Precedence of renewable energy sources over traditional fossil fuel based energy supply is well established in the wake of twenty first century. However, most attractive renewable sources come with its inherent challenges of intermittency and inherent unreliable nature, especially when compared to today’s stable, day ahead based power grid. Thus, integration of energy storage with the renewable energy sources are one of the toughest and sought after challenges. In this dissertation, the current state of the art of power conversion systems that integrates photovoltaic and battery energy storage systems, and it appeared that the bidirectional power flow required in and out of the energy storage device can be improved by optimizing its modulation and control. Additionally, the traditional multistage conversion systems, although offer the required integration ability, but suffers from lack of flexibility of operation and reduced efficiency and increased cost. Based on this, a novel three port converter was developed which allows bidirectional power flow between battery and the load, and unidirectional power flow from the photovoltaic port. The bidirectional converter was optimized in terms of modulation scheme and used for the proposed three port converter. Subsequently, the proposed converter was improved both in terms of cost and efficiency by minor alteration of the topology. The improved version of the three port is reduced in functionality but a perfect fit for the targeted microinverter application. Overall control system was designed to allow multidirectional power flow between the energy sources and loads, with faster response time so that fast transients in renewable sources can be addressed. The bidirectional converter and both the proposed three port converters were analyzed theoretically and an experimental prototype was built to verify the performance.

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The public is welcome to attend.