Design of an X-band GaN Power Amplifier

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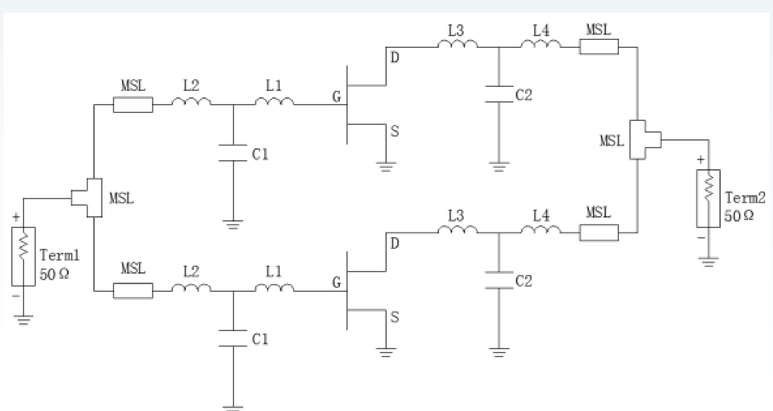
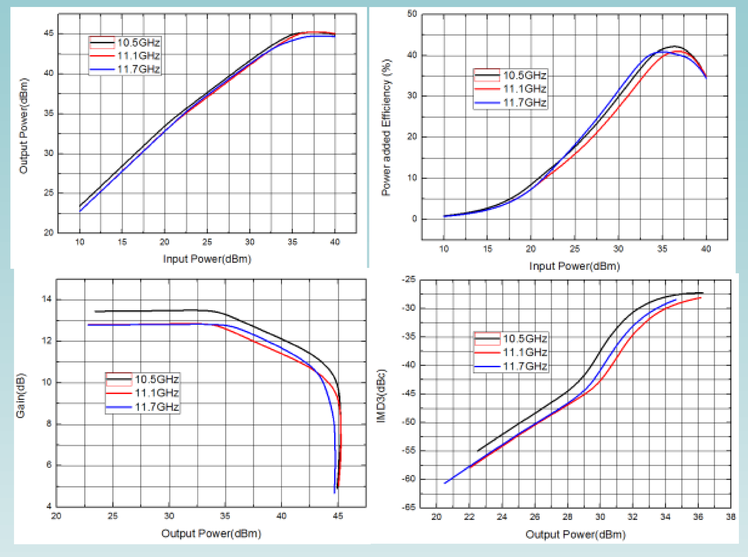
Introduction

In recent years, with the accelerated deployment of 5G networks, demands for network capacity, complexity, and latency have increased significantly. Microwave technology, serving as a crucial transmission solution in scenarios lacking fiber optics, offers advantages such as flexible deployment and low cost. Its usage is expected to expand further with the evolution of 5G [1] [2]. In point-to-point microwave backhaul applications, the power and linearity of the power amplifier are among the most critical factors affecting system transmission performance and distortion [3]. Highly linear power amplifiers facilitate the construction of advanced and stable microwave backhaul bearer networks, consequently imposing increasingly stringent requirements on amplifier performance.

SIMULATION AND DESIGN

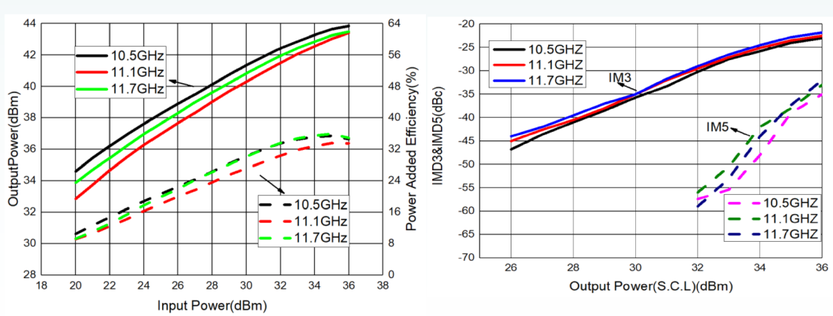
Simulation results indicated that the first L-C stage at the input is most sensitive to the amplifier's performance metrics and requires very short gold wire lengths.

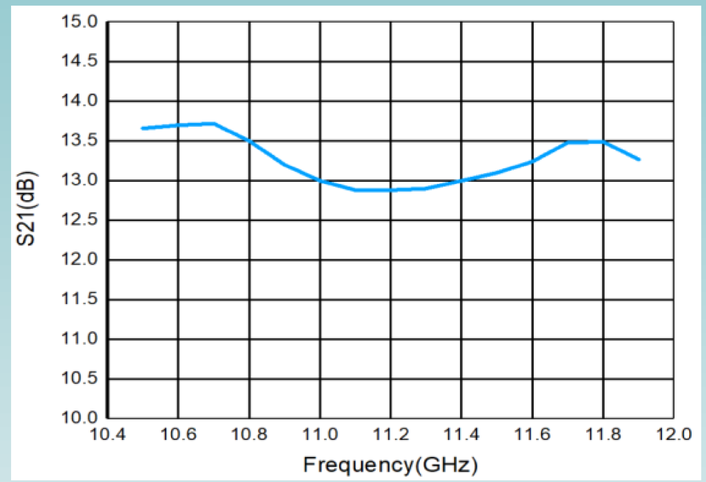




PERFORMANCE TESTINGIS

(1). Under continuous-wave saturation conditions, the amplifier generates approximately 40W of heat. The temperature rise of the test fixture causes the amplifier die to operate at an elevated temperature, leading to a reduction in saturated output power capability.(2). Insertion losses caused by SMA connectors and the surface roughness of the fabricated circuit board were not rigorously characterized in the engineering tests.





Conclusion

This paper has successfully designed a low-cost, highperformance, internally matched X-band power amplifier by leveraging the respective advantages of GaN chips and ceramic materials. Testing confirms that within the 10.5–11.7 GHz band, the amplifier achieves a small-signal gain greater than 12.7 dB, a continuous-wave saturated output power of 43.4 dBm, and an average power-added efficiency of 34%. At an output power of 30 dBm (S.C.L) and Δf=10 MHz, the third-order intermodulation distortion (IMD3) reaches -35 dBc, representing an advanced level domestically in China. Compared to similar international products, this design offers a gain improvement of 2–3 dB and a low-frequency bandwidth extension of approximately 200 MHz, while maintaining comparable performance in saturated output power and power-added efficiency. The research presented in this paper can provide valuable reference for the design of X-band power amplifiers.