

Sumitomo Electric and Cadence

Compact GaN HEMT Doherty Amplifier
Using AWR Software

Key Challenges

Next-generation 4G/5G telecommunication systems require power amplifiers (PAs) to operate with high efficiency over a wide frequency range in order to provide multiband and multi-standard concurrent operation. In these systems with increased bandwidth and high data rates, the transmitting signal is characterized by high peak-to-average power ratio (PAPR) due to wide and rapid variations of the instantaneous transmitting power. Therefore, it is important to provide high efficiency at maximum output power and at lower power levels over a wide frequency bandwidth. Sumitomo Electric designers were tasked with developing an innovative high-power, wideband Doherty amplifier covering nearly 1GHz of operation bandwidth at 2.25GHz. The compactness of the design was of critical importance. In addition, low impedance levels from the transistor die to the packaged device gate terminal were required for circuit matching (Figure 1).

Application

- ▶ Amplifier

Software

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

Benefits

- ▶ Ease of use
- ▶ Speed of simulations
- ▶ High accuracy
- ▶ Proficient support services

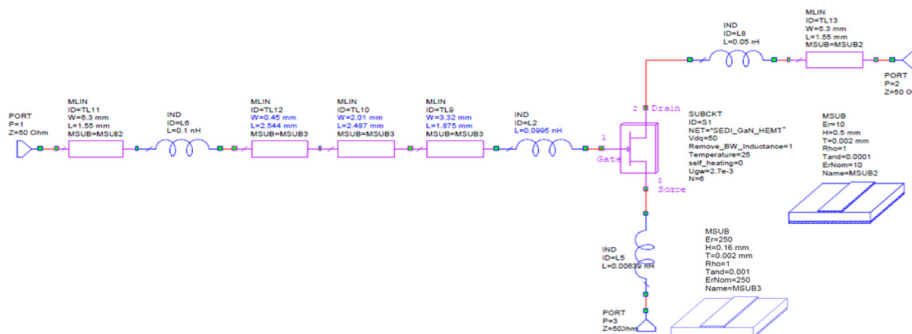


Figure 1: Equivalent circuit of packaged devices

Figure 2 shows its input return loss performance and Figure 3 show the layout of the low-impedance transform network and related results in AWR Microwave Office software.

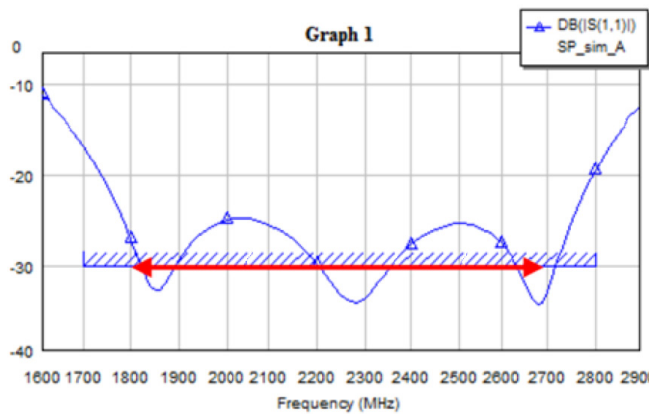


Figure 2: Return loss (dB[S11])

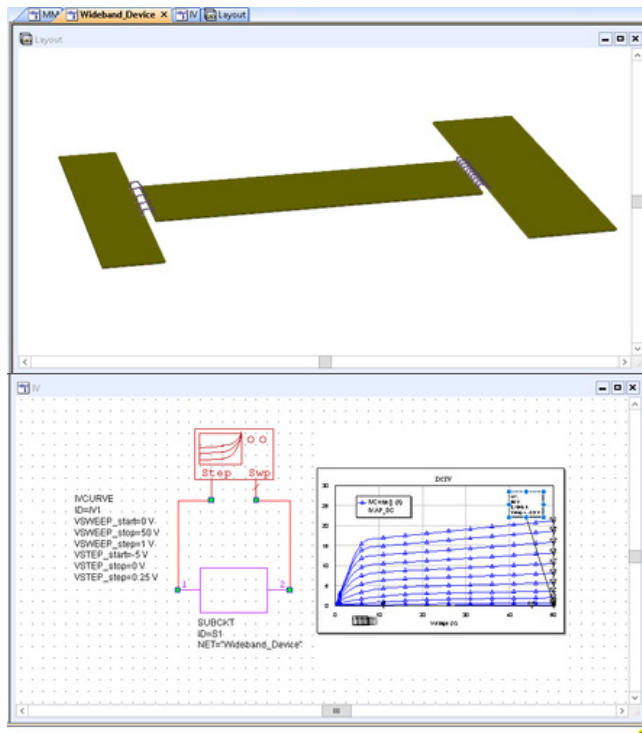


Figure 3: The layout (top) of the low-impedance transform network and the DC IV curves (bottom)

Solution

The designers chose the AWR Design Environment platform, specifically AWR Microwave Office circuit design software and AWR AXIEM planar EM simulator, for this PA design, because of the software's high rate of first-pass design success. The fast and accurate AWR AXIEM EM analysis helped overcome the challenge of using different high dielectric materials. The device achieved average efficiencies of 50%-60% for output powers up to 100W and significantly reduced the cost, size, and power consumption of the transmitters.

Summary

Sumitomo Electric designers highlighted the simplicity and accuracy of the simulations, the intuitive user interface, simulation speed, and excellent support services as benefits that helped them achieve success with this novel design. They said, as an example, that a simple matching network designed in AWR software is different from other legacy software. When practically verified on hardware using the same device and built with different networks, the legacy software required tuning whereas AWR software was spot on.



After conducting the verification of our Doherty amplifier with several witnesses (amongst them non-users of AWR software), there was no argument about which simulation tool came out on top, especially in terms of speed and accuracy.

James Wong, Sumitomo Electric