

## International Journal of Innovative Research in Science, Engineering and Technology

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# Reduced Total Harmonic Distortion by Using FC TCR at various Time Period to Operate Thyristor

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**ABSTRACT:** This paper deals with simulation of reduced THD (%) of power quality of fixed capacitor thyristor controlled reactor system. The FC TCR system is simulated using MATLAB and the Time Vs Current simulation results are presented. The simulation results are presented. The current drawn by the TCR varies with the variation in the firing angle and time period. The simulation results are compared with the theoretical results.

**KEYWORDS:** Power Quality, FC TCR, MATLAB, Simulink, Total Harmonic Distortion

## I. INTRODUCTION

In present circumstances the used of semiconductor switching devices is becoming more important in a various ranges of applications in power supply networks, domestic and Industrial loads. In such applications commonly used in adjustable-speed motor drives, diode and rectifiers, uninterrupted power supplies, present nonlinear operational characteristics, these devices bring in disruption to voltage and current waveforms at the nonlinear industrial loads. The thyristor controlled reactors of a variety of network configurations that are commonly used in industries and all other power systems for harmonic reduction and dynamic power factor improvement. This thyristor operated reactors are operate as a variable reactance in together the inductive and capacitive domains For the bidirectional power supply applications system, for this the current supply converter is modeling and simulated with nonlinear types RL load. The required modeling and simulations are carrying out in MATLAB software using SIMULINK and power system block. The performance of different configurations of switching on power quality is studied throughout. In this paper we have analyze the THD (%) of FC TCR at different time period of operation Thyristor.

## II. POWER QUALITY

Power quality can be defined by the reactive power, harmonics and load unbalance. The best ideal electric supply will be sinusoidal voltage waveform through constant magnitude and frequency but into the practical due to the greater than zero impedance of the power supply system the large range of loads can be encountered and other phenomena that is transients and outages, the actuality is often different. If the power quality of network will be good then any load connected to the network will be reliable and efficient.

In AC power supply, the current is usually phase shifted in the source voltage. The active power  $P$  [KW], it's responsible for the useful work, which is related with the fraction of the current which is in phase to the voltage. The relation between the dynamic power and the apparent power is referred to as the power factor ( $\cos\phi$ ) and is a measure of efficient utilization of the electrical energy. Unity power factor ( $\cos\phi$  equals to one) refers to the more efficient transfer of positive energy. A  $\cos\phi$ , which is equals to zero refer to the more inefficient way of transferring the energy.

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## III. TOTAL HARMONIC DISTORTION (%)

Harmonic distortion is mainly component power quality which effects on the power quality at variation in load and operating time of power electronic switches (like Thyristor, MOSFET and IGBT) in FC TCR. Harmonic distortion is defined as the Total Harmonic Distortion (THD) which is the ratio of summation of all harmonic substances to the fundamental.

$$\text{THD} = \frac{\sqrt{V_2^2 + V_3^2 + V_4^2 + \dots + V_n^2}}{V_1}$$

$$\text{THD} = \sqrt{\sum_{i=2}^n V_i^2}$$

Where  $V_i$  is  $i^{\text{th}}$  harmonic component of the signal  $V$ .

The THD is mainly contain in a favor of rated voltage. Harmonic has some major effects on electric power quality problems that may become entire system paralyses.

## IV. FC TCR (FIX CAPACITOR THYRISTOR CONTROL REACTOR)

The FC-TCR provides continuously controllable lagging to leading VAR through thyristor control of reactive current. The configuration of the FC-TCR type SVC is shown in fig. (1).

- I. Fixed capacitor that provides a permanently connected source of reactive power.
- II. Thyristor Controlled Reactor that consist of bi-directional thyristor valves in series with shunt reactor, usually connected in delta configuration.

Fix Capacitor is reducing the voltage drop due to voltage profile increases. Therefore fixed value of capacitance added in transmission line. The fix capacitor banks which are usually connected in a star configuration are split in to more than one 3-phase group. Each capacitor contains a small tuning inductor connected in series and act as a filter for a specific harmonic order. The schematic diagram of a fixed capacitor thyristor controlled reactor is shown in figure1.

Normally, Thyristor Control reactor (TCR) provides continuously controllable reactive power in a lagging power factor range. A fix capacitor bank is shunt connected with TCR. TCR MVA is rated larger than the fix capacitor to compensate. The capacitive MVA is provide net inductive-reactive power should lagging power factor operation be desires.

A shunt connected, Thyristor Control Inductor with which effective reactance is varied in continues manner by partial conductor controlled of the thyristor. TCR is a subset of in which conduction time and hence, current in a shunt reactor is controlled by thyristor based ac switch with firing angle control.

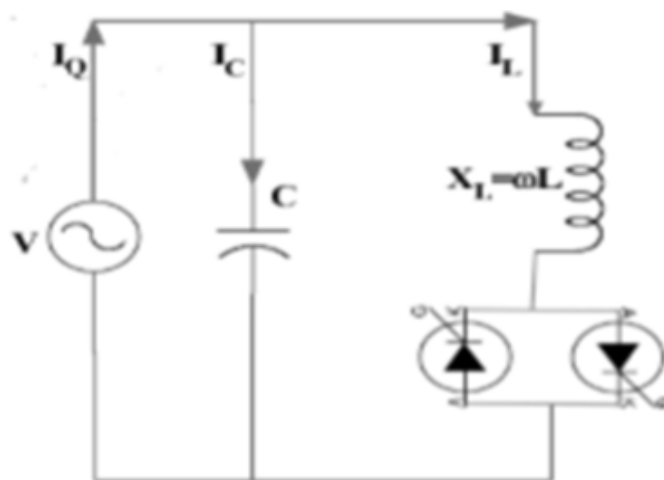


Fig. 1: Circuit of FC TCR

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### V. V – I CHARACTERISTIC OF FC TCR

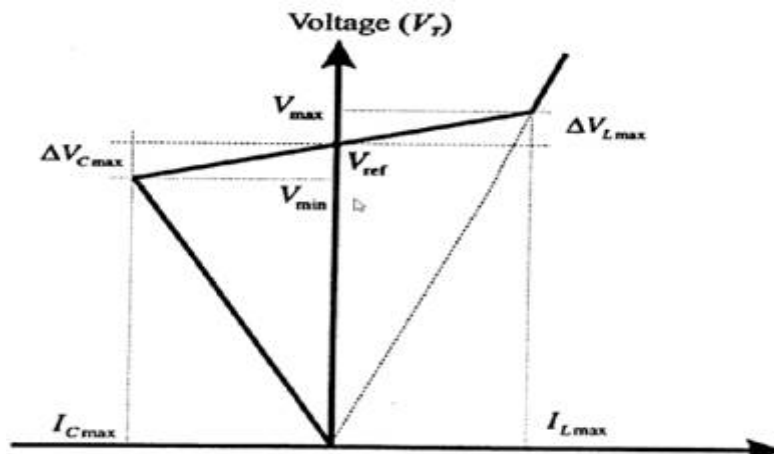


Fig.2 V-I characteristic of FC TCR.

In Fig.2 the voltage defines the V-I operating area of the FC-TCR is defined by the peak attainable capacitive and inductive admittance and VAR generator and current rating of the power components (capacitor, reactor, and thyristor valve). To reduce the capacitive output, the current in the reactor is increased by reduced delay angle  $\alpha$ . At zero VAR output, the capacitive and inductive currents become similar and thus both the VAR cancels out. With further reduce of angle  $\alpha$ , the inductive current becomes larger than the capacitive current, resulting in a net inductive output.

The voltage at which the static compensator neither absorbs nor generates reactive power is the reference voltage ( $V_{ref}$ ) (figure 2). Practically, this reference voltage can be adjusted within the typical range of  $\pm 10\%$ . The slope of the characteristic represents a variation in voltage with compensator current and therefore, can be taken as a slope reactance  $X_{SL}$ .

### VI.SIMULATION OF FC TCR

For simulation, a single phase AC voltage source is of 240 volt, 50 Hz is taken. The parameters are R, L and C is  $1\Omega$ , 1mH and  $50\mu F$  respectively. The real power and reactive power in the load is measured using the Active & Reactive Power measurement Block. The current is measured by Current measurement Block after that performing FFT analysis at various time period to operate thyristor. Here, time period is taken between  $0 < t < 0.02$  and firing angle is  $180^\circ$ .

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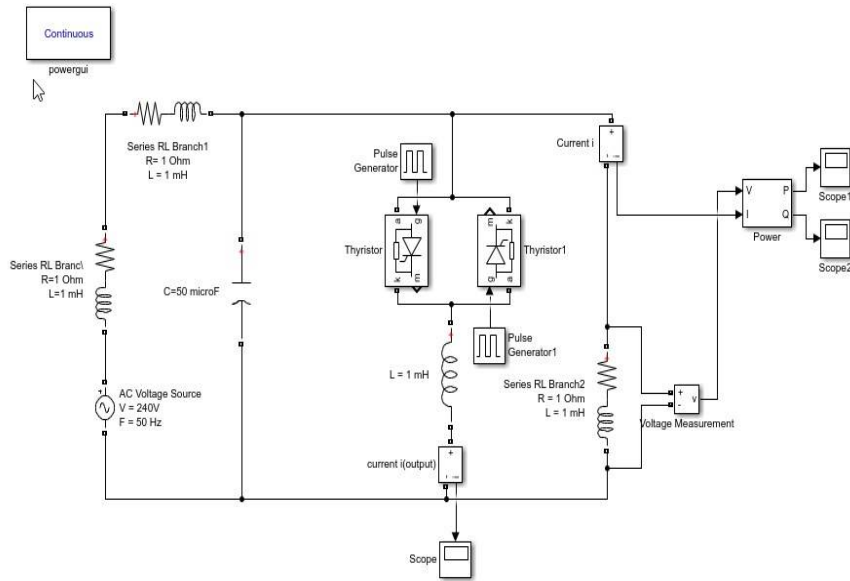


Fig. (3): Simulation Model of FC TCR

## VII.SIMULATION RESULT

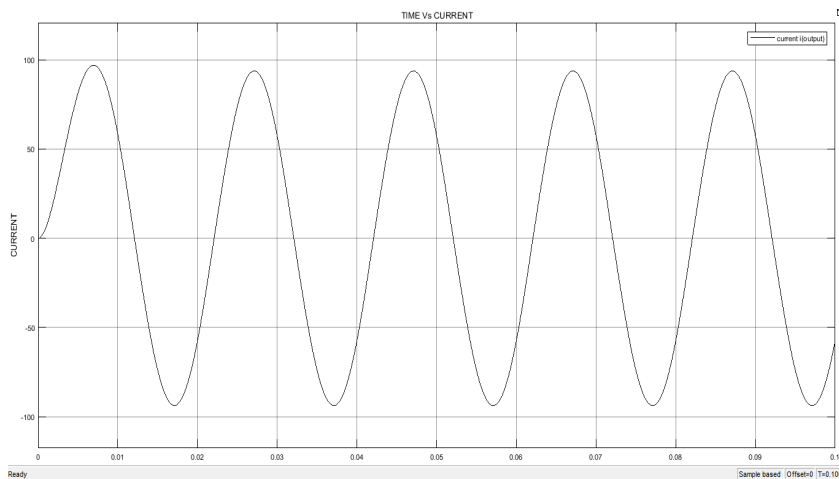


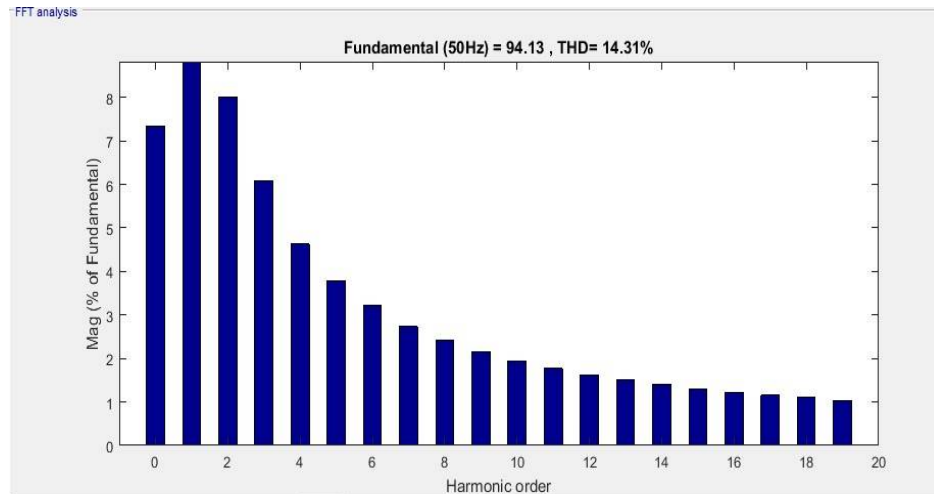
Fig. (4): Time Vs Current waveform of FC TCR

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**Fig. (5): THD (%) of FC TCR**

**Table: THD (%) in FC TCR at Different Time Period (t).**

Time Period (t) $0 < t < 0.02$	THD (%)
Thyristor = 0 Thyristor1 = 0.005	14.43%
Thyristor = 0 Thyristor1 = 0.01	14.31%
Thyristor = 0 Thyristor1 = 0.015	26.35%
Thyristor = 0 Thyristor1 = 0.02	34.84%

### VIII. CONCLUSION

From the above simulation and its result The FC TCR is able to compensate Total Harmonic Distortion and Power factor. It can also increase stability, Reliability and continuity of the power system. The simulation result indicate the

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saying. It can be steady for the most effective way improving power quality, but at operating thyristor at different time period we can't reduce 100% Total harmonic Distortion.

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