ANJUMAN - I - ISLAM'S
KALSEKAR TECHNICAL CAMPUS,
NEW PANVEL

A Report on

THREE PHASE FAULT ANALYSIS WITH AUTO RESET ON TEMPORARY FAULT AND PERMANENT TRIP OTHERWISE

DEPARTMENT OF ELECTRICAL ENGINEERING

UNDER THE GUIDANCE OF

PROF. SAYED KALEEM

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AFFILIATED TO

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A PROJECT REPORT

ON

"THREE PHASE FAULT ANALYSIS WITH AUTO RESET ON TEMPORARY FAULT AND PERMANENT TRIP OTHERWISE."

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ELECTRICAL ENGINEERING – 2021

CERTIFICATE

Date:

This is to certify that the Project Report for **"THREE PHASE FAULT ANALYSIS WITH AUTO RESET ON TEMPORARY FAULT OTHERWISE PERMENENT TRIP"** submitted by following students the partial fulfillment of the requirement for the award of the degree of **B.E in Electrical Engineering** of **University of Mumbai** is a record of the bona-fide work carried out by here under my supervision and guidance. The work submitted, in my opinion, has reached to a level required for being accepted for the examination. The matters embodied in this dissertation work, to the best of my knowledge.

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1) Mohammad Husen.
2) Mohammed Ejaz
3) Rehan Ahmed
4) Mohmed Adil

PREFACE

We are glad to present our project entitled

"THREE PHASE FAULT ANALYSIS WITH AUTO RESET ON TEMPORARY FAULT AND PERMANENT TRIP OTHERWISE."

The main objective of this report is 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.

This project is aimed to reduce the outage time due to faults and provide a higher level of service continuity to the customer. Furthermore, successful high-speed auto re-closing on transmission circuits can be a major factor when attempting to maintain system stability. For those faults that are permanent, auto re-closing will re-close the circuit into a fault that has not been cleared, which may have adverse effects on system stability (particularly at transmission levels).

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.

The major advantage of the project is, it is not only save the appliance but it will also show the type of fault that has been occurred in the system so it will be easy for the operator to solve the problem easily. It will also check whether the fault is permanent or temporary fault. If the fault is temporary fault then the supply will be restored after a predefined time of 15sec otherwise permanent trip signal is given to the relay.

ABSTRACT

This project develops 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 electrical substation which supply the power to the consumers, have failures due to some faults which can be temporary or permanent. These faults lead to substantial damage to the power system equipment. In India it is common, 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. This 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.

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CHAPTER – 1

INTRODUCTION

[1.1]. PROBLEM SUMMARY AND INTRODUCTION:

Generally we are transmitting power from the generating station through the transmission line. Mainly, there are two types of transmission lines.

1. Overhead transmission lines
2. Underground transmission lines

As from the latest research 70% to 90% of faults are occurred in overhead transmission lines which are transient. There are many faults due to some kind of error or natural error.

Mainly there are three types of faults as following way. A transient fault, such as an Insulator flashover.

•

Different types of faults in 3 phase systems are:

1. L-L fault (line to line fault)
2. L-G fault (line to ground fault)
3. 2L-G fault (double line to ground fault)

Is a fault which is cleared by the immediate tripping of one or more circuit breakers to isolate the fault, and which does not recur when the line is re-energized?

Faults tend to be less transient (near the 80% range) at lower, distribution voltages and more transient (near the 90% range) at higher, sub transmission and transmission voltages.

Lightning is the most common cause of transient faults, partially resulting from insulator flashover from the high transient voltages induced by the lightning. Other possible causes are swinging wires and temporary contact with foreign objects.

Thus, transient faults can be cleared by momentarily de -energizing the line, in order to allow the fault to clear. Auto reclosing can then restore service to the line that"s why we make this made this project.

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 electrical substation which supply the power to the consumer""s i.e. industries or domestic can have failures due to some faults which can be temporary or permanent. These faults lead to substantial damage to the power system equipment. 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. This 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.

[1.2]. AIM AND OBJECTIVES OF THE PROJECT:

This project is aimed to design reduce the outage time due to faults and provide a higher level of service continuity to the customer.

Furthermore, successful high-speed reclosing auto reclosing. On transmission circuits can be a major factor when attempting to maintain system stability. For those faults that are permanent, auto reclosing will reclose the circuit into a fault that has not been cleared, which may have adverse effects on system stability (particularly at transmission levels).

[1.2.1]. DESCRIPTION OF PROJECT:

Aim: The main aim of this project is to make transmission line more reliable and clearing the fault.

Design: The project consists of transformer, voltage regulator, relay, filter, 555 timer, diode, resistor, capacitor etc. In this circuit six number of step down transformer are used forming the star and delta connection. Their input is 220 volt and gives output in 12 volt. This is due to low voltage testing of fault and detect the fault condition and operate circuit breaker and other device to limit the loss of service due to failure.

Costs: The costs include Capital costs, Installation costs, Commissioning costs, Maintenance and Servicing costs etc.

CHAPTER: 2

LITERATURE SURVEY

[2.1]. LITERATURE REVIEW:

[1] Vinesh Gamit, Vivek Karode, Karan Mistry, "**FAULT ANALYSIS ON THREE PHASE SYSTEM BY AUTO RECLOSING MECHANISM**", *IJERA,* eISSN: 2319-1163, Volume:04 Issue:05, May-2015, pp: 292-298

Conclusion:

Various faults have been Simulated to develop an automatic tripping mechanism for the three phase supply system while temporary fault and permanent faults occur. Here timer 555 has been used with relay for the fault analysis. Short duration fault back to the supply to the load immediately called as temporary trip while long duration shall result in permanent trip.

[2] Sathish Bakanagari[1], A. Mahesh Kumar[2], M. Cheenya, "**Three Phase Fault Analysis with Auto Reset for Temporary Fault and Trip for Permanent Fault**", *IJERA*, eISSN: 2248-9622, Volume: 3 Issue: 6 , NOV-DEC 2013, pp: 1082-1086

Conclusion:

This project is designed in the form of Hardware for three single phase transformers 230v to12V 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 theload 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.

[3] Deendayal Nagar1 Deep Singh Bhalla2 Deepesh Paliwal, **"Three Phase Auto Recloser Scheme"**, *IJERA*, eISSN: 2321-0613, Volume: 4 Issue: 1 , 2016, pp: 820-8022

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 are using 555 -timer with relay for the determination wheather 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.

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

[2.2]. KEY ACTIVITIES:

The key activities to be carried out are as follows:

- Research and Development
- Design of Distribution system
- testing of project
- commissioning of project
- Site Selection
- Installation of project
- Maintenance and service of installed project

CHAPTER – 3

IMPLEMENTATION

[3.1] INTODUCTION TO THREE PHASE FAULT:

Six numbers of steps down transformers are used for forming star and delta secondary's at low voltage output. Fault condition is created with a set of switches to input LL, LG, 3L fault the circuit. This triggers a 555 timer in monostable to reset after fault clearance in a short duration temporary fault or permanently trip the output in case of prolonged fault. We know that if the fault accurse then it creates many problems to the load. Many times load is damaged. So it is very important to protect the system again the faults.

Different types of faults in 3 phase system are:

1. L-L fault (line to line fault)
2. L-G fault (line to ground fault)
3. 2L-G fault (double line to ground fault)

[3.2] FAULT ANALYSIS:

Faults are classified into two parts, Active and Passive Fault.

[3.2.1] ACTIVE FAULT:

When current passing from one phase to another phase or phase to ground is known as Active fault. This fault must be cleared as quickly as possible otherwise its damages to the conductor or line or the equipment.

[3.2.2] PASSIVE FAULT:

Passive faults are stressing the system beyond its design and long duration fault which ultimately results in active fault.

Examples are:

- **Overloading** – When load increased its results in voltage increased and insulation is overheating.
- **Overvoltage** – Voltage is increased to its rated voltage and stressed to

the insulation.

- **Under frequency** – Frequency goes below to its rated frequency it results in plant to behave incorrectly.
- **Power swings** – generators outage and loss of synchronism.

[3.2.3] TYPES OF FAULTS ON 3 PHASE SYSTEM:

Faults occurred on a three phase A.C. system shown in fig – 2.1 are as follows:

A) Single line to ground fault

B) Phase-to-phase fault

C) Phase-to-phase-to-earth fault

D) Three phase fault

E) Three phase-to-earth fault

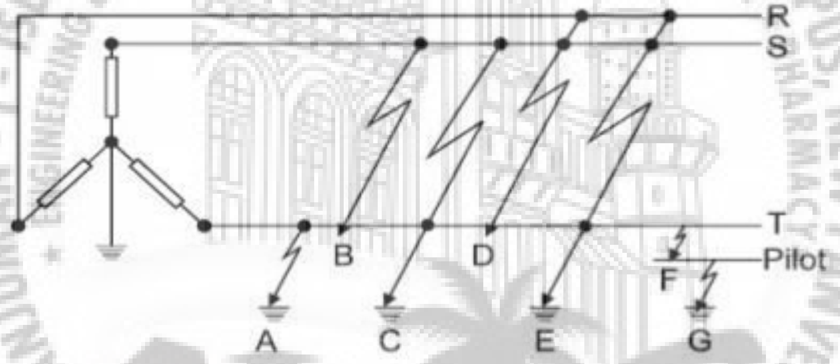

Figure: 3.1 Types of faults

- Single line to ground fault:

  The single line-to-ground fault is usually referred as "short circuit" fault and occurs when one conductor falls to ground or makes contact with the neutral wire.

- Line-to-Line Fault :

  A line-to-line fault may take place either on an overhead and/or underground transmission system and occurs when two conductors are short-circuited. One of the characteristic of this type of fault is that its fault impedance magnitude could vary over a wide range making very hard to predict its upper and lower limits. It is when the fault impedance is zero that the highest asymmetry at the line-to-line fault occurs.

[3.2.4] TRANSIENT AND PERMENENT FAULT:

Transient faults are did not damage the insulation of wire and there are small in time duration and after that period circuit is re-energized. These faults are occur on outdoor equipment because the air is main medium to take place the transient fault. Example of transient fault are insulator flashover and lightning stroke, when it happen the circuit is de-energized or open by circuit breaker and after a brief interval it will reclose. Permanent fault as name suggest it is the permanent fault, which damage permanently to the insulation. In this period line will permanent de-energized and repaired.

[3.2.5] SYMMETRICAL AND ASYMMETRICAL FAULT:

A symmetrical fault is a balanced fault which are occurred on three phase. These three phase has same value of fault current. Magnitude of all fault current is same. These faults are same in three line or three line to ground fault. An asymmetrical fault has a D.C. offset, transient in nature and unbalanced fault. They are occur on single line, double line or single line to ground or double line to ground.

[3.3] HARDWARE COMPONENTS:

1) Transformer
2) voltage regulator
3) 555 timer
4) diode
5) relay
6) resistor
7) capacitor
8) comparator

[3.3.1] TRANSFORMERS:

A transformer is a static electrical device that transfers energy by inductive coupling between its winding circuits. A varying current in the primary winding creates a varying magnetic flux in the transformer's core and thus a varying magnetic flux through the secondary winding. This varying magnetic flux induces a varying electromotive force (emf) or voltage in the secondary winding. Transformers can be used to vary the relative voltage of circuits or isolate them, or both. Transformers range in size from thumbnail sized used in microphones to units weighing hundreds of tons interconnecting the power grid. A wide range of transformer designs are used in electronic and electric power applications. Transformers are essential for the transmission, distribution, and utilization of electrical energy.

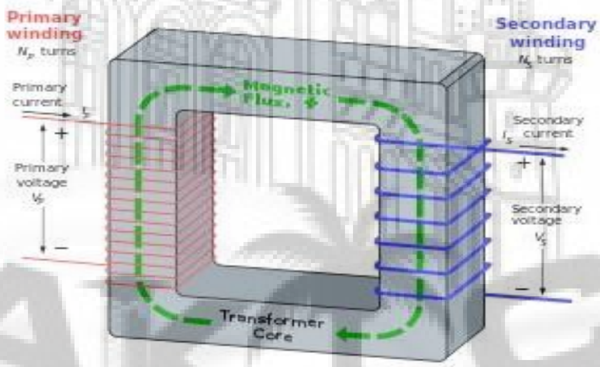

Figure [3.2] Transformer circuit

The ideal transformer model assumes that all flux generated by the primary winding links all the turns of every winding, including itself . In practice, some flux traverses paths that take it outside the windings. Such flux is termed *leakage flux* , and results in leakage inductance in series with the mutually coupled transformer windings. Leakage flux results in energy being alternately stored in and discharged from the magnetic fields with each cycle of the power supply.

It is not directly a power loss (see Stray losses below), but results in inferior voltage regulation, causing the secondary voltage not to be directly proportional to the primary voltage, particularly under heavy load. Transformers are therefore normally designed to have very low leakage inductance. Nevertheless, it is impossible to eliminate all leakage flux because it plays an essential part in the operation of the transformer.

The combined effect of the leakage flux and the electric field around the windings is what transfers energy from the primary to the secondary. In some applications increased leakage is desired, and long magnetic paths, air gaps, or magnetic by pass shunts may deliberately be introduced in a transformer design to limit the short-circuit current it will supply. Leaky transformers may be used to supply loads that exhibit negative resistance, such as electric arcs, mercury vapor lamps, and neon signs or for safely handling loads that become periodically short-circuited such as electric arc welders.

The conducting material used for the windings depends upon the application, but in all cases the individual turns must be electrically insulated from each other to ensure that the current travels throughout every turn. For small power and signal transformers, in which currents are low and the potential difference between adjacent turns is small, the coils are often wound from enameled magnet wire, such as Formvar wire. Larger power transformers operating at high voltages may be wound with copper rectangular strip conductors insulated by oil-impregnated paper and blocks press board.

Figure 3.3 Transformer

High-frequency transformers operating in the tens to hundreds of kilohertz often have windings made of braided Litz wire to minimize the skin-effect and proximity effect losses. Large power transformers use multiple-stranded conductors as well, since even at low power frequencies non-uniform distribution of current would otherwise exist in high-current windings. Each strand is individually insulated, and the strands are arranged so that at certain points in the winding, or throughout the whole winding, each portion occupies different relative positions in the complete conductor. The transposition equalizes the current flowing in each strand of the conductor, and reduces eddy current losses in the winding itself. The stranded conductor is also more flexible than a solid conductor of similar size, aiding manufacture.

The windings of signal transformers minimize leakage inductance and stray capacitance to improve high-frequency response. Coils are split into sections, and those sections interleaved between the sections of the other winding. Power-frequency transformers may have taps at intermediate points on the winding, usually on the higher voltage winding side, for voltage adjustment. Taps may be manually reconnected, or a manual or automatic switch may be provided for changing taps. Automatic on-load tap changers are used in electric power transmission or distribution, on equipment such as arc furnace transformers, or for automatic voltage regulators for sensitive loads. Audio-frequency transformers, used for the distribution of audio to public address loudspeakers, have taps to allow adjustment of impedance to each speaker. A center-tapped transformer is often used in the output stage of an audio power amplifier in a push-pull circuit. Modulation transformers in AM transmitters are very similar.

Dry-type transformer winding insulation systems can be either of standard open-wound 'dip-and-bake' construction or of higher quality designs that include vacuum pressure impregnation (VPI), vacuum pressure encapsulation (VPE), and cast coil encapsulation processes. In the VPI process, a combination of heat, vacuum and pressure is used to thoroughly seal, bind, and eliminate entrained air voids in the winding polyester resin insulation coat layer, thus increasing resistance to corona. VPE windings are similar to VPI windings but provide more protection against environmental effects, such as from water, dirt or corrosive ambient, by multiple dips including typically in terms of final epoxy coat. Closed-core transformers are constructed in 'core form ' or ' shell form'.

When windings surround the core, the transformer is core form; when windings are surrounded by the core, the transformer is shell form . Shell form design may be more prevalent than core form design for distribution transformer applications due to the relative ease in stacking

the core around winding coils. Core form design tends to, as a general rule, be more economical, and therefore more prevalent, than shell form design for high voltage power transformer applications at the lower end of their voltage and power rating ranges (less than or equal to, nominally,
230 kV or 75 MVA). At higher voltage and power ratings, shell form transformers tend to be more prevalent. Shell form design tends to be preferred for extra high voltage and higher MVA applications because, though more labor intensive to manufacture, shell form transformers are characterized as having inherently better kVA-to-weight ratio, better short-circuit strength characteristics and higher immunity to transit damage.

[3.3.2] VOLTAGE REGULATOR:

A voltage regulator 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 on the design, it may be used to regulate one or more AC or DC voltages. Electronic voltage regulators are found in devices such as computer power supplies where they stabilize the DC voltages used by the processor and other elements. In automobile alternators and central power station generator plants, voltage regulators control the output of the plant. In an electric power distribution system, voltage regulators may be installed at a substation or along distribution lines so that all customers receive steady voltage independent of how much power is drawn from the line.

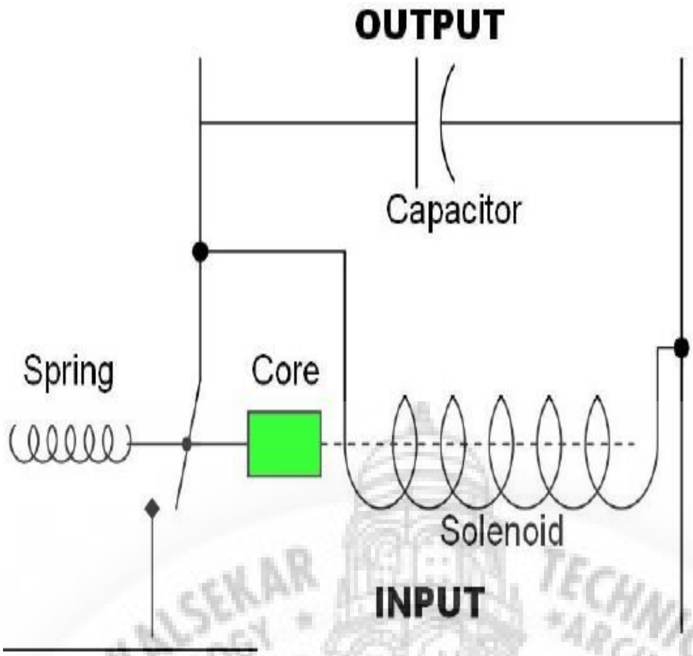

Figure [3.4] Voltage Regulator

Load regulation is the change in output voltage for a given change in load current (for example: "typically 15 mV, maximum 100 mV for load currents between 5 mA and 1.4 A, at some specified temperature and input voltage"). Line regulation or input regulation is the degree to which output voltage changes with input (supply) voltage changes - as a ratio of output to input change (for example "typically 13 mV/V"), or the output voltage change over the entire specified input voltage range (for example "plus or minus 2% for input voltages between 90 V and 260 V, 50-60 Hz"). Other important parameters are: Temperature coefficient of the output voltage is the change with temperature (perhaps averaged over a given temperature range).

Initial accuracy of a voltage regulator (or simply "the voltage accuracy") reflects the error in output voltage for a fixed regulator without taking into account temperature or aging effects on output accuracy. Drop out voltage is the minimum difference between input voltage and output voltage for which the regulator can still supply the specified current. A low drop-out (LDO) regulator is designed to work well even with an input supply only a volt or so above the output voltage.

The input-output differential at which the voltage regulator will no longer maintain regulation is the drop out voltage. Further reduction in input voltage will result in reduced output voltage. This value is dependent on load current and junction temperature. Absolute maximum ratings are defined for regulator components, specifying the continuous and peak output currents that may be used (sometimes internally limited) , the maximum input voltage, maximum power dissipation at a given temperature, etc. Output noise (thermal white noise) and output dynamic impedance may be specified as graphs versus frequency, while output ripple noise (mains "hum" or switch-mode "hash" noise) may be given as peak-to-peak or RMS voltages, or in terms of their spectra.

Quiescent current in a regulator circuit is the current drawn internally, not available to the load, normally measured as the input current while no load is connected (and hence a source of inefficiency; some linear regulators are, surprisingly, more efficient at very low current loads than switch-mode designs because of this). Transient response is the reaction of a regulator when a (sudden) change of the load current (called the load transient) or input voltage (called the line transient) occurs. Some regulators will tend to oscillate or have a slow response time which in some cases might lead to undesired results.

This value is different from the regulation parameters, as that is the stable situation definition. The transient response shows the behavior of the regulator on a change. This data is usually provided in the technical documentation of a regulator and is also dependent on output capacitance. Mirror-image insertion protection means that a regulator is designed for use when a voltage, usually not higher than the maximum input voltage of the regulator, is applied to its output pin while its input terminal is at a low voltage, volt-free or grounded. Some regulators can continuously withstand this situation; others might only manage it for a limited time such as 60 seconds, as usually specified in the datasheet. This situation can occur when a three terminal regulator is incorrectly mounted for example on a PCB, with the output terminal connected to the unregulated DC input and the input connected to the load. Mirror-image insertion protection is also important when a regulator circuit is used in battery charging circuits, when external power fails or is not turned on and the output terminal remains at battery voltage. A simple voltage regulator can be made from a resistor in series with a diode (or series of diodes). Due to the logarithmic shape of diode V-I curves, the voltage across the diode changes only slightly due to changes in current drawn or changes in the input.

When precise voltage control and efficiency are not important, this design may work fine. Feedback voltage regulators operate by comparing the actual output voltage to some fixed reference voltage. Any difference is amplified and used to control the regulation element in such a way as to reduce the voltage error. This forms a negative feedback control loop; increasing the open-loop gain tends to increase regulation accuracy but reduce stability (avoidance of oscillation, or ringing during step changes).

There will also be a trade-off between stability and the speed of the response to changes. If the output voltage is too low (perhaps due to input voltage reducing or load current increasing), the regulation element is commanded , up to a point , to produce a higher output voltage – by dropping less of the input voltage (for linear series regulators and buck switching regulators), or to draw input current for longer periods (boost-type switching regulators); if the output voltage is too high, the regulation element will normally be commanded to produce a lower voltage. However, many regulators have over-current protection, so that they will entirely stop sourcing current (or limit the current in some way) if the output current is too high, and some regulators may also shut down if the input voltage is outside a given range (see also: crowbar circuits).

[3.3.3] TIMER:

IC Depending on the manufacturer, the standard 555 package includes over 20 transistors, 2 diodes and 15 resistors on a silicon chip installed in an 8-pin mini dual-in-line package (DIP-8). Variants available include the 556 (a 14-pin DIP combining two 555s on one chip), and the 558 (a 16-pin DIP combining four slightly modified 555s with DIS & THR connected internally, and TR falling edge sensitive instead of level sensitive).

Figure [3.5] Timer

Ultra-low power versions of the 555 are also available, such as the 7555 and TLC555. The 7555 is designed to cause less supply flitching than the classic 555 and the manufacturer claims that it usually does not require a “control” capacitor and in many cases does not require a power supply bypass capacitor.

The 555 has three operating modes:

- Monostable mode:

  In this mode, the 555 functions as a “one-shot”. Applications include timers, missing pulse detection, bounce free switches, touch switches, frequency divider, capacitance measurement, pulse-width modulation (PWM) etc.

- Astable – free running mode:

  The 555 can operate as an oscillator. Uses include LED and lamp flashers, pulse generation, logic clocks, tone generation, security alarms, pulse position modulation, etc.

- 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, etc.

Usage

The connection of the pins is as follows:

Pins	Name	Purpose
1	**GND Ground**	low level (0 V)
2	**TRIG OUT**	rises, and interval starts, when this input falls below 1/3V CC
3	**OUT**	This output is driven to $+V_{CC}$ or GND
4	**RESET**	A timing interval may be interrupted by driving this input to GND.
5	**CTRL**	"Control" access to the internal voltage divider (by default, 2/3V CC).
6	**THR**	The interval ends when the voltage at THR is greater than at CTRL.
7	**DIS**	Open collector output; may discharge a capacitor between intervals.
8	**V+,V_{CC}**	Positive supply voltage is usually between 3 and 15 V.

Table [3.1 pin configuration]

555 Basics

The 555 timer IC is a sim plea 8 pin DIL package IC. It can:

1) be used as a monostable
2) be used as an astable
3) source or sink 100 Ma
4) use supply voltages of 5v to 15v disrupt the power supply- use a decoupling capacitor

Using the 555 as a buffer

A buffer circuit allows an input circuit to be connected to an output circuit, it is like an interface between one circuit and another. The buffer circuit requires very little input current but should be able to supply adequate output current. The 555 can supply in excess of 100Ma of current and so can be used as a convenient buffer for logic gates which cannot supply much current. The 555 can also “sink” a similar amount of current.

The circuit used is:

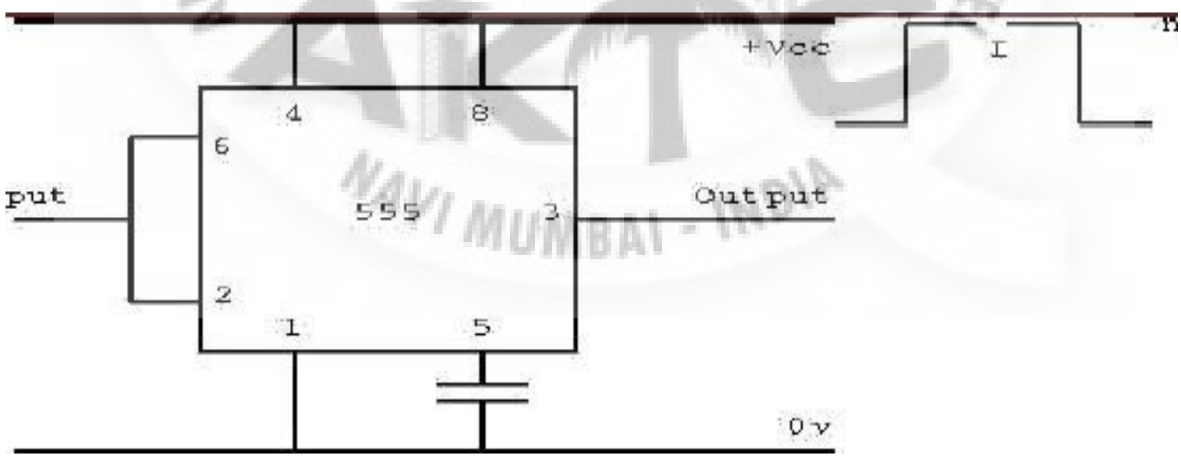

FIG: [3.6] TIMER AS A BUFFER

The circuit acts like an inverter or NOT gate. When the input is held low, the output is high and will provide (source) current. When the input is held high, the output is low and will sink current. Remember, for a buffer for even higher power devices that require even larger currents, the 555 buffer can be used to drive a relay or a transistor circuit.

Using the 555 as a nonstable:

1) The 555 can be used as a monostable using the circuit shown:
2) The output is normally low but will go high for a short length of time depending on the values of the other components.
3) R and C determine the time period of the output pulse.
4) The input is normally high and goes low to trigger the output (falling edge triggered).
5) The length of the input pulse must be less than the length of the output pulse.
6) The 47Uf capacitor „decoupes" the supply to avoid affecting other parts of the circuit.
7) It is standard to add a 10Nf capacitor from pin5 to gnd.

$$T = 1.1\,R\,C$$

T–seconds, R–ohms, C–Farads

The minimum value of R should be about 1k to avoid too much current flowing into the 555. The maximum value of R should be about 1M so that enough current can flow into the input of the 555 and there is also current to allow for the electrolytic capacitors leakage current. The minimum value of C = 100Pf to avoid the timing equation being too far off. The maximum value of C should be about 1000µF as any bigger capacitors will discharge too much current through the chip. These maximum and minimum values give a minimum period of 0.1 µs and a maximum period of 1000s.

[3.3.4] DIODE:

Diodes are used to convert AC into DC these are used as half wave rectifier or full wave rectifier. Three points must he kept in mind while using any type of diode.

1. Maximum forward current capacity
2. Maximum reverse voltage capacity
3. Maximum forward voltage capacity

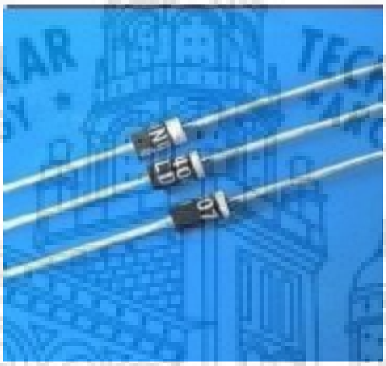

Figure [3.7]: 1N4007 Diode

The number and voltage capacity of some of the important diodes available in the market are as follows:

Diodes of number IN4001, IN4002, IN4003, IN4004, IN4005, IN4006 and IN4007 have maximum reverse bias voltage capacity of 50V and maximum forward current capacity of 1 Amp. Diode of same capacities can be used in place of one another. Besides this diode of more capacity can be used in place of diode of low capacity but diode of low capacity cannot be used in place of diode of high capacity. For example, in place of IN4002; IN4001 or IN4007 can be used but IN4001 or IN4002 cannot be used in place of IN4007.The diode BY125 made by company BEL is equivalent of diode from IN4001 to IN4003. BY 126 is equivalent to diodes IN4004 to 4006 and BY 127 is equivalent to diode IN4007.

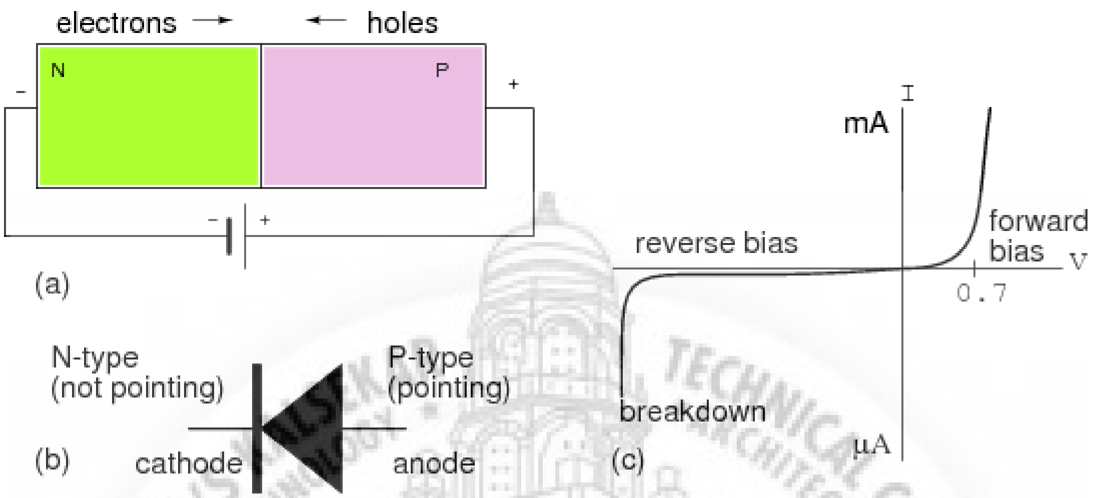

Figure: [3.8] P-N junction Diode

- PN JUNCTION OPERATION:

Now that you are familiar with P- and N-type materials, how these materials are joined together to form a diode, and the function of the diode, let us continue our discussion with the operation of the PN junction. But before we can understand how the PN junction works, we must first consider current flow in the materials that make up the junction and what happens initially within the junction when these two materials are joined together.

- Current Flow in the N-Type Material:

Conduction in the N-type semiconductor, or crystal, is similar to conduction in a copper wire. That is, with voltage applied across the material, electrons will move through the crystal just as current would flow in a copper wire. The positive potential of the battery will attract the free electrons in the crystal. These electrons will leave the crystal and flow into the positive terminal of the battery. As an electron leaves the crystal, an electron from the negative terminal of the battery will enter the crystal, thus completing the current path. Therefore, the majority current carriers in the N-type material (electrons) are repelled by the negative side of the battery and move through the crystal toward the positive side of the battery.

- Current Flow in the P-Type Material:

Current flow through the P-type material is illustrated. Conduction in the P material is by positive holes , instead of negative electrons. A hole moves from the positive terminal of the P material to the negative terminal. Electrons from the external circuit enter the negative terminal of the material and fill holes in the vicinity of this terminal. At the positive terminal, electrons are removed from the covalent bonds, thus creating new holes. This process continues as the steady stream of holes (whole current) moves toward the negative terminal.

[3.3.5] RELAY:

A relay is an electrically operated switch. Many relays use an electromagnet to operate a switching mechanism mechanically, but other operating principles are also used. Relays are used where it is necessary to control a circuit by a low-power signal (with complete electrical isolation between control and controlled circuits), or where several circuits must be controlled by one signal. The first relays were used in long distance telegraph circuits, repeating the signal coming in from one circuit and re-transmitting it to another. Relays were used extensively in telephone exchanges and early computers to perform logical operations. A type of relay that can handle the high power required to directly control an electric motor or other loads is called a contactor. Solid-state relays control power circuits with no moving parts, instead using a semiconductor device to perform switching. Relays with calibrated operating characteristics and sometimes multiple operating coils are used to protect electrical circuits from overload or faults; in modern electric power systems these functions are performed by digital instruments still called "protective relays".

A simple electromagnetic relay consists of a coil of wire wrapped around a soft iron core, an iron yoke which provides a low reluctance path for magnetic flux, a movable iron armature, and one or more sets of contacts (there are two in the relay pictured). The armature is hinged to the yoke and mechanically linked to one or more sets of moving contacts. It is held in place by a spring so that when the relay is de-energized there is an air gap in the magnetic circuit. In this condition, one of the two sets of contacts in the relay pictured is closed, and the other set is open.

Other relays may have more or fewer sets of contacts depending on their function. The relay in the picture also has a wire connecting the armature to the yoke. This ensures continuity of the circuit between the moving contacts on the armature, and the circuit track on the printed circuit board (PCB) via the yoke, which is soldered to the PCB.

When an electric current is passed through the coil it generates a magnetic field that activates the armature, and the consequent movement of the movable contact(s) either makes or breaks (depending upon construction) a connection with a fixed contact. If the set of contacts was closed when the relay was de-energized , then the movement opens the contacts and breaks the connection, and vice versa if the contacts were open. When the current to the coil is switched off, the armature is returned by a force, approximately half as strong as the magnetic force, to its relaxed position. Usually this force is provided by a spring, but gravity is also used commonly in industrial motor starters. Most relays are manufactured to operate quickly. In a low-voltage application this reduces noise; in a high voltage or current application it reduces arcing.

When the coil is energized with direct current, a diode is often placed across the coil to dissipate the energy from the collapsing magnetic field at deactivation, which would otherwise generate a voltage spike dangerous to semiconductor circuit components. Some automotive relays include a diode inside the relay case. Alternatively, a contact protection network consisting of a capacitor and resistor in series (snubber circuit) may absorb the surge. If the coil is designed to be energized with alternating current (AC), a small copper "shading ring" can be crimped to the end of the solenoid, creating a small out-of-phase current which increases the minimum pull on the armature during the AC cycle.

A solid-state relay uses a thermistor or other solid-state switching device, activated by the control signal, to switch the controlled load, instead of a solenoid. An opto coupler (a light-emitting diode (LED) coupled with a photo transistor) can be used to isolate control and controlled circuits.

- Relays are used for:

Amplifying a digital signal, switching a large amount of power with a small operating power. Some special cases are:

1) A telegraph relay, repeating a weak signal received at the end of a long wire.
2) Controlling a high-voltage circuit with a low-voltage signal, as in some types of modems or audio amplifiers,
3) Controlling a high-current circuit with a low-current signal, as in the starter solenoid of an automobile , Detecting and isolating faults on transmission and distribution lines by opening and closing

circuit breakers (protection relays),

Figure: [3.9] Relay

A DPDT AC coil relay with "ice cube" packaging

Isolating the controlling circuit from the controlled circuit when the two are at different potentials, for example when controlling a mains-powered device from a low-voltage switch. The latter is often applied to control office lighting as the low voltage wires are easily installed in partitions, which may be often moved as needs change. They may also be controlled by room occupancy detectors to conserve energy, Logic functions. For example, the Boolean AND function is realized by connecting normally open relay contacts in series, the OR function by connecting normally open contacts in parallel. The change-over or Form C contacts perform the XOR (exclusive or) function. Similar functions for NAND and NOR are accomplished using normally closed contacts. The Ladder programming language is often used for designing relay logic networks.

1) The application of Boolean Algebra to relay circuit design was formalized by Claude Shannon in A Symbolic Analysis of Relay and Switching Circuits
2) Early computing. Before vacuum tubes and transistors, relays were used as logical elements in digital computers. See electro-mechanical co mputers such as ARRA (computer), Harvard Mark II, Zeus Z2, and Zuse Z3.

3) Safety-critical logic. Because relays are much more resistant than semiconductors to nuclear radiation, they are widely used in safety-critical logic, such as the control panels of radioactive waste-handling machinery.

Time delay functions. Relays can be modified to delay opening or delay closing a set of contacts. A very short (a fraction of a second) delay would use a copper disk between the armature and moving blade assembly. Current flowing in the disk maintains magnetic field for a short time, lengthening release time. For a slightly longer (up to a minute) delay, a dashpot is used. A dashpot is a piston filled with fluid that is allowed to escape slowly. The time period can be varied by increasing or decreasing the flow rate. For longer time periods, a mechanical clockwork timer is installed. Vehicle battery isolation. A 12v relay is often used to isolate any second battery in cars , 4WDs, RVs and boats. Switching to a standby power supply.

[3.3.6] Resistor:

A resistor is a passive two-terminal electrical component that implements electrical resistance as a circuit element. The current through a res istor is in direct proportion to the voltage across the resistor‟s terminals. This relationship is represented by Ohm's law:

$$I =$$

Where I is the current through the conductor in units of amperes, V is the potential difference measured across the conductor in units of volts, and R is the resistance of the conductor in units of ohms.

The ratio of the voltage applied across a resistor's terminals to the intensity of current in the circuit is called its resistance, and this can be assumed to be a constant (independent of the voltage) for ordinary resistors working within their ratings.

Resistors are common elements of electrical networks and electronic circuits and are ubiquitous in electronic equipment. Practical resistors can be made of various compounds and films, as well as resistance wire (wire made of a high-resistivity alloy, such as nickel-chrome). Resistors are also implemented within integrated circuits, particularly analog devices, and can also be integrated into hybrid and printed circuits.

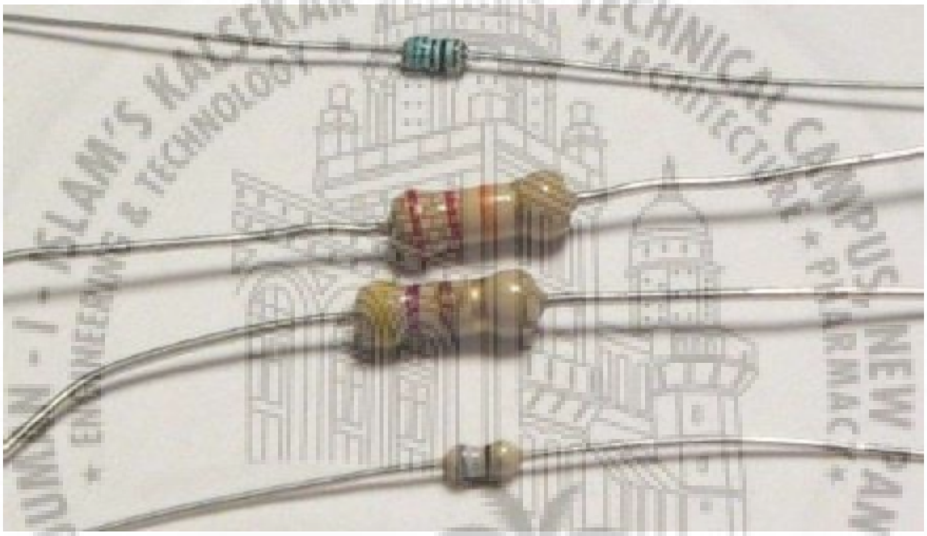

Figure [3.10] Resistors

The electrical functionality of a resistor is specified by its resistance: common commercial resistors are manufactured over a range of more than nine orders of magnitude. When specifying that resistance in an electronic design, the required precision of the resistance may require attention to the manufacturing tolerance of the chosen resistor , according to its specific application . The temperature coefficient of the resistance may also be of concern in some precision applications. Practical resistors are also specified as having a maximum power rating which must exceed the anticipated power dissipation of that resistor in a particular circuit: this is mainly of concern in power electronics applications. Resistors with higher power ratings are physically larger and may require heat sinks.

In a high-voltage circuit, attention must sometimes be paid to the rated maximum working voltage of the resistor. While there is no minimum working voltage for a given resistor, failure to account for a resistor's maximum rating may cause the resistor to incinerate when current is run through it. Practical resistors have a series inductance and a small parallel capacitance; these specifications can be important in high-frequency applications.

In allow-noise amplifier or pre-amp, the noise characteristics of a resistor may be an issue. The unwanted inductance, excess noise, and temperature coefficient are mainly dependent on the technology used in manufacturing the resistor. They are not normally specified individually for a particular family of resistors manufactured using a particular technology . A family of discrete resistors is also characterized according to its form factor, that is, the size of the device and the position of its leads (or terminals) which is relevant in the practical manufacturing of circuits using them.

[3.3.7] CAPACITORS:

A capacitor is a passive electronic component consisting of a pair of conductors separated by a dielectric (insulator). When there is a potential difference (voltage) across the conductors, a static electric field develops in the dielectric that stores energy and produces a mechanical force between the conductors. An ideal capacitor is characterized by a single constant value, capacitance, measured in farads. This is the ratio of the electric charge on each conductor to the potential difference between them.

The capacitance is greatest when there is a narrow separation between large areas of conductor, hence capacitor conductors are often called "plates", referring to an early means of construction. In practice the dielectric between the plates passes a small amount of leakage current and also has an electric field strength limit, resulting in a breakdown voltage, while the conductors and leads introduce an undesired inductance and resistance.

Figure [3.11]: Capacitor

An ideal capacitor is characterized by a single constant value, capacitance, which is measured in farads. This is the ratio of the electric charge on each conductor to the potential difference between them. In practice, the dielectric between the plates passes a small amount of leakage current. The conductors and leads introduce an equivalent series resistance and the dielectric has an electric field strength limit resulting in a breakdown voltage.

The properties of capacitors in a circuit may determine the resonant frequency and quality factor of a resonant circuit, power dissipation and operating frequency in a digital logic circuit, energy capacity in a high-power system, and many other important aspects.

A capacitor (formerly known as condenser) is a device for storing electric charge. The forms of practical capacitors vary widely, but all contain at least two conductors separated by a non-conductor. Capacitors used as parts of electrical systems, for example, consist of metal foils separated by a layer of insulating film.

Figure [3.12]: Types of capacitors

A capacitor (originally known as a condenser) is a passive two-terminal electrical component used to store energy electrostatically in an electric field. The forms of practical capacitors vary widely, but all contain at least two electrical conductors separated by a dielectric (insulator); for example, one common construction consists of metal foils separated by a thin layer of insulating film. Capacitors are widely used as parts of electrical circuits in many common electrical devices.

When there is a potential difference across the conductors, an electric field develops across the dielectric, causing positive charge to collect on one plate and negative charge on the other plate. Energy is stored in the electrostatic field. An ideal capacitor is characterized by a single constant value, capacitance. This is the ratio of the electric charge on each conductor to the potential difference between them. The SI unit of capacitance is the farad, which is equal to one coulomb per volt.

The capacitance is greatest when there is a narrow separation between large areas of conductor, hence capacitor conductors are often called plates, referring to an early means of construction. In practice, the dielectric between the plates passes a small amount of leakage current and also has an electric field strength limit, the breakdown voltage.

The conductors and leads introduce an undesired inductance and resistance. Capacitors are widely used in electronic circuits for blocking direct current while allowing alternating current to pass. In analog filter networks, they smooth the output of power supplies. In resonant circuits they tune radios to particular frequencies. In electric power transmission systems they stabilize voltage and power flow.

[3.3.8] COMPARATOR:

How an op-amp can be used as a comparator?

Potential dividers are connected to the inverting and non-inverting inputs of the op-amp to give some voltage at these terminals. Supply voltage is given to +Vss and –Vss is connected to ground. The output of this comparator will be logic high (i.e., supply voltage) if the non-inverting terminal input is greater than the inverting terminal input of the comparator. i.e., Non inverting input (+) > inverting input (-) = output is logic high If the inverting terminal input is greater than the non-inverting terminal input then the output of the comparator will be logic low (i.e., gnd) i.e., inverting input (-) > Non inverting input (+) = output is logic low

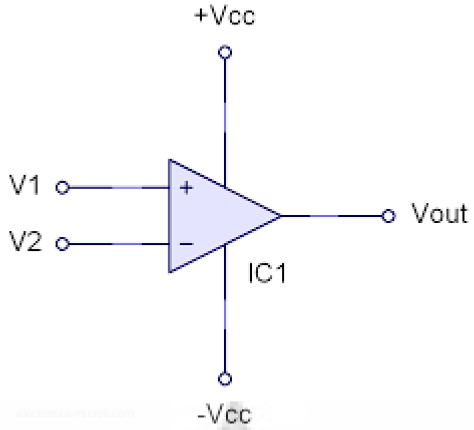

Figure [3.13]: Comparator

CHAPTER: 4

OPERATION OF PROJECT

[4.1]Working:

The project 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 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 phase have their secondary"s connected in delta configuration. The output 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 a stable mode. LED"s are connected at their output to indicate their status. The output of the U3 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.

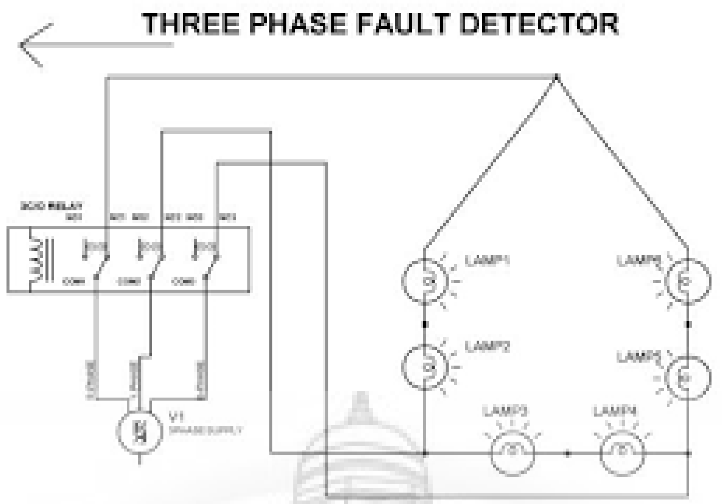

Figure:[4.1]

Operating procedure:

While the board is powered from a 3 phase 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 U3 555 timer which is used in a stable 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 U3 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 U3 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.

Chapter: 5

ADVANTAGES, DISADVANTAGES & APPLICATION

[5.1] ADVANTAGES AND DISADVANTAGES:

Advantages of three phase fault analysis with auto reset on temporary fault and permanent trip otherwise as follows:

- This invention will accurately identifies hazardous faults requiring line de-energization, and also accurately discriminates, or distinguishes, a hazardous fault from other events for which the line should remain energized.
- The invention encompasses such a load analysis system which minimizes unnecessary power service interruptions and outages.
- By using this system the secondary arc current can be abruptly reduced.
- This system is even appropriate for long transmission line transmitting high voltage.
- A timer is also provided to identify weather the fault is temporary or permanent . By doing so frequent tripping of the system can be avoided as temporary faults are self-correcting.
- A individual re-closure to every phase so that if there is fault in any one phase then that phase only is deactivated keeping the other phases in working condition.by doing so the efficiency of the system increases .
- This invention provides relatively low cost and reliable apparatus for the intended purpose.
- The invention will respond correctly to phase-ground faults occurring simultaneously on two of the three phase lines.
- By using this proposed circuitry work should be completed time to time . Also auto reclosing can significantly reduce the outage time due

to faults and provide a higher level of service continuity to the customer. It helps to maintain system stability.

Disadvantages:

- If any fault occurs due to natural calamities then this invention will not able to overcome the fault.

[5.2] APPLICATIONS:

- Substation
- Transformer
- Drives & Relay
- Transmission Line.

CHAPTER:6

SIMULINK

[6.1]. COMPARISON OF SIMULATION AND PRACTICAL RESULTS:

SIMULINK MODEL:

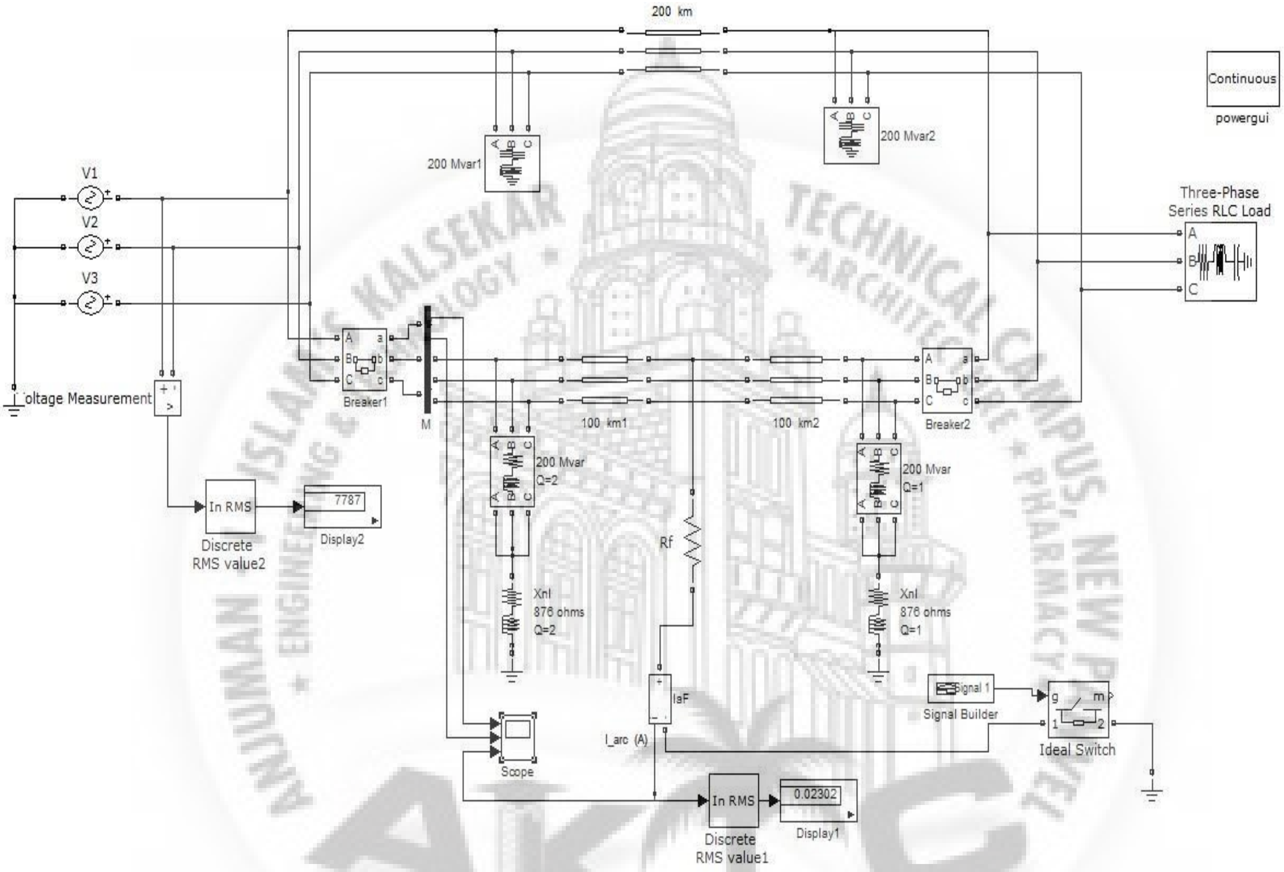

Figure [6.1] Simulink model

For simulation MATLAB software is used. In this software the simulation is carried out by making the transmission line with loads. Circuit breaker is used for opening at fault instant and closing at fault clearance. Switch is used for creating the fault. Simulink model shown in fig

In this model fault time is given by the Signal builder. Ideal switch is connected with signal builder when signal is given to the switch, it is going to close and fault will occur in the system and that instant circuit breaker is operate and disconnect the system from faulty part.

[6.2] RESULTS AND ANALYSIS:

Different voltage unbalance such as LL (Line to Line), LG (Line to Ground), and 3L (Three Lines) has been observed. These faults are carried out by closing the fault switch in simulink model. These faults are taken temporary as well as permanent.

- **Line to Ground Fault**

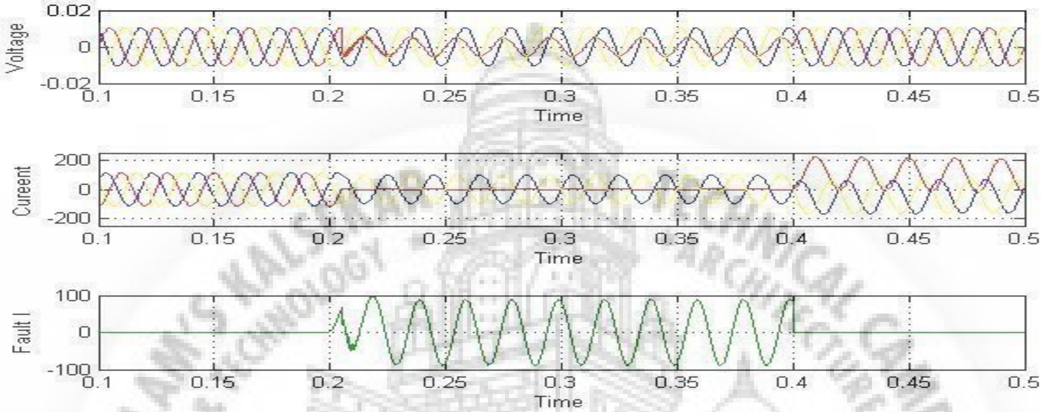

Figure [6.2] Temporary Line to Ground Fault

X-axis shows Time and Y-axis shows three system Voltage, Current and Fault current between two contacts of Circuit Breaker. From the Figure 3.2, it is shown that fault occurs in one line at a time 0.2 second and it is cleared at 0.4 second. It is a Temporary fault which is cleared by auto reset.

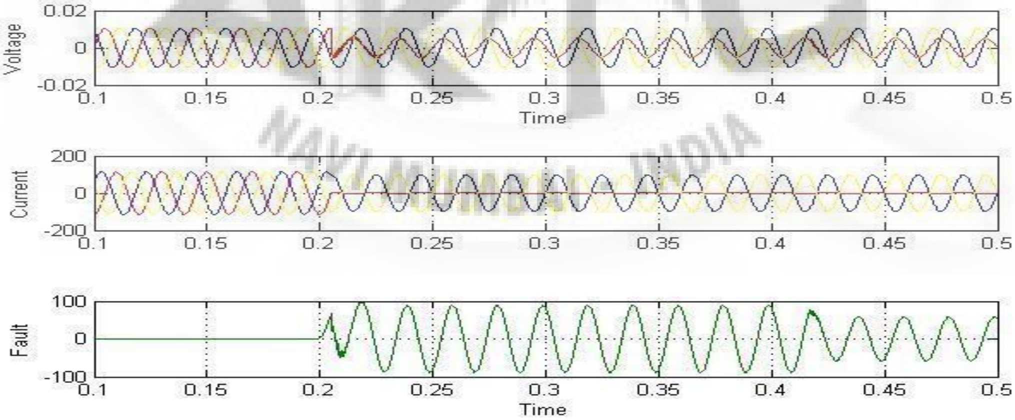

Figure [6.3] Permanent Line to Ground Fault

From figure 6.3 it‟s clear that the line to ground fault is permanent, it‟s not cleared at a time instant of 0.4 second. Hence, its permanent fault and line will shut down.

- **Line to Line Ground Fault :**

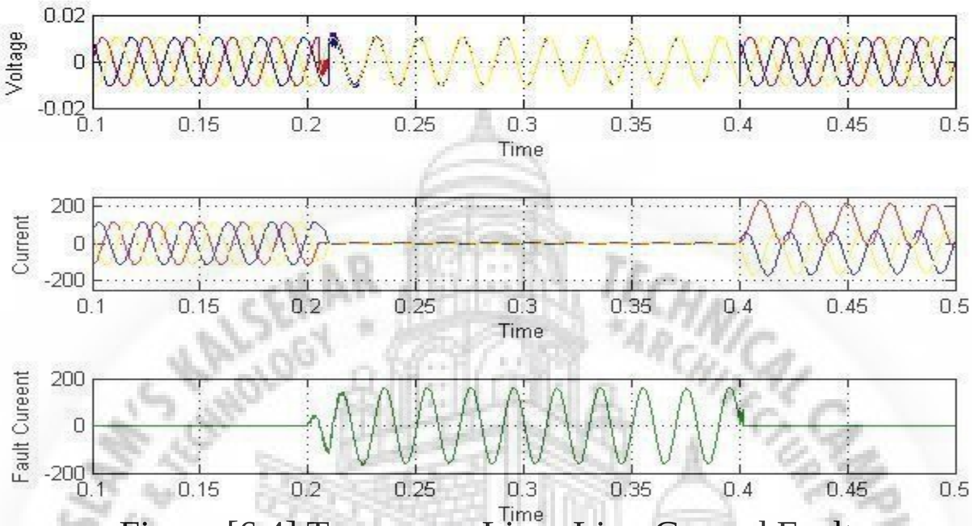

Figure [6.4] Temporary Line- Line-Ground Fault

In this, line-line-ground fault has been shown and from the waveform, it Can be shown that it‟s temporary.

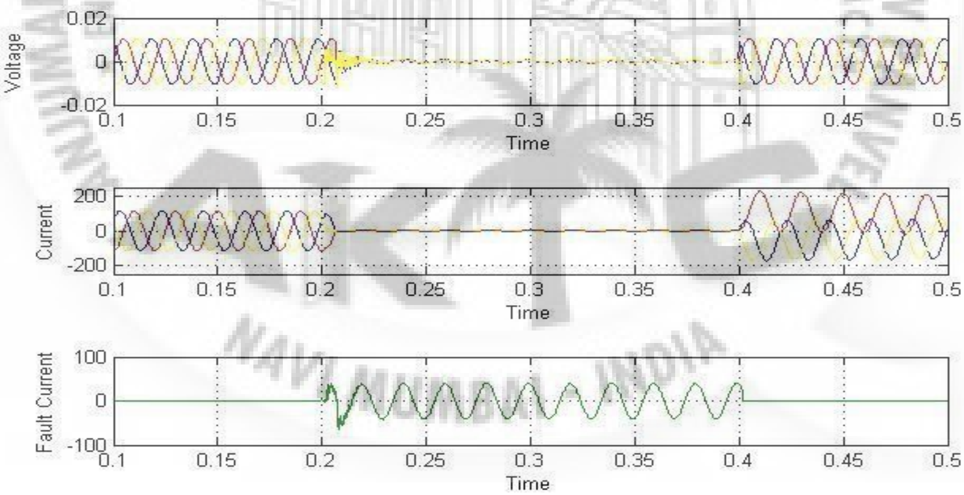

Figure [6.5] Temporary Line-Line-Line-Ground Fault

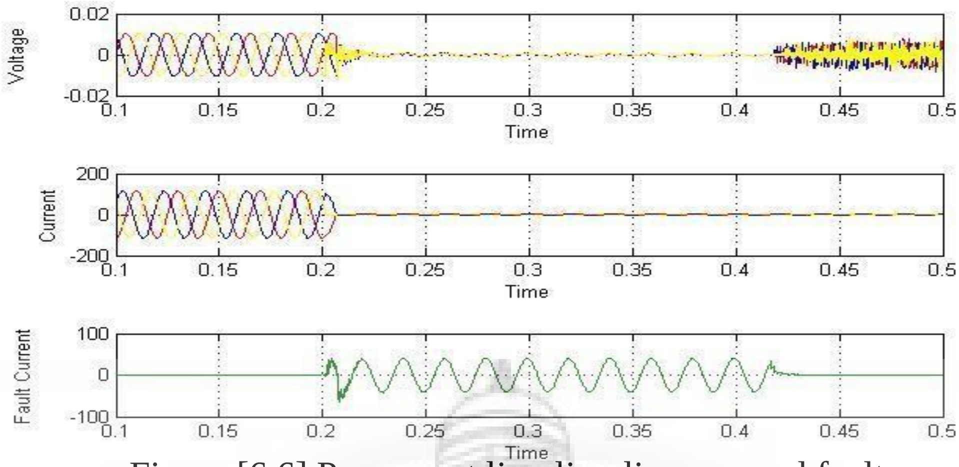

Figure [6.6] Permanent line-line-line- ground fault

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. 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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