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Institute of Robust Power Semiconductor Systems

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Bachelor- / Research- / Master-Thesis

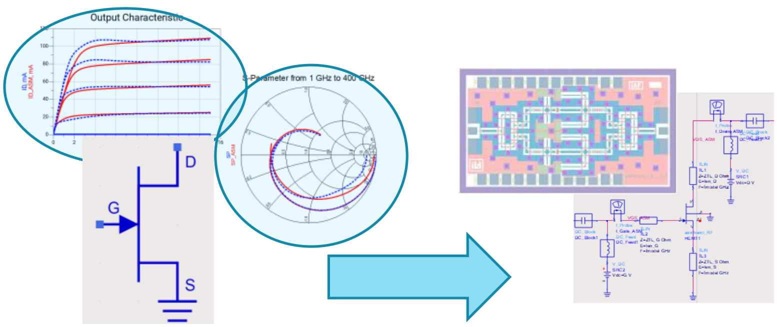
RF

GaN mHEMT Modeling in D-Band for Improved Performance Prediction

Motivation:

The increasing demand for high-performance devices in high frequency bands for next-generation communication systems and radar applications has driven significant interest in Gallium Nitride (GaN) semiconductor devices. In particular, GaN-based metamorphic High Electron Mobility Transistors (mHEMTs) have emerged as a promising solution due to their superior electron mobility and high breakdown voltage, these devices are able to operate at millimeter-wave frequencies with high power levels. The Fraunhofer IAF GaN technology is currently state of the art with superior output power levels even at E- (60-90 GHz) and D-band (110-170 GHz) frequencies. Especially the D-band is of great interest for emerging technologies such as 6G communication and advanced sensing, presents unique challenges for circuit designers given the high frequency, thermal, and power demands.

For most applications accurately predicting transistor behavior is essential to ensure the circuit functions as intended. Precise modeling is crucial for designing schematics and layouts that perform reliable after fabrication, as it allows engineers to anticipate the actual behavior of the devices and minimize the risk of performance deviations.



One issue of newest technologies is the lack of precise models for active devices. However, to ensure accurate representation across all operating regions, a model must be adaptable to the actual performance of the transistors. The Advanced Spice Model (ASM) provides a solid base for this, offering the flexibility needed to adjust the specific behavior of GaN transistors and therefor is a wide used model for transistor description.

Goals:

- Enhance the ASM model that represents DC, small signal and large signal behaviour of the GaN technology under various operating conditions.
- Improved description of different effects occurring in GaN transistors, such as non-linear behavior, memory effects, charge trapping and thermal behavior.
- Implementation of a scalable model for various transistor sizes.

The specific scope and objectives of the project will be tailored in collaboration with the student, based on their interests and knowledge. Further, it is possible to work on the topic as Bachelor-, Research-, or Master thesis with adjusted workload.