UNIVERSITI TEKNOLOGI MARA

VOLTAGE CONTROLLED SINGLE PHASE MATRIX CONVERTER WITH LOW HARMONICS AND HIGH VOLTAGE CONVERSION RATIO

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CONFIRMATION BY PANEL OF EXAMINERS

I certify that a Panel of Examiners has met on 20th October 2015 to conduct the final examination of Mazratul Firdaus Binti Mohd Zin on her Master of Science thesis entitled " Voltage Controlled Single Phase Matrix Converter with Low Harmonics and High Voltage Conversion Ratio" in accordance with Universiti Teknologi MARA Act 1976 (Akta 173). The Panel of Examiners recommends that the student be awarded the relevant degree. The Panel of Examiners was as follows:

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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 result 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 other degree or qualification.

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

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ABSTRACT

Recently, with the rapid development of microprocessor-based technology, the power quality issues have become a major attention to the power distributor and the end-users. Due to the awareness growth among the consumers, the need of better quality of power utility has increased. One of the major concerns of the power quality issue is harmonics. The existence of harmonics in power system damages the sensitive equipment. Thus, there is an urgent need for innovation of the mitigation method for the harmonics disturbance. This project focuses on the harmonics reduction and the output voltage boosting in an AC-AC single phase matrix converter that operates by a closed-loop voltage control with adaptation of passive filter. The main objective of this research is to focus on the reduction of the harmonics content produced in an AC-AC single phase matrix converter at the input current, output current and the output voltage. Since a single phase matrix converter produces high harmonics that is detrimental which can cause overheating to equipment, power losses and affects the utility system end users, a method of reducing the harmonics has to be designed. A closed-loop control is designed for the AC-AC topology single phase matrix converter in order to control the total harmonic distortion and to gain a boosted output voltage. The SPMC functions as an improved ac-ac converter with a commutation strategy implemented and the switching topology is generated using SPWM signal. In this project, the proposed voltage controlled-SPMC is a combination of both closed-loop PI control and a passive filter to gain a better outcome by reducing the harmonics content and the output voltage. The closed-loop control design that operates to generate the SPWM is implemented using peripheral integral controller devices that are programmed using MPIDE software. In this work, the simulation is done using SimPower System blocks running under MATLAB/Simulink. An experimental test-rig is then constructed to verify the operation; incorporated with the digital closed-loop control, gate drives and power circuits. Additionally, a step change analysis has been carried out to investigate the response stability of the RMS output voltage with respect to the change of reference voltage. The proposed voltage controlled SPMC is proven to maintain the stability after the step change is being applied. The research and study in this paper is focused on the proposed voltage-controlled SPMC and the design of the closed-loop control. The total harmonic distortion of the system obtain is between the average of 1.72-3.75%. The voltage conversion ratio is increased from 1.0 to 1.25 in this project implementation. A successful test on higher voltage rating to the voltage controlled SPMC also has been implemented to ensure its reliability to be applied at practical distribution level. The voltage controlled SPMC is proven to be practically reliable with the ability to boost the output voltage plus sustaining low harmonics.

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