Dynamic Simulation of H-Bridge Cascaded Multilevel Converter topology with reduced Circuitry using

Matlab - Simulink

M. Mahendran*1 , S.Raja#2,

Dept. of EEE, SCSVMV Deemed to be University

Abstract

Multilevel electrical converters are widely employed in high power industrial applications. This paper presents a newly changed cascaded H-Bridge topology based electrical converter with reduction of switching devices. In the existing CHB inverters, the circuit needs additional elements to function, it appear to be a more complex circuitry and ponderous. In recent most of researcher concentrate to improve the performances of the Multilevel Inverter like that reduction in number of switches, modulation techniques and control methods etc. The Proposed multilevel inverter output voltage level increasing by using less number of switches driven by the multicarrier modulation techniques. In this paper the H-Bridge cascaded seven level converter designed , simulation results with MATLAB/SIMULINK .

1. INTRODUCTION

The aim of this Project is to design low THD and analyze the performance of seven level Inverter using Pulse Width Modulation Techniques like Phase Disposition (PD) and Phase Shifting (PS) both in Uni-polar and Bi-polar modes of single phase cascaded H-Bridge Seven Level Inverter to drive a single phase induction motor.The traditional two or three levels inverter does not completely eliminate the unwanted harmonics in the output waveform. Therefore, using the cascaded multilevel inverter as an alternative to traditional PWM inverter is investigated[1],[2],[3]

This paper describes the Optimized Harmonic Elimination Stepped Waveform (OHESW) technique to improve the output waveform quality of seven level inverter fed induction motor. The proposed method also is used to minimize the Total Harmonic Distortion THD of the synthesized multilevel waveform.

2. Objective of the Work

The objective of this Project is to Design low THD and analyze the performance of seven level Inverter using Pulse Width Modulation Techniques like Phase Disposition (PD) and Phase Shifting (PS) both in Uni-polar and Bi-polar modes of single phase cascaded H-Bridge Seven Level Inverter.

The traditional three or five level inverter does not eliminate the unwanted harmonics in the output waveform and engages more switches which increases cost and circuit complexity. Moreover it does not diminish lower order Harmonics effectively.

Total harmonic distortion values of low level inverters, level (>20%) and five level inverters (>10%) are found to be more. So the proposed cascaded seven level inverter is to reduce the total harmonic distortion and to make the output voltage more sinusoidal.

Therefore, the usage of the cascaded seven level inverter as an alternative to traditional five level inverter is investigated. This project describes Pulse Width Modulation Techniques like Phase Disposition (PD) and Phase Shifting (PS) both in Uni-polar and Bi-polar modes of single phase cascaded H-Bridge Seven Level Inverter to improve the output waveform quality of seven level inverter fed induction motor. The proposed method also minimizes the Total Harmonic Distortion THD of the synthesized multilevel waveform.

3. FEATURES OF PROPOSED INVERTER

1. The cascaded bridge model allows a scalable, modularized circuit layout and packaging since each bridge has the same structure.
2. Phase Change redundancy for inner voltage level is possible because the phase voltage is always the output sum of each individual bridge voltage output.
3. Possibility of electrical hazards and shocks are reduced due to distinguished power supplies.
4. Requires less number of components when compared to other types. Because of the reduction in the number of switches the initial cost reduces.
5. Controlling becomes easier.
6. The proposed inverter engages only twelve switches which reduces cost and circuit complexity. Moreover it effectively diminishes lower order harmonics.
7. The inverter generates a high quality ac output voltage waveform and effective reduction of total harmonics distortion
8. It reduces dv/dt stress imposed on power switching devices

Table 1. Comparison of Multilevel Inverter

Converter Type	Diode clamped	Flying capacitor	Cascaded Inverter	MLDCLI
Main Switching Devices	(m-1)*2	(m-1)*2	(m-1)*2	m+3
Main diodes	(m-1)*2	(m-1)*2	(m-1)*2	m+3
Clamping diodes	(m-1)*(m-2)	0	0	0
Dc bus capacitors	(m-1)	(m-1)	(m-1)/2	(m-1)/2
Balancing Capacitors	0	(m-1)*(m-2)/2	0	0

The proposed model is based on connecting H-bridge inverters in cascaded connection to get a AC output. The output voltage is the total sum of the individual voltage generated by each individual bridge. The multilevel inverter using the series connected converters with individual DC sources is discussed here. The cascaded multilevel inverter utilizes a desired voltage from various sources of DC voltages such as batteries, fuel cells or solar cells.

This mode of operation has recently become highly popular in high-capacity AC supplies and adjustable-speed drive applications. This converter avoids additional clamping diodes and voltage-balancing capacitors. Each DC source is connected to a separate H-bridge converter. The output voltages of converters are connected in series to get the overall output. With the combinations of the four switches, S1-S4, each converter level can generate three different voltage outputs, +Vdc, -Vdc and zero. The outputs voltages of different full-bridge inverters in the same phase are connected in series such that the total output voltage is the sum of the individual converter outputs. The total cascaded circuit output is the sum of the individual converter outputs. This method defines the number of output-phase voltage levels by m=2N+1, where N is the number of input supplies. A seven level cascaded converter consists of three DC sources and three full bridge converters. By controlling the conduction angles Gamma – γ, we can easily obtain the minimum harmonic distortion.

By switching the MOSFETS at the appropriate firing angles, we can obtain the seven level output voltage. MOSFET is ideally chosen device, because of its speedy nature of phase switching. The firing angle α to be selected to minimize the total harmonic distortion. The major advantage of this type of seven level multi – level inverter is that it requires least number of power devices in comparison with the diode clamped or the flying capacitor based circuits. This is to ensure the lesser cost and as well the complexity and increased space of the circuitry.

Fig.1. Seven level inverter circuit diagram

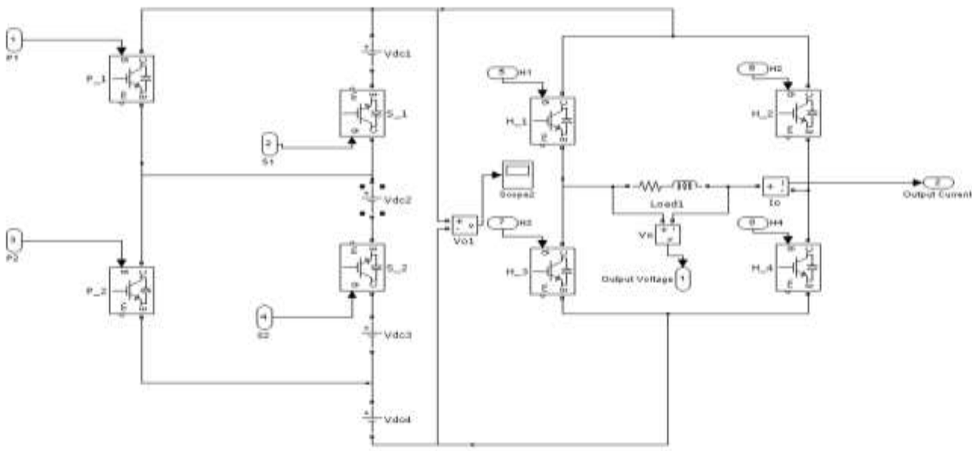
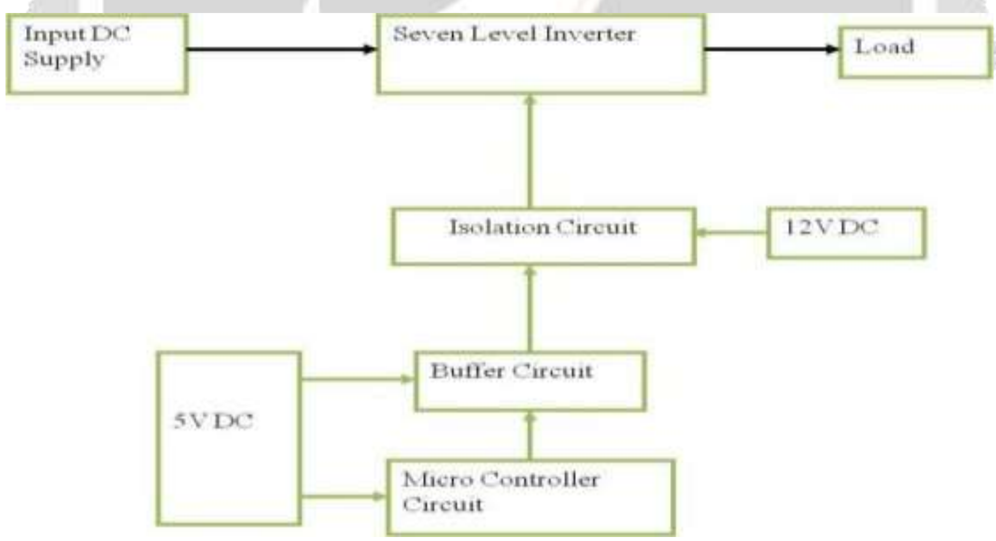


Fig.2. Seven level inverter block diagram with controller



4. SIMULATION OUTPUT FOR 9-LEVEL SYMMETRICAL TOPOLOGY

In our proposed seven-level inverter circuit the number of switches is only one more than the cascaded H-bridge inverter. To produce the same output voltage the cascaded H-bridge has to use the two inverter cells where as only one cell is required with the proposed topology. The total harmonic distortion produced by the proposed inverter is 35.03% only, Fig.3 shows the THD in % for three phase 7-level proposed multilevel inverter which is very low as compared to the single unit of conventional H-bridge inverter having THD of 65.64%. In order to produce the seven levels of output voltage the conventional H-bridge requires three cells whereas the proposed topology requires only two cells

Fig.3. Current and voltage wave form

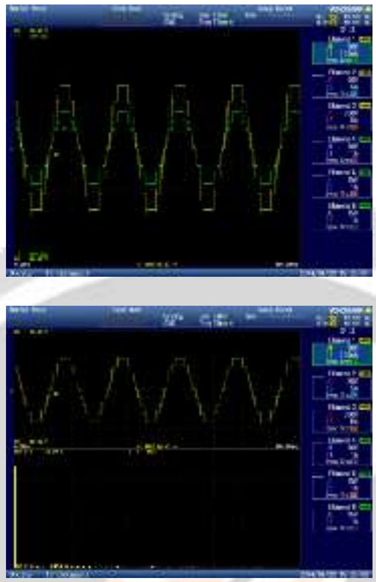


Fig.4. Simulation Output for 7-Level symmetrical Topology

Fig.5. Simulation Design for 7-Level symmetrical Proposed Topology

5. CONCLUSION

This idea presents a new modified cascaded H-Bridge multilevel inverter with reduction of number of switching component. In traditional cascaded H- Bridge type of DC – AC converters requires more number of components and hence it is more complex in terms of control circuitry design. The proposed multilevel inverter output voltage level increasing by using less number of switches driven by the multicarrier modulation techniques.

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