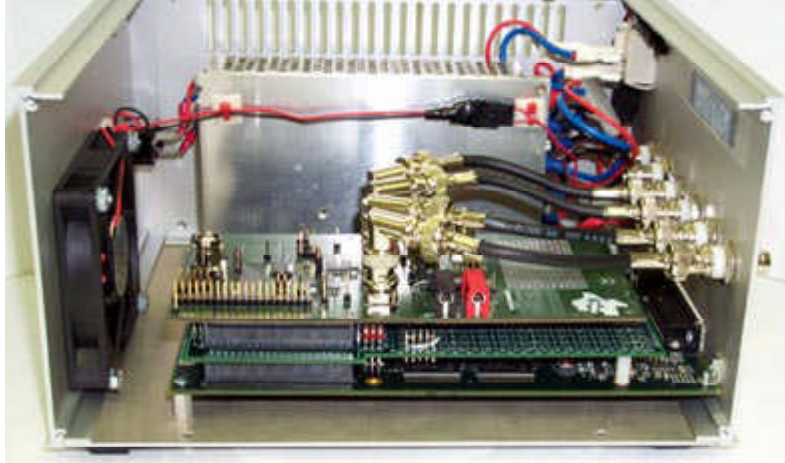


Intelligent dc-dc Converter Technology Developed and Tested



Prototype digital controller for the intelligent dc-dc converter.

The NASA Glenn Research Center and the Cleveland State University have developed a digitally controlled dc-dc converter (see the photograph) to research the benefits of flexible, digital control on power electronics and systems. Initial research and testing has shown that conventional dc-dc converters can benefit from improved performance by using digital-signal processors and nonlinear control algorithms.

A standalone digital controller has been integrated with a 1-kW full-bridge dc-dc converter to evaluate digital-control algorithms. The standalone digital controller is made of four circuit boards packaged in one assembly: a digital-signal processor board, a complex programmable logic device board, an analog-to-digital converter board, and an analog signal isolation board. The analog signal isolation board isolates and filters the dc-dc converter output voltage signal, the analog-to-digital converter board converts the analog signal to a digital signal, and the digital-signal processor board runs the data through the nonlinear control algorithms. The complex programmable logic device board manages the pulse-width-modulation switching of the dc-dc converter transistors through four discrete digital signals.

A unique nonlinear control algorithm was developed and has shown superior performance over its linear counterpart. Using the digital controller, 1-kW dc-dc converter, and the nonlinear control algorithm, the controller has demonstrated a load transient response time improvement of 150 percent along with a 50-percent reduction in the load transient magnitude.

Future work includes the research of digital control algorithms that can tailor the converter's impedance, reduce electromagnetic interference in the system, and guarantee stable operation under all conditions. These advances will result in dc-dc converters with improved performance and electrical power systems with lower design and integration

costs.

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