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Automatic Load Sharing of Transformer

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***Abstract*: The transformer is a static device, which converts power from one level to another level. The aim of the project is to protect the transformer under overload condition by load sharing. Due to overload on transformer, the efficiency drops and windings get overheated and may get burnt. Thus, by sharing load on transformer, the transformer is protected. This will be done by connecting another transformer in parallel through a micro-controller. The microcontroller compares the load on the first transformer with a reference value. When the load exceeds the reference value, the second transformer will share the extra load. Therefore, the two transformer work efficiently and damage is prevented. In this project three modules are used to control the load currents. The first module is a sensing unit, which is used to sense the current of the load and the second module is a control unit. The last module is micro-controller unit and it will read the analogue signal and perform some calculation and finally gives control signal to a relay. A GSM modem is also used to inform the control station about switching. The advantages of the project are transformer protection, uninterrupted power supply, and short circuit protection. When designing low-voltage power system to the supply large load currents, paralleled lower-current modules are often preferred over a single, large power converter for several reasons.**

These include the efficiency of designing and manufacturing standard modular converters which can be combined in any number necessary to meet a given load requirement and the enhanced reliability gained through redundancy.

***Keywords*: Transformer, Overload, GSM, Arduino.**

1. Introduction

Transformer is the main component in the electric power transmission and distribution system. The problems of overloading, voltage variation and heating effects are very common. It requires high cost for repair and also more time. This work is all about protecting the transformer under overload condition. When overload condition occurs its secondary winding get overheated and it may burn. So the transformer can be protected by removing extra load and This can be done by operating another transformer in parallel with main transformer.

To accomplish this requirement there is one method of manual approach. In this other transformer is connected manually during heavy loading condition. But practically manual approach is not efficient. So we are employing Arduino to make the switching of transformer automatically. Arduino is an automation-based microcontroller device which will automatically switch the transformer into circuit when overloading condition occur for transformer one. Thus this will result in efficient working of both transformers. Also when load is constant both transformers are switched on into the circuit alternately. This will avoid continuous heating of only one transformer.

The Arduino compares the load on the first transformer with a reference value. When the load exceeds the reference value, the second transformer will automatically be connected in parallel with first transformer and share the extra load. Therefore, a number of transformers work efficiently under overload condition and the damage can be prevented.

In this work, the second transformers share the load of main transformer in the case of over load and over temperature conditions. A sensor circuit containing current sensor, Arduino, current transformer etc. is designed to take the data from main transformer and if it is found to be in overload condition, immediately the second transformer will be connected in the parallel to the main transformer and the load is shared. The Arduino will analyze the load current and temperature of transformer and displays the values on LCD.

Whenever loads are added to the secondary side of the transformer, the current at the secondary side rise. As the load current exceeds the rated current rating of the transformer, the temperature of the secondary winding rises, therefore the Arduino will send a trip signal to the relay, thereby turning on the second transformers. Initially when we switched ON the load that load will be shared by the first transformer. Once load has been increased on first transformer above its rated capacity then the stand by transformer (second) will share the load automatically.

In this project three modules are used to control the load current. The first module is the sensing unit, which is used to sense the current of the load; the second module is control unit in which relay plays the main role, and its function is to change the position with respect to the control signal and last module is Arduino.

This arrangement offers proper maintenance facility for both transformers. All these advantages will make this system very efficient.

2. Block diagram

A. Circuit Breaker

A circuit breaker is used to isolate the faulty point of the power system in case of abnormal conditions such as faults.

It is a protective device which energizes and de-energizes a circuit and provides over-current protection. Circuit breakers operate on receiving a signal from relay.

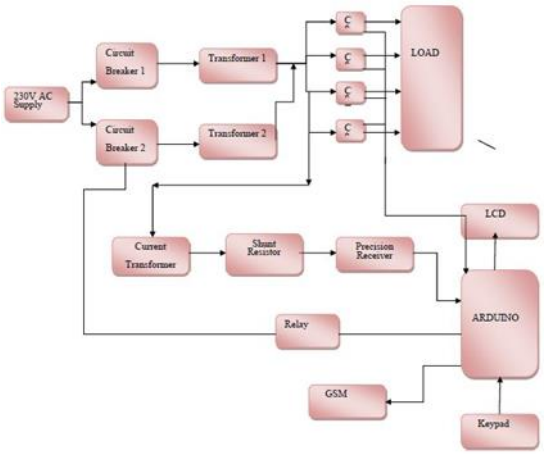

Fig. 1. Block diagram

B. Transformers

A transformer is an electrical device that transfers electrical energy between two or more circuits through electromagnetic induction Transformers convert AC voltage from one level to another level with a little loss of power. A transformer operates on the principals of "electromagnetic induction", in the form of mutual induction.

The transformer used here is a step-down transformer so that it can be directly fed to the measuring devices by rectification.

C. Relay

Relays are components which allow low power circuit to operate high current application circuits. It is an electrically operated switch and is 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 relay used here is of electromagnetic type.

D. Current Transformer

The Current Transformer is a type of "instrument transformer" that is designed to produce an alternating current in its secondary winding which is proportional to the current being measured in its primary. Current transformers reduce high voltage currents to a much lower value and provide a convenient way of safely monitoring the actual

electrical current flowing in an AC transmission line using a standard ammeter. The principle of operation of a current transformer is same as that of an ordinary transformer.

E. GSM Modem

A GSM modem is a specialized type of modem which accepts a SIM card, and operates over a subscription to a mobile operator, just like a mobile phone. Here the purpose of GSM modem is to send the monitoring parameters values and faults of transformer to authorized person's number in control room.

It is a class of wireless modem devices that is designed for communication of a computer with the GSM and GPRS network. It requires a SIM card to send the message.

F. Arduino

Arduino board designs use a variety of microprocessors and controllers. The boards are equipped with sets of digital and analog input/output (I/O) pins that may be interfaced to various expansion boards ('shields') or breadboards (For prototyping) and other circuits. The boards feature serial communications interfaces, including Universal Serial Bus (USB) on some models, which are also used for loading programs from personal computers.

3. Operation

In the proposed system, only one transformer is operating to feed the loads. A standby transformer is connected in parallel through a circuit breaker and relay. The current transformer continuously measures the load current and feeds it to the Arduino. The reference value or the maximum load limit is entered by the user and priority level of the load is also set by the user or concern authority. As the load demand increase during peak hours, a single transformer would not be able feed all the load. During this condition, when the load demand exceeds the reference value, the Arduino will give a control signal to energize the relay coil. Thus the stand by transformer will be connected in parallel and share the load equally. Since the transformers are of the same ratings. Thus all the loads are fed efficiently providing un-interrupted power supply.

When the load increases to further to a value which is greater than the capacity of the two transformers, priority based load shedding will be implemented. The loads which have the lowest priority will be shut down by opening the respective circuit breaker.

When the load decreases, and comes to normal working condition, first transformer will be shut down in order to avoid thermal loading. This is done because the first transformer operates for a longer time interval than standby transformer and its body temperature rises. By providing alternative switching the transformers can be cooled by natural methods. This will improve the efficiency of the system.

4. Advantages

1) The load is shared by transformers is automatically.
2) No manual errors are taking place.
3) It prevents the main transformer from damage due to the problems like overload and overheats.
4) Un-interrupted power supply to the consumers is supplied.

5. Conclusion

The future scope of our project is particularly in Substation. In substations particularly during the peak hours there is a need for the operation of additional transformer to supply the

additional load requirement. Our project automatically connects the transformer under critical loads. Thus there is no need to operate both transformers under normal loads, particularly during off peak hours. Thus power is shared intelligently with the transformers in parallel.

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