UNIVESITI TEKNOLOGI MARA

POWER CONVERTER FOR DUAL-POWER PHOTOVOLTAIC-GRID ENERGY SYSTEM

INTAN RAHAYU BINTI IBRAHIM

Thesis submitted in fulfilment
of the requirements for the degree of
Doctor of Philosophy

Faculty of Electrical Engineering

April 2017

AUTHOR'S DECLARATION

I declare that the work in this thesis was carried out in accordance with the regulations of Universiti Teknologi MARA. It is original and is the results of my own work, unless otherwise indicated or acknowledged as referenced work. This thesis has not been submitted to any other academic institution or non-academic institution for any degree or qualification.

I, hereby, acknowledge that I have been supplied with the Academic Rules and Regulations for Post Graduate, Universiti Teknologi MARA, regulating the conduct of my study and research.

Name of Student	:	Intan Rahayu binti Ibrahim
Student I.D. No.	:	2010475422
Programme	:	Doctor of Philosophy (Power Electronics) – EE990
Faculty	:	Electrical Engineering
Thesis Title	:	Power Converter for Dual-power Photovoltaic-Grid Energy System
Signature of Student	:	....
Date	:	April 2017

ABSTRACT

High frequency switching activities of power electronic devices in the power converter produce switching losses, harmonic distortions and raise high voltage and magnetic stresses in the power converter circuit, consequently affecting the efficiency and quality of output of the converter. In this research study, a new power converter utilizing low fundamental frequency switching technique is being proposed to resolve harmonics distortion issues. This research aims to develop switching and control technique for power converter in dual-power photovoltaic-grid energy system. 21-level cascaded H-bridge multilevel inverter is developed by cascading five of 5-level H-bridges with five separate PV sources. 5-level H-bridge produces high level of output "stepped" voltage with reduced number of power switches. The optimized switching strategy of proposed MhyPSO technique successfully reduced the THD level to 3.94% in the simulation circuit and 6.7% in the hardware circuit. Each of 5-level H-bridges is equipped with the individual boost regulator embedded with MPPT and battery management system. The operation and the synchronization of the power converter system is digitally controlled to ensure the system works at the maximum captured power and produces fixed 240V, 50Hz power supply in variation of environmental conditions. The supervisory controller administers the transition of supply and mode of operation, meanwhile, the converter controller commands electronic switches in power converter components. It is verified in the simulation works, the boost regulator circuit is capable of tracking maximum power point and boosting the PV module voltage to 72V. The simulation analysis of the battery management circuit verified that the algorithm implemented is succeeded in detecting PV current, evaluating charging mode and regulating charging current. The switchover circuit and supervisory controller is capable of monitoring the PV current and trigger the transition of power supply whenever PV current is below or above the pre-set condition. The transition delay recorded during the transition of power supply are 2.2ms and 4ms for transition of supply power from PV to grid and grid to PV respectively. All simulation works are verified with the experimental findings and it is concluded that all the research objectives have been achieved.

TABLE OF CONTENTS