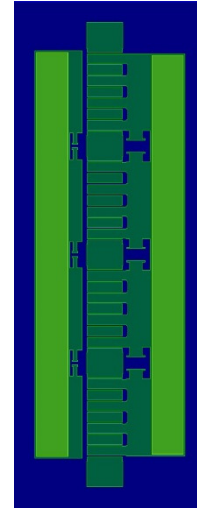


### Product Overview

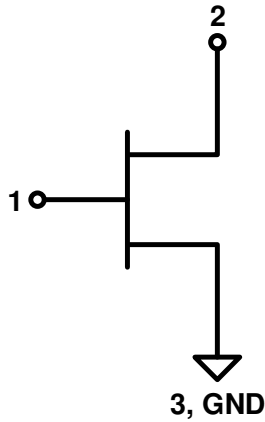
The Qorvo TGF2934 is a 14 W ( $P_{3dB}$ ) discrete GaN on SiC HEMT which operates from DC to 25 GHz and 28 V supply. The device is constructed with Qorvo’s proven QGaN15 process. The device can support pulsed, CW, and linear operations.

Lead-free and ROHS compliant



1.457 x 0.551 x 0.100 mm

### Functional Block Diagram



### Key Features

- Frequency: DC to 25 GHz
  - Output Power ( $P_{3dB}$ )<sup>1</sup>: 14 W
  - Linear Gain<sup>1</sup>: 14 dB
  - Typical PAE<sub>3dB</sub><sup>1</sup>: 49%
  - Typical Noise Figure<sup>1</sup>: 1.5 dB
  - 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
TGF2934	3A001b.3.b	DC–25 GHz, 28 V, 3.5 W GaN RF Transistor

### Absolute Maximum Ratings<sup>1</sup>

Parameter	Rating	Units
Breakdown Voltage, $BV_{DG}$	+60	V
Gate Voltage Range, $V_G$	-7 to +1.5	V
Drain Current, $I_{D_{MAX}}$	4	A
Gate Current Range, $I_G$	See page 20.	mA
Power Dissipation, CW, $P_{DISS}^2$	17.4	W
RF Input Power, CW, 10 GHz, $T = 25\text{ }^\circ\text{C}$	+33	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.
2. Base temperature at 85  $^\circ\text{C}$

### Recommended Operating Conditions<sup>1</sup>

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, $I_{DQ}$	80	160	320	mA
Drain Current, $I_D$	-	1000	-	mA
Gate Voltage, $V_G^3$	-	-2.8	-	V
Channel Temperature ( $T_{CH}$ )	-	-	250	$^\circ\text{C}$
Power Dissipation, CW ( $P_D$ ) <sup>2</sup>	-	-	15.8	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 Tuned<sup>1</sup>

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, $I_{DQ}$	160	160	160	160	160	160	160	160	mA
Output Power at 3dB compression, $P_{3dB}$	40.7	41.6	40.8	41.7	40.8	41.5	39.5	41.8	dBm
Power Added Efficiency at 3dB compression, $PAE_{3dB}$	56.9	51.7	55.0	51.3	51.4	49.3	43.7	44.9	%
Gain at 3dB compression, $G_{3dB}$	18.7	21.5	13.3	15.4	8.9	11.2	5.9	6.9	dB
Load Reflection Coefficient <sup>(2)</sup> , $\Gamma_L$	$0.63 \angle 162^\circ$	$0.45 \angle 153^\circ$	$0.73 \angle 164^\circ$	$0.67 \angle 153^\circ$	$0.82 \angle 166^\circ$	$0.85 \angle 159^\circ$	$0.92 \angle 167^\circ$	$0.92 \angle 167^\circ$	--

Notes:

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

### Model Load Pull Performance – Efficiency Tuned<sup>1</sup>

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, $I_{DQ}$	160	160	160	160	160	160	160	160	mA
Output Power at 3dB compression, $P_{3dB}$	40.2	41.3	40.1	41.7	40.8	41.5	39.5	41.8	dBm
Power Added Efficiency at 3dB compression, $PAE_{3dB}$	58	53.1	57.5	51.3	51.4	49.3	43.7	44.9	%
Gain at 3dB compression, $G_{3dB}$	18.4	23.0	13.6	15.4	8.9	11.2	5.9	6.9	dB
Load Reflection Coefficient <sup>(2)</sup> , $\Gamma_L$	$0.67 \angle 153^\circ$	$0.50 \angle 143^\circ$	$0.76 \angle 157^\circ$	$0.67 \angle 153^\circ$	$0.82 \angle 166^\circ$	$0.85 \angle 159^\circ$	$0.92 \angle 167^\circ$	$0.92 \angle 167^\circ$	--

Notes:

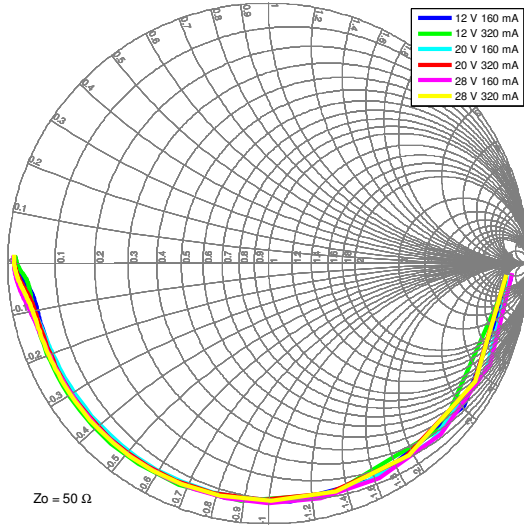
1. CW, bondwires not included
2. Characteristic Impedance,  $Z_0 = 50 \Omega$ .

### Model S-parameters<sup>1</sup>

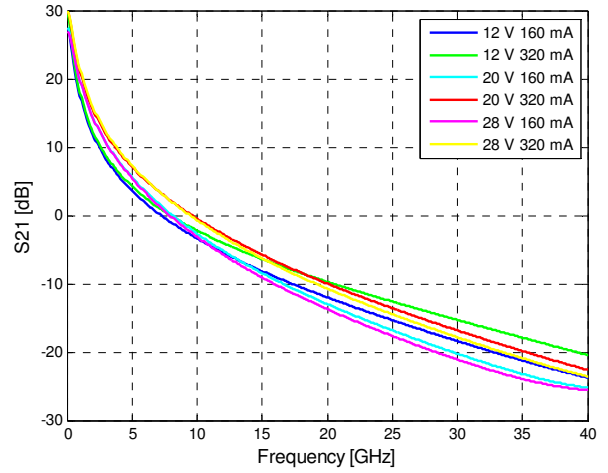
Notes:

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

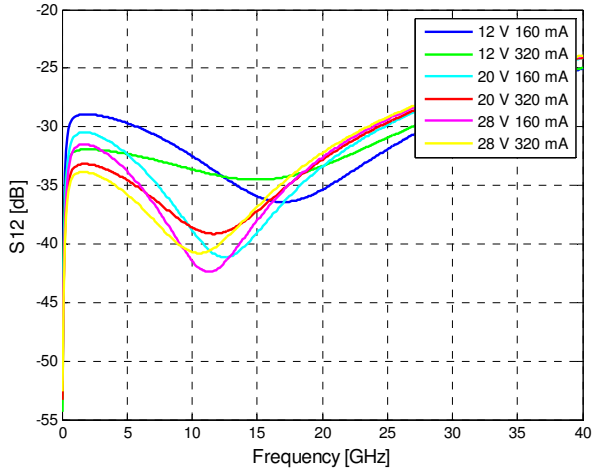
S11 from 0.01 GHz to 40 GHz



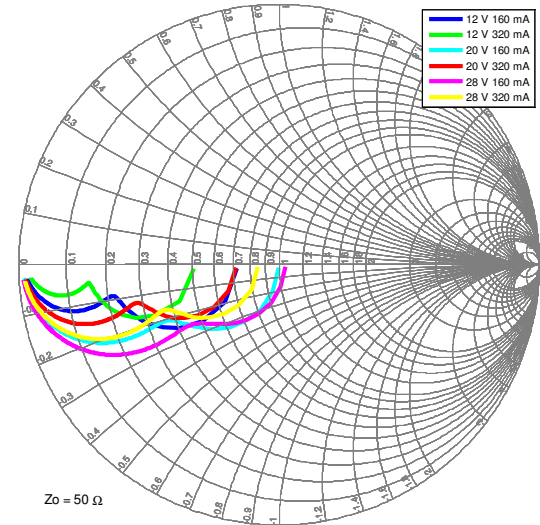
S21



S12



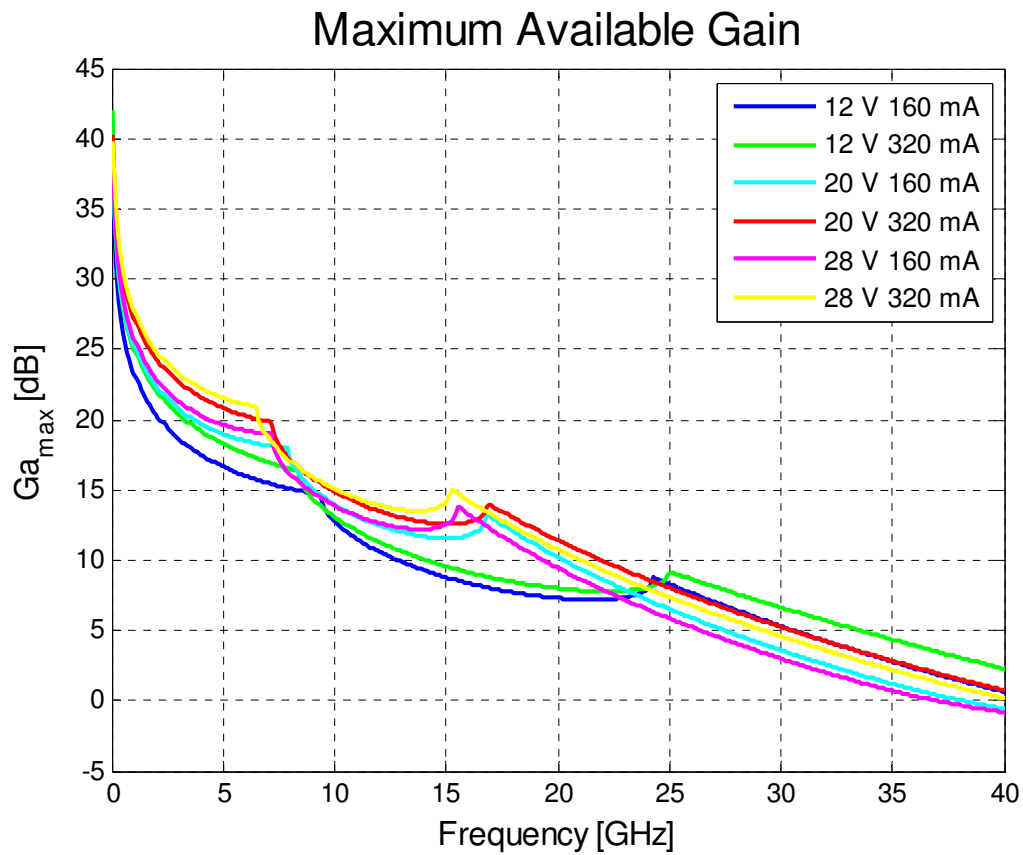
S22 from 0.01 GHz to 40 GHz



Model Maximum Available Gain<sup>1</sup>

Notes:

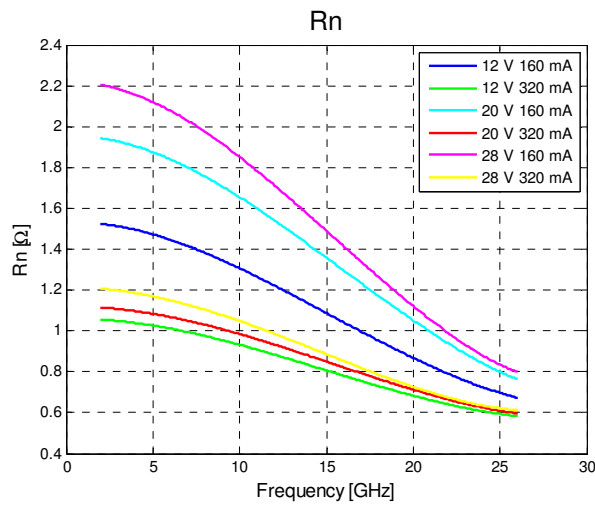
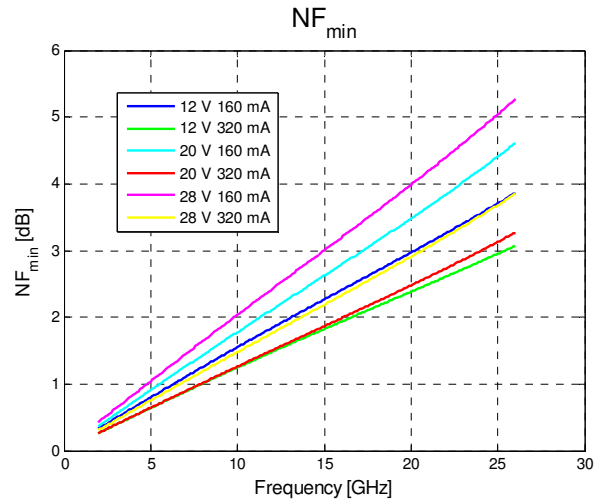
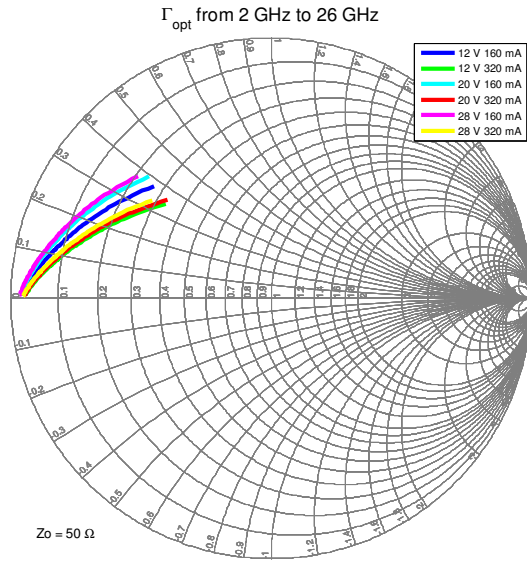
1. Bondwires are not included. T = 25 °C.



Model Noise<sup>1</sup>

Notes:

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

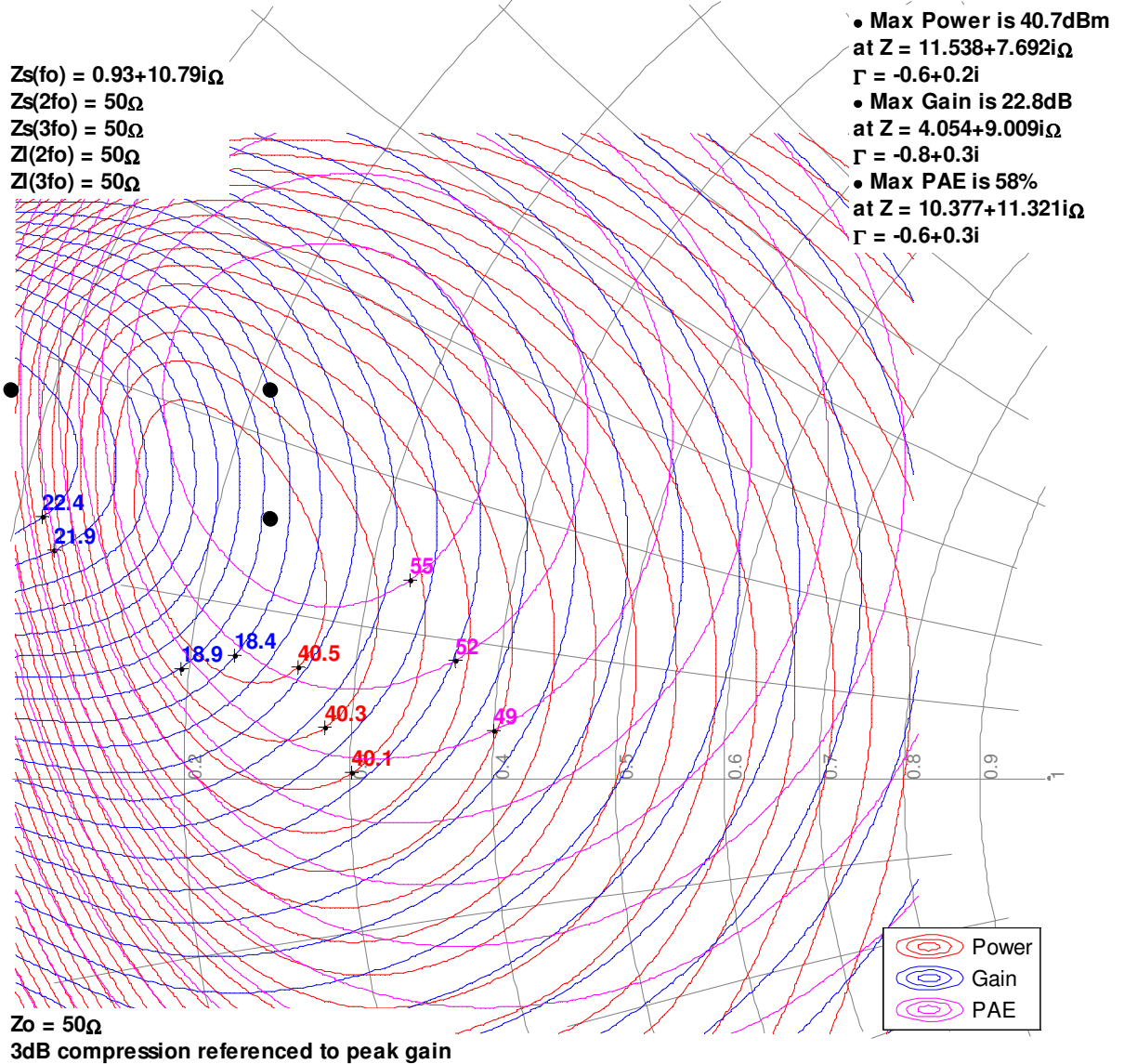


Model Load-Pull Smith Charts<sup>1, 2, 3</sup>

Notes:

1. Test Conditions:  $V_D = 20\text{ V}$ ,  $I_{DQ} = 160\text{ mA}$ , 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<sup>1,2</sup>**

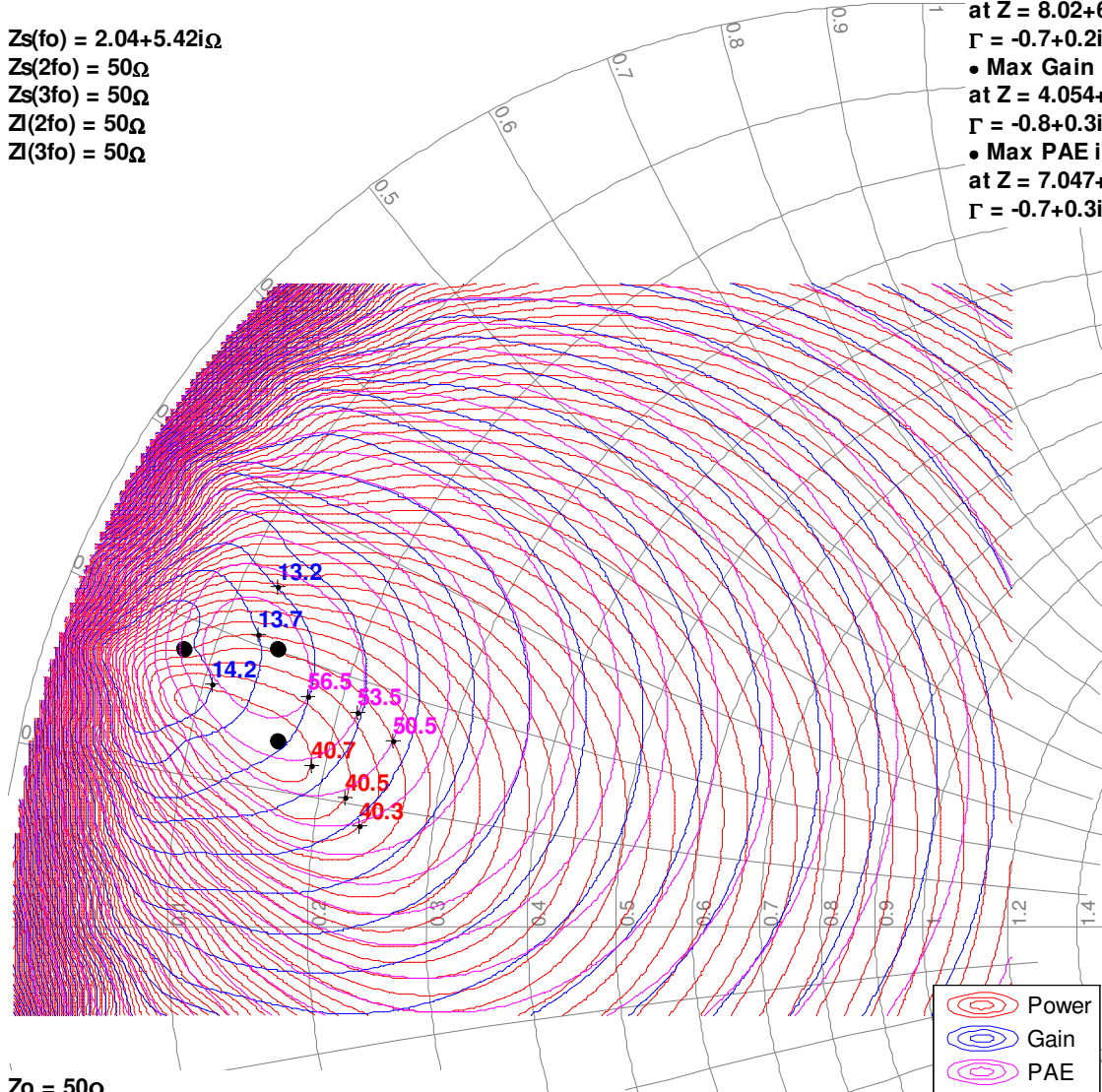
Notes:

1. Test Conditions:  $V_D = 20\text{ V}$ ,  $I_{DQ} = 160\text{ mA}$ , CW, Bondwires not included
2. See page 22 for load pull reference planes where the performance was simulated.

**6GHz, Load-pull**

$Z_s(f_0) = 2.04 + 5.42i\Omega$   
 $Z_s(2f_0) = 50\Omega$   
 $Z_s(3f_0) = 50\Omega$   
 $Z_l(2f_0) = 50\Omega$   
 $Z_l(3f_0) = 50\Omega$

- Max Power is 40.8dBm at  $Z = 8.02 + 6.826i\Omega$   
 $\Gamma = -0.7 + 0.2i$
- Max Gain is 14.3dB at  $Z = 4.054 + 9.009i\Omega$   
 $\Gamma = -0.8 + 0.3i$
- Max PAE is 57.5% at  $Z = 7.047 + 10.067i\Omega$   
 $\Gamma = -0.7 + 0.3i$



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



Model Load-Pull Smith Charts<sup>1, 2</sup>

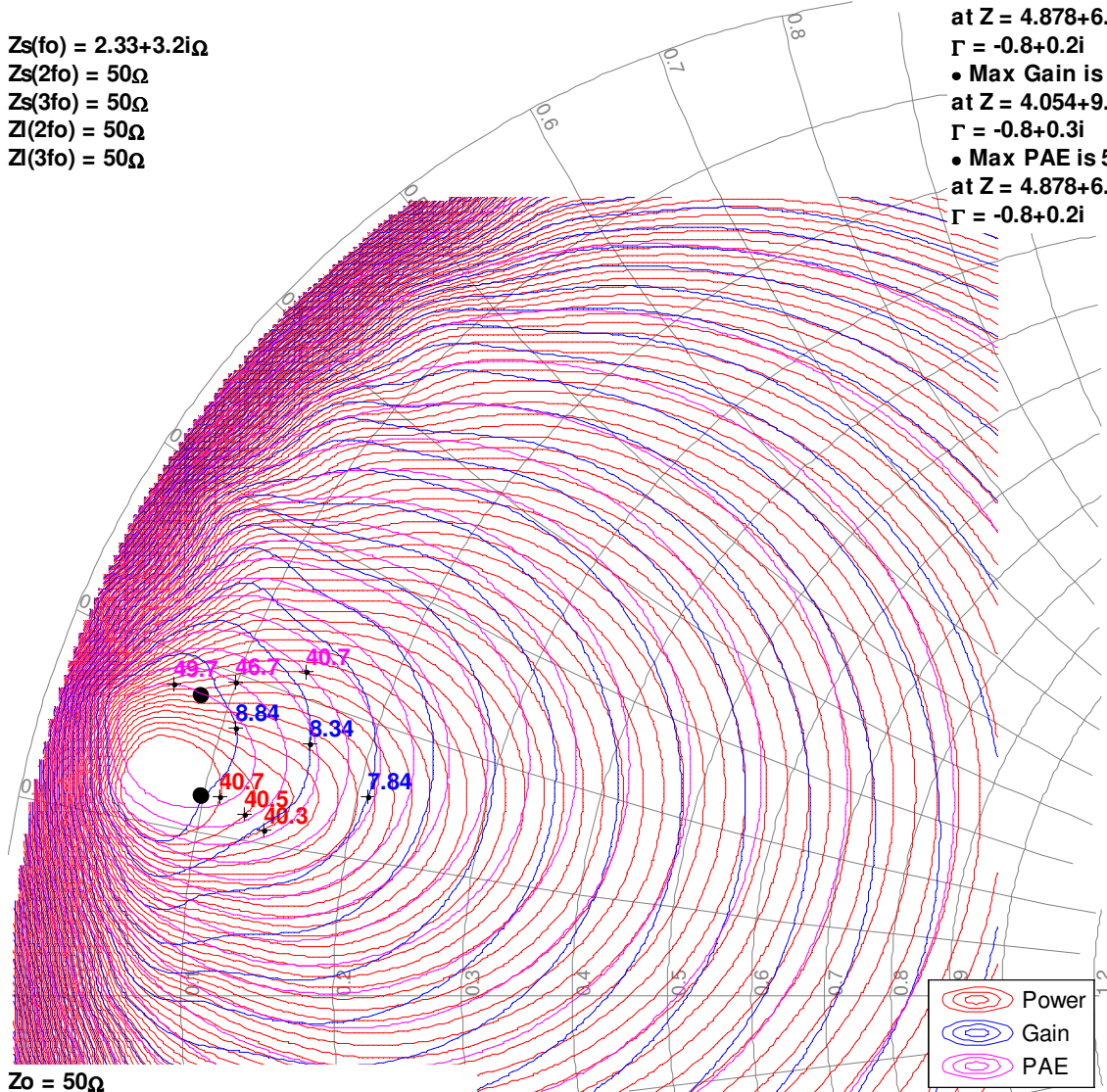
Notes:

1. Test Conditions:  $V_D = 20\text{ V}$ ,  $I_{DQ} = 160\text{ mA}$ , CW, Bondwires not included
2. See page 22 for load pull reference planes where the performance was simulated.

10GHz, Load-pull

$Z_s(f_0) = 2.33 + 3.2i\Omega$   
 $Z_s(2f_0) = 50\Omega$   
 $Z_s(3f_0) = 50\Omega$   
 $Z_l(2f_0) = 50\Omega$   
 $Z_l(3f_0) = 50\Omega$

- Max Power is 40.8dBm at  $Z = 4.878 + 6.097i\Omega$   
 $\Gamma = -0.8 + 0.2i$
- Max Gain is 9dB at  $Z = 4.054 + 9.009i\Omega$   
 $\Gamma = -0.8 + 0.3i$
- Max PAE is 51.4% at  $Z = 4.878 + 6.097i\Omega$   
 $\Gamma = -0.8 + 0.2i$



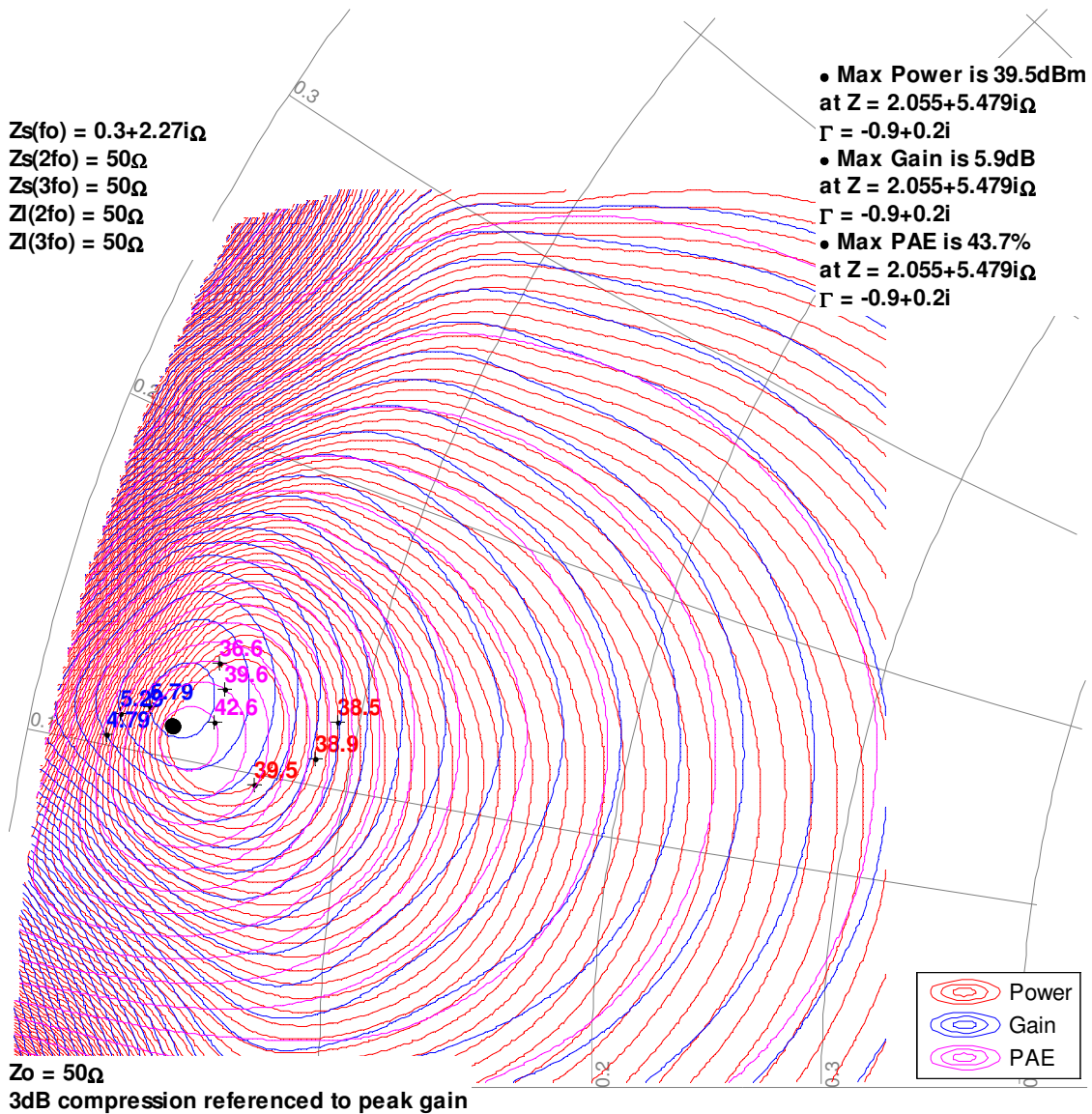
$Z_0 = 50\Omega$   
 3dB compression referenced to peak gain

Model Load-Pull Smith Charts<sup>1, 2</sup>

Notes:

1. Test Conditions:  $V_D = 20\text{ V}$ ,  $I_{DQ} = 160\text{ mA}$ , CW, Bondwires not included
2. See page 22 for load pull reference planes where the performance was simulated.

18GHz, Load-pull

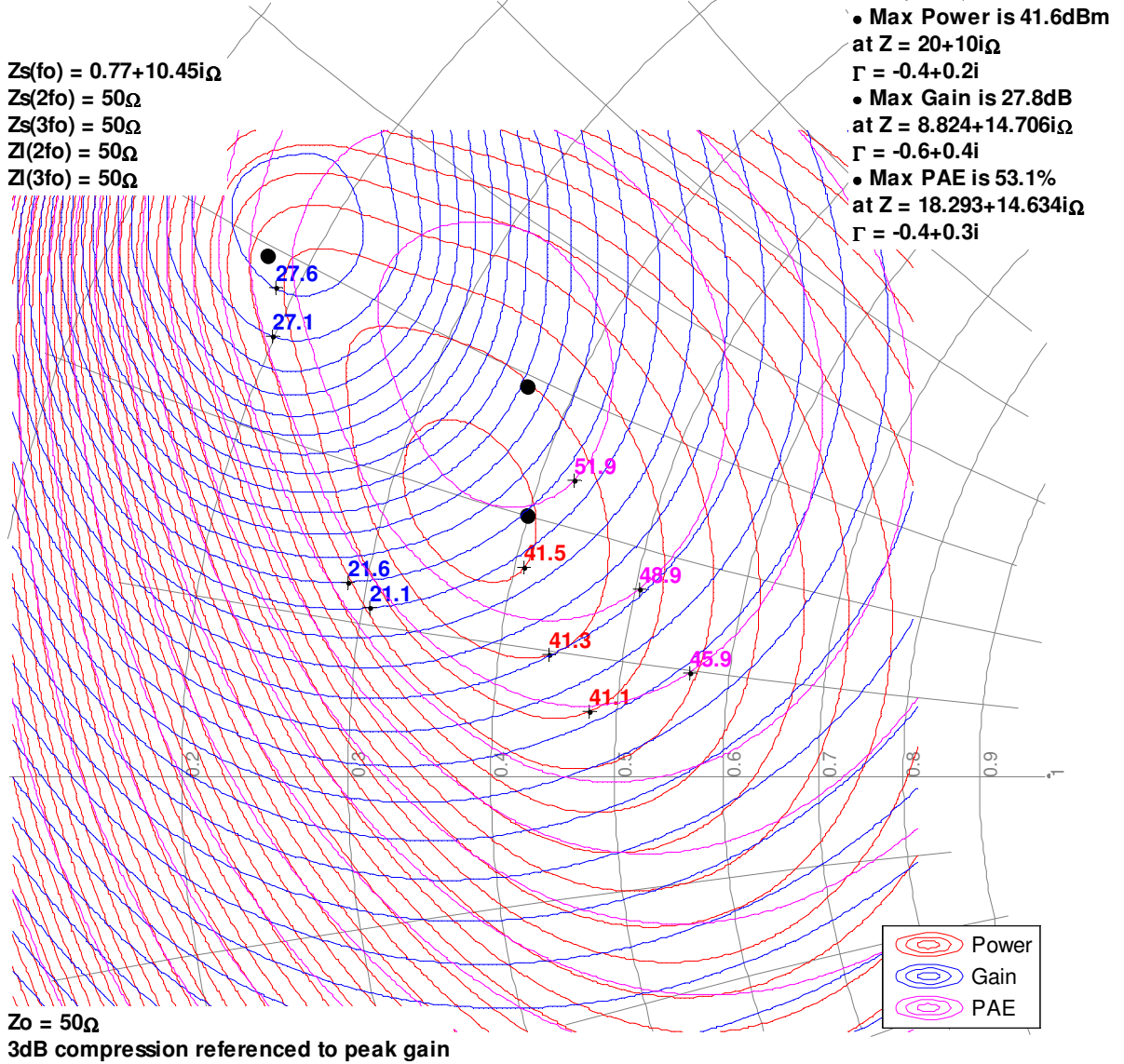


Model Load-Pull Smith Charts<sup>1,2</sup>

Notes:

1. Test Conditions:  $V_D = 28\text{ V}$ ,  $I_{DQ} = 160\text{ mA}$ , 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<sup>1,2</sup>

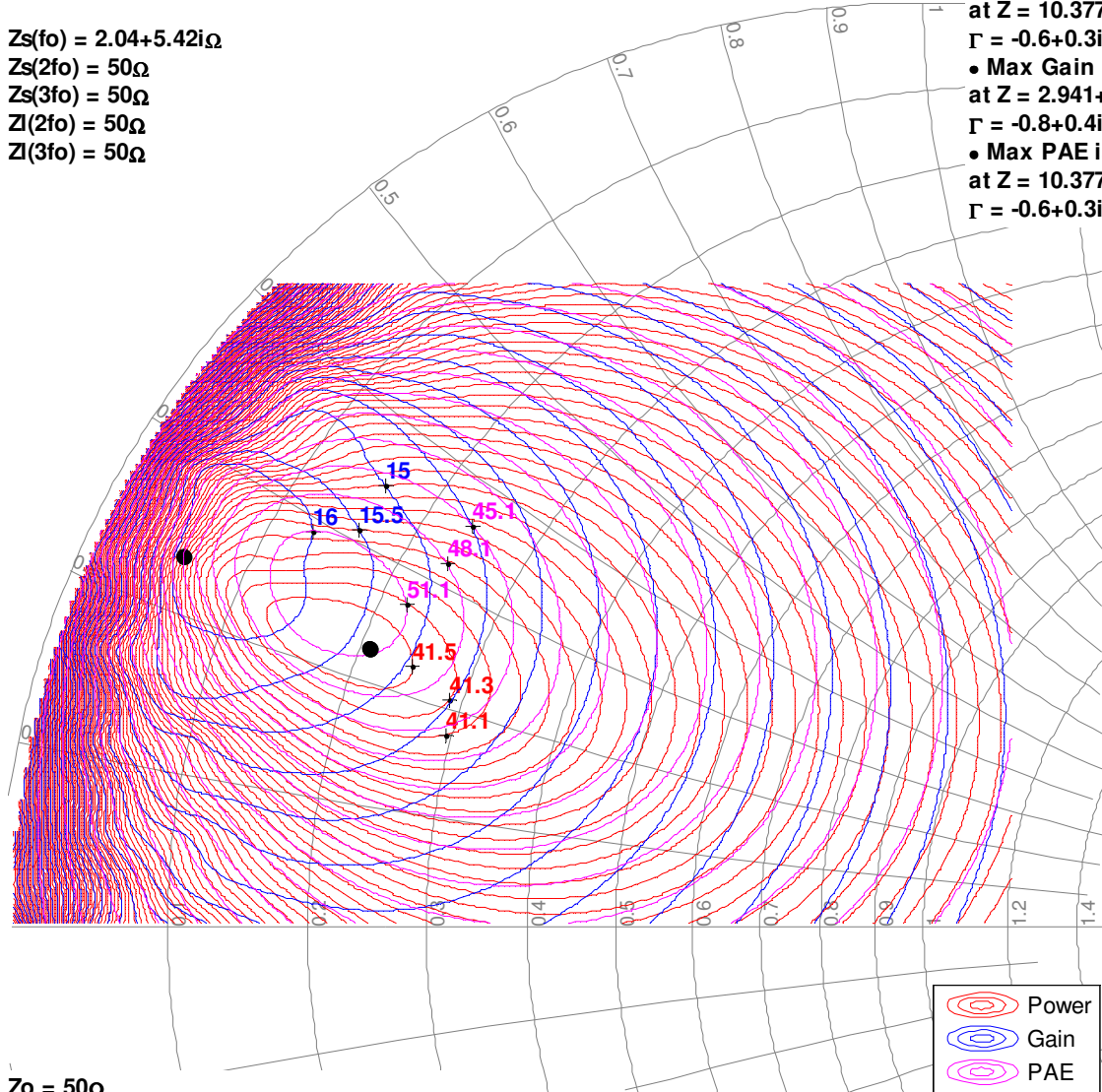
Notes:

1. Test Conditions:  $V_D = 28\text{ V}$ ,  $I_{DQ} = 160\text{ mA}$ , CW, Bondwires not included
2. See page 22 for load pull reference planes where the performance was simulated.

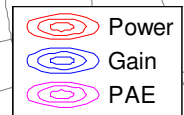
6GHz, Load-pull

$Z_s(f_0) = 2.04 + 5.42i\Omega$   
 $Z_s(2f_0) = 50\Omega$   
 $Z_s(3f_0) = 50\Omega$   
 $Z_l(2f_0) = 50\Omega$   
 $Z_l(3f_0) = 50\Omega$

- Max Power is 41.7dBm at  $Z = 10.377 + 11.321i\Omega$   
 $\Gamma = -0.6 + 0.3i$
- Max Gain is 16.4dB at  $Z = 2.941 + 11.765i\Omega$   
 $\Gamma = -0.8 + 0.4i$
- Max PAE is 51.4% at  $Z = 10.377 + 11.321i\Omega$   
 $\Gamma = -0.6 + 0.3i$



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





Model Load-Pull Smith Charts<sup>1, 2</sup>

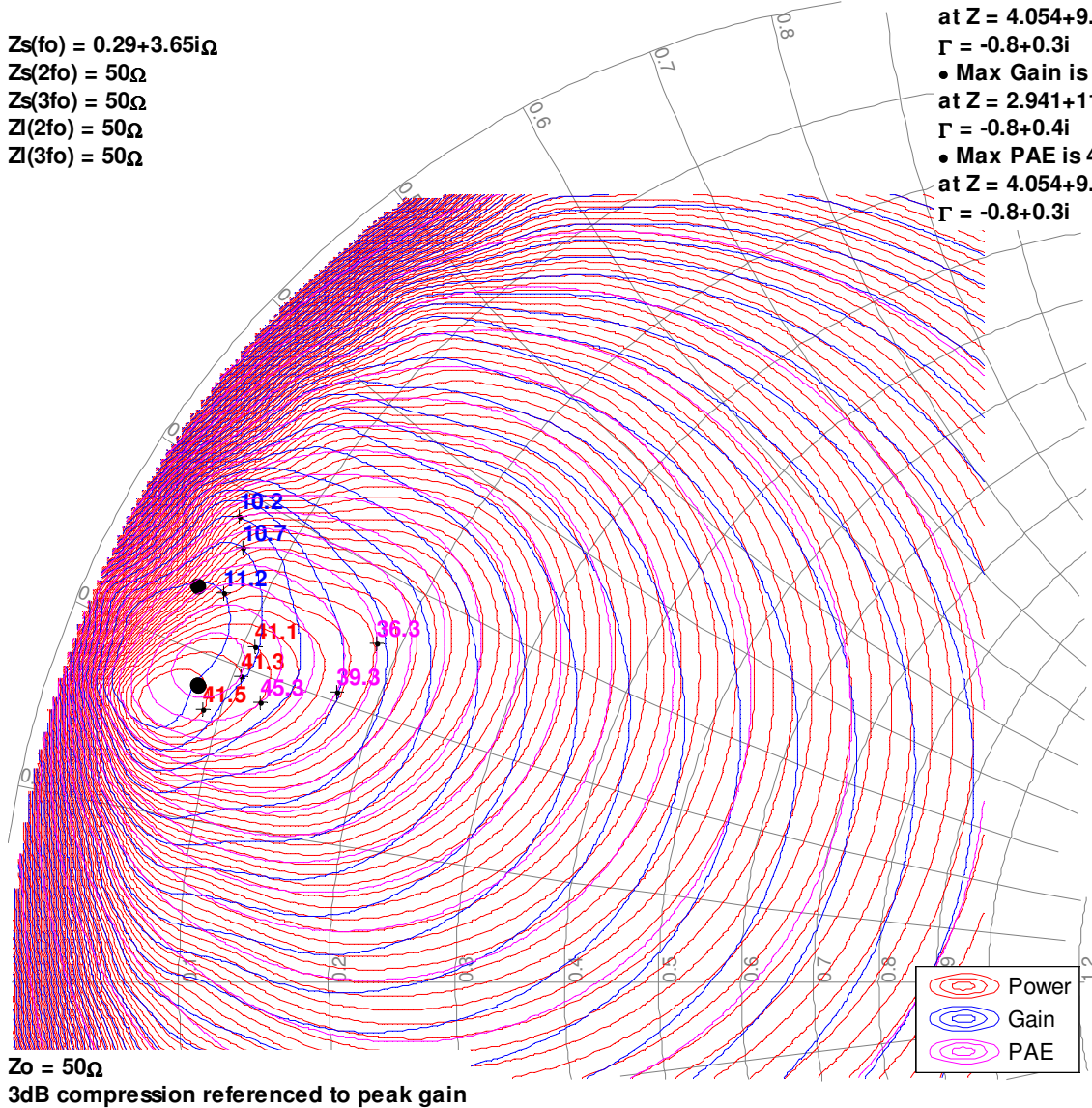
Notes:

1. Test Conditions:  $V_D = 28\text{ V}$ ,  $I_{DQ} = 160\text{ mA}$ , CW, Bondwires not included
2. See page 22 for load pull reference planes where the performance was simulated.

10GHz, Load-pull

$Z_s(f_0) = 0.29 + 3.65i\Omega$   
 $Z_s(2f_0) = 50\Omega$   
 $Z_s(3f_0) = 50\Omega$   
 $Z_l(2f_0) = 50\Omega$   
 $Z_l(3f_0) = 50\Omega$

- Max Power is 41.5dBm at  $Z = 4.054 + 9.009i\Omega$   
 $\Gamma = -0.8 + 0.3i$
- Max Gain is 11.3dB at  $Z = 2.941 + 11.765i\Omega$   
 $\Gamma = -0.8 + 0.4i$
- Max PAE is 49.1% at  $Z = 4.054 + 9.009i\Omega$   
 $\Gamma = -0.8 + 0.3i$

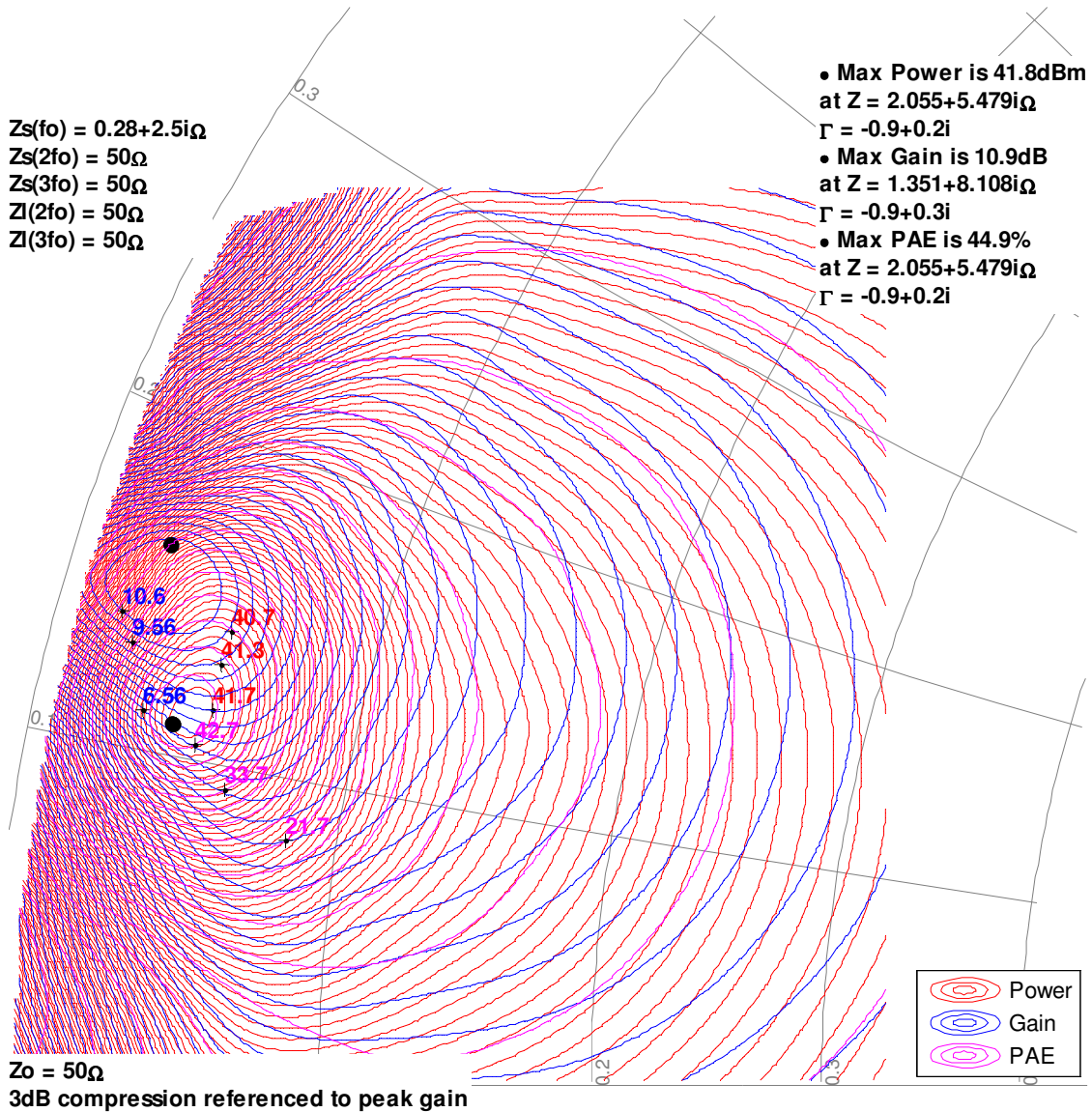


Model Load-Pull Smith Charts<sup>1, 2</sup>

Notes:

1. Test Conditions:  $V_D = 28\text{ V}$ ,  $I_{DQ} = 160\text{ mA}$ , CW, Bondwires not included
2. See page 22 for load pull reference planes where the performance was simulated.

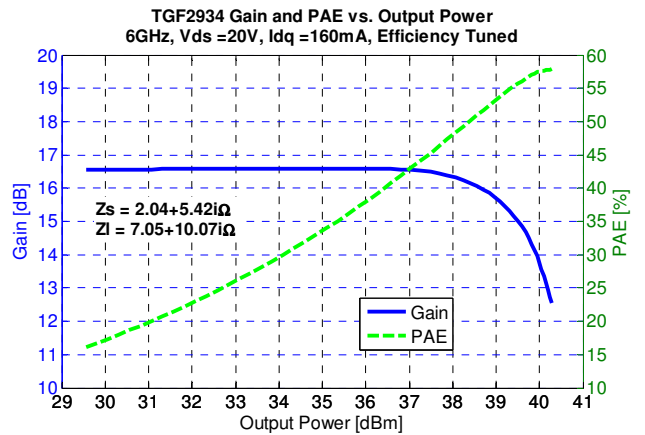
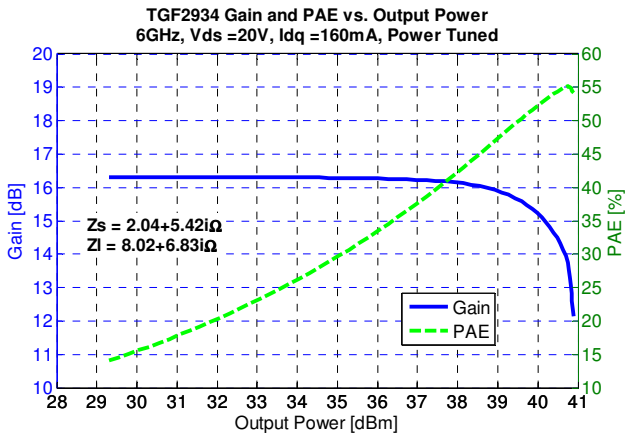
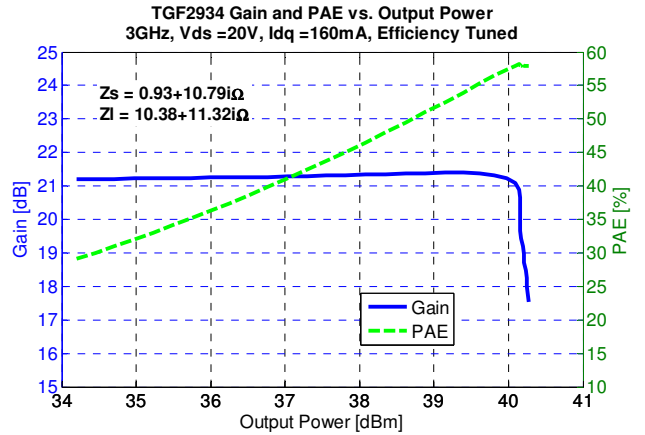
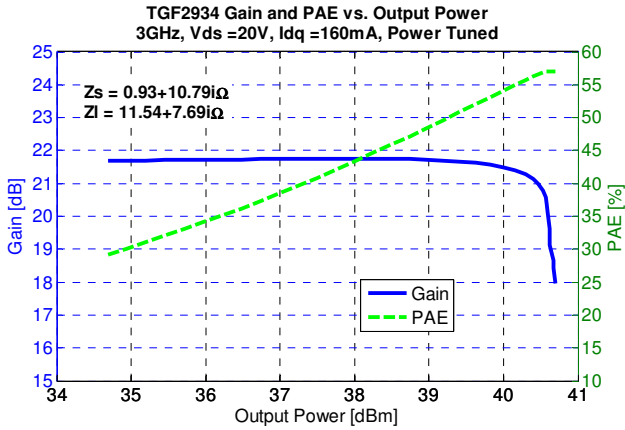
18GHz, Load-pull



### Typical Model Performance – Load-Pull Drive-up<sup>1, 2</sup>

Notes:

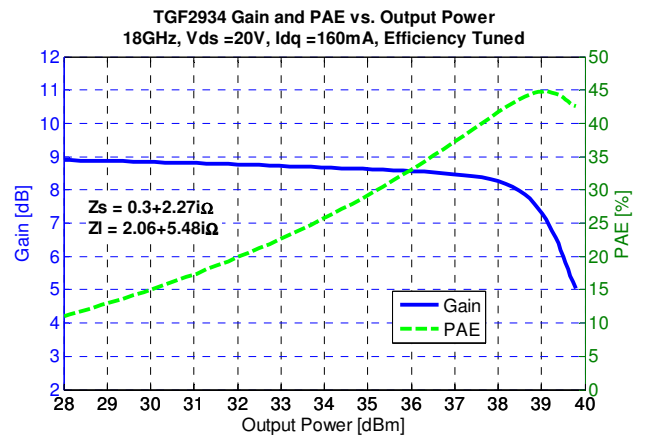
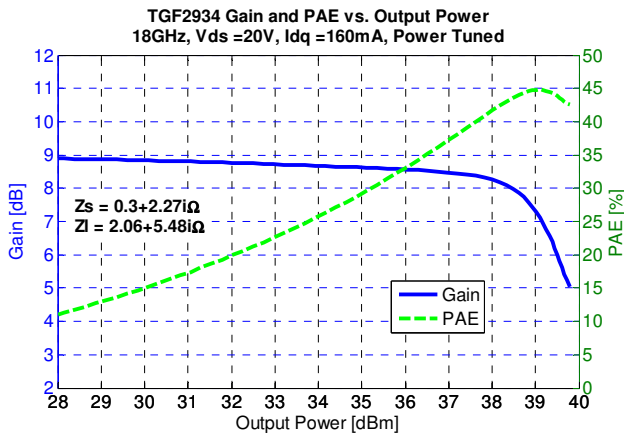
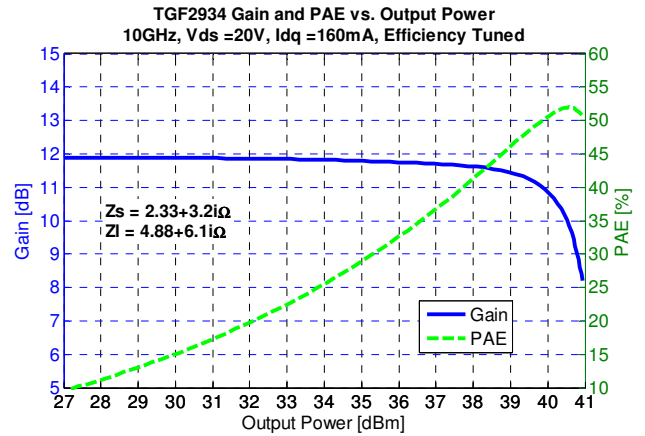
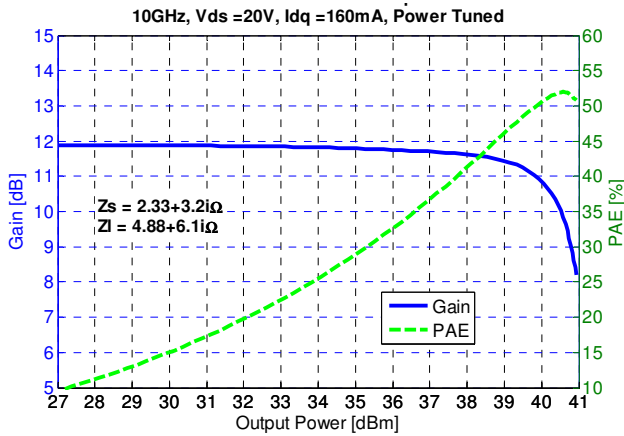
1. CW, Bondwires not included
2. See page 22 for load-pull and source-pull reference planes where the performance was measured.



### Typical Model Performance – Load-Pull Drive-up<sup>1,2</sup>

Notes:

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

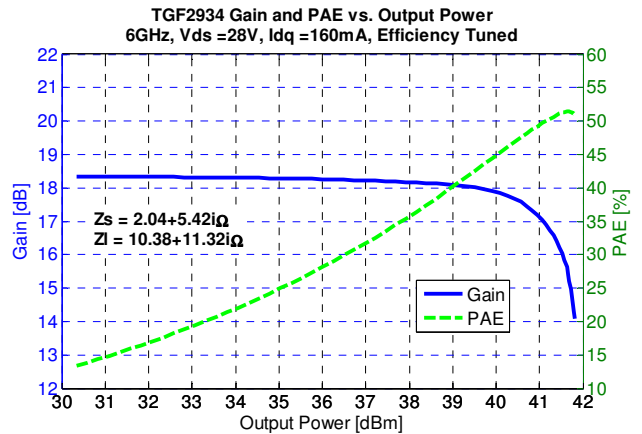
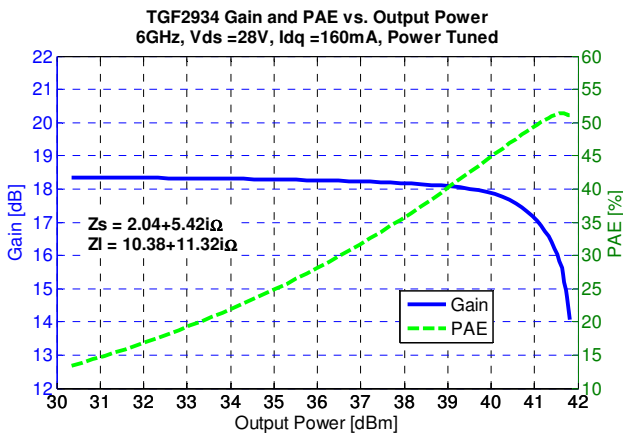
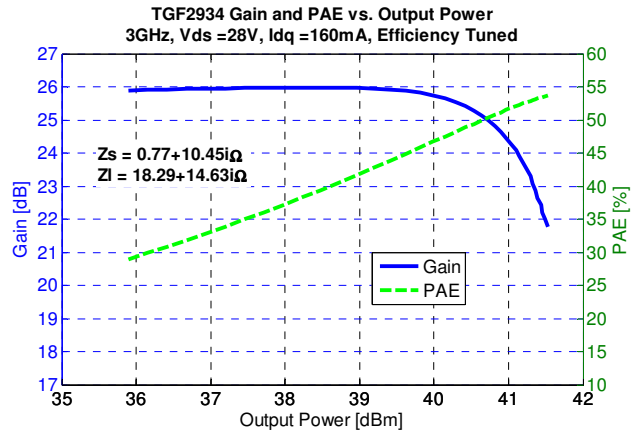
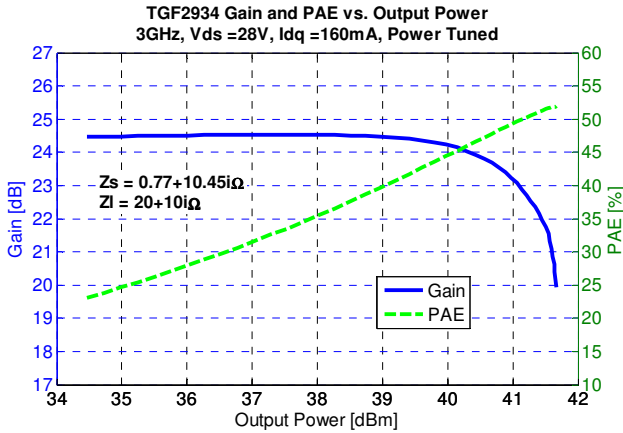




### Typical Model Performance – Load-Pull Drive-up<sup>1,2</sup>

Notes:

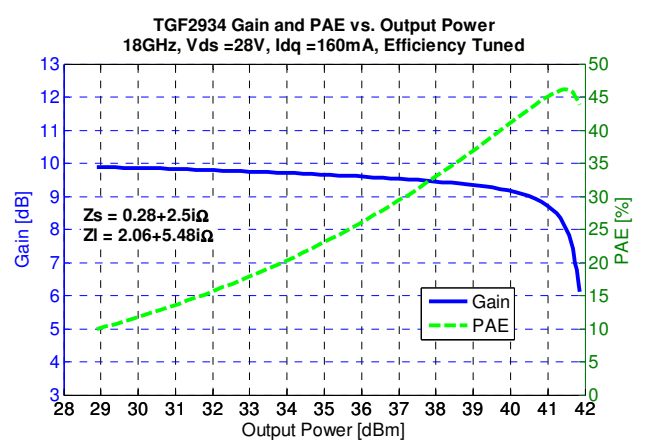
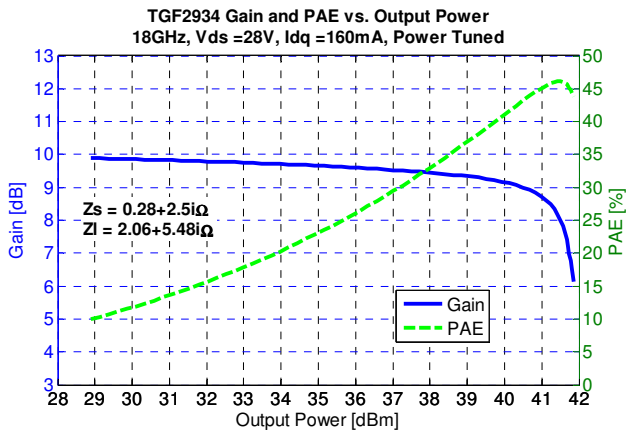
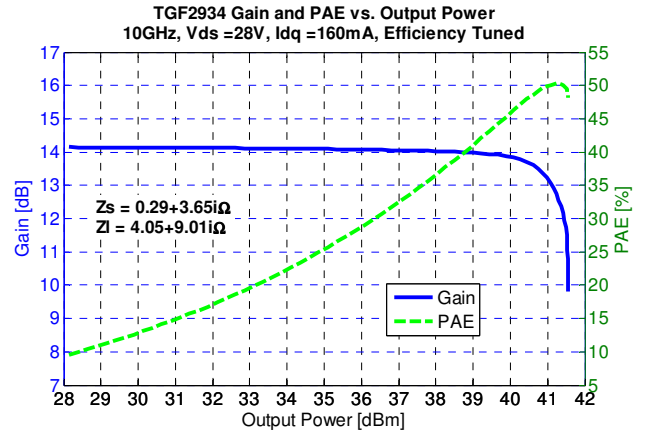
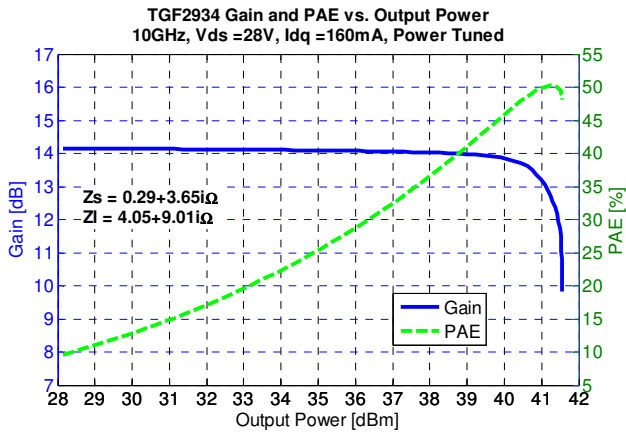
1. CW, Bondwires not included
2. See page 22 for load-pull and source-pull reference planes where the performance was measured.



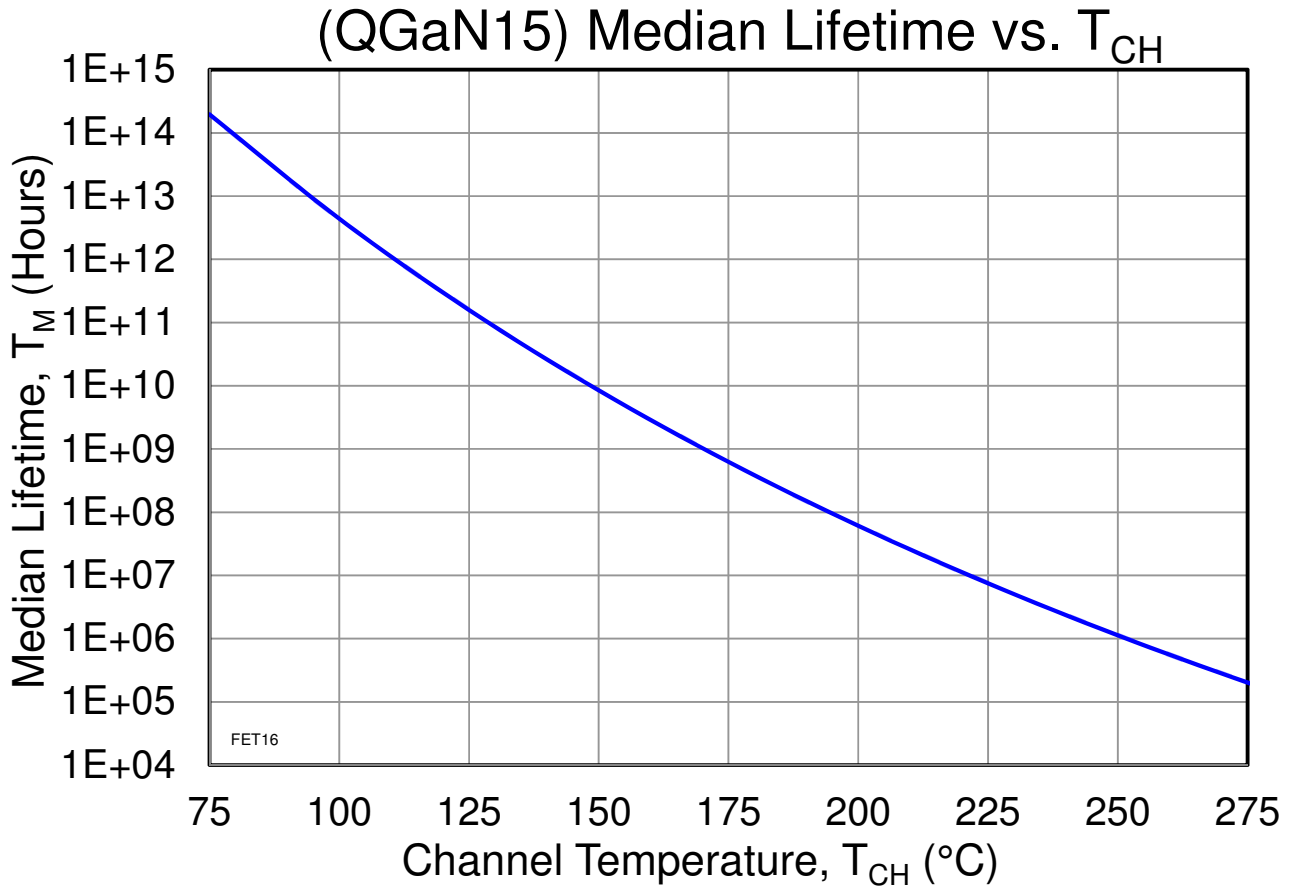
### Typical Model Performance – Load-Pull Drive-up<sup>1,2</sup>

Notes:

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



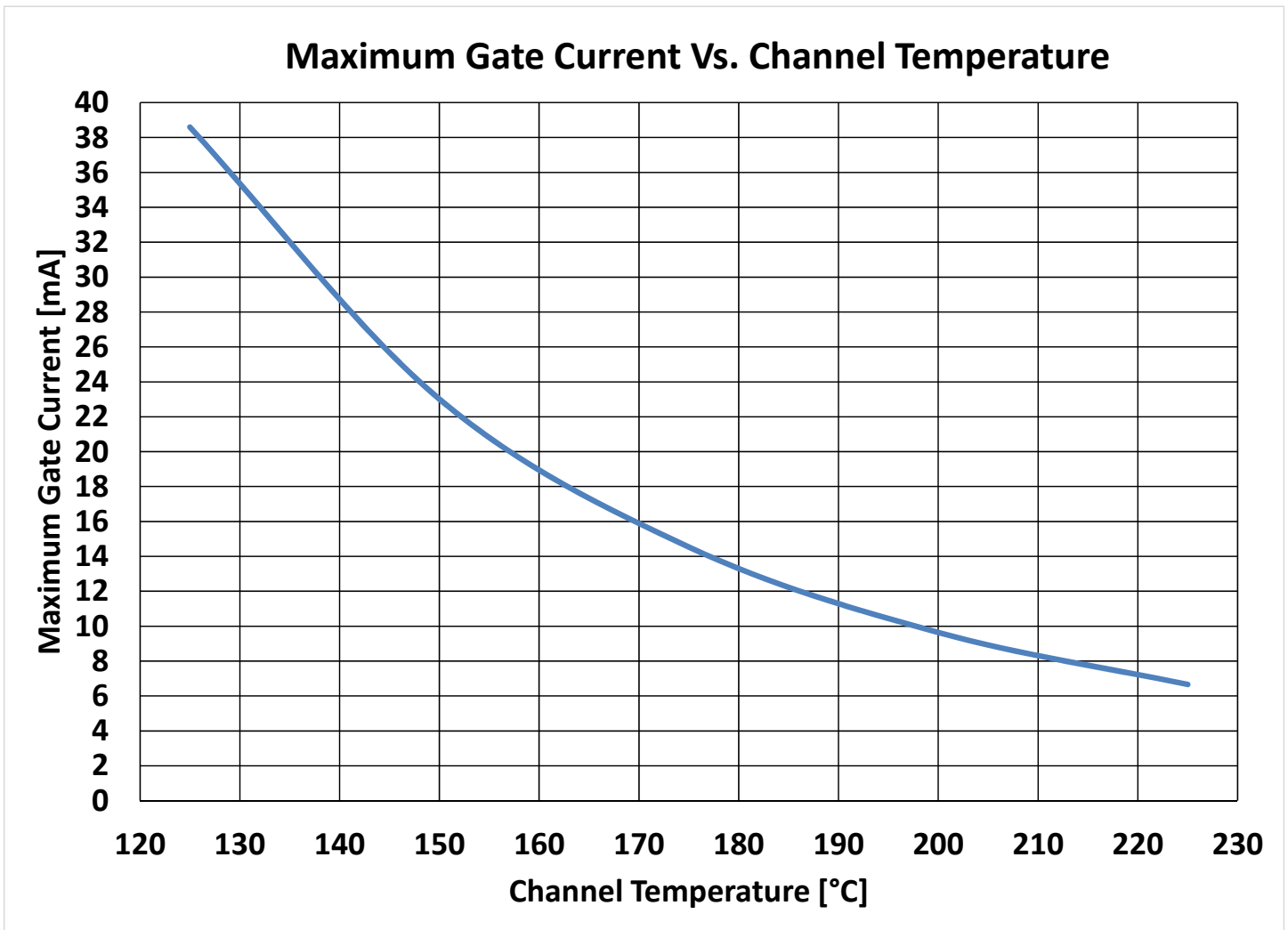
Median Lifetime<sup>1</sup>



Notes:

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

## Maximum Gate Current

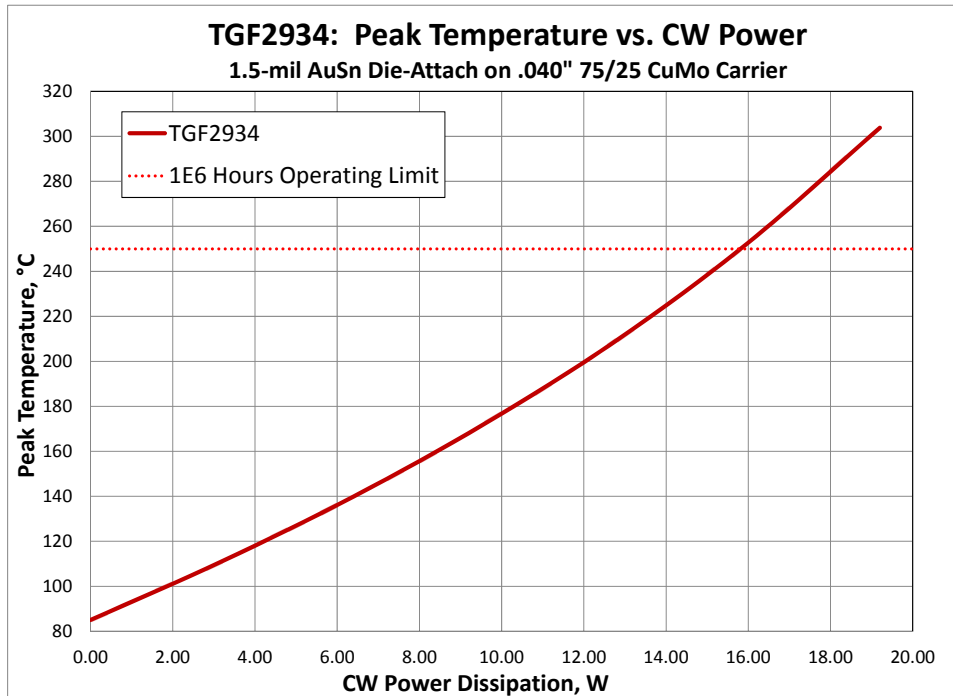


### Thermal and Reliability Information

Parameter	Test Conditions	Value	Units
Thermal Resistance, $\theta_{JC}$ <sup>(1)</sup>	CW	8.1	°C/W
Channel Temperature, $T_{CH}$	$T_{baseplate} = +85\text{ °C}$	111	°C
Median Lifetime, $T_M$	$P_{DISS} = 3.2\text{ W}$	9.7E11	Hrs
Thermal Resistance, $\theta_{JC}$ <sup>(1)</sup>	CW	8.6	°C/W
Channel Temperature, $T_{CH}$	$T_{baseplate} = +85\text{ °C}$	140	°C
Median Lifetime, $T_M$	$P_{DISS} = 6.4\text{ W}$	2.6E10	Hrs
Thermal Resistance, $\theta_{JC}$ <sup>(1)</sup>	CW	9.1	°C/W
Channel Temperature, $T_{CH}$	$T_{baseplate} = +85\text{ °C}$	172	°C
Median Lifetime, $T_M$	$P_{DISS} = 9.6\text{ W}$	8.4E8	Hrs
Thermal Resistance, $\theta_{JC}$ <sup>(1)</sup>	CW	9.7	°C/W
Channel Temperature, $T_{CH}$	$T_{baseplate} = +85\text{ °C}$	209	°C
Median Lifetime, $T_M$	$P_{DISS} = 12.8\text{ W}$	2.8E7	Hrs
Thermal Resistance, $\theta_{JC}$ <sup>(1)</sup>	CW	10.5	°C/W
Channel Temperature, $T_{CH}$	$T_{baseplate} = +85\text{ °C}$	253	°C
Median Lifetime, $T_M$	$P_{DISS} = 16\text{ W}$	9.1E5	Hrs
Thermal Resistance, $\theta_{JC}$ <sup>(1)</sup>	CW	11.4	°C/W
Channel Temperature, $T_{CH}$	$T_{baseplate} = +85\text{ °C}$	304	°C
Median Lifetime, $T_M$	$P_{DISS} = 19.2\text{ W}$	3.3E4	Hrs

Notes:

1. Thermal resistance measured at back of package.





### 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 200 mA.
3. Slowly adjust  $V_G$  until  $I_D$  reaches 160 mA.
4. Set  $I_D$  limit to 1200 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 of  $V_G$ .

### 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 (C<sub>15</sub>H<sub>12</sub>Br<sub>4</sub>O<sub>2</sub>) 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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