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Power Quality Improvement in 3-Φ Power System with Shunt Active filter using Synchronous Detection Method

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Abstract— *Research paper focuses on enhancement of the power quality, Harmonic reduction and Reactive power compensation . Power quality problems became the foremost important concern now a days. Active filters with synchronous detection methodologies are vividly employed in distribution system to be sure that the harmonics generated by non-linear loads is reduced and leads to less voltage distortion and leads to lesser power superiority problems. The three physical characteristics that mostly underline the power quality and a power quality issues are Voltage, Current and Frequency. Harmonics is defined as a disturbance demonstrated in current or voltage or frequency waveforms which result in devastation, or failure of final equipment ..This paper examines the control of Shunt Active Power Filter with Synchronous Detection Method . Simulation results using MATLAB SIMULINK demonstrates the application of these methods to the control of Active Power Filter . Moreover, this work shows that how the power quality improvement in 3 phase is done with Synchronous Detection Method .*

Keywords*— *Synchronous Detection, Active Power Filters, Nonlinear Load; Power Quality (PQ) , Simulink.

I. INTRODUCTION

The nonlinear loads and equipment within the consumer side and therefore the renewable energy sources within the generation side give birth to new problems in electrical systems. Then, power electronics appears as an important interface to enhance power quality [1]. Due to the increasing use of different nonlinear loads by the consumers the power drawn from the availability isn't of excellent quality. These loads inject current harmonics and also reduces input power factor. Current harmonics results in various problems like malfunctioning of sensitive equipment, feeder voltage distortions, overheating of distribution transformers etc. In order to avoid these problems, equipment like Custom Power Devices (CPD) which may suppress harmonics are needed. [2]. The active filters are often pure or hybrid active power filters. To reduce the disadvantages of passive filters and active filters and to possess the benefits of both the filters

II. ACTIVE POWER FILTERS

Active power filters are better than passive filters and can suppress supply current harmonics and also reactive power components .Active power filters consist of power electronic devices and can generate specific current components to reduce the harmonic currents caused by nonlinear loads. Active power filters are often connected serial also as in shunt to the nonlinear loads. Fig 1 indicate a three-phase shunt active power filter where the active filter is connected in parallel with the load. In this paper, a three-phase shunt active power filter is employed . The cost of shunt active filters is comparatively high, and that they aren't preferable for a large-scale system because the facility rating of the shunt active filter is directly proportional to the load current to be compensated. [4]

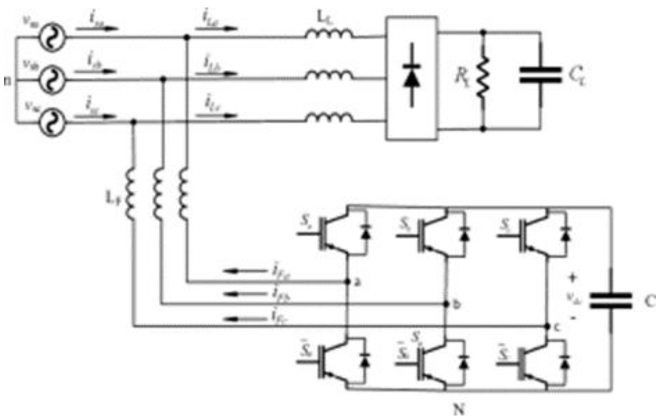

Fig.1 Three phase active power filter

III. SYNCHRONOUS DETECTION SCHEME

In instantaneous power theory, there's a requirement of a source that's balanced. But, in pragmatic distributions, it becomes hard to supply balanced voltages across the circuit. So, taking care of unbalanced sources with respect to harmonics becomes a challenge., The synchronous detection method is a scheme that works on phase by phase basis i.e. on every phase and calculations are done to obtain needed compensating parts.

Three different quite approaches that use same power, similar current, and using equal resistance conceptions within the synchronous detection scheme are discoursed. This method has various advantages like balancing unbalanced line parts, attaining near unity power factor, and getting obviate unwanted harmonics on the user end

IV. OVERVIEW OF PROPOSED WORK DONE

Many Journals and papers were studied. The associated problems in quality of power were examined from Reference [3]and [2], also from where the IEEE regulations pertaining to power quality were deduced. Reference[4], [5] and [7] provide information of the active power filters while assisting in making understand the demerits of passive filters as compared to active filters. Post that the mathematical analysis of the control methods was concluded. Active and reactive power compensation method(p–q method)analysis was concluded with citation from reference[3], [6], [8], [7] and [10]. Then the mathematical study of more highly developed technique of active and reactive current compensation method(id–iq method)was performed and its advantages over p–q method were analyzed with aid from reference[9],[11]and[12].Reference[13]was helpful for studying synchronous detection technique.

V. CONFIGURATION OF ACTIVE POWER FILTER

The passive devices also are a series inductor and capacitor set for reducing the power capacity of the power converter within the APF. However, the function of the series inductor and capacitor set within the proposed APF isn't an equivalent as that of the hybrid power filter APF. However, the function of the series inductor and capacitor set within the proposed APF isn't an equivalent as that of the hybrid power filter. The inductor of the series inductor and capacitor set is employed to filter the switching ripple thanks to switching operation of the facility - electronic devices utilized in the power converter, and therefore the capacitor of the series inductor and capacitor set supplies fixed compensation reactive power. The number of power-electronic devices employed within the proposed three-phase APF are often reduced. [3]. Power system quality is caused mainly by the use of constant growth of nonlinear loads, which essentially contain semiconductor devices [14]

VI. SYSTEM PARAMETERS

Table1 : System Parameter Values taken for simulation purpose.

AC Supply Voltage	220 V RMS
Fundamental frequency	f =50 Hz
Source Inductance	0.1 milli Henry
Load	R/L=8 Ω / 100 mH
DC bus capacitor	C=4 mF
Filter Inductor	L=1 mH

VII. SIMULINK MODEL

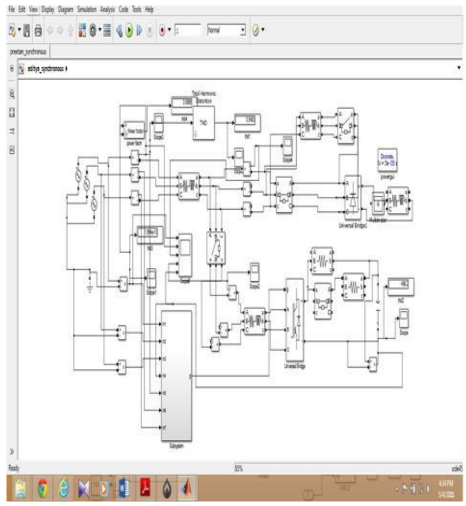

Fig.2 SIMULINK diagram of synchronous method active filter

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VIII. SIMULINK RESULT

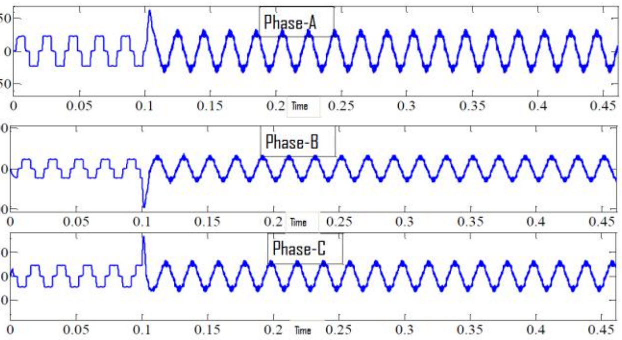

Fig.3 Output phase currents

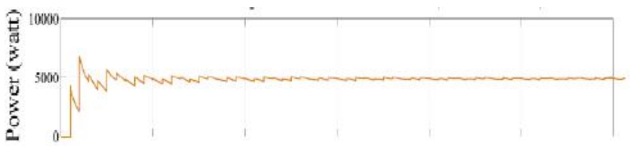

Fig.4 Power after compensation for load

IX. RESULTS

The model is developed and run in a MATLAB/SIMULINK tool to verify the results. The parameters are provided in Table 1. Simulation uses Butterworth Low Pass Filter of order four having a cut off frequency of 25 Hertz. The gross THD is found using d-q method using PI controller is 7.35%.

Then simulation is done for synchronous detection method.THD comes out be 9.4%. The application is additionally developed in a MATLAB/SIMULINK tool to prove the result.

X. CONCLUSION

A synchronous detection scheme and a filter based on the principle of id – iq compensation scheme has been calculated in this work. Also synchronous detection scheme is a application in SIMULINK. A mathematical study of p-q method as well as id – iq compensation method has been completed to assimilate the control schemes. As the id – iq compensation mechanism depends on a rotating frame resulting from mains voltages that doesn't incorporate phase locked loop and carries better-quality compensation results, simulation was done based on this control method. After considering balanced conditions the id – iq control scheme is found to have satisfactory harmonic compensation performance. Here the harmonics were produced by three – leg VSC and by the appliance of the Hysteresis controller. The control scheme illustrated vows for the operation of the Active Filter in changing frequency circumstances sans any adaptation. But the above method deals with only a balanced system, therefore synchronous detection method is employed to take care of unbalanced three phase systems. With reference to synchronous detection method, from the results and simulation findings, the projected synchronous detection scheme is aptly fit harmonic compensation during a system that's unbalanced.

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