

Module-1

Introduction _ Power Diodes _ Diode Rectifier

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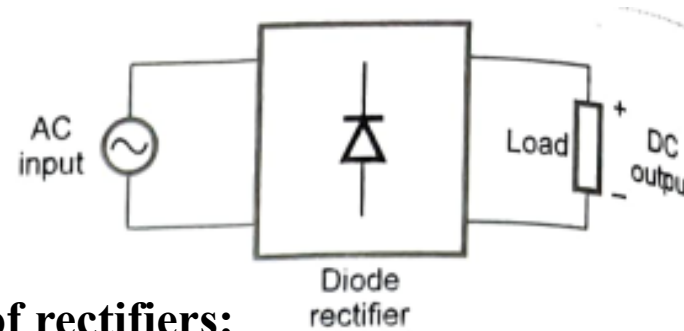
Module-1

Introduction: Applications of Power Electronics, Ideal Characteristics of switches, Characteristics of practical devices; Specifications of Switches, control characteristics of power devices, Types of Power Electronic Circuits, Peripheral Effects, Intelligent Modules.

Power Diodes: Introduction, Diode Characteristics, Reverse Recovery Characteristics, Power Diode Types, Silicon Carbide Diodes, Silicon Carbide Schottky Diodes, Freewheeling diodes, Freewheeling diodes with RL load.

Diode Rectifiers: Introduction, Diode Circuits with DC Source connected to R and RL load, Single-Phase Full Wave Rectifiers with R load, Single-Phase Full-Wave Rectifier with RL Load.

Diode Rectifiers:



Classification and types of rectifiers:

i) 1 \emptyset diode rectifiers

- 1 \emptyset half wave rectifiers
- 1 \emptyset Full wave rectifiers
- 1 \emptyset bridge rectifiers

ii) 3 \emptyset diode rectifiers

- 3 \emptyset half wave rectifiers
- 3 \emptyset Full wave rectifiers
- 3 \emptyset bridge rectifiers

Advantages:

1. Simple circuits available at all power capacities
2. No control circuits are required.
3. Single rectifiers are available in 10 and 34.
4. High frequency as well as low frequency rectifiers are available.
5. Low cost.

Applications:

1. UPS
2. Simple electronic circuits.
3. Low power battery chargers.
4. Simple and low power supplies.

Disadvantages:

1. Output voltage is uncontrolled.
2. Power flow is unidirectional.
3. High ripple content for 1Ø rectifiers.

$$FF = V_{0rms} / V_{0av}$$

3. **Ripple Factor (RF):** It is the measure of ripple content. i.e

$$RF = \sqrt{\left[\frac{V_{o(rms)}}{V_{o(av)}} \right]^2 - 1} = \sqrt{FF^2 - 1}$$

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Performance Parameters:

1. **Rectification efficiency or ratio of rectification (η):** It is the ratio of DC load power to AC or rms load power.

$$\text{Rectification efficiency, } \eta = \frac{\text{DC or average load power}}{\text{AC or rms load power}}; \quad \frac{P_{o(av)}}{P_{o(rms)}} = \frac{V_{o(av)} I_{o(av)}}{V_{o(rms)} I_{o(rms)}}$$

2. **Form Factor (FF):** It is the measure of shape of output voltage.

$$FF = \frac{V_{o(rms)}}{V_{o(av)}}$$

3. **Ripple Factor (RF):** It is the measure of ripple content.

$$RF = \sqrt{\left[\frac{V_{o(rms)}}{V_{o(av)}} \right]^2 - 1} = \sqrt{FF^2 - 1}$$

4. Transformer utilization factor: It is the measure of size of the transformer. It is defined as the ratio of load average power to total power at transformer secondary.

$$\text{TUF} = \frac{P_{o(av)}}{V_{s(rms)} \cdot I_{s(rms)}}$$

5. Displacement Factor (DF) or Displacement Power Factor (DPF) : It is the cosine of angle between fundamental components of input or supply current and voltage

$$\text{DF} = \cos \phi$$

6. Harmonic Factor (HF) or Total Harmonic Distortion (THD): It is the measure of ripple content or distortion in input or supply current.

$$\text{HF} = \sqrt{\left[\frac{I_{s(rms)}}{I_{s1(rms)}} \right]^2 - 1}$$

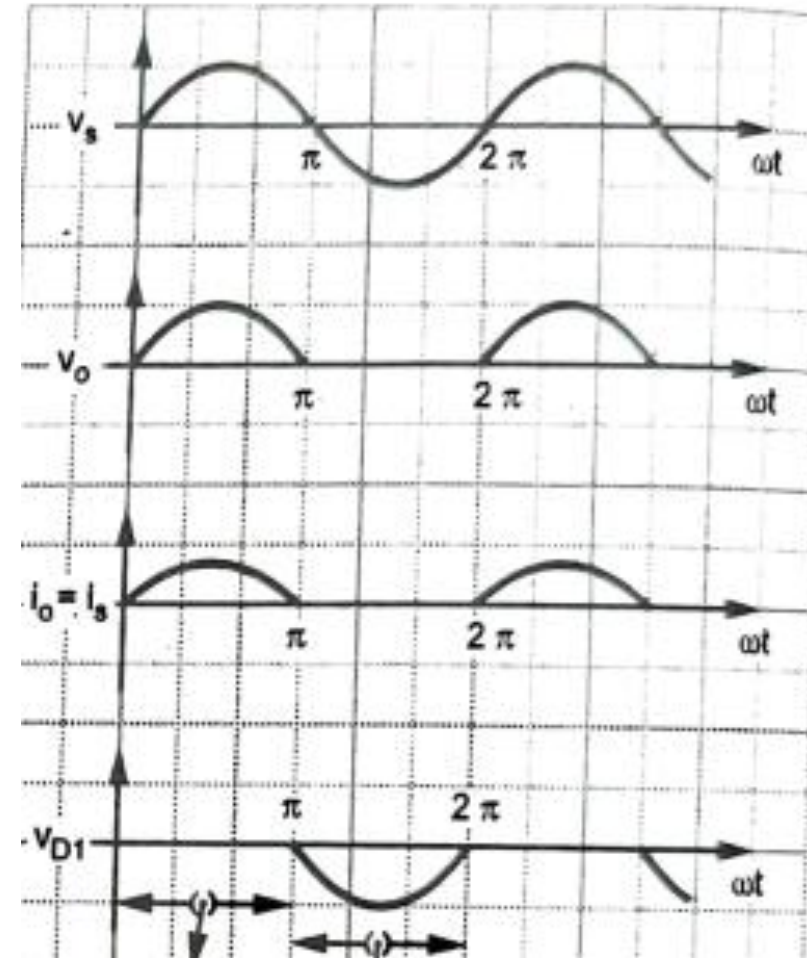
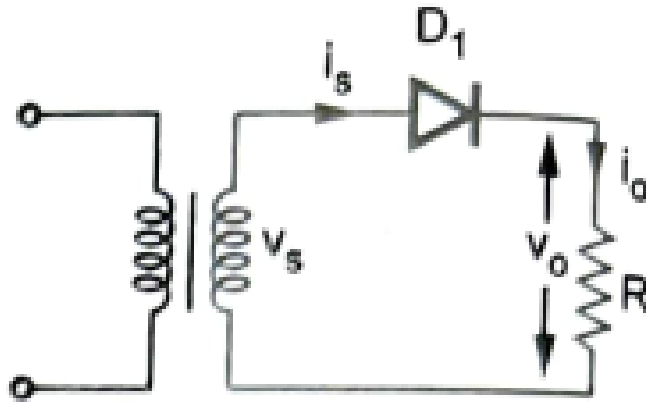
7. Crest Factor (CH): It is the ratio of peak value of supply current to rms value of supply current.

$$CF = \frac{I_{s(peak)}}{I_{s(rms)}}$$

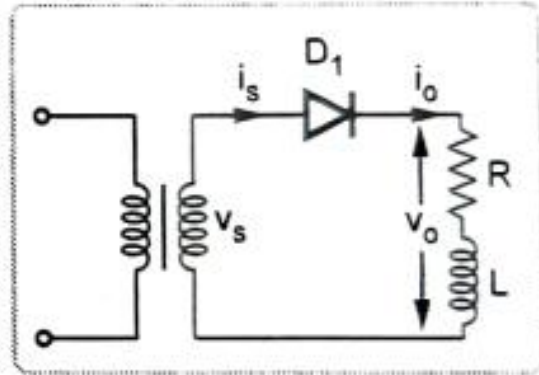
8. Power Factor (PF): It is the measure of reactive power content in the supply due to load.

$$PF = \frac{V_{s(rms)} I_{s1(rms)} \cos \phi}{V_{s(rms)} \cdot I_{s(rms)}}$$
$$= \frac{I_{s1(rms)}}{I_{s(rms)}} \cos \phi$$

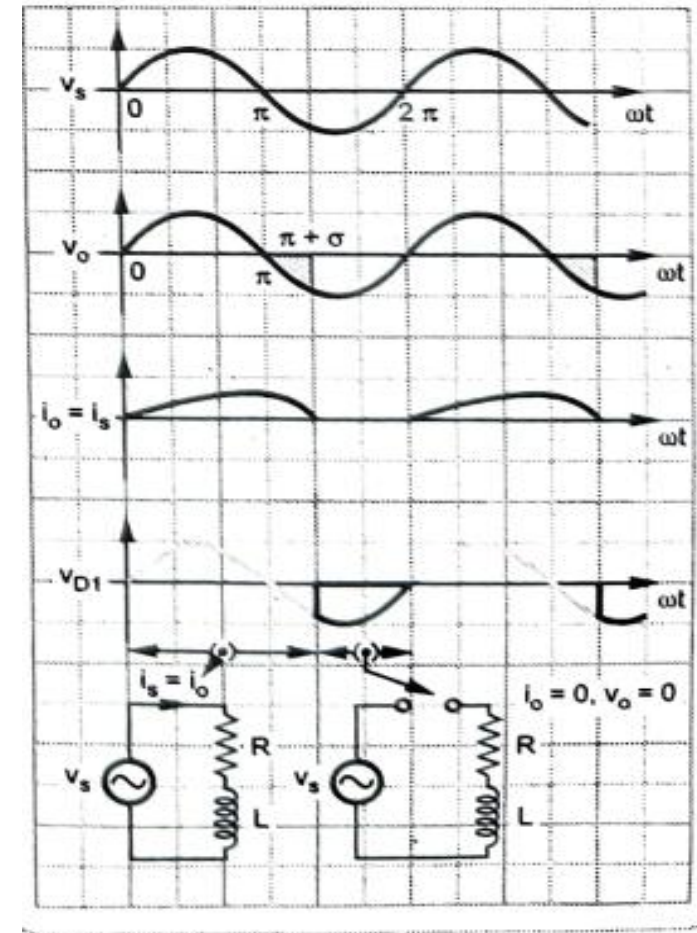
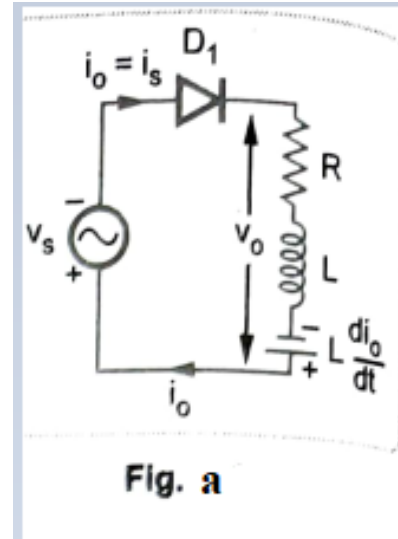
Single Phase Half Wave Rectifier with R Load:



Single Phase Half Wave Rectifier with RL Load:

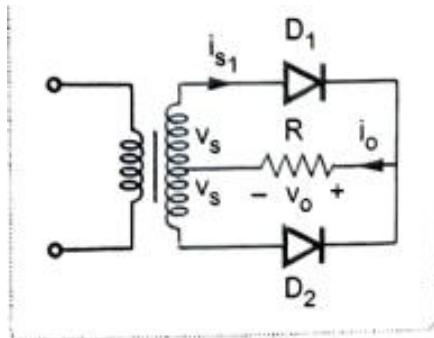


1 ϕ half wave rectifier

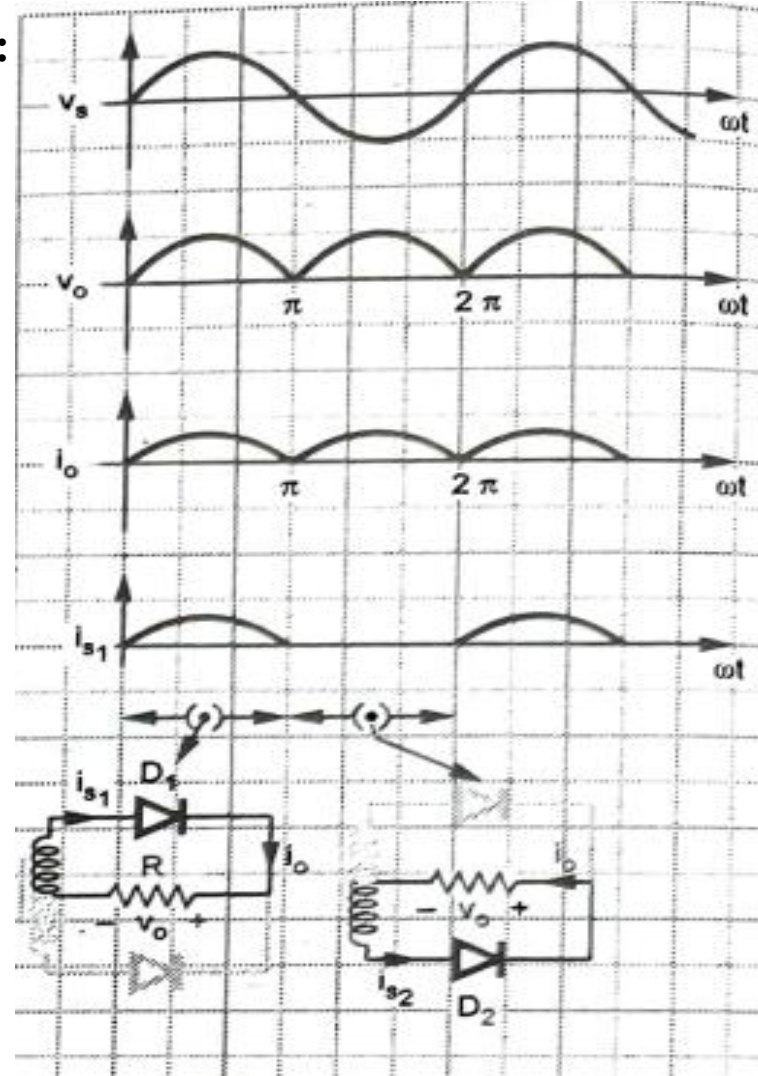


Waveforms of 1 ϕ half wave rectifier (RL load)

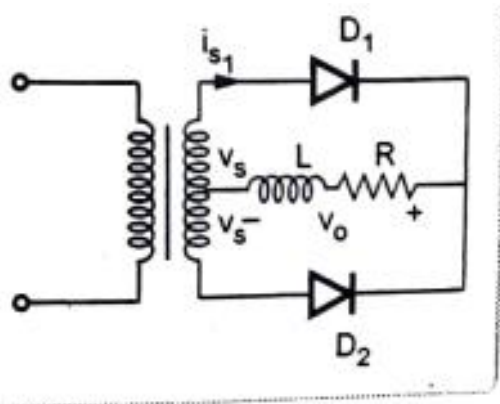
Single Phase Full Wave Rectifier with R Load:



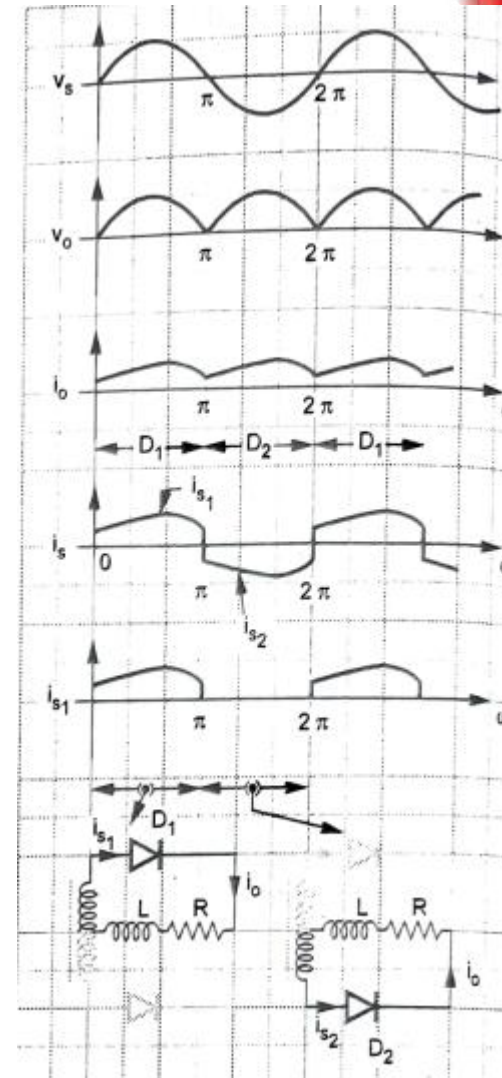
1 ϕ full wave rectifier with R load



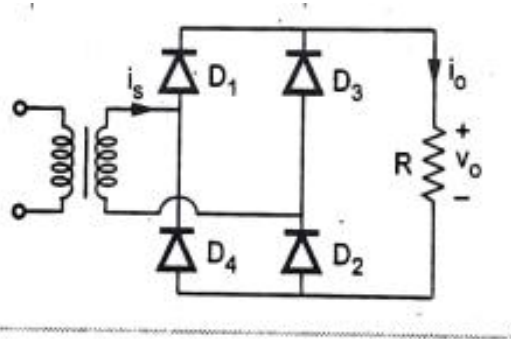
Single Phase Full Wave Rectifier with RL Load:



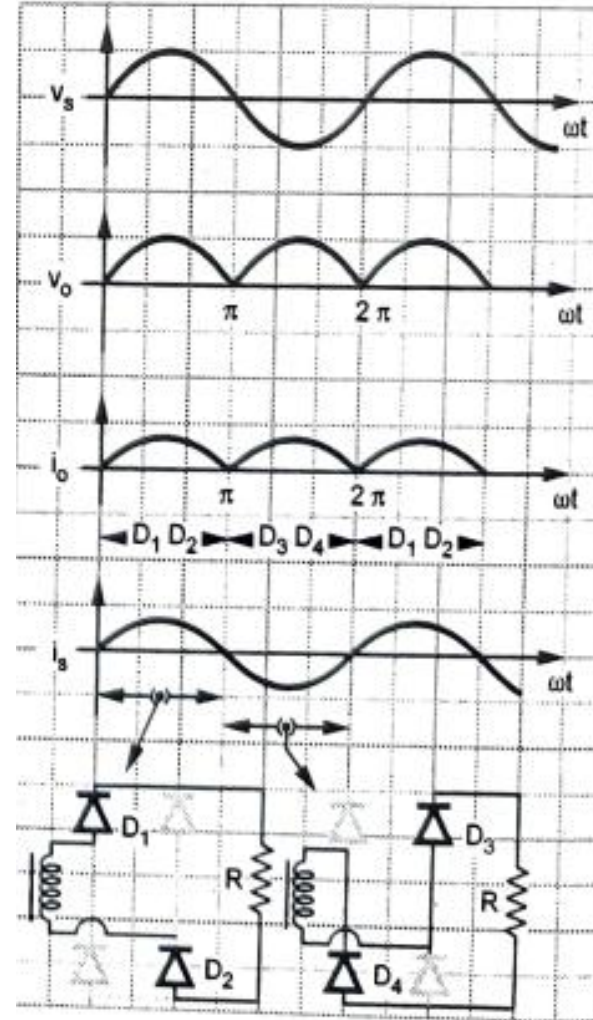
1 ϕ full wave rectifier with RL load



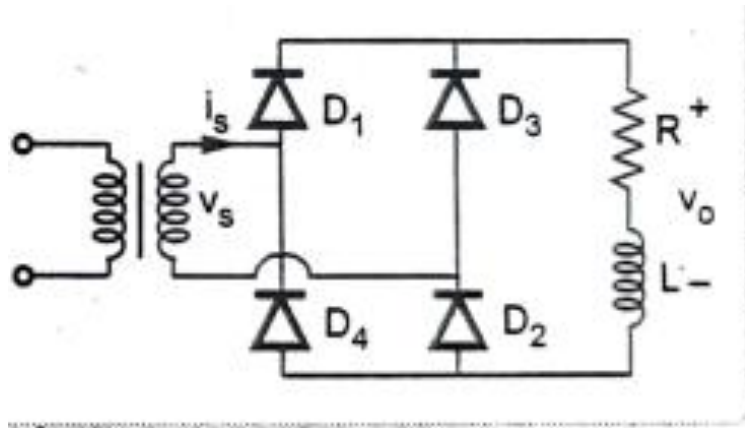
Single Phase Bridge Rectifier with R Load:



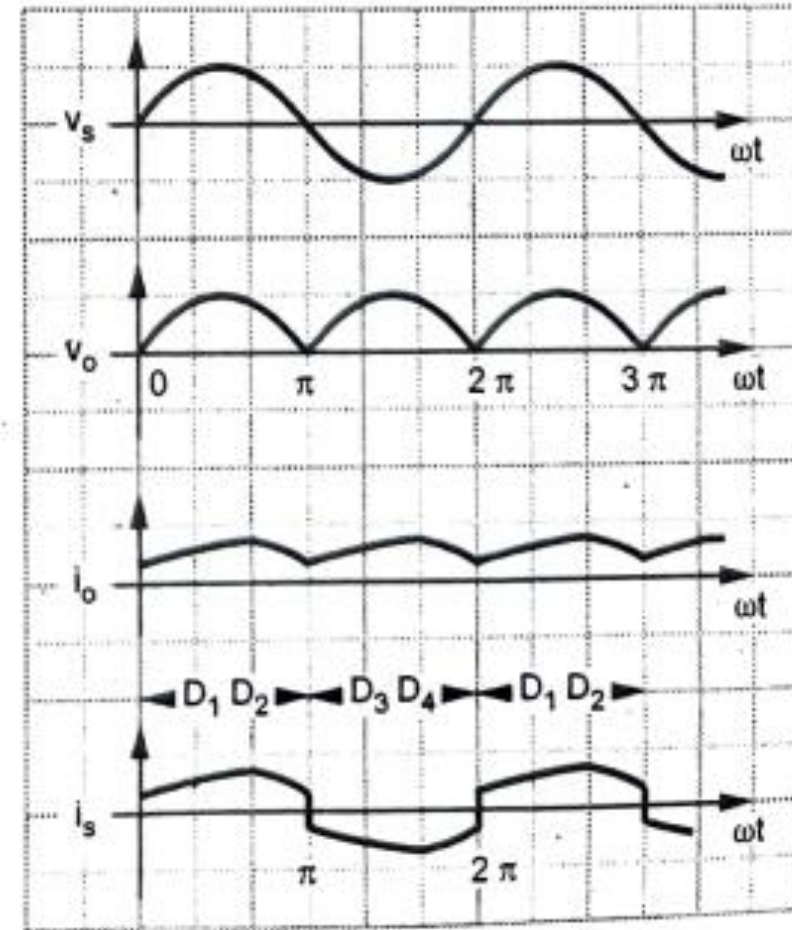
1 ϕ bridge rectifier



Single Phase Bridge Rectifier with RL Load:



1 ϕ bridge rectifier with RL load





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