



COLLEGE OF ENGINEERING AND TECHNOLOGIES
ALMUSTAQBAL UNIVERSITY

AC Power Converter

EET 307

Lecture 5

**- Full Wave Rectifier (Bridge Rectifier) -
(2024 - 2025)**

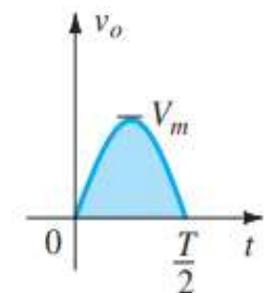
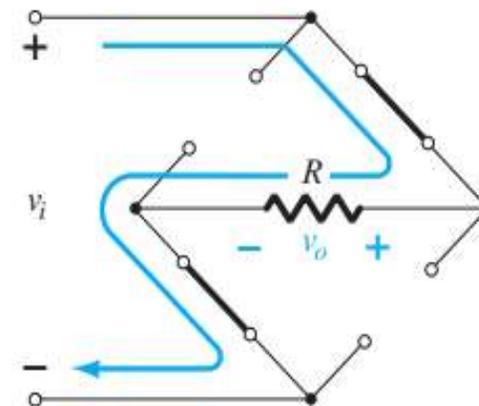
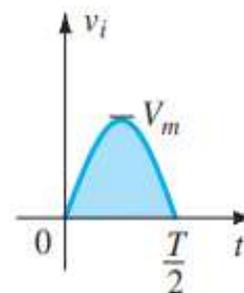
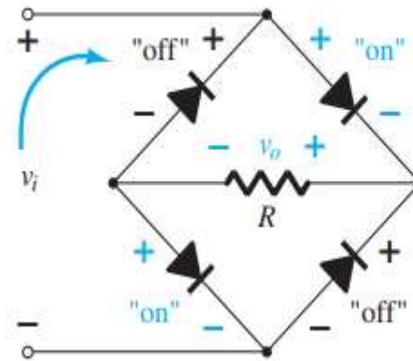
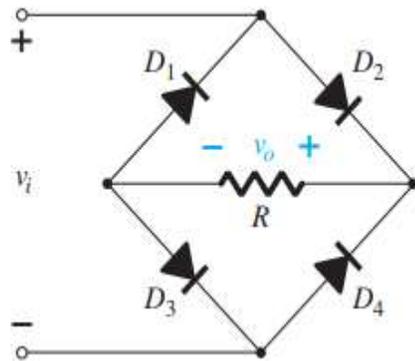
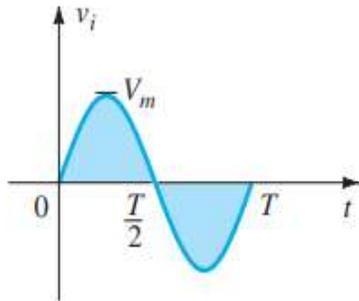
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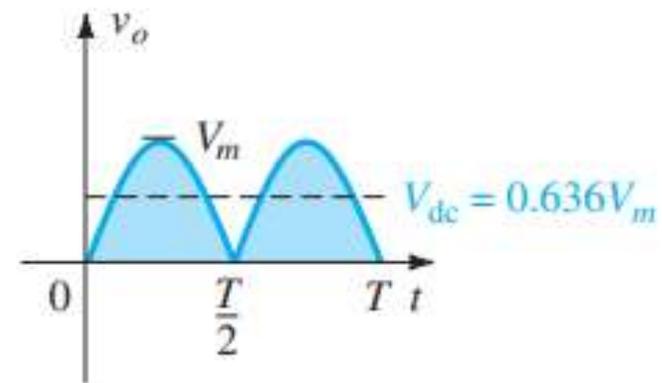
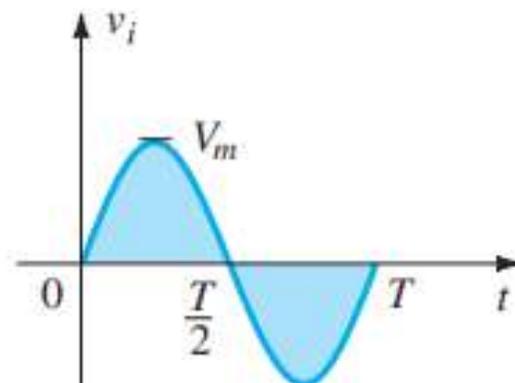
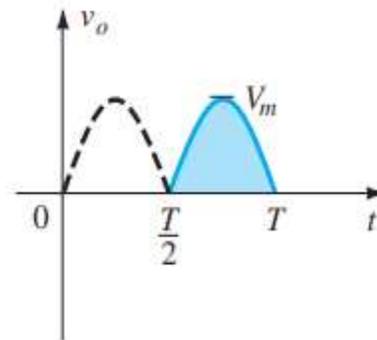
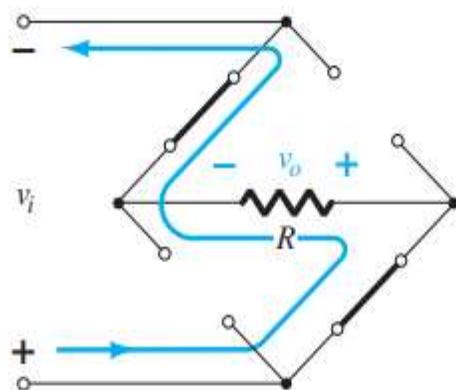
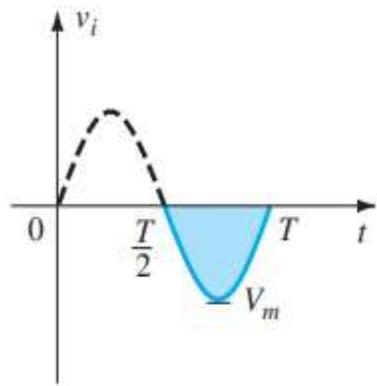
- The full-wave bridge rectifier uses four diodes, as shown in the Figure below.
- The input cycle is positive, diodes D_1 and D_2 are forward-biased and conduct current in the direction shown.
- A voltage is developed across RL that looks like the positive half of the input cycle.
- During this time, diodes D_3 and D_4 are reverse-biased.

Positive cycle

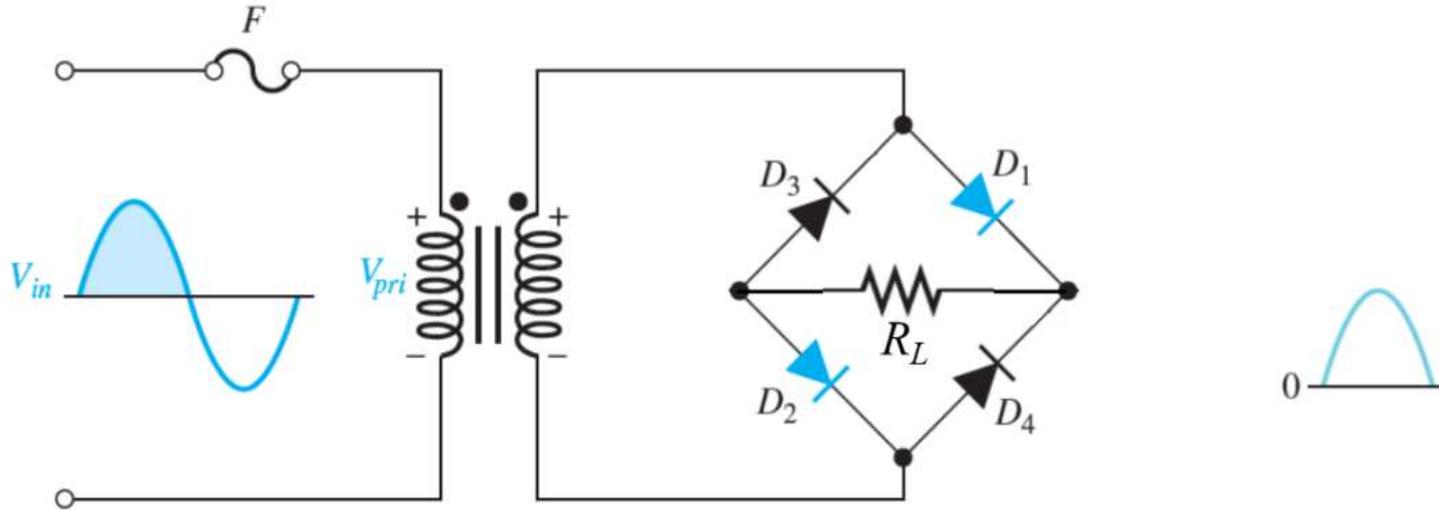


- The input cycle is negative, diodes D_3 and D_4 are forward-biased and conduct current in the same direction through as during the positive half-cycle.
- During the negative half-cycle, D_1 and D_2 are reverse-biased.
- A full-wave rectified output voltage appears across RL as a result of this action.

Negative cycle

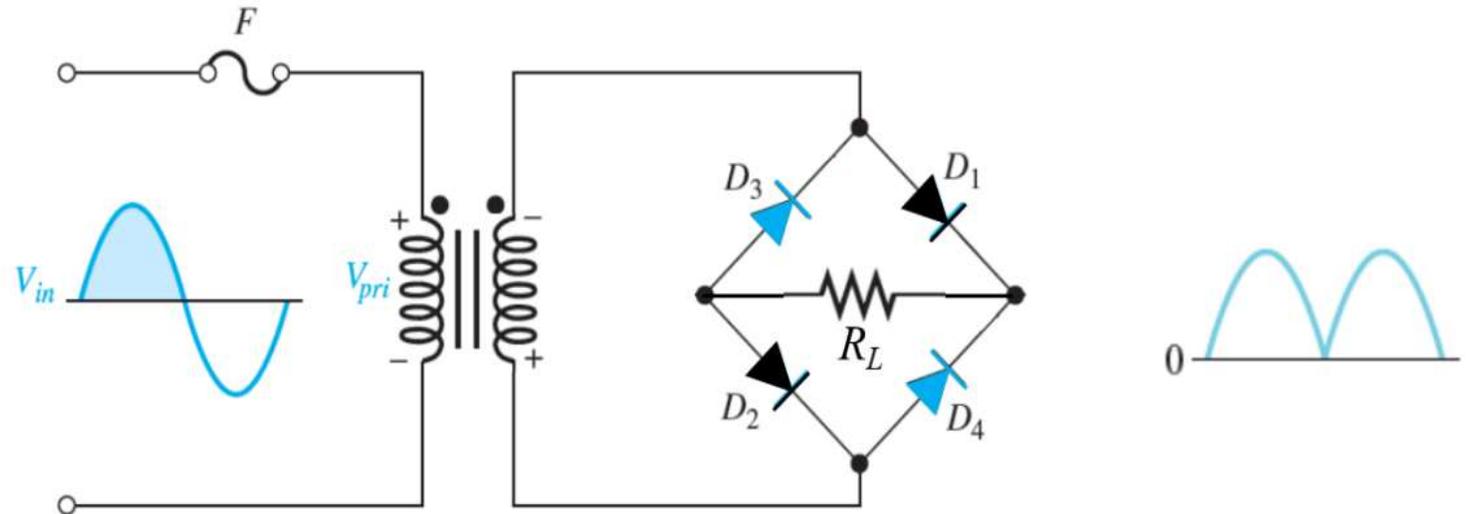


Positive - Negative cycle



Positive cycle

Negative cycle



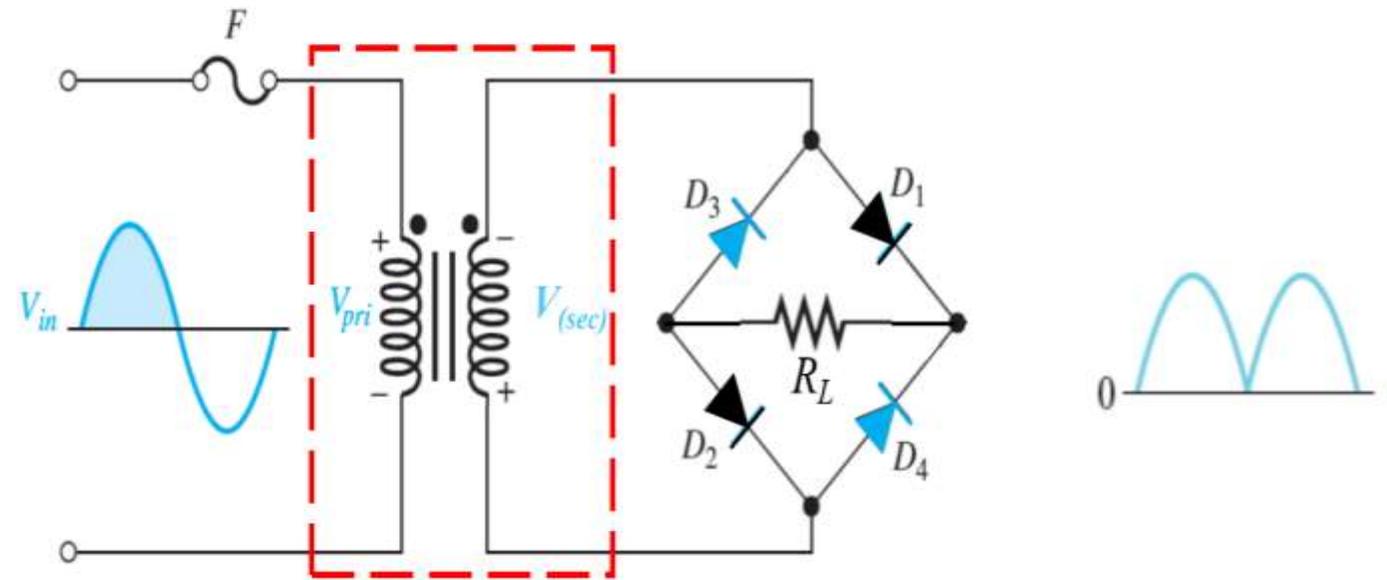
Full Wave Bridge Rectifier

The bridge output voltage from the transformer:

The secondary voltage is equal to the primary voltage times the turns ratio as stated by the equation:

$$V_{p(sec)} = V_{p(out)}$$

$$V_{p(sec)} = V_{p(out)} = nV_{p(pri)}$$



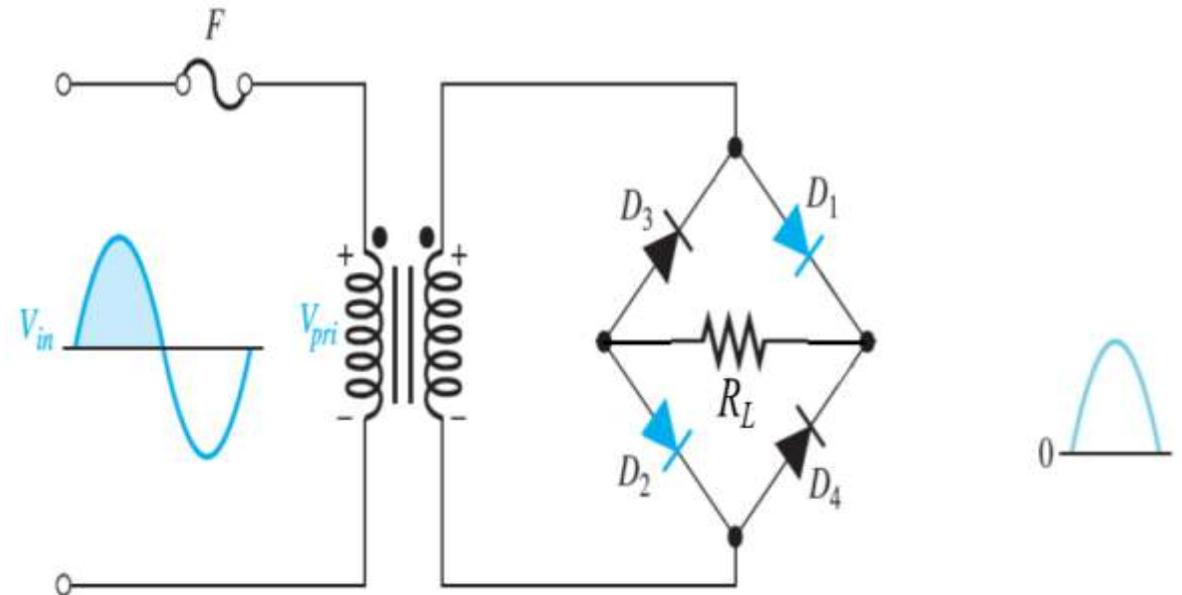
Peak Inverse Voltage (PIV)

The positive half-cycle:

- D_1 and D_2 are forward-Biased
- D_3 and D_4 are reversed-Biased
- PIV is equal to the $V_{p(sec)}$

which is equal to the $V_{p(out)}$

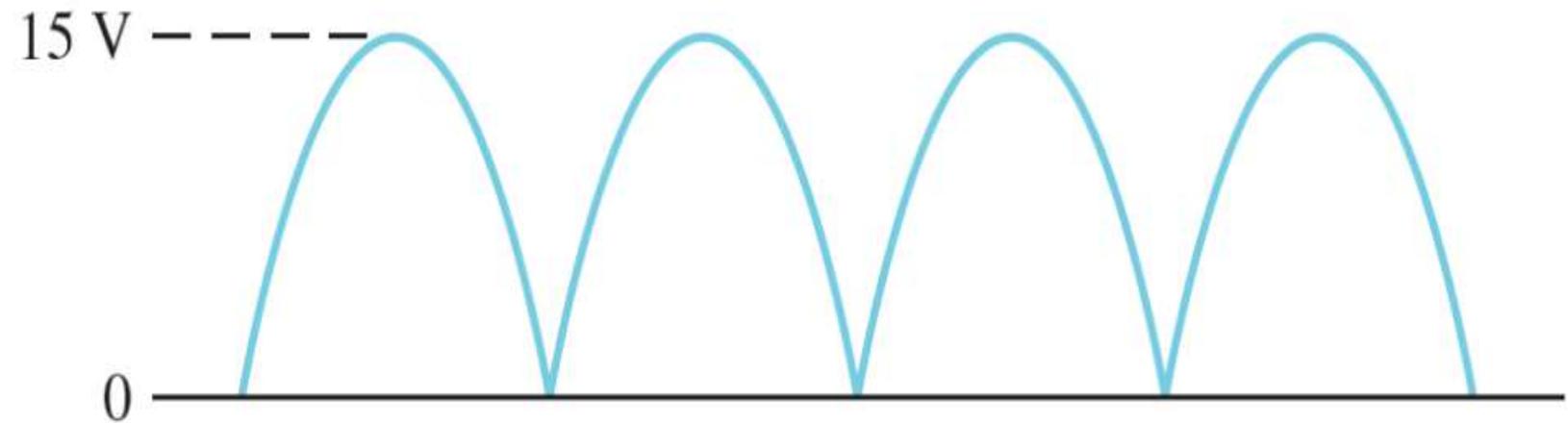
$$PIV = V_{p(sec)} = V_{p(out)}$$



Example

Find the average value of the full-wave rectified output voltage in the Figure below.

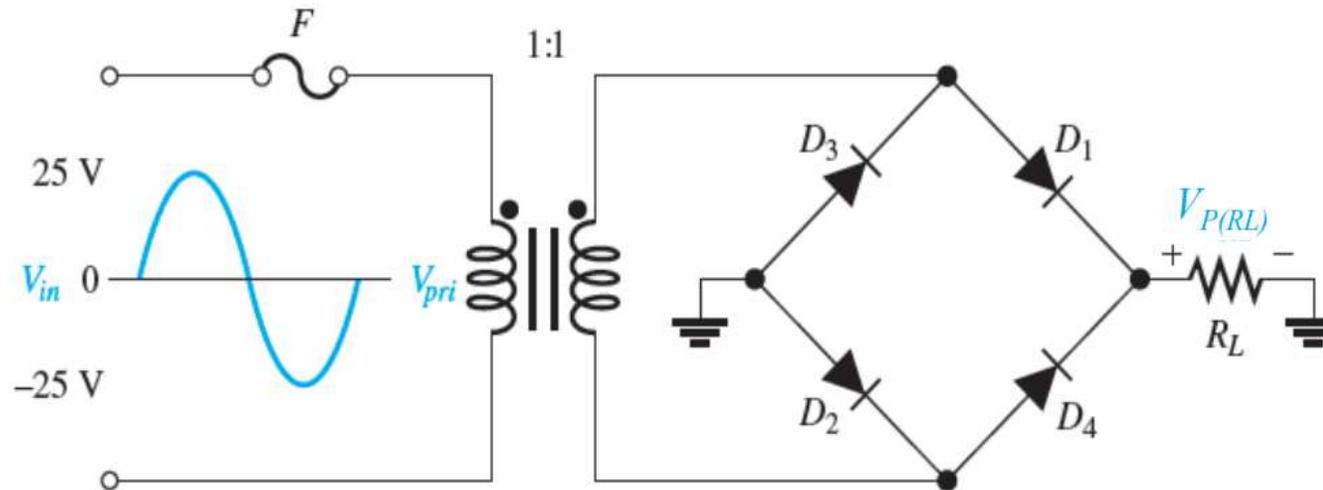
Sol:



$$V_{AVG} = \frac{2V_{p(out)}}{\pi} = \frac{2*15}{3.14} = 9.55 V$$

Example

- a) Determine the peak output voltage $V_{p(\text{out})}$, $V_{p(\text{RL})}$ and V_{AVG} for the bridge rectifier in Figure below.
- b) What is the minimum PIV rating required for the diodes?



Sol:

$$\text{a) } V_{p(out)} = V_{p(sec)} = nV_{p(in)} = (1)25 \text{ V} = 25 \text{ V}$$

$$V_{p(RL)} = V_{p(out)} - 2(V_B) = 23.6 \text{ V}$$

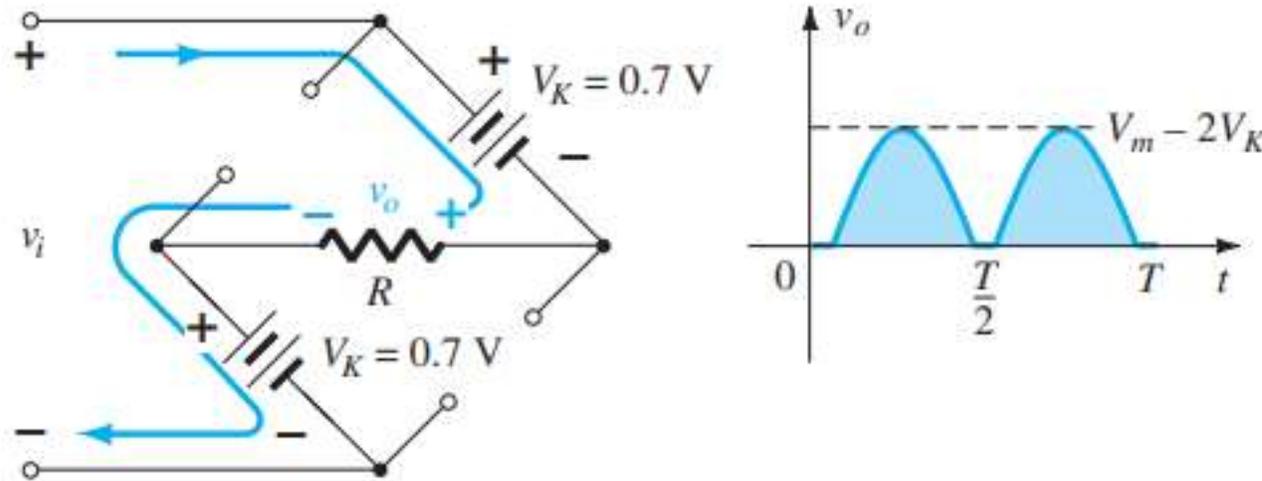
$$V_{AVG} = \frac{2V_{p(RL)}}{\pi} = \frac{47.2}{3.14} = 15 \text{ V}$$

$$\text{b) } PIV = V_{p(sec)} = V_{p(out)} = 25 \text{ V}$$

Full Wave Bridge Rectifier

If silicon rather than ideal diodes are employed as shown in Figure below, the application of Kirchhoff's voltage law around the conduction path results in

$$v_i - V_K - v_o - V_K = 0$$
$$v_o = v_i - 2V_K$$



Full Wave Bridge Rectifier

$$V_{dc} = 2(0.318V_m),$$

$$V_{dc} = 0.636 V_m \quad \text{full-wave}$$

The peak value of the output voltage V_o is therefore

$$V_{o_{max}} = V_m - 2V_K$$

For situations where $V_m \gg 2V_K$, the following equation can be applied for the average value with a relatively high level of accuracy:

$$V_{dc} \cong 0.636(V_m - 2V_K)$$

Equations

Approximate:

Silicon: $V_K = 0.7 \text{ V}$; I_D is determined by network.

Germanium: $V_K = 0.3 \text{ V}$; I_D is determined by network.

Gallium arsenide: $V_K = 1.2 \text{ V}$; I_D is determined by network.

Ideal:

$V_K = 0 \text{ V}$; I_D is determined by network.

For conduction:

$$V_D \geq V_K$$

Half-wave rectifier:

$$V_{dc} = 0.318V_m$$

Full-wave rectifier:

$$V_{dc} = 0.636V_m$$

