Environmental Engineering and Management Journal

March 2024, Vol. 23, No. 3, 503-518
http://www.eemj.icpm.tuiasi.ro/; http://www.eemj.eu
http://doi.org/10.30638/eemj.2024.039

"Gheorghe Asachi" Technical University of Iasi, Romania

AN INNOVATIVE POWER ELECTRONIC TRANSFORMER STRUCTURE TO ENHANCE POWER QUALITY OF RENEWABLE-BASED DISTRIBUTION SYSTEM

Shima Saneie[1], Seyed Saleh Ghoreishi Amiri[1], Hadi Dehbovid[1]*, Mohammad Rezvani[2]

[1]Department of Electrical Engineering, Nour Branch, Islamic Azad University, Nour, Iran
[2]Department of Electrical Engineering, Sari Branch, Islamic Azad University, Sari, Iran

Abstract

Access to high-quality electricity has a significant effect on capital savings and economic benefits for manufacturing industries. Indeed, the occurrence of any event that causes distortions in voltage, current, and frequency will lead to improper operation of electrical equipment and a severe reduction in power quality. By connecting the renewable energy sources to the grid or load through electronic power converters, power quality issues can be appropriately improved. This paper proposes an innovative power electronic transformer to meet the power quality requirements, which has been constructed by a new high-gain boost converter, a new multilevel inverter and high frequency transformer. The proposed boost converter can provide two outstanding advantages: reduction of input current ripple and increase of high output voltage for photovoltaic and fuel cell systems. Since the high input current and low output voltage of the dc/dc converter respectively lead to energy discharge and load loss, this structure not only greatly improves the power quality issues, but also promises the high reliability during the compensation process. The proposed multilevel inverter can provide required staircase sinusoidal voltage to compensate all power quality issues. The simulation results under different disturbance scenarios have validated the compensation capability of the proposed power electronic transformer. To further validate the proposed power electronic transformer structure, its prototype model based on the ATmega2560-Arduino has been provided and tested in laboratory.

Key words: boost converter, fuel cell, multilevel inverter, photovoltaic, power electronic transformer, power quality

Received: April, 2023; Revised final: November, 2023; Accepted: January, 2024; Published in final edited form: March, 2024

* Author to whom all correspondence should be addressed: e-mail: dehbovidhadi@gmail.com