# Design & Implementation of Sine Wave Single Phase Inverter for Photovoltaic

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*Abstract*— This paper deals with the basic theory of a Pulse Width Modulated Inverter. its Simulink modelling, estimating various designing parameters and various instabilities. The project will be commenced by a basic accepting of the circuitry of the SPWM Inverter, the components used in its design and the reason for choose such components in this circuitry. Controlled rectifiers have a wide range of applications, In this paper, a new topology, based on the H-bridge designed with IGBTs midpoint grounding by sequence diode switching is proposed (NPC). In this topology without use ac bypass circuit consisting of a diode rectifier and a switch with clamping to the dc midpoint we can achieve the improvement in efficiency while conversion and low leakage current. The topology is simulated and experimentally validated, and a comparison with other existing topologies is performed. High conversion efficiency and low leakage current are verified. The proposed topology is verified using MATLAB and the all results are validated.

***Key words:*** Single Phase Inverter, MOSFET

## I. INTRODUCTION

Ac loads require constant or adjustable voltages at their input terminals. When such loads are fed by inverters, it is essential that the output voltage of inverters is so controlled as to fulfil the requirements of AC loads. The DC-AC inverters usually operate on Pulse Width Modulation (PWM) technique. The PWM is a very advance and useful technique in which width of the Gate pulses are controlled by various mechanisms. PWM inverter is used to keep the output voltage of the inverter at the rated voltage (depending on the user's choice) irrespective of the output load .In a conventional inverter the output voltage changes according to the changes in the load. To nullify this effect of the changing loads, the PWM inverter correct the output voltage by changing the width of the pulses and the output AC depends on the switching frequency and pulse width which is adjusted according to the value of the load connected at the output so as to provide constant rated output. The inverters usually operate in a pulse width modulated (PWM) way and switch between different circuit topologies, which means that the inverter is a nonlinear, specifically piecewise smooth system. In addition to this, the control strategies used in the inverters are also similar to those in DC-DC converters. Both current-mode control and voltage-mode control are employed in practical applications. In the last decade, studies of complex behaviour in switching power converters have gained increasingly more attention from both the academic community and industry. Various kinds of nonlinear phenomena, 3 such as bifurcation, chaos, border collision and coexisting attractors, have been revealed. Previous work has mainly focused on DC power supply systems including DC-DC converters and AC-DC power factor correction (PFC) converters.

## II. PREVIOUS WORK

There are two types of single phase inverters i.e. full bridge inverter and half bridge inverter. 1) Half Bridge Inverter The half bridge inverter is the basic building block of a full bridge inverter. It contains two switches and each of its capacitors has an output voltage equal to Vdc/2. In addition, the switches complement each other i. e. if one is switched ON the other one goes OFF. 2) Full Bridge Inverter This inverter circuit converts DC to AC. It is obtained by turning ON and OFF the switches in the right sequence. It has four different operating states which are based on which switches are closed. A low cost, microcontroller-based sinusoidal power source with variable voltage variable frequency (VVVF) is developed. MOSFET H-bridge inverter is used in power source with a standalone LCD as a display system. Sinusoidal pulse width modulation signals are generated for the driver circuit of the inverter. In sinusoidal pulse width modulation (SPWM), pulses are generated with constant amplitude but having different duty cycles for each period. The developed system has been properly worked for an ac voltage range of 30–80 V rms and a frequency range of 40–70 Hz. The power source is having an incorporated ROM-based LUT which provides desired performance and additional robustness for achieving proposed system capability. The system uses two microcontrollers where one of them microcontroller is used to generate the proposed variable frequency sine wave PWM drive and the other one microcontroller is used for controlling the stand alone LCD display of the developed power source [1].

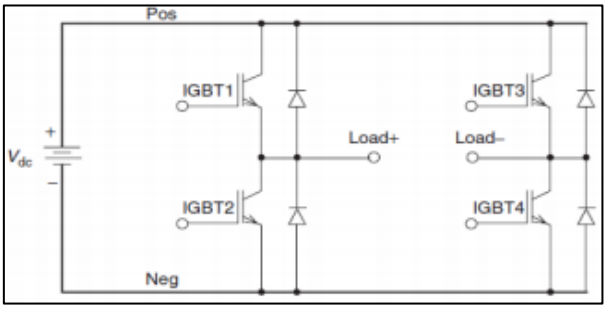


Fig. 1: Single Phase Full Bridge Inverter [9]

A single phase inverter is design and implemented by using IGBT as switch and the output responses are studied. The inverter consists of the control circuit and the power circuit where the control circuit is used to generate the gate pulses to trigger the IGBTs and the power circuit consists of IGBTs and according to the duty cycle of the gate pulses these IGBT's can be turn on and off. The pulse width modulation i. e. PWM technique has been used. A microcontroller is used to obtained Pulse width modulated (PWM) pulses and to achieve the controlled AC output voltage, these PWM pulses are being used as triggering pulses for the inverter circuit. A sine-wave should be the desired output waveform with very low harmonic distortion. The advantages of pure sine wave inverters are such as inductive loads like motors and

 

microwaves run faster, cooler and quieter. It reduces electrical and audible noise in fans, audio amplifiers, TV, fax, fluorescent lights and answering machines. It prevents glitches in monitors and crashes in computers [2].

A single phase inverter control circuit is developed which produces a pure sine wave. The output voltage magnitude and frequency is same as of grid voltage. To operate electrical and electronic appliances smoothly power rating inverter is required. The example of square wave inverter or quasi sine wave inverter is most of the available commercially uninterruptible power supplies (UPSs). Due to the harmonic contents, the electronic device managed by these inverters gets damaged. The available pure sine wave inverters neither cheaper nor generates pure sinusoidal output while the sine wave generation is extremely important in power electronics. The sinusoidal pulse width modulation (SPWM) switching technique is used for getting a pure sine wave. This involves a certain switching pattern used in the inverter bridges. The SPWM is widely used in power electronics applications such as the renewable energy system, the motor driver and UPS. The peripheral interface controller (PIC) microcontroller is used which is capable of storing commands to generate the necessary pulse width modulation waveform using built in PWM module. The applied voltage on the gate drive can be controlled by using variable frequency pulse width modulation signal which is provided by the microcontroller.

## III. PROPOSED WORK

Designing a single phase inverter for household purpose or UPS (Uninterruptible Power Supply) of rating 220V or 230V, the basic things we have to design are: LC Filter ,PI controller and we have to choose an appropriate step-up Transformer. LC Filter Design a low pass LC filter is required at the output terminal of Full Bridge VSI to reduce harmonics generated by the pulsating modulation waveform. While designing L-C filter, the cut-off frequency is chosen such that most of the low order harmonics is eliminated. To operate as an ideal voltage source, that means no additional voltage distortion even though under the load variation or a nonlinear load, the output impedance of the inverter must be kept zero. Therefore, the capacitance value should be maximized and the inductance value should be minimized at the selected cut-off frequency of the low-pass filter. Each value of L and C component is determined to minimize the reactive power in these components because the reactive power of L and C will decide the cost of LC filter and it is selected to minimize the cost, then it is common that the filter components are determined at the set of a small capacitance and a large inductance and consequently the output impedance of the inverter is so high. With these design values, the voltage waveform of the inverter output can be sinusoidal under the linear load or steady state condition because the output impedance is zero. But in case of a step change of the load or a nonlinear load, the output voltage waveform will be distorted because by the slow system response as the output response is non-zero. Figure 14 shows the power circuit of the single phase PWM-VSI with any linear or nonlinear load. The load current flows differently depending on the kind of loads such as linear and nonlinear load. Therefore it is difficult to represent the transfer function of inverter output voltage to load current

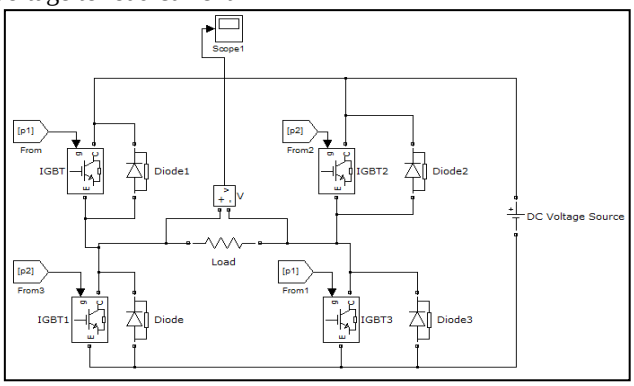


Fig. 2 Simulation Model

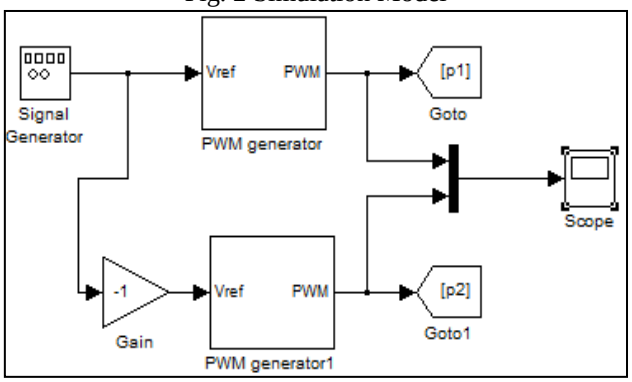


Fig.3 Simulation Sub Model

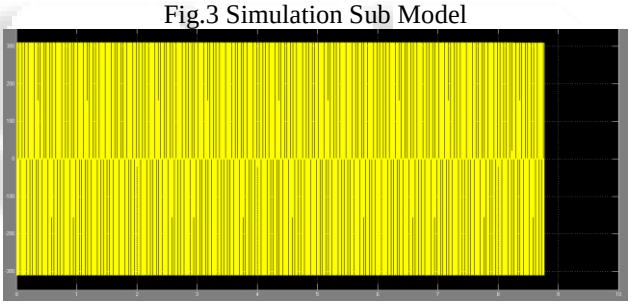

Fig. 4: Output Waveform of Full Wave Controlled Rectifier

## IV. CONCLUSION

This paper has evaluated two types of PWM control schemes for single phase DC-AC converter applications i.e. Square wave and modified Square (Quasi- Square) Wave. Better supply power factor - lower harmonic contents in the supply current and output voltage - linear control for DC value according to the duty cycle .Shifting the high amplitude harmonics to higher frequencies resulted in an easier filter design. Value of DC average component is directly proportional to the duty cycle k while the number of PWM pulses has no effect on the DC value

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