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Design of Shunt Active Power Filter for Power Quality

Dr. D. P. Kadam, U. L. Mohite, A. S. Jain
Department of Electrical Engineering, Bhujabal Knowledge City, MET-Institute of Engineering, Nashik, Maharashtra, India

ABSTRACT

The power quality of the system can be expressed by the three physical characteristics Voltage, current and frequency. and a power quality issue is defined as "any occurrence disturbance in current, voltage, or frequency that results in damage, upset or failure of end-use equipments". The higher switching frequency and the non-linearity in the properties of the power electronics devices are mostly responsible for the power quality issue. So importance is being given to the development of Active Power Filters to solve these problems to improve power quality among which shunt active power filter is used to eliminate voltage and load current harmonics and for reactive power compensation. The shunt active power filters have been developed based on control strategies like instantaneous active and reactive power compensation scheme (p-q control) and instantaneous active and reactive current scheme (Id-Iq control). Considering its superior nature, a study on the Id-Iq control scheme based shunt active filter is brought out in this project. The compensation is carried out by the use of PI based controllers. A theoretical study based on both the compensation schemes is done in this paper and then the theory of Id-Iq control scheme is implemented in simulation work and its harmonic compensation results are analyzed.

Keywords : Power Quality, Shunt Active Power Filter, harmonics, P-Q theory.

I. INTRODUCTION

In recent years, the increasing use of power semi-conductor technology and non linear loads, industrial machines and automation devices in industries, commerce and households, have led to a significant increase in disturbances, which affect power quality in power systems. Therefore, it is necessary to develop and implement solutions to improve power quality in electrical power systems[1-2]. Conventionally passive L-C filters were employed to reduce harmonics and capacitors were used to improve the power factor of the loads. But passive filters have the demerits of fixed compensation, large size and resonance. The increased severity of harmonic pollution in power distribution network has attracted the attention to develop dynamic and adjustable solutions to the power quality problems giving rise to active filter.[3]

Now days, three-phase four-wire shunt active power filters have appeared as an effective method to solve the problem of harmonics, unbalanced load currents together with reactive power compensation. Active power filters are connected to AC mains in order to eliminate voltage variations and harmonic components. Shunt active power filter eliminates the current harmonic components working as a source with only the harmonic components and power factor correction, so that only the fundamental component is supplied in the AC mains.

The Shunt Active Power Filter is connected in parallel with the line through a coupling inductor. Its main power circuit consists of a three phase three-leg current controlled voltage source inverter with a DC link capacitor. An active power filter operates by generating a compensating current with 180 degree phase opposition and injects it back to the line so as to cancel out the current harmonics introduced by the nonlinear load. This will thus suppress the harmonic content present in the line and make the current waveform sinusoidal. So the process comprises of detecting the harmonic component present in the line current, generating the reference current, producing the switching pulses for the power circuit, generating a