Control topology for high efficiency small scale wind energy conversion systems

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Abstract

This paper will present the importance of control topology for power systems used in wind energy conversion systems (WECS). The efficiency and the method of sizing the components of the system are different from one control method to the other. Also a control method is proposed and analysed by using a power factor correction (PFC) controller in a novel configuration suitable for modular design. By using modular design, the same converter can be used in multiple applications. A wind model is used in order to better simulate the behaviour of the system and test the MPPT algorithms. The proposed control topology for modular design is build around the UC3854 power factor controller. The novelty of this control structure is that allows a modular system design. The same converter can be used in multiple applications: MPPT controller for WECS, MPPT controller for photovoltaic systems, PFC, etc. Also this configuration allows easy interconnection with other systems. The advantages of using it are: implementation with analog controller, automatic switching between the two voltage loops (input voltage control and bus voltage control), proper start-up of the inverter and current short circuit protection. The simplified schematic of the step-up converter with UC3854 is presented in Fig. 1a). In Fig. 1b) is presented the start-up sequence of the system and how the current reference node (IREF) changes. For simplification, the inverter is modelled like a voltage source (because of its internal voltage loop that imposes the voltage on the DC bus). The experimental results validate the theoretical and simulated ones.

Fig. 1. a) Proposed control structure; b) Start-up sequence of the system.

References

