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THD Improvement of a Bidirectional Flyback Inverter by Using Sliding-Mode Control

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Abstract

This paper is focused on a control method to improve the THD factor of a bidirectional flyback inverter. The inverter structure, presented in a previous paper of the authors, contains a DC-DC converter tracking a rectified sinusoidal voltage waveform, and a full-bridge to obtain the AC waveform. The flyback inverter has a zero in the right half plane for the output voltage transfer function in continuous conduction mode (i.e., non-minimum phase system) that produces instability. A novel control method is proposed using a phase lead type compensator for the output voltage error to stabilize the inverter, followed by a sliding mode-PI controller to ensure good dynamic tracking performance and robustness. An average model for stability analysis is developed and used to test the flyback inverter operation with the proposed controller. A detailed system switching model is implemented in PSIM to confirm the results obtained by using the average model. The THD factor is reduced more than three times to a value below 1%, compared with the previous work of the authors. Simulation results involving the flyback inverter switching model prove that the proposed control method provides a good dynamic tracking performance with robust response to step variations in the output current and in the input power supply voltage.

Keywords

Author Keywords: average model; bidirectional power flow; flyback inverters; sliding mode control; stability analysis; total harmonic distortion (THD)

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