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Design and Implementation of Thyristor Switched Capacitor for Reactive Load

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***Abstract**: This paper deals with design and implementation of thyristor switched capacitor for voltage regulation and reactive power compensation. Thyristor switched capacitor based static VAR compensator has been proposed for single phase system at static and dynamic load conditions. In this scheme capacitor values are chosen in different ranges. Excessive inductive reactive powers absorb by thyristor switched capacitor and maintain voltage stability. The effect of TSC based SVC on load voltages are also analyzed. Experimental results shows substantial improvement in voltage regulation and reactive power compensation is achieved by TSC compensator.*

***Keywords**: Thyristor Switched Capacitor (TSC), Reactive power compensation, Voltage sag, Closed loop control*

I. INTRODUCTION

In any power system due to the presence of inductive load their is reduction in the voltage profile .Then the voltage stability is lost by the inductive load when reactive power is active. now a days there is increased demand for consumption of electrical power. When the system is not affected by the overloads then the system is known as reliable. Their should be constant voltage with loss in power be less. Compensation of the overload conditions should be done by using appropriate compensators. Shunt compensation and Series compensation are mainly two types of compensations. In shunt compensation the line is injected with the reactive power, so the amount of reactive power supplied by source is reduced. It changes the receiving end voltage as it can be a direct acting method. The power is improvement is done. In this paper, shunt compensation method is used with the FACTS controller. Thyristor Switched Capacitor is a FACTS controller used. Depending on the loading conditions TSC is connected and disconnected and the reactive power is compensated.

II. THYRISTOR SWITCHED CAPACITOR (TSC)

Thyristor switched capacitor is a ON & OFF to a line through a pair of anti-parallel thyristors. The basic circuit is shown in Fig. 1 But this is not the actual circuit which is implemented. A thyristor switched capacitor (TSC) is a type FACTS device used for compensating reactive power in electrical systems. It consists of a bidirectional thyristor valve is connected in series with capacitor and, usually, a current limiting reactor (inductor). When the current flow through the thyristor controlled resistance it will different from the maximum to zero by varying the firing angle α. The α is denoted as a firing angle point at which the voltage will become positive and the thyristor will become on & there will be current flow.

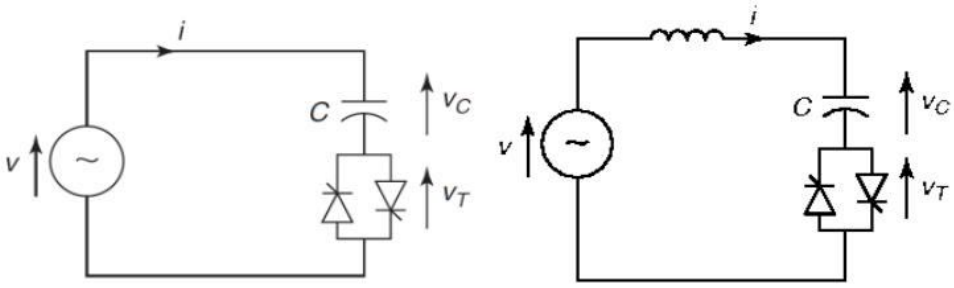

Fig.1. Basic & Actual Circuit of TSC

In a circuit connecting a capacitor in parallel to the line will inject the reactive power of the system which in result in power factor improvement and voltage compensation. This effect will improve the power quality and power factor and hence will make

the system reliable. Any kind of harmonics is not injected by using TSC as FACTS controller . The power transfer can be increased accordingly if rated current is to be taken from supply.

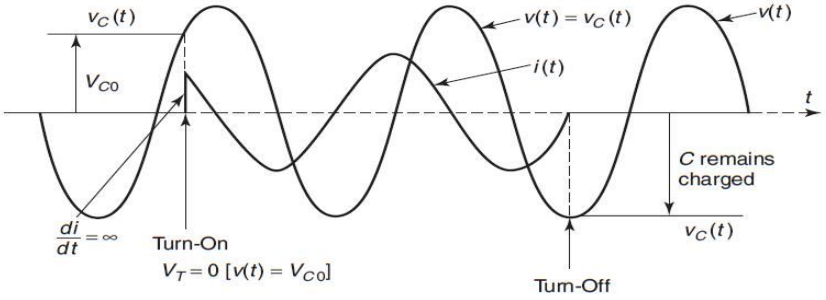

Fig.2. Waveform of TSC

III. SYSTEM MODELLING

This circuit consists of DC power supply unit, , Micro-controller, zero voltage crossing detectors ,opto-isolator, LCD display SCR and Capacitor. The required DC power supply for Micro-controller and other is supplied by the DC power supply. For the calculation of the power factor and reactive power by the Micro-controller we need voltage signals and current signals. The voltage signal taking from converted into pulsating DC by bridge rectifier and is given to a comparator. it generates the digital voltage signal. Similarly the current signal is converted into the voltage signal by current transformer of the load current across the line.

This Analog ac signal is converted into digital signal as done for the voltage signal. Then these digital voltage signal and current signal are given to the micro-controller. The micro-controller calculates the time difference between the zero crossing points of current and voltage, which is directly proportional to the power factor and it determines the range in which the power factor is. Micro-controller sends information regarding time difference between current and voltage and power factor to the LCD display to display them. Depending on the range it sends the signals to the opto-isolators that in turn switch ON back to back connected SCRs (power switches) to bring the capacitors in shunt across the load. Thus, the required numbers of capacitors are connected in parallel to the load as required. By this the power factor will be improved.

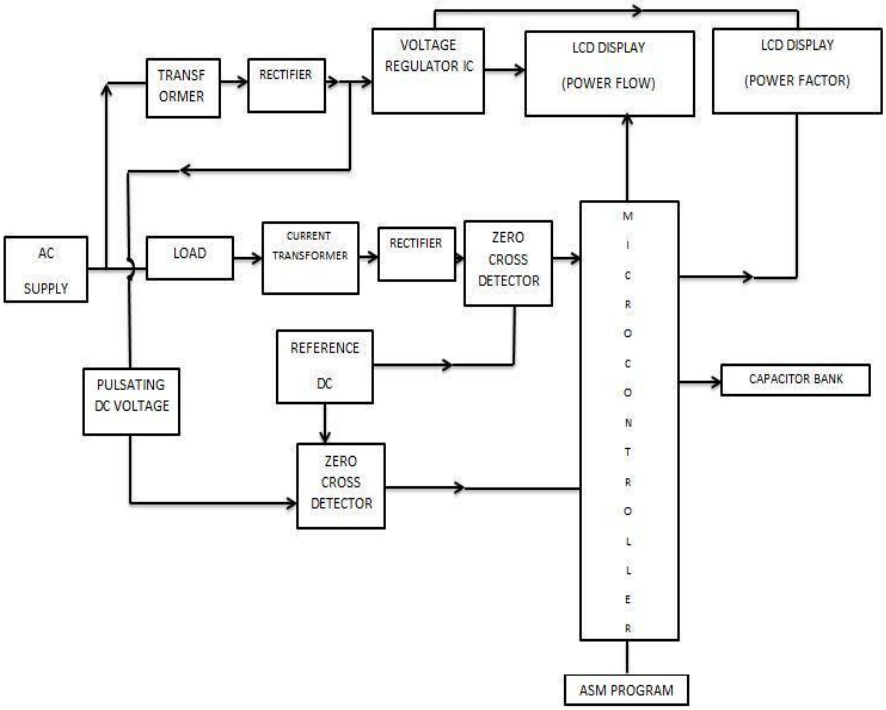

Fig. 3: Block diagram of reactive power compensation using Thyristor Switched Capacitor.

IV.CLOSED LOOP CONTROL OF THYRISTOR SWITCHED CAPACITOR

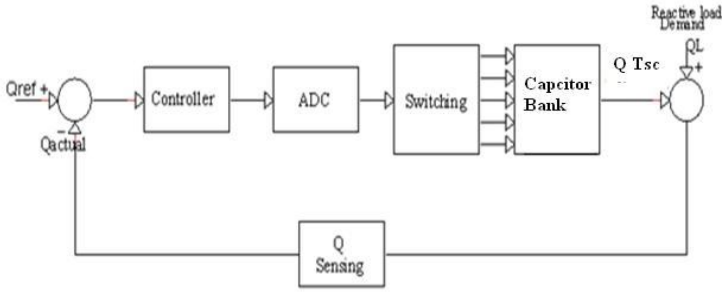

Fig.4.Block Diagram of Closed Loop Control

The closed loop circuit senses the voltage sag, compares it with the reference value, and if it is found lesser than the reference value then start the TSC module hence the compensation which increases the voltage instantaneously.

When switching the capacitors, precautions must be taken to ensure that the rated current is limited to a non-destructive value. The right capacitor switching device is a key to reliable and trouble free capacitor bank performance. This proposed method is to present a solution for capacitor switching based on controlled voltage semiconductor switches which have a large number of operations, and capable of reducing voltage transients and switching and rated current.

The thyristor switches the capacitor quickly when the difference between capacitor voltage and system voltage equals to zero. Capacitors gets switch ON when a current reaches to zero value of supply voltage. This is carried out by ZCD circuit; Due to this the transient occurrence at the instant of switching of capacitor is avoided.

V. CONCLUSIONS

The work in this paper deals with the analysis, design and implementation of thyristors switched capacitor. The TSC bank is proposed for the reactive power compensation and voltage regulation. In this paper the switching of capacitor is transient free and it does not inject any harmonics into the system. The closed loop control continuously monitors the voltage at receiving end and it switch ON the TSC bank as per requirement of reactive power. The TSC in the system caused to improve reactive power, voltage profile and power factor. This serves the purpose of a reliable power system, that receiving end voltages should not be changes in spite of load changes. The system is continuously monitored for voltage and frequency changes.

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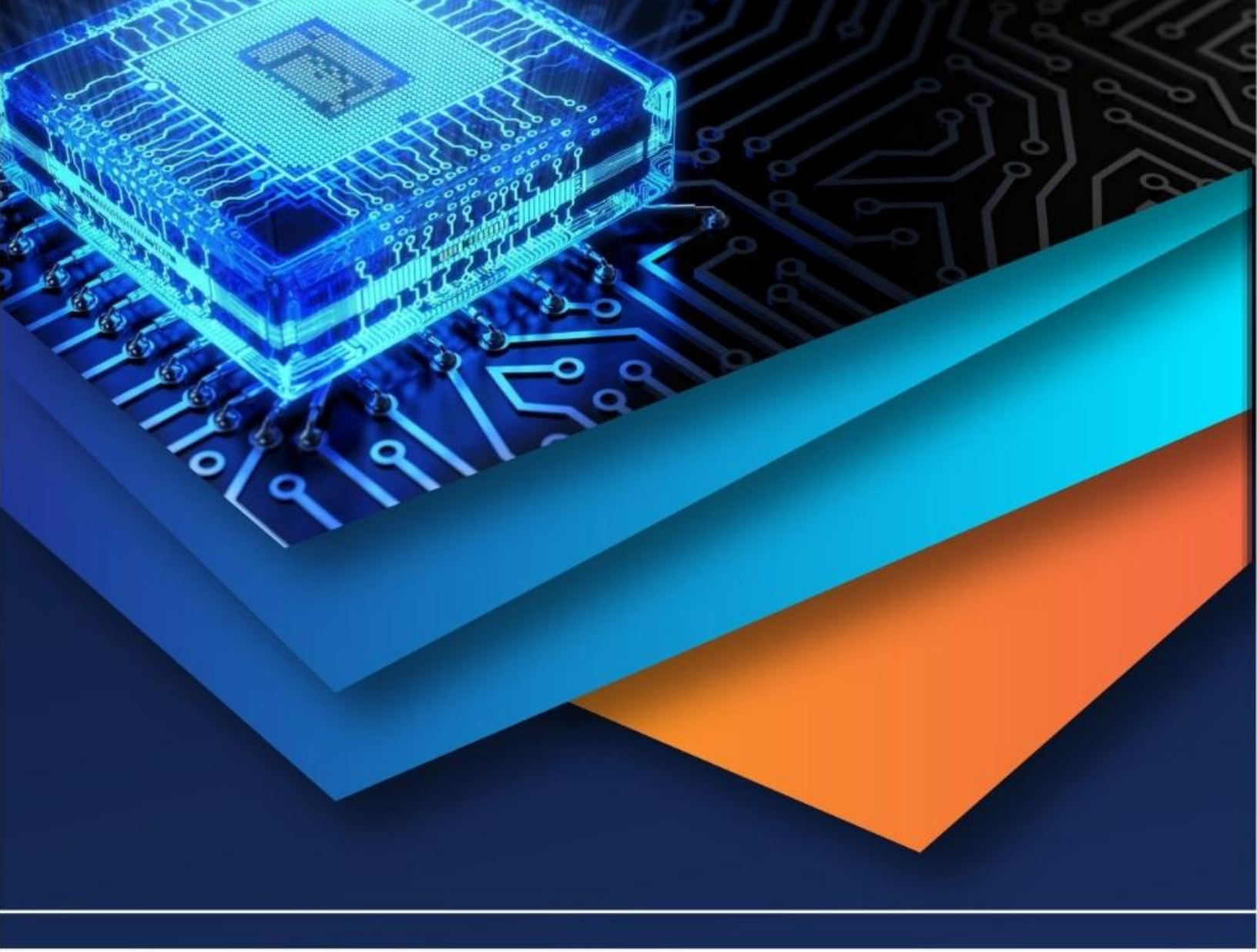

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