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Mosfet Based Inverter with Three Phase Preventer & Selector for Industrial Application

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ABSTRACT: In this competing world where efficient and effective production takes place, industries uses 3 phase supply that cannot afford a failure of even a single phase. Failures of any phases make appliances prone to erratic functioning and may even lead to failure of that appliance. Goal is to build a system that can support one of the phase supplies with the help of existing phase supply. The development of this system will be achieved by using microcontroller which can be programmed using embedded. This microcontroller is then coupled with inverter using driver circuitry. If we go to have a three-phase inverter, which is available in market the cost of it is more. So, here is an attempt made to have single phase to three phase inverter using Microcontroller, which saves money up to great extent.

KEYWORDS: RYB indicator; automatic phase selector circuit; MOSFET based inverter.

1 INTRODUCTION

In this fast changing world, electronics has made a great impact in each and every field. Just press of button tedious jobs performs easily. Now day's electric supply has become one of the basic needs but due to Environmental conditions and practical limitation the generation of electricity is Insufficient hence to fulfill the electricity requirement load shading is used, but is not satisfying the complete requirement. Inverter is used to obtain A.C. supply from battery. In industries three phase Appliances are frequently used due to their advantages over single-phase power supply. If we go to have a three-phase inverter, which is available in, market cost of it is more. So, here is an attempt made to have single phase to three phase inverter using Microcontroller, which saves money up to great extent. Now day's different inverters are used to avoid the erratic functioning. Here, in particular the circuit is used to generate the three-phase variable frequency supply required in the industries for controlling the various appliances. Basically, in this total hardware project one can generate the variable frequency from 10Hz to 100Hz to operate the appliances used in the industries. We can control the phase induction motor from this inverter. Due to feature of variable frequency we can control the speed of the three phase induction motor.

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1.1 DEFINITION AND CONCEPT OF INVERTER

The d.c. to a.c. power converters are known as inverters. In other words, an inverter is a circuit which converts a d.c. power into an a.c. power at desired output voltage and frequency. The a.c. output voltage could be fixed at a fixed or variable frequency. This conversion can be achieved either by controlled turn-on and turn off devices (e.g. BJTs, MOSFETs, IGBTs, and MCTs). The output voltage waveform of ideal inverter should be sinusoidal. The voltage waveforms of practical inverters are, however non-sinusoidal and contain certain harmonics. Square wave or quasi square wave voltages may be acceptable for low and medium power applications, and for high power application low-distorted, sinusoidal waveforms are required. The d.c. power input to the inverter may be battery, fuel cell, solar cells or other d.c. source. But in most industrial application, it is fed by a rectifier.

1.2 CLASSIFICATION OF INVERTERS

Based on the nature of input power source, inverters are classified as i) Voltage source inverter (VSI) ii) Current source inverter (CSI). In case of VSI, the input to the inverter is provided by a ripple free dc voltage source whereas in CSI, the voltage source is first converted into a current source and then used to supply the power to the inverter. The inverters can be again classified according to the nature of output voltage waveforms as: i) Square-Wave inverter ii) Quasi-Square Wave inverter iii) Pulse Width Modulated (PWM) inverter. A square wave inverter produces a Square-Wave ac voltage of constant magnitude. The output voltage of this type of inverter can only varied by controlling the input dc voltage. Square wave ac output voltage is adequate for low and medium power applications. The second method, pulse width modulation uses a switching scheme within the inverter to modify the shape of the output voltage waveform.

2 LITERATURE SURVEY

The three phase inverters are used for high power applications such as an ac motor drives, induction heating, and ups. A three phase inverter circuit changes DC input voltage can be from a DC source or a rectified AC voltage. A three phase bridge inverter can be constructed by combining three single phase half bridge inverter. In three phase inverter which is based on a novel three-phase uncontrollable rectifier inverter without or with a quite small dc-link capacitor. This inverter has many advantages such as simpler structure, higher reliability, more effective harmonics elimination (P. Hammond et al, 1997). Inverter are widely used in many industrial applications such as variable-frequency velocity modulation, UPS, VAR compensator etc. In order to supply high quality power for loads, it is significant for this inverter to eliminate harmonics in output voltage effectively. Pulse width modulation (PWM) technique that has satisfied performance in harmonics elimination, voltage regulation, responding speed is widely used in all kinds of inverters. Another system which is based on Multilevel Inverter-Fed Induction Motor Drive in which the output harmonic content is reduced by using multilevel inverter. In symmetrical circuit, the voltage and power increase with the increase in the number of levels of inverter. The switching angle for the pulse is selected in such way to reduce the harmonic distortion. This drive system has advantages like reduced total harmonic distortion and higher torque. The model of the multilevel inverter system is developed with SVM strategy to control the induction motor (L. M. Malesani et al, 1995). Cascaded H-Bridge Multilevel Inverter Using Micro-Controller for Single Phase Induction Motor (Richa Bhargava et al, 2012), this paper presents a micro controller based control of multilevel inverter for single phase Induction motor. IGBT is used as power element. It is based on the symmetric regular sampling PWM with a single carrier and multiple modulating signals. This algorithm is implemented by a low-cost fixed-point microcontroller on an experimental five level cascaded inverter test-rig. In this paper the hardware is implemented using the PIC microcontroller PIC16F877. The advantages of the PIC microcontroller is that the instruction set of this controller are fewer than the usual microcontroller. Unlike conventional processors, which are generally complex, instruction set computer (CISC) type, PIC microcontroller is a RISC processor. The advantages of RISC processor against CISC processor are RISC instructions are simpler and consequently operate faster A RISC processor takes a single cycle for each instruction, while CISC processor requires multiple clocks per instruction. In the main routine the port c, inputs to the IGBT gate driver circuit produced by the controller, are used, firstly, we determine the IGBT combination to be switched ON and output values to the corresponding port C which is connected too gate driver circuit. After each PWM counter next combination is switched ON. This system having some demerits like Limited to certain applications where separate DC Sources are available, Usage of the power semiconductor switches increases exponentially whenever the level is to be increased and Each H-bridge needs an isolated DC supply compared to the other solutions which need only one supply.

Enhanced Performance of Multilevel Inverter Fed Induction Motor Drive (Venkata Anil Babu Polisetty et al, November 2013) Multilevel inverter technology generally used for high power medium-voltage control and also for improving the total harmonic distortion by reducing the harmonics. the poor quality of voltage and current of a conventional inverter fed

induction machine is obtained due to the presence of harmonics and hence there is a significant level of energy losses. this paper presents the simulation of three phases nine level inverter fed induction motor drive. In inverters by increasing the number of steps it generates the very high quality of the output voltage and current. This paper presents a nine levels multi level inverter and these nine levels can follow a voltage reference with accuracy and with the advantage that the generated voltage can be modulated in amplitude instead of pulse-width modulation. Therefore a harmonic elimination method is applied to eliminate any number of specific higher order harmonics of multilevel converters with unequal dc voltages. The effectiveness of the system is verified through simulation using MATLAB / SIMULINK package. Nine level inverter consists of a series of diode clamped inverter units connected to three phase induction motor. The general function of this multilevel inverter is to synthesize a desired voltage from several dc sources. The ac terminal voltages of each bridge are connected in series. This configuration is useful for constant frequency applications such as active front-end rectifiers, active power filters, and reactive power compensation.

Implementation of Multilevel Inverter-Fed Induction Motor Drive (Mr. G. Pandian et al, June 2008) this paper presents the simulation and implementation of multilevel inverter fed induction motor drive. The output harmonic content is reduced by using multilevel inverter. In symmetrical circuit, the voltage and power increase with the increase in the number of levels of inverter. The model of the multilevel inverter system is developed with SVM strategy to control the induction motor. SVM is based on vector selection in the q-d stationary reference frame. The induction motors were mainly used for essentially constant speed applications because of the unavailability of the variable-frequency voltage supply. The concept of multilevel inverter control has opened a new possibility that induction motors can be controlled to achieve dynamic performance equally as that of DC motors. AC input is rectified using a diode rectifier. It is filtered using a capacitor filter. DC is applied to the multilevel inverter. The output of the inverter is fed to the induction motor. The pulses are generated using SVM method. The speed loop ensures that the actual speed of the motor is equal to set speed. The torque of the motor is improved due to the elimination of the fifth harmonic, which produces negative torque. A Microcontroller based gating circuit generates the pulses required by the inverter.

Automatic phase changer (Muhammad ajmal p., july 2007) The circuit provides correct voltage in the same power supply lines through relays from the other phase where correct voltage is available. Automatic phase changer (rax tech, 2013) Automatic phase changer needs to be designed with abuse and longevity in mind. Avail brand APC Monitors the incoming voltage in all 3 phases using reliable and rugged sensors. In the event of power failure or low voltage in up to 2 of the 3 incoming phases, the Avail APC automatically transfers your equipment supply to the healthiest phase. The Low Voltage Cut off is a smart unique feature with Avail APC protects equipment from the harmful effects of unhealthily low voltage. In all these system inverters are used that converts dc into ac but when any one phase is missed at that time all the work is stop. In farm when motors are ON and when there is overload on system at that time any one phase is fail so in that case motor damage. So the system that prevent the damage and it will avoid the interruption between the work is necessary now a days. Because in case of large scale industries no single interruption is desirable.

3 SYSTEM OVERVIEW

A scheme that address on building up system as a mention above is presented here single phase to three phase converter for load schedule management using embedded. The government of Maharashtra has been decided for single phasing. So it is useful in industrial equipment or home appliances. So we can use such a system to drive the applications. When phase are present at the same time 4 pole 4 way relay will activate and 3 phase will connect directly to load or motor. If there is any missing phase then suddenly motor will disconnect from 3 phase. It will prevent motor or load. Auto phase selector circuit select particular phase which is present in sequence of R Y B phase, & .After B phase again cycle is continue to R phase. Present single phase is converted AC to DC using bridge rectifier circuit to making of 350 volt dc supply to use across the MOSFET based power inverter circuit. To convert from DC to AC the present single phase connects to 4 winding transformer. In replace of 6 transformers we can use one transformer.

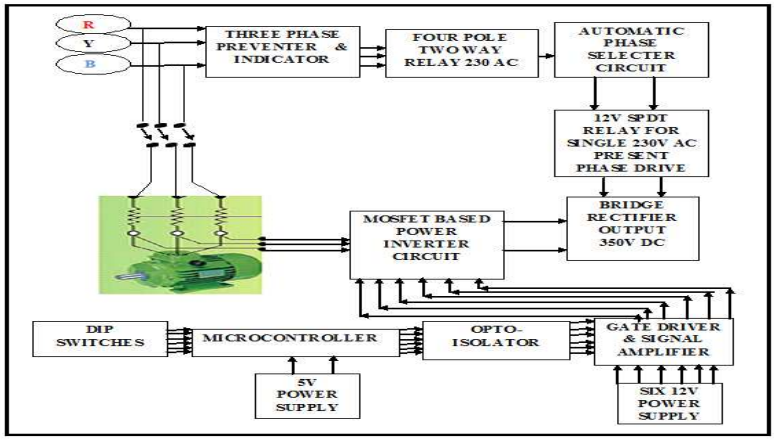

Fig. 1. Block Diagram

3.1 VARIOUS ATTRIBUTES

- DIP Switches- DIP switches are used as input to the microcontroller 89C52. The DIP switches are consisting of 8 parallel switches. The output of the DIP switches is given to the port 1 of microcontroller 89C52 is used to select the appropriate frequency as well as to select the mode of operation.
- Optoisolator- It isolates the control circuitry from the power circuitry. Power circuitry operates on 350v and control circuitry operates on 5v so to isolate these voltage optoisolator is used.
- Signal Amplifier- The output of optocoupler is not sufficient for driving the mosfet so amplification of signal is required due to that signal amplifier is used.
- RYB indicator- R, Y & B phase are indicating by three led. Presence of phase is indicate by these led.
- Inverter circuitry- The inverter circuitry consisting of power device named as mosfet; they are connected in the bridge configuration. MOSFET stands for metal oxide semiconductor for filled effect transistor which having many advantages over the other power device like MOSFET, FET and SCR. The output of inverter is can be obtained in either 180deg or 120 deg depending on the user's requirement. In the 120deg mode phase voltage waveform is quasi square while line voltage is of six step waveform. In 180deg mode the phase voltage is of six step waveform while line voltage waveform is quasi square waveform.

4 RELEVANCE OF PROJECT

This project can be used in different areas like house, industries, chemical plant etc. The application circuit can be changed to control various home appliances or industries. All the number of applications can be increased with very minor changes.

5 RESULTS

Microcontroller 89c51 is used for PWM pulse generation. These six pulses are given to optocoupler PC-817. This optocoupler is used for isolation of voltage between the control circuit and power circuit. Gate driver voltage is 3.2v across the output of signal amplifier. Signal amplifier TIP-122 is used for current boosting. Time period calculation of PWM pulses.

$T_{ON} = 1.4 \times 5 \times 10^{-3}$ sec
$T_{OFF} = 2.6 \times 5 \times 10^{-3}$ sec
$T = T_{ON} + T_{OFF}$
T = 20 msec
F =1/T
F= 50 Hz

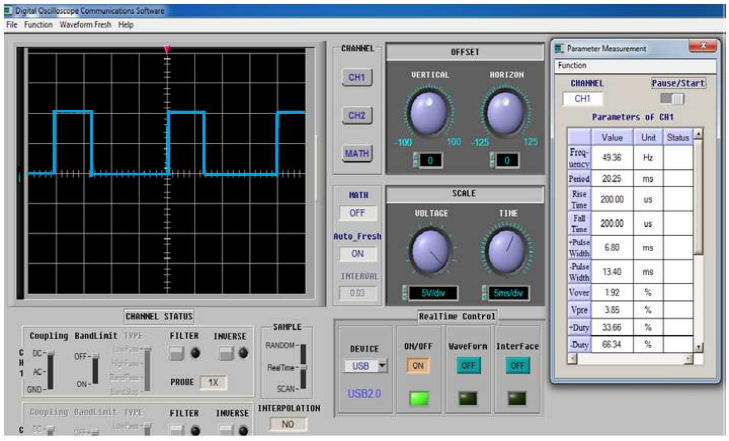

Fig. 2. Gate driver waveform

Line Voltage: Voltage across any two line is called as line voltage
$V_{RY} = V_{YB} = V_{BR}$ = Line voltage = V_L
Practically calculated Line voltage
V_{RY}= 247v
V_{YB}= 252 v
V_{BR}= 250v

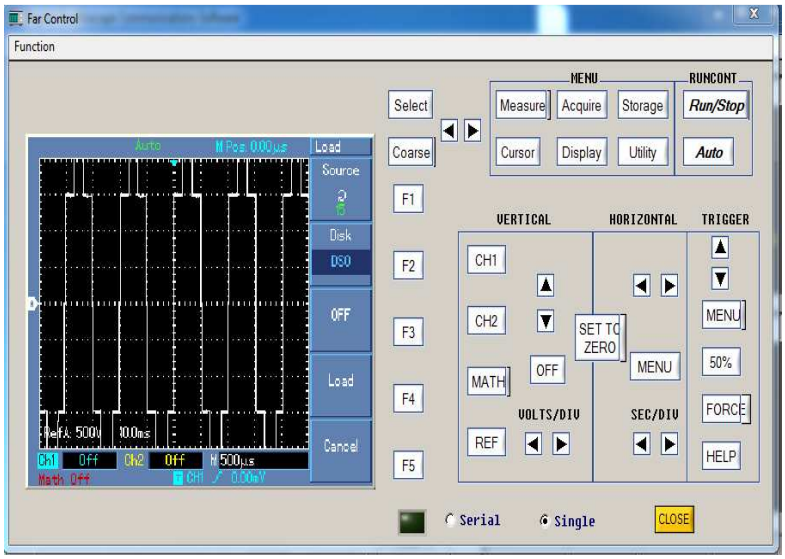

Fig. 3. Line Voltage waveform

Phase Voltage: Voltage across the line with respect to the Neutral is known as phase voltage.
$V_{RN} = V_{YN} = V_{BN}$ = Phase voltage = V_{PH}
Practically calculated phase voltage
V_{RN} = 113v
V_{YN} = 109v
V_{BN} = 121v

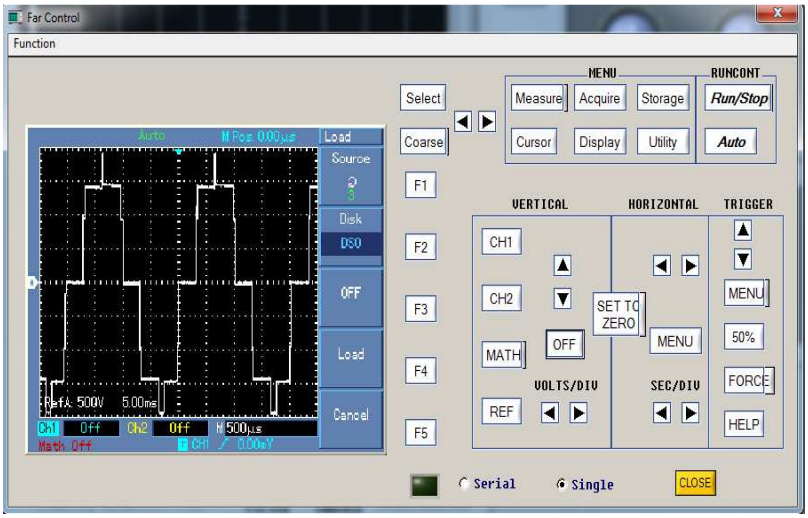

Fig. 4. Phase Voltage Waveform

We get these line voltages and phase voltages across output when R phase is missing. We get the three phase output with this system by using mosfet based inverter and microcontroller assembly.

1 CONCLUSION

The system has significant excellences such as continue supply and low expenses. A scheme that address on building up system single phase to three phase converter for load schedule management using embedded. Different inverters are used to avoid load scheduling but when any phase lost in that case that system doesn't work. The basic aim of proposed system is to generate the three-phase inverter from Single phase using microcontroller using the assembly language of microcontroller. Here we can generate six pulse PWM output. The frequency of the PWM output can be varied from 10Hz to 100Hz.

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