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Special Purpose Power Electronics Converters for Nano-Grids & Smart Homes Applications

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A Nano-grid is a model version of a smart grid with the ability to function as separate power generator. The power electronics converters are playing very important roles in smart homes. So this paper proposes three important converters as the following: Single-Input Multi-Outputs (SIMO) DC-DC Converter, Multi-Inputs Multi-Outputs Converter (MIMO) and Multi-Level Cascaded Inverter (MLCI) Design, Simulation and Implementation. A DC-DC converter is designed effectively and precisely to suit its function in a Nano-grid. The converter is a single-input-multi-output converter (SIMO) which is taking one dc voltage from alternative energy sources like solar photovoltaic panel and applying it to two dc output voltages. This boost converter takes the input and increases its voltages level, leading to the outputs respectively based on the customer' needs. This single input- multi output converter is designed, simulated and tested using MATLAB/SIMULINK. The input and output characteristic are well depicted in figures form. The Multi-Input-Multi-Output (MIMO) converter, in this work, is a type of switch-mode power supply. The alternative power supplies are in many different operating modes. Finding the right operating mode is key to the MIMO converter fulfilling the needs of design. Simulation and experimental results for rectification, conversion modes are presented with the switching criteria and control characteristics. The modeling, design and simulation are done with the aid of multi-sim software and Simulink. The implementation is done using printed board, power diodes and MOSFETs. Finally, this paper proposes design, modeling and implementation of a multi-level cascaded inverter for a single-phase connected photovoltaic system. The cascaded inverter consists of two full bridge topologies and AC outputs in series. Each bridge has the ability to produce three different voltage outputs. In this work, a single level, three level, and nine levels are proposed using MATLAB/Simulink with circuit implementations. The proposed configuration reduces the complexity in design and modularity when compared to conventional method which also provides reduced switching losses and harmonics.

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