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AUTOMATIC TRIAC BASED ON LOAD TAP CHANGER

1st Geo Varghese
Electrical and Electronics Engineering
Mar Athanasius College of Engineering
Kothamangalam, India

2nd Govind Sivaraj K
Electrical and Electronics Engineering
Mar Athanasius College of Engineering
Kothamangalam, India

3rd Nirmal Varghese
Electrical and Electronics Engineering
Mar Athanasius College of Engineering
Kothamangalam, India

4thNanditha S
Electrical and Electronics Engineering
Mar Athanasius College of Engineering
Kothamangalam, India

5thProf.Neema S
Electrical and Electronics Engineering
Mar Athanasius College of Engineering
Kothamangalam, India

***Abstract*—It is expected that increasing amounts of new gener- ation technologies will be connected to electrical power systems in the near future. Most of these technologies are connected to distribution grids.When connected in small amounts, the impact of distributed generation on power system transient stability will be negligible. However, if its penetration level becomes higher, distributed generation may start to influence the dynamic behavior of the power system as a whole.The effects of distributed generation are increased short circuit levels,changes in load losses**

,changes in voltage profiles along the network, voltage transients will appear, power quality and reliability may be affected and the networks protections may not function properly.The transients introduced will tend to change the input side voltage of a transformer.But in order to maintain a constant output, it is necessary to implement effective control methods.Conventionally, this is done by On-Load Tap Changing mechanism.It is a method in which the turns ratio is varied in accordance with the input voltage variations and thus maintains a constant output.But the conventional system uses manually controlled mechanical tap changers.This has certain disadvantages like arcing, wear and tear of contacts and thus requiring frequent maintenance.The proposed system uses a TRIAC based OLTC technology.It main- tains the output of the transformer constant even when there is variation in input due to voltage fluctuations, sag etc.Its response time is much better than the conventional system and the problem of arcing, wear and tear etc., are reduced.

***Index Terms*—Triac,Optocoupler,Transformer,Arduino**

I. INTRODUCTION

Tap changing mechanism is used in transformers,which allows to select variable turns ratios in discrete steps.Variable turns ratio is obtained by connecting to various access points called taps,which are provided on the primary or secondary of the transformer.

There are two types of tap changing mechanism-No load tap changing and on load tap changing.In no load tap chang- ing,the transformer winding must be de-energized before the turns ratio is adjusted.Where as in on load tap changing,the

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turns ratio can be adjusted without de-energising the wind- ing.Conventionally,the tap changing is achieved by a manual tap changer,but with the advancement of technology,this has been automated.

Automated tap changing mechanism provides better control and reduce the losses associated with the conventional tap changing mechanism.Taps can be provided in either of the windings but are usually provided in high voltage(low current) windings,for easy access and to minimise current load during operation.

Due to the penetration of the distributed energy resources the utility grid is prone to more power quality issues like volt- age fluctuation.In order to provide an uninterrupted suply to the consumers,the voltage in the output side of the transformer must be maintained as constant.For this we require automated tap changing mechanism.

II. AUTOMATIC TRIAC BASED ON LOAD TAP CHANGER

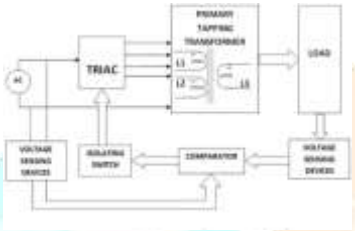

Fig. 1. Block Diagram of OLTC.

The potential transformer connected across the supply volt- age are designed to provide negligible load to supply being measured to have an accurate voltage ratio and phase rela- tionship to enable accurate secondary measurement. As the voltage is much higher potential transformer is required to scale it to a lower range.

Both the voltage signals are passed through a bridge rectifier and filter capacitor to convert the ac signal into a pure dc signal. The rectifier output is scaled to a lower voltage value ie, 5 V using a voltage divider ,input and output is measured seperately and both the signals are given to ports A0 and A1 in the arduino board. These measured values are displayed in the LCD display as ports A4 and A5 of arduino are connected to 16*2 LCD display.

The arduino board act as a comparator which compares the output voltage with the set reference value and if there is any change in the value of output voltage from the set reference value then the arduino processes to make the output voltage approximately constant.This is done by the arduino board which in turn control the triac switches through an optocoupler.

The tappings from the high voltage side of the transformer is connected to the gate terminal of the appropriate traics which triggers the particular triac.The MT2 terminals of all the triacs are provided with a common neutral from the potential transformer. The MT1 terminal of the triacs are connected to the arduino board through an optocoupler which provides the required electrical isolation between triac and the arduino board which is used as the comparator in the circuit.

The arduino board is programmed in a way that it triggers the appropriate triacs for each tapping. It triggers the triac only for the set voltage at each tap. When there occurs a change in the output voltage of the transformer due to load variation Arduino detects the error and change the tap accordingly to regulate the voltage as approximately constant.

A. Triac

Triacs are widely used in power electronics applications. They are capable of switching high levels of voltage and current, and over both parts of an AC waveform. This makes triac circuits ideal for use in a variety of applications where power switching is needed.Triacs are mainly used for low to medium power applications.The triac switching action occurs on both halves of an AC waveform means that for AC power applications, the complete cycle can be used. For basic thyristor circuits, only half the waveform is used and this means that basic circuits using thyristors will not utilise both halves of the cycle. Two devices are required to utilise both halves. However the triac only requires one device to control both halves of the AC waveform.

The triac is a three terminal, four layer bilateral semiconductor device. It incorporates two SCRs connected in inverse parallel with a common gate terminal in a single chip device.it has six doped regions. The gate terminal G makes ohmic contacts with both the N and P materials. This permits trigger pulse of either polarity to start conduction. Since the triac is a bilateral device, the term anode and cathode has no meaning, and therefore, terminals are designated as main terminal 1. (MT 1), main terminal 2 (MT 2) and gate G.

B. Optocoupler

Transformers isolate the primary input voltage from the secondary output voltage using electromagnetic coupling.OPtocoupler is used to obtain electrical isolation between an input source and an output load .This device allows you to transmit an electrical signal between two isolated circuits with two parts: an LED that emits infrared light and a photosensitive device which detects light from the LED. Both of these parts are contained within a traditional black box with a pair of pins for connectivity. At a glance, its easy to mix up an Optocoupler with an integrated circuit .It prevent high voltages from affecting the system receiving the signal.

III. SYSTEM IMPLEMENTATION

Basically, the system consists of a transformer with taps, a potential transformer for supplying working voltage to the Arduino and to measure the supply side voltage.The Arduino senses any variation in input voltage and trigger the suitable triac. The high voltage side of transformer is isolated from low voltage side of Arduino by an optocoupler.The input side and output side voltages are displayed in the LED display and the present tap position is also displayed.

Fig. 2. Hardware Setup of Triac Based OLTC.

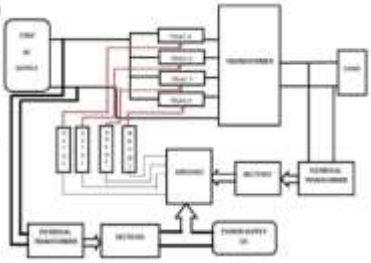

Fig. 3. Circuit Diagram of OLTC.

CONCLUSION

In conventional system,as we are using mechanical type onload tap changer having drawbacks like arcing, high maintenance,high service cost, losses in switching, slow response time of mechanical taps. These factors cause several disturbances and fluctuations in the power system reducing the stability and reliability of the system. In our system as we use Triac devices. There are no mechanical losses, reduced arcing problems, faster switching response,thus increasing the

reliability and stability of the system. Triac are used as main- tenance cost is almost low. In our system optocoupler triggers the appropriate Triac for change in the suitable tapings of the primary tapped transformers improving the power quality and stability of the system thus giving a quick response time than the traditional mechanical tap changers. Any variation in the output voltage or input voltage of the transformer is sensed by the voltage sensing device and the appropriate Triac and the tap will get selected. As a Triac is a static device and it has several advantages, thus it is used instead of other switching devices

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