International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 06 Issue: 04 | Apr 2019 www.irjet.net p-ISSN: 2395-0072

Load sharing of Transformer using Microcontroller

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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 microcontroller unit and it will read the analogue signal and perform some calculation and finally gives control signal to a relay. 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**: **Capacity, Interruption, Load; System, Transformer, Microcontroller.

1.INTRODUCTION

Power travels from the power plant to house through an amazing system called the power distribution grid. For power to be useful in a home or business, it comes off the transmission grid and is stepped-down to the distribution grid. This may happen in several phases. The place where the conversion from "transmission" to" distribution" occurs is in a power substation. It has transformers that step transmission voltages (in the tens or hundreds of thousands of volts range) down to distribution voltages (typically less than 10,000 volts). It has a "bus" that can split the distribution power off in multiple directions. It often has circuit breakers and switches so that the substation can be disconnected from the transmission grid or separate distribution lines can be disconnected from the substation when necessary.

Transformers being one of the most significant equipment in the electric power system, needs protection as a part of the general system protection approach. Moreover the increasing population and their unavoidable demands have lead to an increasing demand on electrical power. With this increased needs, the existing systems have become overloaded. The overloading at the consumer end appears at the transformer terminals which can affect its efficiency and protection systems. Due to overload on the transformer, the efficiency drops and the windings gets over heated and may get burnt. It takes a lot of time to repair and involves a lot of expenditure. Transformers are occasionally loaded beyond nameplate ratings because of existing possible contingencies on the transmission lines, any failure or fault in power systems, or economic considerations. One of the reported damage or tripping of the distribution transformer is due to thermal overload. To eliminate the damaging of transformers due to overloading from consumer end, it involves the control against over current tripping of distribution transformer. Rise in operating temperature of the transformer due to overloading has an influence on ageing of transformers. The accelerated aging is one of the main consequences of overloading power transformers. Thus load limitations must be implemented to operate the transformers within safe limits. Moreover on overloading the transformers voltage regulation may increase and power factor drops.

The project is all about protecting the transformer under overload condition. This can be done by connecting another transformer in parallel through a microcontroller and a relay which shares the excess load of the first transformer. The transformers are switched alternatively to avoid thermal overloading. Therefore, two transformers work efficiently under overload condition and damage can be prevented. If there is a further increase in load beyond the capacity of two transformers there will be a priority based load shedding of consumers which will provide un-interrupted power supply for the hospitals, industries etc.

1.1 Objectives

The main aim of the project is to protect the transformer under overload condition by sharing load with a standby transformer and to provide un-interrupted power supply to the consumers.

2. LITERATURE REVIEW

Rekha.T,BinduPrakash,Asna.S,Dinesh.Sand Nandana. S.Prasad (2015), Distribution transformers are an important part of power system which distributes power to the low-voltage users directly, and its operation condition is important for the entire distribution network operation. However, their life is significantly reduced if they are subjected to overloading and over temperature resulting in unexpected failures and loss of supply to a large number of customers thus effecting system reliability. Protection against fault in power systems is very essential and vital for its reliable performance. This project is a simplified approach to protect the transformers from unusual conditions. For this purpose two similar types of distribution transformers are used so that, if any one transformer fails, then immediately another transformer is brought into the circuit during over loading, over temperatures, input voltage variations and provides conventional 230V supply to the consumers without burning of transformers. Most of the loads (e.g. Induction motors, arc lamps) are inductive in nature and hence have low lagging power factor. The low power factor is highly undesirable as it causes an increase in current, resulting in additional losses of active power in all the elements of power system from power station generator down to the utilization devices. So in this paper an automatic power factor correction circuit is also incorporated with the load sharing module.

Ashish R. Ambalkar, Nitesh M. Bhoyar, Vivek V. Badarkhe and Vivek B. Bathe (2015), The transformer is very costly and bulky equipment of power system. It operates for 24 hours of a day and feeds the load. Sometimes the situation may occur when the load on the transformer is suddenly increased above its rated capacity. When this situation occurs, the transformer will be overloaded and overheated and damage the insulation of transformer resulting in interruption of supply. The best solution to avoid the overloading is to operate the number of transformers in parallel. In this work, a slave transformer shares the load of master transformer in the case of over load and over temperature. A sensor circuit is designed to log the data from master transformer and if it is found to be in overload condition, immediately the slave transformer will be connected in the parallel to the master transformer and the load is shared. 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 work we are used a relay and comparator IC's for automatic load sharing between three transformers. The number of transformers to be operated in parallel can also be increased according to demand of a particular area.

3. METHODOLOGY

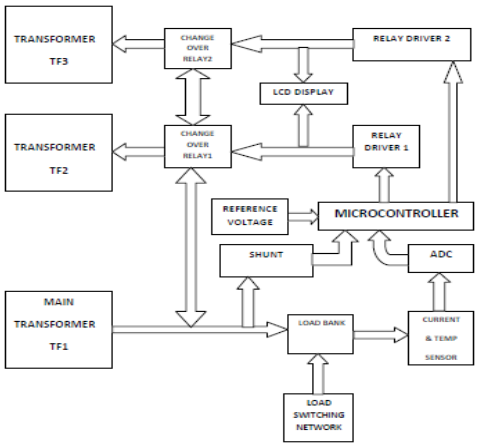

fig-1: Block diagram

In the block diagram circuit breakers are used to make and break the connections to the transformers. A relay is used to send a tripping signal to the circuit breakers and they are energized on receiving a signal from the microcontroller. The current transformer is used for measurement purpose.

Three identical transformers are using which are connected in parallel through change over relay. Transformer-TF1 is a main transformer, which is called master transformer and transformer-TF2 is an auxiliary transformers which is called as slave transformers. Each transformer has its own load handling capacity. In case of a normal operation the master transformer shares the load but as the load is beyond the rated capacity of main transformer the slave transformer is connected in parallel automatically and shares the load.

Load switching network is provided to ON/OFF the load on the transformers which is connected to load bank. Shunt is used to distribute the current to all the sections of the circuit. Comparator is having two inputs one is from shunt and the second is from the reference voltage. Reference voltage is set by the user. Comparator (microcontroller) compares the reference voltage and system voltage continuously and the output signal is given to the relay driver circuit. Relay driver circuit consists of NPN transistor to drive the relay. Relay driver gives the signal to the change over relay in case of overload conditions. Change over relay closes its contact when load on the master transformer is more than it's rated capacity and the transformer-T2 i.e. slave transformer is automatically connected in parallel with the main transformer and if the load is increased to such a amount

that can't be handled with the two transformers then the third transformer T3 is automatically connected in parallel with T1 & T2 and shares the load. Due to which the transformer-T1 is not overloaded and the problem like overheating, burning of winding of transformer and un-interruption of supply is gets eliminated by this arrangement. The visual indicator contains the LED"s which shows the ON/OFF status of the all transformers.

3.1 Circuit diagram

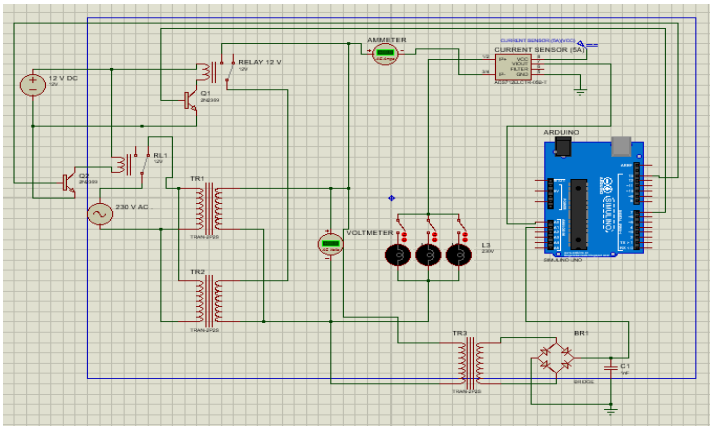

Fig-2: Circuit diagram of system

3.1 Materials used

The following materials are used for load sharing of transformer

Table -1: components

SL NO.	COMPONENTS USED	RATING
1	TRANSFORMER	1 KVA
2	RELAY	5V/10A
3	CURRENT SENSOR	ACS712/5A
4	ARDIUNO UNO	ATMEGA 328P
5	LAMP LOAD	VARIABLE

4.RESULTS

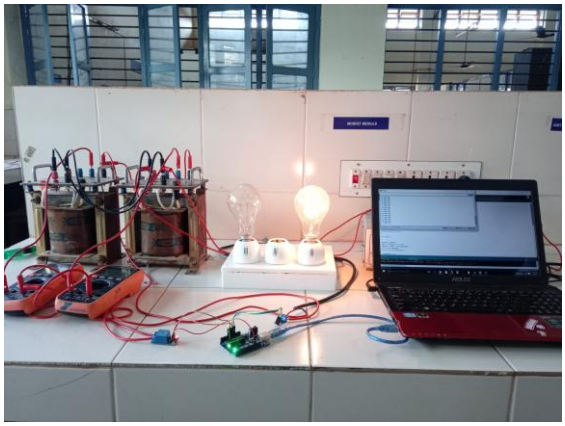

Fig -3:load shared by single transformer

Fig -4:load shared by both transformer

4.1 Advantages

1) Automatic load sharing by transformers.
2) No manual errors are taking place.
3) It prevents the main transformer from damage due to the like overload and overheats.
4) Un-interrupted power supply to the consumers is supplied.
5) Complete monitoring of transformers.

3. CONCLUSIONS

In this project we observed that if load on one transformer is increases then the relay will sense the change in current & microcontroller operates & slave transformers comes automatically in operation to share the load.

The work on "Automatic load sharing of transformers" is successfully designed, tested and a demo unit is fabricated
for operating three transformers in parallel to share the load automatically with the help of change over relay and

relay driver circuit and also to protect the transformers from overloading and thus providing an uninterrupted power
supply to the customers.

ACKNOWLEDGEMENT

We consider it as a privilege to articulate a few words of gratitude and respect to all those deserving individuals who guided us in this project. First and foremost, we would like to extend our profound gratitude and our sincere thanks to our guide **Altaf M.** professor, Department of Electrical and Electronis Engineering, Anjuman Institute of Technology and Management (AITM), Bhatkal, who constantly supported and encouraged us during every step of dissertation. We really feel highly indebted to him for constantly guiding us to continue our work and giving us short term goals.
We are thankful to our project coordinator, **Iqbal Ahmed,** Professor, Department of Electrical and Electronics Engineering, AITM, Bhatkal for his immense support throughout this project.
We take this opportunity to thank **Dr.M.A. Bhavikatti,** Principal, AITM, Bhatkal for his encouragement and useful suggestions to pursue this work.

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