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Phase Disposition PWM Multicarrier Based 5 Level Modular Multilevel Inverter for PV Applications

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Abstract: This paper presents the simulation and study of five level modular multilevel inverter and its modulation techniques for PV system. The multicarrier PWM(MCPWM) techniques such as In Phase disposition PWM, Phase opposition disposition method, Alternate phase opposition disposition method is employed for the control strategy of five level modular multilevel inverter. In this paper the in phase disposition PWM controlling strategy is used for controlling the five level modular multilevel inverter. Simulation has been carried out using MATLAB/Semolina (2012b) and the output voltage waveforms are recorded. The Total Harmonic Distortion (THD) is found to be less for the modular multilevel inverter compared to the cascaded H-bridge multilevel inverter.

Key words: Modular Multilevel Inverter (MMI) · Multicarrier PWM(MCPWM) · In Phase disposition(PD) · Phase Opposition Disposition (POD) · Alternate Phase Opposition Disposition (APOD) · Total harmonic Distortion (THD) · Matrix Laboratory (MATLAB)

INTRODUCTION

Modular multilevel converters (MMCs) can be used for obtaining the high number of levels. It uses more commercially available low-rated IGBTs, so the cost of the semiconductor device is reduced and also the need of filter components can also be reduced. Modular design, excellent output voltage waveforms, low switching frequency, high efficiency are some of the advantages of MMC [1,2,3]. Multilevel converters have emerging applications in the electrical power industry in recent years. They have a lot of advantages which makes them suitable for high voltage systems and power system applications.The configuration of the modular multilevel inverter makes them to work at a very high voltage with low harmonic content. For ac/dc and dc/ac conversion, which is a major requirement in high-voltage high-power applications, the Diode clamped converter topology is used [4,5,6]. But, the proper use of this topology requires balancing of the dc link capacitor voltages. A two switch based MMC proposed in is simpler than the cascaded 4-switch H-bridge-based converter and has advantages like modular extension to any number of levels and simplicity. This paper presents the topology of the modular multilevel converters. The fundamental concept and the controlling scheme are introduced. A modified multilevel fundamental switching modulation scheme adopting the multicarrier pulse width modulation concept is presented. A capacitor voltage balancing technique is proposed. Finally, simulation model is done for 5-level MMC. The modulation and controlling strategy presented are confirmed by MATLAB/ SIMULINK simulations. The multicarrier pulse width modulation converter control strategy improves the output voltage and reduces total harmonic distortion. This new type of converter is suitable for high-voltage drive systems and power system applications such as high voltage dc (HVDC) transmission, reactive power compensation equipment and so on.

The input voltage from the PV panel is given to the DC-DC converter. The input voltage is measured and given to the MPPT circuit. From the MPPT circuit the control signal is given to the DC-DC converter. The converter output is given to the Modular Multilevel Inverter. The output of the Modular Multilevel Inverter is given to the load.

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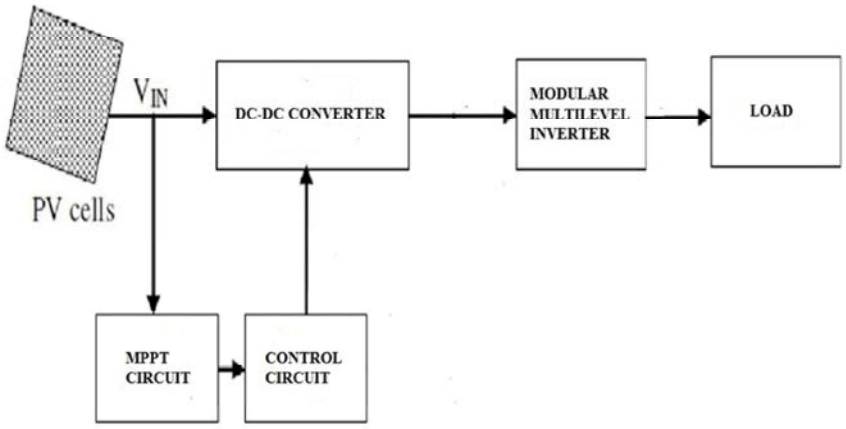

Design of PV Fed Converter System: The power produced by a single PV module is not sufficient to satisfy the power demands for most of the practical purposes. PV arrays can use inverters to convert the dc output into ac and use it for motors, lighting and other loads. The modules are connected in series for more voltage rating and then in parallel to meet the current specifications.

The Fig. 1. represents the PV module. Its design calculations are given in the Table 1.

Table 1: Design Calculation for Pv Array

PARAMETERS	VALUES
Open Circuit Voltage(V_{OC})	21.6 V
Short Circuit Current(I_{SC})	1.5 A
No of Series Connected Solar cells	36
Configuration of cells	9(solar cells)*4
No. of cells in a module	9 solar cell
No. of modules in a panel	4 modules(36 cells)
No. of panels in an array	2panel(72cells)

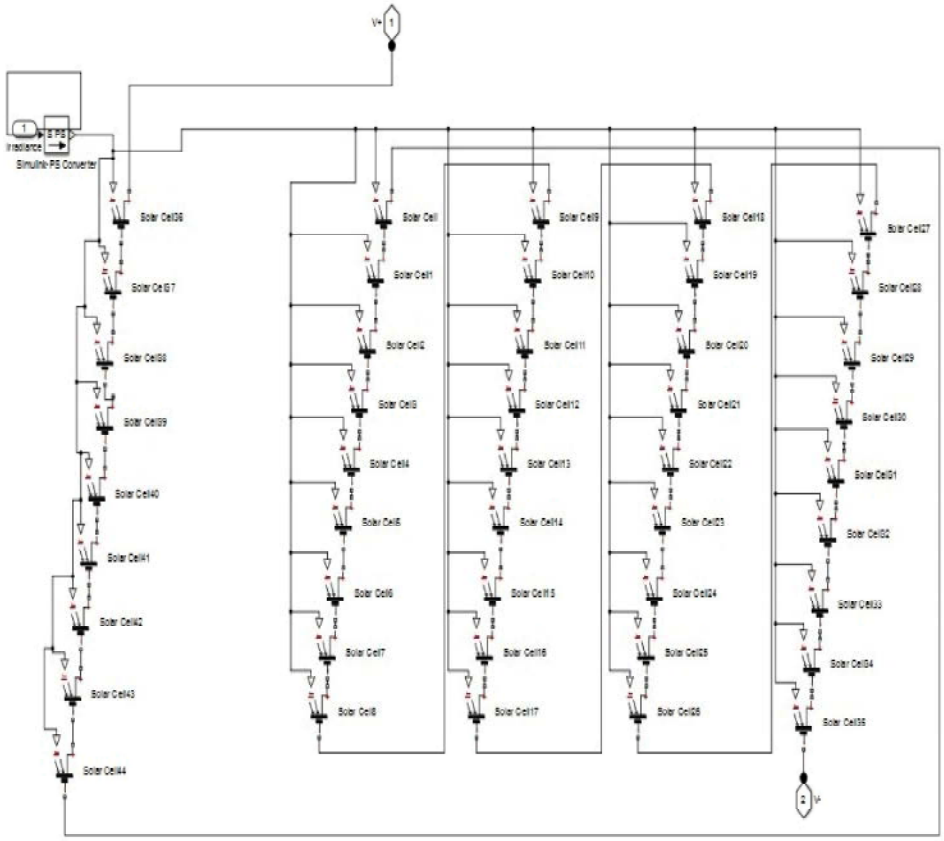

Fig. 1: Model of Solar array