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LIBRATING BETWEEN CONVENTIONAL INVERTER AND MULTILEVEL INVERTER- A Review

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ABSTRACT- *This paper deals with structure and simulation of conventional inverter and single phase 3 level H-bridge inverter focusing on the reduction of its power electronic elements and maximization of its efficiency. The main objective of this paper is to improve the efficiency at minimum power switches with reduction of total harmonic distortion and electromagnetic interference, compare to conventional inverter. Basically, this inverter is a part of multilevel inverter. In the multilevel inverter, the H-bridge type inverter has been implemented as the new topology for flexible control of the output voltage due to separated input voltage sources. The Simulation of the new circuit topology has been simulated in the MATLAB simulink and the result is compared with aspects of used power electronic elements and their losses with conventional inverter topology.*

KEYWORDS:- Multilevel Inverter, Power Switches, Single Phase, H-bridge Inverter, Simulink, Total Harmonic Distortion, Output Voltage

INTRODUCTION:- Basically the multilevel inverter is the power electronic converter circuit topology which is used for conversion of DC voltage to AC voltage at the desired magnitude and frequency. The magnitude of the output terminal side voltage depends upon the sources or capacitors available at the input side[3]. The output voltage waveforms of the multilevel inverter produce as the staircase which is similarly to sinusoidal waveform. The Multilevel inverter output voltage has low Total Harmonic Distortion (THD) compared to the conventional inverter output voltage.The Total Harmonic Distortion(THD) may be reduced at the zero value by increasing the numbers of the level or increase upto N-level (Where N = 3, 5, 7,....) [1]. The main purpose of going towards the multilevel inverter is low efficiency of the conventional inverter due to high total harmonic distortion, power switches losses, Electromagnetic interference, dv/dt stress and high cost [1]-[3]. In 1995, Cascade multilevel Inverter was proposed behind the concept of multilevel inverter [1]. The multilevel inverters are used in the medium and high power appliances. These appliances may be motor drives, industrial appliances, renewable power loads. FACTs etc. Multilevel inverter is mainly categorized in three types. These are following 1.) Flying Capacitor (FC) Inverter, 2.) Neutral Point Clamped (NPC) Inverter and 3.).Cascaded H-bridge (CHB) Inverter .

In the FC inverter a large number of storage capacitors are required for higher voltage level and it is difficult to balance capacitors' voltage [2]. Due to requirement of large capacitor banks, pre-charging circuitry and uneven voltage distortion, FC is less attractive [3].

In the NPC inverter several capacitors are connected in the series connection. It is the drawback of NPC inverter because the unequal voltage is shared in the series connected capacitors [2][3].

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To overcome these types of the disturbance of output voltage, The CHB is much preferred because of its less number of power electronic elements and simple expansion circuit compared to NPC and FC inverter[3].

COMPARISON BETWEEN CONVENTIONAL AND MULTILEVEL INVERTER:-

CONVENTIONAL INVERTER:- The conventional inverter (2 level inverter) is used for conversion of the DC voltage into AC voltage as controllable output voltage[4]. It has the limitations against using in the medium and high power applications. Because this inverter has more power electronic switches for controlling the output voltage and current.

The conventional inverter has the same input source i.e. two input voltages for two level inverter and its waveform is produced using PWM. Output voltage and current distorted due to PWM, So THD are poor. In the low power loads, the efficiency of the conventional inverter is dominated using the rectifier losses. If another comparison aspect consists of the cost of inverter then conventional inverter has high cost due to more numbers of power electronic elements.

The constructed two level inverter is shown in fig 1. In the conventional inverter the power losses are more compared to the tree level H-bridge type inverter. Most of the power loss occurs due to switches and DC link capacitor.So the total losses in the Single phase conventional inverter is given as:-

$$P_{total} = P_{cond} + P_{switch} + P_{capacitor} \quad \text{.....(1)}$$

Where,
P_{total} = Total power loss in the conventional Inverter
P_{cond} = Conduction Loss of the inverter
P_{switch} = Losses due to Switching Elements
$P_{capacitor}$ = DC-link capacitor Loss

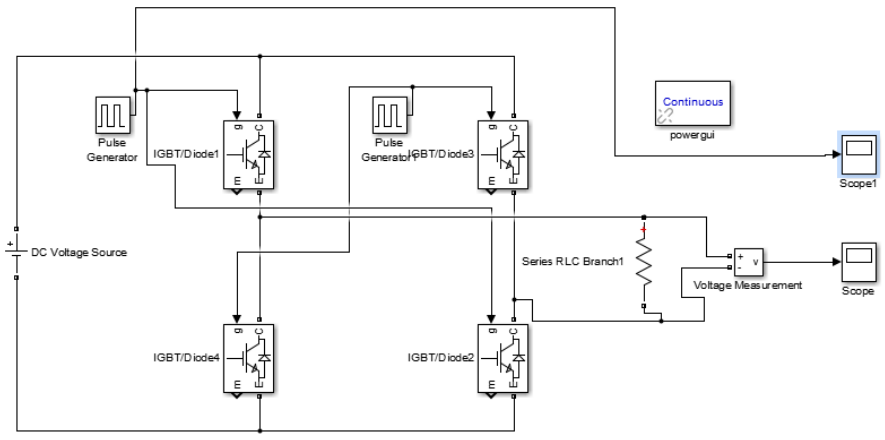

Fig1. Simulation model of Single Phase Two Level Inverter

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RESULT OF SINGLE PHASE 2 LEVEL INVERTER:-

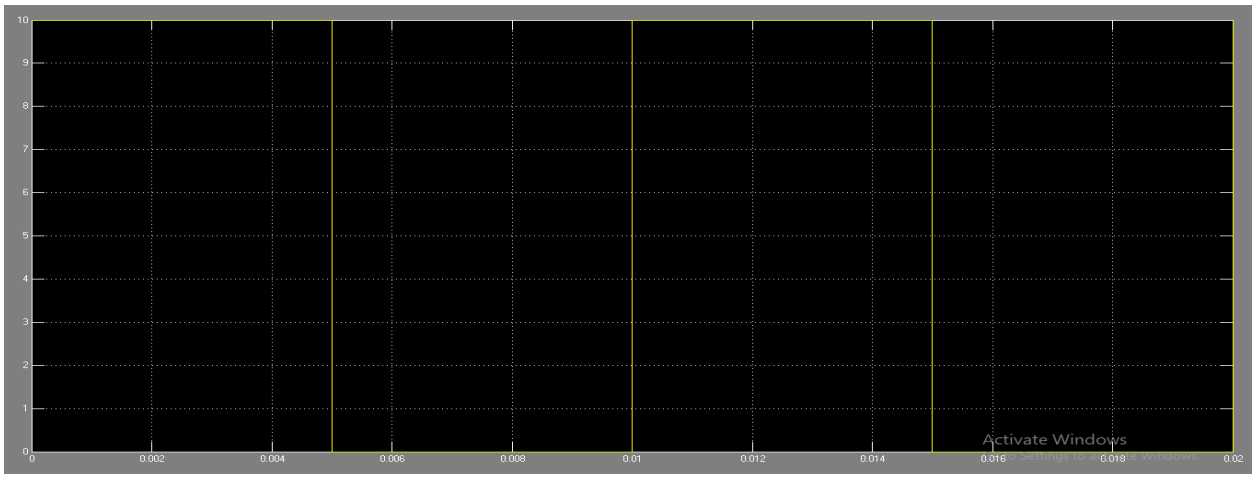

Fig 2: The output of the scope 1

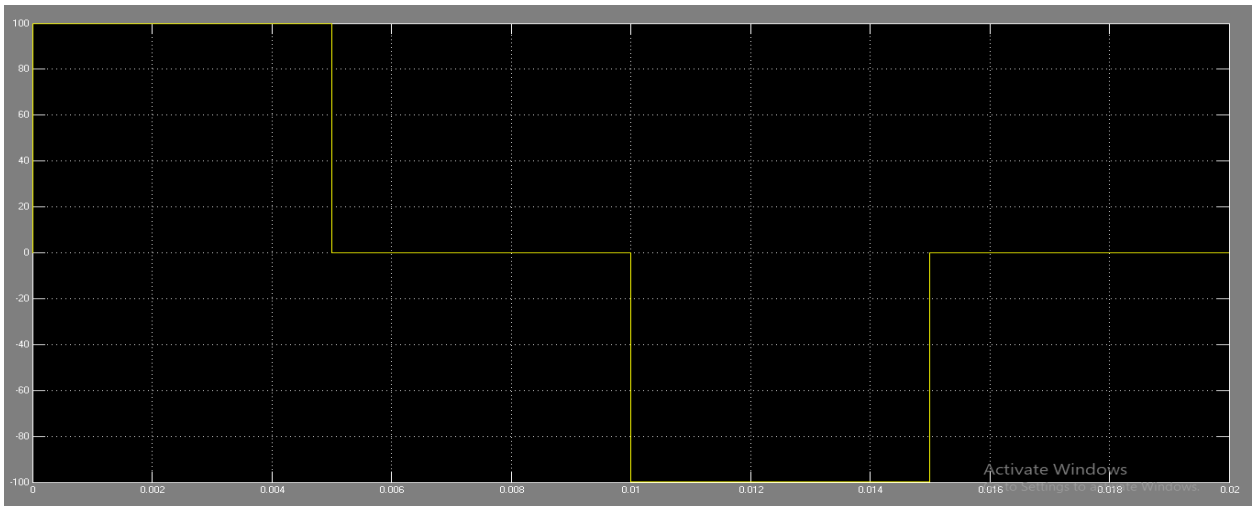

Fig 3: The output of the scope

SIMULATION ANALYSIS:-

The Simulation model has been simulated and performed for the 3 level H-bridge inverter. The new circuit topology of the single phase 3 level inverter is shown in fig .
The spectrum of the input and output variables are also shown in further Figures.

MULTILEVEL INVERTER :- The multilevel inverter is the new proposed inverter circuit topology which has less power switches and used for the reduction of the Total Harmonic Distortion. In this paper, we will take the single phase 3 level inverter as the multilevel inverter for comparison with 2 level inverter. The constructed single phase 3 level inverter is shown in Fig 4. In 3 level inverter there are two

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H-bridges and their output voltages of each bridge are connected in series connection. In the constructed circuit two DC voltages are connected to each bridge as the input source.

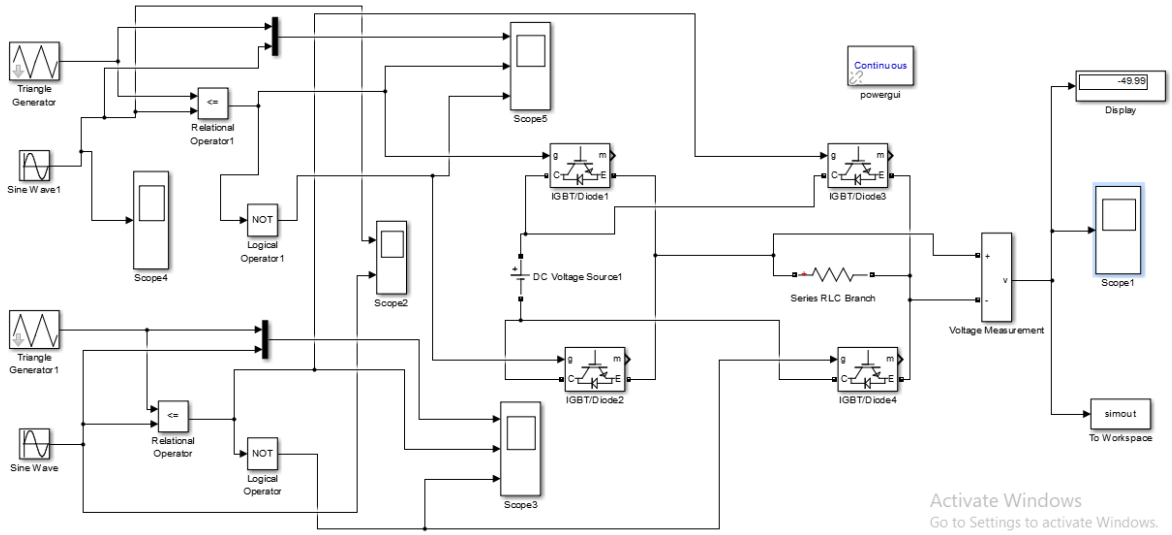

Fig4. Simulation Model of Single phase 3 level multilevel inverter

RESULT OF SINGLE PHASE 3 LEVEL MULTILEVEL INVERTER:-

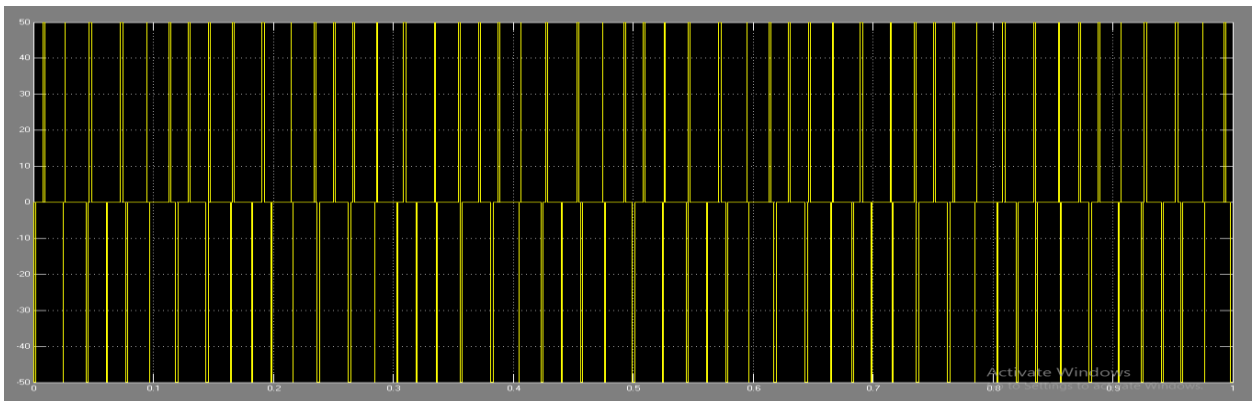

Fig 5: The output of the scope 1

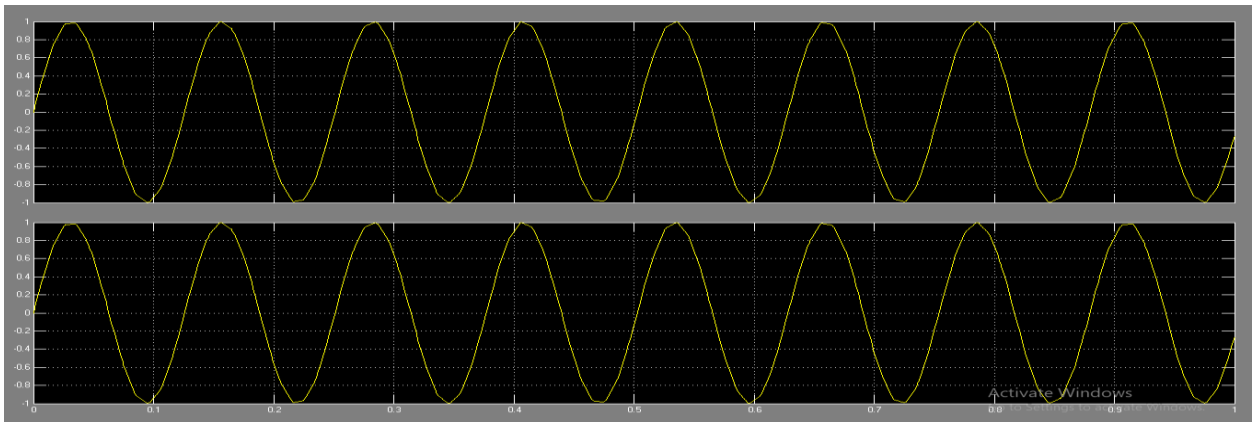

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Fig 6: The output of the scope 2

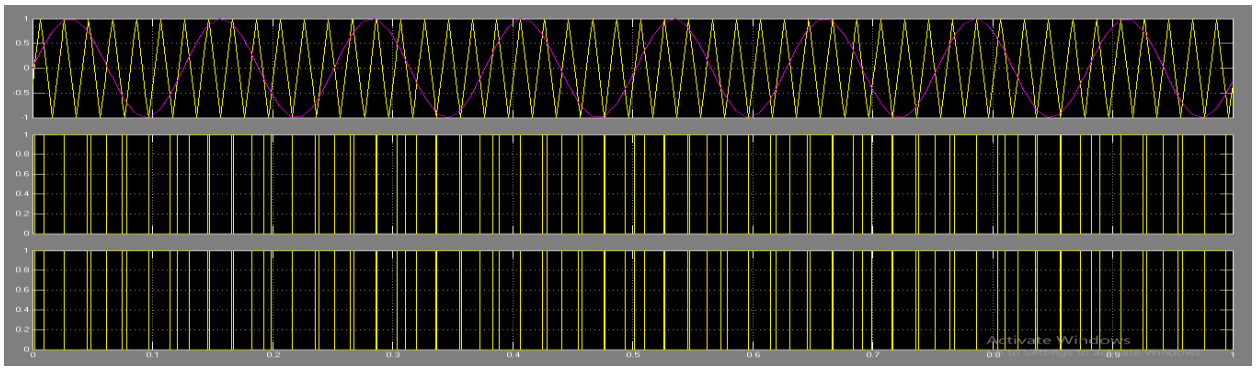

Fig 7: The output of the scope 3,5

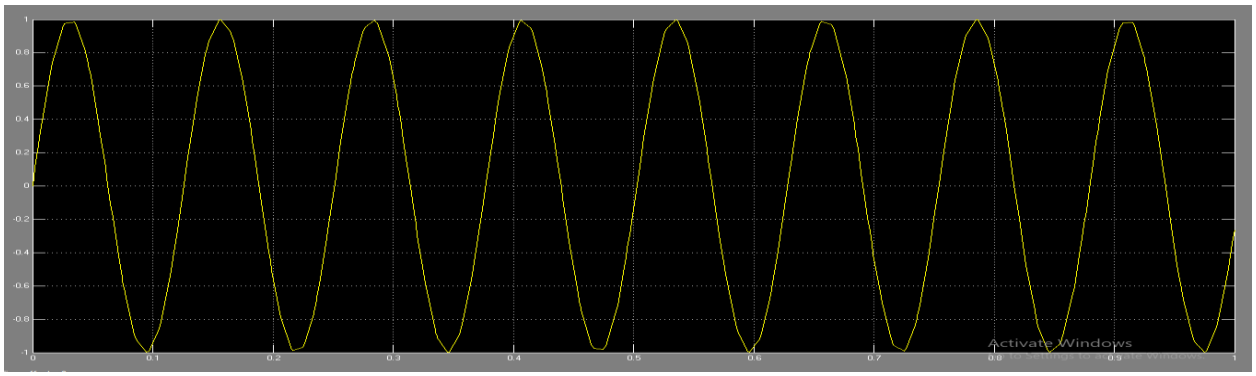

Fig 8: The output of the scope 4

COMPARISON AMONG CONVENTIONAL AND MULTILEVEL INVERTER IN TABULAR FORM:-

S.No.	Conventional Inverter	Multilevel Inverter
1.	Due to higher switching frequency switching losses is high.	Reduction in switching losses with the help of lower switching frequency.
2.	Higher total harmonic distortion in output voltage.	Low total harmonic distortion in output voltage.
3.	In this type of inverter higher voltage level are not produced.	In this type of inverter higher voltage level are produced.

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4.	Conventional inverters are not applicable for high voltage applications.	Multilevel inverters are applicable for high voltage applications.
5.	More switching stresses on devices.	Reduced switching stresses in device.

Table 1. Comparison among conventional and multilevel inverter

The conclusion of this comparison is that new circuit topology is more efficient and it can be preferred for the Single phase 3 level H-bridge inverter.

COMPARISON BETWEEN THD & SWITCHING LOSSES IN 2 LEVEL AND 3 LEVEL INVERTER:-

The total harmonic distortion and switching losses depends on the frequency of output voltage. The dependency on the frequency of the switching losses and THD are as following[8]:-

Frequency (Hz)	THD		Switching Losses (mj)	
	2 LEVEL	3 LEVEL	2 LEVEL	3 LEVEL
1500	44.26	34.10	25.80	21.88
2500	40.48	22.05	47.68	31.68
3500	37.56	14.68	62.35	39.40
5000	31.83	8.97	88.18	46.64

Table 2. THD and Switching losses in the 2 level and 3 level inverter

From the above comparison the result is that there are fewer switching losses and less THD in the three level inverter. Instead of reducing the Power switching losses and THD, another concept behind the multilevel inverter is reduction in power electronic switches. As the multilevel inverters are divided into 3 types, they can be compared on the basis of the requirement of power switches. The comparisons of the power electronic elements requirement for the m-level(where m is the number of level of the inverter) inverters are following[10]:-

CONCLUSION:-

The new topology of single phase 3 level inverter consists of two cascaded H-bridges and each H-bridge has separated input DC voltage source. By the Simulation result, it is proved that the H-bridge inverters

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have less total harmonic distortion and improve efficiency compared to the conventional inverters. These inverters are used for the medium and high power applications because of its less THD, less cost and less electromagnetic interference due to less number of used power electronic elements[1][3][5]. This paper indicates that this new prototype of H- bridge multilevel inverter is more advantageous than other conventional inverters. The goal is to perform efficient power conversion with the flexible control. In H-bridge type multilevel inverter separated input are used for each H-bridge. So, it can be easily synthesized for various output voltages. Further plan is to implement the hardware of the single phase 3 level cascaded multilevel inverter.

The conclusion of this comparison is that new circuit topology is more efficient and it can be preferred for the Single phase 3 level H-bridge inverter.

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