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AWR® Success Story

Michael Boers, Ph.D. Student, Wins IEEE MTT-S Power Amplifier Competition, 85% PAE Achieved with Microwave Office

MACQUARIE UNIVERSITY

CREE®

Application:
Power Amplifier

AWR Software:
Microwave Office™

COMPANY PROFILE

Michael Boers received his Bachelor of Electrical Engineering degree from the University of Sydney in 2005. Since 2006, he has been working towards a Ph.D. at Macquarie University, New South Wales, Australia, where he is focusing on the design of millimeter-wave circuits and systems for next-generation gigabit wireless networks at the university's Centre for Microwave and Wireless Applications. In particular Michael is interested in system-level design, transmitter architectures, and high-efficiency power amplifier design, as well as methods that will reduce the time-to-market and cost of millimeter-wave IC systems.

Cree, Inc. (www.cree.com) is a market-leading innovator and manufacturer of semiconductors and devices that enhance the value of solid-state lighting, power and communications products by significantly increasing their energy performance and efficiency.

THE DESIGN CHALLENGE

Michael won the 2007 IEEE Microwave Theory & Techniques Symposium (MTT-S) Student Design Competition in June. The competition required the design of a power amplifier (PA) with the highest possible efficiency at an output power above 5W and at a frequency above 1GHz. To meet these criteria Michael designed his amplifier for an output frequency of 1.2GHz, an output power of >38dBm, and an efficiency above 80% (prior year winner).

AWR®'s Microwave Office software was used for the design of the amplifier. The unique, integrated environment enables the concurrent design and simulation of PCB or IC RF circuits through the unified data model, as well as providing seamless connection to EM simulators such as Sonnet through the EM Socket interface. Instead of using multi-match software to synthesize the input and output matching networks, an input and load termination optimization method was used to obtain the maximum power-added-efficiency and matching networks were designed around these components.

The transistor chosen for this winning design was a 10W RF power GaN HEMT, the device and samples for which were obtained courtesy of Cree (CGH40010). The transistor used is available in a screw-down package and is not internally matched. It comes with an accurate non-linear model, which is critical for the design of high-efficiency power amplifiers.

THE SOLUTION

What design problem did AWR software help solve?

The purpose of the competition was to challenge aspiring engineers to design a device with the highest efficiency at an output power above 5W and at a frequency above 1GHz. In order to meet these strict criteria and surpass the efficiency of past winners, I designed my amplifier for an output frequency of 1.2GHz, an output power of >38dBm and an efficiency above 80%. The premise of my project was that EDA

> "The combination of the integrated Microwave Office environment and accurate Cree device models enabled me to achieve a design in a matter of days that simulated to within a few percent of my measured output power and achieved greater than 85% PAE."
>
> *Michael Boers*
> *Ph.D. Student*
> *Macquarie University*
> *www.mq.edu.au*

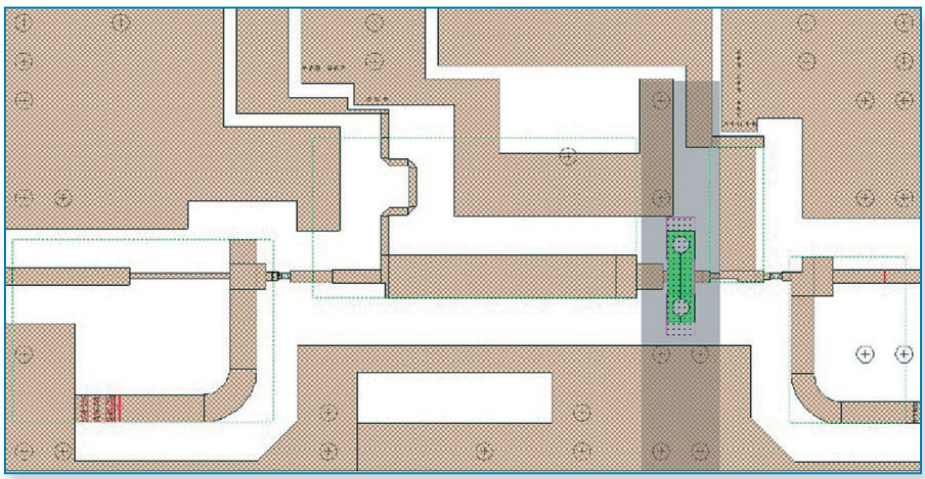
simulation tools, accurate device models, and sensible design rules can produce first-pass power amplifier design success. I needed a design tool with an intuitive-to-use, integrated environment that would help me to quickly and accurately design a device to meet the stringent competition criteria, and that would work seamlessly with my electromagnetic (EM) simulator tool.

Why was Microwave Office selected?

I chose Microwave Office as my design software tool because its integrated environment provides the ability to significantly improve the performance, capacity, and accuracy of designs, as well as shortening design cycle time for the design and simulation of printed circuit board (PCB) and RF integrated circuits (RFICs). In addition, the software enables seamless integration with the third-party electromagnetic (EM) simulator I used for my EM analysis.

What were the key benefits of using AWR software?

The Microwave Office overall stability and intuitiveness, as well as the powerful environment, enables the fast and accurate design of devices to meet exacting criteria, and its seamless integration with third-party tools enabled me to use the EM simulator of my choice to perform analysis.



Microwave Office layout of the winning power amplifier design.

SS-MACR-CREE-2012.11.9

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