*Renewable Energy and Power Quality Journal* (RE&PQJ), ISSN 2172-038 X, No.9, 12th May 2011, Reference Paper: 230

| European Association for the Development of Renewable Energies, Environment and Power Quality (EA4EPQ) | International Conference on Renewable Energies and Power Quality (ICREPQ'11)<br>Las Palmas de Gran Canaria (Spain), 13th to 15th April, 2010 |
| --- | --- |

# A Practical Comparative Evaluation of Different Active Harmonic Filter Topologies

P. Salmerón, S. P. Litrán, R.S. Herrera, J. R. Vázquez

Departamento de Ingeniería Eléctrica y Térmica
Escuela Politécnica Superior, Universidad de Huelva
Ctra. de Palos de la Frontera s/n, 21819, Palos de la Frontera, Huelva, Spain
Phone: +34-959217585, Fax: +34-959217304
e-mail: patricio@uhu.es; salvador@uhu.es; reyes.sanchez@die.uhu.es; vazquez@uhu.es

**Abstract-** Along the last years, the practical use of active filters to mitigate harmonics has been extended in electric power systems. Different configurations of series active filters versus shunt active filters have been proposed, among them, hybrid topologies which combine active and passive filters. Nevertheless, there is not any clear accordance about the most suitable configuration for each type of harmonic sources. In this paper, four different topologies of active power filters to eliminate harmonics have been analyzed. An experimental prototype has been implemented to each configuration and have been submitted to different performance tests. With this objective, a test bank has been developed, which includes nonlinear loads kind harmonic current source, ahrmonic voltage source, and other whose behavior is between they both. The analysis of experimental results obtained allows the most suitable active filter power topology to be determined for each type of load.

## Key words
Power quality, active filters, hybrid filters, harmonics.

## 1. Introduction

Harmonics exist in electrical networks since the beginning of the electrical engineering. Along the years, different techniques have been applied and different devices have been used to mitigate harmonics, mainly based on passive filters configurations. Nevertheless, at the end of the seventies, equipments constituted by power electronic converters were presented to eliminate harmonics. It was the beginning of a new period corresponding to the called active power filters, APFs. Different topologies and control strategies have been proposed to make practical use of these equipments, [1-3].
An active power filter is a static compensation system based on a power electronic converter using a PWM (Pulse Width Modulation) control technique. The converter allows the suitable voltage or current waveform to be generated according to the proposed compensation target.
The most extended APF in the technical literature and the most used in low voltage system is the shunt active power filter. It supplies to the electrical networks a harmonic current whose amplitude is the same as the load current harmonics and whose phase is in opposite way. The performance of this configuration kind has been analyzed for loads as phase-controlled thyristor rectifier with SCRs (Silicon Controlled Rectifier) and a large inductance in DC side, cycle-converters or regulators constituted by branches composed of two antiparalell SCRs. These non-linear loads can be considered harmonics current sources (HCS). However, other types of non-linear loads like diode rectifiers with direct smoothing DC capacitors are considered harmonics voltage sources (HVS). Using filters to compensate HVS nonlinear loads does not completely eliminate the load current harmonics, therefore, its use is ineffective in this situation, [1].
With HVS loads, the use of series active filters has been proposed. They constitute a suitable harmonic compensation equipment for this type of load, although it is not commonly used in low voltage networks.
Besides shunt and series active filters, other topologies constituted by a combination of active and passive filters have been proposed. Passive filters are LC branches tuned to main load harmonics frequencies. These configurations are generally known as hybrid filters, [3].
On spite of the high number of papers published about the different compensation systems with APFs, there are not many practical studies that analyze the performances of the most usual configurations to compensate harmonics in low voltage networks.
In this paper, four different filter topologies to eliminate harmonic have been used and compared. They are:

- Shunt active power filter, PAF (Parallel Active Filter), Fig. 1, [4].
- Series active power filter, SAF (Series Active Filter), Fig. 3, [6].