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Multilevel DC to AC Inverter with Superior Performance

Geevarghese Mathew Kurian, P.Aruna Jeyanthy, D.Devaraj

Department of Electrical and Electronics Engineering, Kalasalingam Academy of Research and Education, Krishnankoil, Tamil Nadu, India

Abstract

This paper bestowed a construction of electrical multilevel converter is reducing the most important power quality issues with the system. The planned construction inverter system produces output AC voltage with correct gate signals style. The proposed system which reduces the switching losses and voltage stretch of systems. The harmonics are delivered by control electronic devices. Basic voltages can be modulated precisely by utilizing little step measure and making it appropriate for utility. The utilize of less number of switches will progress the effectiveness of the control gadget. In this multilevel invertor system, the pulse width modulation scheme with multi carrier technology is used to produce output voltage. This planned system reduces the output voltage and complete consonant bending of the conveyance. The MATLAB simulation link is employed to simulate the proposed multilevel invertor system.

Keywords: Multilevel Inverter (MLI), Pulse Width Modulation (PWM), Total Harmonic Distortion (THD), Power Quality, Multicarrier Pulse Width Modulation (MCPWM).

1. Introduction

Now a day the important problem is power breaks and power fluctuations. Electric power with certain quality should be maintained for the economic progress as well as development of the nation [1-3]. The electric power is the product of voltage and current. If any fluctuation in terms of voltage, current or frequency may lead to serious damage of electrical equipment's so that power quality considers as a prime factor now a days [4]. A good electric power with allowable limit is a key feature of the electrical distribution system [5].The invention of electric power is the tremendous development in the field of electronic and electrical production industry. The invention of electric power helps to carried out different experiments in the electrical equipment's. Since the usage electricity is increasing rapidly so that energy management as well as power quality is an important thing now a days [6]. The major problems in the electrical system are power failure and quality of power in the sense of voltage, current, frequency, shape of wave etc. so we should maintain the electrical power quality. The main solution of this power failure and degraded power quality is the multilevel inverter.

The implementation of multilevel inverters in medium and high voltage power conditions has to be a boon [7]. Power quality can be improved by using multilevel inverter techniques [7, 8], for that a closed loop fifteen level MLI used with PI with MCPWM techniques used to improve power quality. In this paper compare the 15 level MLI with open loop, closed loop with MCPWM and closed loop with PI with MCPW techniques. Multilevel inverters are of three sorts to be specific Flying capacitors, diode

clamped, and cascaded H-bridge MLI [9-11]. In diode clamped type, it used diodes and produces multiple voltage level outputs [12-14]. In flying capacitors type, it uses capacitors and output will be half of input DC voltage. In cascaded H-bridge, it uses capacitors and switches in form of an H-bridge cell. Control electronic rebellious like UPS and Inverter can more often than not produce harmonics in control framework. This could make control Quality issues in control frameworks.

Fundamentally a multilevel converter is composed of cluster of control semiconductors and capacitive voltage sources which produces multistep voltage waveform with controllable recurrence, stage and sufficiency. It is utilized for high control quality requesting applications [15]. Some of the applications are hybrid and electric vehicles, wind energy transformation. This demonstrate we are employing a new multi-level inverter having there are fewer switches. The power quality is achieved by decreasing the amount of harmonics produced. In various mechanical applications which require high power can be achieved [15-18].

2. Proposed System

A solar power or any renewable energy can be used to charge the battery in the charging section of the inverter. There are two components to this MLI. There is a charging component as well as an inverter component. This inverter employs an H-bridge MLI topology. We use three voltage sources each of which is located in a different location. The inverter gets its energy from the solar panel. The load will receive power from the inverter. Frequency distortion is also a problem with traditional multilevel inverters. Using this 15 level inverter, the inverter's total harmonic distortion can be reduced. The percentage value of THD for high voltages should be below 8%, as IEEE 519 standard [20].

2.1 Implementation

This inverter consists of voltage sources, switches, diodes, PI controller and load shown in Figure 1. The corresponding gate signal to each switch will be as shown in figure2 and 3. The total function of the multilevel inverter is described in the modes of operation section. This proposed system is a closed system with a PI controller for better performance and compensation of error. Modified MCPWM PI based control is used in this MLI.

Figure 1. Circuit Diagram

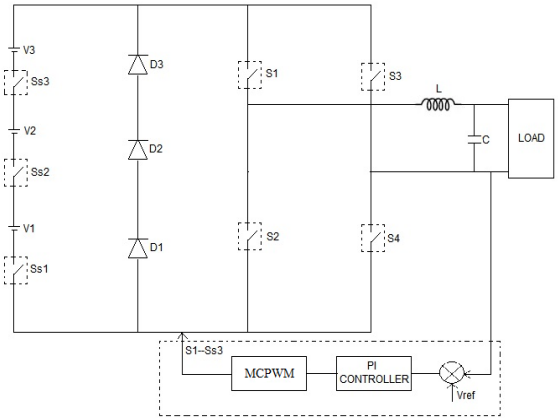


Figure2. Gate Pulses given to each Switch

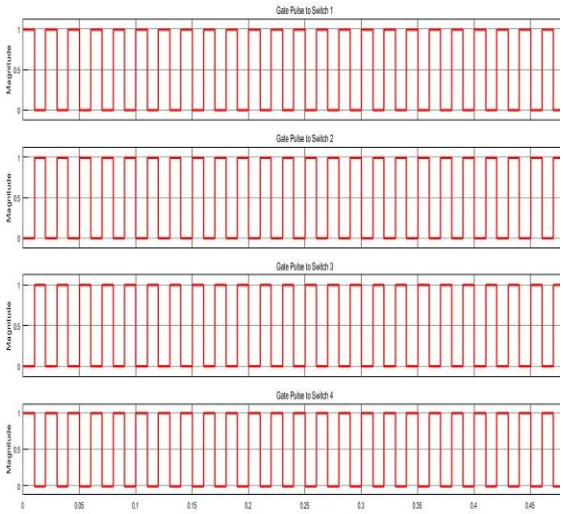
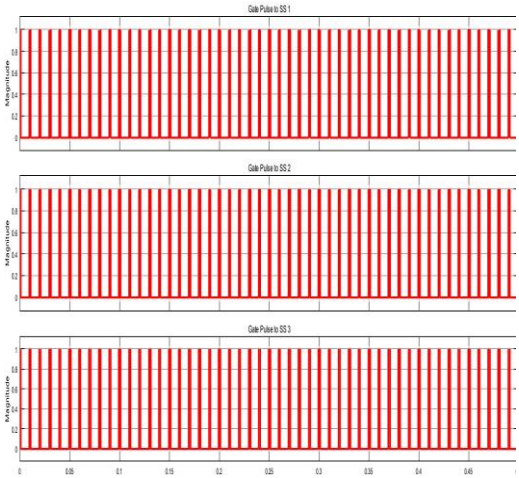


Figure 3. Gate pulses to ss1, ss2, ss3



2.2 Modes of Operation

It this MLI contains seven switches, three diodes, and three power supply units; instead of a solar panel or other renewable sources, three voltage sources are used for simulation purposes. As a switch, MOSFET is used. This inverter produces a 15-level output stepped level and has seven operating modes, as shown in Table I.

The cumulative harmonic distortion decreases with stepped stages increases. The inverter's operation divided into two halves; positive half cycle and negative half cycle. There are seven modes in each cycle. This system's modes each produce one half cycle. The overall system's performance becomes more accurate sinusoidal, which increases power efficiency.

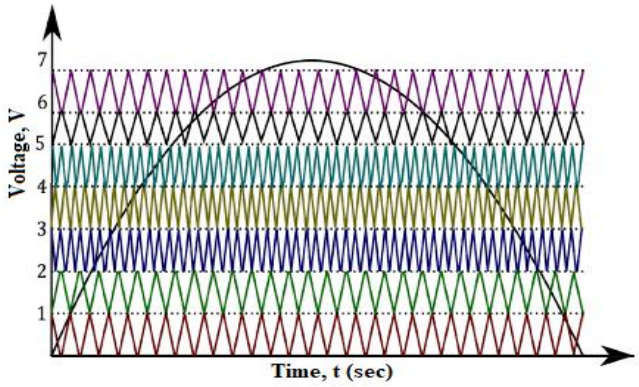
Table 1. shows the switching pattern of output combination levels

Switching pattern							**Output**
SS1	**SS2**	**SS3**	**S1**	**S2**	**S3**	**S4**	
ON	OFF	OFF	ON	OFF	OFF	ON	Vout<V1
OFF	ON	OFF	ON	OFF	OFF	ON	V1<Vout<V2
ON	ON	OFF	ON	OFF	OFF	ON	V2<Vout<V1+V2
OFF	OFF	ON	ON	OFF	OFF	ON	V1+V2<Vout<V3
ON	OFF	ON	ON	OFF	OFF	ON	V3<Vout<V3+V1
OFF	ON	ON	ON	OFF	OFF	ON	V3+V1<Vout<V2+V3
ON	ON	ON	ON	OFF	OFF	ON	V3+V1<Vout<V1+V2+V3

3. Control Circuit

Various modulating techniques measure accessible for handling the electrical converter construction. Here we implement multicarrier modulation (MCPWM) with PI controller is employed. It is accustomed turn out of the seven pulses for the generation of fifteen level output of the electrical converter. Simple implementation and ease of makes the utilization of the electrical converter a lot of desirable. It is shown in the figure 4 below.

Figure. 4. Multicarrier PWM



This completely different multi triangular carrier are placed by part disposition mechanism. In this technique power quality is well achieved by the use of PI controller. In this technique the inverter switches are triggered to start the operation. In this strategy the THD (Total harmonic distortion) is reduced by using multicarrier pulse width modulation (MCPWM).

In this method, the previous value of error is recorded and thus in the output section, the generated error is compensated and more quality output is generated.

Also this proposed system is simulated via MATLAB model. The proposed MATLAB model is illustrated in figure 5. The values taken for this proposed model for this simulation model are as shown below.

Input voltage: 30, 60,120V

Output voltage Maximum: 210 V

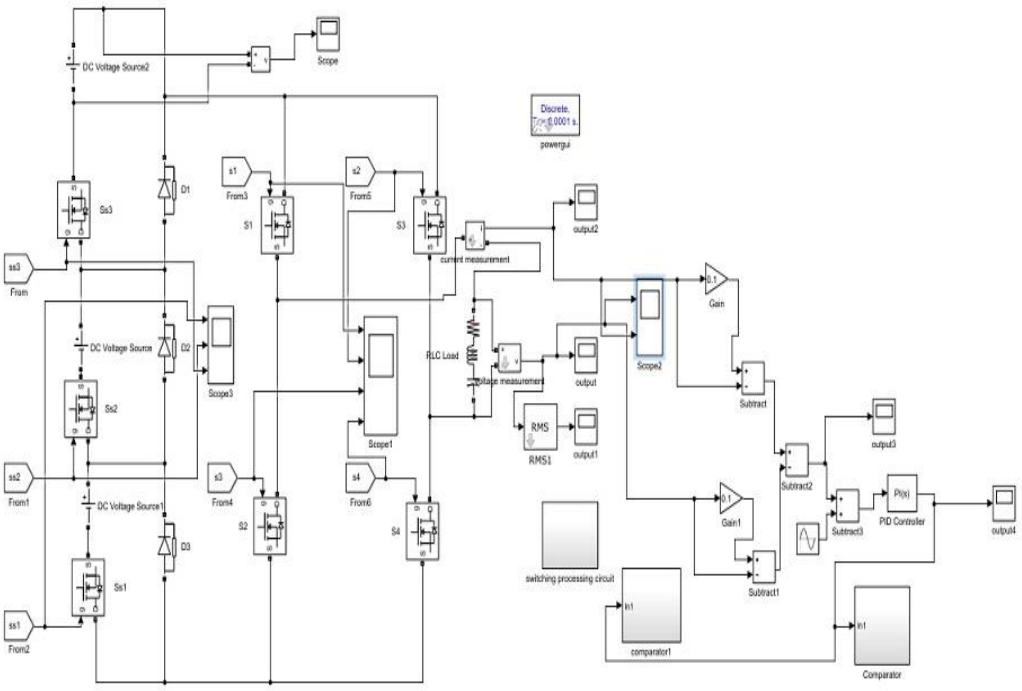
Diode 1N4001

Resistive load : 1kW

IGBT : 1200V, 25A

Pulse Width Modulation band frequency: 2KHZ, 4KHZ

Figure 5. MATLAB model



4. Simulation Results

Figure 6 represents the simulated output waveform that we obtained via MATLAB/SIMULINK model. From the above analysis, when we are using multiple levels, the output obtained corresponds to more sinusoidal. Thus using the PI controller, the error correction is achieved and the more power quality is achieved by reducing the number of power devices.

Figure 6. Simulated Output waveform

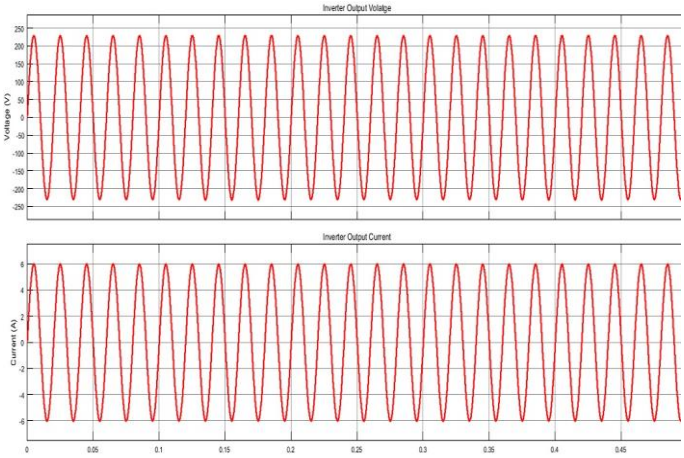
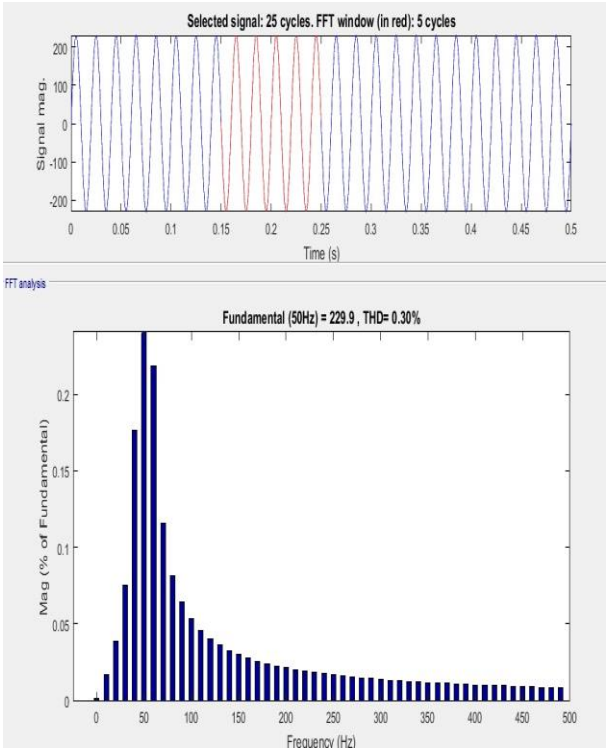


Figure 7 shows the THD value measured using FFT analysis. From the analysis it is clear that the distortion is minimised by reducing the amount of harmonics and more quality output is obtained.

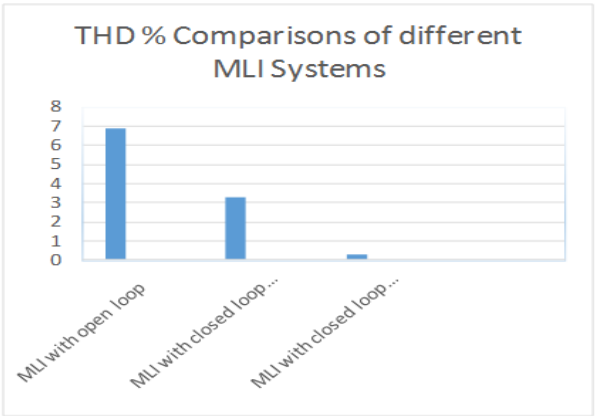
Figure 7. Total harmonic distortion value measured



5. Conclusion

This proposed system achieves power quality improvement by reducing switching loses and harmonics produced. This multilevel inverter converts AC to DC by reducing the amount of power devices. This technology is advantageous to variety of applications such as in standalone applications. The system generates a precise output by increasing the efficiency. In this framework, increasing the number of levels, more accurate the waveform to sine wave and switching stress is reduced. Total harmonic distortion comparisons of different MLI system is shown in graph below. The simulation results affirm a good performance of proposed system.

Figure 8. Total harmonic distortion comparisons of different MLI systems



6. Future Expanation

The system may be enforced for the event of rural areas power. We will use solar array because the supply of energy to the electrical converter .This renewable energy may be enforced to face the energy deficiency and cheap. Instead of solar we can use fuel cell, biomass etc. In the above system we can use DVR system for distributed loads. Inverter side power quality improved by PI closed with MCPWM and distributed side power improved by DVR system. The hardware may be tailored to the agricultural areas far away from supply lines.

Also as a future scope we can consider the asymmetrical multilevel inverters to reduce the harmonic distortion by achieving good performance.

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