Electric Power Systems Research 242 (2025) 111430

Contents lists available at ScienceDirect

Electric Power Systems Research

journal homepage: www.elsevier.com/locate/epsr

Review

A review on soft switched PFC boost converter for efficient lowering of switching losses

Irtiza Bashir [a,*], Abdul Hamid Bhat [a], Salman Ahmad [b]

[a] Department of Electrical Engineering, National Institute of Technology Srinagar, India
[b] Department of Electrical Engineering, Islamic University of Science and Technology, Kashmir, India

ARTICLE INFO

Keywords:
Electricity
Switching losses
Power factor correction
Boost converters
Pulse width modulation

ABSTRACT

The inefficient power factor (PF) of electrical loads can lead to high current consumption, straining the electricity distribution system. Correcting PF is crucial for minimizing electricity bills, reducing capacity charges, and monthly demand. Simultaneously, soft switching methods enhance the reliability and efficiency of Power Factor Correction (PFC) converters by minimizing switching losses, thereby improving power conversion effectiveness. Various PFC boost converters have been explored in existing works (2015–2023) to mitigate switching losses in diverse applications. This study aims to summarize these works, providing a comprehensive review of soft-switched PFC boost converters. It delves into theoretical aspects, including types of PFC methods, perspectives of soft-switching converters, and PFC boost converters with analog and digital circuits. The theoretical foundation aids in identifying significant drawbacks and understanding the complexities involved. The study employs tabular analysis to unveil the diverse converters used for switching loss reduction and assesses their prevalence in conventional works across different applications. In conclusion, the study identifies major issues during the analysis of conventional works and offers relevant suggestions. This comprehensive overview equips practitioners and researchers with insights into contemporary findings, guiding future research endeavors in the field of PFC boost converters and soft switching methods.

1. Introduction

With the increase in electric demand and economic rivalry, the industries are recently forced to enhance the efficacy to gain success in the market. Poor PF and imbalance are the main factors that directly contribute in impacting the functional costing for electricity consumers and supply utilities. Generally, electric power experiences three huge phases: generation at power house, transfer to the substations and final distribution to the users. This inter-associated network is together claimed as electric power system [1]. Partitioning the intricate power system structure, certain sub-partitions are included. Accordingly, sub-station generation is the initial phase of the power system that fundamentally includes the use of different forms of energy for turning or rotating the turbine corresponding to electric generator, which eventually results in electricity generation that could be transmitted.

The electric power which is generated in generation sub-stations are typically within specific ranges (from 11 kV to 25 kV). Electricity transfer in these low voltages include high current which are eventually related with the need for thick conductors, responsible for heat losses and expenses. For averting this, typically, electric power which is generated in generating stations are stepped up with the use of step up transformers to maximum voltage (in range 115 kV, 132kV/400 kV). Later, this is transferred to minimize the losses owing to maximum current. Moreover, an electrical sub-station also acts for several purposes inclusive of circuit isolation for maintenance and sudden enhancement in load demand for protecting generation stations as well as its equipment, existence of bus-bars for permitting the electric power split particularly for the distribution intentions and housing-safety equipment to protect machineries like fuses and circuit breakers. In addition, a sub-transmission substation is typically included in stepping the voltage attained from transmission substations to make usage of the step down transformers. As a final phase of power system, the distribution substations nourish the substations that are closer to commercial users [2]. Moreover, under the ideal settings, voltage and current of a circuit should exist in phase, allowing PF to be an ideal unity. In an electrical viewpoint, low PF indicates that, comparatively high current is crucial for supplying similar power to corresponding equipment. This is the vital aspect resulting to electricity wastage. Taking into account the

* Corresponding author.
E-mail addresses: irtizabashir19@gmail.com (I. Bashir), bhatdee@nitsri.net (A.H. Bhat), salmanahmad19@gmail.com (S. Ahmad).

https://doi.org/10.1016/j.epsr.2025.111430
Received 25 February 2024; Received in revised form 26 December 2024; Accepted 15 January 2025
Available online 23 January 2025
0378-7796/© 2025 Elsevier B.V. All rights are reserved, including those for text and data mining, AI training, and similar technologies.