

Design of a boost converter for a DC grid powered by a photovoltaic panel

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Electricity generation through renewable energy sources has gained interest in countries around the globe as such sources are environmentally friendly. Photovoltaic systems are becoming a popular renewable energy source. The main issue with the PV system is the intermittent nature of the output power. In addition, such system will be connected in weak distribution systems, which introduce stability and protection issues to the utility network. MicroGrid is an attractive solution to overcome the above issues. MicroGrid is a small power system with local generation and local loads which can be operated autonomously or by grid connected nodes. DC MicroGrid reduces power conversion losses at the point of generation and loads.

This paper discusses the development of a DC MicroGrid with photovoltaic systems as the electricity generation method. This paper also presents the design and simulation of a boost converter for the DC MicroGrid. The operating voltage of DC loads is 48 V. Therefore, the DC grid voltage was selected as 48 V. The selected photovoltaic panel, Mitsubishi PV-UJ225GA6, produces 225 W and 30 V at the Maximum Power Point (MPP) under steady state conditions. Therefore, a boost converter is required to interface the photovoltaic panel to the DC grid. The control function of the boost converter is to ensure that the PV panel is operating at the MPP.

A 250 W, 30V-48V boost converter was designed and simulated in EMTDC/PSCAD software. Then, the small signal model around the operating point of the boost converter was derived. Using the model, a closed-loop controller was developed for the converter to control the average inductor current. The results of the converter under open-loop and closed-loop are presented in this paper. According to the results, it was possible for the converter to deliver the required power at 48 V output voltage and the controller was able to follow the command reference current.