

# Voltage Source Inverter with Three Phase Preventer and Selector for Industrial Application

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**Abstract-** In this competing world industries uses 3 phase supply that even a single phase failure of supply not allow where efficient and effective production takes place, aim is to design a system with the help of existing phase supply that can support one of the phase. The development of this system will be completed by using microcontroller which can be programmed using embedded. . Microcontroller is then connected to 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 aim to have single phase to three phase inverter with appliance protection and live phase selection, which saves money up to great extent.

Index Terms - DIP switch; Opt-isolator; Phase selector circuit; Gate drive; Indicator; MOSFET based inverter;

## 1. INTRODUCTION

Now a day's electrical supply has at most important become one of the basic needs but due to some climatic and environmental conditions and practical limitation the generation of electricity is less to fulfill the electricity requirement of common mankind in these fast changing world, electronics has made a great improvement in each and every field. Just press of button complex jobs performs easily. So load shading is done, but it is not satisfying the need of people. A.C. supply from battery is required for Inverter is used to have supply. Due to their advantages over single-phase power supply industry use three phase appliances are frequently used. The cost of inverter is very high. Due to its simple and rugged construction induction motor is the most widely used motor in the industry. As compare to the other electrical motors it requires less maintenance an important role in its long life service the induction motor used. Mainly the variation of the input supply affects the induction motor needs protection from variable supply for small motors which is in common use not only in big industry but also in small scale industries to increase their capital cost the small scale industries are not able to provide costly protection to the drives .

In India there are so many industries in different fields. For example steel sector, oil sector, irrigation etc. All industries have many drives and equipment's like conveyor belts, pumps, Mill etc. All drives of industries use electrical motors. Most of the electrical motors are designed for 50 Hz three phase supply. Due to single-phasing three phase Induction Motors get damaged, when they are subjected to low supply. The motor will operate within its rating when the voltages

Balanced. When the voltages become unbalanced, excessive heating will occur, and the motor will have to be dreaded. To operate when a disturbance on the system causes the terminal voltages a three-phase induction motor operating in the steady-state will continue to become single phased. This condition is referred to as "single phasing" and will result in an operating condition that produces excess heating in the motor [7].

### 1.1. Concept of Inverter

An inverter is a circuit which converts a D.C. power into an A.C. 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. BJT's, MOSFET's, IGBT's, and MCT's). The output voltage of ideal inverter should be sinusoidal. But it is non-sinusoidal and contains certain distortion. The D.C. power to inverter may be battery, fuel cell, solar cells or other D.C. source. But in most industrial application, it is fed by a rectifier. The filtering of distortion is not flexible when the output frequency varies over a large range, and the generation of A.C. waveforms with low. Harmonic content is important. When inverter A.C. output is given to a transformer or A.C. motor, this output voltage must be varied in conjunction with frequency to maintain the proper magnetic conditions. Therefore the output frequency of an inverter is determined by the rate at which the semiconductor devices are switched on and off by the inverter control. Voltage control is an essential feature of an adjustable frequency system.

### **1.2. Inverters Classification**

Inverters based up on input power source, inverters are classified as i) Voltage source inverter (VSI) ii) Current source inverter (CSI). In case of VSI, a ripple free dc voltage source is provided by inverter but in CSI, the voltage source is converted into a current source and then used to supply the power to the inverter. Inverters can classify depending up on the nature of output voltage waveforms as: i) Square-Wave inverter ii) Quasi-Square Wave inverter iii) Pulse Width Modulation inverter. A square wave inverter produces a Square-Wave ac voltage of constant magnitude. Square wave ac voltage is adequate to less and medium power applications. To achieve voltage control within the inverter and to reduce the distortion content in output voltage, PWM inverters, width of the output pulses are modulated to achieve the voltage control.

## **2. LITERATURE SURVEY**

The high power applications used three phase inverters such as an ac motor drives, induction heating, and ups. An inverter circuit changes DC input voltage or a rectified AC voltage. An inverter three phases can be Design by combining three single phase half bridge inverter. In this inverter Simpler structure, higher reliability, more effective harmonics elimination. (P. Hammond et al, 1997) [1].

Variable frequency inverter, velocity modulation, UPS inverter, VAR Compensator these are the industrial applications of Inverter. In eliminate harmonics in output voltage effectively is to supply high quality power for loads; it is significant for this inverter. Another system which is based up on Multilevel Inverter induction Motor Drive in which the output harmonic content is reduced by using multilevel inverter.

In symmetrical circuit, the power and voltage increase with the increase in the number of levels of inverter to reduce the harmonic distortion. Total harmonic distortion and higher torque reduced by this system. To control the induction motor model of the multilevel inverter system is developed with SVM strategy. (L. M. Malesani et al, 1995) [2] Inverter for Photovoltaic Application is design of Three Phase PWM Voltage Source (Bandana Bhutia, 2014) [8]. Inverters are used in a number of power applications. Major

improvement in power electronics scenes the last decade. A DC to AC power converts by inverter. these are offered to as Voltage Source Inverters (VSI). A fixed voltage from a device, such as a dc power supply, and converts it to a variable-frequency AC supply is a voltage source inverter (VSI). VSI are classifying into three categories, Single-phase Inverters, Pulse-width Modulation Inverters, and square-wave Inverters with Voltage Cancellation. This paper will tell about the Pulse-width Modulated inverter.

Cascaded H-Bridge Multilevel Inverter Using Micro-Controller for Single Phase Induction Motor (Richa Bhargava et al, 2012) [3], Inverters are used in a large number of power applications. Within the last decade, there has been major upgrading in power electronics. An Inverter is basically a converter that converts DC-AC power. The function of an inverter is to convert DC power to AC; these are offered to as Voltage Source Inverters (VSI). A voltage source inverter (VSI) is one that takes in a fixed voltage from a device, such as a dc power supply, and converts it to a variable-frequency AC supply. VSI are divided up into three categories: Pulse-width Modulated (PWM) Inverters, Square-wave Inverters, and Single-phase Inverters with Voltage Cancellation. This paper will talk about the Pulse-width Modulated inverter. Cascaded H-Bridge Multilevel Inverter Using Micro-Controller for Single Phase Induction Motor (Richa Bhargava et al, 2012) [3],

This 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. Modeling and Simulation of Three-Phase Voltage Source Inverter Using a Model Predictive Current Control (Ali M. Almaktoof2014) [9]

This is focuses on a of three-phase inverter that controls the load current with a predictive current control to provide an optimized system three phase Voltage Source Inverter (VSI) .The strategy for a two-level three-phase VSI with resistive- inductive load (RL-Load) contribution presents a Finite Set-Model Predictive Control (FS-MPC). In order to decreases the computational effort which gives rise to multiple possibilities has been determined. With different cases the evaluation of the system is done. Firstly, the system performance with long prediction horizon is carried out. Secondly, the reference is investigated dynamic response of the system with step change in the amplitude of Simulations are carried out using MATLAB/Simulink to test automatic phase changer the effectiveness of an FS-MPC for the two-level VSI with RL-Load. (Muhammad ajmal p., July 2007) [6]

The circuit provides correct voltage in the same power supply lines through relays from the other phase where correct voltage is available. (rax tech, 2013) to be designed with abuse and longevity in mind automatic phase changer needs. Available brand APC Monitors using reliable and rugged sensors the incoming voltage in all 3 phases. In the Available APC automatically transfers your equipment supply to the healthiest phase in event of power failure or low voltage in up to two of the three incoming phases. The Low Voltage Cut off is a smart unique feature with Available APC protects equipment from the harmful effects of unhealthy low voltage. In all these system inverters are used to 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 anyone 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. In large scale industries no single interruption is desirable.

### **3. SYSTEM DEVELOPMENT**

Phase absence is a very common & severe problem in industry [7]. Many times one or two phase may not be live in three phase supply. Due to this some electrical appliances will be "ON" in one block and "OFF" in another block. This create big disturbance. For load schedule management a scheme that is presented here single phase to three phase converter by using embedded system. The government of Maharashtra has started single phasing and we can't run three phase appliances on single phase supply so we can use such a system to drive the applications. Microcontroller 89c51 is heart of system which is design to generate PWM pulses. These pulses are not sufficient to drive the gate of MOSFET so signal amplifier is design to boost the current. Opt isolator is design for isolation between power circuitry and control circuitry. In single phasing condition load is directly disconnect from mains by using four poles two way switches. These system consist of different block such as

- Power Supply
- Gate Driver Circuit
- Microcontroller Circuit
- Six In One Power Supply
- MOSFET Based Inverter
- Power Supply For Inverter
- Three Phase Appliance Protector
- Automatic Phase Selector Circuit
- Induction Motor

Four Pole two ways Switch a single phase to three phase converter scheme that address on building up system as a mention above is presented for load schedule management using embedded. When phase are present simultaneously 4 pole 4 way relay will activate and 3 phase will connect directly to load or motor. If there is failure of phase then suddenly motor will disconnect from 3 phase. It will prevent motor or load. Live phase is selected by the automatic Phase

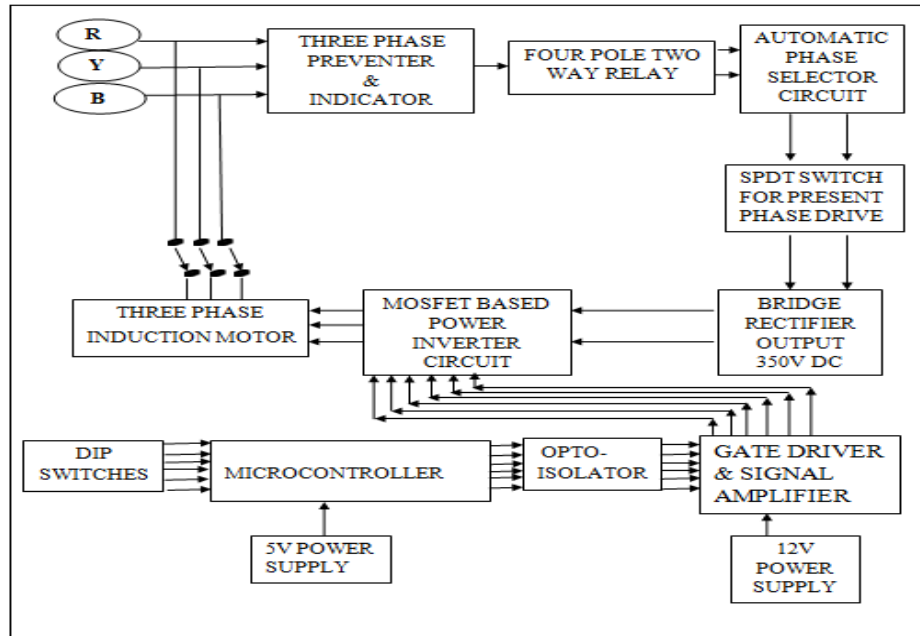


Fig. 1. Block diagram of proposed system

selector circuit. That single phase is then converted into the three phase with the help of inverter circuit.

1) DIP Switches-are used as input to the heart of the system that is microcontroller 89C52. The DIP switch consists of 8 parallel switches. Microcontroller has given the output of dip switch. Dip switch select the frequency between 10 Hz to 100 Hz.

2) Opt isolator- It isolates the control circuitry from the power circuitry. Control circuitry operates on 5v and Power circuitry operates on 350v. So to isolate these voltage opt isolator is used [5].

3) Signal Amplifier- amplification of signal is required as output of opt coupler is not sufficient for driving the MOSFET so the signal amplifier is used.

4) RYB Indicator- Three phase appliance protector has provided the three led for indication.

5) Inverter circuitry- The inverter circuitry consisting of MOSFET as power device as they are connected in the bridge configuration. MOSFET have many advantages over the other power device like MOSFET, FET and SCR.

There are two modes of inverter 120 degree and 180 degree. A quasi square waveform the 120deg mode phase voltage 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 [10].

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## REFERENCES

- [1] P. Hammond, "A new approach to enhance power quality for medium voltage AC drives", IEEE Trans. Ind. Applicant., vol. 33, pp.202–208 Jan./Feb. 1997.
- [2] L. M. Malesani, L. Rossetto, P. Tenti, and P. Tomasin, "AC/DC/AC PWM converter with reduced energy storage in the DC link", IEEE Trans. Ind. Applicant. vol. 31, pp. 287 292 ar./Apr.1995.
- [3] Richa bhargava, amit shrivastava, "cascaded h-bridge multilevel inverter using micro controller for single phase induction motor", International Journal on Emerging Technologies 3(2): 101-108 02 December, 2012.

- [4] Venkata Anil Babu Polisetty, B.R.Narendra, "Enhanced performance of multilevel inverter fed induction motor drive", International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering Vol. 2, Issue 11 November 2013.
- [5] Mr. G. Pandian and Dr. S. Rama Reddy "Implementation of Multilevel Inverter-Fed Induction Motor Drive", journal of industrial Electronics, Vol 24(June 2008).
- [6] Muhammad ajmal p, "automatic phase changer" July 2007.
- [7] William H. Kersting, "Causes and Effects of Single-Phasing Induction Motors" IEEE transactions on industry applications, vol. 41, no. 6, November/December 2005.
- [8] Bandana Bhutia & Dr. S. M. Ali "The Three Phase PWM Voltage Source Inverter for Photovoltaic Application". International journal of innovative research in electrical, electronics, instrumentation and control engineering vol. 2, issue 4, April 2014.
- [9] Ali M. Almaktoof, A. K. Raji eatl. "Modeling and Simulation of Three-Phase Voltage Source Inverter Using a Model Predictive Current Control" International Journal of Innovation, Management and Technology, Vol. 5, No. 1, February 2014.
- [10]K. P. Basu, "Experimental Investigation Into Operation Under Single-Phasing Condition of a Three-Phase Induction Motor Connected Across a Zigzag Transformer" IEEE transactions on education, vol. 47, no. 3, august 2004