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A Modernistic Technique of Power Quality Enhancement for Low Voltage Distribution System

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Abstract—*Today low power factor and poor power quality is the two major problems in the industries as well as in the domestic area. Due to this, the efficiency of the power system is decrease and also power losses are increase. And also reactive power is escalate in the whole system. Due to escalate of reactive power, sometime whole system gets black out. This paper presents the inexpensive technique to improve the power factor as well as power quality. In this technique a simple series RLC filter is modulated that work as FACT devices. Its construction is simple than ordinary fact device. A novel technique tri loop error control is used with the controller which decreases the steady state error and gives the stable result. By application of this technique, THD of the system also decreases and improve the power quality of the power supply for linear and nonlinear load.*

Keywords*:-Low Voltage , linear load, nonlinear load , RLC filter , tri loop error control tecq.*

1. INTRODUCTION

Today poor power quality is the latest issue in all the sector like commercial, industrial, domestic etc. due to low power quality efficiency of the system is decrease. That's whythe losses in the system is increase that decreases the efficiency of the system. In good power quality we consider the good power factor, fewer harmonic; less THD etc. this entire factor is depend upon which type of load connected with the system. In case of nonlinear load power factor of the system is low and generate the harmonics in the system. In the industrial/commercial sector today hybrid nonlinear load is apply like lightning, motorized, computers, arc type etc. and all these type of load is causes the low power factor. In the industrial process due to rectifiers, power supplies and motorized loads causing the voltage flickering, low power quality and waveform distortion. [1-2]

For improvement of power factor we used the capacitor bank and auxiliary motor device but it is not effective in case of harmonics and gives the solution of low power quality. For both solutions we used the passive filter and active filter. But it is not capable the large problem of poor power quality.[3-4] So that's why we used the FACT devices for improvement of power quality. But its construction is complicated. This is expensive for small distribution system. So that to remove these entire drawback we used the simple RLC filter. It is modulated as like a FACT device and it's also works as a FACT device. Its construction is shown in Fig. [1].

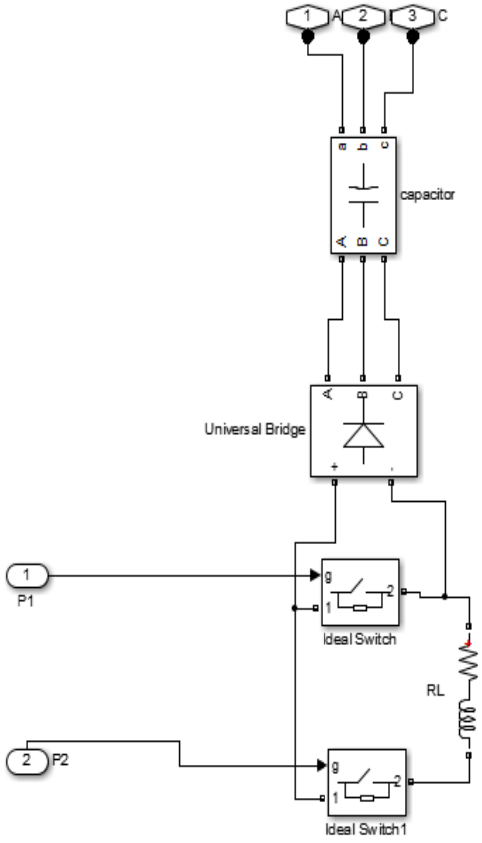

Fig. 1: Modulated RLC filter

2. SYSTEM DESCRIPTION

The Fig. 2 shows the sample study low voltage distribution system using the 3 phases 3 wires for a residential buildings, commercial load centers and industrial. It is with nonlinear and linear loads. The error control tri-loop technique width controller is shown in Fig. [3]. And modulated filter as show in Fig. [1].

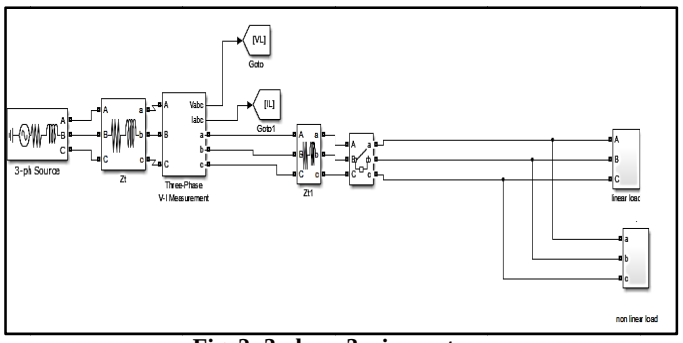

Fig. 2: 3 phase 3 wire system

3. CONTROL STRATEGY

The load voltage and load current are controlled with a tri-loop error control technique. These tri-loop error control technique calculate the errors of RMS load voltage and, RMS load current and transmitted power in the system as shown in Fig. [4].

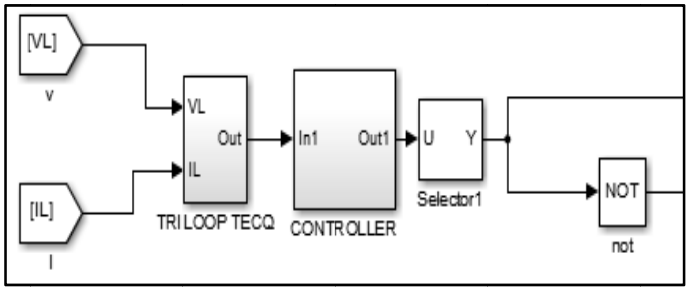

Fig. 3: Controlling scheme

These three loops, is used for improve power factor, improve reactive and apparent power and also reduce THD. So that it improve the overall efficiency of the system.

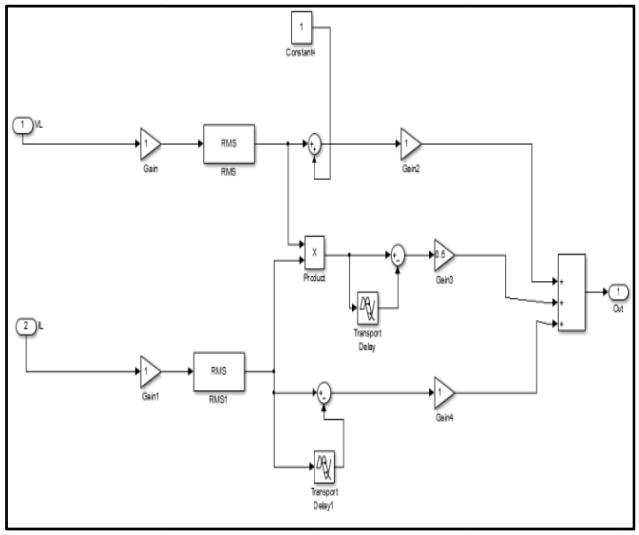

Fig. 4: Tri loop error control technique

Loop 1 is used as like a main loop for the steady state error of the RMS Load voltage on the load side and this control signal weight (γV) is 1.

Loop 2 is used for the steady state error of the RMS load current on load side and its weight (γI) is 0.5.

Loop 3 is used for the steady state error for power and the weight (γP) is 1.

The total error signal of the tri-loops is passed through a PID controller for the angle order and it is converted into degrees. Than this phase order is given to discrete PWM generator through saturation and firing circuit to arrange the sequences of ideal switches. This tri-loop error controller is used for power factor improvement, reduce the distortion and reactive compensation using Matlab-Simulink and Sim-Power Toolbox software environment.[5-8]

4. DIGITAL SIMULATION RESULTS

This modulated RLC filter device is more effective and inexpensive for power quality enhancement. It is the solution for improving the power factor, reactive power compensation and harmonics reduction using the low cost modulated tuned arm RLC power filter. Matlab Software was also used to designing and testing the effectiveness of modulated device.Various results are obtained in case either filter connected or not.

The Matlab/Simulink/Sim-power digital simulation of the sample study system model at load condition and improve the results with modulated RLC filter scheme. Fully digitalSimulation results are shown in Fig. 5 to Fig. 13.

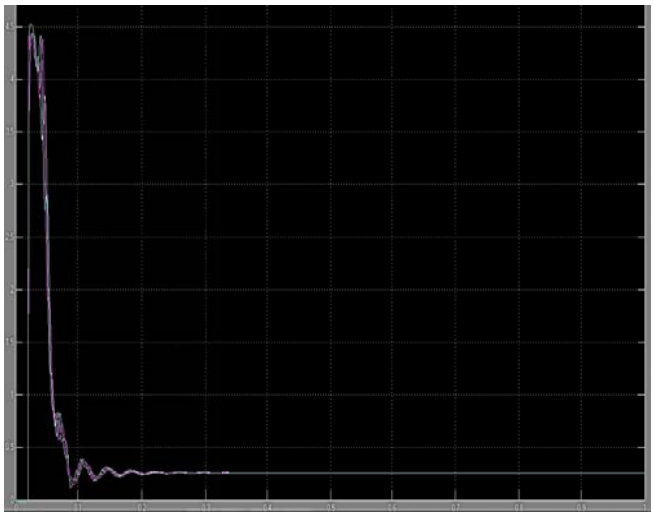

Fig. 5: Active power without filter

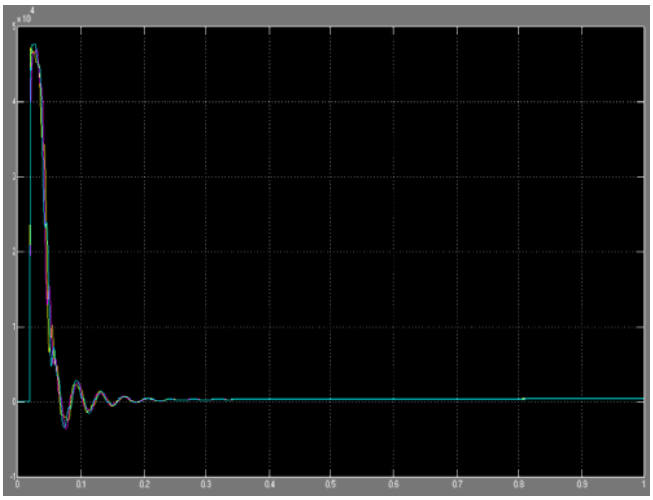

Fig. 6: Active power with filter

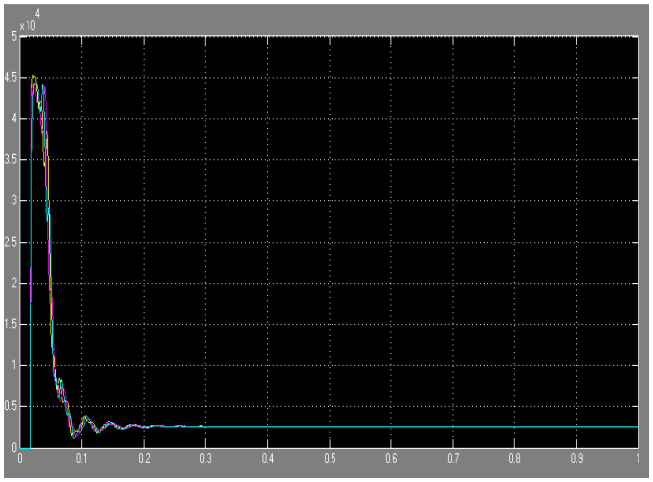

Fig. 7: Reactive power without filter

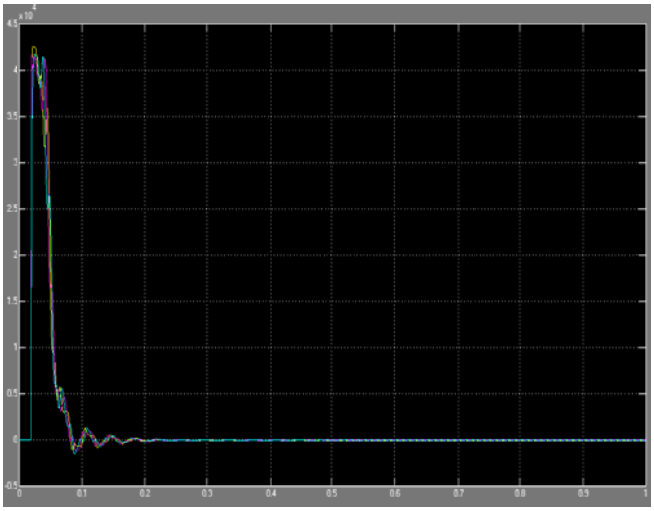

Fig. 8: Reactivepower with filter

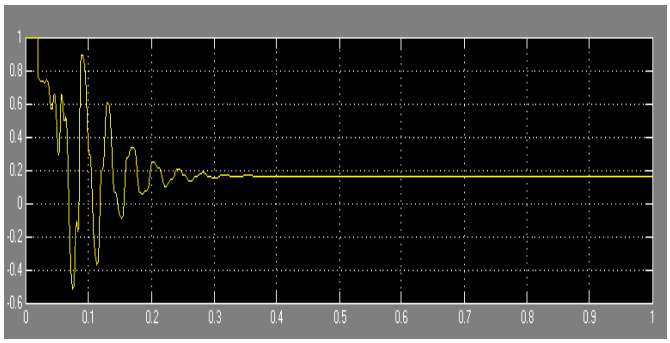

Fig. 9: Power factor without filter

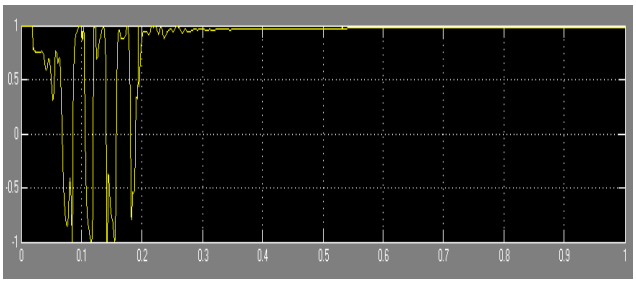

Fig. 10: Power factor with filter

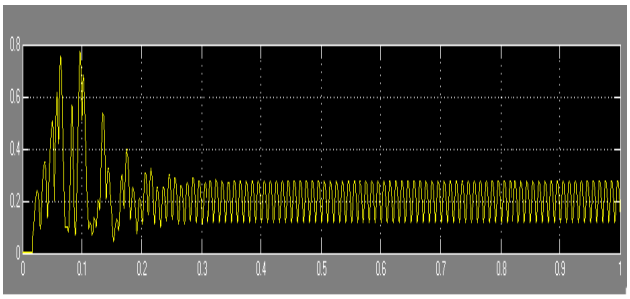

Fig. 12: THD without filter

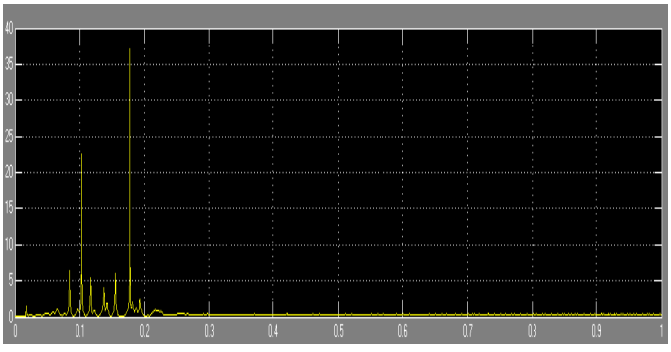

Fig. 13: THD without filter

5. CONCLUSION

The paper presents a modernistic technique of power quality enhancement for low voltage distribution system. It is low cost

voltage compensation device. It regulates the steady state error by using tri-loop controller. It reduces the THD and improves the low power factor. It also compensates the reactive power in the system. That's why it reduces the possibility black out of the system. It increases the power quality of the supply in any commercial, industrial and residential sector. As a result, efficiency of the overall system is increase and all energy utilized by the load. Power quality can be greatly enhanced.

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