Faculty of Engineering and Technology
Department of Electrical and Computer Engineering

ENEE 2103

CIRCUITS AND ELECTRONICS LABORATORY

Experiment #6, Pre-Lab #2

“ Diode Characteristic and Applications ”

Prepared by: Nour Naji

Student ID: 1190270

Section: 1

Supervised by: Dr. Alhareth Zyoud

Teaching assistant: Eng. Esmail Abualia

Date: 27/9/2021

Table of Contents

1. Part A (DIODE CHARACTERISTICS):

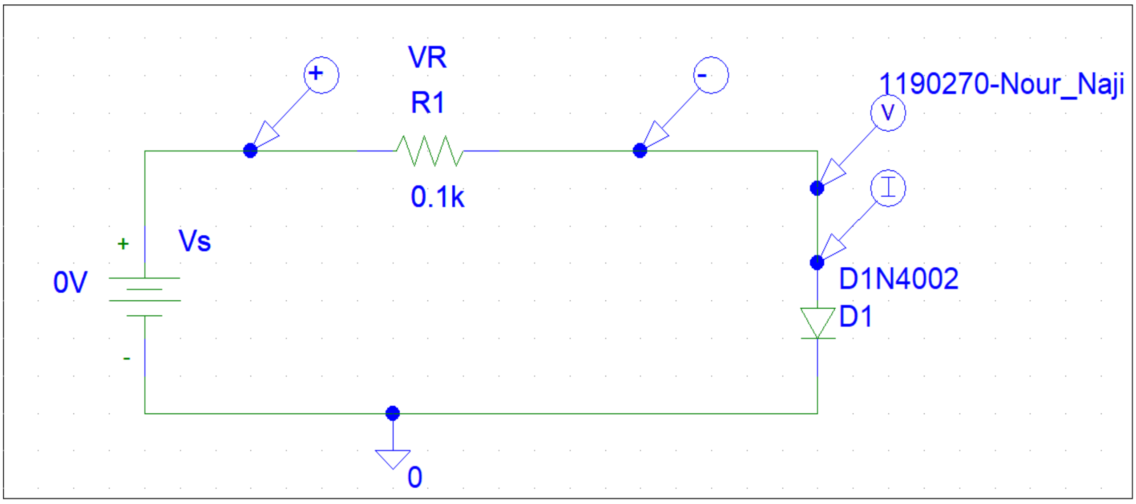
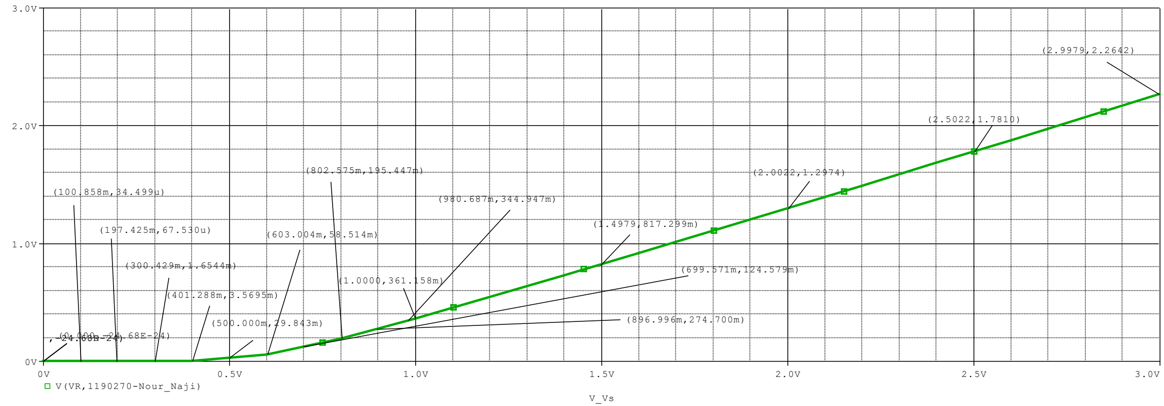
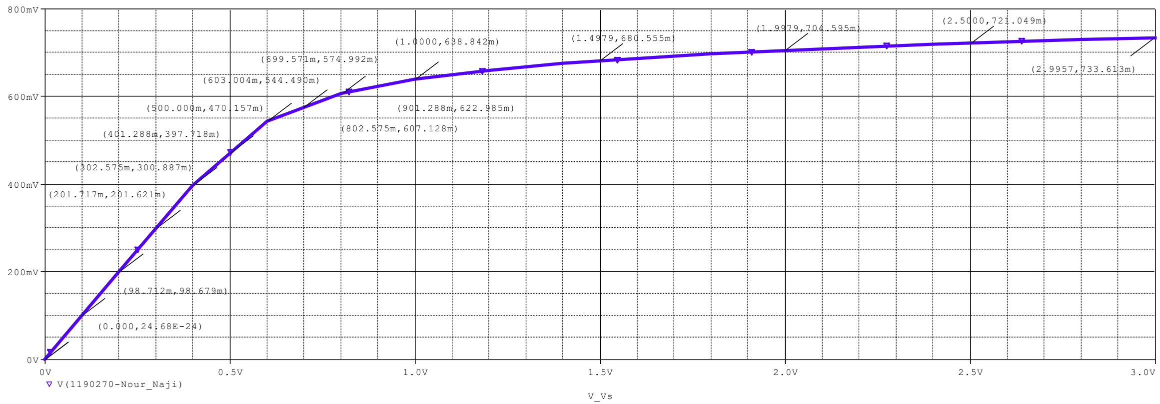


Figure 1.1: RD series circuit implementation

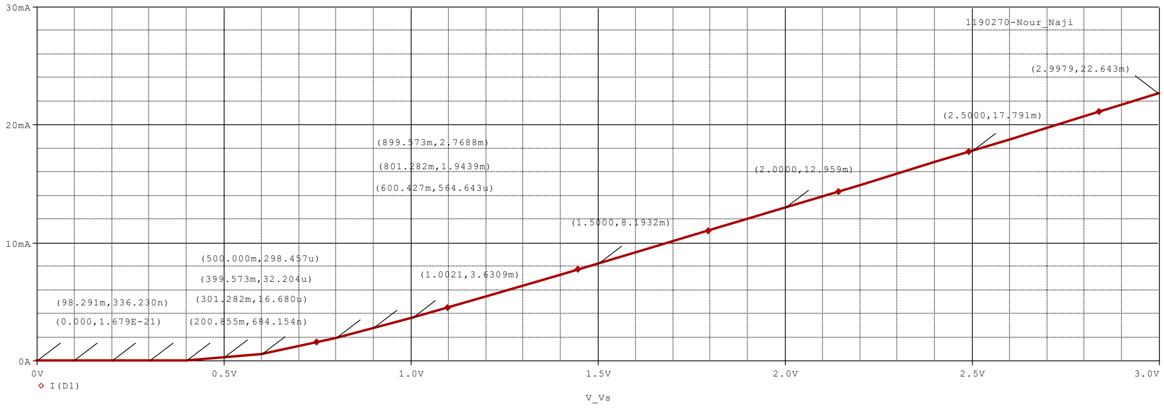
- measure VR



- measure VD



- measure ID



V_S	V_R-v-	V_D -v-	I_D – mA-
0	0	0	0
0.1	39.499u	98.679m	336.230n
0.2	67.530u	201.621m	684.154n
0.3	1.6544m	300.887m	16.680u
0.4	3.5695m	397.718m	32.204u
0.5	29.843m	470.157m	298.457u
0.6	58.514m	544.490m	564.643u
0.7	124.574m	574.992m	
0.8	195.447m	602.128m	1.9439m
0.9	274.7m	622.985m	2.7688m
1.0	361.158m	638.842m	8.1932m
1.5	817.299m	680.555m	8.1932m
2	1.2974m	704.595m	12.959m
2.5	1.7810m	721.049m	17.791m
3	2.2642m	733.613m	22.643m

- When reverse the diode:

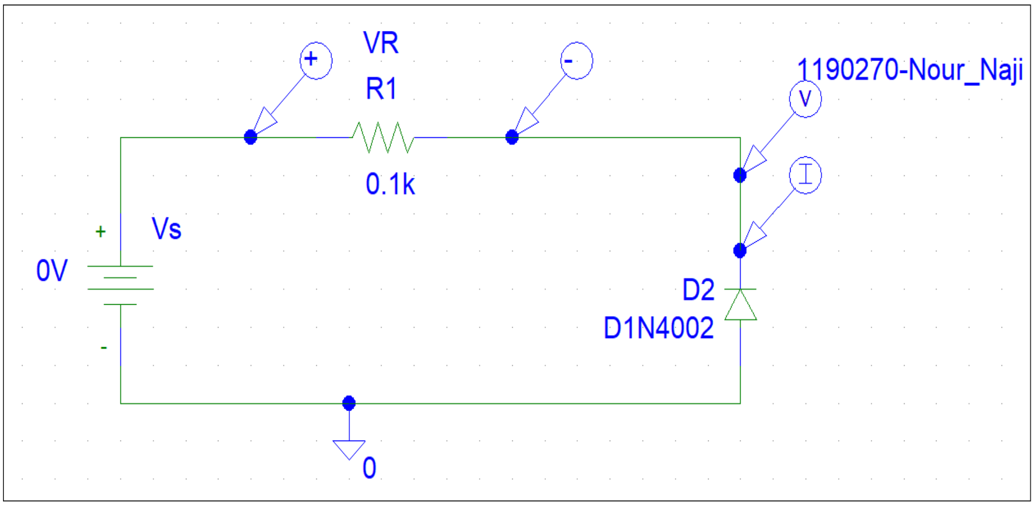
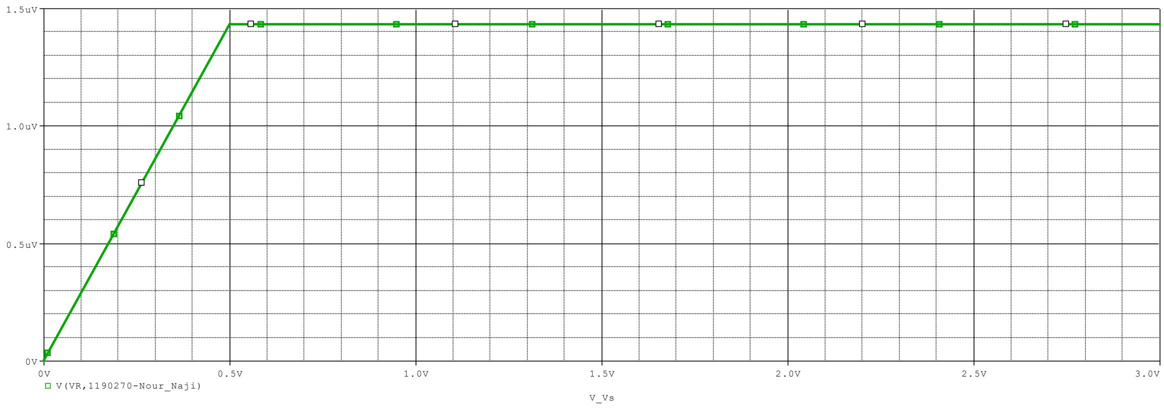
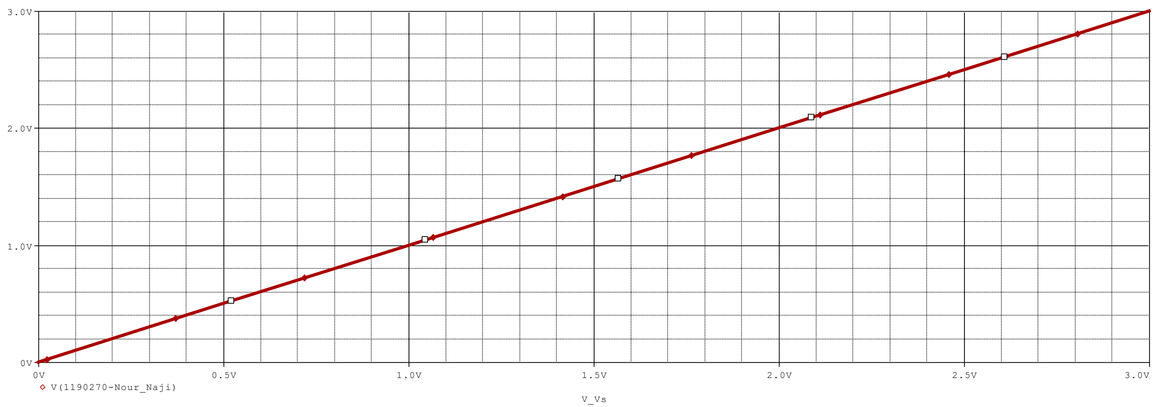


Figure 1.2: RD series circuit implementation– When reverse the diode

- measure VR

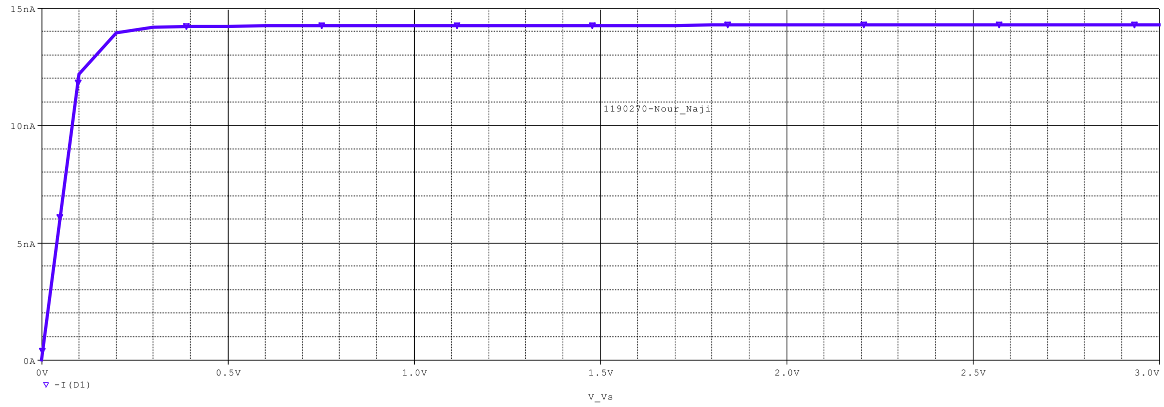


- measure VD



we can see, the voltage of the diode will be always equal the input voltage , since it is open in this case- Reverse-, so appears as open circuit.

- measure ID


15nA
10nA
5nA
0A
0V
0.5V
1.0V
1.5V
2.0V
2.5V
3.0V
-I(D1)
V_Vs
1190270-Nour_Naji

2. Part B (RECTIFICATION) :

2.1 HALF - WAVE RECTIFICATION.

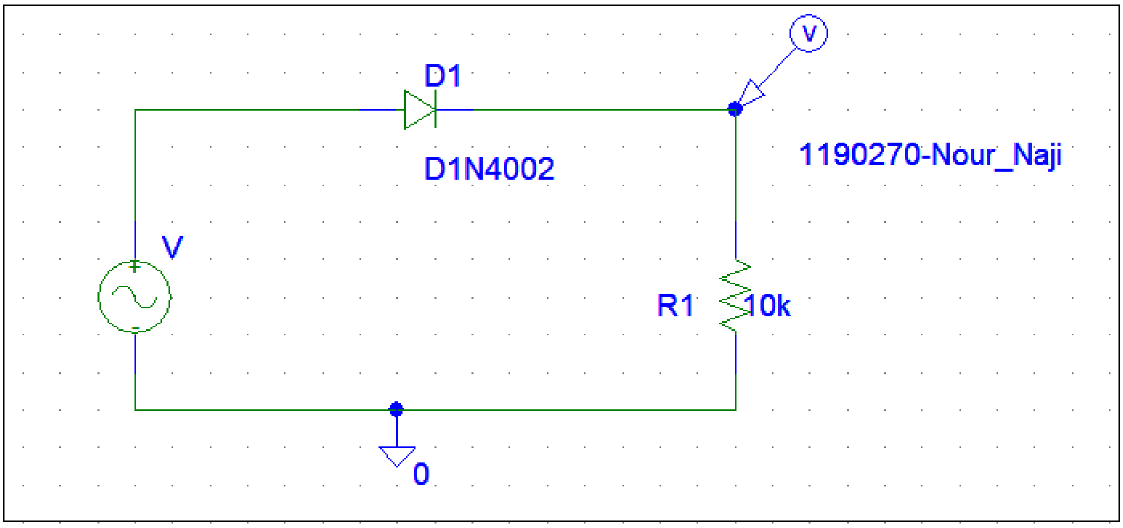


Fig 2.1.1 : Half-Wave Rectification circuit implementation to get the voltage response

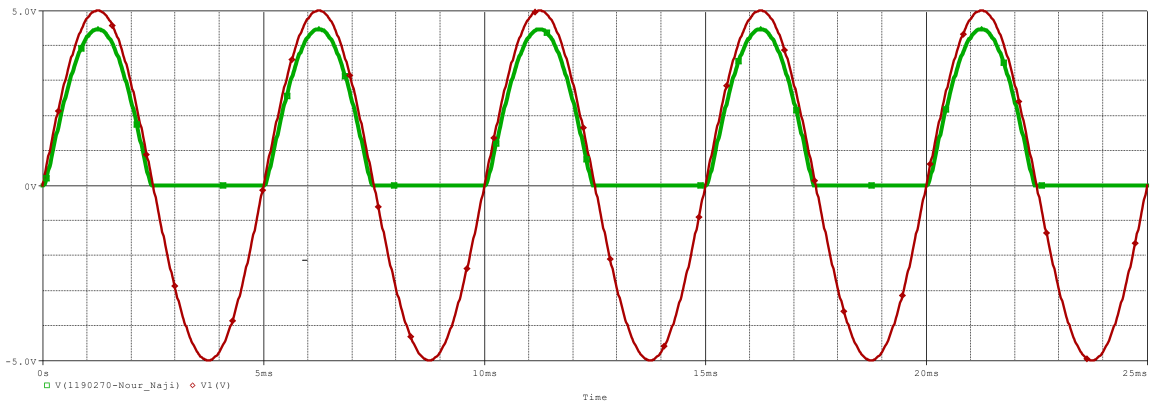


Fig 2.1.2 : Half-Wave Rectification circuit implementation to get the voltage response -wave form

- **Period T and dc value**

⇨ T = 1 / f = 1/200 = 5 ms

⇨ peak value Vpk (experimentally) = 4.4683v

⇨ dc value = Vpk/ π = 1.42305v

- When reverse the diode:

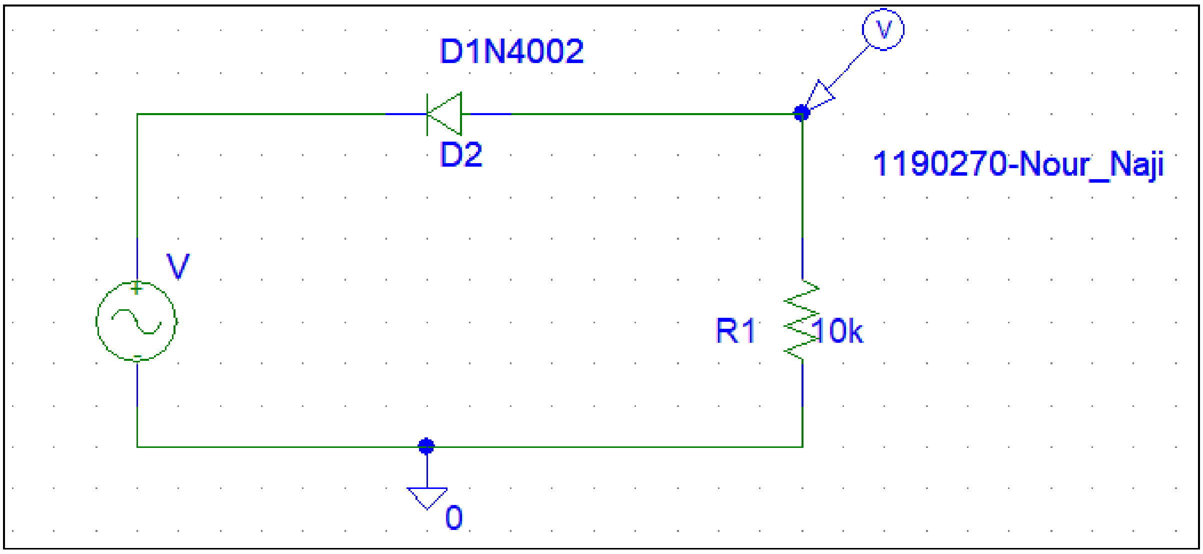


Fig 2.1.3 :Half-Wave Rectification circuit implementation to get the voltage response- When Reverse the diode

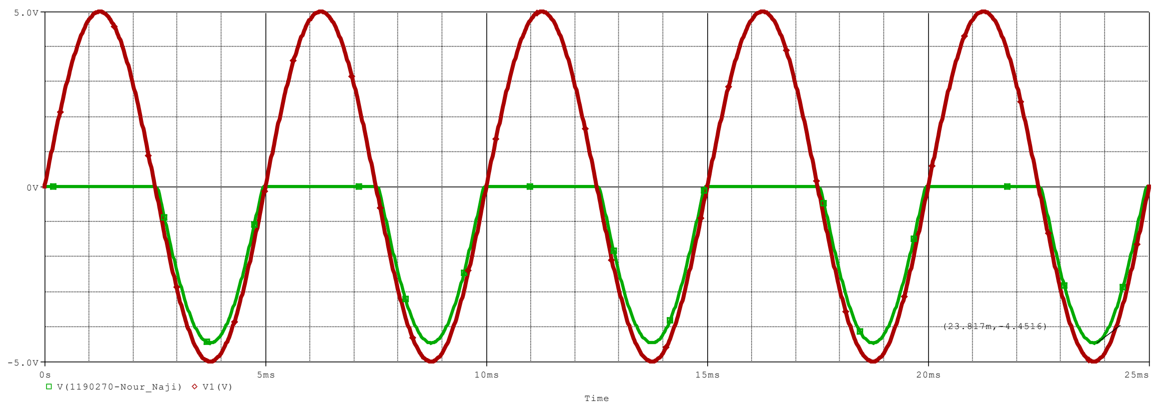


Fig 2.1.4 : Half-Wave Rectification circuit implementation to get the voltage response - When Reverse the diode-wave form

➢ Period T and dc value

⇨ T = 1 / f = 1/200 = 5 ms

⇨ peak value Vpk (experimentally) = - 4 .4516v

⇨ dc value = Vpk/ π = - 1.4177v

- When Adding C = 2.2 μF :

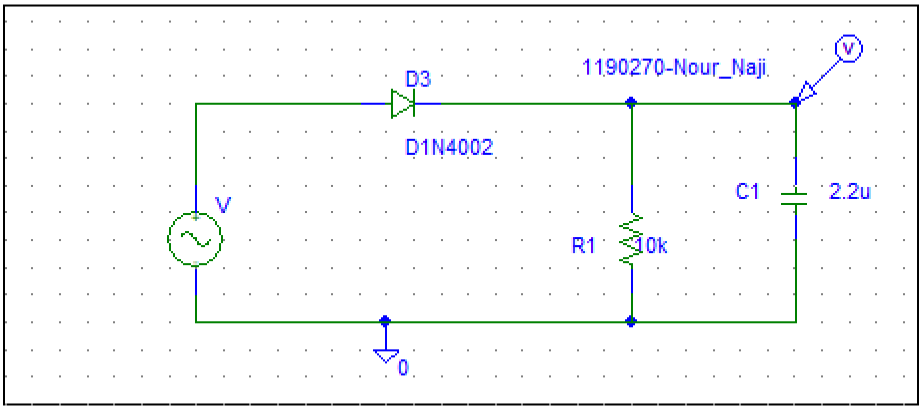


Fig 2.1.5 : Half-Wave Rectification circuit implementation after adding 2.2 μF capacitor

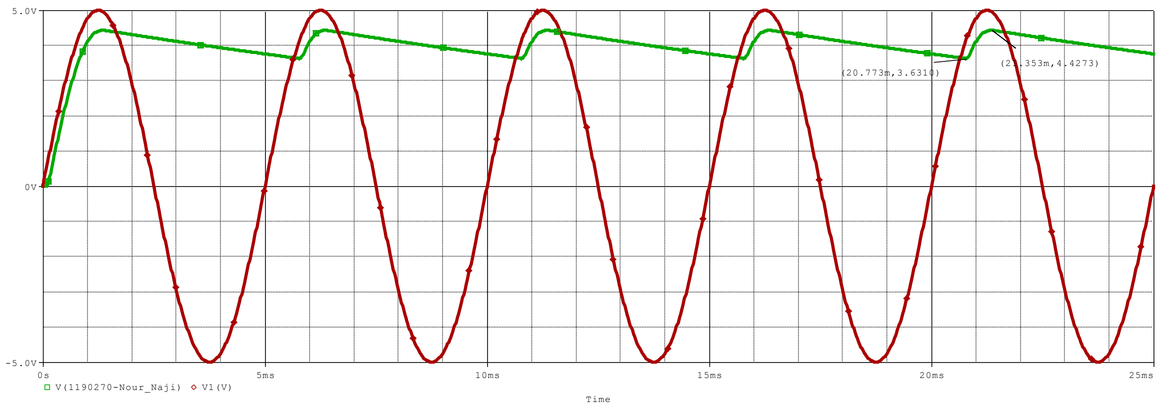


Fig 2.1.6 : Half-Wave Rectification circuit implementation after adding 2.2 μF capacitor -wave form

- **dc value:**

⇨ peak value Vpk (experimentally) = 4.4273 v

⇨ VLR-pp = 4.4273 – 3.6310 = 0.7963v

⇨ dc value = Vavg = Vpk − 0.5 VL-pp = 4.4273 − 0.5 ∗ 0.7962 = 4.02915 v

- **ripple factor:**

$$r\%\ (\text{experimentally}) = \frac{\frac{VLR-PP}{2\sqrt{3}}}{Vavg} * 100\% \quad = 5.7052\%$$

$$r\%\ (\text{theoretically}) = \frac{1}{\sqrt{3}[2f0RC-1]} * 100\%$$

$$= \frac{1}{\sqrt{3}[2*200*10*1000*2.2*10^{-6}-1]} * 100\% = 7.4019$$

- Using C = 47 μF :

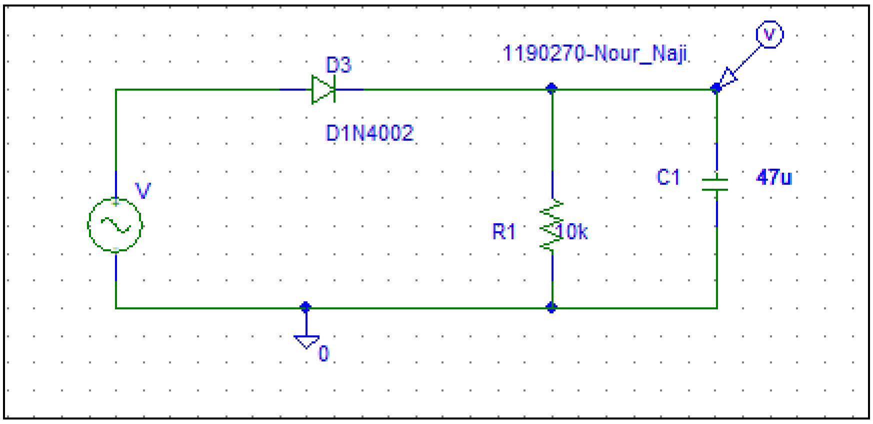


Fig 2.1.7:: Half-Wave Rectification circuit implementation after adding 47 μF capacitor

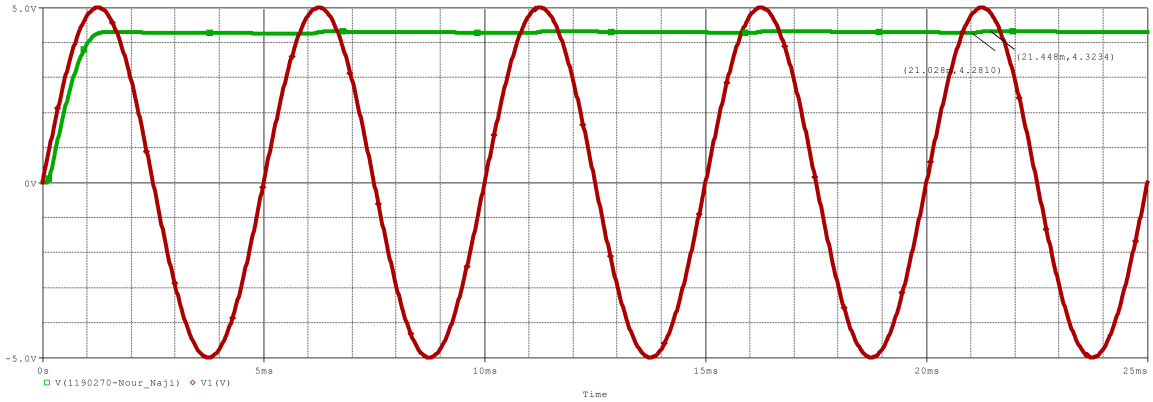


Fig 2.1.8:: Half-Wave Rectification circuit implementation after adding 47 μF capacitor-wave form

- **dc value:**

⇨ peak value Vpk (experimentally) = 4.3234 v

⇨ VLR-pp = 4.3234 – 4.2810= 0.0424v

⇨ dc value = Vavg = Vpk − 0.5 VL,p−p = 4.3234 − 0.5 ∗ 0.0424 = 4.3022 v

- **ripple factor:**

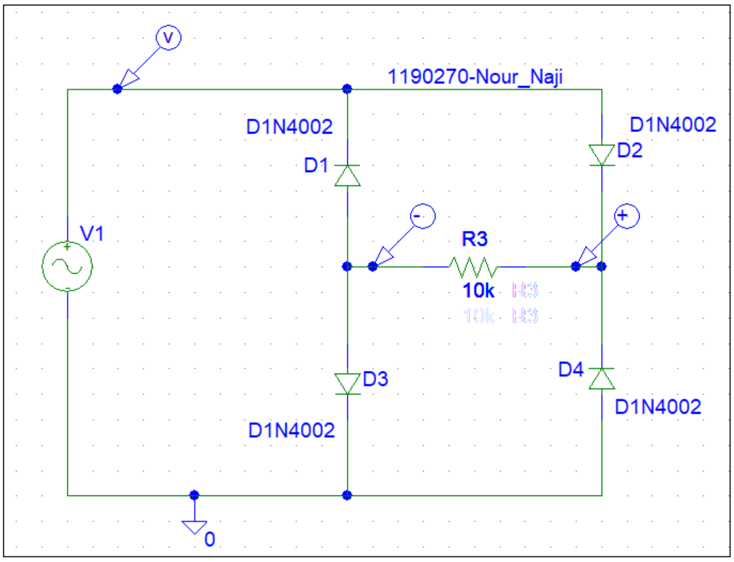
$$r\% \text{ (experimentally)} = \frac{\frac{VLR-PP}{2\sqrt{3}}}{Vavg} * 100\% = 0.2845\ \%$$

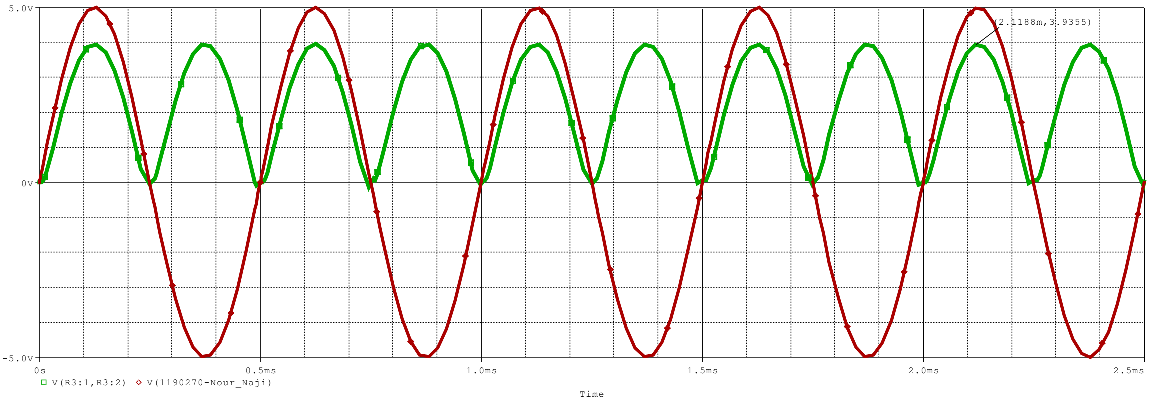
$$r\% \text{ (theoretically)} = \frac{1}{\sqrt{3}[2f0RC-1]} * 100\%$$

$$\frac{1}{\sqrt{3}[2*200*10*1000*47*10^{\wedge}-6]} * 100\% = 0.3087\%$$

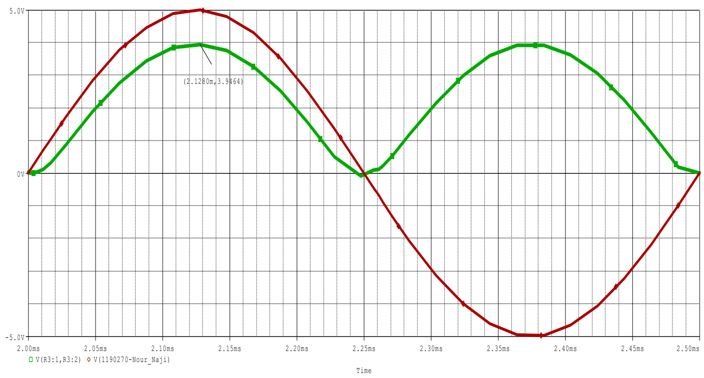
✓ We note that when the capacitor's value is increased, the ripple factor decreases and the value of the mean voltage increases.

2.2 FULL - WAVE RECTIFICATION:





➢ Period T and dc value



⇨ T = 1 / f = 1/2000 = 0.5 ms

⇨ peak value Vpk (experimentally) = 3.9355v

⇨ dc value = Vpk/ π = 1.2533v

- When Adding C = 2.2 μF:

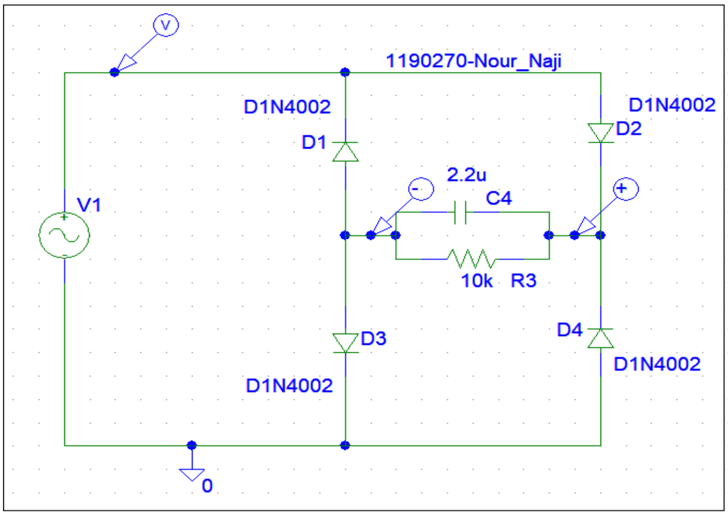


Figure 2.2.3: Full-Wave Rectification when adding the capacitor of 2.2 μF voltage response

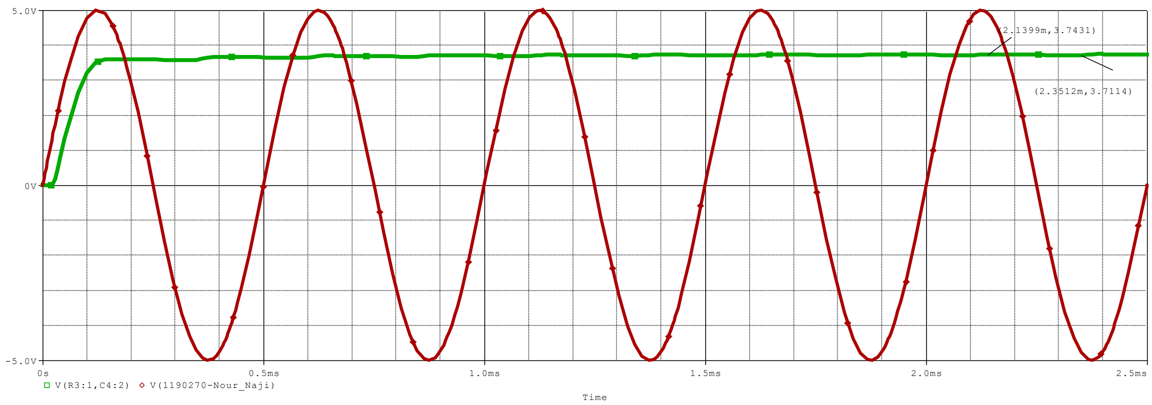
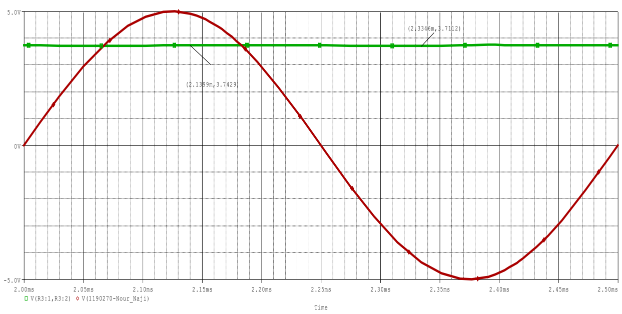


Figure 2.2.4: Full-Wave Rectification when adding the capacitor of 2.2 μF voltage response-wave form

- **dc value**



⇨ peak value Vpk (experimentally) = 3.7431v

⇨ VLR-pp = 3.7431–3.7114= 0.0317v

⇨ dc value = Vavg = Vpk − 0.5 VL,p−p = 3.7431− 0.5 ∗ 0.0317 = 3.7272v

- **ripple factor**

$$r\% \text{ (experimentally)} = \frac{\frac{VLR-PP}{2\sqrt{3}}}{Vavg} * 100\% \quad = 0.2455\ \%$$

$$r\% \text{ (theoretically)} = \frac{1}{\sqrt{3}[4f0RC-1]} * 100\%$$

$$= \frac{1}{\sqrt{3}[4* 2000 * 10 * 1000 * 2.2 * 10^{-6}]} *100\% \quad =0.3299\%$$

3. Part C (Other applications):

- ## 3.1 CLIPPING

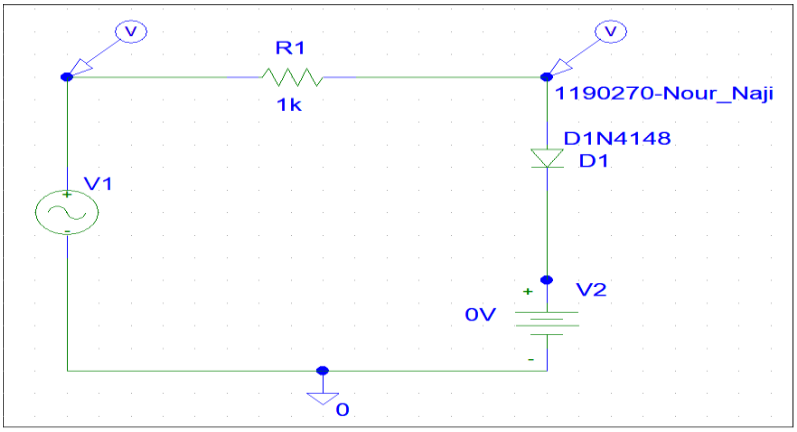


Figure 3.1.1: Clipping circuit implementation

- **When dc = 0**

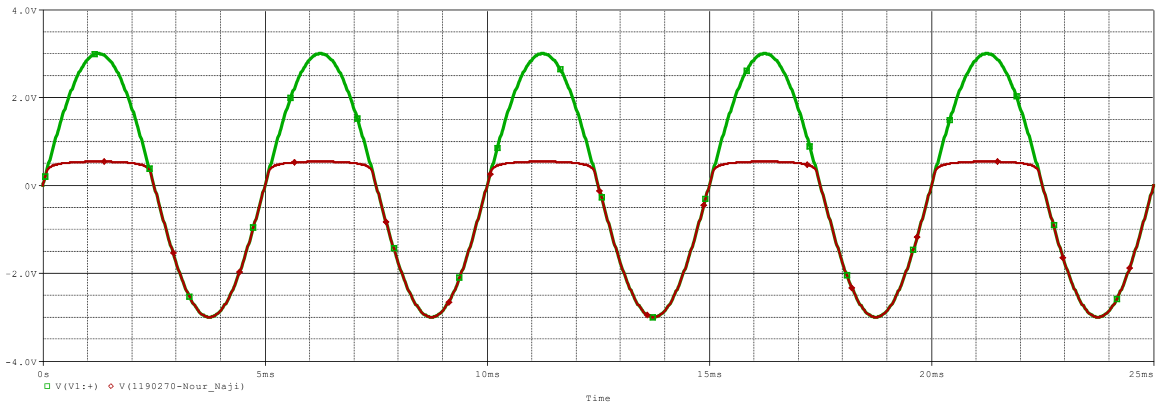


Figure 3.1.2: Clipping circuit implementation-wave form when dc = 0v

- **When dc = 1.5 v.**

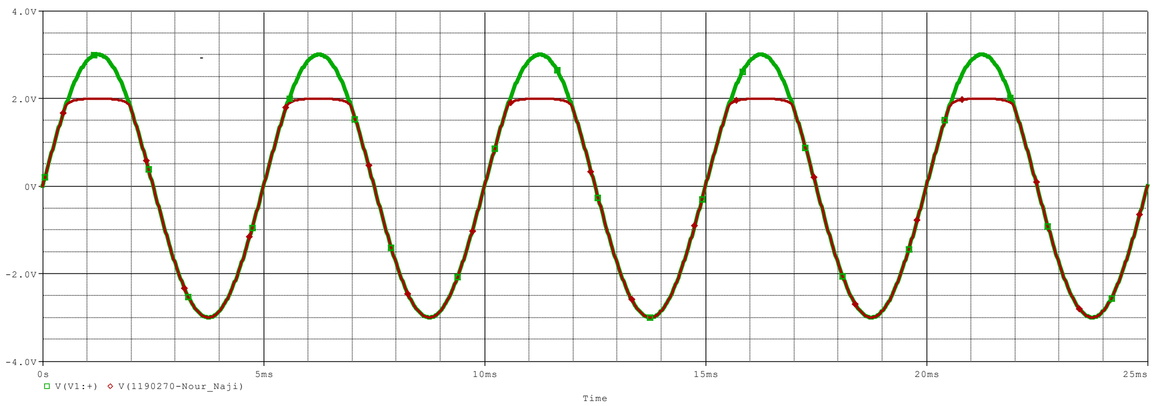


Figure 3.1.2: Clipping circuit implementation -wave form when dc = 1.5v

- **When dc = 3.5 v**

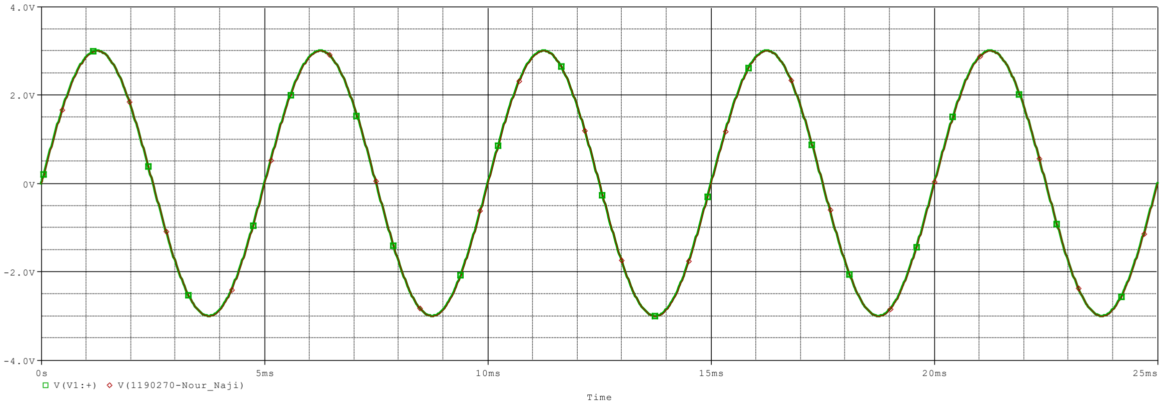


Figure 3.1.4: Clipping circuit implementation -wave form when dc = 3.5v

3.2 CLAMPING:

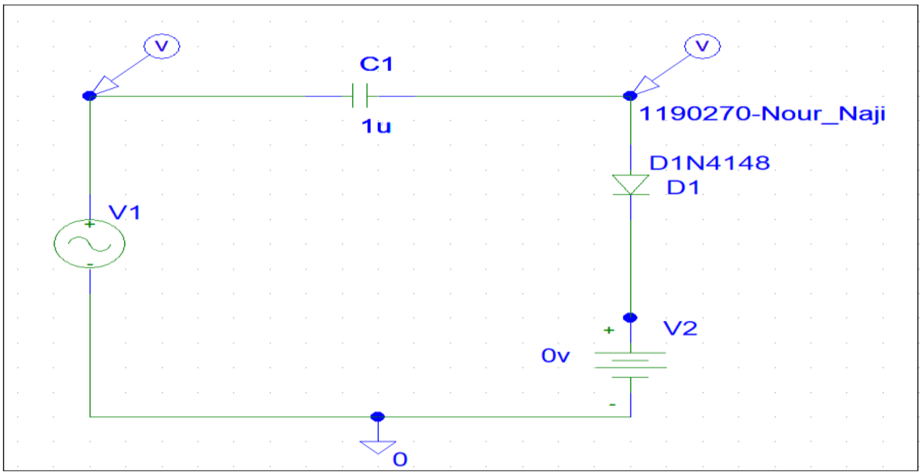


Figure 3.2.1: Clamping circuit implementation

- **When dc = 0**

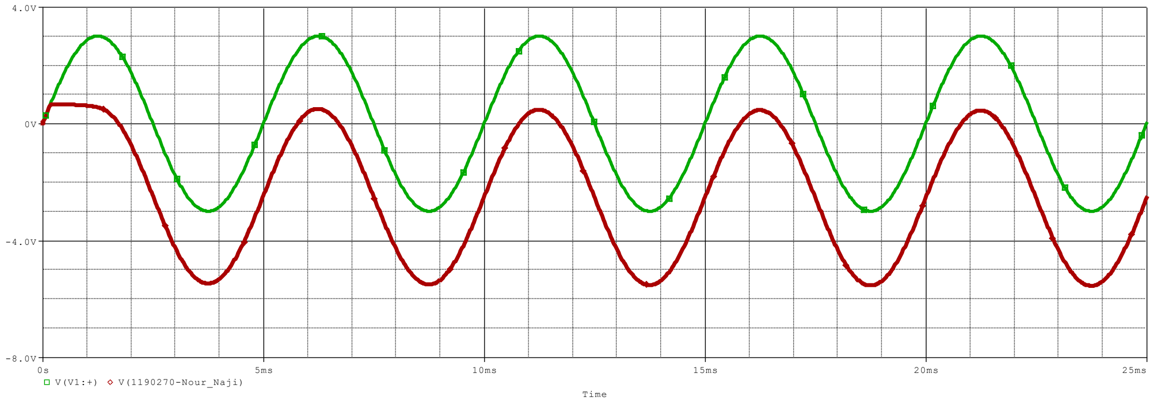


Figure 3.2.2: Clamping circuit implementation- wave form when dc = 0v

- **When dc = 1.5 v**

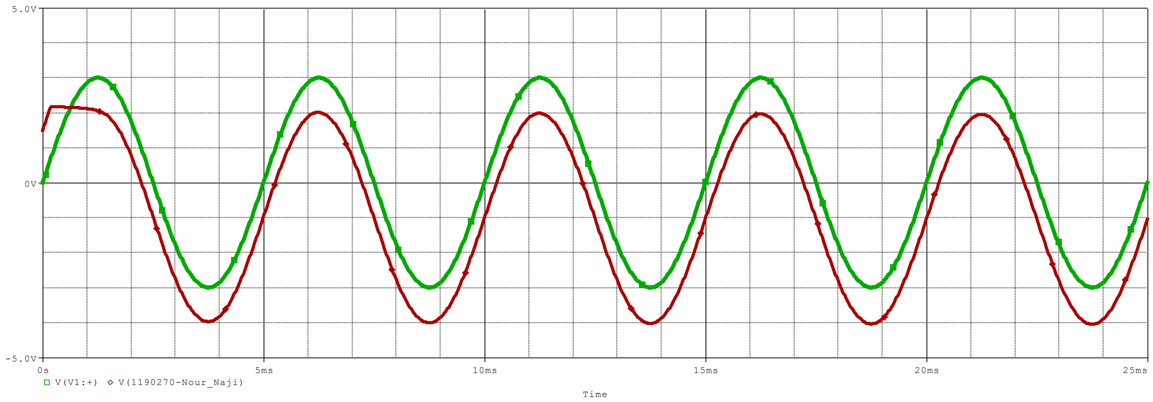


Figure 3.2.3: Clamping circuit implementation- wave form when dc = 1.5v

- **When dc = 3.5 v**

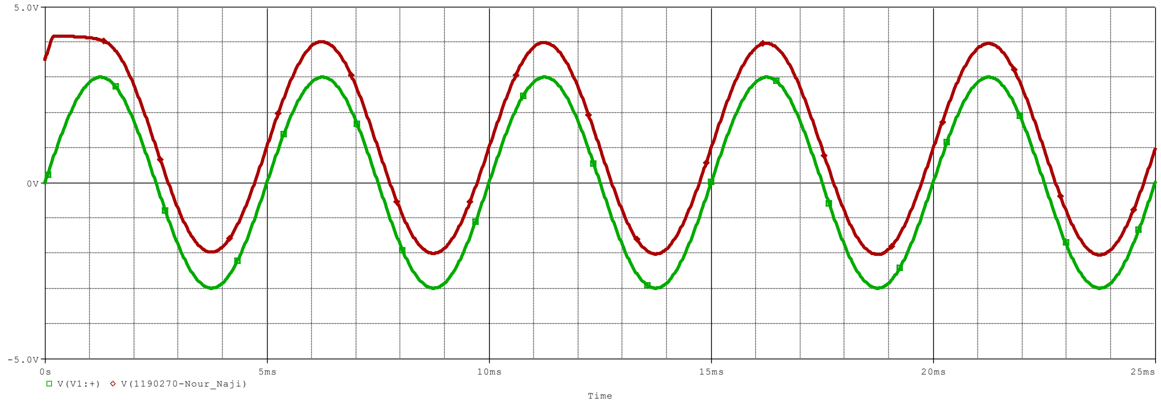


Figure 3.2.4: Clamping circuit implementation- wave form when dc = 3.5v

3.3 VOLTAGE MULTIPLICATION CIRCUITS:

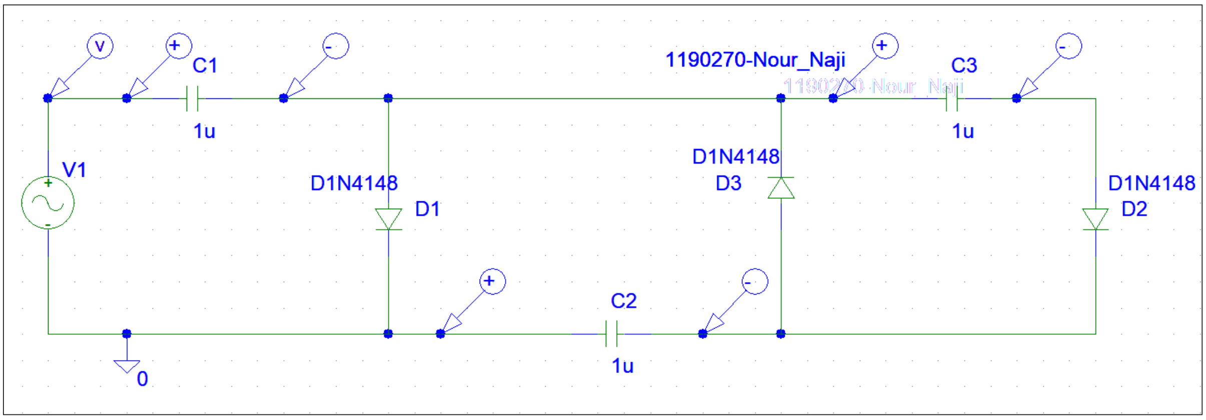
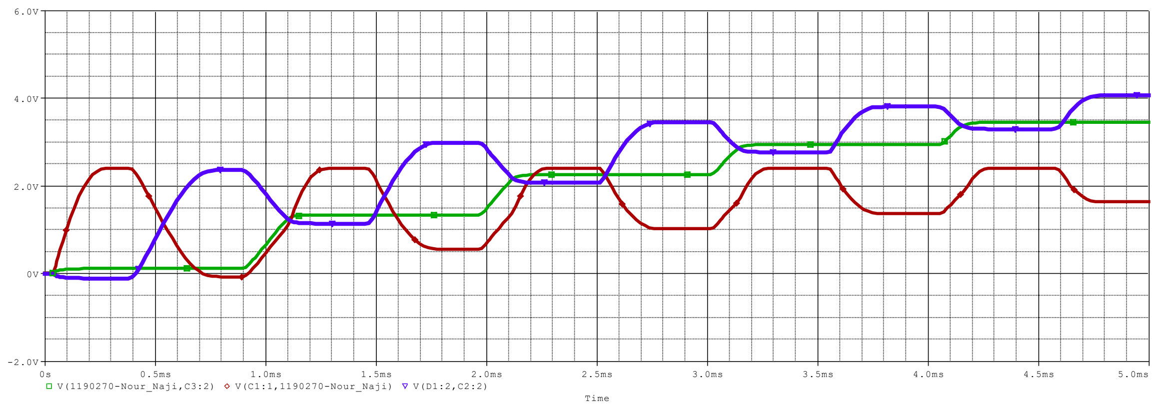


Fig 3.3.1 : VOLTAGE MULTIPLICATION CIRCUITS

- measure voltage across each capacitor:



- measure voltage across C1 + C3