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Numerical Protection Of Transformer

Namita Gawas[1], Darshna Jain[2], Soham Patil[3], Rudal Shengale[4] ,
Rajeev Valunjkar[5] , Priti Singh[6]
(Department Of Electrical Engineering ,Atharva College Of Engineering, Mumbai)

Abstract: *Single phase transformer are one of the most important equipment in power system network. The data acquisition, condition monitoring, automatic controlling are the important issues. This paper describes the design and implementation of the micro controller-based system for protecting single phase transformer. The proposed system discriminates between internal fault and external faults, differential protection, over current protection, over voltage protection. In this paper, software and hardware of micro controller based system have been explained and designed. The design implementation and testing of the system are also presented.*
Keywords – *Power Transformer,PIC Microcontroller automation,Numerical Monitoring and Control.*

I. Introduction

A single phase transformer is a very valuable and important link in a power system. A monitoring is essential to evaluate the transformer performance and safe operating conditions. High reliability of the transformer is essential to avoid disturbances. The various types of fault in single phase transformer can be detected and diagnosed by using microcontroller systems. The transformer protection is a challenge to researchers such as protection applications of the in-line transformers. A high quality single phase transformer is properly designed and supplied with suitable protective relays and monitors. When a fault occurs in a transformer of electrical system, the damage is normally severe due to high rating of power. The aim is that to minimize the response time after occurring fault. Also an innovative design to develop a system which is based on AVR microcontroller that is used for logging the voltage, current of a single phase transformer and to protect the system from any uncertainty conditions. Operation of a system without a transformer is difficult. The impact of a transformer fault is more serious than a transmission line outage. There are various types of faults which occur in transformer. These faults are mainly internal and external faults. The main aim of the protection system is to isolate the faulty sytem and protect it from all the faults.

As per literature review,a branch of electrical power engineering that deals with protection of Power system from faults is known as power system protection. It does this by isolating the faulted parts of the system from the rest of healthy electrical network. The main aim of power system protection scheme is to isolate a section that is faulty in the system. This ensures that the remaining portion is able to function satisfactorily locking out chances of damage that may be caused by fault current.

To the user, life is of most important concern. In summary, power protection is necessary to:

a) User/Personnel- ensure safety i.e. Prevent injury/accident.
b) Electrical equipment - to protect the equipment from cases of over current, overvoltage and frequency drift that can destroy the equipment.
c) General Safety -Prevent secondary accidents that occur as a result of system fault like fire.
d) Power Supply Stability- Ensures a continuous and stable supply of electrical power.
e) Operation Cost -Ensure optimal operating efficiency so as to reduce equipment maintenance/replacement cost

II. Working Principle

2.1 Over Voltage Protection: Supply is converted from AC to DC, when above a threshold limit over voltage condition is created and Transformer is switched off.

2.2 Over Current Protection: Any additional load if put in the circuit the current requirement shoots up and over current condition is generated. Current is measured using Current Transformer.

2.3 Differential Current protection: This principle clears the internal faults in the transformer. It detects the difference in current on primary and secondary sides.

2.4All of the faults generated will get displayed on LCD.

2.5 The microcontroller will monitor the faults and will take specific actions accordingly.

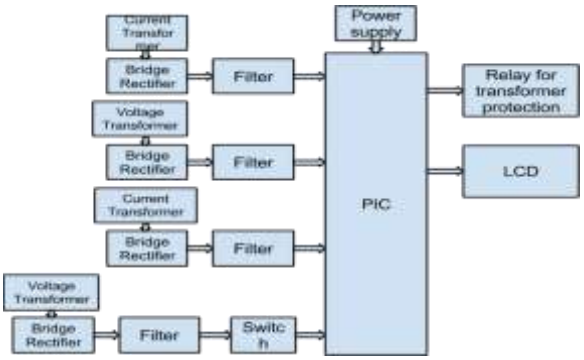

Fig . Block diagram

III. Components

III.I PIC18F452

The PIC18F452 is a Enhanced Flash Microcontroller having 8 channels of 10-bit Analogue-to-digital (A/D) converter. The PIC18F452 features a C compiler friendly development environment, 256 bytes of EEPROM, self-programming, an ICD, 2 capture/compare/PWM functions, the synchronous serial port can be configured. All this features make the PIC ideal for use for all the equipments, conditioning & monitoring.

III.II AC to DC Converter

Analog to digital converter is used in the filter circuit after getting a pure rectified dc power to convert the measured analog signal into digital signal. This digital signal is then given to the microcontroller.

III.III Relay

Relay is used here as a circuit breaker to islolate the transformer when faults occur.It works according to the microcontroller coding .A relay switch can be divided into two parts: input and output. Its input section has a coil that generates magnetic field when a voltage from an electronic circuit is applied. This voltage is called the operating voltage. The output section of relay has contactors which connect or disconnect mechanically.

III.IV Current Transformer.

Current transformers (Bar Type) is used for measuring current and monitoring the operation of the power system. Current transformers, along with voltage or potential transformers are instrument transformers. A current transformer gives a secondary current that is proportional to the current flowing in its primary. Also the current transformer presents a negligible load to the primary circuit.

III.V Voltage Transformer

The use of Laminated core transformers is to convert mains voltage to low voltage to power electronic devices. They are designed so that they give negligible load to the supply being measured and have an accurate voltage ratio and phase relationship to enable accurate secondary connected metering.

III.VI LCD Display.

It will display the names of Faults occurring and various parameters.

IV. Methodology

The numerical protection of transformer provides protection to the transformer from internal and external faults. Internal faults include Differential current protection and external faults includes over current protection and overvoltage protection.

The differential current protection compares current from primary side and secondary side of the transformer via current transformers. As this fault is an internal fault, separate relay is used for clearing this fault. The differential current relay will operate only for internal fault and it will not operate for external fault. The differential current relay will be connected to both primary and secondary current transformer to calculate the change in current. As the differential current relay detects the change in current due to any internal fault then it will isolate the transformer.

The over current protection provides protection to the transformer in case of over current fault in the transformer. An additional load is put in the circuit for creating an over current condition and current is

measured using Current Transformer. Separate relay is used to clear external fault. To show the over current fault in the project the additional load is used which is increased and then over current fault is detected by the relay and it isolates the transformer.

The over voltage protection provides protection to the transformer in case of over voltage. The over voltage is detected and the transformer is isolated. This fault is cleared by the same relay which clears the over current fault as this fault is also an external fault. For showing the over voltage fault we will short circuit line and neutral which will create a over voltage fault condition and thus the relay will detect the over voltage fault and it will isolate the transformer.

V. Conclusion

Single phase Transformers are among the most generic piece of equipment of system. Previously maintenance of transformers was done based on a pre-determined schedule. Based on the fault analysis a prototype model of a microcontroller based transformer ,a kit is developed in laboratory. Using digital controller analysis results are regularly updated. During abnormal conditions of the transformer where it exceeds specified limits, information is immediately communicated through the microcontroller to the relay & remedial action is taken by isolating the transformer. This type of remote observation of condition of transformer not only increases the life of transformer but also gives increased reliability and decreased cost of power system operation.

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