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A Simplified Topology for Nine level Modified Cascaded H-bridge Multilevel Inverter with Reduced Number of Switch & Low THD

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Abstract - *Multilevel inverter is used in applications that need high voltage and high current. The topology of multilevel inverter has several advantages such as lower THD, better output waveform and higher efficiency for a given quality of output waveform. Multilevel inverter has the advantage of its reduced number of devices compared to conventional cascaded H-bridge multilevel inverter. According to this we are going to make inverter for output of Single phase 9-level .Motor is driven with this inverter for testing purpose. The verification of MLI is done using MATLAB.*

Key Words*: *Cascade H-bridge ; Sources ; Switches & MATLAB simulation.

1.INTRODUCTION

An ***inverter*** is an electric that changes direct power (DC) to alternating power (AC).The application areas for the inverters includes the Uninterrupted Power Supply(UPS),as inverter as power backup for home etc.The concept of multilevel Inverter (MLI) is kind of modification of two-level inverter. In multilevel inverters we don't deal with the two level voltage instead in order to create a smoother stepped output waveform, more than two voltage levels are combined together. Smoothness of the waveform is proportional to the voltage levels, as we increase the voltage level the waveform becomes smoother**[1].**

Multilevel inverter is very effective and practical solution for increasing power & reduction harmonic of AC waveform. Three types of Multilevel inverters:

1- Diode clamped
2- Flying capacitor
3- The cascade H-bridge

a) - Asymmetric cascade H-bridge multilevel inverter

b) - Symmetric cascade H-bridge multilevel inverter

The unequal voltage balancing among the DC link capacitors that leads to an increase in clamping diodes as the voltage level increases, can be considered as the limitation of the diode clamped at a higher level. The flying capacitor multilevel inverter circuits becomes complex as a large number of capacitor are required at higher voltage levels. The cascade H-bridge multilevel inverter topology can be an acceptable option for high voltage applications. We are used the Symmetric cascade H-bridge multilevel inverter. Number of switches & Sources are reduce. Increase the efficiency of inverter. The single phase H-bridge cell; which is the building block for the cascade H-bridge inverter is associated with separate dc sources**[5];[12]**

2. SYSTEM OVERVIEW

This paper proposes the comparison of different topologies of cascaded multilevel inverters.

Table 2:- Per phase switching status of the proposed 9-level inverter

Output Voltage	S1	S2	S3	S4	S5	S'1	S'2	S'3	S'4	S'5
4V	1	0	0	1	0	1	0	0	1	0
3V	0	0	0	1	1	1	0	0	1	0
2V	0	0	0	1	1	0	0	0	1	1
V	1	0	1	0	0	0	1	0	0	1
0	1	0	1	0	0	1	0	1	0	0
-V	0	1	0	1	1	0	0	0	0	1
-2V	0	1	0	0	1	0	0	0	1	1
-3V	0	0	1	0	0	0	1	1	0	1
-4V	0	1	1	0	0	0	1	1	0	0

The multilevel inverter topology also produces 5-level with 5 switches & 9-level with 10 switches. A 5-level inverter required 2 battery sources. A 9-level inverter required 4 battery sources.

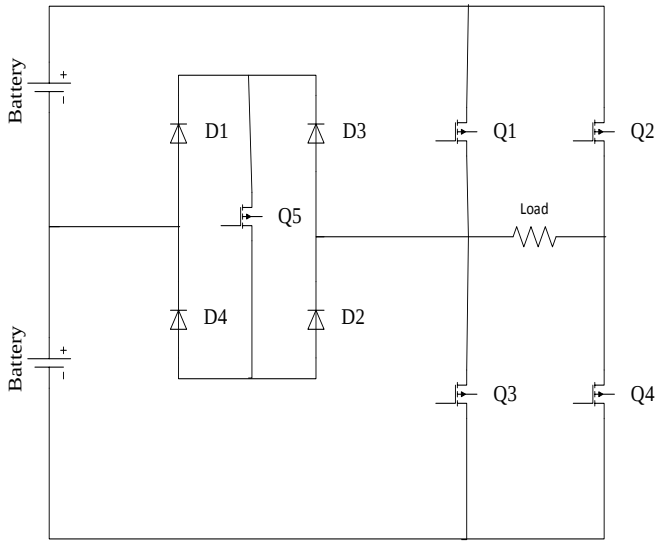

Figure -1:5-level cascaded multilevel inverter

Table 1:- Per phase switching status of the proposed 5-level inverter					
Output Volt.	**Q_1**	**Q_2**	**Q_3**	**Q_4**	**Q_5**
$+V_{dc}$	**1**	0	0	**1**	0
$+V_{dc}/2$	0	0	0	**1**	**1**
0	0	0	**1**	**1**	0
$-V_{dc}$	0	**1**	**1**	0	0
$-V_{dc}/2$	0	**1**	0	0	**1**

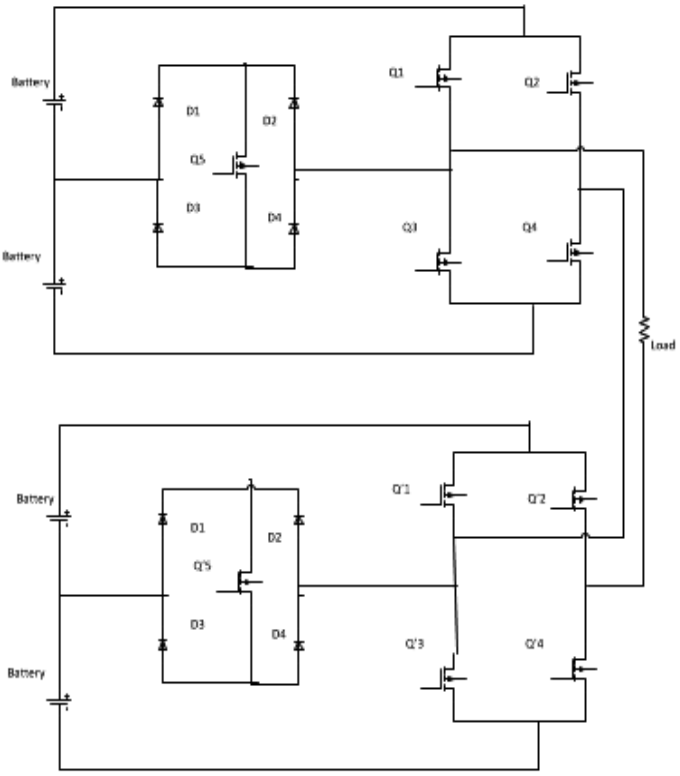

Fig 2 9-level cascaded multilevel inverter

3. SIMULATION RESULTS

The simulation model was designed using MATLAB/Simulink Software. The gating signals for the inverter are generated by using multicarrier pulse width modulation technique

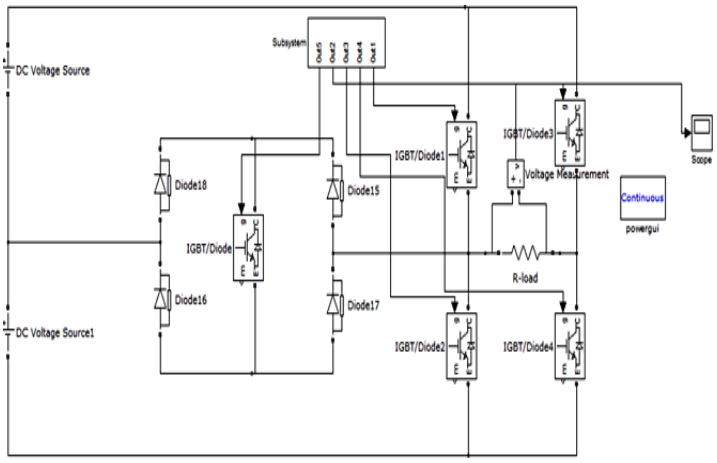

Fig 3 MATLAB simulation circuit diagram for Circuit for 5 level multilevel inverter topology

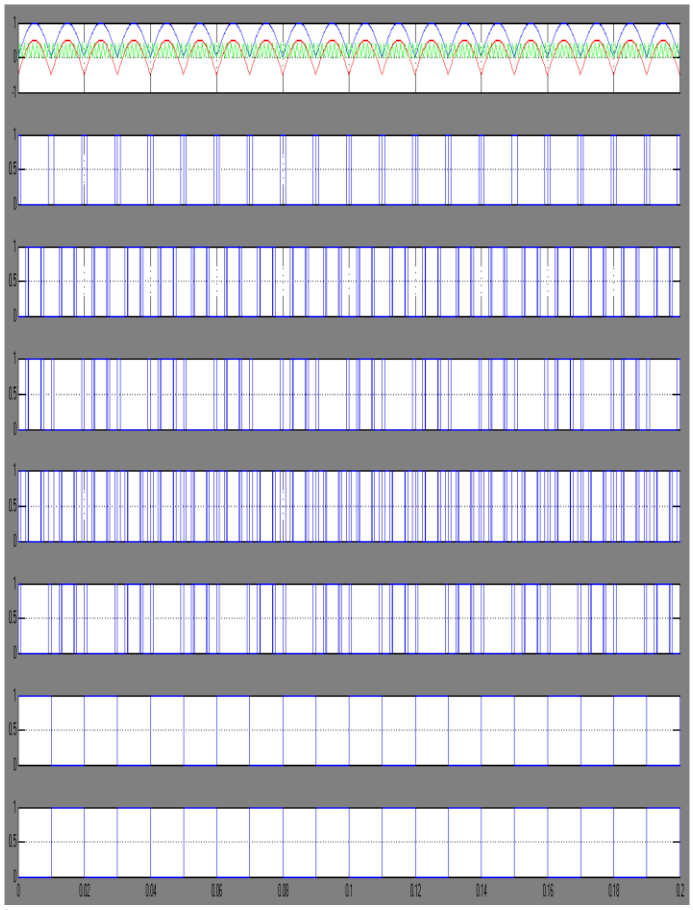

Fig 4 Gate pulses of 5-level multilevel inverter topology

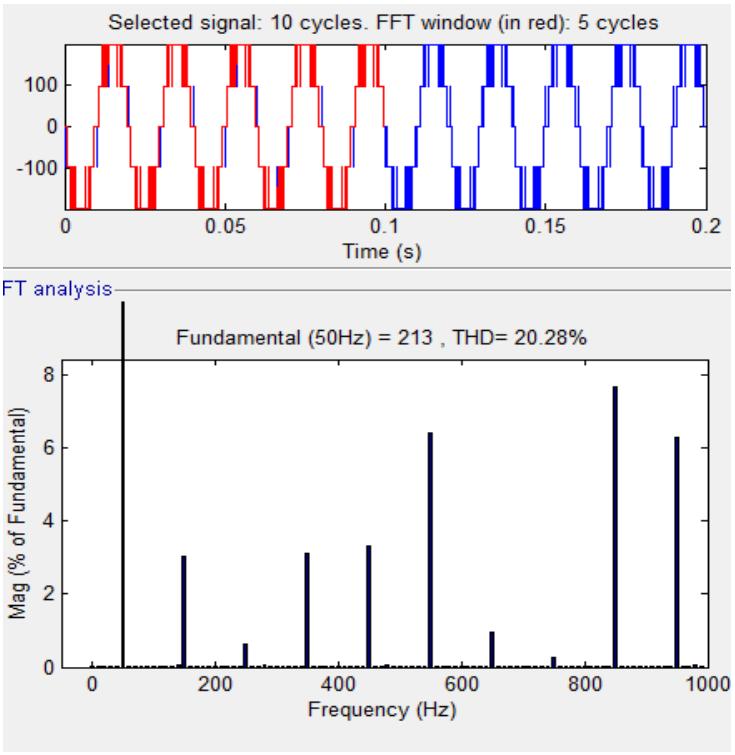

Fig 6 5-level multilevel inverter topology with multicarrier modulation THD=20.28%

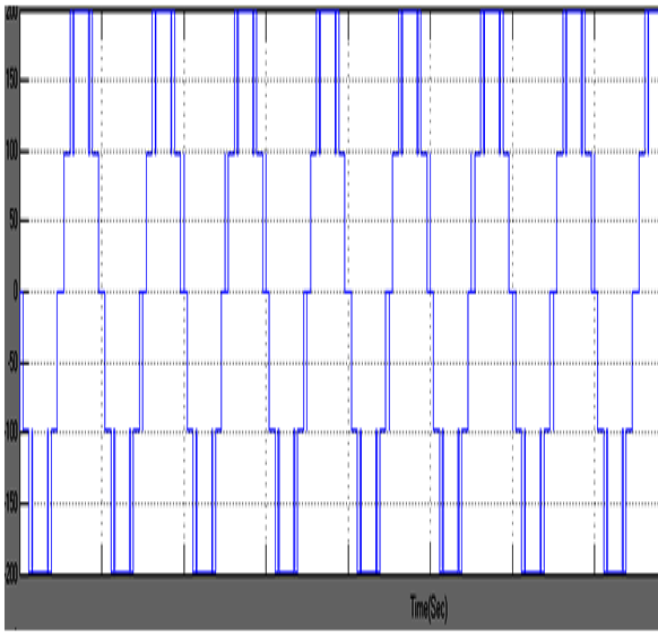

Fig 5 output voltage of 5-level multilevel inverter topology

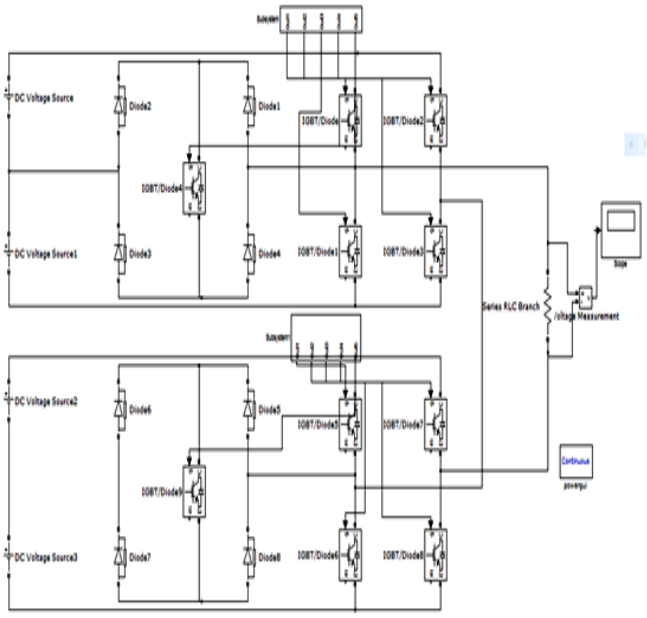

Fig 7 MATLAB simulation circuit diagram for Circuit for 9 level multilevel inverter topology

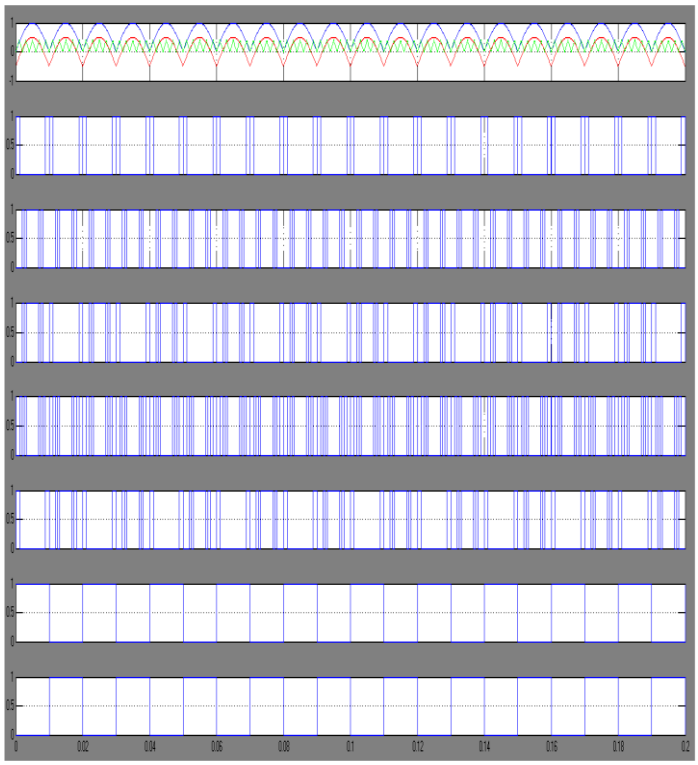

Fig 8 Gate pulses of 9-level multilevel inverter topology

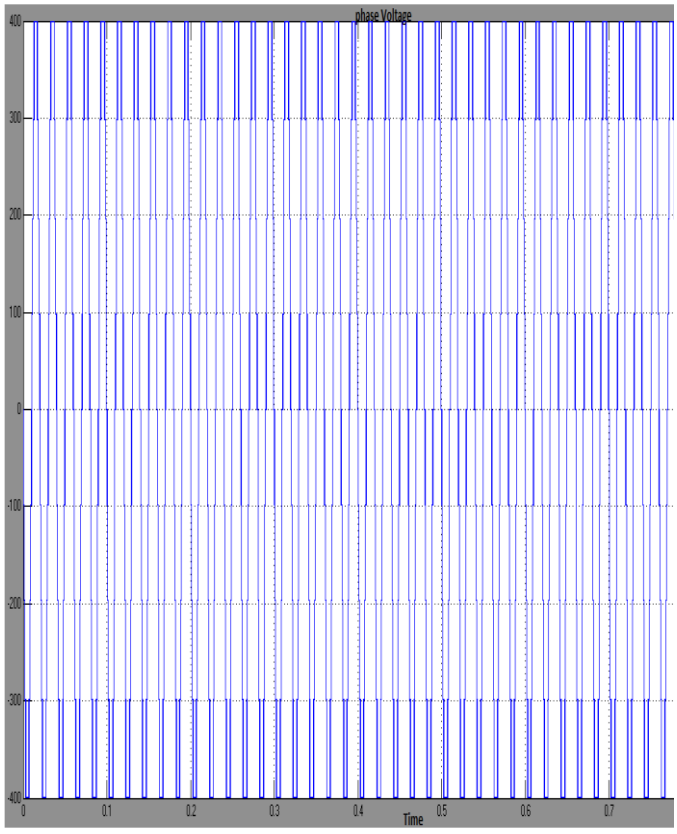

Fig 9 output voltage of 9-level multilevel inverter topology

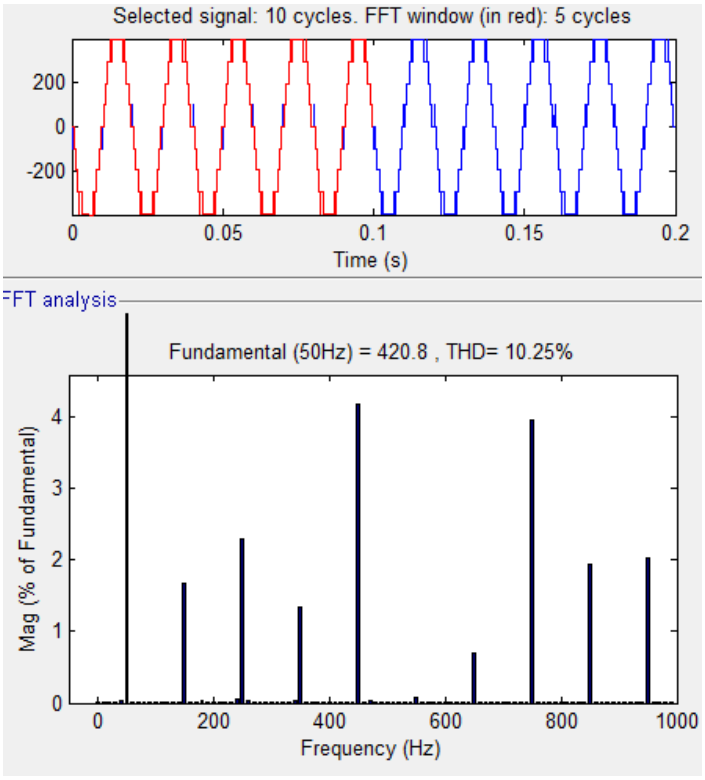

Fig 10 9-level multilevel inverter topology with multicarrier modulation THD=10.25%

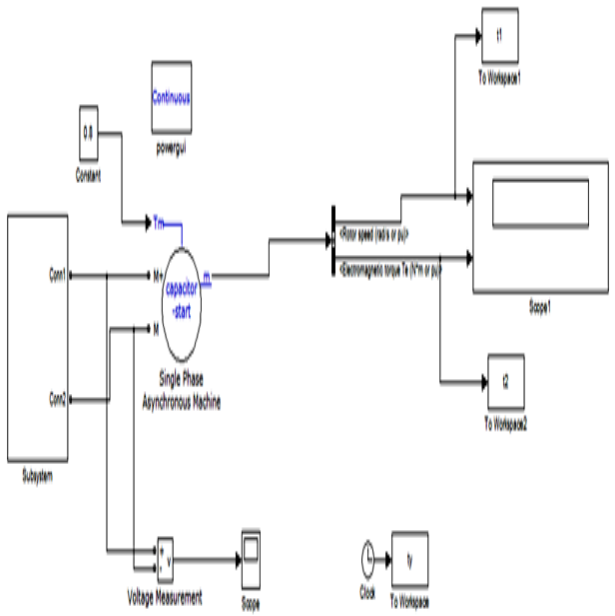

Fig 11 9-level multilevel inverter topology with using Motor load.

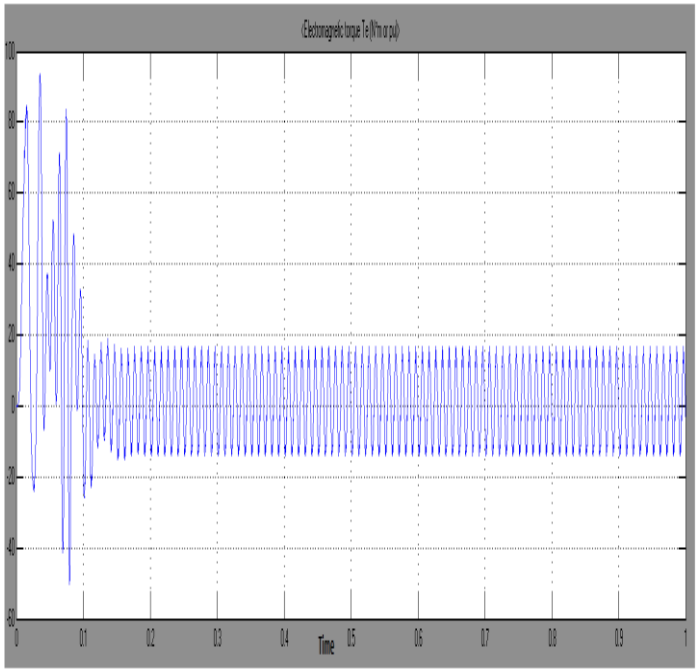

Fig 12 Torque wave-form

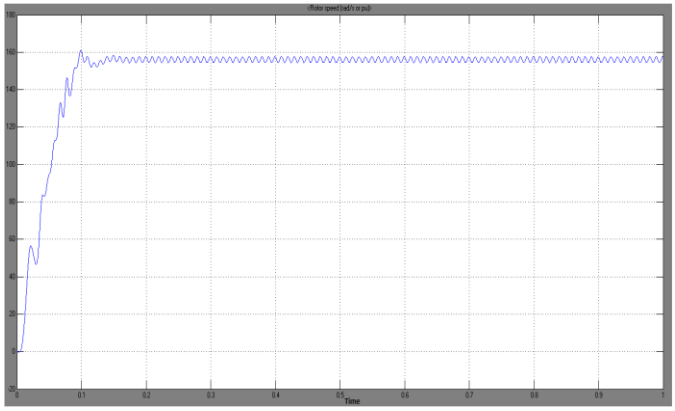

Fig 13 Rotor wave-form

Multilevel inverter	Number of battery source	Number of switches	Number of diodes	THD (%)
5-level cascaded multilevel inverter	2	5	4	20.28%
9-level cascaded multilevel inverter	4	8	8	**10.25 %**

Table 3:- Comparisons of various Topologies

Topology / Parameters	Flying capacitor	Diode clamped	Cascaded H bridge	Modified multilevel inverter
Voltage imbalance	High	Average	Very small	Very small
Circuit complexity	Less complex to diode clamped	Complex	Less complex compared to Flying capacitor	Less complex compared to Cascaded H bridge
Cost	High	Low	High compare to diode clamped	Less compare to Cascaded H bridge
Author's 9-level cascaded multilevel inverter	4	8	8	13.15%

4. CONCLUSION

Comparing the result of different topologies prove that 9 level inverter is better as it gives low THD with reduce number of switches. Author's 9-level cascaded multilevel inverter THD is 13.15% ; It's compare to our THD is 2.9% less. So, Our 9-level cascaded multilevel inverter is better to Author's 9-level cascaded multilevel inverter.

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