



جامعة المستقبل
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Analogue Electronic

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1st semester

Chapter Two

Diode and its Application

Lecture 5

Full wave rectifiers

Although half-wave rectifiers have some applications, the full-wave rectifier is the most commonly **used** type in **DC power supplies**.

A full-wave rectifier **allows** unidirectional (**one-way**) **current** through the load during the entire of the input cycle.

Whereas a **half-wave rectifier** allows current through the **load only during one-half of the cycle**.

The output voltage have twice the input frequency.

$V_{AVG} = \frac{2V_p}{\pi} = V_{AVG}$ is approximately **63.7 % of V_p**

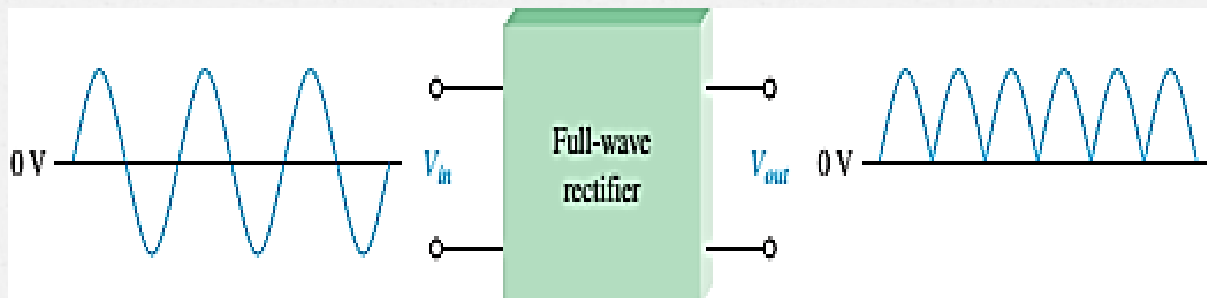


Figure 14

Center-Tapped Full-Wave Rectifier Operation

A center-tapped rectifier uses **two diodes** connected to the secondary of a center-tapped transformer, as shown in Figure 1.

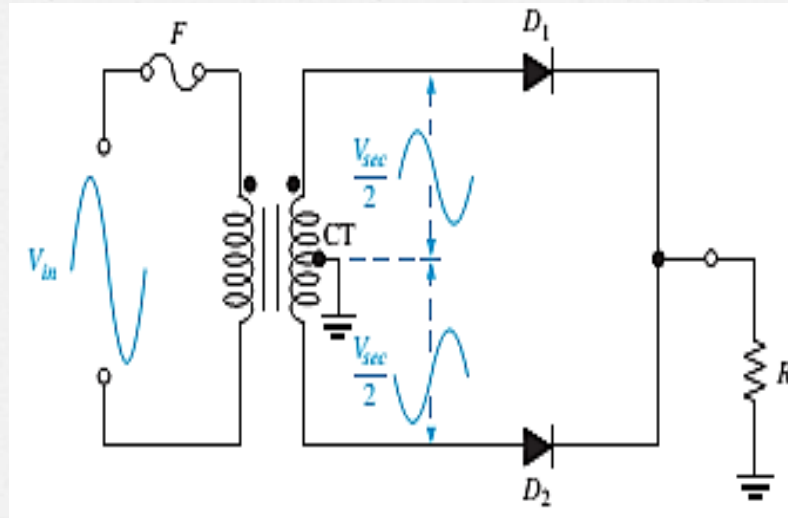
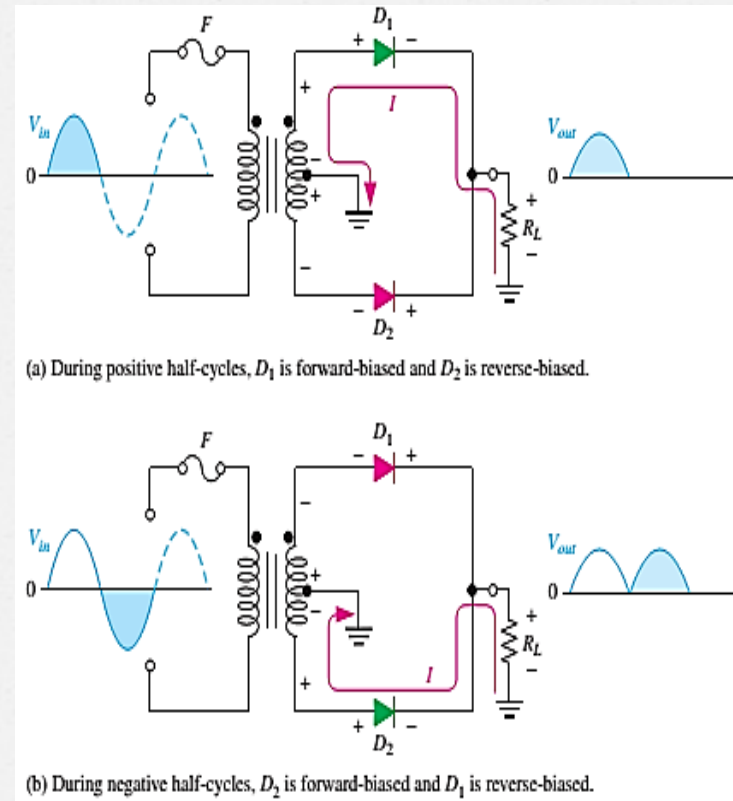
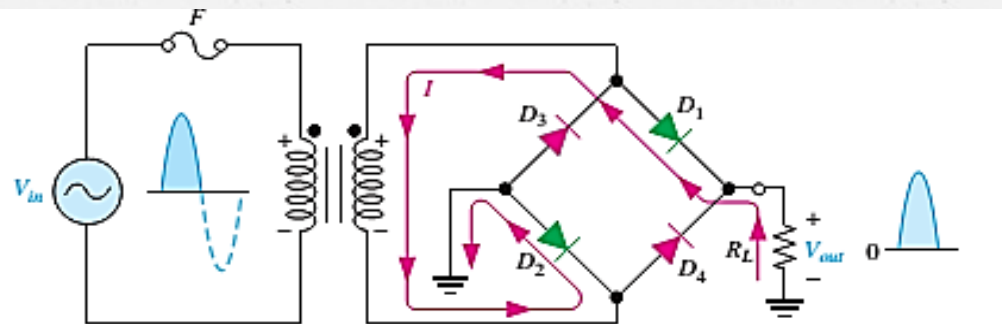


Figure 1: Basic operation of a center-tapped full-wave rectifier.

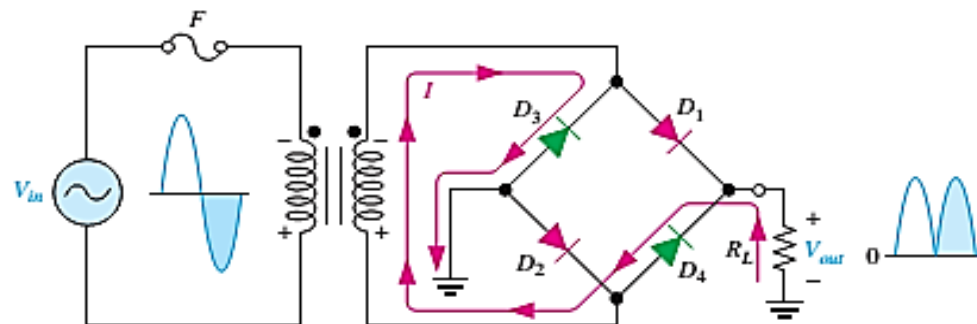


The Bridge Full-wave rectifiers

The Bridge Full-Wave rectifier uses **four diodes** connected across the entire secondary, as shown in Figure below.



(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.



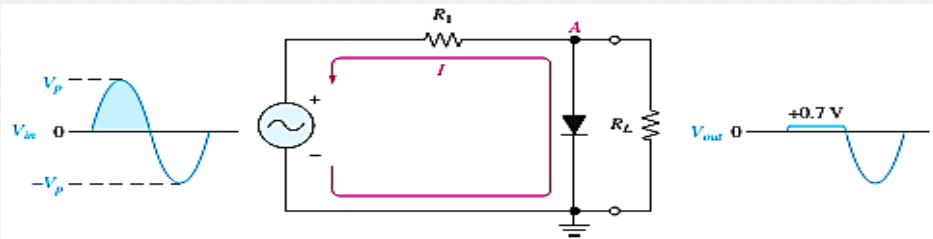
(b) During the negative half-cycle of the input, D_3 and D_4 are forward-biased and conduct current. D_1 and D_2 are reverse-biased.

Diode Limiters

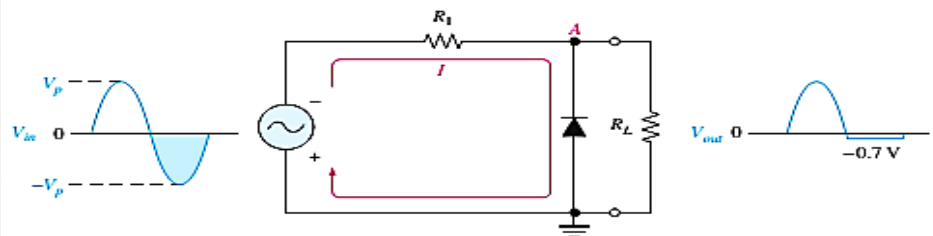
Diode circuits, called **limiters or clippers**, are used to **clip off portions of signal voltages above or below certain levels**.

Point A is limited to **+0.7V** when the input voltage exceeds this value (Figure 3(a)).

If the diode is **turned around**, as in Figure 3(b), the negative part of the input voltage is clipped off. When the diode is forward-biased during the negative part of the input voltage, **point A** is held at **-0.7V** by the diode drop.



(a) Limiting of the positive alternation. The diode is forward-biased during the positive alternation (above 0.7 V) and reverse-biased during the negative alternation.



(b) Limiting of the negative alternation. The diode is forward-biased during the negative alternation (below -0.7 V) and reverse-biased during the positive alternation.

Figure 3: Examples of diode limiters (clippers).

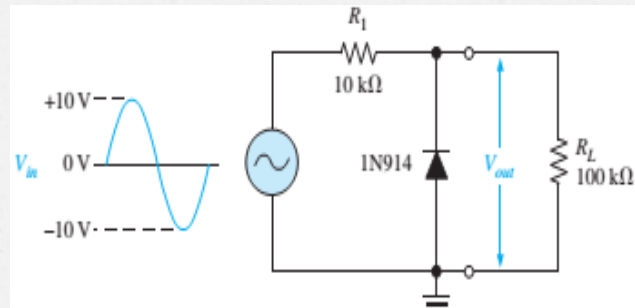
A **power supply** or **voltage divider** can attain the desired amount of **limitation**.

The **amount clipped** can be **adjusted** with **different levels of V_{BIAS}** .

The **peak output voltage** across **R_L** is determined by the following equation:

$$V_{out} = \left(\frac{R_L}{R_1 + R_L} \right) V_{in}$$

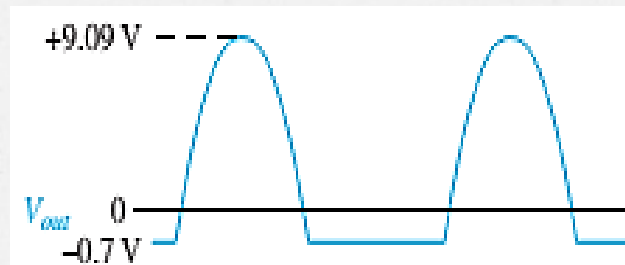
Example 2: What would you expect to see displayed on an oscilloscope connected across R_L in the limiter shown in the following Figure/



Solution: The diode is forward-biased and conducts when the input voltage goes below $-0.7V$. So, for the negative limiter, determine the peak output voltage across R_L by.

$$= \left(\frac{R_L}{R_1 + R_L} \right) V_{in} = \left(\frac{100k\Omega}{110k\Omega} \right) 10V = 9.09V$$

The scope will display an output waveform as shown in following Figure

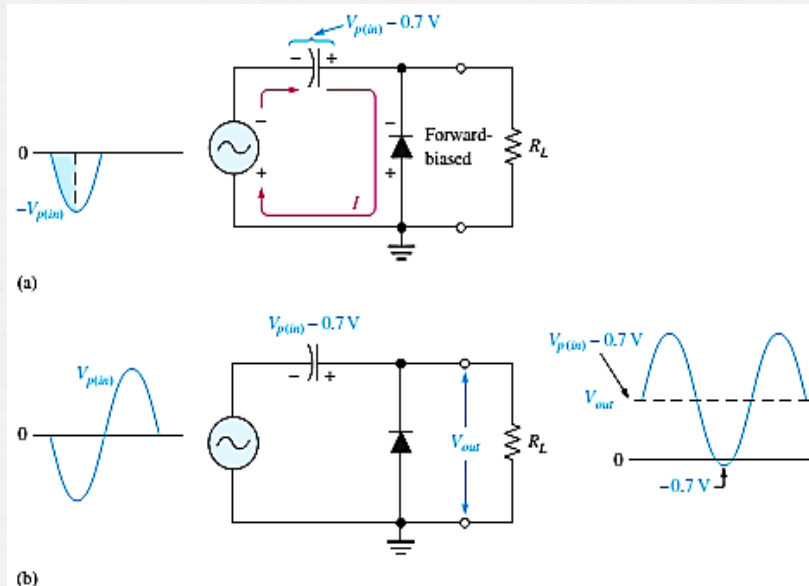


Diode Clampers

Another type of diode circuit, called **a clamper**, is used to **add or restore a dc level to an electrical signal**.

The **capacitor charges to the peak of the supply minus the diode drop**. Once charged the capacitor acts like a battery in series with the input voltage.

The **AC voltage** will “ride” along with the DC voltage. The polarity arrangement of the diode determines whether the DC voltage is negative or positive.



Voltage Multiplier

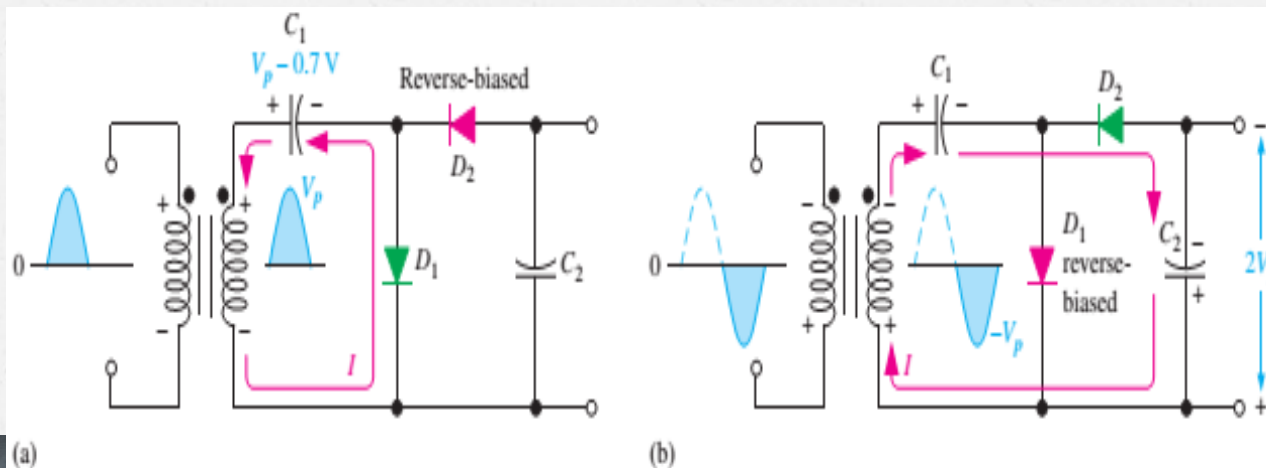
Voltage multipliers use **clamping action** to **increase peak rectified voltages without the necessity of increasing the transformer's voltage rating.**

Multiplication factors of two, three, and four are common. Voltage multipliers are **used in high-voltage, low-current applications** such as **cathode-ray tubes (CRTs)** and **particle accelerators.**

In the Figure below, a **half-wave voltage doubler**, voltage doubler is a voltage multiplier with a multiplication factor of two.

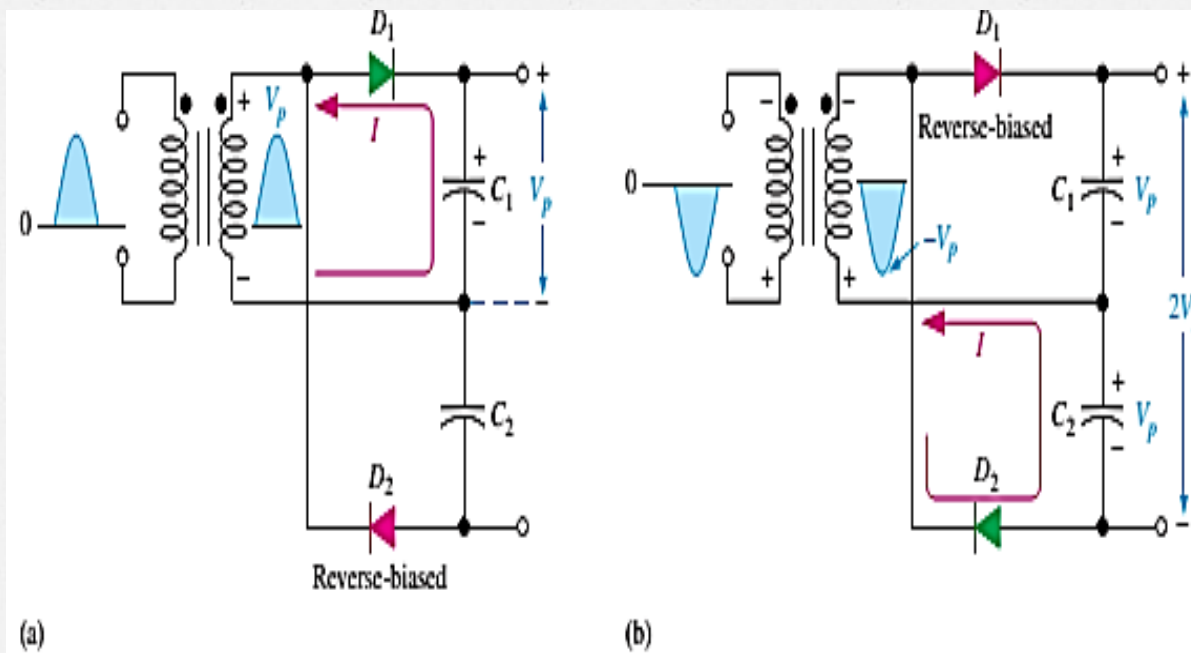
Once C_1 and C_2 charge to the peak voltage, it acts like two batteries in series, effectively doubling the voltage output.

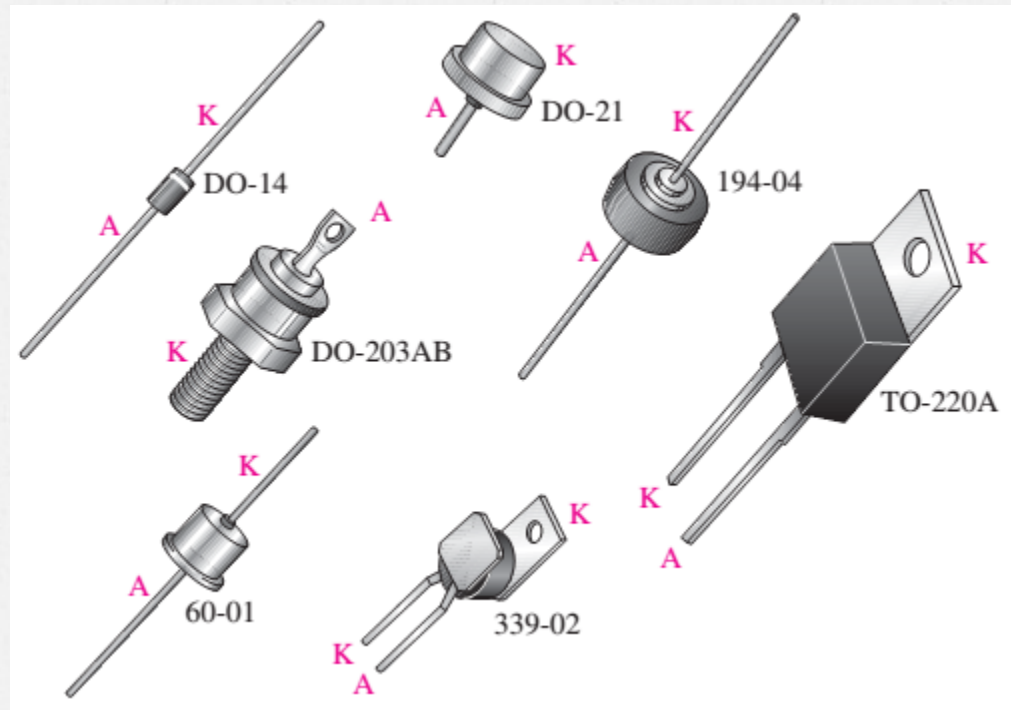
The **current capacity** for voltage multipliers is **low.**



The **full-wave voltage doubler** arrangement of diodes and capacitors takes advantage of **positive and negative peaks** to charge the capacitors, giving them more current capacity.

Voltage triplers and **quadruplers** utilize **three and four-diode-capacitor arrangements**, respectively.





Typical diode packages with terminal identification. The letter K is used for cathode to avoid confusion with certain electrical quantities that are represented by C. Case type numbers are indicated for each diode.