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Evaluation of Commercial GaN HEMTs for Pulsed Power Applications

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Introduction

The present study investigates the behaviour and performance of commercially available GaN HEMTs when used for the amplification of pulsed waveforms. GaN technology is not as well understood and established as its GaAs counterpart and a number of studies have reported potential problems, namely:

- Current reduction due to surface states & buffer traps
- Virtual gate formation
- Gate and drain lag transients
- Non-linearities in the source resistance

These effects could potentially be exacerbated by operating the device in pulsed mode and the experiments conducted aimed to study such phenomena and assess the suitability of commercial GaN HEMTs to pulsed RF applications such as Radar.

Test Setup

MATLAB was used to control the instruments through GPIB and LAN interfaces and also for data acquisition and processing. The pulsed RF was generated by a purpose built interface board which safely turned the transistor fully on and fully off to ensure that full transients would be undergone by the device.

Results

In this section we present the changes in pulse power, rise times and fall times at different input powers as the PRF is increased. Transients on output waveforms are also presented and analysed.

The pulse power was found to remain largely constant across the PRF range. This would suggest that there is no current reduction due to trapping effects or self-heating at the power levels used.

It is apparent that the relationship between the pulse output power and the input power is a linear one albeit some slight variations as the transistor approaches saturation.

The board was also used to transform the TTL voltage levels generated by the Agilent 81110A into the bias levels required to switch the transistor on and off.

The accuracy of such figures was however affected by the difference in the number of samples points available at different PRFs and by the envelope averaging performed during data analysis. The rise and fall times may therefore be considered largely constant across the PRF range for a given power level.

Conclusions

Future work will focus on repeating the experiments presented in this paper at much higher power levels and on devices with higher power ratings. Bare die HEMTs will also be subjected to similar tests at frequencies ranging from 6 to 10 GHz.

Acknowledgements

The authors wish to thank Cree Inc and Novacom Microwave for supplying free samples, and providing great assistance and support.

This work has been partially supported by MBDA.