Adjustable-Speed Unsymmetrical Two-Phase Induction Motor Drive for Photovoltaic Powered Air Conditioners

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Abstract

This article proposes a novel application of adjustable-speed one-phase induction motors in air conditioners powered by photovoltaic arrays. Employing the slip-frequency control scheme, an off-the-shelf one-phase induction motor is operated as an unsymmetrical two-phase induction motor. Maintaining certain control conditions, the unsymmetrical two-phase induction motor is made to behave like a symmetrical two-phase induction motor. This has the advantage of increasing the motor efficiency and reducing the torque pulsations inherent to unsymmetrical two-phase induction motors. The proposed control scheme reduces both initial and running costs of the proposed photovoltaic system. Initial cost is cut down by reducing the required size of the photovoltaic array through (i) limiting the motor current during both transient and dynamic phases of operation, (ii) extracting maximum power from the photovoltaic array under various climate conditions by operating the photovoltaic array on the maximum power line, and (iii) dispensing with the need for specially designed two-phase induction motors. Reduction in the running cost of the photovoltaic system is achieved by enhancing the motor efficiency through eliminating the backward component of the air gap flux. The article outlines a procedure for sizing the photovoltaic arrays. Simulation results of the system behavior during transient and dynamic phases confirm the capability of the proposed scheme.

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