

International Journal of Innovative Research in Science, Engineering and Technology

(A High Impact Factor, Monthly, Peer Reviewed Journal)

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Vol. 9, Issue 3, March 2020

Three Phase Fault Analysis and Tripping using Timer

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ABSTRACT: The project is designed to develop an automatic tripping mechanism for the three-phase supply system. The project output resets automatically after a brief interruption in the event temporary fault while it remains in tripped condition in case of permanent fault. The faults might be LG (Line to Ground), LL (Line to Line), 3L (Three lines) in the supply systems and these faults in three phase supply system can affect the power system. To overcome this problem a system is built, which can sense these faults and automatically disconnects the supply to avoid large scale damage to the control gears in the grid sub-stations. 555 timers are used for handling short duration and long duration fault conditions. A set of switches are used to create the LL, LG and 3L fault in low voltage side, for activating the tripping mechanism. Short duration fault returns the supply to the load immediately called as temporary trip while long duration shall result in permanent trip.

KEYWORDS: Temporary fault; permanent fault; 555 timer

I. INTRODUCTION

In India it is common to observe the failures in supply system due to the faults that occur during the transmission or distribution. The faults might be LG (Line to Ground), LL (Line to Line), 3L (Three lines) in the supply systems and these faults in three phase supply system can affect the power system. To overcome this problem a system is built, which can sense these faults and automatically disconnects the supply to avoid large scale damage to the control gears in the grid sub-stations.

This system is built using three single phase transformers which are wired in star input and star output, and 3 transformers are connected in delta connections, having input 220 volt and output at 12 volt. C.Nagarajan et al [2,4,6] have developed the concept low voltage testing of fault conditions is followed as it is not advisable to create on mains line. 555 timers are used for handling short duration and long duration fault conditions.

A set of switches are used to create the LL, LG and 3L fault in low voltage side, for activating the tripping mechanism. Short duration fault returns the supply to the load immediately called as temporary trip while long duration shall result in permanent trip. The concept in the future can be extended to developing a mechanism to send message to the authorities via SMS by interfacing a GSM modem.

Auto reset means the systems get restart after fault clearing automatically itself it does not require to start it manually. Auto reset is happened when fault is of temporary fault i.e. the system detect fault is of for lower time i.e. temporary fault means loads get automatically off when fault occurs and automatically after fault clearing process is called as Auto Reset.

Permanent trip means, we have to start the system after fault clearing process manually. In this prototype model this permanent trip is happened when fault is of permanent fault i.e system detect fault is of for higher time .Here loads get

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automatically off when fault occurs and after fault clearing process load will not get automatically thus we have to restart the system manually is called as Permanent trip.

Temporary fault is nothing but the fault which occurs for the small duration, which causes disturbance in the power system for small duration, and clear after some time and resets the system automatically .

II. DESIGN METHODOLOGY

The modern power system is very big and there many chances of fault occurrence on the power system. In order to protect the power system we have to take precaution means by using protecting devices such as fuses, circuit breaker, relays and other fault detector. Because of use of this type of devices we can protect power system from fault and avoid damage to it. For such protection there are various types of devices available in the market, we have to choose the correct equipment and apply it as per rating required.

Functional Block Diagram

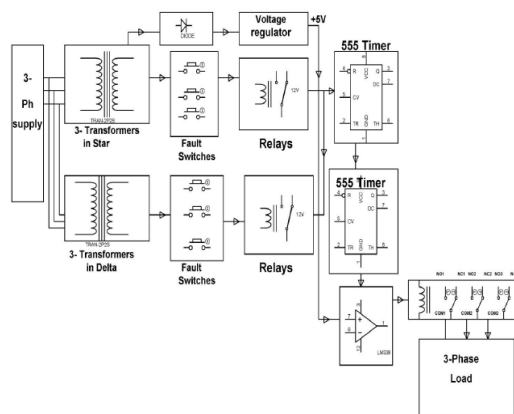


Fig 1: Functional block diagram

The above shown diagram shows the functional block diagram of prototype model which is used for the fault clearing process. The model uses 6 numbers step-down transformers for handling the entire circuit under low voltage conditions of 12v only to test the 3 phase fault analysis. The primaries of 3 transformers are connected to a 3 phase supply in star configuration, while the secondary of the same is also connected in star configuration. The other set of 3 transformers with its primary connected in star to 3 phases have their secondaries connected in delta configuration. The outputs of all the 6 transformers are rectified and filtered individually and are given to 6 relay coils. 6 push buttons, one each connected across the relay coil is meant to create a fault condition either at star i.e. LL Fault or 3L Fault. The NC contacts of all the relays are made parallel while all the common points are grounded. The parallel connected point of NC are given to pin2 through a resistor R5 to a 555 timer i.e. wired in monostable mode. The output of the same timer is connected to the reset pin 4 of another 555 timer wired in astable mode. LED'S are connected at their output to indicate their status. The output of the U2 555 timer from pin3 is given to an Op-amp LM358 through wire 11 and d12 to the non-inverting input pin3, while the inverting input is kept at a fixed voltage by a potential divider RV2. The voltage at pin2 coming from the potential divider is so held that it is higher than the pin3 of the Op-amp used as a comparator so that pin1 develops zero logic that fails to operate the relay through the driver transistor Q1. This relay Q1 is '3CO' relay i.e. is meant for disconnecting the load to indicate fault conditions.

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Operating Procedure

Turn the preset fully anticlockwise and connect the 6 transformers to the board, all the 6 relay LED, power supply LED, 3 phase relay LED shall be glowing. After that observe that the LED of both 555 timer shall be in off position. Turn the preset slowly clockwise notice that 3 c/o relay LED goes off that completes the setting procedure and the model is ready for use. While the board is powered from a 3phase supply all the 6 relay coils get DC voltage and their common point disconnects from the NC and moves on to the NO points there by providing logic high at pin2 of 555 timer U1 i.e. that is kept on monostable mode. While any push button across the relay is pressed it disconnects that relay and in the process in common contacts moves to the NC position to provide a logic low at trigger pin of 555 timer to develop an output that brings the U2 555 timer which is used in astable mode for its reset pin to high such that the astable operation takes place at its output which is also indicated by flashing D11 LED. If the fault is off temporary in nature i.e. if the push button pressed is released immediately the U1 monostable disables U2 the output of which goes to zero in the event of any push button kept pressed for a longer duration the monostable output provides a longer duration active situation for U2 the astable timer the output of which charges capacitor C13 through R11 such that the output of the comparator goes high that drives the relay to switch off three phase load. The output of Op-amp remains high indefinitely through a positive feedback provided for its pin1 to pin3 through a forward biased diode and a resistor in series. This results in the relay permanently switched on to disconnect the load connected at its NC contacts permanently off. In order to maintain the flow of DC supply the star connected secondary set DC'S are paralleled through D8, D9 & D10 for uninterrupted supply to the circuit voltage of 12V DC and 5V DC derived out of voltage regulator IC 7805.

Temporary Fault Clearing Process

Turn the preset fully anticlockwise and connect the 6 transformers to the board, all the 6 relay LED, power supply LED, 3 c/o relay LED shall be glowing. After that observe that the LED of both 555 timer shall be in off position. Turn the preset slowly clockwise notice that 3 c/o relay LED goes off that completes the setting procedure and the model is ready for use. While the board is powered from a 3phase supply all the 6 relay coils get DC voltage and their common point disconnects from the NC and moves on to the NO points there by providing logic high at pin2 of 555 timer U1 i.e. that is kept on monostable mode. While any push button across the relay is pressed it disconnects that relay and in the process in common contacts moves to the NC position to provide a logic low at trigger pin of 555 timer to develop an output that brings the U2 555 timer which is used in astable mode for its reset pin to high such that the astable operation takes place at its output which is also indicated by flashing D11 LED. If the fault is off temporary in nature i.e. if the push button pressed is released immediately the U1 monostable disables U2 the output of which goes to zero. In this condition the output of U1 monostable 555 timer is directly applied across the 3 c/o relay coil which switches off the load and when the switch is released the load gets on automatically means "Auto Reset" on temporary fault.

Permanent Fault Clearing Process

Turn the preset fully anticlockwise and connect the 6 transformers to the board, all the 6 relay LED, power supply LED, 3 c/o relay LED shall be glowing. After that observe that the LED of both 555 timer shall be in off position. Turn the preset slowly clockwise notice that 3 c/o relay LED goes off that completes the setting procedure and the model is ready for use. While the board is powered from a 3phase supply all the 6 relay coils get DC voltage and their common point disconnects from the NC and moves on to the NO points there by providing logic high at pin2 of 555 timer U1 i.e. that is kept on monostable mode. While any push button across the relay is pressed it disconnects that relay and in the process in common contacts moves to the NC position to provide a logic low at trigger pin of 555 timer to develop an output that brings the U2 555 timer which is used in astable mode for its reset pin to high such that the astable operation takes place at its output which is also indicated by flashing D11 LED. If the fault is off temporary in nature i.e. if the push button pressed is released immediately the U1 monostable disables U2 the output of which goes to zero in the event of any push button kept pressed for a longer duration the monostable output provides a longer duration active situation for U2 the astable timer the output of which charges capacitor C13 through R11 such that the output of the comparator goes high that drives the relay to switch off three phase load. The output of Op-amp remains high indefinitely through a positive feedback provided for its pin1 to pin3 through a forward biased diode and a resistor in

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series. These results in the relay permanently switched on to disconnect the load connected at its NC contacts permanently off, this are called as permanent trip. After this permanent trip we have to shut down the whole system and restart the system.

Power Circuit diagram

In power circuit diagram of fault clearing prototype. uses 6 numbers step-down transformers for handling the entire circuit under low voltage conditions of 12V only to test the 3 phase fault analysis. The primary of 3 transformers is connected to a 3-phase supply in star configuration, while the secondary of the same is also connected in star configuration. The other set of 3 transformers with its primary connected in star to 3 phases have their secondary connected in delta configuration. The output of all the 6 transformers is rectified and filtered individually and is given to 6 relay coils. 6 push buttons, one each connected across the relay coil is meant to create a fault condition either at star i.e. LL Fault or 3L Fault. The NC contacts of all the relays are made parallel while all the common points are grounded. The parallel connected point of NC is given to pin2 through a resistor R5 to a 555 timer i.e. wired in monostable mode. In the control circuit diagram of fault clearing prototype which uses two 555 IC, one in monostable mode and second in astable mode. The output of the same timer is connected to the reset pin 4 of another 555 timer wired in astable mode. LED'S are connected at their output to indicate their status. The output of the U2 555 timer from pin3 is given to an Op-amp LM358 through wire 11 and d12 to the non-inverting input pin3, while the inverting input is kept at a fixed voltage by a potential divider RV2. The voltage at pin2 coming from the potential divider is so held that it is higher than the pin3 of the Op-amp used as a comparator so that pin1 develops zero logic that fails to operate the relay through the driver transistor Q1. This relay Q1 is '3 contacts (3CO) relay i.e. is meant for disconnecting the load to indicate fault conditions. Result

Continuity test: In electronics, a continuity test is the checking of an electric circuit to see if current flows (that it is in fact a complete circuit). A continuity test is performed by placing a small voltage (wired in series with an LED or noise-producing component such as a piezoelectric speaker) across the chosen path. If electron flow is inhibited by broken conductors, damaged components, or excessive resistance, the circuit is "open". Devices that can be used to perform continuity tests include multimeters which measure current and specialized continuity testers which are cheaper, more basic devices, generally with a simple light bulb that lights up when current flows. An important application is the continuity test of a bundle of wires so as to find the two ends belonging to a particular one of these wires; there will be a negligible resistance between the "right" ends, and only between the "right" ends. The test is performed just after hardware soldering and configuration has been completed. This test aims at finding any electrical opening paths in the circuit after the soldering. Many time's the electrical continuity in the circuit is lost due to improper soldering wrong and rough handling of PCB improper usage of soldering component failures and presence of bugs in the circuit diagrams. we connect both the terminals across path that needs to be checked. If there is continuation then it will appear beep sound.

Power on Test:

This test is performed to check whether the voltage at different terminals is according to requirement or not. We take a multimeter and put it in voltage mode. Remember that this test is performed without microcontroller. Firstly, we check the output of the transformer whether we get the required 12v AC voltage Then we apply this voltage to the power supply circuit. Note that we do this test without microcontroller because if there is any excessive voltage, this may lead to damping the controller. We check for the input to voltage regulator. In this way we can ensure that voltage at all terminals is as per the requirement.

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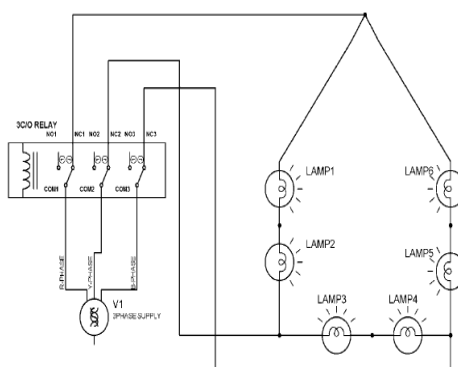


Fig:2. Load connections

Load Connection:

The above diagram shows the connection of 3 co relay connected to load i.e. 6 lamps which were connected in series with each other. Each lamp has rating of 250V,15W and the relay i.e. 3co relay used which is having 11 terminals which consists of 3 NC contacts, 3 NO contacts, 3 common points and 2 & 10 terminals are used as coil for the operation of relay. In this chapter we have seen that the information regarding to the prototype and its power circuit diagram, control circuit diagram and load connected to 3 co relay diagram explanation and its working and basic information, functions and characteristics about the components used in this prototype.

III. CONCLUSION

This project is designed in the form of Hardware for three single phase transformers 230v to 12V of output for to develop an automatic tripping mechanism for the three phase supply system while temporary fault and permanent fault occurs. Here we used 555 timer with relay for the fault is temporary or permanent. Short duration fault returns the supply to the load immediately called as temporary trip while long duration shall result in permanent trip.

IV. FUTURE SCOPE

The model output resets automatically after a brief interruption in the event of temporary fault while it remains in tripped condition in case of permanent fault. By incorporating sensors and microcontrollers we can make this system more advances. Because of this addition of microcontrollers and sensors the system will analyse fault very early and clear early. In future the prototype model can be develop with a mechanism when fault occur it will send a message to the authorities via SMS by interfacing a GSM modem and it will play important role in power system as reliable protection system. In future there can be more advancement in three phase fault analysis system like [1] GPRS based network used for tracking transformers [2] A mechanism to send message to authorities via SMS by interfacing GSM modem [3] Improvement to human machine interface [4] Long distance Data transmission.

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ISSN(Online): 2319-8753
ISSN (Print): 2347-6710

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Vol. 9, Issue 3, March 2020

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