To relieve energy shortage and environmental pollution issues, renewable energy, especially PV energy has developed rapidly in the last decade. The micro-inverter systems, with advantages in dedicate PV power harvest, flexible system size, simple installation, and enhanced safety characteristics are the future develop trend of the PV power generation systems. The double-stage structure which can realize high efficiency with nice regulated sinusoidal waveforms is the main stream for the micro-inverter.

This thesis studies a double stage micro-inverter system. Considering the intermittent nature of PV power, a PFC with energy storage is integrated into the system. When the solar power is less than required, PFC can drag power from utility grid.

The DC/DC stage of micro-inverter is realized by a LLC converter, which can realize soft switching automatically under frequency modulation. However it has complicated relationship between voltage gain and load. Thus conventional variable step P&O MPPT techniques for PWM converter are no longer suitable for the LLC converter. To solve this problem, a novel MPPT is proposed to track MPP efficiently. Simulation and experimental results verify the effectiveness of the proposed MPPT.

The DC/AC stage of micro-inverter is realized by a BCM inverter. By using duty cycle and frequency modulation, ZVS is achieved through controlling the inductor current bi-directional in every switching cycle. This technique requires no additional resonant components and can be employed for various low power applications on conventional full-bridge and half-bridge inverter topologies. Three different current mode control schemes are derived from the basic theory of the proposed technique. They are referred to as Boundary Current Mode (BCM), Variable Hysteresis Current Mode (VHCM), and Constant Hysteresis Current Mode (CHCM) in this paper and their advantages and disadvantages are compared. Simulation and experimental results demonstrate the feasibilities of the proposed soft-switching technique and its control schemes.

The PFC converter is applied by a single stage bi-flyback topology, which combines the advantages of single stage PFC and flyback topology together, with its additional advantages in low intermediate bus voltage and current stresses. A digital controller without current sampling requirement is proposed based on the specific topology. To reduce the voltage spike caused by leakage inductor, a new snubber cell combined soft switching technique with snubber technique together is proposed. Simulation and experimental waveforms are the same as theoretical analysis.

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The public is welcome to attend.