Electronics Laborotary

Experiment No.2

Half-Wave Rectifier (HWR)

1. Objectives:

- Construct the half-wave rectifier circuit.
- Measure/plot the input and output waveform.
- Find the peak and average value of the output signal

2. Components and equipment

- AC power supply (Function generator) or standard transformer
- An two-channel Oscilloscope.
- Breadboard, Semiconductor Diode, and 1KΩ Resistor.

3. Theory:

Because of the diode's ability to conduct current in one direction and block current in the other direction, diodes are used in circuits called rectifiers that convert AC voltage into DC voltage. Rectifiers are found in all dc power supplies that operate from an ac voltage source.

In Fig. 1, a diode is connected to an AC source that provides the input voltage V_{in} to a load resistor R_L, forming a half-wave rectifier.

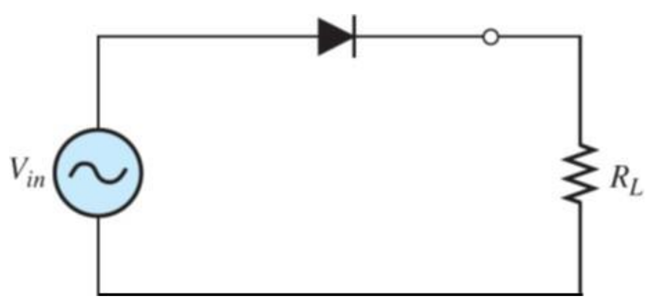

Figure 1: Half-wave rectifier circuit

When the sinusoidal input voltage goes positive, the diode D is forward-biased and conducts current through the load resistor R_L, as shown in Fig.2.

The current produces an output voltage across the load R_L, which has the same shape as the positive half-cycle of the input voltage.

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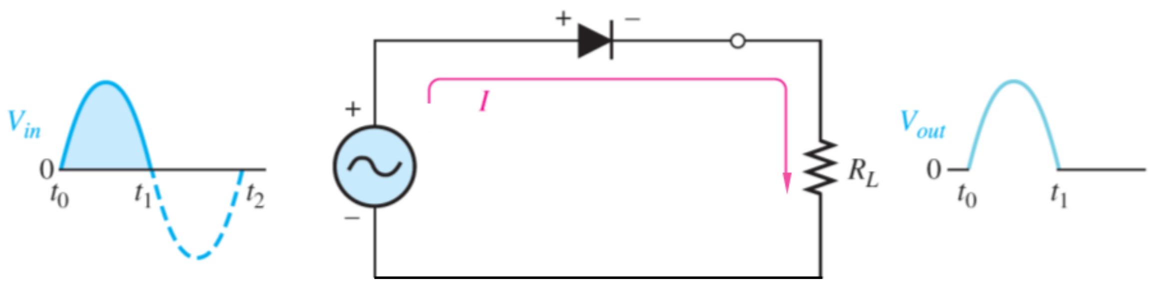

Figure 2:Operation during positive alternation of the input voltage

When the input voltage goes negative during the second half of its cycle, the diode is reverse-biased. There is no current, so the voltage across the load resistor R_L is zero, as shown in Fig. 3.

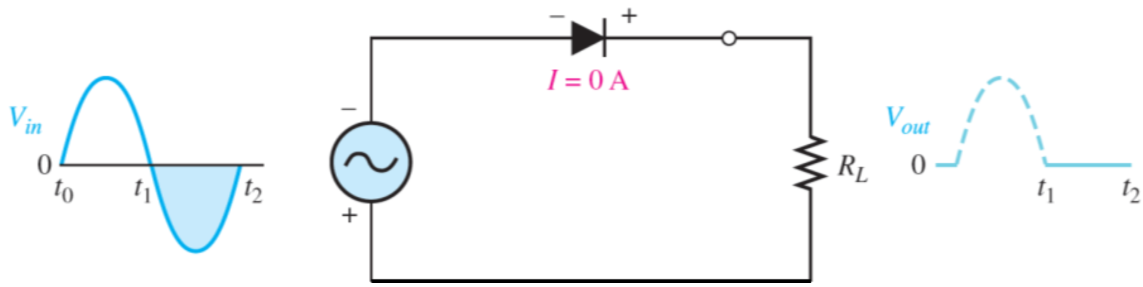

Figure 3: Operation during negative alternation of the input voltage

The net result is that only the positive half-cycles of the ac input voltage appear across the load. Since the output does not change polarity, it is a pulsating DC voltage, as shown in Fig.4.

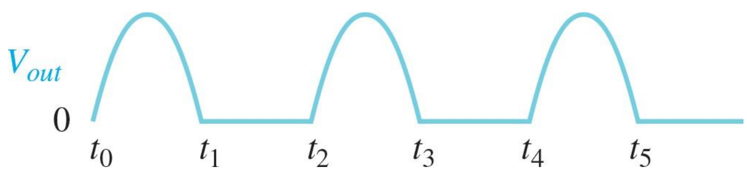

Figure 4: Half-wave output voltage for three input cycles

Average Value of the Output Voltage

The average value of a half-wave rectified output voltage is the value you would measure on a DC voltmeter. It can be calculated with the following equation, where $V_{p(out)}$ is the peak value of the half-wave rectified output voltage:

$$V_{AVG} = \frac{V_{p(out)}}{\pi}$$

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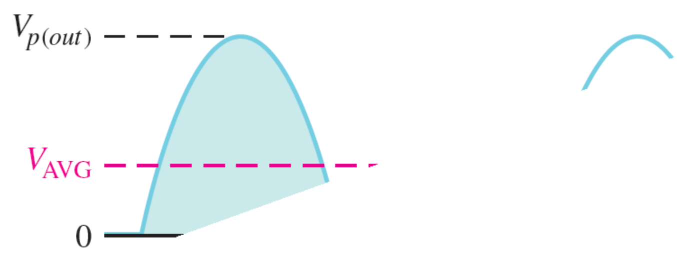

Figure 5: Shows the half-wave voltage with its average value indicated by the red dashed line.

4. Experiment procedure

1. Connect the circuit as shown in Fig. 1 using an AC power supply (Function generator) or standard transformer, a diode, a 1kΩ resistor (R_L)
2. Apply $^{V}{}_{p.p}$ =10 V and a frequency of 50 Hz.
3. Display the input and output signal on the oscilloscope.
4. Measure the $V_{p.p,}$ $V_{max,}$ $V_{rms,}$ $V_{avg,}$ and frequency of the input signal.
5. Measure the $V_{p.p,}$ $V_{max,}$ $V_{rms,}$ $V_{avg,}$ and frequency of the output signal.
6. Tabulate your measurement result in a table as shown.

nput Signal	**utput Signal**
P.P=	P.P=
MAX=	MAX=
RMS=	RMS=
AVG= (Exp.)	AVG= (Exp.)
AVG= (Theo.)	AVG= (Theo.)
=	=
raw the input signal	raw the output signal

5. Discussion

1. Why the V_{AVG} of the input signal is close to zero?
2. On a graphic paper, draw the input and output signals, both on one chart (on top of each other). Indicating the voltages (V_p, V_{rms}, and V_{AVG}).
3. What would be the outcome if the diode is flipped? Why? Draw the output signal.

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