An Improved iUPQC Controller to Provide Additional Grid-Voltage Regulation as a STATCOM

Abstract
Certainly, power-electronics devices have brought about great technological improvements. However, the increasing number of power-electronics-driven loads used generally in the industry has brought about uncommon power quality problems. In contrast, power-electronics-driven loads generally require ideal sinusoidal supply voltage in order to function properly, whereas they are the most responsible ones for abnormal harmonic currents level in the distribution system. In this scenario, devices that can mitigate these drawbacks have been developed over the years. Some of the solutions involve a flexible compensator, known as the unified power quality conditioner (UPQC) and the static synchronous compensator (STATCOM).

Existing system
In this configuration the series active filter is voltage controlled in order to compensate the grid distortion, allowing the load voltage to be consisted only by the fundamental
content. This way, the voltage compensated by the series active filter is composed by a fundamental content in order to compensate the sags/swells and the voltage unbalance, and by the harmonics, the same harmonics which are intended to compensate from the grid voltage, 180° phase shifted. The parallel filter is current controlled and it is responsible for draining the load current complementary harmonic contents, allowing a sinusoidal grid current. The parallel filter may still drain a fundamental content in order to compensate the load displacement power factor. The series filter connection to the utility grid is made through a transformer, while the parallel filter is most of the time connected directly to the load connection, in low voltage grid applications.

**Proposed system**

This paper proposes an improved controller, which expands the iUPQC functionalities. This improved version of iUPQC controller includes all functionalities of those previous ones, including the voltage regulation at the load-side bus, and now providing also voltage regulation at the grid-side bus, like a STATCOM to the grid.
Advantages
- Compensating harmonic current and voltage imbalances.

Applications
- Distributed generation and energy storage systems.
- Renewable resources such as solar and wind power.
Block diagram
Tools and software

- MPLAB – microcontroller programming.
- ORCAD – circuit layout.
- MATLAB/Simulink – Simulation.