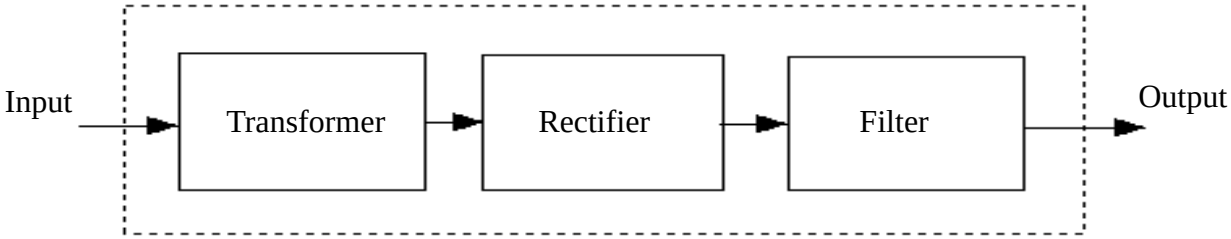
AC TO DC CONVERSION

Purpose

To study the rectification of AC to DC voltage. To work with the diode and the capacitor.

Introduction

The most sophisticated electronic device is constructed from discrete circuits. Most of these discrete circuits require power to operate. The discrete circuit which supplies the power to all the other discrete circuits within a device is called a **power supply**. The power supply itself usually consists of three circuits: a transformer, a rectifier, and a filter.



POWER SUPPLY

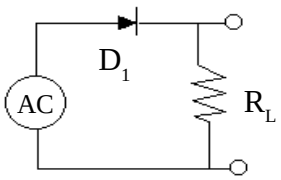
Transformer

A transformer is device used to transfer energy from one circuit to another by electromagnetic induction. A basic transformer consists of two coils of wire (called the primary and the secondary) wound around a common magnetic core. Although the two coils are not electrically connected, power in the primary is coupled into the secondary by the changing magnetic field which magnetically links the two coils. By having more or fewer turns in the secondary coil compared to the primary coil, the tranformer can step-up or step-down the generator voltage and provide the required amount of secondary voltage. Please note that the transformer is a discrete component and will not require assembly.

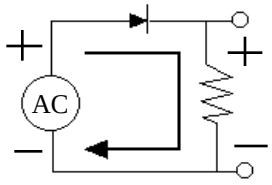
Rectifier

The conversion of AC to DC is called rectification. During the rectification, the negative half-cycle of the supply current is either eliminated or turned around(rectified). The current thru the load (R_L) will always flow in the same direction. The two rectification circuits which will be examined in this experiment are the half-wave rectifier and the full-wave rectifier.

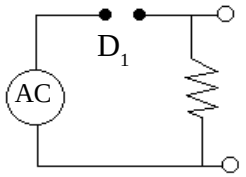
(a) Half-wave rectification takes place when only the positive half-cycle of the source voltage is used. Compared to the full-wave rectifier, half-wave rectifiers are cheaper to construct (fewer parts) but are less efficient.



Half-wave Rectifier

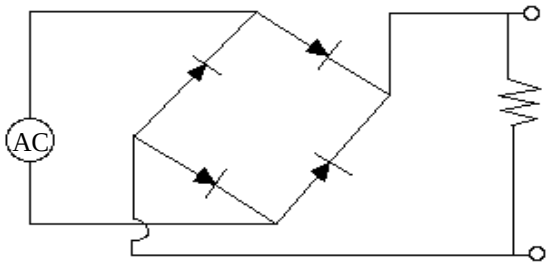


Positive half-cycle



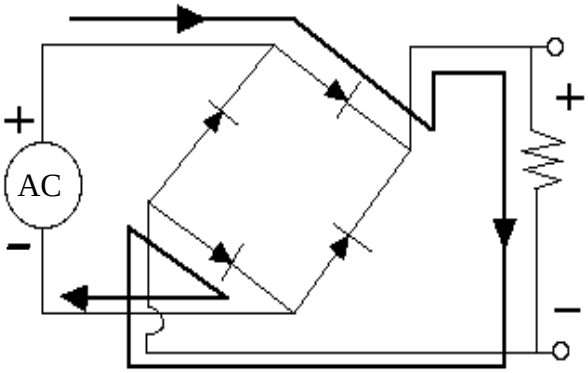
Negative half-cycle

(b) Full-wave rectification allows current to flow during both the positive and negative half-cycles. Notice that only two diodes are active for a given half-cycle the inactive diodes appear as an open circuit path to the current. Also note that the current path thru the load is unidirectional.

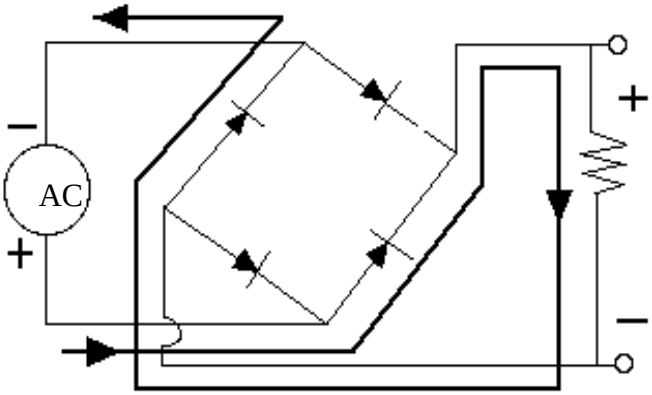


Full-wave Rectifier

Positive half-cycle



Negative half-cycle



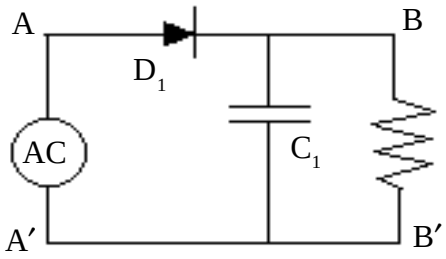
Filter

The purpose of the filter is to smooth the AC ripple in the rectifier's output. The simplest form of a filter is a large capacitor placed in parallel with the load (R_L). This capacitor charges rapidly at each peak of the rectifier output voltage, then discharges slowly through the load, maintaining a nearly constant level until the next peak occurs.

Procedure

Note: For this experiment, the oscilloscope's input mode selector must be set to the DC position. Use the GND position to first center the zero baseline.

1. For the half-wave rectifier, construct the circuit shown below with no capacitor. Sketch the input waveform [A,A′] and the output waveform [B,B′].
2. Then put a 1μF capacitor in parallel with the resistor and sketch the new output waveform. Have the instructor place a electrolytic 220μF capacitor in addition to the capacitor already in place. Have the instructor initial your worksheet.
3. For the full-wave rectifier, construct the circuit shown at the top of this page with 4 diodes and no capacitor. Sketch the output waveform with no capacitor. Then add the 1μF capacitor in parallel with R_L and use a dotted line to show the new output waveform. Have the instructor once again place the larger electrolytic capacitor in addition to the smaller capacitor and draw the new waveform with a solid line. Have the instructor initial your worksheet.



R_L = 30kΩ (approximately!)

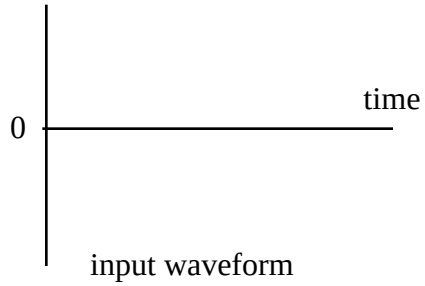
Name _____
Period _____
Workbox # _____

AC to DC Conversion - Worksheet

Complete the sketches. Show several complete cycles. You need not label the time axis.

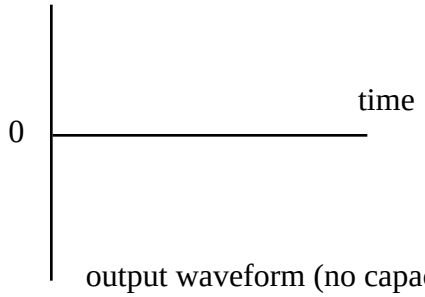
Procedure 1 Half-wave Rectifier

Volts (V)



input waveform

Volts (V)



output waveform (no capacitor)

Procedure 2 Half-wave Rectifier

Volts (V)

output waveform
with 1μF capacitor

Leave this small ceramic capacitor connected and have the instructor bring the larger capacitor.

Volts (V)

output waveform
with 220μF capacitor

Instructor's verification _____
(Do **not** connect this 220μF capacitor, yourself.)

Procedure 3 Full-wave Rectifier

Volts (V)

output wave, no capacitor

Instructor's verification _____

Volts (V)

output wave 1μF (dotted line)
220μF (solid line)
(Do **not** connect this 220μF capacitor.)

Microphone/Speaker Extra Credit

Instructor's verification _____