UNSE
Universidad Nacional
de Santiago del Estero

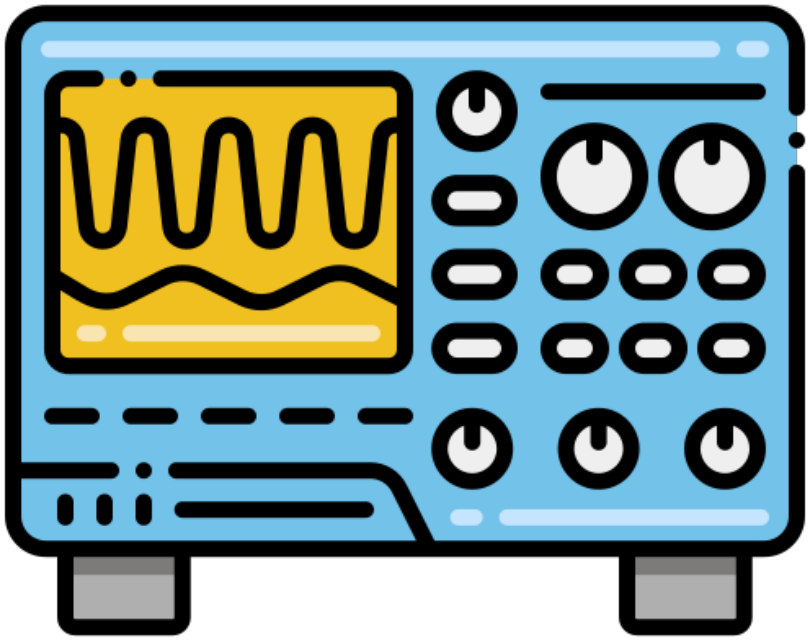
Facultad de Ciencias
Exactas y Tecnologías

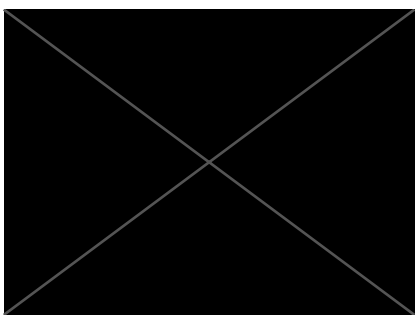
Santiago del Estero, 24 de abril del 2025

Ingeniería eléctrica

TP N° 1: Half-Wave Rectifier

Electronica II





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Objectives

- Assemble a half-wave rectifier circuit and analyze how the waveform behaves when varying the load resistance.

Introduction

Rectifier diodes

Diodes are fundamental components in electronics because they allow current to flow in only one direction. Their non-linear behavior underpins many applications, with rectification being one of the most important. Understanding how they work is essential for analyzing circuits that convert alternating current (AC) to direct current (DC).

Half-wave rectifier

This report specifically studies the half-wave rectifier, one of the simplest and most representative circuits for diode applications. This type of rectifier uses only one half-cycle of the AC signal, generating a single-polarity signal that is useful as a basis for low-complexity power supplies.

Maximum power of a resistor

In the study of electrical circuits, one of the key aspects when working with resistors is knowing the maximum power these components can dissipate without being damaged. The power dissipated by a resistor is calculated from known circuit variables. Determining its maximum power involves analyzing the relationship between the applied voltage, the current flowing through it, and the manufacturer's specifications.

Materials used

- Transformer:
  Input voltage: 230 V AC
  Output voltage: (12 + 12) V
  AC Output current: 1 A
- Oscilloscope Rigol DS1052t 2 channels 50 MHz
- Protoboard
- Rectifier diode 1N4007
- Capacitor: 100 µF / 25 V
- Resistors: 100 Ω / 5 W and 1 kΩ / 1.2 W

Development

During the lab only half of the variac was connected, so 12 volts were used between its output and neutral.

After connecting the oscilloscope between neutral and the variac output, both were powered and the readings were noted (Image 1, Graph 1). Next, a diode was added in series with the variac and voltages were measured between:

- The variac neutral and the variac output (Image 2, Graph 2 “Blue”)
- The variac neutral and the diode output (Image 2, Graph 2 “Yellow”)

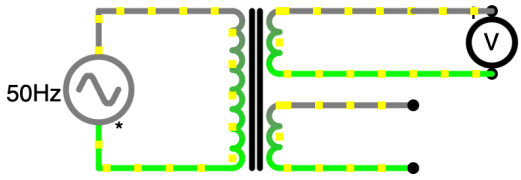


Image 1[1]

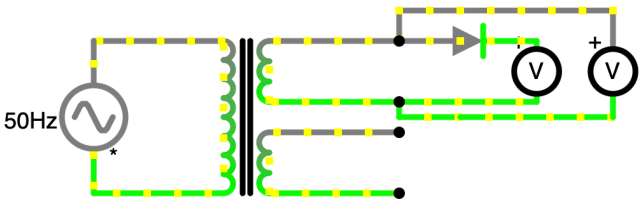
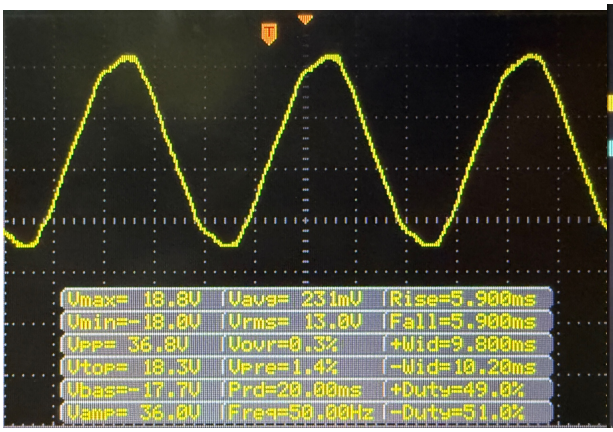


Image 2[2]



Graphic1

Graphic2

For the third circuit, the variac, diode, and capacitor were connected in series, and the voltages were measured between the variac neutral and the capacitor output (Image 3, Graph 3).

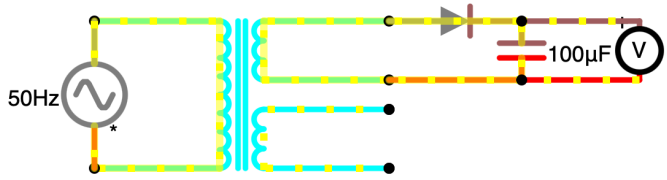
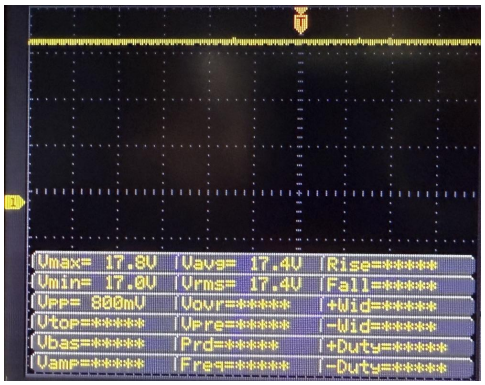


Image 3[3]



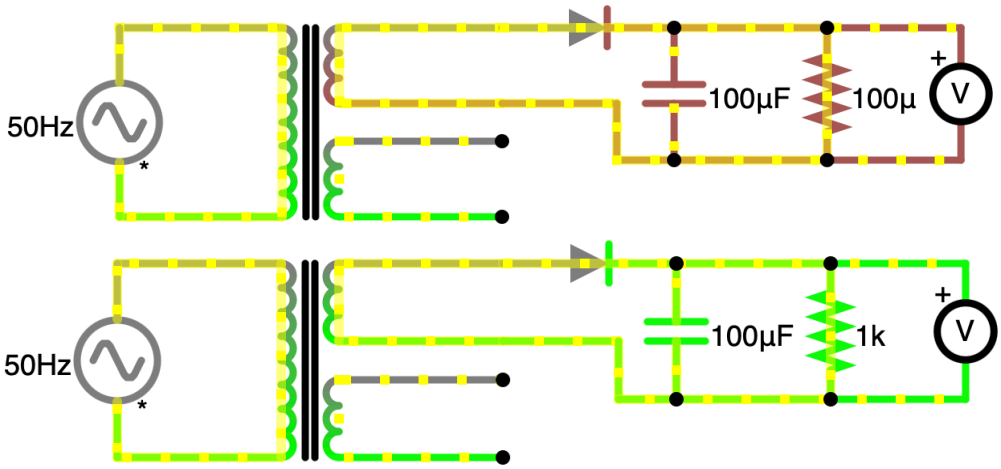
Graphic3

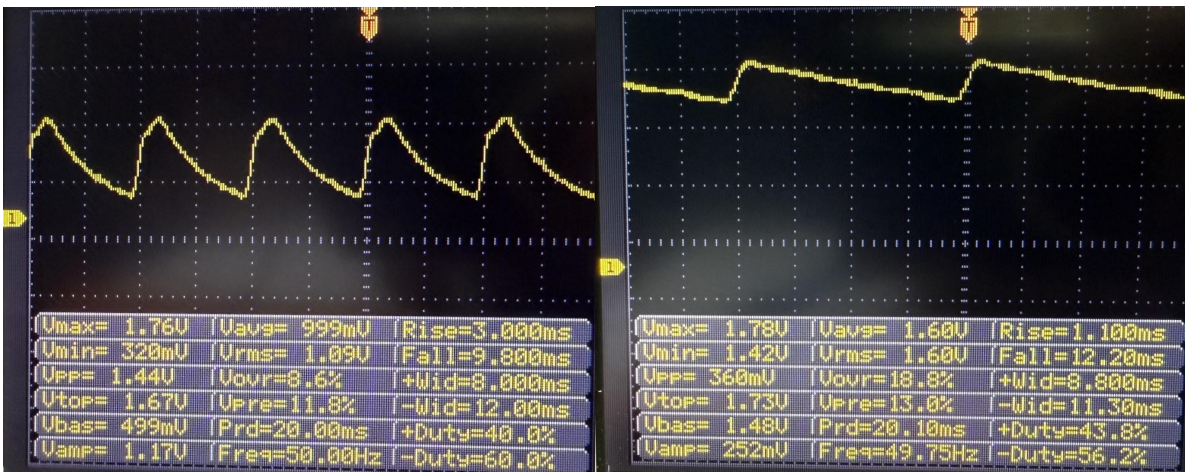
[1] Paul Falstad. (2025, April 26). *Circuits builder*. Falstad. https://www.falstad.com/
[2] Paul Falstad. (2025, April 26). *Circuits builder*. Falstad. https://www.falstad.com/
[3] Paul Falstad. (2025, April 26). *Circuits builder*. Falstad. https://www.falstad.com/

For the fourth circuit, the load resistor RL required to obtain an output current of 600 mA was calculated. The maximum power dissipated by the resistor was also computed, obtaining the following results: 29.66 Ω (see Data and calculations).

Since the required resistor was not available, the resistors listed under Materials were used to test the circuit. Beforehand, the power dissipated by those resistors was calculated to ensure there was no risk of burning them (see Data and calculations).

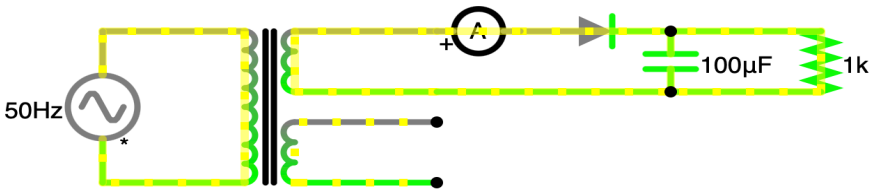
With both resistors, the voltages across their terminals were measured.





graphic 4 *graphic 5*

Finally, the current in the last circuit was measured and the following result was obtained: **16.6 mA**.



Data and calculations

Resistor for 600 mA output:

$E_C = 17{,}8\ V \quad \rightarrow \quad R_L = \frac{17{,}8\ V}{0{,}6\ A} = 29{,}6\underline{6}\ \Omega \quad \rightarrow \quad P_{max} = 0{,}6A * 17{,}8V = 10{,}68\ W$

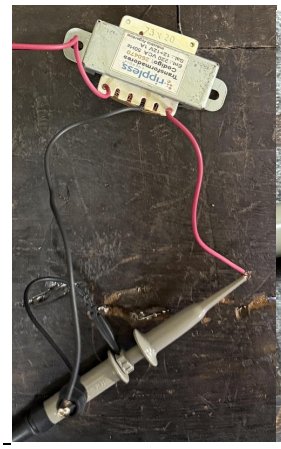
Power with 100 Ω / 5 W resistor:

$i_{R\,max} = \frac{17{,}8\ V}{100\ \Omega} = 178\ mA \quad \rightarrow \quad P_{max} = (178\ mA)^2 \quad * 100\Omega = 3{,}97\ W\ <\ 5\ W$

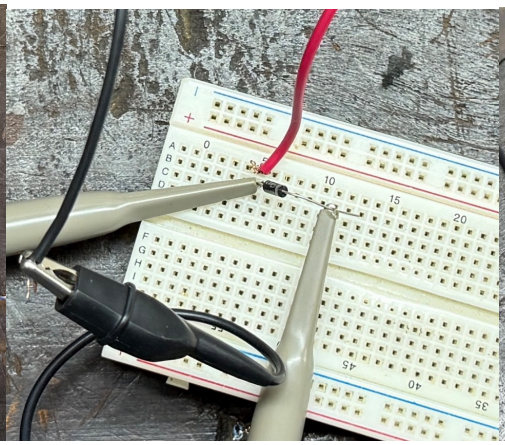
Power with 1 kΩ / 1.2 W resistor:

$i_{R\,max} = \frac{17{,}8\ V}{1\ K\Omega} = 17{,}8\ mA \quad \rightarrow \quad P_{max} = (17{,}8\ mA)^2 \quad * 1000\Omega = 0{,}317\ W\ <\ 1{,}2\ W$

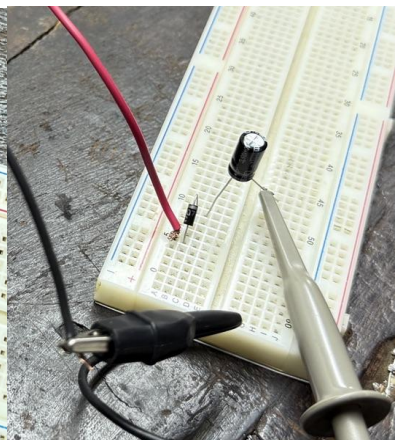
Annex



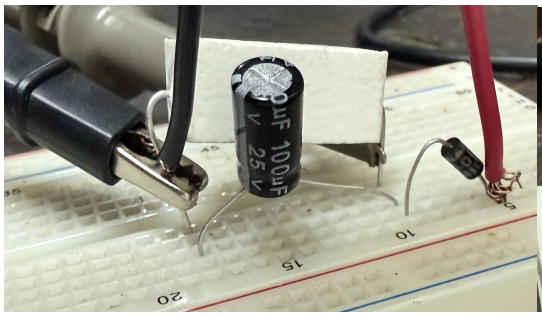
Circuit 1



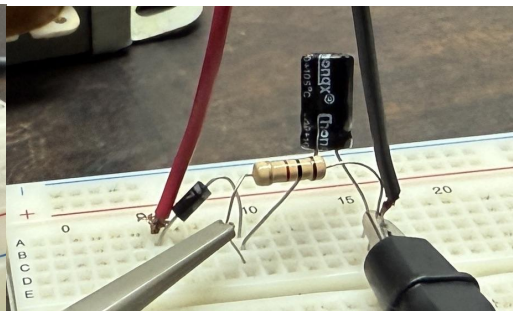
Circuit 2



Circuit 3



Circuit 4



Circuit 5

References

Paul Falstad. (2025, April 26). *Circuits builder*. Falstad. https://www.falstad.com/