A-5 Level Inverter For Regulated Power Supply From DC Generator

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Abstract—The 5-level inverters, it is mostly used to convert DC voltage into the AC voltage. The 5-level inverter or converter can only create two different output voltages from the load, +2Vdc or -2Vdc. To build the AC output voltage there are two voltages which are basically switched with the controller. So this method is effective to reduce the THD. In high-power rating and high-voltage application there is some limitation in operating with high frequency rating mainly due to the switching loss or constrains of device rating. The concept of 5-Level Inverters do not keep depend on levels of voltage to build an AC signal. Instead of this the more voltage levels are added at each other to create a smoother stepped waveform, to add the voltage level so we need to add the switches in inverter, so the dv/dt will be low. With the more voltage levels in the output waveform, it becomes smoother. If we go at further levels the design becomes more complicated due to more component and more switches are used in it; due to this more complicated controller for the inverter is needed.

Keywords—H-bridge Five level Inverter, THD, Matlab/Simulink

I. INTRODUCTION

Power electronics inverter are becoming popular in various industrial drives application. The H-bridge five level inverter has gained much attention in recent years due to its advantages in high voltage and high power with low harmonics applications. In conventional inverter the harmonic distortion is higher due to that the machine’s life time gets reduces and creates the synchronization problem with grid voltage. To reduce the harmonic distortion in conventional inverter we need a large size filter that make the system larger/bulky. So to reduce the size of inverter we are emerged in the family of multilevel inverter which can work with high voltage level and low harmonic distortion.

II. LITERATURE SURVEY

There are numerous study showing about conventional inverter which has more harmonic and it uses the DC renewable energy sources like solar energy and wind energy system for use, to reduced total harmonic distortion problem and so on.

In [1] Zulkiflie bin Ibrahim & Md. Linton Hossain 2014. By using suitable topology and control method we can reduce the harmonic distortion. We discussed the several multilevel inverter topologies to reduce the harmonic and improve the quality of the voltage. The most commonly used topologies are diode clamped, capacitor clamped and H-bridge type inverter. In the capacitor and diode clamped inverter if the level increases the component also increases so the system becomes bulky and difficult to implement. The problem can be solved by using cascade H-bridge multilevel inverter topology which is free from clamping of diodes and capacitor. In this paper we have modelled about five level cascade H-bridge inverter which gives the better output and has a simple circuit.

In [2] P Yoganand Reddy, MLN Vital, 2016. In single phase multi level inverter, each phase is connected to single dc source. Each level generates three voltages which are positive, negative and zero. This can be obtained by connecting the AC source with the DC output and the using different combination of the four switches. The inverter will be ON when two switches with the opposite position will also be ON. It will turn OFF when the all the inverter switch ON or OFF. To reduce the total harmonic, switching angles are defined and implement. In 5 level H bridge inverter, two H bridge inverter are cascade. It has 5 levels of output and uses 8 switches devices to control whereas in conventional multilevel inverter has a four switches to control the output voltage.

In [3] Vinayaka B.C & S. Nagendra Prasad, 2014 The concept of this inverter is based on connecting 5-level H-bridge inverters in series to get a sinusoidal voltage output. The output voltage is sum of voltage that is generated by each cell. Single-phase full-bridge, or H-bridge inverter. Inverter level generates three different voltage outputs, +Vdc, 0, and −Vdc by connecting the dc source to the ac output by different combinations of the four switches, S1, S2, S3, and S4. To obtain +Vdc, switches S1 and S2 are turned on, whereas −Vdc can be obtained by turning on switches S3 and S4. By turning S1 and S2 or S3 and S4 switches, the output voltage is 0. Similarly S5 and S6 for +Vdc, switches S7 and S8 are turned on for −Vdc. The AC outputs of each of the different full-bridge inverter levels are connected in cascade such that the voltage waveform is the sum of the outputs. The output voltage is sum of voltage that is generated by each cell. The number of output voltage levels are 2n+1, where n is the number of cells. The switching angles can be choose in such a way that the total harmonic distortion is minimize. An n level cascaded H bridge multilevel inverter needs 2(n-1) switching devices where n is the number of the output voltage level.
In [4] Archan B. Patel, Vipul J. Anghan, Purvi B. Anghan, Chandni M. Vora, 2015. One of the control used in multilevel inverter is the cascaded multilevel inverter or series h-bridge inverter. This topology avoids the use of clamping diodes and capacitors used for voltage balancing. To avoid short circuit of DC sources, the separate DC sources configuration is applied to the cascaded multilevel inverter. Because of structure of separate DC sources, series multilevel inverter is well suited for various renewable energy sources such as photovoltaic cell, fuel cell etc. For active power conversion from AC to DC and then DC to AC as per requirement, the series multi level inverter is best suitable. With its modularity and flexibility, the cascaded multilevel inverter shows supremacy in high power applications. Compared to other topologies of multilevel inverters the proposed topology gives advantages like: reduced number of switches, optimization layout is possible because of same structure for all levels, simple control etc. While using h-bridge inverter various problems have been faced and these problems can be solved using cascading the h-bridge inverter.

III. MATERIAL AND METHOD

After studying these papers few points to be considered during RESs like reduced harmonic distortion and switch controlling scheme of the cascade H bridge inverter. Hence a system must to be designed which will consider all these points and will make certain improvements on them.

A. Block diagram

![Block diagram of 5-level inverter](image)

a) Block diagram of 5-level inverter

B. Control Method

The harmonic distortion can be controlled by the control circuit in the 5-level inverter. There is 8 switches in the control circuit which generates the three different voltage output like +Vdc, 0 and –Vdc. By connecting the DC source to the AC output by different combination of the eight switches which is S1, S2, S3, S4, S5, S6, S7 and S8. When the output voltage is 0 the switch S3, S4, S7 and S8 is turned ON. Similarly when the output voltage is V then the switches S1, S3, S7 and S8 is turned ON. While when the output voltage is 2V then the switch S1, S3, S5 and S7 is turned ON. During the –V then the switch S2, S4, S7 and S8 is turned ON. While the output voltage is –V2 the switch S2, S4, S6 is turned ON. To generate the output voltage this way the switch has to be controlled to reduce the harmonic which can expand the life of machine’s.

C. Advantages

It will give the better waveform quality means it will reduce the total harmonic distortion which will increase the life of the machine and it will also reduce the switching stress due to increasing in the switches. Output voltage level are doubled the number of sources. We can also use lower voltage device on it

D. Conclusion

With increasing no. of levels %THD and dv/dt stress across each device reduces. With increase in no. of switches the voltage across each device is less hence the switching losses and converter efficiency is increased. By varying the width of pulses the selective harmonics can be eliminated. %THD depends on the width of different voltage levels by varying the width of pulses the limit of minimum harmonics can be obtained.

References


5. Analysis Of Cascaded Multilevel Inverter Induction Motor Drives” By—“Yashobanta Panda, Department of Electrical Engineering National Institute of Technology, Rourkela.

Books: