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Reactive Power Compensation by Facts Thyristor Switched Reactor (TSR) Using Microcontroller

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Abstract— **The scheme is designed to implement FACTS by TSR (Thyristor Switched Reactor) which is controlled by microcontroller This method is used either when charging the transmission line or when there is very low load at the receiving end. Due to very low or no load, very low current flows through the transmission line and shunt capacitance in the transmission line becomes dominant. This causes voltage amplification (Ferranti Effect) due to which receiving end voltage may become more than the sending ends voltage and power factor also reduce near to the zero leading (generally in case of very long transmission lines). To compensate this, shunt inductors are automatically connected across the transmission line. Shunt reactor decreases the receiving end voltage to the normal sending end value and also maintain the power factor nearer to the unity.**

Index Terms*— *FACTS by TSR, Reactive Power compensation, Microcontroller

I. INTRODUCTION

Modern power systems are designed to operate efficiently to supply power on demand to various load centers with high reliability.In addition to transmission lines that carry power from the sources to loads, modern power systems are also highly interconnected for economic reasons.

The problem due to the reactive power is most importantly, we pay for reactive power in the form of energy losses created by the reactive current flowing in home. These losses are in the form of heat and cannot be returned to the grid.The FACTS is a concept based on power electronics controllers, which enhance the value of transmission networks by increasing the use of their capacity. As these controllers operate very fast, they enlarge the safe operating limits of a transmission system without risking stability.[1]

FACTS system is more efficiently used in A.C. transmission power system. FACTS means flexible A.C. transmission system, in which capacity of transmission of power and control is increased by making use of power electronics and other static controller.As these controllers operate very fast, they enlarge the safe operating limits of a transmission system without risking stability.

FACTS devices can be effectively used for power flow control, load sharing among parallel corridors, voltage regulation, and enhancement of transient stability and mitigation of system oscillations.

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II. ILLUSTRATION

A basic single phase TSR (Thyristor switched reactor) comprises an anti-parallel connected pair of thyristor valves, T_1 and T_2, in series with a linear air core reactor, as illustrated in figure . The anti parallel connected thyristor pair acts like a bidirectional switch, the thyristor valve T1 connecting in positive half cycles and thyristor valve T2 connecting negative half cycle of the supply voltage. The firing angle of appearing across its terminals.

The TSR is a special case of TCR in which the variable firing angle control option is not exercised. Instead, the device is operated in two states only, either fully on or fully off. If the thyristor valve are fired exactly at the voltage peaks corresponding $\alpha = 90^0$ for the forward thyristor valve T_1 and $\alpha = 270^0$ ($90^0 + 180^0$) for the reverse thyristor valve T_2, as depicted in fig. full conduction results. The maximum inductive current flows in the TCR as if the thyristor switches were replaced by short circuit. However, if no firing pulses are issued to the thyristors, the TSR will remain in a blocked-off state, and no current can flow[1]

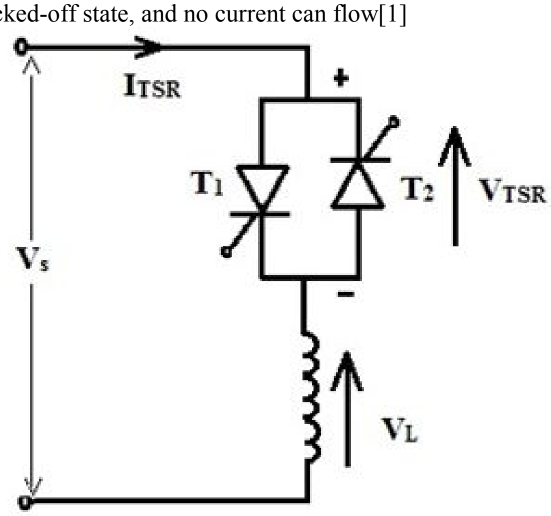
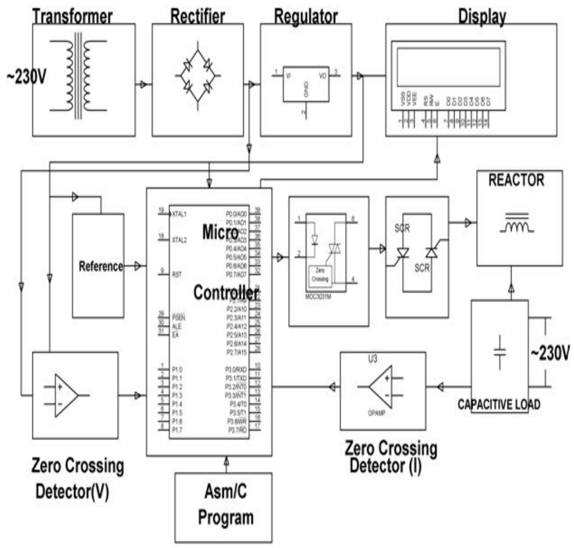


Fig. Single phase TSR.

The TSR ensures a very rapid availability of rated inductive reactor power to the system. When a large magnitude of controlled reactive power, Q is required, a part of Q is usually assigned to a small TSR of rating, say Q/2; the rest is realized by means of a TCR also of a reduced rating Q/2. This arrangement results in substantially decreased losses and harmonic content as compared to a single TCR of rating Q.[1]

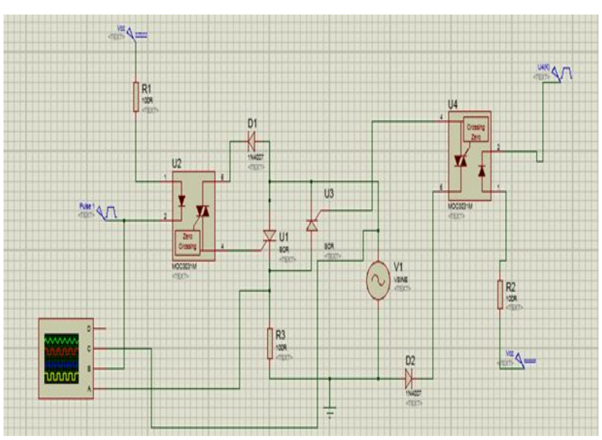
III. BLOCK DIAGRAM



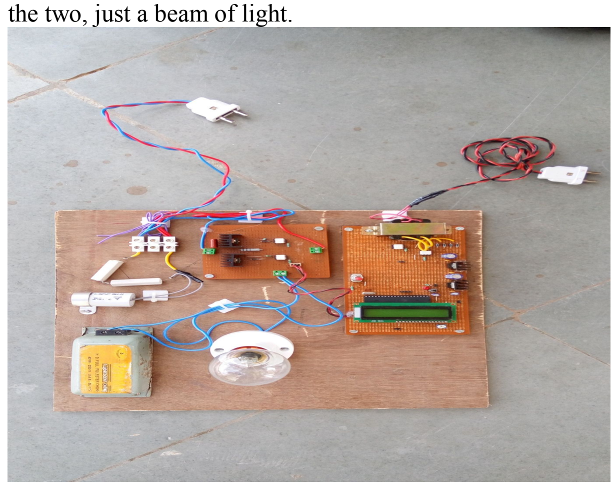
This circuit consists of DC power supply unit, zero voltage crossing detectors, Micro-controller, LCD display, opto-isolator, SCR and Capacitor. Let us see how it operates. The required DC power supply for Micro-controller and other peripherals is supplied by the DC power supply.

For the calculation of the power factor by the Micro-controller we need digitized voltage and current signals. The voltage signal from the mains is taken and it is converted into pulsating DC by bridge rectifier and is given to a comparator which generates the digital voltage signal. Similarly the current signal is converted into the voltage signal by taking the voltage drop of the load current across a resistor of 10 ohms. This A.C signal is again converted into the digital signal as done for the voltage signal. Then these digitized voltage and current signals are sent 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 inductor in shunt across the load. Thus inductor are connected in parallel to the load as required. By this the power factor will be improved.

IV. HARDWARE MODEL AND CALCULATION



Above figure show the SCR firing circuit simulate on the software. Opto-isolators, or Opto-couplers, are made up of a light emitting device, and a light sensitive device, all wrapped up in one package, but with no electrical connection between the two, just a beam of light.



From hardware here use capacitor for voltage magnification and due to these voltage increase about 10% of normal value and power factor during these period is 0.01 and then inductor used as a 40 Watt choke so the reactive power due to capacitor is compensated by thyristor switch reactor here used tube light choke and voltage decreases and power factor also increases up to 0.71

CONCLUSION

From above information we can find value of inductance (L), hence this value are used to compensate the capacitive effect (Ferranti effect) in system. Hence the system are become flexible and voltage amplification are compensate. And power factor improve here improve power factor from 0.01 to 0.7

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