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A Comparative Study of 9-Level Inverter and 15-Level Multi Inverter for a Grid Connected System

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Abstract:** Recently, the emergence of single phase multilevel inverter has been increased due to its advantages over traditional one. Multilevel Inverters [MLI] are the ones which can give out a stepwise output waveform with the use of power electronic switches, power diodes and some DC voltage source which might be a series/parallel connected PV cells, a renewable source or a battery. Multilevel inverters not only produce low harmonic distortion but also decrease the dv/dt stresses on the equipment Multilevel inverters is a good option as the output voltage of a Multilevel inverter is a stepped waveform which approaches a sinusoid providing lesser harmonic distortion. As the number of levels are increased the harmonic distortion reduces but at the same time the number of switching devices and the DC voltage sources required increases, thus increasing the complexity of the system design and control. Multilevel inverter proposed in this paper uses only 7 switches to provide 9 levels and 15 levels of output voltage. A symmetrical Cascaded H bridge Multi level inverter (SCHBMLI) and Asymmetrical Cascaded H bridge Multilevel Inverter (ASCHBMLI) using PD-PWM technique have been analysed in this paper for grid connection. The Asymmetric Cascade H Bridge [ASCHMLI] implemented in real time system using PIC16F877A microcontroller with RL load. This type of proposed system is used for high power applications in photovoltaic and it's reduce overall cost as well as size of the system.

I. INTRODUCTION

Power electronics is the application of solid-state electronics for the control and conversion of electric power. It also refers to a subject of research in electronic and electrical engineering which deals with design, control, computation and integration of nonlinear, time varying energy processing electronic systems with fast dynamics.

The first high power electronic devices were mercury-arc valves. In modern systems the conversion is performed with semiconductor switching devices such as diodes, thyristors and transistors, pioneered by R. D. Middlebrooks and others beginning in the 1950s. In contrast to electronic systems concerned with transmission and processing of signals and data, in power electronics substantial amounts of electrical energy are processed.

An AC/DC converter (rectifier) is the most typical power electronics device found in many consumer electronic devices, e.g. television sets, personal computers, battery chargers, etc. The power range is typically from tens of watts to several hundred watts. In industry a common application is the variable speed drive (VSD) that is used to control an induction motor. The power range of VSDs start from a few hundred watts and end at tens of megawatts. The power conversion systems can be classified according to the type of the input and output power AC to DC (rectifier), DC to AC (inverter), DC to DC (DC-to-DC converter), AC to AC (AC-to-AC converter)

II. INVERTER

An inverter provides an ac voltage from dc power sources and is useful in powering electronics and electrical equipment rated at the ac mains voltage. In addition they are widely used in the switched mode power supplies inverting stages. The circuits are classified according the switching technology and switch type, the waveform, the frequency and output waveform.

A. Basic Inverter Operations

The basic circuits include an oscillator, control circuit, drive circuit for the power devices, switching devices, and a transformer. Switching devices and transformer.

The conversion of dc alternation energy stored in the dc sources such as the battery output, into an alternating voltage. This done using switches devices which are continuously turned on and off and then stepping up using the transformer. Although there are some configurations which do not use a transformer, these are not widely used.

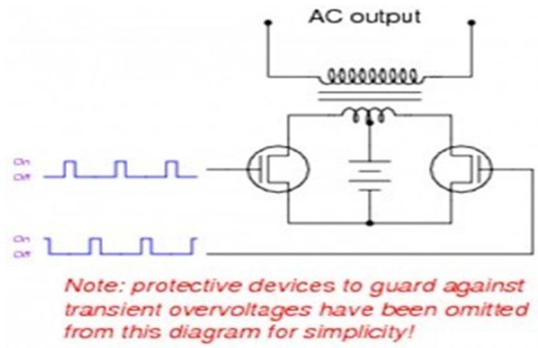

Figure 1: Block diagram of 9-LEVEL INVERTER AND 15-LEVEL MULTI INVERTER

III. MULTILEVEL INVERTER [MLI]

Now a day's many industrial applications have begun to require high power. Some appliances in the industries, however, require medium or low power for their operation. Using a high power source for all industrial loads may prove beneficial to some motors requiring high power, while it may damage the other loads. Some medium voltage motor drives and utility applications require medium voltage. The multi-level inverter has been introduced since 1975 as an alternative in high power and medium voltage situations. The Multilevel inverter is like an inverter and it is used for industrial applications as an alternative in high power and medium voltage

A. Cascaded H Bridge Multilevel Inverter

The circuit cascaded H-bride multilevel inverter is to use capacitors and switches and requires less number of components in each level. This topology consists of a series of power conversion cells and power can be easily scaled. The combination of capacitors and switches pair is called an H-bridge and gives the separate input DC voltage for each H-bridge. It consists of H-bridge cells and each cell can provide the three different voltages like zero, positive DC, and negative DC voltages. One of the advantages of this type of multi-level inverter is that it needs less number of components compared with diode clamped and flying capacitor inverters. The price and weight of the inverter are less than those of the two inverters. Soft-switching is possible by some of the new switching methods. Multilevel cascaded inverters are used to eliminate the bulky transformer required in case of conventional; multi phase's inverter, clamping diodes required in case of diode clamped inverter and flying capacitor inverter. But these require a large number of isolated voltages to supply each cell

IV. 9-LEVEL INVERTER

Symmetrical Cascaded H Bridge Inverter (SCHB-MLI) topology In this Circuit, When MOSFET Controlled Switch is Turned On, the DC Voltage Source and MOSFET Controlled Switch are connected in series, so that the current flows from DC Source to MOSFET and the Diode becomes Reverse biased Condition. When MOSFET controlled Switch is turned OFF, the Current flows via diode and the diode is forward biased. The Circuit needs three DC voltage sources, 7 switches and 3 diodes. [1] The 4 DC sources are equal with Voltage of 80VDC, and this circuit will generate Nine Level output voltage of 240VDC, 180VDC, 120VDC, 60VDC, 0VDC, -60VDC, -120VDC, -180VDC, --240VDC respectively [3]

TABLE 1: The Switching Configuration of Symmetrical CHBMLI

Vo	S1	S2	S3	S4	S5	S6	S7
Vdc	ON	ON	OFF	OFF	ON	ON	ON
3Vdc/4	ON	ON	OFF	OFF	OFF	ON	ON
2Vdc/4	ON	ON	OFF	OFF	OFF	OFF	ON
Vdc/4	ON	ON	OFF	OFF	OFF	OFF	OFF
0	OFF	ON	ON	OFF	OFF	OFF	OFF
Vdc/4	OFF	OFF	ON	ON	OFF	OFF	OFF
2Vdc/4	OFF	OFF	ON	ON	OFF	OFF	ON
3Vdc/4	OFF	OFF	ON	ON	OFF	ON	ON
Vdc	OFF	OFF	ON	ON	ON	ON	ON

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V. 15-LEVEL INVERTER

The Asymmetrical Cascaded H Bridge Inverter (ASCHB-MLI) topology. In this Inverter the DC source magnitudes are unequal. The DC source magnitude are designed with binary form of voltage such as 25VDC, 50VDC, 100VDC respectively. Both the inverter consists of same number of Power semiconductor switches but the voltage level varies.[5]

TABLE 2: Switching operation of Asymmetric CHBMLI

V_o	S_1	S_2	S_3	S_4	S_5	S_6	S_7
V_{dc}	1	1	1	1	1	0	0
$6V_{dc}/7$	0	1	1	1	1	0	0
$5V_{dc}/7$	1	0	1	1	1	0	0
$4V_{dc}/7$	0	0	1	1	1	0	0
$3V_{dc}/7$	1	1	0	1	1	0	0
$2V_{dc}/7$	0	1	0	1	1	0	0
$V_{dc}/7$	1	0	0	1	1	0	0
$0V_{dc}$	0	0	0	1	0	1	0
$0V_{dc}$	0	0	0	0	1	0	1
$-1V_{dc}/7$	1	0	0	0	0	1	1
$-2V_{dc}/7$	0	1	0	0	0	1	1
$-3V_{dc}/7$	1	1	0	0	0	1	1
$-4V_{dc}/7$	0	0	1	0	0	1	1
$-5V_{dc}/7$	1	0	1	0	0	1	1
$-6V_{dc}/7$	0	1	1	0	0	1	1
$-V_{dc}$	1	1	1	0	0	1	1

B. *Simulation Diagram*

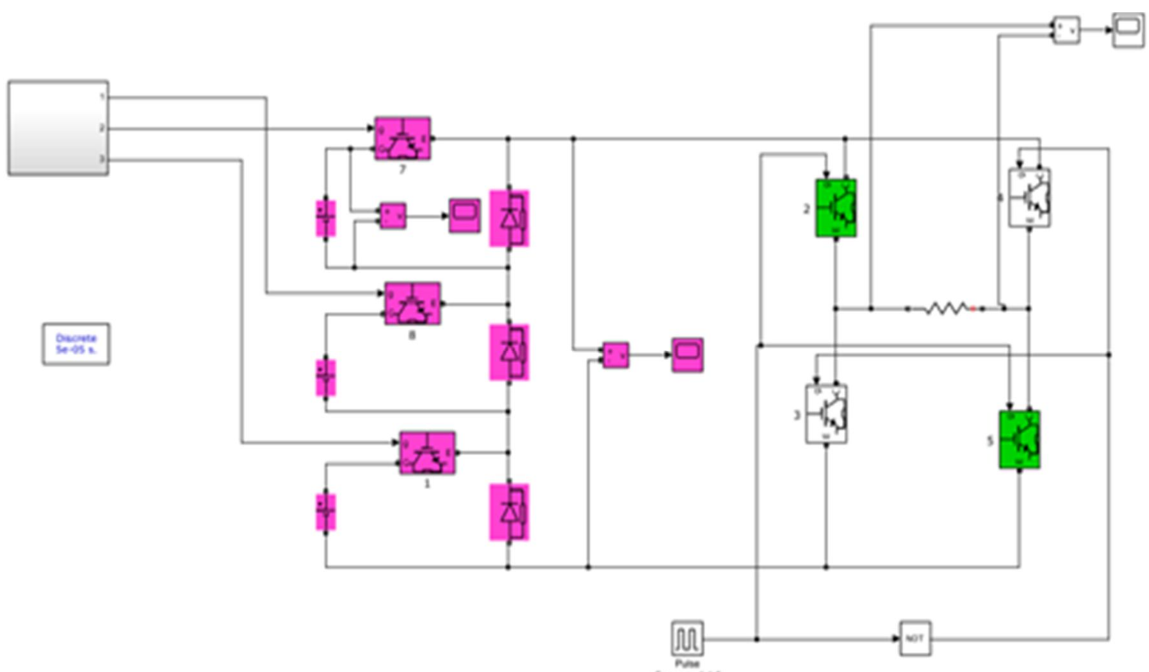

Figure 4: 9 and15 level SCHB and ASCHB Inverter respectively with PD-PWM technique

VI. RESULTS AND DISCUSSION

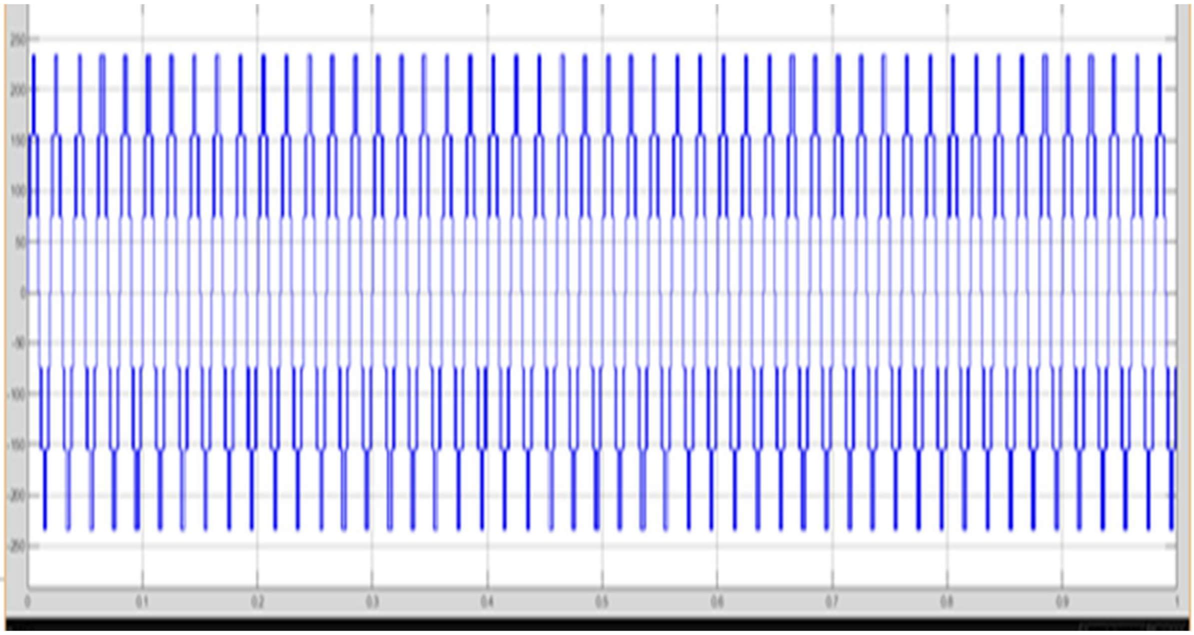

Figure 5: Output Voltage for symmetric 9 level CHB Inverter

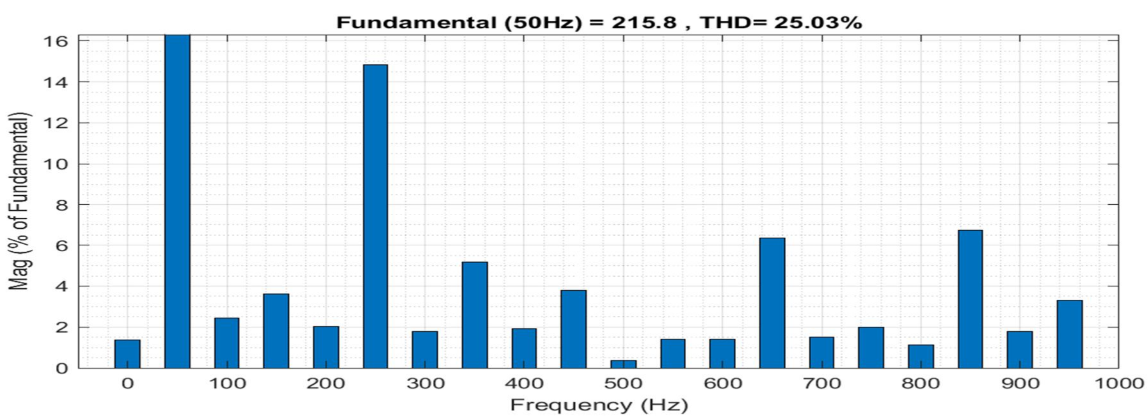

Figure 6: THD of symmetric 9 level CHB Inverter

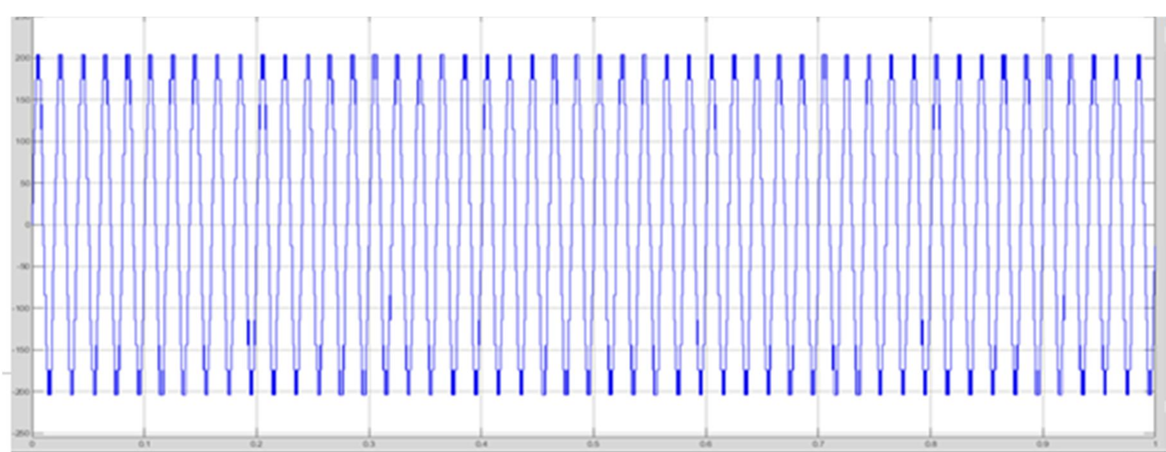

Figure 7: Output Voltage for Asymmetric 15 level CHB Inverter

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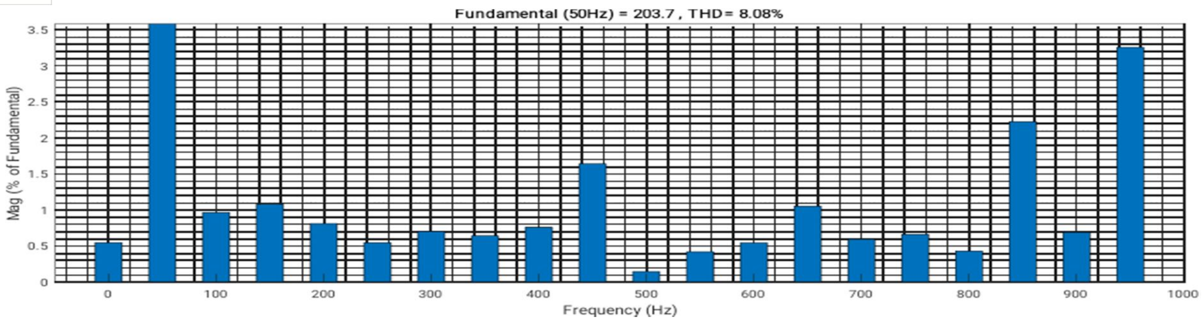


Figure 8: THD of Asymmetric 15 level CHB Inverter

VII. CONCLUSION

A symmetrical Cascaded H bridge Multi level inverter (SCHBMLI) and Asymmetrical Cascaded H bridge Multilevel Inverter (ASCHBMLI) using PD-PWM technique have been analyzed in this paper. Both Inverters consist of same power semiconductor switches but output voltage levels are different. In SCHBMLI the output voltage is 9 level, whereas ASCHBMLI the output voltage level is 15 level. The THD analysis for ASCHBMLI is 8.08%, whereas THD analysis for SCHMLI is 25.03%. In this system the THD is very less in ASCHMLI and it is implemented in real time system using PIC16F877A microcontroller with RL load. This type of proposed system is used for high power applications in photovoltaic and it's reduce overall cost as well as size of the system.

REFERENCES

[1] Krishna Kumar Gupta,Alekh Ranjan, Palaver Bhatnagar,Lalit Kumar Sahu and Shailendra Jain : Multilevel Inverter topologies with reduced device count: A Review. IEEE Transactions on Power Electronics (Volume: 31, Issue: 1, Jan. 2016)

[2] Prabaharan N., and Palanisamy K.: Comparative Analysis of Symmetric and Asymmetric Reduced Switch Multilevel Inverter Topology Using Unipolar Pulse Width Modulation Strategies. IET Power Electronics, DOI: 10.1049/iet-pel.2016.0283

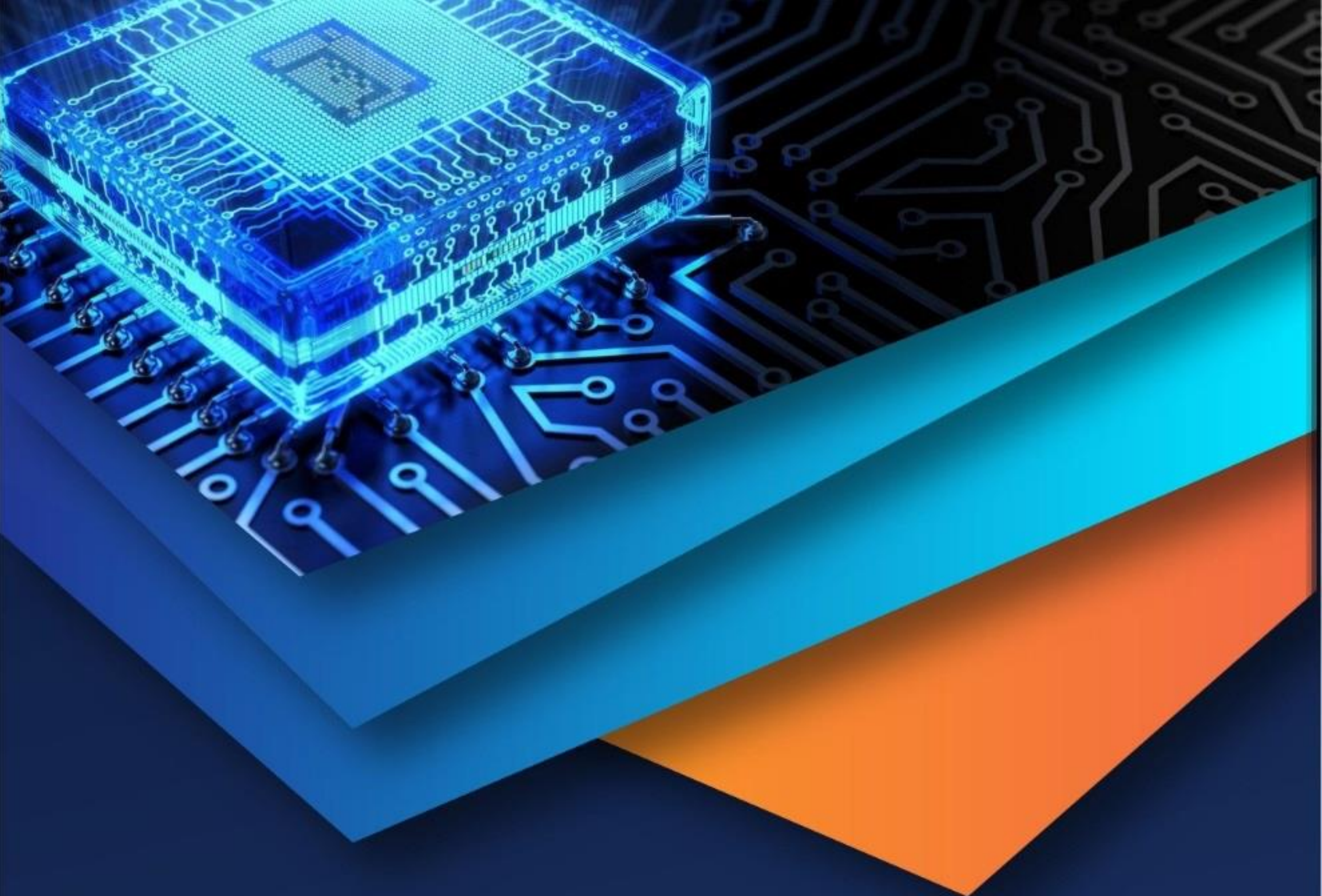
[3] Eduardo e. Espinosa, jose r. Espinoza, pedro e. Melín, roberto o. Ramírez, felipe villarroel,javier a. Muñoz, member, and luis morán, fellow, ieeea new modulation method for a 13-level asymmetric inverter toward minimum thd ieee transactions on industry applications, vol. 50, no. 3, may/june 2014.

[4] Mohammad farhadi kangarlu and ebrahim babaei, a generalized cascaded multilevel inverter using series combination of submultilevels invertes ieee transactions on power electronics, vol. 28, no. 2, february 2013

[5] Eduardo Espinosa; Jose Espinoza ; Roberto Ramirez ; Jaime Rohten ; Felipe Villarroel ; Pedro Melina ; Johan Guzman New modulation Technique for 15-Level Asymmetrical Inverter operating with Minimum THD Industrial Electronics Society, IECON 2013 - 39th Annual Conference of the IEEE.

[6] Rajasekhar Gorthi, K. Giribabu, Dr S. Shiva Prasad: Simulink model for cost-effective analysis of Hybrid system: International journal of modern Engineering Research(Volume :4 , Issue: 2, Feb 2014)

[7] Dr. Rajesh Thipparaju, Suddala Janardhan, Rajasekhar Gorthi : PV array based BLDC motor driven water pump using solar Technology: The International journal of analytical and experimental modal analysis (Volume: 12, Issue : 7, July 2020)



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