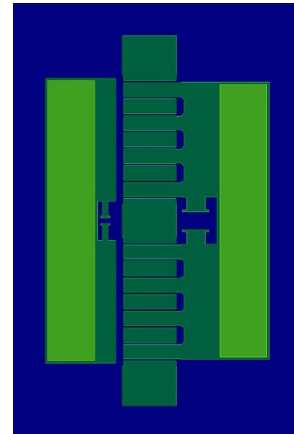


Product Overview

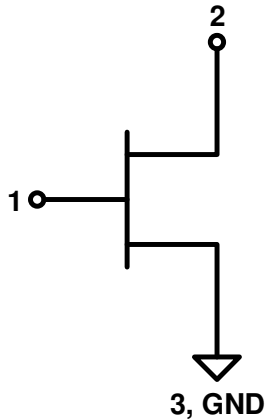
The Qorvo TGF2933 is a 7 W (P_{3dB}) discrete GaN on SiC HEMT which operates from DC to 25 GHz and 28 V supply. The device is constructed with Qorvo’s proven QGaN15 process. The device can support pulsed, CW, and linear operations.

Lead-free and ROHS compliant



0.833 x 0.551 x 0.100 mm

Functional Block Diagram



Key Features

- Frequency: DC to 25 GHz
 - Output Power (P_{3dB})¹: 7.2 W
 - Linear Gain¹: 15 dB
 - Typical PAE_{3dB}¹: 57%
 - Typical Noise Figure¹: 1.3dB
 - Operating Voltage: 28 V
 - CW and Pulse capable
 - Non-linear & Noise Models available
- Note 1: @ 10 GHz

Applications

- Defense and Aerospace
- Broadband wireless
- Low noise amplifier

Ordering info

Part No.	ECCN	Description
TGF2933	EAR99	DC–25GHz, 28 V, 7 W GaN RF Transistor

Absolute Maximum Ratings¹

Parameter	Rating	Units
Breakdown Voltage, BV_{DG}	+60	V
Gate Voltage Range, V_G	-7 to +1.5	V
Drain Current, I_{D_MAX}	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, $T = 25\text{ }^\circ\text{C}$	+30	dBm
Channel Temperature, T_{CH}	275	$^\circ\text{C}$
Mounting Temperature (30 Seconds)	320	$^\circ\text{C}$
Storage Temperature	-65 to +150	$^\circ\text{C}$

Notes:

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

Recommended Operating Conditions¹

Parameter	Min	Typ	Max	Units
Operating Temp. Range	-40	+25	+85	$^\circ\text{C}$
Drain Voltage Range, V_D	+12	+20	+29.5	V
Drain Bias Current, I_{DQ}	40	80	160	mA
Drain Current, I_D	-	500	-	mA
Gate Voltage, V_G^3	-	-2.8	-	V
Channel Temperature (T_{CH})	-	-	250	$^\circ\text{C}$
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 $^\circ\text{C}$
3. To be adjusted to desired I_{DQ}

Model Load Pull Performance – Power Tuned¹

Parameter	Typical Values								Units
	3		6		10		18		
Frequency, F									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}	37.7	38.8	37.7	39.0	37.5	38.6	37.6	37.9	dBm
Power Added Efficiency at 3dB compression, PAE_{3dB}	60.4	57.1	60.3	58.0	59.2	50.5	48.6	51.2	%
Gain at 3dB compression, G_{3dB}	22.1	21.3	15.5	16.3	11.7	11.9	6.5	9.0	dB
Load Reflection Coefficient ⁽²⁾ , Γ_L	$0.36 \angle 146^\circ$	$0.22 \angle 117^\circ$	$0.50 \angle 143^\circ$	$0.50 \angle 121^\circ$	$0.72 \angle 146^\circ$	$0.64 \angle 141^\circ$	$0.85 \angle 159^\circ$	$0.89 \angle 153^\circ$	--

Notes:

1. CW, bondwires not included
2. Characteristic Impedance, $Z_0 = 50 \Omega$.

Model Load Pull Performance – Efficiency Tuned¹

Parameter	Typical Values								Units
	3		6		10		18		
Frequency, F									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}	37.0	38.1	36.6	38.6	36.2	38.5	37.6	37.9	dBm
Power Added Efficiency at 3dB compression, PAE_{3dB}	64.6	60.8	63.6	60.6	59.7	57.0	48.6	51.2	%
Gain at 3dB compression, G_{3dB}	23.0	22.8	16.3	16.9	12.0	12.6	6.5	9.0	dB
Load Reflection Coefficient ⁽²⁾ , Γ_L	$0.45 \angle 117^\circ$	$0.40 \angle 90^\circ$	$0.64 \angle 129^\circ$	$0.58 \angle 121^\circ$	$0.78 \angle 140^\circ$	$0.78 \angle 140^\circ$	$0.85 \angle 159^\circ$	$0.89 \angle 153^\circ$	--

Notes:

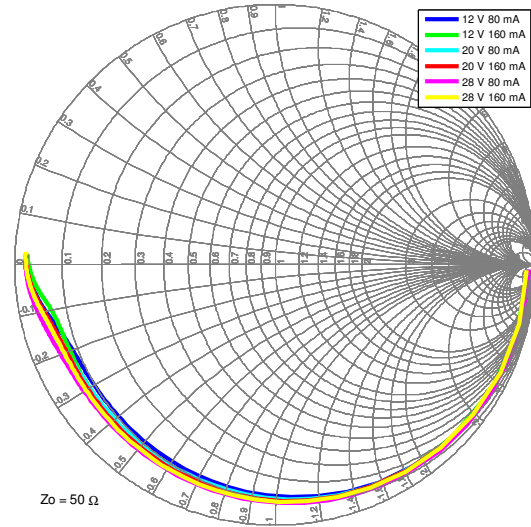
1. CW, bondwires not included
2. Characteristic Impedance, $Z_0 = 50 \Omega$.

Model S-parameters¹

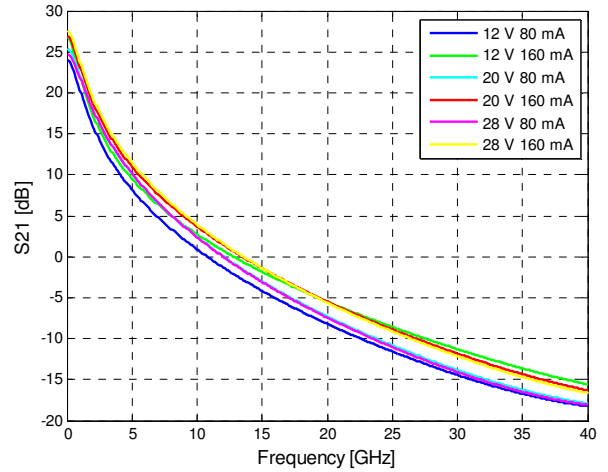
Notes:

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

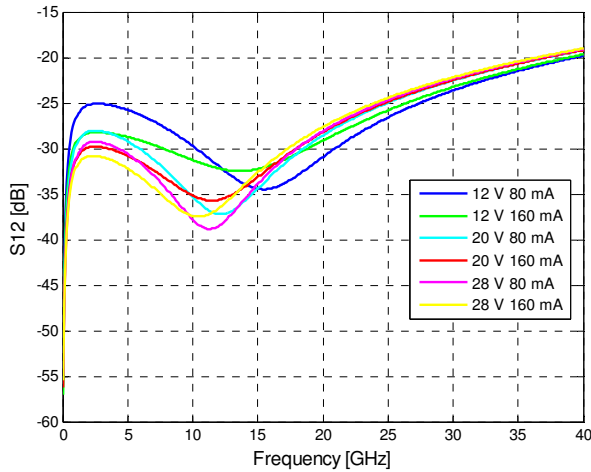
S11 from 0.01 GHz to 40 GHz



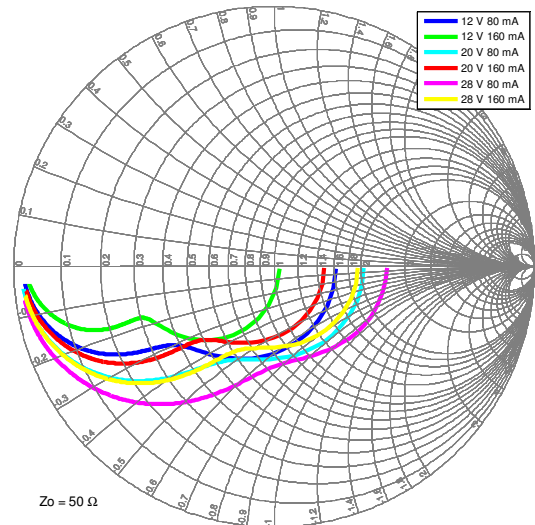
S21



S12



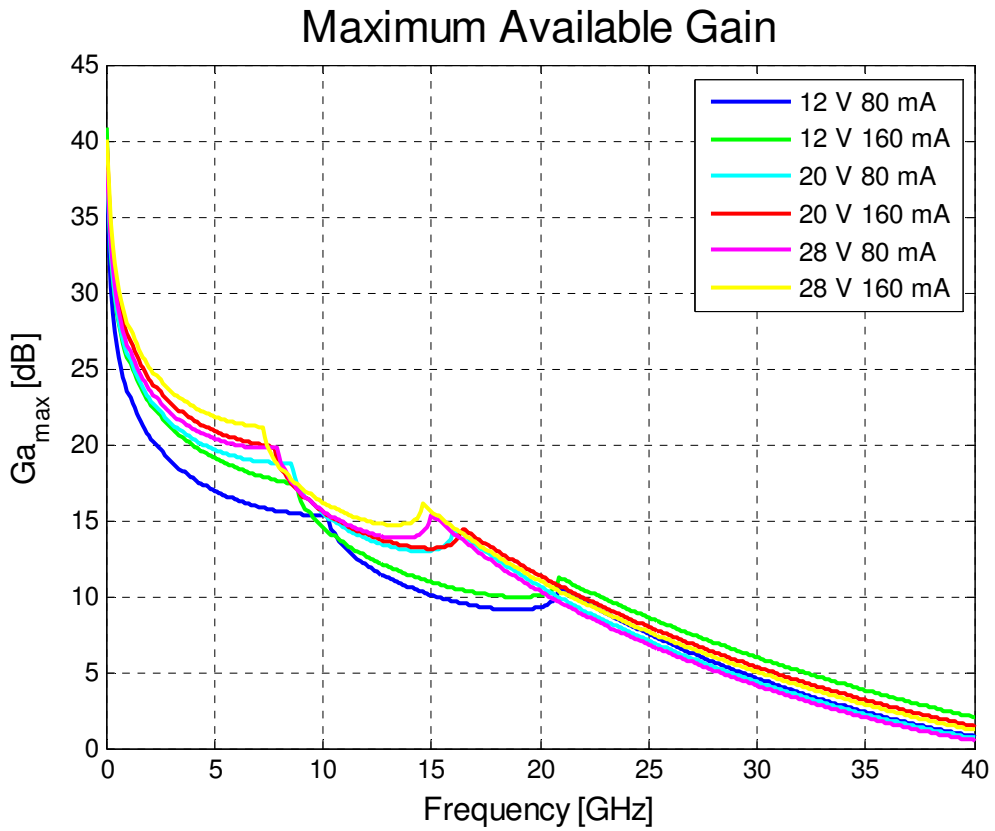
S22 from 0.01 GHz to 40 GHz



Model Maximum Available Gain¹

Notes:

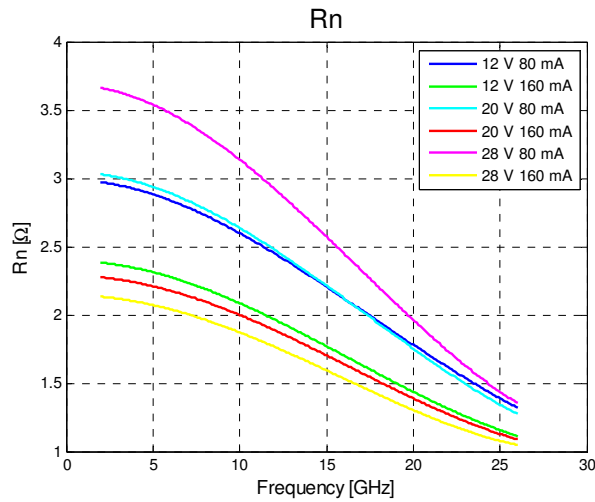
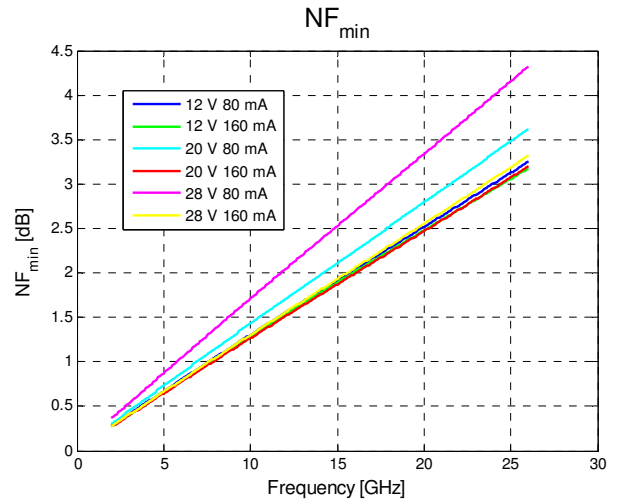
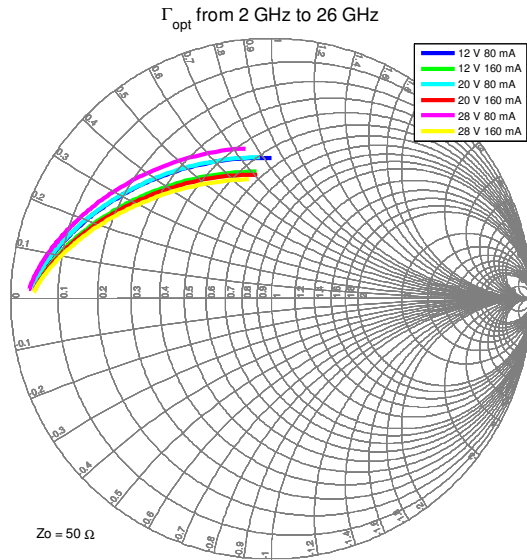
- 1. Bondwires are not included. T = 25 °C.



Model Noise¹

Notes:

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

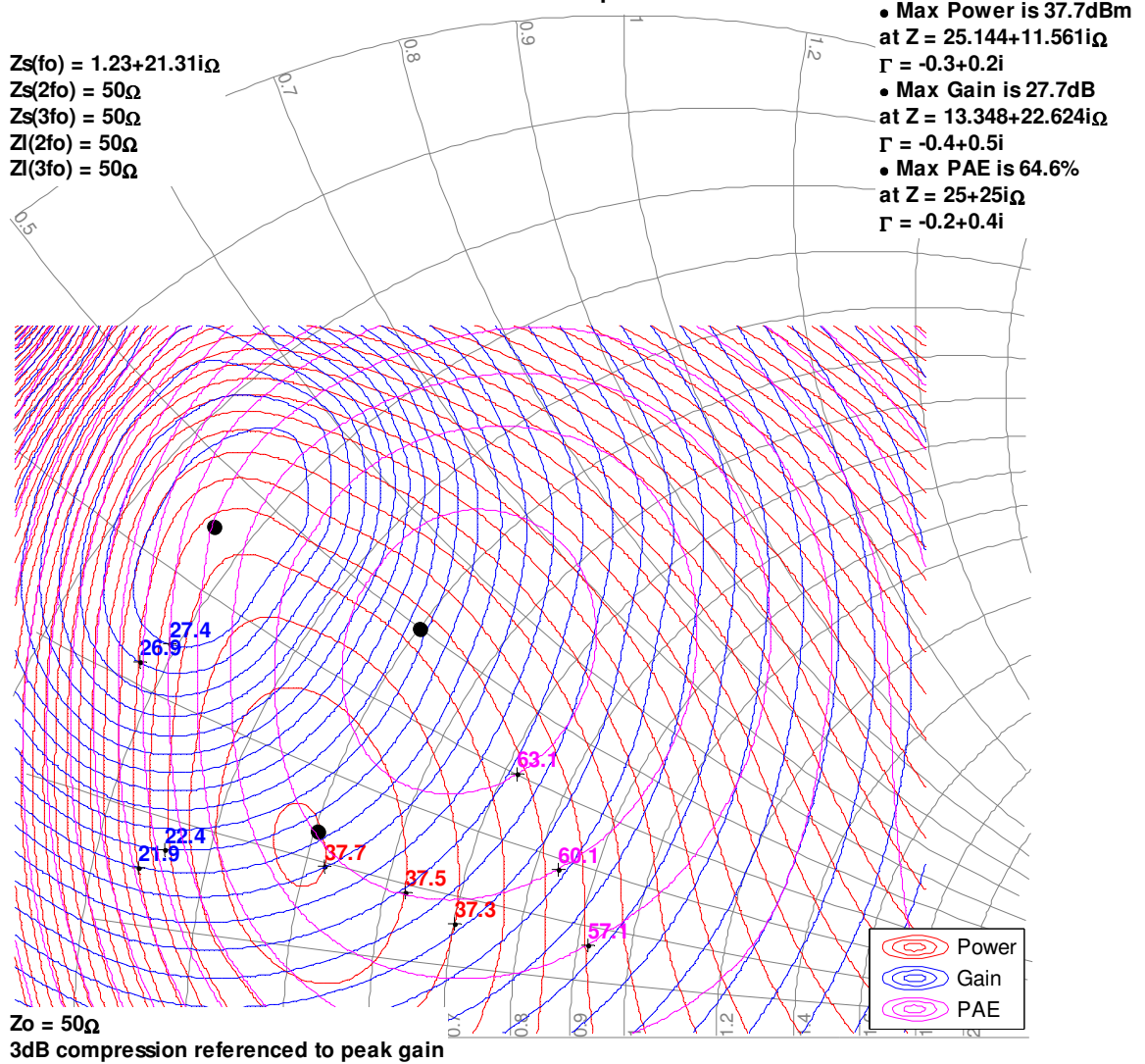


Model Load-Pull Smith Charts^{1,2}

Notes:

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

3GHz, Load-pull



Model Load-Pull Smith Charts^{1,2}

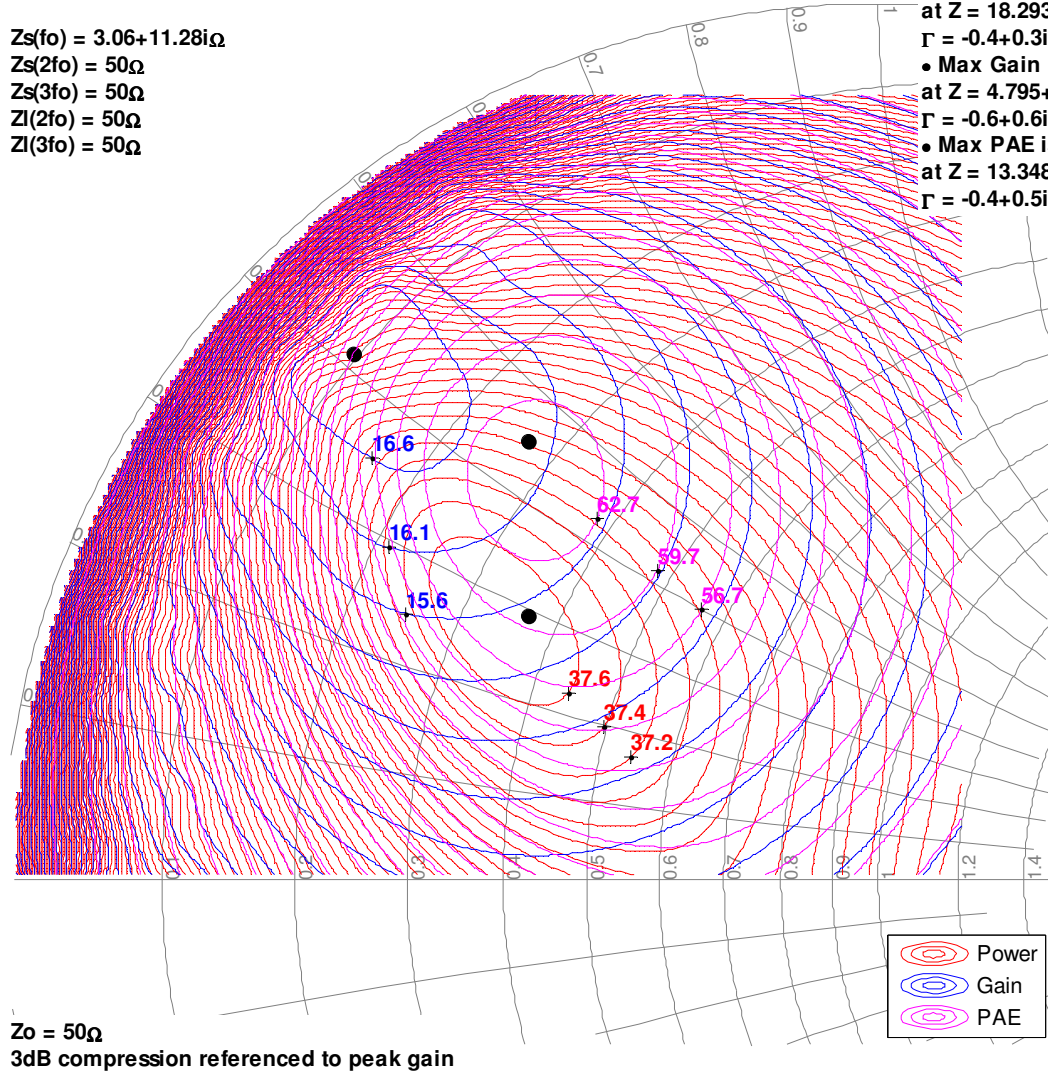
Notes:

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

6GHz, Load-pull

$Z_s(f_0) = 3.06 + 11.28i\Omega$
 $Z_s(2f_0) = 50\Omega$
 $Z_s(3f_0) = 50\Omega$
 $Z_l(2f_0) = 50\Omega$
 $Z_l(3f_0) = 50\Omega$

- Max Power is 37.7dBm at $Z = 18.293 + 14.634i\Omega$
 $\Gamma = -0.4 + 0.3i$
- Max Gain is 16.7dB at $Z = 4.795 + 20.548i\Omega$
 $\Gamma = -0.6 + 0.6i$
- Max PAE is 63.6% at $Z = 13.348 + 22.624i\Omega$
 $\Gamma = -0.4 + 0.5i$



Model Load-Pull Smith Charts^{1,2}

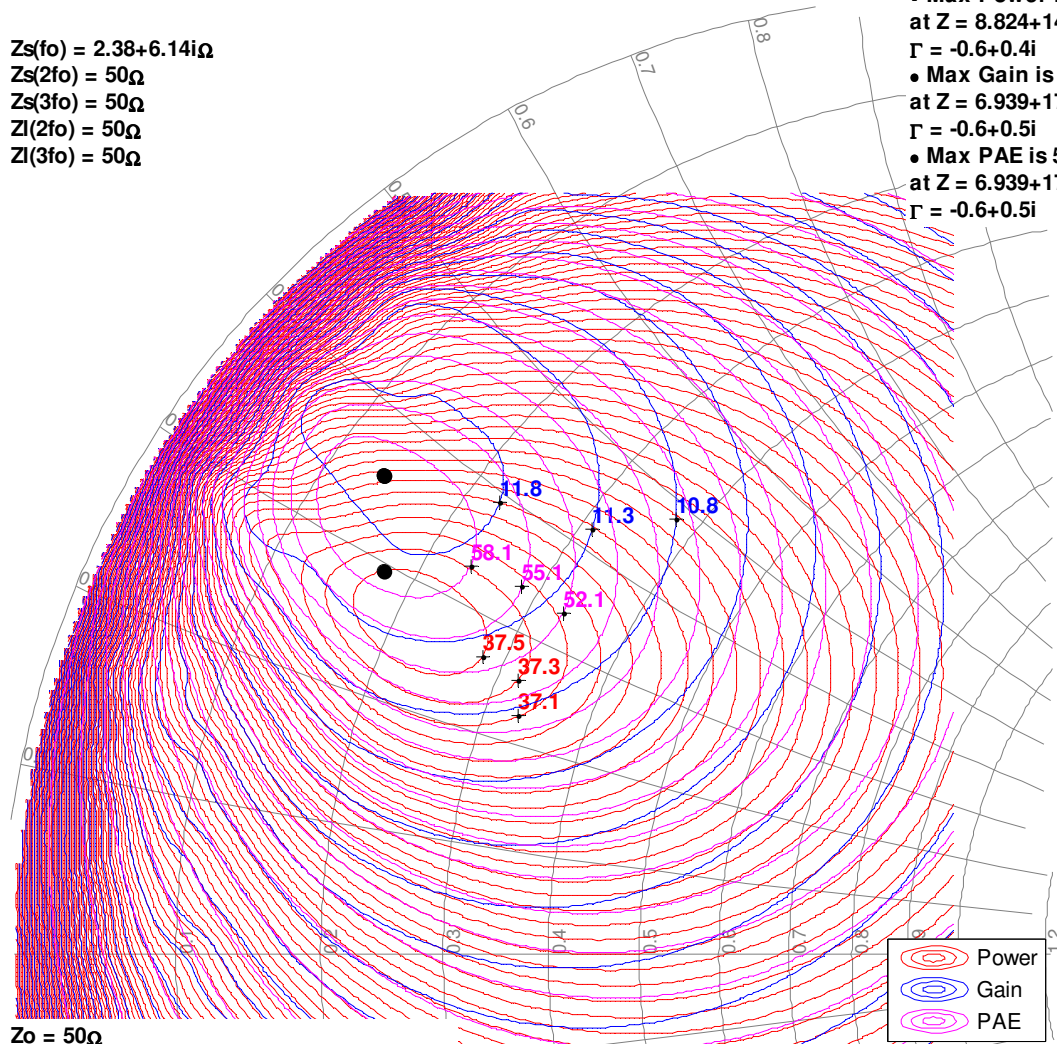
Notes:

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

10GHz, Load-pull

$Z_s(f_0) = 2.38 + 6.14i\Omega$
 $Z_s(2f_0) = 50\Omega$
 $Z_s(3f_0) = 50\Omega$
 $Z_l(2f_0) = 50\Omega$
 $Z_l(3f_0) = 50\Omega$

- Max Power is 37.5dBm at $Z = 8.824 + 14.706i\Omega$
 $\Gamma = -0.6 + 0.4i$
- Max Gain is 12dB at $Z = 6.939 + 17.793i\Omega$
 $\Gamma = -0.6 + 0.5i$
- Max PAE is 59.6% at $Z = 6.939 + 17.793i\Omega$
 $\Gamma = -0.6 + 0.5i$



$Z_0 = 50\Omega$
 3dB compression referenced to peak gain

Model Load-Pull Smith Charts^{1,2}

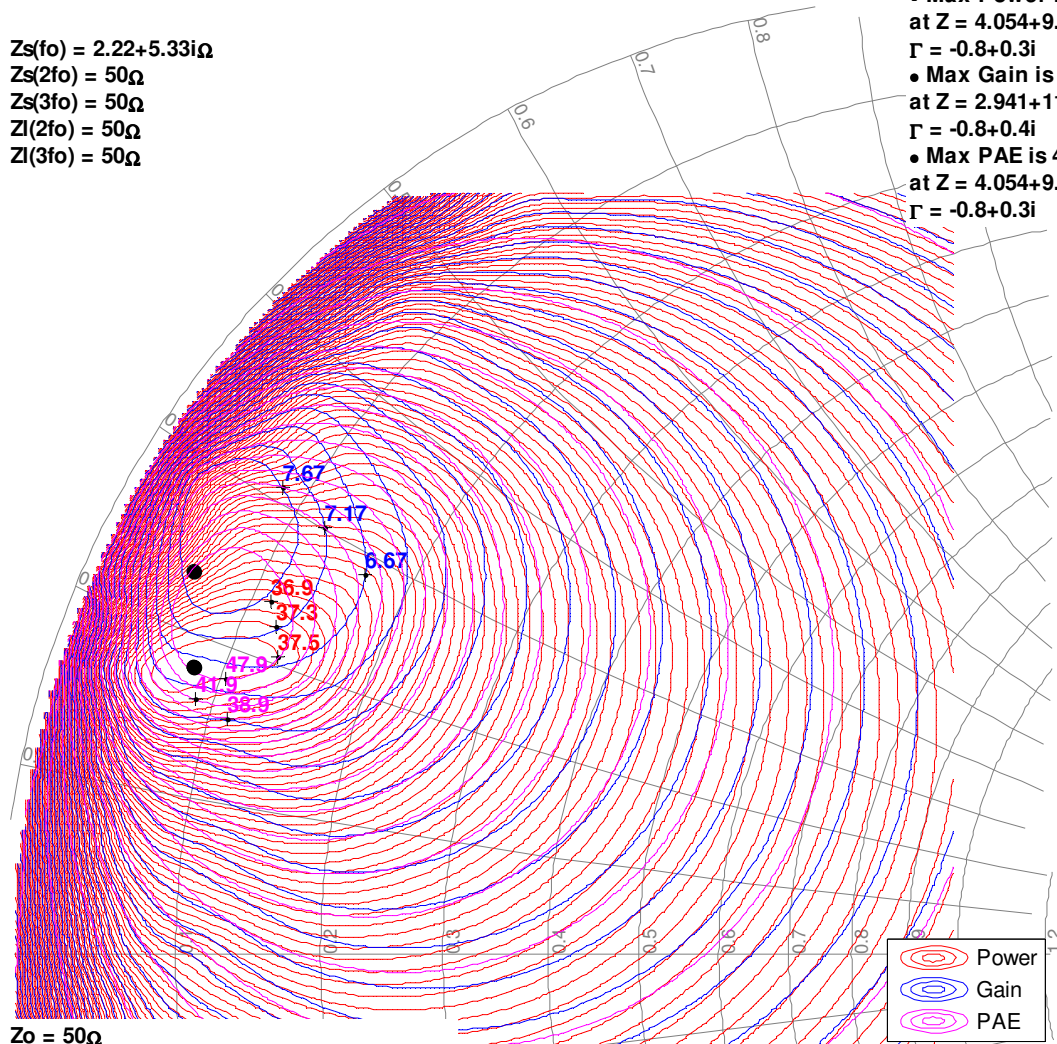
Notes:

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

18GHz, Load-pull

$Z_s(f_0) = 2.22 + 5.33i\Omega$
 $Z_s(2f_0) = 50\Omega$
 $Z_s(3f_0) = 50\Omega$
 $Z_l(2f_0) = 50\Omega$
 $Z_l(3f_0) = 50\Omega$

- Max Power is 37.6dBm at $Z = 4.054 + 9.009i\Omega$
 $\Gamma = -0.8 + 0.3i$
- Max Gain is 7.9dB at $Z = 2.941 + 11.765i\Omega$
 $\Gamma = -0.8 + 0.4i$
- Max PAE is 48.6% at $Z = 4.054 + 9.009i\Omega$
 $\Gamma = -0.8 + 0.3i$

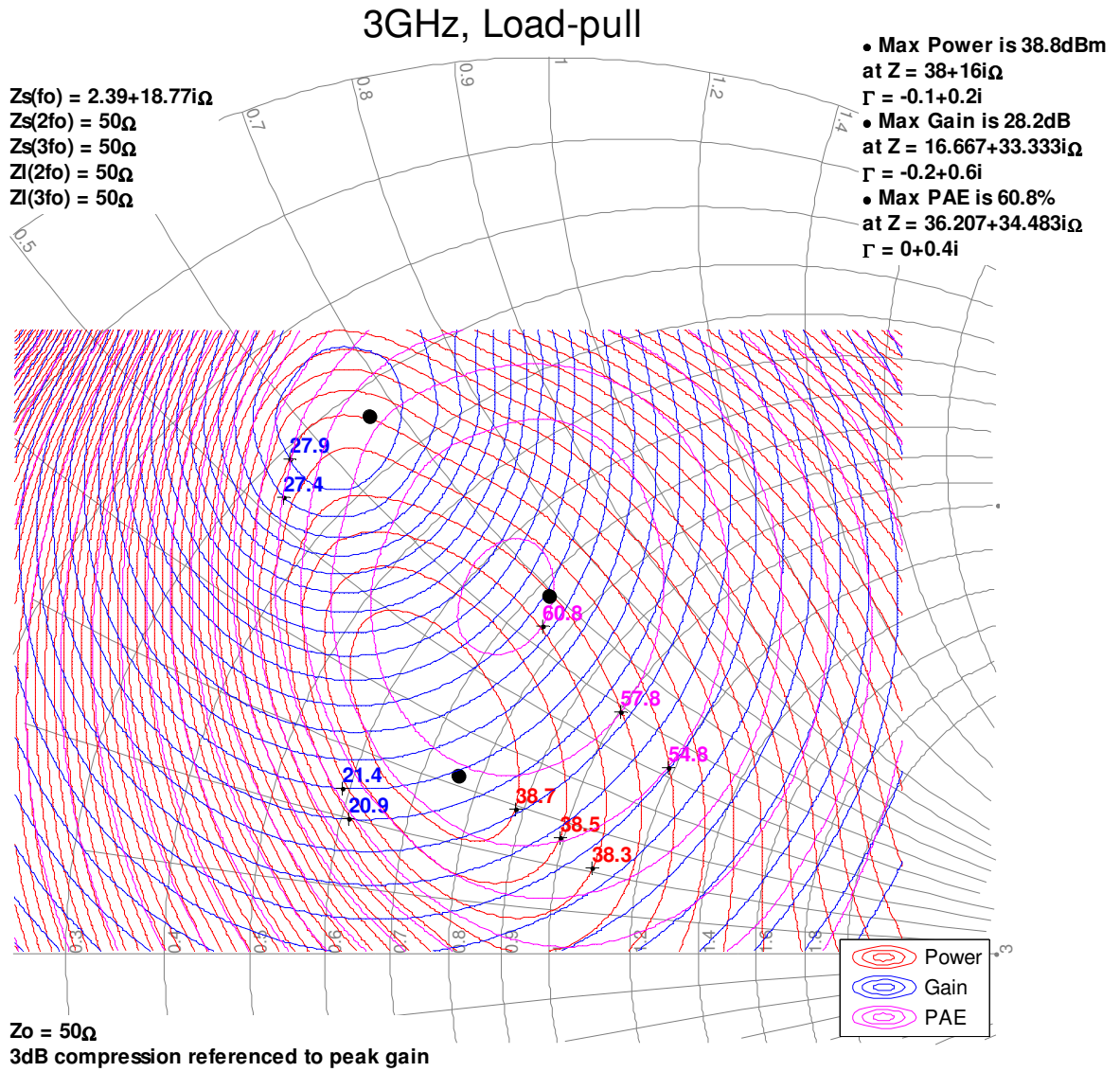


$Z_0 = 50\Omega$
 3dB compression referenced to peak gain

Model Load-Pull Smith Charts^{1, 2}

Notes:

1. Test Conditions: $V_D = 28\text{ V}$, $I_{DQ} = 80\text{ mA}$, 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}

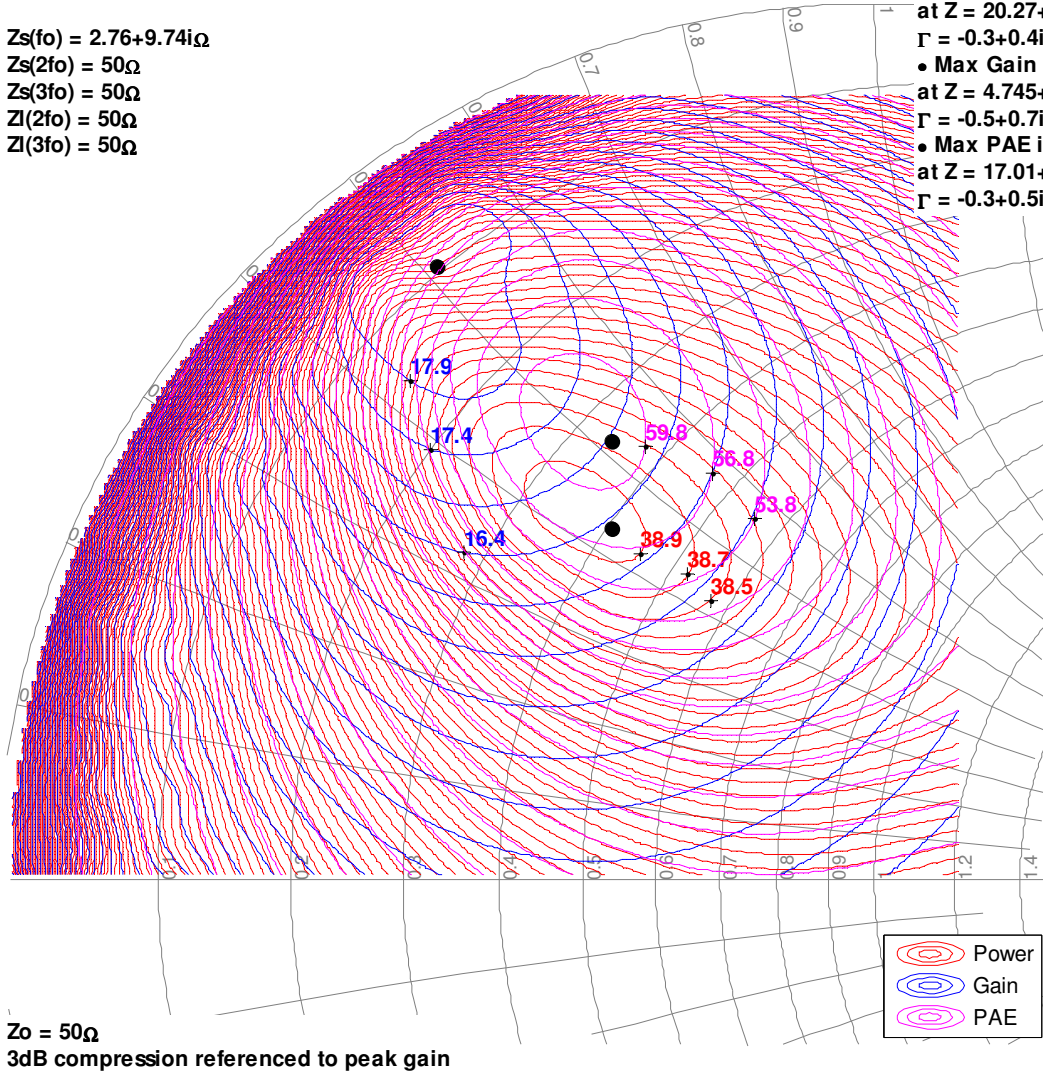
Notes:

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

6GHz, Load-pull

$Z_s(f_0) = 2.76+9.74i\Omega$
 $Z_s(2f_0) = 50\Omega$
 $Z_s(3f_0) = 50\Omega$
 $Z_l(2f_0) = 50\Omega$
 $Z_l(3f_0) = 50\Omega$

- Max Power is 39dBm at $Z = 20.27+21.621i\Omega$
 $\Gamma = -0.3+0.4i$
- Max Gain is 18.3dB at $Z = 4.745+25.547i\Omega$
 $\Gamma = -0.5+0.7i$
- Max PAE is 60.6% at $Z = 17.01+25.773i\Omega$
 $\Gamma = -0.3+0.5i$



Model Load-Pull Smith Charts^{1,2}

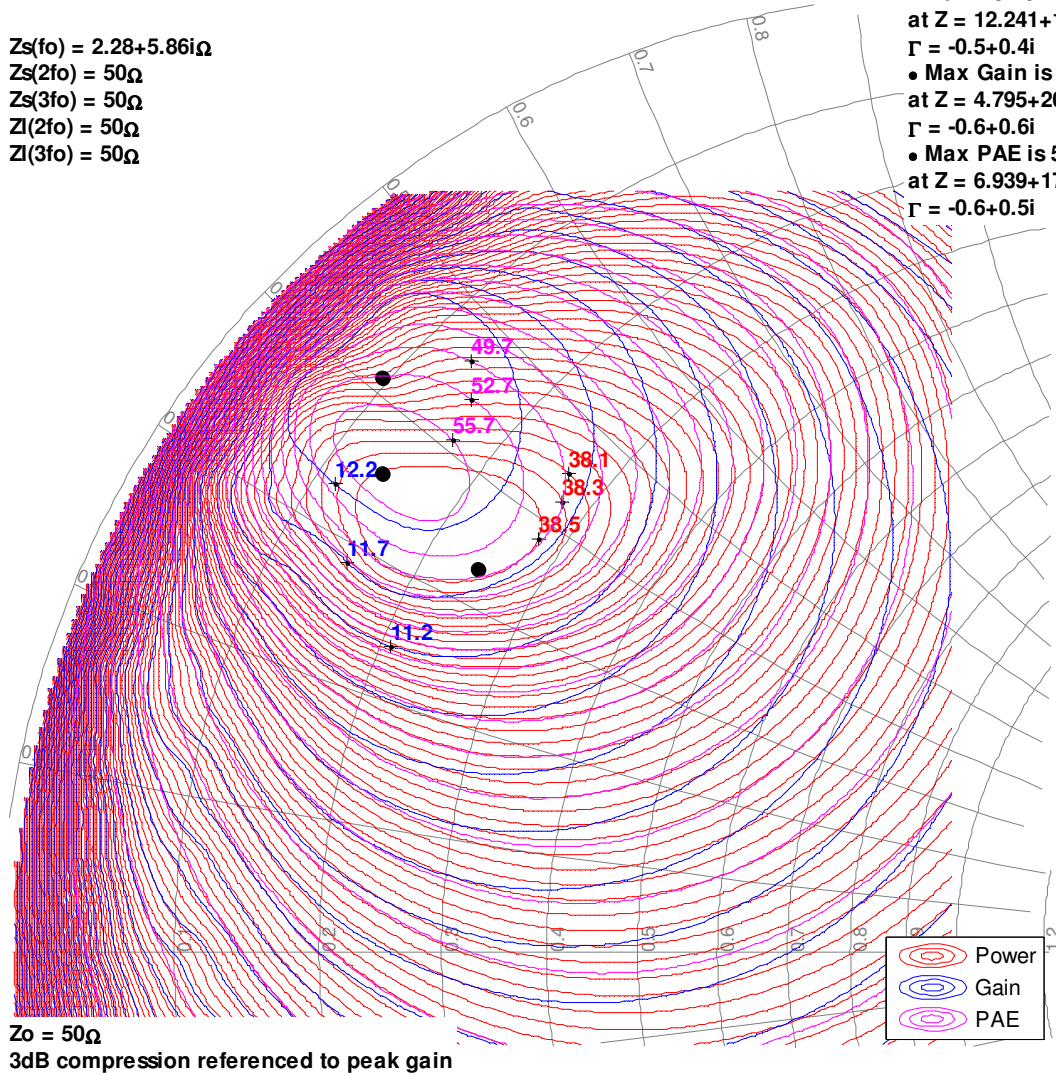
Notes:

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

10GHz, Load-pull

$Z_s(f_0) = 2.28 + 5.86i\Omega$
 $Z_s(2f_0) = 50\Omega$
 $Z_s(3f_0) = 50\Omega$
 $Z_l(2f_0) = 50\Omega$
 $Z_l(3f_0) = 50\Omega$

- Max Power is 38.6dBm at $Z = 12.241 + 16.597i\Omega$
 $\Gamma = -0.5 + 0.4i$
- Max Gain is 12.7dB at $Z = 4.795 + 20.548i\Omega$
 $\Gamma = -0.6 + 0.6i$
- Max PAE is 57% at $Z = 6.939 + 17.793i\Omega$
 $\Gamma = -0.6 + 0.5i$



Model Load-Pull Smith Charts^{1, 2}

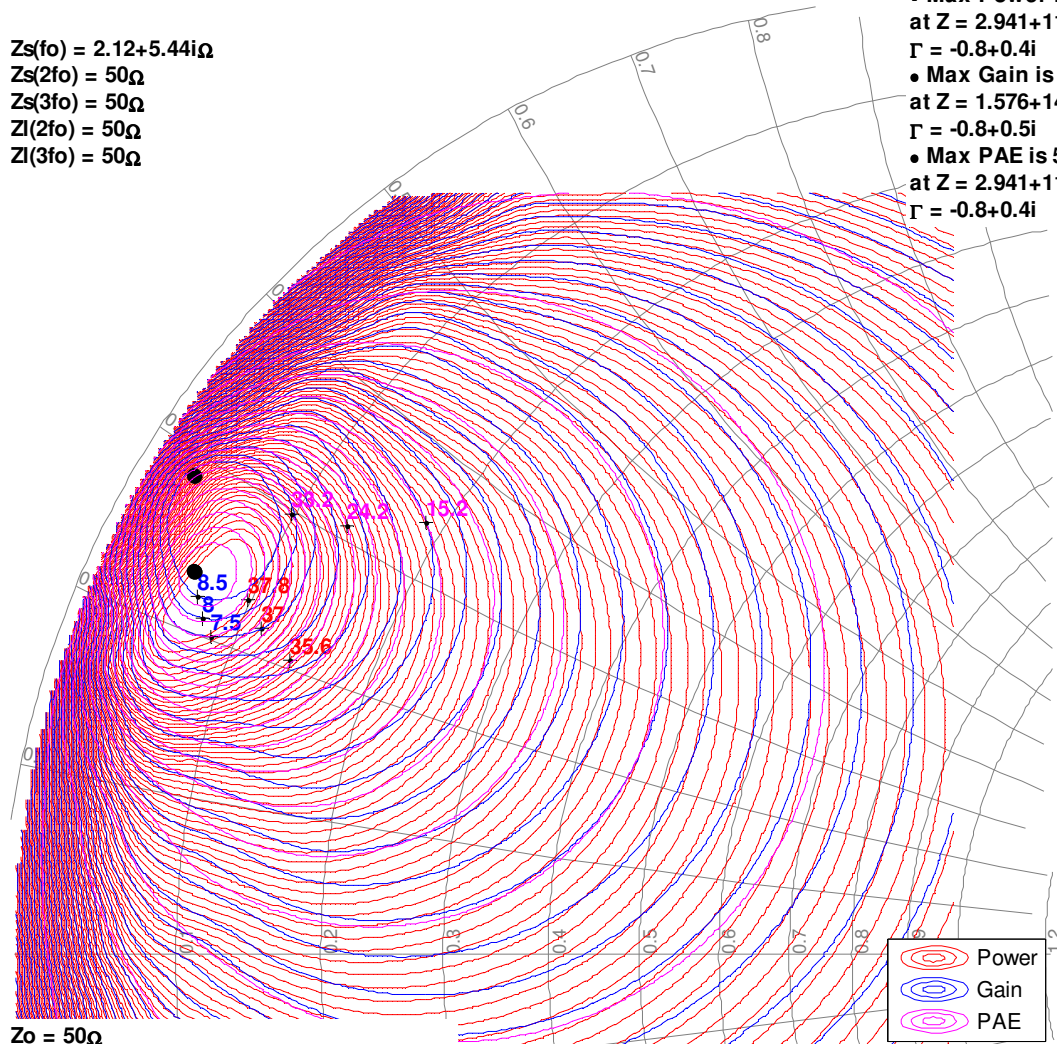
Notes:

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

18GHz, Load-pull

$Z_s(f_0) = 2.12 + 5.44i\Omega$
 $Z_s(2f_0) = 50\Omega$
 $Z_s(3f_0) = 50\Omega$
 $Z_l(2f_0) = 50\Omega$
 $Z_l(3f_0) = 50\Omega$

- Max Power is 37.9dBm at $Z = 2.941 + 11.765i\Omega$
 $\Gamma = -0.8 + 0.4i$
- Max Gain is 9dB at $Z = 1.576 + 14.326i\Omega$
 $\Gamma = -0.8 + 0.5i$
- Max PAE is 51% at $Z = 2.941 + 11.765i\Omega$
 $\Gamma = -0.8 + 0.4i$

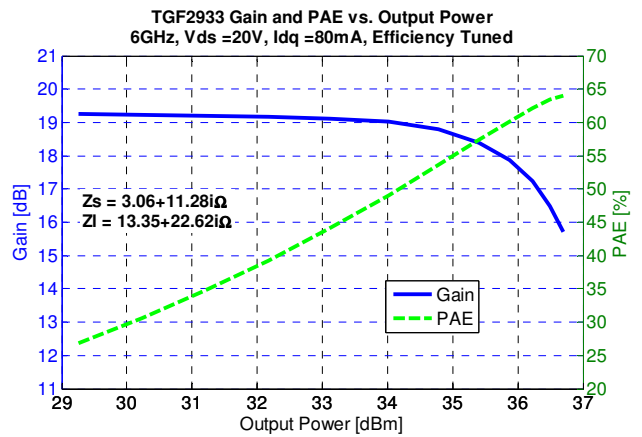
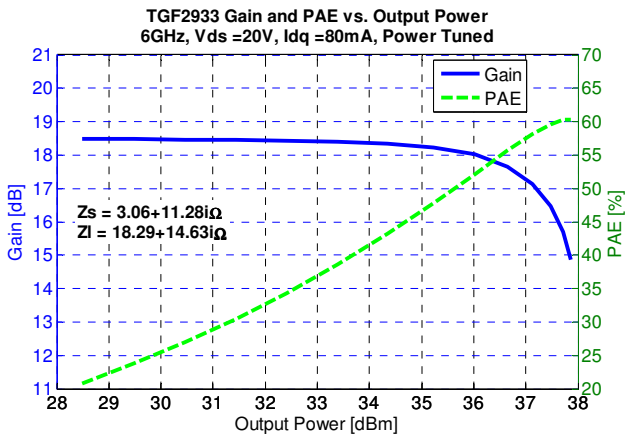
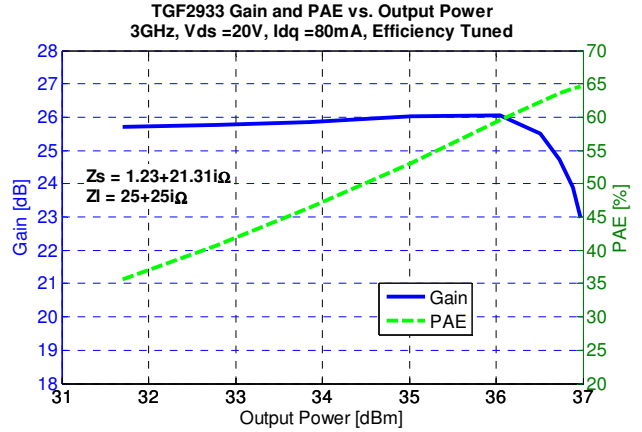
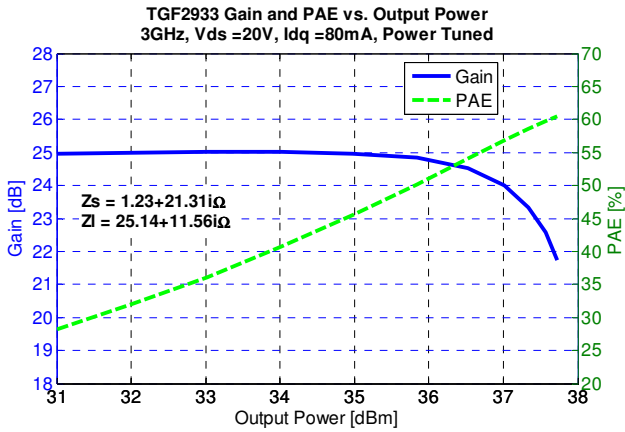


$Z_0 = 50\Omega$
 3dB compression referenced to peak gain

Typical Model Performance – Load-Pull Drive-up^{1,2}

Notes:

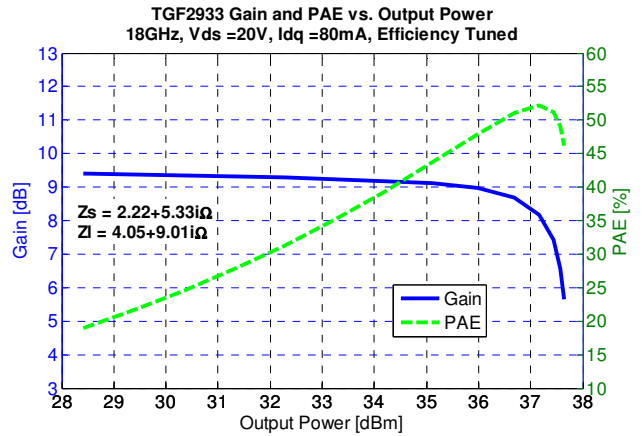
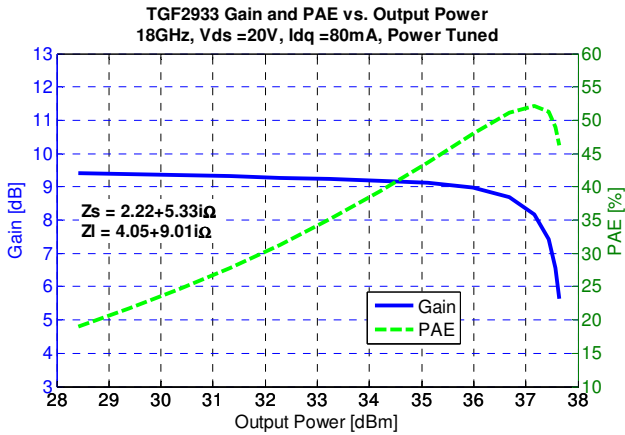
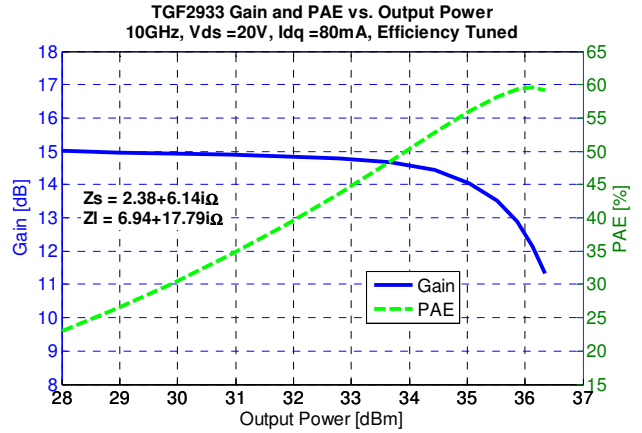
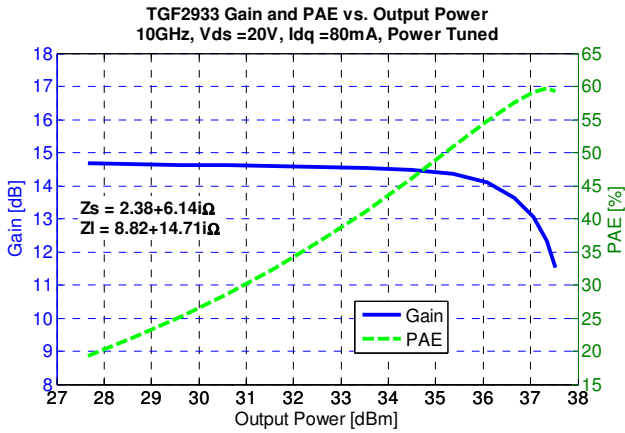
1. CW, Bondwires not included
2. See page 22 for load-pull and source-pull reference planes where the performance was measured.



Typical Model Performance – Load-Pull Drive-up^{1,2}

Notes:

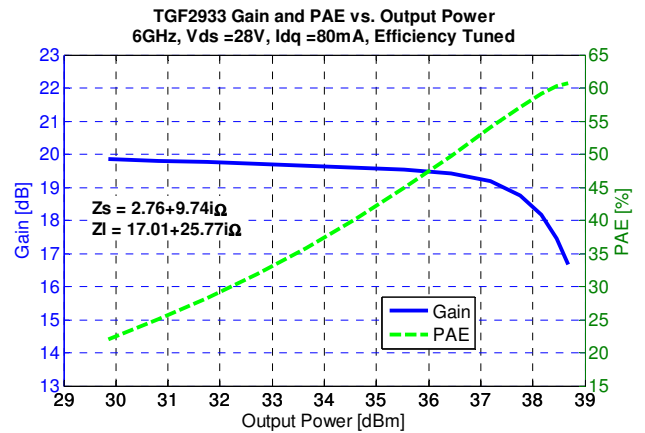
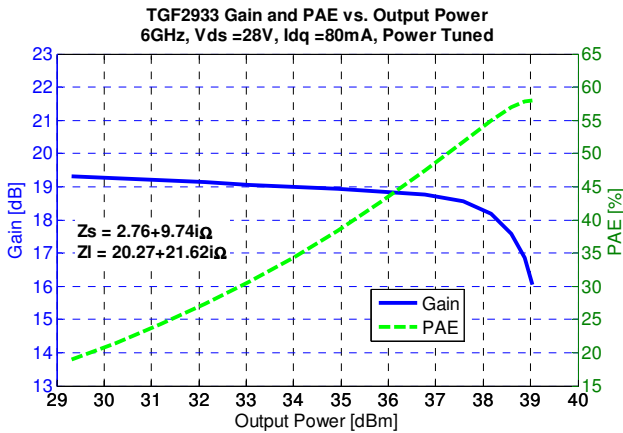
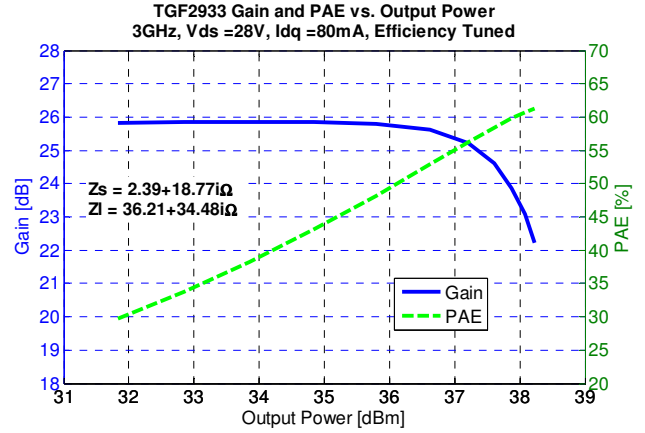
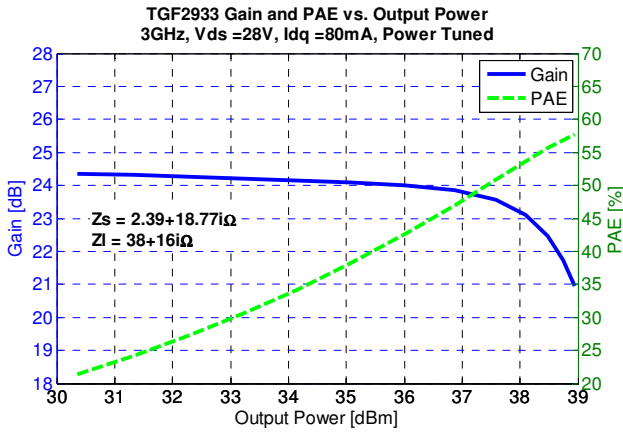
1. CW, Bondwires not included
2. See page 22 for load-pull and source-pull reference planes where the performance was measured.



Typical Model Performance – Load-Pull Drive-up^{1, 2}

Notes:

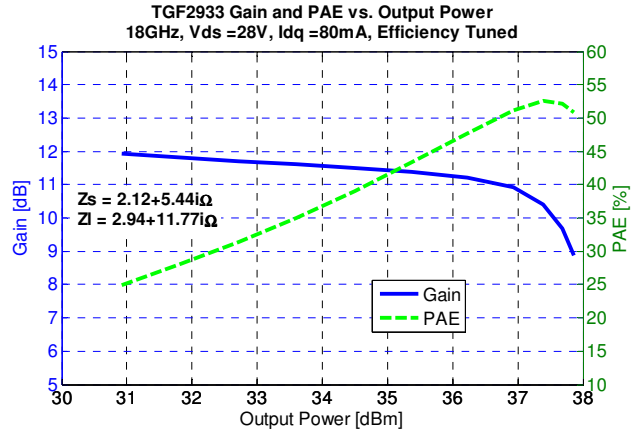
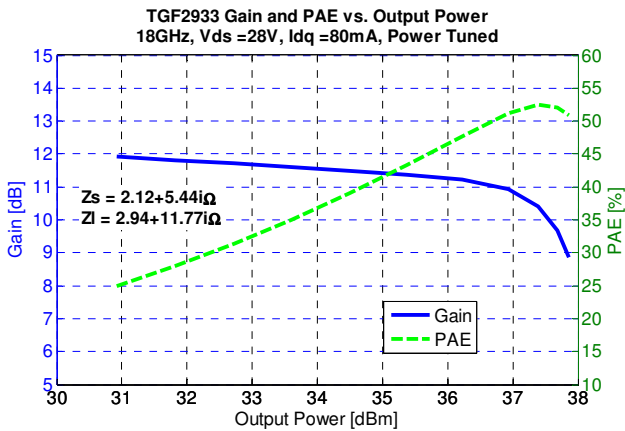
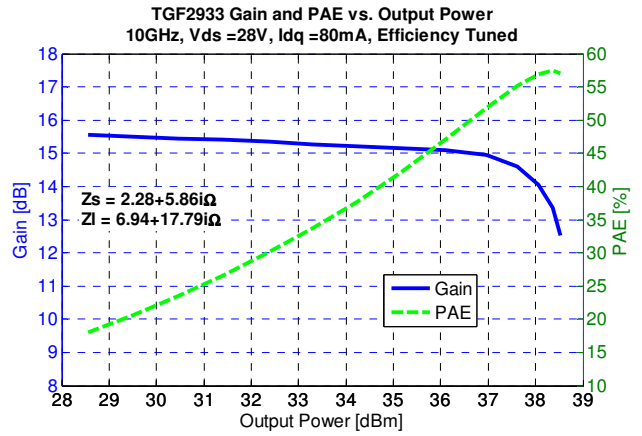
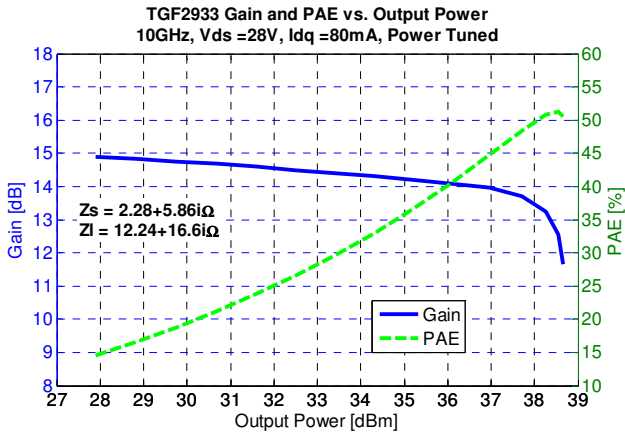
1. CW, Bondwires not included
2. See page 22 for load-pull and source-pull reference planes where the performance was measured.



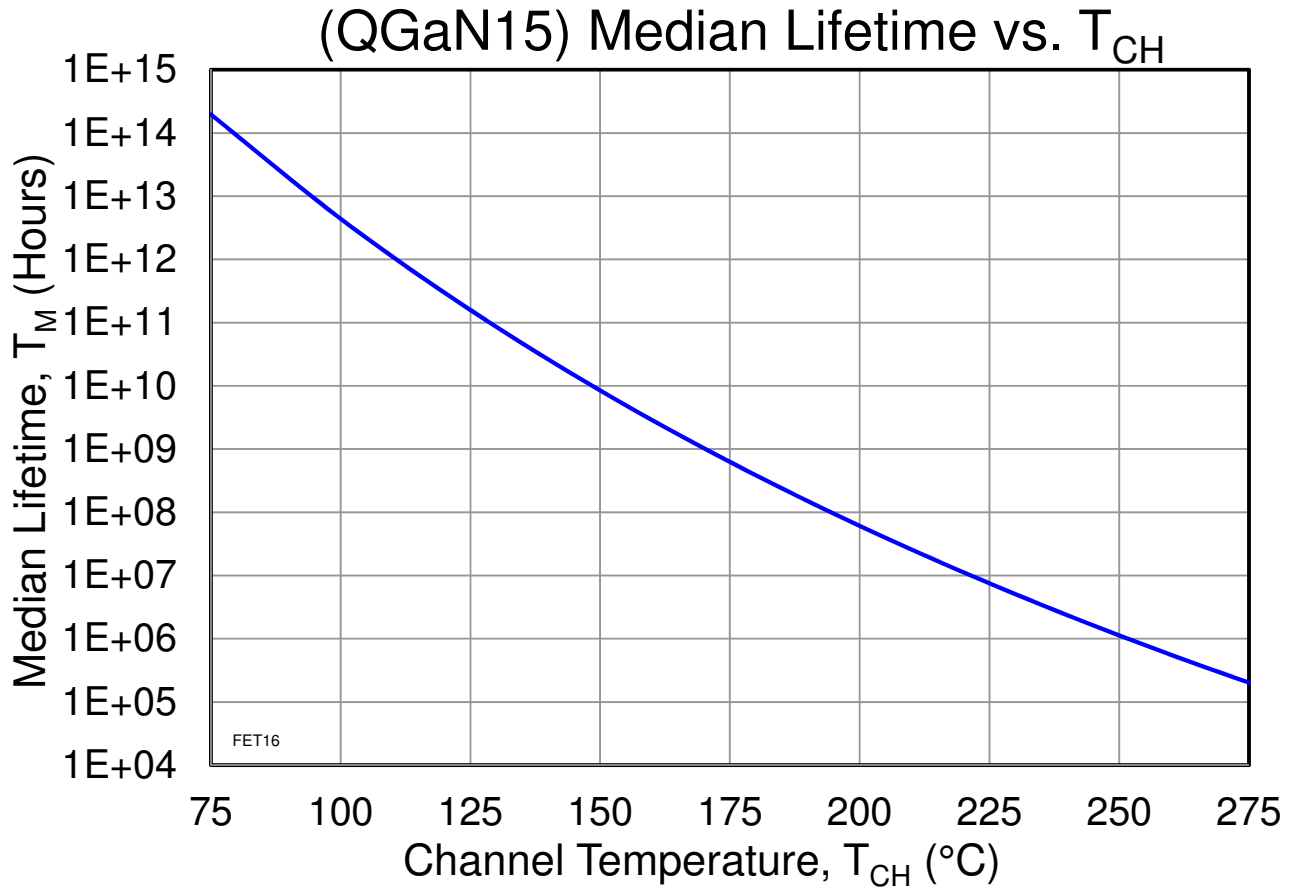
Typical Model Performance – Load-Pull Drive-up^{1,2}

Notes:

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



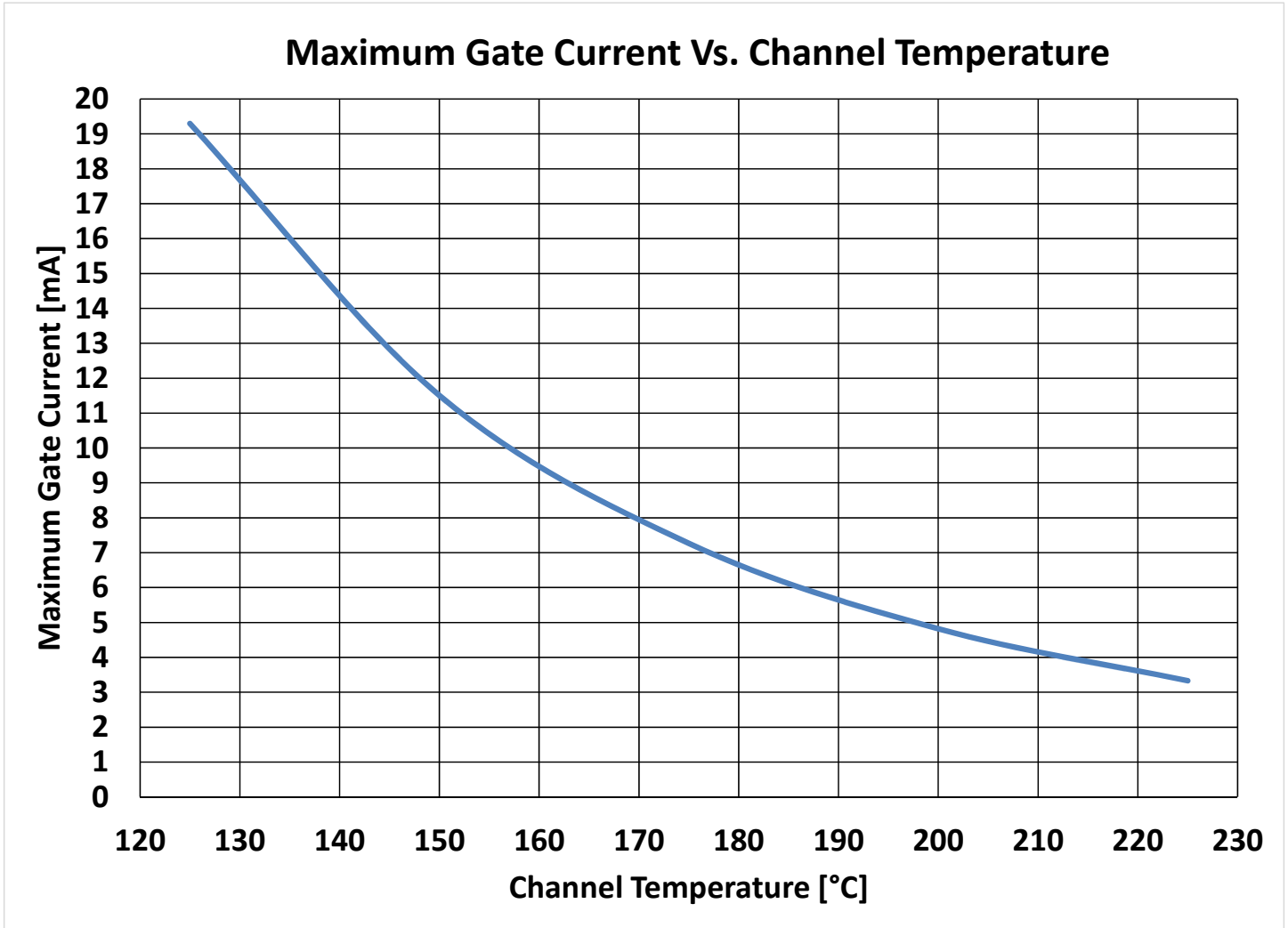
Median Lifetime¹



Notes:

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

Maximum Gate Current

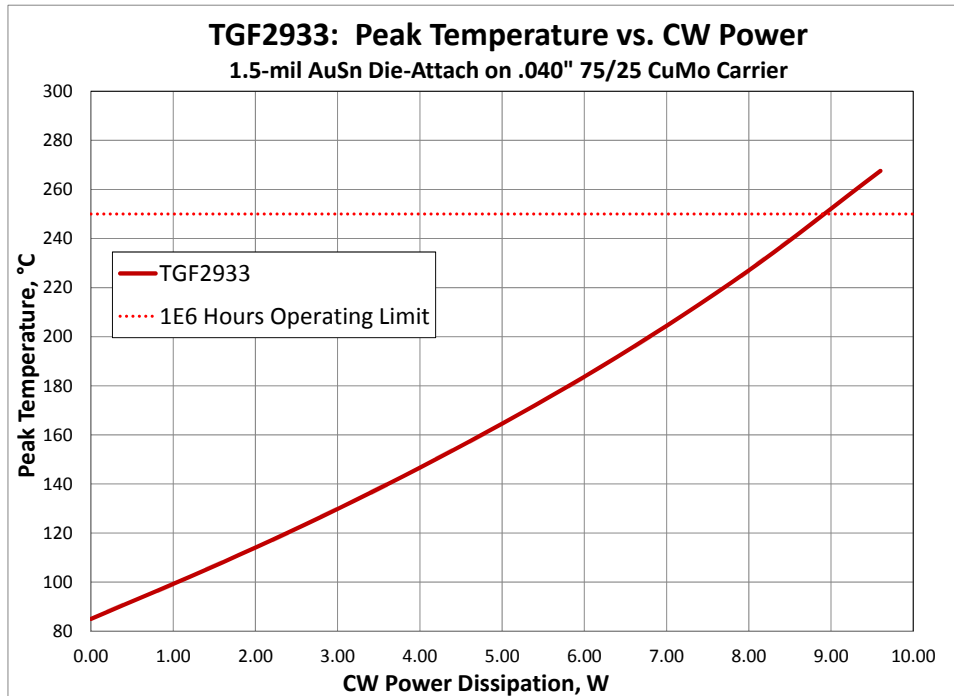


Thermal and Reliability Information

Parameter	Test Conditions	Value	Units
Thermal Resistance, θ_{JC} ⁽¹⁾	CW	14.4	°C/W
Channel Temperature, T_{CH}	$T_{baseplate} = +85\text{ °C}$	108	°C
Median Lifetime, T_M	$P_{DISS} = 1.6\text{ W}$	1.4E12	Hrs
Thermal Resistance, θ_{JC} ⁽¹⁾	CW	15.0	°C/W
Channel Temperature, T_{CH}	$T_{baseplate} = +85\text{ °C}$	133	°C
Median Lifetime, T_M	$P_{DISS} = 3.2\text{ W}$	6.0E10	Hrs
Thermal Resistance, θ_{JC} ⁽¹⁾	CW	15.8	°C/W
Channel Temperature, T_{CH}	$T_{baseplate} = +85\text{ °C}$	161	°C
Median Lifetime, T_M	$P_{DISS} = 4.8\text{ W}$	2.6E9	Hrs
Thermal Resistance, θ_{JC} ⁽¹⁾	CW	16.7	°C/W
Channel Temperature, T_{CH}	$T_{baseplate} = +85\text{ °C}$	192	°C
Median Lifetime, T_M	$P_{DISS} = 6.4\text{ W}$	1.2E8	Hrs
Thermal Resistance, θ_{JC} ⁽¹⁾	CW	17.8	°C/W
Channel Temperature, T_{CH}	$T_{baseplate} = +85\text{ °C}$	227	°C
Median Lifetime, T_M	$P_{DISS} = 8\text{ W}$	6.4E6	Hrs
Thermal Resistance, θ_{JC} ⁽¹⁾	CW	19.1	°C/W
Channel Temperature, T_{CH}	$T_{baseplate} = +85\text{ °C}$	268	°C
Median Lifetime, T_M	$P_{DISS} = 9.6\text{ W}$	3.2E5	Hrs

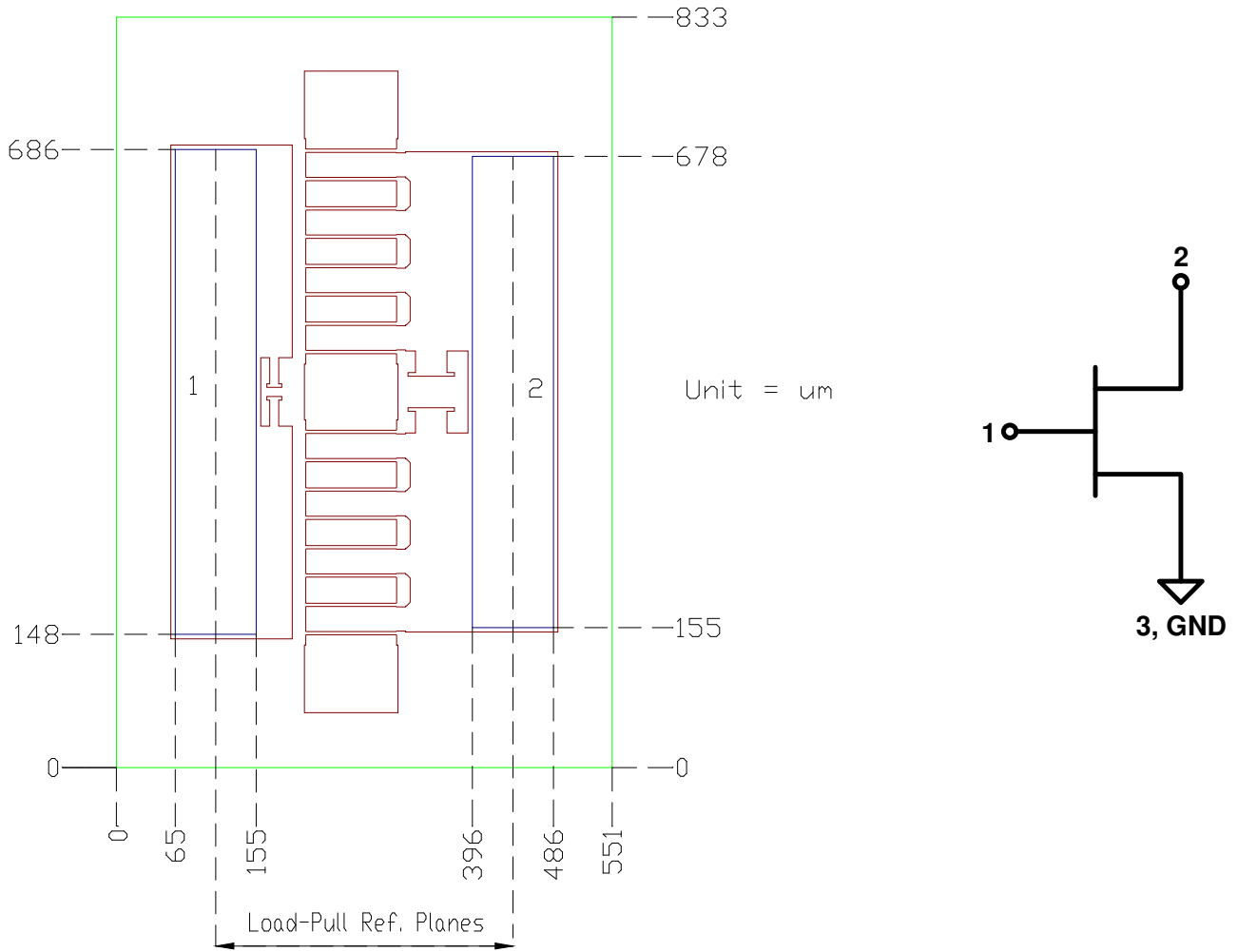
Notes:

1. Thermal resistance measured at back of package.



Pin Configuration and Description¹

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



Pin Description

Pin	Symbol	Description	Dimension
1	RF IN / V_G	Gate	0.538 x 0.090 mm
2	RF OUT / V_D	Drain	0.523 x 0.090 mm
3	Source	Source / Ground / Backside of die	0.833 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

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 500 mA.
5. Apply RF signal.

Bias-down Procedure

1. Turn off RF signal.
2. Turn off V_D and wait 1 second to allow drain capacitor discharge.
3. Turn off V_G .

Handling Precautions

Parameter	Rating	Standard
ESD – Human Body Model (HBM)	N/A	ESDA / JEDEC JS-001-2012
ESD – Charged Device Model (CDM)	N/A	JEDEC JESD22-C101F
MSL – Moisture Sensitivity Level	N/A	IPC/JEDEC J-STD-020



Caution!
ESD-Sensitive Device

Solderability

Compatible with both lead-free (260°C max. reflow temp.) and tin/lead (245°C max. reflow temp.) soldering processes. Solder profiles available upon request.

Contact plating: NiPdAu

RoHS Compliance

This part is compliant with 2011/65/EU RoHS directive (Restrictions on the Use of Certain Hazardous Substances in Electrical and Electronic Equipment) as amended by Directive 2015/863/EU.

This product also has the following attributes:

- Lead Free
- Halogen Free (Chlorine, Bromine)
- Antimony Free
- TBBP-A (C₁₅H₁₂Br₄O₂) Free
- PFOS Free
- SVHC Free



Contact Information

For the latest specifications, additional product information, worldwide sales and distribution locations, and information about Qorvo:

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