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DESIGN AND MATLAB/SIMULINK IMPLEMENTATION OF FOUR SWITCH INVERTER FOR MICROGRID UTILITIES

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Abstract

This article presents a design and implementation of four switch inverter (FSI) for micro-grid application. The main benefit of the designed inverter has flexibility in design, simple control, minimal cost as well as less space. It is appropriate for medium and high power applications. The designed inverter has produced pure sinusoidal output voltage waveform with help of pulse width modulation (PWM) control scheme which leads to decrease the total harmonic distortion (THD) of it. For designing the inverter with help of the switches, this is directly related to their voltage drops and also, this switching voltage drops has increases the overall loss of this system. The Efficiency of the system is decreased due to this high overall converter loss. In order to increase the efficiency, reduce the switches and the switching losses, FSI is developed. The structure of the FSI is a combination of the push-pull and the synchronous buck converters. The performance of the complete model is investigated at different operating stages by making the MATLAB/Simulink models. The simulation results are presented to show the efficacy of the designed inverter.

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Keywords:Switching losses;Powerloss;Voltage drop;THD;mutual inductance

1. Introduction

In current scenario, the demand of the electricity and need for reliable power source plays a major role in industrial, commercial and household applications. In this regards, a lot of investments in alternative energy solutions, to increase energy efficiency and power quality problems. There are a number of generation methods for supplying the

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offered demand. Sadly, the fossil fuels are ditched; alternative energies such as renewable energy sources are becoming more popular. Still, the incapability of renewable energy sources to supply good eminence of electric power electrical load in standalone mode and injecting sinusoidal current to grid in grid connected mode needsanimproved characteristics inverter has been reported [1]. Hence, the main objective of inverter is very important to select the best topology of inverter from the existing topologies [2].

A grid is a network of high voltage transmission lines which are used for carrying electrical power from isolated sources to load centres, usually to distribute electric power to consumers.A smart grid (SG)offers a high-quality opportunity for better power quality and reduces harmonics of the power circuits [3]-[4].The significance of power eminence is considered from generator face, grid face and demand side. The issues of power quality and a load management concept for minimising THD in distribution feeders has been well presented [5].This smart technology leads to increase the accessibility of power supply. A SG construction with more strength and high efficiency in utilization is on schedule worldwide. By using the current days information technologies, the SG is accomplish of delivering power in more efficient directions.

The pulse width modulation (PWM) techniqueselection plays a key role for generation of inverter output. The PWM refers to a method of carrying information on train of pulses and it is to be encoded in the width of pulses. The PWM is applying to control the inverter output voltage with controlling the inverter itself by changing switching periods of the inverter. Itis applied to control the modern power electronic networks. The basic idea is to control the duty cycle of the switches so that the load gets a controllable voltage. The PWM techniques are the effective methods to control the output frequency and magnitude. Various PWM methods for inverters have been reported[6].The designed method can produce the desired output voltages from regulated and non-regulated input voltage.

The traditional inverter topologies apply either a single common source or multiple dc sources. According to the electrical isolation between the input side and output side, again the inverters are sub-divided into isolated and non isolated inverters. The depending on the input dc voltage range over to the output ac voltage, inverters can be possible for buck, boost, buck-boost inverters [8][9][10]].However, It gives the information about various schemes to generate output at various voltage levels avoiding redundant switching states.All the active inverters can be grouped in to three main modules namely Supply frequency transformer (SFT), High frequency transformer (HFT) and transformer less structures.Different topologies of inverters have been executed and presented in [11].

The transformer less topology has some challenges:

- High leakage currents results in safety hazards
- By using transformer less topologies, there is a danger of direct current (dc) injection into the grid. DC in an AC system causes diffusion of distribution transformers in the network and also accuracy of the meter will be affected.

A high voltage gain transformer is inevitable where there is a requirement to convert a low voltage DC to a high voltage AC.nevertheless, there are a small number of problems in the conventional LFT which consists of a full bridge inverter. In order to overcome the above pointed-out problems, in this article, a transformer with coupled circuits based four switch inverter for grid application is designed. The structure of this inverter consists of synchronous buck converter and push pull converter. The performance of the designed model is verified at various loads operating conditions by making the MATLAB/Simulink.