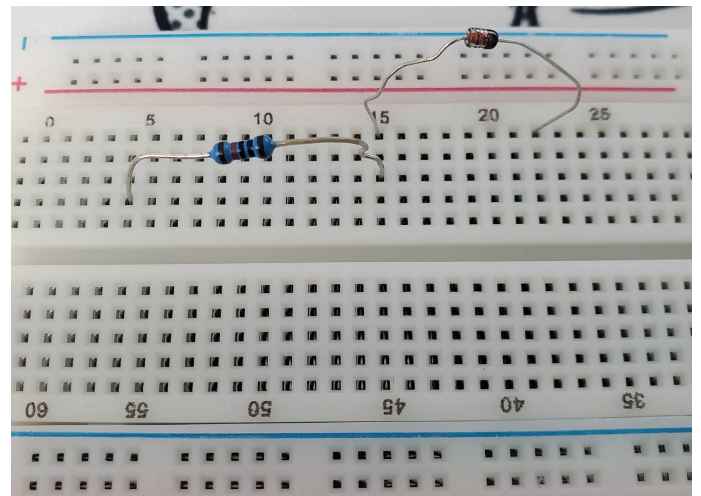
With a resistor of an arbitrary impedance greater than 50Ω ($R \geq 100\Omega$), and the natural impedance of the Function Generator in series ($R_{TOT} = R_{FG} + R \geq 150\Omega$), the (1N4148 silicon) diode is set in series to forward-bias from the function generator. Set the function generator @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

Figure 1: Series R + Diode

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



(b) Series RD Circuit 499 Ω



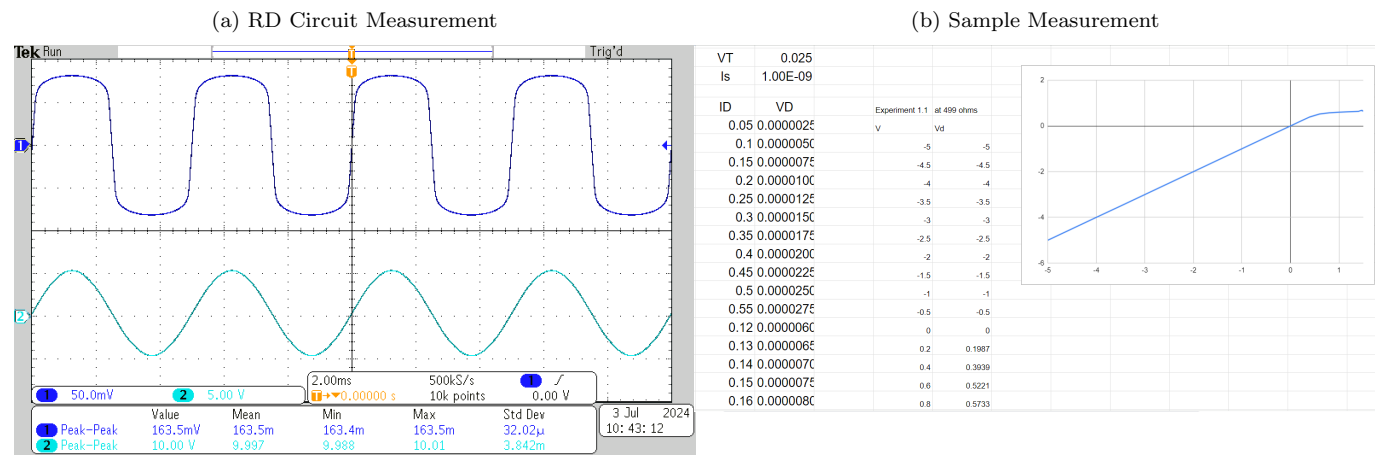
(c) Series RD Circuit 100 Ω

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 $I_{D,max}$
$$I_D = I_S(e^{\frac{V_D}{V_T}} - 1); \text{ reference Figure 1b.}$$
- iii. In the circuit, what limits I_D ?
The characteristics of the I-V curve of a diode has current I_D exponentially rise towards a cut-off at the threshold, towards the C.V.D @ V_D .
- iv. Explain why V_D does not change much while I_D can change a lot.
Given the equation of a Diode's characteristics of $I_D = I_S(e^{\frac{V_D}{V_T}} - 1)$. Putting the equation in reference to I_D is an exponential function, while V_D is a logarithmic function with a very slow rise time.

Figure 1: RD Circuit



Summary & Conclusions

Revealed in Figure RD-Circuit 1A & 1B, the generated oscilloscope readings of the two periodic function match the characteristics of the transfer function found in the transfer function. So the measurements do infact closely align.

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 electron (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.