ELECTRICAL, THERMAL, AND EMI DESIGNS OF HIGH-DENSITY, LOW-PROFILE POWER SUPPLIES

by

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(ABSTRACT)

This work presents the analyses and designs of high-density, low-profile power supplies, including the electrical, thermal, and EMI aspects. Emphasis is placed on forward and flyback converters.

The efficiency improvements of employing synchronous rectification are theoretically derived and experimentally verified in forward and flyback converters. The performances of synchronous rectifiers in forward converters are analyzed with regards to transformer reset and SR driven method. The effectiveness of synchronous rectification in flyback converters is evaluated in various operation modes and control schemes. The paralleling techniques utilized to realize high-density, low-profile power conversion are presented. Current sharing in transformer paralleling is addressed and evaluated in forward topology. The performance and the operation principles of one-choke and two-choke interleaved forward converters are analyzed.

The thermal management of high-density power supplies in sealed enclosures is optimized using computational fluid dynamics simulations. The theoretical limit of power density

due to thermal constraint is determined. In addition, the thermal-design optimization guidelines are given and verified experimentally.

A systematic methodology is developed to facilitate the analysis and design of conducted EMI problems in high-density power supplies. Partial element equivalent circuit method is employed for parasitic parameter extraction. Layout and packaging are optimized to minimize conducted EMI noises. Noise predictions by Saber simulations are confirmed by experimental measurements.

To my wife

Lily

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