Thesis Title

Simulation and Analysis of Photovoltaic System with Interleaved Boost Converter

By

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A thesis submitted to Islamic University of Technology in partial fulfillment of the requirements for the degree of

M.Sc. in Electrical and Electronic Engineering

Department of Electrical and Electronic Engineering

Islamic University of Technology (IUT)

Organization of Islamic Cooperation (OIC)

Board Bazar, Gazipur-1704, Bangladesh

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It is hereby, declared that the work presented in this paper is the outcomes of the investigation performed by me under the supervision of Prof. Dr. Md. Ashraful Hoque, Professor, Department of EEE, Islamic University of Technology (IUT), Dhaka, Bangladesh. I also declare that no part of this paper has been submitted elsewhere for the award of any degree.

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Acknowledgement

Firstly, I would like to express my sincere gratitude to my thesis supervisor Prof. Dr. Md. Ashraful Hoque, for the continuous support of my study and related research, for his patience, motivation, and immense knowledge. His guidance helped me in all the time of research and writing of this thesis. I could not have imagined having a better supervisor and mentor for my M. Sc. study.

Secondly, I would like to thank my family: my parents, my wife and sister for supporting me spiritually throughout writing this thesis and my life in general.

My sincere thanks also goes to all of our faculty members, friends, classmates and every person who has helped and supported me to make this thesis possible.

Finally, thanks to ALLAH, for His blessing.

Abstract

In today's world, energy is a global issue and energy demand is increasing day by day. To satisfy the increasing demand renewable energy sources are fast gaining importance over non-renewable. Among different source of renewable solar power generation system tops the list as it provides a clean, cheap and environment friendly solution. Though PV system has lots of advantages it is less efficient and the power available from photovoltaic source is variable in nature. The voltage, current and consequently the power continuously vary depending on the load and the climate condition such as solar irradiance, cloud, and temperature. To minimize the effect DC-DC boost converter is used between the source and the load.

This thesis focuses on Interleaved DC-DC boost converter (IBC) for photovoltaic system. Input current ripple and output voltage ripple are two important performance parameters of IBC. The main source of the ripple in IBC is inductors which usually switched at a high frequency. A stable output voltage from a variable input voltage can be maintained by switching the inductors at different duty cycle and this duty cycle and inductance of inductors determine the amount of ripple on the input current which indirectly affects the efficiency of the converter as well as whole PV system. The effects of input voltage, duty ratio and inductor value on input current ripple are analyzed in this paper. It is found that using different inductor at different duty cycle can reduce the input ripple current and increase the efficiency.

In this paper three optimized inductor values for three adjacent duty cycle ranges is chosen. Using these different inductors a new boost converter topology is proposed. A digital controller is required for the converter and based on the input voltage/duty ratio switching among different inductor is occurred to maintain minimum input current ripple. The new proposed circuit is simulated using MATLAB/Simulink and the result is presented in this paper. From the simulation result it is also found that the inductor value has no remarkable contribution on output voltage ripple. For implementing switching logic for the digital controller an algorithm and flow chart is also developed and presented. Using the proposed controller with the proposed controlling algorithm a stable output voltage from a variable solar output with a minimized ripple current can be achieved. The input current ripple measured using the proposed controller is 3.3% lesser than the traditional IBC and the efficiency is improved by 0.87%. The proposed converter can be used in high power solar application as well as low power application. As the ripple is further reduced it can be a good choice for battery less solar powered IoT sensor node.

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List of Abbreviation

Acronyms	Description
PV	Photovoltaic
IBC	Interleave Boost Converter
SCM	Synchronous Conduction Mode
MPP	Maximum power point
IoT	Internet of Things
PID	Proportional Integral Derivative
CCM	Continuous Conduction Mode
DCM	Discontinuous Conduction Mode
SMPS	Switching mode power supply
SEPIC	Single Ended Primary Inductor Converter