International Journal of Engineering Sciences & Emerging Technologies, Mar. 2017.
ISSN: 22316604 Volume 9, Issue 4, pp: 119-123 ©IJESET

LOAD SHARING OF TRANSFORMERS BASED ON MICROCONTROLLER

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ABSTRACT

The term transformer is the main component of any power system. It converts the level of voltage from one to another. The main aim of the project is to provide the uninterrupted power supply to the consumer and also increase the reliability of whole the power system. If the fault occurs in line at that time the supply will be cutout. Hence, the consumer cannot get reliable power supply. So, for providing the reliable power supply we connect the transformers in ring main system. Microcontroller is connected between the transformers. Microcontroller has a reference value of voltage it compares the voltage with its reference voltage. Here, three circuits, first sensing circuit which gives the output of 5V to the controller pin, second is the power supply circuit which gives the 5V DC for the operation of the microcontroller and third is the relay driver circuit which take the signal from controller according to it relay changes the position of contact. In project, we interface the LCD with microcontroller which display the normal or abnormal condition.

KEYWORDS: *Transformers, Short circuit, Microcontroller, Reliable power supply*

I. INTRODUCTION

Transformer is the main equipment in electrical power system. Transformer works on the principle of mutual induction. It states that, the alternating current flow through the primary winding of the transformer will produces the alternating flux. The change in the produced alternating flux will link with the secondary winding of the transformer. It is called as the principle of mutual induction. Distribution transformer is the main part of the distribution system. Also, we can say it is the heart of whole system. The main function of electrical power distribution system is to provide power to individual consumer premises. The transmitted electric power is stepped down in substation, for primary distribution system. Now, these stepped down electric power is fed to the distribution transformer through primary distribution feeders. These stepped down electric power is provided to consumer through secondary distribution line. The symmetrical and unsymmetrical faults occur in distribution line. Because of these faults in line power cuts off. For the effective and reliable power system, we need to control the voltage and frequency which are the main parameters of transformer. For the load sharing in ring main system we need to protect the all the transformer which are the part of the system. Hence we control and monitor all the parameters of transformer like voltage current, etc. continuously. Nowadays some line faults like L-G, L-L, L-L-G, etc. so, At the time of faulty condition or we can say fault at transmission line, purpose of the project is to fulfil the reliable power to the consumer. A symmetric or balanced fault affects each of the three phases equally. In transmission line faults, roughly 5% are symmetric. This is in contrast to an asymmetrical fault, where the three phases are not affected equally.

For the solution of this is, first parallel connection of transformer and second is ring main unit. In parallel connection method, sometimes existing transformer are paralleled in industrial and

commercial facilities when facility engineers, consultants, maintenance staffs are looking for ways of making power systems more reliable, provide better power quality and additional load requirement. So, sometimes load sharing of transformer using parallel connection is preferred. In ring main unit we easily shares the load of one transformer to another transformer at the time of faulty condition.

II. RELATED WORK

Transformer used in the power system is loaded with 50-60% of its rated capacity. Hence if the fault occurs on the line at that time one transformer take the load of another transformer.
Following steps are the procedure for the load sharing of the transformer with another transformer in ring main system. This whole process is totally automatic by using the microcontroller.

1. First we load the transformer at 50-60% of its rated capacity another transformer is connected in ring through circuit breaker.
2. We continuous measure the voltage of the line and convert it into the DC value which gives to the microcontroller. It compares DC value with the reference value.
3. If any type of permanent fault occurs on the line at that instant controller get low signal and it gives the high logic to the relay driver circuit which closes the contact and shares the load of another transformer.
4. We interface the LCD with microcontroller which display the actual condition of the system.
5. This type of system is extended by increasing the number of transformer in ring main system.
6. This system gives the uninterrupted power supply to the consumer and make the system efficient.

Algorithm for the microcontroller for load sharing of the transformer is working and the program executed in loop and this loop will repeat infinite times.

III. BLOCK DIAGRAM

Figure 3.1 shows the block diagram for the load sharing of the transformer based on microcontroller. Various blocks of the system are described below.

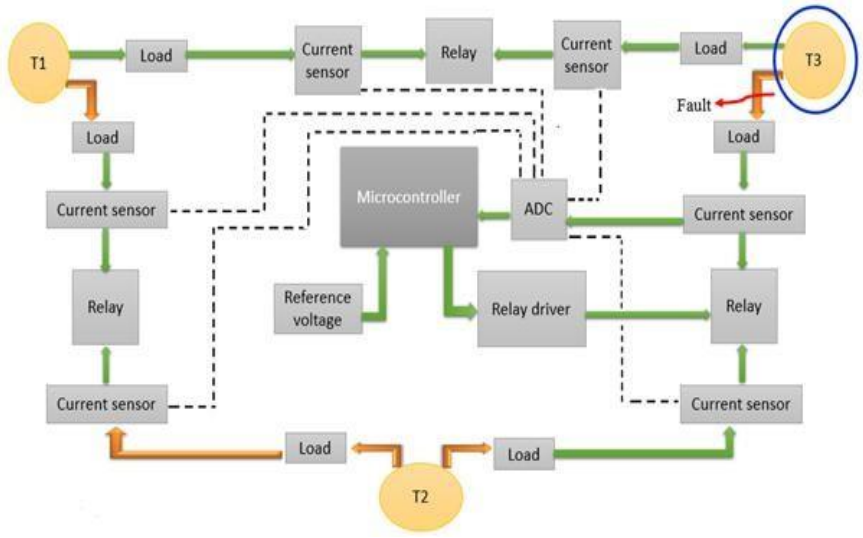

Fig. 3.1 Block Diagram

In the block diagram, we connect the relay between the two transformers. We sense the voltage from the line and give it to the microcontroller. Microcontroller compares that voltage with the reference voltage and give the high or low logic to the relay driver circuit which provide the sufficient current to the relay for change its contact and shares the load of one transformer with another transformer.

In block diagram dotted line will show the connection of the current sensor with ADC if current sensor is used.

Transformer: Transformer is the electrical device which converts the voltage from one level to another level as per our requirement. Transformer works on the principle of "electromagnetic induction" of mutual induction. Here we use the step-down transformer and fed it to the microcontroller by rectification.

Microcontroller: Microcontroller is used for to made this whole process automatically. Here we use 8051 microcontroller because here we sense the voltage so no need of ADC which is inbuilt in Arduino.

Circuit Breaker: Circuit breaker is the device which is use to isolate the faulty part from the system. It has electromagnetic coil which is energize or de-energize at the time of abnormal condition. Circuit breaker are operating on the signal of relay. Here 240/415V circuit breaker is used which is tripped 60000 times.

Relay: Relay is the electrical equipment which senses the fault in the system. A relay is electro mechanical switch which is used in industrial application to provide isolation between high voltage and low voltage circuits. Normally open electro mechanical relay is used. A voltage required to energize the coil, vary from relay to relay. Voltage may vary from 5 volt to 50 volt and current may vary from mA to 20mA. The relays also have minimum voltage rating. Its means below voltage rating relay will not operate.

Relay Driver: In market, there are many types of relay driver circuit are available but here we use ULN2003 because it has less number of component and also easy to interface with low voltage circuitries. ULN2003 is 16 pin driver circuit which is less expensive so here use of the ULN2003 make the low cost of project.

IV. CIRCUIT DESCRIPTION

Here two transformers are working at 50-60% of its rated capacity. Because of this working capacity we can transfer some load of one transformer to another transformer. In this project, for getting the uninterrupted power supply, need to sense the line faults like L-G, L-L, L-L-G, etc.

In this existing method, the voltage of the line is compared with the reference value using voltage sensor circuit. If there is any difference between the voltage, then it is indicated the fault occurs on the line. Here voltage sensor is provided at the secondary side of the transformer. And reference value is set at microcontroller. This reference value is depending on the rating of the transformer. If here we sense the current, then we need to connect ADC which converts analog signal into digital signal. The output of these current sensor value is connected to the Analog to digital converter. ADC converts these analog inputs into digital. Then Microcontroller compares the measured value with reference value. If compared result has any negative sign, it indicates the fault occurs on the line. Microcontroller operate the relay driver at overload condition. Relay driver is used to drive the relay. Here microcontroller cannot provide the sufficient current for the operation of relay. So, we need to provide relay driver circuit. Hence relay will operate and transformer shares the load with another transformer. There is a need of relay driver circuit because controller will not provide enough current to operate the relay or close/open the contact of relay. Advantage of project is, first consumer get uninterrupted power supply continuously and also increase the reliability of the ring main system.

Components used in our project are described as follows:

Table 5.1 Hardware Description

Component	Rating
Transformer	230V/110V
Relay	5A
Microcontroller	8051 µC
Resistors	1KΩ
Capacitors	2200µF
Circuit breaker	240/415V

Circuit Diagram

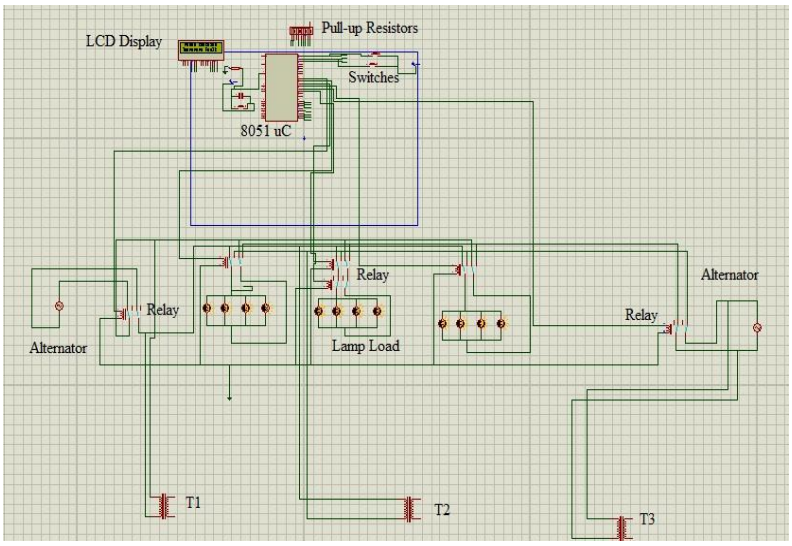

Fig.5.1 Circuit Diagram

Figure shows the simulation circuit diagram for load sharing of transformer base on the microcontroller. Here the use of the microcontroller is to make the system automatic. Three transformer are works on its own load which are minimum 50-60% of its rated capacity. Here many relays are use which are shows in diagram. If the fault occurs at the line or feeder the relay coil will energize and it operate and close its contact. Also, it give signal to the circuit breaker and isolate the faulty part from the system.
The simulation circuit for the load sharing of transformer in ring main system. In normal condition, System is healthy system and all the loads are continuously run without any interruption. At the time of temporary fault occur on the line transformer will not share its load with another transformer. At the time of permanent fault the isolated load will shared by another transformer and give the reliable power to the consumer.

Operating Principle

Here transformers are loaded below its rated capacity. Hence it is capable to take the load of another transformer at the abnormal condition of the system. Here this abnormal condition is related to the line faults which are discussed above. If the fault occurs at any line it sensed by the relay. Circuit breaker are connected in series with the first or main transformer for isolate the load from the system at the time of fault. This circuit breaker is connected with the relay driver or driver circuit. Driver circuit are connected with the microcontroller because controller give the logic high or low to the driver. As a result of this microcontroller are interfaced with the LCD display which displays the current condition of the system i.e. load will be shared with another transformer or not. Also, sensor circuit are introduced in project which senses the voltage or current from the main line. This will be done in ring main system.

V. SIMULATION RESULTS

- Hardware implementation of the Load Sharing of Transformers based on Microcontroller was developed using 8051 microcontroller.
- Also Multisim software use in this project and output will be verified.
- Simulation was done in PROTEUS ver. 7.7 and the output was verified.
- It provided un-interrupted power supply to certain loads like hospitals,
- Load is shared by the transformers if the fault occur on line or feeder.

VI. CONCLUSION

This project reduces the manual work for sharing the load of transformer. Also, provide the reliable power to the consumer by using the load sharing of the transformer with another transformer, it increases the efficiency of the system. Using this methodology, we supplied the uninterrupted power

supply to the consumer and to provide the solution for the fault on the line and continuous electricity provide to run the loads. This will have done automatically. o increase the life of the transformer and to make the system efficient.

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