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Comparative Analysis for Power Electronic Converter

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***Abstract*— Aim of the paper is to measures the different parameter of power electronic inverter and increase the level of output voltage. This parameter is the most important for producing output sinusoidal voltage. Parameter contains total harmonic distortion, power factor etc. Speed control of machine is dependent on sinusoidal voltage and current which are provided by inverter. Various modulation schemes are used for drive application. Here we used carrier based PWM scheme are used with multilevel inverter. This new technology gives better performance as compared to conventional method. It also helps to maintain the value of power factor. %THD is reduced by using SPWM with multi-carrier switching technique in multilevel inverter. Simulink model are used for implementation.**

Key Words: *Total harmonic distortion (THD), Power factor (PF), Sinusoidal pulse width modulation (SPWM), Unipolar, Bipolar, Phase disposition technique (PDPWM).*

I. INTRODUCTION

A power converter is an electrical or electromechanical device for converting electrical energy. This could be as simple as a transformer to change the voltage of AC power, but also includes far more complex systems. The term can also refer to a class of electrical machinery that is used to convert one frequency of alternating current into another frequency. The task of a power converter is to process the flow of electric energy by supplying voltages and currents in a form that is suited for the output loads. Power conversion systems often incorporate redundancy and voltage regulation. There are also devices and methods to convert between power system designed for single and three phase operation.

Multilevel inverters are used for high voltage application. There are number of different types of multilevel inverter but generally cascaded H-bridge inverters are used at industry level, because it having number of advantages as compared to other. Figure.1 shows meshed network of electrical components that acts as a linking, adapting or transforming stage between two sources. In static inverter do not use moving parts in the conversion process.

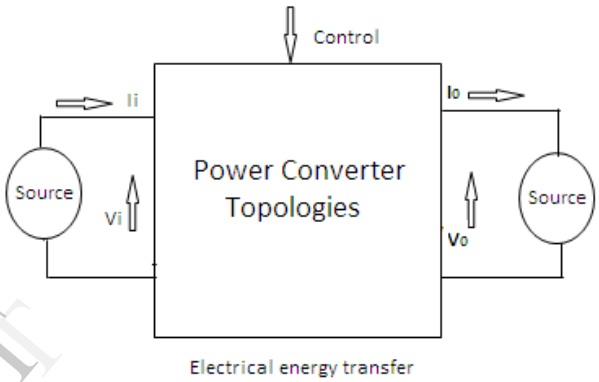

Fig.1: Power Electronic Converter

A power inverter is an electronic device that changes direct current (DC) to alternating current (AC). It is combination of mechanical effects and electronic circuitry. The input voltage, output voltage and frequency, and overall power handling depend on the design of specific device or circuitry. The inverter does not produce any power, the power is provided by the DC source. An inverter can produced square wave, modified sine wave, pulsed sine wave or sine wave depending on circuit design.

There are two basic designs for producing household plug-in voltage from a lower voltage DC source, the first of which uses a switching boost converter to produce a high voltage DC and then converts to AC. The second method converts DC to AC at battery level uses line frequency transformer to create output voltage.

The resulting switching frequencies, spectrum of the output waveform and the use of inverter state redundancies. Considering the above mentioned points, the different PWM methods for a single-phase five-level multi-level inverter will be reviewed in this paper. The level of the inverter indicates the number of carriers used. There are four carriers are used in five level inverter.

II. RESEARCH METHODOLOGIES

Pulse width modulation technique is the generation of constant amplitude pulse by modulating the pulse duration or width of carrier by using modulating signal.

A. SPWM Techniques

Sinusoidal pulse width modulation (SPWM) is generated by comparing amplitude of triangular wave and sinusoidal reference signal. Figure.2 shows that triangular wave is the carrier signal and sinusoidal reference is the modulating signal. SPWM technique for single phase inverter is similar to that three phase inverter. Generally, each switch is controlled by comparing reference wave with triangular carrier wave. The fundamental frequency of the output is same as the reference wave, and the amplitude of the output is determined by relative amplitudes of the reference and carrier waves. This SPWM technique is used for half bridge inverter.

In this modulation technique are multiple numbers of output pulse per half cycle and pulses are of different width. The width of each pulse is varying in proportion to the amplitude of a sine wave evaluated at the center of the same pulse.

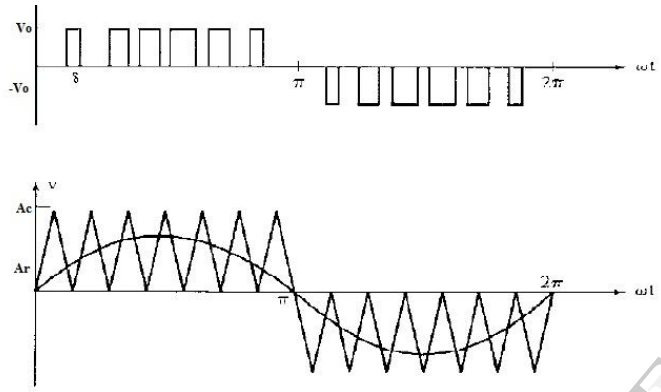

Fig.2: Sinusoidal Pulse Width Modulation

B. Carrier-based PWM methods

In these techniques, the reference waveform is sampled through a number of carrier waveforms displayed by contiguous of the reference waveform amplitude. Figure.3 indicate that Phase shifted multicarrier modulation

There are different types of carrier based modulation methods are available such as Phase Disposition PWM (PD-PWM), Phase Opposition Disposition PWM (POD-PWM), Alternative Phase Opposition Disposition PWM (APODPWM). In this paper we are discussed only Phase Disposition PWM for full bridge inverter and multilevel inverter.

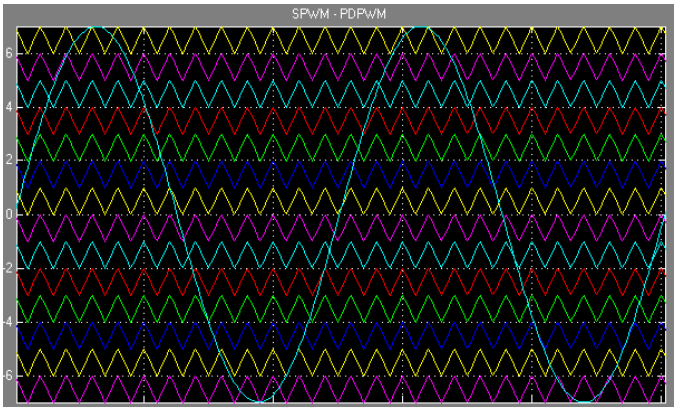

Fig.3: Phase shifted multicarrier modulation

III. SINGLE PHASE VOLTAGE SOURCE INVERTER

A. Single Phase Voltage Source Half Bridge Inverter

It consists of two semiconductor switches T1 and T2. These switches may be BJT, Thyristor, and IGBT etc. with a commutation circuit. D1 and D2 are called Freewheeling diode also known as the Feedback diodes as they feedback the load reactive power. Figure.3 indicates single phase voltage source half bridge inverter.

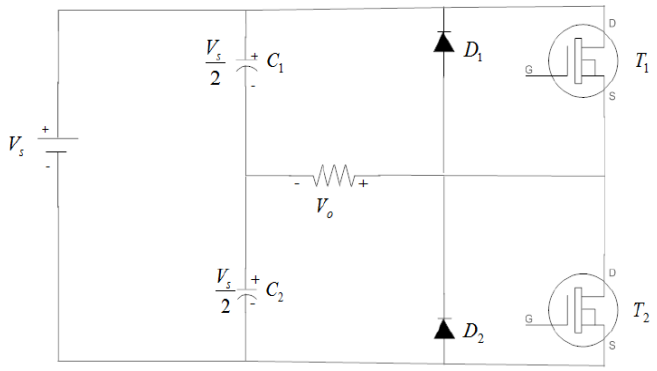

Fig.4: Single Phase Half Bridge Inverter

B. Single Phase Voltage Source Full Bridge Inverter

Figure.4 consists of two arms with a two semiconductor switches on both arms with antiparallel freewheeling diodes for discharging the reverse current. In case of resistive-inductive load, the reverse load current flow through these diodes. These diodes provide an alternate path to inductive current which continue so flow during the Turn OFF condition.

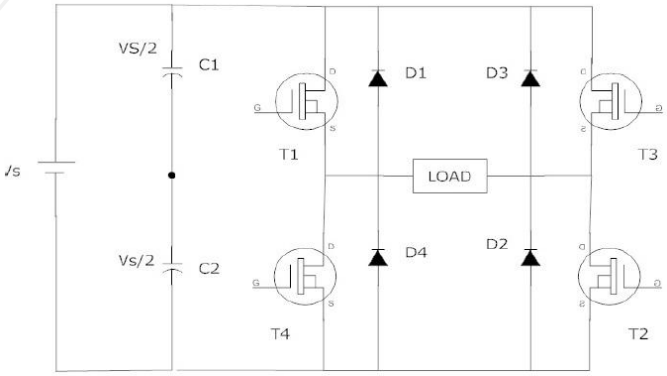

Fig.5: Single Phase Full wave Bridge Inverter

C. Single Phase Voltage Source Multilevel Inverter

It consists of two full bridge inverter circuits are cascaded with different DC sources. It consists of the 8 MOSFET switches, which is controlled with the help of SPWM model by using the phase disposition technique. Figure.5 shows multilevel inverter in which number of switches is used. The most attractive features of multilevel inverters are as follows

- They can generate output voltages with extremely low distortion and lower dv/dt.
- They draw input current with very low distortion.
- They generate smaller common-mode (CM) voltage, thus reducing the stress in the motor bearings. In addition, using sophisticated modulation methods, CM voltages can be eliminated.
- They can operate with a lower switching frequency.

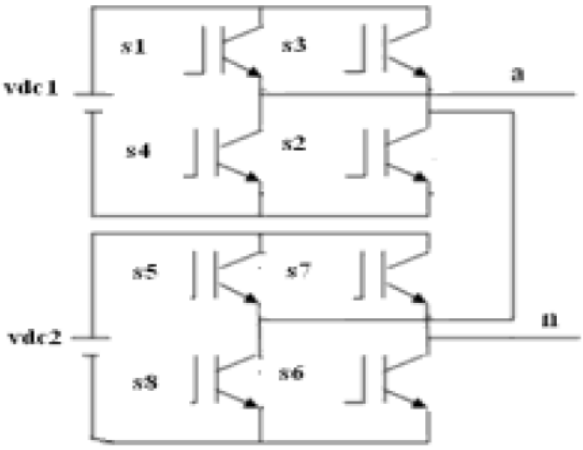

Fig.6: Single Phase for multilevel inverter

IV. MATLAB SIMULATION

The following results are done by works space model using MATLAB Simulink and comparison of SPWM & PDPWM in THD level is following below. The various method of the carrier based disposition analysis and gets the output waveform. SPWM generation circuit contains four carrier wave and one reference sine wave, then compared signal is given to the corresponds IGBTS to the multilevel inverter

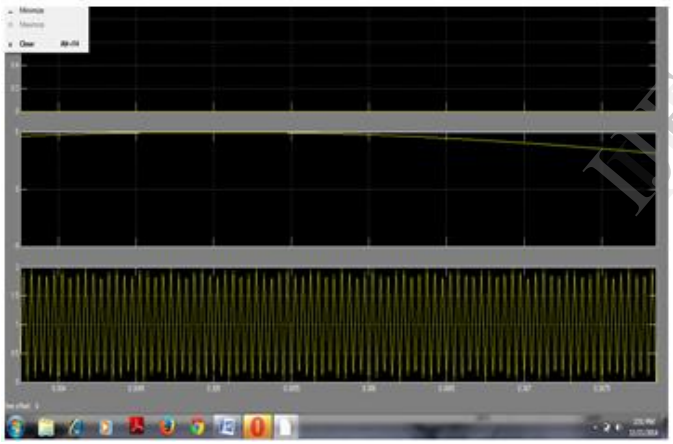
Fig.7: Carrier signal for half bridge inverter

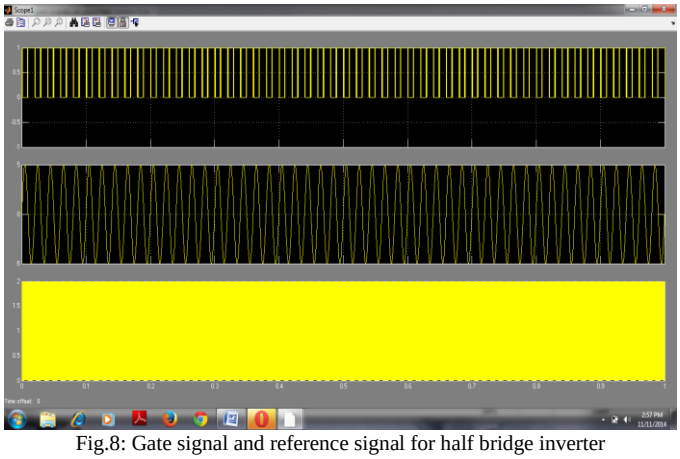
Fig.8: Gate signal and reference signal for half bridge inverter

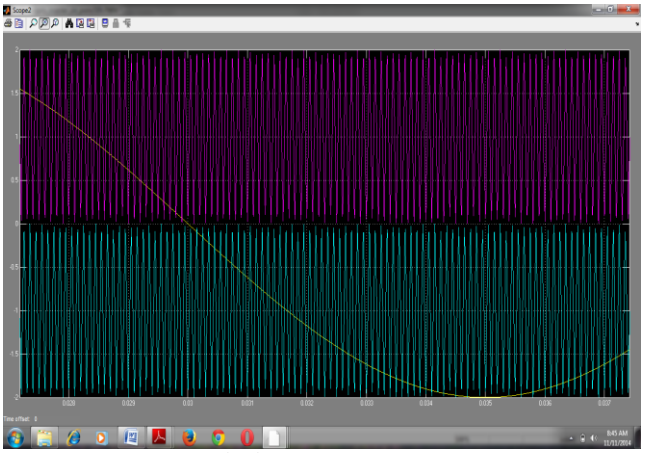
Fig.9: Simulation result for full bridge inverter using phase disposition technique

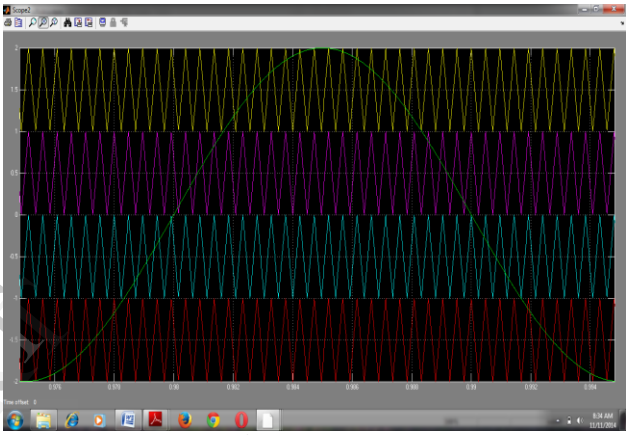
Fig.10: Simulation result for cascade H-bridge inverter using phase disposition technique

Figure.6 shows the simulation results for half bridge inverter. Figure.9 contains four carrier waves for 5-level inverter. We also perform FFT analysis for all models using power GUI module. We can also configure the parameter load, modulation index with the help of power GUI module.

V. CONCLUSION

Power converter system using different inverter was designed and implemented. It was tested with different parameter. This study represents analysis of single phase inverter circuit. It is observed that proposed work of Single phase five level multilevel cascade inverter output voltage total harmonics distortion is reduced, maintain the level of power factor and improve the efficiency of system compare with different topologies of single phase five level multilevel cascade inverter. For future scope we can apply different technique for improve the performance of the system.

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