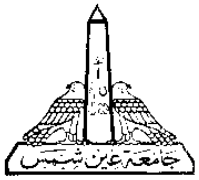

AIN SHAMS UNIVERSITY

FACULTY OF ENGINEERING

Electronics Engineering and Electrical Communications

Supercapacitor for photovoltaic applications

A Thesis submitted in partial fulfilment of the requirements of the degree of

Master of Science In Electrical Engineering

(Electronics Engineering and Electrical Communications)

By

Asmaa Alamin Ahmed Mohammed

Bachelor of Science In Electrical Engineering

(Electronics Engineering and Electrical Communications)

Faculty of Engineering, Benha University, 2013

Supervised By

Prof. Wagdi Anis

Prof. Ahmed Attiya

Cairo - (2019)

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Date: 07 October 2019

Statement

This thesis is submitted as a partial fulfilment of Master of Science in Electrical Engineering, Faculty of Engineering, Ain shams University.

The author carried out the work included in this thesis, and no part of it has been submitted for a degree or a qualification at any other scientific entity.

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Thesis Summary

Supercapacitors are extraordinary types of capacitors which are characterized by much larger electrical capacitance, light weight, flexible possibility and high power density. The associated advantages and importance can be observed when using in power electronic system especially solar cell systems. By combining with batteries, Supercapacitors could reduce the extraction of current in case of dense loads. In order to charge supercapacitor from power source like solar cell and feed a specific load, it would require to use a linear regulator. Despite the advantages and importance of conventional linear regulators, low efficiency of about 40% is one of their main drawbacks. Supercapacitor based low dropout regulator called by (SCALDO), is a linear DC to DC assisted technique that can be used to duplicated efficiency of conventional linear regulator. Therefore, supercapacitor is playing a crucial role to maximize the efficiency as a result of being nearly lossless voltage dropper element, it minimizes the losses in the pass element and power semiconductors. This research presents the mathematical principles of SCALDO and a simple implementation by using simple and costly effective electronic components. The proposed low dropout regulator is used to convert 12V to 5V. The designed high efficiency SCALDO linear regulator is appropriate for solar cell power systems applications.

On the other hand, a full packed supercapacitor was fabricated and studied based on composite nanomaterials. The composite consists of polyaniline and reduced graphene oxide (RGO-PANI) which was synthesized via functionalized ferrite on graphene oxide as corresponding PANI nucleation sites. This procedure dramatically increases the composite specific capacitance and lifetime when compared with crude PANI.

Asymmetric paper-based SCs were fabricated and electrochemically tested by using different electrolytes namely; KOH, H_2SO_4, H_3PO_4 and Na_2SO_4. These electrolytes correspond to strong alkaline, strong acid, weak acid and neutral electrolytes. The impact of various electrolytes was studied intensively by using Bio-Logic ultimate versatile multipotentiostat VSP 300 to perform impedance spectroscopy, Galvanostatic test and cyclic voltammetry as well. The highest achieved specific capacitance was more than 500 F/g of pure electric double layer behavior that is considered to be relatively high values of crude PANI or PANI-graphene composites electric double layer SCs. The composite was described and studied using scanning electron microscopy, Raman spectroscopy, transmission electron microscopy and X-ray diffraction.

Keywords:

Supercapacitor, linear regulators, LDO regulator, DC to DC converter, reduced graphene oxide, polyaniline, EDL supercapacitor, nucleation sites.

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