In the field of renewable energy, solar photovoltaic is growing exponentially. Grid-tied PV micro-inverters have become the trend for future PV system development because of their remarkable advantages such as: Enhanced energy production; High reliability; Simple design, installation, and management. Conventional approaches for the PV micro-inverters are mainly in the form of single-phase grid connected and they aim at the residential and commercial rooftop applications. It would be advantageous to extend the micro-inverter concept to large size PV installations such as MW-class solar farms where three-phase AC connections are used.

This dissertation presents a new zero voltage switching control method that is suitable for low power applications such as three-phase micro-inverters. The proposed hybrid boundary conduction mode (BCM) current control method increases the efficiency and power density of the micro-inverters and features both reduced number of components and easy digital implementation.

Different BCM ZVS current control modulation schemes are compared based on power losses break-down, switching frequency range, and current quality. Based on the loss analysis, a dual-mode current modulation method combining ZVS and zero current switching (ZCS) schemes is proposed to improve the efficiency of the micro-inverter.

Finally, a method of maintaining high power conversion efficiency across the entire load range of the three-phase micro-inverter is proposed. The proposed control method substantially increases the conversion efficiency at light loads by minimizing switching losses of semiconductor devices as well as core losses of magnetic components. This is accomplished by entering a phase skipping operating mode wherein two phases of an inverter are disabled and three inverters combined to form a new three phase system with minimal grid imbalance.

Major: Electrical Engineering

Educational Career:
Bachelor’s of Electrical Engineering, BS, 2007, Shahrood University of Technology
Master’s of Electrical Engineering, MS, 2010, Shahrood University of Technology

Committee in Charge:
Dr. Issa Batarseh, Chair, Electrical Engineering and Computer Science
Wasfy B. Mikhael, Electrical Engineering and Computer Science
Thomas Wu, Electrical Engineering and Computer Science
Saeed Lotifard, Electrical Engineering and Computer Science
Nasser Kutkut, College of Business Administration

Approved for distribution by Dr. Issa Batarseh, Committee Chair, on January 20, 2014.

The public is welcome to attend.