Analysis of three phase fault in a power system using auto reclosing mechanism

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Abstract— **This paper provides automatic tripping mechanism for three phase supply system for the prevention from damage due to faults. The electrical power supplied to the consumer from the substation can have some failures. Due to failure in the supply system, the fault that occur during the transmission or distribution. In electrical system, LG, LL, 3L short circuit fault and various faults occur. These faults are lead to damage to the power system equipment's. In this paper it has been discussed how to overcome this problem by using auto reclosing mechanism for temporary fault and trip for permanent fault.**

I. INTRODUCTION

A fault in a power system is any failure due to over voltage or over current. Which interface the normal flow of current. Lightening stroke cause the most faults on high voltage transmission line producing a very high transient that greatly exceeds the rated voltage of the line. This high voltage usually causes flashover between the phases and/or the ground creating an arc. Faults involving ionized current paths are also called transient faults. They usually clear if power is removed from the line for a short time and then restored. If one or two or three phases break or if insulator breaks due to fatigue or inclement weather, this fault is called permanent fault. Approximately 75% of all faults in power system are transient in nature knowing the magnitude of fault current is important when sitting protection equipment. (Size, types, etc.)

Types of faults

The faults are broadly classified as

- Symmetrical faults
- Unsymmetrical faults

The shunt faults are characterized by increase in current, and fall in voltage and frequency and they are classified as

- Single line-ground faults (SLG)
- Double line –ground fault(LLG)
- Line-line faults (LL)
- 3 Phase fault

Types of faults	Abbreviations	Type	%
SLG FAULT	SLG	UN SYM	70
LL FAULT	LL	UN SYM	15
LLG FAULT	LLG	UN SYM	10
3PH FAULT	3P	SYM	5

Table 1: Severity of faults

Line-line faults: A short circuit occurs between two lines or phases of a system.
Single line-ground fault: Short circuit occurs between one phase of system and the earth.
Double line-ground fault: short circuit occurs between two phases along with the earth at a same time.
3 phase fault: An open circuit fault where all the 3phases are interrupted by some failure.

II. BLOCK DIAGRAM

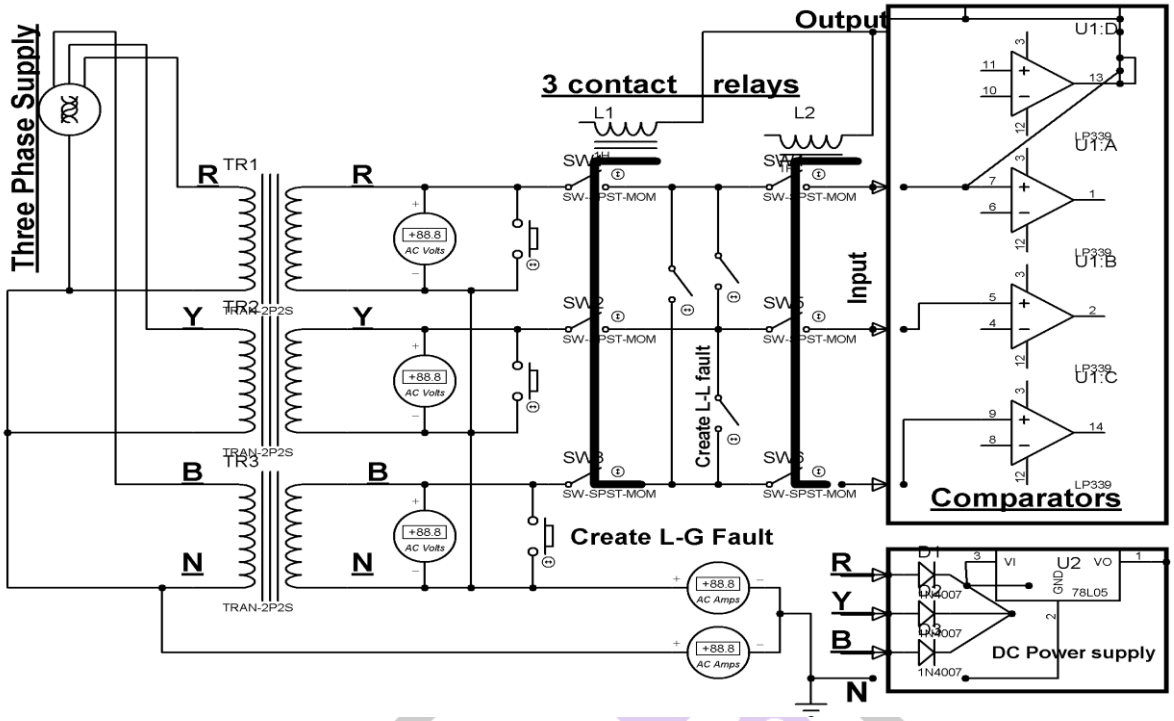

Fig 1.1: Block diagram arrangement

The major components required are Power transformer, Voltage regulator, Relays, 555 timers, and LM358 Comparator.

Power transformer:

Fig 1.2: power transformer

Transformer is a static device that consist of two windings wrapped around an electromagnet that transfers electricity from one circuit to another circuit without change in the frequency of electrical energy. There are two types

- Step up transformer with increase in voltage.
- Step down transformer with decrease in voltage.

By knowing the primary and secondary turn's ratio we can determine what type of a transformer i.e. step down or step up. If secondary having large number of turn's ratio than primary is called step up transformer and if secondary having less number of turn's ratio than primary is called step down transformer.

Voltage regulator:

Fig 1.3: voltage regulator

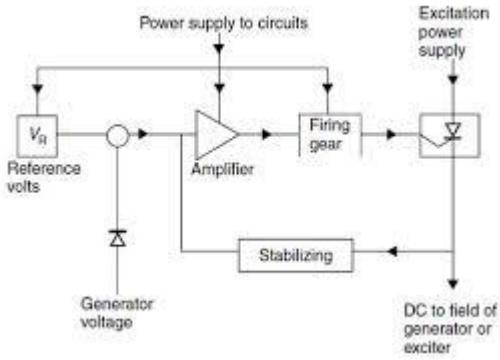

Fig 1.4: automatic voltage regulator

A voltage regulator shown in fig1.3 is designed to automatically maintain a constant voltage level, a voltage regulator may be a simple "feed-forward" design or may include negative feedback control loops. It may use an electromechanical mechanism or electronic components. Depending upon the design it may be used to regulate one or more AC or DC voltages.
How an AVR works: In the first place the AVR monitors the output voltage and controls the input voltage for the exciter of the generator by increasing or decreasing generator control voltage. The output voltage of the generator increases or decreases accordingly. The AVR calculates how much voltage has to be sent in a sec. therefore stabilizing the output voltage to a predetermined set point.

Relay:

Fig 1.5: relay

Relays are switches that open and close circuits electromechanically or electronically. Relays control one electrical circuit by opening and closing contacts in another circuit. When a relay contact is normally open (NO) there is an open contact when a relay is not energized, when a relay contact is normally closed (NC), there is a closed contact when the relay is not energized in either case, applying electrical current to the contactors will change their state. Protective relays can prevent equipment damage by detecting electrical abnormalities including over current, undercurrent, over loads and reverse currents.

IC 555 Timer:

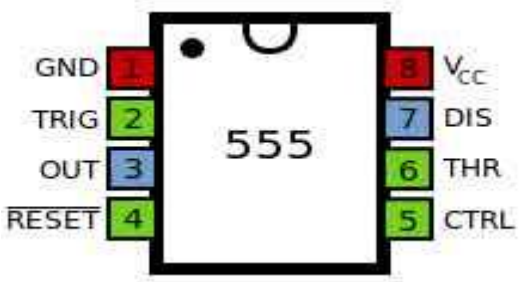

Fig 1.6: IC 555 timer pin diagram

The 555 timer IC is an integrated circuit or a chip used in a variety of timers, pulse generators, and oscillator applications. The 555 timer can be used to provide time delays, as an oscillator and has a flip-flops element. It is an 8 pin IC it has 3 operating modes.

1. Bistable mode or Schmitt trigger:
   The 555 can operate as a flip-flop, if the DIS pin is not connected and no capacitor is used. Uses include bounce-free latched switches.
2. Monostable mode:
   In this mode, the 555 timer functions as a "one-shot" pulse generator applications include missing pulse detection, bounce free switches, touch switches, frequency divider, capacitance measurement, PWM and so on.
3. Astable mode or free running mode:
   This means there will be no stable level at the output so the output will be swinging between high and low. This character of unstable output is used as clock or square wave output for many applications such as logic clocks, tone generation, security alarm's etc.

Comparator

These devices consist of two independent high gain frequency compensated operational amplifiers design to operate from a single supply or split supply over a wide range of voltages.

Features:

- wide supply ranges
- Single supply: 3V to 32V.
- Dual supply: ±1.5v to ±16v.
- Low supply-current drain, independent of supply voltage: 0.7mA typical.
- Internal frequency compensation.
- Open loop differential voltage gain: 100Db typical.

Construction

In this model, it has six number of step down transformers for operating the complete circuit. Under low voltage condition of 12V only to determine three phase faults. The primary winding of all the three transformers are connected in star configurations and are connected to an input supply. While the secondary winding of this transformer is also connected in same configuration. The remaining set of three transformers with its primary connected in star and secondary in delta configuration. All the six transformer outputs are filtered and rectified separately and are given to six relays. Six push buttons are used, in order to create the faults in star configuration. Each one push button connected across the relay coils. By making NC contacts of the relays in parallel while all the common points are grounded. The normally closed contact of relay coil is given to the pin 2 of IC 555 timers through resistor R5. I.e. wired in monostable mode. The output of the IC 555 timer wired in astable mode. The Led's are connected at the output to display their status. The output of the 555 timer from pin 3 is given to comparator through wire 11 and D12 to the non inverting input pin 3, and the inverting input is kept at a constant voltage by potential divider RV2. The voltage at pin coming from the potential divider is so held that the pin 3 of the op-amp used as comparator so that pin 1 generates zero logic it is not able to operate the relay through the driver transistor Q1. This relay Q1 is three contacts relay i.e. meant for disconnecting the load to identify the faults.

Operating procedure

When a three phase supply is given to the board all the six relay coil gets energized and their common point removed from the NC contacts and move on to the NO points. At pin 2 of 555 timer U1 provide a logic high i.e. remains on monosatble mode. If any push button pressed across the relay it disconnects that relay the common point's moves to the NC position to provide a logic low at trigger pin of 555 timers. To build an output that brings the U3 555 timer which is used in astable mode. In case of permanent fault: if any push button is pressed for long period then the output of the IC 555 timer present in monostable mode provides a longer period of active situation for 555 timer. The output of the same charges the capacitor C13 through R1. The output of the comparator gets high which drives the relay through the transistor Q1 to switch of three phase load. In case of temporary faults: if any push buttons is released after a short period, the output of U3 of 555 timers goes to zero when 555 timer U1 in monostable mode disables U3.

Hardware implementation model:

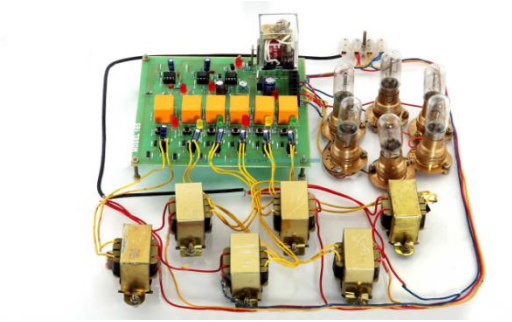

Fig1.7 hardware test kit

Applications

- Used in substation.
- Applied in transmission and distribution system.
- Used in Drives &Relay in power system.
- For clearing temporary faults in industries and commercial sectors.

Conclusion

This project is designed to give protection against the temporary and permanent fault occurs in a power system by using automatic mechanism. 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.

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