Protection of Transformer by Using Differential protection Scheme

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Abstract

Protection of Transformers is a very challenging problem in power system relaying. Since it is very important to minimize the frequency and duration of unwanted outages, this is a high demand imposed on power transformer protective relays. Different relaying principles have been suggest and used to protect transformers against different types of faults. Relays that use over current, over flux and overheating principles protect the transformers against overloads and externally applied conditions. Differential relays protect the transformers against internal fault. In this study, microcontroller based relay system like, hardware and software has been elaborate and designed. The arrangement implementation and testing of the system are also presented.

Key words: - *Transformer, PIC Microcontroller, Relays, Driver, Current Transformer and Potential Transformer, temperature detector.*

Introduction:-

Power transformers are very expensive and vital components in electric Power systems. They occasionally experience faults resulting from insulation failures caused by atmospheric disturbances and switching surges. These transformer faults can be divided into two main classes .The first class is internal faults due to faults between adjacent turns or parts of coils and faults to ground on terminals or on parts of windings. The second class is overload and externally applied conditions include over current, over voltage, external short circuits and reduced system frequency

This study describes the design and implementation of the microcontroller-based system for protecting power transformer. The system includes facilities, including differential protection, over current protection, over voltage protection and under voltage protection, it provide facilities for discrimination between internal fault current and magnetizing inrush current. In this study software and hardware of microcontroller based system have been explained and designed. The design implementation and testing of the system are also presented.

Electromechanical relays are able to perform signal processing functions which enable the relay designer to used the basic protection principles and enhance the relay performance, facilitating faster, more secure and dependable protection for power transformers have used inrush protection of power transformers, form second harmonic method.

Microcontrollers based relay for power transformer protection has been implemented the major emphasis of this work is the description of hardware and software development of the relay. The percentage differential protections, over current protection and external faults, over and under voltage protection have been carried out. The method of rate of change of the primary current with respect to time (di/dt) in the first quarter of primary current wave method has been adopted to discriminate the internal faults current from inrush, this method depends on the fact that the magnetizing inrush current wave has high di/dt compared with di/dt of internal current wave.

LITERATURE REVIEW

Protection of induction transformer plays an important role in its long life service. Many researchers have The done work in this area but their protection scheme is costly and unfeasible in our Indian condition. Three phase induction transformer can continue to run when one phase of the supply goes out of service due to any fuse blowing or opening of phase by protective device.

The heat produced by the transformer under single phasing condition needs to be taken care of in adequate time. When phase opens at distribution transformer or at feeder end, the stator and rotor losses increases to ten times and the shaft output power decreases to negligible. But if the single phasing occurs at transformer terminals the losses increases twice and the shaft power reduces to nearly 70%. Transformer life shortens as the temperature increases. To protect the transformer all the terminals should be open. On distribution feeders, majority of faults are single phase.

On an average single phase fault occurs 70%, double phase fault 20% and symmetrical fault 10%. Voltage at transformer terminals may be higher than nominal value in a complicated industrial system and can be quite below from nominal value in a heavily loaded industrial system.

IEEE, NEMA and other power communities have different definitions about voltage unbalance. These definitions only give an idea about the voltage unbalance. The complex algebra is avoided in these definitions to make paper

calculations easy. Unbalance voltages have Negative impact on the performance of three phase induction transformers. Under voltage in all the three phases adversely affects the efficiency of the transformer as compared to three phases over voltage condition. Positive sequence voltage and negative sequence voltage effects the Transformer's power factor and its efficiency.

BLOCK DIAGRAM:-

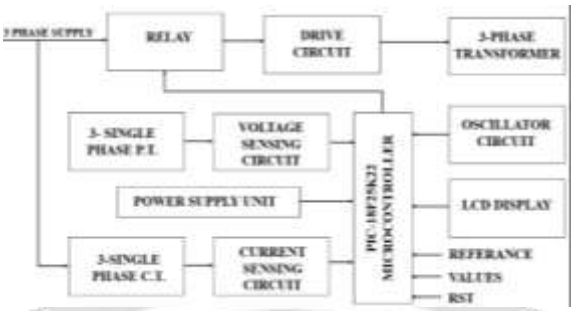

Fig. Block Diagram of Differential Protection of Transformer

C.T. – CURRENT TRANSFORMER
P.T. – POTENTIAL TRANSFORMER

CIRCUIT DIAGRAM:-

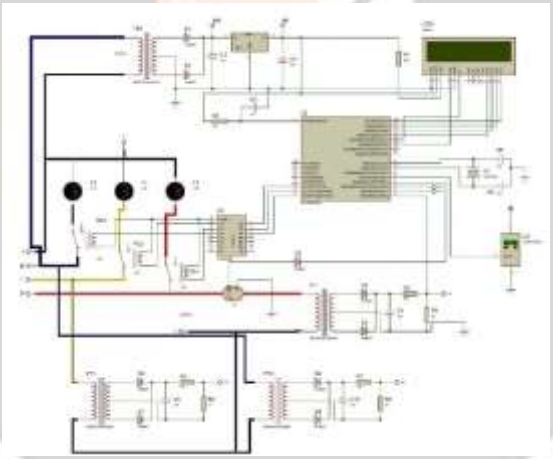

Fig. Circuit Diagram of Differential Protection of Transformer

The circuit diagram shown above is the differential protection of transformer. First of all to supply the power to the circuit there is center tapped transformer which step down voltage from 220 V to 12V. Then there is center tapped rectifier which converts AC into pulsating DC to remove the AC contain which presents in rectifier output there are used capacitor filter it gives DC in pure form. Microcontroller required constant 5v supply but rectifier output is not constant 5v it may vary with respect to input therefore to maintain constant 5v supply there are used voltage regulated IC 7805 and it is also supply constant 5v supply to LCD display. Crystal oscillator is connected to microcontroller. The crystal oscillator to generate the clock pulse 16 Mhz.

The driver IC ULN 2003A connect directly to the microcontroller to operate the relay. As Relay is operate on 12V DC supply so there is a driver IC which amplify the 5v voltage in to 12v. There is a LN35 temperature sensor which gives 10mV for every 1^0C, this temperature sensor is connect to microcontroller at AN_0 pin. As the temperature increase above the limit the temperature sensor gives signals to the microcontroller then microcontroller gives command to relay to trip the circuit.

Current transformer in the circuit which is connected in series with each phase is use to measure current of each phase. There are three potential transformers and voltage divider circuits which are use to scale down the voltage from 0-300V to 0-3V and are also used to measure the voltage of each phase. LCD 16x2 alphanumeric Display is used to display different faults and all the parameters of the system.

EXPERIMENTAL SETUP:-

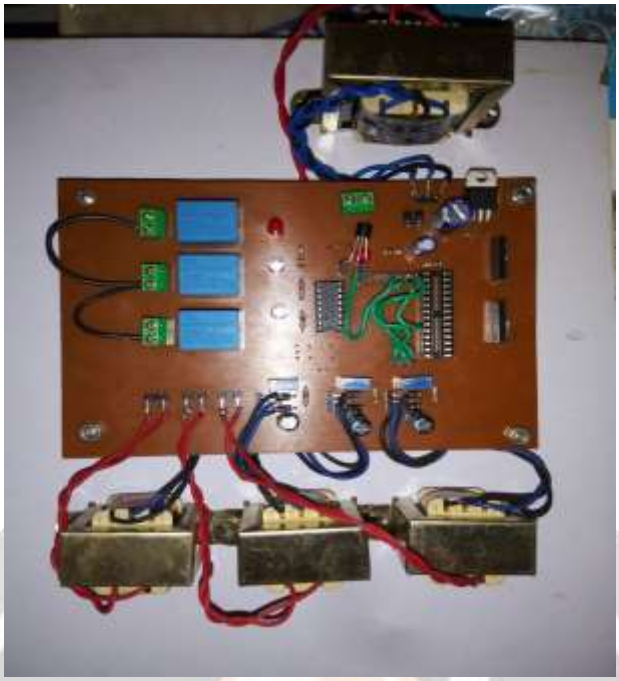

Fig. Block Diagram of Differential Protection of Transformer

Hardware presented in the experimental setup is to protect the transformer from any internal faults and provide protection to it. The base of setup was made up of microcontroller, C.T., P. T. Relays, etc provide protections against the over voltage, over current, under voltage, under current, over temperature, etc.

CONCLUSION:-

This protection system is an improved method because it is a very low cost device as compared to other protective devices. The system is tested in the laboratory for many times on Three phase induction transformer under faulty condition and it gives desirable results. The system is reliable and rugged. It is designed in a manner that by changing CT and relay within the same circuit, it can be used for higher rating transformers. The MOSFET is preferred instead of IGBT because the current rating to control the relay is very small. This is a prototype for the protection of transformer for under voltage, over voltage, unbalance voltage, over current and single phasing.

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