Graph

Further analysis examined the relationship between duty cycle and voltage gain for both converters (Table 3 and Figure 5). The proposed converter exhibits a negative voltage gain, which increases significantly with increasing duty cycle,confirming the derived gain equation.

Battery Charger/USB Charging Ports in Portable Devices: Everyone wants their smartphone, tablet, or portable battery pack to charge quickly without heating up their portable devices. A synchronous BUCK converter can be used for this application. Typically, a charging port for a mobile device is a micro USB port. It accepts a regulated 5 V. The charging circuits are on the inside of the mobile device, which is often a BUCK converter.

AMOLED (Active Matrix OLED) Displays in Wearable Devices: Powering AMOLED displays wearable devices requires DC-DC switching converters that offer high power efficiency and tight output voltage accuracy.

DDR-SDRAM Memory: DDR-SDRAM memory requires DC-DC switching converters with tight accuracy requirements and ability to support fast load transients.

Energy Harvesting Systems: High efficiency switching converters are a vital block in energy harvesting systems. It is the most adequate voltage regulation method in such low power systems. Boost converters with clock-controlled input impedance are used for MPPT (Maximum Power Point Tracking) operation.

DVFS (Dynamic Voltage Frequency Scaling): Performance-Power in microprocessors and digital signal processing circuits is managed using switching converters. Increasing the digital circuit supply leads to increasing the performance (speed) at the expense of dynamic power consumption and vice versa.

4. ADVANTAGES AND APPLICATIONS

The key advantages of the proposed DC-DC buck-boost converter are:

- **High Efficiency:** The converter demonstrates high efficiency, especially under varying load conditions, addressing a common drawback of traditional buck-boostconverters.
- **Negative Output Voltage with High Gain:** The topology allows for generating a negative output voltage from a positive input voltage, with the capability of achieving high voltage gain through a low duty cycle.

Potential applications for this converter include:

- **Audio Amplifiers:** Negative voltage rails are often required for biasing operational amplifiers in audio circuits.
- **Instrumentation Amplifiers:** These amplifiers benefit from negative voltage rails for improved common-mode rejection.

5. CONCLUSION

This paper presented a DC-DC buck-boost converter topology based on the buck converter structure, enabling high efficiency and generation of a negative output voltage with high voltage gain. Simulation results validate the proposed design and demonstrate its superior performance under varying load conditions compared to a conventional buck converter.

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