ELECTRONICS (ETEN1000)

STUDENT NUMBER: **22663281**

NAME: Dhrubo Jouti das Troyee

GROUP: **12 pm to 2pm Thursday**

LABORATORY: **3 Diodes and Rectification**

LABORATORY SUPERVISOR: **: Dr King Sun Chan**

LABORATORY PARTNERS: **Tashi Lhadon**
22155746

DATE PERFORMED: **13/09/2024**

DATE DUE:

DATE SUBMITTED: 27/10/24

I hereby declare that the calculation, results, discussion and conclusions submitted in this report is entirely my own work and have not copied from any other student or past student.

Student Signature: Troyee

Diodes and Rectification

Introduction

The purpose of the lab was to observe the operation of diodes and rectifier in a circuit. Moreover, observing the effects of capacitors in a rectification circuit.

Aim

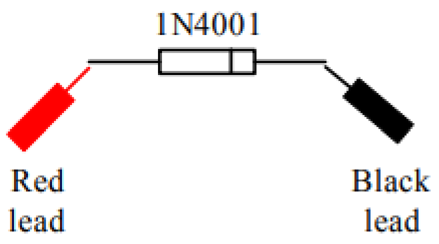
This experiment's main goal is to investigate how diodes work in rectifier circuits, covering half-wave and full-wave designs. This lab also attempts to measure and compare a diode's forward and reverse resistance values, as well as analyse the impact of various capacitors on output waveform smoothing.

Summery

We used diodes to connect half-wave and full-wave rectifier circuits in this experiment, and we measured the output waveforms that produced. Improvements in the DC output's stability and smoothness were noted when capacitors were added in parallel with the load resistor. Diode forward and reverse resistance measurements were made on a variety of ranges. A thorough examination of diode characteristics and rectification efficiency was made possible by the laboratory setup, which included oscilloscopes, digital multimeters, and function generators.

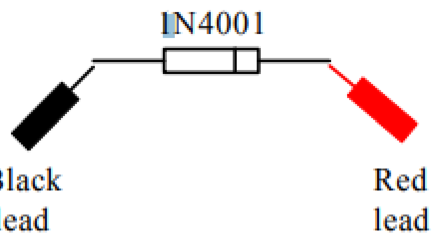
Circuit

Circuit 1 – Forward Resistance



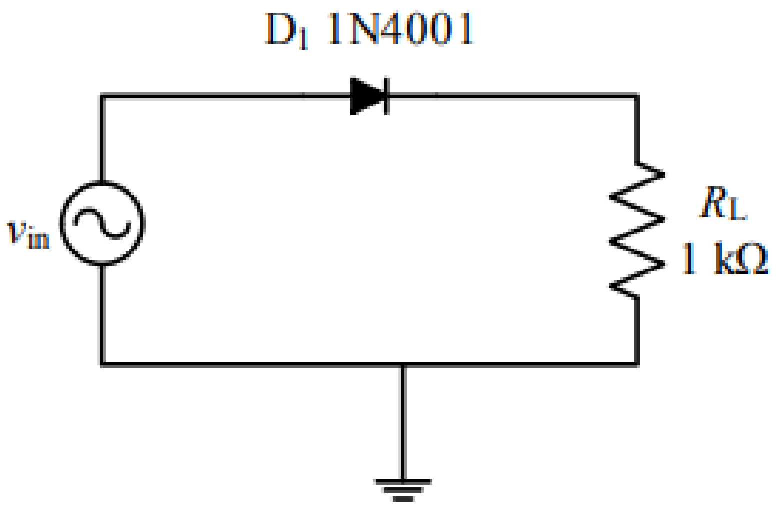
Forward Resistance

Circuit 2 – Reverse Resistance

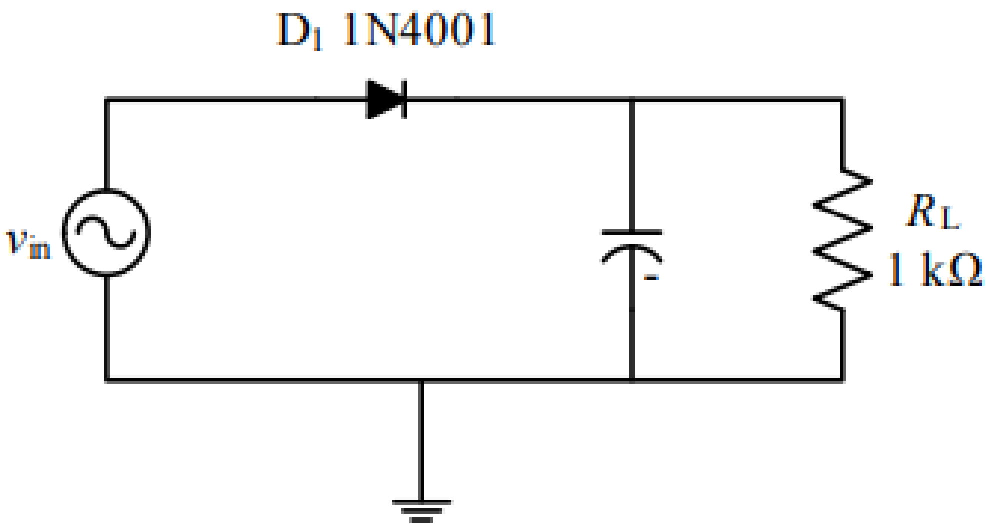


Reverse Resistance

Circuit 3 – Half Wave Rectification



Circuit 4 – Half Wave Rectification with Capacitor in Parallel to RL



Circuit 5 – Full Wave Rectification

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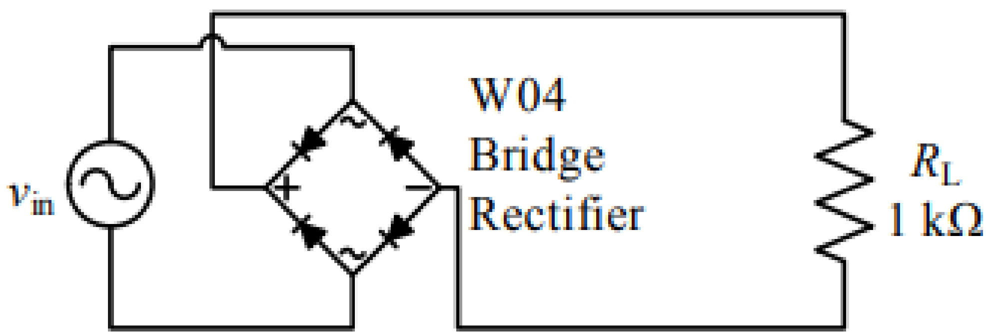

Result

Scale	**Forward resistance**	**Reverse resistance**
200 Ω	**0Ω**	**0Ω**
2 kΩ	**1.1883 kΩ**	**0Ω**
20 kΩ	**9.665 kΩ**	**0Ω**
200 kΩ	**77.72 kΩ**	**0Ω**
2 MΩ	**0.5778 mΩ**	**0Ω**

Table 1 :forward and reverse resistance of a diode

In forward bias, the diode is conducting, as indicated by the measurable forward resistance values at each scale. Current can flow through a diode when its anode (positive side) is connected to the voltage source's positive terminal and its cathode (negative side) to its negative terminal. By reducing the diode's internal potential barrier, this configuration permits the majority carriers—holes and electrons to pass through the junction and conduct current. To keep this current flowing, the source voltage needs to be higher than the voltage drops across the diode.

The diode displays 0 Ω resistance for all measured scales when in reverse bias, suggesting it does not conduct. In this case, the cathode and anode are linked to the voltage source's positive and negative terminals, respectively. By increasing the diode's internal potential barrier, this arrangement stops any current flow. In simpler terms, by preventing any current from flowing through, the reverse bias "turns off" the diode and causes it to function as an insulator.

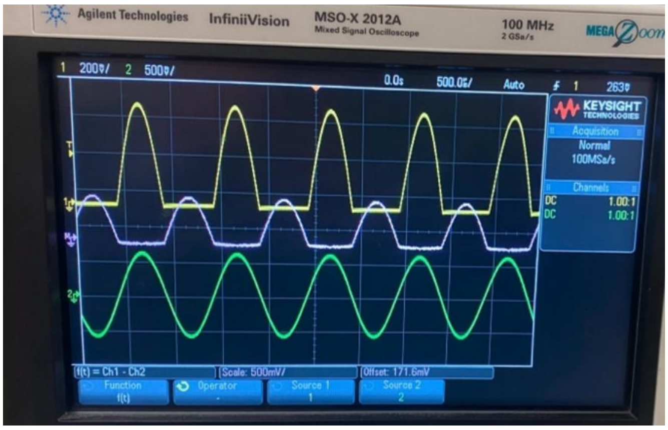

Figure 1 Half Wave Rectification

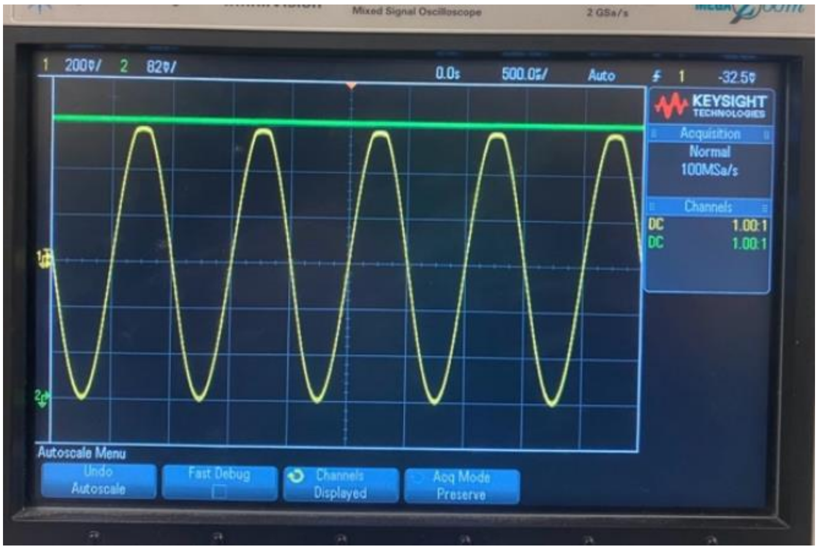

Figure 2 Half Wave Rectification with a 100 pico F capacitor in parallel with R_L

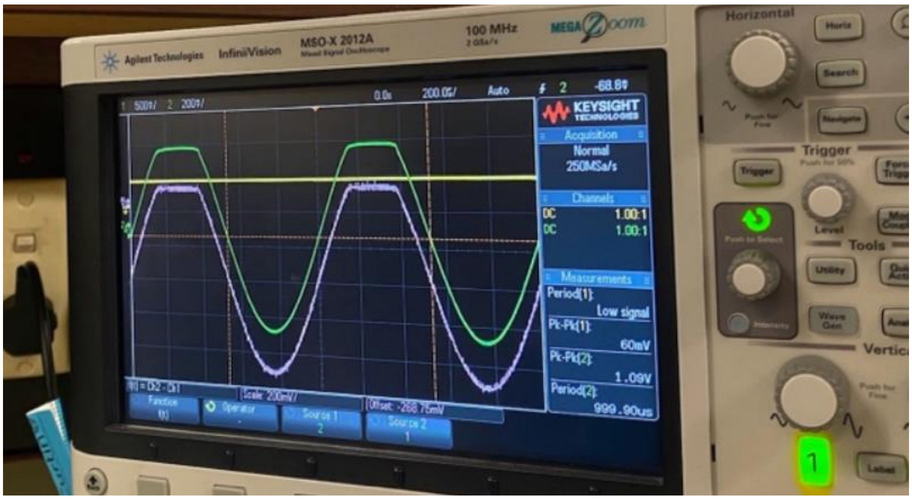

Figure 3 Half Wave Rectification with a 470 pico F capacitor in parallel with R_L

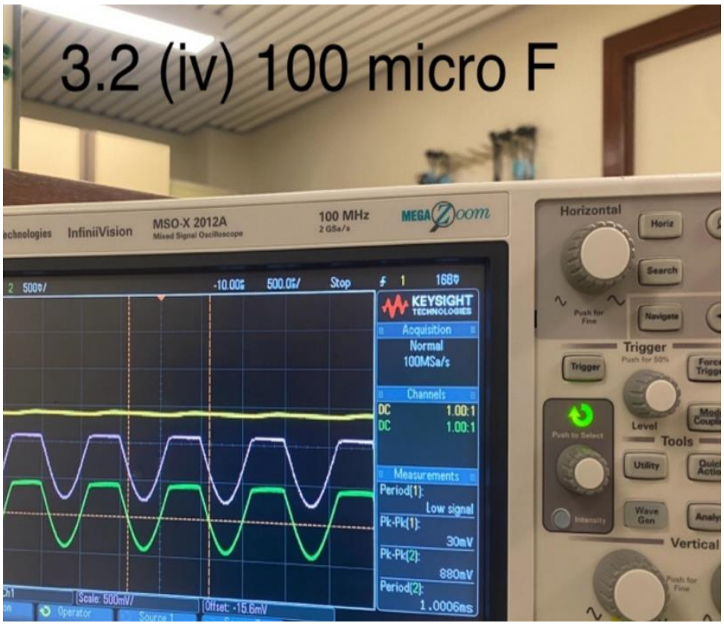

Figure 4 Half Wave Rectification with a 100 pico F capacitor in parallel with R_L 100 Ω

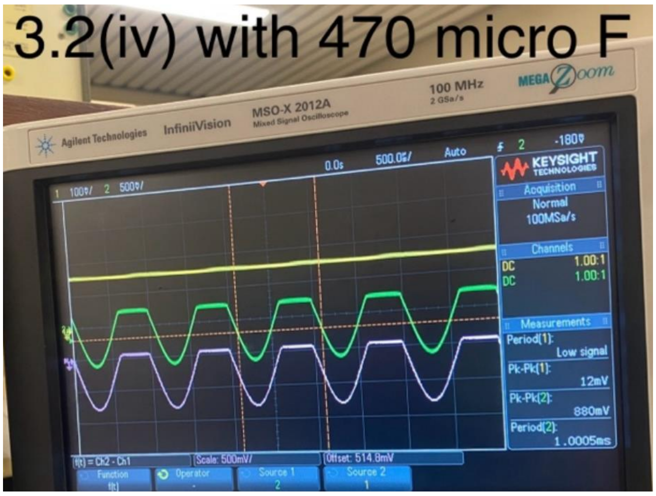

Figure 5 Half Wave Rectification with a 470 pico F capacitor in parallel with R_L 100 Ω

Figure 6 Full Wave Rectification

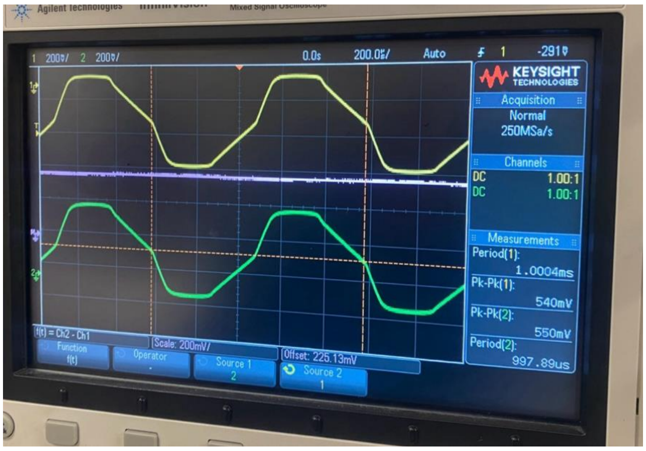

Figure 7 Full Wave Rectification with a 100 pico F capacitor in parallel with R_L

Discussion

The voltage between the input and the load resistor RL and the diode was successfully measured by using Figure 1, where the measurements were achieved by giving an AC sinusoidal signal with 12 Vpeak-peak from Function Generator as the input voltage. Using the oscilloscope's SUBSTRACT function, the waveforms over the diode were acquired, and the resulting wave showed particular peaks. In figure 1 the green waveform displays the input voltage. Yellow waveform one displays the output current, where purple shows the output voltage waveform which obtained by subtracting two waveforms.

In figure 2 , the capacitor in the circuit is charged to the input signal's maximum voltage. It gradually discharges after reaching its full charge, supplying a constant current through the load resistor R_L .The voltage across the load slowly drops as a result of this discharge until the capacitor is recharged by next input cycle. Continuous repeating of this charging and discharging cycle produces an output waveform (green) that approaches the input voltage peak value (yellow). This smoothing effect produces a more stable DC-like output.

The peaks in Figure 3 are much smoother since a 470 pF capacitor was used .The yellow waveform, which represents the output voltage, shows a smoother line than in earlier findings.. This effect is caused by a connection between the voltage ripple and the capacitance; a higher capacitance reduces ripple, which raises the output voltage's consistency and quality.

Figure 4 shows how the waveforms alter when the capacitor is returned to 100 pF and R_L changes to 100 Ω resistor rather than the original 1 **k** $\boldsymbol{\Omega}$. The reduced capacitance has caused a little distortion in the yellow waveform. The capacitance is directly proportional to voltage stability and inversely related to ripple, therefore a lower value of the capacitor leads to more fluctuation and a less stable output voltage, as previously explained.

The waveforms in Figure 5 are altered when the capacitor is re-adjusted to 470 pF and R_L is swapped out for a 100 Ω resistor rather than a **1 k $\boldsymbol{\Omega}$.** The yellow output waveform shows a noticeable decrease in distortion when a 470 µF capacitor is used. This highlights how the value of the capacitor directly affects the output voltage since higher capacitance produces a smoother and more stable waveform by reducing ripple.

The shown results were obtained by adjusting the circuit to incorporate a Bridge Rectifier, as seen in Figure 6, and using a 12-volt peak-to-peak input voltage from the function generator. The bridge rectifier successfully transformed the AC input into a full-wave rectified output; the input current is represented by the yellow waveform, the load current by the green waveform, and the voltage across the load by the purple waveform. This configuration shows effective rectification by assuring a continuous output waveform with no pauses in between cycles.

A small adjustment was performed to connect a 100 µF capacitor in parallel with R_L in order to obtain the results shown in Figure 7. With this arrangement, the current can pass through the load resistor while processing both the positive and negative half-cycles of the AC input signal. By reducing ripple, the capacitor's presence smoothes the output waveform and produces a more stable output.

Conclusion

In summary, the laboratory results supported our knowledge of diodes in rectification and the significance of capacitors in smoothing DC output by matching theoretical assumptions. In accordance with the study material, this experiment offered beneficial findings.

References

Nil

Appendices

Nil