

Study and Implementation of 19-Level Multilevel Inverter and Its Configurations

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ABSTRACT

We can't envision a day in the twenty-first century without electrical appliances, and the most important thing is to have an uninterrupted power supply. In the construction of a continuous running power supply system, the inverter is an essential part. This project proposes a novel pulse-width-modulated (PWM) control scheme and a nineteen-level single-phase multilevel inverter with reduced switch count. The output voltage level of the proposed multilevel inverter is increased by using eight switches driven by multi-carrier modulation techniques. The inverter can generate 19 levels of output voltage from the dc supply voltage using an asymmetrical configuration. The proposed system was tested using MATLAB simulation, and the DSPIC30F2010 controller was used to implement the hardware.

Keywords : multi-level inverter (MLI), pulse width modulation (PWM), total harmonic distortion (THD).

1. INTRODUCTION

Large inverters had been used to meet the growing need of high-power industrial applications, which might range from tens to hundreds of megawatts. The medium voltage range (2,3-13,8 kilovolt) of AC engines is some examples of this fact. Because of the high voltage range, connecting only one semiconductor switch to the grid directly is difficult. To put it another way, a new type of power converter has been implemented in high-power applications as a way to address this difficulty. Multilevel converters use high-speed switching modules that prevent the problem of connecting them to the grid directly by connecting individual devices to

multiple DC stages[1-4]. Many implementations include multi-level converters; automotive engine drives, renewable energy systems interfaces (photo-voltaic, wind, and fuel cell systems)[5], high-voltage, direct current transmission systems (HVDC), and traction systems. In different applications, multi-level converters are also available.

Such benefits of using this type of converter are:

- ❖ They work at a lower switching frequency than the traditional converter.
- ❖ A very low harmonic distortion can be drawn input current.
- ❖ They reduce the machine tension so that it generates a lower voltage mode.
- ❖ A staircase waveform can be produced as an output with less harmonic .

Several multilevel topologies have been developed in recent years. The number of switching alternatives available makes it more difficult to modulate than the two-level conventional converter[6-7]. Besides, several modulation techniques for these converters have been developed. Two modulation techniques are Sinusoidal Pulse Width Modulation and Selective Harmonic Removal[8-11]. The modular multi-level converter is the newest and best available topology for high-performance applications (M2C). For this topology, different methods of control and modulation were proposed. This master thesis aims to study and test one of them, based on a Pulse Width (PWM) technique, which is phase-shifted, with the carrier[12-15].

2. MATERIALS AND METHODS:

This system is made up of a single-phase conventional H-bridge inverter, 4 switches, and 4 voltage sources. MOSFETs are the switching devices used in this application[16-17]. As compared to other transistors such as BJT and IGBT, its operating frequency is higher and it produces lower switching losses. It's also compact and cost-effective[28][29]. As compared to inverters with the same number of levels, the H-bridge topology has major benefits over other topologies, such as fewer voltage switches, power diodes, and ideally no capacitors, as compared to inverters with the same number of levels[18-27][30][31]

2.1 OBJECTIVE

The main purpose of this research is to learn,

- ❖ The generation of 19-level AC output is based on DC sources such as batteries and solar panels.
- ❖ The switch count is to be condensed in this proposed system.
- ❖ Total Harmonics distortions (THD) are to be reduced in the output.

2.2 WORKING PRINCIPLE

For this nineteen-step inverter, a MOSFET-based complete bridge inverter circuit is cascaded are shown in figure.1. This H bridge inverter circuit already has three switches attached to it. To shield the switching devices from dv/dt and di/dt ratings, a snubber circuit (RC) is wired over both switches. The three switches are connected in series by three diodes. When the switch is opened, it completes the circuit. The simulink model are shown in figure.2

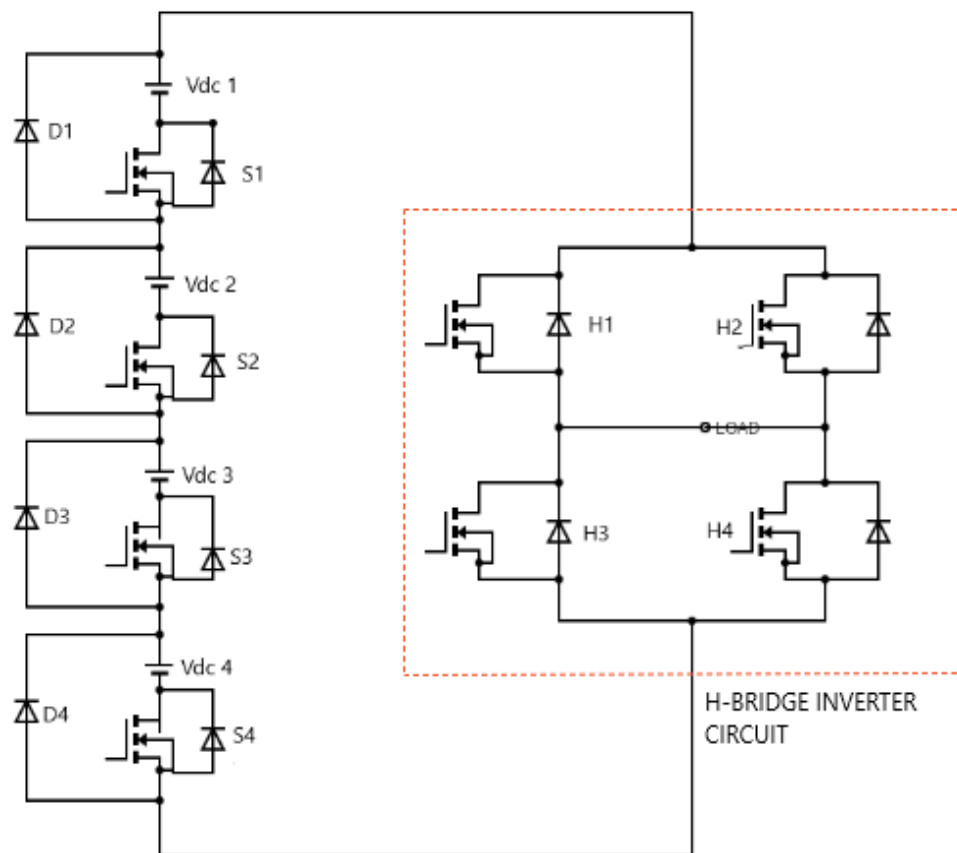


Figure.1 Circuit diagram for 19-level MLI

3. SIMULATION RESULTS:

3.1 PROPOSED SYSTEM SIMULINK:

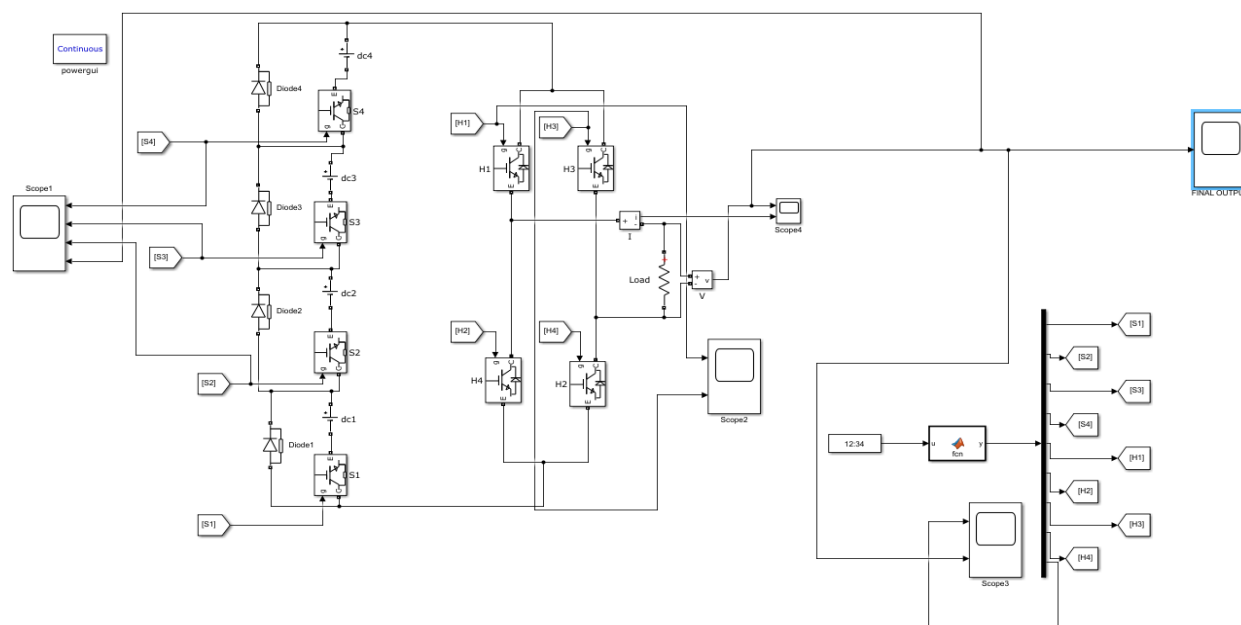


Figure.2 Simulation Model

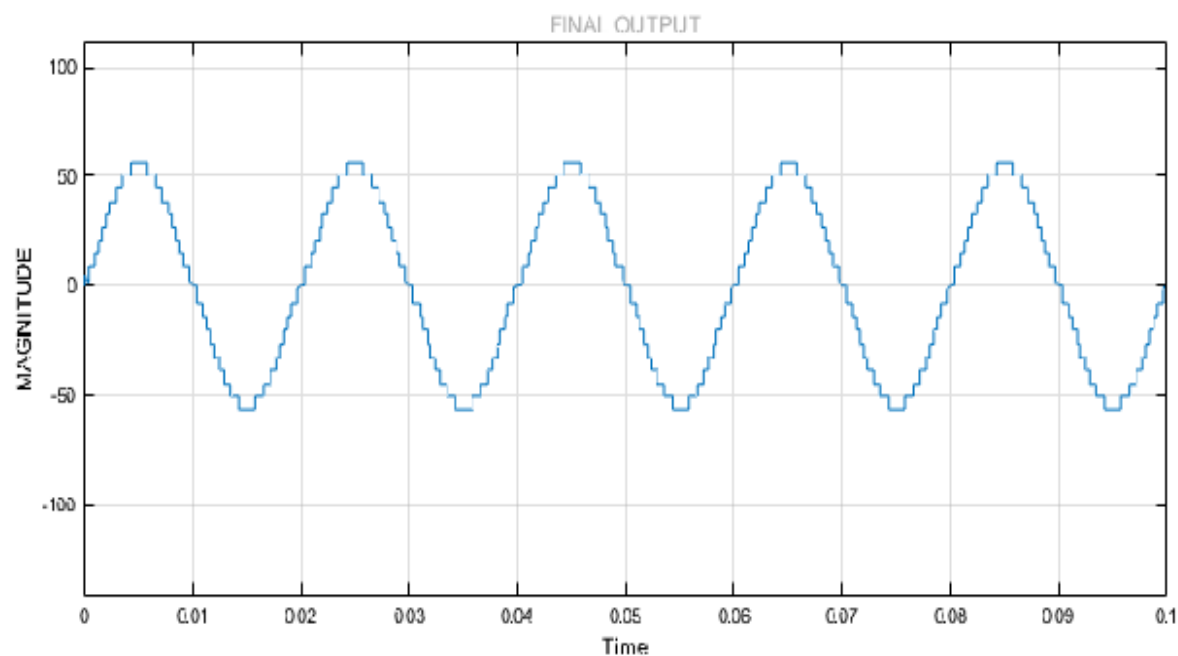


Figure.3 Proposed 19-level inverter output

The voltage waveforms of a nineteen-level inverter is seen in the fig.3. The waveform of the output voltage is almost sinusoidal. With just eight switches, the proposed topology was able to

achieve the nineteen-level output voltage. Its THD value also complies with the IEEE harmonics normal are shown in figure.4

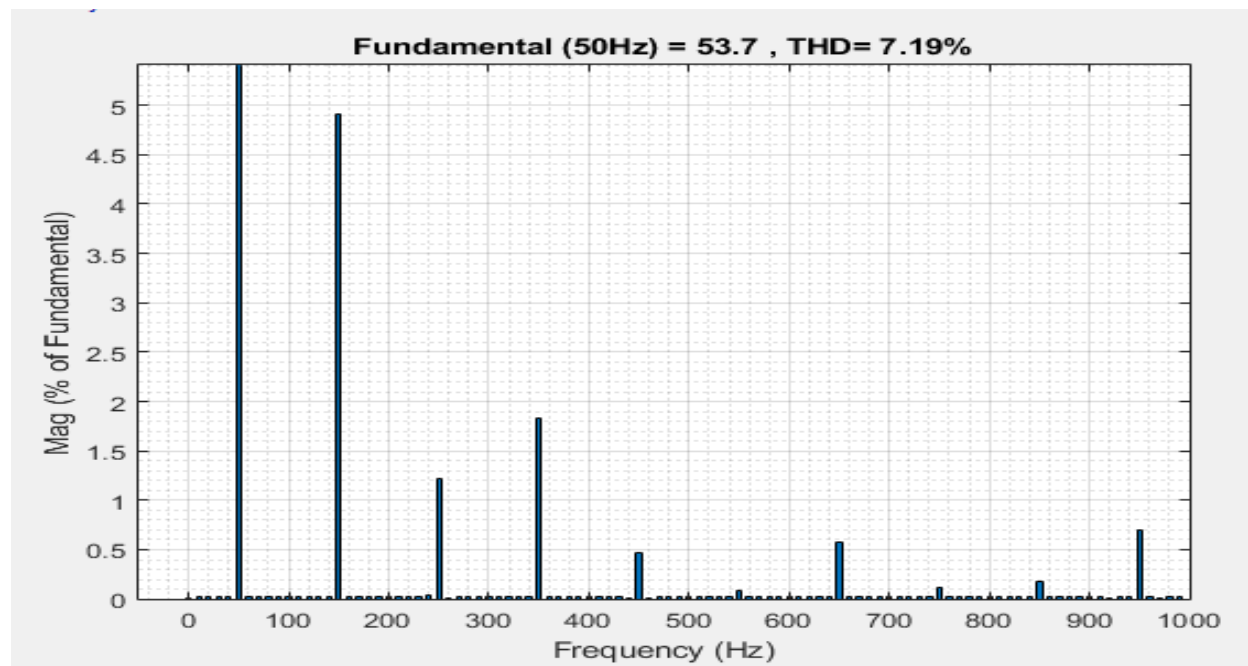


Figure.4 THD value of the nineteen-level output voltage

4. CONCLUSION

Multilevel inverters produce better output waveforms with less THD. This article has presented a new PWM system for the multi-level inverter proposed. Only one reference signal is used in this project, and it is compared to a triangular wave signal to generate PWM signals. In these multi-level inverters, three different levels of DC voltage are used. As a result, this configuration is known as an asymmetrical cascaded inverter. The nineteen levels of the output voltage are achieved by controlling the modulation index and different levels of DC voltage. By feeding the nineteen-level output voltage into a matrix converter, we can obtain variable AC output voltage. The nineteen-level inverter can power any industrial AC load. The output of the nineteen levels can be increased even more. When renewable energy sources are used effectively, overall system efficiency can be improved.

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