BESPOKE CASCADED 15 LEVEL H-BRIDGE MULTILEVEL INVERTER WITH MODULAR STRUCTURE HAVING LESS DC SOURCE AND LOW HARMONICS.

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1 ABSTRACT:

This paper highlights a Hybrid Multilevel Inverters have gained much attention in the Field of the Medium Voltage and high Power applications because of their many advantages, such as their low voltage Stress on Power Switches, low harmonic and EMI Output. Multilevel inverters have very important development for high power medium voltage AC drives. Quite a lot of topologies have found industrial approval; Neutral Point Clamped, flying capacitor, H-bridge, cascaded with separated DC source, several control and modulation strategies have been developed Pulse Width Modulation (PWM), Sinusoidal PWM, Space Vector PWM and Selective harmonic eliminations etc. A most important issue with multilevel inverter is eliminating the harmonics from the output voltage. The output voltage of the inverter must meet maximum Total Harmonics Distortion (THD) boundaries as specified. In this new topology the output wave form consists of SVdc: S-number of stages and associated number of level equal to 2s+1 - 1. The output waveform has 15 levels. Moreover, the stage with higher DC link voltage as lower switching frequency and hereby reduces the switching losses.

Keywords: *Multilevel Inverter, PWM Converter, Switching*

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2. INTRODUCTION:

Every individual inverter is capable of generating three different voltage output +Vdc , 0, -Vdc by connecting the dc source to the ac output side by different combinations of the four switches S1 , S2 , S3 and S4 . The synthesize ac output voltage waveform of the sum of all the individual inverter's outputs. The number of output phase voltage level of cascade multilevel inverter is 2s+1 where S is the number of dc sources. CUSTOM power devices like DSTATCOM and DVR are capable of providing a number of power quality functions which can be employed selectively or simultaneously. The devices appear as fully

synchronous sources which are capable of absorbing and injecting reactive power on an electricity system at distribution voltages. PWM converters are widely used as front end converters in custom power devices. Direct power control strategies have gained importance in recent past due to faster response and superior control characteristics. DPC block for PWM converter essentially comprises of active and reactive power comparators, power estimators and switching pattern generators.

2.1 HYBRID TOPOLOGY OF MULTILEVEL INVERTER:

Considering the configuration of hybrid topology of the single phase N-level k module cascaded inverter is presented. The basic element of the general topology is Ni-level full bridge module. At the same time, several controllable degrees of freedom are included in such as the types of the full bridge module, the level number of each full bridge module and the dc voltage proportional relation of the adjacent modules. The selections of these degrees of freedom can produce different hybrid topologies. The hybrid topologies gives can be considered special cases of the general hybrid topology given in fig1. Utilizing the degrees of freedom of the full bridge type apart from the H bridge power module given being used as the basic module.
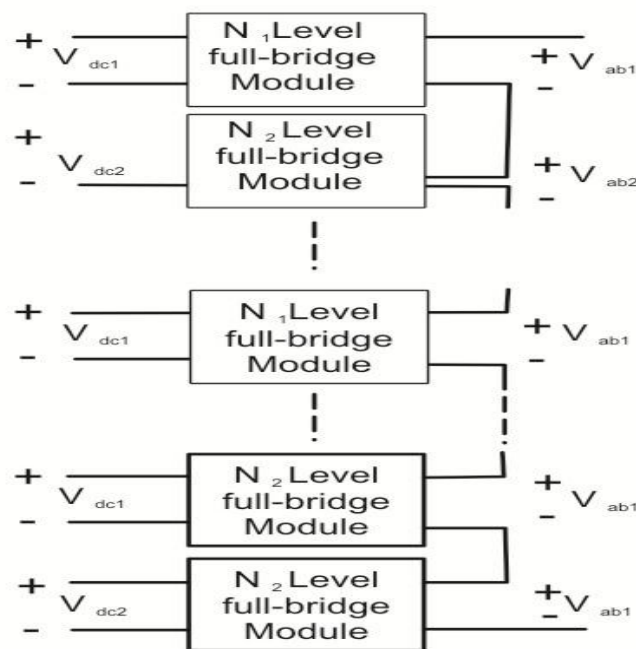

Fig 1 General Hybrid topology of multilevel inverter

This paper focuses on series connected voltage source PWM inverter. In this area, present control techniques are based on the following methods:
1. Sinusoidal PWM   (SPWM)
2. Space vector PWM (SVPWM)
3. Non sinusoidal carrier PWM

4. Mixed PWM,
5. Special structure of cell connections and
6. Selected harmonic elimination PWM (SHEPWM).

This project on the multilevel inverter technique should focus on new multilevel topologies based on the following existing multilevel topologies

2.2 NEW TOPOLOGY OF H- BRIDGE

The conventional single H-bridge inverter uses four switches. Positive voltage is generated using two switches and negative voltage by another set of two switches. The new topology is constructed in which the number of switches is reduced by half. The H-bridges are cascaded such that the positive voltage is obtained by the cascaded set of inverters and the negative voltage is obtained by using conventional H-bridge at the output of the cascaded set of inverters. In this new topology binary logic switching technique is used. Thus increased number of levels at the output is obtained with reduced number of switches.
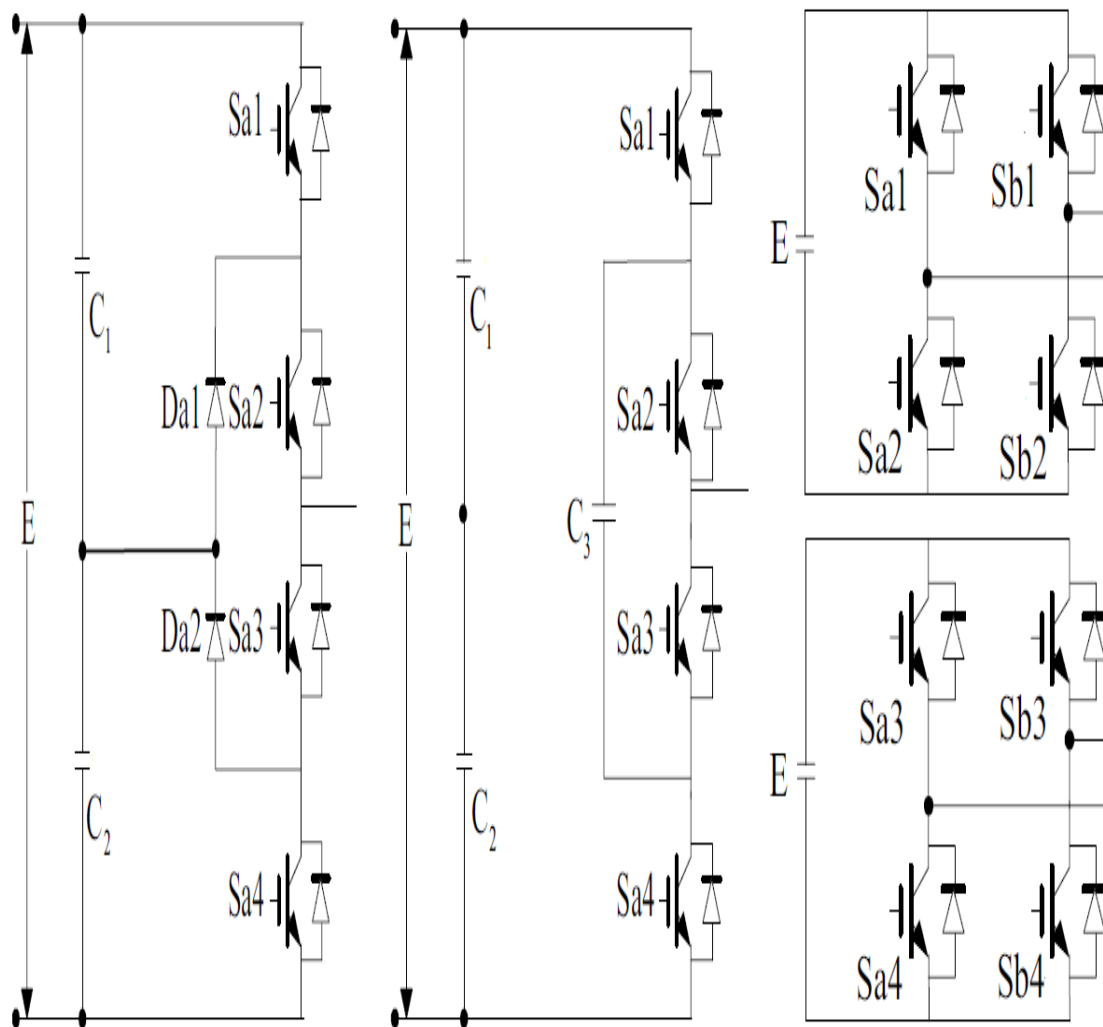

Fig. 2. New topology of H- bridge multilevel inverter with reduced number of switches

In the circuit given in fig.4 s1, s2, s3 and s4 are the main switches and s1', s2', s3' and s4' are complementary switches. For example, turning on switches s2, s3, s1' and s4' yields a voltage of 6E. The various voltage levels and switching strategies of H bridge multilevel inverter are given in table 1.

s1	s2	s3	s4	E
0	0	0	0	0
0	0	0	1	1
0	0	1	0	2
0	0	1	1	3
0	1	0	0	4
0	1	0	1	5
0	1	1	0	6
0	1	1	1	7
1	0	0	0	8
1	0	0	1	9
1	0	1	0	10
1	0	1	1	11
1	1	0	0	12
1	1	0	1	13
1	1	1	0	14
1	1	1	1	15

Table 1.Switching states for H- bridge multilevel inverter with reduced number of switches

2.3 OPERATION AND DESIGN OF MULTILEVEL INVERTERS

The concept of utilizing multiple small voltages to perform power conversion was patented by an MIT researcher over twenty years ago. Advantages of this multilevel approach include good power quality, good electromagnetic compatibility (EMC), low switching losses, and high voltage capability. The main disadvantages of this technique are that a larger number of switching semiconductors are required for lower – voltage systems and the small voltage steps must be supplied on the dc side either by a capacitor bank or isolated voltage sources. The first topology introduced was the series H-bridge design. This was followed by the diode clamped converter which utilized a bank of series capacitors.

A later invention detailed the flying capacitor design in which the capacitors were floating rather than series connected. Another multilevel design involves parallel connection of inverter phases through inter   phase reactors. In this design, the semiconductors block the entire dc voltage but share the load current. Several combinational designs have also emerged some involving cascading the fundamental topologies. These designs can create higher power quality for a given number of semiconductor devices than the fundamental topologies alone due to a multiplying effect of the number of levels. Recent advance in power electronic have made the multilevel concept practical. In fact, the concept is so advantageous that several major drives manufactures have obtained recent patents on multilevel power converters and associated switching techniques.

3. SIMULATION AND OUTPUT RESULT ANALYSIS

Simulation results is an initiative process it is used to study the relationship between parameters with interact system. In some cases it may point out error in a design which can cause the design to be unworkable. In another case it permits optimization of a design for maximum performance or economic of operation or construction. In still other instances the system may be so compels that simulation is only the way in which the variable affecting the design and their interactions with each other can be controlled and studied

This chapter deals with the simulation of Bespoke Cascaded 15 level H-Bridge Multilevel Inverter with modular structure having less dc source and low harmonics software. It has been observed that that the simulation results are found to agree with analytical results to an appreciable degree. MATLAB features family of an appreciable specific solution called tool boxes. Very important to most use of MATLAB tool boxes allow you to learn and apply specified technology. Tool boxes are comprehensive collection of MATLAB functions   (M-Files) that extend the MATLAB environment to solve particular classes of system nural networks, fuzzy logic, wavelet simulation and others.Fig3 shows the Simulation diagram.
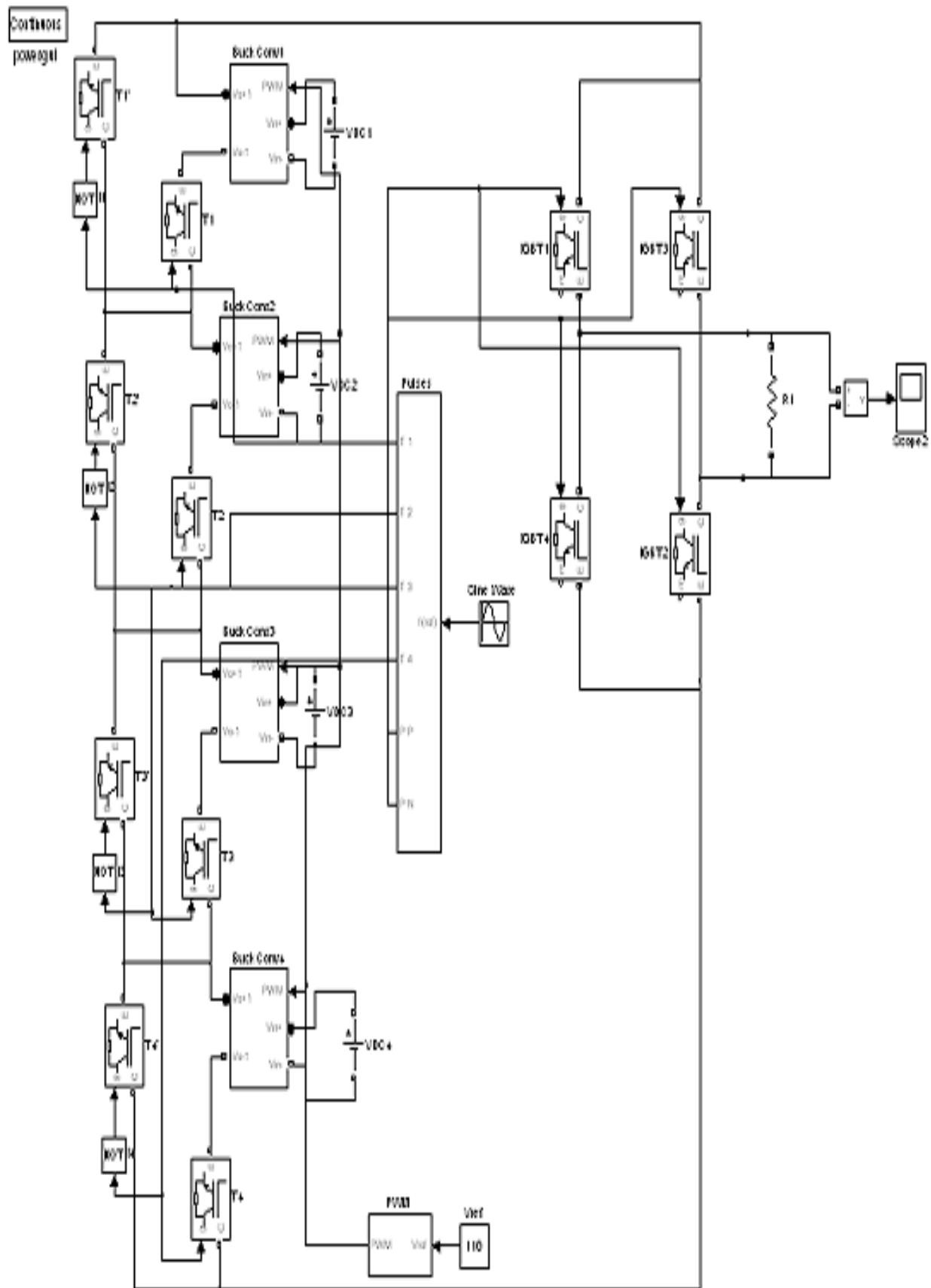
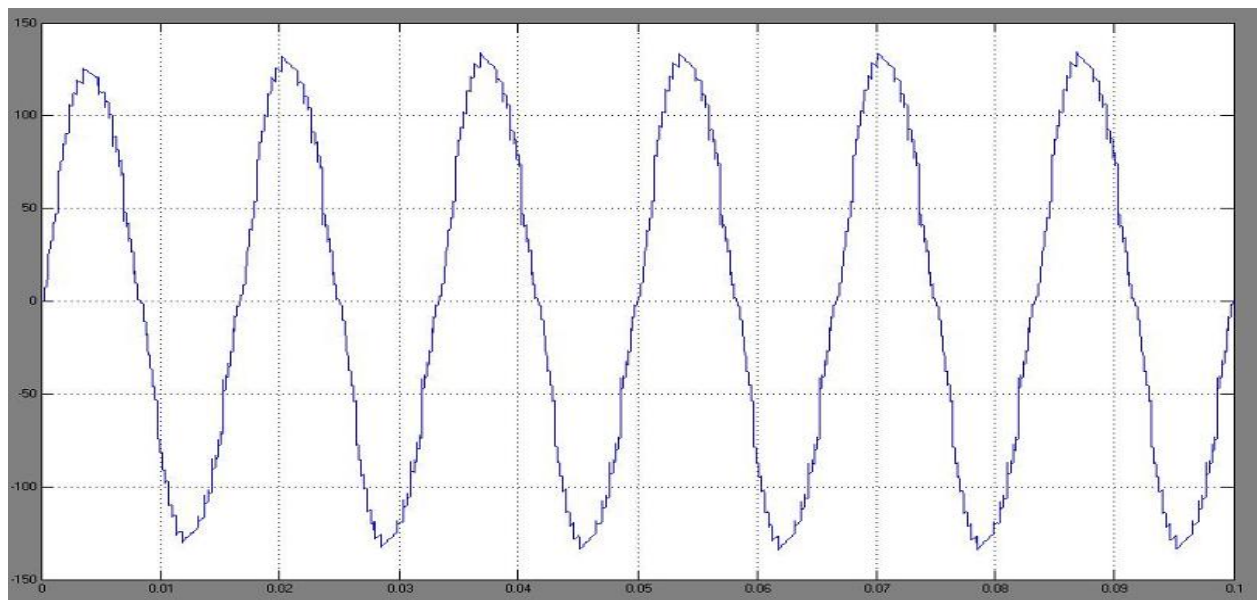Fig 3. Simulation Diagram cascade H bridge multilevel inverter

Fig 4 Output voltage wave form at 110 volt , 60 Hz cascaded H bridge multilevel inverter with reduced number of switches
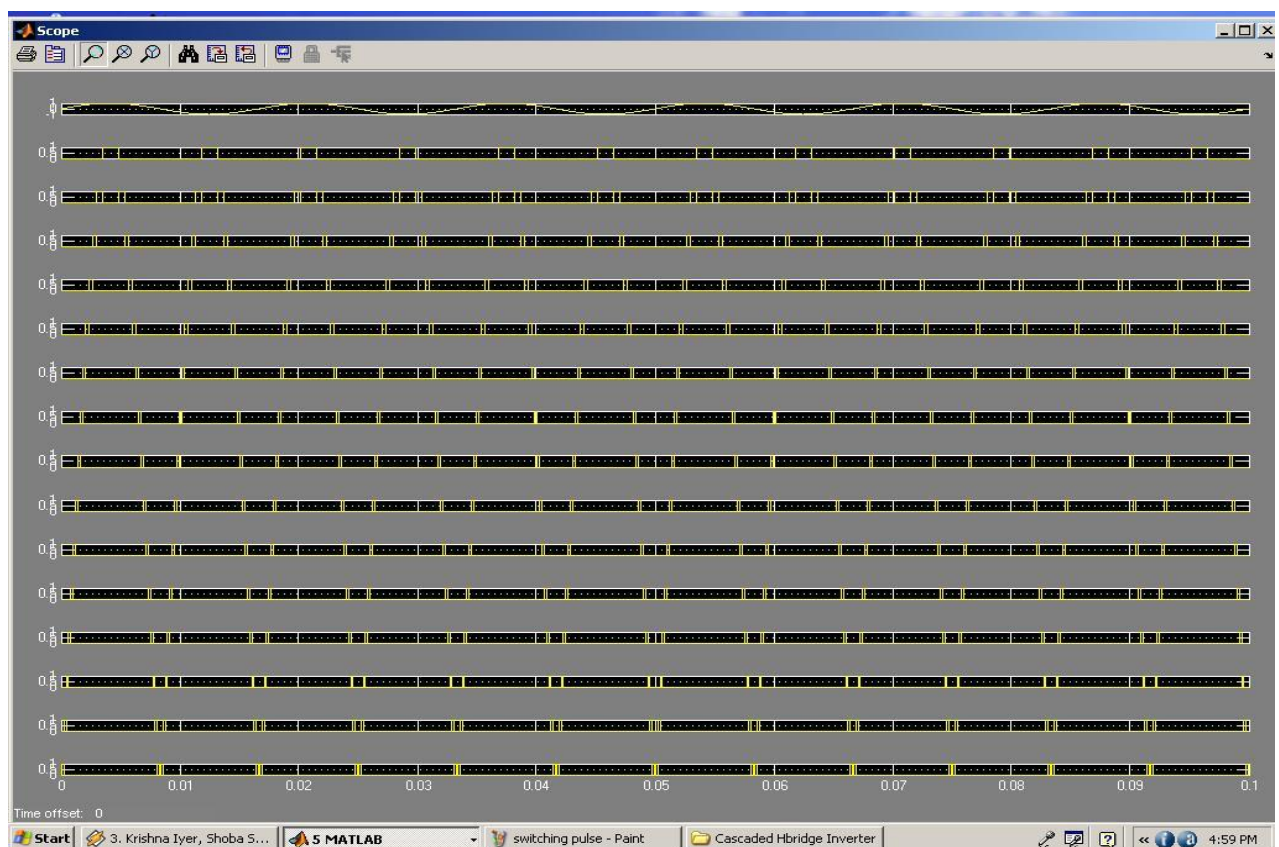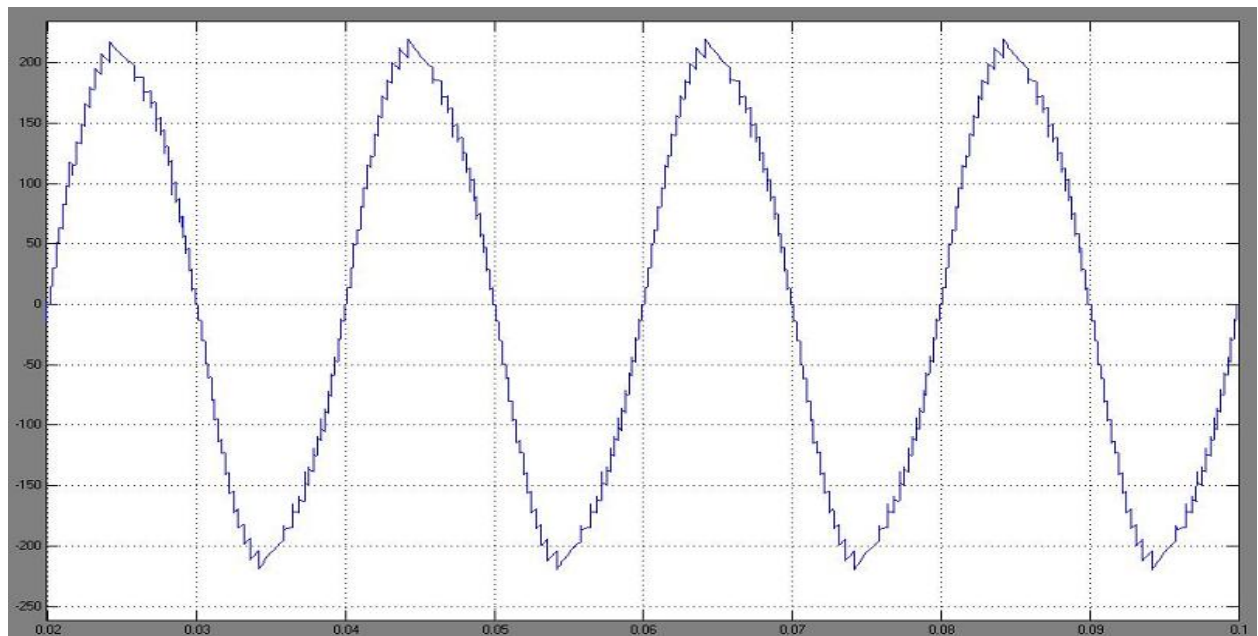

Fig5. Switching Pulse 110v, 60Hz

Fig 6 Output voltage wave form at 230 volt , 50 Hz cascaded H bridge multilevel inverter
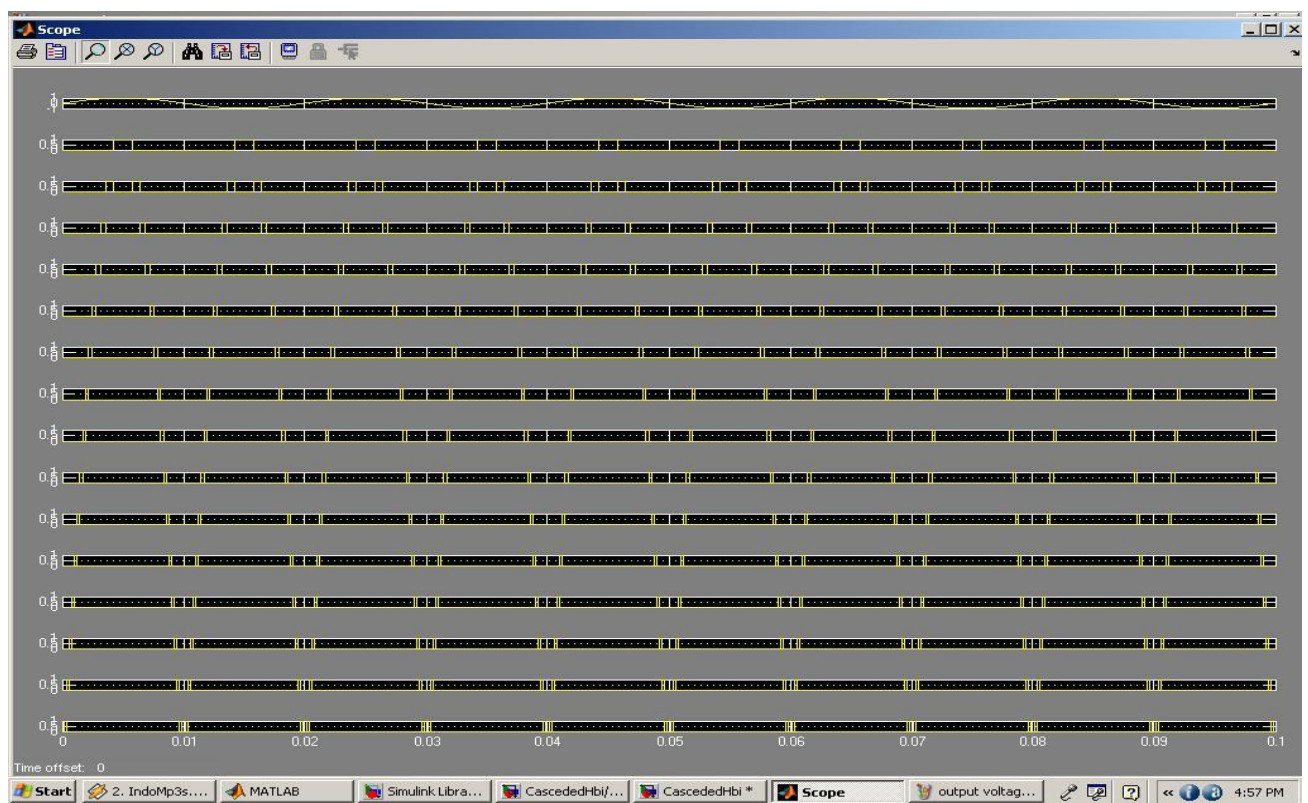with reduced number of switches

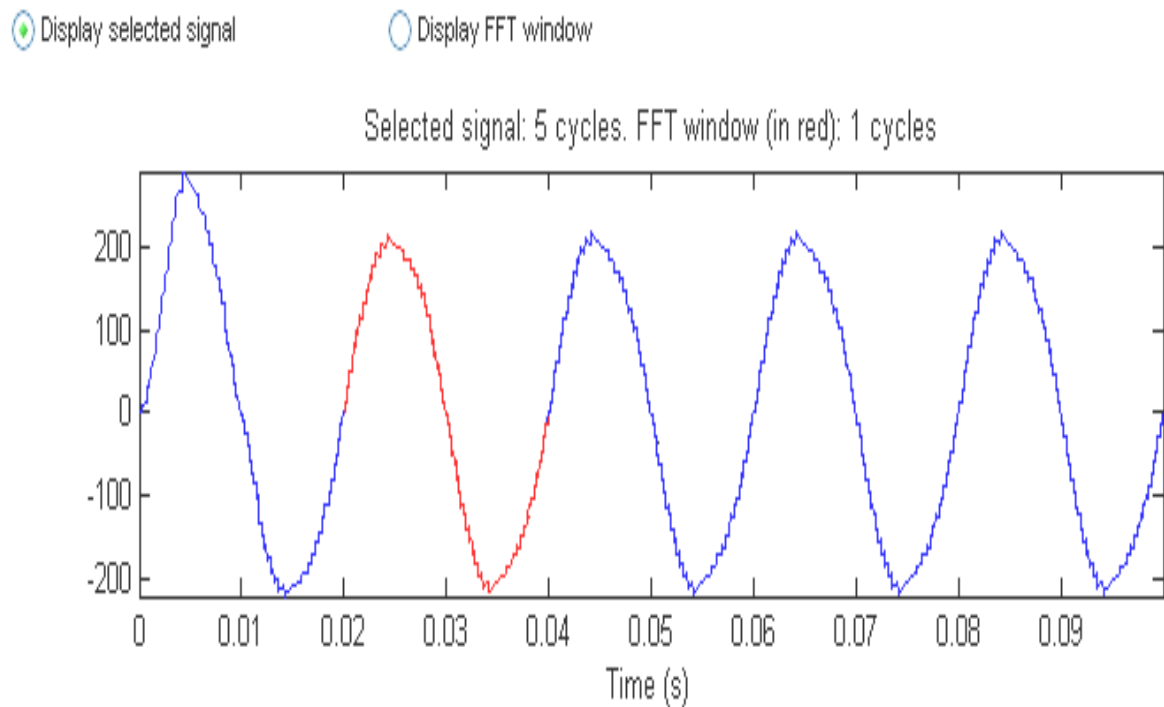Fig7. Switching Pulse 230v, 50Hz
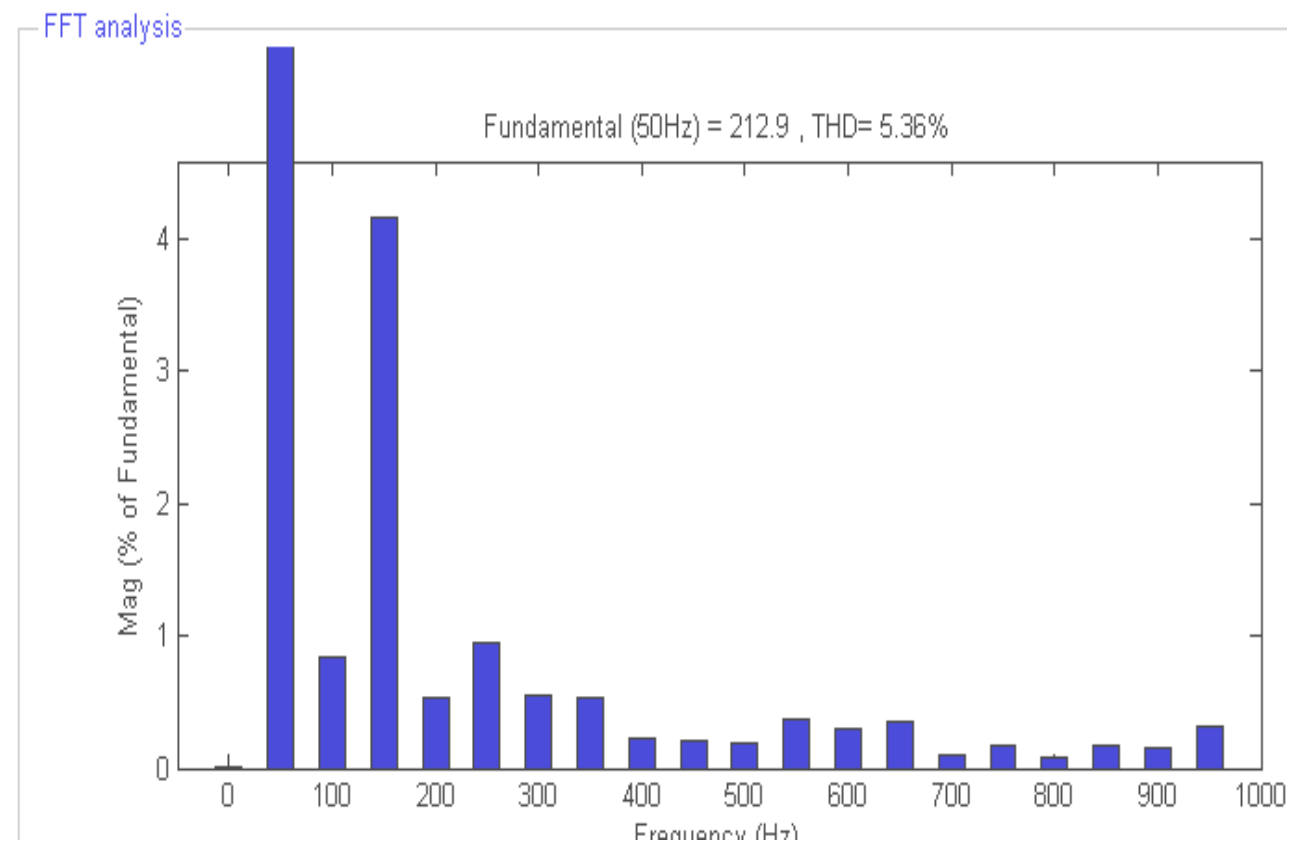
Fig.8. FFT Analysis output

Fig.9. Total Harmonics Distortion

4.CONCLUSION

An improved hybrid multilevel inverter structure is proposed. The proposed hybrid inverters scheme is to get bet the better sinusoidal output compare with low level inverters. It is seen that the percentage of harmonics in the multilevel inverter is less compare to classical inverter. The hybrid multilevel inverter techniques are used to improve the level of inverter and extend to design flexibility and reduced harmonics. The idea of hybrid modulation strategies can be magnificently applied to other hybrid topology modifications. Simulation results verify the validity of the proposed method.

REFERENCES

1.Z hou jinghuar Li Zhengxi, "Research on Hybrid Modulation Strategies Bared On General Hybrid Topology of Multilevel Inverter," IEEE Trans. Ind. Electron, Vol, issue, 11-13, pp. 784-788, June 2008.

2.S.Mariethoz A. Rufer Lausanne, "New Configurations for the three Phase Asymmetrical Multilevel inverter," IEEE Trans. Ind. Electron, Vol. 2 pp. 828-835 , Oct 2004.

3.Lie P.Pillay, "Multilevel   selective Harmonics Elimination PWM Technique in Series Connected Voltage Inverters," IEEE Trans. Ind. Electron, Vol. 36. pp 160-170, Jan 2000

4.Haiwen Liu,Leon Tolbert,Surin Khomfoi,Burak Ozhpioneei Du, "Hybrid Cascaded Multilevel Inverter with PWM Control Method," IEEE Trans. Ind. Electron,Vol, issue, 15-19, pp. 162-166, June 2008.

5.Remu Teodorescu, Frede Blaabjerg, John.K.Pedersen, Ekrem Cengelci, and Prasad N.Enjeti, "Multilevel Inverter by Cascading Industrial VSI," IEEE Trans. Ind. Electron. Vol. 49, no. 4, pp 832 -838, Aug 2002.

6. Madhav D. Manjrekar and Thmos A. Lipo, "Hybrid Multilevel Power Conversion System: A competitive solution for high power applications," IEEE Trans. Ind. Electron. Vol. 36, no. 3, pp 834 -844, May 2000.

7. Jose Rodriguez, Jih-sheng Lai,r, ,and Fang Zhenge Peng, "Multilevel Inverters: A survey of Topologies, Controls, and applications," IEEE Trans. Ind. Electron. Vol. 49, no. 4, pp 724 -738, Aug 2002.

8. Sergio Dahar, Jurgen Schmid and Fernando L.M. Antunes, " Multilevel topologies for stand- alone PV system," IEEE Trans. Ind. Electron. Vol. 55, no. 7, pp 2703 -2711, July 2008.

9. Dr.Keith Corzine, " Operation and Design of multilevel Inverters," IEEE Trans. Ind. Electron. Vol. 49, no. 4, pp 724 -738, Aug 2002.

10. Jose Rodrfguez and Jorge, "Multilevel voltage source converter topologies for industrial medium voltage drives," IEEE Trans. Ind. Electron. Vol. 34, no. 1, pp 178 -186, Jan 2007.
11. MD Manjrekar, "Hybrid Multilevel Power Conversion System," IEEE Trans. Ind. Electron. Vol. 36, no. 3, pp 834 -841, May 2000

12. Y.S. Lai and F.S.Shyee, "Topology for hybrid multilevel inverter,"   IEEE Trans. Ind. Electron. Vol. 32, no. 3, pp 211 -216, Nov 2002

13. Dr.Keith A.Corzine, " Control of cascaded multilevel inverter voltage balancing," IEEE Trans. Ind. Electron. Vol. 19, no. 3, pp 732 -738, May 2004

14. Martin Veenstra and Alfred Rufer, "Control of a Hybrid Asymmetric multilevel inverter for competitive medium- voltage industrial drives," IEEE Trans. Ind. Electron. Vol. 41, no. 2, pp 655 -664, March 2005

15. Lemon M.Tolbert and Thomas G.Habetler , "Multilevel converters for large electric drives," IEEE Trans. Ind. Electron. Vol. 35, no. 1, pp 36 -44, Jan 1999

16. Mariethoz and A.Rufer,"Design and control of asymmetrical multilevel inverters,' in Proc.int conf. ind. Electron control Instrum Seville, spain 2002,pp 840-845

17. Rech and J.R.Pinheiro ,"Hybrid multilevel converters: unified analysis and design considerations," IEEE Trans.Ind . Electron, vol 54 no. 2 pp.1092- 1104, Apr.2007

18. J.Dixon and L.Moran," High-level multistep inverter optimization using a minimum number of power transistors," IEEE Trans. Power Electron, vol 21.no.2pp 330- 337, Mar.2006

19.Y.S.lai and F.S.Shyu,"Topology for hybrid multi level inverter", IEEE Proc- Electro power Appl.vol 149 no 6 Nov 2002.

20.Gui-jia su ," Multilevel Dc link inverter," IEEE trans on industry appl.vol.41.no3 May 2005