Trinity College Dublin
Coláiste na Tríonóide, Baile Átha Cliath
The University of Dublin

Electro technology Lab Report

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LAB SESSION: SESSION 2 (4 – 6PM)

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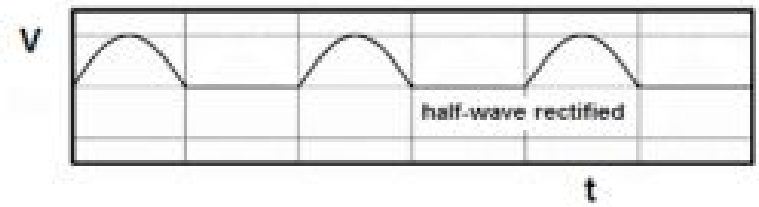
MODULE: CS 1025

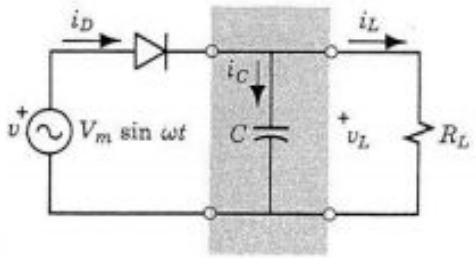
OBJECTIVE

Observe the output graphs of a circuit consisting of a resistor, a.c current and a diode and a capacitor. Note the purpose and effect of adding a capacitor to the circuit. Observe the graph on the oscilloscope.

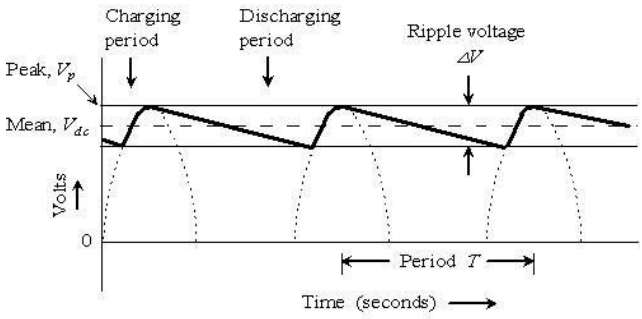
INTRODUCTION

Alternating current (AC) can be converted into direct current (DC) using a half wave rectifier. Rectifiers are used in circuits that require a steady voltage. However, after converting to direct current, only half of the original signal is passed to the next stage, giving a large variation of voltage with time. Most electronic applications required DC voltage with a smoother change in voltage. One way to smooth the half wave rectified voltage is to place a capacitor in parallel with the load





By adding the capacitor, the load voltage is smoothed



APPARATUS

1. 10KΩ resistor
2. A.C current source
3. 1 diode
4. Breadboard

5. Oscilloscope
6. 1 µF capacitor
7. 10 µF capacitor

BACKGROUND INFORMATION

CAPACITANCE

Capacitance is the ability of a dielectric (*insulator*) to hold or store an electric charge. The higher the charge the higher the capacitance. The symbol for capacitance is *C,* and the unit measurement is the farad (F),

CAPACITOR

A capacitor consists of an insulator (*dielectric)* between two conductors. The conductors make it possible to apply voltage across the insulator. One of the main functions of a capacitor is to block a steady dc voltage while passing ac signals. The higher the frequency, the less the opposition to ac voltage.

DIODES

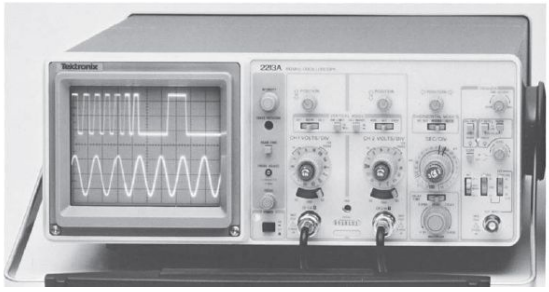
A *diode is a* semiconductor and is made by joining *p* - and *n* –type semiconductor materials. It is a 'current valve', allowing current to flow in one direction but not the other

METHOD

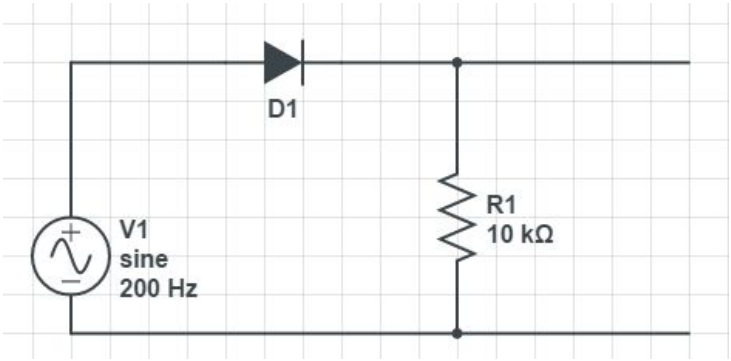
HOW TO USE AN OSSILOSCOPE

Oscilloscopes have the ability to measure the time, frequency, and voltage level of a signal, view rapidly changing waveforms, and determine if an output signal is

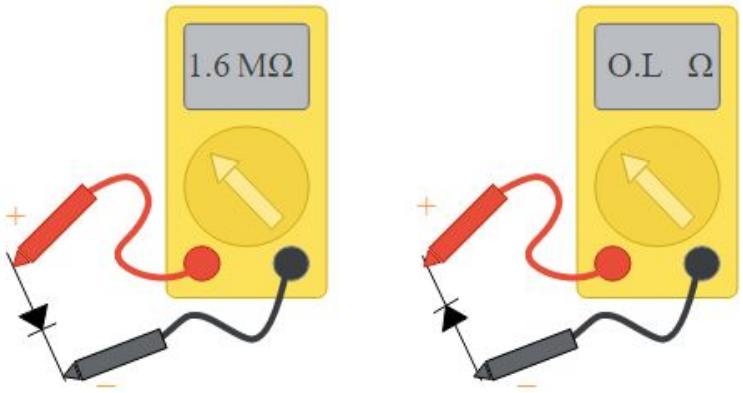
distorted. An analog oscilloscope displays the instantaneous amplitude of an AC voltage waveform versus time on the screen of a cathode-ray tube (CRT). The oscilloscope is a graph-displaying device. The vertical axis (Y) represents voltage and the horizontal axis (X) represents time. Inside the cathode-ray tube is an electron gun assembly, vertical and horizontal deflection plates, and a phosphorous screen. The electron gun emits a high-velocity beam of electrons that strike the chemical coating on the inside face of the CRT, causing it to emit light. The intensity of light can be varied by a control located on the oscilloscope front panel. In general, an oscilloscope is normally used to make two basic measurements; amplitude and time. Oscilloscope probes (*LOW-CAPACITANCE PROBE (LCP) & DIRECT PROBE)* are the test leads used for connecting the vertical input signal to the oscilloscope. Before starting an experiment with the oscilloscope we must ensure that it is calibrated correctly to ensure we get accurate results.



Circuit 1

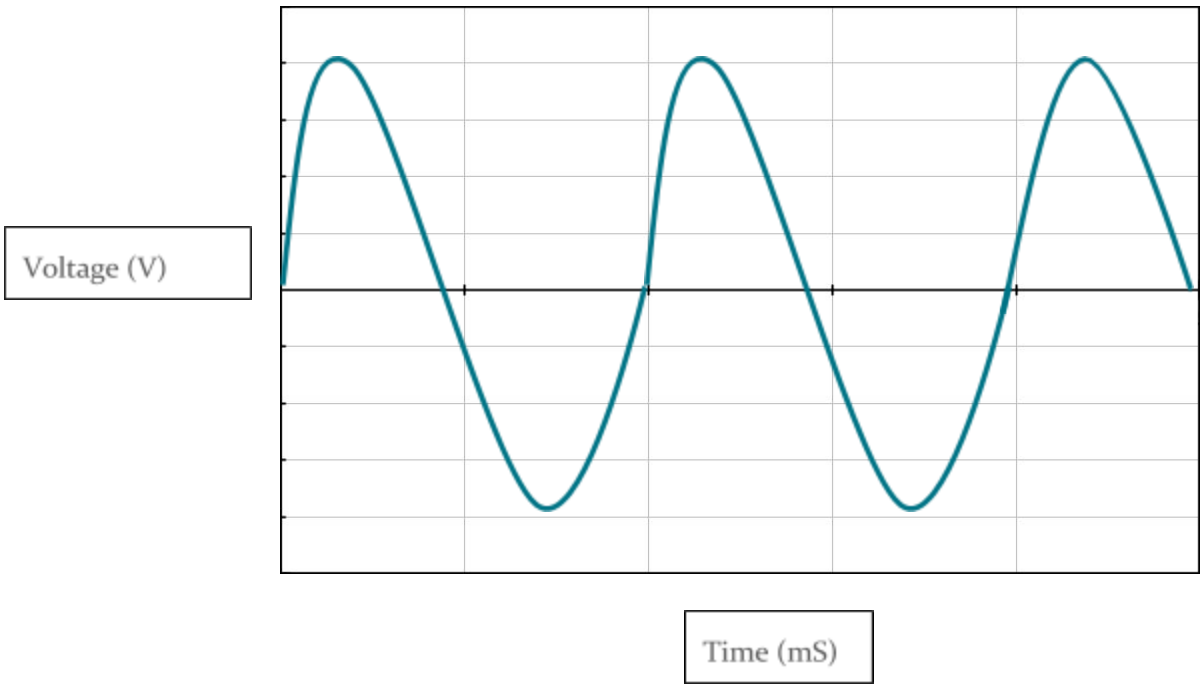


1. Before beginning the experiment we had to verify the identity of the terminals of the diode using the ohm-meter. We needed this to figure out the forward current direction. On the resistance setting, the meter puts a small voltage on its test leads. You use that small voltage to see which way current flows. If the ohm-meter reads a finite resistance, that means the diode is conducting a small current in the forward direction, and the red ++plus lead from the meter is touching the anode. If the resistance reads O.L (for overload), the diode is not conducting current. That means the red ++plus test lead is touching the cathode.

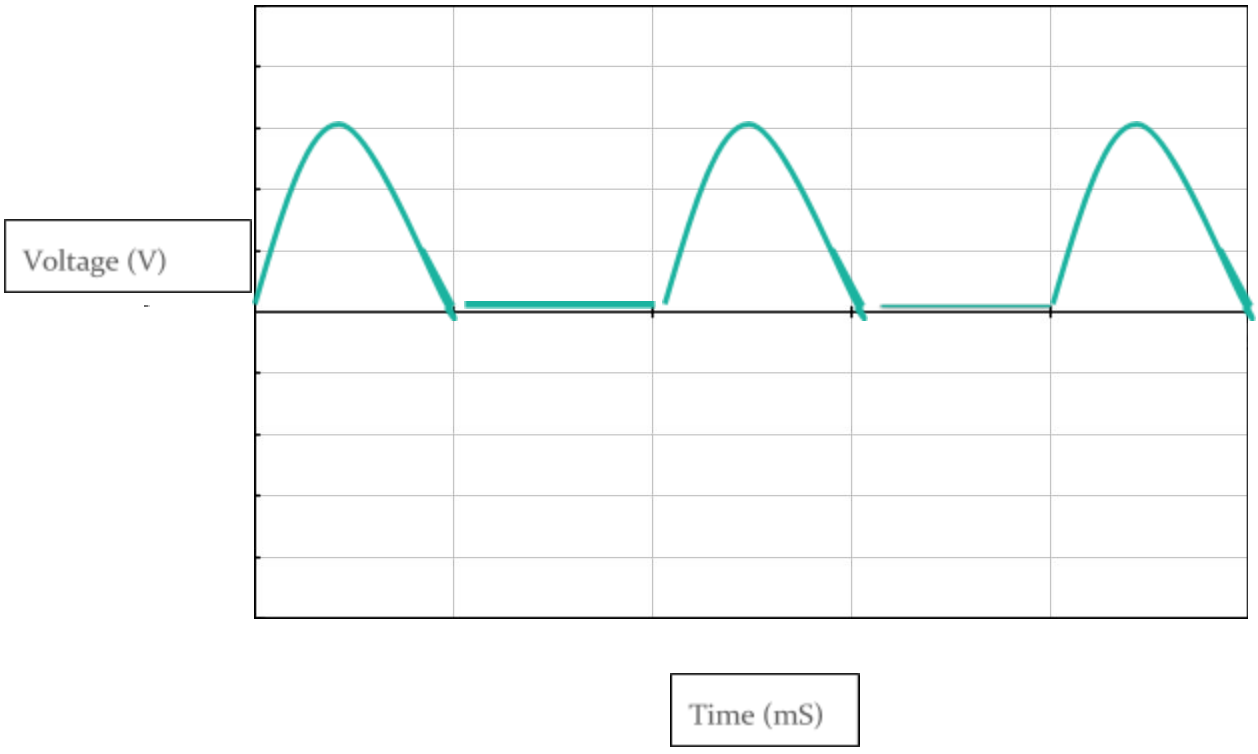


2. Place the sinusoidal waveform voltage source, the resistor and the diode in the breadboard.
3. Connect the diode and resistor in parallel.
4. Connect the function generator to the resistor and channel 1 of oscilloscope to the circuit output.
5. Connect function generator, oscilloscope ground terminal to the common ground of the breadboard.
6. Set the frequency and amplitude of the input signal.

INPUT



OUTPUT GRAPH



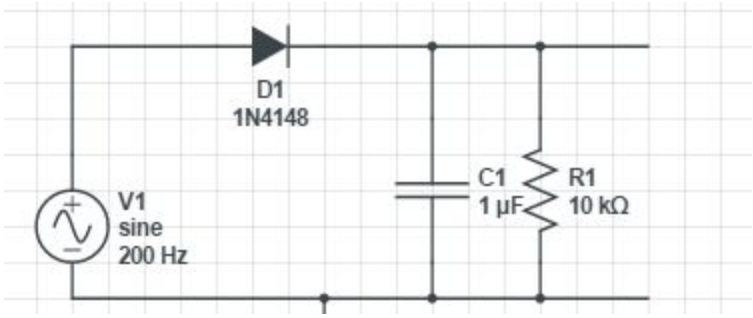
ANALYSIS OF GRAPHS

For the diode to become forward biased, it must have the input voltage greater than +0.6 volts. When this happens the diodes begins to conduct and holds the voltage across itself constant at 0.6V until the sinusoidal waveform falls below this value. Then the output voltage which is taken across the diode cannot be greater than 0.6 volts during the positive half cycle. When the diode is in forward bias its increase in its voltage the forward current increases slowly. When the forward voltage is equal to the threshing voltage the forward voltage increases rapidly.

Alternating current (AC) can be converted into direct current (DC) by using a half wave rectifier. However, after converting to direct current, only the half of the original signal is passed to the next stage.

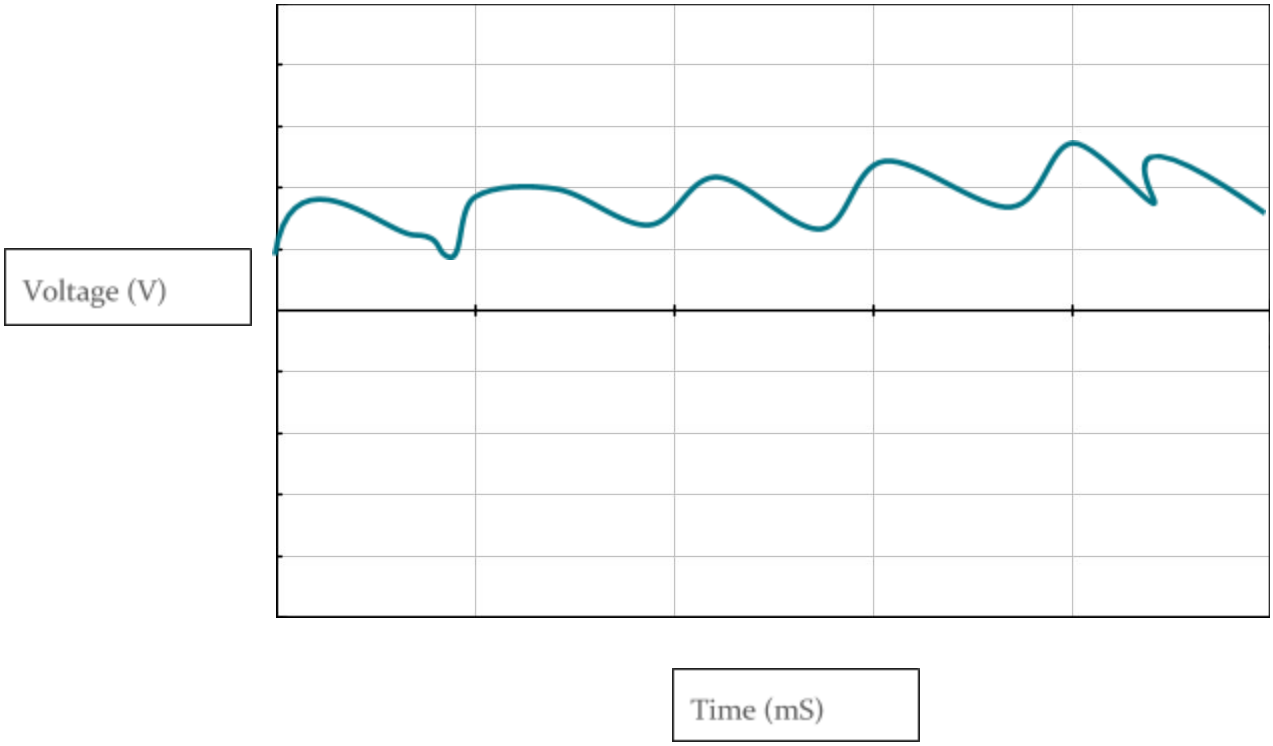
A half wave rectifier is rarely used in practice. It is never preferred as the power supply of an audio circuit because of the very high ripple factor. High ripple factor will result in noises in input audio signal, which in turn will affect audio quality.

CIRCUIT 2

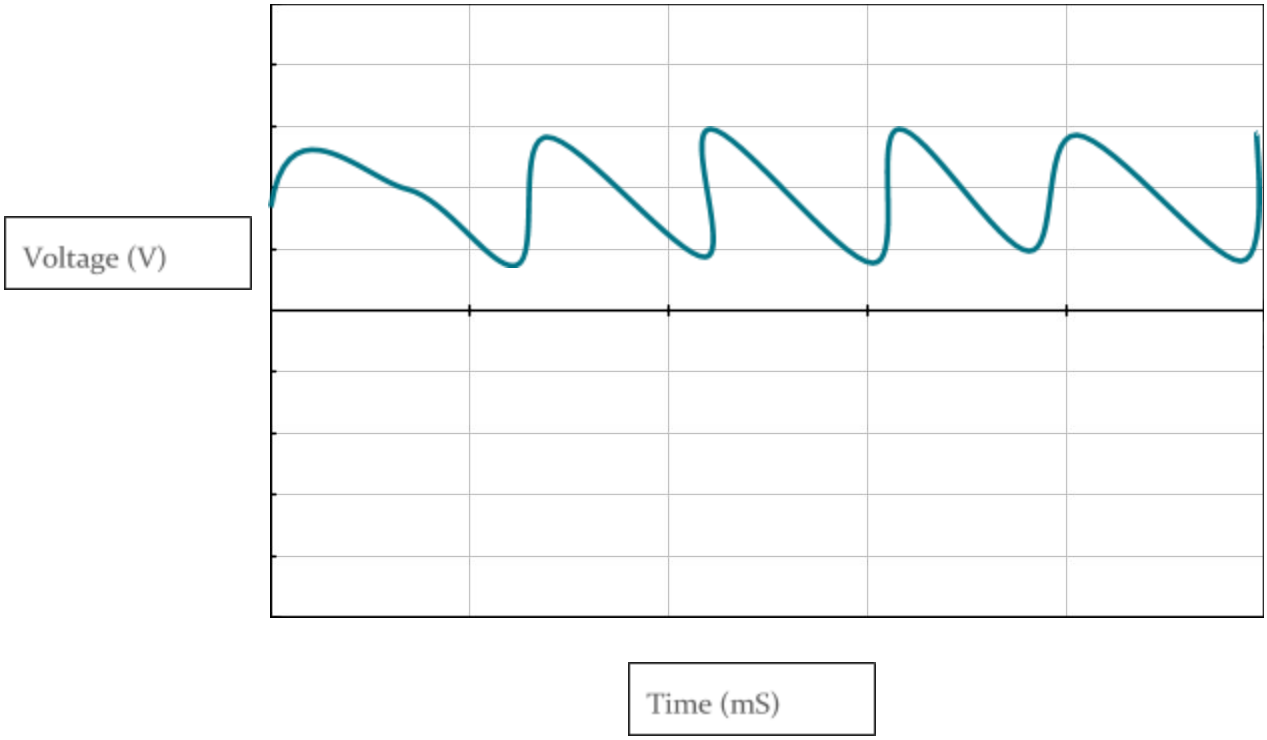


8. Repeat this experiment twice, for the first case with a 1 µF capacitor and the second case with a 10 µF capacitor

10 µF capacitor



1 µF capacitor

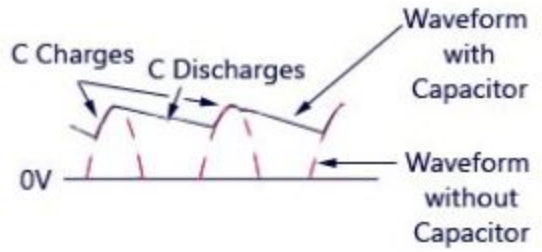


ANALYSIS OF GRAPH

Output of half wave rectifier is not a constant DC voltage. This is visible from the output diagram that it's a pulsating dc voltage with ac ripples. In real life applications, we need a power supply with smooth wave forms. We need a DC power supply with constant output voltage. A constant output voltage from the DC power supply is very important as it directly impacts the reliability of the electronic device we connect to the power supply.

We can make the output of half wave rectifier smooth by using a resistor-capacitor coupled filter. On the charge cycle of the smoothing capacitor, the capacitor needs to replace all the lost charge, but it can only achieve this when the voltage from the rectifier exceeds that from the smoothing capacitor. This only occurs over a short period

of the cycle. Consequently the current during this period is much higher. The large the capacitor, the better it reduces the ripple and the shorter the charge period.



This capacitor charges up when the voltage from the rectifier rises above that of the capacitor and then as the rectifier voltage falls, the capacitor provides the required current from its stored charge.

CONCLUSION

By using a resistor-capacitor coupled filter a half wave rectifier can produce a smoothed d.c current. The wave can be viewed on the oscilloscope screen.

SOURCES

http://scholarcommons.usf.edu/cgi/viewcontent.cgi?article=4856&context=ujmm

http://www.circuitstoday.com/half-wave-rectifiers

http://www.radio-electronics.com/info/circuits/diode-rectifier/rectifier-filtering-smoothing-capacitor-circuits.php

Grob's Basic Electronics 11th Edition