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Comparison of Performance of Seven Level Neutral Point Clamped and Multi Source Topologies

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ABSTRACT: - Multi Level Inverters are the emerging power electronic converters in the present scenario. To realize them many more topologies have been proposed. Out of which diode clamped topology is the basic topology to model them. When multiple sources are available this topology is not preferable. This paper proposes a multi source topology for modeling a seven level inverter and compares its performance with neutral point topology.
KEYWORDS: - Neutral point clamped, Multi source, Seven level inverter, THD, Topologies

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I. INTRODUCTION

In order to introduce number of levels in the output voltage of inverter many methods have been proposed. Out of which the most possible methods are to introduce more number of sources or divide the supply voltage into different voltage levels using same value of capacitors connected in series and use the power semiconducting switches to convert the dc to ac. To realize multi level inverters many conventional and hybrid topologies have been proposed. [1-8].

II. NEUTRAL POINT SEVEN LEVEL TOPOLOGY

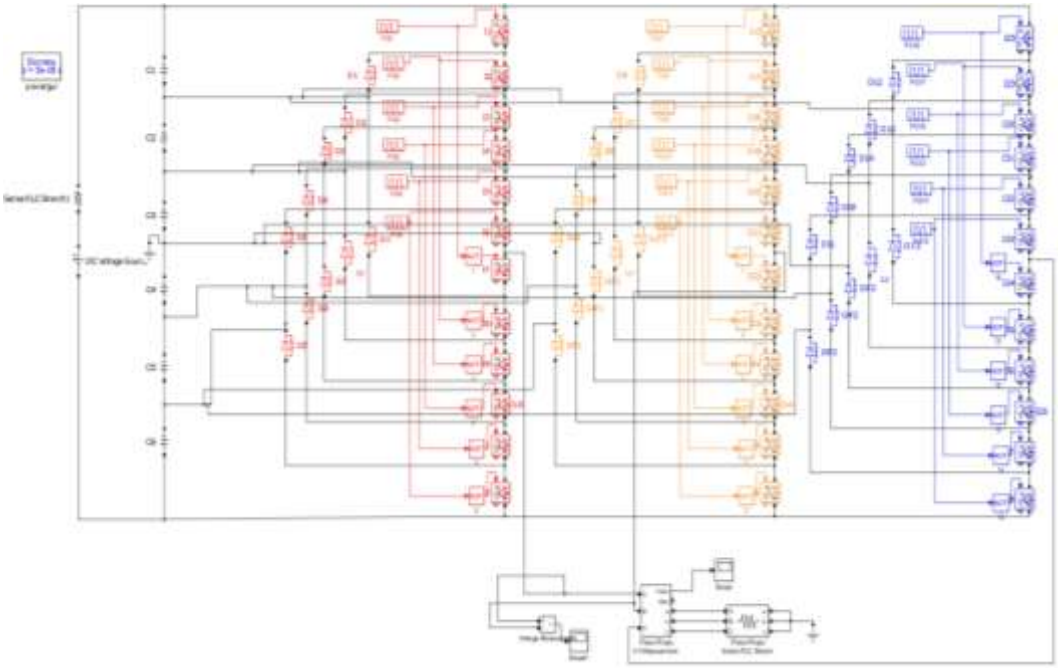

Fig. 1 Simulation circuit of Diode Clamped Seven Level Inverter.

A seven level neutral point multi level inverter requires 10 diodes, in which two are connected in each leg to clamp the voltage at a particular level. It also requires six capacitors in series to divide the supply voltage into six equal parts. The three phase simulation diagram is shown in Fig.1.

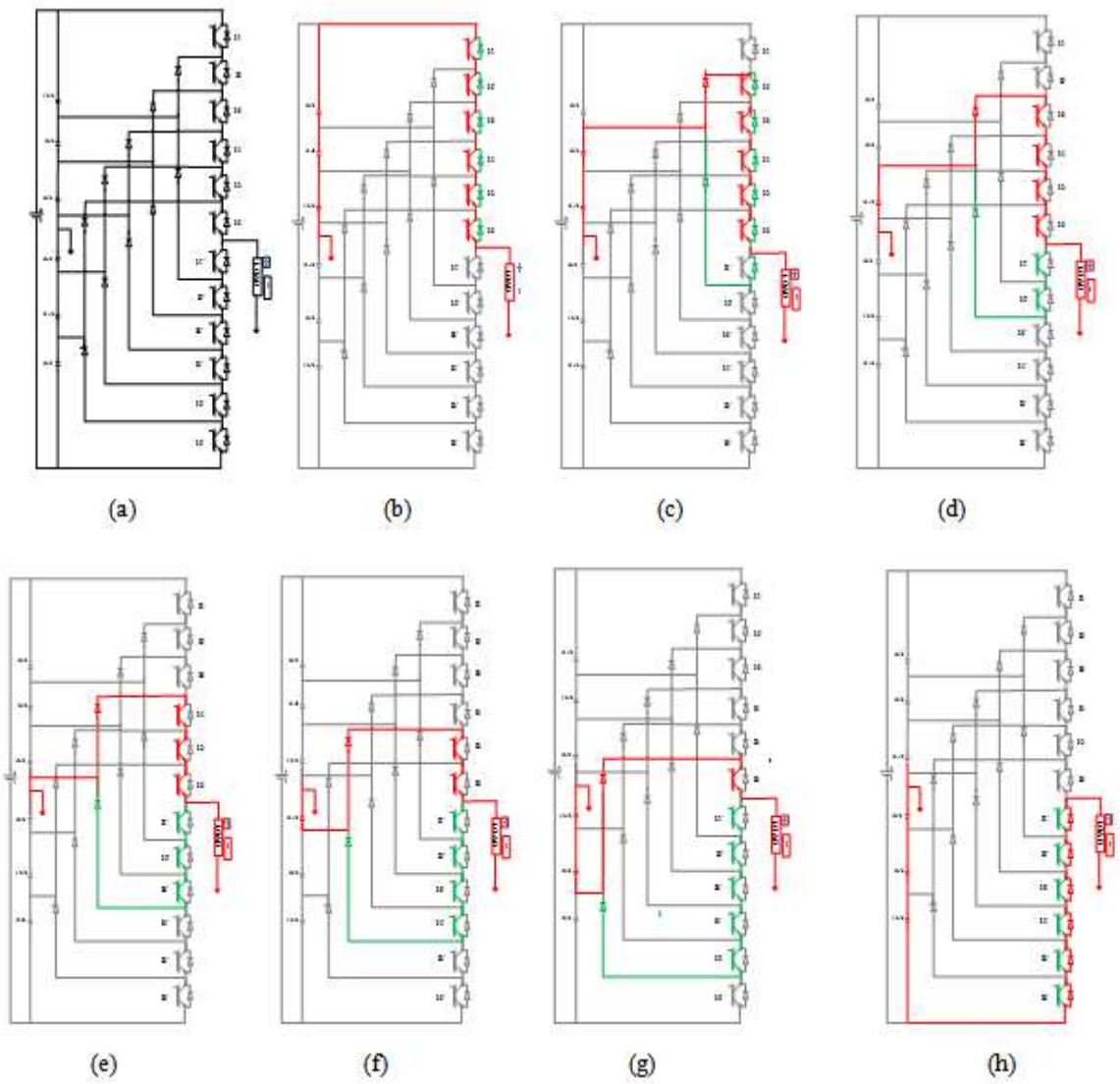

Fig. 2 Single phase equivalent (a) and circuits for an output voltage of V, 2V/3, V/3, 0, -V/3, --2V/3, -V of neutral point clamped seven level inverter.

The single phase equivalent circuit of the neutral point clamped seven level inverter is shown in Fig. 2(a). For an output voltage of V/2, the switches S_1-S_6 must be turned ON and the remaining must be in OFF state which is depicted in Fig. 2(b). The switching states and the equivalent circuits for 2V/3, V/3, 0, -V/3, -2V/3, -V are shown in Fig. 2(c) to 2(h). The switching states are given in table 1.

Table I: Switching Table for Neutral Point Clamped Topology

	V	**2V/3**	**V/3**	**0**	**-V/3**	**-2V/3**	**-V**
S1	1	0	0	0	0	0	0
S2	1	1	0	0	0	0	0
S3	1	1	1	0	0	0	0
S4	1	1	1	1	0	0	0
S5	1	1	1	1	1	0	0
S6	1	1	1	1	1	1	0
S7	0	1	1	1	1	1	1
S8	0	0	1	1	1	1	1
S9	0	0	0	1	1	1	1
S10	0	0	0	0	1	1	1
S11	0	0	0	0	0	1	1
S12	0	0	0	0	0	0	1

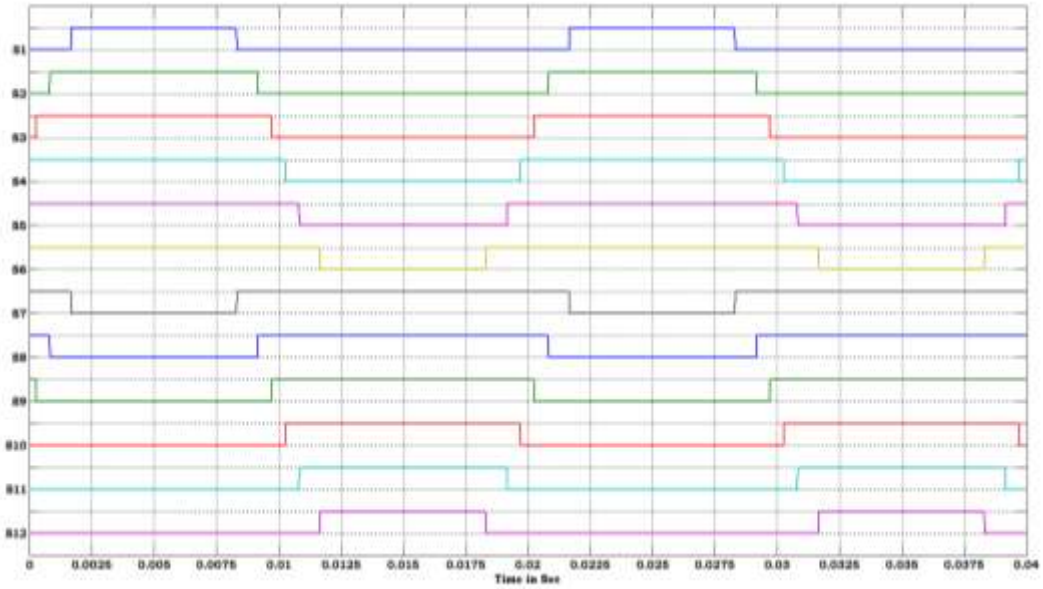

Fig. 3 The control signals required for neutral point clamped seven level inverter.

In order to model neutral point seven level inverter, the control signals used are shown in Fig. 3. Here it is observed that, the switches S_1 and S_7, S_2 and S_8, S_3 and S_9, S_4 and S_{10}, S_5 and S_{11}, S_6 and S_{12} are complementary to each other. Hence a total number of six pulse generators are required.

III. MULTI SOURCE TOPOLOGY

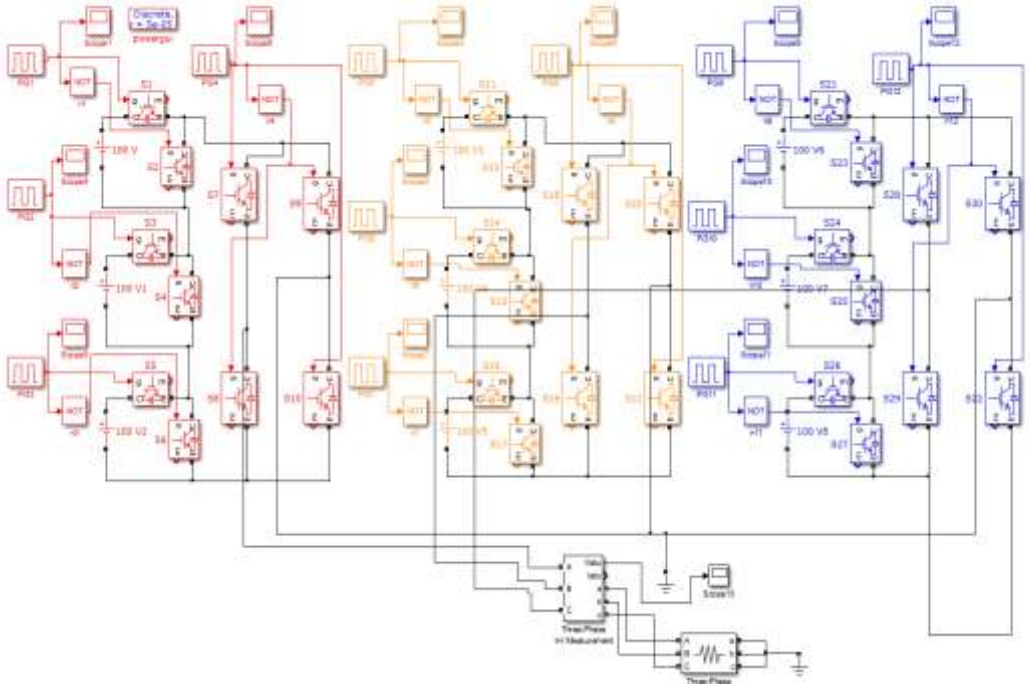

Fig. 4 Simulation circuit of Multi Source Topology Seven Level Inverter.

In this topology, each source must be V/3 for symmetrical configuration. For each phase a total number of 10 switching elements are required. Six switches are used at sources and four are required at the H-bridge. The simulation circuit of multi source topology seven level inverter is shown in Fig.4.

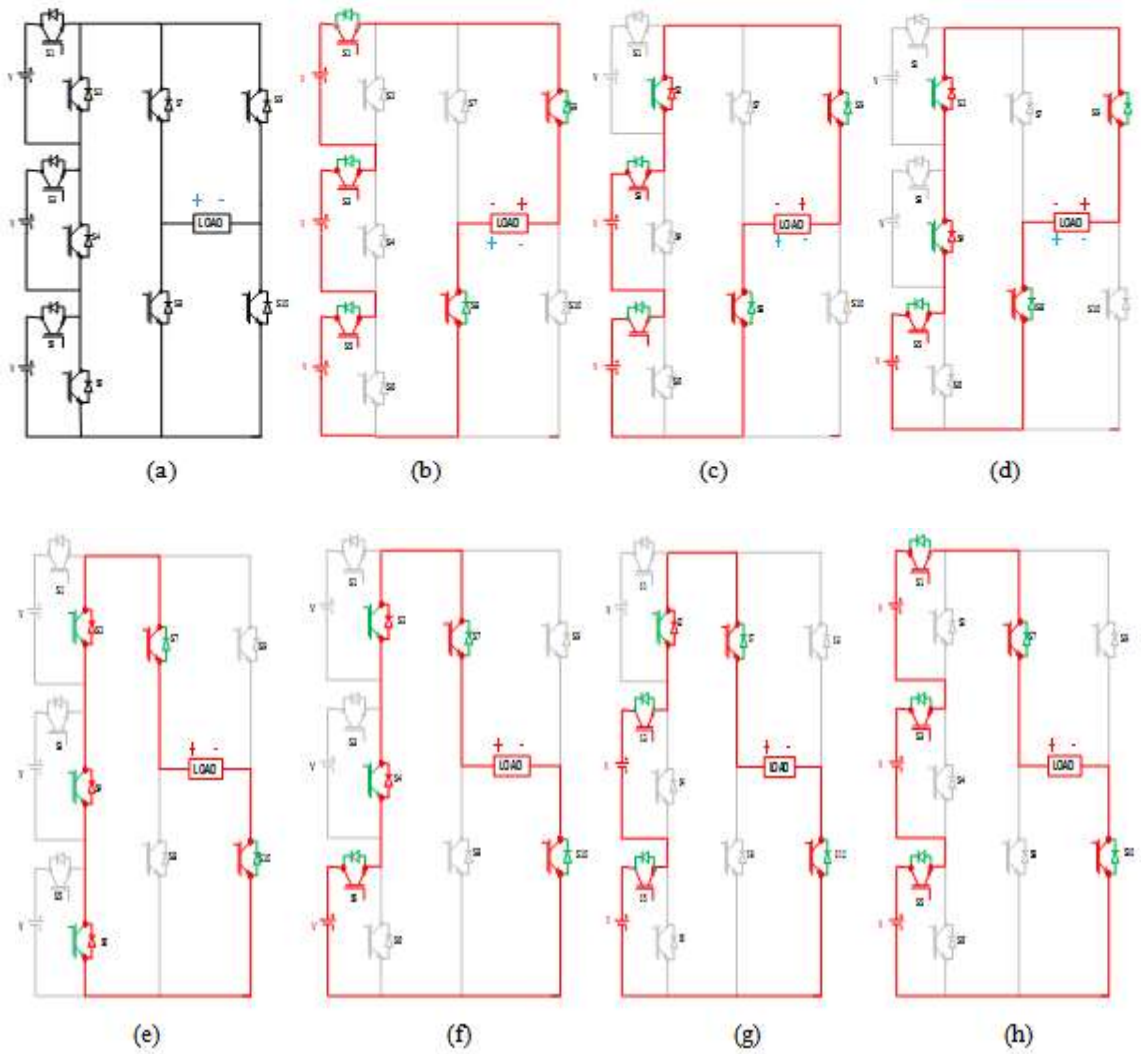

Fig. 5 Single phase equivalent (a) and circuits for an output voltage of V, 2V/3, V/3, 0, -V/3, --2V/3, -V of multi source seven level inverter.

The single phase equivalent circuit of the multi source seven level inverter is shown in Fig. 5(a). For an output voltage of V, the switches connected in series with each source must be turned ON and the two switches of h-bridge must be ON, which is shown in Fig. 5(b). The switching states and the equivalent circuits for 2V/3, V/3, 0, -V/3, -2V/3, -V are shown in Fig. 5(c) to 5(h). The switching states are given in table 2.

Table II: Switching Table for Multi Source Topology

	V/2	**V/3**	**V/6**	**0**	**-V/6**	**-V/3**	**-V/2**
S1	1	0	0	0	0	0	1
S2	0	1	1	1	1	1	0
S3	1	1	0	0	0	1	1
S4	0	0	1	1	1	0	0
S5	1	1	1	0	1	1	1
S6	0	0	0	1	0	0	0
S7	1	1	1	1	0	0	0
S8	0	0	0	0	1	1	1
S9	0	0	0	0	1	1	1
S10	1	1	1	1	0	0	0

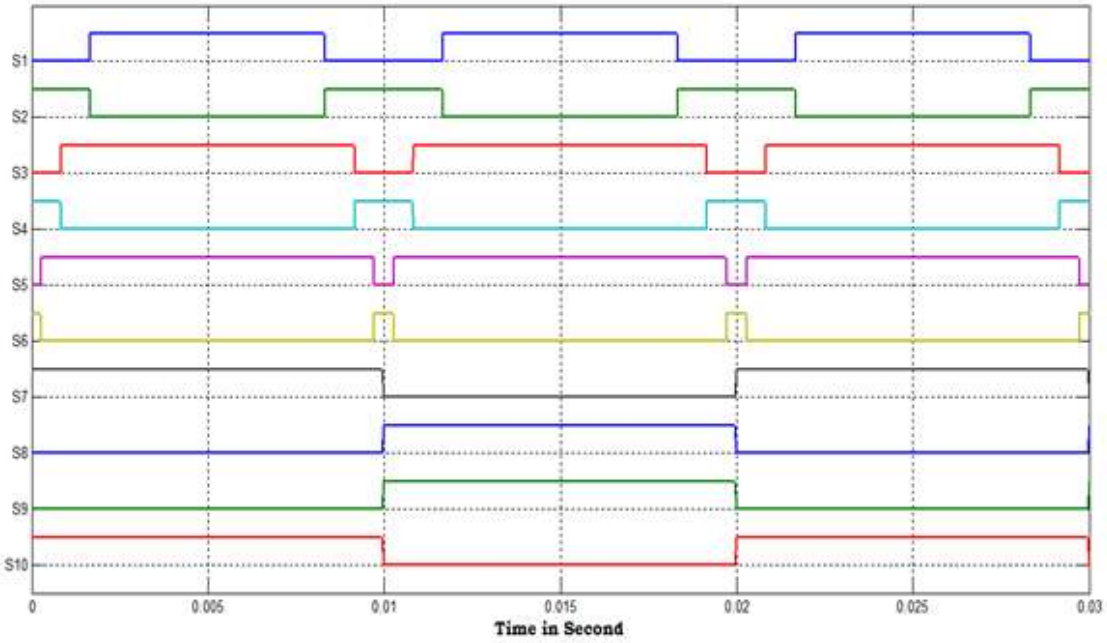

Fig. 6 The control signals required for multi source seven level inverter.

In order to model multi levvel seven level inverter, the control signals used are shown in Fig. 6. Here it is observed that, the switches S_1 and S_2, S_3 and S_4, S_5 and S_6, S_7 and S_8, S_9 and S_{10} are complementary to each other. Hence a total number of five pulse generators are required.

IV. RESULTS

The simulation is carried in MATALB Simulink environment. The circuits are modelled and their phase voltages are observed for the same duration of particular level. Hence their output voltages and their frequency spectrums are same which are shown in Fig. 7 and Fig. 8 respectively.

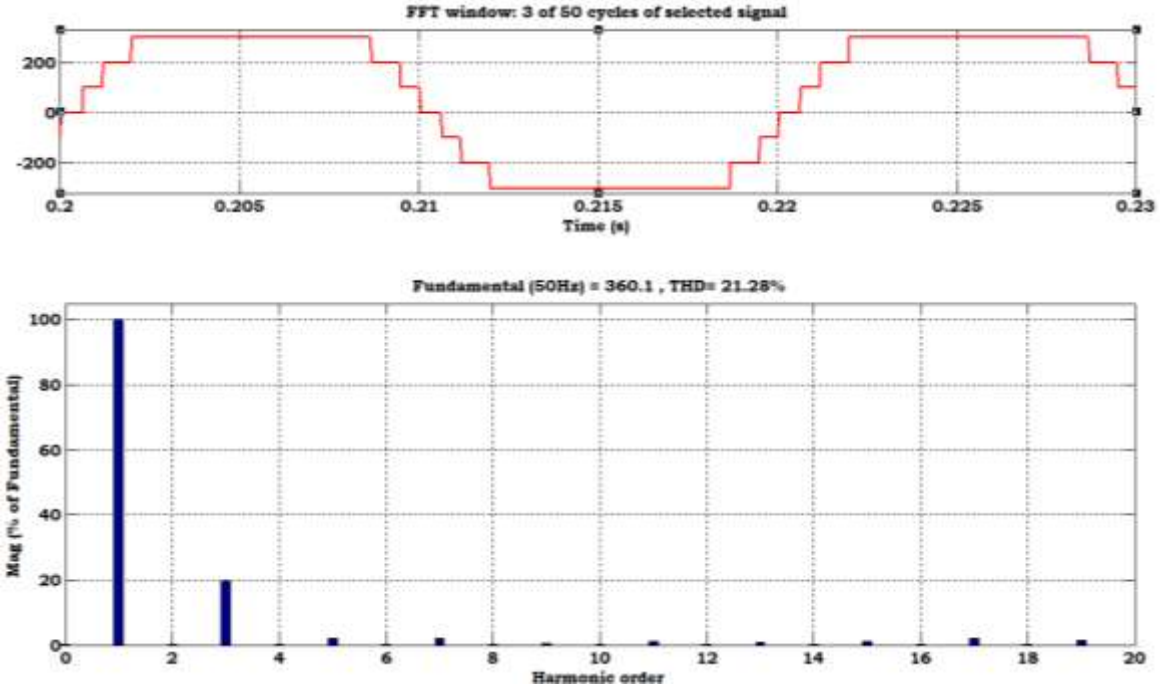

Fig. 7 The phase voltage and its frequency spectrum of neutral point seven level inverter.

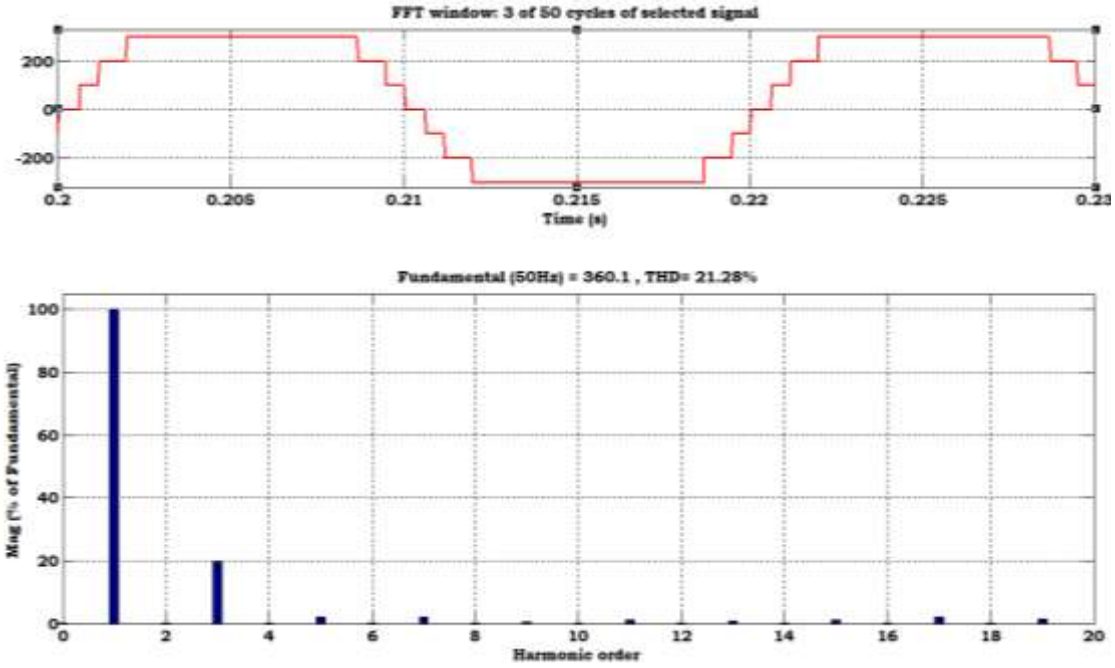

Fig. 8 The phase voltage and its frequency spectrum of multi source seven level inverter.

V. CONCLUSION

The simulation analyses reveals that, to obtain the same output neutral point clamped topology requires a source voltage of 2V whereas multi source topology the supply voltage required is 3 times V/3, i.e. V. The total number of switches required for neutral point topology is twelve per phase whereas the total number of switches required is ten per phase. Hence the multi source topology is more efficient than the neutral point topology for a given application.

REFERENCES

[1] Rodriguez, J.-S. Lai, and F. Z. Peng, "Multilevel inverters: A survey of topologies, controls, and applications," IEEE Trans. Ind. Electro, vol. 49, no. 4, pp. 724-738, Aug. 2002.

[2] L. G. Franquelo, J. L. Rodriguez, J. Leon, S. Kouro, R. Portillo, and M. A. Prats, " The age of multilevel converters arrives," IEEE Ind. Electron. Mag., vol.2, no. 2, pp. 28-39, Jun. 2008.

[3] H. Abu-Rub, J. Holtz, J. Rodriguez, and G. Baoming, "Mediumvoltage multilevel converters - state of the art, challenges, and requirements in industrial application," IEEE Trans. Ind. Electr. vol. 57, no. 8, pp. 2581-2596, Aug. 2010

[4] M. Zahra, M. Jafari, Md. R. Islam and J. Zhu, "A comparative study on characteristics of major topologies of voltage source multilevel inverters," IEEE Innovative Smart Grid Tech., pp. 612-617, 2014

[5] T. Murali Krishna, C. Bhargav, A new hybrid Multi Level Inverter to improve the performance of induction motor, International Conference on Computation of Power, Energy Information and Commuincation (ICCPEIC), 2015 , pp.264-268

[6] T. Murali Krishna, C. Bhargav, "Modeling and Performance Comparison of Two Different Hybrid Multi Level Topologies", Procedia Computer Science, 85(2016) , pp.641-647. [8]

[7] T. Murali Krishna, C. Harish, N. Anusha, "Modeling and Performance Analysis of Six Level Inverter for Medium Voltage Drives", International Journal of Emerging Technology and Advanced Engineering, Vol.8, Issue.1, pp.176-180.

[8] E. Babaei, S.H.Hosseini, "New cascaded multi level inverter topology with minimum number of switches," J.EnergyConvers.Manage.,vol.50, no. 11, pp. 2761–2767, Nov. 2009.

T. Murali Krishna. "Comparison of Performance of Seven Level Neutral Point Clamped and Multi Source Topologies." International Journal Of Engineering Research And Development , vol. 14, no. 04, 2018, pp. 43–48.