Announcing the Final Examination of Xi Chen for the degree of Doctor of Philosophy

Time & Location: July 1, 2019 at 9:30 AM in Harris Corporation Engineering Center (HEC) 356
Title: Analysis, Design and Efficiency Optimization of Power Converters for Renewable Energy Applications

DCâ€“DC power converters are widely used in renewable energyâ€“based power generation systems due to the constant demand of highâ€“power density and highâ€“power conversion efficiency. DCâ€“DC converters can be classified into nonâ€“isolated and isolated topologies. For nonâ€“isolated topologies, they are typically derived from buck, boost, buckâ€“boost or forth order converters and they usually have higher conversion efficiency than isolated topologies. However, with the applications where the isolation is required, LLC resonant converter is an attractive selection because of its soft switching, high powerâ€“density, high efficiency, etc.

In lowâ€“power applications, such as battery chargers and solar microinverters, increasing switching frequency can reduce the size of passive components, current ripple and rootâ€“meanâ€“square current, resulting in higher powerâ€“density and lower conduction loss. However, switching losses, gate driving loss and electromagnetic interference may increase as a consequence of higher switching frequency.

Several optimization approaches have been presented to improve the efficiency, powerâ€“density and reliability of power converters in this dissertation. In first part, an adaptive switching frequency modulation technique is proposed to improve efficiency based on the precise loss model of a cascadedâ€“buckâ€“boost converter. Due to the major power losses are from the inductor, a new lowâ€“profile nanocrystalline inductor is designed to significantly reduce the magnetic loss. To further improve the efficiency, the adaptive switching frequency modulation technique is applied on the converter with designed nanocrystalline inductor.

In second part, a novel dualâ€“input DCâ€“DC converter is developed according to the LLC resonant topology. This design concept minimizes the circuit components by allowing single resonant tank to interface multiple input sources. Semiâ€“active rectifiers are used on the transformer secondary side to improve efficiency while maintaining the voltage gain. Besides, a burstâ€“mode control strategy is proposed to improve the light load efficiency. This control strategy is able to be readily implemented on any power converter since it can be achieved directly through firmware and no circuit modification is needed.

Major: Electrical Engineering

Educational Career:
Bachelor's of Photovoltaic and Solar Energy, BS, 2014, University of New South Wales
Bachelor's of Applied Physics, BS, 2014, South China University of Technology
Master's of Electrical Engineering, MS, 2016, University of Central Florida

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Qun Zhou, Electrical and Computer Engineering
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Approved for distribution by Issa Batarseh, Committee Chair, on June 6, 2019.

The public is welcome to attend.