ISSN (Print) : 2320 – 3765
ISSN (Online): 2278 – 8875

International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering

(An ISO 3297: 2007 Certified Organization)

Vol. 4, Issue 7, July 2015

Performance Evaluation of CSI Based Active Filter and Passive Filters

S. Sherine, Anitha Sampathkumar

Assistant Professor, Dept. of EEE, Bharath University, Chennai, Tamil Nadu, India

Assistant Professor, Dept. of EEE, Bharath University, Chennai, Tamil Nadu, India

ABSTRACT: The aim of this project is to simulate CSI based active power filters to Non-linear load for improving power quality. THD is used as measuring index for comparing performances of these filters. These filters can reduce harmonic in supply current. When a non-linear load is connected to an AC supply it produces a quasi square waveform which contains harmonic current. Thus, active filters injects harmonic currents and changes quasi-square waveform to sinusoidal current. In this work, SVM based the voltage source shunt active filters and passive filters are compared. The circuits are simulated using MATLAB simulink. Harmonic distortion is found to be lowest in the case of VSI filter.

I. INTRODUCTION

The growing number of power electronics base equipment has produced an important impact on the quality of electric power supply. Both high power industrial loads and domestic loads cause harmonics in the network voltages. At the same time, much of the equipments causing the disturbances is quite sensitive to deviations from the ideal sinusoidal line voltage. Therefore, power quality problems may originate in the system or may be caused by the consumer itself. [1-3]

Consumers that are becoming increasingly aware of the power quality issues and being more informed about the consequences of harmonics, interruptions, sags, switching transients, etc. Motivated by deregulation, they are challenging the energy suppliers to improve the quality of the power delivered.[4]

The technology of active power filter has been developed during the past two decades reaching maturity for harmonics compensation, reactive power, voltage balance in ac power networks. All active power filters are developed with PWM inverters (current source or voltage source inverters). [5]The current fed PWM inverter bridge structure behaves as a sinusoidal current source to meet the harmonic current requirement of the non-linear load. It has a self supported dc capacitor that ensures the continuous circulation of the dc current. They present good reliability and require higher values of parallel capacitor filters at the ac terminals to remove unwanted current harmonics. However, they cannot be used in multilevel or multistep diodes configurations to allow compensation in higher power ratings.

The other converters used in active power filters topologies is the voltage-source PWM inverter. This converter is more convenient for active power filtering applications since it is lighter, cheaper, expandable to multilevel and multistep versions, to improve its performance for high power rating compensation with lower switching frequencies. The PWM voltage source inverter has to be connected to the ac mains through the coupling reactors. An electrolytic capacitor keeps a dc voltage constant and ripple free.

II. ACTIVE FILTERS

An active filter is basically a power electronic converter incorporating energy-storage components. In theory, the active filter can perform various firnctions. depending on the configuration of active filter, to improve the power quality of an electrical system. For example, a so-called shunt active filter can inject harmonic currents into a system at the point of common coupling to cancel the current distortion of the supply. Other forms of active filters also exist such as a series active filter and a unified active filter. Two main types of converters can be used as an active filter, -. namely voltage-source inverter (VSI) and current-source inverter (CSI).

ISSN (Print) : 2320 – 3765
ISSN (Online): 2278 – 8875

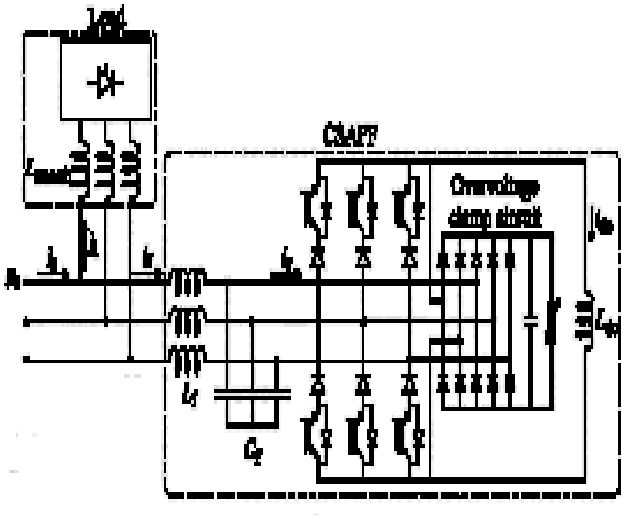
International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering

(An ISO 3297: 2007 Certified Organization)

Vol. 4, Issue 7, July 2015

A. Current-Source Active Power Filter

The current-source active filter [Fig.2] PWM bridge is built with six controllable unidirectional switches. Fig.2 shows the antiparallel diodes of the commercial IGBT power modules. Because of these and the very low reverse voltage blocking capability of the IGBTs, additional diodes have to be connected in series with the transistors. Instead of the series connection the use of the RB–IGBTs dis-cussed previously would also be possible. Although the lifetime of the dc coil is not limited as was that of the electrolytic capacitor in the VSAPF, the coil is a bulky and heavy component. The VSI type is more commonly used, since it is less bulky, cheaper and expandable as coinpaied to the CSI type.[6-8]



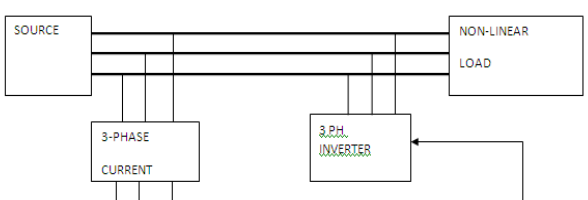
III . PASSIVE HARMONIC FILTERS

Passive harmonic filters work on the principle of electrical resonance in tuned circuits which is useful in mitigating harmonic orders corresponding to a particular frequency. The concept is that at resonant frequency the tuned RLC circuit considered to be the passive filter provides a least resistance path for the harmonic current to flow out of the system that feeds the loads. [9-10]Thus it reduces harmonics in the system. The impedance offered by the filters is minimum and purely influenced only by the resistive nature of the circuit at resonance conditions. Thus maximum current corresponding to the harmonic order is filtered out from the path that feeds the loads.

FILTER TYPE	VALUES
Double tuned filter 3rd & 5th Harmonics	L=5mH, C=225e-6 F and 81.057 F
High pass filter	R=100 ohms. C=31.58e-6F
Single tuned filter (7th harmonics)	L=5mH, C=41.356e-6F

III. SPACE VECTOR MODULATION (SVM)

Space Vector Modulation (SVM) is quite different from the PWM methods. In the figures presented, the following notations are used: "+ " refers to the on-state of the upper switch and "- " to the on-state of the lower switch while "0" indicates that both of the switches in a phase are in off-state and "± " that both of the switches in a phase are on.[11-13]



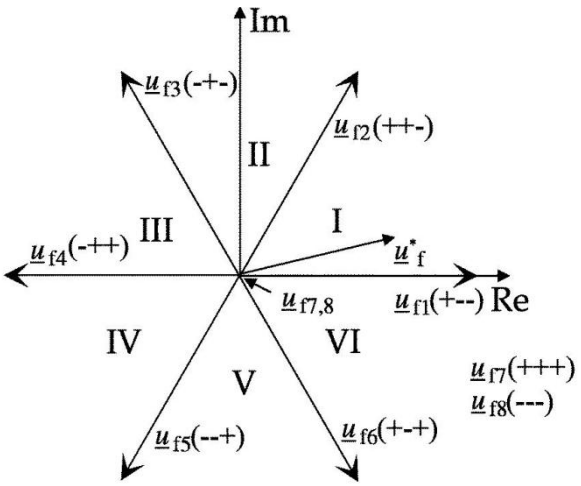
ISSN (Print) : 2320 – 3765
ISSN (Online): 2278 – 8875

International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering

(An ISO 3297: 2007 Certified Organization)

Vol. 4, Issue 7, July 2015

Fig. Block diagram representation of SVM



	sector I							
$\underline{u}_{fi}$	8	1	2	7	7	2	1	8
phase a	-	+	+	+	+	+	+	-
phase b	-	-	+	+	+	+	-	-
phase c	-	-	-	+	+	-	-	-

0 $T_{sw}/2$ T_{sw}

Fig. Switching vectors and applied sequence of vectors when the reference vectors lies in sector I in the case of fig1 current-source PWM bridge.

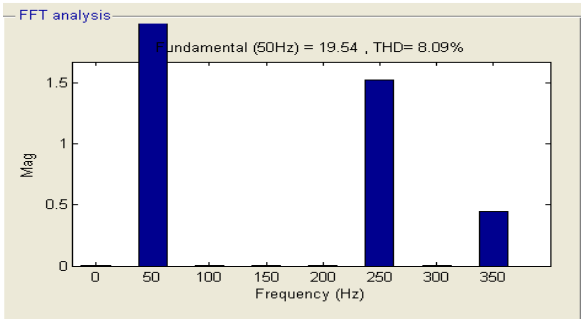
IV.SIMULATION RESULTS

ISSN (Print) : 2320 – 3765
ISSN (Online): 2278 – 8875

International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering

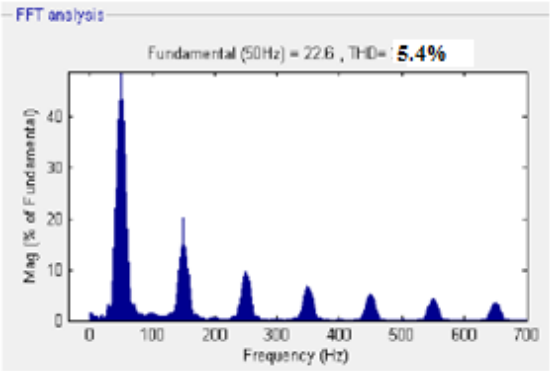
(An ISO 3297: 2007 Certified Organization)

Vol. 4, Issue 7, July 2015

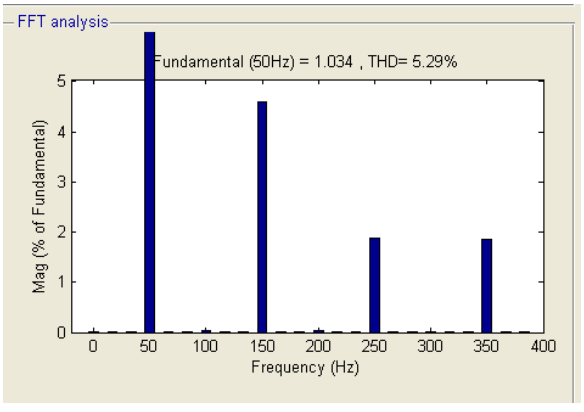


FFT Analysis without filter

The above shown fig represents the FFT Analysis without filter. The THD content is found to be 8.09% which should be reduced to obtain an undistorted waveform, for this purpose we use shunt active filters.



The THD content is found to be 8.09% in passive filters.



FFT Analysis with CSI SVM filter

The fig represents the FFT Analysis with CSI SVM filter and found that the THD content is reduced to 5.29%. Thus the THD content is reduced with the use of SVM based CSI filter than the use of SVM based VSI filter

V.CONCLUSION AND SCOPE FOR FUTRE WORK

ISSN (Print) : 2320 – 3765
ISSN (Online): 2278 – 8875

International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering

(An ISO 3297: 2007 Certified Organization)

Vol. 4, Issue 7, July 2015

CONCLUSION:

Highly inductive load is connected at the output of the rectifier. The A.C current drawn by the rectifier is Non-linear as shown in fig 6.a. The current drawn is quasi-sinusoidal current, thus the load acts as a Non-linear load. The harmonic distortion is found to be 24.68%.
When the power system is fed with CSI SVM filter the harmonic content is found as 3.57% Thus the THD content is found to be reduced with the use of SVM based VSI filters.

The THD content is found to be 8.09% in passive filters.

Thus Harmonic distortion is found to be lowest in the case of CSI filter and hence it is widely used in industrial applications.

FUTURE WORK:

The following work can be imposed on the topic done

- To simulate CSI and VSI fed active filter using SVM technique.

REFRENCES

[1] H. Akagi, "New trends in active filters for power conditioning," *IEEE Trans. Ind. Appl.*, vol. 32, no. 6, pp. 1312–1322, Nov./Dec. 1996.
[2] Y. Hayashi, N. Sato, and K. Takahashi, "A novel control of a currentsource active filter for ac power system harmonic compensation," *IEEE Trans. Ind. Appl.*, vol. 27, no. 2, pp. 380–385, Mar./Apr. 1991.
[3]Mahalakshmi K., Prabhakar J., Sukumaran V.G., "Antibacterial activity of Triphala, GTP & Curcumin on Enterococci faecalis", Biomedicine, ISSN : 0970 2067, 26(Mar-4) (2012) pp. 43-46.
[4]Bhuvaneswari B., Hari R., Vasuki R., Suguna, "Antioxidant and antihepatotoxic activities of ethanolic extract of Solanum torvum", Asian Journal of Pharmaceutical and Clinical Research, ISSN : 0974-2441, 5(S3) (2012) pp. 147-150.
[5]Sathyanarayana H.P., Premkumar S., Manjula W.S., "Assessment of maximum voluntary bite force in adults with normal occlusion and different types of malocclusions", Journal of Contemporary Dental Practice, ISSN : 1526-3711, 13(4) (2012) pp.534-538.
[6]Selva Kumar S., Ram Krishna Rao M., Deepak Kumar R., Panwar S., Prasad C.S., "Biocontrol by plant growth promoting rhizobacteria against black scurf and stem canker disease of potato caused by Rhizoctonia solani", Archives of Phytopathology and Plant Protection, ISSN : 0323-5408, 46(4) (2013) pp.487-502.
[7]Hariharan V.S., Nandlal B., Srilatha K.T., "Efficacy of various root canal irrigants on removal of smear layer in the primary root canals after hand instrumentation: A scanning electron microscopy study", Journal of Indian Society of Pedodontics and Preventive Dentistry, ISSN : 0970-4388, 28(4) (2010) pp.271-277.
[8] M.-X. Wang and H. Pouliquen, "Performance of an active filter using PWM current source inverter," in *Proc. 5th Eur. Conf. Power Electron. Appl. (EPE'93)*, Sep. 13–16, 1993, vol. 8, pp. 218–223.
[9] H. Akagi, "Trends in active power line conditioners," *IEEE Trans. Power Electron.*, vol. 9, no. 3, pp. 263–268, May 1994.
[10] T. Halkosaari and H. Tuusa, "Optimal vector modulation of a PWM current source converter according to minimal switching losses," in *Proc. 31st Annu. Power Electron. Spec. Conf. (PESC'00)*, Jun. 18–23,
2000, vol. 1, pp. 127–132.
[11] M. Routimo, M. Salo, and H. Tuusa, "A control delay compensation method for voltage source active power filter," in *Proc. 9th Eur. Power Qual. Conf. (PCIM'03 Eur.)*, May 20–22, 2003, pp. 93–97.
[12] M. Salo and H. Tuusa, "A novel open-loop control method for a current- source active power filter," *IEEE Trans. Ind. Electron.*, vol. 50, no. 2, pp. 313–321, Apr. 2003.
[13] M. Lindgren and J. Svensson, "Control of a voltage-source converter connected to the grid through an LCL-filter—application to active filtering," in *Proc. 29th Annu. Power Electron. Spec. Conf. (PESC'98)*, May 17–22, 1998, vol. 1, pp. 229–235.
[14] Thooyamani, K.P., Khanaa, V., Udayakumar, R., "Wireless cellular communication using 100 nanometers spintronics device based VLSI", Middle - East Journal of Scientific Research, v-20, i-12, pp:2037-2041, 2014.
[15] Vanangamudi, S., Prabhakar, S., Thamotharan, C., Anbazhagan, R., "Dual fuel hybrid bike", Middle - East Journal of Scientific Research, v-20, i-12, pp:1819-1822, 2014.
[16] Udayakumar, R., Kaliyamurthie, K.P., Khanaa, Thooyamani, K.P., "Data mining a boon: Predictive system for university topper women in academia", World Applied Sciences Journal, v-29, i-14, pp:86-90, 2014.
[17] Satheesh, S., Lingeswaran, K., "High efficiencytransformer less inverter for single-phase photovoltaic systems using switching converter", Middle - East Journal of Scientific Research, v-20, i-8, pp:956-965, 2014.
[18] Vijayaragavan, S.P., Karthik, B., Kiran Kumar, T.V.U., "A DFIG based wind generation system with unbalanced stator and grid condition", Middle - East Journal of Scientific Research, v-20, i-8, pp:913-917, 2014.