SUBJECT: BASIC ELECTRONICS

Full Wave Rectifier (Center Tapped)

Elementrix Classes

Full Wave Rectifier (Center Tapped)

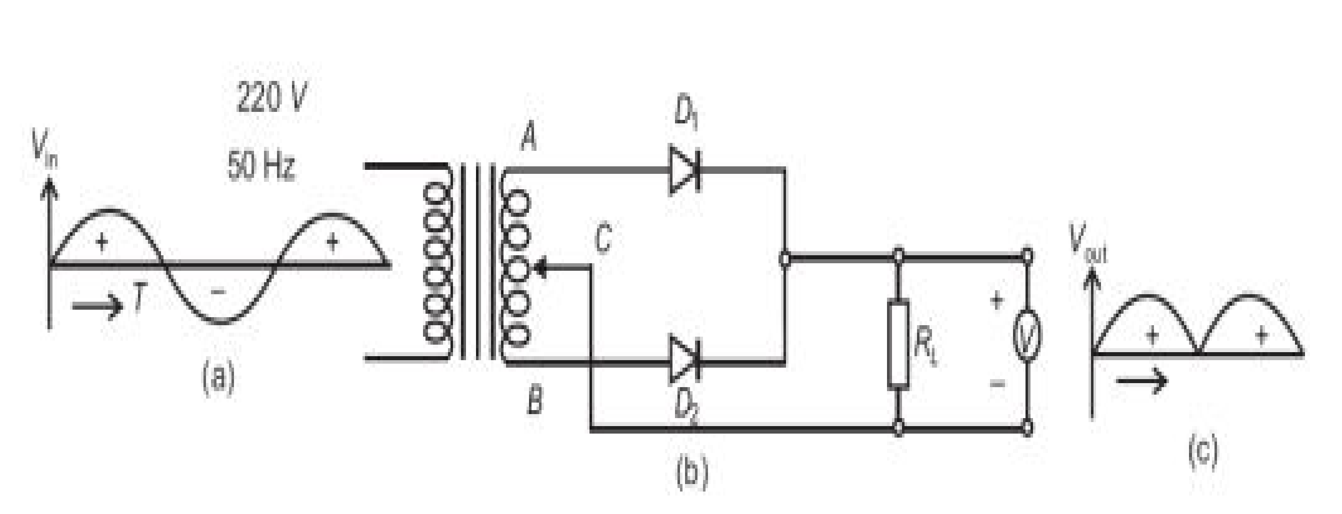
- **Rectifier:** A rectifier is an electrical device that converts alternating current (AC), which periodically reverses direction, to direct current (DC), which flows in only one direction.

- **Need of Full Wave Rectifier:** A full-wave rectifier is preferred over a half-wave rectifier because it utilizes both halves of the AC waveform, providing a more continuous and efficient conversion of AC to DC, resulting in a smoother and more stable DC output. This leads to higher efficiency and reduced ripple in the output voltage.

- A full-wave rectifier is an electronic circuit that converts alternating current (AC) to direct current (DC) by utilizing both positive and negative halves of the AC waveform, resulting in a more continuous and efficient DC output compared to a half-wave rectifier.

Working

- In this type of full-wave rectifier, a centre-tapped step down transformer and two diodes are used to achieve full wave rectification.



- At any moment during a cycle of, V_{in} if point A is positive relative to C, point B is negative relative to C. So, the voltage applied to the anode of each diode is equal but opposite in polarity at any given instant.

- In one half of the input cycle, when A is positive relative to C, the anode of D_1 is positive with respect to its cathode. Hence D_1 will conduct current but D_2 will not.

- During the second half of the input cycle, B is positive relative to C. The anode of D_2 is therefore positive with respect to its cathode, and conducts while D_1 does not.

- Since the two diodes have a common-cathode load resistor R_L, the output voltage across R_L results from the alternate conduction of D_1 and D_2. So, during the entire input cycle, either D_1 or D_2 conducts current so that the output voltage takes the form shown in Fig.

- For an AC voltage given the waveform of the output voltage of a full wave rectifier can be written as (for an ideal diode)

$$V_o(t) = \begin{cases} V_m \sin(\omega t), & 0 \le t \le T/2 \\ V_m \sin(\omega t - \pi), & T/2 \le t \le T \end{cases}$$

Full Wave Rectifier (Center Tapped) Calculations

- **Average output voltage (V_{dc}):** This represents the average value of the rectified DC voltage over a full cycle. For a full wave rectifier,

$$V_{dc} = \frac{2V_m}{\pi}$$

- **Root mean square (RMS) output voltage (V_{rms}):** This refers to the effective value of the AC component remaining in the DC output. For a full wave rectifier,

$$V_{rms} = \frac{V_m}{\sqrt{2}}$$

- **Ripple Factor (γ):** Ripple is the unwanted AC component remaining when converting the AC voltage waveform into a DC waveform. Even though we try out best to remove all AC components,there is still some small amount left on the output side which pulsates the DC waveform. This undesirable AC component is called ripple.

  This measures the AC variation present in the DC output, indicating its smoothness. It's calculated as

$$\gamma = \sqrt{\left(\frac{V_{rms}}{V_{dc}}\right)^2 - 1}$$

- **Efficiency:** The ratio of the DC power available at the load to the applied input AC power is known as the efficiency, **η**. Mathematically it can be given as:

$$\eta = \frac{DC\, power\, output}{AC\, power\, input} = \frac{P_{dc}}{P_{ac}} = 81.2\%$$

- **Form factor:** Form factor (f.f.) is defined as the ratio between RMS load voltage and average load voltage. The form factor of the full wave rectifier is as,

$$f.f. = \frac{V_{rms}}{V_{dc}}$$

- **Peak inverse voltage (PIV):** Peak Inverse Voltage (PIV) is the maximum voltage that the diode can withstand during reverse bias condition. If a voltage is applied more than the PIV, the diode will be destroyed.Thus for a full wave (center tapped) rectifier,

$$PIV = 2V_m$$

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