
Vehicle Electrification System Standards

VII. 3-Phase Power Inverter Systems and Controls

VII.d 3-Phase Power Inverter Operation

Overview:

3-Phase Power Inverter Operation

- Purpose of Power Inverter
 - DC to AC operation
 - AC to DC operation
- Overview of Creating a Sine Waves
- Power Inverter Hardware and Interfacing
 - Review of the MC
 - IGBT and Gate Drive System
 - What Makes the Motor Spin?
 - 6-Pack Motor Drive
 - Creating Waveforms: 6-Step & Sine Wave
 - Waveform and IGBT Operation
 - Waveform Amplitude & Frequency
 - Sine Wave Current Regulation
 - Regen Power Control
 - Bus Capacitors, Power Factor Correction, and Phase Angle

Description:

Drive motor and generator electric machine torque and speed are controlled by the power inverter module internal components and control software. Control of the electric machine determines electric power provided for propulsion, regenerative braking, or coasting modes. Understanding the operating controls of the power



inverter module is a necessary requisite for establishing an analysis and diagnostic processes.

Outcome (Goal):

Students will have a working knowledge of how the power inverter module controls electric machine torque and speed by focusing on how 3-Phase waveforms are created with power electronic devices and controlled with software. Students will also be able to describe the function of the power inverter module bus capacitors and power factor correction.

Objective:

Students shall be able to:

1. Describe how stator AC magnetic fields oscillate/change polarities during a Sine wave cycle that cause stator magnetic fields to interact/couple with rotor magnetic fields to cause rotor rotation
 2. Describe how the IGBT switching creates a 6-Step control waveform and advantages of the 6-Step waveform
 3. Describe how the PWM and IGBT switching creates a Sine waveform and advantages of the Sine waveform
 4. Describe how the software independently controls Sine wave amplitude and frequency
 5. Describe how PWM and IGBT switching current regulation is controlled and why it is desirable to include current regulation
 6. Describe power factor, how this relates to phase angle, and how the Bus Capacitors ensure high power factor
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Task:

1. Students will be provided worksheets with various 3-Phase waveforms and describe specific element characteristics of each waveform and determine the stator frequency switching speed
2. Students will be provided worksheets to describe the operation of current regulation controls within waveforms and determine the IGBT switching frequency



3. Students will be provided worksheets to describe the difference between a propulsion waveform and a regenerative braking waveform by visual interpretation
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To comment or offer suggestions on this standard, contact Ken Mays:

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