A NOVEL FIVE-LEVEL THREE PHASE DC-AC CONVERTER FOR HIGH VOLTAGE APPLICATIONS

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***Abstract*-In this paper a novel five-level three phase inverter is proposed.The topology is consists of 12 diodes and power switches to achieve a five-level three phase output. There is lower harmonic distortion and the output line to line voltage is five level. Compared to the traditional three-phase inverters. By using the less components five level three phase output can be produced .These are used in interconnecting system to produce the larger voltages.**

Keywords-Five level, three phase, power switch, total harmonic distortion.

I.INTRODUCTION

Due to the energy unavailability in the world, conventional energy systems are broadly established to offer power to the distribution system. The advantage of three phase topology is high power density. The motors can be driven by using three phase inverter [1]. The other inverters for example half-bridge inverter and H-bridge inverter will to transfer the power efficiently to the grid [2].Multi-level inverter transfer the power efficiently with the required voltage levels [3].The multi-level inverters have the following advantages:

1) It has the ability to produce high range output

2) Harmonic distortions are low.

3) There will be low losses in the power switches.

4) Lower current and voltage stress on the power switches.

Multilevel inverters convert DC into AC where there is a series connection of power split capacitors and power devices for high voltage applications [4].The output of these inverters resembles a stair case wave. It has the advantage that it has better quality power, high voltage capability and less losses in the switches. The drawback of this technique are thatlow voltage system require large semiconductors. The diode clamped inverter gives bank of multiple voltage level by connecting the phases to bank of capacitor in series. The voltage level can be increased by increasing the capacitors. Hence the system will have more components. The cascaded H-bridge inverter constitutes of series of connection of single-phase inverter. It has separate DC sources. The voltage level in the cascaded bridge is given by

$$M=(2h+1)$$

In which H is the number of H-bridge cells

The sum of active switches used in cascaded inverter varies on the number of voltage levels of the inverter

There will be more levels in the output voltages as the DC sources increases. This CHB can be used for many high power applications. The switching stress for each switch will be lesser as compared to other inverter among the many inverter topologies each circuit has its characteristics [5].By using the input capacitor the voltage pressure can be clinched and in diode clamped inverter the pressure can be reduced by clamping capacitor and this makes the making choice of switches informal. The more quantity capacitors and power switches will cause the full system complicatedas the output levels get more in the conventional interface such as bridge inverter it will unable to transfer the whole power togrid. Sothe proposed five level three-phase inverter can attain the output voltage of five levels with less number of components [6].The main purpose of the project is to simply the difficulty in the inverters.so the inverter consists of three-phase six-switch inverter with the bi directional auxiliary switch.

II. PROPOSED INVERTER

The inverter has bi directional auxiliary switch with three phase six switches. The auxiliary is comprise of six switches and six diodes. This inverter produces an output with minimum number of power switches, this inverter produces a five level three phase output.

III CIRCUIT DIAGRAM OF THE INVERTER

The inverter consists of one input DC voltage source and the two capacitors are connected in opposite with the source. The circuit consists of

- Power switches
- Diodes

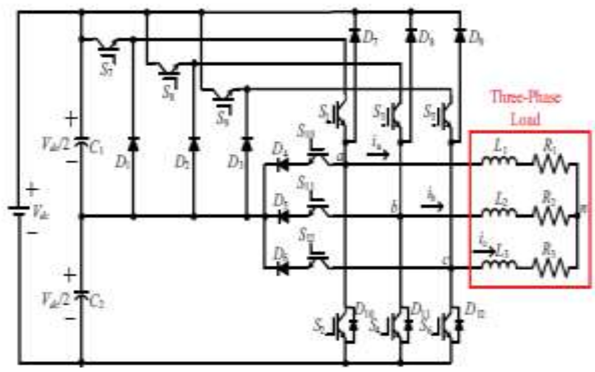


Figure 1.Five level three phase circuit

A.Fundamental switching frequency control

There are different kind of modulation control schemes there are mainly two types:

- Fundamental switching frequency
- High switching frequency PWM.

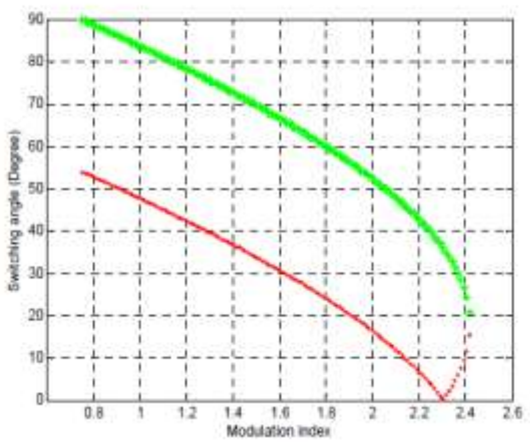
In fundamental control switching frequency modulation has two switching angles Ѳ1 and Ѳ2.We have two equations

$$\cos(\theta_1) + \cos(\theta_2) = m_a$$
$$\cos(5\theta_1) + \cos(5\theta_2) = 0$$

Where ma is the modulation index and it is given as

$$m = \frac{V_1}{V_{dc}/2}$$

The relationship of output voltage and modulation index is given by



$$m = \frac{4}{\pi} m_a$$

B. Operation of the inverter

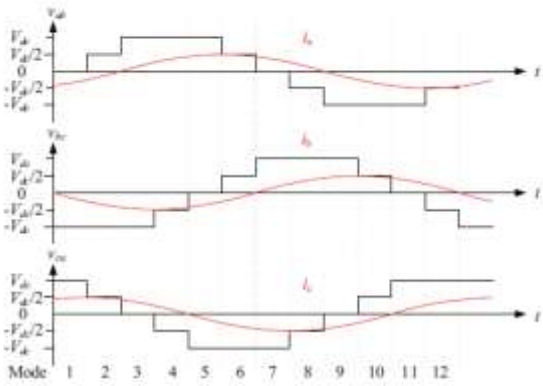


Figure2.Modes of operation

There are 12 switches in the proposed inverter. Each operates at angle of 30 degrees. The MOSFET switches operate equally to produce the desired AC output. There are many switching losses which occur in MOSFET that are reduced but using the diodes in parallel with the inverter.

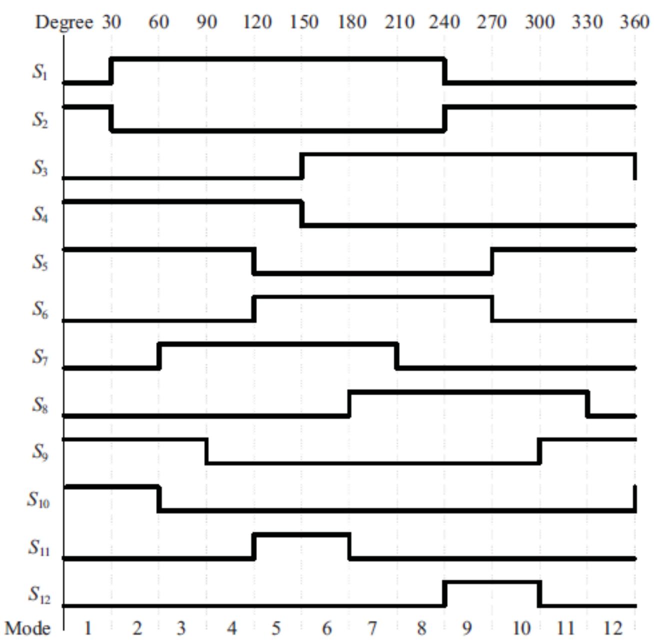


Figure 3. Switch stages

Mode 1: In mode 1 the node is ia and ib is negative and ic is positive charge flows through the corresponding switches S1, S5, S2 and S4 are active. The voltage at pointa is 0v and point b is 0v and point c is vdc. The output voltagesVab is 0v, Vbc is –Vdc and Vca is Vdc.

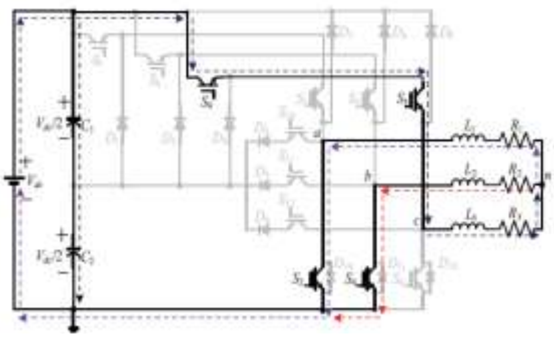
Mode 2: In the mode2 the ia is positive ib is negative and ic is positive. The switches S4, S5, S9& S10 re active. The node voltage are Vdc/2,0 and Vdc. The output line to line voltage are Vab is Vdc/2, Vbc is-Vca is Vdc/2.

Mode 3: In the mode3,ia is positive, ib is negative and ic is positive as shown by the dotted line shows the current flowing the switches S1,S5,S7 and S9 are active.The node voltages are vdc, 0v and vdc. The output voltages are vdc,-vdc &0v.

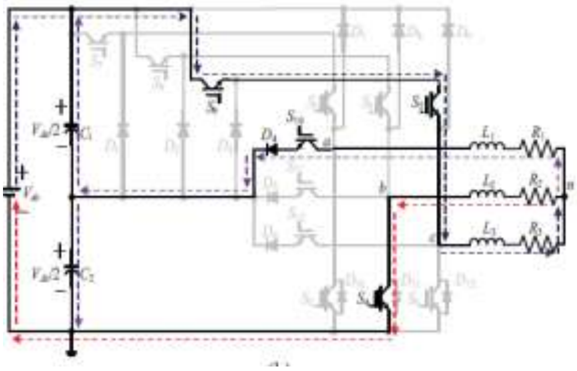
Mode 4: In the mode4 positive current ia flows, negative current is ib and ic is positive.The switches S1, S4, S5, S7 are on and the S3 is active.The voltage at the three different nodes are vdc, 0v and Vdc/2 the output line to the voltage are vdc,-Vdc/2 and Vdc/2.the capacitors c2 released power to the load in the mode4..

Mode 5: Inthe mode5ia is positive current, ib is negative and ic is positive. The node voltage at node a is vdc and the node b is 0v and node c is 0v.The voltages Vab is Vdc is 0v and Vca is –Vdc.

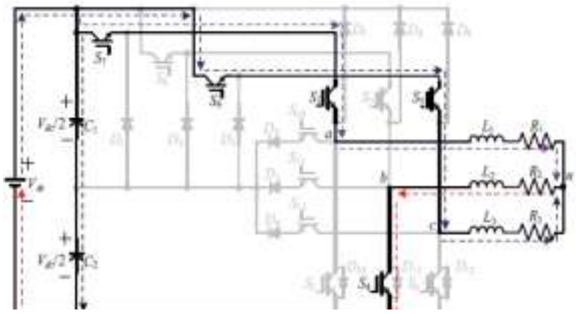
(A)



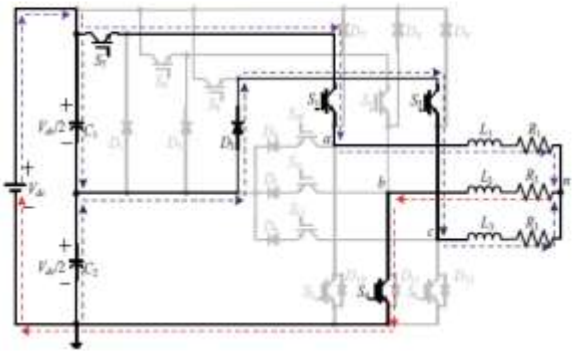
(B)



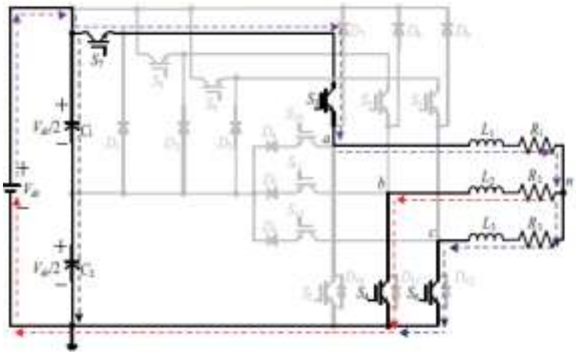
(C)



(D)



(E)



4.(A)Mode 1 (B) Mode 2 (C) Mode 3 (D) Mode 4 (E) Mode 5

There are 12 modes of operation.5 modes are explained above and the same cycle repeats for the remaining modes and the corresponding switches gets on due to the node currents at different nodes. The line to line and phase to neutral voltages are obtained. The rms value is obtained by the equation

$$RMS = \sqrt{\frac{1}{T}\int_0^T \int f(x)^2 dt}$$

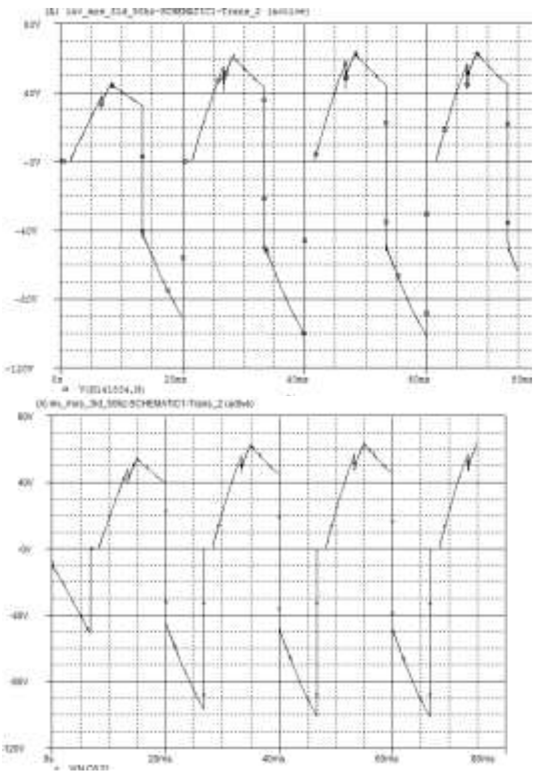
III. RESULTS OF SIMULATION OF THE INVERTER

The five level three phase inverter is simulated by using PSPICE. Figure 5 and Figure 6 shows the simulated results. Vab, Vbc and Vca are the line to line output voltages. The output phase to neutral voltages are Van, Vbn and Vcn.

IV.SIMULATION AND CIRCUIT PARAMETERS

Control scheme	Fundamental switching frequency
Inputvoltage	300V
Output voltage	100vrms
Switching frequency	50hz

Control scheme	Fundamental switching frequency
C1 andC2	330uf
S1 to S12	IXGH32N60A
D1 to D12	DSEP30-60A
L1 to L3	20mH



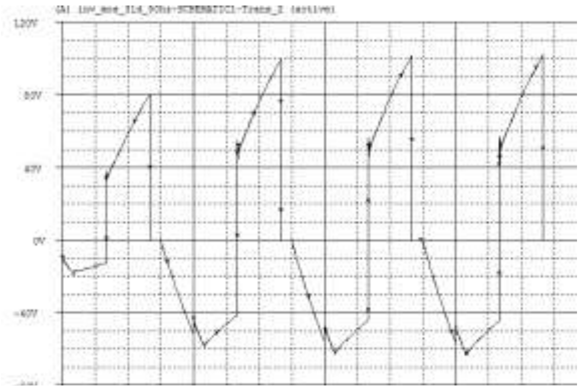


Figure5.Phase to neutral voltages

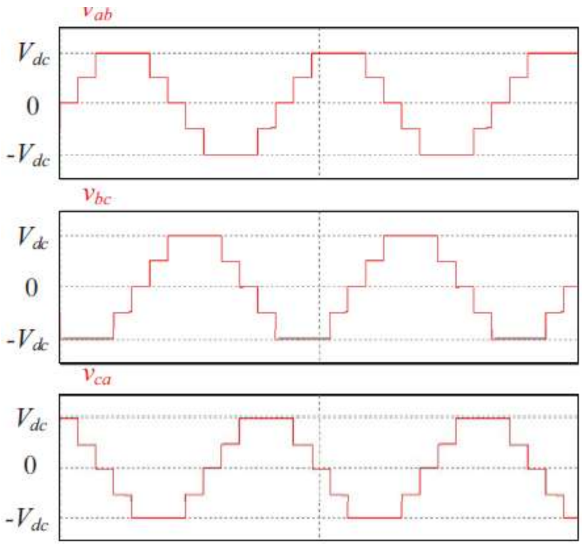


Figure6.Phase to line voltages

The results of PSPICE simulation have verified that it can reduce the THD effectively. The three phase output can be obtained by fewer components.

IV.CONCLUSION

The proposed inverter can produce same levels as in other topologies with the auxiliary switch combine with three phase six switch topology. In this less components are needed. It does not have unbalance problem due to the use of diodes. The proposed inverter can produced the different five levels AC output voltage the fewer components which leads to the less switching losses. The multi-level inverters are playing an important role in the power electronics. The proposed inverter can produce five level three phase output to drive the three phase load. The fundamental interchanging frequency control can be used to know the on and off status of the IGBTs used and the control scheme is easier.

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