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A Hybrid Topology for Multilevel Inverter Using Amplitude Modulation.

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Abstract — *This paper proposed a new topology for multilevel inverter in this topology we are using bypass diode technique and one H bridge to generate any levels. Due to this topology the cost of switches, driver circuit and installation area are reduced considerably. Here this paper also proposed a two new formula one to decide number of level generated according to source availability and other to determine time at which mosfet will be turned on and off. The proposed topology works on Amplitude Modulation technique which increases efficiency but problem of Amplitude Modulation technique is it needed different DC sources in multiple off 2. Here this paper proposed simulation of 127 level inverter. With its output waveform, FFT analysis, switching table and Fourier analysis.*

Keywords- *Hybrid Topology; Hybrid Multilevel Inverter; Multilevel Inverter; Cascaded H bridge inverter; Amplitude Modulation.*

I. INTRODUCTION

Inverter are generally used to convert DC voltage to AC voltage. Now generally in H bridge inverter DC voltage is converted to AC voltage in form of Square Wave whose THD content is very high so to tackle this situation concept of multilevel inverter was introduce in which steps are created in output form. Now due to this step the waveform tries to become identical to sinusoidal waveform. As waveform tries to become identical to sinusoidal waveform the THD level is reduce to very low value. To make output waveform as identical to sinusoidal waveform the number of level or steps should be more. So to produce sinusoidal waveform we have done simulation of 127 level inverter and THD is reduce to very low value we have done simulation of 127 level inverter whose THD content is 0.89%.

II. HYBRID MULTILEVEL INVERTER.

In this hybrid topology the need for voltage balancing capacitor and clamping diode is removed. We also provide separate configuration for different DC sources due to which chance of short circuiting of sources will be removed. With this topology the complexity of triggering faced in cascaded h bridge is also removed. In this topology we use only One H Bridge to generate and H Bridge remain constant irrespective of level to be generated. The number of switches are also reduced due to switching loss is also reduced. Here in this topology Amplitude Modulation Technique is used to generate multilevel output. Benefit of Amplitude Modulation Technique over Pulse Width Modulation technique is higher efficiency and reduces number of switches and finally cost is reduced. The only problem of this topology is that we need different DC sources and all DC sources should have floating neutral.

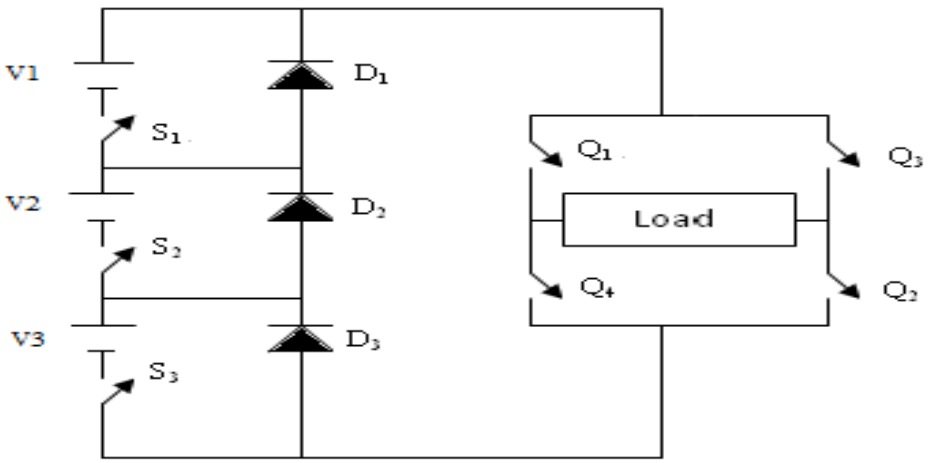

Fig 1. HYBRID MULTILEVEL INVERTER.

III. SIMULATION RESULTS.

Simulation is carried out in Matlab Simulink Model. Here we have present simulation of 127 level using hybrid topology and amplitude modulation.

3.1. Simulation of 127 level inverter using amplitude modulation.

For deciding voltage we use this formula $\left(\left(2^n-1\right)*2\right)+1$, n is number of sources.

The model of 127 level inverter using amplitude modulation is shown. We have use 4V, 8V, 16V, 32V, 64V, 128V DC sources. Maximum voltage obtain is 252V. Here we have used 6 sources to generate 127 level and single H Bridge is used to produce output. THD output, Fourier analysis and triggering pulses are also shown.

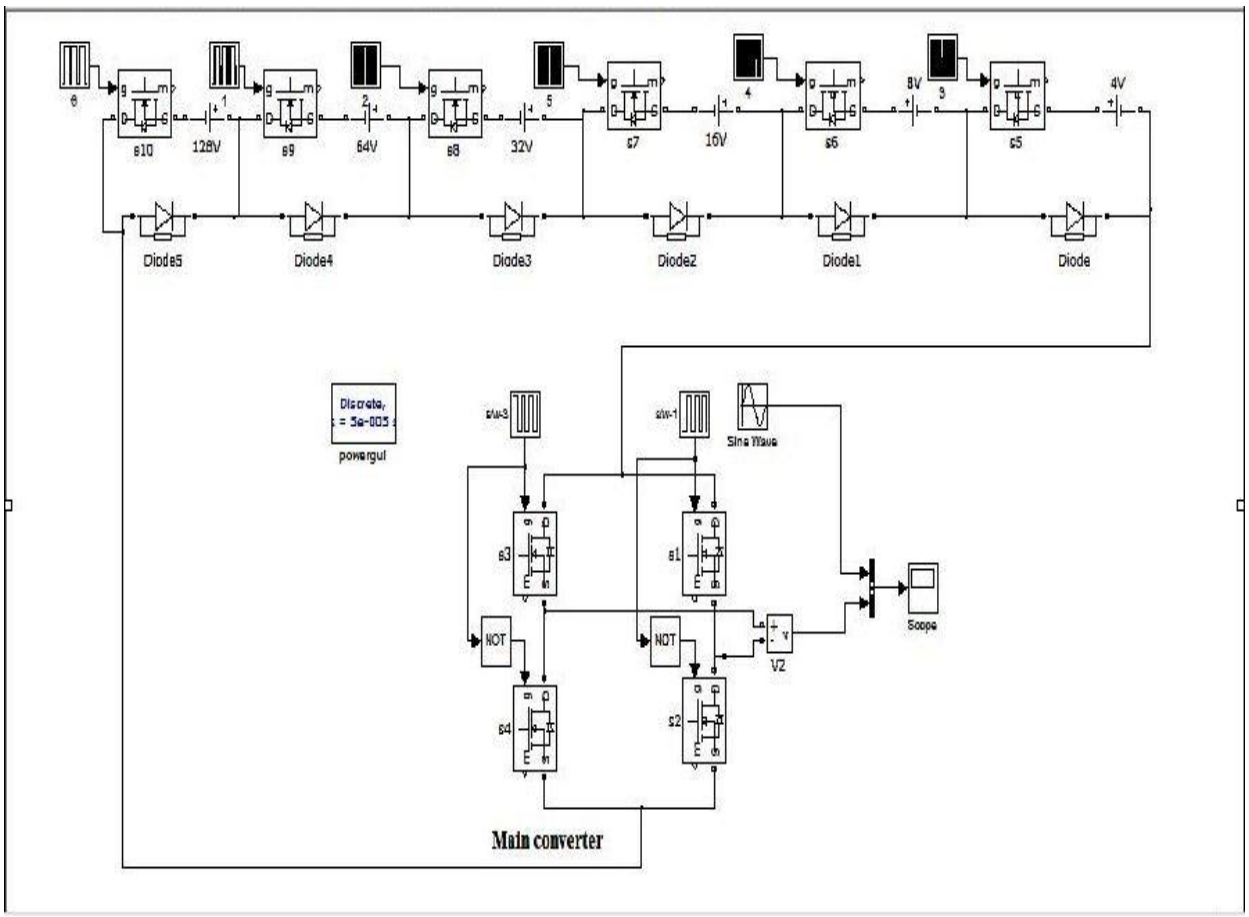

Fig 2. SIMULINK MODEL OF 127 LEVEL INVERTER.

TABLE 1. SWITCHING TABLE OF 127 LEVEL INVERTER.

Sr no	128V	64V	32V	16V	8V	4V	output
1	0	0	0	0	0	0	0V
2	0	0	0	0	0	1	4V
3	0	0	0	0	1	0	8V
4	0	0	0	0	1	1	12V
5	0	0	0	1	0	0	16V
6	0	0	0	1	0	1	20V
7	0	0	0	1	1	0	24V
8	0	0	0	1	1	1	28V
9	0	0	1	0	0	0	32V
10	0	0	1	0	0	1	36V
11	0	0	1	0	1	0	40V

12	0	0	1	0	1	1	44V
13	0	0	1	1	0	0	48V
14	0	0	1	1	0	1	52V
15	0	0	1	1	1	0	56V
16	0	0	1	1	1	1	60V
17	0	1	0	0	0	0	64V
18	0	1	0	0	0	1	68V
19	0	1	0	0	1	0	72V
20	0	1	0	0	1	1	76V
21	0	1	0	1	0	0	80V
22	0	1	0	1	0	1	84V
23	0	1	0	1	1	0	88V
24	0	1	0	1	1	1	92V
25	0	1	1	0	0	0	96V
26	0	1	1	0	0	1	100V
27	0	1	1	0	1	0	104V
28	0	1	1	0	1	1	108V
29	0	1	1	1	0	0	112V
30	0	1	1	1	0	1	116V
31	0	1	1	1	1	0	120V
32	0	1	1	1	1	1	124V
33	1	0	0	0	0	0	128V
34	1	0	0	0	0	1	132V
35	1	0	0	0	1	0	136V
36	1	0	0	0	1	1	140V
37	1	0	0	1	0	0	144V
38	1	0	0	1	0	1	148V
39	1	0	0	1	1	0	152V
40	1	0	0	1	1	1	156V
41	1	0	1	0	0	0	160V
42	1	0	1	0	0	1	164V
43	1	0	1	0	1	0	168V
44	1	0	1	0	1	1	172V
45	1	0	1	1	0	0	176V
46	1	0	1	1	0	1	180V
47	1	0	1	1	1	0	184V
48	1	0	1	1	1	1	188V
49	1	1	0	0	0	0	192V
50	1	1	0	0	0	1	196V
51	1	1	0	0	1	0	200V
52	1	1	0	0	1	1	204V
53	1	1	0	1	0	0	208V
54	1	1	0	1	0	1	212V
55	1	1	0	1	1	0	216V
56	1	1	0	1	1	1	220V
57	1	1	1	0	0	0	224V
58	1	1	1	0	0	1	228V
59	1	1	1	0	1	0	232V
60	1	1	1	0	1	1	236V
61	1	1	1	1	0	0	240V
62	1	1	1	1	0	1	244V
63	1	1	1	1	1	0	248V
64	1	1	1	1	1	1	252V

In this table 1 means ON and 0 means OFF.

To find out timing at which the mosfet will turn on or off is decided by formula $\sin^{-1}\left(\left(i-0.5\right)/n\right)/360 * f$ where i is level, n is total voltage and f is fundamental frequency.

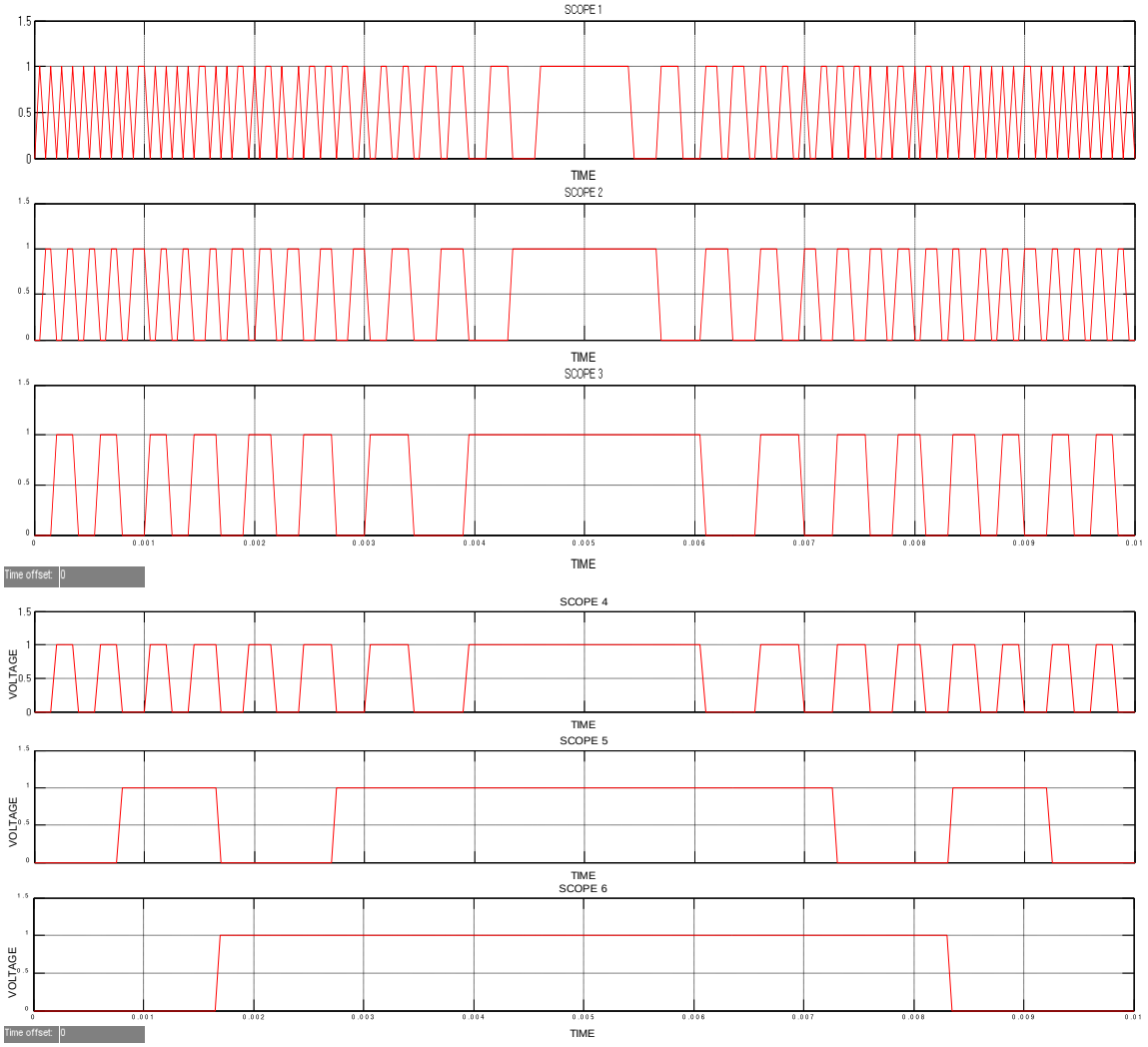

Fig 3. SHOWS TRIGGERING PULSES.

Output waveform of 127 level inverter.

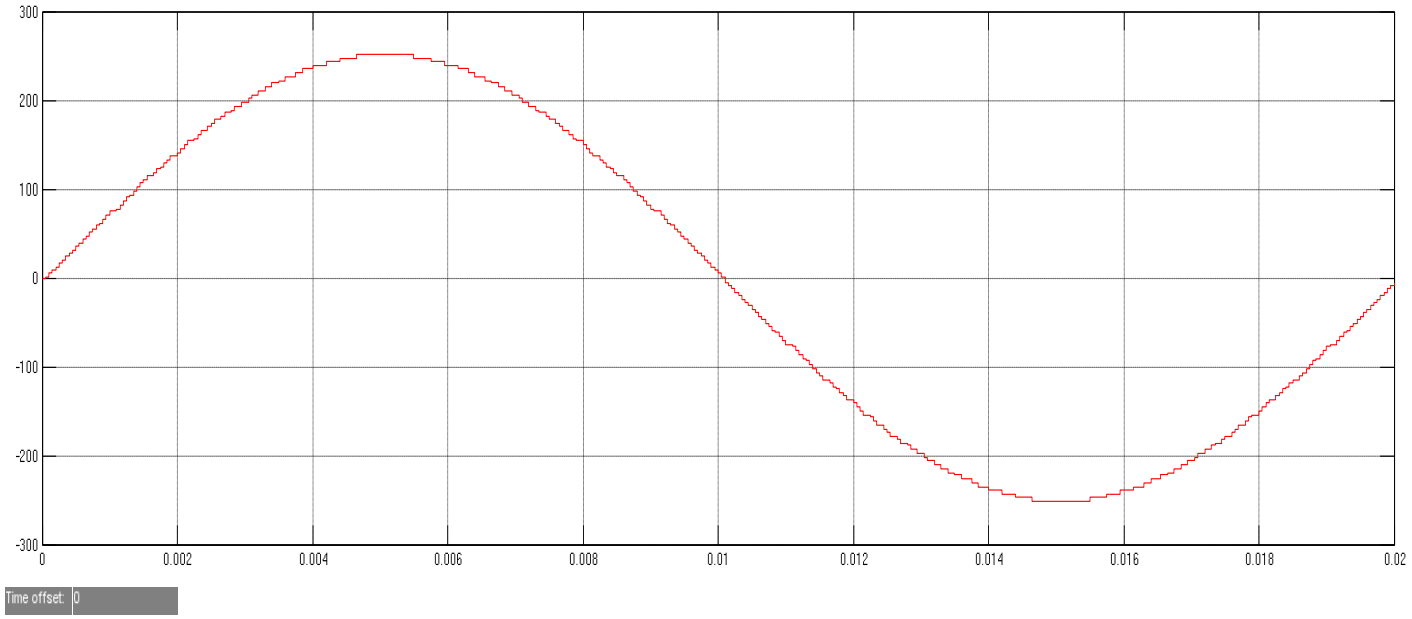

Fig 4. OUTPUT WAVEFORM OF 127 LEVEL INVERTER OUTPUT.

FFT Analysis of 127 level inverter.

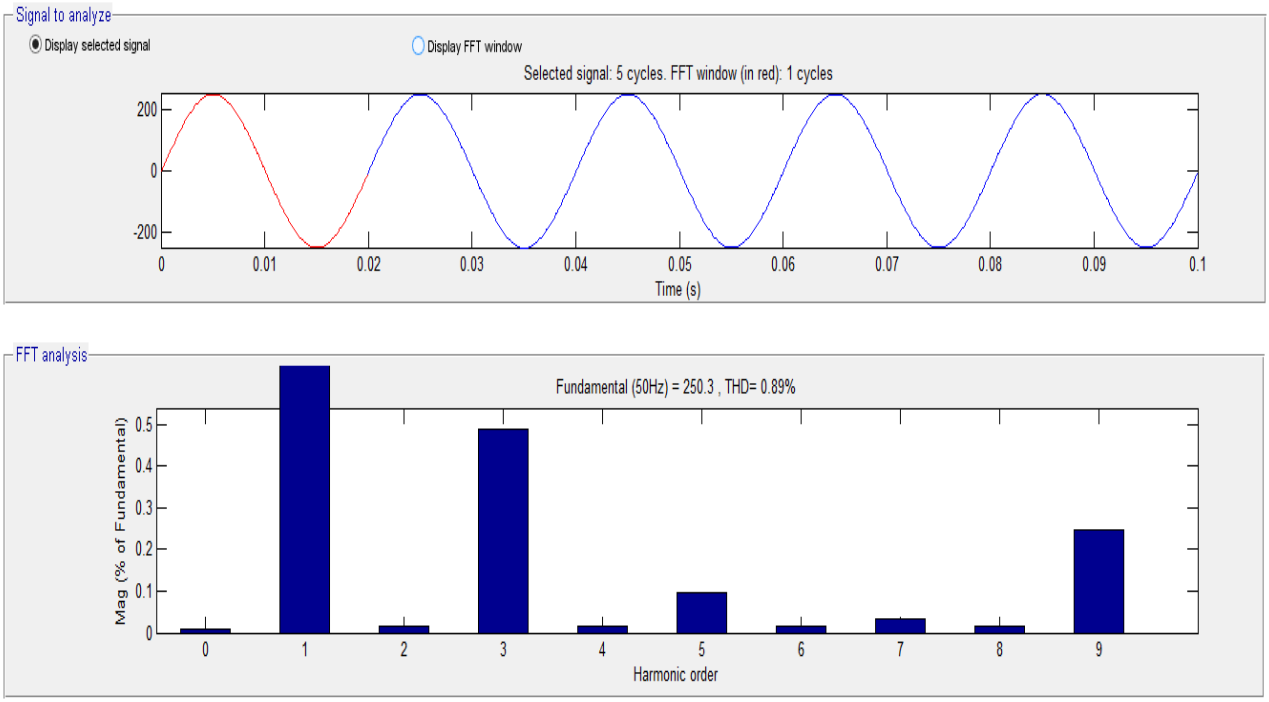

Fig 5. FFT ANALYSIS OF 127 LEVEL INVERTER OUTPUT

Fourier analysis of 127 level inverter output.

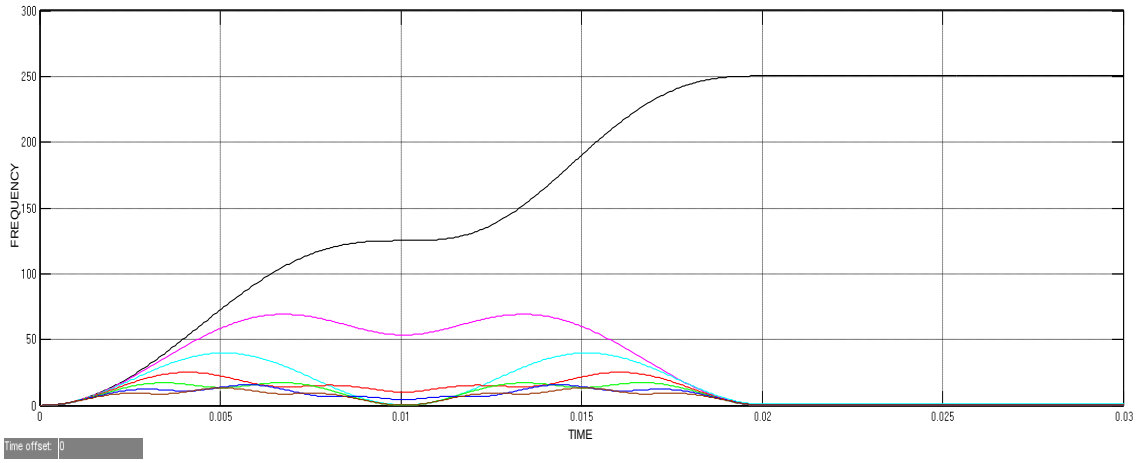

Fig 6. FOURIER ANALYSIS OF 127 LEVEL INVERTER OUTPUT.

THD% table according to level.

Level	THD
3	17.26%
5	17.04%
15	5.61%
31	2.91%
127	0.89%

TABLE 2. THD%.

IV. CONCLUSION

In this paper a new topology has been introduced which uses bypass diode and one H bridge to generate any level. Due to this Power electronics switches cost, its driver circuit cost and installation area is reduced. This paper also proposed a two newer formula one to calculate level can be generated according to source availability and other to calculate time of mosfet to be turned on and off. This paper also proposed how amplitude modulation can be implemented to increase efficiency its only drawback is it needed source in multiple of 2. The FFT analysis of 127 level inverter shows only 0.89% harmonics in output of inverter and output waveform is nearly similar to sinusoidal waveform.

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