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Suppression of Fault Currents using Variable Reluctance Transformer

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Abstract: The purpose of this study is to experimentally confirm the ability of a transformer with variable reactance to limit the fault current and regulate the secondary voltage. This circuit can change the leakage reactance with a switching inductor to increase or decrease the reactance of the circuit in the event of a fault. There are three functions: voltage conversion, fault current limiting and voltage regulation. Small test equipment was manufactured, and these functions were experimentally demonstrated. Its characteristics and items that need to be improved are also being clarified. It is also expected to be useful for controlling power flow and short circuit current limiting in loop networks. We have developed a small trial circuit for limiting the current, experimentally proved its function and clarified its characteristics and points that need to be improved.
Keywords: Transformer, Faults, Variable Reactance, Fault Current Limiter

I. INTRODUCTION

Transformers in distribution networks were passive components of equipment, but in the future, they become active components of the network and interact dynamically to ensure throughput, reliability and efficiency in the network. In the new project specification, several preliminary design considerations have been implemented in the transformer to improve reliability and ease of use. Current control plays an important role in various industrial drives and AC transformers. Another important change in traditional designs is a change in the characteristics of the leakage inductance. Leakage inductance has a beneficial effect by limiting the current through the transformer without consuming power.

Changes in leakage inductance are achieved by adding inductance to the circuit. By designing a transformer with 100% leakage inductance, the transformer will not burn out after a short on the secondary winding. Developing a practical approach, we will design such transformer circuits for applications that use AC nominal currents such as neon signs, gas discharge lamps, laboratory fixtures, and so on.

II. RESEARCH METHODOLOGY

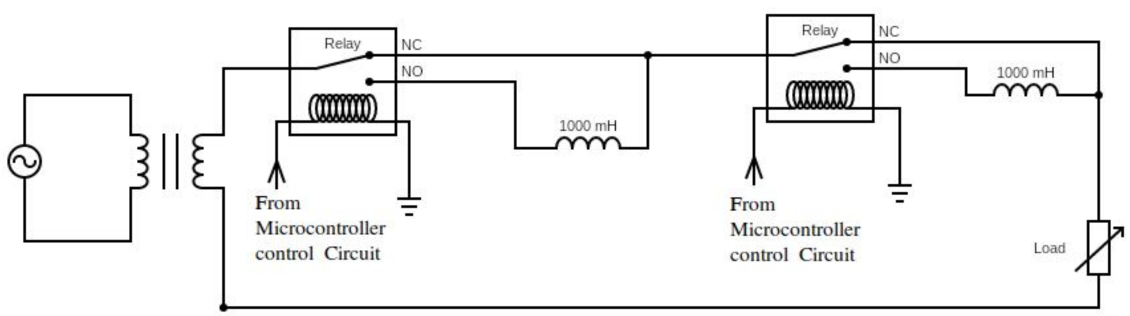

Fig.1 Conceptual Circuit Diagram of Proposed System

If inductors are connected in series, the total inductance is the sum of the inductances of the individual inductors. To understand why this is so, consider the following. The final measure of inductance is the amount of voltage that falls on the inductor for a constant rate of change of current through it.

Fig.2 Line Inductance

Limiter is suitable for high current circuits (IL> 1000 A). One phase of the limiter is shown. Copper winding WCu inserted in the circuit and connected to winding HTS. During normal operation, zero impedance reflected the primary side. The resistance developed in the HTS winding during damage is reflected in the primary winding to limit the damage.

The induction limiter can be modelled as a transformer. The impedance of this limiter in steady state is approximately zero since the zero impedance of the secondary winding is primarily reflected. In the event of a failure, a large current in the circuit causes a large current to flow in the secondary winding, and the winding loses superconductivity. The resistance of the secondary winding is reflected in the circuit and limits the fault.

Fault current limiters (FCLs) are expected to play an important role in protecting future electrical networks. Inductive FCLs are of particular interest because of their inherent response to failure, but they are not marketed because they have too much magnetic material to cause an induced overvoltage in the DC winding.

III.PROPOSED SYSTEM MODEL

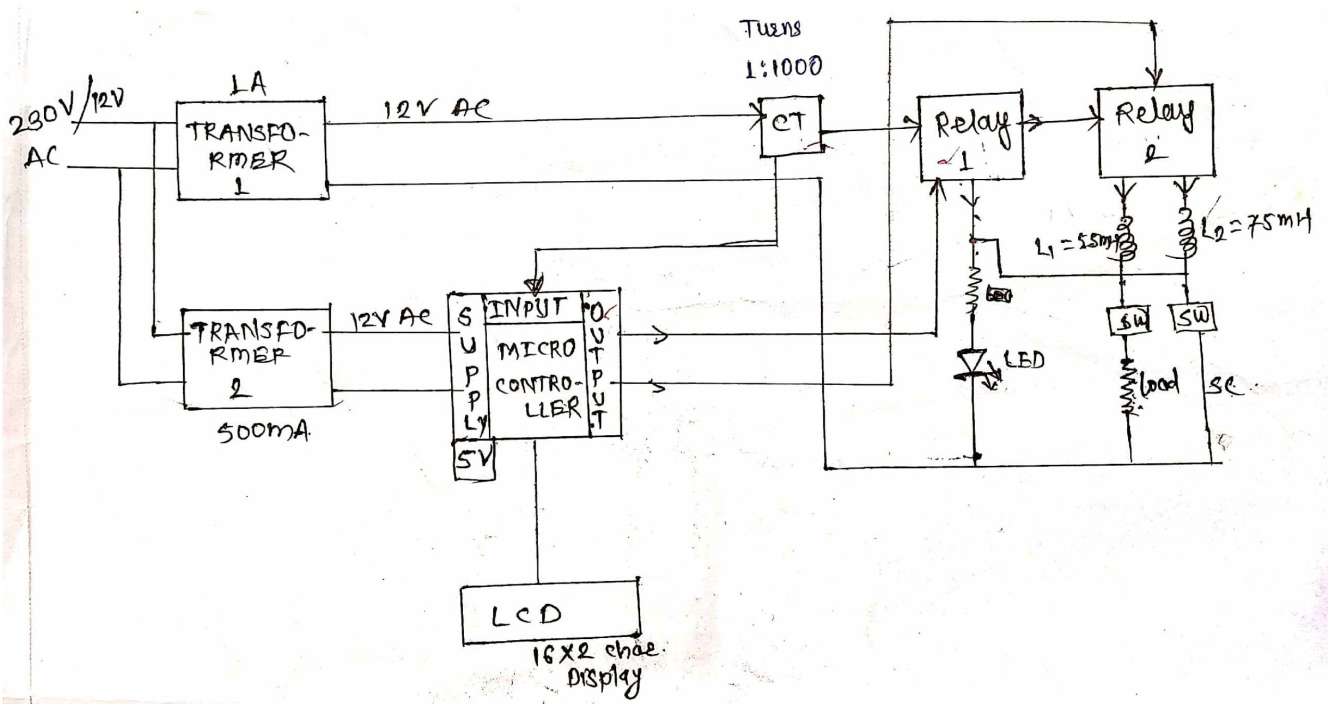

Fig. 3 Proposed System Block Diagram

Shorts in the power system can not be ignored for many reasons. When a short circuit occurs in the power system, a large current flow in the system, and heat generation and electromagnetic force may damage the equipment. In addition, if there is a failure somewhere in the grid (depending on the distance to the failure point), a voltage drop will occur. This problem may cause the normal plants connected to the network to stop completely. The energy constraint is that 80-90% of customers complain about brownout problems.

Fig.3 shows a proposed system block diagram where the microcontroller monitors the on / off state of a faulty inductor (transformer). Increasing the inductance during fault conditions increases the reactance. Thus, the short circuit current is reduced and the voltage across it is also stabilized. The LCD displays the status of the fault. Inductors, also called coils or reactors, are energy that is temporarily stored in magnetic fields in passive bipolar electrical components that resist changes in the current passing therethrough. It usually consists of a conductor such as a wire wound around a coil. When current flows, the coil flows. When the current through the inductor changes, the time-varying magnetic field induces a voltage in the conductor according to Faraday's induction law, which cancels out the change in the current that caused it.

For both FCL and CLT applications, there is a general feature of current limiting.

1) Strong current limiting damage (unlimited current is about 8 times higher)
2) These devices limit the first peak of current damage without the occurrence of dangerous over voltages.

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IV. PROPOSED SYSTEM HARDWARE AND RESULTS

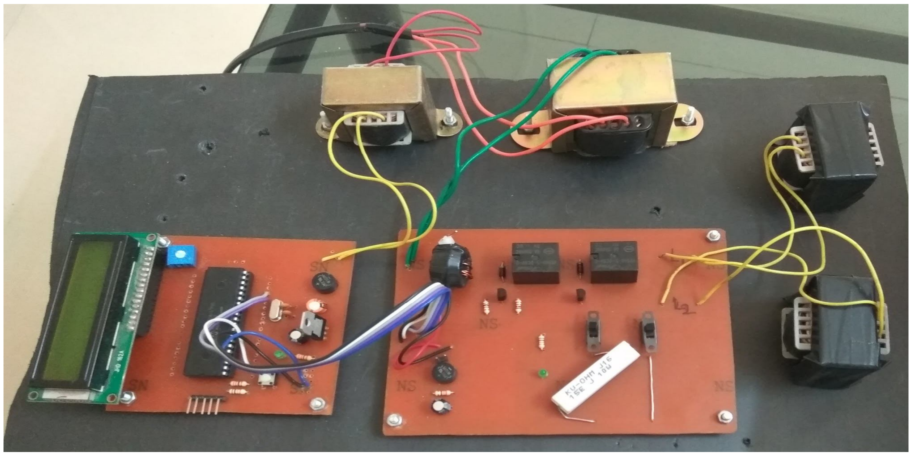

Fig.4 Proposed System Hardware

Here in the hardware of the proposed system, we used transformers as an inductor which is added in the circuit while in a fault condition. Here we created short circuit fault by link connected in series with a switch. When we turn ON this switch, fault condition occurs. Under this fault condition inductors come into the circuit and hence fault current reduced.

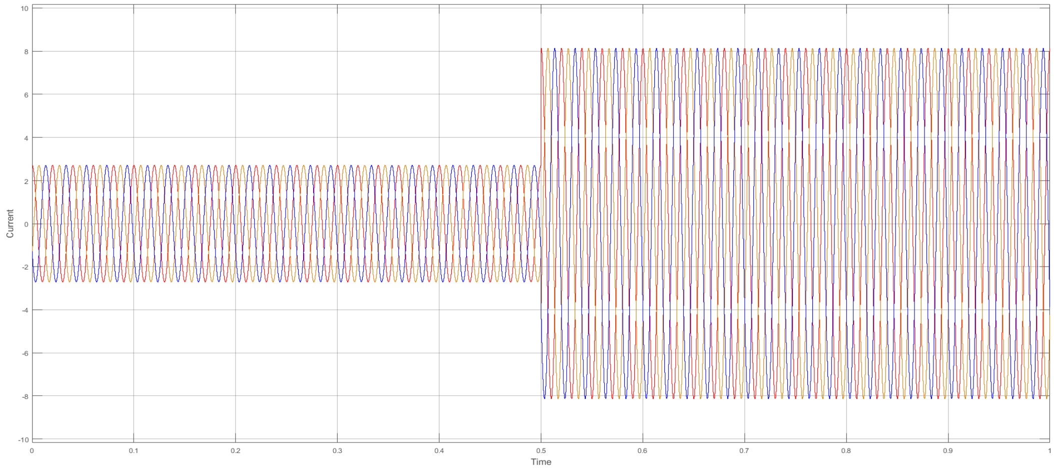

Fig. 5 Waveform of current under fault condition

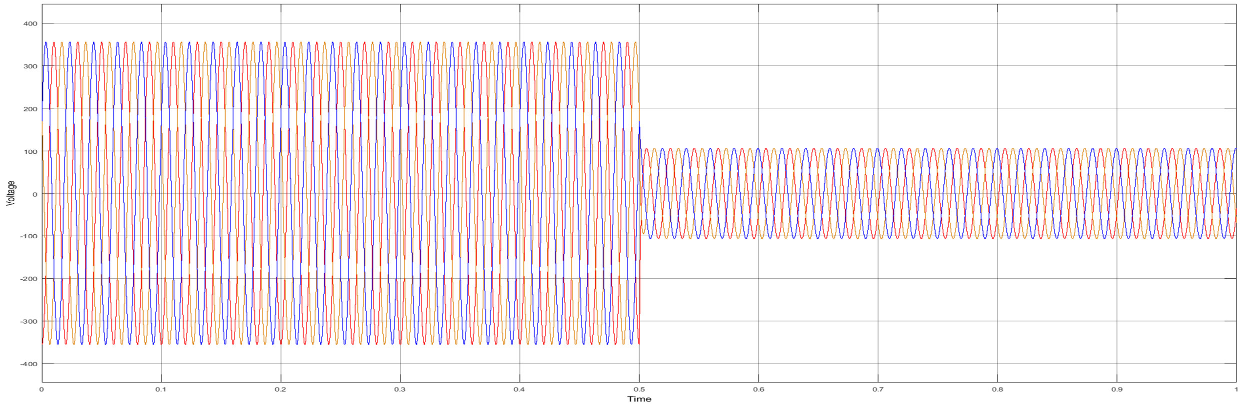

Fig. 6 Waveform of voltage under fault condition

Fig.4 shows proposed system hardware. Fig. 5 and Fig.6 shows a waveform of current and voltage under fault condition. It has been observed that fault current is so much small which is under a limit. Its magnitude is 8A which can be easily capable to handle this current. This magnitude is still more than normal rated current i.e. 3A. As well as voltage also regulated well under fault condition.

V. CONCLUSION

The proposed system can control the amount of fault current. The primary winding of the isolation transformer is connected in series with a line to control the fault current. With current control, the fault current is reduced, and the voltage at the common point of communication is maintained at an acceptable level. Thus, this system significantly reduces switching over voltages. The current transformer sends a current to the input of the current attenuator.

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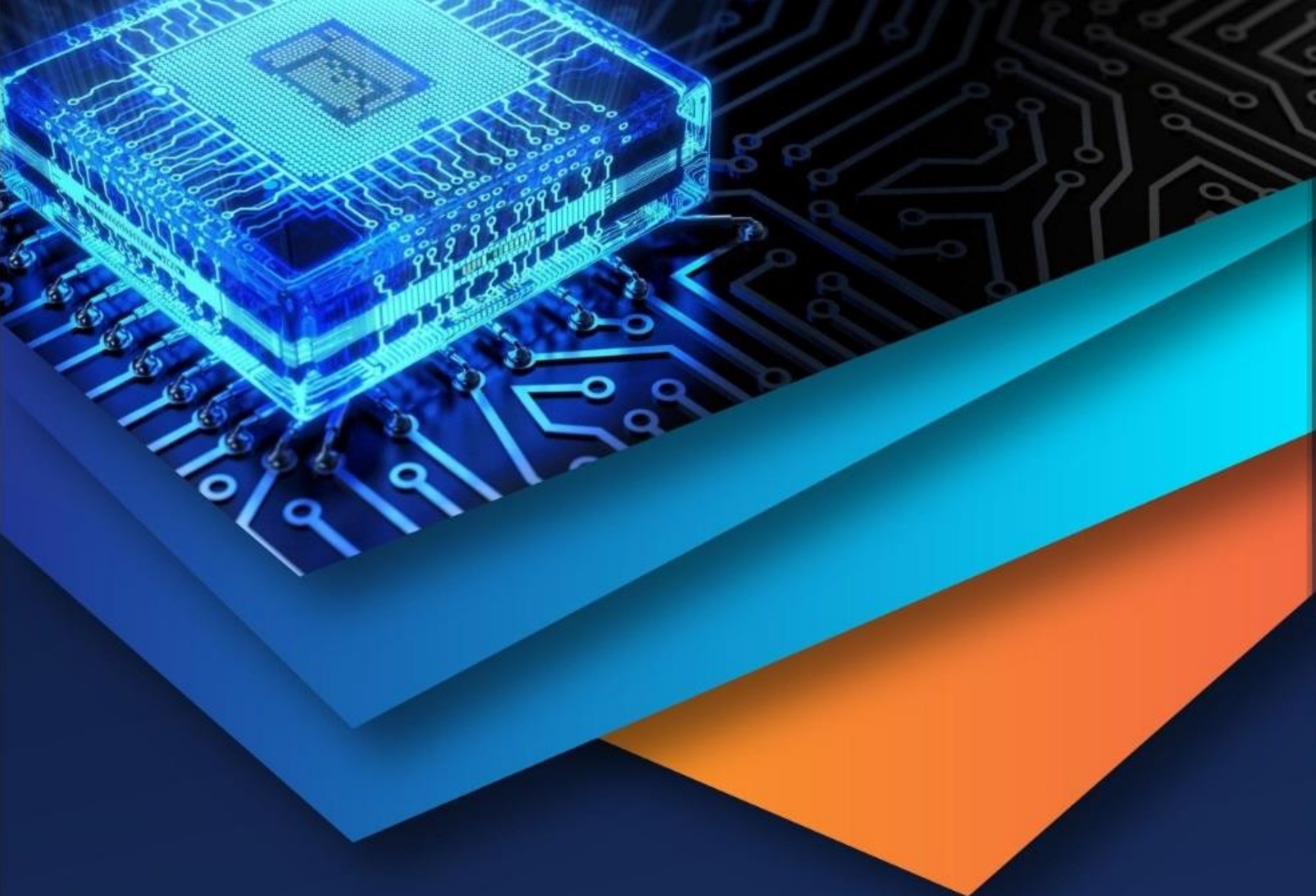

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