IJDACR
ISSN: 2319-4863

IJDACR
International Journal Of Digital Application & Contemporary Research

International Journal of Digital Application & Contemporary research
Website: www.ijdacr.com (Volume 1, Issue 9, April 2013)

Implementation of Active Harmonic Filter with MATLAB/Simulink to compensate Non-Linear Loads

Smt. SmitaSinghai
smita_singhai@rediffmail.com
Prof. Bharti Dewani
Asst. Prof. DIMAT Raipur(C.G., India)

Abstract—**In this paper, the implementation of a shunt active power filter is given for three phase system is presented. The circuit models a standard shunt AHF with IGBT inverter and series inductor on the AC side and DC capacitor energization. The AHF uses a PLL to generate a reference sinusoidal source current which is in-phase and has the same RMS gain as the load current. The AHF aims to inject this current error at the point of common coupling in order to match the source current as closely as possible with the reference current.**

Keywords— **Shunt AHF, IGBT inverter, Series Inductor.**

I. Introduction

After a brief analysis performed on evolution of electric power consumption during the last two decades, it can be observed a change mainly on nature of electric power consumption and profile of consumers. The main causes are represented by introduction of new equipment and facilities to increase comfort in civil construction, new appliances and equipment in order to raise efficiency and diversification of production for industrial consumers, or coexistence in the same building of both households and some industrial consumers. We must also note the impact of the new sources of energy that can easily transform the consumer into power supplier. However, all these changes have led to the emergence of undesirable phenomena in all power system, accounting for thenew challenges to be addressed by engineers and scientists involved in the power system design and management. Among the measures required there must be mentioned the need to adapt the existing electrical network to the new requirements and the introduction of new advanced methods of control, management and monitoring, in order to ensure the efficiency of electricity use.Non-linear loads, especially power electronicloads, create harmonic currents and voltages inthe power systems. For many years, variousactive harmonic power filters (AHPF) have been developedto suppress the harmonics, as well as compensatefor reactive power, so that the utility grid willsupply sinusoidal voltage and current with unitypower factor.Conventionally, the shunt type APF acts toeliminate the reactive power and harmoniccurrents produced by non-linear loads from thegrid current by injecting compensating currentsintended to result in sinusoidal grid current withunity power factor [1].

The aims of this paper are to present a solution to improve the operation of consumers' electrical installations, to reduce the electric power consumption and default costs allocated for the purchase of electricity and removing unwanted effects caused by the presence of harmonics. In order to achieve this, the main goal is to increase the power quality available for consumers. In the case of power consumers affected by the presence of harmonic pollution, power quality improvement can be achieved by implementing systems based on active filtering of the unwanted components. This type of automated system based on shunt active filter is presented in the following sections.

II. Active Harmonic Filter

Figure 1 shows basic APF block diagram includingnon-linear load on three-phase supply condition. In thisstudy, three-phase controlled thyristor bridge rectifier withohmic–inductive loading are considered as a non-linear loadon three-phase ac mains. This load draws non-sinusoidal currentsfrom ac mains and can be controlled by changing itsfiring angle.APF overcome the drawbacks of passive filters by usingthe switching mode power converter to perform the harmoniccurrent elimination. Shunt active power filters are developedto suppress the harmonic currents and compensate reactivepower simultaneously. The shunt active power filters are operatedas a current source parallel with the non-linear load.The power converter of active power filter is controlled togenerate a compensation current, which is equal but oppositethe

IJDACR
ISSN: 2319-4863

IJDACR
International Journal Of Digital Application & Contemporary Research

International Journal of Digital Application & Contemporary research
Website: www.ijdacr.com (Volume 1, Issue 9, April 2013)

harmonic and reactive currents generated from the nonlinearload. In this situation, the mains current is sinusoidaland in phase with mains voltage.A voltage-source inverter having IGBT switches and anenergy storage capacitor on dc bus is implemented as a shuntAPF. The main aim of the APF is to compensate harmonics,reactive power and to eliminate the unwanted effects of non-idealac mains supplies only unity power factor sinusoidalbalanced three-phase currents.

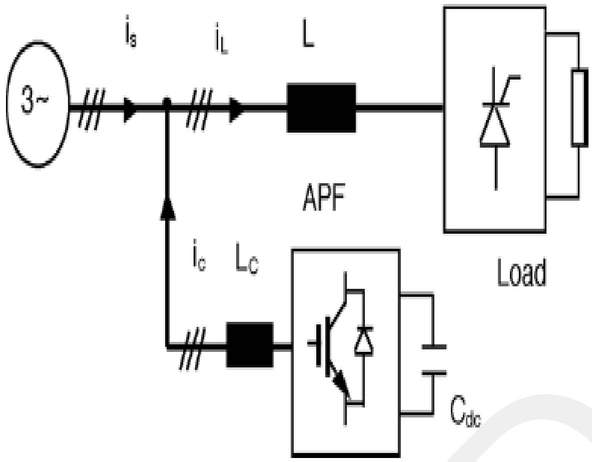

Figure-1: Active Harmonic Filter

III. Modelling and Simulation

All The circuit models a standard shunt AHF with IGBT inverter and series inductor on the AC side and DC capacitor energization. The load consists of two diode rectifiers which are phase-shifted by 30 degrees. The Delta-Y connected rectifier is connected after 10 cycles to change the load from 6-pulse to 12-pulse.

The AHF uses a PLL to generate a reference sinusoidal source current which is in-phase and has the same RMS gain as the load current. The current error between the load current and the reference current is generated by the IGBT Bridge through hysteresis switching. The AHF aims to inject this current error at the point of common coupling in order to match the source current as closely as possible with the reference current.

Figure-2 showing the MATLAB implementation of discussed work.

IV. Results

By directly controlling the grid current, a threephaseshunt APF can be provided for all nonlinearloads at the PCC instead of compensatingeach load individually. The system is simplerand more efficient because only one currentsensor for each phase is located in the grid side.The presented simulation results were obtained by usingMatlab–Simulink Power System Toolbox software, fora three-phase power system with a shunt APF.The proposed algorithmdynamic performances under such

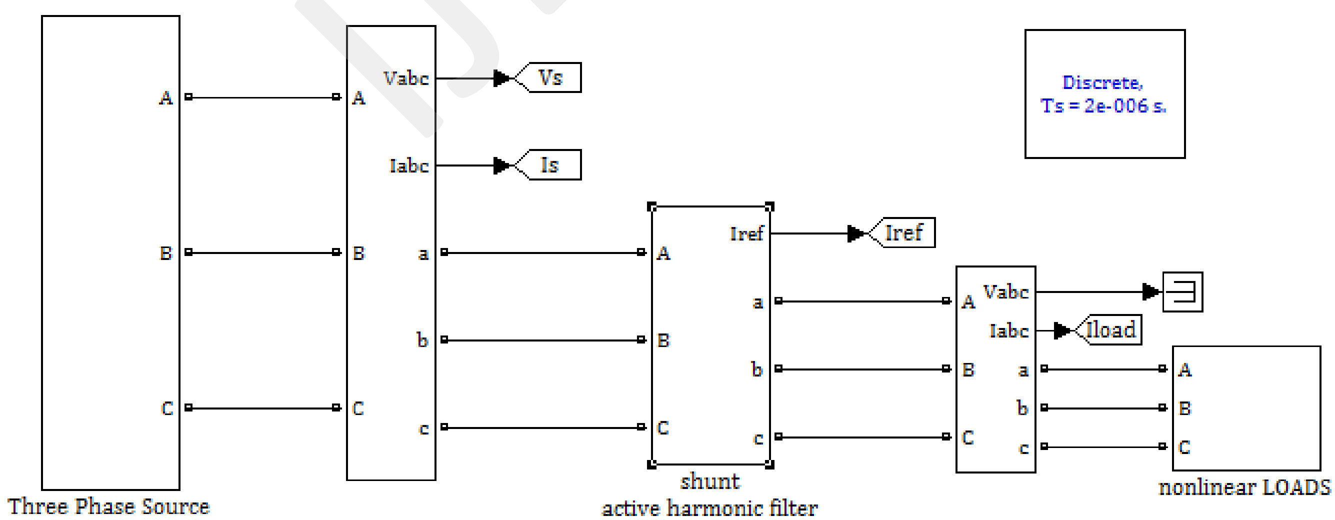

Figure-2: Proposed Simulink model

IJDACR
ISSN: 2319-4863

International Journal of Digital Application & Contemporary research
Website: www.ijdacr.com (Volume 1, Issue 9, April 2013)

dynamic conditions areinvestigated by detailed simulation study. The simulation resultsare discussed below.

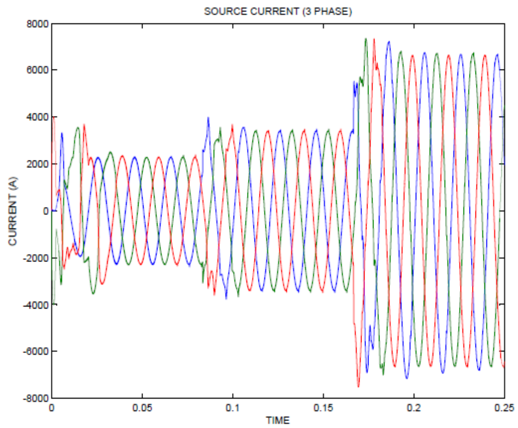

Figure-3: Source Current due to nonlinear loads

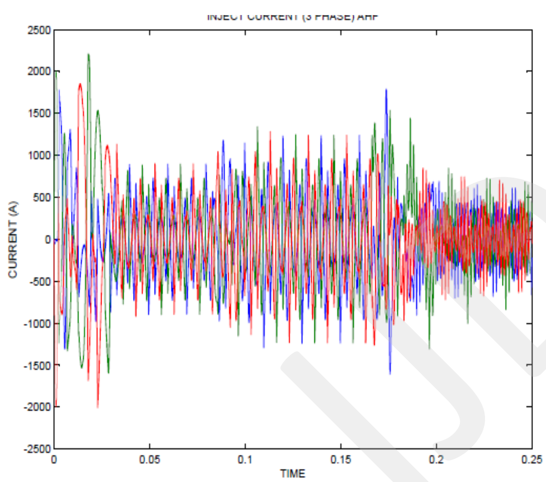

Figure-4: inject current by AHF for Compensation

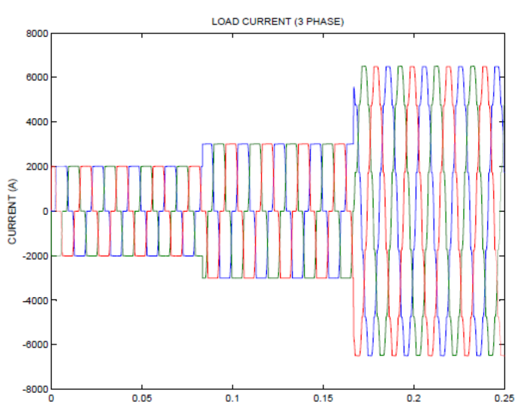

Figure-5: Load Currents

IV. CONCLUSIONS

This paper proposes the implementation of athree-phase active power filter together with with the loadoperated to directly control the ac grid current tobe sinusoidal and in phase with the grid voltage.From the simulation results, this system providesunity power factor operation of non-linear loadswith harmonic current sources, harmonic voltagesources, reactive, and unbalanced components.

REFERENCES

[1] Hanny H. Tumbelaka and Chem V. Nayar Lawrence J. Borle.,"application of a shunt active power filter To compensate multiple non-linear loads".

[2] C.C. Chen, Y.Y. Hsu, A novel approach to the design of a shunt active filter for an unbalanced three-phase four-wire system under nonsinusoidal conditions, IEEE Trans. Power Deliv. 15 (4) (2000) 1258–1264.

[3] H. Akagi, A. Nabae, S. Atoh, Control strategy of active power filters using multiple voltage-source PWM converters, IEEE Trans. Ind. Appl. 1A-22 (1986) 460–465.

[4] J. Afonso, et al., Active filters with control based on the p–q theory, IEEE Ind. Electron. Soc. Newsletter 47 (3) (2000) 5–11.

[5] F.Z. Peng, G.W. Ott, D.J. Adams, Harmonic and reactive power compensation based on the generalized instantaneous reactive power theory for 3-phase 4-wire systems, IEEE Trans. Power Electron. 13 (November) (1998) 1174–1181.

[6] B. Singh, K. Haddad, A. Chandra, A new control approach to threephase active filter for harmonics and reactive power compensation, IEEE Trans. Power Syst. 13 (1) (1998) 133–138.

[7] W.E. Kazibwe, M.H. Sendaula, Electric Power Quality Control Techniques, Van Nostrand Reinhold, New York, 1993.

[8] N.G. Hingorani, L. Gyugyi, Understanding FACTS, IEEE Press, New York, 2000.

[9] H. Akagi, New trends in active filters for power conditioning, IEEE Trans. Ind. Appl. 32 (1996) 1312–1322.