

Qorvo

Qorvo Solves Entire Non-Uniform Distributed Power Amplifier MMIC Using AWR Software

Key Challenges

Qorvo, a leader in high-performance RF components for wireless communication, designs wideband power amplifier monolithic microwave integrated circuits (MMICs) suitable for electronic warfare (EW) systems. These systems require amplifiers with high power, wide bandwidth, and high efficiency to which Qorvo researchers have developed power amplifier MMICs utilizing the non-uniform distributed power amplifier (NDPA) approach. Showcasing impressive results, these NDPA MMICs (Figure 1) are designed for saturated operation.

This requires accurate electromagnetic data up to the 5th-7th harmonic frequency, which results in a very large mesh/matrix. Because solving the entire structure was not practical, it was never attempted, but upon hearing about the nearly linear scaling in the AWR AXIEM planar EM simulator within the AWR Design Environment platform, Qorvo fellow Chuck Campbell elected to take the AXIEM challenge.

Application

- ▶ MMIC Power Amplifier

Software

- ▶ Cadence® AWR Design Environment® Software Portfolio, including:
 - Cadence AWR® AXIEM® Planar Electromagnetic (EM) Simulator

Benefits

- ▶ Speed of simulations
- ▶ High accuracy
- ▶ Design efficiency

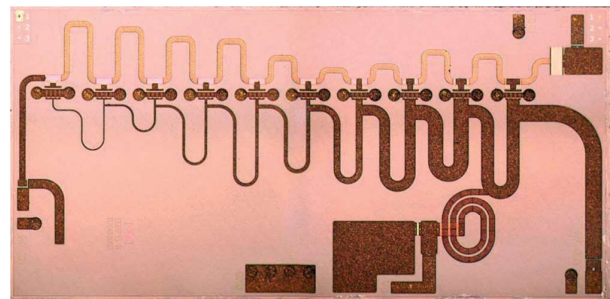


Figure 1: Photograph of the NDPA MMIC

The Solution

Prior to EM, Qorvo had never attempted to simulate the entire MMIC circuit of their NDPA, which includes more than 32 ports and, for a gridded planar EM tool, upwards of 30,000 unknowns.

Nevertheless, Campbell decided to put the AXIEM simulator to the test. The result: the entire structure from DC to 120GHz was solved in under two minutes per frequency using a quad-core desktop PC with 4G RAM (32-bit OS) (Figure 2).

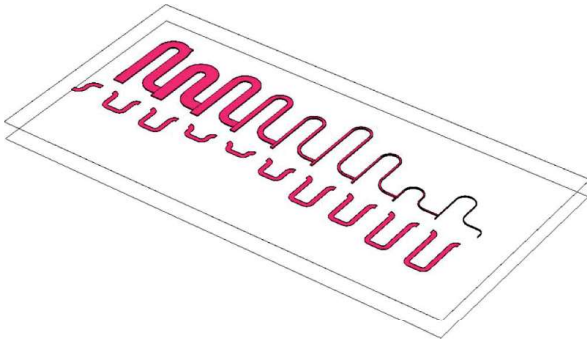


Figure 2: 32-port AXIEM layout

What's more, the software's shape pre-processor and hybrid adaptive meshing algorithms meant that the final mesh size was little more than 6,000 unknowns, which was highly efficient.



The power and speed of AXIEM 3D planar EM software made it possible to accurately and efficiently simulate the entire structure of this very complex NDPA MMIC.

Chuck Campbell, Qorvo

Summary

The power and speed of the AWR AXIEM simulator made it possible to accurately and efficiently simulate the entire structure of the very complex Qorvo NDPA MMIC device. The simulated and measured results, as shown in Figure 3, were in good agreement, and, in the 1.5–17GHz band, experimental results of 9–15W saturated output power with an associated PAE were typically above 20%. To Campbell's knowledge, these results are among the highest reported for a monolithic solid-state power amplifier covering this frequency range.

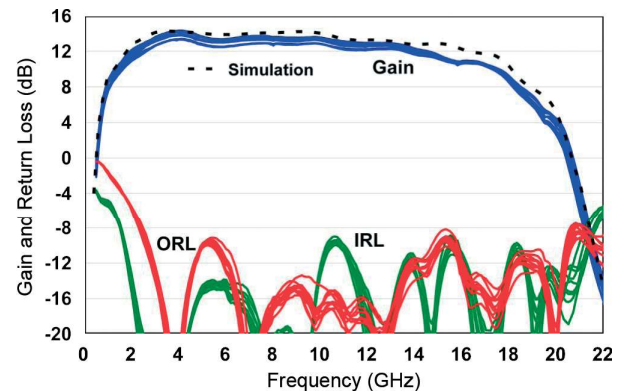


Figure 3: 30V small signal gain and return loss (simulated small signal gain is the broken line)