MODELING AND PERFORMANCE ANALYSIS OF SHUNT ACTIVE POWER FILTER FOR POWER DISTRIBUTION SYSTEM

A THESIS

submitted by

KHOISNAM STEELA (S11019)

for the award of the degree

of

MASTER OF SCIENCE (BY RESEARCH)

SCHOOL OF COMPUTING & ELECTRICAL ENGINEERING

INDIAN INSTITUTE OF TECHNOLOGY MANDI, INDIA

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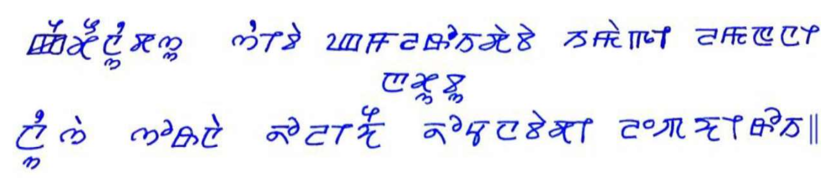
To my mother



Declaration by the Research Scholar

This is to certify that the thesis titled **MODELING AND PERFORMANCE ANALYSIS OF SHUNT ACTIVE POWER FILTER FOR POWER DISTRIBUTION SYSTEM**, submitted by me to the Indian Institute of Technology Mandi for the award of the degree of **Master of Science** (by Research) is a bonafide record of research work carried out by me under the supervision of **Dr. Bharat Singh Rajpurohit**. The contents of this thesis, in full or in parts, have not been submitted to any other Institute or University for the award of any degree or diploma.

Khoisnam Steela.

Mandi, 175001
Date: 3rd Nov. 2014.

Khoisnam Steela

THESIS CERTIFICATE

This is to certify that the thesis titled **MODELING AND PERFORMANCE ANALYSIS OF SHUNT ACTIVE POWER FILTER FOR POWER DISTRIBUTION SYSTEM**, submitted by Ms. **Khoisnam Steela**, to the Indian Institute of Technology Mandi, for the award of the degree of **Master of Science** (By Research), is a bonafide record of the research work done by her under my supervision. The contents of this thesis, in full or in parts, have not been submitted to any other Institute or University for the award of any degree or diploma.

Mandi, 175001

Date: 3-11-2014

Dr. Bharat Singh Rajpurohit

M.S. Research Guide

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ABSTRACT

KEYWORDS**:** *Power quality, harmonic mitigation, Active power filter, shunt-APF control strategies, p-q theory, d-q method, i_d-i_q method, adaptive hysteresis-band current controller, dc-link voltage regulation, PI controller, Fuzzy logic controller.*

Increasing proliferation of non-linear loads in power system networks and the consequent rise in severity of harmonic infliction and power quality issues have attracted the attention of power engineers to develop and design appropriate and cogent solutions. Power filters came up as a means to meet the requirement of clean, harmonic-free power. Various types of power filters were introduced one after another, with the aim of achieving near-perfect compensation. Earlier, conventional passive L-C filters were employed. Passive filters effectively reduce harmonics and correct power factor, but, cannot satisfy the requirement of dynamicity in response. Consequently, active power filters (APFs) were introduced to cope up with these requirements. APF technology is a prolific technology that provides dynamic and versatile solution to power quality issues. In fact, APFs are considered to be the most viable solution to power quality problems. APF has gained great popularity, and extensive research is being done on various aspects of APFs. With this, APF technology boosted up swiftly resulting in various configurations, topologies and control schemes.

This research work is targeted on improving the performances of power quality enhancement techniques. The dynamic performances of three most extensively used control schemes, namely, Instantaneous Reactive Power Theory (*p-q* theory), Synchronous Reference Frame Theory (*d-q* method) and Instantaneous Active and Reactive Current Method (i_d-i_q method) are thoroughly evaluated under different supply conditions and the key areas of improvement are identified. Following the analysis, an adaptive hysteresis-band current controller is designed. This controller can hold the switching frequency of voltage source inverter (VSI) used in and as the APF nearly constant, thereby, increasing the effectiveness of the APF scheme. A fuzzy logic controller (FLC), for regulation of dc-link voltage of APF, is also proposed in this work. The FLC is proposed to be employed in lieu of conventionally used PI controller in order to achieve smoother control over a wider range of conditions. The proposed FLC has a Mamdani-Type

fuzzy inference system (FIS) with two inputs characterized by seven level triangular membership functions. The schemes for improving performance of APFs suggested in this thesis work have been extensively evaluated under varied operating conditions through simulations and the effectiveness of the same are validated.