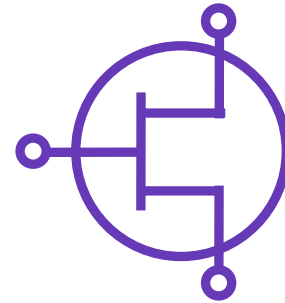


Model Features

- Broadband (DC to 30 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-MWT11F-001
MwT-11F
Discrete GaAs MESFET

Model Description

The HMT_MWT_MWT11F_001 is a non-linear model for the MwT-11F a discrete 2400 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.

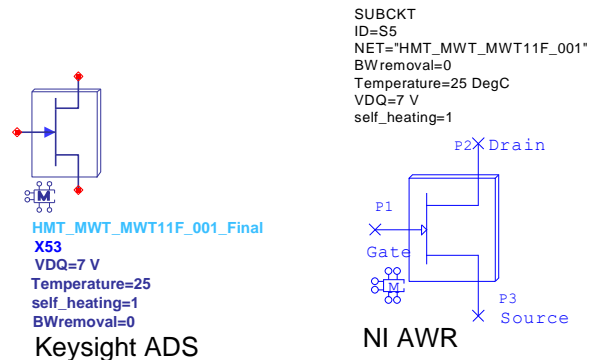
Technical Notes

- Model is optimized for 2, 4 and 7V operation (208.8mA (30% IDSS), 348 mA (50% IDSS) and 417.6mA (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.

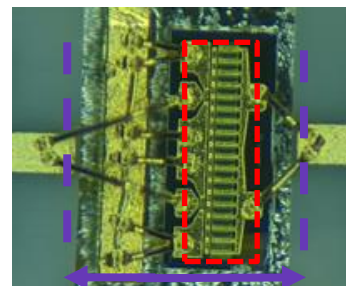
Model Simulation Settings

- **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



Reference Planes

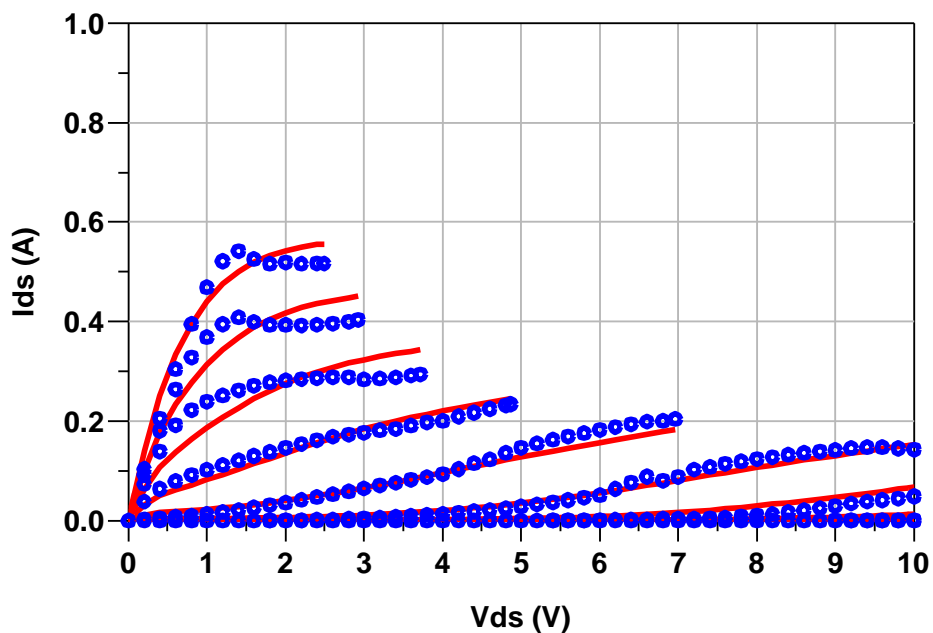


Model and Measurement Reference Planes (BWremoval=1)

Model and Measurement Reference Planes (BWremoval=0)

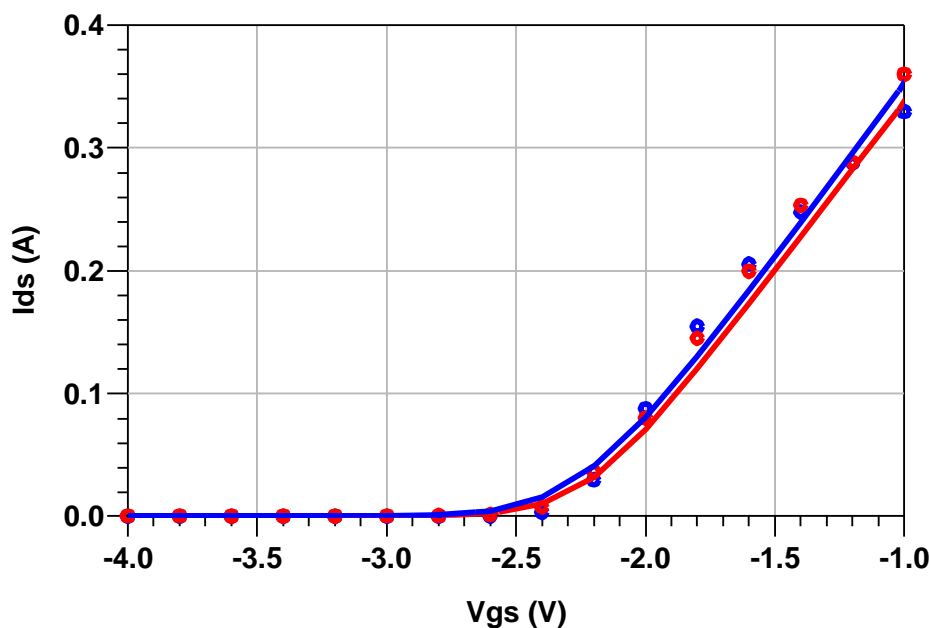


DC I-V Characteristics: VDSQ = 7V, 25C



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.

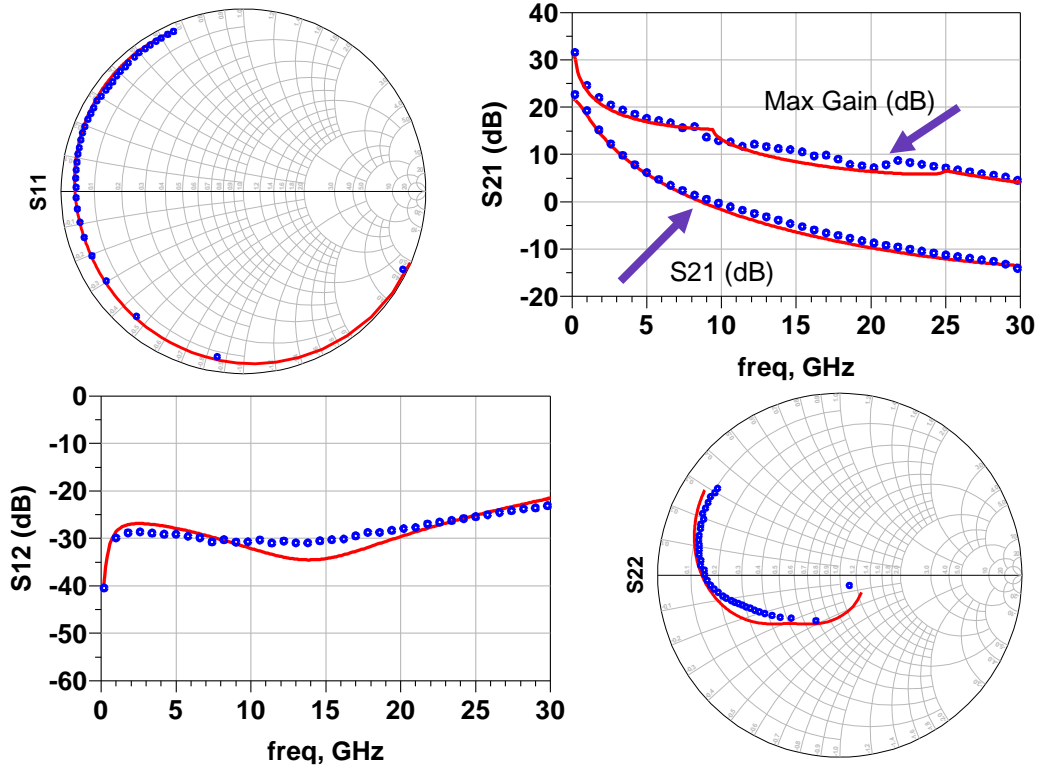
Model vs. Measurement Temperature IV Characteristics



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 = -0.75V, IDS = 417.6mA (60% IDSS), 25C

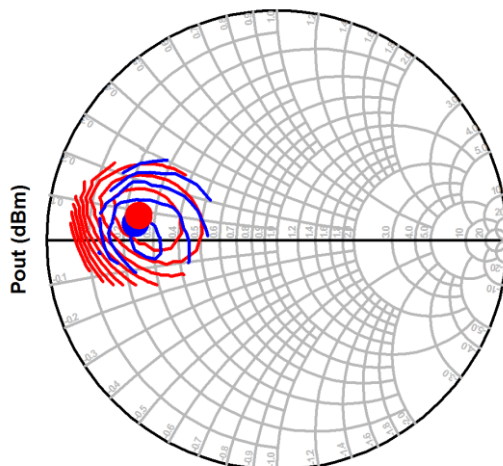


Legend: Red Solid lines - Model data, O Symbols - Measured data
 Simulated at 25C with the frequency range from 0.2 – 30GHz. 50Ω Smith Charts
 BWremoval = 0



Load Pull Validation: Frequency = 8GHz
VDS = 7V, VGS = -0.74V, IDS = 417.6mA (60% IDSS),
Input Power = 23dBm, Z0 = 50Ω Center, 25C

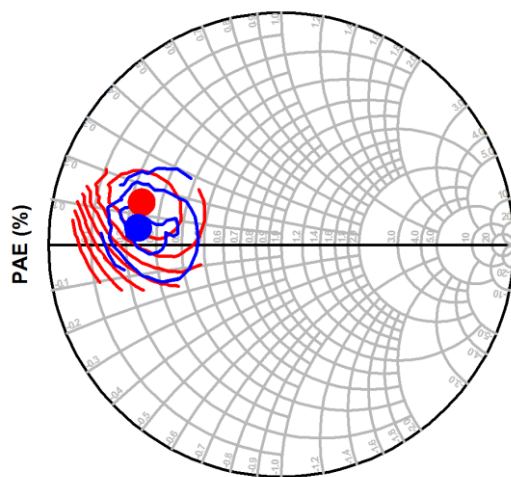
Power Tuning (0.5dB contour step)



Test Bench Impedances (Ohms):

- ZS = 8.4 - j*2.7
- ZS2 = 10.0 + j*6.0
- ZS3 = 49.8 + j*28.1
- ZLoad2 = 19.1 + j*26.7
- ZLoad3 = 109.7 + j*22.7

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	11.7 + j*2.8	31.8	11.7 + j*2.8	46.5
Model	12.3 + j*5.2	31.7	12.3 + j*5.2	47.2

Load pull data has been processed for contour display

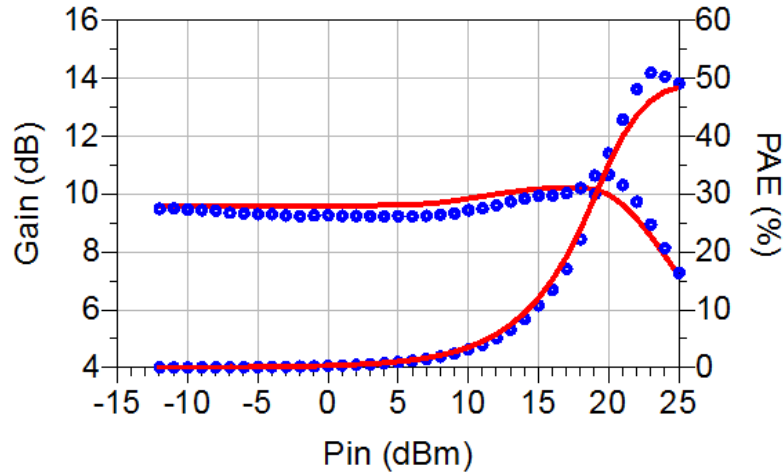
Single Tone Power Sweep: Frequency = 8GHz
 VDS = 7V, VGS = -0.74V, IDS = 417.6mA (60% IDSS), 25C

Load Condition: Measured Power Tuned

Transducer Gain and Power Added Efficiency (PAE)

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

ZS = 8.4 - j*2.7
 ZS2 = 10.0 + j*6.0
 ZS3 = 49.8 + j*28.1
 ZLoad = 13.6+j*2.0
 ZLoad2 = 22.1+j*27.7
 ZLoad3 = 112.5+j*15.3



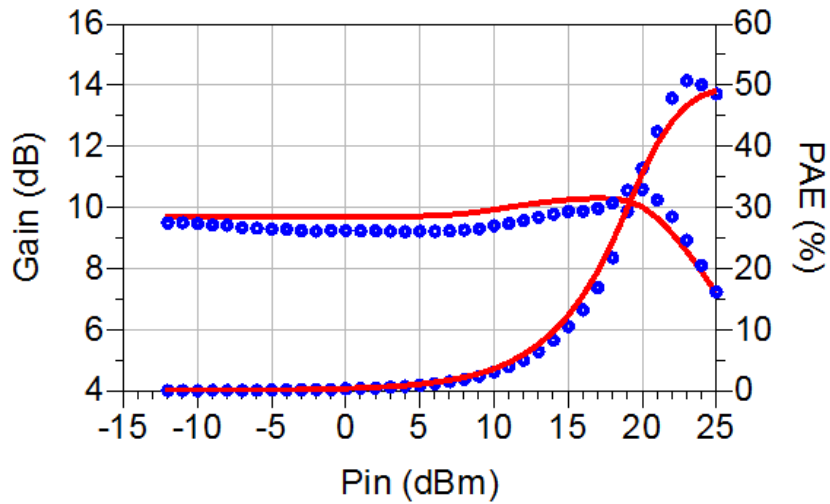
Legend: Red Solid lines - Model data, O Symbols - Measured data, BWremoval = 0

Load Condition: Measured PAE Tuned

Transducer Gain and Power Added Efficiency (PAE)

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

ZS = 8.4 - j*2.7
 ZS2 = 10.0 + j*6.0
 ZS3 = 49.8 + j*28.1
 ZLoad = 11.7 + j*2.8
 ZLoad2 = 19.1 + j*26.7
 ZLoad3 = 109.7 + j*22.7

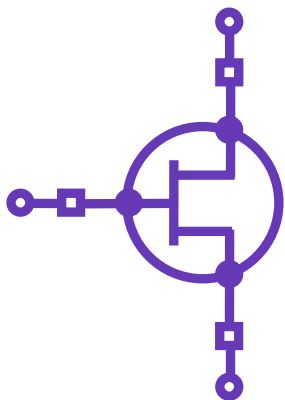


Legend: Red Solid lines - Model data, O Symbols - Measured data, BWremoval = 0



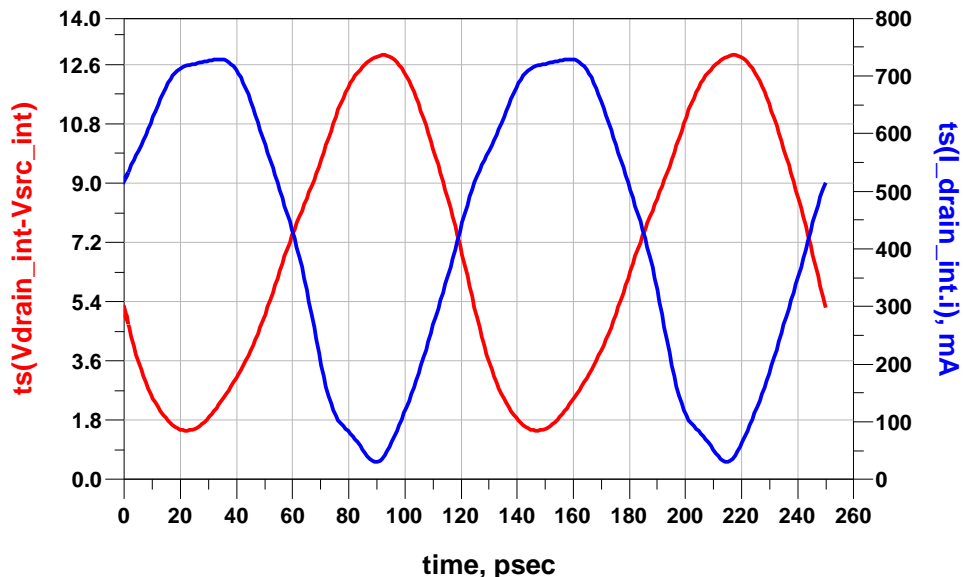
Advanced Model Features: Intrinsic Voltage/Current Sensing

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



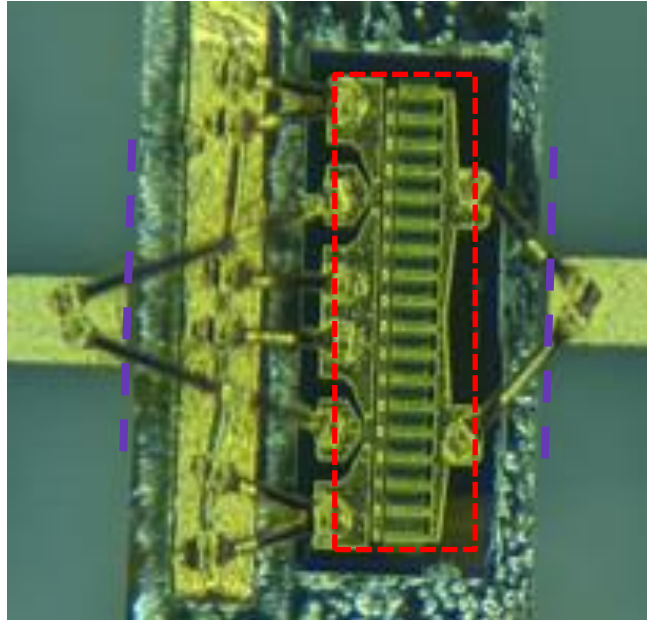
- External Model Planes
- Internal Model Planes for I/V waveform analysis
- Parasitic networks available separately from intrinsic I/V model

Example Plot of internal node Ids and Vds



Results based on harmonic balance simulation at 19dBm input power, PAE matched at 8GHz, 7V, and 417.6mA. $ZS = 8.4 - j*2.7$ Ohms, $ZS2 = 10.0 + j*6.0$, $ZS3 = 49.8 + j*28.1$, $ZLoad = 13.6+j2.0$, $ZLoad2 = 22.1+j27.7$, $ZLoad3 = 112.5+j15.3$ Ohms

Assembly Diagram



Test fixture details:

- Device thickness: 3.93 mil
- Test board thickness: 5 mils
- Bond-wire diameter: 1 mil gold
- Gate bond-wire length: 18 mils +/-2 (average)
- Drain bond-wire length: 12 mils +/-2 (average)
- Source bond-wire length (two wires per source pad): 8 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