3-Phase Selector and Preventor for Industrial Appliances Using 89c52.

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Abstract— In today's competitive world where efficient and effective production takes place, 3 phase supply is used by industries that cannot afford a failure of even a single phase. Failures of any phases can lead to unpredictable functioning of appliances and may even lead to their failure. The aim is to develop a system that can support one of the phase supplies with the help of existing phase supply. The development of such system can be achieved by using 89C52 microcontroller. This microcontroller can be coupled with inverter using driver circuitry. A Three-phase inverter, which is available in the market, is costly. So, an attempt is made to have single phase to three phase inverter using Microcontroller, which can be an economical alternative.

Keywords— Phase selector circuit, MOSFET based inverter, 89c52 microcontroller, induction motor.

1. INTRODUNCTION

Nowadays, in Industrial applications most of the appliances operate on three phase supply. This paper is about developing a system that can support one of the phase supplies with the help of existing phase supply. The project basically consists of microcontroller 89C52 which generates pulses at its output. Port 0 and Port 1 is used for generating six pulse output. Pull up registers of 10K Ohms are connected to port 0 and 1 to amplify the current required for giving input from DIP switches and for giving input to Optoisolator .Special winding transformer is used to drive the six Optoisolator. The output of Optoisolator is given to Darlington pair of transistor TIP 122 for amplification of current, which is required for driving MOSET. The three phases A.C. output of inverter is connected to dummy load and can be used to drive different industrial appliances. Due to feature of variable frequency we can control the speed of the three phase induction motor.

2. SYSTEM DESIGN

The system in this paper proposes consist of consists of AT89S52 microcontroller, inverter circuitry, PC817 Opto isolator gate drive power supply, 200V unregulated power supply MOSFET inverter circuitry, DIP switches, signal amplifier, 5V regulated power supply, R & RL load.

5V power supplies consist of RF choke, step down transformer, bridge rectifier, and filter circuitry and regulator.

The hardware and software description of the implementation of 3-Phase selector and preventor for industrial appliances using 89c52.

Overall system design is as follows.

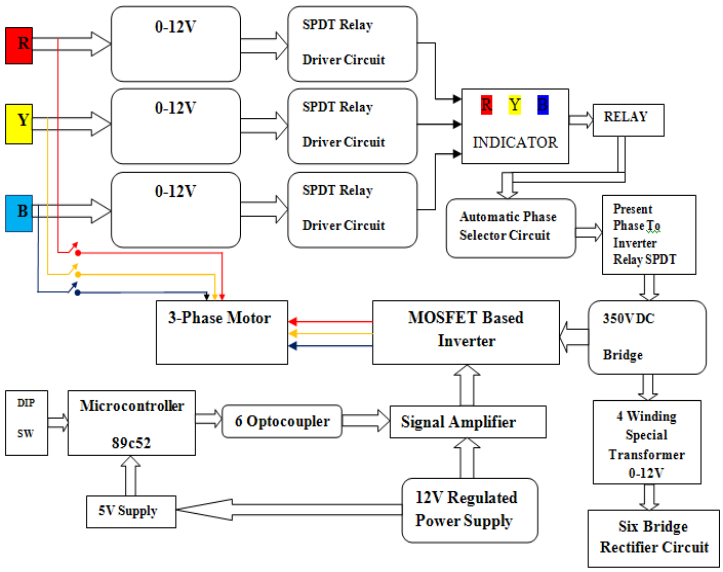

Figure.1: Overall System Design

3. SYSTEM OPERATION

When three phase supply is given as an input then AC chock will switch that three phase input directly to the three phase load. When any obstacle is occurred or even if failures in any phase the available phase supply is selected by the phase selector circuit. That is available single phase 230v AC supply is given phase selector circuit. To prevent output from suddenly failure in three phase preventer circuit is used.

A given 230v AC supply is selected by selector circuit and it is given to the rectifier, this rectifies that 230v ac into rectified dc voltage. This rectified dc voltage is filtered by 400v capacitor (220micro farad). This 350v dc voltage is applied to next circuit i.e. inverter circuitry to convert dc to ac supply. There is microcontroller circuitry is for which separate power supply is used. A 230v is converted into 5V supply using step down transformer which is rectified and converted into 5V dc supply, which is given to microcontroller. In inverter circuitry MOSFET are used as an inverter so, to trigger the MOSFET triggering pulses should be provided.

For this purpose 230V is step down to 12 v ac supply by transformer and rectified by rectifier and filtering circuit. This 120v six supply are given to port0 of microcontroller through register bank. Then microcontroller will produces PWM (Pulse Width Modulation) pulses. To isolate between inverter circuitry and microcontroller circuitry optoisolator is used.

The 5V PWM pulses are given to optoisolator then it is given to transistor circuit. This transistorized circuit will uses darlington-pair to boost the 5V pulse to the 12V amplitude. This six PWM pulses are given to gate of each MOSFET to trigger them. Then350v dc across the inverter is getting converted into three phase ac supply. This three phase ac supply is given to the load. Thus, the single phase 230V ac supply is get converted three phase supply efficiently. Microcontroller is used for variable frequency drive. DIP switch is used to vary frequency from10 Hz to 100hz.it is also possible to vary firing angle from 120 degree to 180 degree. Hence from given 230V supply three phase supply is generated conveniently and efficiently.

Assembly of the 3 Phase Selector and Preventor is as follows.

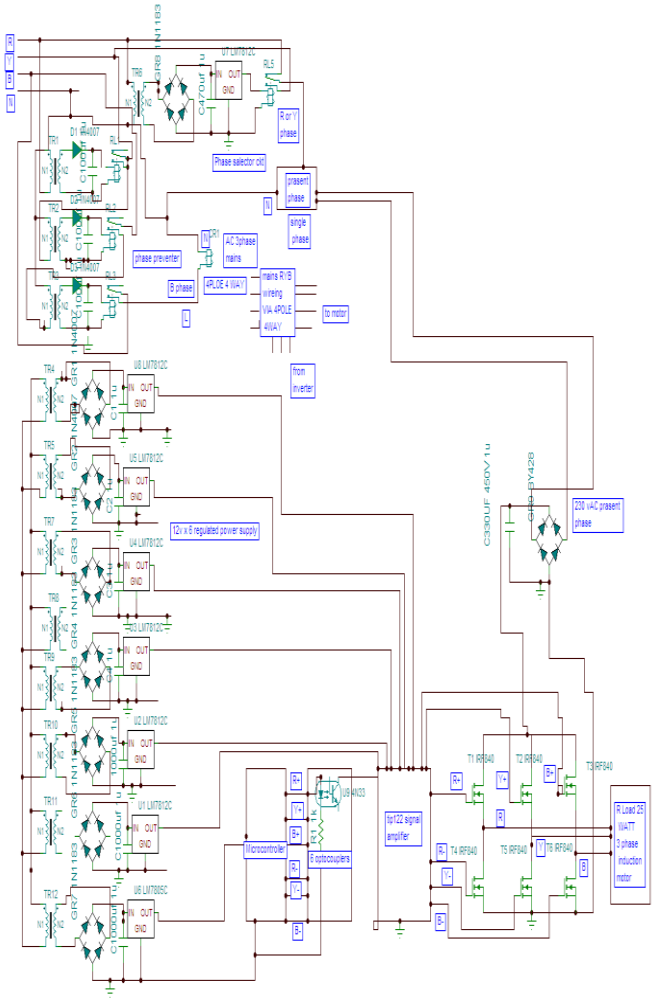

Figure 2. Assembly of the 3 Phase Selector and Preventor

3.1.1 89S52 Microcontroller

The microcontroller 89C52 is used to generate six pulses PWM output in both 120 and 180 deg. modes. The 89C52 is used to generate six pulses PWM output in both 120 and 180 deg. mode .The microcontroller 89C52 is used to generate six pulses PWM output in both 120 and 180 deg. mode.

3.1.2 MOSFET IRF-840

The 300V DC power supply is given to inverter circuitry and is converted into the 110 V AC supply. The output of inverter is can be obtained in either 180deg or 120 deg depending on the users 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.

3.1.3 Optoisolator PC817

The secondary turns of the transformer are reduced to have 12V AC at the secondary winding. The 12V AC is further given to the rectifier circuitry to convert it into 10 V DC. This voltage is further given to opto isolator for its proper operation

3.1.4 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.

3.1.5 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 other power device like MOSFET , FET and SCR.
The 300V DC power supply is given to inverter circuitry and is converted into the 110 V AC supply. The output of inverter is can be obtained in either 180deg or 120 deg depending on the users 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.

3.1.6 MOSFET BASED INVERTER

The D.C. supply to the inverter is derived from single phase 230 VA.C. Mains supply. Here in lies the beauty of the inverter; it provides total isolation of the input supply and output to the motor, allowing us to operate a three phase induction motor on a single phase supply. In system such as electrical vehicles where energy generated Is stored in large battery array, we can replace the A.C. supply- rectifier- filter assembly by a battery and battery charger assembly [1]

3.1.7 Four Winding Transformers

A specially designed transformer in our project is the Four Winding transformer. The specialty of the transformer is that it has a single primary winding and Four secondary winding;

S1, S2, S3, S4.S1, S2, S3 the first three secondary windings are of 0-12V, 150mA each but the fourth and last winding has turns which carry 0-12V and 450mA. The total voltage and current input to the primary winding is 230V, 1.5A.The 230V AC 50 Hz is given to the primary winding of the transformer. The secondary winding of the transformer is divided into four winding of the transformer is divided into four winding among which one is connected to the three separate bridge rectifier circuits.

The secondary turns of the transformer are reduced to have 12V AC at the secondary winding. The 12V AC is further given to the rectifier circuitry to convert it into 10 V DC. This voltage is further given to opto isolator for its proper operation.

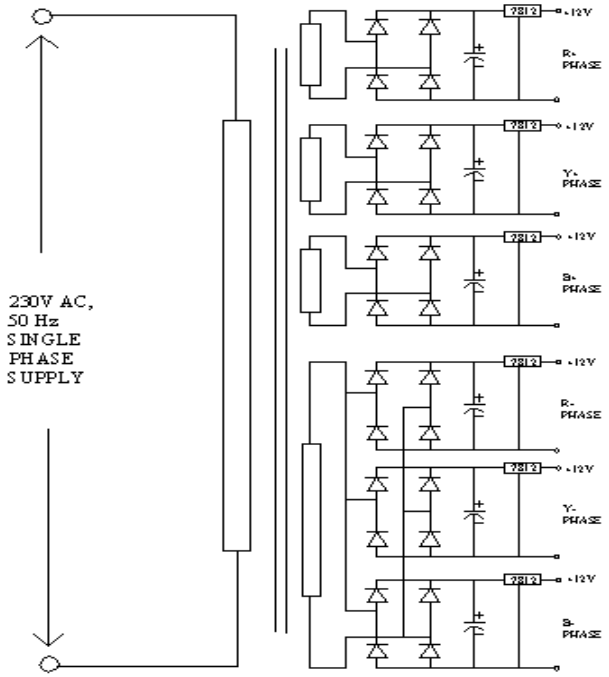

Figure 3. Internal Structure of 4-Winding Transformer

Features of system design:

- Auto change switch with cut of 2 phases.
- Automatic phase selection/detection.
- Preventer for 3 phase supply checked present phase Single phase and convert into three phases for 3 phase appliance.
- Stand by mode inverter circuit.
- Variable output frequency from 10Hz to 100Hz.
- Can be implemented by using IGBT.
- Speed of motor can be varied by varying frequency.
- When 3 phase supply is failure then single phase to three phase converter.
- DC to AC voltage generator.

4. RESULT

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. Output waveforms are shown an follows.

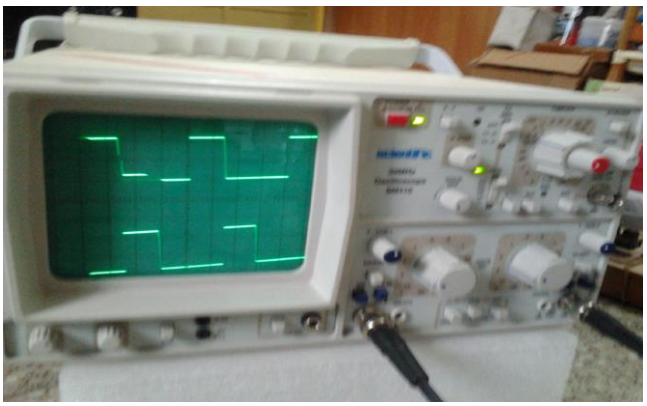

Figure 4. TP1,TP2, TP3, TP4, TP5, TP6 – R, Y, B Phase Output s of 89C52

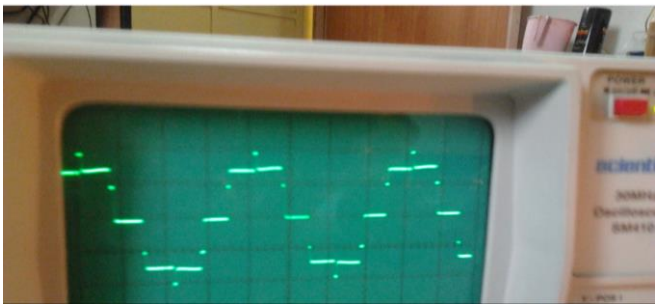

Figure 5. B-Output of Inverter

Figure 6. R, Y, B-Phase output of inverter with respect to neutral

5. CONCLUSION

We have learnt many useful lessons during the course of this project. The control of the microcontroller programming for generation of PWM pulses was found to be more challenging than expected. This could probably be because time constraints did not permit us to do a simulation study of the proposed systems before actually getting down to the hardware impedance. As a result sometimes, trial and error

method had to be resorted to in order to get the modules to work as desired. The control circuitry was very sensitive to the high voltage peak due to the power circuitry hence the Optoisolator have been used by us but due to effect of the reverse current MOSET were burnt. In the end the system was found to meet the aims of the project. Even so, this system I primitive in comparison with existing PWM based single phase to three phase inverter. This is because a great deal of technical experience and practical experience is necessary to design and implement a useful & efficient three phase inverter. We are confident that we will be able to do so in due course of time. 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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