Palestine Technical University - Kadoorie
جامعة فلسطين التقنية - خضوري

Electrical Engineering Department

Electronics Lab

Exp (2):
Rectifiers (Half wave and Full wave)

Presentation By:
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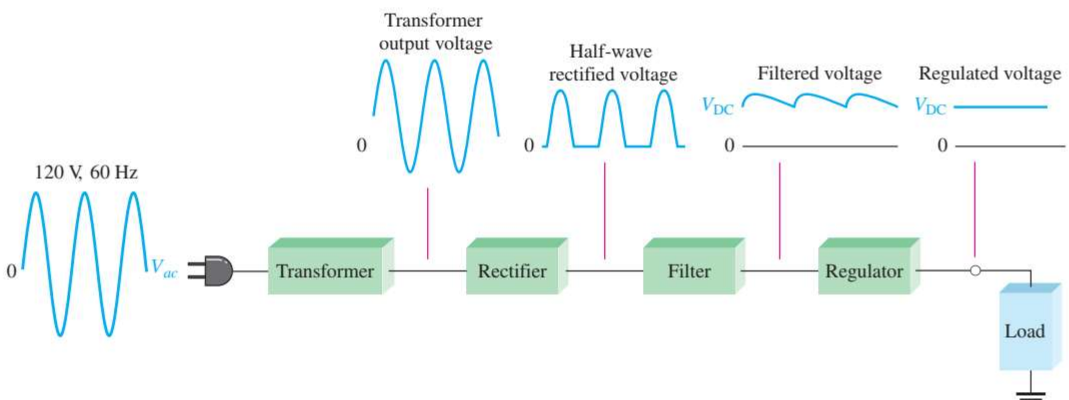
Basic DC Power Supply



(a) Complete power supply with transformer, rectifier, filter, and regulator

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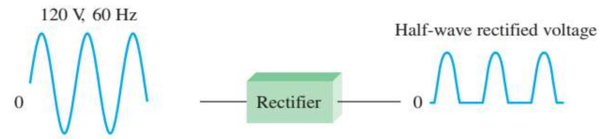
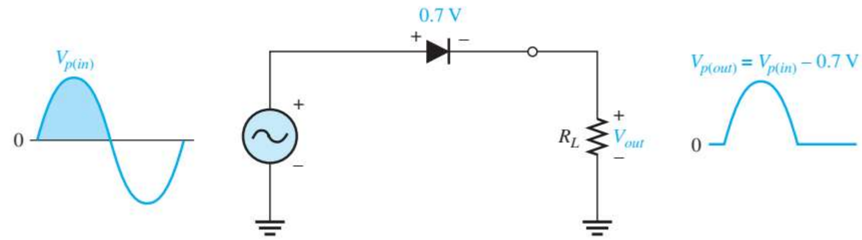
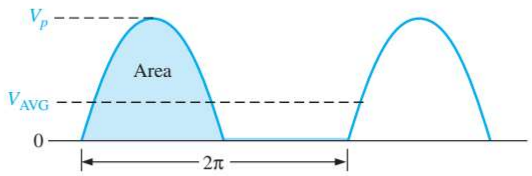
Half Wave Rectifier



(b) Half-wave rectifier



$$V_{p(out)} = V_{p(in)} - 0.7\text{ V}$$



$$V_{AVG} = \frac{V_p}{\pi}$$

$$f_{out} = f_{in}$$

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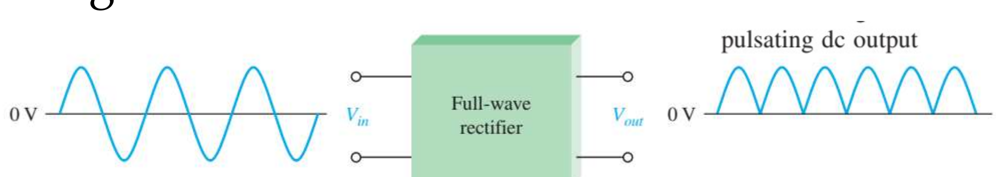
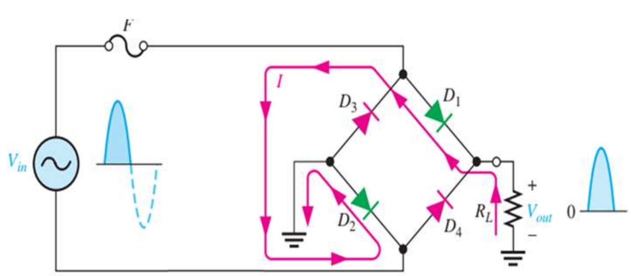
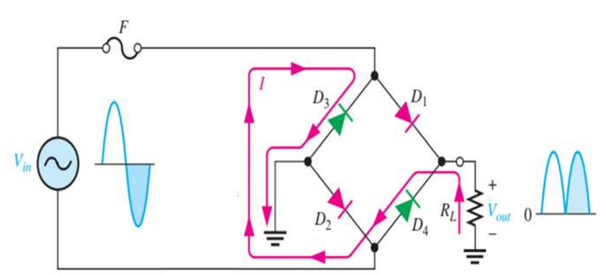
Bridge Full Wave Rectifier





(a) During the positive half-cycle of the input, D_1 and D_2 are forward-biased and conduct current. D_3 and D_4 are reverse-biased.



(b) During the negative half-cycle of the input, D_3 and D_4 are forward-biased and conduct current. D_1 and D_2 are reverse-biased.

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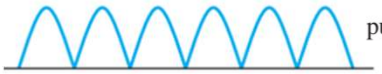
Bridge Full Wave Rectifier



$$V_{p(out)} = V_{p(in)} - 1.4\,\text{V}$$

$$V_{AVG} = \frac{2V_{p(out)}}{\pi}$$

$$f_{out} = 2f_{in}$$

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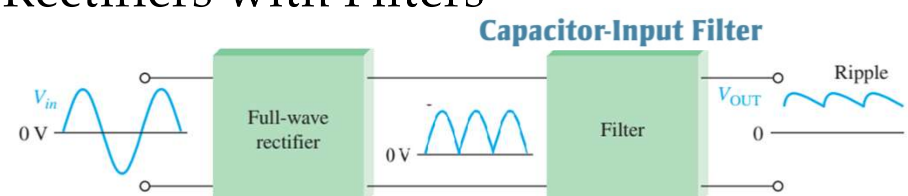
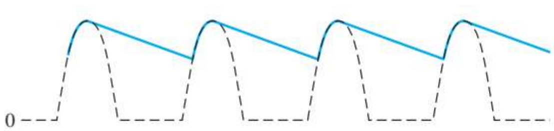
Rectifiers with Filters



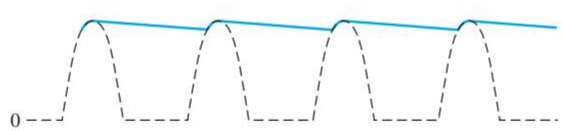
(b) Rectifier with a filter (output ripple is exaggerated)

The small amount of fluctuation in the filter output voltage is called *ripple.*

The variation in the capacitor voltage due to the charging and discharging is called the **ripple voltage**.



(a) Larger ripple (blue) means less effective filtering.

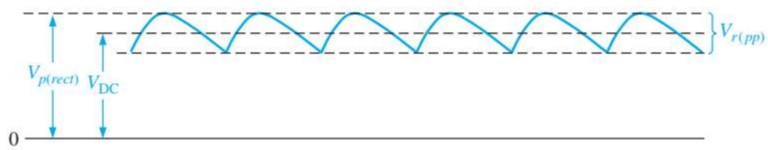


(b) Smaller ripple means more effective filtering. Generally, the larger the capacitor value, the smaller the ripple for the same input and load.

Rectifiers with Filters

Ripple Factor The **ripple factor (r)** is an indication of the effectiveness of the filter and is defined as

$$r = \frac{V_{r(pp)}}{V_{DC}}$$



$$V_{r(pp)} \cong \left(\frac{1}{fR_LC}\right)V_{p(rect)}$$

$$V_{DC} \cong \left(1 - \frac{1}{2fR_LC}\right)V_{p(rect)}$$

The lower the ripple factor, the better the filter. The ripple factor can be lowered by increasing the value of the filter capacitor or increasing the load resistance (T=RC).

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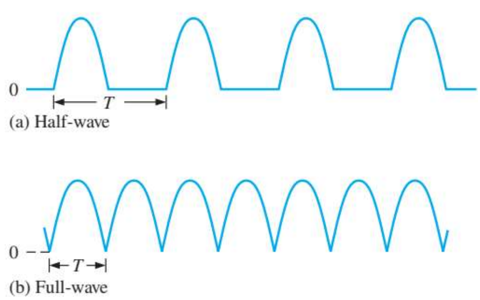
Rectifiers with Filters

Which is better to filter, HW or FW?

FIGURE 2–45

The period of a full-wave rectified voltage is half that of a half-wave rectified voltage. The output frequency of a full-wave rectifier is twice that of a half-wave rectifier.



When filtered, the full-wave rectified voltage has a smaller ripple than does a half-wave voltage for the same load resistance and capacitor values. The capacitor discharges less during the shorter interval between full wave pulses

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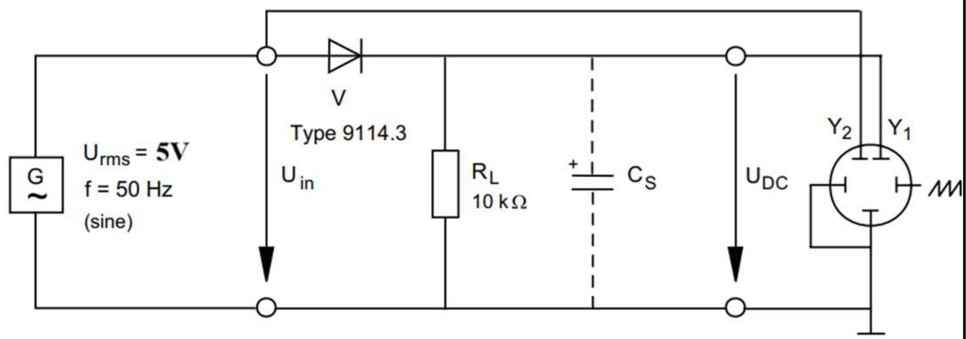
Practical Part:

Part 1: Half Wave Rectifiers with and without capacitor

1. Set up the circuit according to the Fig. shown below.
2. Measure the input voltage Uin and the DC voltage UDC
3. Calculate the ratio UDC to Uin.
4. Draw the input and output signals using oscilloscope.
5. Evaluate the peak-to-peak value and the frequency of the ripple voltage Urip from the oscilloscope diagram

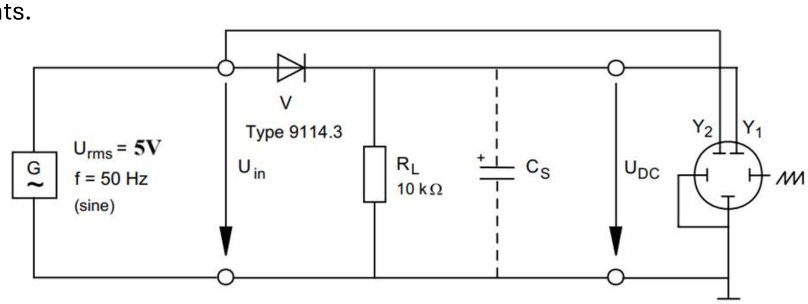


Practical Part:

Part 1: Half Wave Rectifiers with and without capacitor

6. connect the smoothing capacitors CS in parallel to the load resistor RL as in the following Table and repeat the measurements.

Half-wave rectifier circuit M1				
C_S [μF]	without	10	100	470
U_{in} [V]				
U_{DC} [V]				
$\frac{U_{DC}}{U_{in}}$ =				
$u_{rip\ pp}$ [V]				
f_{rip} [Hz]				

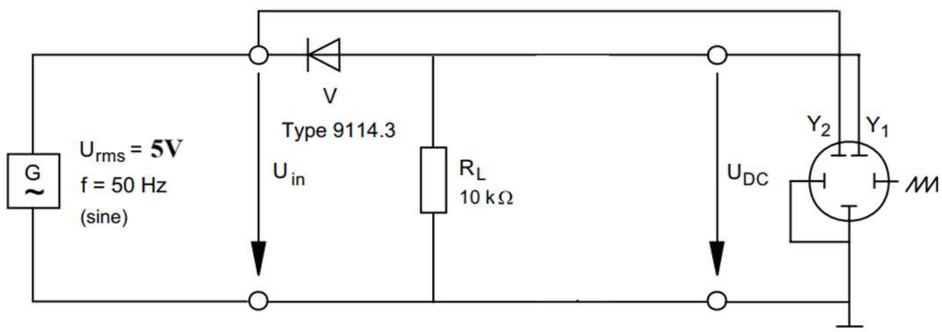


7. Plot the curve of input voltage Uin and of DC voltage UDC which results using the smoothing capacitor 10, 100 and 470 micro farad.
8. Calculate the ripple factor (use measured and calculated values).

Practical Part:

Part 1: Half Wave Rectifiers with and without capacitor

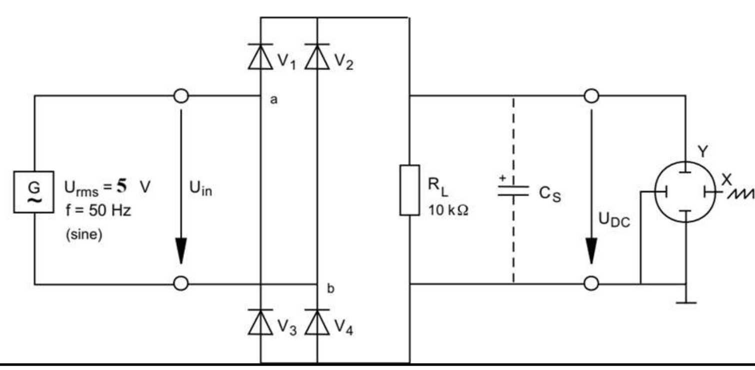
9. disconnect the smoothing capacitors
10. reverse the polarity of the diode in the circuit
11. Draw the input and output signals using oscilloscope.



Practical Part:

Part 2: Full Wave Rectifiers with and without capacitor

1. Set up the circuit according to the Fig. shown below.
2. Measure the input voltage Uin and the DC voltage UDC
3. Calculate the ratio UDC to Uin.
4. Draw the input and output signals using oscilloscope.
5. Evaluate the peak-to-peak value and the frequency of the ripple voltage Urip from the oscilloscope diagram

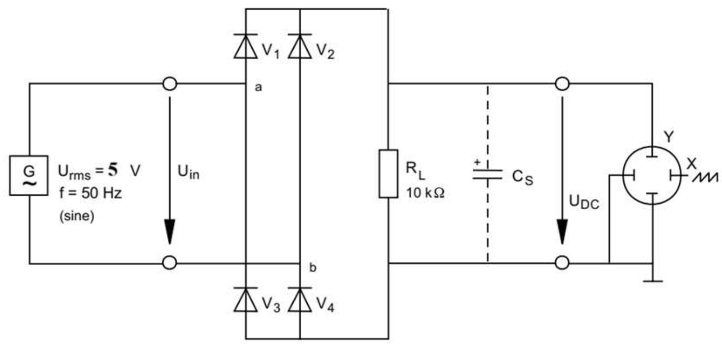


Practical Part:

Part 2: Full Wave Rectifiers with and without capacitor

6. connect the smoothing capacitors CS in parallel to the load resistor RL as in the following Table and repeat the measurements.

Bridge rectifier circuit B2				
C_S [µF]	without	10	100	470
U_{in} [V]				
U_{DC} [V]				
$\frac{U_{DC}}{U_{in}}$ =				
$u_{rip\ pp}$ [V]				
f_{rip} [Hz]				



7. Plot the curve of input voltage Uin and of DC voltage UDC which results using the smoothing capacitor 10, 100 and 470 micro farad.
8. Calculate the ripple factor (use measured and calculated values).
9. Compare between HW and FW circuits (use the obtained results)