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Design and Implementation of 3kVA Grid-Tied Transformerless Power Inverter for Solar Photovoltaic Application

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Abstract : Power Inverter is a very important device in renewable energy use particularly for solar photovoltaic power application because it is the effective interface between the DC power generator and the load or the grid. Transformerless inverter is getting more and more preferred to the power converter with galvanic isolation transformer and may eventually supplant it. Transformerless inverter offers advantages of improved DC to AC conversion and power delivery efficiency; and reduced system cost, weight and complexity. This work presents thorough analysis of the design and prototyping of 3KVA grid-tie transformerless inverter. The inverter employs electronic switching method with minimised heat generation in the system and operates based on the principle of pulse-width modulation (PWM). The design is such that it can take two inputs, one from PV arrays and the other from Battery Energy Storage BES and addresses the safety challenge of leakage current. The inverter system was designed around microcontroller system, modeled with Proteus® software for simulation and testing of the viability of the designed inverter circuit. The firmware governing the operation of the grid-tied inverter is written in C language and was developed using MicroC software by Mikroelectronica® for writing sine wave signal code for synchronization to the grid. The simulation results show that the designed inverter circuit performs excellently with very high efficiency, good quality sinusoidal output waveform, negligible harmonics and gives very stable performance under voltage variation from 36VDC to 60VDC input. The prototype confirmed the simulated results and was successfully synchronized with the utility supply. The comprehensive analyses of the circuit design, the prototype and explanation on overall performance will be presented.

Keywords : grid-tied inverter, leakage current, photovoltaic system, power electronic, transformerless inverter
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