Analysis of the Interleaved Isolated Boost Converter with Coupled Inductors

Abstract

Introduction:
A configuration with many parallel-connected boost-flyback converters sharing a single active clamp has been proposed, which requires $n + 1$ magnetic elements, where $n$ is the phase number. A bidirectional boost coupled with a flyback stage has been proposed, giving rise to a nonisolated structure, where soft-switching is achieved at the expense of a high circulating current. A family of isolated converters providing a continuous input current is described, where two isolated flyback converters, including cross-coupled windings and a single active clamp, are used. These topologies require two transformers with three windings each. A cascaded boost and isolated half-bridge stages sharing the same switching cell are described, in which the total power is processed twice. An interleaved boost with series-connected outputs is presented, which is able to achieve input current ripple cancelation at a predetermined duty-cycle value. A double dual boost has been analyzed, with the focus on small-signal modeling and control design. An isolated converter with an interleaved current source generator employing a resonant tank for zero-current
commutation is proposed. A voltage doubler rectifier is also used to increase the voltage gain. However, operation at duty-cycle values below 50%, i.e., in a nonoverlapping mode, is not possible, unless suitable provisions are taken to limit the device overvoltage when both switches are open.

**Existing system:**

Conventional step-up converters, such as the boost converter and flyback converter, cannot achieve a high step-up conversion with high efficiency because of the resistances of elements or leakage inductance; also, the voltage stresses are large. A boost converter (step-up converter) is a DC-to-DC power converter with an output voltage greater than its input voltage. It is a class of switched-mode power supply (SMPS) containing at least two semiconductors (a diode and a transistor) and at least one energy storage element, a capacitor, inductor, or the two in combination. Filters made of capacitors (sometimes in combination with inductors) are normally added to the output of the converter to reduce output voltage ripple.

**Proposed system:**

Continuous input current can also be obtained using an interleaved boost input stage, for the nonisolated version, and for the isolated version herein called interleaved boost with coupled inductors (IBCI). Similar interleaved topologies are
described, where the two coupled inductors are replaced by one or two inductors and a transformer. In addition, the value of the output capacitors is reduced, so as to exploit the resonance between them and the secondary side inductor $L$, thus changing some commutations from zero voltage to zero-current type.

**Advantages:**
- continuous input current, due to ripple cancelation
- inherent current sharing
- reduced switch voltage stress
- zero-voltage commutations in a wide load range
- leakage inductance exploitation
- clean device voltages without ringing

**Applications:**
- fuel cells (FCs)
- single photovoltaic (PV) modules

**Block diagram:**

- **INPUT**
  - DC supply

- **Full bridge inverter**
  - 5 V DC
  - 12 V DC

- **Gate driver circuit**
  - BUFFER circuit
  - PIC controller circuit

- **High frequency transformer**

- **Voltage doubler**

- **Load**
Tools and software used:

- MPLAB – microcontroller programming.
- ORCAD – circuit layout.
- MATLAB/Simulink – Simulation.