Design of Automatic Phase Selector from any Available three Phase with the use of Logic Gate and Relay driver

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Abstract- Power failure is a common problem. It hampers the production of industry, construction work of new plants and buildings. It can be overcome by using a backup power supply such as a generator. But it is cost effective and also time consuming as certain time is required to switch on the generator manually. It is often noticed that power interruption in distribution system is about 70% for single phase faults while other two phases are in normal condition. Thus, in any commercial or domestic power supply system where 3 phases is available, an automatic phase selector system is required for uninterrupted power to critical loads in the event of power failure in any phase. There is no requirement of backup power supply in that case. Also there is no time consumption as the phase is changed automatically within a few seconds. The main aim of this paper is to present the real idea of an automatic phase switch for 220V to 240V alternating current. Although, there are many designs that can perform almost similar functions like, single phase change-over switches, two phase automatic transfer switch and three phase automatic change-over switch, but this model is about an automatic phase switchover (phase selector) which is designed for only three phase A.C input power to single phase output applications.

Keywords – Automatic phase selector, power failure, single phase load

I. INTRODUCTION

The basic idea for the development of the project is to provide uninterrupted supply to the single phase load .More than 70% of the faults are single phase faults. For large 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 3 phase supply.

In an electric power system, a fault or fault current is any abnormal electric current. For example, a short circuit is a fault in which current bypasses the normal load. An open-circuit fault occurs if a circuit is interrupted by some failure. In three-phase systems, a fault may involve one or more phases and ground, or may occur only between phases. In a "ground fault" or "earth fault", current flows into the earth. The short circuit current of a predictable fault can be calculated for most situations. In power systems, protective devices can detect fault conditions and operate circuit breakers and other devices to limit the loss of service due to a failure.

In a poly phase system, a fault may affect all phases equally which is a "symmetrical fault". If only some phases are affected, the resulting "asymmetrical fault" becomes more complicated to analyses. The analysis of these types of faults is often simplified by using methods such as symmetrical components.

The design of systems to detect and interrupt power system faults is the main objective of power-system protection

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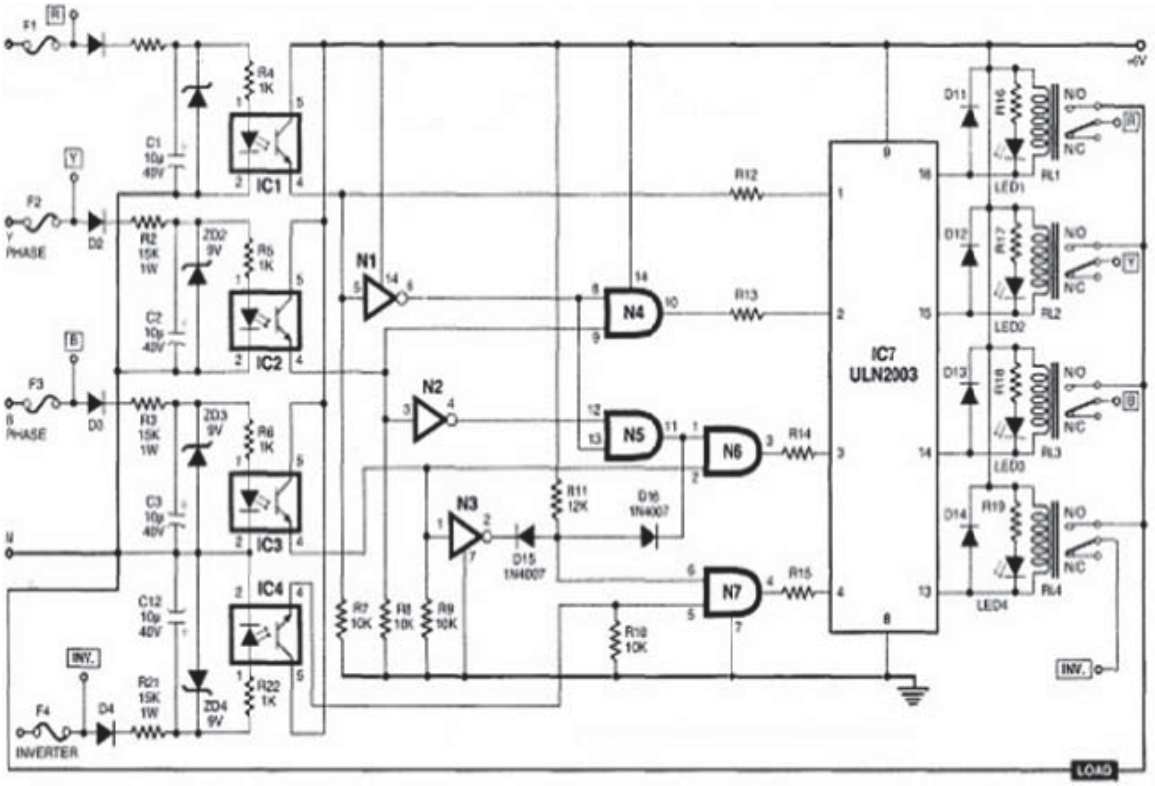
phase systems, a fault may involve one or more phases and ground, or may occur only between phases. In a "ground fault" or "earth fault", charge flows into the earth. The prospective short circuit current of a fault can be calculated for power systems. In power systems, protective devices detect fault conditions and operate circuit breakers and other devices to limit the loss of service due to a failure. In a poly phase system, a fault may affect all phases equally which is a "symmetrical fault". If only some phases are affected, the resulting "asymmetrical fault" becomes more complicated to analyze due to the simplifying assumption of equal current magnitude in all phases being no longer applicable. The analysis of this type of fault is often simplified by using methods such as symmetrical components.

Components Requirement:

A. Diode (IN 4007)
B. Capacitor(100μF)
C. Register (1KΩ , 2KΩ , 2.2 KΩ, 10KΩ, 12 KΩ)
D. Relay Driver (ULN 2003A)
E. Relay (12v)
F. Opto-coupler (MCT2E)
G. NOR Gate (CD7804)

II. CIRCUIT DIAGRAM



III. CONSTRUCTION

The model is designed to provide uninterrupted AC mains supply i.e., 230 volt to a single phase load. This is achieved by automatic changeover of the load from the missing phase to the next available phase in a 3 phase system. It is often noticed that power interruption in distribution system is about 70% for single phase faults while other two phases are in normal condition. Thus, in any commercial or domestic power supply system where 3 phase is available, it is advisable to have an automatic changeover system for uninterrupted power to critical loads in the event of missing phase. In this system auto selection is achieved by using a set of relays interconnected in such a way that if one of the relay feeding to the load remains energized always. Under the phase failure condition the corresponding step down transformer secondary delivers zero voltage which is duly rectified to DC and then fed to the logic gates comprising of AND & OR to switch on the next relay that delivers the power to the load. It also has a provision of connecting to an inverter source which delivers uninterrupted power to the load incase all the 3 phases go missing. The project is supplied with three transformers connected to the 3 phases supply. Further the project can be enhanced by incorporating power semiconductor devices such as thyristors /IGBTs for instantaneous changeover to the next available phase. This overcomes the drawback of the changeover time generally witnessed by relay switching operations.

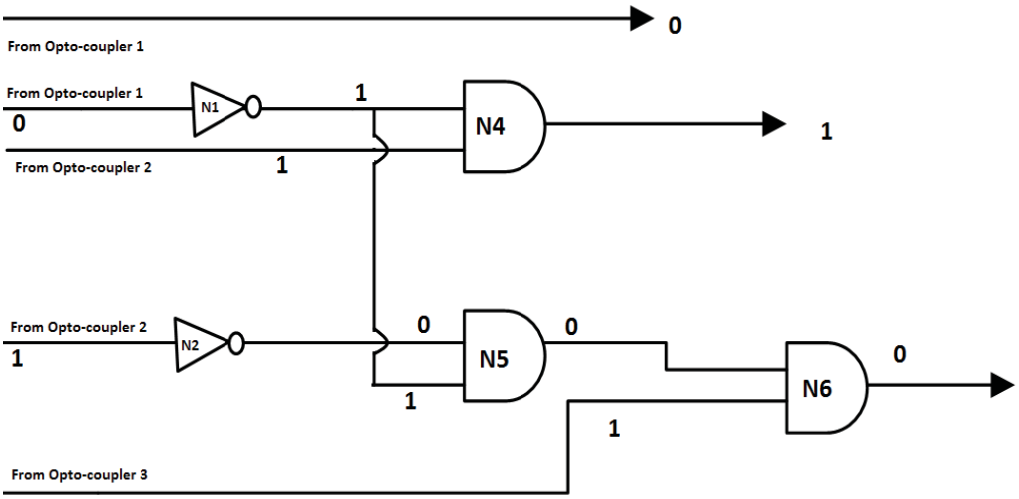
IV. WORKING PRINCIPLE

The main 3 phase supply is stepped down to 12 V by 3 single phase transformers attached to each phase.
Then the 12V is passed through full bridge rectifier and we obtain 12 V DC supply which is required for running the opto-coupler, relay drivers and NOT gate.
The opto-coupler isolates the circuit from the supply.
The three phases are connected with the relay driver via the NOT gate.
In normal working condition when there are no faults, the first phase supplies the single phase load and the relays of the other phases remain normally open. When fault occurs in that phase, the NOT gate sends a low signal to the relay driver and the relay connected to the next healthy phase becomes normally closed and thus the supply to the single phase
load remains unaffected. If three phase fault occurs and all the phases become unavailable then a separate connection can be made by another port of relay driver, relay and NOT gate connected to alternate power source like inverter or battery.

V. PRIORITY SELECTION OF THE ACTIVE PHASE

R	**Y**	**B**	**SELECTION OF PHASE**
0	0	1	B phase activated
0	1	0	Y phase activated
0	1	1	Priority selection required (1)
1	0	0	R phase activated
1	0	1	Priority selection required (2)
1	1	0	Priority selection required (3)

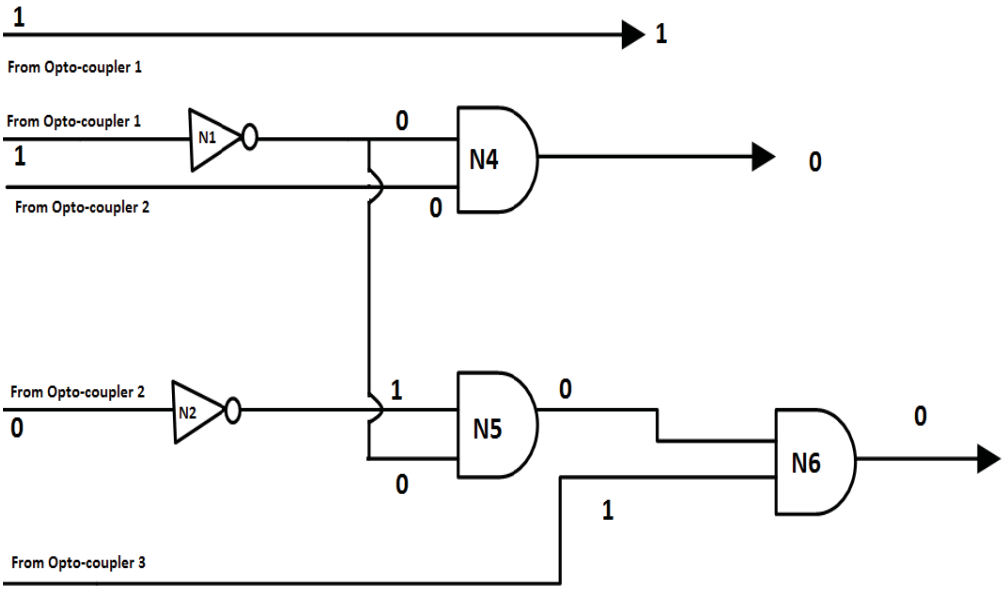
PRIORITY SELECTION OF CASE 1 :



When fault occurs in R- phase, the output from opto-coupler 1 is LOW i.e. 0. Thus the output of N1 NOT gate is 1 and the output of opto-coupler 2 is also HIGH i.e. 1. Hence we get HIGH output from the AND gate N4. Output of N2 NOT gate is LOW which is fed to N5 AND gate. The other input of N5 gate is from N1 and thus we obtain LOW output from N5 gate which is again fed to N6 AND gate. The other input for N6 AND gate is from opto-coupler 3 which is HIGH. Thus the overall output of N6 gate is LOW.

Hence the active phase is **Y- PHASE**

PRIORITY SELECTION OF CASE 2 :

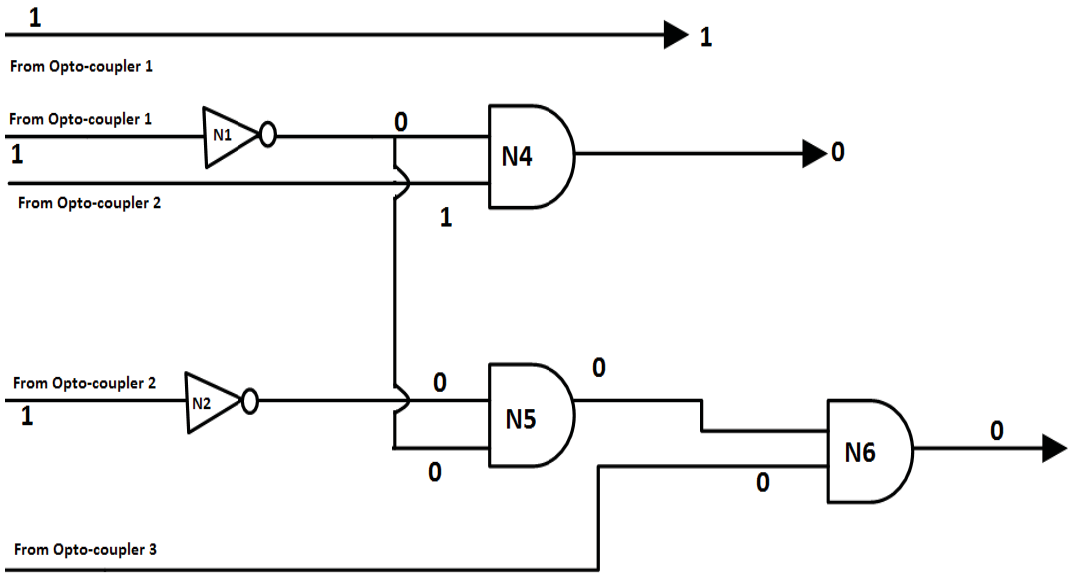


When fault occurs in Y -phase, the output from opto-coupler 2 is LOW i.e. 0. The other two phases are available, so the output of opto-coupler 1 is HIGH. The output of N1 NOT gate is LOW i.e. 0. Thus we get LOW output from the AND gate N4.

Output of N2 NOT gate which is fed by the LOW output of opto-coupler 2 is HIGH which is fed to N5 AND gate. The other input of N5 gate is from N1 and thus we obtain LOW output from N5 gate which is again fed to N6 AND

gate.
The other input for N6 AND gate is from opto-coupler 3 which is HIGH. Thus the overall output of N6 gate is LOW.
Hence the active phase is **R PHASE**

PRIORITY SELECTION OF CASE 3 :



When fault occurs in B -phase, the output from opto-coupler 3 is LOW i.e. 0. The other two phases are available, so the output of opto-coupler 1 is HIGH. The output of N1 NOT gate is LOW i.e. 0. The output of opto-coupler 2 is HIGH as Y phase is also active Thus we get LOW output from the AND gate N4.
Output of N2 NOT gate which is fed by the LOW output of opto-coupler 2 is LOW which is fed to N5 AND gate . The other input of N5 gate is from N1 and thus we obtain LOW output from N5 gate which is again fed to N6 AND gate.
The other input for N6 AND gate is from opto-coupler 3 which is LOW. Thus the overall output of N6 gate is LOW.
Hence the active phase is **R PHASE**

TRUTH TABLE

Input				Output				Active
R	Y	B	INV	R	Y	B	INV	
1	1	1	1	1	Not in use	Not in use	Not in use	R-Phase
Fault	1	1	1	X	1	0	Not in use	Y-Phase
1	Fault	1	1	1	X	0	Not in use	R-Phase
1	1	Fault	1	1	0	X	Not in use	R-phase
Fault	Fault	1	1	X	X	1	Not in use	B-phase
Fault	1	Fault	1	X	1	X	Not in use	Y-phase
1	Fault	Fault	1	1	X	X	Not in use	R-phase
Fault	Fault	Fault	1	X	X	X	1	Inverter

- Here we consider the equipments/consumers of R-Phase.
- In input side 1 means active phase.
- In output side 1 stands for high signal which is able to operate the relay driver.
- In output side X stands for faulty phases and 0 stands for low signal which is not able to operate relay driver

VI. ADVANTAGE

- The time required for switching between the phases have been drastically reduced.
- More automatic operation with the elimination of selector switch.
- Reduced circuit size and easier implementation with the use of relay driver.
- The problem of unwanted rotation of gear motor does not arise.
- The problem of sparking between the selector switch and the phase connection does not arise.

VII. LIMITATION

The ratings of the distribution transformer have to be made higher so that it can support the load of other phases when single phase fault occurs in them. It can make the distribution process costly but with the advantage of providing uninterrupted power supply.

VIII. CONCLUSION

We aimed at developing something that can reduce the problem of sudden power failure.often we read news about operations being stalled, malfunction of life saving equipments due to power failure in hospitals, exams being interrupted in schools and colleges overall everyone gets affected due to this power failure.

We hope that this Automatic Phase selector can reduce the problems faced due to single phase faults.

REFERENCES

[1] Ashish Kumar Gupta, Chandan Singh, Gurpreet Singh, Arun Kumar, "Automatic Cost Effective Phase Selector" International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering, Vol. 4, Issue 5, May 2015
[2] Oduobuk, E. J., Ettah, E. B., Ekpenyong, E. E., "Design and Implementation of Automatic Three Phase Changer Using LM324 Quad Integrated Circuit" International Journal of Engineering and Technology Research Vol. 2, No. 4, April 2014
[3] Krishan Malik, Sumit Kumar, Anil Kumar "MINOR PROJECT REPORT ON AUTOMATIC PHASE CHANGER" KURUKSHETRA UNIVERSITY, KURUKSHETRA
[4] Atser A. Roy, Gesa, F. Newton & Aondoakaa, I. Solomon, " Design and Implementation of a 3-Phase Automatic Power Change-over Switch" American Journal of Engineering Research (AJER), Volume-3, Issue-9,2014
[5] Nwafor Chukwubuikem M**.,** Electronics Development Institute, Awka, National Agency for Infrastructure,
[6] Federal Ministry of Science and Technology, NIGERIA, Volume-2, No-2, March 2012