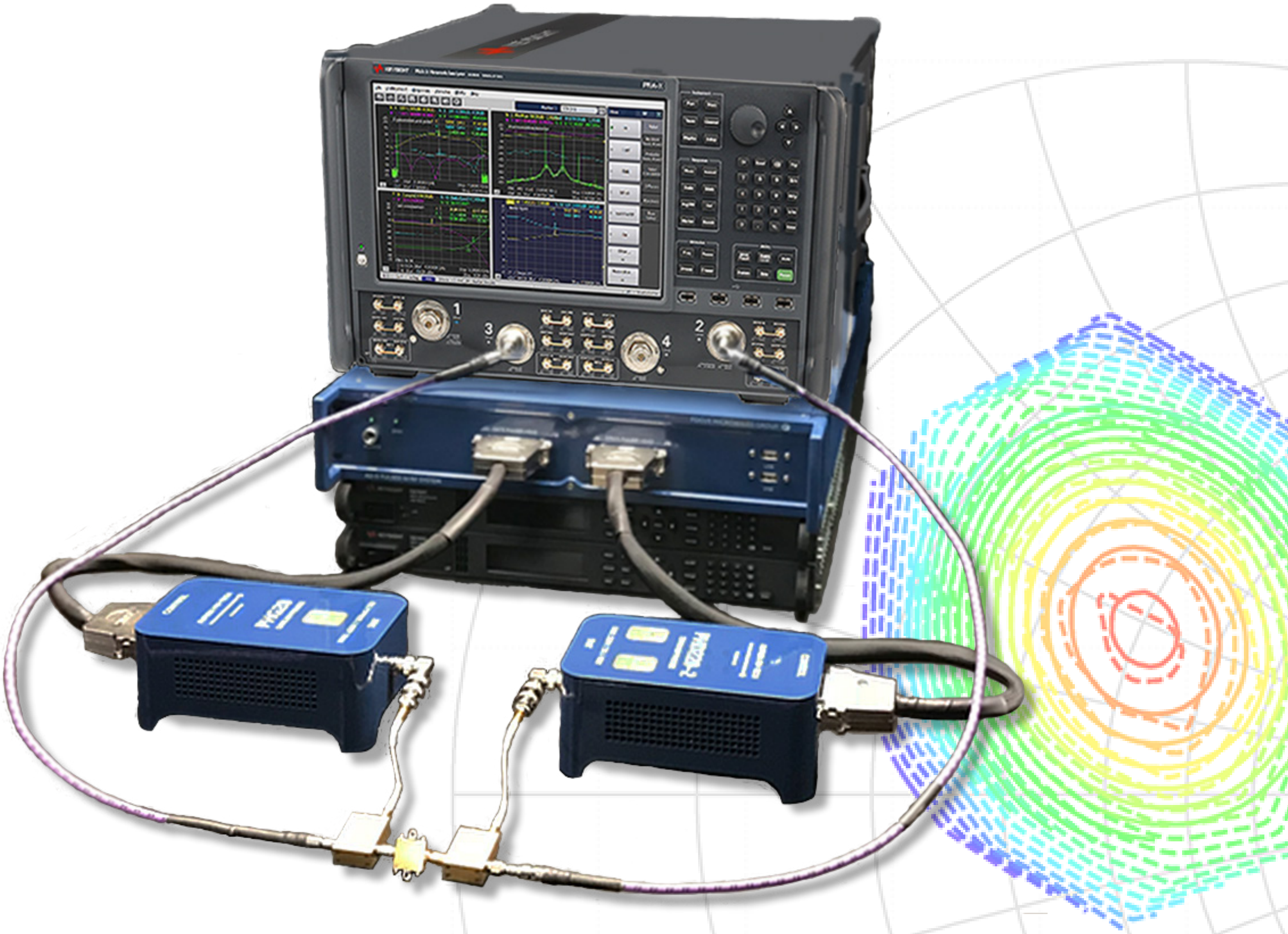
Focus Compact Modeling



The intuitive advanced compact model

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Introduction

The Focus Compact Model (FCM) utility is a streamlined software package designed to be used with Focus' AURIGA high-end pulse system, that is used to generate Compact Models for transistors from their Pulsed-IV and wideband pulsed s-parameter data.

This is achieved by generating a network of lumped circuit elements that represent accurately the fundamental linear & non-linear behaviour of the device over a broad range of bias and power range.

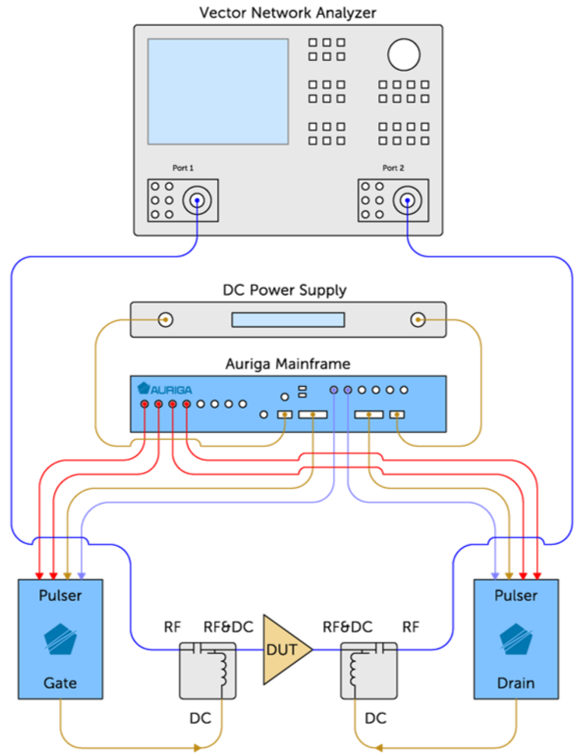
The result of the modelling is a netlist and compatible with- the most common CAD tools used in RF Design such as AWR Microwave office (MWO) and Keysight Advanced Design Studio (ADS).

Key features of the FCM:
Linear and Non-Linear Compact Transistor Model Extraction of III-V materials (GaN HEMT or similar model).
High frequency FET model parameters from a combination of DC and S-parameter measurements.
Gate-lag and drain-lag trapping.
Basic thermal model extraction.

Linear Model:
8 Extrinsic parameters (RG, RD, RS, LG, LD, LS, CPG, CPD)
8 Bias dependent Intrinsic parameters (RGD, Ri, CGS, CGD, CDS, GM, RDS, & Γ)

Non-Linear Model:
NL Capacitances CGS & CGD
NL Current Sources IDS
NL Diodes DGS & DGD
Export Capability to ADS and MWO.

Pulsed IV & S-Parameter Meas. Setup

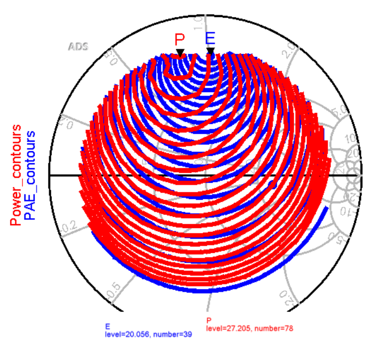


Simulation

Experimental conditions:
Vgs = -3.3 V Vds = 40 V Ids = 30mA Pavail_in=10dBm Freq = 2GHz
Source Impedances (Polar) F0: 0.80, 150.02° F1: 0.00, -171.71° F2: 0.66, -98.33°

Pdel_dBm Max	27.232
Max power Rho	0.763/101.702

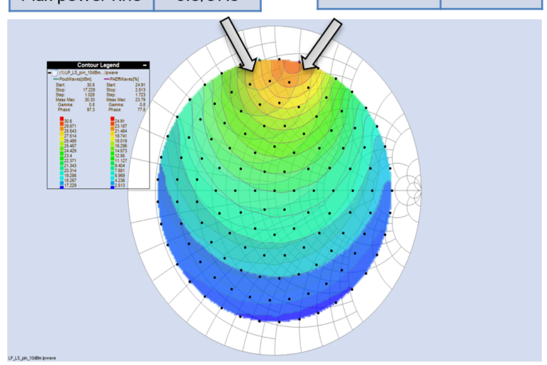
PAE Max	20.076
Max PAE Rho	0.747/88.305



Measurements

Pout Max	27.18 dBm
Max power Rho	0.8/97.3

PAE Max	20.091
Max PAE Rho	0.8/77.8



Equivalent Circuit HemT

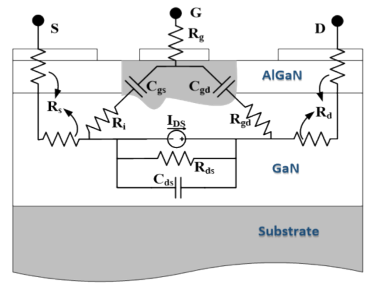
The purpose of electrical representation or equivalent circuit of HEMT or any transistor in the form of lumped circuit elements is to implement and simulate its static and RF behaviour in CAD tools. This technique is particularly useful and often directly correlated to physical entities within the device structure, as illustrated below.

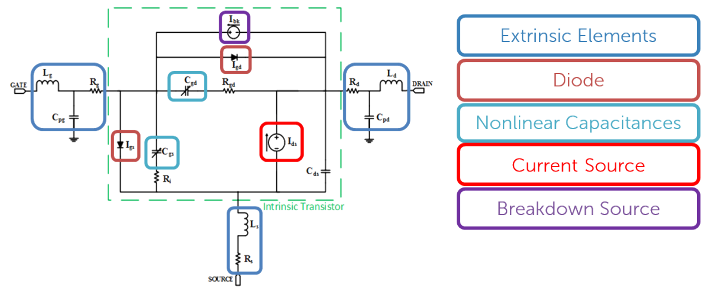
This is divided into two parts:

i) The Intrinsic part where the region under the gate (modulation occurs here) represented with a set of 8 intrinsic elements (RGD, Ri, CGS, CGD, CDS, GM, RDS, Γ).

ii) The Extrinsic part represented with a set of 8 extrinsic elements (RG, RD, RS, LG, LD, LS, CPG, CPD). These elements need to be extracted for small signal model implementation. The extraction process will be discussed in the following section.

AlGaN/GaN HEMT transistor





Keysight ADS Data Display

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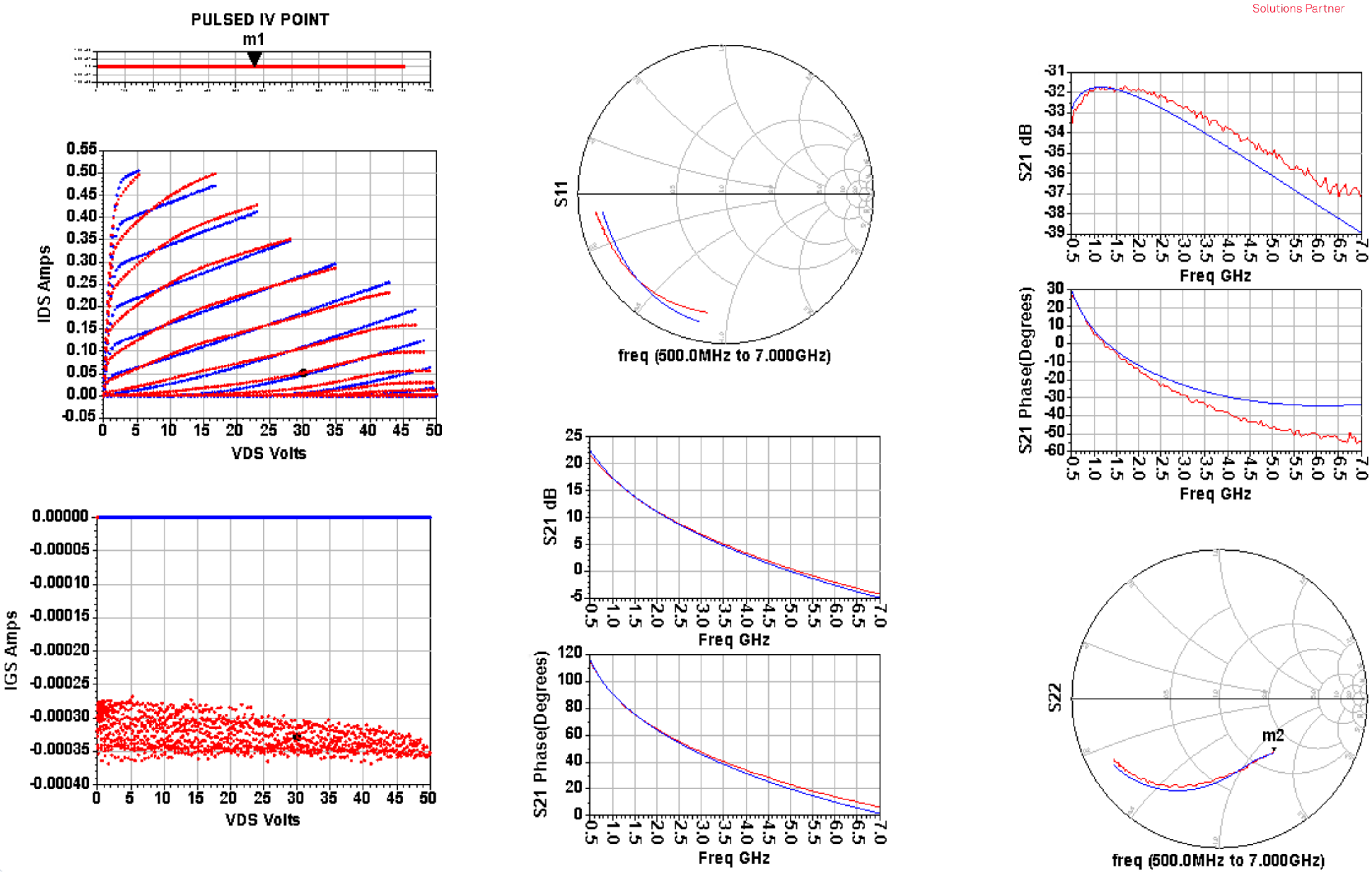


Extraction & Example

Linear Elements Extraction

The linear model extraction is a crucial step as this will be the basis for the non-linear model development.

i) From a set of initial extrinsic values, de-embedding of S-parameters is done at the intrinsic reference plane of the transistor.

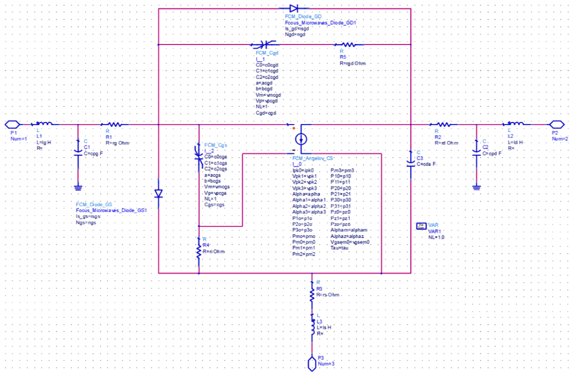
ii) Using these intrinsic S-parameter measurements, an explicit calculation of the intrinsic elements is achieved for each frequency. These intrinsic parameters need to be independent of frequency and this condition is checked during the optimization process.

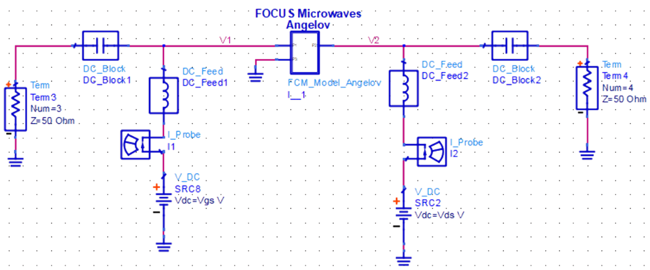
iii) If the intrinsic elements depend on the frequency, a new set of extrinsic elements are provided.

iv) An optimization algorithm is used in a loop to generate iterative steps for the extrinsic parameters that give a correct set of extrinsic elements. These elements are independent of bias.

EDA Example

The Focus Compact Model portfolio is fully supported in all major EDS tools including AWR Microwave office and Keysight Advanced Design System.





Optimisation Process