

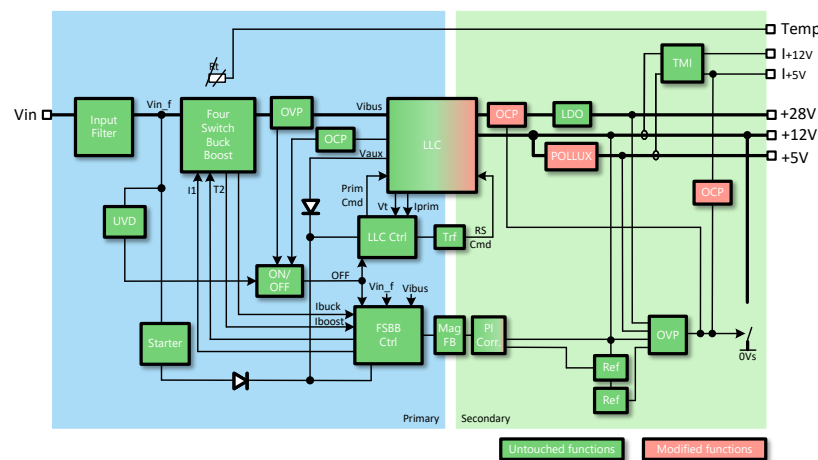
ADHA Power Module: Architecture and Measured Performance of the Engineering Model

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Abstract

This paper presents the power module of the Advanced Data Handling Architecture (ADHA), an ESA initiative standardizing on-board data handling units around the CompactPCI Serial Space backplane. The module integrates a nominal and a redundant 203 W power chain in a single 6U board. Each chain cascades two soft-switched GaN cells: a four-switch buck-boost (FSBB) pre-regulator under quadrangle control at 292 kHz, and an LLC cell operated as a DC transformer (DCX) at its resonant frequency. The FSBB timings minimizing the inductor RMS current are computed offline over the full operating plane and approximated by analog circuits; no digital controller is used. Switching timings measured on the engineering model over 223 operating points are confronted with the recomputed optima: the analog implementation carries a median RMS excess of 16–19 % above half load. Measured efficiency at ambient reaches 90.8 % with all outputs loaded and 92.1 % without the 28 V rail; the estimated loss breakdown identifies the litz LLC transformer as the dominant contributor. A second part details the evolutions prepared for the qualification model (QM): a revised architecture (point-of-load 5 V, single-point 12 V regulation, integrated output protections, improved FSBB control) and planar magnetics. The predicted gain is one efficiency point at the worst-case operating corner and two points on average over the operating range.



Block diagram of one chain of the ADHA power module, qualification-model architecture.

Keywords: ADHA, power module, DC-DC converter, four-switch buck-boost, LLC, DCX, GaN, soft switching, quadrangle control, space power electronics.

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