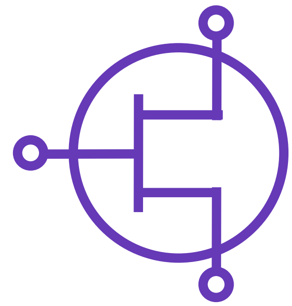
GaAs MESFET MODEL

Model Features

- Broadband (DC to 40 GHz)
- Large-signal model (Modelithics-Enhanced Angelov)
- Measurement Validations:
  - Pulsed I-V (25C to 85C)
  - Multi-bias S-parameters (25C to 85C)
  - Load pull (25C)
- Advanced model feature: enabling intrinsic I-V sensing
- IP3 validated against MwT spec



HMT-MWT-MWT1F-001
MwT-1F
Discrete GaAs MESFET

HMT-MWT-MWT1F-001

Model Description

The HMT_MWT_MWT1F_001 is a non-linear model for the MwT-1F a discrete 630 um GaAs MESFET (additional information is available at www.mwtinc.com). The model is based on the extraction of a customized Angelov non-linear model that is validated against the following Modelithics measurement data: I-V, S-parameters & load pull.

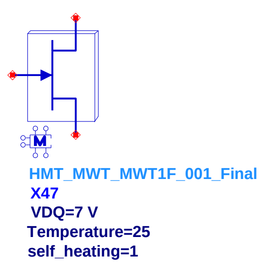
Technical Notes

- Model is optimized for 2, 4 and 7V operation (54.81mA(30% IDSS), 91.35 mA (50% IDSS) and 109.62mA (60% IDSS)).
- Model Parameters:
  - **VDSQ:** For setting the optimum bias point of the model (default=7V).
  - **Temperature:** represents the backside ambient temperature, validated at 25C and 85C.
  - **Self_heat:** switch for the electrothermal model (0 or 1), 0= self-heating is turned off, 1 (default)= self-heating is turned on.
  - **BWremoval:** 0 includes wire assembly (only) used in measurements, 1 (default) sets model reference planes at the center of the gate, drain, and source bond pads.

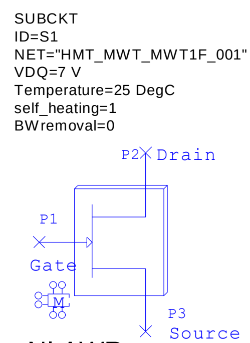
Model Simulation Settings

- **I-V:** self_heat: 0 for I-V simulations (self heating model turned OFF), Temperature=25C
- **S-Parameters:** self_heat: 1 for CW bias, Temperature=25C
- **Load Pull Validations and Single-tone Power sweeps:** self_heat: 1 for CW bias; Temperature=25C.

Model Representation

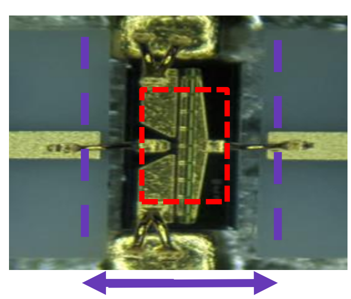


Keysight ADS



NI AWR

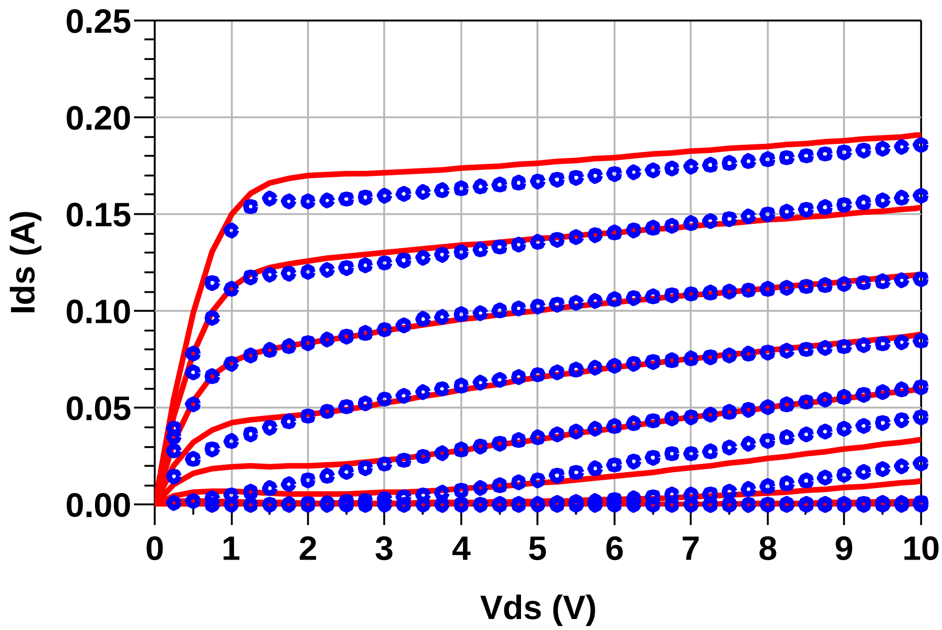
Reference Planes



Model and Measurement Reference Planes (BWremoval=1)

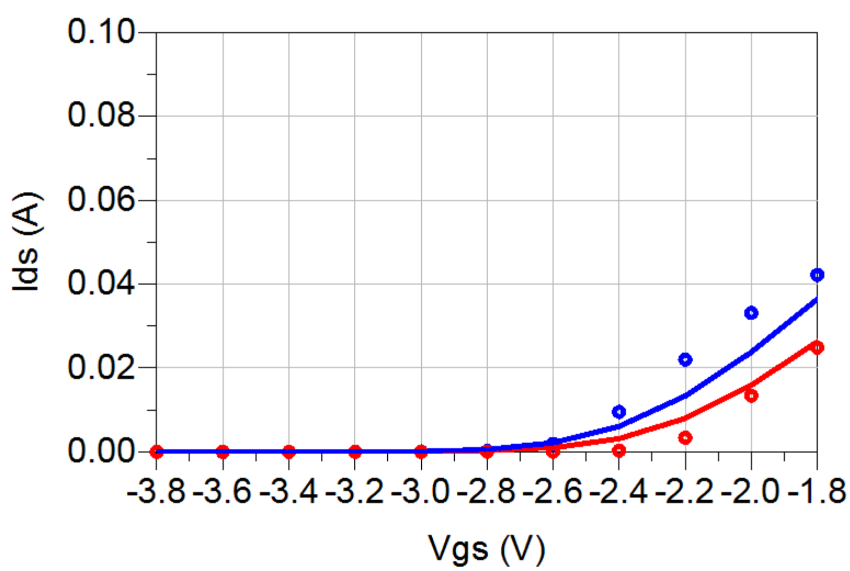
Model and Measurement Reference Planes (BWremoval=0)

DC I-V Characteristics: VDSQ = 7V, 25C



Legend: Red Solid lines - Model data, O Symbols - Measured data
Simulated at 25C with VGS varying from -4 to 0V in steps of 0.4V,
VDS varying from 0 to 10V in steps of 0.25V. Model self_heat = 0.

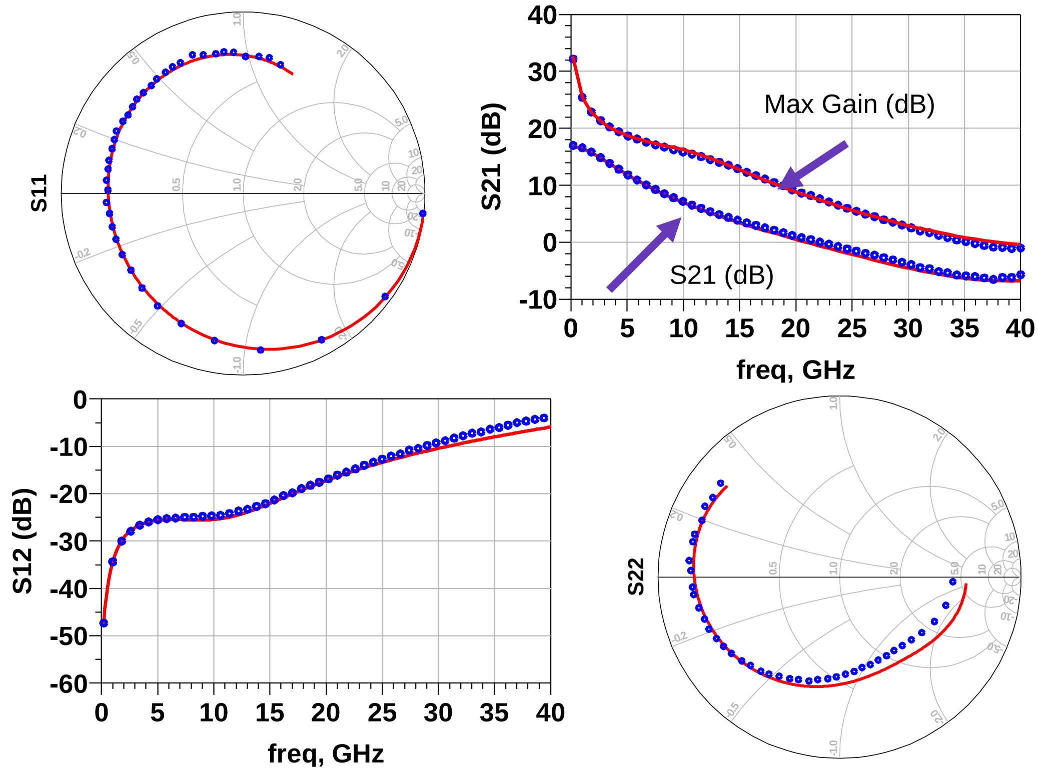
Model vs. Measurement Temperature IV Characteristics



Legend: Red Solid lines: 85C, Blue Solid lines: 25C.
Solid lines - Model data, Symbols - Measured data
Simulated at 25C and 85C, VDSQ of 7V. Model self_heat = 0, BWremoval = 0

S-Parameters Model vs. Measured:

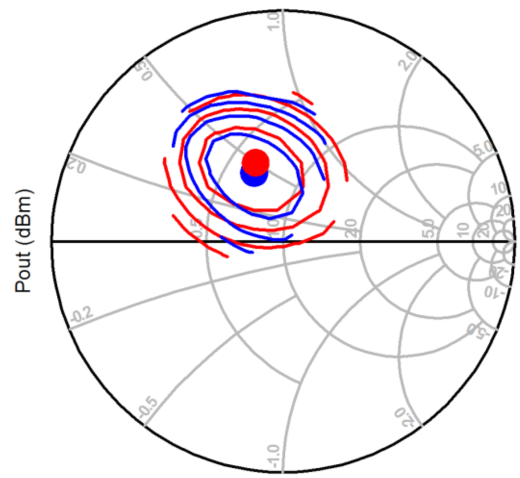
VDS = 7V, VGS = -0.605V, IDS = 109.62mA (60% IDSS), 25C



Legend: Red Solid lines - Model data, O Symbols - Measured data
Simulated at 25C with the frequency range from 0.2 – 40GHz. 50Ω Smith Charts
BWremoval = 0

Load Pull Validation: Frequency = 12GHz
VDS = 7V, VGS = -0.59V, IDS = 109.62mA (60% IDSS),
Input Power = 16dBm, Z0 = 50Ω Center, 25C

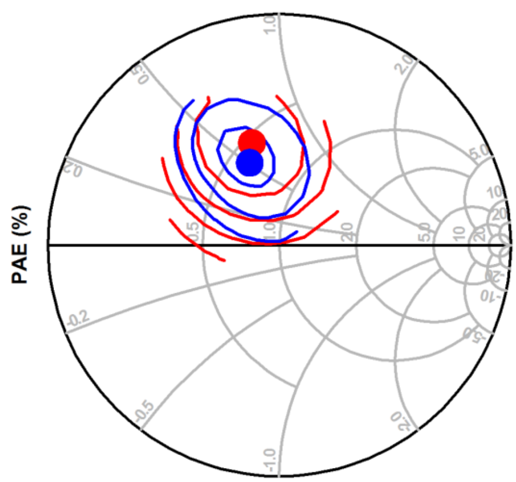
Power Tuning (0.5dB contour step)



Test Bench Impedances (Ohms):

ZS = 8.2 + j*5.4
ZS2 = 77.7 + j*30.5
ZS3 = 40.7 + j*23.7
ZLoad2 = 67.0 - j*19.6
ZLoad3 = 39.9 - j*32.2

Efficiency Tuning (5% contour step)



Legend: Red Solid lines – Model, Blue Solid lines – Measured, BWremoval = 0

Load Pull Summary	Max Power Load Impedance (Ohms)	Max Power Value (dBm)	Max PAE Load Impedance (Ohms)	Max PAE Value (%)
Measured	33.0 + j*21.9	25.8	30.5 + j*25.4	43.1
Model	34.0 + j*25.9	25.4	21.8 + j*28.1	41.9

Load pull data has been processed for contour display

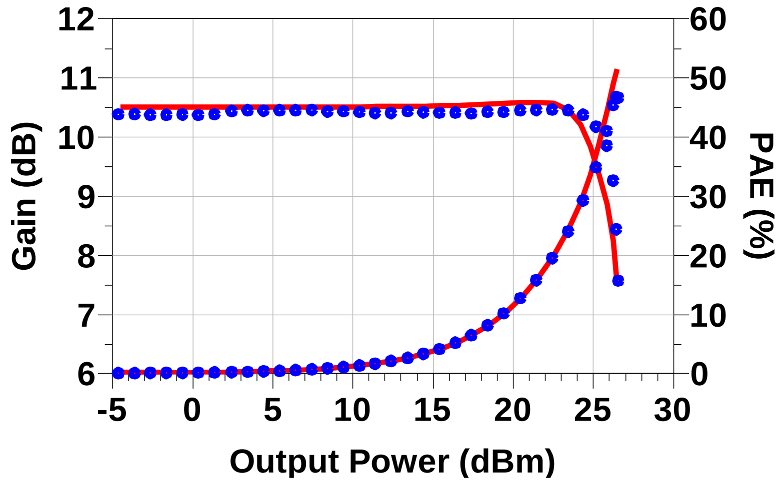
Single Tone Power Sweep: Frequency = 12GHz
VDS = 7V, VGS = -0.59V, IDS = 109.62 mA (60% IDSS), 25C

Load Condition: Measured Power Tuned

Load Condition: Power Tuned
Test Bench Impedances (Ohms):

ZS = 8.2 + j*5.4
ZS2 = 77.7 + j*30.5
ZS3 = 40.7 + j*23.7
ZLoad = 30.8 + j*19.1
ZLoad2 = 84.9 - j*10.2
ZLoad3 = 128.8 + j*27.1

Transducer Gain and Power Added Efficiency (PAE)



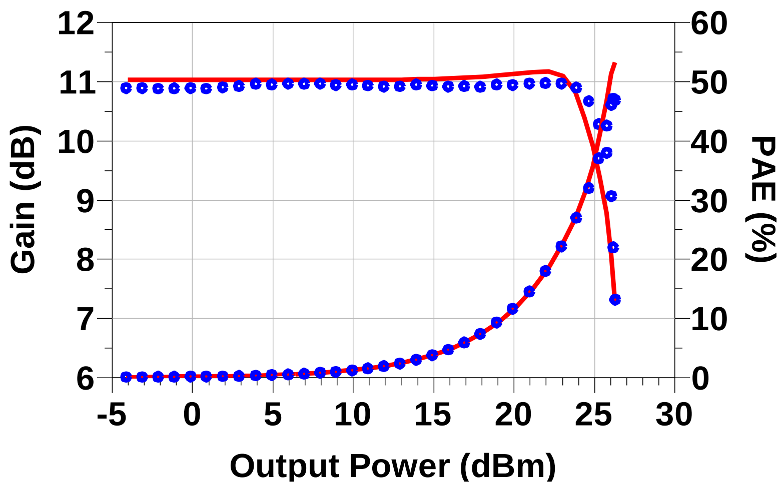
Legend: Red Solid lines - Model data, O Symbols - Measured data, BWremoval = 0

Load Condition: Measured PAE Tuned

Load Condition: PAE Tuned
Test Bench Impedances (Ohms):

ZS = 8.2 + j*5.4
ZS2 = 77.7 + j*30.5
ZS3 = 40.7 + j*23.7
ZLoad = 30.5 + j*25.4
ZLoad2 = 73.85- j*11.7
ZLoad3 = 119.6 - j*25.7

Transducer Gain and Power Added Efficiency (PAE)

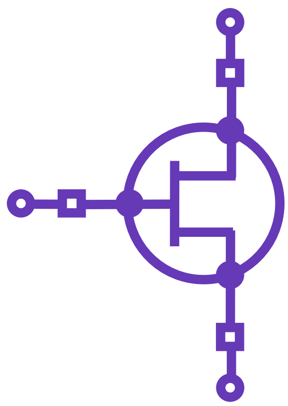


Legend: Red Solid lines - Model data, O Symbols - Measured data, BWremoval = 0

Advanced Model Features:

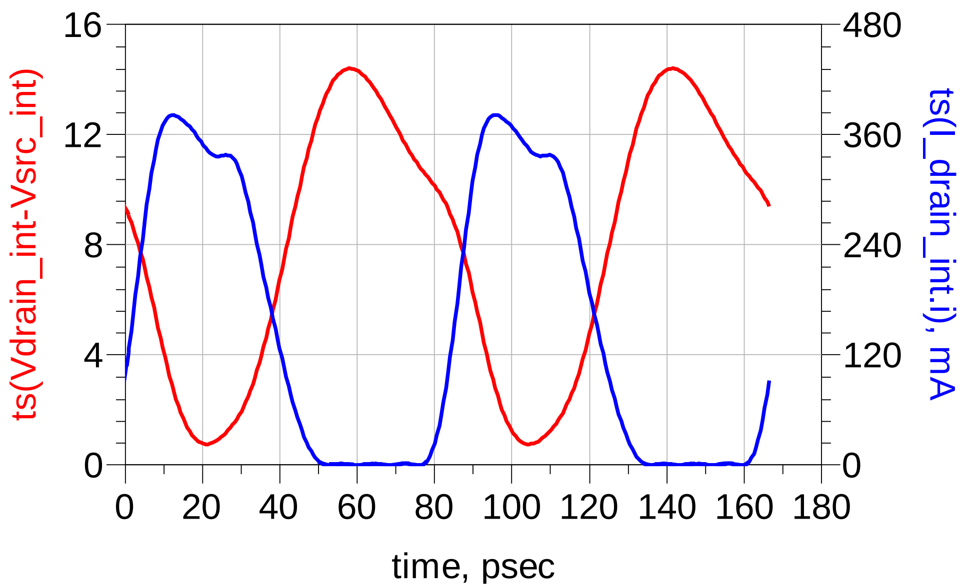
Intrinsic Voltage/Current Sensing

Get Vds and Ids model data near current generator intrinsic planes while tuning.



- External Model Planes
- Internal Model Planes for I/V waveform analysis
- Parasitic networks available separately from intrinsic I/V model

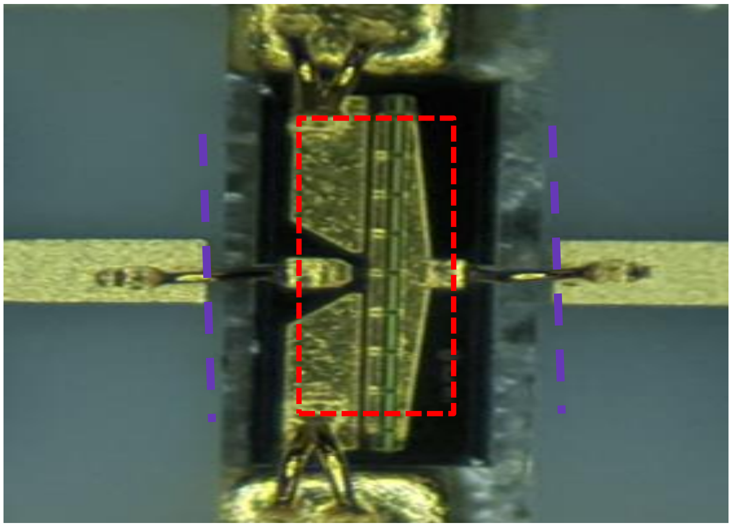
Example Plot of internal node Ids and Vds



Results based on harmonic balance simulation at 19dBm input power, PAE matched at 12GHz, 7V, and 109.62mA. ZS = 8.2 + j*5.4 Ohms, ZS2 = 77.7 + j*30.5, ZS3 = 40.7 + j*23.7, ZLoad = 30.8 + j*19.1, ZLoad2 = 84.9 - j*10.2, ZLoad3 = 128.8 + j*27.1 Ohms

Notice: Modelithics models represent as-measured characteristics of sample devices using specific testing and fixture configurations. The accuracy of models may vary as a result of differing device characteristics, test fixtures, or test conditions. No liability shall be assumed by Modelithics for use of its models, or for any infringement of rights of third parties that may result from their use. Modelithics reserves the right to revise its models and its product line without prior notice.

Assembly Diagram



Test fixture details:

- Device thickness: 3.93 mil
- Test board thickness: 5 mils
- Bond-wire diameter: 1 mil gold
- Gate and Drain single bond-wire length: 6 mils +/-2 (average)
- Source bond-wire length (two wires per source pad): 6 mils +/-2 (average)
- Metal standoff external next to each source pad is 4 mils thick, its purpose is to shorten the bondwire lengths to the source/ground.
- Blue line is model planes with bondwires ON (BWremoval=0)
- Red line is model planes with bondwires OFF (BWremoval=1)

Model and Datasheet Revision Notes

12/27/2022 Original model and datasheet development

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