ABSTRACT
Multilevel inverter arrangement consists of semiconductor switches for triggering purpose. In this paper modeling of five-level inverter is carried out using different semiconductor switches such as MOSFET, IGBT and GTO. MATLAB/Simulink software is used for modeling and simulation of multilevel inverter. Output waveforms for load voltage of inverter are obtained for different semiconductor switches.

Keywords— Multilevel inverter, IGBT, GTO, MOSFET, MATLAB/SIMULINK

I. INTRODUCTION
The developments in power electronics and semiconductor technology have triggered the improvements in power electronic systems. So, different circuit configurations namely multilevel inverters have become popular and considerable interest by researcher are given on them. Various modeling and simulation of multilevel inverter is carried out until now [2][3][4][6]. The concept of multilevel inverters has been introduced since 1975. The cascaded multilevel inverter was first introduced in 1975. Although the cascade multilevel inverter was invented earlier, its application did not prevail until the mid 1990s. Subsequently, several multilevel inverter topologies have been developed. In 1981, diode-clamped multilevel inverter also called the Neutral-Point Clamped (NPC) inverter schemes were proposed. In 1992, capacitor-clamped (or flying capacitor) multilevel inverters, and in 1996, cascaded multilevel inverters were proposed [2]. The elementary concept of a multilevel inverter to achieve higher power is to use a series of power semiconductor switches with several lower voltage dc sources to perform the power conversion by synthesizing a staircase voltage waveform. In this paper modeling of five-level inverter is carried out in MATLAB/SIMULINK using different semiconductor switches such as MOSFET, IGBT and GTO. Several multilevel inverter topologies have been developed. Referring to the literature reviews, the cascaded or H-bridge multilevel inverter with separated DC sources is clearly the most feasible topology for use as a power converter for medium & high power applications.

II. CASCADED H-BRIDGE MULTILEVEL INVERTER
The concept of this inverter is based on connecting H-bridge inverters in series to get a sinusoidal voltage output. The output voltage is the sum of the voltage that is generated by each cell. Each H-Bridge inverter circuit consists of four active switching elements that can make the output voltage either positive or negative polarity or simply zero which is depend on switching condition of switches in the circuit. The number of output voltage levels required are 2n+1, where n is the number of cells. The number of controlled switches required in this topology is 4n. The switching angles can be chosen in such a way that the total harmonic distortion is minimized.
Figure 1: Single phase cascaded multilevel inverter.

Figure 1 shows the power circuit for one phase leg of a three-level cascaded inverter. In a 3-level cascaded inverter each single-phase full-bridge inverter generates three voltages at the output: +Vdc, 0, -Vdc.

One of the advantages of this type of multilevel inverter is that it needs less number of components comparative to the Diode clamped or the flying capacitor, so the price and the weight of the inverter is less than that of the two types [4].

III. PULSE WIDTH MODULATION (PWM)

The main objective of the PWM is to control the inverter output voltage and to reduce the harmonic content in the output voltage. Inverters generally use pulse width modulation control signals to provide an AC output signal. Switching techniques of pulse width modulation (PWM) have been popular in the area of power electronics and drive systems. PWM is commonly used in applications like motor speed control, converters audio amplifiers etc. PWM is used to adjust voltage applied to the motor [1]. There is no single PWM method which can suite for all applications. As per the advanced technology in solid state power electronic devices and microprocessors, various pulse-width modulation (PWM) techniques have been developed for different industrial applications. For the above reasons, the PWM techniques have been the subject of intensive research since 1970s. The pulse width modulation (PWM) techniques are mainly used for voltage control. These techniques are most efficient and they control the drives of the switching devices. The different PWM techniques are Single pulse width modulation, Multiple pulse width modulation, Phase displacement control, Sinusoidal pulse width modulation, Harmonic Injection modulation, Space Vector pulse width modulation, Hysteresis (Delta) pulse width modulation, Selective Harmonic Elimination and Current Controlled pulse width modulation. Hysteresis controller is used for Current source inverter and all the remaining PWM techniques are used for Voltage source inverter. Sinusoidal and Space Vector PWM techniques are most widely used. They control the output voltage as well as reduce the harmonics.

IV. MATLAB/SIMULINK IMPLEMENTATION AND SIMULATION RESULT

Five-level cascaded H-bridge inverter is design in MATLAB/SIMULINK software. Figure 2 shows model of five-level MOSFET based inverter. Likewise other model is designed using another semiconductor switches such as IGBT and GTO shown in figure 3 & 4. Here simple pulse width modulation technique is used for triggering purpose.
Inverter output waveforms of load voltage are shown in figure 5, 6 & 7.

Figure 5. Output waveform of load voltage of MOSFET based inverter.

Figure 6. Output waveform of load voltage of IGBT based inverter.

Figure 7. Output waveform of load voltage of GTO based inverter.

V. CONCLUSION

Modeling and simulation of five-level cascaded H-bridge inverter using different semiconductor switches are carried out in MATLAB/SIMULINK. Output waveforms of load voltages are studied using different semiconductor switches such as MOSFET, IGBT and GTO shown in figure 5, 6 & 7. In future performance of semiconductor switches in inverter can be compared or studied.

REFERENCES


