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# VOLTAGE SOURCE INVERTER FOR AUTOMOTIVE APPLICATION USING INDUCTION MOTOR

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**Abstract:**

This paper presents a three phase voltage source inverter used to control the speed of an induction motor. Induction motor speed control can be done by various techniques, here uses controlling of voltage for speed control. Here the voltage source inverter is operated at 180 degree conduction mode that is each power electronic switch is operated for 180 degrees. Simple pulse width modulation (PWM) is implemented with 180 degree conduction mode pulses and by controlling the duty cycle of the PWM output voltage can be controlled hence speed of induction motor can be controlled. Control pulses for the switches are generated by using PIC16F877A. Since the output voltage of microcontroller is 5V, which is not feasible for the proper switching of the MOSFET, here uses a driver circuit which consist of TLP250.

**Keywords**: Voltage source inverter, Induction motor, PWM, Driver circuit.

## 1. INTRODUCTION

The word inverter in the context of power-electronics denotes a class of power conversion circuits that operates from a dc voltage source or a dc current source and converts it into ac voltage or current. The function of inverter is reverse of what ac-to-dc converter does. Usually input to an inverter circuit is a dc source, but it is not uncommon to have this dc derived from an ac source such as utility ac supply. For example, the primary source of input power may be utility ac voltage supply that is converted to dc by an ac to dc converter and then inverted back to ac using an inverter. The final ac output may be of a different frequency and magnitude than the input ac of the utility supply. DC motors have been used during the last century in industries for variable speed applications due to its easy controllability of flux and torque by means of changing the field and armature currents respectively.

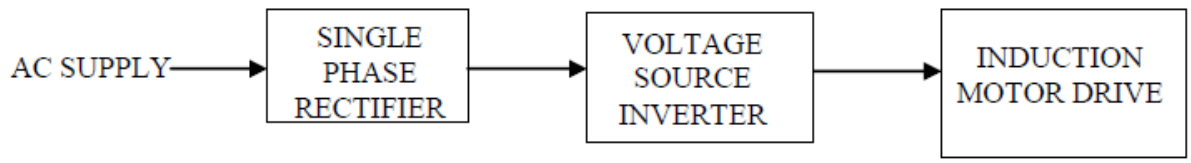


**Fig.1. Block diagram of VSI fed induction motor drive**

Additionally, operation in the four quadrants of the torque speed plane including temporary standstill was achieved. Almost for a century, induction motor has been the workhorse of industry due to its robustness, low cost high efficiency and less maintenance. Earlier induction motors were mainly used for essentially constant speed applications because of the unavailability of the proper speed control techniques. The advancement of power electronics has made it possible to vary the speed of induction motor by varying supply voltage, supply frequency or both. In AC grid connected motor drives, a rectifier consists of common diode bridge providing a pulsed DC voltage from the mains is required. Although the basic circuit for an inverter may seem to be simple, accurately switching these devices

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provides a number of challenges. Voltage source inverter can be classified into two stepped wave inverter and PWM inverter. Stepped wave inverter is also called square wave inverter and which has two operating modes, 180 degree conduction mode and 120 degree conduction mode. In 180 degree conduction mode each switch is operated for 180 degrees and it is 120 degree for the other. Some examples where voltage source inverters are used are: uninterruptible power supply (UPS) units, adjustable speed drives (ASD) for ac motors, electronic frequency changer circuits etc. Commercially available inverter units used in homes and offices to units to power some essential ac loads in case the utility ac supply gets interrupted are also familiar. In such inverter units, battery supply is used as the input dc voltage source and the inverter circuit converts the dc into ac voltage of desired frequency.

## 2. LITERATURE SURVEY

Inverters are used to convert dc to ac by the proper switching of the power electronic switches shows two schematic circuits, which uses transistor-switches, for generation of ac voltage from dc input. In both the circuits, the transistors work in common emitter configuration and are interconnected in push-pull manner. For having a single control signal for the transistor switches, one transistor is of n-p-n type and the other of p-n-p type and their emitters and bases are shorted as shown in the figures. Both circuits require a symmetrical bipolar dc supply. Collector of n-p-n transistor is connected to positive dc supply (+E) and that of p-n-p transistor is connected to negative dc supply of same magnitude (-E). Load, which has been assumed resistive, is connected between the emitter shorting point and the power supply ground.

## 3. SYSTEM DESCRIPTION

Voltage source inverters are most commonly used in industrial applications such as speed control of induction motor. For controlling speed of the induction motor it is necessary to vary the voltage or frequency.

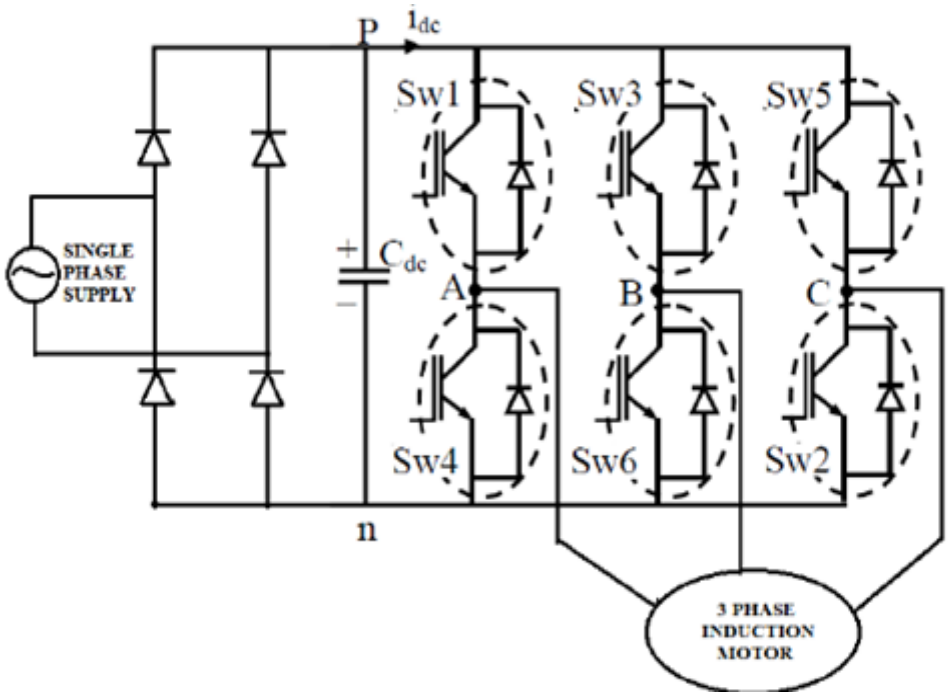


**Fig.2. Voltage source inverter**

Single phase 230V, 50 Hz supply is used, which rectified into dc by using a diode bridge rectifier. Output of the diode bridge rectifier contains large amount of ripples. In order to get a ripple free dc, a

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capacitor filter is used here. This dc provided as input of the voltage source inverter. Voltage source inverter is operated in 180 degree conduction mode here. Output of the voltage source inverter is three stepped waves of sinusoidal characteristic and of 120 degree phase shift with each other, which is provided as input of the three phase induction motor. Voltage source inverter is operated in 180 degree conduction mode here, it is shown in Fig. 10. Each switch is operated for 180 degrees. No two switches in the same leg operated simultaneously. At any time instant three switches are on in this mode. Inorder to reverse the output phase sequence, the switching sequence may simply be reversed. The gating signals and the resulting line voltages for stepped wave inverter in 180 degree. The phase voltages are derived from the line voltages assuming a balanced three phase system. Considering the symmetry in the switch conduction pattern, it seems that at any time three switches conduct. It can be two from the upper group , which are connected to positive dc bus, and one from lower group or vice-versa (i.e., one from upper group and two from lower group).

## 4. SIMULATION RESULTS

Simulation diagram of the dc side is shown Input to the system is 230V single phase ac. This provides to a single phase full bridge diode rectifier. Diode rectifier converts ac into dc, but the output of diode rectifier usually contains large ripples, which is eliminated using capacitor filter.

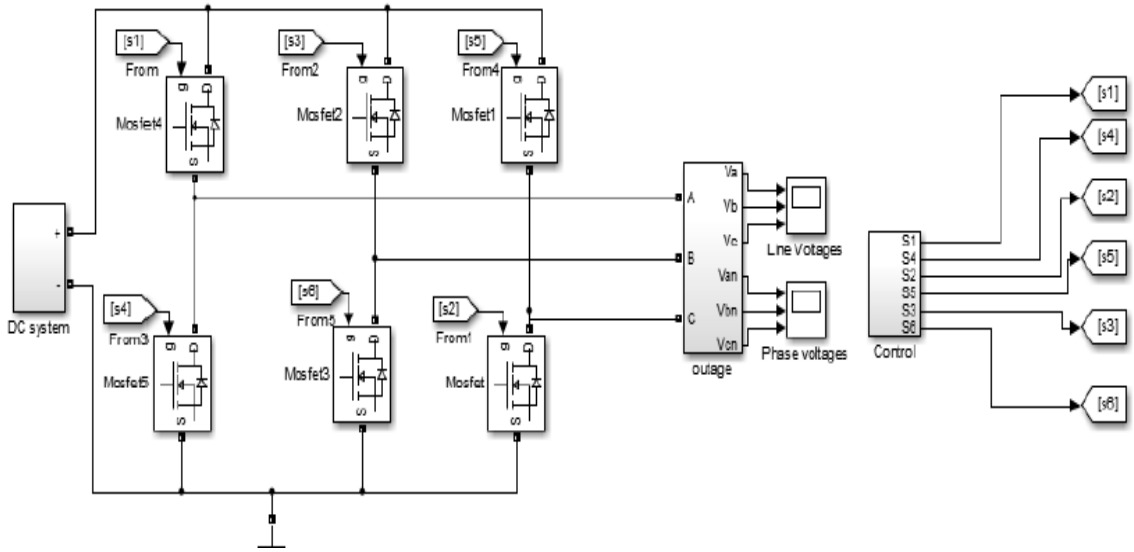


**Fig.3.simulation results**

Voltage source inverter is operated in 180 degree conduction mode here. Each switch is operated for 180 degree and three switches are on simultaneously for any time period. 180 degree conduction mode pulses are generated using pulse generators and then these pulses are anded with a PWM signal of frequency 1Khz. These signals are provides to the gate of the inverter switches. Controls are provided by using PIC16F877A with 12MHz clock frequency. Control pulses are provided from PIC has a magnitude of 5V. Since MOSFET need a gate voltage above 10V for good performance a driver circuit is used. TLP250 is used as the driver circuit here. MOSFET used here is IRF630 with voltage rating of 200V and current rating of 9A. Hardware is shown in Fig 17. Input to the system is a single phase ac supply of 230V, 50Hz, it is provided from a auto transformer and this single phase ac supply is rectified into dc by using a diode bridge rectifier. Output of the diode bridge rectifier contains large amount of ripples. It should be eliminated before providing to the voltage source inverter.

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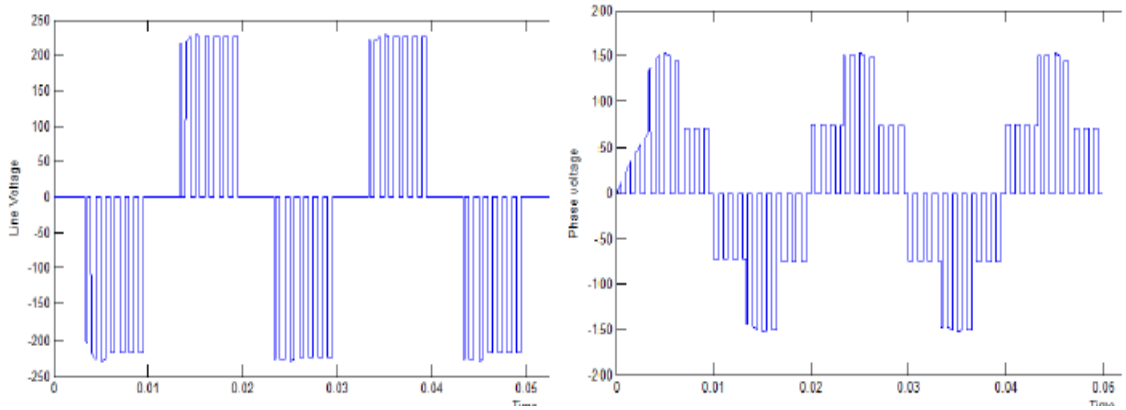


**Fig.4.Output results**

A capacitor filter is provided at the output of diode rectifier in order to minimize the ripples. Then the constant dc voltage at the output of the capacitor filter is provided as the input of the voltage source inverter. PWM pulses are generated with 1KHz switching frequency and it is also incorporated with 180 degree conduction mode pulses by using AND gates. So two AND gate IC 7408 is used here.

## CONCLUSION

Voltage source inverter fed induction motor drive is fabricated and tested. Speed control is easily obtained by controlling the supply voltage to the motor. This is achieved by controlling the duty ratio of the PWM pulses. The hardware is reduced since single phase rectifier is used. The reliability is increased by using microcontroller as the on chip intelligent controller. Usually large heat sinks are used for the MOSFETS and other power electronic switches in high power applications. But by properly designing the driver circuit the need for large heat sinks is eliminated here. By implementing a special control of PWM with the 180 degree conduction mode, harmonics is reduced than a usual stepped wave inverter.

## REFERENCES

[1] F. W. Fuchs, “Some diagnosis methods for voltage source inverters in variable speed drives with induction machines-A survey,” in Proc. 29th Annu. Conf. IEEE Ind. Electron. Soc., Roanoke, VA, pp. 1378– 1385, Nov. 2003.
[2] R. A. Hanna and S. Prabhu, “Medium-voltage adjustable-speed drives users and manufactures experiences,” IEEE Trans. Ind. Appl., vol. 33, no. 6, pp. 1407–1415, Nov./Dec. 1997.
[3] DUBEY, G.K, “Power semiconductor controlled drives” , Second edition, Prentice-Hall, New Jersey, 1989.
[4] BOSE, B.K, “Power electronics and AC drives”, second edition, Prentice-Hall, New Jersey, 1986.
[5] Muhammed H Rahid,”Power electronics, circuits, devices and applications”, Third edition, Pearson prentice hall, West florida, 2004.
[6] BOSE, B.K, “Technology trends in microcomputer control of electrical machines”, IEEE Trans. Ind. Electron., 35 (l), pp. 160- 177, Mar. 1988. [7] P. S. Bimbhra,” Power Electronics”, Third edition, Khanna publishers, Delhi, 2003.