LECTURE 6

Full-Wave Rectifier (FWR)

Analog Electronics

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By

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Outline and Aim

After completing this lecture, you should be able to:

- Analyze the operation of a Full-Wave Bridge Rectifier
- Describe how the diodes function in a Full-Wave Bridge Rectifier
- Determine the average value of a Full-Wave Bridge Rectifier
- Determine the peak inverse voltage (PIV)
- Compare between (HWR), Centre-tapped (FWR) & Bridge (FWR)

Full-Wave Bridge Rectifier

The full-wave **bridge rectifier** uses four diodes, as shown in Fig. 1.

a) When the input cycle is positive, as in Fig. 1, a), diodes D_1 and D_2 are forward-biased and conduct current in the direction shown. A voltage is developed across R_L that looks like the positive half of the input cycle. During this time, diodes D_3 and D_4 are reverse-biased.

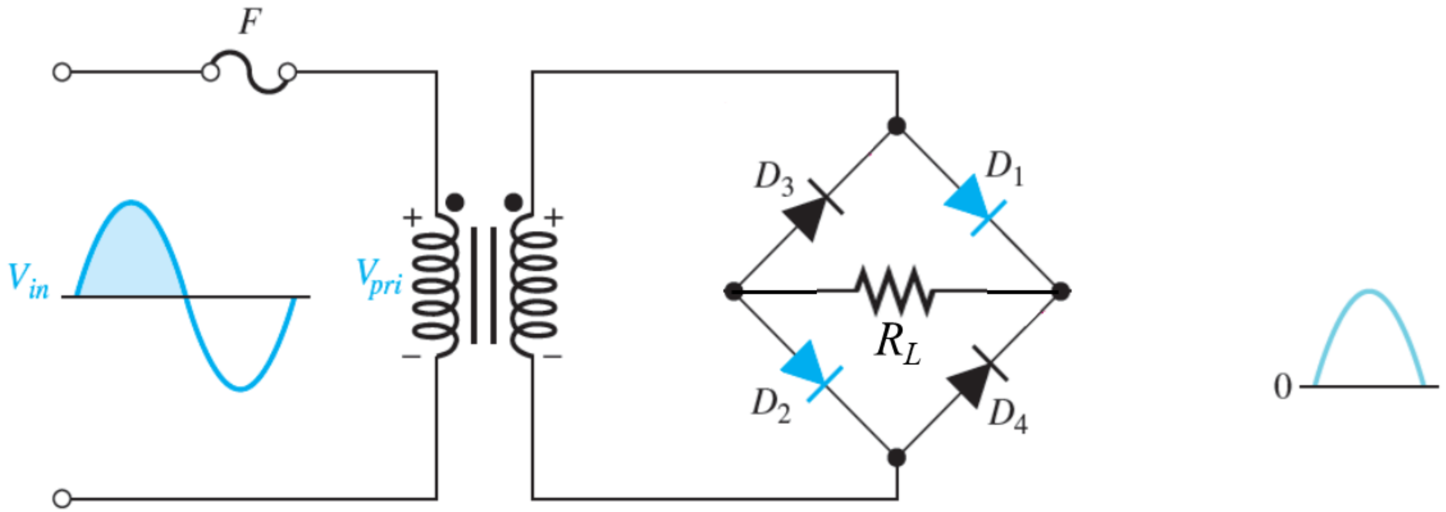


Fig. 1, a): During positive half-cycle of the input, D_1 and D_2 are forward-biased and conduct current. D_3 and D_4 are reverse-biased

Full-Wave Bridge Rectifier

The full-wave **bridge rectifier** uses four diodes, as shown in Fig. 1.

b) When the input cycle is negative, as in Fig. 1, b), 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 R_L as a result of this action.

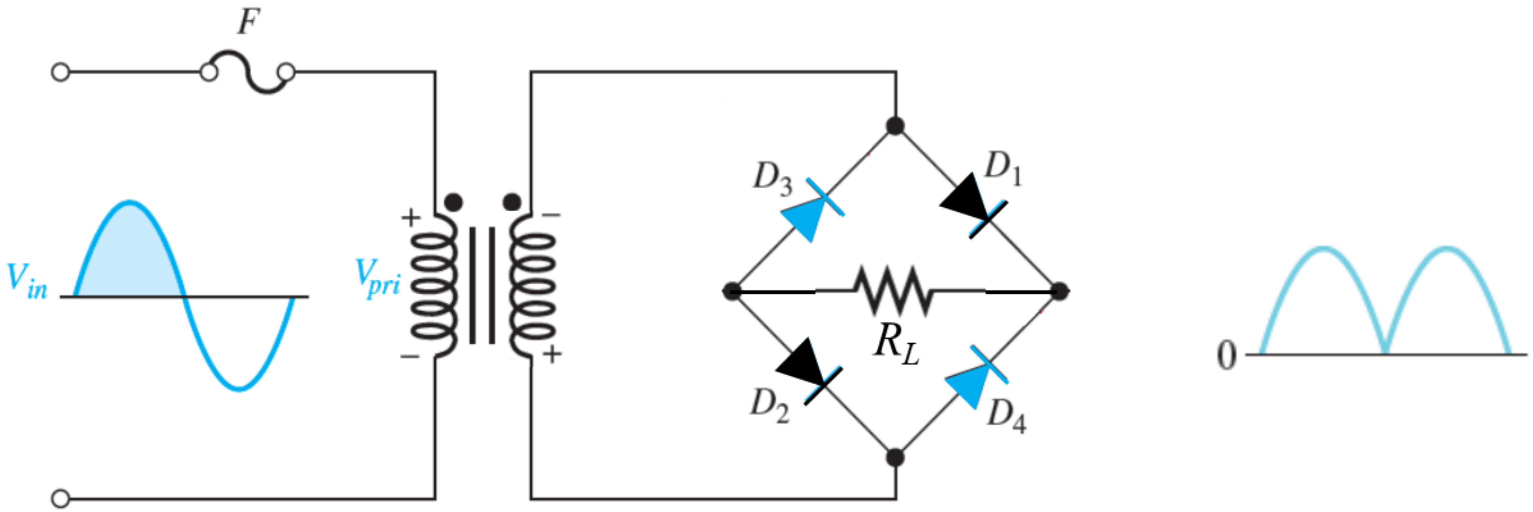


Fig. 1, b): During positive half-cycle of the input, D_3 and D_4 are forward-biased and conduct current. D_1 and D_2 are reverse-biased

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:

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

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

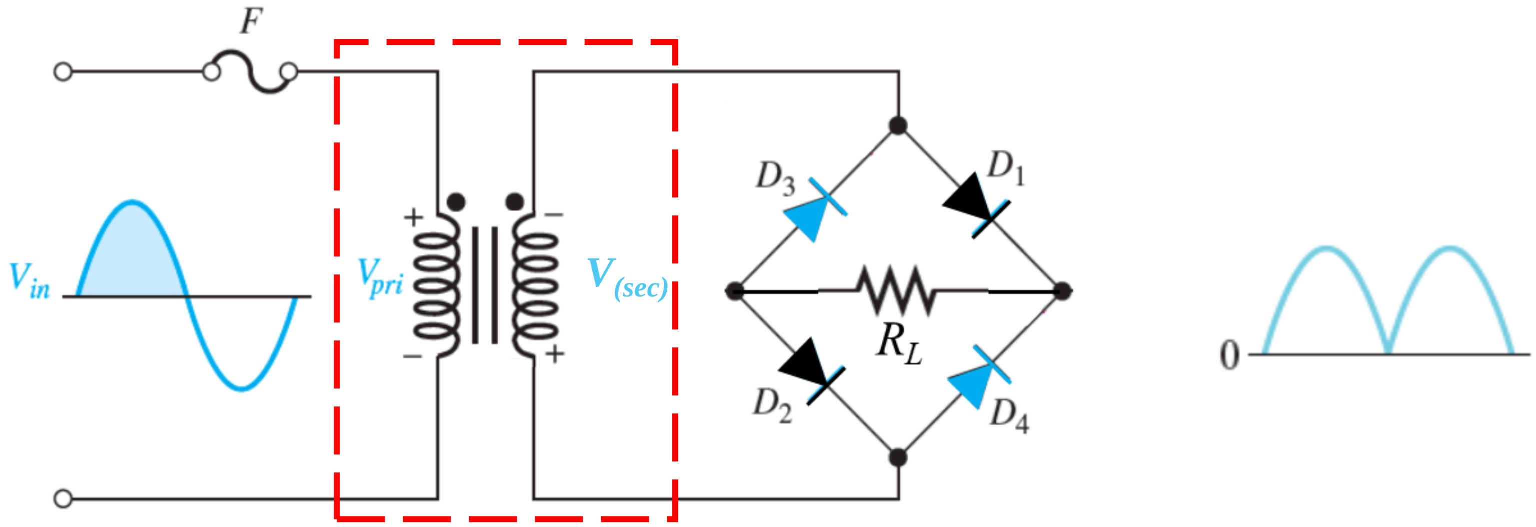


Fig. 2: The bridge output voltage from the transformer

Full-Wave Bridge Rectifier

Peak Inverse Voltage (PIV)

Let's assume that the input is in its positive half-cycle Then:

- D_1 and D_2 are forward-Biased
- D_3 and D_4 are reversed-Biased
- In Fig.1, a), PIV is equal to the $V_{p(sec)}$ which is equal to the $V_{p(out)}$

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

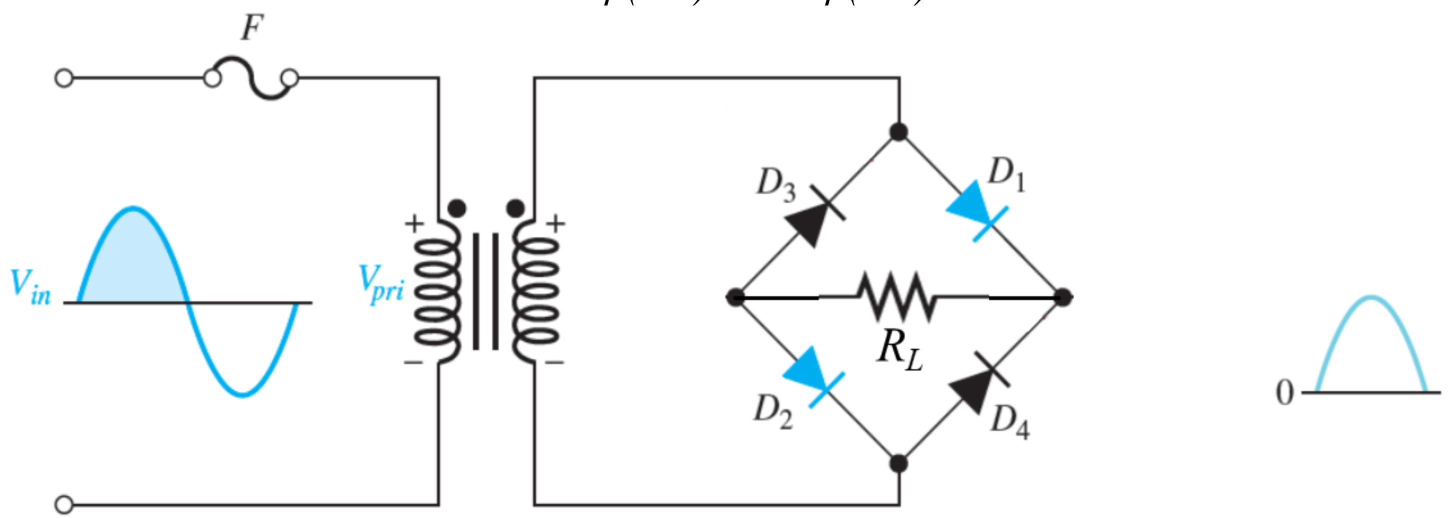


Fig. 1, a): During positive half-cycle of the input, D_1 and D_2 are forward-biased and conduct current. D_3 and D_4 are reverse-biased

Full-Wave Bridge Rectifier

Peak Inverse Voltage (PIV)

The PIV rating of the **bridge diodes** is **half** that required for the **center-tapped rectifier** for the same output voltage.

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

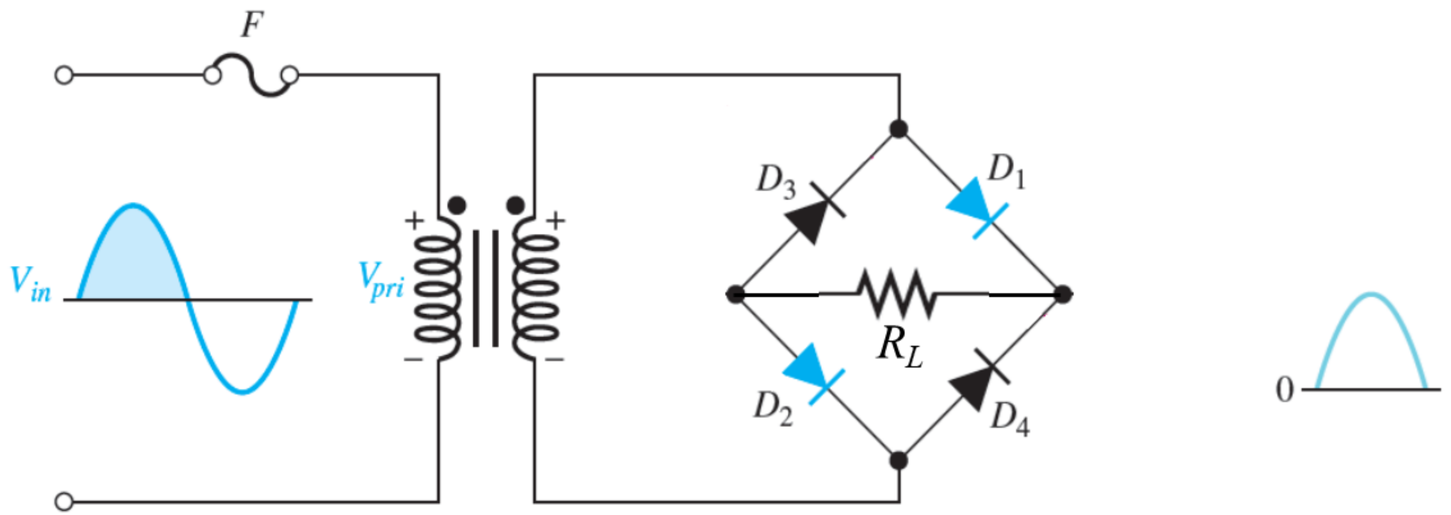


Fig. 1, a): During positive half-cycle of the input, D_1 and D_2 are forward-biased and conduct current. D_3 and D_4 are reverse-biased

Full-Wave Bridge Rectifier

Example 1:

a) Determine the peak output voltage $V_{p(out)}$, $V_{p(RL)}$ and V_{AVG} for the bridge rectifier in Fig. 3.

b) What is the minimum PIV rating required for the diodes?

Solution:

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

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

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

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

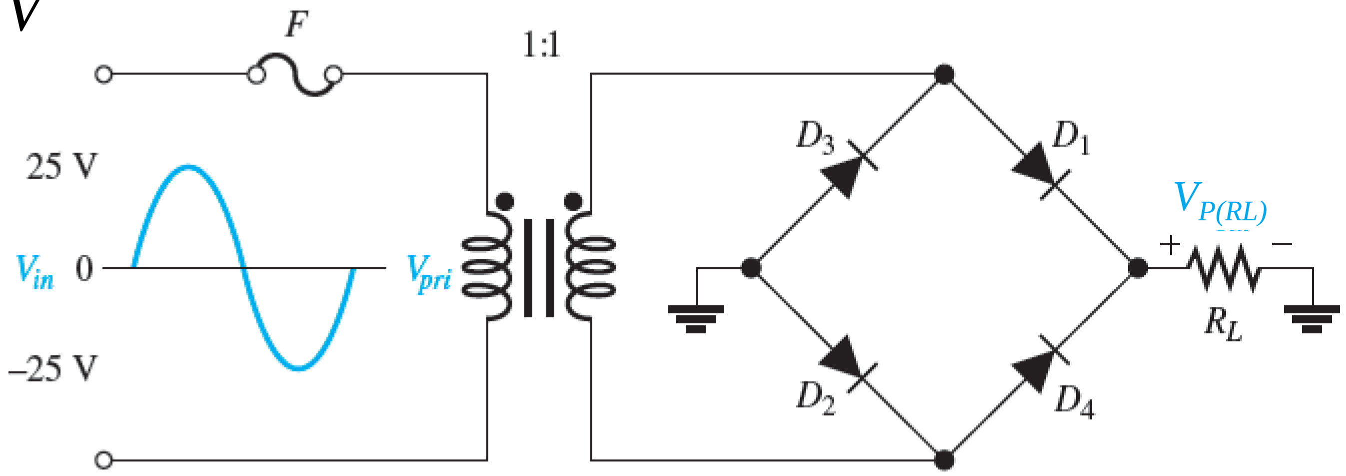
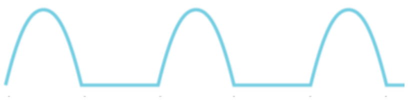


Fig. 3: Full-Wave Bridge Rectifier

Compression between (HWR), Centre-tapped (FWR) & Bridge (FWR)

	HWR	Center-tapped FWR	Bridge FWR

Compression between (HWR), Centre-tapped (FWR) & Bridge (FWR)

	HWR	**Center-tapped FWR**	**Bridge FWR**
Allows	Allows only one-half	Allows unidirectional half	Allows unidirectional half
Output wave			
Transformer type	Standard	Center-Tapped	Standard
Number of diodes	1	2	4
V_{AVG}	$= \dfrac{V_{p(out)}}{\pi}$	$V_{AVG} = \dfrac{2V_{p(out)}}{\pi}$	$V_{AVG} = \dfrac{2V_{p(out)}}{\pi}$
$V_{p(RL)}$	$= V_{p(out)} - 0.7\ V$ $= V_{p(sec)} - 0.7\ V$	$= V_{p(out)} - 0.7\ V$ $= \dfrac{V_{p(sec)}}{2} - 0.7\ V$	$= V_{p(out)} - 2 \times 0.7\ V$ $= V_{p(sec)} - 2 \times 0.7\ V$
PIV	$= V_{p(sec)}$	$= V_{p(sec)} = 2V_{p(out)}$	$= V_{p(sec)}$
Frequency	Equal	Double	Double