**Hardware Design of Three Phase Voltage Source Inverter using Arduino Microcontroller and its Harmonic Analysis**

**ABSTRACT**

This paper work aims at design and implementation of a three-phase Voltage Source Inverter. DC to AC Converter are widely used in the area of renewable energy and in Industrial Drives. Generally, Inverters are used in high power applications for driving Industrial based Motors. Speed Control of Induction Motor is widely done through three-phase Inverter and Inverter convert the DC input from the solar panel to the mains. Hence designing the cost-effective inverter with less harmonics has always been a challenge in the area of Power Converter. This paper explores the design methodology and focuses on designing a simple and cost-effective control circuit for a three-phase Voltage Source Inverter. The switching logic is implemented in a microcontroller (Arduino) and the driver circuit is designed using TLP350 (optocoupler). MATLAB/Simulink and Hardware Design of Three-phase Voltage Source Inverter for 120o mode has been done and it is use to drive 1H.P Three-phase Induction Motor. Designed Inverter was studied and its Harmonic Analysis was done and compares using power analyzer. Both the Hardware and Simulation of three-phase VSI has been explained, compared and is verified.

**INTRODUCTION**

With the advancement in Power Electronics devices Inverter converts DC power into AC power at desired output voltage and frequency. High-performance inverter for smooth operation of electrical and electronics appliances are of special attention. For providing an adjustable frequency power to industrial application three-phase inverter are more used than single-phase inverter and it takes their DC supply from a battery or more usually from a rectifier. A three-phase inverter is basically a six-step bridge inverter. The input supply of the inverter is DC and it is taken from either rectifier or from the battery. The three-phase Voltage Source Inverter uses Six MOSFET Switches, two switches in each of the three legs of VSI for their operation. Since MOSFET is low power high switching frequency device so it is better to use in Inverter Circuit. MOSFET produce less distortion as they are more linear the another switches. There are different techniques to fire the Inverter switches but simple and easy method to use Arduino for firing the Inverter switches. Using Arduino making the system cheap and also robust and it is widely used now. The Three-phase Voltage Source Inverter are basically having two types of conduction modes: 180o conduction mode and 120o conduction mode. The firing sequence for both the conduction mode are little bit different from each other and here the design is for 120o conduction mode, this firing sequence are written as code in Arduino board which is having a microcontroller chip where the code is been burned and the output of Arduino is given to the TLP350 and hence firing pulse is generated for the Inverter Switches. As switches start conducting we got the output waveforms at the load end. Since we know that for driving the motor it needs a converter a Rectifier, Inverter or Chopper depending upon the input of the motor. The Power Electronics not only increases the reliability of the system but it also reduces the cost and size of the system. Different technologies in the field of electric motor play a major role in vehicles dynamic performance and the type of efficient converter has been used for controlling the vehicle operating characteristics. Here Induction motor is operated using this Inverter.

**PROPOSED SYSTEM**

The hardware design of 3-ph VSI includes the design of the gate driver circuit, power board with snubber circuit and design of a 3-ph low pass filter. The TLP350 optocoupler is to provide isolation between the Power MOSFET Bridge and the Arduino Microcontroller. Another function of TLP350 optocoupler is to provide amplified gate control signals to IRFP460 Power MOSFETs. The figure 4.4 shows the gate driver unit for driving a three phase inverter, the driver circuit consists of 6 optocoupler which has a control input from the microcontroller and the output of the optocoupler is input to the gate circuit of MOSFET. The selection of the passive elements for designing the driver circuit has been done using datasheets of IRFP460. and TLP350. Arduino Uno is a microcontroller. To operate a three-ph VSI using Arduino, the arduino program should be written and while writing the program three factors should be considered: Each pulse should be 10ms ON and 10ms OFF period. Time delay of 3.33msec between firing pulse of adjacent MOSFET. Sufficient time delay should be provided to the MOSFETs present in the same arm/leg to avoid simultaneous ON and OFF of MOSFETs. The firing pulse generated in Arduino and passing through optocoupler give to a MOSFETs.

The DC supply is provided to the IRFP460 Power MOSFET Bridge through the DC regulator.

**PROPOSED SYSTEM ADVANTAGE**

* The design of a cost effective inverter.
* The filter circuit is used to increase the power quality and voltage waveform.
* The designed inverter was then used to drive a 1H.P 3ph Induction motor to its rated value.
* The motor was run to its rated value and there was minimum temperature rise in the power converter

**BLOCK DIAGRAM**

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**HARDWARE REQUIREMENT**

* Arduino uno
* Gate driver
* Inverter circuit
* Load
* Power supply

**SOFTWARE REQUIREMENT**

* Arduino UNO.