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RESEARCH ARTICLE

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SINGLE PHASE TO THREE PHASE CONVERSION FOR THREE PHASE DEVICES

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ABSTRACT

This paper presents a simple method of using Single phase ac power supply for driving a load of 3 phase using 6 active switching IGBTs. The converter is designed to supply balanced output voltages at variable frequencies, the proposed topology allows us to reduce the rectifier switching currents, harmonic distortions at the converter's input side, and improves the fault and control approaches, supported by test results. The converter takes single phase supply and converts it into three phase supply with the help of rectifier. The single phase supply is first converted into dc supply by using rectifier. This dc supply of rectifier is given to inverter where IGBT's are used and converts this dc supply into 3 phase ac supply. The experimented result proves that with the increase in load the sinusoidal waveform produced remained approximately constant and the developed setup has satisfactory converted the single phase power to three phase power supply.

Keywords: AC to DC converter, DC to AC converter, IGBTs, driver system, inverter.

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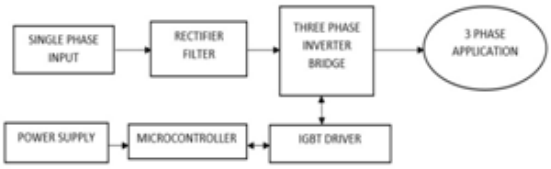
I. INTRODUCTION

Previously, three phase systems were obtained from single phase system by connection of passive elements capacitors and reactors with autotransformer converters. There were many limitations and disadvantages with such systems. To overcome these problems newly adopted technologies were used which includes power devices such as thyristors, mainly SCR's, MOSFET, IGBT's etc. This project is about using IGBTs to convert single phase ac supply to 3 phase ac supply. From the beginning of Solid State electronics, power processors were mainly driven by the semiconductor devices. Improvisation in power switches led to many innovations in the field of 3-phase to 3-phase, single phase to single phase and 3-phase to single phase conversion systems. The 3 phase induction motor is driven by 3 phase

induction motor driver in some industrial applications but in some areas where only single phase supply is available, we should convert single phase supply into 3 phase supply. This paper gives an alternative solution for phase conversion with low cost and good overall performance of the load. This system allows to fulfill the requirements in the areas where only a single-phase supply is available.

II. Block Diagram

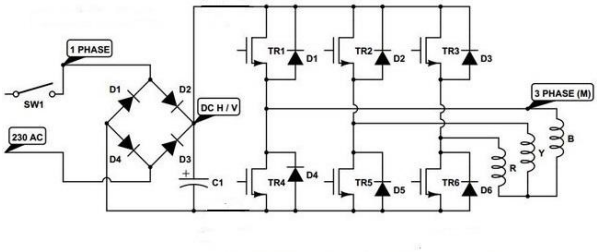


As we all know any device needs the power source to get activated. All the Electrical and Electronic components needs the AC power supply. So, here we are converting the single phase power supply into the three phase power supply. Using this 3 Phase power supply we will be able to drive the three phase applications. The above block diagram consists of the single phase input, Rectifier filter circuit, 3 phase inverter bridge, load, IGBT driver circuit, Microcontroller and the power supply.

As shown in the block diagram there are two inputs given to the system, first input is given to the rectifier filter and second input is provided to the Microcontroller. The rectifier input is the 230V/50Hz AC power supply, which is converted into the regulated pulsating dc output, all the AC contents are also been filtered and we get the pure regulated DC output. Further the supply is given to the 3 phase invertor bridge where IGBT's are connected. In addition to the main power supply there is also an energizing stage which use to energize IGBT's i.e IGBT DRIVERS. This stage is connected to the micro controller where programs are made accordingly. This supply is given to three phase inverter bridge as per the programmer's and circuit requirement.

At the output of the inverter bridge we get the three phase AC output in the form of three wire. After the conversion of single phase power supply into the three phase power supply we will provide this supply to our three phase application.

III. Proposed Circuit Diagram :



Single Phase to Three Phase conveter

The Digital processing from microcontroller unit gives a 3.3V signal, while the waveform generators allow for a specified voltage level. The gate-source voltage needed for desired operation of the IGBT is on a 110 DC level. In this circuit the high side of IGBT do not have the source connected to the ground, so the actual voltage needed to drive the gate depends on the variable voltage at the source. The Single phase to Three phase converter using IGBT with SPWM for driving three-phase devices is by using switching frequency about 7 kHz. The sinusoidal waveform of 3-phase which is converted from the single phase input of the 230 AC rectified by bridge diodes.

The gate drive circuit needs to provide the interface between the switching signals from the waveform generator that is the microcontroller and the IGBT in the circuit. The gate-source voltage needed for desired operation of the IGBT is on a 110 DC level. The high side of the IGBT in this circuit do not have the source connected to ground, so the voltage level required to drive the gate depends on the variable voltage at the source. Switching Signal currently small systems are expensive and implement control schemes use relatively high switching frequencies such as sine-triangle PWM control. The only drawback of high switching frequency is the decrease in efficiency that occurs from switching loss. The controlling scheme has been widely used and generates little acoustic noise since the switching frequency is on the upper end of the audible acoustic range (20 Hz-20 kHz). These control schemes also provide good dynamic performances. However, the application does not require good dynamic performance since there are no dynamic load and speed requirements. The ratings of power elements such as gate driver power

IGBTs dc bus power supply must be in line with the rating power of three phase application.

IV. Working

As shown in the figure, the single phase 230V AC supply is given at the input of the rectifier and filter circuit to convert this single phase AC to DC. The filter reduces the harmonics present in the AC supply and produces an output of pulsating regulated DC output. In the rectifier circuit we have also added boosting circuit to get maximum DC output voltage at the output of our whole circuit. The output of the rectifier and filter circuit is given to the 3 phase inverter bridge to again covert this DC voltage in AC.

At the inverter circuit we have used six fast switching IGBT's. The gate terminal of each IGBT is connected to each terminal of microcontroller. But to drive all these the IGBT driver circuit is also included. In the inverting stage as we are using six IGBT's the upper side IGBT's are called as positive group IGBT and lower side three IGBT's are called as the negative group IGBT's.

During the switching one IGBT from upper group and two IGBT's from lower groups are ON and afterwards one from lower and two from upper, this procedure is followed by whole inverter circuit. This happens because the IGBT's work in 180 degree mode of operation. Freewheeling diodes are connected beside each IGBT to limit the reverse flowing current through the inverter. From each of the lines we get the single phase output and from the three pairs of upper and lower IGBT's we get three single phase lines together called as the three phase.

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