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Simulation of Three Levels Single Phase Inverter Using Proteus Software.

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Abstract. Photovoltaic is use to supply electricity from sunlight. Inverter is used to convert the direct current (DC) from photovoltaic to alternating current (AC). This project is to design and develop a single phase inverter that able to invert the input voltage of DC to and voltage output of AC using PROTEUS software. The inverter based on 8 bits for one cycle of a driver pulse wave. This simulation used before doing the hardware. This software can save a lot of time on this exact simulation of the prototype.

Introduction

The inverter is one of the power conversion devices that widely use in the world to convert DC input voltage AC output voltage. The output voltage waveform of ideal inverters should be sinusoidal. However, the waveform of practical inverter is non-sinusoidal and contains harmonics. The electronic devices, managed by this inverter will be damaged due to the contents of harmonic. The disadvantage of the conventional inverter is less efficient, high cost and high the switching losses. The multilevel is the best solution for the disadvantage of the conventional inverter. The concept of the multilevel inverter is to achieve high power energy which is for renewable energy application such as in wind power, solar energy, hydro power, biomass and geothermal energy. The multilevel also is used for high power and high voltage application.

Proteus Ares application designed by Labcenter Electronics company developers is schematic capture circuit with capability to simulate not only standard analog and digital components, but it can also simulate the programmable components like microcontrollers, LCD displays with built in graphic controllers, or components with specific communication protocols. It is very useful tool in creating animated presentations of circuit and PCB design functionality. the microcontroller drawn on the schematics diagram, and select the file somewhere on our disk containing the code executable by that microcontroller. If everything done right, our code compiled with the same tools used for the real microcontroller will execute on the virtual component, but the operation will also be determined with other components on the schematic diagram surrounding the microcontroller[1].

Procedure of three-level inverter

Generating a sin wave centered on zero voltage requires both positive and negative. This can be achieved from a single source through use of H-bridge inverter circuit in Figure 1. In standard H-bridge circuit switch S1(MOSFET 1), S3(MOSFET 3), S2(MOSFET 2), and S4(MOSFET) are arranged in this configuration [2]. Both gating signal Gs1(gate MOSFET 1) and $Gs_{4(\text{gate MOSFET 4})}$ are switched simultaneously at one half of a cycle while both gating signals $Gs_{2(\text{gate MOSFET 2})}$ and $Gs_{3(\text{gate MOSFET 3})}$ are simultaneous switch at the other half [3] [4].

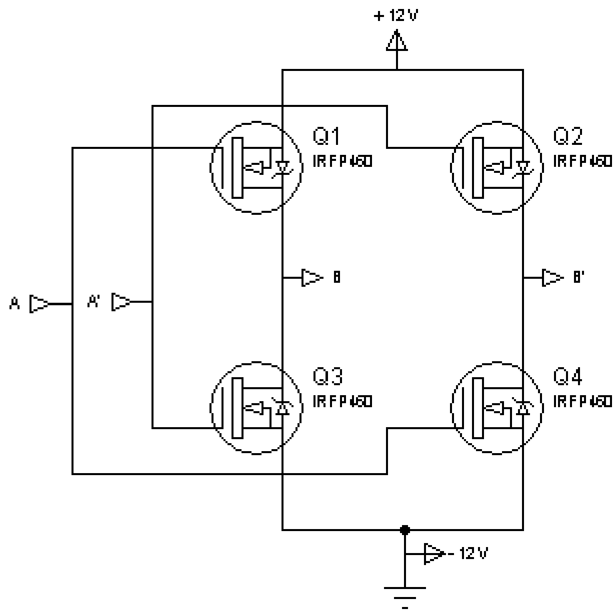

Figure 1: The Full bridge single phase inverter.

The simulation of TPVI is simulated using Proteus as stated below:

1. in the simulation of the three level single phase inverter produce two pulse wave outputs of microcontroller will drive the full bridge inverter circuit. The end of the full bridge inverter circuit produce an AC three level single phase voltage waveform.
2. the program in C language in PIC C compile the program to create an AC three level single phase voltage waveform with frequency of 50 Hz.
3. compile the listing program into hexadecimal number. The complete is done to fill the number into the microcontroller PIC16F877A.
4. the hexadecimal file is import to the PIC model in PROTEUS simulation circuit to run the circuit.

The procedure to produce the AC three level voltage waveform of the three level single phase transformerless PV inverter that has been explain above can be simplest in flow chart as shown in Figure 2.

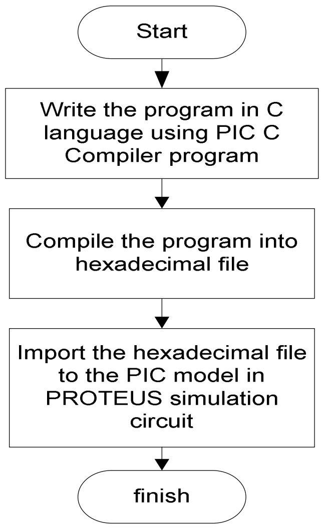

Figure 2: Flow chart of procedure to produce the AC three level voltage waveform.

Figure 3 shows the duty cycle for MOSFET using programs in the microcontroller. The delay uses 7500us and 2500us. From PIC16F877A used pin b_0 (point A) and b_1 (point A') to generate the inverter circuit. In PROTEUS software the program from the microcontroller it just installs to the PIC model in PROTEUS so the result will shown in digital oscilloscope.

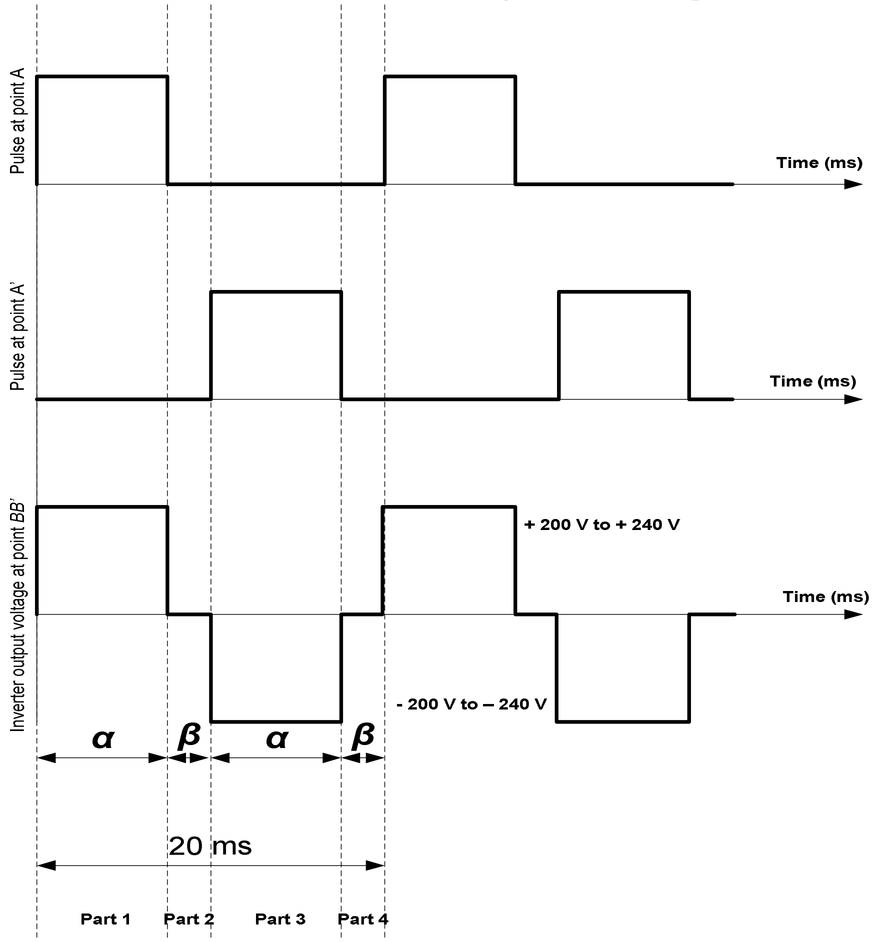

Figure 3: The duty cycle for PIC programmer.

Figure 4 shows that the schematic diagram setup of the implementation inverter circuit to obtain sinusoidal wave AC output voltage. These values are agreeing with the voltage and frequency of the grid, the PIC16F877A is operating at clock speeds of 20MHz.

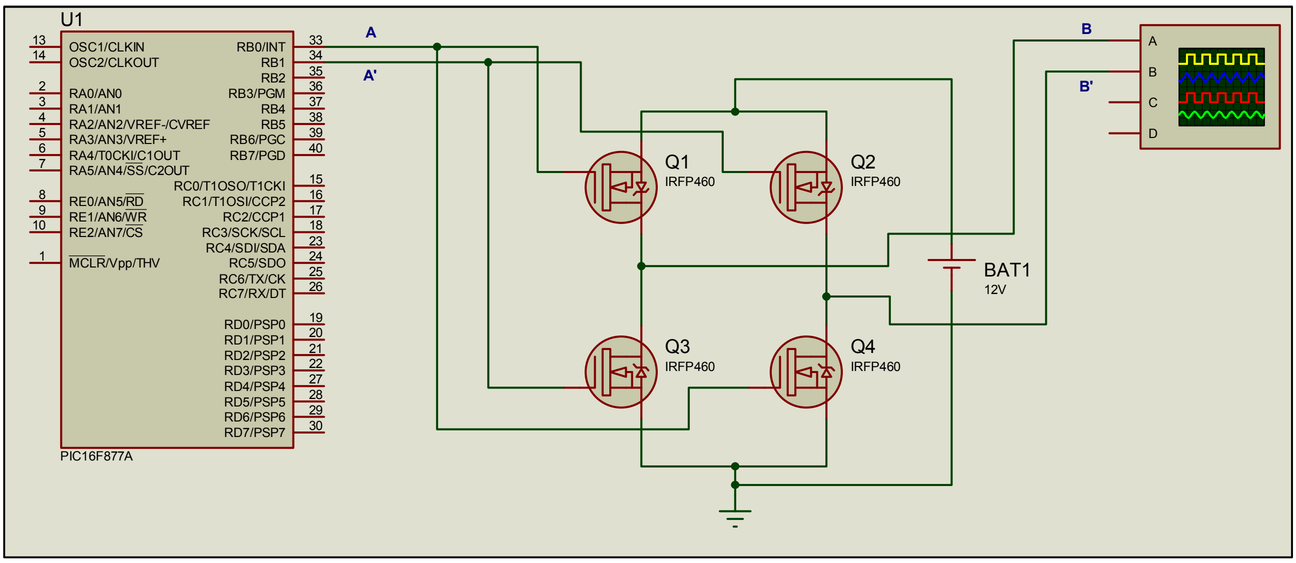

Figure 4: Schematic diagram

Result and Discussion

The circuit diagram of the full bridge and driver circuit shown in Figure 4. The illustrated, full bridge inverter consist of four IRFP460 of high power MOSFET switches, battery 12V supply for the MOSFET and PIC microcontroller program for the circuit. The operation of the circuit follows, the MOSFET driver IRFP460 is used to apply the switching pulse coming from the microcontroller to the MOSFET switch. Microcontroller is storing command to generate the pulse width modulation waveform. The microcontroller is providing the variable frequency pulse width modulation signal that controls the applied voltage on the gate drive by using the system of PIC16F877A. The microcontroller is flexible and simple to change control algorithms in a real time without further change in hardware and reduce the complexity of the control circuit for the signal phase inverter. The application of this inverter is to be either for stand alone or for grid connection from a direct supply of photovoltaic [5]. Figure 5 shows the simulation result of an output waveform of the bridge single phase inverter. The output voltage of bridge inverter has a periodic waveform that is not sinusoidal wave. The frequency of the output waveform of the simulation is 50Hz. This frequency is exactly equal to grid frequency. The three level inverter single phase AC output is shown in Figure 6.This output same with the theorytical as shown in Figure 3.

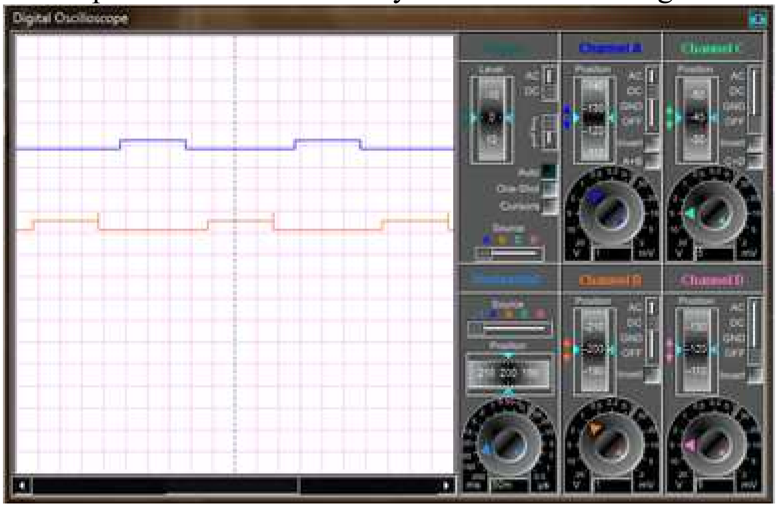

Figure 5: The DC input in Proteus software.

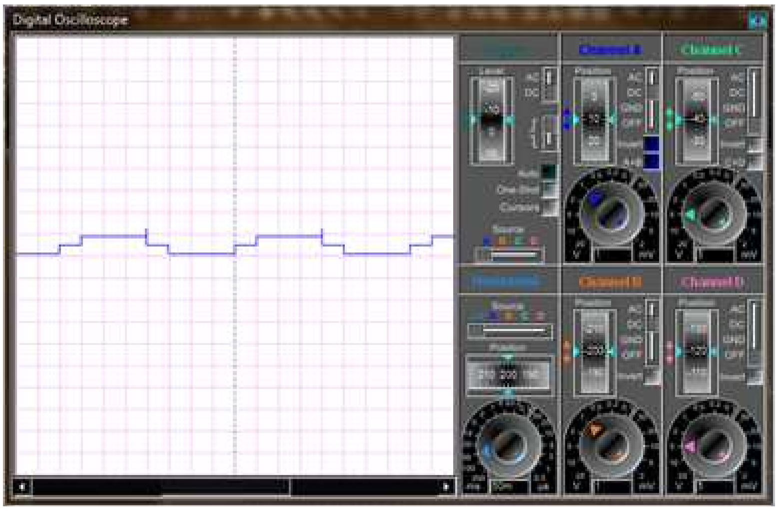

Figure 6: Three level AC output in Proteus software.

Proteus is used to simulate the electronic and electromechanical components and system while watching animated behavior on the screen. LED segments are going bright when specified current starts flowing through them. This software shows the output from the oscilloscope same the function with the real oscilloscope, so it's easier to use this software for testing the circuit before doing in hardware.

Conclusion

The Proteus software is very suited for educating future engineering in a wide area of application. The software is easy to use during teaching basic electrical circuit which can be used to describe a system that includes a software design. A single phase bridge Cascaded multilevel inverter research has been successfully completed and presented in this paper. The main objective of this project is to simulate, design, construct and testing the circuit by using the bridge cascaded multilevel inverter has been successfully done by simulation using Proteus software. This paper is developed and improve the control circuit for a single phase inverter with has been implemented using the PIC microcontroller.

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