

Chapter 15

Synchronous Motor Drives

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- A large variety of applications – higher efficiency

Rotor Structure

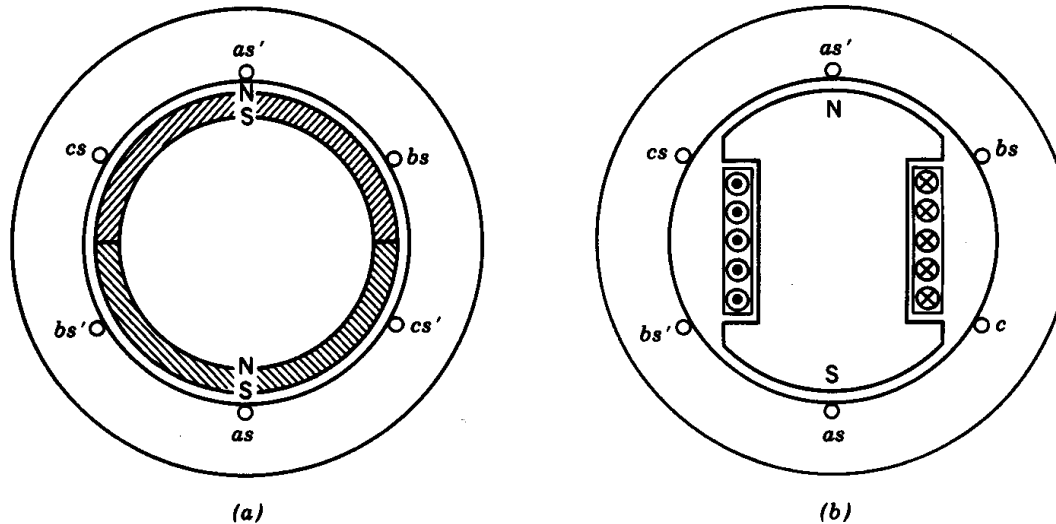


Figure 15-1 Structure of synchronous motors: (a) permanent-magnet rotor (two-pole); (b) salient-pole wound rotor (two-pole).

- Permanent-magnet or wound with a field winding

Per-Phase Representation

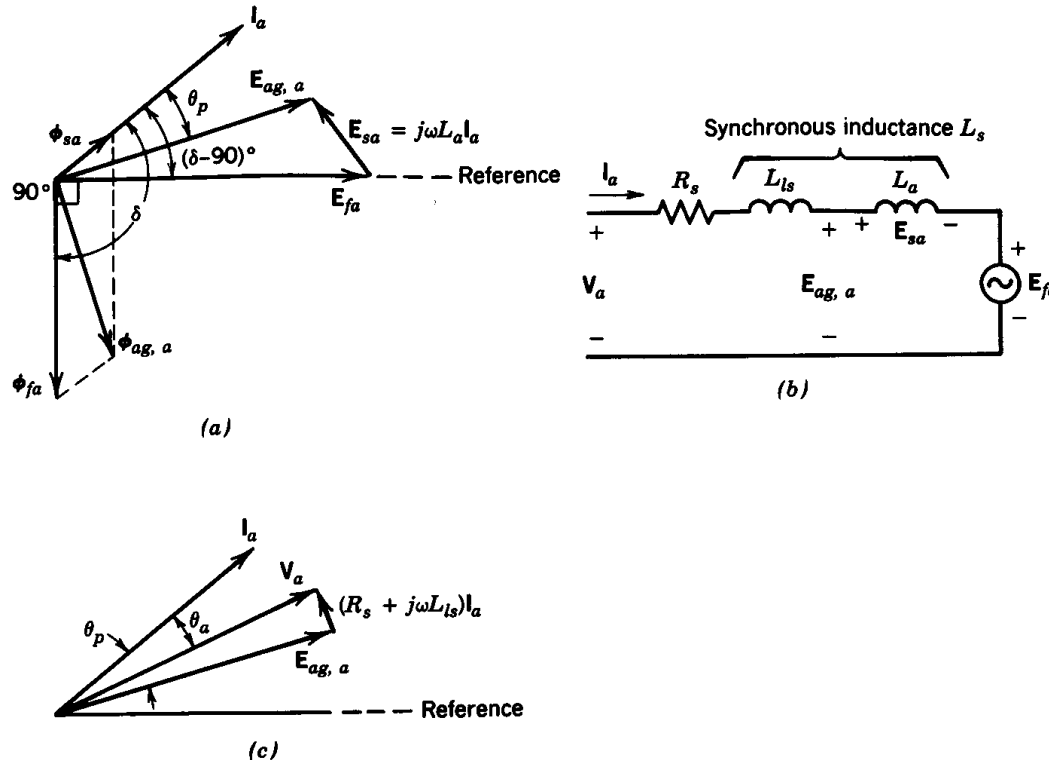


Figure 15-2 Per-phase representation: (a) phasor diagram; (b) equivalent circuit; (c) terminal voltage.

- In sinusoidal steady state

Phasor Diagram

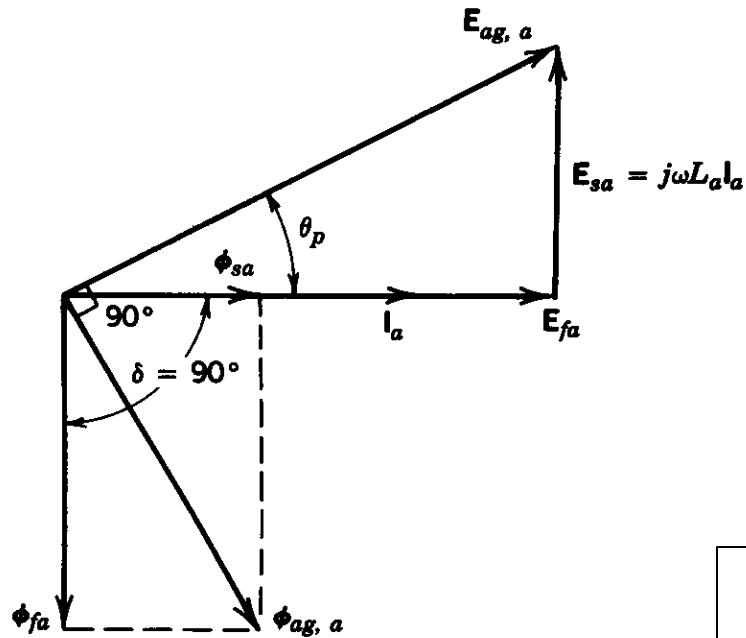


Figure 15-3 Phasor diagram with

$$\delta = 90^\circ.$$

- Optimum operation

Rotor Position

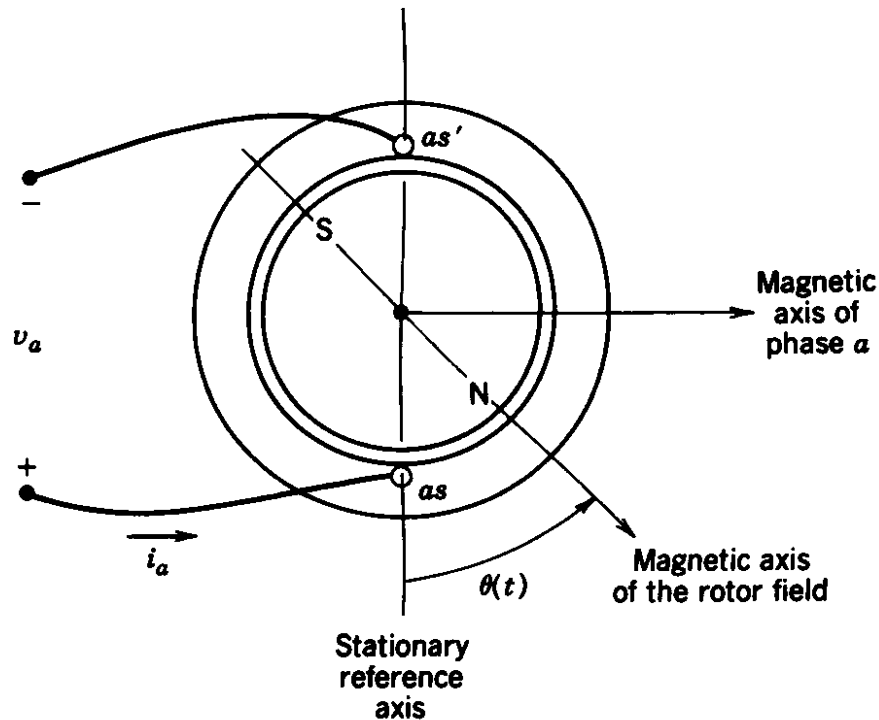


Figure 15-4 Measured rotor position θ at time t .

- Needs closed-loop operation knowing the rotor position

Synchronous Motor Drive

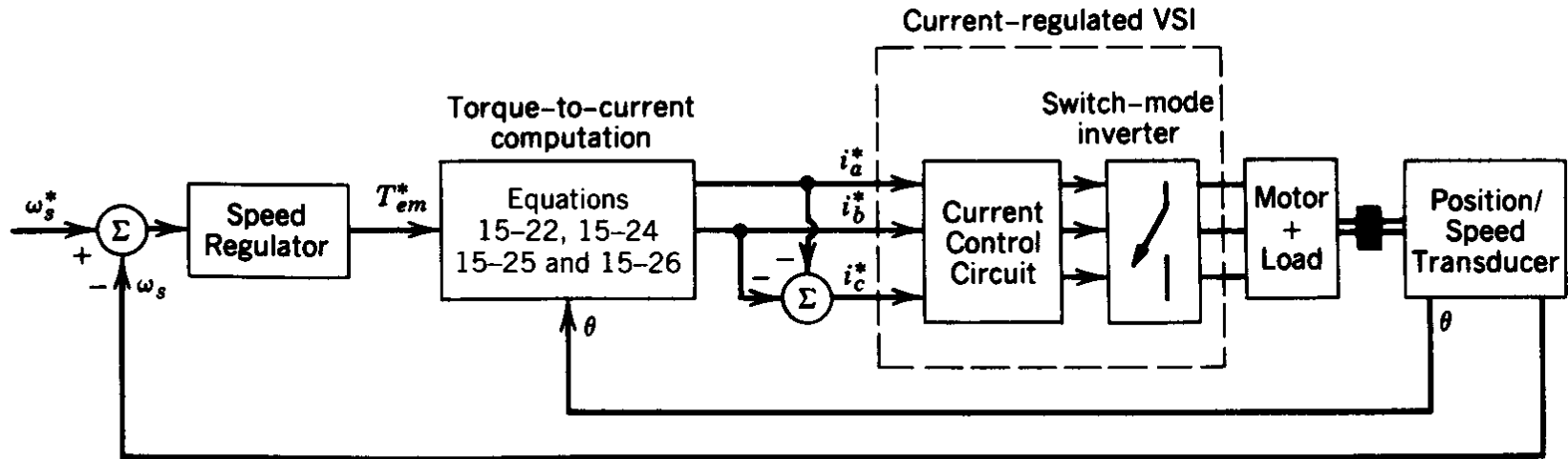


Figure 15-5 Synchronous motor servo drive.

- Controller based on steady state operation

Trapezoidal Waveform Synchronous Motor

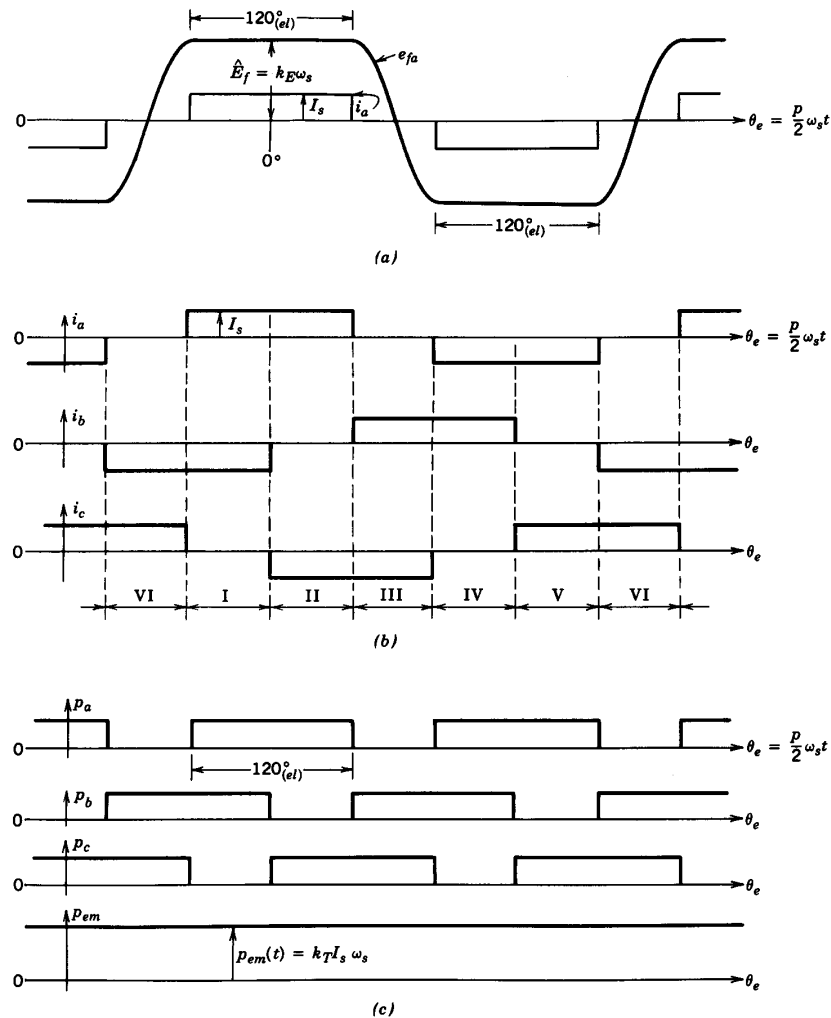


Figure 15-6 Trapezoidal-waveform synchronous motor drive.

- used in applications where speed of response not critical

Load-Commutated Inverter (LCI) Drive

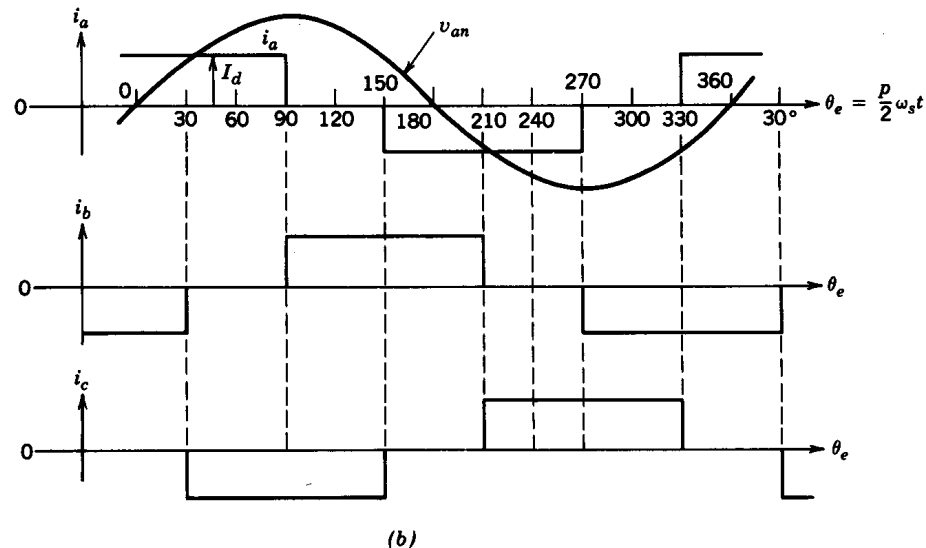
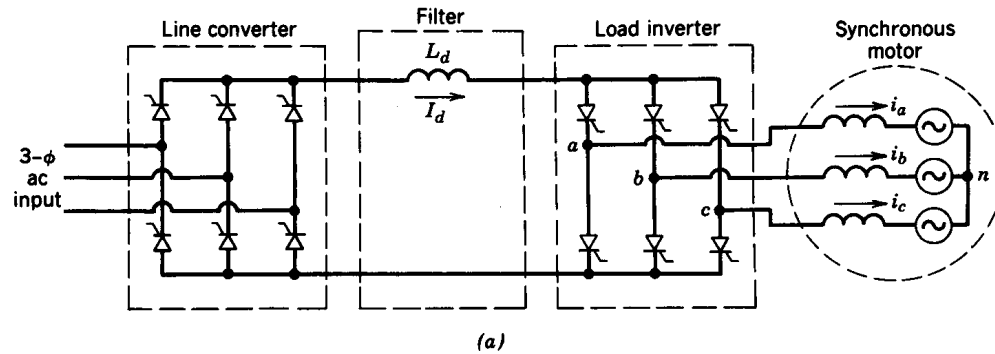


Figure 15-7 An LCI drive: (a) circuit; (b) idealized waveforms.

- Used in very large power ratings

LCI Drive Controller

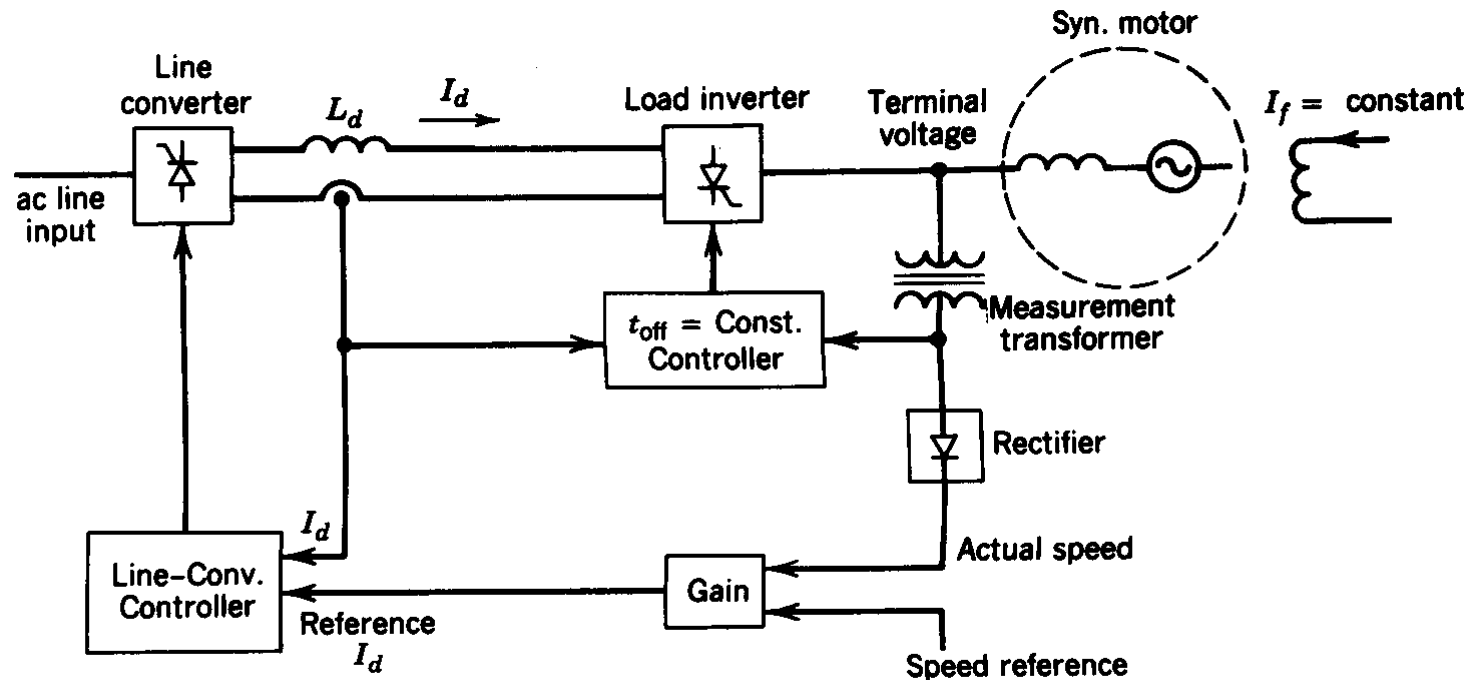


Figure 15-8 An LCI drive controller.

- Line converter controls the dc-link current

Three-Phase Cycloconverter

- Low-frequency ac output is synthesized

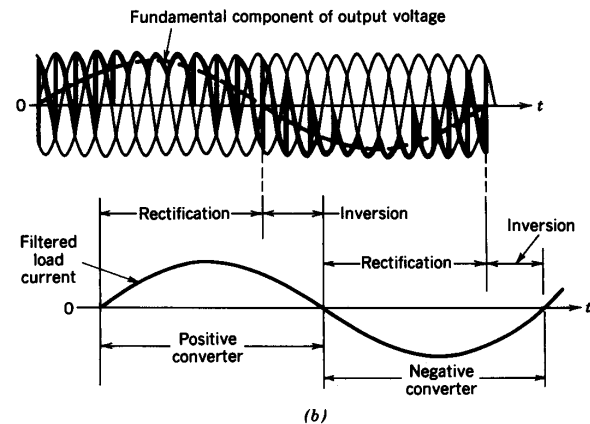
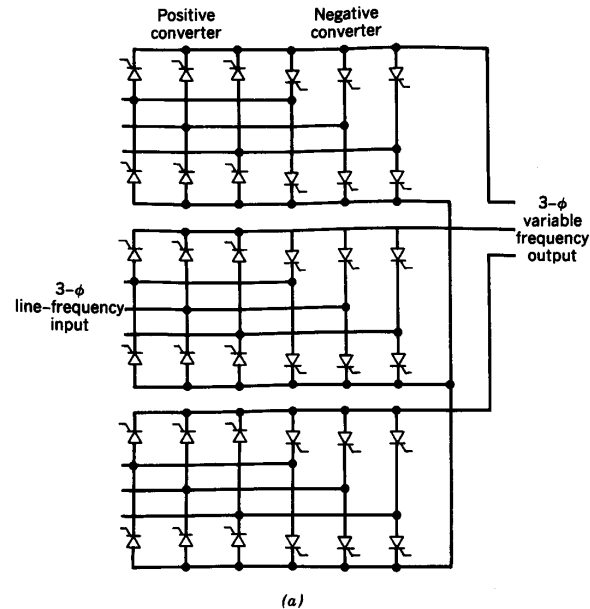


Figure 15-9 Three-phase cycloconverter.