Abstract

In today societies, the production of non-linear loads such as household appliances and industrial electricity devices is growing rapidly. Their mass connection to the supply network (despite compliance with EMC emission standards) may cause a deterioration in the quality of the supplied electricity.

The power quality refers mostly to the supply voltage quality (frequency, amplitude, waveform, etc.) which should be in accordance with the recommendations set by the standards. Therefore, in case of poor quality of the supply voltage at the point common coupling (PCC), its improvement is a necessity, the standards conditions and applicable regulations must be met. The electrical power is as a commodity and taking care of its quality is essential. The disturbances in the quality of electricity supply are numerous and varied (voltage drops and swells, flickers, deformation, etc.), which means that many methods are used to reduce their level in the electrical power system. This work focuses on mitigating disturbances such as asymmetry, harmonics and reactive power of fundamental harmonics, using methods such as passive harmonic filter (PHF), active power filter (APF) and hybrid active power filter (HAPF).

The purpose of the work is to design a HAPF, which is the combination of PHF and APF. In order to effectively design such a filter, this work presents a detailed analysis (simulation and laboratory tests) of various PHF and APF structures. Other methods used to reduce voltage and current distortion are also discussed.

The following PHF structures are considered: single-tuned filter, the series PHF, the double-tuned filter, the broad-band filters (first-order, second-order, third-order and C-type filter) and Hybrid passive harmonic filter (HPHF). Each of them is individually analyzed focusing on the impedance versus frequency characteristics and influence of detuning phenomenon and damping resistance on their efficiency. Some PHF structures (group of two single-filters & double-tune filter, series PHF & hybrid PHF) are compared as well as the methods of sharing the total reactive power in the filter group. The simulation studies are confirmed after the investigation in the laboratory of the following PHF structures: single-tune filter, group of two single-tuned filters, first and second-order filters.

In this work, the SAPF (three legs three wire) is analyzed. The goal of its design is to compensate the load fundamental harmonic reactive power, harmonics, and asymmetry using the original control algorithm - based on *p-q* theory - proposed by author. The studies of the influence of the line reactor: connected between the PCC and the grid, rectifier input and SAPF input as well as the SAPF DC capacitor on the filter efficiency is considered in this work. The laboratory experiments of SAPF confirming the simulation results is carried out using the four wires three legs structure.

After detailed studies of PHF and SAPF structures, the HAPF structures: model of SAPF (three legs three wires) connected in series with the single-branch filter (simulation studies) and model of SAPF (three legs four wires) connected in parallel with the group of two single-branch filters (laboratory studies) were next analyzed. The author proposed an original control algorithm based on *p-q* theory for this structure.

29-04-2020 Azebaze Mbouing

Data i podpis