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A New Three Phase AC-DC-AC Five Level Multilevel Inverter

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***Abstract:** Nowadays multilevel inverters are a very attractive solution for medium-voltage high-power conversion applications; they convert DC power to AC power at required output voltage and frequency level. In the design of multilevel inverters, different topologies have been evolved. These topologies include diode clamped multilevel 1 inverter, flying capacitor multilevel inverter and cascaded H bridge multilevel inverter. The main limitations of the conventional topologies are large number of switches. This article treats the design and realization of a new five-level single-phase inverter structure controlled by a microcontroller-based digital strategy. The proposed topology needs less number of switches and carrier signals and THD of the proposed topology is less compared to conventional topologies. All circuits are modelled and simulated using Matlab-Simulink software.*

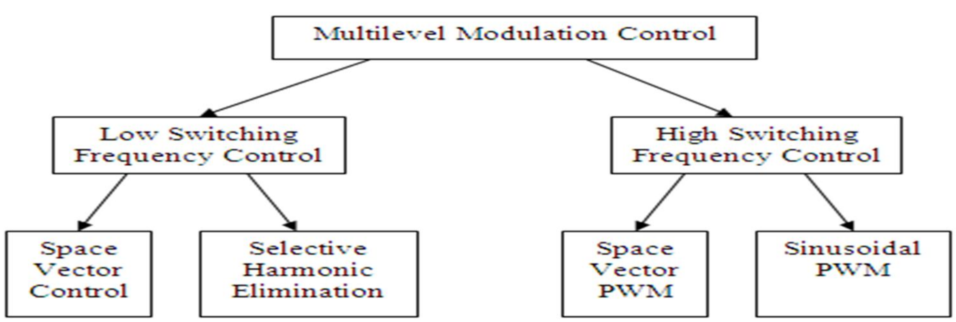
***Keywords:** Inverter, flying capacitor, Diode Clamped, IGBT Switch, THD.*

I. INTRODUCTION

The multilevel converter is one of the more promising techniques for mitigating the problems. Multilevel converters utilize several DC voltages to synthesize a desired AC voltage. For this reason, multilevel converters can reduce (dv/dt) to conquer the motor failure problem and EMI problem. Multilevel converters as well have emerged as the answer for work with superior voltage levels. Multilevel converters comprise an array of capacitor voltage sources and power semiconductors, which produce output voltages with stepped waveforms. The commutation of the switches permits the adding of the capacitor voltages, which reach high voltage at the output, while the power semiconductors must withstand simply decreased voltages. One application for multilevel converters is distributed power systems. Multilevel converters can be implemented using distributed energy resources such as photovoltaic and fuel cells, and then be connected to an AC power grid. If a multilevel converter is made to either draw or supply purely reactive power, after that the multilevel converter is utilizing similar to a reactive power compensator.

II. CONTROL AND MODULATION TECHNIQUES OF MULTILEVEL INVERTERS

The modulation methods used in multilevel converters can be classified according to switching frequency. Methods that work with high switching frequencies have numerous commutations for power semiconductors in one cycle of the fundamental output voltage.
The popular methods for high switching frequency methods are classic carrier-based sinusoidal PWM (SPWM) and space vector PWM. The popular methods for low switching frequency methods are space vector modulation (SVM) method and selective harmonic elimination method.
A very popular method with high switching frequency in industrial applications is the classic carrier-based sinusoidal PWM that employ the phase-shifting method to increase the effective switching frequency. Therefore, the harmonics in the load voltage can be reduced.

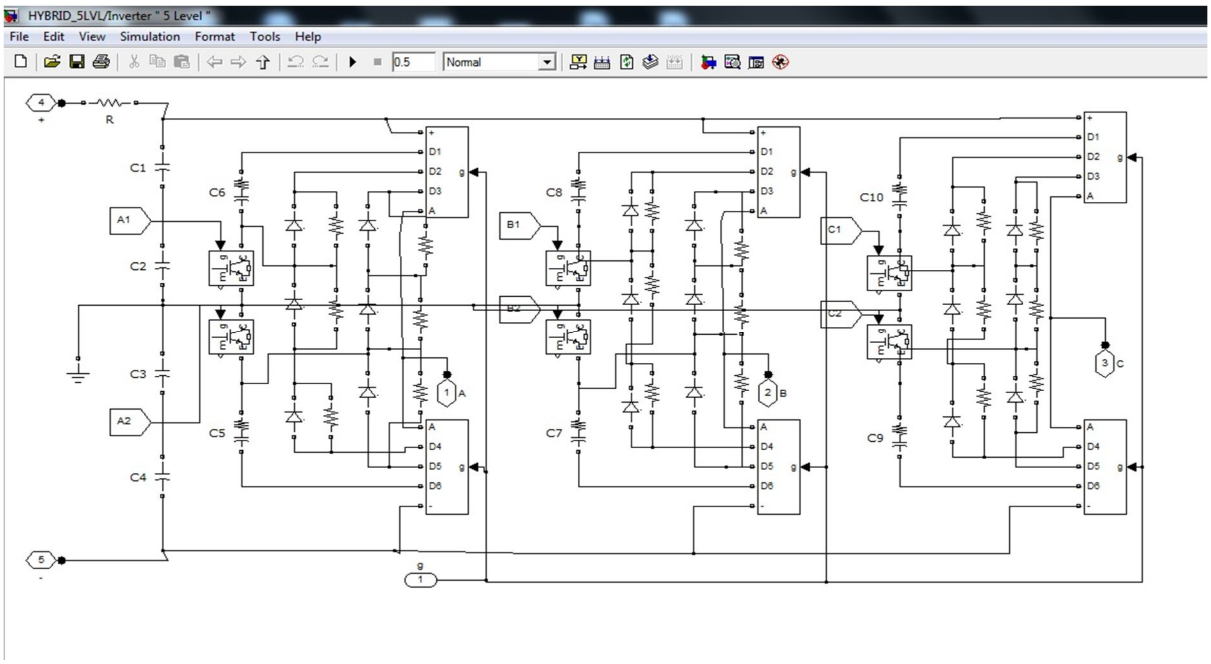


Classification of multilevel modulation methods

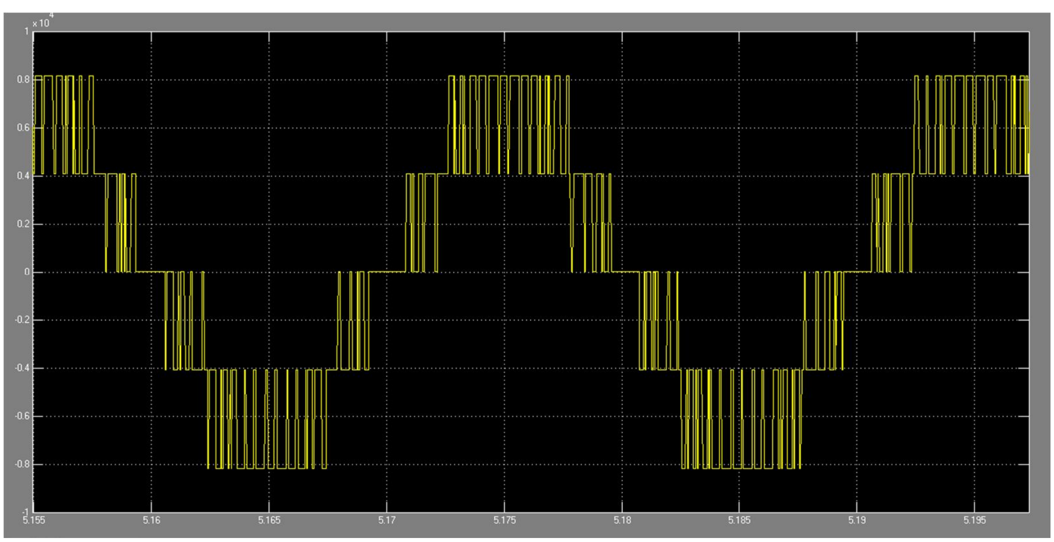
Another interesting method is the SVM strategy, which has been used in three-level converters. Methods that work with low switching frequencies usually achieve one or two commutations of the power semiconductors during one cycle of the output voltages to generate a staircase waveform. Representatives of this family are the multilevel selective harmonic elimination based on elimination theory and the space-vector control (SVC).

III. MATLAB SIMULINK MODEL AND SIMULATION RESULTS

To confirm the process of the projected topology and the presentation of the modulation technique provide in section III, a demonstration is developed and simulated with PSIM software. The presentation of the usual matching technique for a three stage 12kV inverter provide a 5MVA load at manage factor of 0.7 is shown in Centred space vector modulation (CSVPWM) is use at inflection indicator of 1.09 and carrier



Rate of recurrence 5 kHz. The dc-link voltage is set at 18kV and flying capacitors are 330μF. It can be seen that even without an RLC balance booster, the capacitor voltage errors are limited to less than 4%.



Simulation result of Phase voltage

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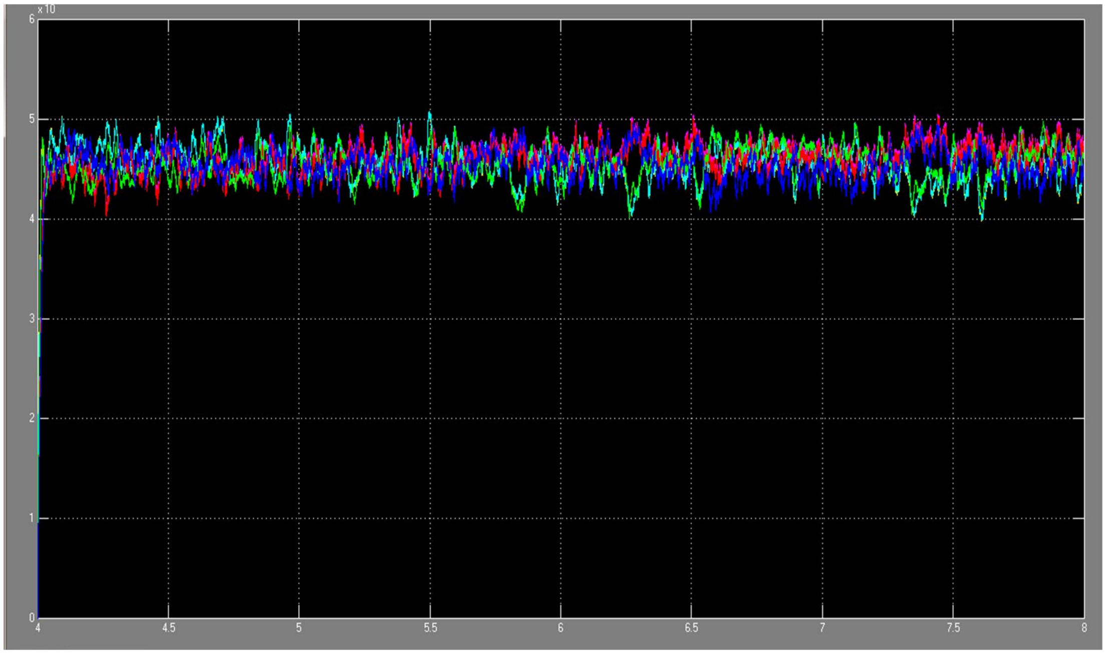
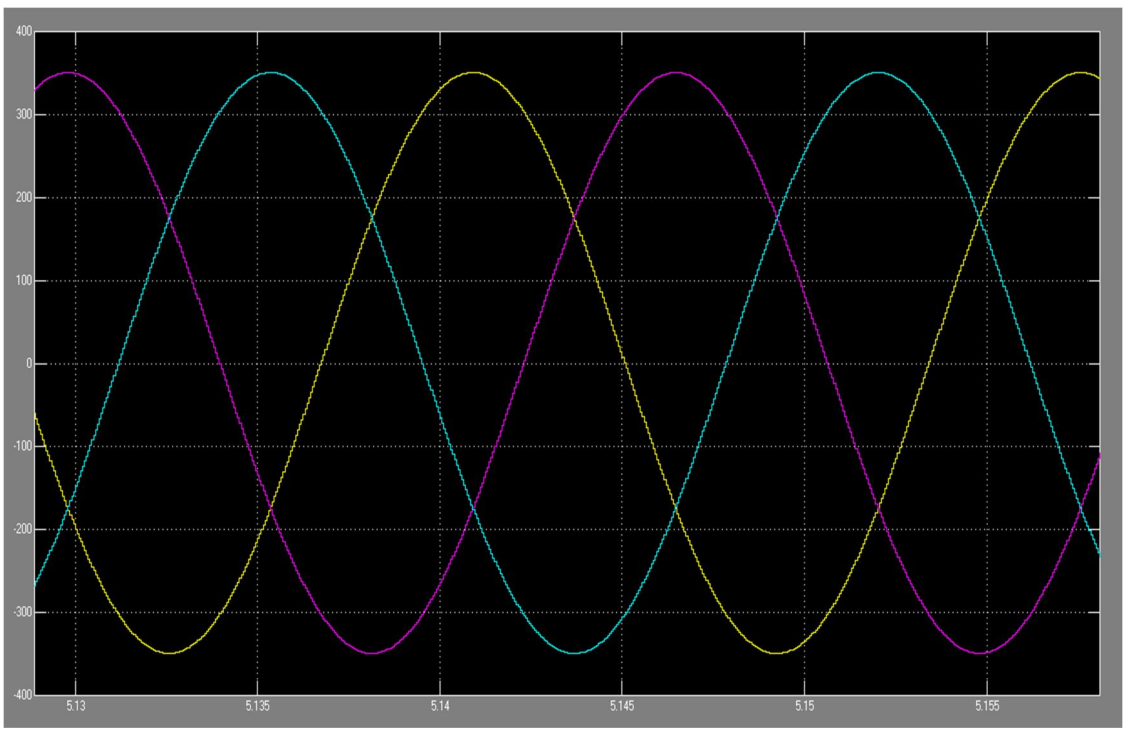


Simulation result of Flying capacitor voltages



Three phase load current

IV. CONCLUSION

A new hybrid 5-level inverter topology and modulation technique is projected. Compared to 5-level ANPC as the most similar topology, this new topology requires 2 less switches at the value of a further capacitor and 6 diodes. However, since the capacitors still see the switching frequency and their size remain a similar, it's expected to cut back the inverter's total value. Also, in contrast to 5-level ANPC, all switches must withstand a similar voltage which eliminates the requirement for series association of switches and associated coincident activate and off drawback. good loss distribution among switches can increase the inverters rated power or give higher switching frequency and smaller capacitance size.

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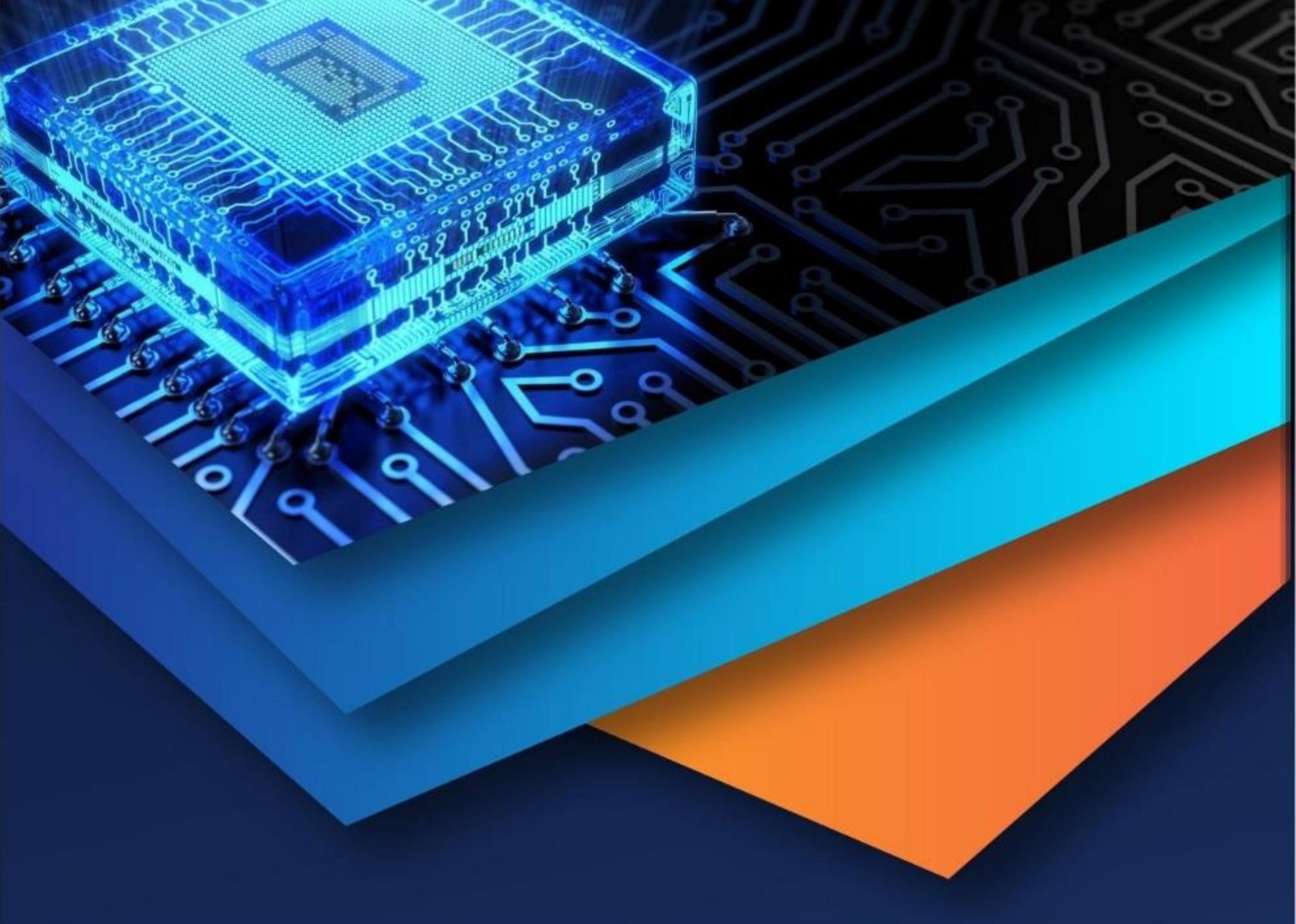

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