

Cree Speeds Development of High-Performance GaN Doherty Amplifiers by 70%

Microwave Office Capabilities Provide First-Pass Design Success of Complex 2.1-GHz Circuits

CUSTOMER BACKGROUND

While Cree, Inc., based in Durham, NC, is best known outside the microwave industry for its pioneering of blue, green and white LEDs for solid-state lighting and backlighting, it has long been a major force in development of wafers and devices for RF and microwave wireless applications based on silicon carbide (SiC) and gallium nitride (GaN). The company's SiC MESFETs and GaN HEMTs are increasingly used in commercial wireless and defense amplifier applications thanks to the company's efforts with the inherent characteristics of these materials. Current products include SiC MESFETs that deliver 60 W at 2.7 GHz, GaN HEMTs such as the latest CGH21240F that deliver 240 watts at 4 GHz, and GaN HEMT-based MMICs that deliver 3 watts from 20 MHz to 6 GHz and 25 W from 2.5 to 6 GHz.

THE DESIGN CHALLENGE

GaN has risen in a few short years from a promising RF power technology to a "must have" in amplifiers for defense applications, and is moving quickly into the wireless arena, currently the domain of silicon LDMOS devices. Cree has long concentrated on making GaN a viable alternative, and to achieve this must create new devices, faster, and at lower cost. The company uses AWR's Microwave Office® design environment to bring many of these products to fruition, including all of its hybrid-based GaN power amplifiers. One of the most impressive of these is the CDPA21480 Doherty amplifier (the current power architecture of choice for base station transceivers) that delivers 480 W peak and 80 W average RF power for WCDMA applications in the 2110 to 2170 MHz UMTS band.



This CGH21240F GaN HEMT power amplifier supports Cree's commitment to "HIGH GaN RF POWER".



Application:
Gallium Nitride-based
(GaN) Doherty
Amplifier

AWR Software:
Microwave Office®



"The speed and ease of use of Microwave Office together with the accurate passive component and transistor models allows us to realize first pass design success. We are also able to create more designs in a given time, which makes our development engineers more efficient."

*Simon Wood
RF Product Development Manager
Cree, Inc.
www.cree.com*

THE SOLUTION

What design problem did AWR's software help you to solve?

Doherty amplifiers have unique characteristics that when coupled with digital predistortion linearization provide substantial increases in efficiency when driven by signals with high peak-to-average ratios. A Doherty amplifier is actually comprised of two separate amplifiers that function under different signal conditions. By using Microwave Office, Cree's designers were able to optimize the Doherty's performance over a range of power levels using individual source and load pull measurements for both these carrier and peaking amplifiers.

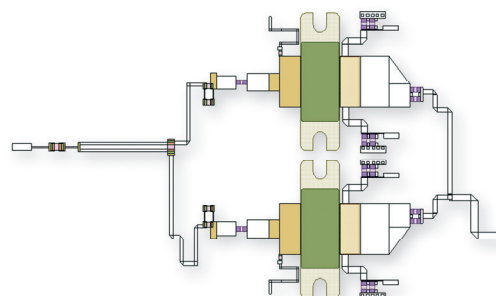
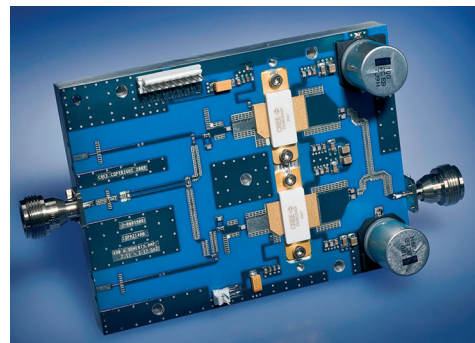
The design task was further aided considerably by the software's simulation accuracy as well as the accuracy of its models, which when complemented by Cree's accurate large-signal models reduced design time by as much as 70%.

The amplifier design required the use of the full breadth of Microwave Office software's capabilities, from linear frequency-domain and harmonic balance simulation through electromagnetic (EM) analysis. Designers specifically noted the straightforward, seamless approach to the design flow, as well as simulation speed, linking of layout and schematic, and excellent support provided by AWR's support team.

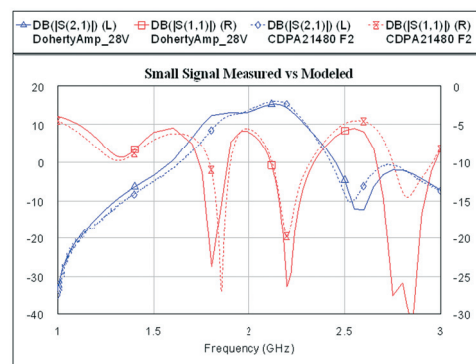
"The speed and ease of use of Microwave Office together with the accurate passive component and transistor models allows us to realize first pass design success on the demonstration amplifiers we provide to our customers," said Simon Wood, RF product development manager at Cree. "In addition to reducing our time to market, we are also able to create more designs in a given time, which makes our development engineers more efficient."

ABOUT MICROWAVE OFFICE

Microwave Office design suite is the industry's fastest growing microwave design platform and has revolutionized the communications design world by providing users with a superior choice. Built on the AWR high-frequency design environment platform with its unique Unified Data Model™, Microwave Office software is intuitive and offers powerful, innovative technologies and unprecedented interoperability, enabling integration with best-in-class tools for each part of the design process. The Microwave Office design suite includes all of the essential technology: linear and nonlinear circuit simulators, EM analysis tools, integrated schematic and layout, statistical design capabilities, and parametric cell libraries with built-in DRC.



The complete Cree CDPA21480 Doherty amplifier (top photo) and corresponding Microwave Office software layout (lower image).



The exceptional agreement between "turn-on" measured small signal parameters of the Doherty amplifier and the Microwave Office simulations results meant there was absolutely no tuning of the PCB required and these are true "first turn-on results."



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