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Hybrid Shunt Active Power Filter with Improved Power Factor and Lower Harmonics

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Abstract— The electronic industry faces the harmonic distortion as one of the main problem affecting the power quality. Harmonics generated due to non sinusoidal current consumption due to the prevailing non linear loads, affect the power quality. Since the non linear electronic devices have the advantages of flexibility, energy efficiency and are economical thus having a wide usage in the industry even with the prevailing problem of harmonics. Harmonic suppression is done by conventional two ways of active filtering and passive filtering. Passive filtering provides an easy solution to minimize harmonics but has lower efficiency as it donot always responds correctly to the dynamics of the power distribution systems. Active filters can be used for single or multiple non linear loads. They provide controlled current injection to remove harmonic current from the source side of electric system and also improves the power factor. This paper presents a method capable of designing power filters to reduce harmonic distortion and correct the power factor by which the power quality of a distribution system can be improved. MATLAB 7.6 is used to stimulate and analyze the proposed system.

Keywords— Harmonic suppression, Hybrid Filter, MATLAB 7.6 , Power Quality, Shunt Active Power Filter, Total Harmonic Distortion

I. INTRODUCTION

During the industrial use of electricity in older days, harmonic components of voltage and current curves were still a problem. Around 1893, analysis of harmonics was proposed as a way to solve problems. Today more than half of the receivers are supplied with the use of frequency converters, switching mode power supply , electronic ballasts etc. The diodes, thyristors or transistors used to convert AC voltage in DC voltage and DC voltage in AC voltage or DC voltage in DC voltage have non linear characteristics which causes harmonic currents in the industrial distribution systems. Harmonic current affects the voltage curve at the point of coupling and affects efficiency of the system. Various methods are adopted to reduce harmonics like changing the resonance frequency, filtering harmonic distortions using filter systems. There are 3 types of filters namely active, passive and hybrid filter. Design of filter plays a major role in harmonic reduction and in power quality.

II. CONFIGURATION OF THE SYSTEM

Fig.1 demonstrates a proposed framework comprising of a Shunt active power filter and Passive filter. The motivation behind utilizing this consolidated framework is to decrease the harmonics adequately. The power factor additionally enhanced by utilizing the consolidated system. The power factor also improved by using the combined system.

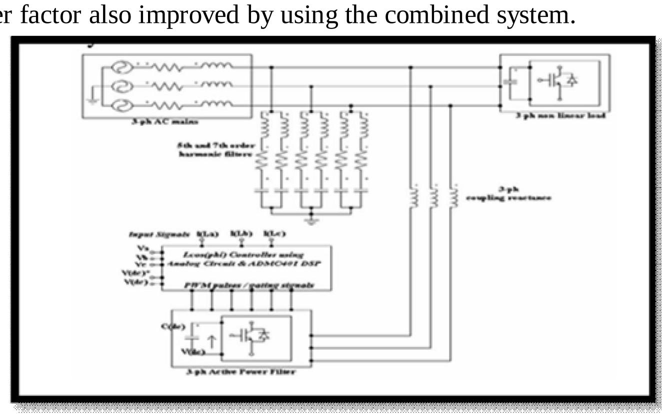

Figure 1 Combination of shunt active filter and passive Filter.

III. RESULTS

The simulation diagram with shunt Active Power Filter and PPF is shown in Fig.2. The diagram consists of the source, non-linear load, Passive Power Filter, shunt Active Power Filter and its control circuit.

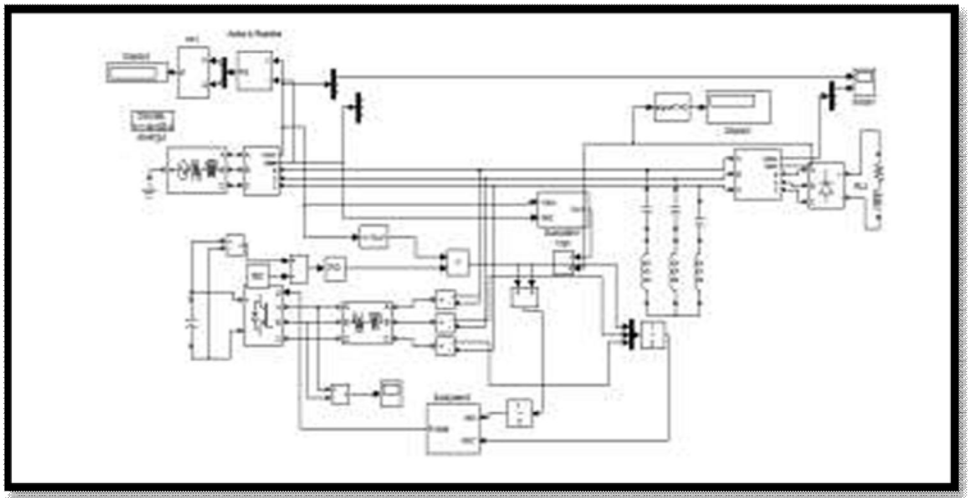

Figure 2 simulation diagram with SAPF and PPF

Figure 3 shows the waveform of supply current after compensation. The waveform is more sinusoidal when compared to other two techniques.

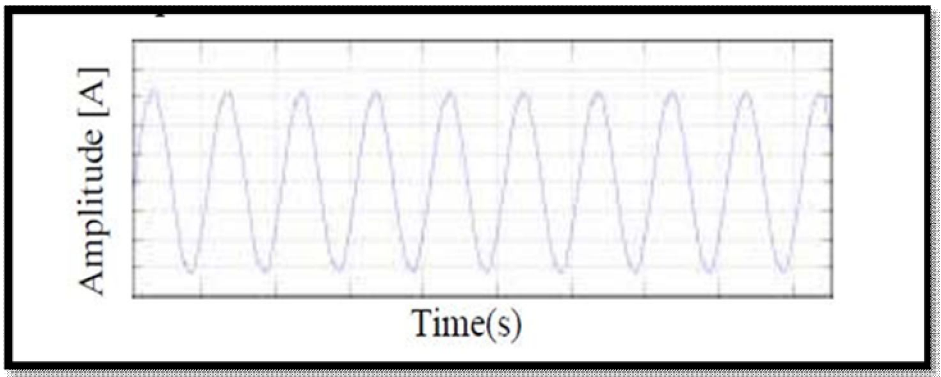

Figure 3 Supply current waveform –after compensation using SAPF and PPF

Figure 4 shows the spectrum analysis of supply current after compensation. The Total Harmonic Distortion of the supply current is reduced to 1.95% from 30.44%.

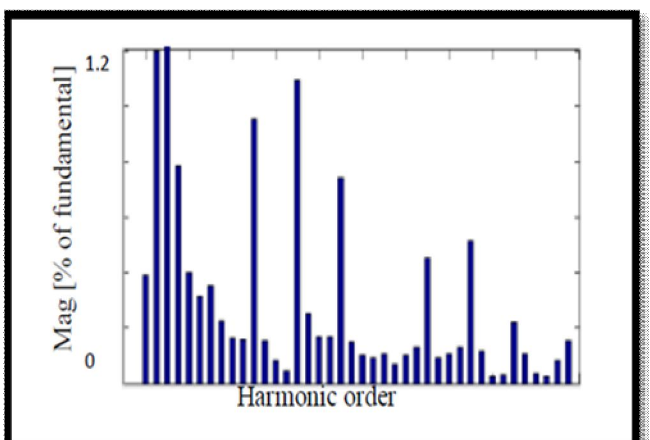

Figure 4 Spectrum analysis of supply current- after compensation using SAPF and PPF

IV. RESULT ANALYSIS

The numarical values of the harmonics are listed in table 1. The comparisons are made between before compensation, Shunt Active Filter and the combination of Shunt Active Power Filter and Shunt passive Filter. Table 1. Comparison of % of harmonics

Harmonic order	% of harmonics		
	Before compensation	SAPF	SAPF+PPF
3rd	4.80	0.71	0.36
5th	18.91	3.28	0.96
7th	14.54	2.78	1.30
9th	1.16	0.09	0.76
11th	1.77	1.35	0.11
13th	7.77	1.37	0.48

Table 1 shows the comparison chart of harmonic order. The % of harmonics can be reduced in the combination of Shunt Active Filter and Passive Power Filter when compared to Passive Power Filter alone. For the comparison only even order harmonics only considered.

Table 2. Comparison of Power factor

System	Power factor
Passive power Filter	0.9218
Shunt active Power Filter	0.9547
Combination of PPF+SAPF	0.9554

As listed in table 3 the power factor also improved to 0.9554 when compared to other two methods.

V. CONCLUSION

The system of Passive power Filter, Shunt Active Power Filter and the combination of Passive power Filter and Shunt Active Power Filter is proposed in this work. When compared to the three methods the combination of Passive power Filter and Shunt Active Power Filter is efficient for harmonic suppression and power factor improvement. By this method the % of THD can be reduced to 1.95 and the power factor is increased to 0.9554.

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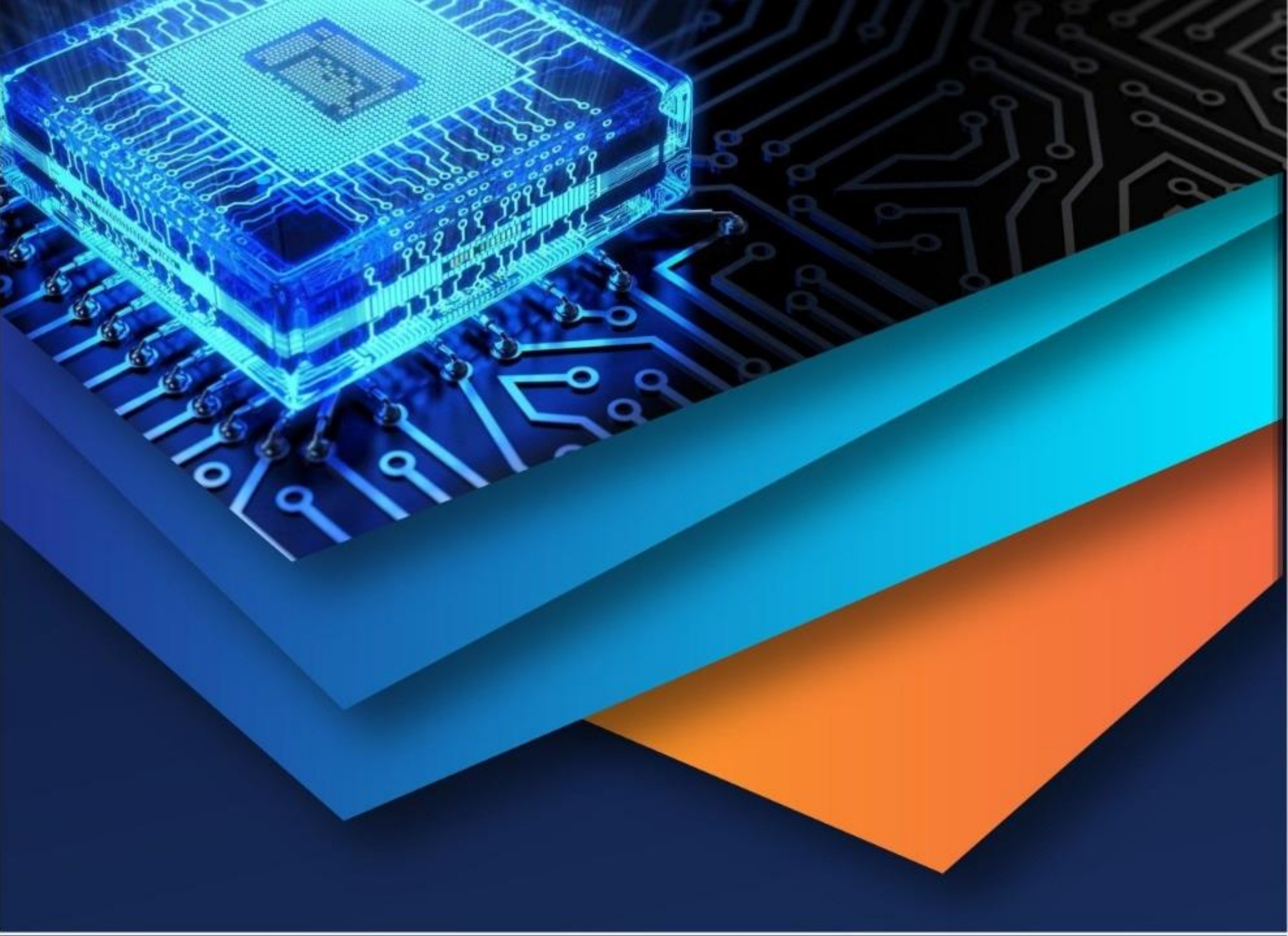

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