

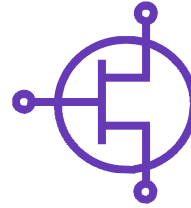
GaAs HFET MODEL



HMT-TQT-TGF2961-SD

Model Features

- Broadband (DC-6GHz)
- Non-linear (Angelov model)
- Measurement validations:
 - Pulse IV
 - Multi bias S-parameters
 - Single tone Power sweep for (0.8, 1, 2 and 2.5GHz)
 - Two tone Power sweep for (0.8, 1, 2 and 2.5GHz)
 - Load pull (0.8, 1, 2 and 2.5GHz)



TriQuint TGF2961-SD Packaged HFET

Model Description

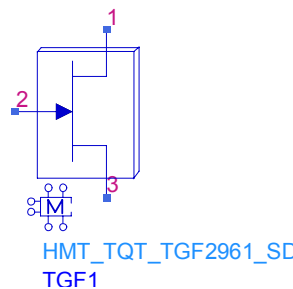
The HMT-TQT-TGF2961-SD is a non-linear model for the packaged GaAs HFET device based on the Angelov model. The model is intended for use with microstrip applications operating from DC to 6 GHz. The device is designed for use in cellular base stations, WiMAX, RFID applications and other commercial systems.

Technical Notes

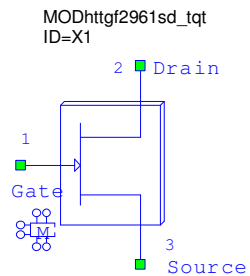
- The non-linear model is extracted from Pulsed IV and multi-bias S-parameter measurements
- The non-linear model is used to simulate power, PAE and intermodulation behavior.
- The model has been validated with measurements over the frequency range DC to 6 GHz in a common source configuration.
- Typical bias condition is $V_{ds}=8V$, $I_{ds}=200mA$
- Via-grounding effects are included as part of the model (see layout diagram on next page).
- The substrate used to extract the model: 20mil FR4

Model Representation

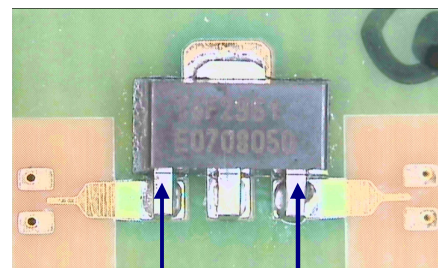
ADS symbol



AWR symbol



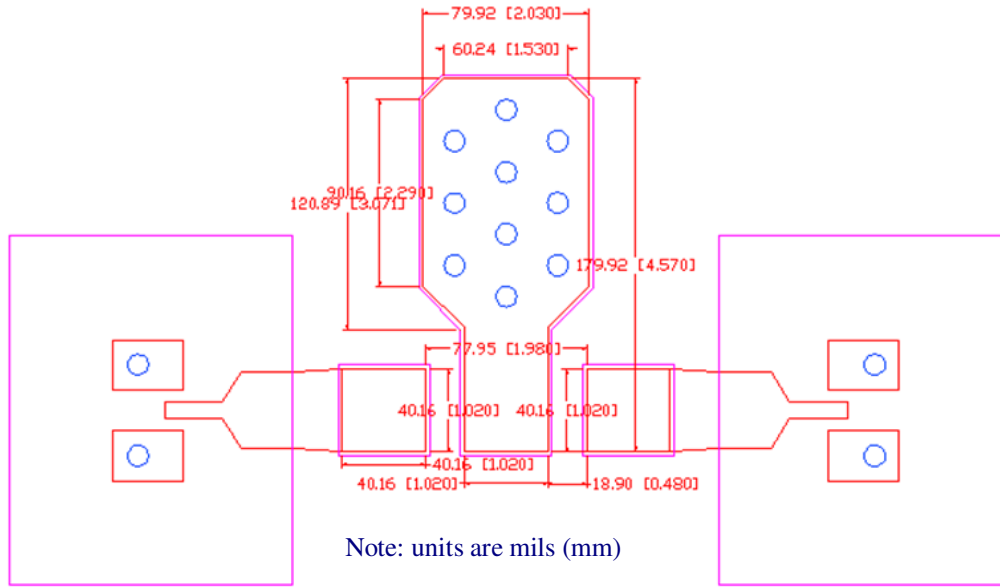
Device image



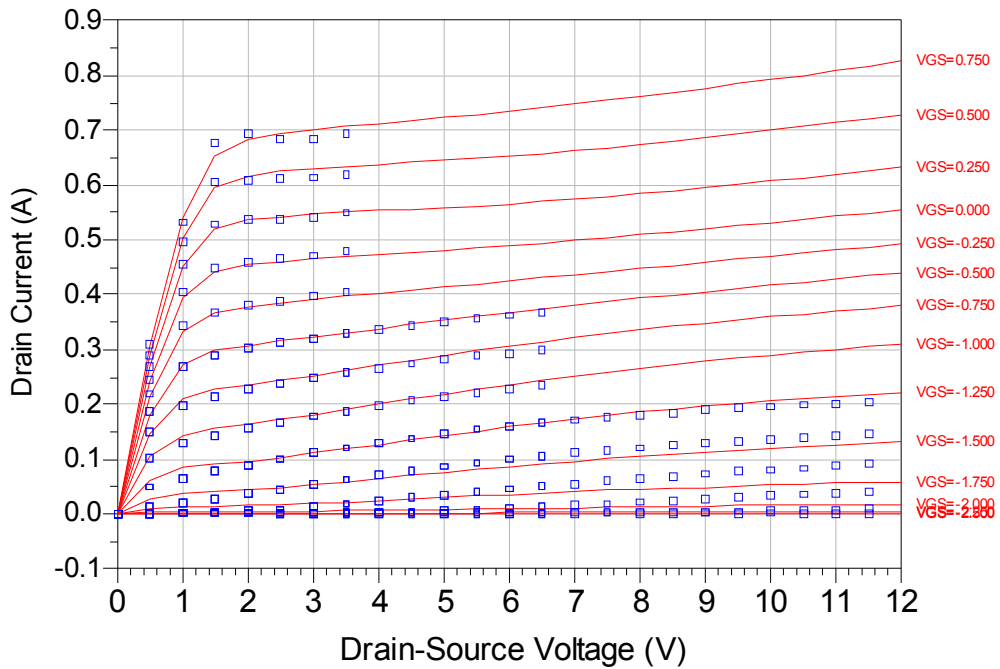
model reference Planes



Test Layout



Pulsed IV Characteristics (25C)

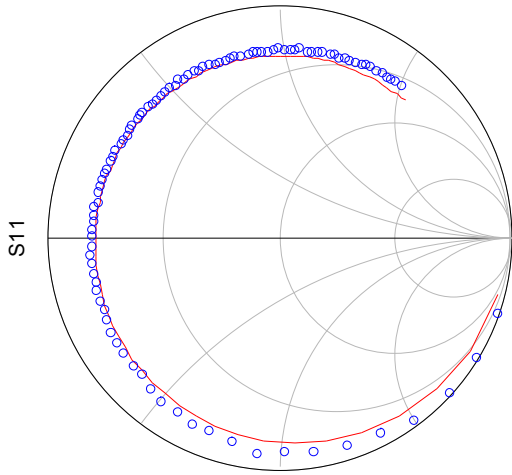


Legend: Solid Red lines-Model, dashed lines with Blue \square markers-Measured data

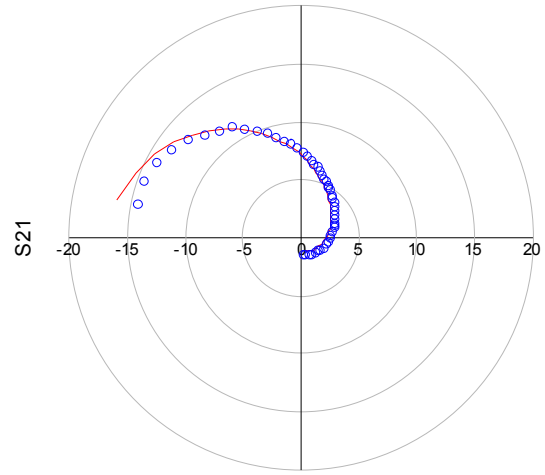
Simulated at T=25C with VGS varying from -2.5 to 0.75V in steps of 0.25V and VDS=0 to 12 V in steps of 0.5V

S-parameters

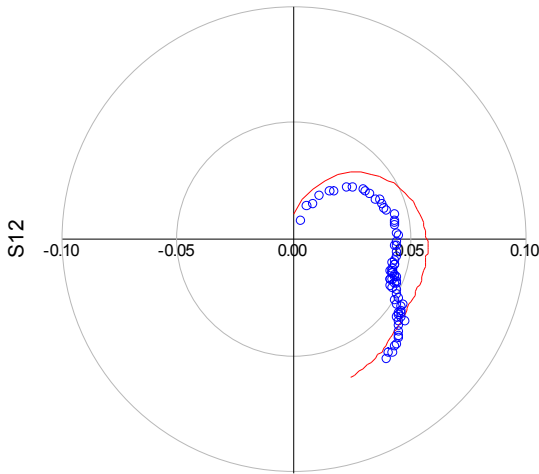
HMT-TQT-TGF2961-SD



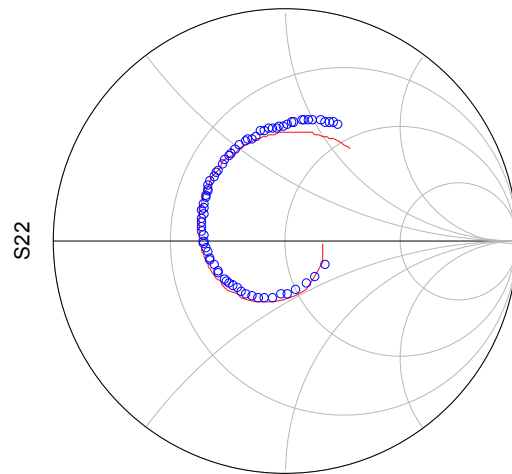
freq (100.0MHz to 6.000GHz)



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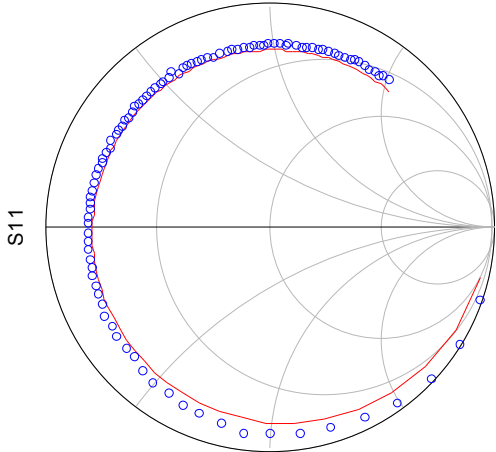
freq (100.0MHz to 6.000GHz)

Legend: Solid Red lines-Model, dashed lines with Blue o markers-Measured data

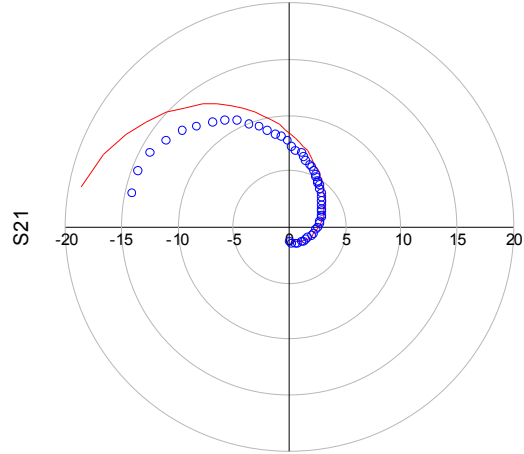
Bias condition: $V_{ds}=6V$, $V_{gs} = -1.2$, $I_{ds}=170mA$.
Frequency range is 0.1 to 6 GHz.

S-parameters

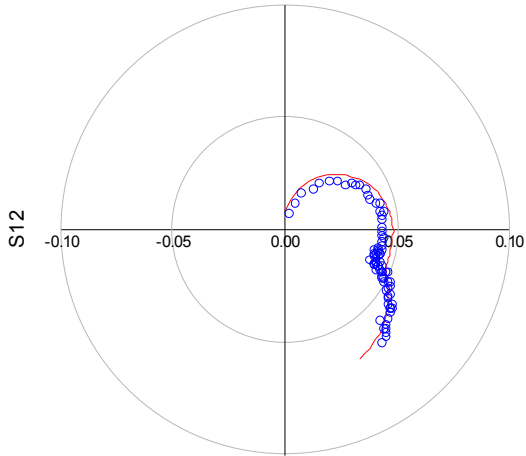
HMT-TQT-TGF2961-SD



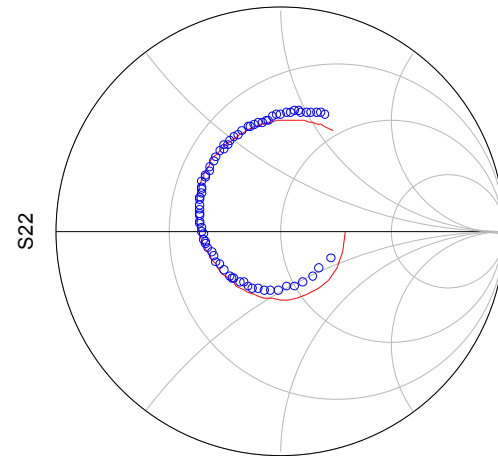
freq (100.0MHz to 6.000GHz)



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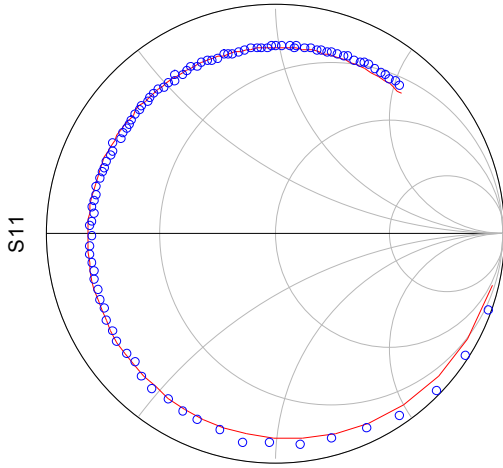
freq (100.0MHz to 6.000GHz)

Legend: Solid Red lines-Model, dashed lines with Blue o markers-Measured data

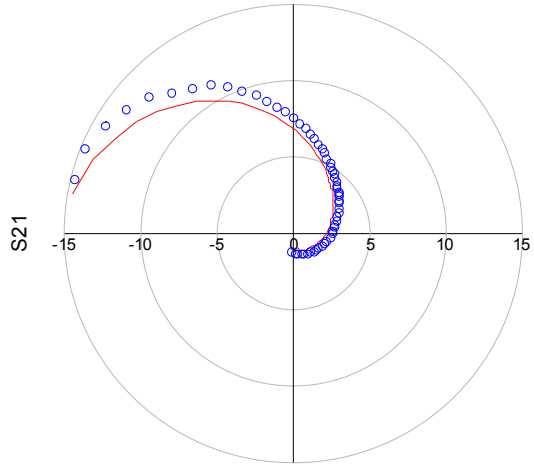
Bias condition: $V_{ds}=8V$, $V_{gs} = -1.2$, $I_{ds}=200mA$.
Frequency range is 0.1 to 6 GHz.

S-parameters

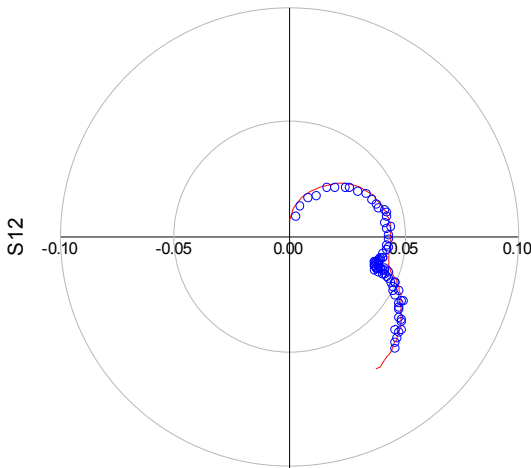
HMT-TQT-TGF2961-SD



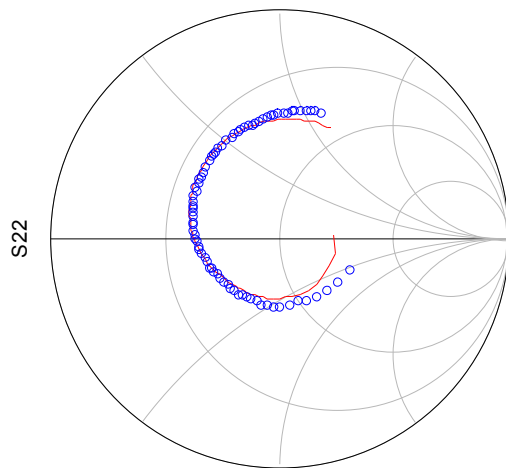
freq (100.0MHz to 6.000GHz)



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freq (100.0MHz to 6.000GHz)

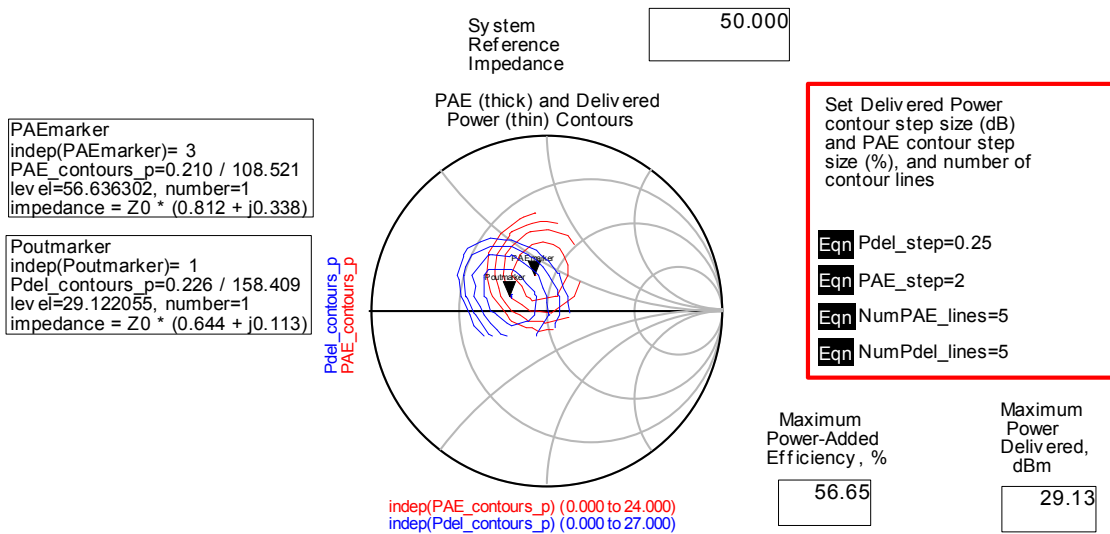


freq (100.0MHz to 6.000GHz)

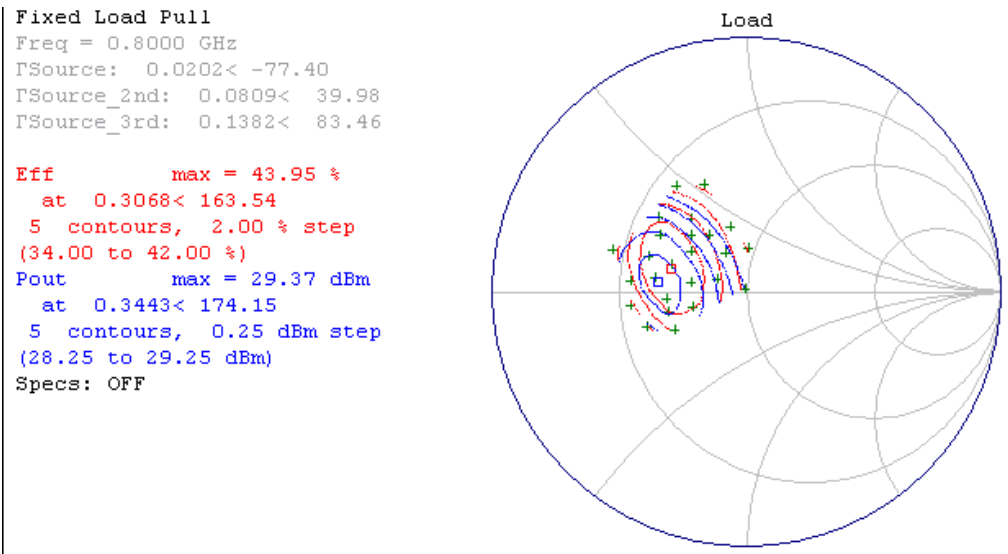
Legend: Solid Red lines-Model, dashed lines with Blue o markers-Measured data

Bias condition: $V_{ds}=8V$, $V_{gs} = -0.8V$, $I_{ds}=300mA$.
Frequency range is 0.1 to 6 GHz.

Load Pull Validations (f=800MHz)



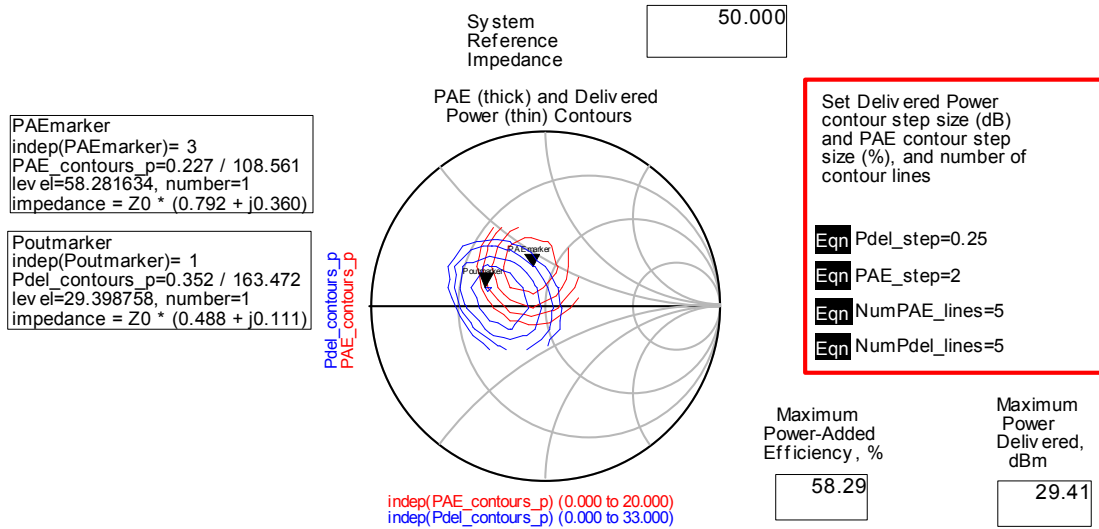
Delivered power (blue) and PAE (red) contours for model (top) and measurement (bottom)



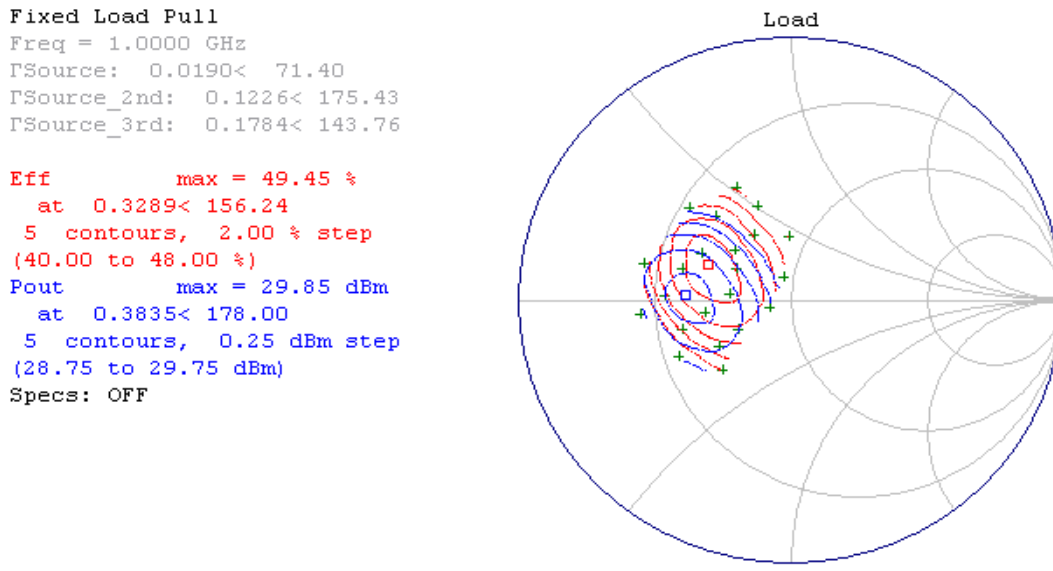
	Max. PAE Value (%)	Load impedance at max PAE (ohm)	Max Pout Value (dbm)	Load impedance at max Pout (ohm)
Measured	43.95	27.3 +j4.96	29.37	24.7 +j1.98
Model	56.65	40.5 + j16.8	29.13	32 + j5.8

Comparison of load pull between the measurement data (bottom) and the model performance (top). The bias conditions: Vgs=-1.2V and Vds=8V, Input power=11dBm, Frequency = 800MHz. Source impedance is set at 50.4 - j1.96

Load Pull Validations (f=1000MHz)



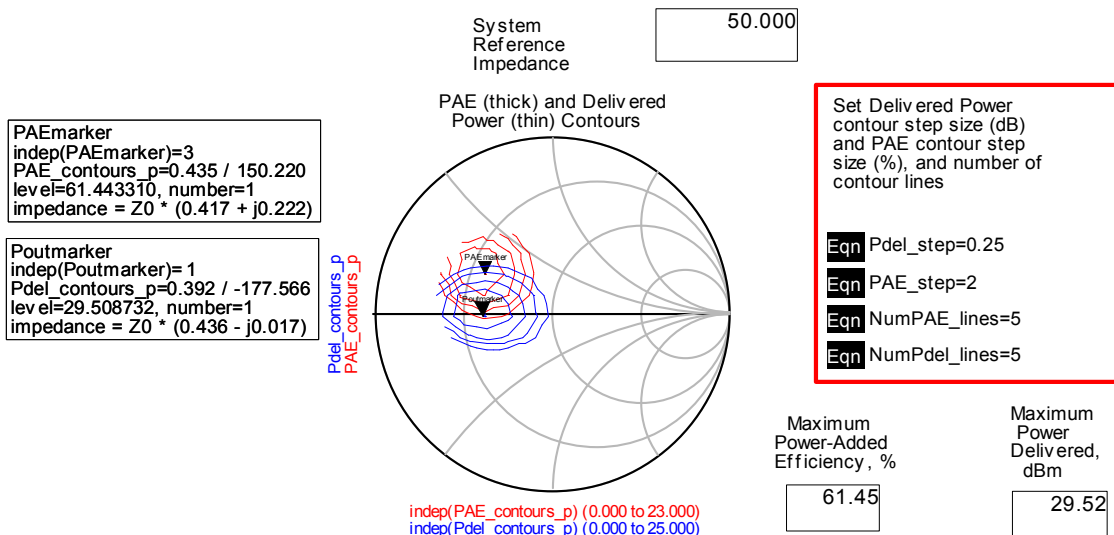
Delivered power (blue) and PAE (red) contours for model (top) and measurement (bottom)



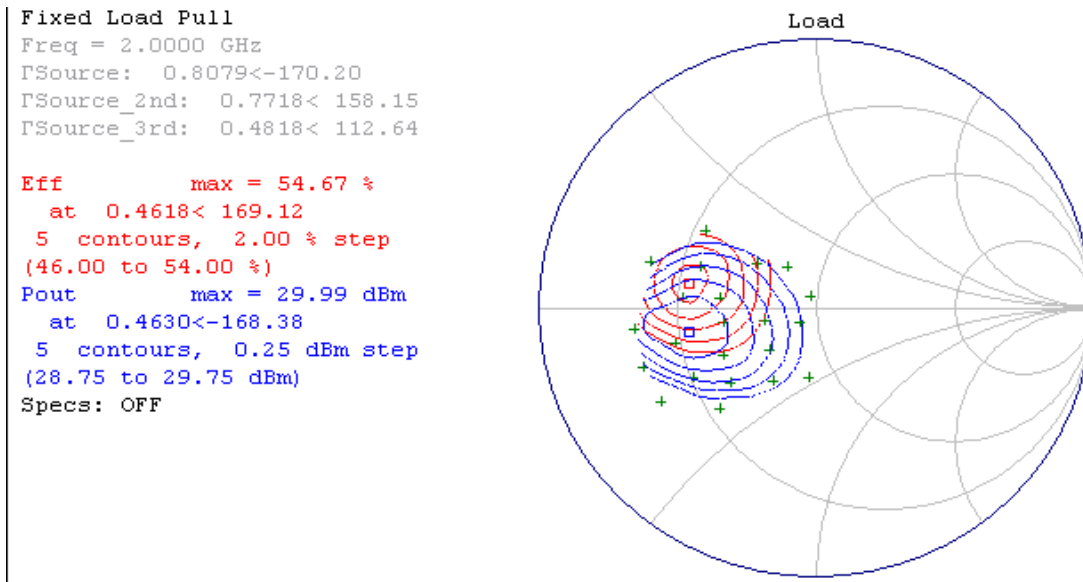
	Max. PAE Value (%)	Load impedance at max PAE (ohm)	Max Pout Value (dbm)	Load impedance at max Pout (ohm)
Measured	49.45	26 + j7.8	29.85	22.5 + j0.7
Model	58.29	39.4 + j18	29.41	24.5 + j5.7

Comparison of load pull between the measurement data (bottom) and the model performance (top). The bias conditions: Vgs=-1.2V and Vds=8V, Input power=13dBm, Frequency = 1000MHz. Source impedance is set at 50.5 + j1.82

Load Pull Validations (f=2000MHz)



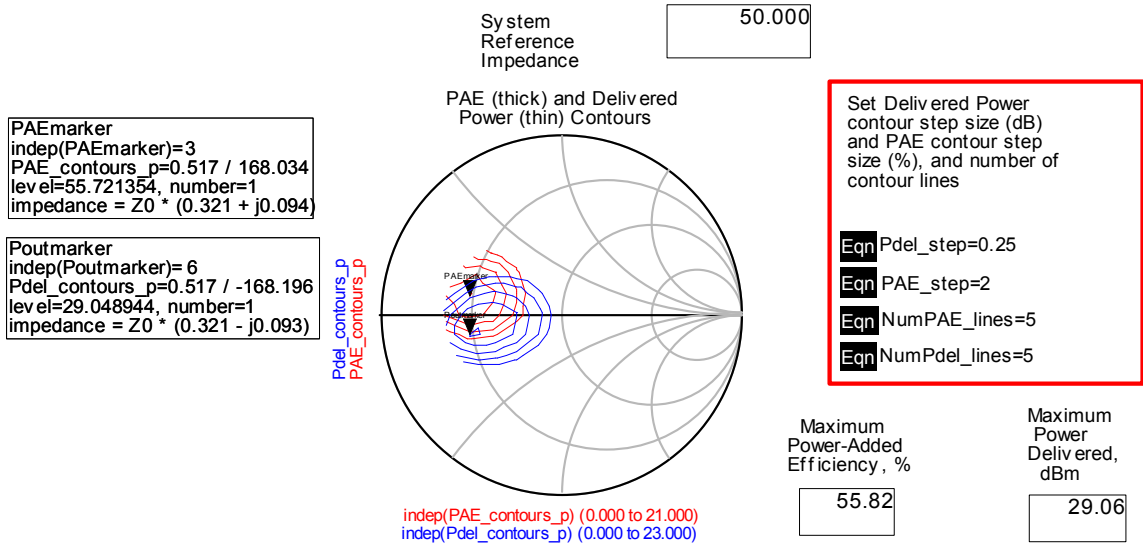
Delivered power (blue) and PAE (red) contours for model (top) and measurement (bottom)



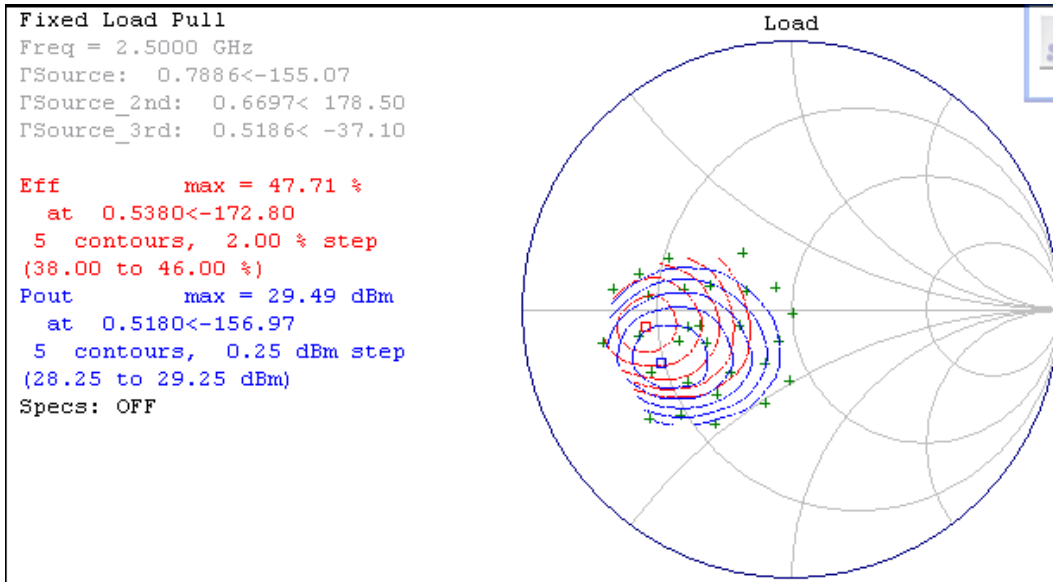
	Max. PAE Value (%)	Load impedance at max PAE (ohm)	Max Pout Value (dbm)	Load impedance at max Pout (ohm)
Measured	54.67	18.6 + j4.15	29.99	18.66 - j4.5
Model	61.45	20.6 + j11.2	29.52	21.94- j0.7

Comparison of load pull between the measurement data (bottom) and the model performance (top). The bias conditions: Vgs=-0.9V and Vds=8V, Input power=13dBm, Frequency = 2000MHz. Source impedance is set at 5.6 - j4.3

Load Pull Validations (f=2500MHz)



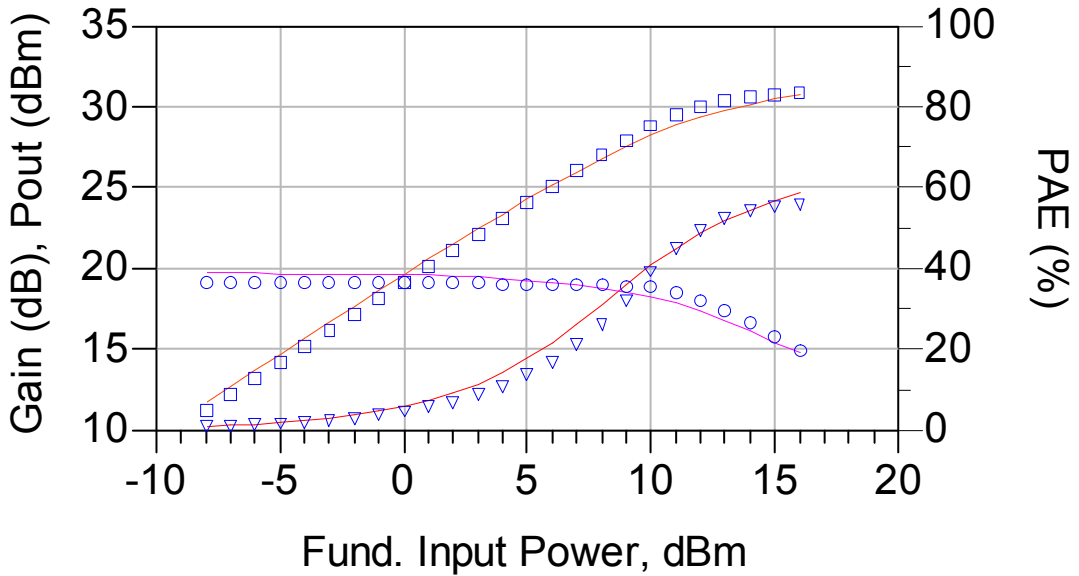
Delivered power (blue) and PAE (red) contours for model (top) and measurement (bottom)



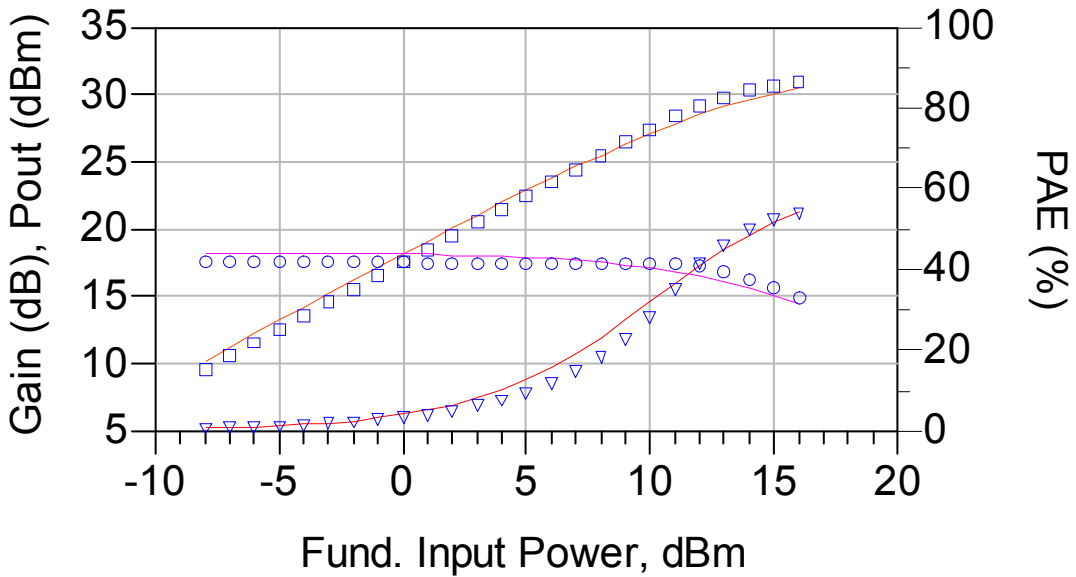
	Max. PAE Value (%)	Load impedance at max PAE (ohm)	Max Pout Value (dbm)	Load impedance at max Pout (ohm)
Measured	47.71	14.98 - j2.78	29.49	16.38 - j9.2
Model	55.82	15.94 + j4.7	29	15.94 - j4.73

Comparison of load pull between the measurement data (bottom) and the model performance (top). The bias conditions: Vgs=-1.2V and Vds=8V, Input power=14dBm, Frequency = 2500MHz. Source impedance is set at 6.15 - j10.93

Single tone power sweeps



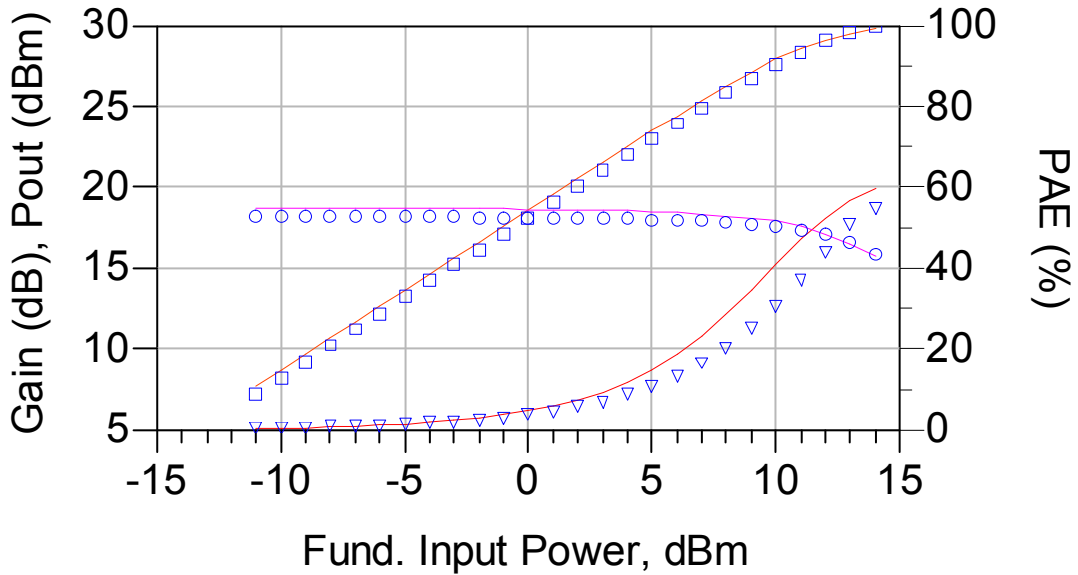
Simulated (solid line) and measured (symbols)
 source impedance = $48.6+j1.29$ ohms and load impedance = $23.68+j3$ ohms.
 Frequency = 800 MHz, Vds = 8V, Ids = 200mA, Vgs = -1.2V



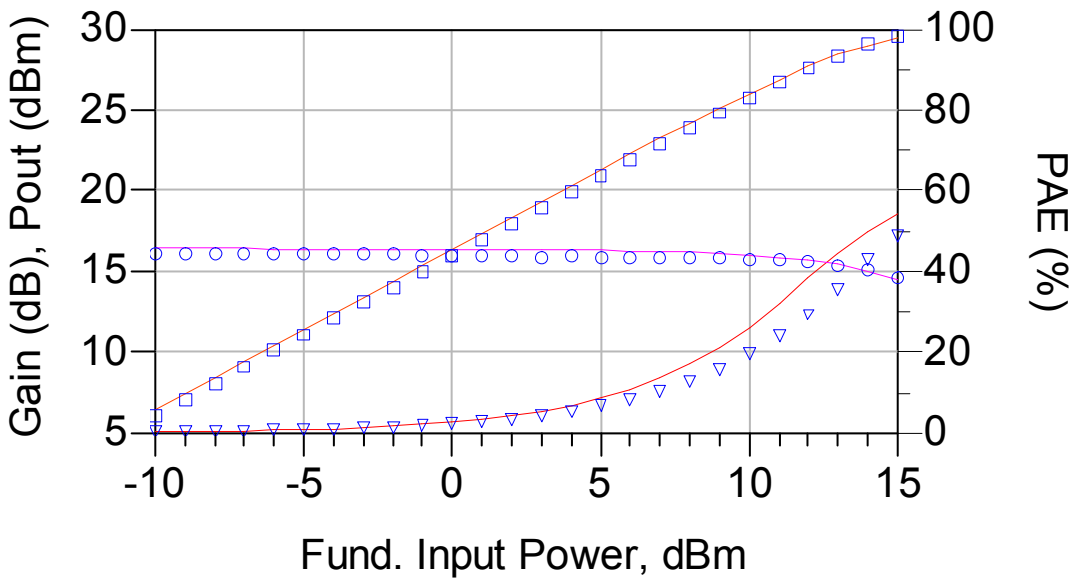
Simulated (solid line) and measured (symbols)
 source impedance = $50.58+j1.82$ ohms and load impedance = $20.9+j1.37$ ohms.
 Frequency = 1000 MHz, Vds = 8V, Ids = 200mA, Vgs = -1.2V

Legend: Solid lines-Model, symbols-Measured data
 ○ -Gain Compression, □ -Output power, ▼ PAE

Single tone power sweeps



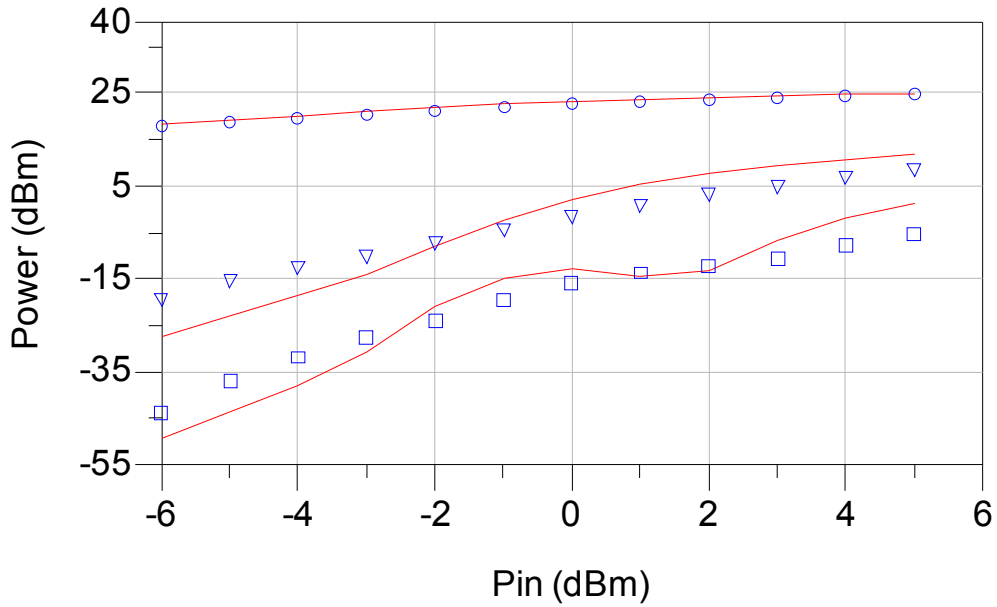
Simulated (solid line) and measured (symbols)
 source impedance = $5.36-j4.2$ ohms and load impedance = $24.55+j2$ ohms.
 Frequency = 2000 MHz, Vds = 8V, Ids = 200mA, Vgs = -1.2V



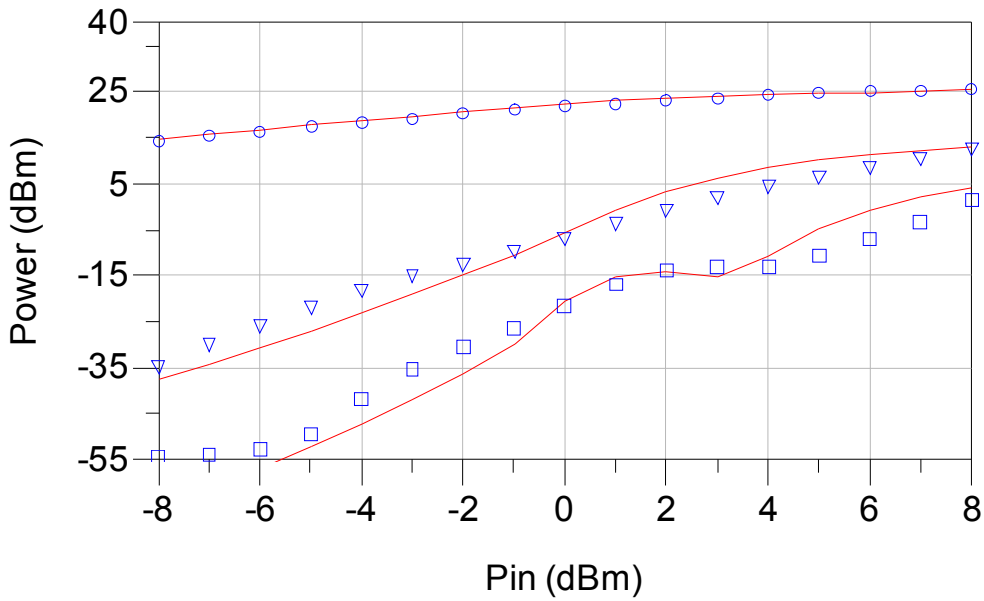
Simulated (solid line) and measured (symbols)
 source impedance = $6.2-j10.8$ ohms and load impedance = $24.66-j3.29$ ohms.
 Frequency = 2500 MHz, Vds = 8V, Ids = 200mA, Vgs = -1.2V

Legend: Solid lines-Model, symbols-Measured data
 ○ -Gain Compression, □ -Output power, ▼ PAE

Two tone power sweeps



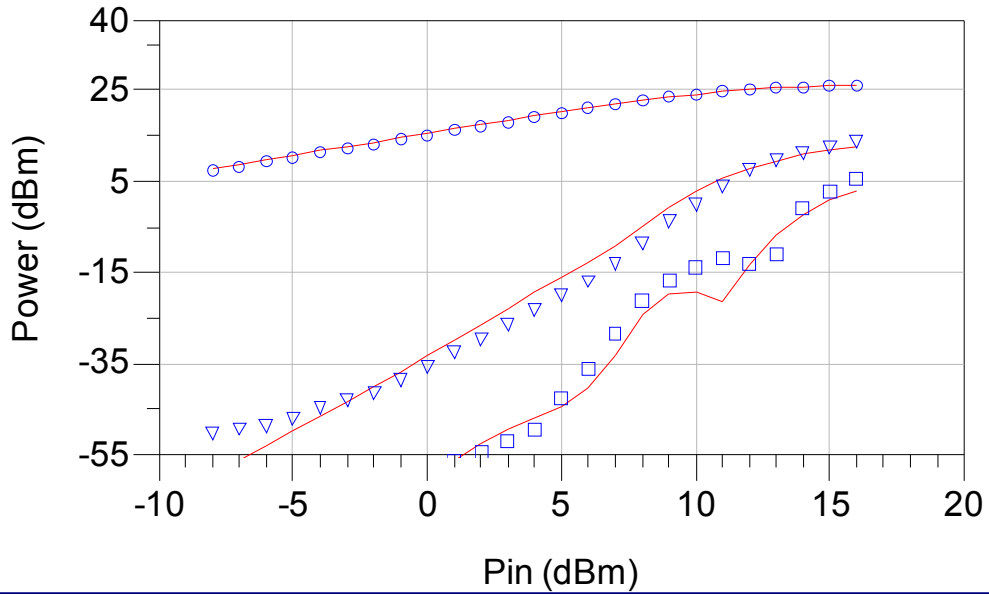
Simulated (solid line) and measured (symbols)
 source impedance = $9.33+j26.65$ ohms and load impedance = $34.15+j16$ ohms.
 Frequency = 800 MHz, Vds = 8V, Ids = 200mA, Vgs = -1.2V



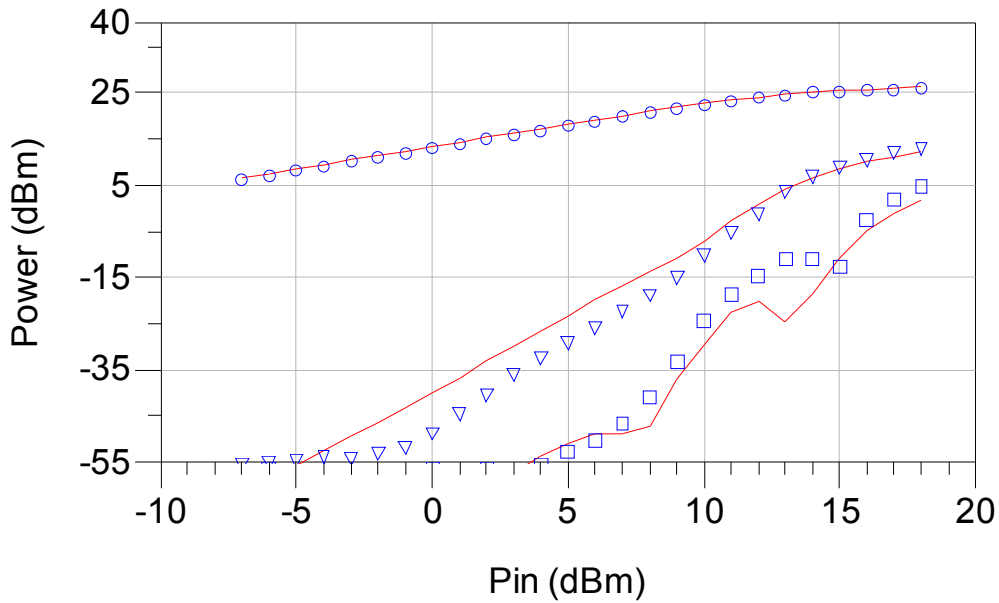
Simulated (solid line) and measured (symbols)
 source impedance = $6.1+j18.8$ ohms and load impedance = $31.2+j12.6$ ohms.
 Frequency = 1000 MHz, Vds = 8V, Ids = 200mA, Vgs = -1.2V

Legend: Solid lines-Model, symbols-Measured data
 ○ -fundamental, ▼ IM3, □ IM5

Two tone power sweeps



Simulated (solid line) and measured (symbols)
 source impedance = **5.36-j4.22 ohms** and load impedance = **24.5+j2.0 ohms**.
 Frequency = **2000 MHz**, $V_{ds} = 8V$, $I_{ds} = 200mA$, $V_{gs} = -1.2V$



Simulated (solid line) and measured (symbols)
 source impedance = **6.2-j10.8 ohms** and load impedance = **24.66-j3.29 ohms**.
 Frequency = **2500 MHz**, $V_{ds} = 8V$, $I_{ds} = 200mA$, $V_{gs} = -1.2V$

Legend: **Solid lines-Model**, **symbols-Measured data**
 ○ -fundamental, ▼ IM3, □ IM5

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