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Automatic Cost Effective Phase Selector System

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***Abstract*: Electricity is lifeline of any country and its continuous availability at minimum cost ensure the country's growth. Reducing the burden over the energy resources leads to the use of alternative sources of energy like Solar, Wind etc. also they are available free of cost. So modern industries and homes, to ensure regular power supply incorporates mainly three sources of energy i.e. Solar, Mains (Utility grid), Diesel generator sets. So an automatic phase selector circuit is required for the switching between these supplies with the Solar having the highest priority followed by Mains for having access of cheapest electricity. The circuit make use of Transformer, Rectifier, Regulator, Comparator and Relays. The switching time is reduced considerably due to the use of high speed electronics devices.**

***Keywords*: Bridge Rectifier, Cost, Mains, Op-amp, Relays, Solar, Transformer.**

1. Introduction

Electricity acts as a backbone of any economy in the world and for the developing nation power instability and high pressure over the natural resources available due to the overpopulation poses a greater threat to their development. So there is necessity for automation of electric power generated along with availability of alternative sources of energy for the purpose of backup to the utility supply. The requirement for the renewable sources can be understood from the following data: India is sixth largest energy consumer in the world, holds a share of about 3.7% of global energy usage, having Maharashtra as the top power generator Indian state among others. Because of India's economic growth, the requirement for power has rise at an average of 3.9% per annum for the last 30 years.

The huge gap between the demand and supply can be met only by making use of non-conventional sources of energy for the generation of electricity. Now in this situation there is need of selection of phase among the received phases from solar, mains and from the diesel generator set. If the changeover is done manually, it results time wasting and may cause damage to the device, product in nut shell there is risk of massive loss to the revenue. The changeover must be automatic although at high speed. Here we felt the need of automation industry. More importantly all electrical systems are built upon the three important factors viz. reliability, safety and economy. Safety and reliability is ensured by making use of automation and switching load to efficient phase conforms economy. The switching circuit make use of elementary electronics devices namely transformer (220V/12V), a bridge rectifier(B20), a set of capacitors having capacitance of 1000 microfarad and 1000 microfarad, a voltage regulator (IC7805), an op-amp as a comparator (LM358), a transistor (BC547) and relays.

Most companies, industrial, commercial and even domestic are dependent on public power supply which has erratic supply such as phase failure, phase imbalances or total power failure due to one or more technical problem in power generation, transmission or distribution. If all the three phases are available, there is need for automation of phase change during phase failure or total power failure in any of three phases in order to safe guard consumer appliances from epileptic power supply. In most cases, many manufacturing companies, whether they are domestic or industrial, which employ single phase equipment for its operation sometimes experience challenges during failures in power supply.

Much time would be required in the process of manual change over. This means that time and the process required for the phase change may cause serious damages to machines and even the products. Hence, there is need for automatic phase switching system. A single phase public utility prepaid meter is operated with a single phase power supply unit. If there is a phase failure from the public utility power supply, the prepaid meter will stop working until the phase is manually changed to an active phase. So a person needs to be present always to make the changes at any point in time. To overcome this problem automatic system is required. The basic idea for the project is to provide uninterrupted supply to the single phase load. More than 70% of the fault are single phase faults. For complexes like hospitals, schools, where there is incoming 3phase supply if any of the phases, out of the 3 phases faces fault, then the supply will be automatically shifted to the next available phase from the 3phase supply.

2. Smart Home Automation System

The prioritized supply from the solar is delivering the power to the load and the portion of it has been taken to feed the switching circuit through the step down transformer. A reduced

voltage output obtained from the secondary of the transformer is delivered to the rectifier and the DC output is smoothened with the help of capacitors. The 12-volt DC when applied to the regulator a voltage of 5 volt is obtained between one of its pin and common. The 5 volt signal is now feed to the comparator, here op-amp acts as the comparator and compare the incoming voltage with a predefined voltage level regulated by the zener diode and if the voltage from the solar remains in the range 200-220V the input at the inverting terminal of the op-amp remains higher than the non- inverting terminal therefore the outcome of the op-amp at pin 6 also remains high making transistor idle and the relay continues the condition of normally connected (NC) and solar is feeding the load directly. In case the input is below the rated value, the load is automatically connected to the Mains if available otherwise the Diesel generator set is asked for the supply.

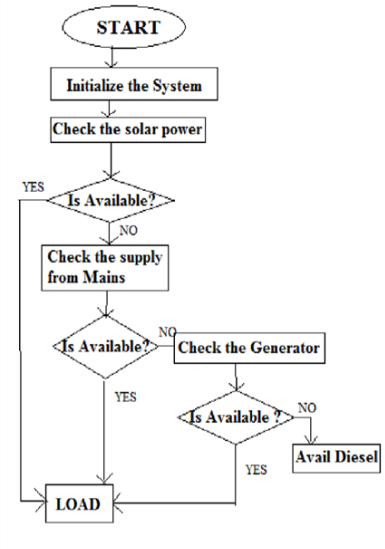

Fig. 1. Flow chart of the process

3. Block diagram of proposed system

The circuit diagram which is required to be laid down on the PCB is shown below in the fig. 2.

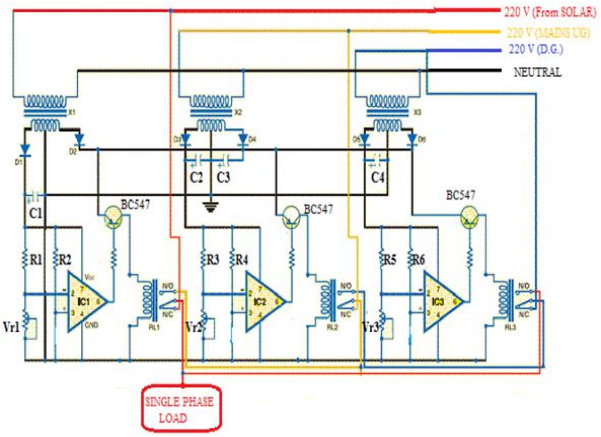

Fig. 2. Circuit diagram of automatic cost effective phase select

In Fig. 2, the overall circuit with all the necessary equipment is laid down. This circuit is implemented by making use of the transformer (220V/12V), Rectifier, Filter, Voltage regulator, Comparator, Transistor and Relays. The selection of equipment with proper rating is done by calculating their minimum and maximum rating of voltage and current across them under normal as well as abnormal operating conditions and proper care is taken in selection of the transformer as it is acting like interface between the electrical and electronics circuit used. The protection of delicate ICs must be ensured. The necessary equipment which used after the stepping down the voltage to 12V is depicted here. The simplicity of the design with high performance is what we get from this circuit of automatic cost effective phase selector.

A. Electromagnetic Relay

Electromagnetic relays are those relays which are operated by electromagnetic action. Modern electrical protection relays are mainly microprocessor based, but still electromagnetic relay holds its place. It will take much longer time to replace all electromagnetic relays by microprocessor based static relays. So before going through detail of protection relay system we should review the various types of electromagnetic relays.

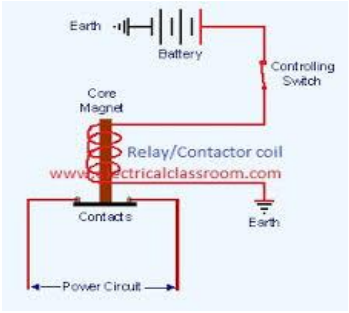

Fig. 3. Electromagnetic Relay

B. Voltage Regulator

The 12-volt DC is not our desired voltage level as the subsequent stage make use of operational amplifier and transistor having working voltage as 5 volts. A 3 pin IC 7805 is used for this purpose. The output voltage of pins is 12 volts, Ground and 5 volts. The 5 volt is further used in the circuit. A voltage regulator incorporates Thyristor whose duty cycle is changed in accordance with the desired voltage level.

C. Operational Amplifier

An op-amp here is used as comparator. It compares the incoming voltage signal from the sources like that of solar, mains and the diesel generator on the basis of priority as indicated with a voltage kept at a constant level by making use of the Zener diode. If the voltage falls below the reference voltage level the load connected to this phase is disconnected and switched over to the mains if solar is not providing thee correct voltage level. Here we have used IC 358. It is an 8 pin IC with pin number 6 as an output pin. LM358 is preferred over the others due to underlying reasons.

1) It is frequency compensated (internally) it has dc voltage gain of 100 dB

It's bandwidth at unity gain is 1 MHz.it has bias current at input of 20 nA.

D. Advantages

1) More Reliable
2) Provide Constant Voltage
3) High Stability
4) Zero Man-Made Errors
5) Continuous Running of Single Phase Loads
6) Better Customer Service

E. Disadvantages

1) Jumping from phase to phase have some phase overload issues
2) Time wasting whenever there is power failure
3) Maintenance is more frequent as the changeover action causes wears and tears

F. Application

1) Boiler pumps, fans & HVAC system
2) Cooling towers
3) Compressors
4) Stairway & packing ventilation
5) Kitchen hoods
6) Roof top units
7) Air handlers
8) Elevators & escalators

4. Conclusion

This paper presented an overview on automatic cost effective phase selector system.

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