Department of

Electrical & Electronics Engineering

Abdullah Gül University

EE1200 ELECTRONIC SYSTEM DESIGN CAPSULE

Project-1 AC to DC Adapter Design

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Submitted by: Ahmet Yasir Cilvez / 110110168

Lab Instructors: Sinan Genç

Grade: / 100

1. INTRODUCTION

A. Project Description

The objective of this project is designing an AC to DC adapter in accordance with the specified specifications. Planned adapter can be used in Turkey's city electricity and the output of the adapter can be used in telephone charging or supply little electronic devices.

B. Project Motivation

Adapters have very huge role in electrics and electronics areas, because every device has a special input voltage and ampere value. As a result of adapters, even though electricity voltage value is same for every device, voltage can be changed to either ac or dc and aimed range. Therefore, an electrical electronics engineer must know adapter technology. Addition of this main aim, the real house electricity voltage, reducing voltage by a transformer, AC to DC converting by a full rectifier circuit, using capacitor for reduce voltage drops, obtaining certain output voltage by LM317 are understand during this project.

2. MATERIALS AND METHODS

A. Required Components and Info About Components

Component Name	Value	Pieces	Cost	Info about Components
Transformer ASL171124	23VA 24V 958mA	1	84 TL	Transformers can be used in increasing or decreasing voltage level or filtering the signals. Voltage decreasing transformer is used in this project.
1N4148 Diode	-	4	0,24 TL	Generally, diodes can transmit electricity just one way (almost). In this project the feature that transmitting just one way is used and a full rectifier circuit is occurred by 4 diodes.

LM317	-	1	1,96 TL	LM317 is a changeable output level voltage regulator.
Capacitor	50V, 100uF	1	0,33 TL	This capacitor is used for eliminate voltage drops after rectifier circuit.
Capacitor	50V, 1uF	1	0,16 TL	These two-capacitor used in LM317 circuit for get a good and continuous DC voltage.
Capacitor	63V, 0.1uF	1	0,16 TL	
Resistor	2W, 1k Ohm	1	0,24 TL	
Resistor	0.25W, 1.3k Ohm	1	0,04 TL	These three resistors are used for set output voltage level of LM317 according to a rate.
Resistor	0,25W, 120 Ohm	1	0,04 TL	
Resistor	0,25W, 100 Ohm	1	0,04 TL	
Perforated Plate	2 x 10 Cm	1	2,29 TL	This is for combine all of components.

Total is : 105,34 TL

B. Project Steps

The AC-DC adapter is occurred by 3 different main part. These are transformer part, full rectifier circuit and LM317 (voltage regulating) part. Also, output ampere value is shown at the end of three parts.

C.1. Transformer Part

A transformer, ASL171124, is used to reduce voltage from 311V to 24V. The circuit diagram on LTSpice is shown in 1.

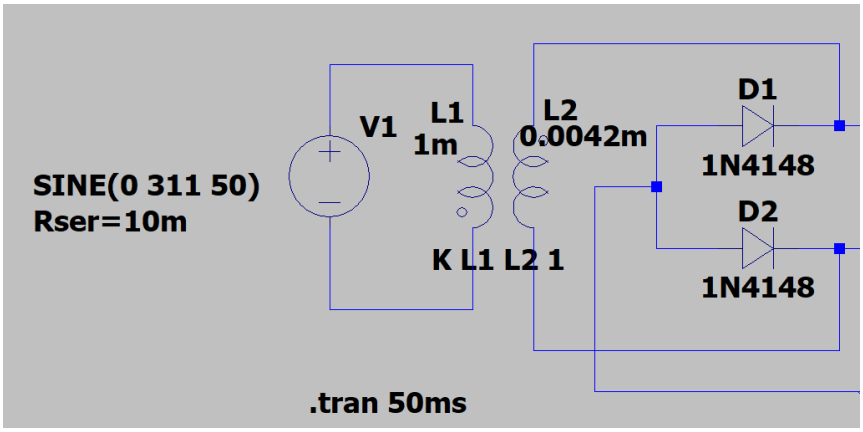


Figure 1

C.2. Full Rectifier Circuit

Rectifier circuits are occurred by 4 diodes, 1 resistor and 1 capacitor. The circuit diagram and graph are shown figure 2.

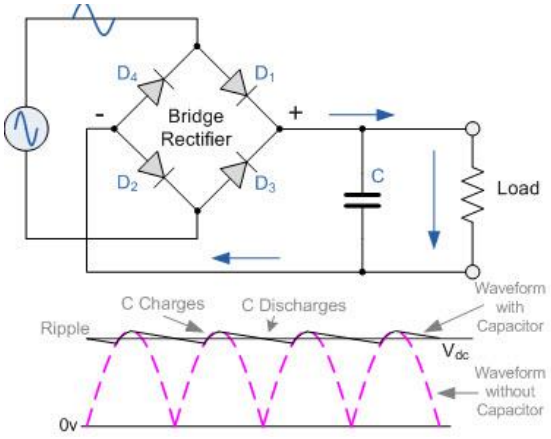


Figure 2

AC voltage's positive and negative signs switch between them. However, diodes transmitting signs are same. That's why they can transmit half of sinus wave like shown in figure 1. At the right of the circuit, capacitor is used for convert absolute sinus wave to a smooth DC line voltage. Capacitor are charged when voltage is increasing, and then while voltage decreases, capacitor discharge and supply the circuit. The circuit on LTSpice is shown in figure 3.

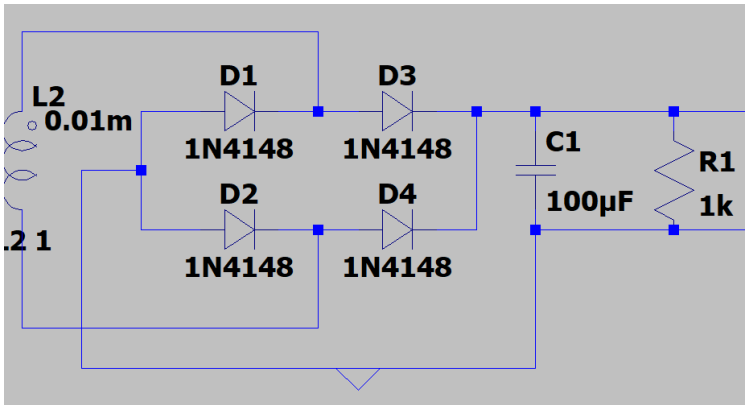


Figure 3

C.3. LM317 Circuit (voltage regulating)

After, rectifier circuit, 30V DC voltage is occurred and transmitted to LM317 voltage regulator. In this step, 24V voltage is regulated and decreased 19 V according to the student number (110110168). The diagram and calculations are shown in figure 4.

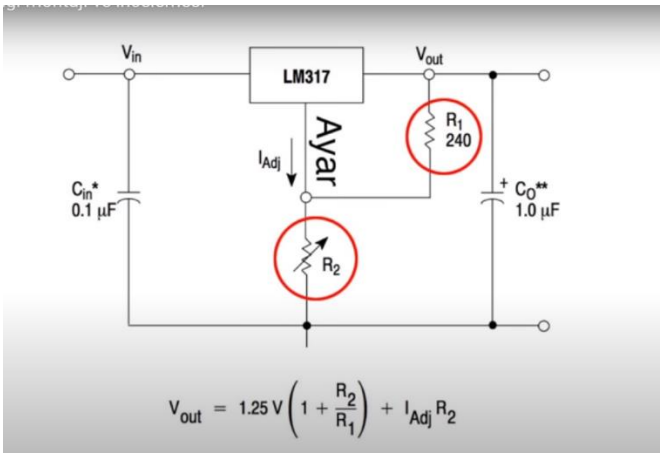


Figure 4

LTSpice diagram is shown in figure 4.

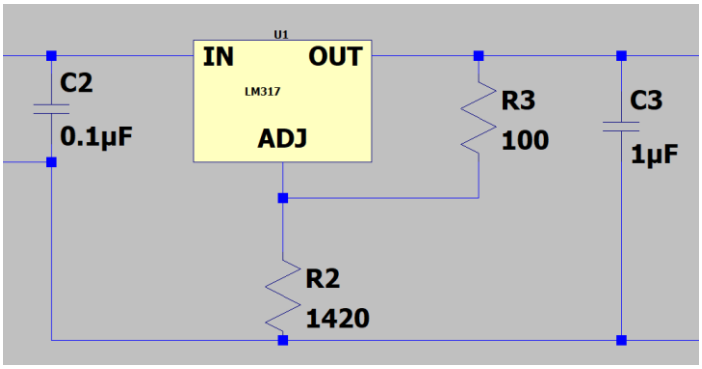


Figure 5

3. RESULTS

A.1 Theorical Transformer Part

In this part, 311V city electricity is aimed to convert 24V because at the end of the whole AC to DC adapter, 19V is targeted. 24V was enough and cheaper than high to high voltage transformers. Also, the formula of calculating inductance:

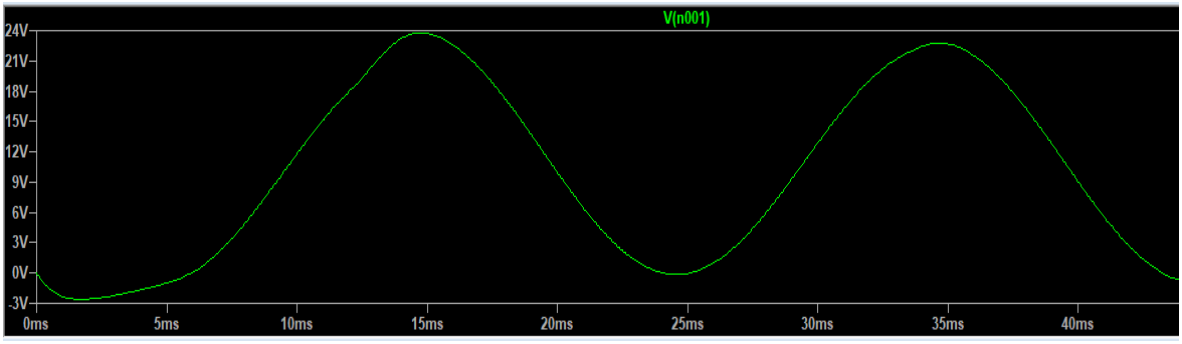
$$L = \frac{\mu . N^2 . A}{\ell}$$

The equation of relationship between input voltage and output voltage:

$$\frac{V_s}{V_p} = \frac{N_s}{N_p}$$

V_s = Secondary Voltage
V_p = Primary Voltage
N_s = Number of windings in secondary coil
N_p = Number of windings in primary coil

A.2 Simulation of Transformer Part



B.1 Theorical Full Rectifier Circuit

In this part, 24V 50Hz sinus input is aimed to convert 24V DC voltage. The theorical graph is shown in figure 6.

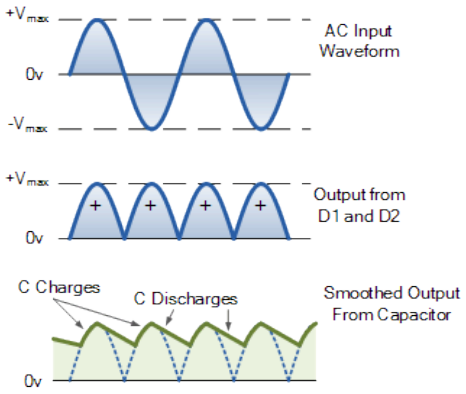
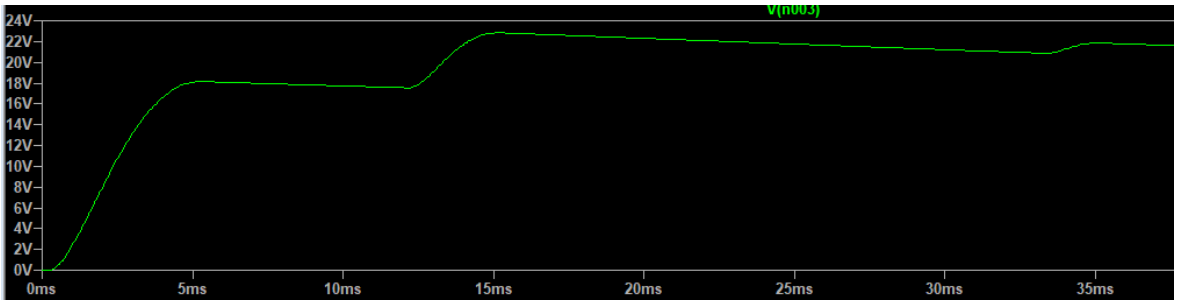


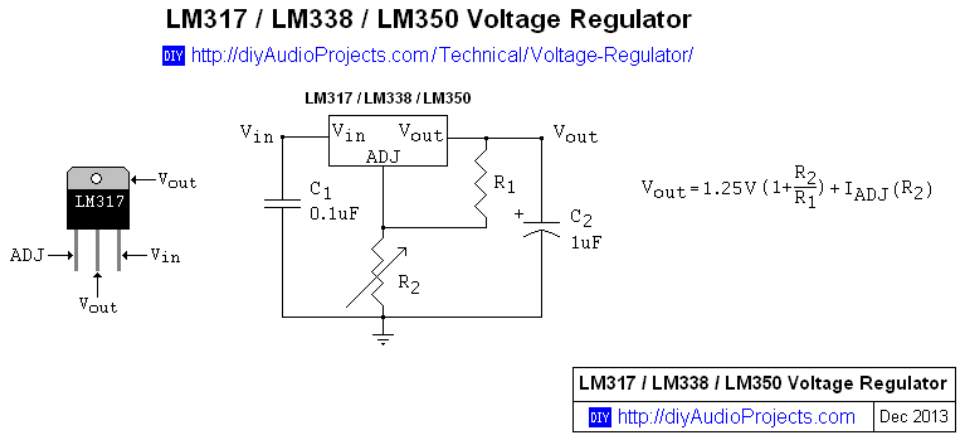
Figure 6

B.2 Simulation of Full Rectifier Circuit



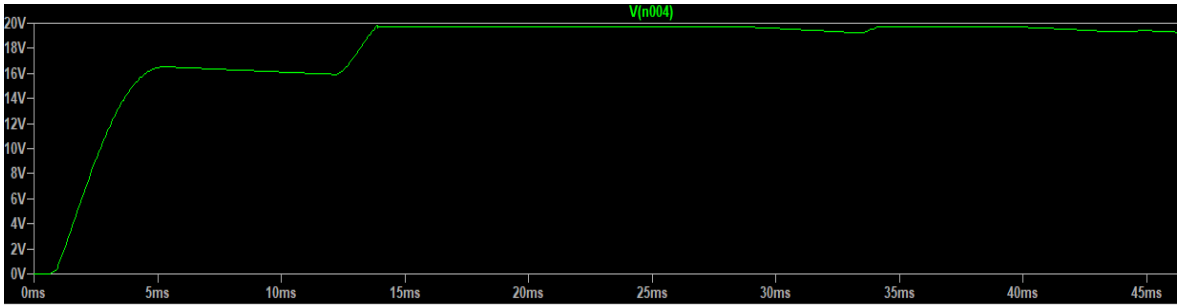
C.1 Theorical LM317 Circuit (voltage regulating)

In this part, input voltage is aimed to reduce to 19V according to the student number. The calculation is shown in figure 7.



To be obtain 19V, 100 ohm is used instead of R1 and 1420 ohm is used instead of R2.

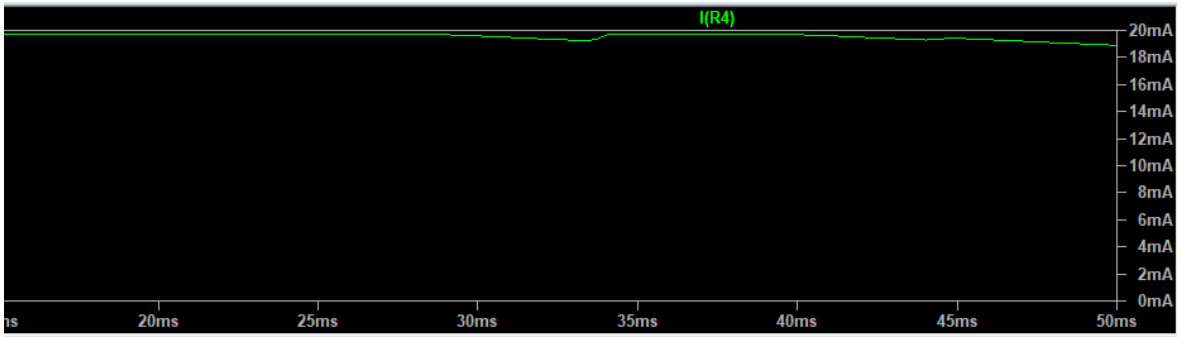
C.2 Simulation LM317 Circuit (voltage regulating)



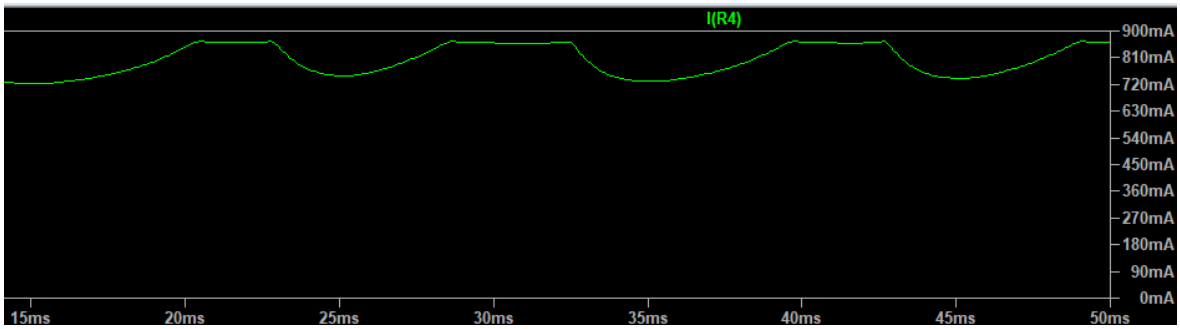
C. Output Ampere on Load Resistor (Telephone Simulation)

If a load resistor is added at the end of the circuit the output ampere is almost 900mA, approx. 890mA.

If 1k ohm resistor is used the ampere is:



If 1 ohm resistor is used the ampere is:



4. DISCUSSION AND CONCLUSION

In this project, an AC to DC adaptor is occurred. If theorical calculations is considered, the simulation results are a little bit different. In the transformer part, the sine wave is harmed and it's shape is change a little. However, in the rectifier part, especially thanks to the capacitor, even though shape is a little change, the DC voltage is obtained quite enough. Then the LM317 part, two extra capacitors are added and all of them help to obtain a good DC result.

At the beginning of the project 220V is used for input in this adapter but 220*sqrt(2)=311V gives to real input voltage. Because 220V is Rms value.

5. REFERENCES

[1]https://diyot.net/enduktans/

[2] https://www.ozdisan.com/

[3] https://diyaudioprojects.com/Technical/Voltage-Regulator/

[4] https://www.allaboutcircuits.com/