International Journal of New Technology and Research (IJNTR)
ISSN:2454-4116, Volume-3, Issue-11, November 2017 Pages 115-117

A Review on Shunt Active Filter Elimination of Harmonic by Shunt Active Filter

Ankur Gheewala , Pratik Tambakuwala , Hiren Lad , Vishvajeetsinh Solanki , Urjit Desai

Abstract— **Most of industrial applications are utilized power electronics converters and drives. Harmonics are introduced because of very large switching frequency of power electronics converters. Hence power quality of voltage and current is deteriorating. The shunt active filter is used to eliminate the harmonics which are present in the system. These problems will be solved with MATLAB simulation. The proposed design of shunt active filter used balanced non-linear load.**

Index Terms — **Shunt active filter, harmonics, non-linear load**

I. Introduction

Power quality is a set of limits or conditions of electrical properties that allows electrical devices to function in their planned manner without loss of performance. Without proper power, an electrical utility may malfunction, fail permanently, or not operate well. There are many possible ways in which electric power can be of poor quality and many more causes or effects of such poor, quality power [1]. Ideally, the voltage is fed as a sinusoidal having a magnitude and a frequency given by the international standards or system specifications with impedance of zero ohms at all frequencies. Power quality disturbance is identified by the inverters and the converters [2]. Now a day's harmonics problems are increased because of extensively use of power electronic converters. Harmonics problems can be eliminated by different type of FACTs devices. Among of all devices, Shunt Active Filters can be effectively utilized for the reduction of harmonics [3]. Electronic filters are circuits which perform signal processing functions, specifically to remove unwanted frequency components from the signal, to enhance wanted ones, or both. Electronic filters can be:

- passive or active
- analog or digital
- discrete-time (sampled) or continuous-time
- linear or non-linear

The oldest forms of electronic filters are passive analog linear filters, constructed using only resistors and capacitors or resistors and inductors. These are known as RC and RL single-pole filters respectively. More complex multipole LC filters have also existed for many years, and their operation is well understood.

Different methods to produce harmonics can be eliminated by different methods in power system. Harmonics problems are identified because of the extensive use of power electronic equipments, various non linear loads and increasing use of office equipments like computers, printers etc. These harmonics will result in a power factor reduction, decrease in efficiency and power system voltage fluctuations [4].

Passive filter is costly and bulky because of use of inductors. Passive filter have no frequency limitation while active filter have limitation due to active elements [5].

We installing (PCC) point of common coupling in a system we can neglect the adverse effect of non-linear harmonics. Shunt active filter compensate load current harmonics by injecting equal but opposite harmonic compensating current [6].

II. Active and Passive Filter

Passive filters include only passive components—resistors, capacitors, and inductors. In contrast, active filters use active components, such as op-amps, in addition to resistors and capacitors, but not inductors. Passive filters are most responsive to a frequency range from roughly 100 Hz to 300 MHz. The limitation on the lower end is a result of the fact that at low frequencies the inductance or capacitance would have to be quite large. The upper-frequency limit is due to the effect of parasitic capacitances and inductances. Careful design practices can be extended by the use of passive circuits well into the gigahertz range. Active filters are capable of dealing with very low frequencies (approaching 0 Hz), and they can provide voltage gain (passive filters cannot). Active filters can be used to design high-order filters without the use of inductors; this is important because inductors are problematic in the context of integrated-circuit manufacturing techniques. However, active filters are less suitable for very-high-frequency applications because of amplifier bandwidth limitations. Radio-frequency circuits must often utilize passive filters [7]. Shunt technology has been brought drastic increase in the use of power electronic equipment resulting in the increase of

Pratik Tambakuwala, Electrical Engineering, shroff sr rotary institute of chemical technology, vataria ankleshwar
Ankur Gheewala, Electrical Engineering, shroff sr rotary institute of chemical technology, vataria ankleshwar,
Hiren Lad, Electrical Engineering, shroff sr rotary institute of chemical technology, vataria ankleshwar,
Vishvajeetsinh Solanki, Electrical Engineering, shroff sr rotary institute of chemical technology, vataria ankleshwar,
Urjit Desai, Electrical Engineering, shroff sr rotary institute of chemical technology, vataria ankleshwar,

harmonics in source current or ac mains current. Intensive use of power converters, various non-linear loads and increasing use of office equipment like computers, faxes, printers are reasons for the increasing harmonics resulting in deterioration if source current and source voltage. Harmonics causes very serious damage in power system. Problem like resonance, overheating of neutral wire, low power factor, damaging microprocessor to filter out current harmonics to get sinusoidal supply current. Passive filter are classified as single tune filter and high pass filter.
Passive filter have following disadvantages:

1) Large configuration size
2) Fixed compensation
3) I resonance with the source impedance

To overcome the problems of passive filters, active filters are developed and used to solve the problem of harmonics the technology of the active filter has improved a lot thereby giving very good result to reduce the problem of harmonics.

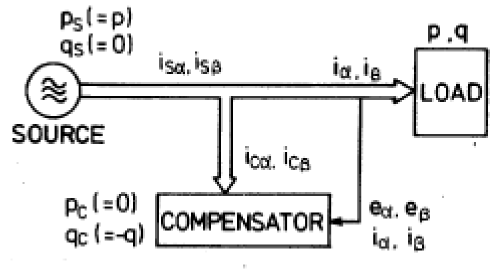


Figure 1.1

Figure 1.1 shows the complete Shunt active filter. In source side active power p is present and reactive power q=0. At load side active and reactive power both are present. Practically source side also active and reactive both power are present. To reduce the reactive power Q we use compensator as shown in figure. In compensators we produce –q, by this we add this –q in transmission line and +q and –q in line and reactive power is 0. By shunt active filter we reduce reactive power and improving power quality.[8]

III. SHUNT ACTIVE FILTER

This is most important configuration and widely used in active filtering applications. A shunt APF consists of a controllable voltage or current source. The voltage source inverter (VSI) based shunt APF is by far the most common type used today, due to its well known topology and straight forward installation procedure. Figure 1.2 shows the principle configuration of a VSI based shunt APF. It consists of a DC-bus capacitor (C_f), power electronic switches and an interfacing inductors (L_f). Shunt APF acts as a current source, compensating the harmonic currents due to nonlinear loads. The operation of shunt APF is based on injection of compensation current which is equals to the distorted current, thus eliminating the original distorted current. This is achieved by “shaping” the compensation current waveform (i_f), using the VSI switches. The shape of compensation current is obtained by measuring the load current (i_L) and subtracting it from a sinusoidal reference. The aim of shunt APF is to obtain a sinusoidal source current (i_s) using the relationship: *i*.

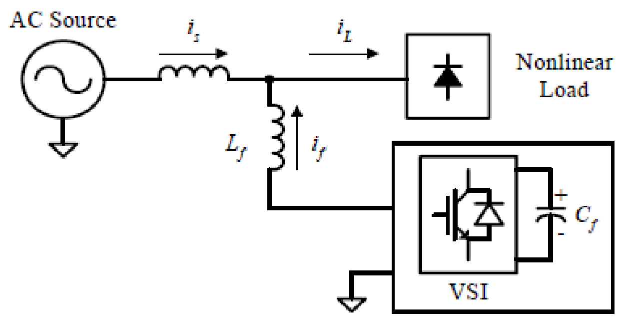


Figure 1.2

the resulting source current is
$I_s = I_L - I_f = I_{L,f}$
which only contains the fundamental component of the nonlinear load current and thus free from harmonics. Figure 1.3 shows the ideal source current when the shunt APF performs harmonic filtering of a diode rectifier. The injected shunt APF current completely cancels the current harmonics from the nonlinear load, resulting in a harmonic free source current.

From the nonlinear load current point of view, the shunt APF can be regarded as a varying shunt impedance. The impedance is zero, or at least small, for the harmonic frequencies and infinite in terms of the fundamental frequency. As a result, reduction in the voltage distortion occurs because the harmonic currents flowing through the source impedance are reduced. Shunt APFs have the advantage of carrying only the compensation current plus a small amount of active fundamental current supplied to compensate for system losses. It can also contribute to reactive power compensation. Moreover, it is also possible to connect several shunt APFs in parallel to cater for higher currents, which makes this type of circuit suitable for a wide range of power ratings [9].

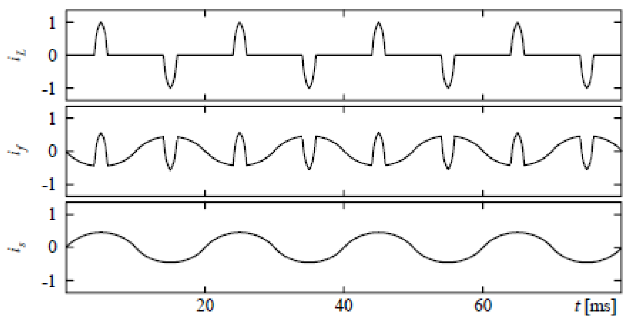


Figure 1.3

IV. INSTANTANEOUS REACTIVE POWER COMPANSATOR

Various type of reactive power compensators has been researched and developed to provide power factor correction.

Notably, the static reactive power compensator comprising switching devices, which requires practically no energy storage components such as capacitors or reactors, was proposed by Gyugyi. However, it has been considered that the compensators eliminate only fundamental reactive power in steady state. The generalized control strategy including the compensation of the fundamental reactive power in transient state. In this theory compensator can eliminate not only the fundamental reactive power in transient state but also some harmonics currents.

V. BLOCK DIAGRAM

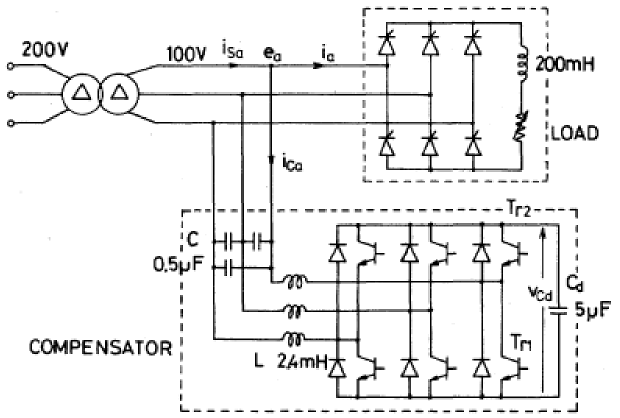
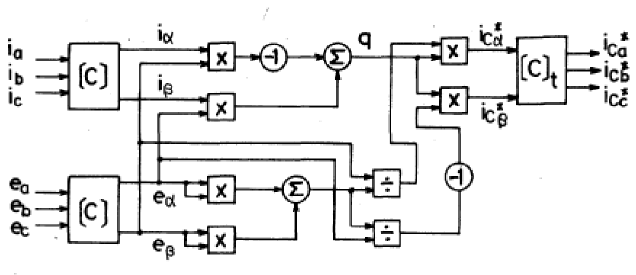


Figure 1.4

Figure 1.4 show that the compensator generate reactive power as per the requirement. The block diagram also control the transmission line. In this diagram transistor, diode, dc capacitor, filter capacitor and filter reactor are use.



$$[C] = \sqrt{\frac{2}{3}} \begin{bmatrix} 1 & -1/2 & -1/2 \\ 0 & \sqrt{3}/2 & -\sqrt{3}/2 \end{bmatrix}$$

Figure 1.5

The figure 1.5 show the control block of instantaneous reactive power compensator. In this control block the value of C is very important. Fig shows the control circuit of the compensator. The references of the compensating currents iCa*, iCb* and iCc*are calculated instantaneously without any time delay by using the instantaneous voltages and currents on the load side. The control circuit consists of several analog multipliers, dividers, and operational amplifiers. Note that neither low-pass filters nor integrators exist in the control circuit [8].

VI. CONCLUSION

From the Reviews we can conclude that harmonics are present in the line because of high frequency switching of power electronic load. When the shunt active filter is connected to transmission line it supplies negative reactive power as compared to load. This negative reactive power and load side reactive power cancel each other and hence improving power quality.

REFERENCES

[1] A. Kusko and M. T. Thomsom, Power Quality in Electrical System, chapter 1, McGraw Hill, New York, NY, USA, 2007.
[2] R. Yacamini and J. C. de Oliveira, "Harmonics produced by direct current converter transformers." The Proceedings of the Institution of Electrical Engineers, vol. 125, no. 9, pp. 873–878, 1978.
[3] www.electricalnotes.wordpress.com
[4] Shuiuly Mukherjee and Nitin Saxena "Power system harmonic compensation using shunt active power filter"
[5] Sanyog and Anand Singh "Implementation of MATLAB –SIMULINK approach in shunt active power filter to minimize the harmonic"
[6] Arpit Shah and Nirav Vaghela "Shunt active power filter for powerquality improvement in distribution system"
[7] https://www.allaboutcircuits.com/technical-articles/an-introduction-to-filters/
[8] HIROFUMI AKAGI, YOSHIHIRA KANAZAWA, AND AKIRA NABAE, MEMBER, IEEE
[9] Zainal Salam , Tan Perng Cheng and Awang Jusoh, "Harmonics mitigation Using Active Power Filter"

Pratik Tambakuwala, Electrical Engineering, shroff sr rotary institute of chemical technology, vataria ankleshwar, 9426618059. (pratik337@yahoo.in)

Ankur Gheewala, Electrical Engineering, shroff sr rotary institute of chemical technology, vataria ankleshwar,

Hiren Lad, Electrical Engineering, shroff sr rotary institute of chemical technology, vataria ankleshwar,

Vishvajeetsinh Solanki, Electrical Engineering, shroff sr rotary institute of chemical technology, vataria ankleshwar,

Urjit Desai, Electrical Engineering, shroff sr rotary institute of chemical technology, vataria ankleshwar,