

ECET 211 Electric Machines & Controls

Lecture 5-3 Electric Motors

(3 of 4)

Text Book: Chapter 5 Electric Motors, Electric Motors and Control Systems, by Frank D. Petruzella, published by McGraw Hill, 2015.

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Lecture 5-3 Electric Motors

- Chapter 5. Electric Motors
 - Part 1. Motor Principles
 - Part 2. Direct Current Motors
 - Part 3. Three-Phase Alternating Current Motors
 - Part 4. Single-Phase Alternating Current Motors
 - **Part 5. Alternating Current Motor Drives**
 - Part 6. Motor Selection
 - Part 7. Motor Installation
 - Part 8. Motor Maintenance and Troubleshooting

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Part 5 Alternating Current Motor Drives

AC Motor Drives

- Made AC squirrel-cage IM controllable and efficient
- Adjustable speed, torque, and horsepower control

Youtube Videos

- Allen-Bradley PowerFlex 525 AC Drive, 5:05 min, <https://www.youtube.com/watch?v=3nVgW5fEb4s>
- Variable Frequency Drives Basics, Altivar 61, 4:17 min, Aug. 21, 2011, https://www.youtube.com/watch?v=nS_0z0GSsFw
- Drives 101: basic Features of AC Drives, published by ABB Drives US, 38:25 min, <https://www.youtube.com/watch?v=MqbNoVTKdcM>

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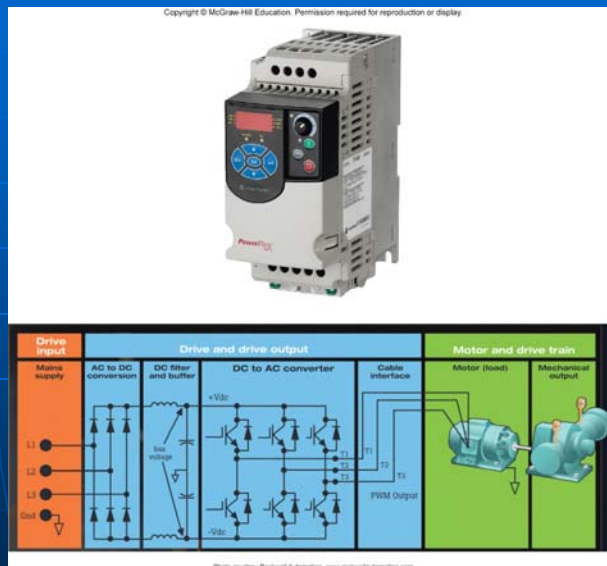
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Part 5 Alternating Current Motor Drives

Figure 5-60 AC Motor Drives

Major blocks

- AC to DC conversion (3 Φ Rectifier)
- DC filter & buffer
- DC to AC converter (inverter; IGBT = Insulated Gate Bipolar Transistor)
- Cable Interface
- Computer & Control electronics



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Part 5 AC Motor Drives

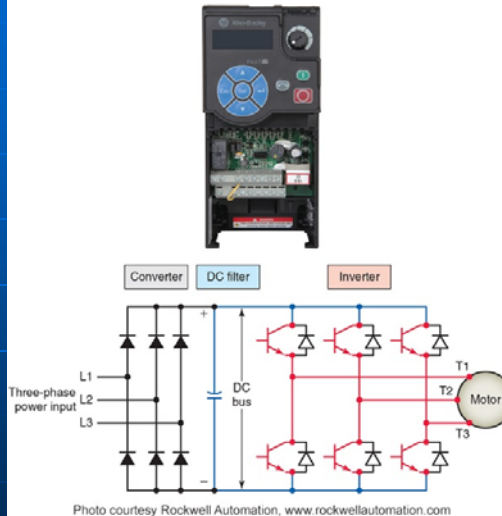
Variable Frequency Drive

- Figure 5-61 Variable-frequency drive controller

Major blocks

- AC to DC conversion (3 Φ Rectifier)
- DC filter & bus
- DC to AC converter (inverter; IGBT = Insulated Gate Bipolar Transistor)
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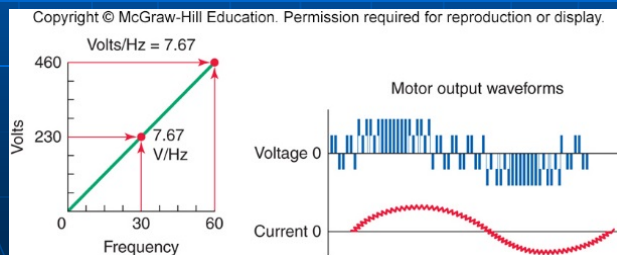
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Part 5 AC Motor Drives

Variable Frequency Drive

Figure 5-62 The ratio of volts per hertz is regulated to a constant value

- If a motor is designed to operate at 460 V at 60 Hz, the applied voltage must be reduced to 230V when the frequency is reduced to 30Hz
- Ratio of **Volts/Hz** = $460/60 = 7.67$



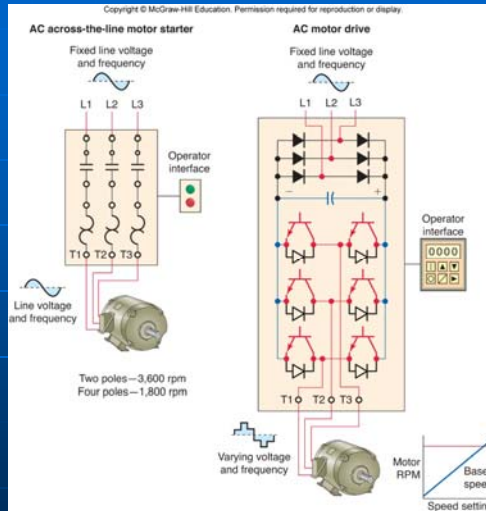
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Part 5 AC Motor Drives

Variable Frequency Drive

- **Figure 5-63** AC motor starter and drive control



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Part 5 AC Motor Drives

Inverter Duty Motor

- **Figure 5-64** Inverter-duty AC induction motor
- Specifically designed for use with VFD
- High switching frequency => high voltage peaks in the windings that exceed their insulation breakdown voltage
- Low motor rpm => reduces the flow of cooling air => increase in temperature



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Part 5 AC Motor Drives

Inverter Duty Motor

- **Figure 5-65** In-line pump with integrated variable frequency drive
- Using a VFD in place of speed controllers such as Belts and Pulleys, Throttle Valves, Fan dampers, and Magnetic clutches
- A pump or fan controlled by a VFD, running at **half-speed** consumes only **one-eighth of the energy** compared to one running at full speed, resulting in considerable **energy saving**.



Summary & Conclusion

Questions?

Contact Prof. Lin through:

- Email: lin@ipfw.edu