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Circuit Theory and Electronics Fundamentals

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2º Laboratory Report

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Contents

1 Introduction

The objective of this laboratory assignment is to chose the architecture of the envelope detector and voltage regulator. By doing this we will design a AC/DC converter and bear in mind that cost is a very important factor and we should make the circuit as budget friendly as possible while keeping a good or great efficiency.

In section 2, a theoretical analysis of the circuit is presented. In section 3, the circuit's simulation analysis results are expressed in graphics and commented. Finally, in section 4, we will compare the simulation and theoretical values and in this way conclude our study.

2 Theoretical Analysis

In this section, the circuit created and used by us is analysed theoretically. The key equations for all the theoretical analysis ar shown below: To compute $'t_on$

$$V_s/n(t) * C * w * sin(w * t_off) = (1/R1) * (V_s/n) * cos(w * t_off) + I_x * (e^{12/eta*Vt*k} - 1) \quad (1)$$

In which $i_D = i_R + i_C$ To compute t_on we use the equation

$$(V_s/n) * cos(w * t_off) = -(V_s/n) * cos(w * t_off) * (e^{(-1/R_eq*C)*(t_on - T_off)} \quad (2)$$

2.1 envelope detector

In this section we will start by analyzing the envelope detector, where t varies from 0 to 20 ms, by using the main equations above.

Using octave we obtain the following table:

Name	Value [mA]
DC Level	12.000000
Voltage ripple	0.000000

Table 1

We can now plot the graph of the solution for t raging from 0 to 20 ms:

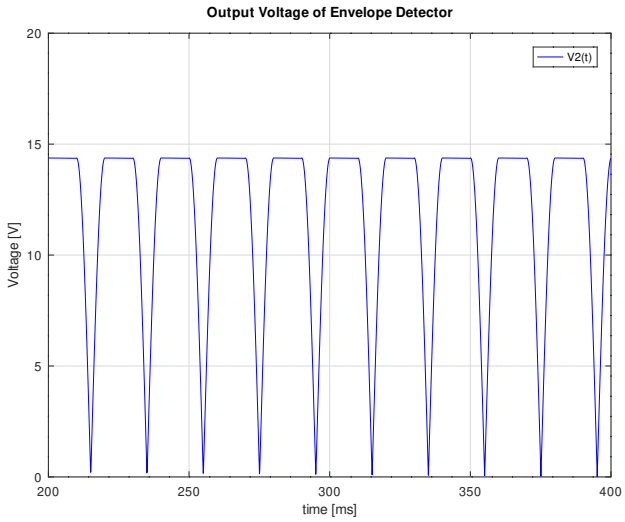

Figure 1: envelop detector output

2.2 voltage regulator

The voltage regulator theoretical analysis of this circuit, like with the envelope detector is done with the help of a key equation above.

After this, we can plot the following graphic:

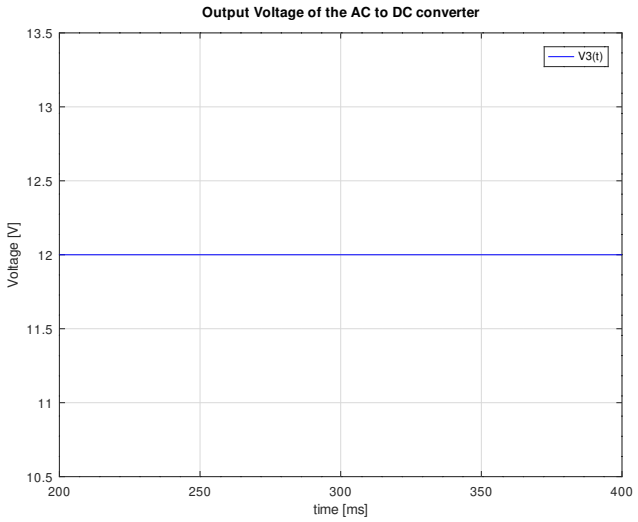

Figure 2: Voltage regulator output

2.3 Voltage regulator deviation

Lastly, we will analyze the voltage regulator deviation plot, which like in the error subsection of the simulation analysis will give us the deviation in our results.

The graphics of the voltage deviation is:

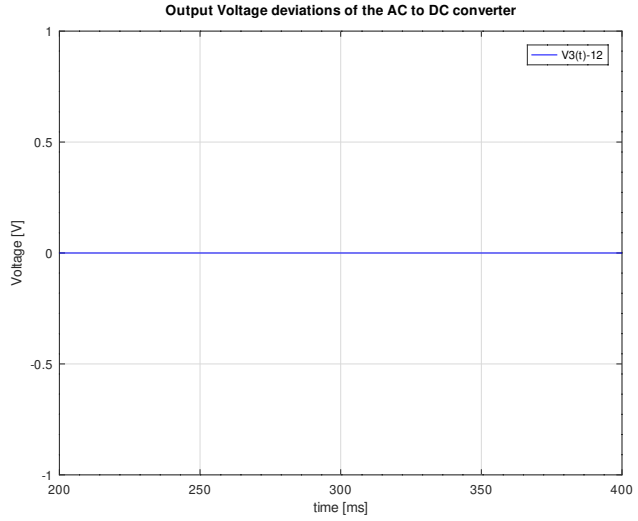

Figure 3: Voltage deviation plot

3 Simulation Analysis

the simulated values we obtained are represented in the graphics present in subsections below. We will add some comments to the results and in the conclusion we will compare them to the theoretical analysis.

3.1 Envelope detector and voltage regulator

First, in order to compute the envelope detector and voltage regulator response . The graphics in the figures 4 and 5 were obtained by executing a transient analysis, with t ranging from 200 to 400 ms. By analyzing the graphics below, which corresponds to the envelope detector and voltage regulator respectively, we can see that the graphics can be summarized in a sinusoidal equation like the ones below:

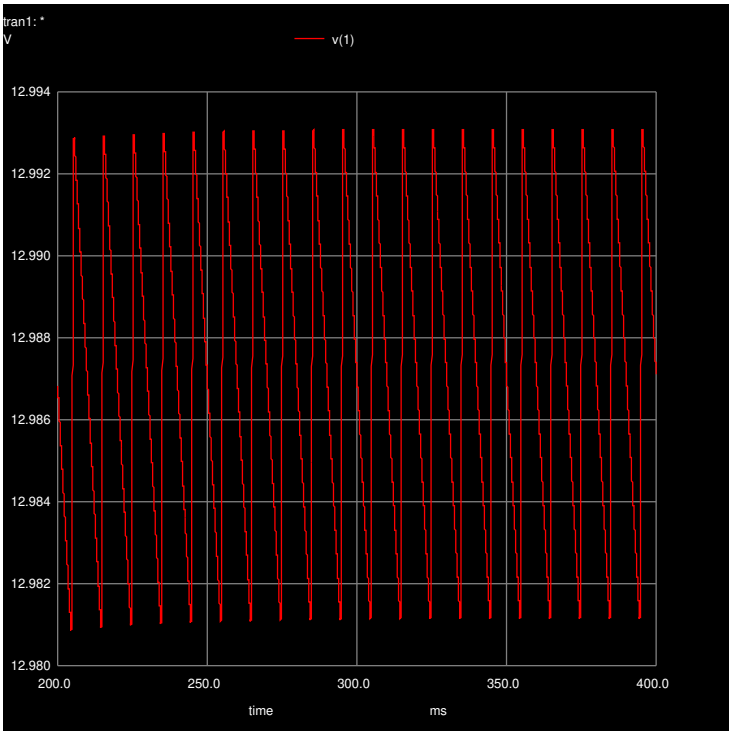

Figure 4: envelope detector output

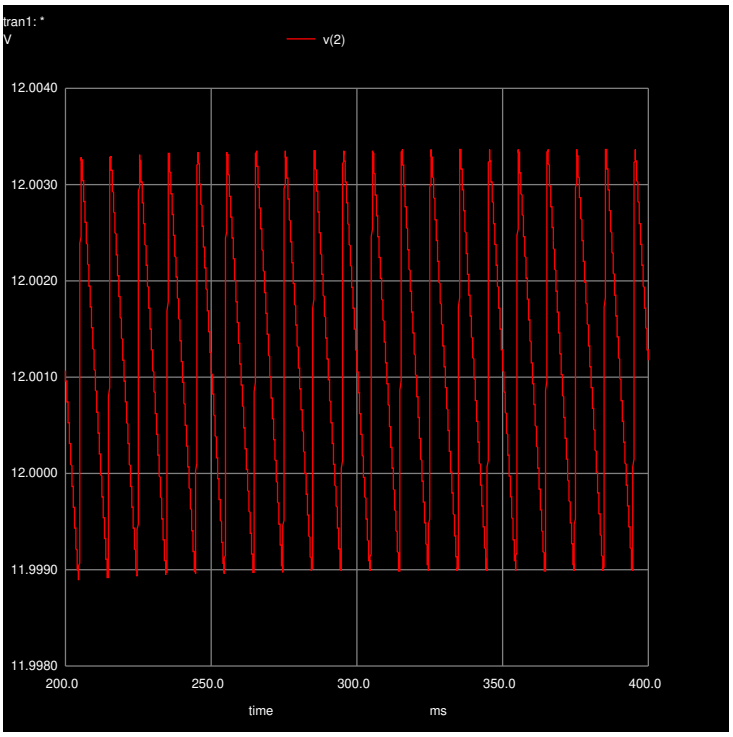

Figure 5: voltage regulator output

3.2 error

On this last graphic, we can see the standard deviation of the value of 12V from the average voltage and the errors between the simulation and theoretical values.

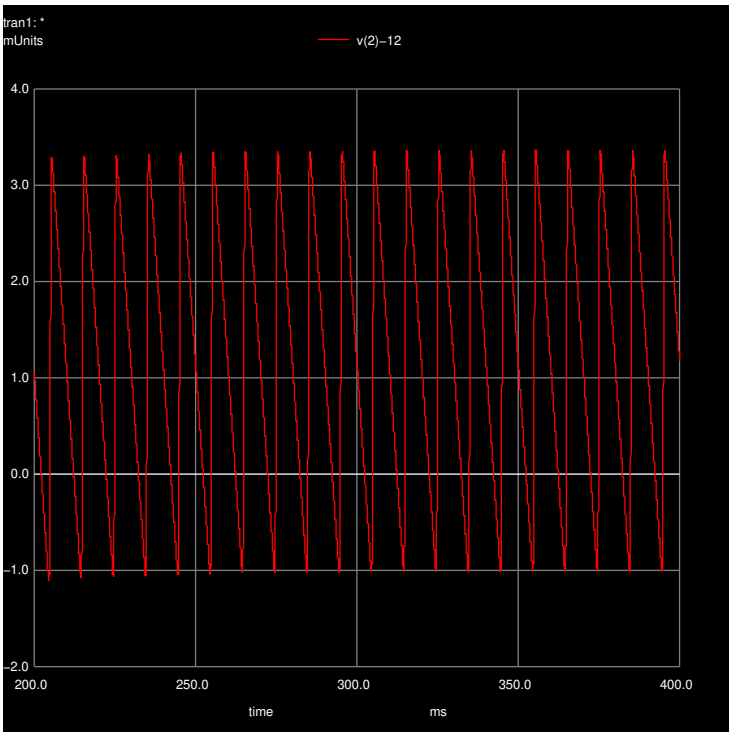

Figure 6: error plot

4 Conclusion

To summarize, the deviation between the theoretical and simulated vales, was higher than what we were expecting, however, this doesn't mean our methods aren't a good aproximation or that they cannot be used to simulate the circuit used in this lab assignment. The errors we obtained are most likely due to some mistakes made when writing the code and the circuit equations in octave and can be fixed. In conclusion, we should also mention that the cost we obtained for our circuit was slightly higher than we hoped for (the cost was 325,48 monetary units), but it was necessary.