جامعة بيرزيت
BIRZEIT UNIVERSITY

Electrical Machine Drive and Special Machines

ENEE5303

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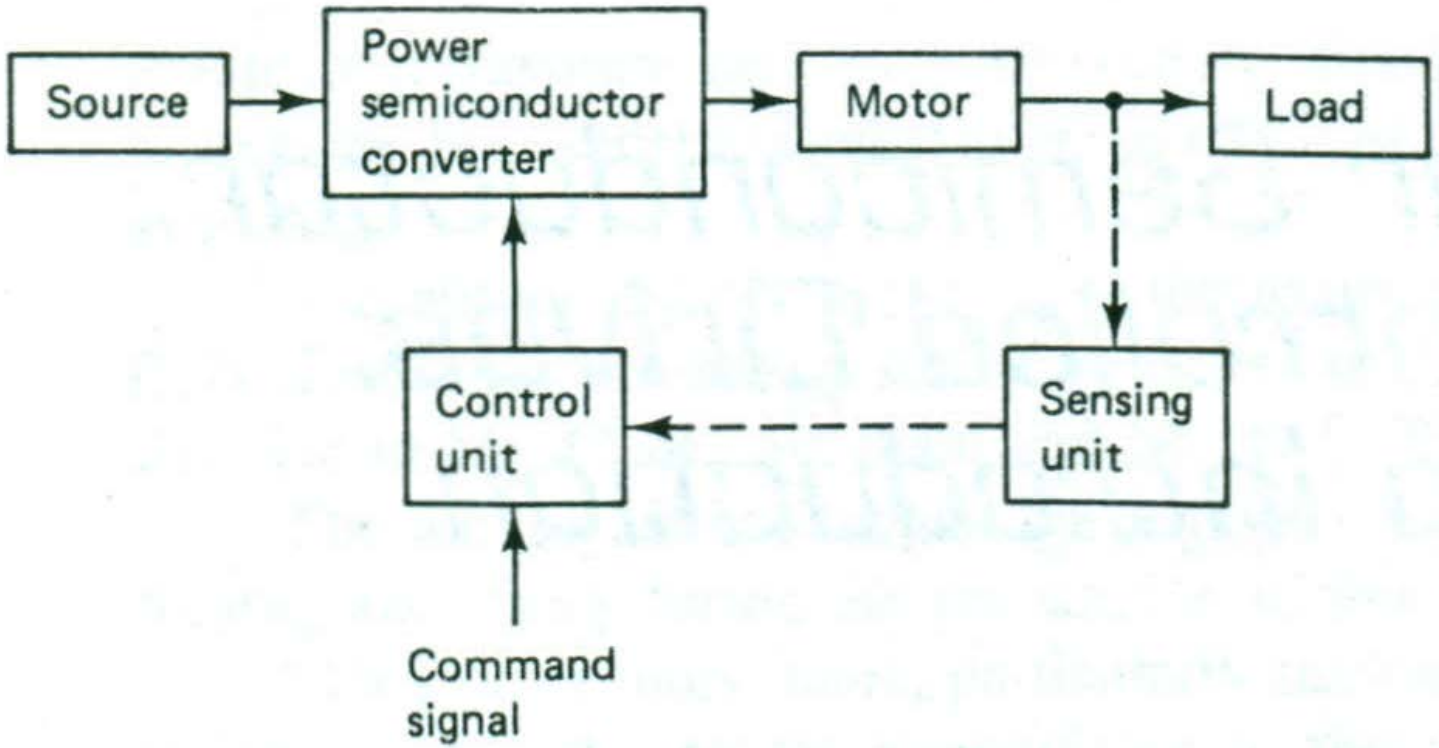
Introduction

- A modern variable speed system has four components:
  1. Power converters or drive circuits
  2. Electric machines
  3. Control system
  4. Load

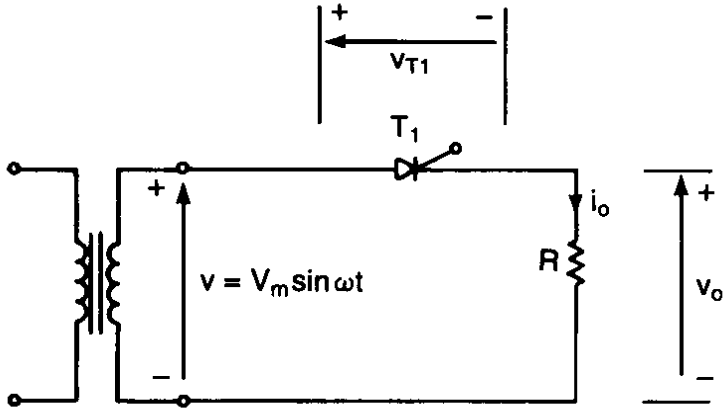
- A Block diagram of an electric drive



1. Power Converters

1.1 Controlled rectifiers

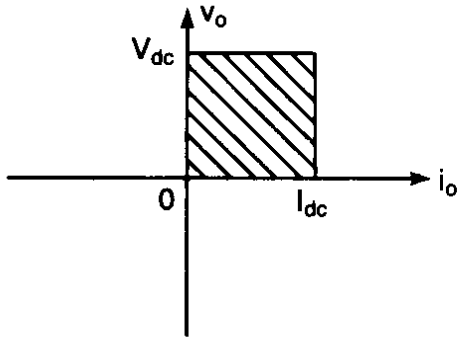
- Types of controlled rectifiers (single and three-phase)
  - Half-wave
  - Semiconverter
  - Full-wave
  - Dual
- They are fed from 1-phase or 3-phase AC main supply and provide a variable DC output voltage for control of DC motors.
- or sometimes input DC supply to the inverters in the case of AC machines



(a) Circuit

Single-phase:

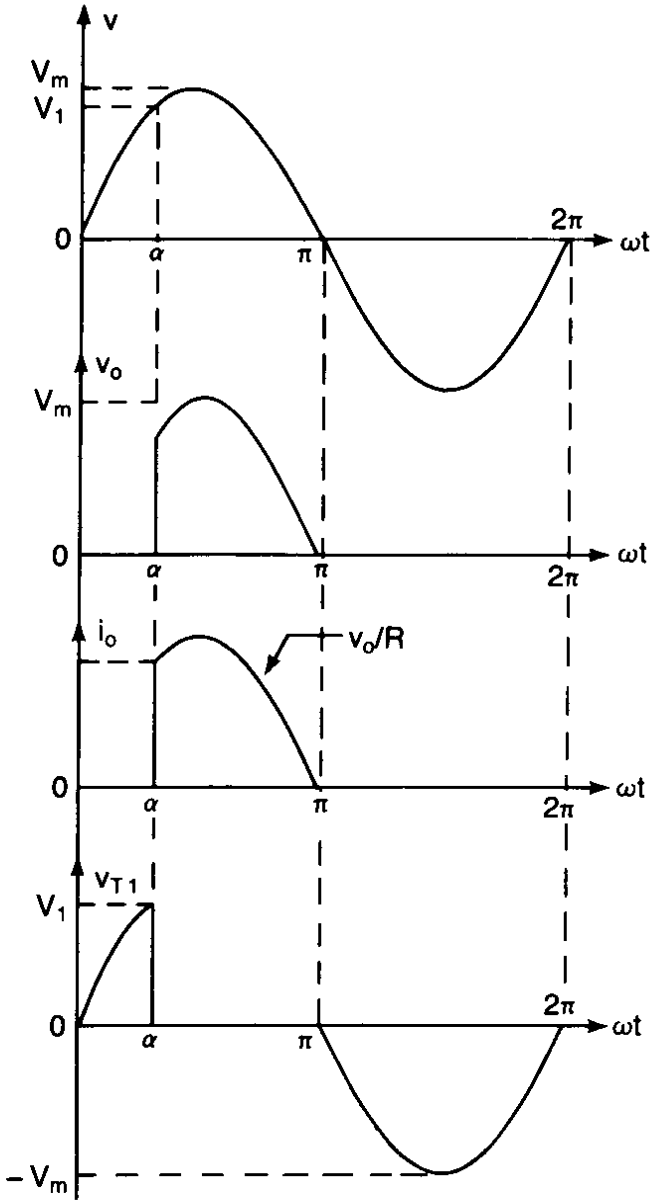
Half-wave controlled rectifier



(b) Quadrant

The average DC output voltage is given by:

$$V_{DC} = \frac{V_m}{2\pi}(1+\cos\alpha)$$



(c) Waveforms

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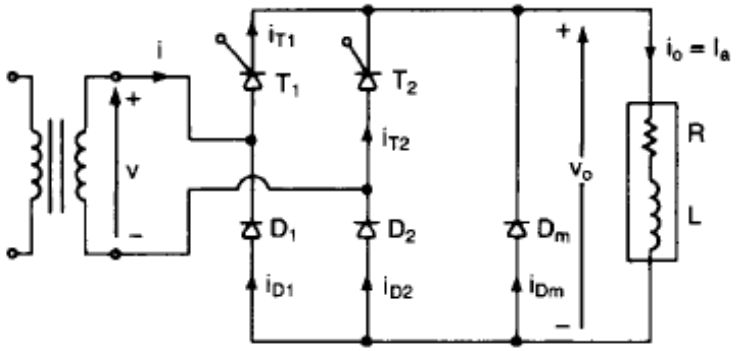
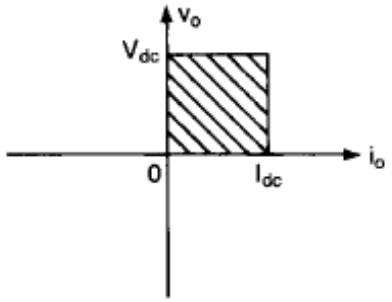
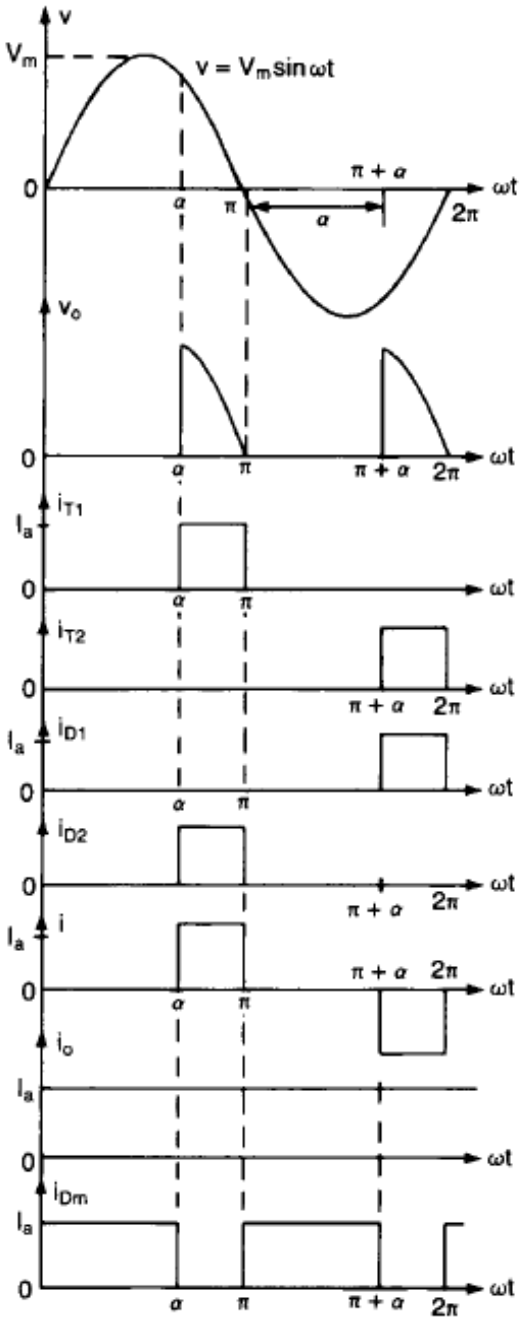


(a) Circuit



(b) Quadrant



(c) Waveforms

Single-phase:

Semiconverter

The average DC output voltage is given by:

$$V_{DC} = \frac{V_m}{\pi}(1+\cos\alpha)$$

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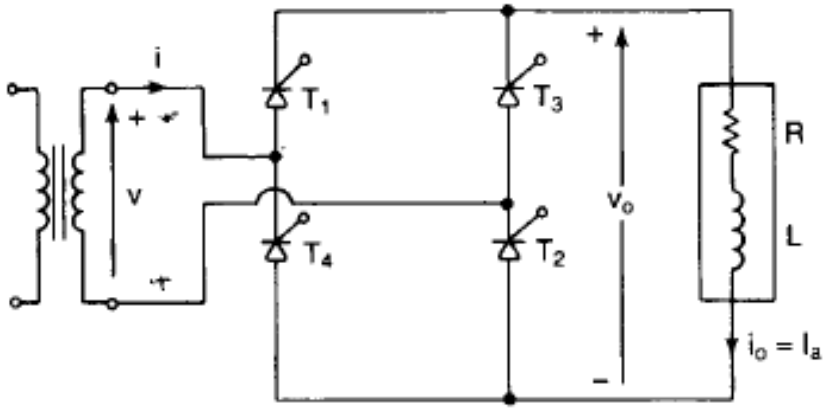
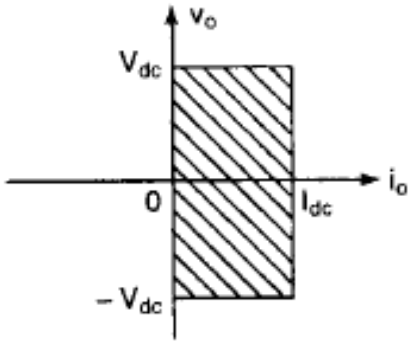
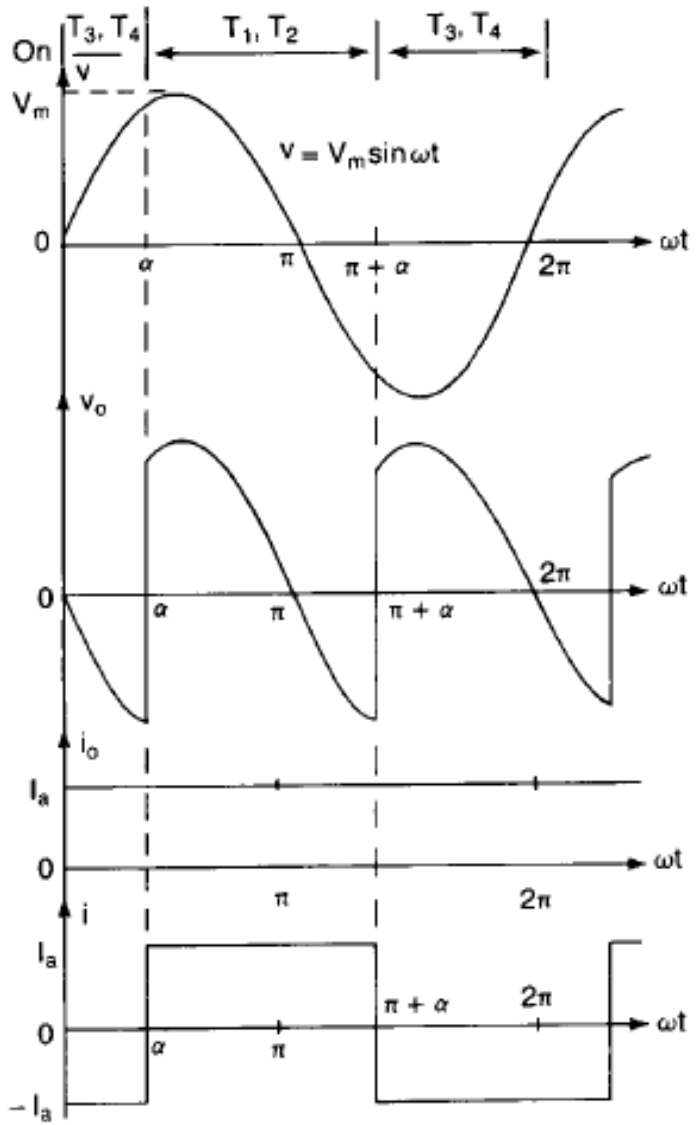


(a) Circuit



(b) Quadrant



(c) Waveforms

Single-phase:

Full-wave controlled rectifier

The average DC output voltage is given by:

$$V_{DC} = \frac{2V_m}{\pi}\cos\alpha$$

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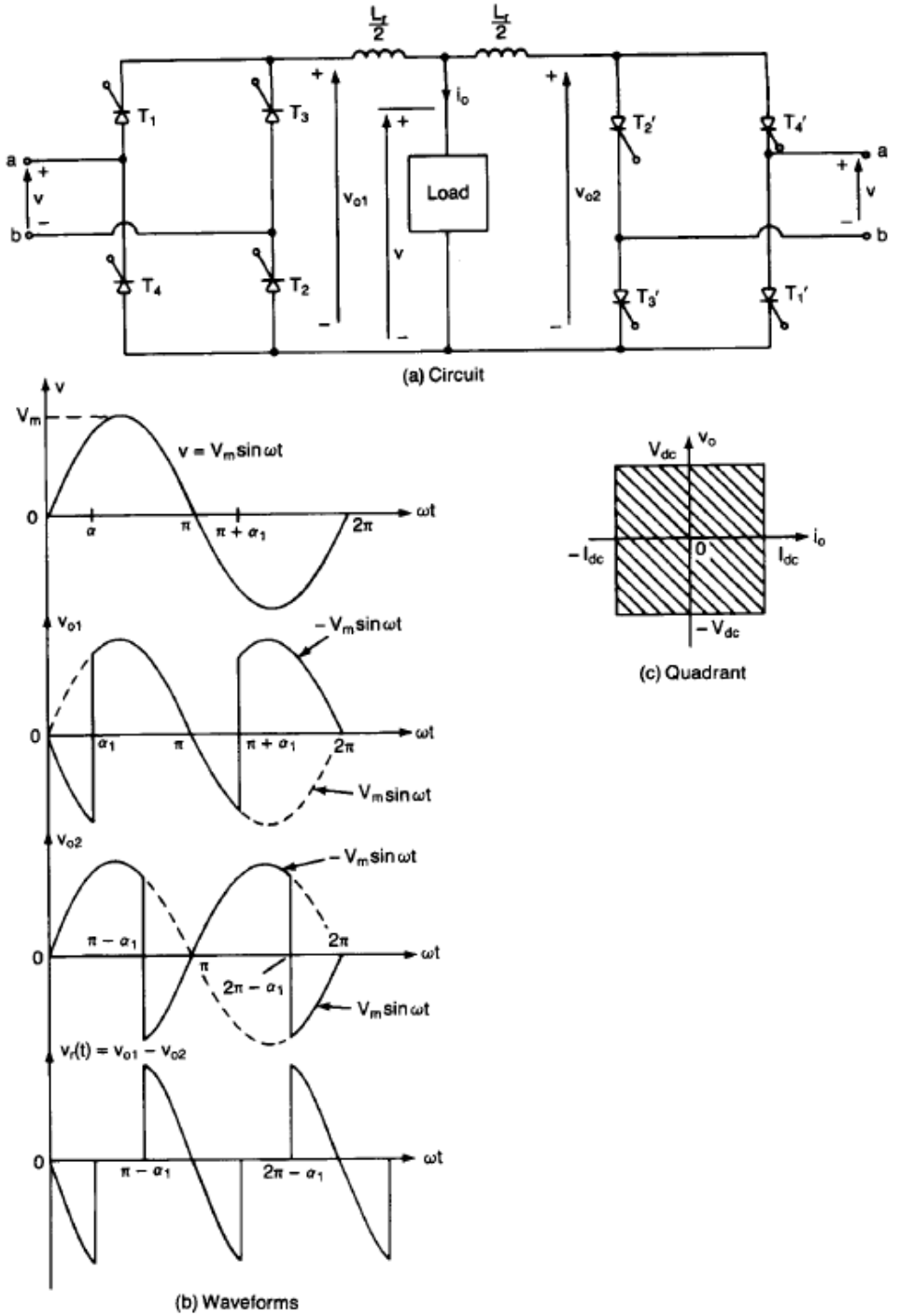
Single-phase:

Dual converter

The average DC output voltage is given by:

$$V_{DC} = \frac{2V_m}{\pi}\cos\alpha$$



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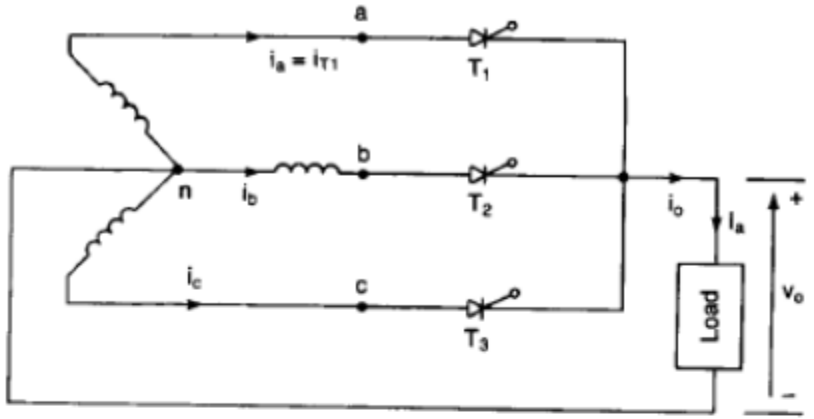


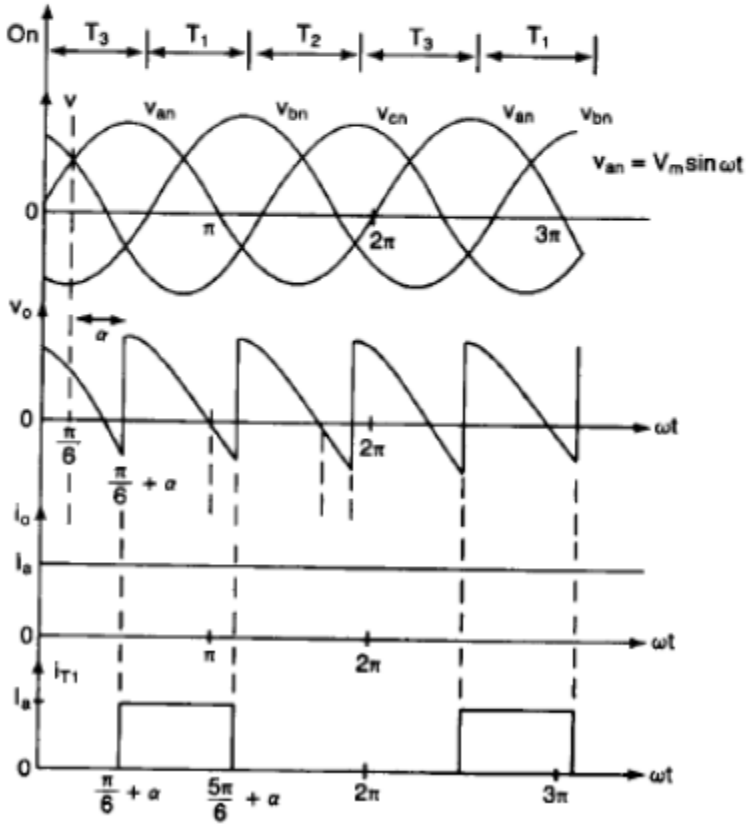
(a) Circuit

Three-phase:

Half-wave controlled rectifier

The average DC output voltage is given by:

$$V_{DC} = \frac{3\sqrt{3}}{2\pi} V_m \cos\alpha$$



(c) For inductive load

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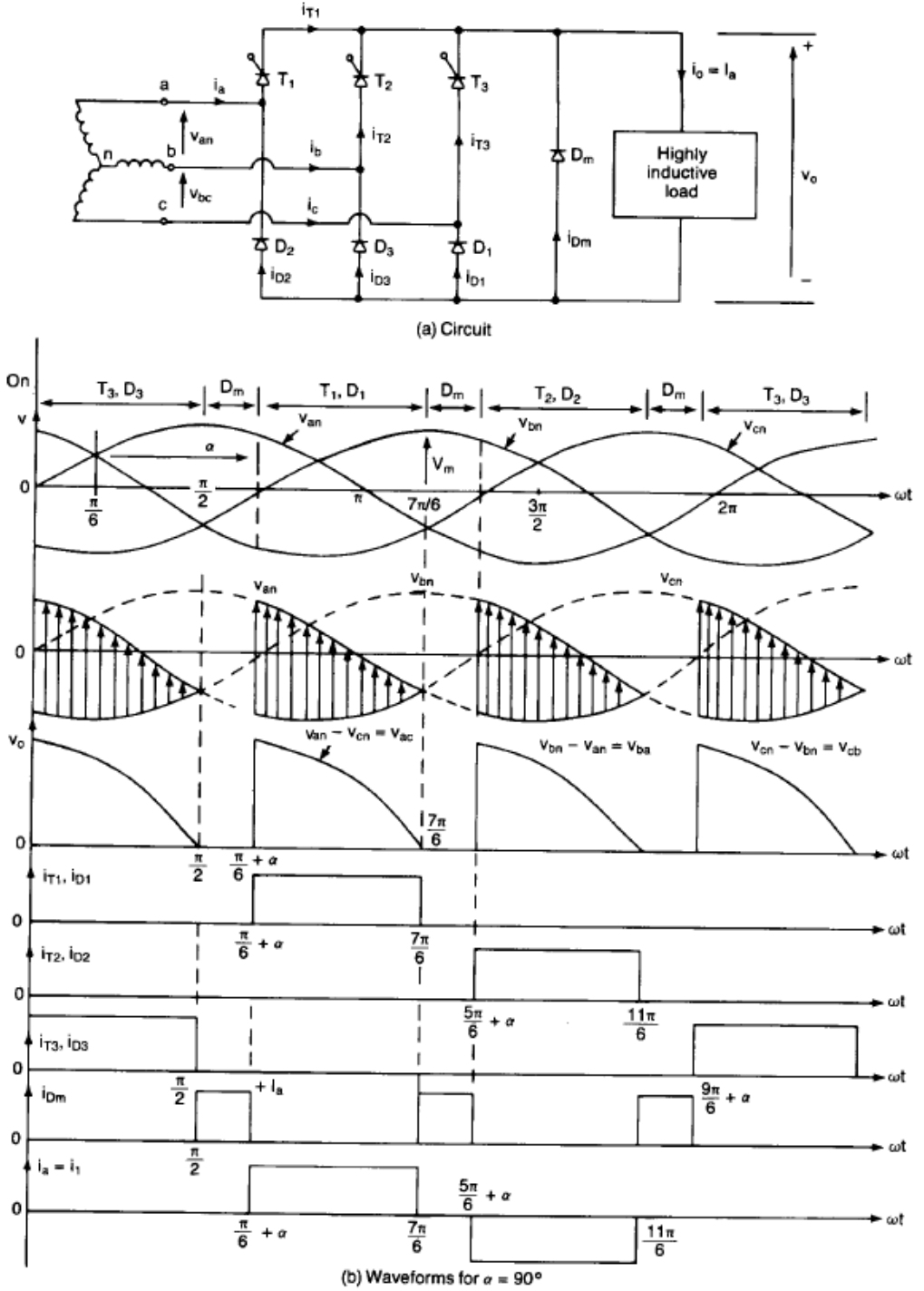
Three-phase:

Semiconverter

The average DC output voltage is given by:

$$V_{DC} = \frac{3\sqrt{3}}{2\pi} V_m \left(1 + \cos\alpha\right)$$



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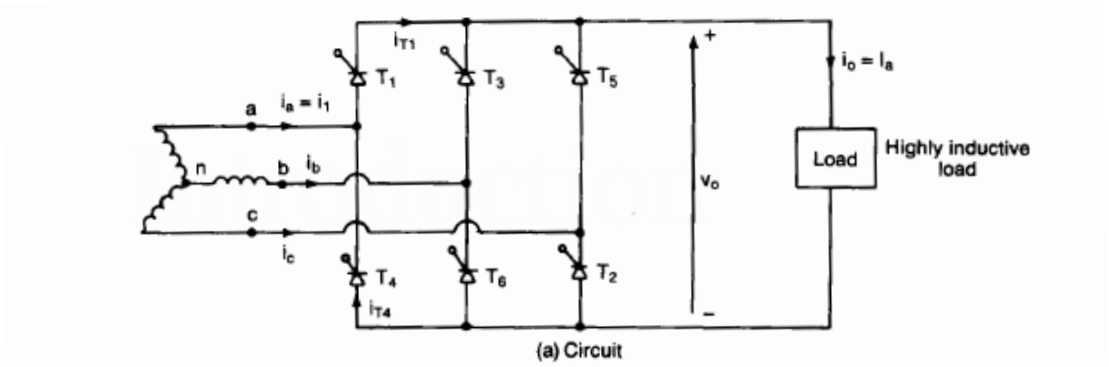
Three-phase:

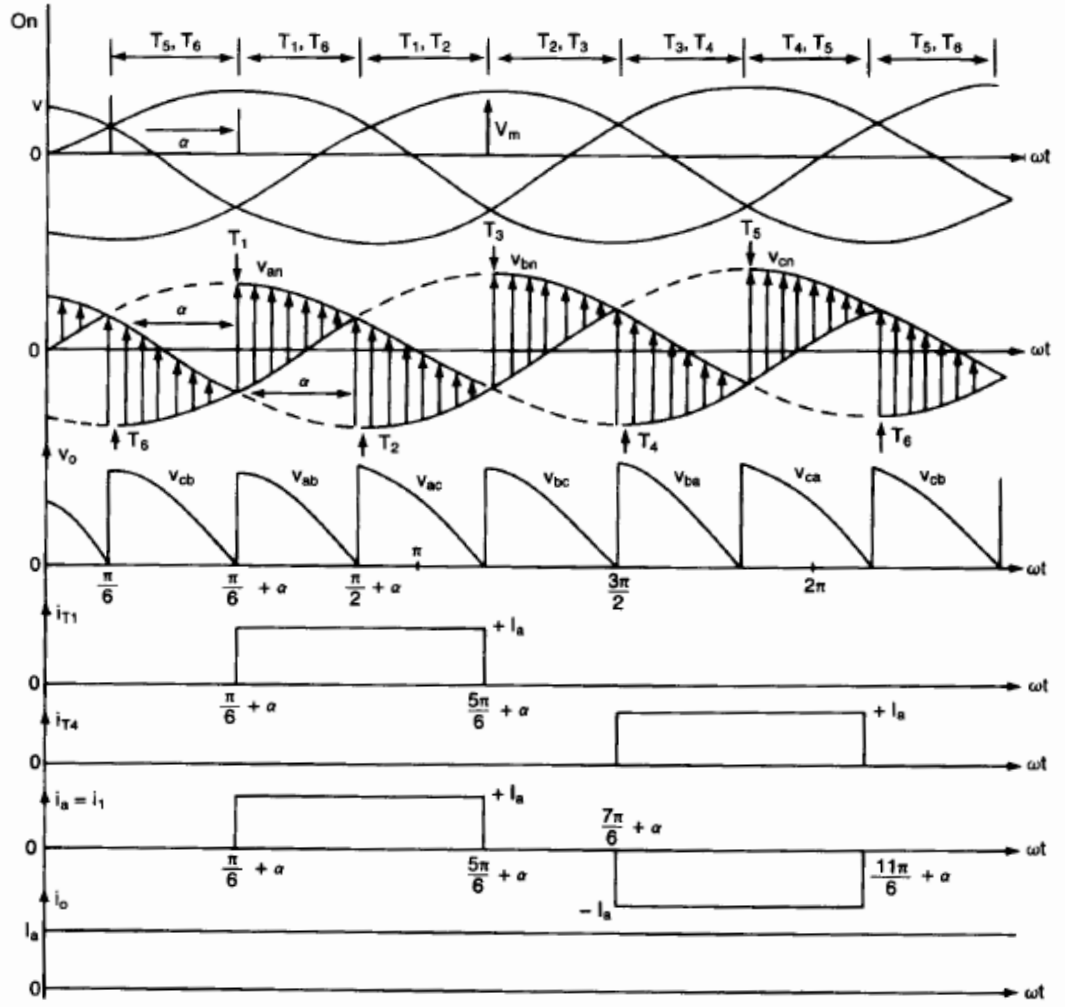
Full-wave controlled rectifier

The average DC output voltage is given by:

$$V_{DC} = \frac{3\sqrt{3}}{\pi} V_m \cos\alpha$$



(a) Circuit



(b) Waveforms

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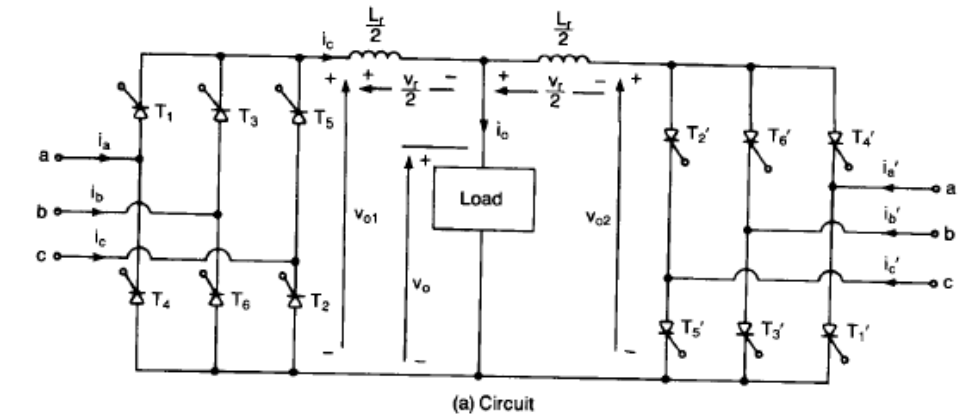
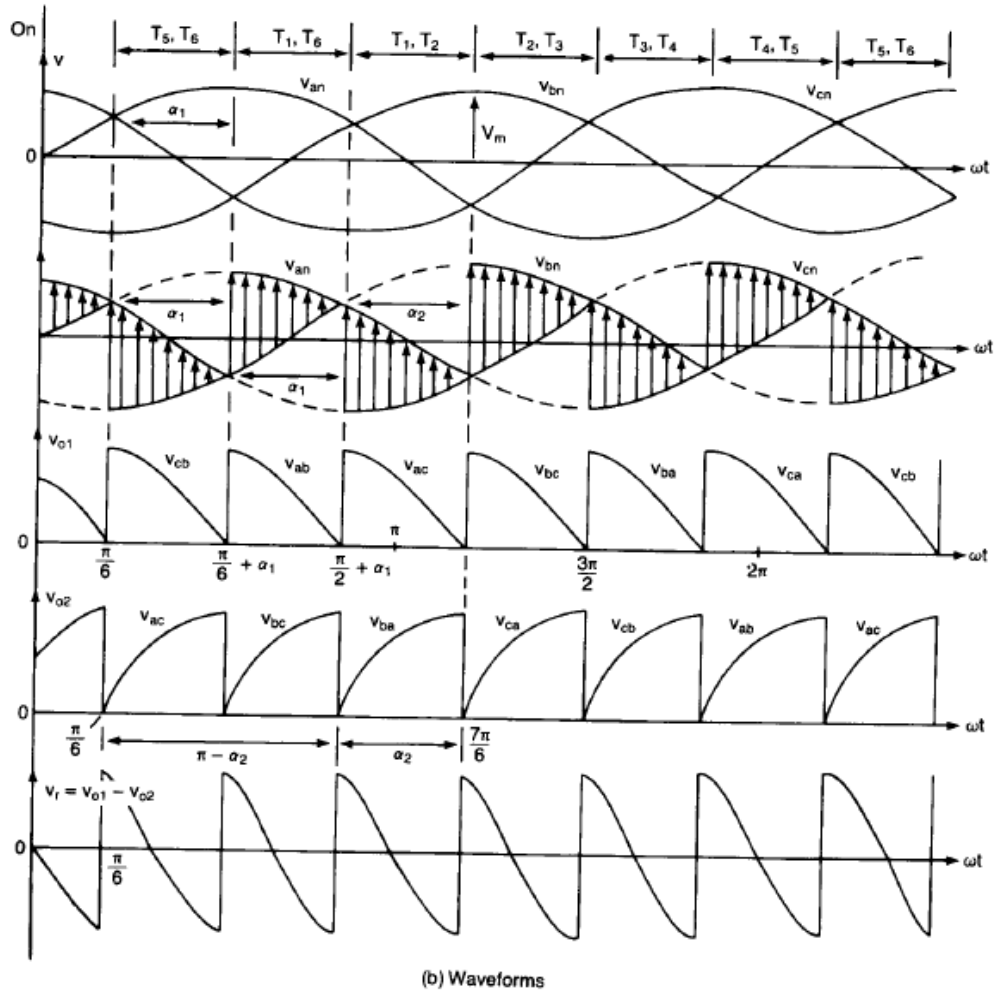
Three-phase:

Dual converter

The average DC output voltage is given by:

$$V_{DC} = \frac{3\sqrt{3}}{\pi} V_m \cos\alpha$$





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