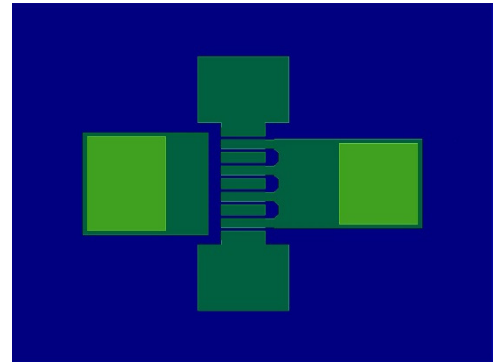


### Product Overview

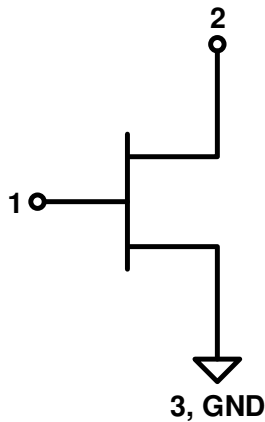
The Qorvo TGF2942 is a 2 W ( $P_{3dB}$ ) discrete GaN on SiC HEMT which operates from DC to 25 GHz and 28 V supply. The device is constructed with Qorvo’s proven QGaN15 process. The device can support pulsed, CW, and linear operations.

Lead-free and ROHS compliant



0.411 x 0.551 x 0.100 mm

### Functional Block Diagram



### Key Features

- Frequency: DC to 25 GHz
  - Output Power ( $P_{3dB}$ )<sup>1</sup>: 2.4 W
  - Linear Gain<sup>1</sup>: 18 dB
  - Typical PAE<sub>3dB</sub><sup>1</sup>: 59%
  - Typical Noise Figure<sup>1</sup>: 1.2 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
TGF2942	EAR99	DC–25GHz, 28 V, 2 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, $I_{D_{MAX}}$	500	mA
Gate Current Range, $I_G$	See page 20.	mA
Power Dissipation, CW, $P_{DISS}$	3.2	W
RF Input Power, CW, 10 GHz, $T = 25\text{ }^\circ\text{C}$	+23	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 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, $I_{DQ}$	10	20	40	mA
Drain Current, $I_D$	-	170	-	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>	-	-	2.9	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 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, $I_{DQ}$	20	20	20	20	20	20	20	20	mA
Output Power at 3dB compression, $P_{3dB}$	32.5	33.8	32.5	33.7	32.6	33.8	32.8	33.8	dBm
Power Added Efficiency at 3dB compression, $PAE_{3dB}$	58.7	61.3	60.5	58.6	57.2	56.6	54.3	54.2	%
Gain at 3dB compression, $G_{3dB}$	20.5	22.5	17.3	19.5	12.8	13.6	8.9	9.8	dB
Load Reflection Coefficient <sup>(2)</sup> , $\Gamma_L$	0.32 $\angle$ 18°	0.54 $\angle$ 22°	0.42 $\angle$ 45°	0.57 $\angle$ 45°	0.45 $\angle$ 63°	0.58 $\angle$ 59°	0.61 $\angle$ 99°	0.70 $\angle$ 90°	--

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, $I_{DQ}$	20	20	20	20	20	20	20	20	mA
Output Power at 3dB compression, $P_{3dB}$	32.1	33.8	31.5	33.7	31.7	33.4	32.1	33.8	dBm
Power Added Efficiency at 3dB compression, $PAE_{3dB}$	62.8	61.3	61.5	58.6	60.3	59.2	56.3	54.2	%
Gain at 3dB compression, $G_{3dB}$	22.6	22.5	17.9	19.5	14.9	15.3	9.4	9.8	dB
Load Reflection Coefficient <sup>(2)</sup> , $\Gamma_L$	0.45 $\angle$ 27°	0.54 $\angle$ 22°	0.57 $\angle$ 45°	0.57 $\angle$ 45°	0.63 $\angle$ 72°	0.67 $\angle$ 63°	0.71 $\angle$ 98°	0.70 $\angle$ 90°	--

Notes:

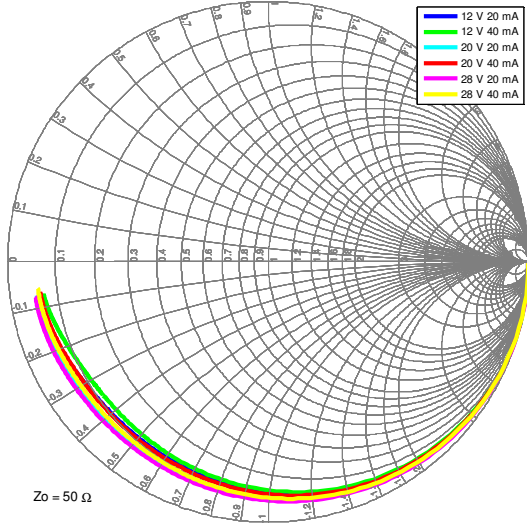
1. CW, bondwires not included
2. Characteristic Impedance,  $Z_0 = 50 \Omega$ .

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

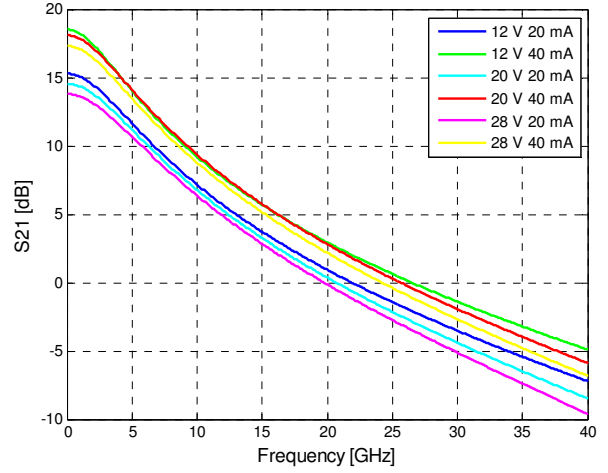
Notes:

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

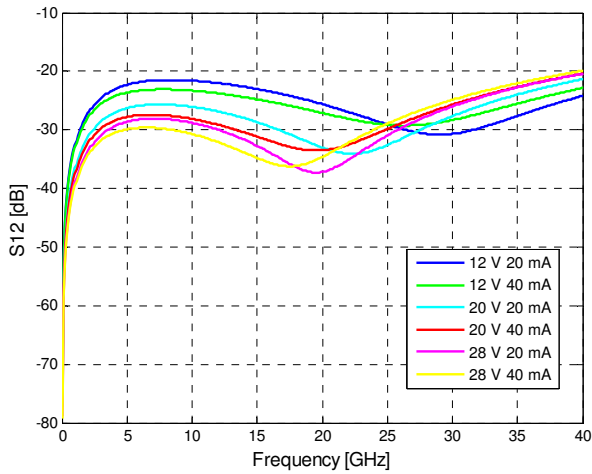
S11 from 0.01 GHz to 40 GHz



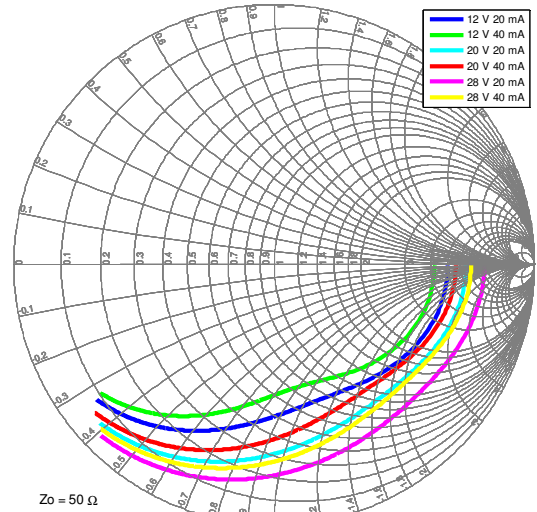
S21



S12



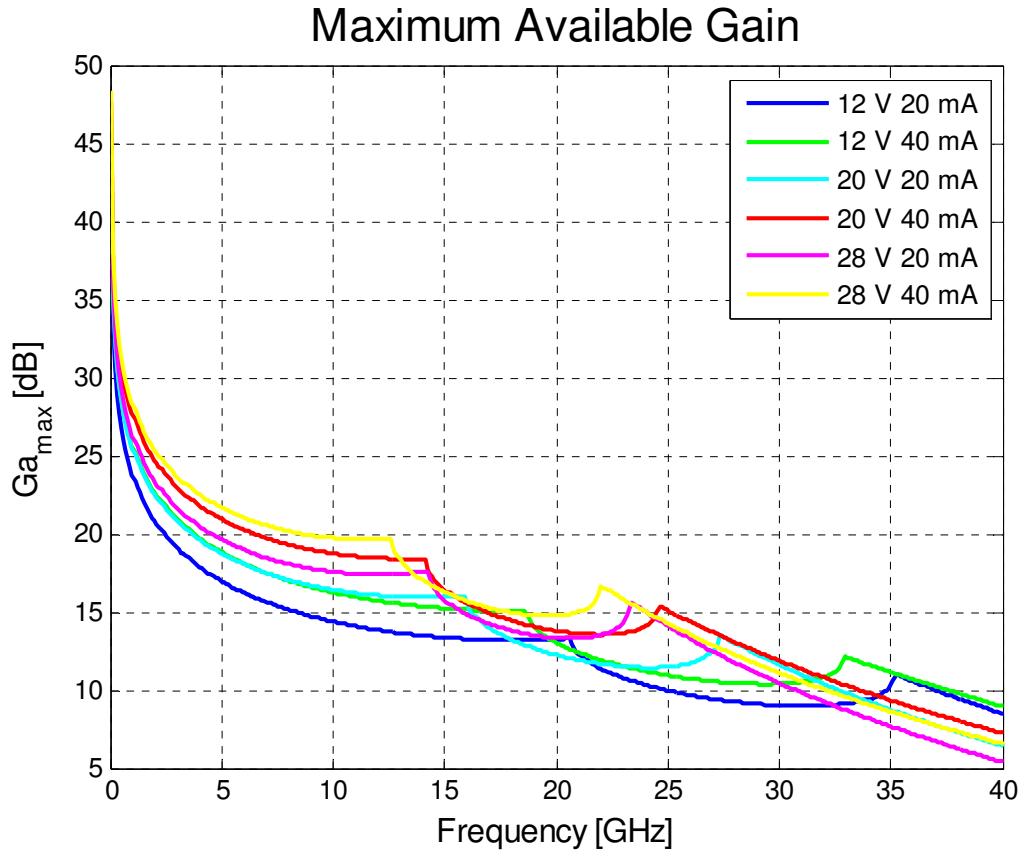
S22 from 0.01 GHz to 40 GHz



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

Notes:

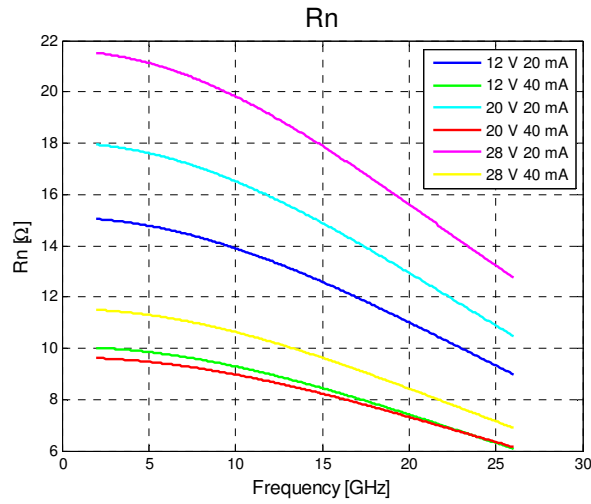
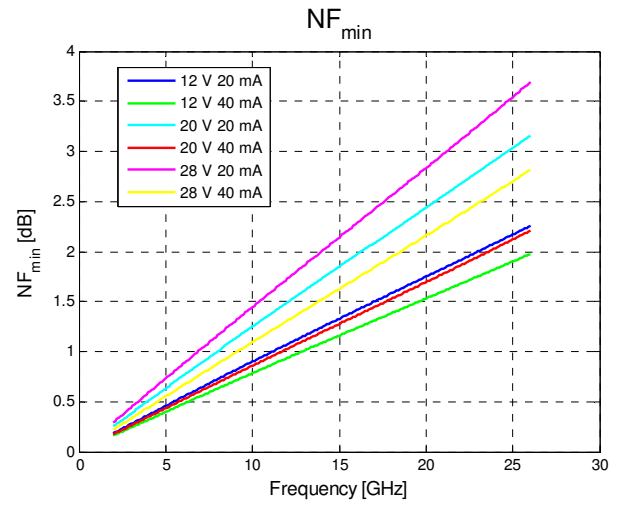
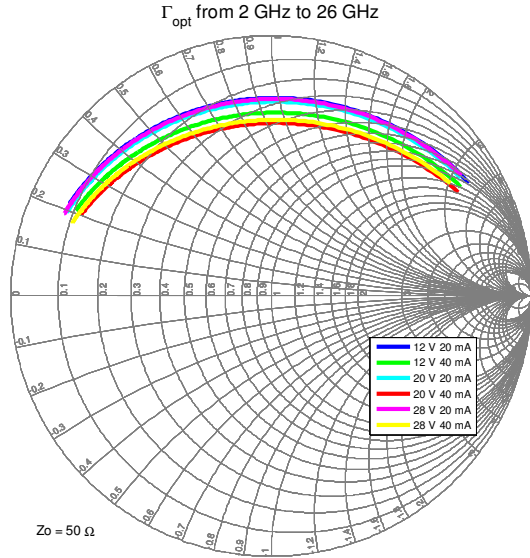
1. Bondwires are not included. T = 25 °C.



Model Noise<sup>1</sup>

Notes:

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

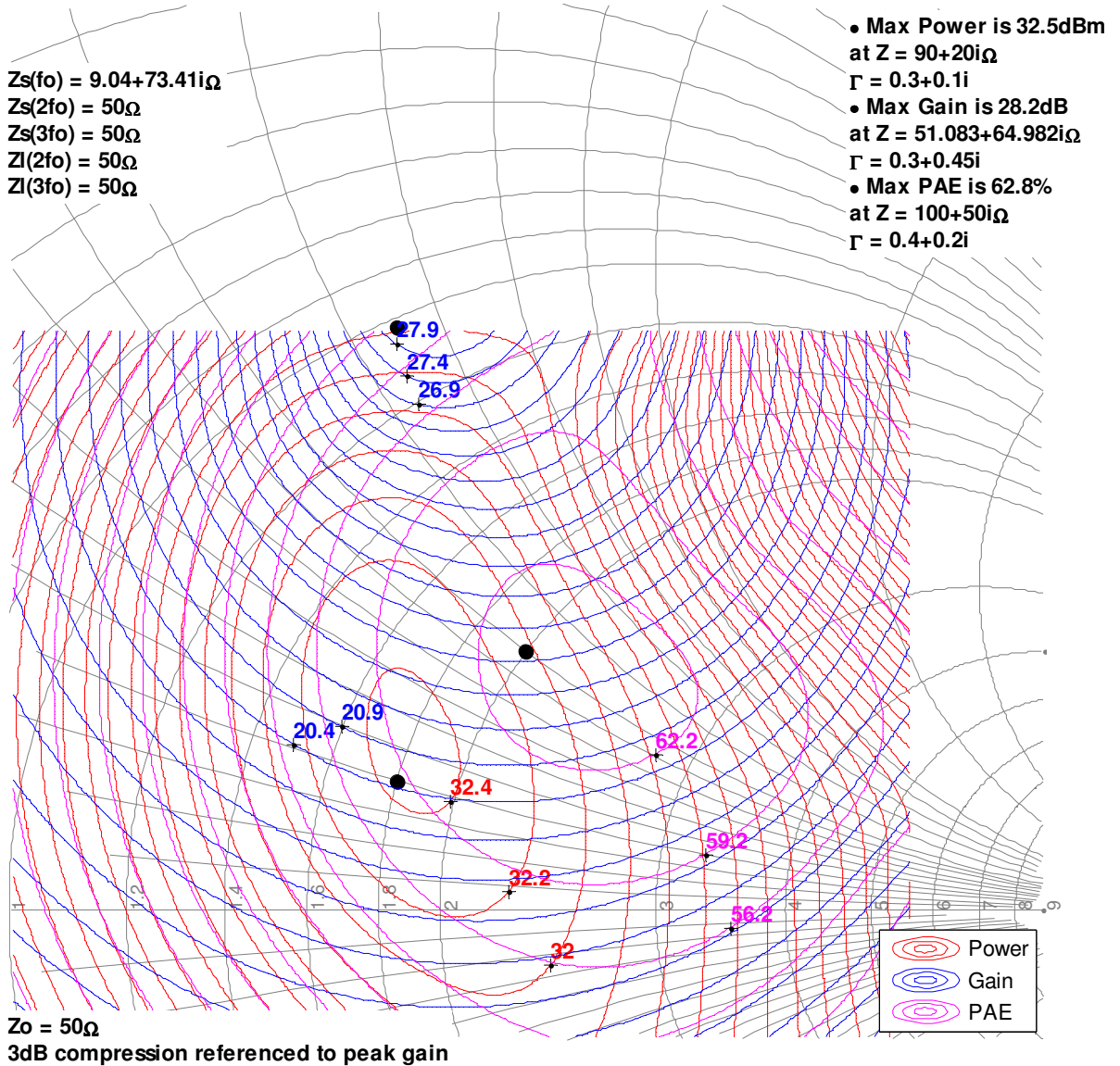


Load-Pull Smith Charts<sup>1, 2</sup>

Notes:

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

3GHz, Load-pull

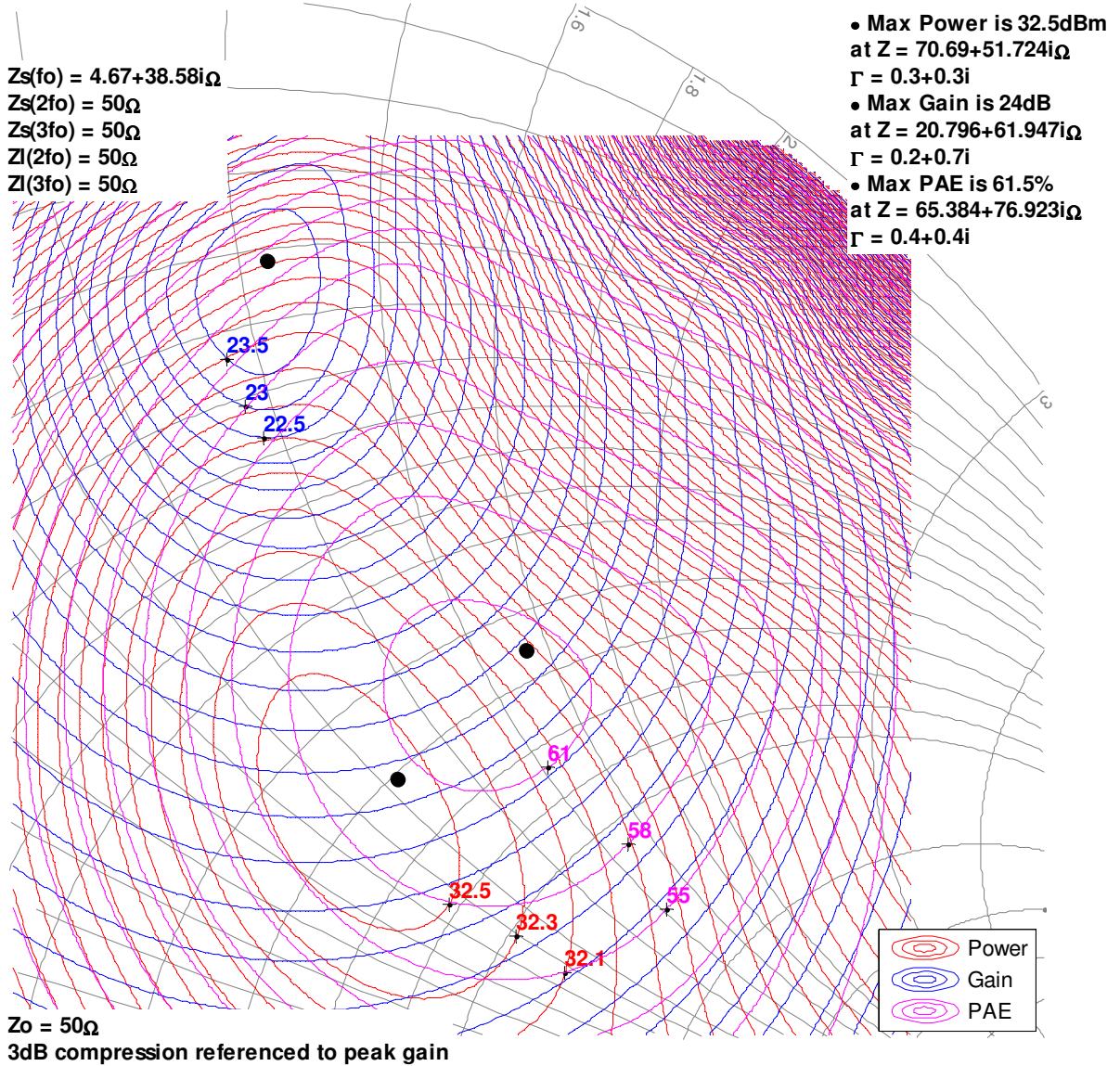


Load-Pull Smith Charts<sup>1, 2</sup>

Notes:

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

6GHz, Load-pull



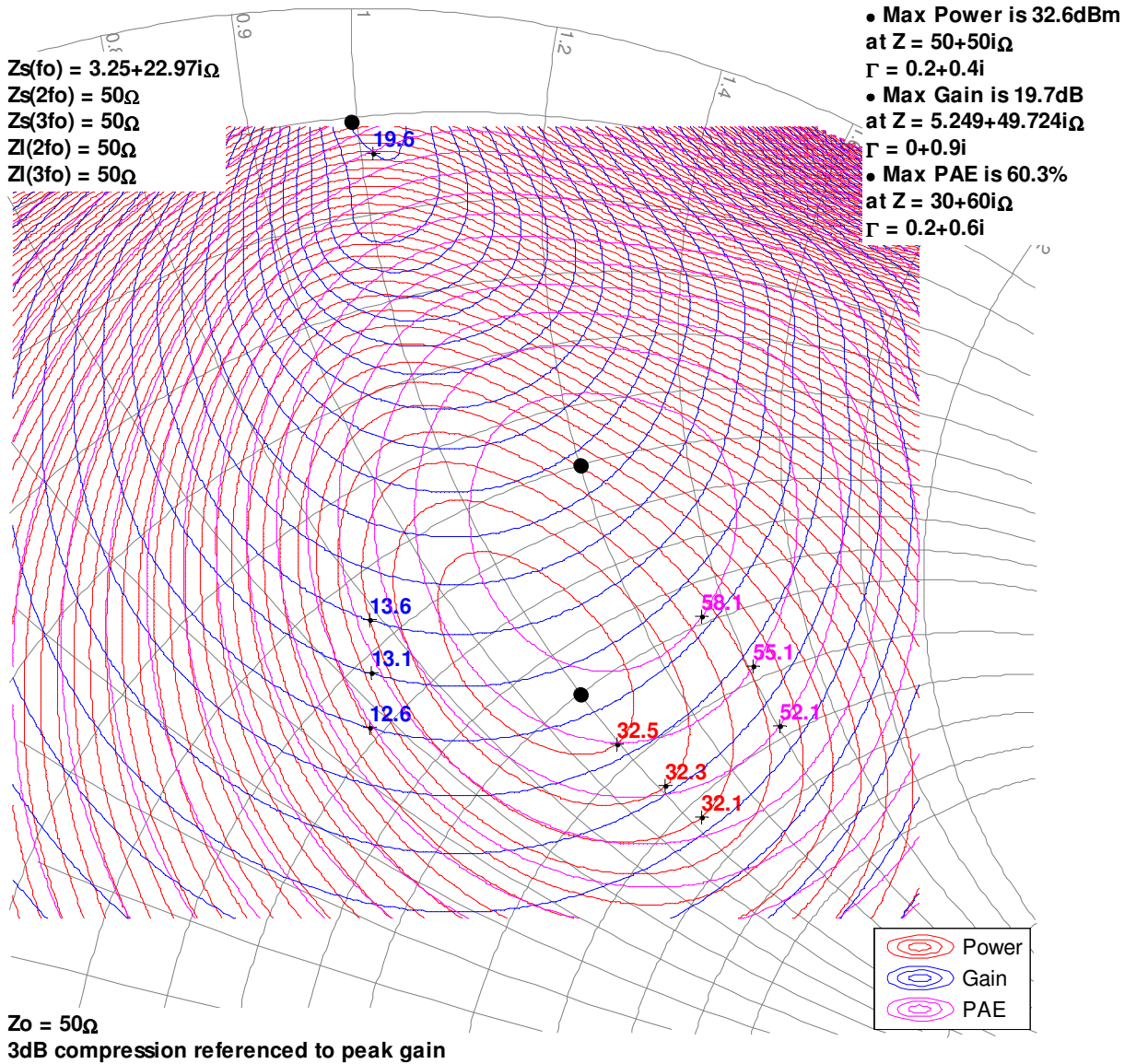


Load-Pull Smith Charts<sup>1, 2</sup>

Notes:

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

10GHz, Load-pull

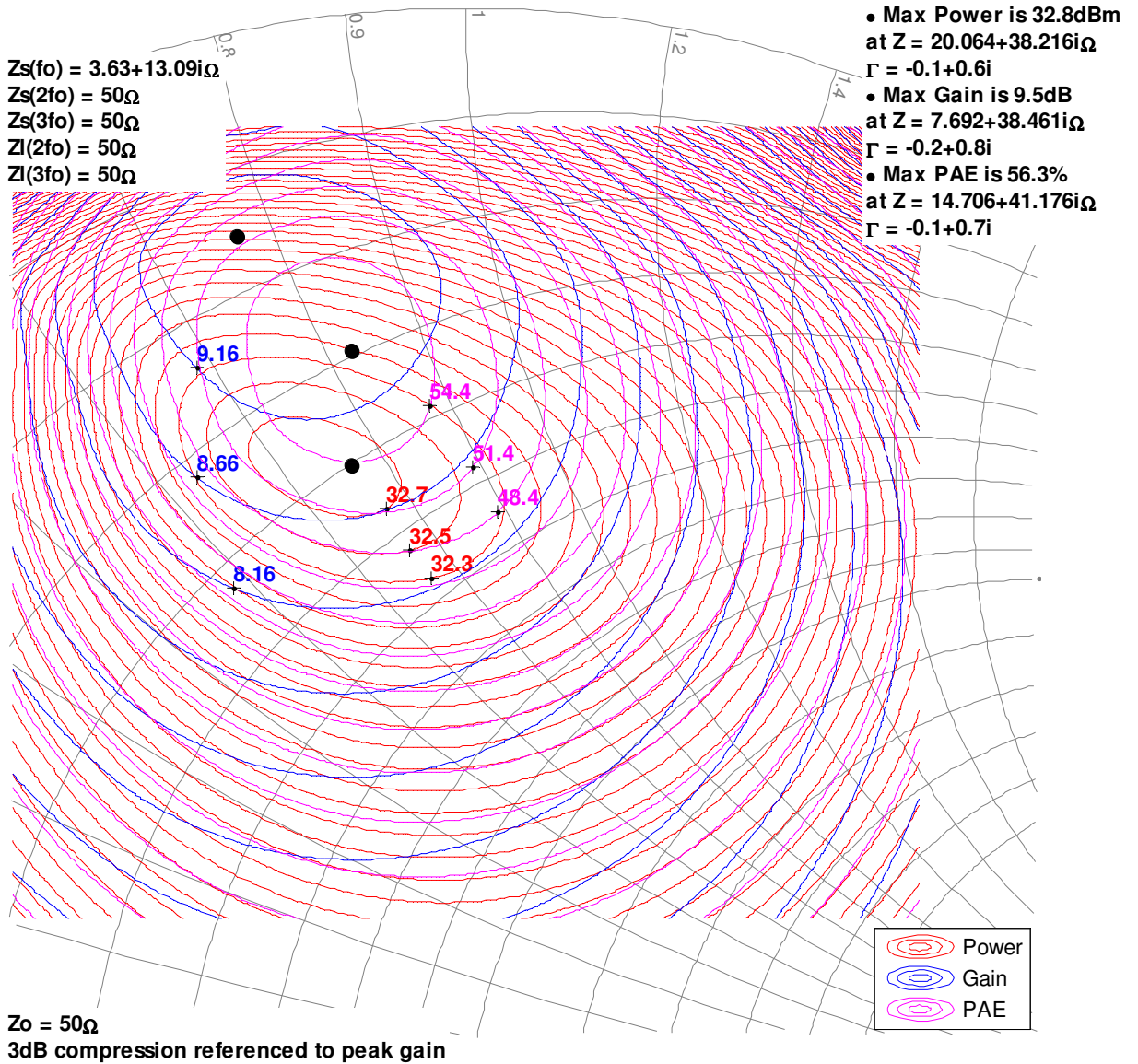


Load-Pull Smith Charts<sup>1, 2</sup>

Notes:

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

18GHz, Load-pull

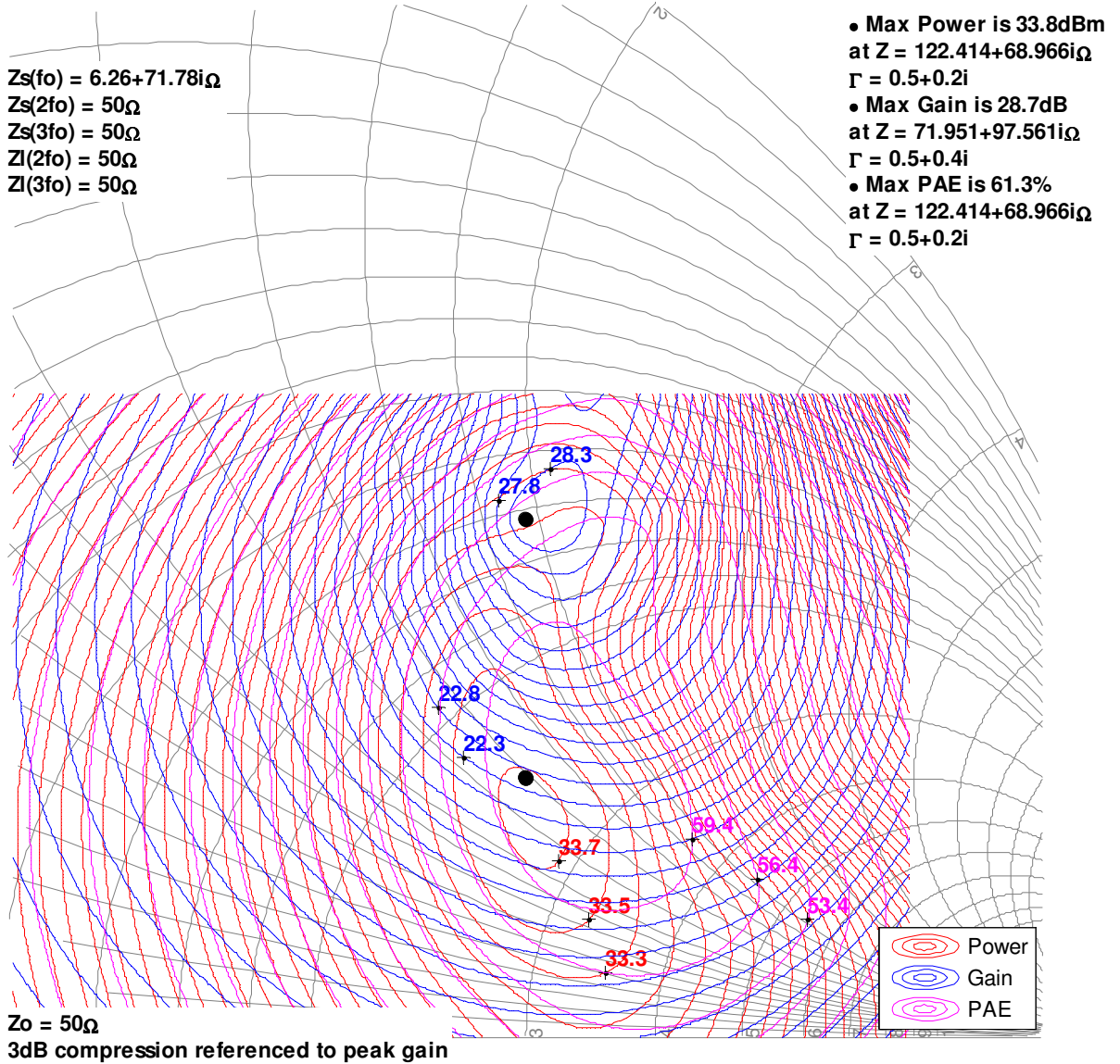


Load-Pull Smith Charts<sup>1, 2</sup>

Notes:

1. Test Conditions:  $V_D = 28\text{ V}$ ,  $I_{DQ} = 40\text{ mA}$ , CW, Bondwires not included
2. See page 22 for load pull reference planes where the performance was simulated.

3GHz, Load-pull

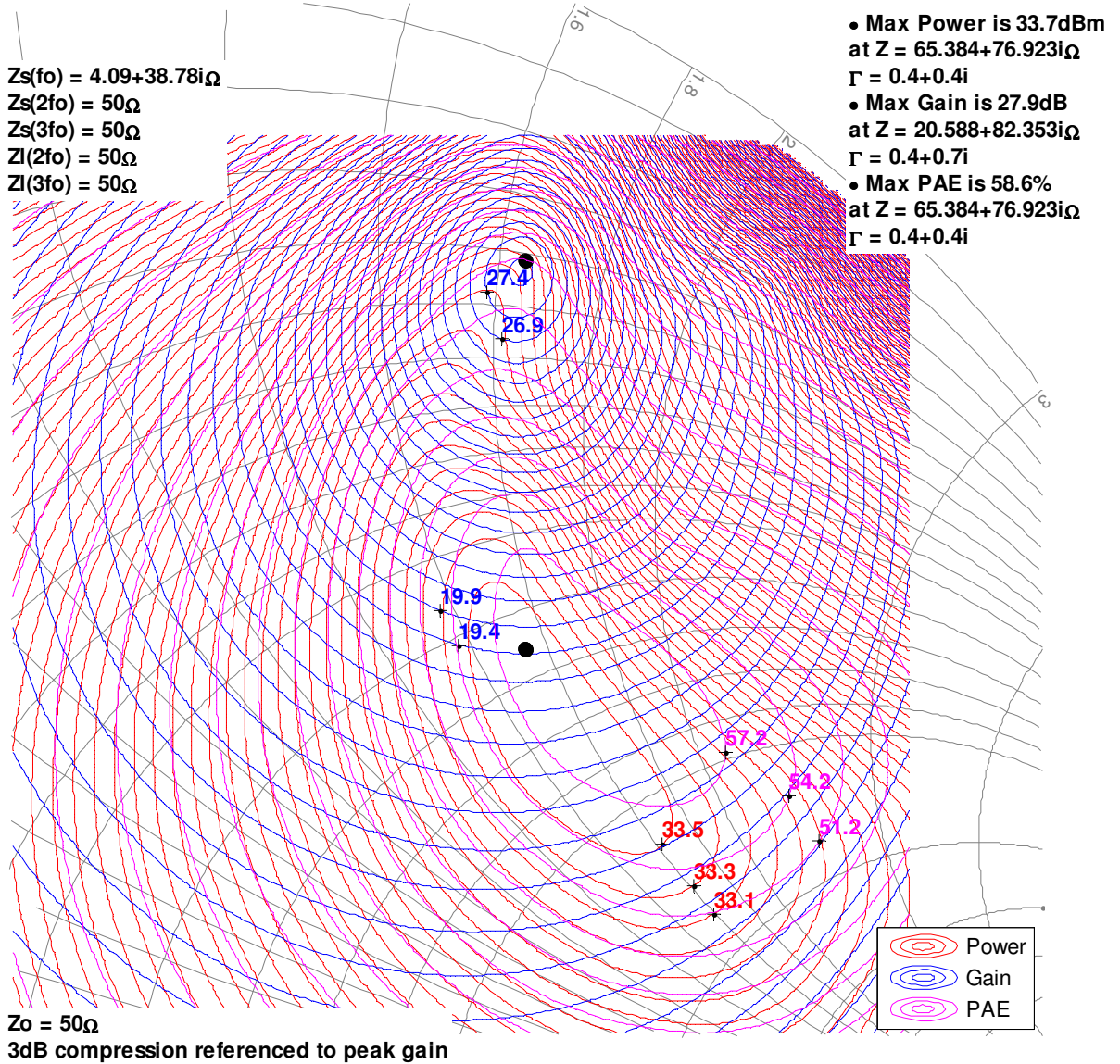


Load-Pull Smith Charts<sup>1, 2</sup>

Notes:

1. Test Conditions:  $V_D = 28\text{ V}$ ,  $I_{DQ} = 20\text{ mA}$ , CW, Bondwires not included
2. See page 22 for load pull reference planes where the performance was simulated.

6GHz, Load-pull

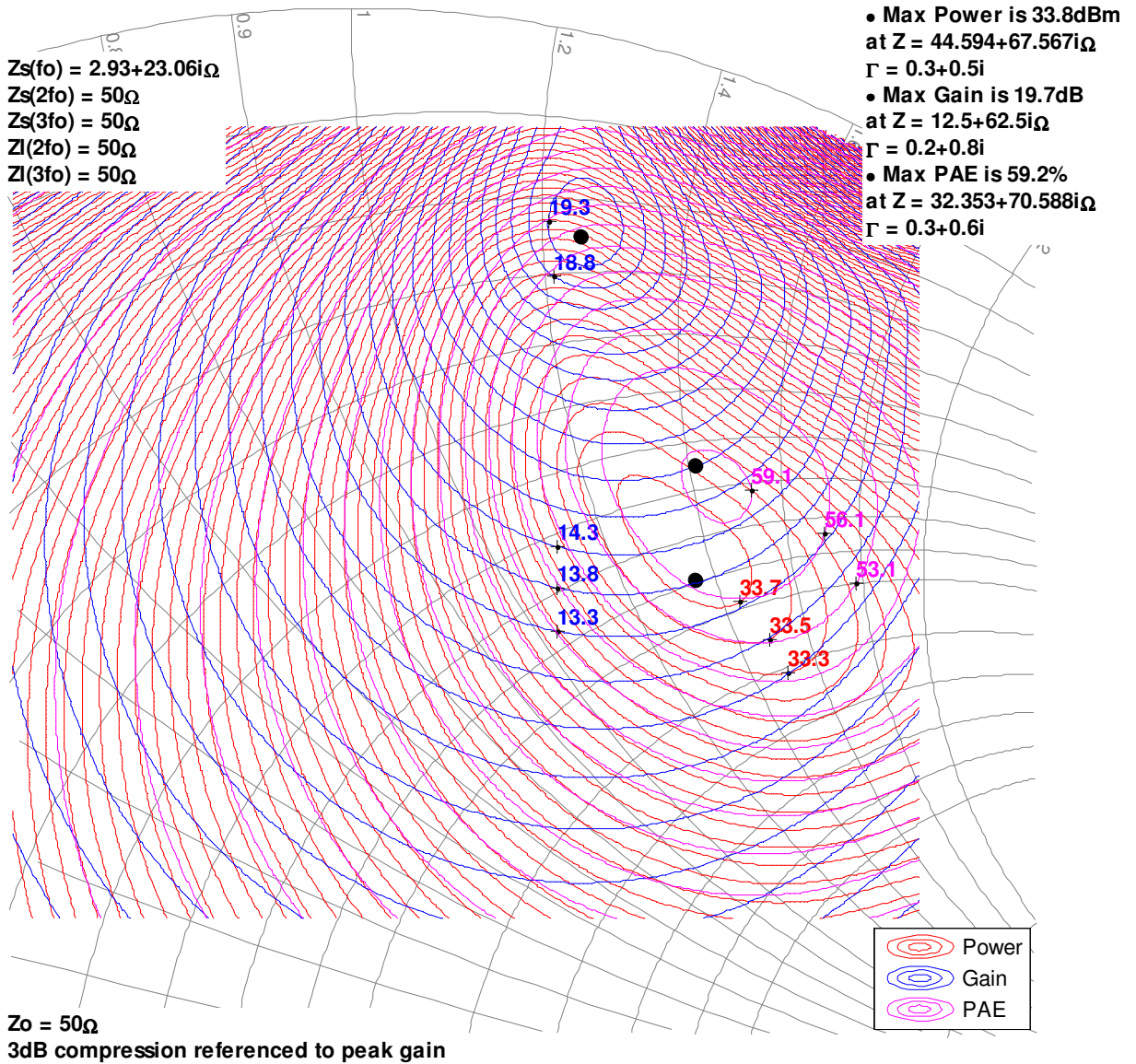


Load-Pull Smith Charts<sup>1, 2</sup>

Notes:

1. Test Conditions:  $V_D = 28\text{ V}$ ,  $I_{DQ} = 20\text{ mA}$ , CW, Bondwires not included
2. See page 22 for load pull reference planes where the performance was simulated.

10GHz, Load-pull

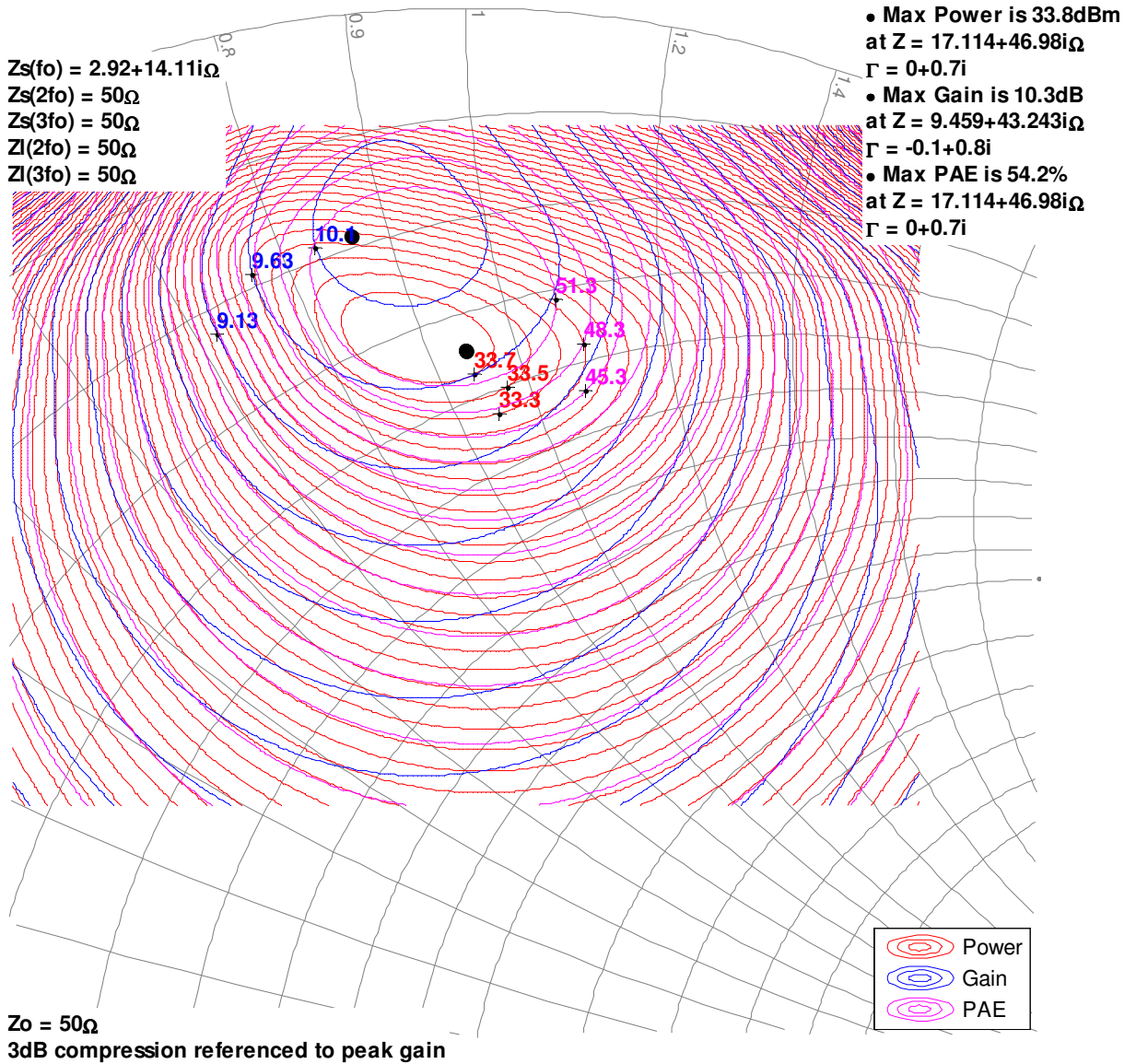


Load-Pull Smith Charts<sup>1, 2</sup>

Notes:

1. Test Conditions:  $V_D = 28\text{ V}$ ,  $I_{DQ} = 20\text{ mA}$ , CW, Bondwires not included
2. See page 22 for load pull reference planes where the performance was simulated.

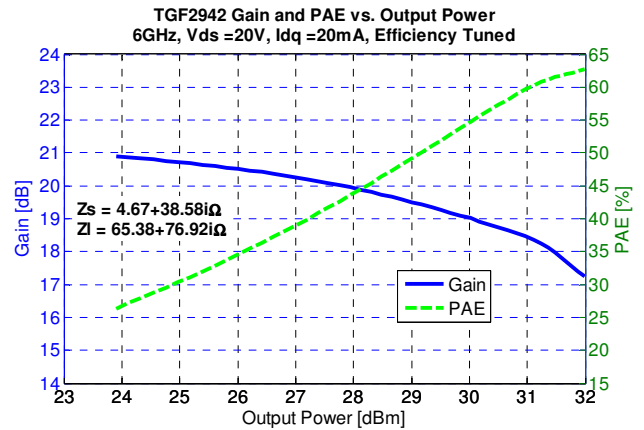
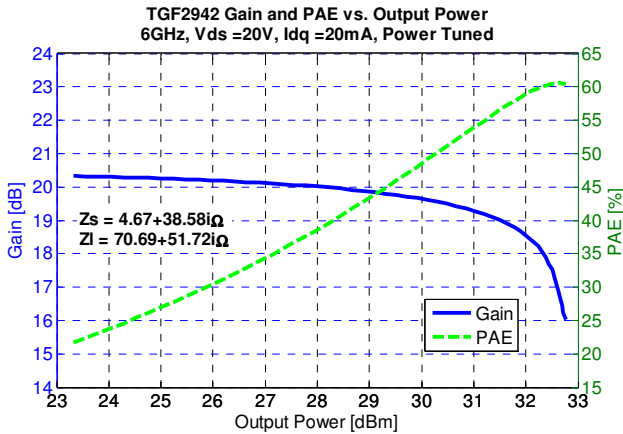
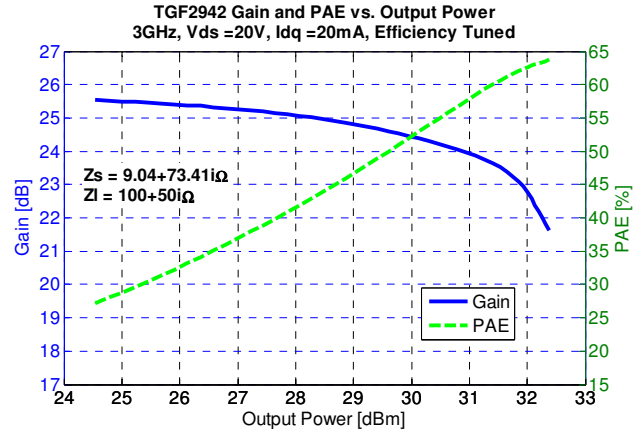
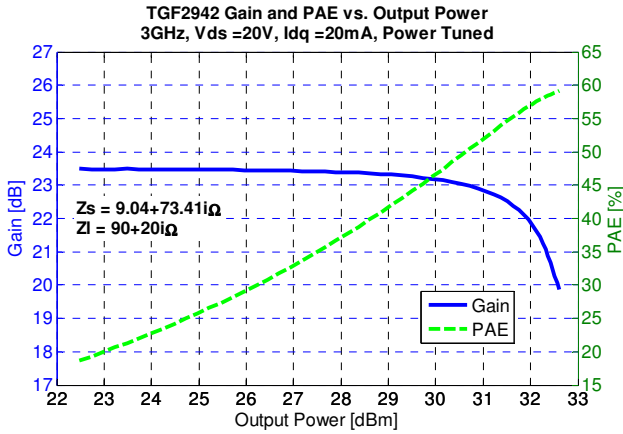
18GHz, Load-pull



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

Notes:

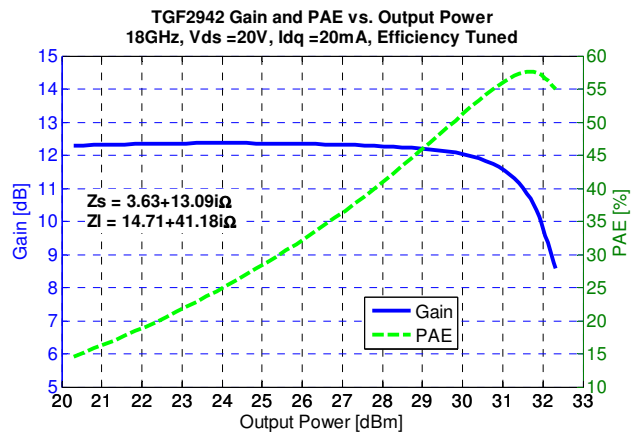
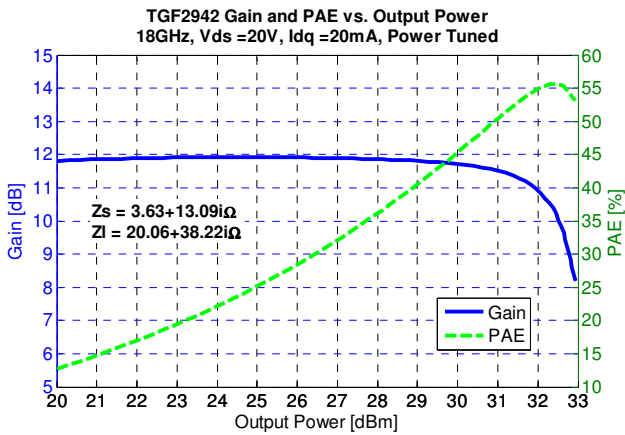
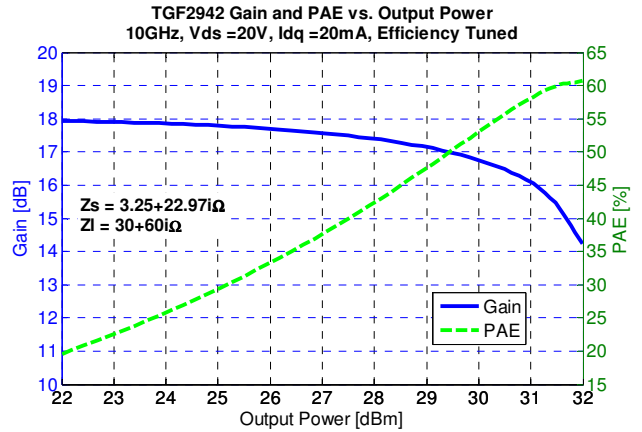
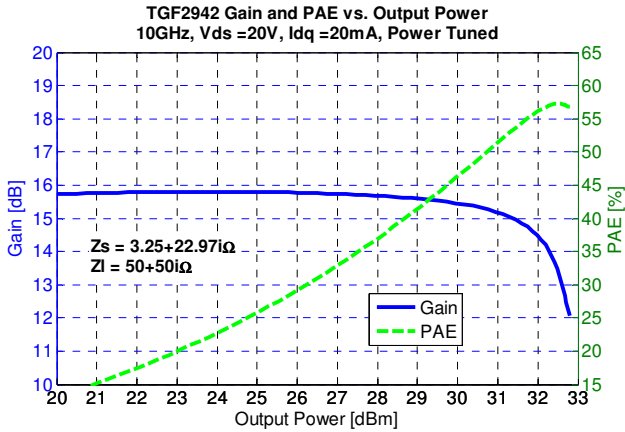
1. CW, Bondwires not included
2. See page 22 for load-pull and source-pull reference planes where the performance was measured.



### 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.

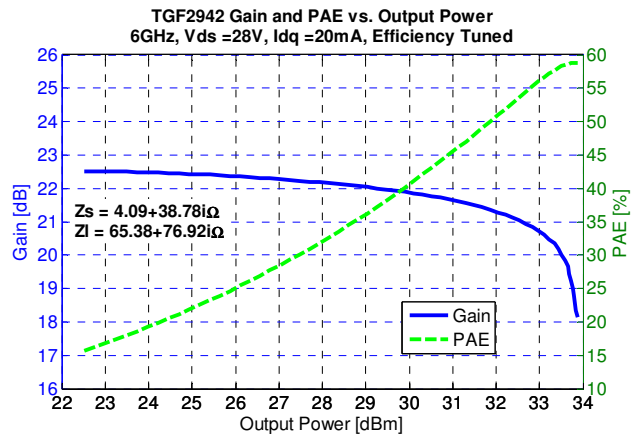
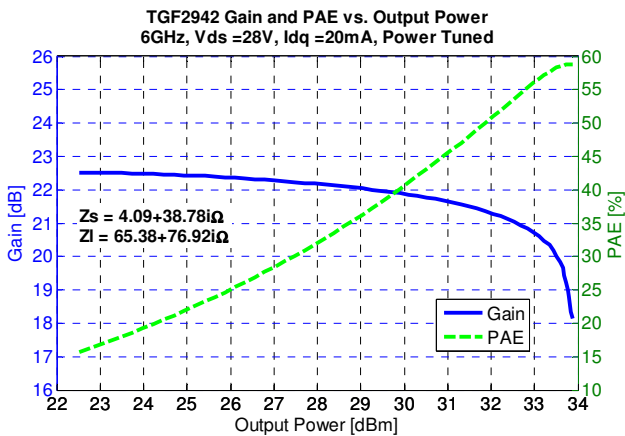
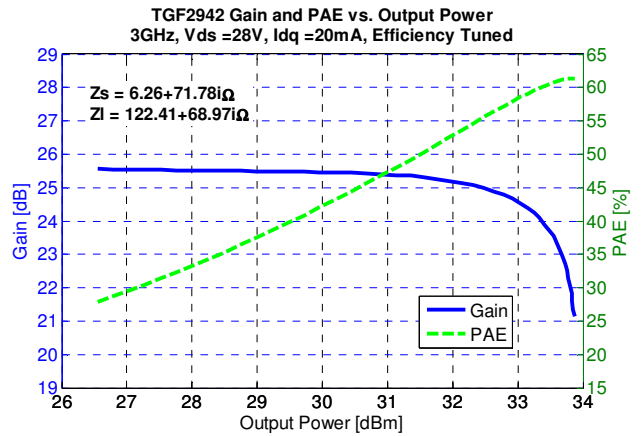
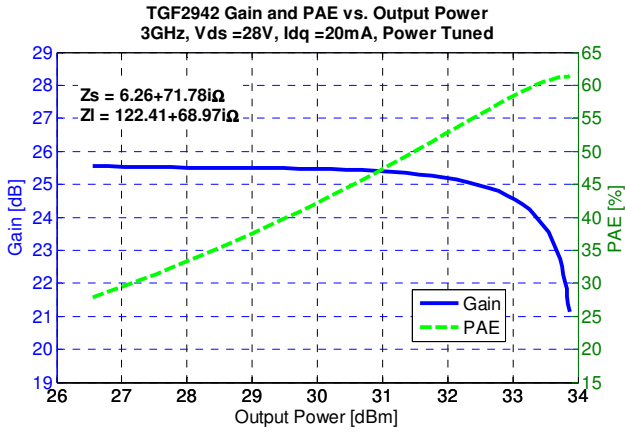




### Typical Model Performance – Load-Pull Drive-up<sup>1, 2</sup>

Notes:

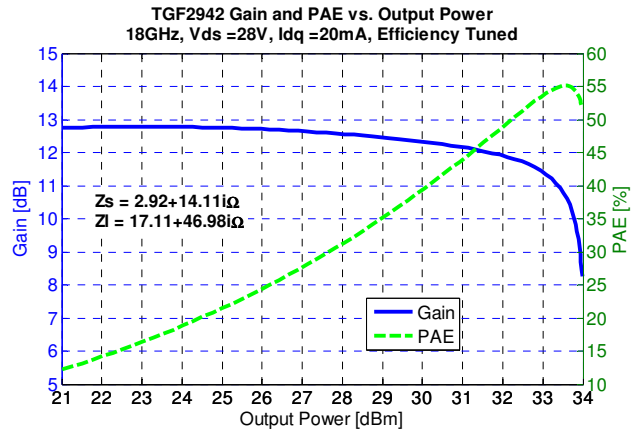
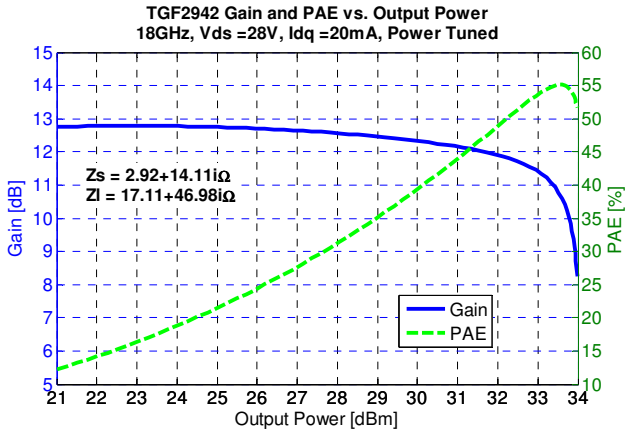
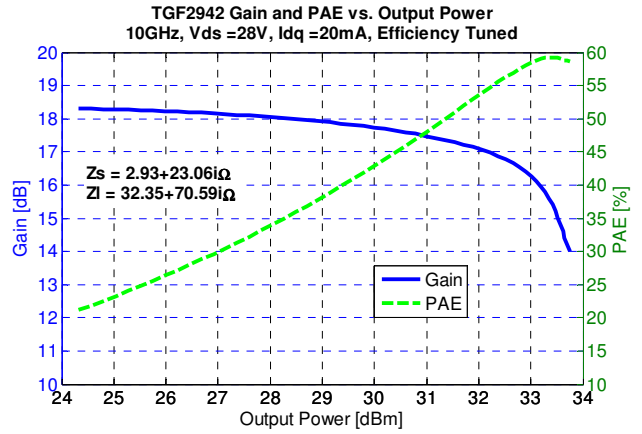
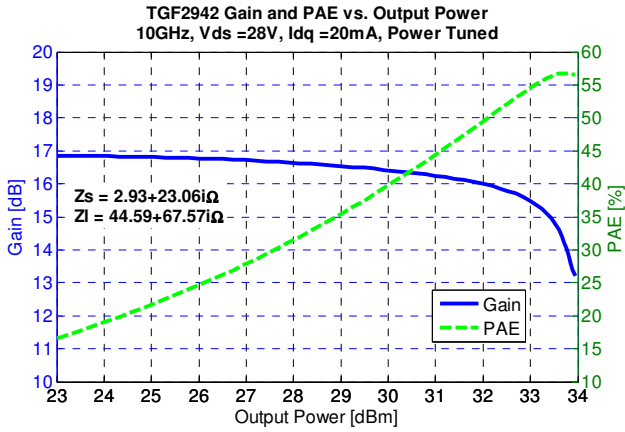
1. CW, Bondwires not included
2. See page 22 for load-pull and source-pull reference planes where the performance was measured.



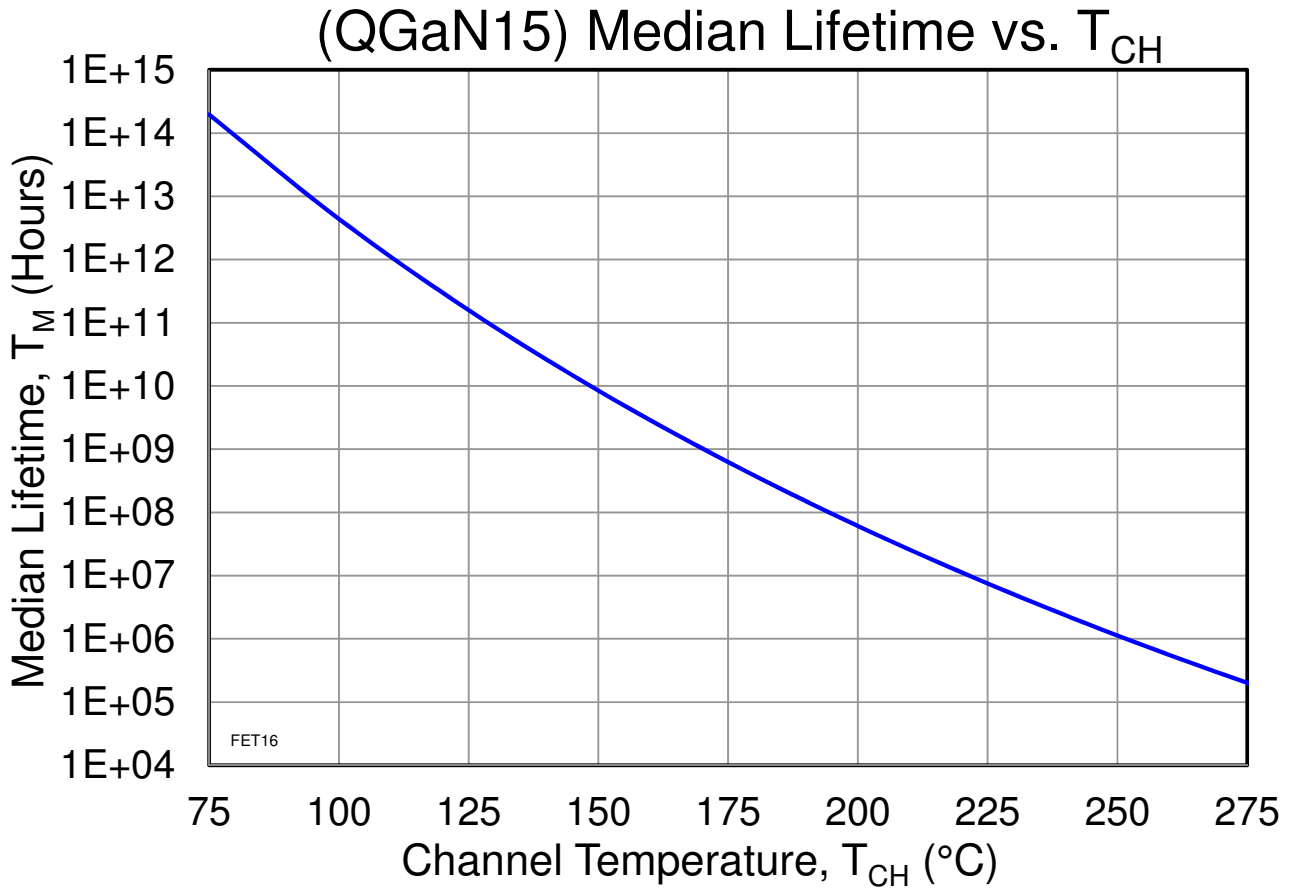
### Typical Model Performance – Load-Pull Drive-up<sup>1,2</sup>

Notes:

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



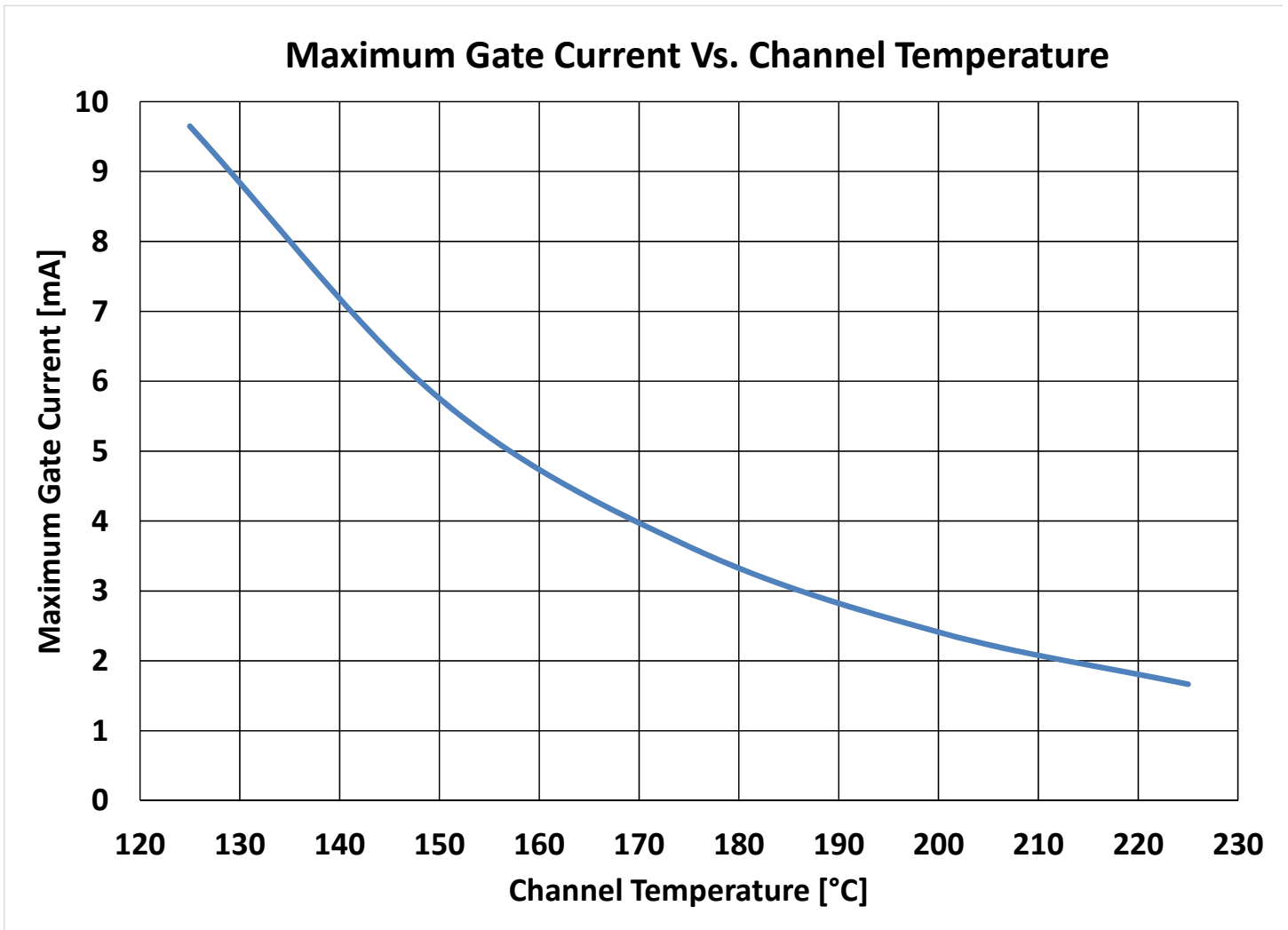
Median Lifetime<sup>1</sup>



Notes:

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

## Maximum Gate Current

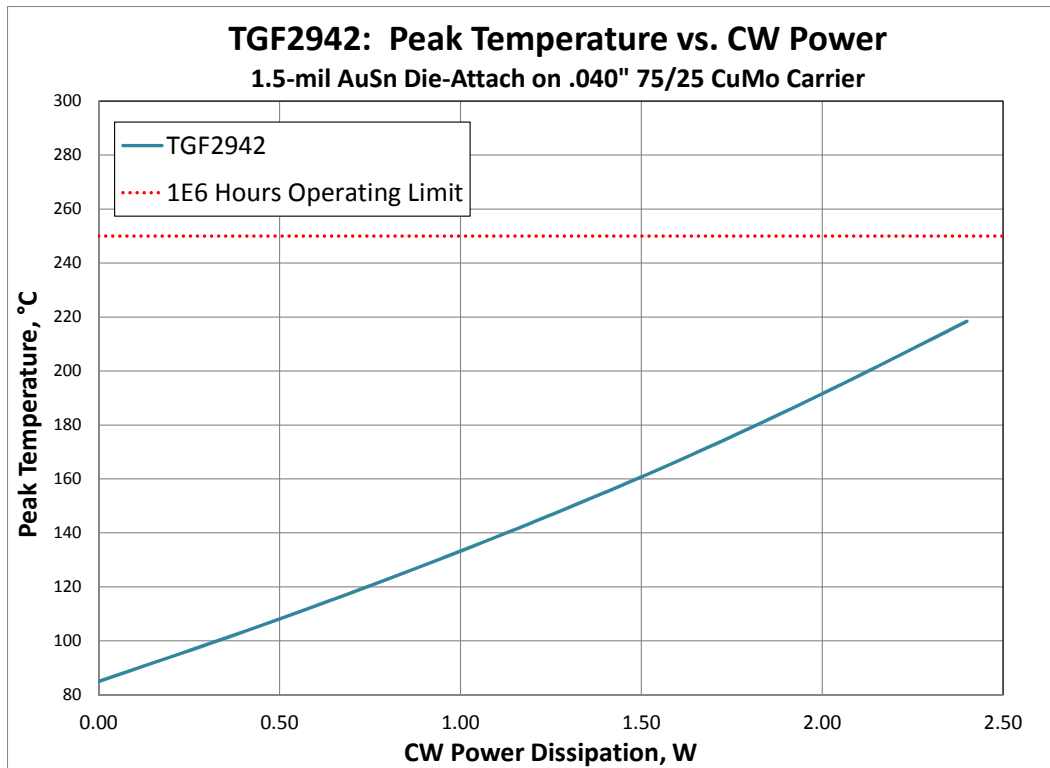


### Thermal and Reliability Information

Parameter	Test Conditions	Value	Units
Thermal Resistance, $\theta_{JC}$ <sup>(1)</sup>	CW	45.0	°C/W
Channel Temperature, $T_{CH}$	$T_{baseplate} = +85\text{ °C}$	103	°C
Median Lifetime, $T_M$	$P_{DISS} = 0.4\text{ W}$	2.9E12	Hrs
Thermal Resistance, $\theta_{JC}$ <sup>(1)</sup>	CW	47.5	°C/W
Channel Temperature, $T_{CH}$	$T_{baseplate} = +85\text{ °C}$	123	°C
Median Lifetime, $T_M$	$P_{DISS} = 0.8\text{ W}$	2.0E11	Hrs
Thermal Resistance, $\theta_{JC}$ <sup>(1)</sup>	CW	49.2	°C/W
Channel Temperature, $T_{CH}$	$T_{baseplate} = +85\text{ °C}$	144	°C
Median Lifetime, $T_M$	$P_{DISS} = 1.2\text{ W}$	1.7E10	Hrs
Thermal Resistance, $\theta_{JC}$ <sup>(1)</sup>	CW	51.3	°C/W
Channel Temperature, $T_{CH}$	$T_{baseplate} = +85\text{ °C}$	167	°C
Median Lifetime, $T_M$	$P_{DISS} = 1.6\text{ W}$	1.4E9	Hrs
Thermal Resistance, $\theta_{JC}$ <sup>(1)</sup>	CW	53.5	°C/W
Channel Temperature, $T_{CH}$	$T_{baseplate} = +85\text{ °C}$	192	°C
Median Lifetime, $T_M$	$P_{DISS} = 2.0\text{ W}$	1.2E8	Hrs
Thermal Resistance, $\theta_{JC}$ <sup>(1)</sup>	CW	55.4	°C/W
Channel Temperature, $T_{CH}$	$T_{baseplate} = +85\text{ °C}$	218	°C
Median Lifetime, $T_M$	$P_{DISS} = 2.4\text{ W}$	1.3E7	Hrs

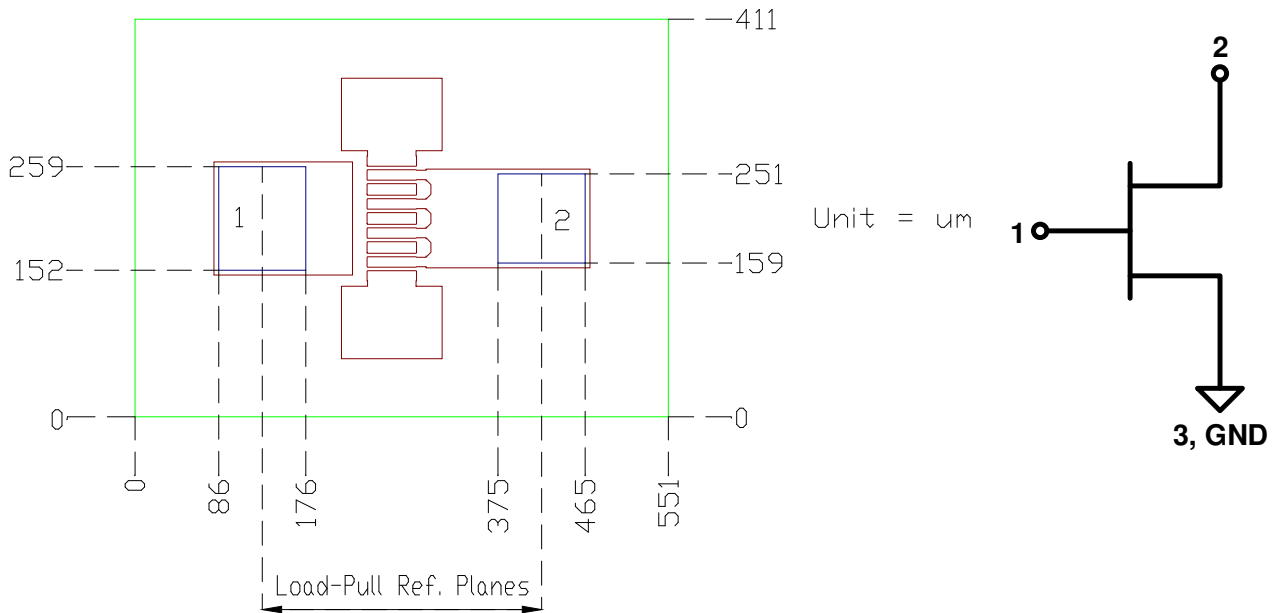
Notes:

1. Thermal resistance measured at back of package.



## Pin Configuration and Description<sup>1</sup>

Notes: 1. Die size tolerance is  $\pm 0.015$  mm.



## Pin Description

Pin	Symbol	Description	Dimension
1	RF IN / $V_G$	Gate	0.107 x 0.090 mm
2	RF OUT / $V_D$	Drain	0.092 x 0.090 mm
3	Source	Source / Ground	0.411 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 25 mA.
3. Slowly adjust  $V_G$  until  $I_D$  reaches 20 mA.
4. Set  $I_D$  limit to 180 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  $V_G$ .