Abstract

The switched mode power electronic converters which convert one level of electrical voltage into another by switching pulses are popular in the renewable energy domain because of their high efficiency and compact size. Therefore the main issue investigated in this work is to select proper converter, the DC bus voltage control and an optimized power sharing mechanism between the non-isolated boost converters connected to multiple PV modules in parallel.

Several techniques were proposed to obtain a proper load sharing, which requires complex circuits, expensive voltage and current sensors and intercommunicating wires, etc. The non-isolated converters in this work are built on the same architecture, but the difference being in the inductance value, current and voltage constraints on components and switching frequency. The modelling of the boost converter, their parallel operation, power sharing and tuning of the PI converter using particle swarm optimization techniques (PSO) is done in Matlab/Simulink. This modern evolutionary control PSO-PI tuning algorithm performance is considerable because of its improvement in transient characteristics in terms of peak amplitude, lesser rise time, peak overshoot and settling time. The performance index for various error criteria for the proposed controller using PSO algorithm is proved to be lesser than the controller tuned by a PI controller with transient performance specification (T-PID) method.

When coming to implementation in hardware, the challenge in power sharing such as component tolerances, variations in unit parameter and imbalances in line impedance is overcome by UC3843 PWM-PI controller IC. This current mode control IC senses the proportional input current to inductor and it is added up with slope compensation voltage and
it is sensed as sawtooth waveform at the current sense input pin of the controller IC. Accordingly the duty cycle is varied, but the switching frequency is fixed. The net result is in regulation of output voltage. The output voltage control of the DC/DC converters over a wide variation of the PV voltage and module temperature is considered.

The 48 Volt hardware board developed is of few watts, which is tested with DC power supply unit and also with PV modules connected with common Rheostat as resistive load. The simulation and hardware results are presented and same is discussed. However, this board can be scaled-up to high powers with higher order components and additional protection circuits. The paralleled converters were tested with two PV modules with irradiance and temperature variations.

The DC bus voltage is controlled and the power sharing between the non-isolated boost converters is achieved with difference being approximately 5 mA at same irradiance at regulated voltage. Considering the DC powered residence, this 48Volt system based on renewable energy can be beneficial in reducing the feeder losses and almost all domestic appliances can be operated under same voltage system under the same roof.