Abstract

The work presented in this thesis is targeted towards the development of a new high-frequency isolated single-stage PV-microinverter topology (250W, 30V-220V/110V, DC to AC converter) that would offer better efficiency and reduced switch voltage stress. A phase-shift full-bridge converter-based DC to AC converter (Full Bridge microinverter) is chosen as the basic isolated single-stage DC to AC converter. The Full Bridge (FB) microinverter topology consists of a full-bridge converter, high-frequency transformer, cycloconverter, and an inductive filter. In this converter, some topological changes are incorporated along with a modulation scheme that helps to achieve soft-switching of all primary and secondary side devices and to eliminate circulating current in the primary side of the converter. A Secondary-side Phase Shift Modulation (SPSM) scheme presented in this thesis would satisfy the aforementioned objectives far better compared to the Primary-side Phase Shift modulation scheme of the FB-microinverter. Subsequently, the voltage ringing problem caused by the leakage inductance of the transformer and the output capacitance of cycloconverter devices is identified as a cause for concern. It makes the voltage-clamp necessary and reduces the efficiency of any Full Bridge (FB) converter irrespective of the modulation schemes used. In this work, a Step Voltage Switching (SVS) technique has been developed to address this voltage ringing issue. The basic idea of the SVS technique is to apply a time-critical two-stepped voltage waveform to the input of the cycloconverter. This SVS technique is first implemented in a Secondary-side Phase Shift (SPS) controlled DC-DC converter (SVS DC-DC) by incorporating some topological changes. It resulted in almost negligible voltage-clamp requirement, and thus, there was considerable (around 3%) improvement in efficiency. Finally, the SVS technique has been implemented for FB-microinverter (SVS DC-AC) to eliminate the voltage ringing that otherwise appears across the cycloconverter MOSFETs. It is found that the proposed SVS technique can be suitably used for any conventional isolated buck-derived topologies in both DC-DC and DC-AC conversions to improve the efficiency of the converter.