INTERNATIONAL RESEARCH JOURNAL IN ADVANCED ENGINEERING AND TECHNOLOGY (IRJAET) E - ISSN: 2454-4752 P - ISSN : 2454-4744
VOL 2 ISSUE 2 (2016) PAGES 918-922
RECEIVED : 27/03/2016. PUBLISHED : 05/04/2016
April 5, 2016

THD REDUCTION USING 19- LEVEL (CASCADED) INVERTER AS FACTS COMPENSATOR

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Abstract:

In this paper mainly focused on the design and implementation of new topology in a single phase 11 level asymmetrical multilevel inverter by using only a 14 switches and five equal DC power source. The main objective of this paper is to reduce the complexity while increasing the output step levels with a low number of switches and sources at fixed frequency. The multilevel voltage source inverters unique structure allows them to obtain high voltages with reduced switches without the use of transformers. The general function of the multilevel inverter is to provide a required AC output voltage from several levels of dc input voltage for these reason multilevel inverters can easily used for the high power applications. In this paper, Single phase 11-level inverter for better accuracy with reduced number of switches and unequal dc input sources. The proposed system used the topology of Asymmetrical cascade H-Bridge Multilevel inverter with separate unequal dc sources for the switching circuit. As the number of step level and voltage increases in the output waveform has more steps, which produces a desired output waveform with low harmonic distortion. Application of multilevel inverter for high power equipments in industry has become popular because of its high-quality output waveform.

Key words: Asymmetrical cascaded H-bridge inverters Switch Reduction Total Harmonic Distortion 11- Level inverters

1. INTRODUCTION

Power Electronic Converters, especially DC/AC PWM inverters have been extending their range of use in industry because they provide reduced energy consumption, better system Efficiency, improved quality of product, good maintenance, and so on. For a medium voltage grid, it is troublesome to connect only one power semiconductor switches directly [1, 2, 3]. As a result, a multilevel power converter structure has been introduced as an alternative in high power and medium voltage situations such as laminators, mills, conveyors, pumps, fans, blowers, compressors, and so on. As a cost effective solution, multilevel converter not only achieves high power ratings, but also enables the use of low power application in renewable energy sources such as photovoltaic, wind, and fuel cells which can be easily interfaced to a multilevel converter system for a high power application. The most common initial application of multilevel converters has been in traction, both in locomotives and track-side static converters [4]. More recent applications have been for power system converters for VAR compensation and stability enhancement [5], Active Filtering [6], High- Voltage motor drive [3], High-voltage DC transmission [7], and most recently for medium voltage Induction motor variable speed drives [8]. Many multilevel converter applications focus on industrial medium-voltage motor drives [3, 9], utility interface for renewable energy systems [10], Flexible AC transmission system (FACTS) [11], and Traction Drive systems [12].

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Now-a-days, in industries, power conversion conventional inverter is voltage stress across the systems become very popular and are used extensively. individual switch is lesser in case of MLI. Many The power conversion system includes AC-DC, DC-AC, topologies of MLI are developed and studied. They are DC-DC, AC-AC conversions. Many high and medium generally classified into [1-9]: voltage applications require such power conversion systems. Those applications are HVDC transmission, Flying-capacitor inverter FACTS, AC/DC drives, renewable energy sources such as Diode-clamped inverter PV solar cells, wind, fuel cells etc. This paper concentrates Cascaded H-bridge inverter on DC-AC conversion (Inverter action). A conventional single phase inverter is able to produce voltage levels of From these inverter topologies cascaded H-Bridge +Vdc, 0, -Vdc, so the output waveform of the inverter is multilevel inverter is widely used. Cascaded inverter has quasi-square wave, which is not advisable to use as an 'n' number of series connected cells, with an individual input to any AC system. Hence, to get nearly sinusoidal DC voltage source connected to each cell. There are two waveform, multilevel inverter is introduced in 1975. The groups of cascade multilevel converters, the symmetric output of multilevel inverter is a staircase wave, which is and the asymmetric multilevel converters. In symmetric nearly sinusoidal. By increasing the number of output MLI all the DC voltage sources used are of equal voltage levels in multilevel inverter the THD can be magnitude, whereas in asymmetric MLI magnitudes of DC minimized.

2. CASCADED MULTILEVEL INVERTER

CHB are multilevel inverters formed by the series connection of two or more single phase H-bridge inverters, hence the name. Each H-Bridge corresponds to two voltage source phase legs where the line-line voltage is converter output. Therefore a single H-Bridge converter is able to generate three different levels. Each leg has only two possible switching states.

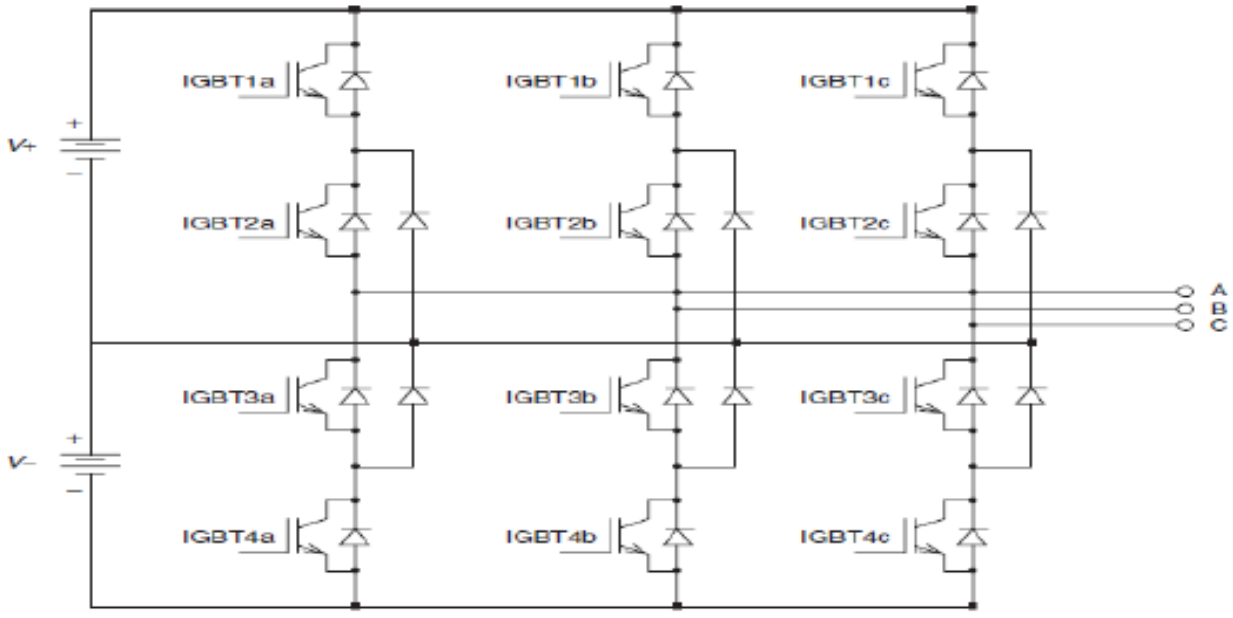

Fig.2.Cascaded Multilevel Inverter

To avoid dc-link capacitor short circuit since there are two legs, four different switches states are possible, although two of them have reduced output voltage. The zero level can be generated connecting the phase outputs to the positive or the negative bars of the inverter. When two or more H- bridges are connected in series. Their output voltages can be combined to form different levels, increasing the total inverter output and also its rated power.

3. HARMONIC REDUCTION IN INVERTERS

In case of an inverter, it is very important to remove the harmonics from the ac output. The harmonics present in a DC to AC inverter are very much obvious compared to the harmonics that can be present in an AC to dc converter. This is because of the output of DC to AC inverter. Thus, the filters that are used in DC to AC inverter have different designs compared to the filters used in AC to DC converters. In case of AC to DC converters, the main objective is to improve the output voltage ripple. Thus, passive filters can be easily used in order to improve the output of an AC to dc converter. While, in case of DC to AC inverter, the harmonic reduction is harder and it also includes the use of active filters. One such technique is explained below. The ratio of Vr/Vc is called Modulation Index (MI) and its control the harmonic contentof the output voltage waveform. The magnitude of fumdamental component of output voltage is proportional to MI, but MI can never be more than unity.

4. PROPOSED METHOD

The proposed structure of the using only a single dc source for each phase is promising An asymmetrical multilevel decreases the number of required dc power supplies, inverter can be defined as a multilevel converter fed by a provides high-quality output power due to its high set of DC voltage source where at least one of them is number of output levels and results in high conversion different to the other one. The main advantage of efficiency and low thermal stress as it uses a fundamental asymmetrical multi level converter is, it uses less frequency switching scheme. This paper was implemented number of semiconductor switches compared with for 7- level HCMLI with fundamental frequency switching symmetrical topology. One interest of the control and how its modulation index range can be asymmetrical configurations is that the number of levels extended using triple harmonic compensation. is higher with the same number of cells. The number of D. Kalyanakumar et al. [15] investigated Hybrid 7-levels is higher with the same number of cells in the Level H– bridge Inverter was used in a Distribution Static symmetrical case, whereas it grows exponentially, in the Compensator (DSTATCOM) in Power System industry, asymmetrical case, the asymmetrical topology requires so that the proposed system benefits of low harmonics only 14 switches to obtain 11 level output voltage. distortion with reduced number of switches to achieve the Whereas in case of symmetrical topology 28 switches are output over the conventional cascaded 7-level inverter needed. and reduced switching losses. The proposed system is This proposed inverter consists of an H Bridge usedto obtain the improved power factor, compensate the circuit with 14 switching devices, five equal dc sources reactive power and suppress the total harmonics and SPWM generation unit. The equal DC voltage distortion (THD) drawn from a Non-Liner Diode Rectifier sources of 50V are connected with MOSFET switches to Load (NLDRL) of DSTATCOM, by using Sub-Harmonics provide the required output voltage with low distortion Pulse Width Modulation (SHPWM) technique is used as for eleven Level. Only one H-bridge is connected with all control for the switches of HSL H – bridge Inverter. The the switches to acquire both positive and negative proposed

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hybrid seven levels H – bridge implemented polarity. Time based pulse generation circuit is designed using MatLab/Simulink simulation software for shunt with the above inverter switches for eleven level output compensation of a 4.5 kV distribution system. [16-18].

5. OUTPUT ANALYSIS

In this thesis, new modified single phase 11 level either one of the two states - turned off or turned on. Any H-Bridge inverter will be focused. Multilevel, i.e., positive, operation in the linear region, other than for the negative and zero level waveform are synthesized using unavoidable transition from conducting to non- such an inverter. In the thesis, the total harmonic conducting, incurs an undesirable loss of efficiency and distortion (THD) methods are used to indicate of the an unbearable rise in switch power dissipation. To control quantity of harmonics contents in the output the flow of power in the converter,

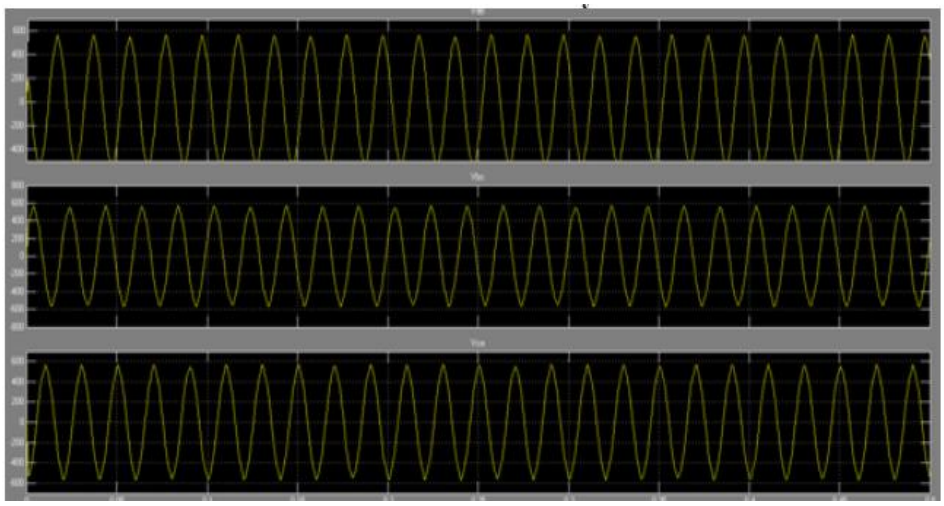

Fig.3.Simulation of Multilevel inverter

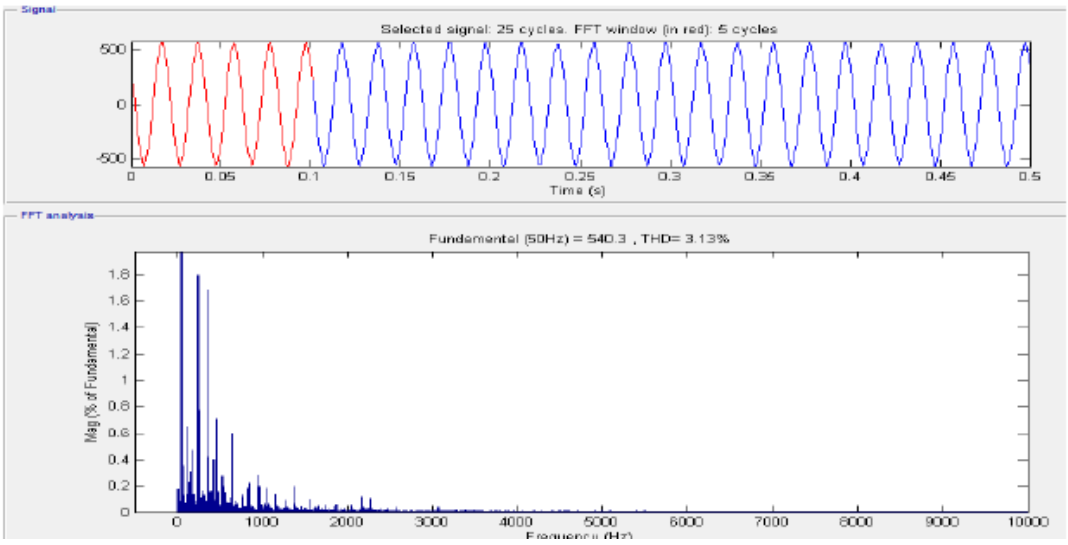

Fig.4.Simulation of Multilevel inverter

the switches alternate waveforms. To reduce the THD in the output voltage, the between these two states. This happens rapidly enough lowest s-1 harmonics in each phase voltage need to be that the inductors and capacitors at the input and output eliminated, where s is the number of the full-bridge nodes of the converter average or filter the switched inverter per phase. signal. The switched component is attenuated and the The Figure 3 shown below is the simulink model of desired dc or low frequency ac component is retained. the new modified H Bridge 11–Level level inverter using This process is called Pulse Width Modulation, since the power system block set. The following parameter values desired average value is controlled by modulating the are used for simulation: dc inputs of 5V,14 MOSFET width of the pulses. switches and time based pulse generation unit.

CONCLUSION

In this research paper, the nine level multilevel H-bridge inverter is briefly discussed. And an implementation is done in MATLAB/SIMULINK software tool. From the analysis, nine level multilevel inverters is the best suited topology for the dc to ac conversion. Multi carrier PWM modulation technique is best technique, which gives low total harmonic distortion (THD).

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