PV-STATCOM SMART INVERTER FOR VOLTAGE CONTROL IN DISTRIBUTION SYSTEM

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Abstract - A new topology for a three phase, three step multilevel inverter (MLI) with common mode voltage (CMV) elimination. The proposed MLI structure is realized with fewer switching power device compared to the conventional MLI solution for CMV elimination. Reduced number of switching power semiconductors results in a smaller amount of driver circuit, less installation space and low cost. Further, due to the elimination of CMV, the proposed MLI is free from issues like EMI and leakage current. Presented topology is compared with other topologies to prove its superiority. Simulation results are presented to confirm the capability of the proposed MLI. The power electronics device which converts DC power to AC power at required output voltage frequency level is known as inverter. Multilevel inverter is to synthesize a near sinusoidal voltage from several levels of dc voltage. The switching sequences of IGBTs are generated using Sine Pulse Width Modulation (SPWM) technique pulses with carrier displacing technique.

1. INTRODUCTION

There is an increased pressure by regulatory agencies on utilities to accommodate higher levels of renewable for their distribution system and to speed up the interconnection process. On the other hand, photovoltaic (PV) are expected to be the quickest 2 these voltage issues depend on the penetration level, location, and the size of distributed PV systems and the configuration and characteristic of distribution feeders. This bad impact decreases the allowed PV hosting capacity 1 of the distribution system and is a serious barrier for further PV integration into the grid. Several techniques to alleviate the voltage rise issue have been proposed. The approach considered herein is by exploiting the inherent reactive power capability of the PV inverters to offset the voltage rise in distribution networks. Using reactive power capability could defer the need for new assets and grid reinforcements. In general, PV systems use inverters to convert DC power from PV arrays to 60 Hz (or 50 Hz) AC power grid standard.

2. BLOCK DIAGRAM

2.1 Functional Blocks

The following Figure 1 shows the overall block diagram.

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Fig. 1 Functional Block Diagram
2.2 Block Diagram Explanation
The block diagram composed of many. Each and every components have their own functions. The components are solar panel, charge controller, battery system and inverter. The solar panel is used to absorb the whole radiation, so it is constructed in order to absorb the whole radiation. The charge controller is used to maintain the amount or quantity of charge which is coming from the panel. The charge coming from the charge controller then moved into the battery system. The battery system is used to store the energy in the form of dc current. Whenever we required the current, it is converted from the battery to ac current with the help of inverter. Inverter converts dc current to ac current.

3. BOOST CONVERTER

3.1 INTRODUCTION
While stepping down current from its input supply to its output (load). It is a class of switched-mode power supply (SMPS) containing at least two semiconductors (a diode and a transistor) and at least one energy storage element, a capacitor, inductor, or the two in combination. To reduce voltage ripple, filters made of capacitors (sometimes in combination with inductors) are normally added to such a converter's output (load-side filter) and input (supply-side filter). A boost converter (step-up converter) is a DC-to-DC power converter that steps up voltage (while stepping down current)

![Fig. 2 Boost Converter](image)

The stationary part of the motor, the stator is made up of two or more electromagnet pole pieces, and the rotor is comprised of the armature, with windings on the core connected to the commutator. The output power source is connected to the armature windings through a brush arrangement connected to the commutator. The rotor has a central axle about which the rotor rotates.

The field winding should be able to support high current because the greater the amount of current through the winding, the greater will be the torque generated by the motor. So the winding of the motor is made up of thick heavy gauge wire. Heavy gauge wire does not allow a large number of turns. The winding is made up of thick copper bars as it helps in easy and efficient dissipation of heat generated as a result of flow of large amount of current through winding.

3.2 Overview
Power for the boost converter can come from any suitable DC sources, such as batteries, solar panels, rectifiers and DC generators. A process that changes one DC voltage to a different DC voltage is called DC to DC conversion. A boost converter is a DC to DC converter with an output voltage greater than the source voltage. A boost converter is sometimes called a step-up converter since it "steps up" the source voltage. Since power (P = V I) must be conserved, the output current is lower than the source current.

3.3 History
For high efficiency, the SMPS switch must turn on and off quickly and have low losses. The advent of a commercial semiconductor switch in the 1950s represented a major milestone that made SMPSs such as the boost converter possible. The major DC to DC converters were developed in the early 1960s when semiconductor switches had become available. The aerospace industry's need for small, lightweight, and efficient power converters led to the converter's rapid development. Switched systems such as SMPS are a challenge to design since their models depend on whether a switch is opened or closed. R. D. Middlebrook from Caltech in 1977 published the models for DC to
DC converters used today. Middle brook averaged the circuit configurations for each switch state in a technique called state-space averaging.

4. HARDWARE IMPLEMENTATION

4.1 Circuit Diagram

The fig.3 represents the circuit diagram

![Circuit Diagram](image)

Fig. 3 Hardware circuit diagram

4.2 Output Waveform

An inverter can produce a square wave, modified sine wave, pulsed sine wave, pulse width modulated wave (PWM) or sine wave depending on circuit design. The two dominant commercialized waveform types of inverters as of 2007 are modified sine wave and sine wave.

There are two basic designs for producing household plug-in voltage from a lower-voltage DC source, the first of which uses a switching boost converter to produce a higher-voltage DC and then converts to AC. The second method converts DC to AC at battery level and uses a line-frequency transformer to create the output voltage.

4.3 Square Wave

![Square Wave](image)

Fig. 4 Square wave

This is one of the simplest waveforms an inverter design can produce and is best suited to low-sensitivity applications such as lighting and heating. Square wave output can produce "humming" when connected to audio equipment and is generally unsuitable for sensitive electronics.
5. CONCLUSION AND FUTURE SCOPE

5.1 CONCLUSION
The simulation of multilevel inverter is carried out in MATLAB/Simulink, to identify the suitable level inverter which has comparatively less total harmonic distortion in its output. A comparative study is done for better configuration of multilevel inverter. Cascaded type multilevel inverter is chosen for this research, because of its simple structure and less component requirements. The nine level cascaded inverter configuration is simulated in open loop control using single PWM, multiple PWM and Sinusoidal PWM techniques. The simulation results are presented and analyzed. From this part of work, the sinusoidal PWM based simulation gives better results. Hence, it is taken for further studies in the proposed inverter. The optimization techniques are applied to calculate the switching angles so as to obtain minimum Total Harmonic Distortion in the output of the cascaded nine level inverter. The genetic algorithm optimization technique is first applied and the switching angles are found based on the objective function and constraints for optimum THD. The results are presented and analyzed. The proposed circuit is then simulated with the switching angles calculated from particle swarm optimization technique and the results are presented. PSO based simulation gives better results than GA based work because of the salient features of PSO technique. This generalized technique can be extended to multilevel inverters with any number of levels. The total harmonic distortion is measured accordingly for different modulation indices. A proto type model of FPGA based nine level inverter has been designed, fabricated and tested. The optimum switching angles corresponding to minimum THD calculated from PSO optimization technique are used for signal generation in FPGA controller. The results are presented and analyzed. The hardware results are compared with the simulation results and are found to closely agree. The cascaded multilevel inverters are mainly used as drive for induction motors, STATCOM, shunt active power filters, aerospace and solar powered applications.

5.2 FUTURE SCOPE
- In the future, it will be really helpful to produce large amount of electrical energy from solar energy.
- Efficiency can be increased by reducing total harmonics.

REFERENCES