Reliability Evaluation of Conventional and Interleaved DC–DC Boost Converters

Abstract

Introduction:
In order to increase the power processing capability and to improve the reliability of the power electronic system, interleaved converters are one of the recent research issues in power electronics engineering. Many articles have studied different aspects of interleaved boost converters. For instance, development of a high-efficiency dual-input interleaved dc–dc converter for reversible power sources to convert low-voltage reversible power sources to a high-voltage dc bus individually or simultaneously by the phase-shift control. A novel multidevice interleaved boost converter that interfaces the fuel cell with the power train of hybrid electric vehicles is proposed. A fault-diagnostic method is introduced for three-phase interleaved dc–dc converters using only the dc-link current derivative sign features. To achieve high step-up gain, an interleaved winding-coupled boost converter is proposed. A two-phase interleaved boost converter is used as critical conduction mode power factor corrector, which uses a variation-tolerant phase shifter to ensure accurate 180° phase shift between the two interleaved
converters. Application of interleaved dc–dc boost converters for the photovoltaic generation system and a maximum power point tracking controller is proposed.

**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:**

This paper calculates the reliability of interleaved boost dc–dc converter and presents a comparison with the reliability of the conventional boost converter. Two different operation scenarios
(half-power and full-power operation) are considered for the interleaved converter. The failure rate of converter components are calculated for different operation scenarios. Also the power loss effect on the failure rate of components and on the reliability of converters is discussed.

Advantages:
- An increase in power.
- Reliability of components.

Applications:
- Photovoltaic (PV) applications.
Block diagram:

```
INPUT DC SUPPLY  -->  INTERLEAVED BOOST CONVERTER  -->  LOAD
                  /                            /
                12V DC                       5V DC
                |                            |
                v                            v
               OPTO COUPLER CIRCUIT      PIC CONTROLLER WITH BUFFER
```
Tools and software used:

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