Design and Implementation of Buck-Boost Converter

A Voltage Mode Control Approach for DC-DC Converters

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Introduction

- • Buck-Boost Converter provides stable voltage output for variable input sources.
- • Combines a Boost and Synchronous Buck converter.
- • Applications: Portable devices, renewable energy systems, EV charging.

Design of Buck-Boost Converter

- • Circuit Design Overview
- • Key Components:
- - Switches: S1, S2
- - Inductors: L1, L2
- - Capacitors: C1, C2, Co
- • Specifications:
- - Input Voltage: 10V-16V
- - Output Voltage: 12V
- - Load Current: 2A

Working Principle

- • Mode I (S1 ON, S2 OFF):
- - C1 charges, L1 magnetizes.
- - C2 discharges, L2 magnetizes.
- • Mode II (S1 OFF, S2 ON):
- - L1 demagnetizes, C2 charges.
- - Energy transfer to output.

Voltage Conversion

- • Voltage conversion ratio: Vo/Vin = D/(1-D)
- • Buck Mode: Output Voltage < Input Voltage (D < 0.5)
- • Boost Mode: Output Voltage > Input Voltage (D > 0.5)

Simulation Results

- • MATLAB Simulation Output:
- - Buck Mode: 16V input, 12V output.
- - Boost Mode: 11V input, 12V output.
- • Stable output voltage achieved.

Experimental Results

- • Buck Mode: 16V input, 12V output.
- • Boost Mode: 11V input, 12V output.
- • Dynamic response for step input changes.

Conclusion

- • Buck-Boost converter provides a simple and efficient solution for variable input voltages.
- • Ensures system stability and fast transient response.
- • Suitable for low-power portable applications.