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# Performance Evaluation of 1-Phase 5-Level T-style Multilevel Inverter using Advanced PWM Techniques

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**Abstract**— The basic idea of a multi-level inverter for higher power is to use a series of semiconductor(power) switches with multiple reduced voltage dc sources in order to convert the energy by synchronizing a waveform of the staircase voltage. Multilevel inverter is capable of increasing output voltage and efficiency with small switching losses and total harmonic distortion as the level improves the harmonic itself. This paper proposes a 1-phase 5-level T-style inverter with various SPWM strategies having less number of devices which possess high and low power region as compared to conventional inverter. Generally, it is used for low power appliances having maximum efficiency. A 1-phase 5-level T-style inverter has been introduced and multi-carrier PWM technology is used to produce 5-level stage output voltage for multilevel inverter strategies. Furthermore, simulation outcomes of a 5-level multi-level inverter topology are performed using MATLAB. / SIMULINK. R2014a with different SPWM approaches such as PD, POD, APOD, ISWCPWM, HRPWM modulation methods.

**Keywords**— Multi-level inverter (MLI), T-style inverter and SPWM techniques

## I. INTRODUCTION

For converting dc to ac power at a required voltage, an inverter is used. But a multi-level inverter can produce a staircase waveform with lower (THD) distortion, lower switching frequency and greater effectiveness. [1]. A multilevel inverter belongs to power electronic consists of semiconductor devices that are used for medium and high power(current and voltage) applications. While conventional inverter having two voltage level is commonly used for domestic and commercial application since it is simple configuration and highly reliable. However, there is some limitations in high power and performance due to two level inverter output voltage is depend on  $V_{dc}$ . Multilevel inverter offers many special benefits over (2L) two-level inverters, enhancement in waveform, reduces system EMI, and, less switching frequency( $f_s$ ) and reduced voltage and current rating of switches for high power (V&I) rating but disadvantages is the use of number of semiconductor switch are increases but can operate at low frequency also. Each switch needs a distinct PWM drive circuit, thus greatly increases the general circuit size and also makes whole system complex. The SPWM approach is widely used in many systems to fix the harmonic issue of this six-step technique. The loss of switching is more marked when the frequency of switching (devices) is enhanced and the voltage of the DC battery link is reduced.[11] A three-level inverter is therefore being studied for more increase in energy efficiency, reliability, power and use in multiple applications.

The topology of multi-level inverters such as the (3L)three-level inverter was created for medium and high voltage

levels. Among various conventional multilevel inverter are categorized as Neutral-Point Clamped multilevel inverter (NPCMLI), Flying Capacitor multilevel inverter (FCMLI) and Cascaded H-bridge multilevel inverter (CHBMLI) have been extensively used[4]. In 1981 Nabae discussed first 3-level diode (neutral clamped) inverter circuits. These three multilevel inverters the cost of each switch is half and the conductive losses owing to the 2 switch series connection become increases in comparison of two-level inverter. [5]. For low-power (V&I) applications, these three-level inverter topologies are therefore not appropriate. The Five-level T-style inverter (5LTI) has been suggested for high effectiveness and performance in low-voltage applications to mitigate these features in MLI topology.

This document proposes a single phase 5-level T-style multilevel topology requiring fewer switches and gate drivers than standard multilevel inverters. With distinct PWM methods, the T-style topology that was earlier suggested here is introduced in single phase. The pulse-

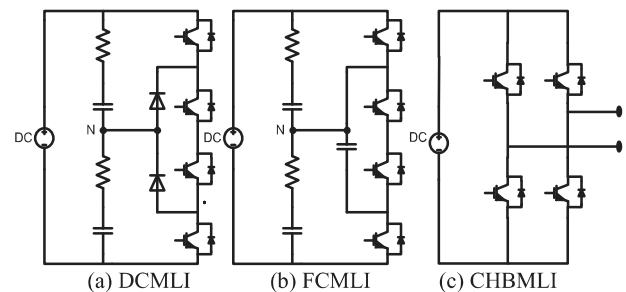


Fig.1.1 Multi-level topologies(conventional)

width control (PWM) is the most effective way to regulate the inverter voltage (output) [6]. The carrier (triangular)-based models used for MLI inverters are very effective technique, when a modulating signal is intersected with a triangular(high frequency) carrier waveform. The article efforts to emphasize that in terms of their quantity of parts and THD, 3LTI are better than standard multilevel inverters. Although the 3LTI is generally implemented and studied for low voltage applications, its application in low power (V&I) domestic appliances is difficult because the enhanced effectiveness is not adequate owing to its complexity and cost issue. [2].