International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 08 Issue: 03 | Mar 2021 www.irjet.net p-ISSN: 2395-0072

Analysis and Simulation of 9-Level Cascaded H-Bridge Multi Level Inverter Using Level-Shift PWM Technique

Narendra Verma[1], Dr. Pramod Sharma[2]

[1]M.Tech Scholar,
[2]Professor,
Dept. of electronics and communication engineering, Regional college for education and technology Jaipur, Rajasthan, India

---

Abstract: This manuscript presents the achieved efforts on 1-ϕ 9-level cascaded H-bridge multilevel inverter. To cheer the quality of 9-level CHBMLI output parameters primarily THD and switching losses, multicarrier level shifted technique is consider for controlling the gate pulse of 9-level CHBMLI and the complete analysis of THD for 9-level is done. This work is performed and results are validated using MATLAB/SIMULINK.

Keywords: Multilevel Inverter (MLI), Cascaded H-Bridge (CHBMLI), Multicarrier pulse width modulation technique (MCPWM).

INTRODUCTION:

Multilevel inverter (MLI) is playing a important role in the field of medium and high voltage industries. The design of MLI is mainly depends on number of DC supplies, number of switches, voltage levels, DC link capacitors and output power quality. Most of the MLI are subdivided into three main categories flying capacitor (FC), neutral point clamped (NPC) and the cascaded H bridge (CHB). CHB MLI is very commonly used in industrial application and has a reliable structure when compare to others. CHB MLI is very beneficial with low dv/dt stress, less total harmonic distortion (THD) and less electromagnetic interference (EMI) among all of them CHB MLI is very suitable for PV array application because each panel of CHB MLI operates with separate DC voltage sources there are very large number of techniques to control the various operations MLI such as space vector pulse width modulation (SVPWM) and sinusoidal pulse with modulation (SPWM) etc and to control the output voltage of multilevel inverter; carrier based PWM is one of them. It is a so called sine triangle PWM; as a reference is sine wave and carrier is triangular wave. Level shifted method is a type of sine PWM technique and it has three types, namely: In this paper simulation of 9-level CHBMLI is done using level shifted PWM technique for single phase, and there THD is analyzed.

CASCADED H BRIDGE MULTILEVEL INVERTER

The multilevel inverter (MLI) is best suited for the application which demands the finest quality of AC output waveform. Cascaded H bridge multilevel inverter (CHB MLI) is different in many features from NPC MLI and CC MLI on the approach to accomplish different voltage waveforms at different levels. It uses cascaded H bridge inverters various DC sources in the formation of various units. The total output voltage in figure is the sum of the total of all full H bridge inverter and all H bridge creates three voltages(+V, 0 & -V).

The switching state of CHB MLI (ss) can be determined by

$$S=2n+1 \quad (9)$$

n is the number of DC sources employed and S is the number of output levels generated.

$$ss=3^m \quad (10)$$

output 2n+1,

In order to minimise the THD, the switching angle can be optimized by adjusting all of them.

The Fig 3 demonstrates the waveform of voltage output for a 7-level CHBMLI [7, 8].

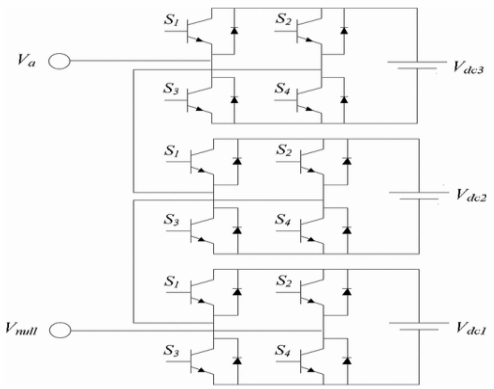

Fig 1: Topology for CHBMLI

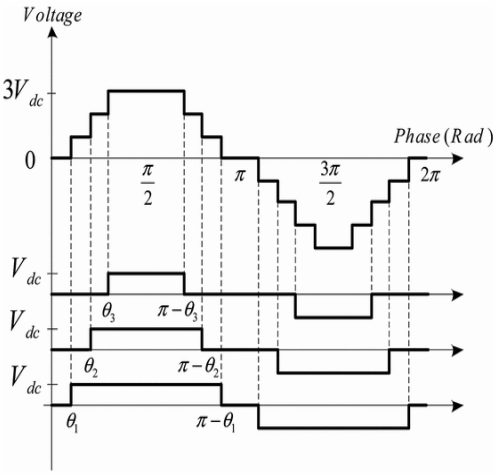

Fig 2: Typical Output Waveform for CHBMLI

MODULATION TECHNIQUE:

Level shifted technique is the reasonable addition of sine triangle PWM for MLI, in which *n*-1 carriers are required for *n*-level inverter. They are approved in vertical shifts in constant bands defined by the levels of the inverter [8]. 3(*n*-1) carriers are requisite for 3-phases. Based on managed degrees of liberty grouping, The PDPWM with single reference is based on the evaluation of a sinusoidal reference signal with *n*-1 carriers which are vertically shifted.

From Fig 4.2 it can be known that the carriers that have the similar frequency f_c and amplitude A_c are in phase. The modulating signal has a frequency of f_r and an amplitude A_r.

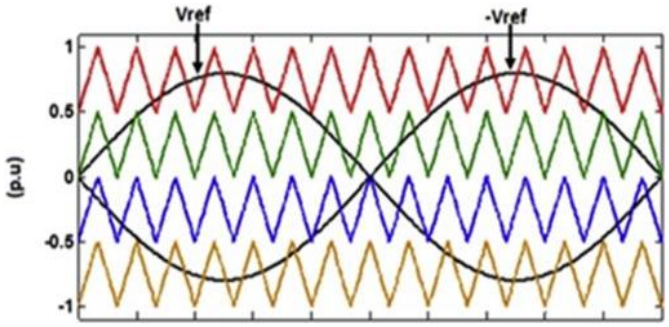

Fig. 3: Assumed reference signal of level shifted PWM technique.

SIMULATION AND RESULTS:

9-level CHBMLI is simulated in MATLAB/SIMULINK and the level shifted modulation technique is employed to trigger gate pulse of multilevel inverter. The output of the 9-level CHBMLI is shown in Fig. 4.

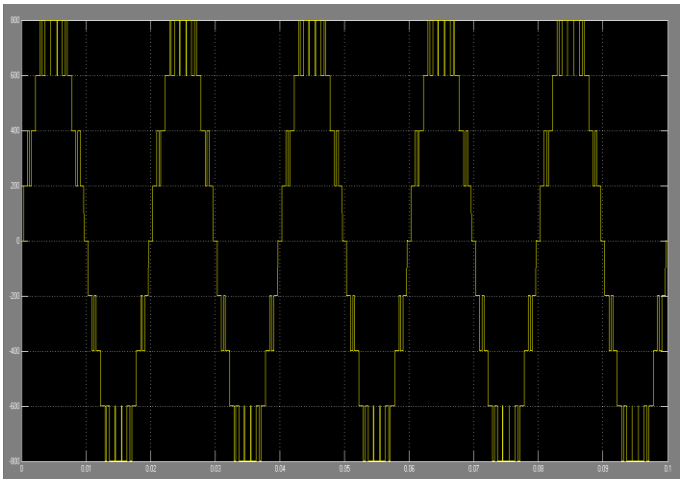

Fig. 4: Output waveform of 9-level CHBMLI.

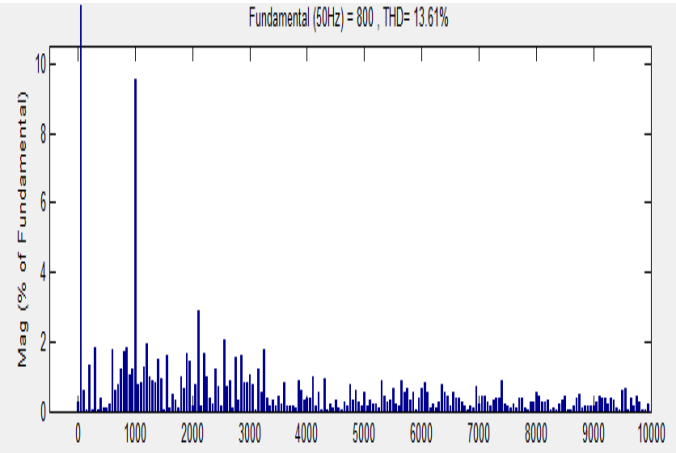

Fig. 5: THD of 9-level CHBMLI.

Conclusion:

This paper present a single phase 9-level cascade H-Bridge multilevel inverter for DC source application. The CHB MLI copious advantages such as generation of high power, low *dv/dt* stress, minimum EMI and less THD. The projected multilevel inverter has lesser %THD without use of filter. Level shifted modulation technique is used to modulate the gate pulses of 9-level CHB-MLI and there simulation is developed in MATLAB platform. From the obtained results by simulations it is observed that level shifted technique can be useful to multilevel inverter.

References:

1. Banaei, MR, Khounjahan, H & Salary, E 2012, 'Single source cascaded transformers multilevel inverter with reduced number of switches,' IET Power Electronics, vol. 5, no. 9, pp. 1748–1753.
2. Carrara, G, Gardella, S, Marchesoni, M, Salutari, R & Sciutto, G 1992, 'A new multilevel PWM method: A theoretical analysis,' IEEE Transaction on Power Electron, vol. 7, no. 3, pp. 497–505.
3. Fu-San Shyu & Yen-Shin Lai 2002, 'Virtual stage pulse-width modulation technique for multilevel inverter/converter', IEEE Transaction on Power Electronics, vol. 17, no. 3, pp. 332-341.
4. Geetha, R & Ramaswamy, M 2015, 'New PWM strategy for three phase multilevel inverter,' International Journal of Power Electronics, vol. 7, no. 1/2, pp. 86 –108.
5. Lai, JS & Peng, FZ 1996, 'Multilevel converters–a new breed of power converters,' IEEE Transaction on Industrial Application, vol. 32, pp. 509–517.
6. Mahdi Toupchi Khosroshahi 2014, 'Crisscross cascade multilevel inverter with reduction in number of components,' IET Power Electronics, vol. 7, no. 12, pp. 2914–2924.