Comparative Analysis of Electromechanical Relay over Numerical/Digital Relay

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Abstract— In this paper the analysis for the protection for different systems by using different kinds of relays is done. In this work a basic focus is on Electro-Mechanical Relay and Numerical/Digital Relay is carried out because It is being noticed that this two kinds of relays are very common in use in various systems for protection purpose. The working of this two relays are mentioned in this work and also in this the comparative analysis of both the relays are available in this paper.
Key words: Electromechanical Relay, Numerical/Digital Relay

I. INTRODUCTION

There are limitless applications of protection circuit as the necessity for energy to all has enlarged. With increasing population, the energy demand has increased and so the need to meet the need has increased. [1]. The most important problem in transmission and distribution in our country is losses and the faults that occur during the process. Faults sometimes can be very harmful to the machines being used during generation, distribution and utilization of electricity. Many protective devices are being used at the present time to avoid the consequences of faults.[1]
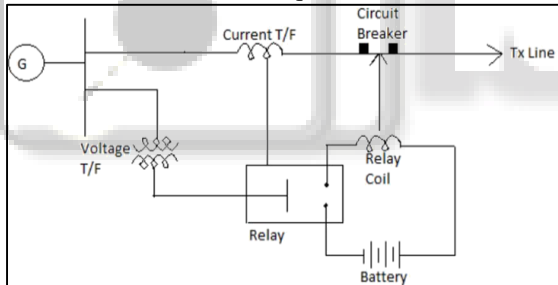

Fig. 1: Basic block diagram of working of relay.

Since the reason of power system protection is to detect faults or abnormal operating situation, relays must be able to evaluate a wide range of parameters to ascertain that corrective action is required. The most common parameters which reflect the presence of a fault are the voltages and currents at the terminals of the protected apparatus, or at the suitable zone boundaries. Occasionally, the relay inputs may also include states – open or closed – off some contacts or switches. A specific relay, or a protection system, must use the appropriate inputs, process the input Signals and determine that a problem exist, and then start some action. In general, a relay can be designed to take action to any observable parameter or effect. The fundamental problem in power system protection is to define the quantities that can differentiate among normal and abnormal conditions. This problem of being able to distinguish among normal and abnormal conditions is compounded by the fact that 'normal' in the present sense means that the disturbance is outside the zone of protection. This aspect – which is of the

greatest significance in designing a secure relaying system – dominates the design of all protection systems.[1]

Basically there are dissimilar three kinds of relays are available which are in very demand nowadays.
– Electro-mechanical relay.
– Static relay.
– Numerical relay.

Among this relays numerical relay or digital relay is very popular due to its more exactness and efficiency. In this work the over current digital/numerical relay is explained with the simulink results and analysis.[1]

II. ELECTRO-MECHANICAL RELAY

The below figure shows the schematic of an Electro-mechanical relay. The parts are as under:
– Spring
– Electromagnet
– Moveable armature
– Stationary contact
– Moveable contact

The basic understanding can be finished by analyzing the block diagram of relay as declare below. [1], [2].
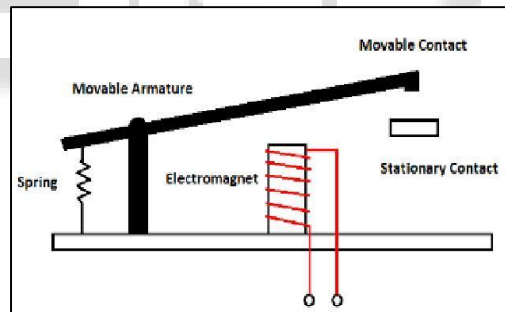

Fig. 2: Basic block diagram of electro-mechanical relay.

The two contacts are kept alienated with the help of a spring. When the electromagnet gets energized the two contacts are pulled mutually. With proper application, the integration between power circuits and control circuits can be done with the help of electro-mechanical relays.[2]

Advantages of Electromechanical relays are no requisite of heat sink, lower cost, availability of multiple poles and easy switching in both AC and DC.[2]

III. STATIC RELAY

In this type of relay, the evaluation or measurement of electrical quantities is performed by a static circuit which gives an output signal for the tripping of a circuit breaker. These are identified as static as they don't have any moving part. In this type of relay as an alternative of magnetic coil or mechanical components we use analog electronic devices to create the relay uniqueness and the incoming current or voltage waveforms are monitored by analog circuits, not

digitized. In these, there is no effect of gravity or vibration or shock. Occasionally, these relays use microprocessor but they can't be called microprocessor relays as it lack the attribute of digital/numeric relay. These relays use semiconductor devices like diodes, SCR, TRIAC, Power transistor etc, to conduct load current.[1],[2].

IV. NUMERICAL RELAY

Numerical relays provide a wide range of protection function such as over current, directional over current, under voltage, overvoltage and also other types of protection [3]. Over current protection is well thought-out as the backbone of any protection strategy particularly in distribution systems [1], [3]. Distribution systems being the biggest section of the power system network, so the diagnosis of faults in this system is a not easy task. The faults that occur in distribution systems will have an effect on the power system reliability, security and even on quality [3].
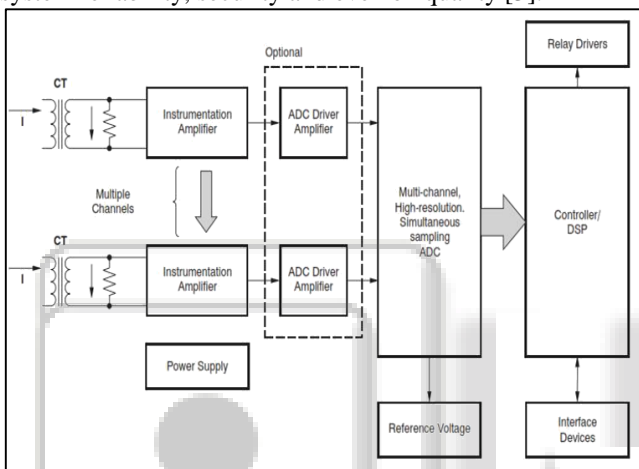
Fig. 3: Basic block diagram of numerical relay.

For the over current protection, the relay operates with or without an intended time delay and trips the related circuit breakers when the current flowing into the relay exceed a set point value [4]. Over current occurs due to existence of faults or overload conditions. For the faults cause by short circuit, the current present may be many times superior to its normal value. in the meantime, overloads occur if the current more than the rated value. These phenomena can cause serious problems because the present of large amount of current may have ruthless damage to both the faulty part and healthy part of power system [4].

Even a small duration of transients in voltage and current may involve the operation of the protection relays. As an output, this will cause the relays to fail-to-trip or mal-trip occasion to occur [4]. Fail-to-trip occurs when the relay fails to trip in the presence of faults. Mal-trip occurs when the relay trips even though it is in healthy condition. Thus, in this paper a high speed superior protection for transient faults by using numerical relay is implemented and its performance is examined.[3],[4]

V. MODELING OF SYSTEM

The simulink model along with the required results is shown in this paper. The modeling is done through MATLAB. It is the software in which the mathematical modeling can be made. For the proposed system it is very helpful to have

analysis and proper results by using this software. The overlook of the MATLAB modeling for the proposed system is as mention below.
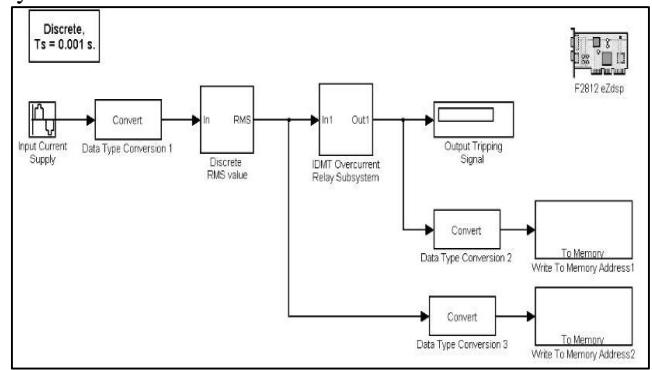
Fig. 4: MATLAB modeling for the proposed system.

VI. RESULT ANALYSIS

By performing this results can be analyze. And the output of the given system can be seen in the given plots as shown below.
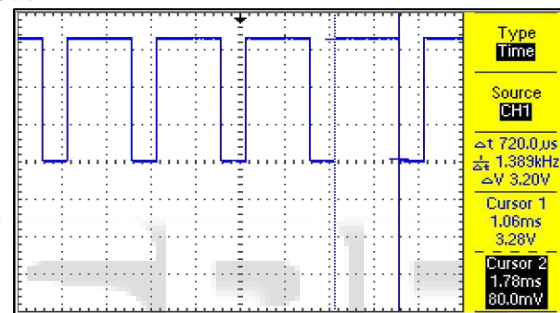
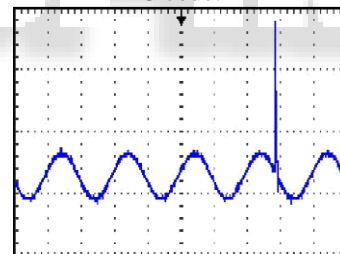Fig. 5: Execution time of the RMS computation for written C code.

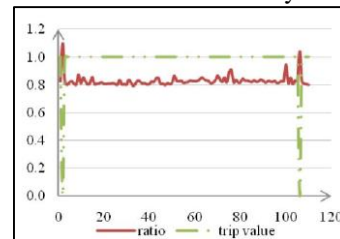Fig. 6: Transient waveform created by external circuit.

Fig. 7: Current ratio and trip value for transient testing.

Parameters	Numerical Relay	Electro-Mechanical relay
Accuracy	More	Less
Time Consume	Less	More
Memory	Extra	No memory
Cost	High	Low

Table 1: Result Analysis

VII. CONCLUSION

The objective of this paper was to design and develop the numerical quadrilateral relay. In this it describes the performance evaluation of protective relay using DSP, TMS320F2812 for over current protection. Results clearly indicate that the operation time obtained for both implementations methods are similar to IEC 255-3 standard. By analyzing the different characteristics of electro-mechanical relay as well as numerical relay, to use numerical relay is more advantageous. According to the results the accuracy of numerical relay is more, same time it is costly.

ACKNOWLEDGMENT

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