

ICSGCE 2011: 27–30 September 2011, Chengdu, China

A Novel Grid-Connected Converter with Active Power Filtering Function

Chao He^a, Xin Xie^b, Hui Yan^a, Chuan Xie^a, Guozhu Chen^{a*}

^a The College of Electrical Engineering, Zhejiang University, Hangzhou, China

^b The New United Group, Changzhou, Jiangsu, China

Abstract

A Novel Grid-Connected Converter with ActivePower Filtering Function was proposed. Considering the specific situation, main circuit and controller were designed. The proposed system can exchange active power with grid and/or compensate harmonic current and reactive power of grid at the same time or respectively. LCL type filter was adopted to attain a good filtering effect. Proportional Integral (PI) control, repetitive control as well as feed forward control which can gain better dynamic performance composed the control system. To track the time-varying active current value, the influence of time lag caused by repetitive control during the fast switching period was considered. DC link voltage controller was designed for its special applications. Simulation results verify the high steady state precision and fast dynamic response of the system.

© 2011 Published by Elsevier Ltd. Open access under [CC BY-NC-ND license](https://creativecommons.org/licenses/by-nc-nd/4.0/).

Selection and/or peer-review under responsibility of University of Electronic Science and Technology of China (UESTC).

Keywords: Grid-connected converter, active power filter, proportional integral control, feedforward control

1. Introduction

The smart grid is the latest direction of power system development for its high efficiency, reliability and flexibility. It allows sorts of different power generating and energy storage systems to plug in, which increases its popularity.

Distributed Generation (DG) system, typically made up of hydro, wind, photovoltaic, fuel cells, biomass, gas turbines and diesel power generation systems, is considered will play an important part in the future smart grid. In the push of world economy modernization, the cost price of traditional energy keeps rising. On this condition, the renewable energy industry closely related with power electronics has progressed rapidly in recent years. The DG system is usually composed of the power generating parts,

* Corresponding author. Tel.: +86-571-87953985.
E-mail address: gzchen@zju.edu.cn.

energy storage systems and grid side converters whose function are transferring energy generated by forward parts to the grid. Unfortunately, those converters introduce extra harmonics, mainly switching ripples, into the grid meantime. The current harmonics injected into the grid is strictly restricted by IEEE Std. 929-2000 and IEEE Std.P1547 [1]. For this consideration, a well-designed output filter, single L or LCL, is usually selected to eliminate the undesired harmonics.

In real world application, arc steel-making stoves, rectifier equipment and welding machines etc., acting as harmonic and reactive power sources, are in most cases required to be applied in smart grid. Usually these apparatus generate so much harmonic and reactive power that inevitable leads to irregular operation or even damage of other sensitive loads. Thus additional devices are needed to overcome those problems. The usual solution is employing equipment like active power filters (APF), static synchronous compensators (STATCOM) and etc. to compensate reactive power and to eliminate harmonics.

In this paper, a strategy control approach based on shunt APF is proposed. The new strategy can transfer active power and compensate reactive power as well as eliminate current harmonics. The aim is that the system can operate as an inverter of distributed generation or/and as a traditional shunt APF independently or simultaneously [2, 3, 4]. Focusing on the grid side convertor, the paper doesn't discuss the power generator as well as storage system in depth.

2. System Configuration

The structure of the proposed system is a three phase three wire grid converter as shown in Fig.1. Where, u_g is the grid phase voltage, L_g is the grid side inductor, C_{dc} is the DC capacitor, L_1, L_2, C and R_d is inverter side inductor, grid side inductor, filtering capacitor and damping resistor respectively. Symbols u_s, i_s, u_{dc}, i_L and i_2 stands for grid phase voltage at the Point of Common Coupling (PCC), grid current, DC bus voltage, load current and compensating current respectively.

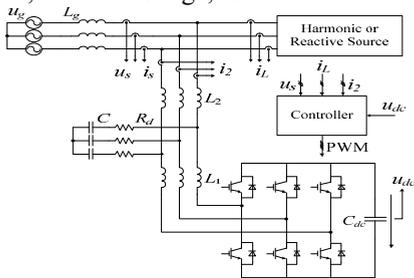


Fig. 1. The grid side converter.

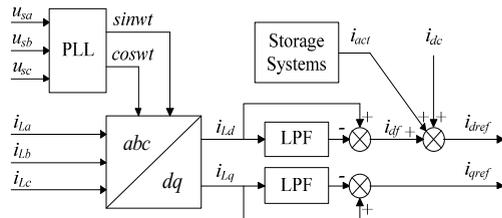


Fig. 2. Current instructions computation.

Apparently this grid side converter is the same as shunt APF with LCL filter structurally. But there exists many features that distinguish it from general APFs and which will be expounded in the following sections.

3. Operation Mode

3.1. Current reference

The proposed grid side converter can not only transfer active power generated by the power generation system, but also compensate reactive power and eliminate harmonics produced by other loads with high accuracy. That means the current instructions are composed of two parts: active power current instructions which are given by the forward system and harmonic as well as reactive power compensating current instructions which are defined by the load current.

متن کامل مقاله

دریافت فوری ←

ISIArticles

مرجع مقالات تخصصی ایران

- ✓ امکان دانلود نسخه تمام متن مقالات انگلیسی
- ✓ امکان دانلود نسخه ترجمه شده مقالات
- ✓ پذیرش سفارش ترجمه تخصصی
- ✓ امکان جستجو در آرشیو جامعی از صدها موضوع و هزاران مقاله
- ✓ امکان دانلود رایگان ۲ صفحه اول هر مقاله
- ✓ امکان پرداخت اینترنتی با کلیه کارت های عضو شتاب
- ✓ دانلود فوری مقاله پس از پرداخت آنلاین
- ✓ پشتیبانی کامل خرید با بهره مندی از سیستم هوشمند رهگیری سفارشات