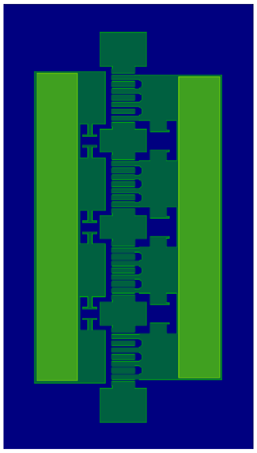
TGF2936

DC – 25 GHz, 28 V, 10 W GaN RF Transistor

Product Overview

The Qorvo TGF2936 is a 10 W (P_{3dB}) discrete GaN on SiC HEMT which operates from DC to 25 GHz and 28 V supply. The device is constructed with Qorvo's proven QGaN15 process. The device can support pulsed, CW, and linear operations.

Lead-free and ROHS compliant



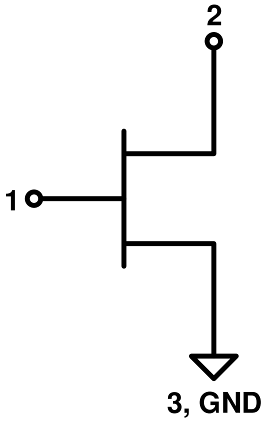
0.983 x 0.551 x 0.100 mm

Key Features

- Frequency: DC to 25 GHz
- Output Power (P_{3dB})[1]: 10 W
- Linear Gain[1]: 16 dB
- Typical PAE_{3dB}[1]: 58%
- Typical Noise Figure[1]: 1.3dB
- Operating Voltage: 28 V
- CW and Pulse capable
- Non-linear & Noise Models available

Note 1: @ 10 GHz

Functional Block Diagram



Applications

- Defense and Aerospace
- Broadband wireless
- Low noise amplifier

Ordering info

Part No.	ECCN	Description
TGF2936	3A001b.3.b	DC–25 GHz, 28 V, 10 W GaN RF Transistor

Absolute Maximum Ratings[1]

Parameter	Rating	Units
Breakdown Voltage, BV_{DG}	+60	V
Gate Voltage Range, V_G	-7 to +1.5	V
Drain Current, I_{DMAX}	2	A
Gate Current Range, I_G	See page 20.	mA
Power Dissipation, CW, P_{DISS}	9.9	W
RF Input Power, CW, 10 GHz, T = 25 °C	+30	dBm
Channel Temperature, T_{CH}	275	°C
Mounting Temperature (30 Seconds)	320	°C
Storage Temperature	–65 to +150	°C

Notes:

1. Operation of this device outside the parameter ranges given above may cause permanent damage.

Recommended Operating Conditions[1]

Parameter	Min	Typ	Max	Units
Operating Temp. Range	–40	+25	+85	°C
Drain Voltage Range, V_D	+12	+20	+29.5	V
Drain Bias Current, I_{DQ}	40	80	160	mA
Drain Current, I_D	–	700	–	mA
Gate Voltage, V_G[3]	–	–2.8	–	V
Channel Temperature (T_{CH})	–	–	250	°C
Power Dissipation, CW (P_D)[2]	–	–	8.9	W

Notes:

1. Electrical performance is measured under conditions noted in the electrical specifications table. Specifications are not guaranteed over all recommended operating conditions.
2. Package base at 85 °C
3. To be adjusted to desired I_{DQ}

Model Load Pull Performance – Power Tuned[1]

Parameter	Typical Values								Units
Frequency, F	3		6		10		18		GHz
Drain Voltage, V_D	20	28	20	28	20	28	20	28	V
Drain Bias Current, I_{DQ}	80	80	80	80	80	80	80	80	mA
Output Power at 3dB compression, P_{3dB}	38.7	40.2	38.7	40.1	38.7	40.1	38.2	39.9	dBm
Power Added Efficiency at 3dB compression, PAE_{3dB}	61.2	61	61.8	61.9	56.1	57.8	51.8	49.8	%
Gain at 3dB compression, G_{3dB}	19.2	21.2	15.9	16.7	11.3	12.7	7.3	8.2	dB
Load Reflection Coefficient (2), Γ_L	0.45∠153°	0.22∠117°	0.58∠149°	0.57∠135°	0.67∠153°	0.72∠146°	0.85∠159°	0.85∠159°	--

Notes:
1. CW, bondwires not included
2. Characteristic Impedance, Zo = 50 Ω.

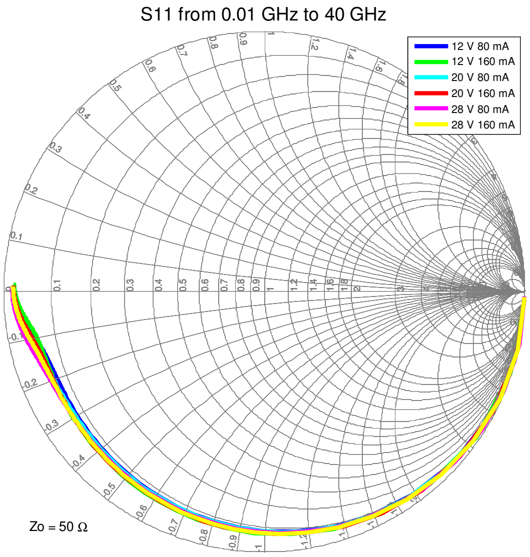
Model Load Pull Performance – Efficiency Tuned[1]

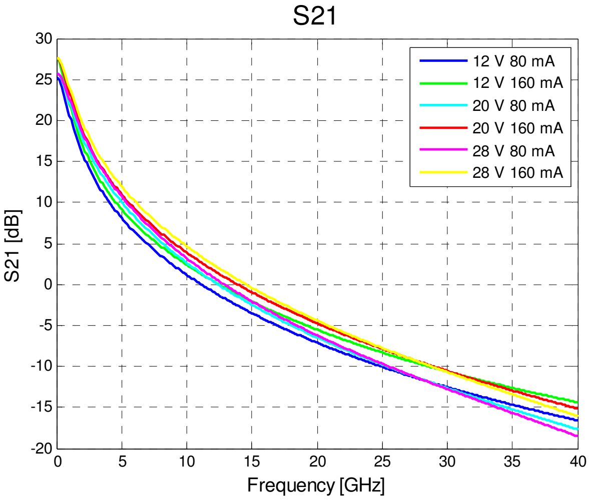
Parameter	Typical Values								Units
Frequency, F	3		6		10		18		GHz
Drain Voltage, V_D	20	28	20	28	20	28	20	28	V
Drain Bias Current, I_{DQ}	80	80	80	80	80	80	80	80	mA
Output Power at 3dB compression, P_{3dB}	37.3	39.8	38.2	39.5	37.8	39.9	38.2	39.9	dBm
Power Added Efficiency at 3dB compression, PAE_{3dB}	67.4	66.3	65.3	63.7	60.2	57.9	51.8	49.8	%
Gain at 3dB compression, G_{3dB}	19.0	21.4	17.0	19.3	12.0	13.2	7.3	8.2	dB
Load Reflection Coefficient (2), Γ_L	0.45∠117°	0.45∠117°	0.64∠141°	0.71∠135°	0.81∠150°	0.81∠150°	0.85∠159°	0.85∠159°	--

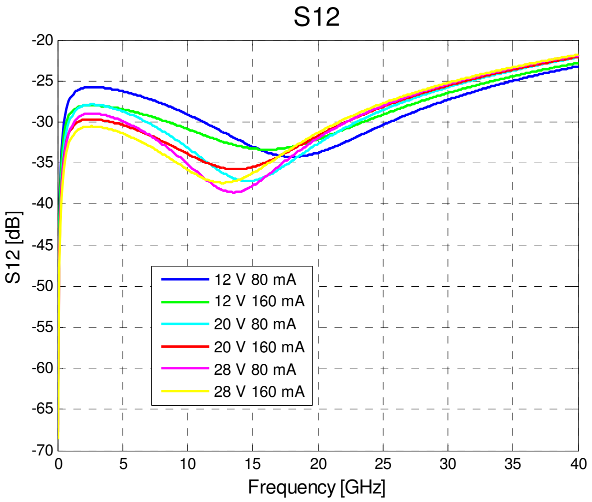
Notes:
1. CW, bondwires not included
2. Characteristic Impedance, Zo = 50 Ω.

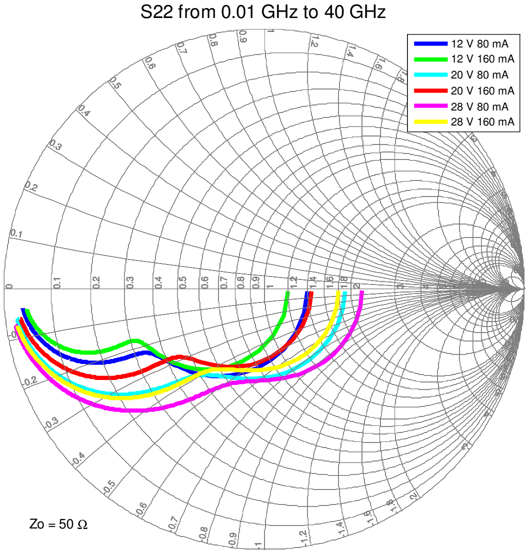
Model S-parameters[1]

Notes:
1. Bondwires are not included. T = 25 °C.



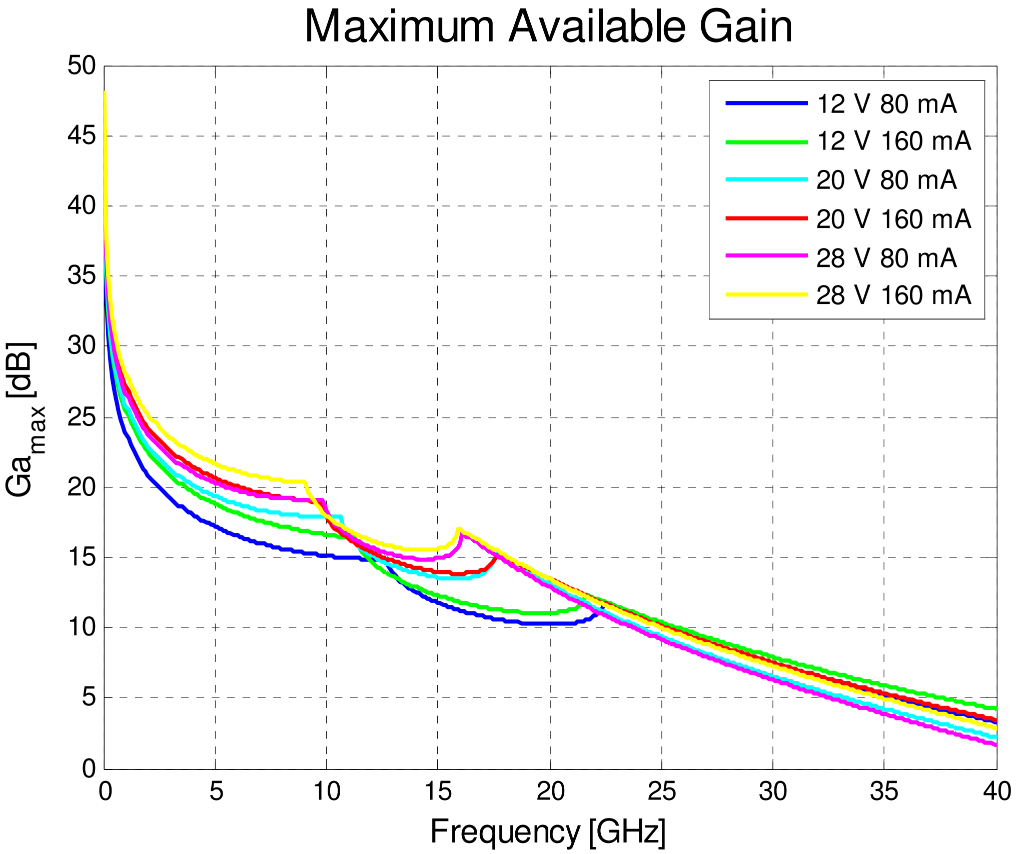






Model Maximum Available Gain[1]

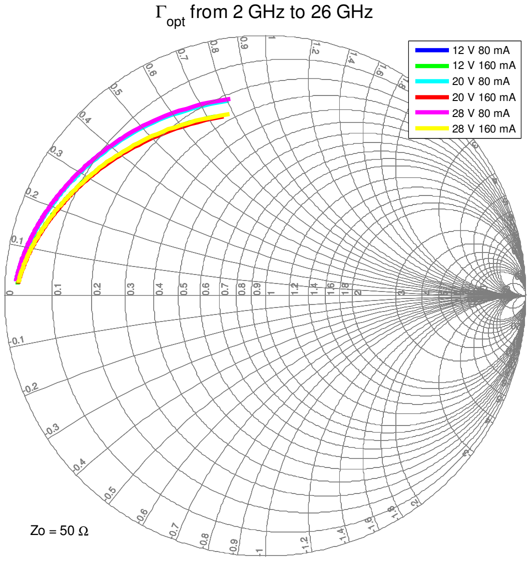
Notes:
1. Bondwires are not included. T = 25 °C.

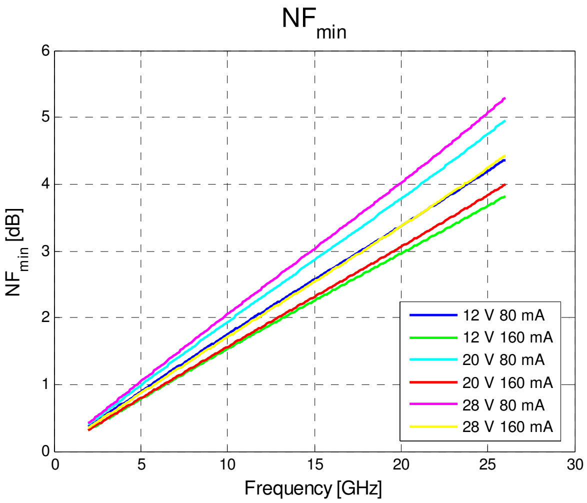


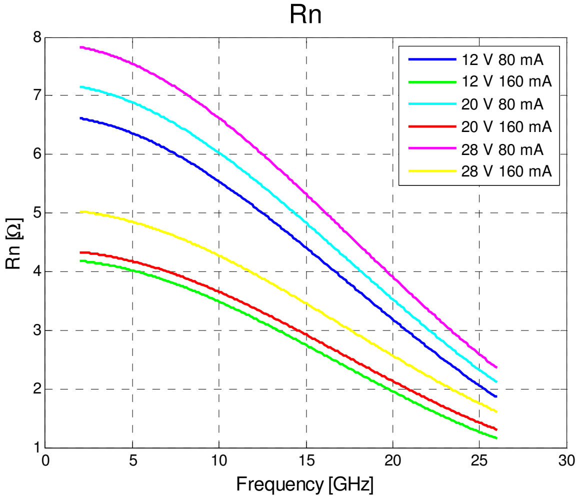
Model Noise[1]

Notes:

1. Bondwires are not included. T = 25 °C.



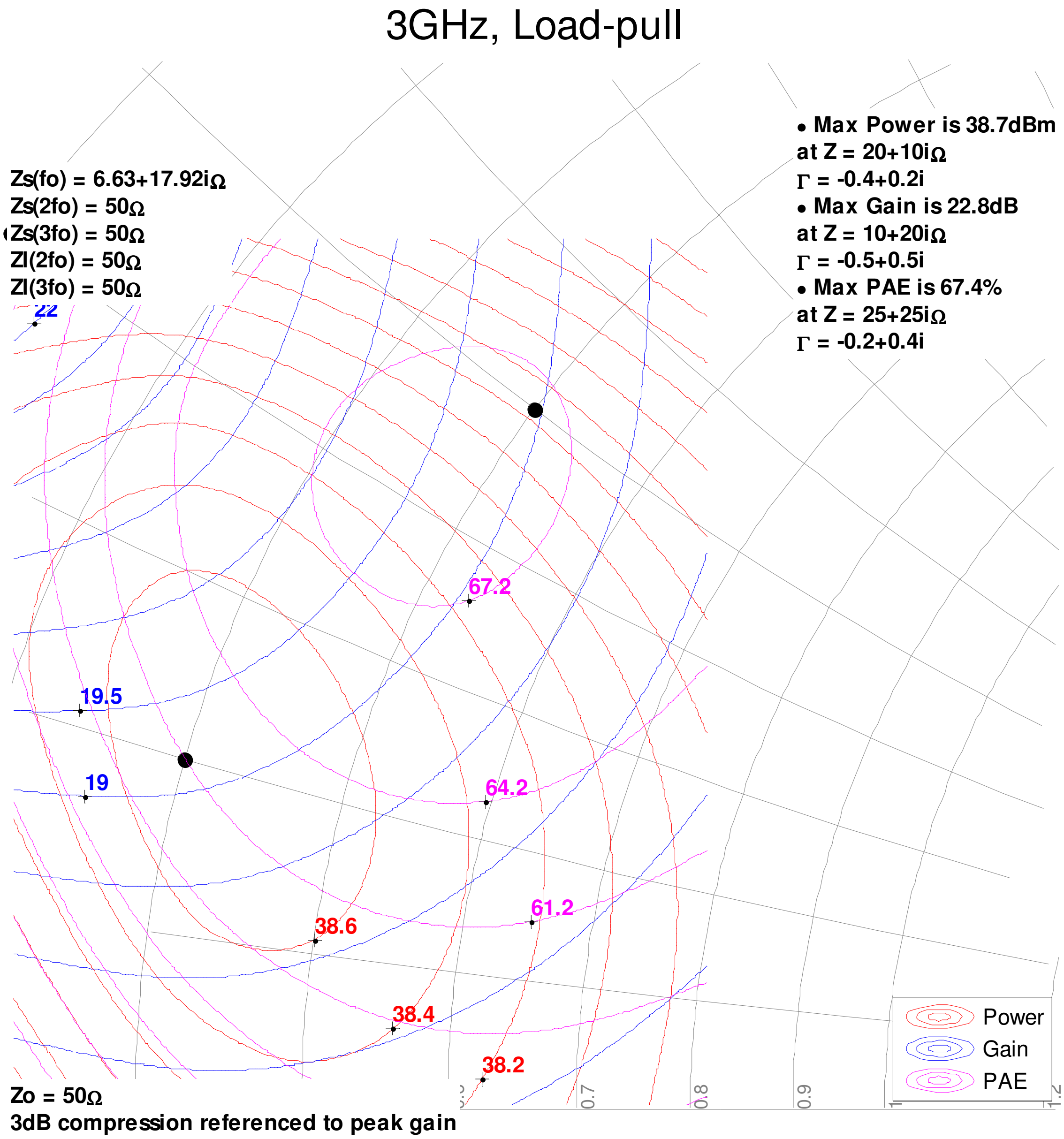




Model Load-Pull Smith Charts[1, 2]

Notes:

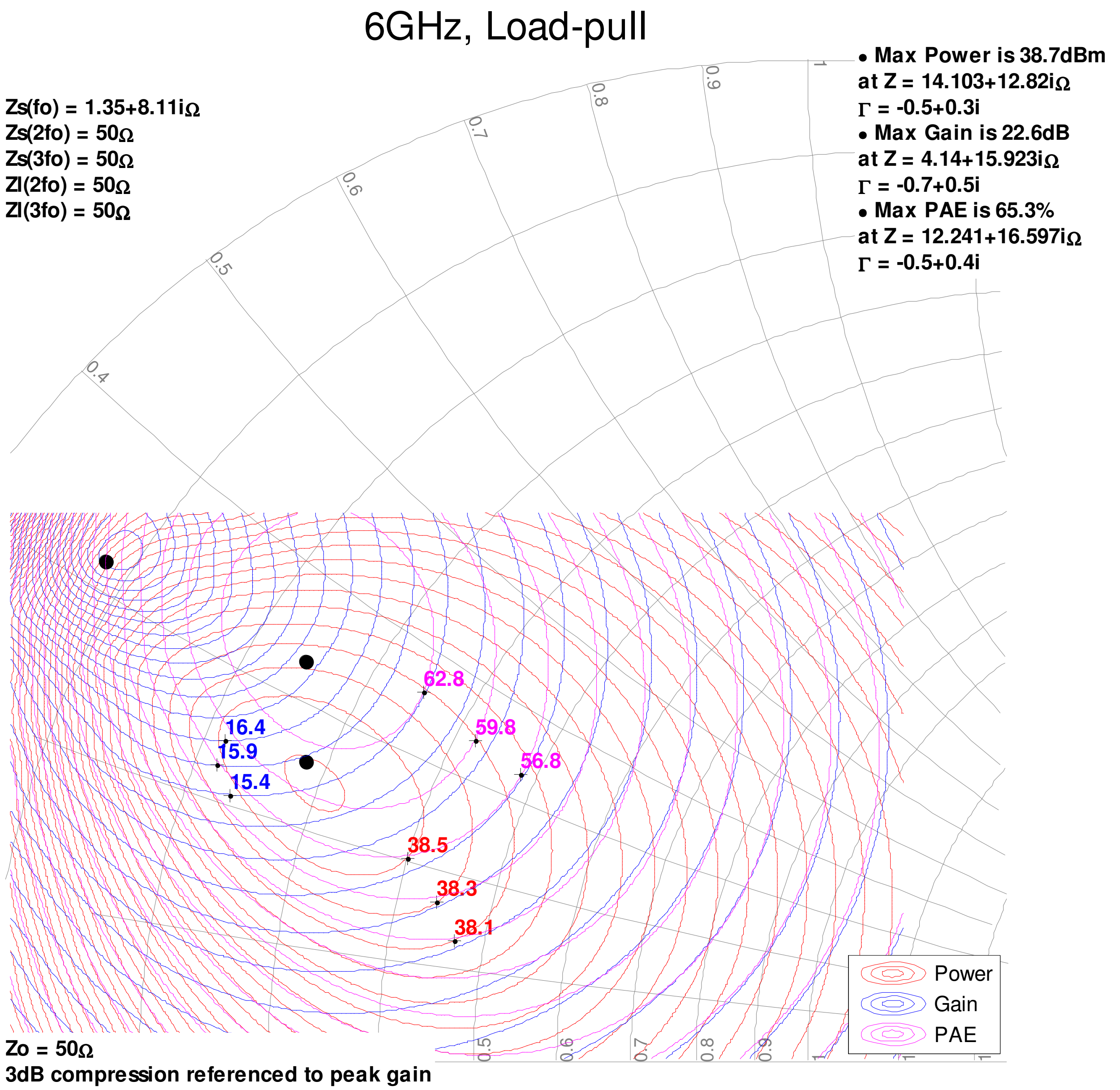
1. Test Conditions: V_D = 20 V, I_{DQ} = 80 mA, CW, Bondwires not included
2. See page 22 for load pull reference planes where the performance was simulated.



Model Load-Pull Smith Charts[1, 2]

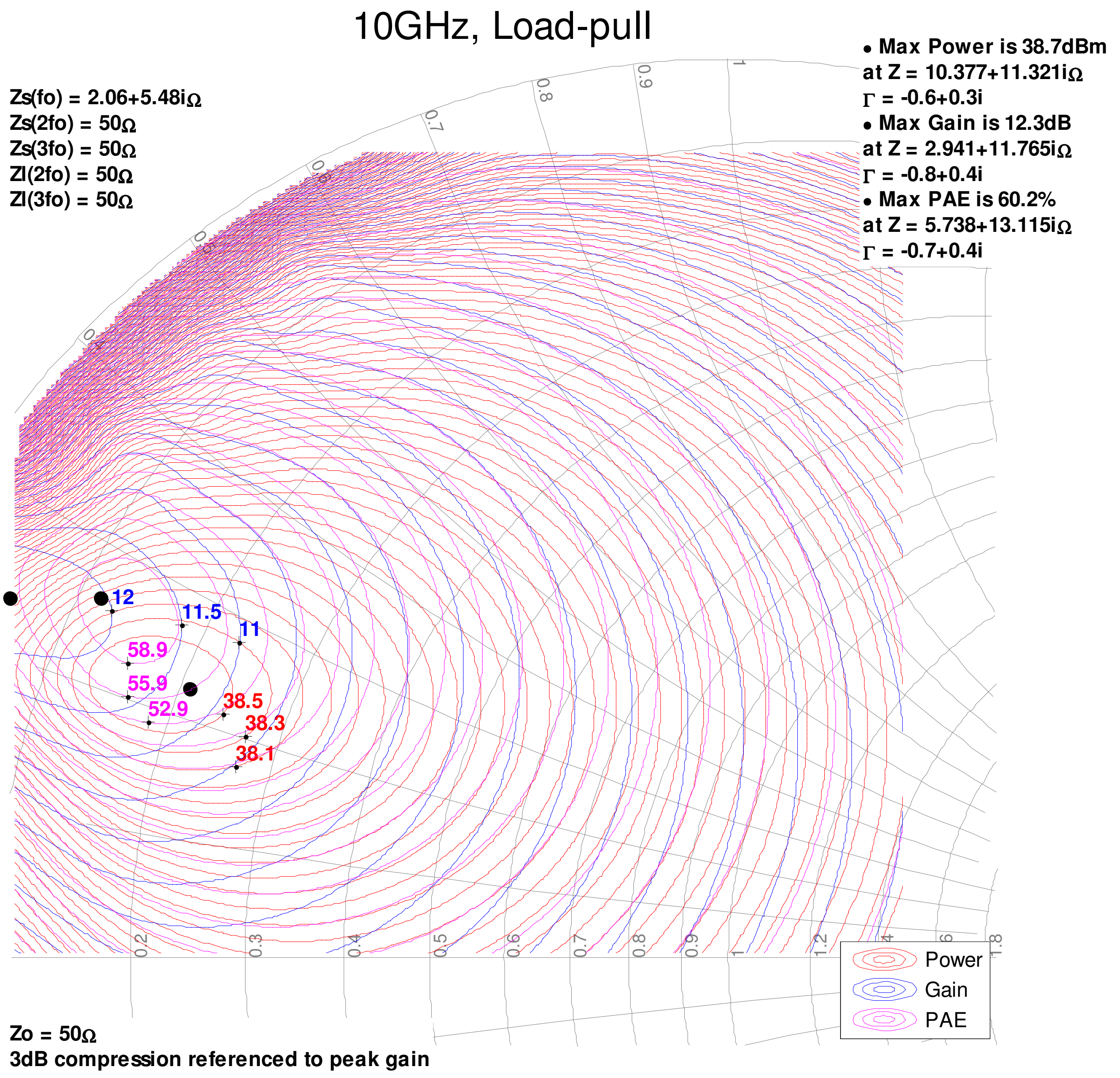
Notes:

1. Test Conditions: V_D = 20 V, I_{DQ} = 80 mA, CW, Bondwires not included
2. See page 22 for load pull reference planes where the performance was simulated.



Model Load-Pull Smith Charts[1, 2]

Notes:
1. Test Conditions: V_D = 20 V, I_{DQ} = 80 mA, CW, Bondwires not included
2. See page 22 for load pull reference planes where the performance was simulated.



10GHz, Load-pull

Zs(fo) = 2.06+5.48iΩ
Zs(2fo) = 50Ω
Zs(3fo) = 50Ω
Zl(2fo) = 50Ω
Zl(3fo) = 50Ω

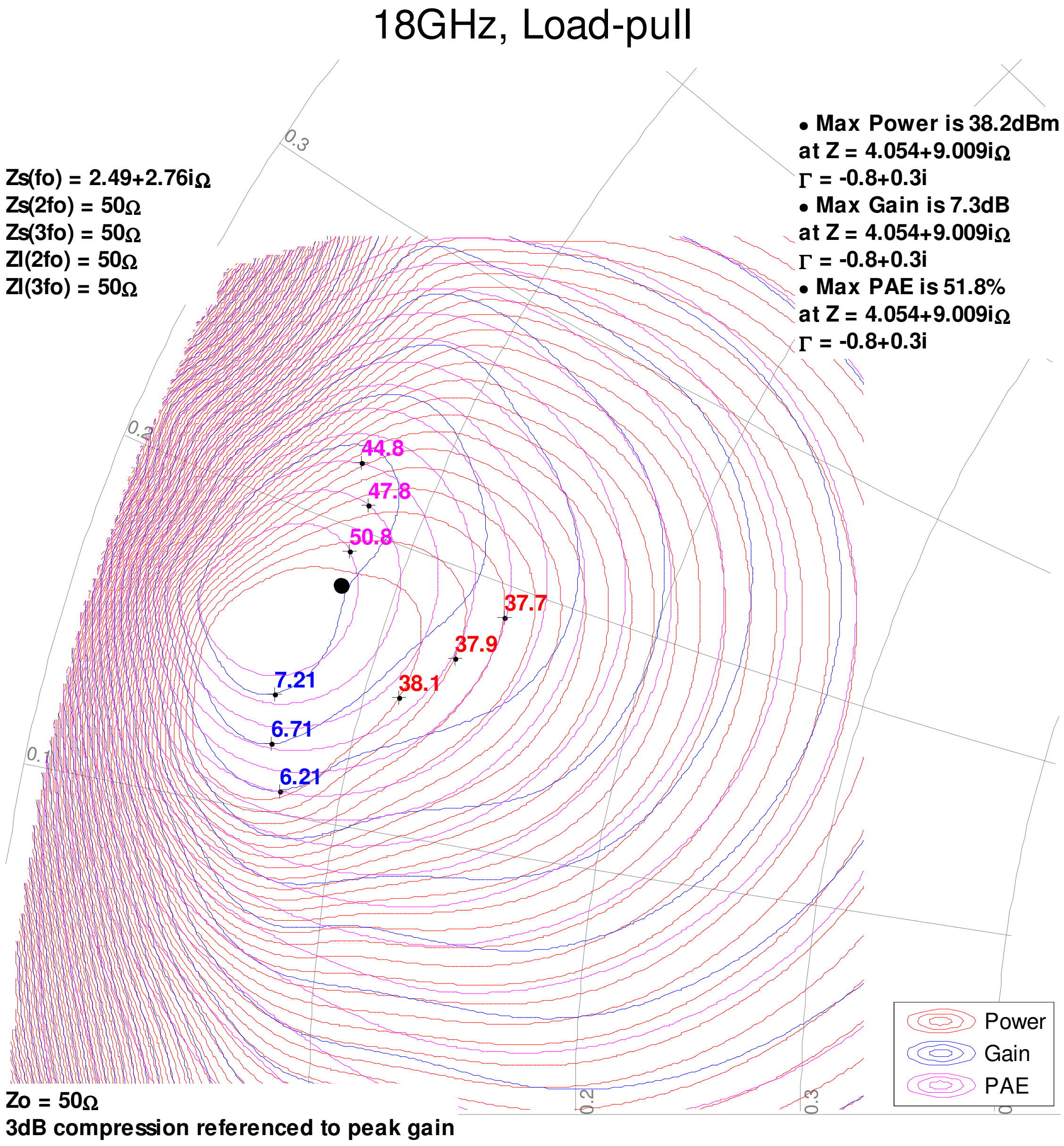
- **Max Power is 38.7dBm at Z = 10.377+11.321iΩ Γ = -0.6+0.3i**
- **Max Gain is 12.3dB at Z = 2.941+11.765iΩ Γ = -0.8+0.4i**
- **Max PAE is 60.2% at Z = 5.738+13.115iΩ Γ = -0.7+0.4i**

Zo = 50Ω
3dB compression referenced to peak gain

Model Load-Pull Smith Charts[1, 2]

Notes:

1. Test Conditions: V_D = 20 V, I_{DQ} = 80 mA, CW, Bondwires not included
2. See page 22 for load pull reference planes where the performance was simulated.



18GHz, Load-pull

Zs(fo) = 2.49+2.76iΩ
Zs(2fo) = 50Ω
Zs(3fo) = 50Ω
Zl(2fo) = 50Ω
Zl(3fo) = 50Ω

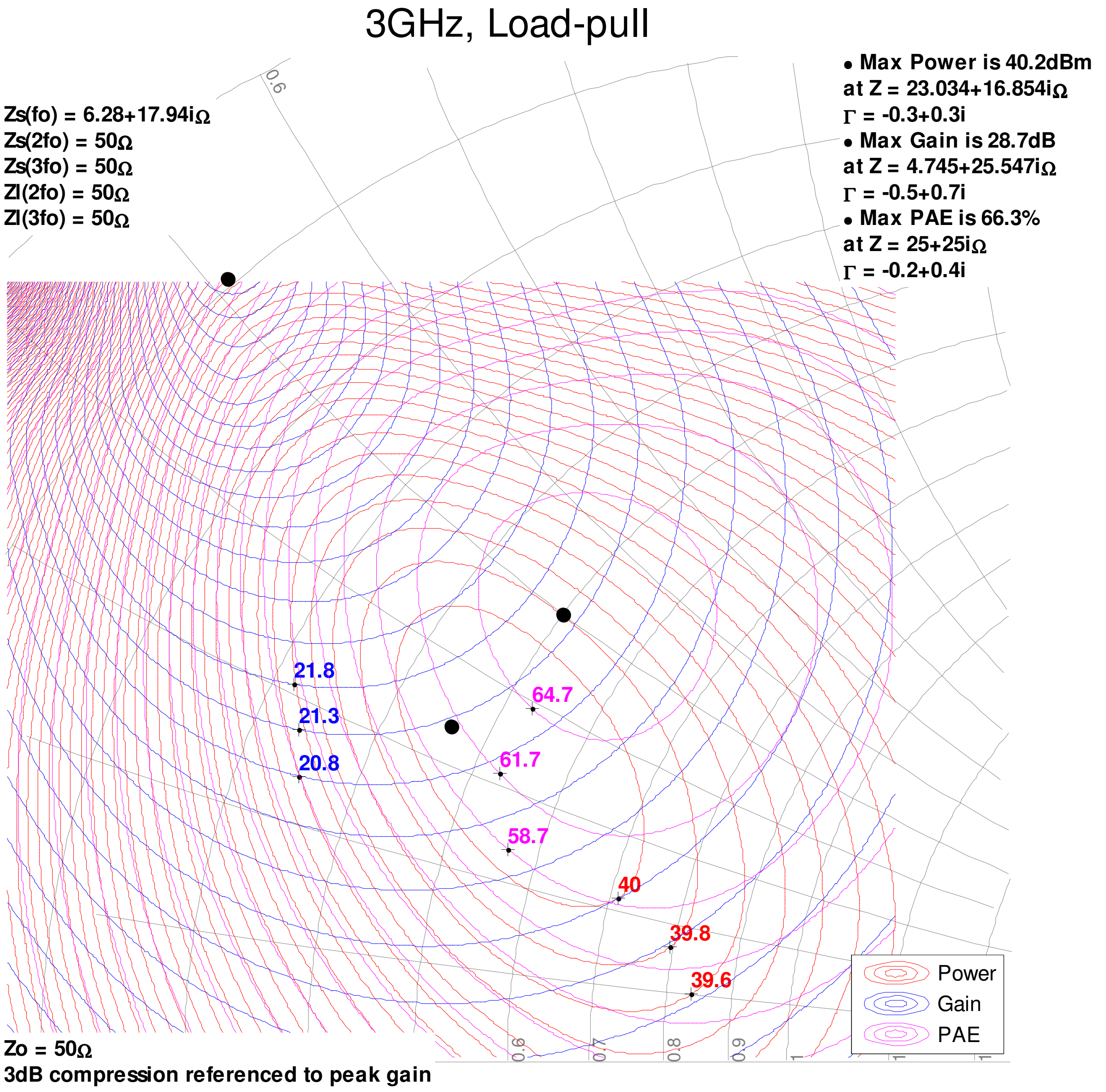
- **Max Power is 38.2dBm at Z = 4.054+9.009iΩ Γ = -0.8+0.3i**
- **Max Gain is 7.3dB at Z = 4.054+9.009iΩ Γ = -0.8+0.3i**
- **Max PAE is 51.8% at Z = 4.054+9.009iΩ Γ = -0.8+0.3i**

Zo = 50Ω
3dB compression referenced to peak gain

Model Load-Pull Smith Charts[1, 2]

Notes:

1. Test Conditions: V_D = 28 V, I_{DQ} = 80 mA, CW, Bondwires not included
2. See page 22 for load pull reference planes where the performance was simulated.


3GHz, Load-pull

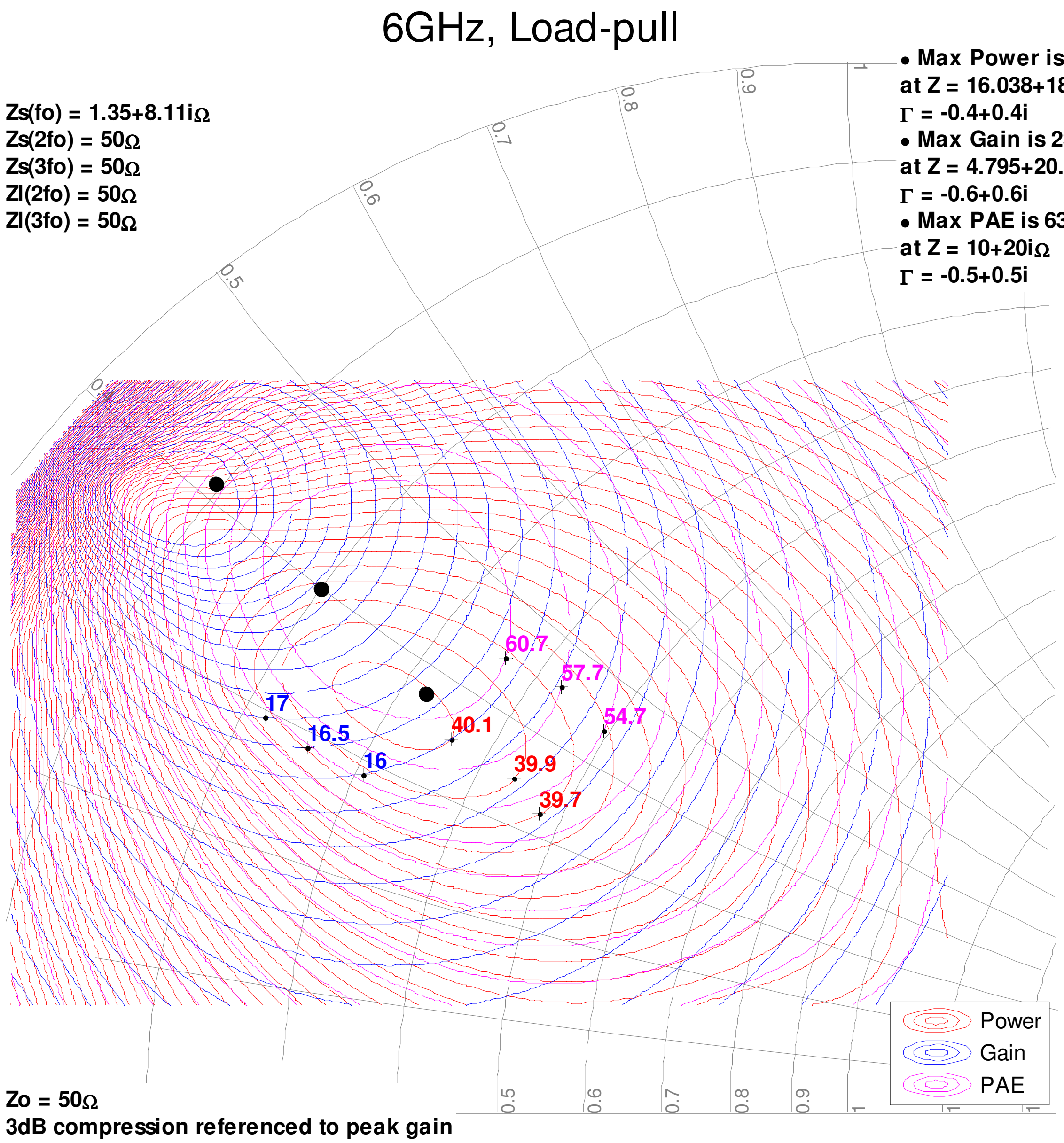
Zs(fo) = 6.28+17.94iΩ
Zs(2fo) = 50Ω
Zs(3fo) = 50Ω
Zl(2fo) = 50Ω
Zl(3fo) = 50Ω

• Max Power is 40.2dBm
at Z = 23.034+16.854iΩ
Γ = -0.3+0.3i
• Max Gain is 28.7dB
at Z = 4.745+25.547iΩ
Γ = -0.5+0.7i
• Max PAE is 66.3%
at Z = 25+25iΩ
Γ = -0.2+0.4i

Zo = 50Ω
3dB compression referenced to peak gain

Model Load-Pull Smith Charts[1, 2]

Notes:
1. Test Conditions: V_D = 28 V, I_{DQ} = 80 mA, CW, Bondwires not included
2. See page 22 for load pull reference planes where the performance was simulated.



6GHz, Load-pull

Zs(fo) = 1.35+8.11iΩ
Zs(2fo) = 50Ω
Zs(3fo) = 50Ω
Zl(2fo) = 50Ω
Zl(3fo) = 50Ω

- **Max Power is 40.1dBm at Z = 16.038+18.868iΩ Γ = -0.4+0.4i**
- **Max Gain is 23dB at Z = 4.795+20.548iΩ Γ = -0.6+0.6i**
- **Max PAE is 63.7% at Z = 10+20iΩ Γ = -0.5+0.5i**

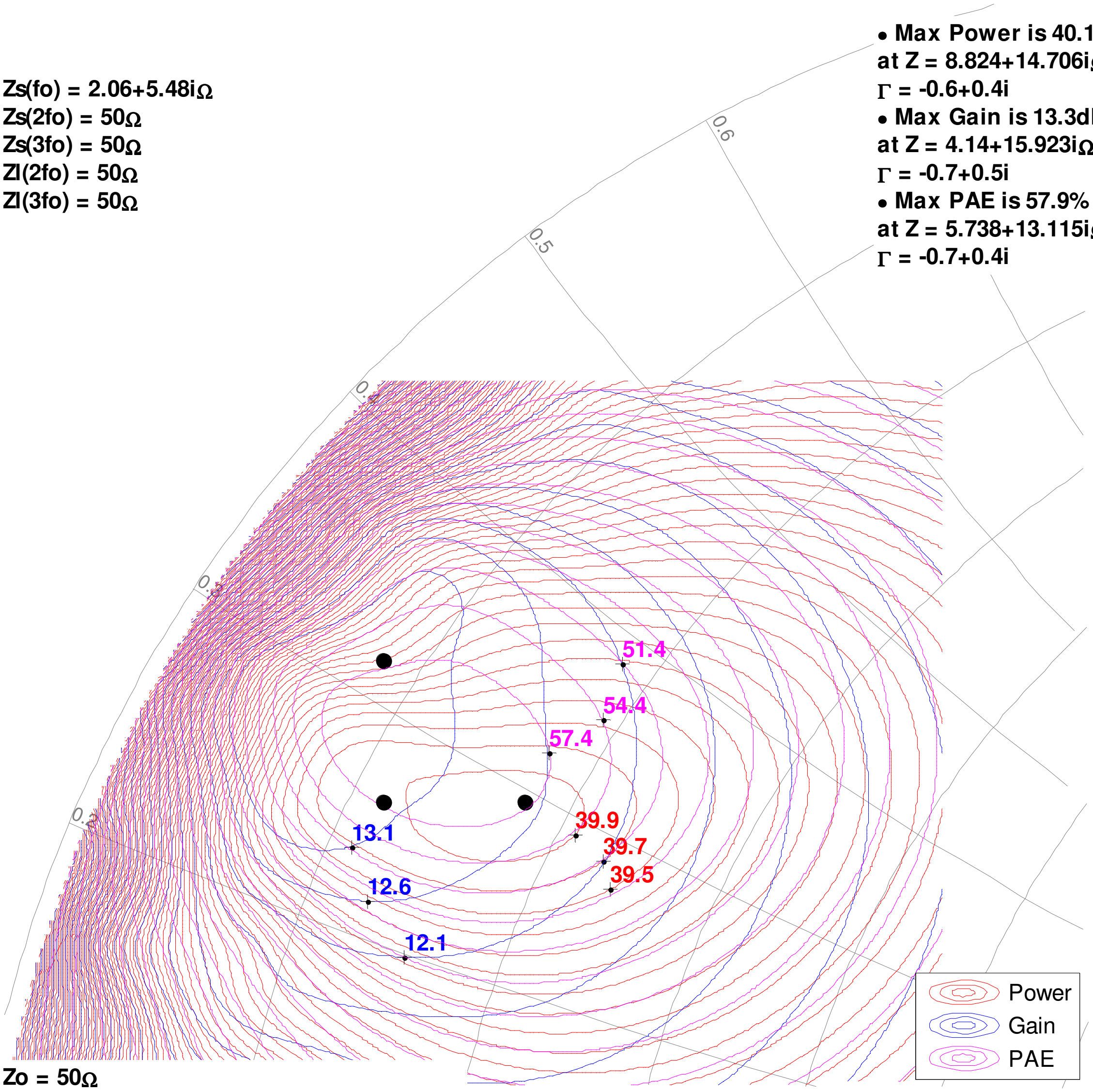
Zo = 50Ω
3dB compression referenced to peak gain

Model Load-Pull Smith Charts[1, 2]

Notes:

1. Test Conditions: V_D = 28 V, I_{DQ} = 80 mA, CW, Bondwires not included
2. See page 22 for load pull reference planes where the performance was simulated.

10GHz, Load-pull



Zs(fo) = 2.06+5.48iΩ
Zs(2fo) = 50Ω
Zs(3fo) = 50Ω
Zl(2fo) = 50Ω
Zl(3fo) = 50Ω

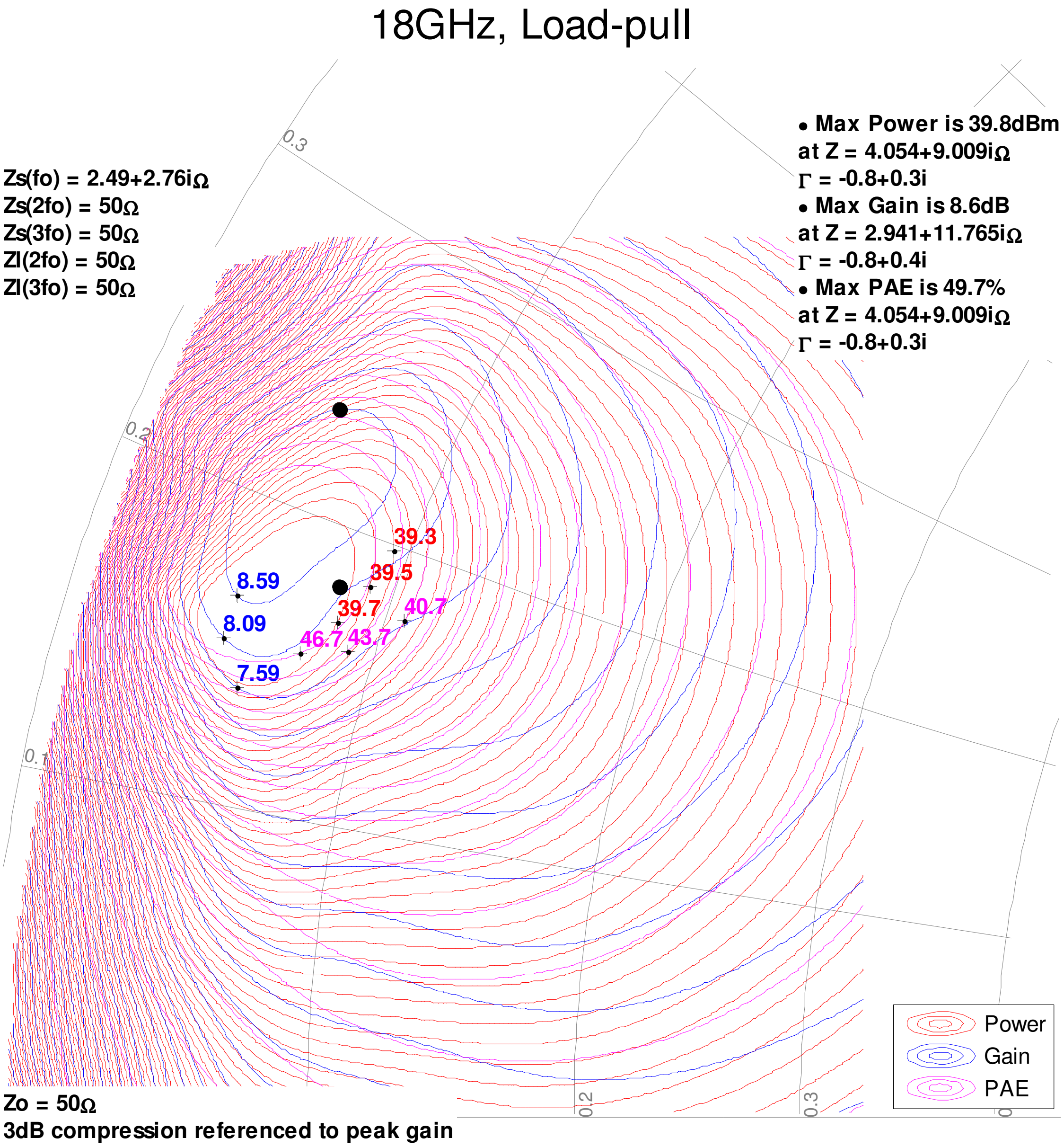
- **Max Power is 40.1dBm at Z = 8.824+14.706iΩ Γ = -0.6+0.4i**
- **Max Gain is 13.3dB at Z = 4.14+15.923iΩ Γ = -0.7+0.5i**
- **Max PAE is 57.9% at Z = 5.738+13.115iΩ Γ = -0.7+0.4i**

Zo = 50Ω
3dB compression referenced to peak gain

Model Load-Pull Smith Charts[1, 2]

Notes:

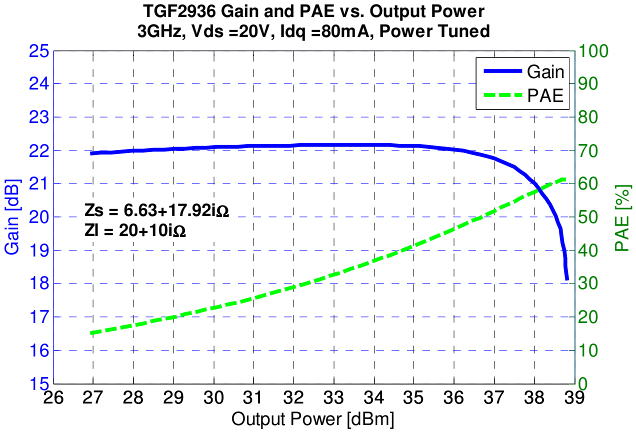
1. Test Conditions: V_D = 28 V, I_{DQ} = 80 mA, CW, Bondwires not included
2. See page 22 for load pull reference planes where the performance was simulated.

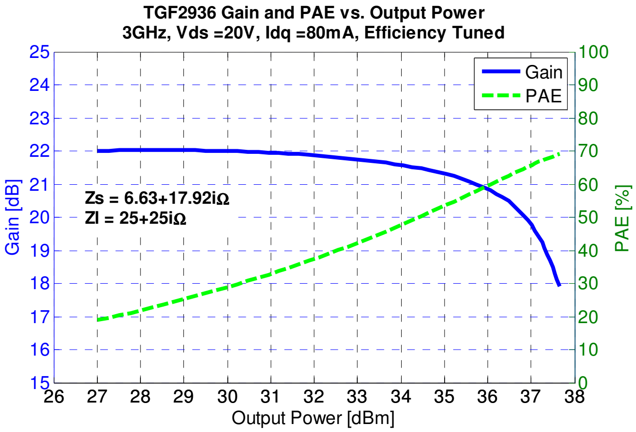


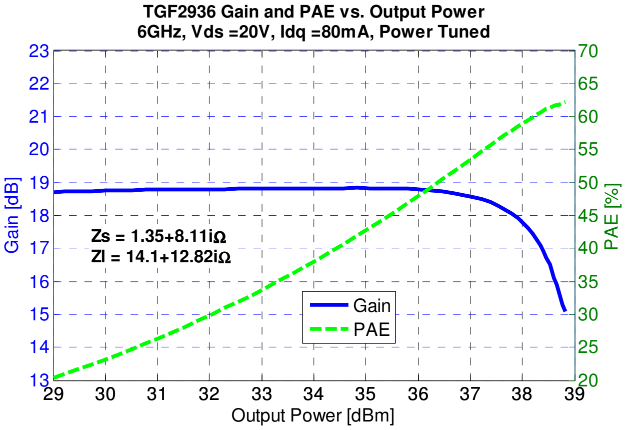
Typical Model Performance – Load-Pull Drive-up[1, 2]

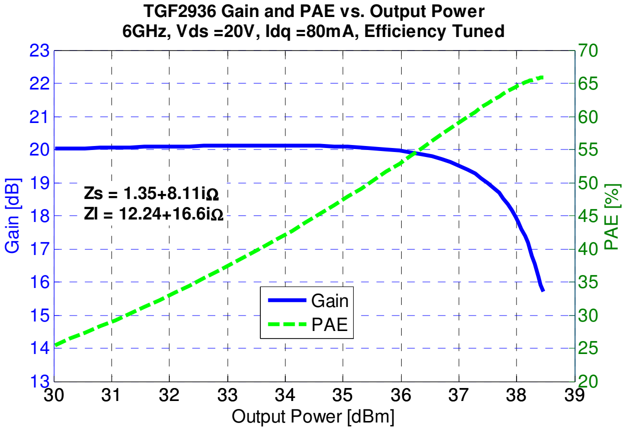
Notes:

1. CW, Bondwires not included
2. See page 22 for load-pull and source-pull reference planes where the performance was measured.





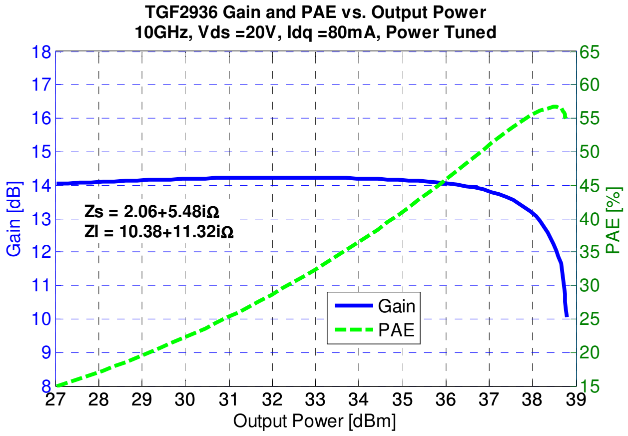


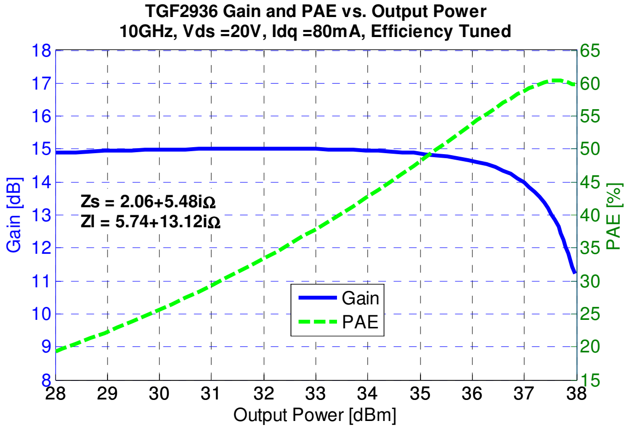


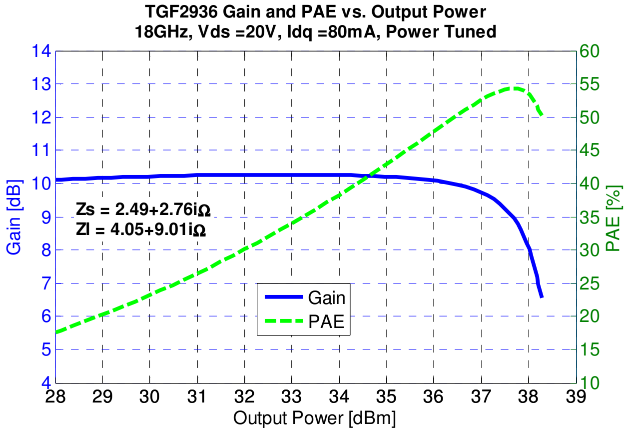
Typical Model Performance – Load-Pull Drive-up[1, 2]

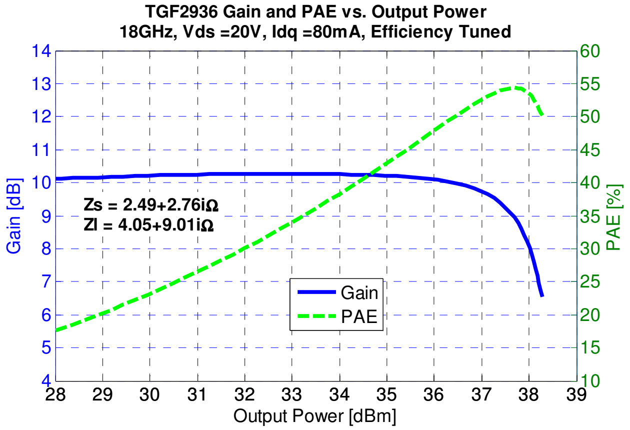
Notes:

1. CW, Bondwires not included
2. See page 22 for load-pull and source-pull reference planes where the performance was measured.


TGF2936 Gain and PAE vs. Output Power
10GHz, Vds =20V, Idq =80mA, Power Tuned

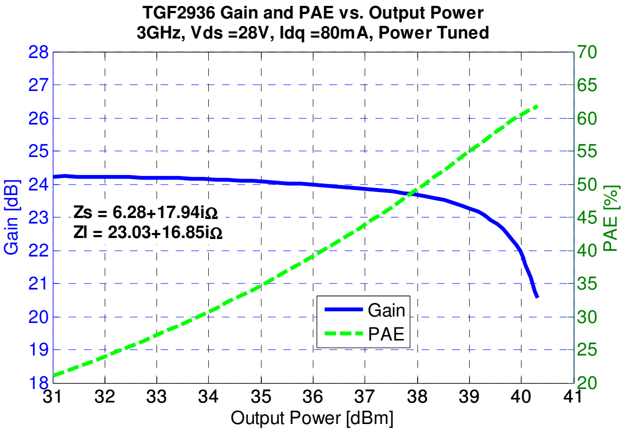

TGF2936 Gain and PAE vs. Output Power
10GHz, Vds =20V, Idq =80mA, Efficiency Tuned

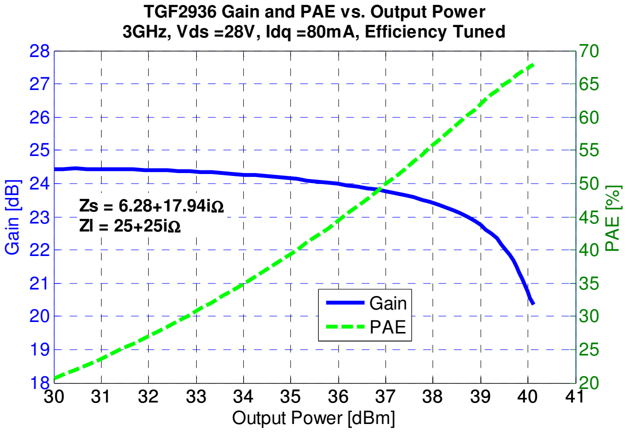

TGF2936 Gain and PAE vs. Output Power
18GHz, Vds =20V, Idq =80mA, Power Tuned

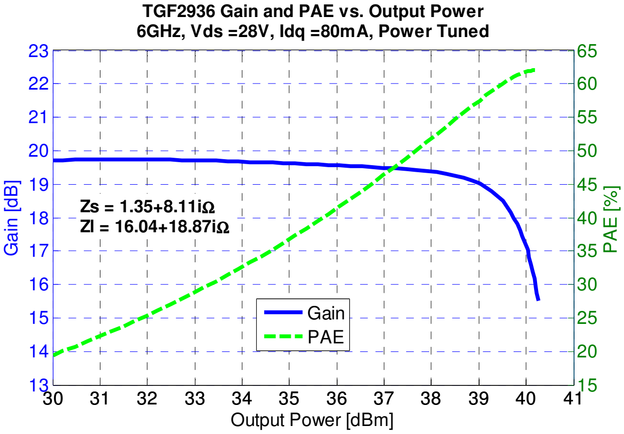

TGF2936 Gain and PAE vs. Output Power
18GHz, Vds =20V, Idq =80mA, Efficiency Tuned

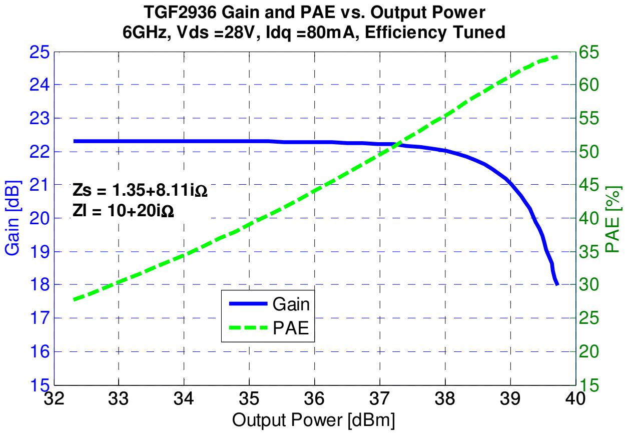
Typical Model Performance – Load-Pull Drive-up[1, 2]

Notes:
1. CW, Bondwires not included
2. See page 22 for load-pull and source-pull reference planes where the performance was measured.





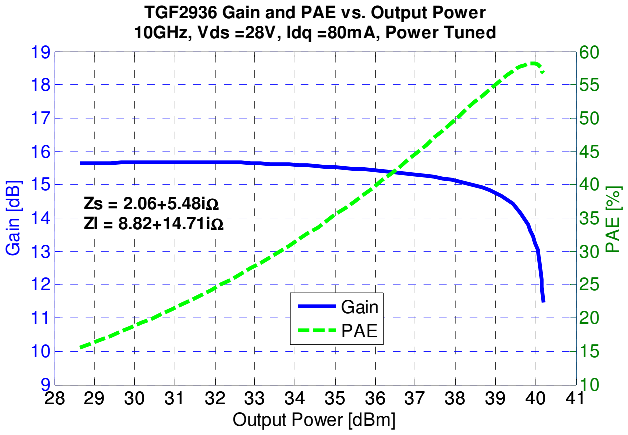


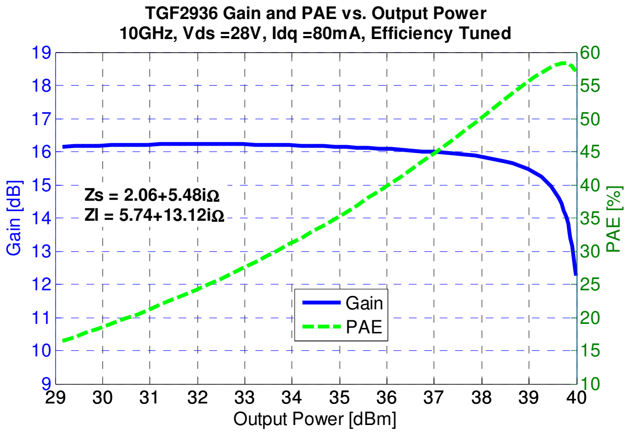


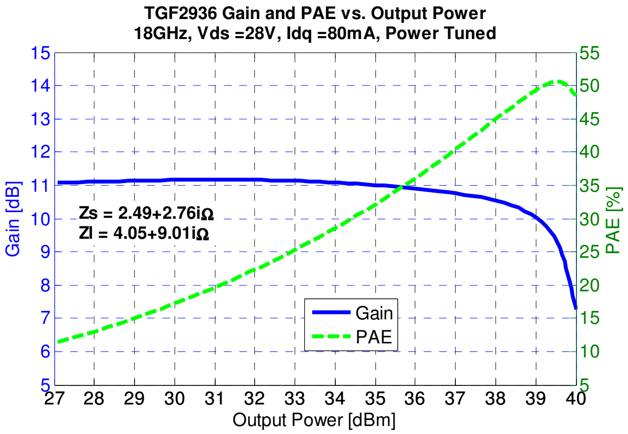
Typical Model Performance – Load-Pull Drive-up[1, 2]

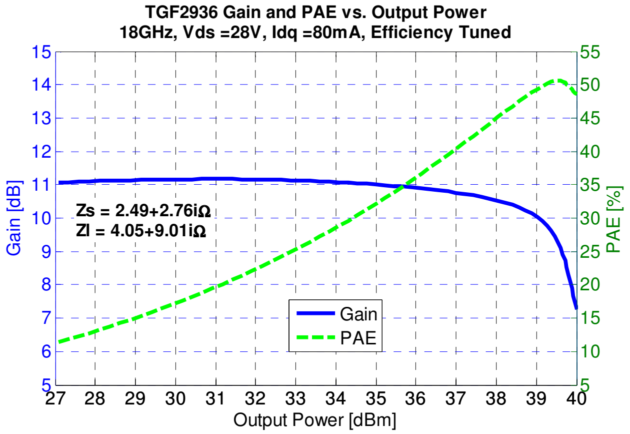
Notes:

1. CW, Bondwires not included
2. See page 22 for load-pull and source-pull reference planes where the performance was measured.

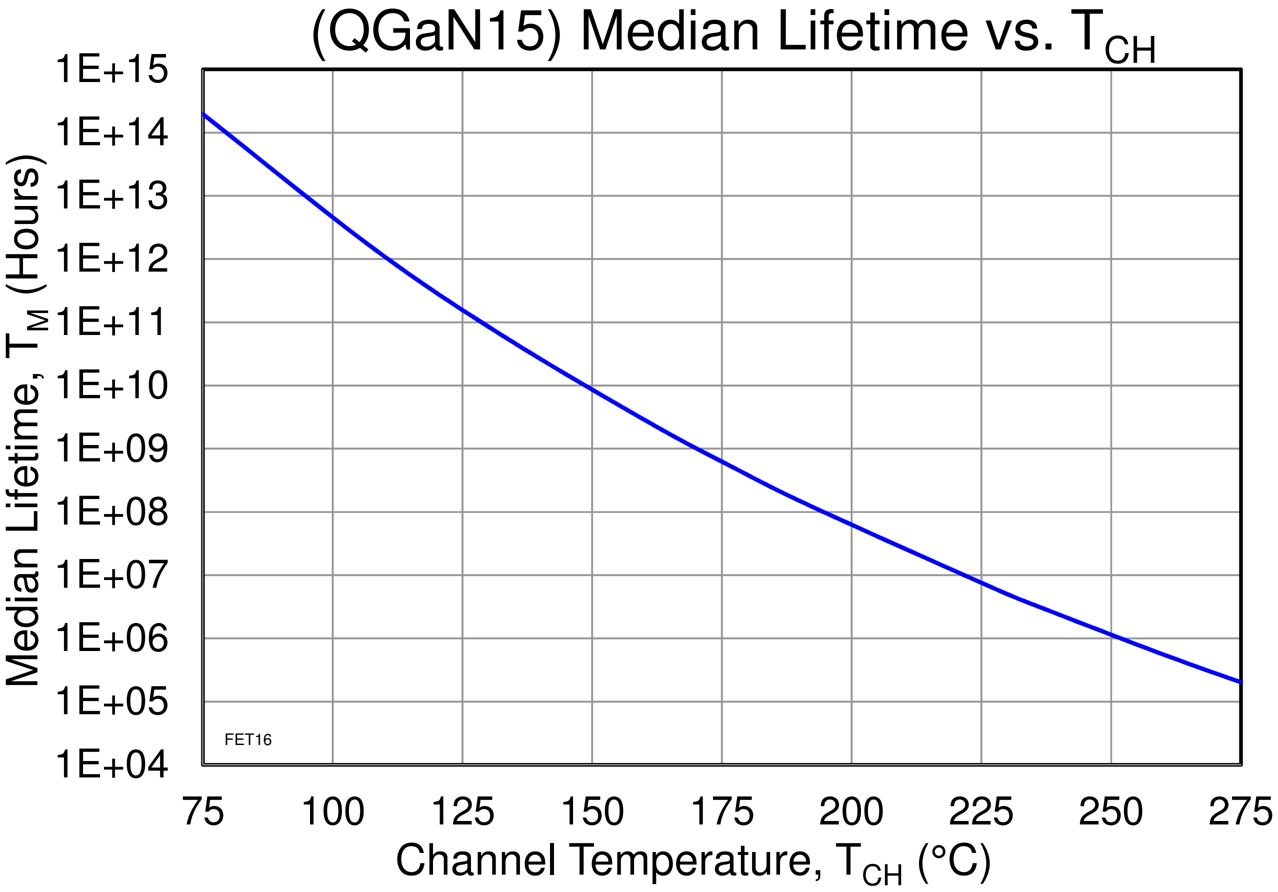

TGF2936 Gain and PAE vs. Output Power
10GHz, Vds =28V, Idq =80mA, Power Tuned


TGF2936 Gain and PAE vs. Output Power
10GHz, Vds =28V, Idq =80mA, Efficiency Tuned


TGF2936 Gain and PAE vs. Output Power
18GHz, Vds =28V, Idq =80mA, Power Tuned


TGF2936 Gain and PAE vs. Output Power
18GHz, Vds =28V, Idq =80mA, Efficiency Tuned

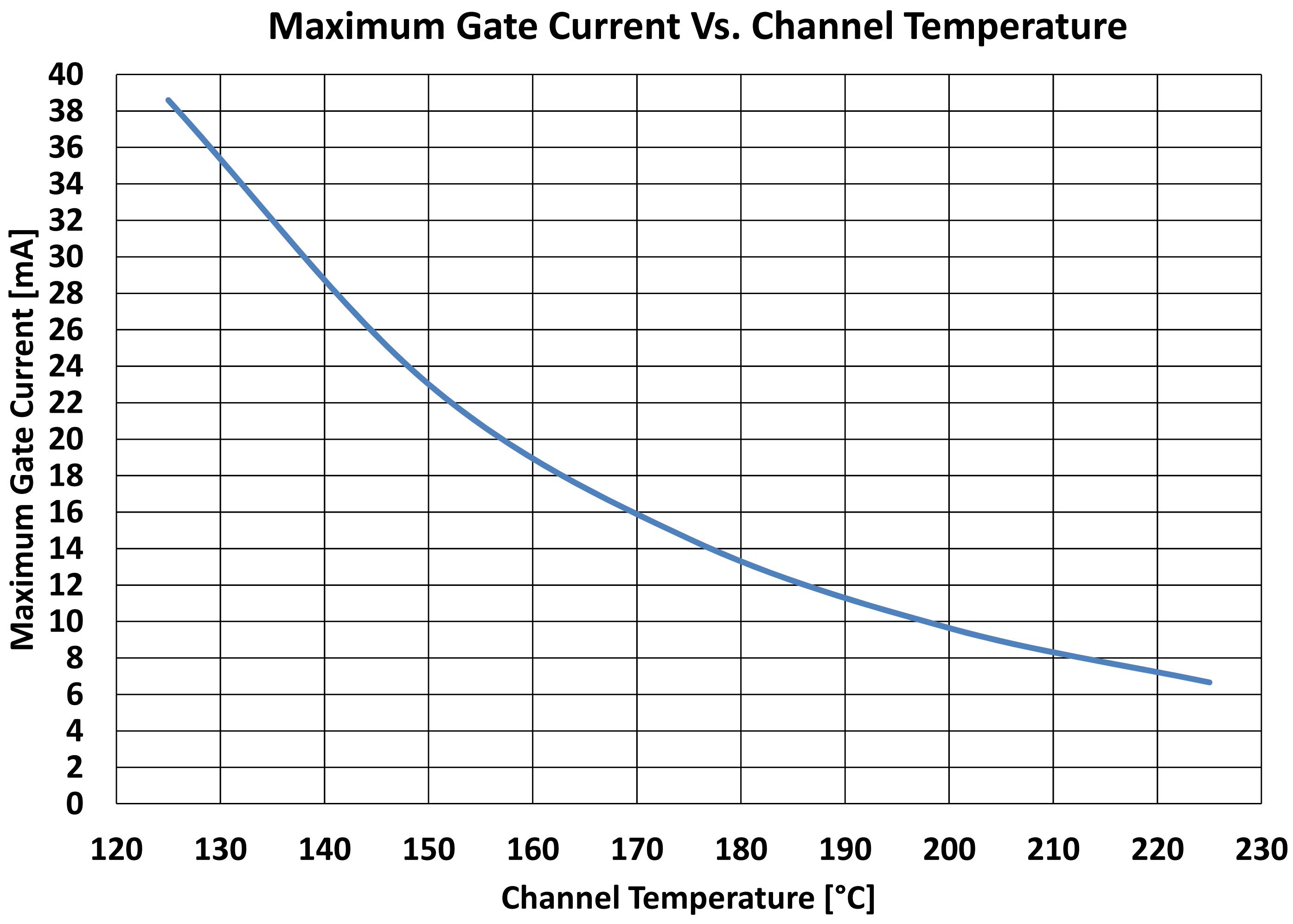
Median Lifetime[1]



Notes:

1. Test Conditions: V_D = +28 V; Failure Criteria = 10 % reduction in I_{D_MAX} during DC Life Testing .

Maximum Gate Current

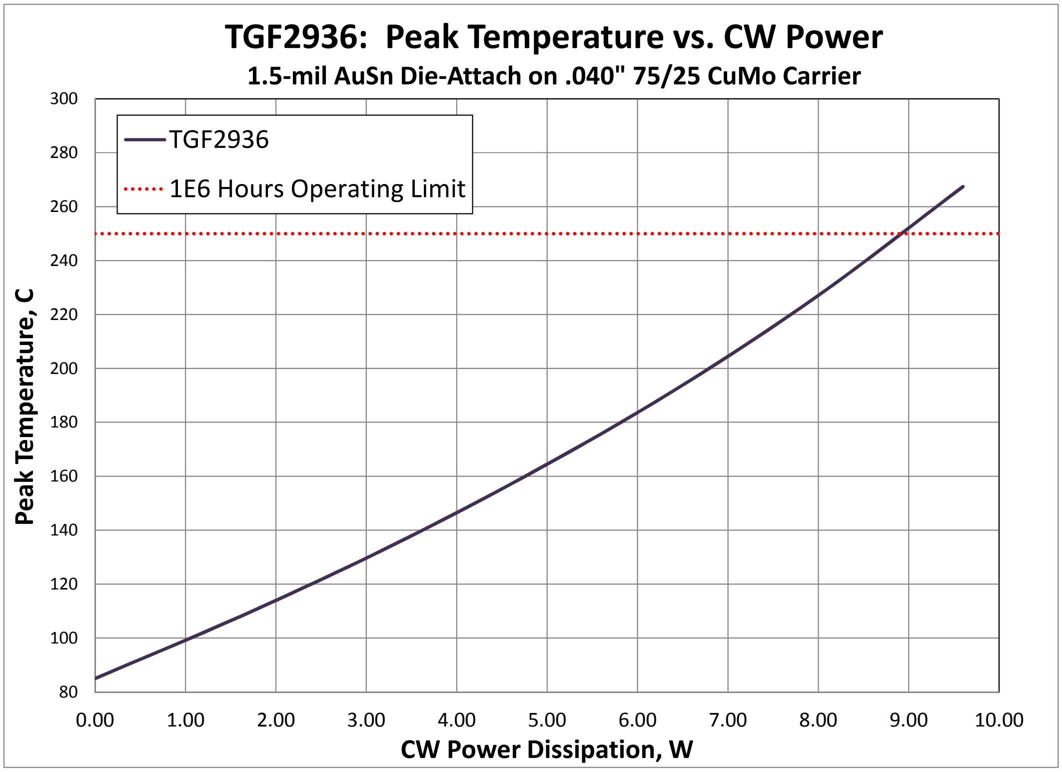


Thermal and Reliability Information

Parameter	Test Conditions	Value	Units
Thermal Resistance, θ_{JC} (1)	CW $T_{baseplate}$ = +85 °C P_{DISS} = 1.6 W	14.4	°C/W
Channel Temperature, T_{CH}		108	°C
Median Lifetime, T_M		1.4E12	Hrs
Thermal Resistance, θ_{JC} (1)	CW $T_{baseplate}$ = +85 °C P_{DISS} = 3.2 W	15	°C/W
Channel Temperature, T_{CH}		133	°C
Median Lifetime, T_M		6.0E10	Hrs
Thermal Resistance, θ_{JC} (1)	CW $T_{baseplate}$ = +85 °C P_{DISS} = 4.8 W	15.8	°C/W
Channel Temperature, T_{CH}		161	°C
Median Lifetime, T_M		2.6E9	Hrs
Thermal Resistance, θ_{JC} (1)	CW $T_{baseplate}$ = +85 °C P_{DISS} = 6.4 W	16.7	°C/W
Channel Temperature, T_{CH}		192	°C
Median Lifetime, T_M		1.2E8	Hrs
Thermal Resistance, θ_{JC} (1)	CW $T_{baseplate}$ = +85 °C P_{DISS} = 8 W	17.8	°C/W
Channel Temperature, T_{CH}		227	°C
Median Lifetime, T_M		6.4E6	Hrs
Thermal Resistance, θ_{JC} (1)	CW $T_{baseplate}$ = +85 °C P_{DISS} = 9.6 W	19.0	°C/W
Channel Temperature, T_{CH}		267	°C
Median Lifetime, T_M		3.4E5	Hrs

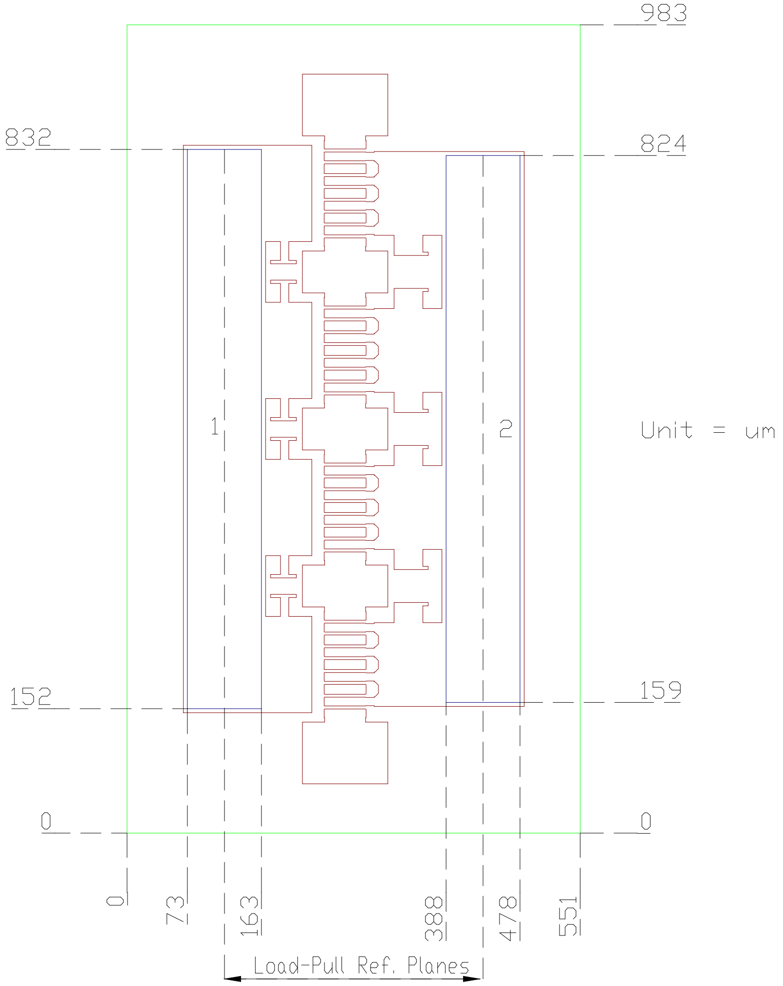
Notes:

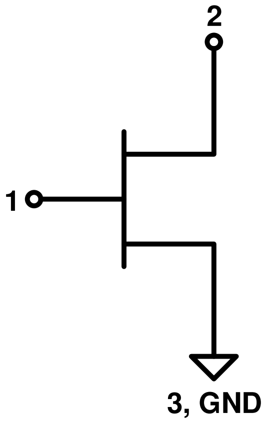
1. Thermal resistance measured at back of package.



Pin Configuration and Description[1]

Notes: 1. Die size tolerance is ± 0.015 mm.





Pin Description

Pin	Symbol	Description	Dimension
1	RF IN / V_G	Gate	0.680 x 0.090 mm
2	RF OUT / V_D	Drain	0.665 x 0.090 mm
3	Source	Source / Ground / Backside of die	0.983 x 0.551 mm

Assembly Notes

Component placement and adhesive attachment assembly notes:

- Vacuum pencils and/or vacuum collets are the preferred method of pick up.
- Air bridges must be avoided during placement.
- The force impact is critical during auto placement.
- Organic attachment (i.e. epoxy) not recommended.

Reflow process assembly notes:

- Use AuSn (80/20) solder and limit exposure to temperatures above 300°C to 3-4 minutes, maximum.
- An alloy station or conveyor furnace with reducing atmosphere should be used.
- Do not use any kind of flux.
- Coefficient of thermal expansion matching is critical for long-term reliability.
- Devices must be stored in a dry nitrogen atmosphere.

Interconnect process assembly notes:

- Ball bonding is the preferred interconnect technique, except where noted on the assembly diagram.
- Force, time, and ultrasonics are critical bonding parameters.
- Aluminum wire should not be used.
- Devices with small pad sizes should be bonded with 0.0007-inch wire.

Disclaimer

GaN/SiC devices are susceptible to damage from Electrostatic Discharge. Proper precautions should be observed during handling, assembly and test.

Bias-up Procedure	Bias-down Procedure
1. Set V_G to -4 V. 2. Set I_D limit to 100 mA. 3. Slowly adjust V_G until I_D reaches 80 mA. 4. Set I_D limit to 800 mA. 5. Apply RF signal.	1. Turn off RF signal. 2. Turn off V_D and wait 1 second to allow drain capacitor discharge. 3. Turn of V_G.