



925/C

A supercapacitor-battery hybrid converter for PV solar powered lighting systems in Sri Lanka

T.C.P.K. Wickramasinghe* and A.G.M. Lokuliyana

Department of Electrical and Computer Engineering, The Open University of Sri Lanka, Nawala, Nugegoda

DC power applications assure significant improvements in overall efficiency with reduction of cost, particularly when energizing the systems with renewable energy sources. In recent years, photovoltaic (PV) solar-based power generation made a revolutionary change in conventional electrical power usage in Sri Lanka. Due to the fluctuating nature of renewable resources, energy storage and voltage regulation are essential for reliable power supply, specifically for standalone applications. To harvest the maximum energy produced by PV panels, efficient storage systems capable of fast charging are required. At present, batteries are the commonly used storage systems in Sri Lanka, with no fast charging capability. This paper presents a study into the possibility of applying a supercapacitor-battery hybrid technique for standalone PV solar-based systems in Sri Lanka. The hybrid technique is used (i) to improve the voltage conversion efficiency and (ii) to optimize energy yield from the PV system.

Supercapacitor (SC) is achieved by depositing activated carbon on electrodes to create a highly distributed porous material in contact with an electrolyte, resulting in an extremely large surface area. Single-cell SCs are available from 0.1 to 5000F. The energy density of a SC is about 1000 times larger than a standard electrolytic capacitor, and the power density is about 10 times larger than electrochemical batteries. The equivalent-series-resistance of a typical SC is in the milliohm range, $\sim 0.3\text{m}\Omega$ to few hundreds of milliohms. Thus, the voltage change across the terminals of a SC provides an effective loss-free *voltage dropping* function in a new DC-DC converter design. This SC-based DC-DC converter is low noise, free of electromagnetic interference issues, and is less complex compared to other high-frequency converter designs. The converter can achieve end-to-end efficiencies from 83 to 90%, and can be used in a variety of electronic applications, which require voltage to step-down.

Key words: supercapacitors, DC-DC converters, efficiency.

tcwic@ou.ac.lk

Tel.: +94 112881272