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Microcontroller Based Power Inverter

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Abstract **Induction motors are getting used in larger numbers throughout a good ort of industrial and business applications as a result of it provides several edges and reliable device to convert the current into mechanical motion. In some applications, it's desired to regulate the speed of the induction motor attributable to the physics of the induction motor the well-liked methodology of dominant its speed is to vary the frequency of the AC voltage driving the motor. In recent years, with the microcontroller incorporated into Associate in Nursing appliance, it become Induction motors area unit getting used in larger numbers throughout a good sort of industrial and business applications as a result of it provides several edges and reliable device to convert the current into mechanical motion. In some applications, it's desired to regulate the speed of the induction motor attributable to the physics of the induction motor the well-liked methodology of dominant its speed is to vary the frequency of the AC voltage driving the motor. In recent years, with the microcontroller incorporated into Associate in Nursing appliance, it becomes potential to use it to come up with the variable frequency AC voltage to regulate the speed of the induction motor.es potential to use it to come up with the variable frequency AC voltage to regulate the speed of the induction motor.**

This study investigates the microcontroller based mostly variable frequency power electrical converter. The microcontroller provides the variable frequency pulse dimension modulation (PWM) signal that controls the applied voltage on the gate drive, that provides the desired PWM frequency with less harmonics at the output of the ability electrical converter.

The totally controlled bridge voltage supply electrical converter has been enforced with semiconductors power devices isolated gate bipolar semiconductor unit (IGBT), and also the PWM technique has been utilized during this electrical converter to provide the motor with AC voltage.

The projected drive system for 3 & single part power electrical converter is simulated victimization Matlab/Simulink. The Matlab simulation results of the projected system were achieved with totally different SPWM. From the result, a stable variable frequency electrical converter over wide selection has been obtained and a decent agreement has been found between the simulation and hardware of a microcontroller based mostly single part electrical converter.

Index Terms —Microcontroller, Induction motor, the and single phase power inverter.

I. INTRODUCTION

The variable frequency inverters area unit utilized in wide applications particularly 3 section induction motor drive traction and it's in style in several high power industrial applications, like speed and force management. Single section

induction motor (SPIM), that contains a common exploitation in residential applications, domestic like dishwashers, clothes dryers, fans, pumps, etc. ,when the SPIMs area unit most popular because of the bigger accessibility of single section power provide. additionally this technique are often utilized in alternative application such as: electrical vehicle, variable speed equipments, and AC variable frequency power supply utilized in the laboratory, wherever there area unit several experiments need the utilization of various AC sources in terms of the voltage amplitude and frequency. Thus, it are often terribly helpful within the laboratory for testing appliances, products, and instrumentality. it should even be useful in an automatic assembly line for checking the Device below take a look at (DUT) during a specified operational vary of voltage and frequency [1].

Various researches on the management of the variable frequency electrical converter are given aslow-priced, superior, and also the development was created in many areas, such as: electronics permitting

the utilization of computer code rather than hardware to unravel complicated management issues for an inexpensive price; power semiconductors technology, providing powerful ,quick and simple to drive switches; management algorithms, that management the electrical converter output and scale back the harmonic. As a results of those efforts, AC motor drives area unit these days terribly attention-grabbing as another to DC motor primarily based systems.

With the increasing demands for high-quality power sources, and reduction of harmonic distortion, a PWM electrical converter has been used as a key component for a superior power conversion system for crucial hundreds like computers, medical instrumentality and communication systems [2].

Recently, microcontrollers and digital signal processors (DSP) area unit used as advanced management techniques. several researchers developed the computer code for the system, that confirmed the top quality of the management supported microcontroller techniques [3] and to supply further real time process throughput in an inverter operation, microcontrollers and DSP features minimize the CPU's overhead in an interrupt intensive application.Motorola MC68HC11 microcontroller has been chosen for this implementation because it is easy to develop, instantly response, high performance, high speed, and low-power chip with multiplexed capable of running at up to 2 MHZ.

Traditionally, variable speed operation of a single phase induction motor suffers from large harmonic and limited speed, therefore the system has been built using voltage control method with semiconductors power devices IGBT and PWM techniques have been implemented to avoid the large harmonics.

Simulation of a single phase and three phase variable frequency inverter, which has been constructed on matlab/simulink software to examine its capability to achieve sinusoidal waveform with variable frequency to use as single phase and three phase variable frequency power supply.

The Matlab simulation results of the proposed system were achieved with different PWM frequencies this system can be considered as high power variable frequency voltage source inverter, with fewer harmonics. From the result, a stable AC voltage with variable amplitude and variable frequency over wide range have been obtained and a good agreement has been found between the simulation and hardware of a single phase inverter.

II. PAST WORKS

Various convert topologies have been compared by Ba-thunya et al [5], and he concluded that, among the converter topologies, the adjusted frequency PWM inverter is the best choice for single phase induction motor drives.

Chomat and Lipo [6], considered a system connected to a single-phase supply, the output portion of the converter consisting of two IGBT switches, generates a PWM output supplying one or both stator windings of a single-phase machine. The variable speed operation is characterized by the fact that the both stator windings are fed from the inverter. The phase shift between the currents in the main and auxiliary windings of the machine is maintained by means of an AC capacitor connected in series with the auxiliary winding. The generation of the triggering pulses for the solid-state switches and the state of the output relay are controlled by a single-chip microcontroller.

Jiangmin Yao [7], has implemented the PIC17C756 microcontroller in a single phase induction motor adjustable speed drive control with hardware setup and software program in C code. The main feature used in this microcontroller was its peripherals to realize pulse width modulation in the single phase motor control. Furthermore, one chip and re-programmable ROM replaces the conventional complicated circuit solution. He concluded that this brought low cost, small size and flexibility to change the control algorithm without changes in hardware. The problem of this microcontroller was that it had no dead band register and only had a three PWM output. Therefore, additional logic analogue circuits

were added to generate their complement signals and to generate dead time in order to avoid the overlapping of turn on for both upper and lower switches.

Bashi, et al [8], had developed the single phase induction motor adjustable speed control using MC68HC11E-9 microcontroller. They programmed the microcontroller to vary the pulse width variation that controls the duty cycle of the DC chopper. The inverter receives the DC signal from the chopper and converted to AC power to feed the motor. Their drive system can be used to achieve speed control of a single-phase induction motor with wide speed range, but their system could be technically possible and economical, but the operation of the drive is not optimal throughout the entire speed range and the significant torque ripple which may arise in some operating points.

In this work, the single phase variable frequency inverter has been implemented. The microcontroller has been programmed to vary the frequency of the output power inverter.

III. MATERIALS AND METHODS

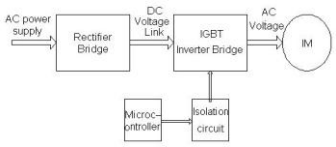


Fig. 1. Block diagram of the system

Three phase variable frequency inverter: The 110Vac 3 phase power supply is converted to into fixed DC voltage by used three phase full bridge diode rectifier. The harmonics are filtered out by an LC filter to provide a smooth DC voltage, which is then applied to the inverter input.

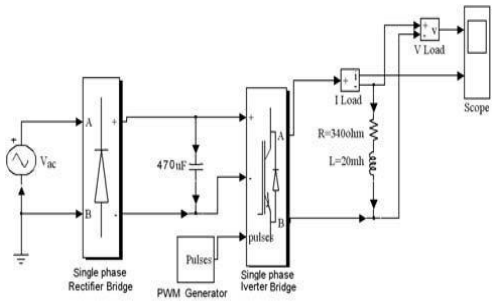
The inverter consists essentially of six power IGBT, this inverter converts the DC link voltage into an adjustable three-phase AC voltage. The PWM control scheme used to control the inverter output voltage and frequency, by modulating the on and off times of power switches.

A. Simulation of the System

Matlab/Simulink software has been used as a tool to simulate the circuit which consists of full bridge rectifier, and inverter circuit. Figure 1 shows the complete system single phase inverter, whereas Figure 2 shows the complete system of three phase inverter.

In the steady state, the motor can be simulated as R-L lumped circuit without loss of accuracy. The resistance R reflects the losses in the stator and rotor cores and the inductance for the winding. An experiment is carried out to measure R and L and the measured values were used in the simulation on Matlab/Simulink [3].

Fig. 2. Block diagram for single phase inverter simulation circuit



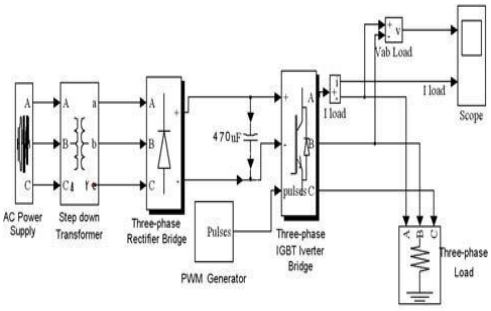


Fig. 3. Block diagram for three phase inverter simulation circuit

B. Experimental Setup

In this study, the full bridge rectifier has been used to convert the AC supply to a DC voltage. A

capacitor and an inductor are connected to form a smoothing filter. The output of the rectifier is the input to the inverter, which receives the smooth DC voltage and converts it to AC power to get the variable frequency power source.

The microcontroller-based control system hardware has been programmed to vary the frequency of the PWM signal that controls the frequency of the power inverter.

The PWM module gets two inputs "duty cycle and frequency" the frequency is configurable within range 20Hz-2 KHz and the duty cycle can be ranged from 0% to 100%. In order to use the output compare function as PWM generator, the frequency is converted from Hz to counts according to the following equation.

$$FREQCNT = \frac{FREQHZ}{0.5\mu s} \quad (1)$$

Where, 0.5μs is the one cycle period of microcontroller.

The PWM signals of the MCU are applied to the gate of IGBT through gate drive; the gate driver provides isolation, low impedance and high current supply to drive the IGBT's. By controlling the input voltage to the ADC, we can control the output frequency of the Microcontroller, since this input

analogue voltage is converting to 8 bit digital signals, with resolution 20mV/step.

Under no-load condition, the output of the power inverter was smooth, and when this output voltage was fed to the single phase induction motor, the motor stared run and the response of the drive system was as expected.

IV. CONCLUSION

The single section and 3 section variable frequency electrical converter is simulated victimisationMatlab/Simulink software package. The stable AC power supply with variable amplitude and variable frequency over big selection has been obtained.

The M68HC11E-9 microcontroller primarily based single section variable frequency power electrical converter has been introduced and it will be with success achieved. Results of the experiment areobtained for the microcontroller, that offers reliable and cheap solutions for single section variable frequency electrical converter and smart agreement was found between simulation and hardware results.

In general, the AC-DC-AC conversion was flourishing, on the opposite aspect, some overshoot were found attributable to suspected causes like the management formula employed in the microcontroller and harmonic content at the electrical converter output. However, smart results confirming the initial intention for style.

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