

A 12 Switch Operated 19-Level Inverter to Reduce Distortion

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Abstract- The idea of a multilayer inverter originated from the development of inverters to more than two layers in order to lessen distortion from the basic sinusoidal waveform. One drawback of employing multiple level inverters is the installation of more switches, which raises system bulk and cost and reduces system dependability due to the increased component count. In order to address the issue of the system becoming bigger, more expensive, and less dependable with less distortion, this work provides a nineteen-level inverter (19-LI) with fewer switches than a symmetrical H-bridged nineteen-level inverter. The idea is developed using the MATLAB platform, then analysis is done to determine how valuable the final product is.

Index Terms- 19-Level Inverter (19-LI), Pulse Breadth Modulation (PBM), Switches

I. INTRODUCTION

Direct current (dc) electricity is converted to alternating current (ac) power at a predetermined voltage and frequency using a power-electronic device called an inverter [1-2]. It is more dependable and effective since it is a power electronic gadget with no moving parts and a high switching ability. Nowadays, an inverter is an essential part of the electrical sector and not just a hobby. The output wave of a basic sine wave with the same period and frequency is slightly warped since a fundamental inverter only has two levels. By raising the chance of a breakdown and introducing harmonics into the circuit, this reduces the system's overall efficiency [3], [4]. Because harmonics produce distortion and system heat, they are bad for the load as well as the power system as a whole. Consequently, the idea of a multilayer inverter was developed, where the levels of the inverter are raised to reduce the distortion of the outgoing wave. The output wave becomes more sinusoidal as the level rises, reducing the harmonic content [4]–[6]. Devices known as multilevel inverters use DC voltage sources to measure the voltage across the load and calculate the levels. Additionally, utilising various switching topologies, the circuit is completed via many routes in a single full wave cycle for varied times.

Dual level inverters have the drawback of having higher harmonic distortion, while multiple level inverters can prevent this. This artwork displays a 19-level inverter with fewer switches (19-LI). Compared to a traditional 19-level H-bridge inverter, the presented 19-LI has less components even if it looks like an H-bridge. A multiple voltage level inverter with two symmetrical blocks and four distinct level DC sources is shown in Figure 1. The current arrangement has twelve

switches. A distinct pulse must be sent to each of the 12 switches in order to analyse the varying voltages under load at various intervals. The control of this system is designed with KVL in mind to guarantee that the necessary voltage is available during load.

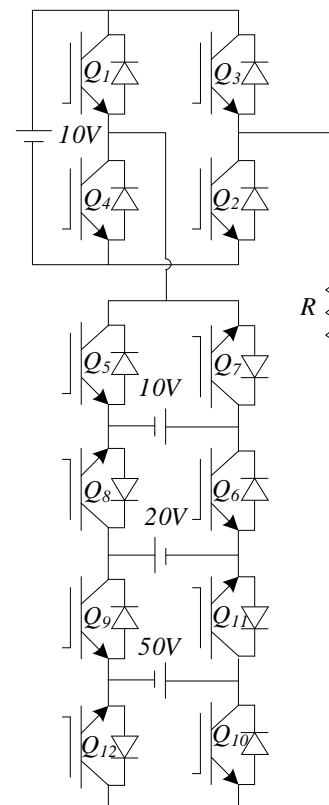


Fig. 1 Presented 19-LI

This section of the article provides a detailed explanation of how the 19-level inverter that is being presented operates.

The inverter's voltage levels are +90 V, +80 V, +70 V, +60 V, +50 V, +40 V, +30 V, +20 V, +10 V, 0V, -10V, - 20V, -30V, - 40V, -50V,-60V, -70V, -80V, -90V. These four values are used to verify these topologies: 10V, 10V, 20V, and 50V. to explain the operation of the inverter that is being displayed.

The network for each of the seven modes is set up in Fig. 2(a)–(g), and each mode is explained as follows.

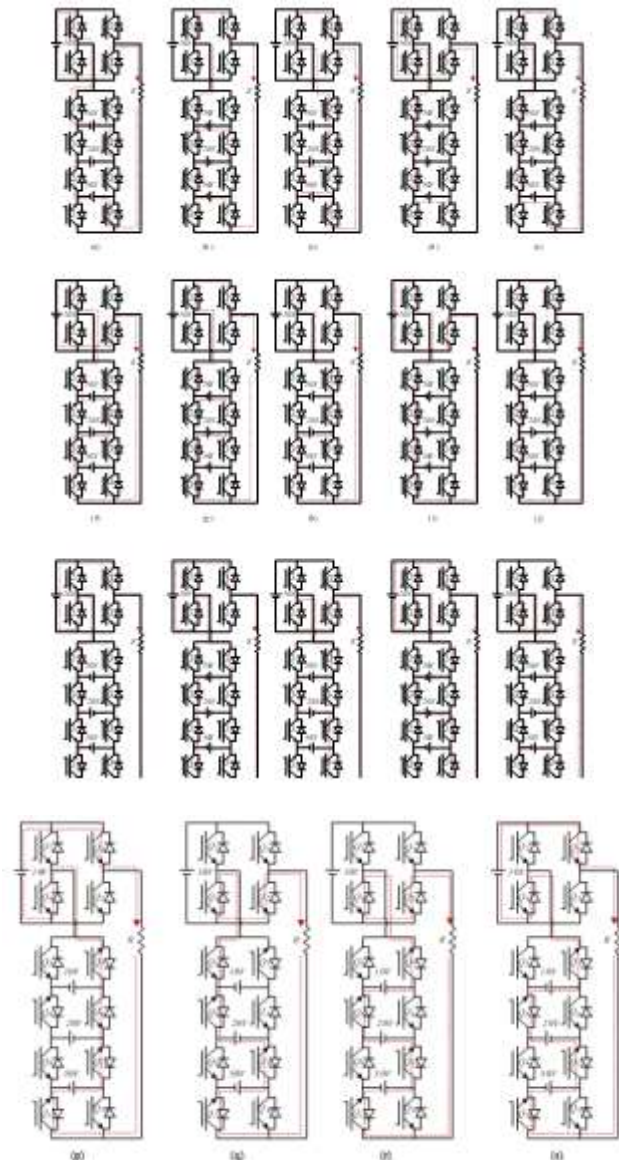


Fig.2 A 19-level inverter working during different load voltage levels (a) +90V, (b) +80 V,(c) +70 V, (d) +60V, (e) +50V, (f) +40V, (f) +40V, (g) +30V, (h) +20V, (i) +10V, (j) 0V, (k) -10V, (l) -20V, (m) -30V, (n) -40V, (o) -50V, (p) -60V, (q) -70V ,(r)(-80), (s) -90V.

- **Mode A:** Q10, Q9, Q6, Q5, Q1, and Q2 switches are activated during mode-A. The potential across the load is measured using Kirchhoff's rule for voltage, yielding +90 V.
- **Mode B:** Q10, Q9, Q6, Q5, Q1, and Q3 switches are operational during mode-B. The potential across the load is measured using Kirchhoff's rule for voltage, yielding +80 V.
- **Mode C:** Q10, Q9, Q6, Q7, Q1, and Q3 switches are operational during mode-C. The potential across the load is measured using Kirchhoff's rule for voltage, yielding +70 V.
- **Mode D:** Q10, Q9, Q8, Q5, Q1, and Q2 switches are operational during mode-C. The potential across the load is measured using Kirchhoff's rule for voltage, yielding +60 V.
- Kirchhoff's voltage rule can thus be used to compute the voltage across the load in various modes. The voltage for each mode is listed in the table below.

II. CONTROL

As illustrated in Fig. 3, the current method enhances the sine quality of the observed waveform under load by employing the phase opposition deposition level shifting pulse breadth modulation technique.

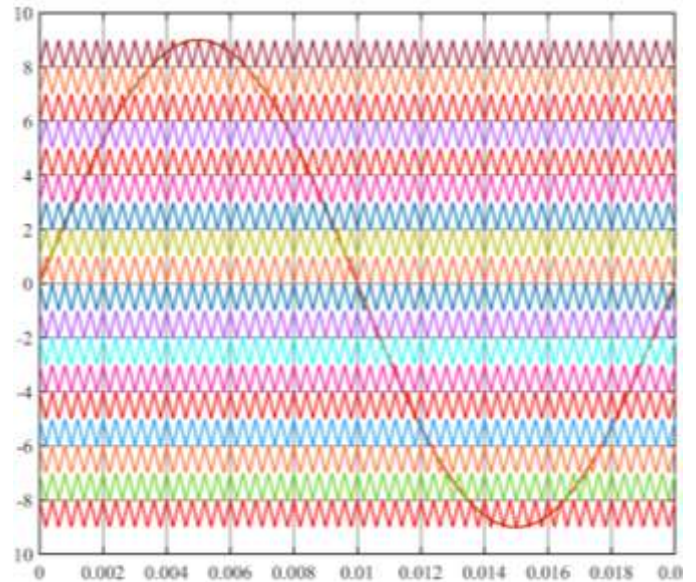


Fig.3 Phase opposite level shift deployed PBM scheme

To provide interception with a perfect sine wave for the extraction of the gate pulse for the 19-LI, the phase deposition technique employs a number of level-shifted waves with 180 degree phase variations. The waveform for inverter control using the same level-shifted, phased pulse width modulation is shown in Figure 3.

III. RESULTS

This section illustrates and describes the output wave shape of the 19-LI-based phase deposition level shifting pulse breadth modulation technique. The output waveform of the seven-level inverter is displayed in Fig. 4.

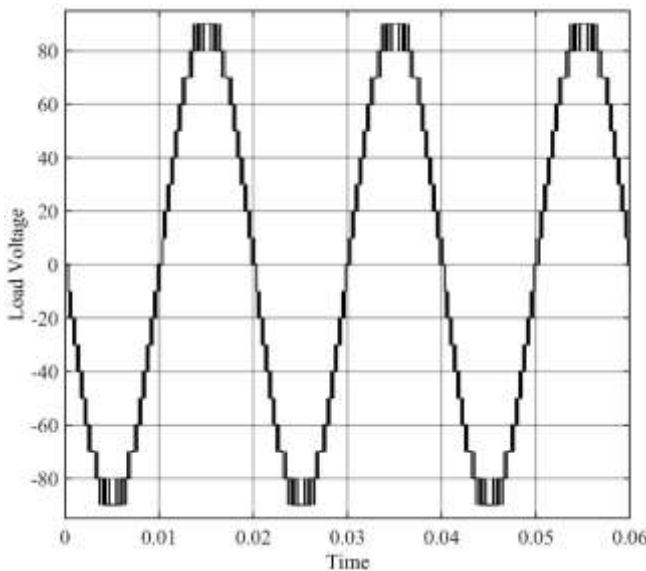


Fig. 4 19-LI outcomes

The output clearly shows an increase in sine nature when compared to the square wave output of a two stage inverter. The harmonic disturbances are displayed in Fig. 5. A two-level inverter produces a square wave as its output, however the image above shows how the output wave's sine nature has changed. The lower THD is similarly found to be 9.21%.

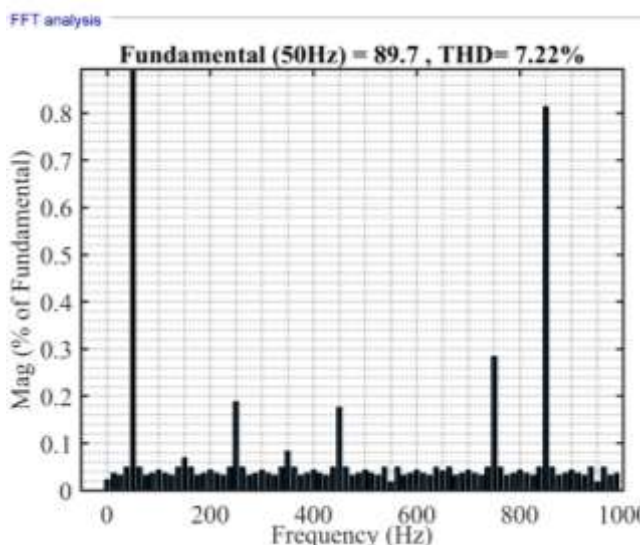


Fig.5 THD Profile

IV. CONCLUSION

This section looks at the inverter's output waveform, which appears to be getting close to a sine waveform. At approx. 9%, harmonic disturbances are found.

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