INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH & DEVELOPMENT

ISSN 2278 – 0211 (Online)

# New Model Eleven Level Inverter Using SPWM Technique

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***Abstract:***
*In this paper a new multilevel inverter is introduced to reduce the harmonic distortions and to require a high performance in industrial applications. By the new multilevel inverter, the power switches are reduced which leads to the minimization of cost and complexity of the system. Where in this paper we used SPWM (Sine Pulse Width Modulation) technique for the reduction of harmonic distortions and to improve the efficiency. The simulation is used to compare the signals for the advanced results in this topology for the better performance or efficiency.*

***Keywords:*** *Multilevel inverter, Sine Pulse Width Modulation (SPWM), Total Harmonic Distortions (THD).*

## 1. Introduction

Now days 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 require high power, while it damage the other loads. The multilevel inverter is introduced as alternative in high and medium voltage states. The multilevel inverter is like an inverter and it is used for industrial applications as alternative in high power and medium voltage states. The need of a multilevel converter is to give a high output power from medium voltage source. Sources like batteries, super capacitors, solar panel are medium voltage sources [1]. The multilevel inverter consists of a several switches. A multilevel inverter is a power electronic device which is capable of providing desired alternating voltage level at the output using multiple lower level DC voltages as an input. Pulse width modulation is a modulation technique used to encode a message into a pulsing signal and its main is to allow the control of the power supplied to electrical devices [6] [7]. Pulse width modulation uses a rectangular pulse wave whose pulse width modulation is modulated resulting in the variation of the average value of the waveform. Whereas sine wave is used instead of a rectangular in PWM which is Sine pulse width modulation to modulate the signal in the method [9]. In the SPWM, switching signals are fed to the FET's that are used in the device. The devices efficiency depends on the harmonic content of the PWM signal.

Generation of the desired output voltage is achieved by comparing the desired reference waveform with a high frequency. Depending on the signal voltage whether larger or smaller than the carrier waveform which is applied at the output. The average voltage applied to the load is proportional to the amplitude of the signal during this period [5] [8]. Here the multilevel inverter is used for a high voltage application in which the two level produces the voltage stress and require more number switches, so we are going to the new multilevel inverter to reduce the harmonic and to use for the high voltage applications. The previous topologies are compared to the Sine pulse width modulation for the better results to use for the further applications [4]. The types of topologies are a) Neutral point clamped (NPC) b) Flying capacitor c) Cascade H-Bridge (CHB). These converters provide better power efficiency and high output power quality which can be used for industrial applications. By using these converters practically when the number of level increases the number of switches also increases and it leads to the complexity of the system.

## 2. Pulse Width Modulation Technique

Recently, the multilevel inverter has drawn tremendous interest for voltage and high power applications. The general structure of multilevel inverter is to synthesize sinusoidal voltage waveform from several levels of voltages typically obtained from capacitor voltage source [5]. Low ratio of carrier frequency modulation to modulation frequency which is the best form of modulation for high power applications which is operating field for multilevel inverter. In this we are using the modulation techniques for more efficiency, Pulse Width Modulation (PWM) is a technique to generate low frequency output signals from high frequency pulses [9].

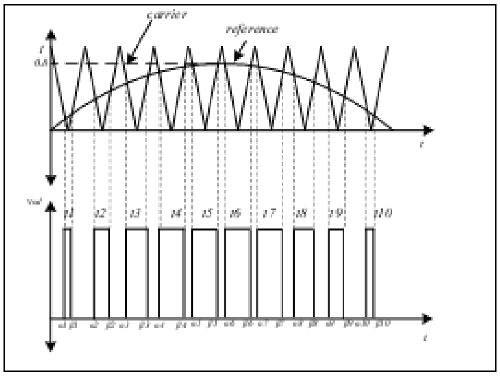


*Figure 1: Generation of SPWM*

PWM output signals are constructed by comparing two control signals, a carrier signal and a modulation signal. This is known as carrier-based PWM. The carrier signal is a high frequency (switching frequency) triangular waveform [1]. The modulation signal can be of any shape. The two main ways, which use switched mode inverters, are square wave and the pulse width modulation. In PWM, adjusts the both frequency and magnitude.

*2.1. Sine Pulse Width Modulation*

Sinusoidal PWM is a type of "carrier-based" pulse width modulation. Carrier based PWM uses pre-defined modulation signals to determine output voltages. In sinusoidal PWM, the modulation signal is sinusoidal, with the peak of the modulating signal always less than the peak of the carrier signal [1][4]. As an alternative of, maintaining the width of all pulses of same as in instance of multiple pulse width modulation, the width of each pulse is varied in proportion to the amplitude of a sine wave evaluated at the Centre of the same pulse. The distortion factor and lower order harmonics are reduced significantly [7]. PWM switching techniques have a DC input voltage that is frequently constant in magnitude. The inverters work is to take this input voltage and output ac where the magnitude and frequency can be controlled [8]. In this method, the preferred output voltage is achieved by varying the frequency and amplitude of a reference voltage or modulating voltage. SPWM based on two level SPWM with triangular carrier and sinusoidal reference waveform. SPWM techniques can be classified on the basis of carrier signals are as follows: a) Phase Disposition (PD) b) Phase Opposition Disposition (POD) c) Alternate Phase Opposition Disposition (APOD). Here the PH techniques produces less harmonics on a line-to-line basis. The circuit is given below is a new multilevel inverter.

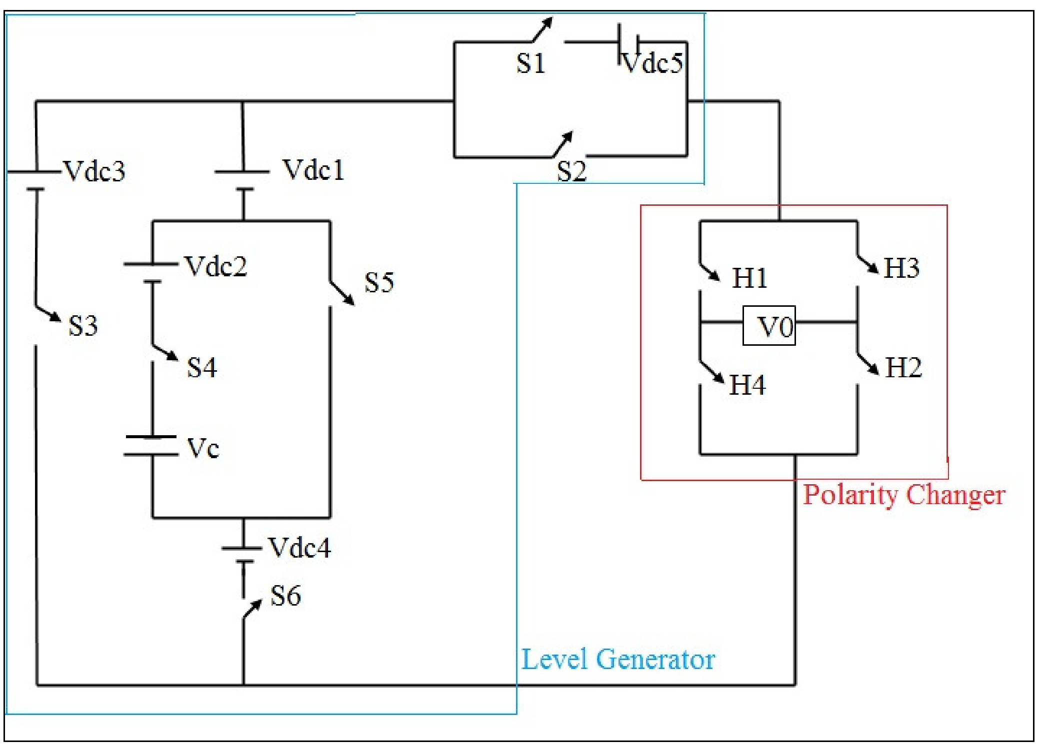


*Figure 2: Circuit diagram of new multilevel inverter*

The above multilevel inverter describes the first half has level generator and the second half as polarity generator. The above system is used to convert the DC to AC source. The first half is used to convert DC into stepped DC output waveform. This level generator has high switching frequency and 6V DC power source is given to each source where the power source is present at the level generator. The second half represents the polarity generator which converts the stepped DC to AC. And the polarity generator mostly works under the low switching frequency.

*2.2. Simulation Results*

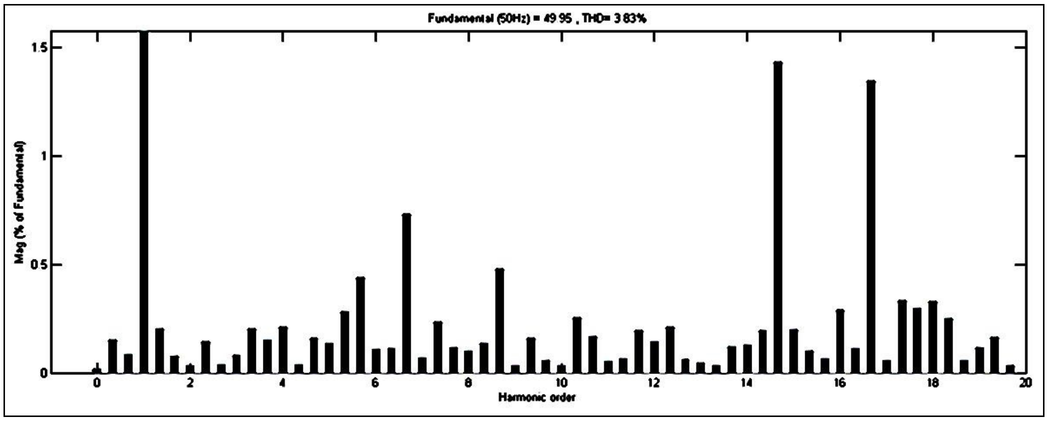


*Figure 3: THD rate for new multilevel inverter in PDSPWM technique*

In the above diagram the rate of THD is shown that 3.83% for new multilevel inverter in the PDSPWM technique and the THD rate of PODSPWM is 3.80% where the PDSPWM is better than the PODSPWM.

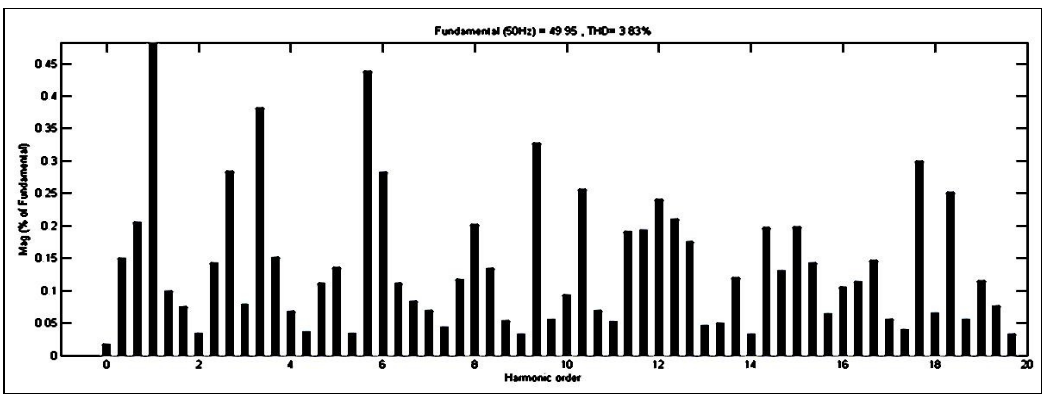


*Figure 4: THD rate of new multilevel inverter in PODSPWM technique*

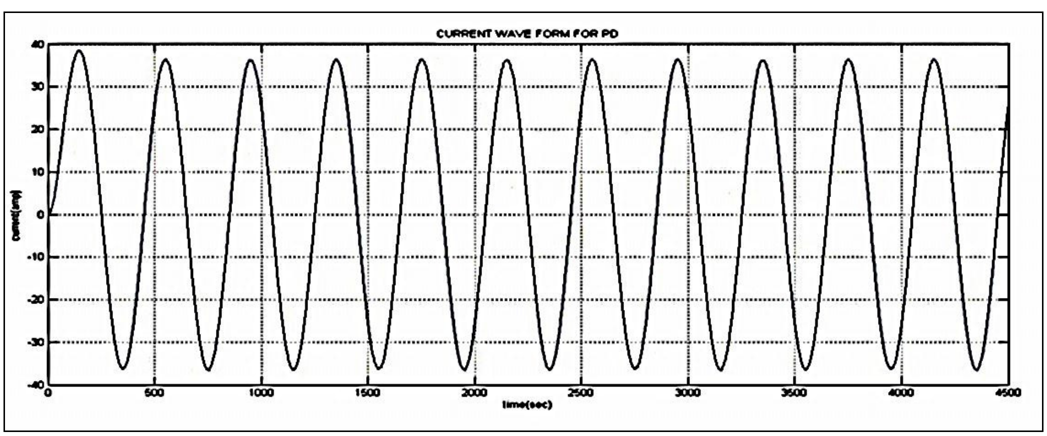


*Figure 5: Current waveform for new model multilevel inverter in SPWM technique*

In the above diagram, the current waveform shows the current phase and neutral of the multilevel inverter circuit output. Where the X-Axis represents the time and the Y-Axis represents the current.

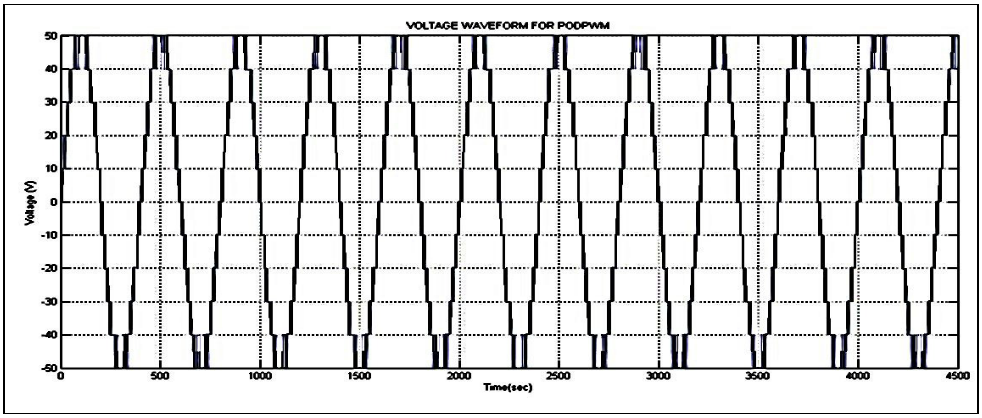


*Figure 6: Voltage waveform for new multilevel inverter*

The above figure shows the voltage waveform of a new multilevel inverter, here the X-axis represents the time and the Y-Axis represents the voltage. The voltage range is 50V.

| Sine Pulse Width Modulation | | | | |
|---|---|---|---|---|
| TYPE | PD | IPD | POD | APOD |
| THD | 3.83% | 3.80% | 3.83% | 3.83% |
| IRMS | 27.48 | 27.49 | 27.5 | 27.49 |
| VRMS | 37.05 | 36.97 | 37.05 | 36.98 |

*Table 1: Comparison of output*

The above table describes the comparison of outputs of the various modulation technique.

*2.3. Conclusion*

This paper proposed a new multilevel inverter using the Sinusoidal Pulse Width Modulation technique and analyzed the results for the best performance and their efficiency. It shows the decrease in the harmonic distortions as the frequency increased.

By comparing the various techniques, the SPWM is better in efficiency and it is concluded that the SPWM is the best by comparing the various techniques and the Total Harmonic Distortions are reduced when number of levels increase.

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