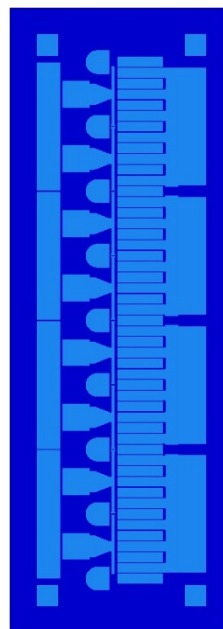


Applications

- Defense & Aerospace
- Broadband Wireless



Product Features

- Frequency Range: DC - 12 GHz
- 47.6 dBm Nominal P_{SAT} at 3 GHz
- 69.7% Maximum PAE at 3 GHz
- 19.3 dB Nominal Power Gain at 3 GHz
- Bias: $V_D = 32 V$, $I_{DQ} = 200 mA$
- Technology: TQGaN25 on SiC
- Chip Dimensions: 1.01 x 2.88 x 0.10 mm

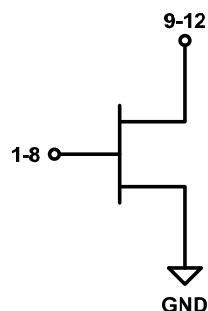
General Description

The TriQuint TGF2956 is a discrete 10.08 mm GaN on SiC HEMT which operates from DC-12 GHz. The TGF2956 is designed using TriQuint's proven TQGaN25 production process. This process features advanced field plate techniques to optimize microwave power and efficiency at high drain bias operating conditions.

The TGF2956 typically provides 47.6 dBm of saturated output power with power gain of 19.3 dB at 3 GHz. The maximum power added efficiency is 69.7 % which makes the TGF2956 appropriate for high efficiency applications.

Lead-free and RoHS compliant.

Functional Block Diagram



Pad Configuration

| Pad No. | Symbol |
|----------|-----------------|
| 1-8 | V_G / RF IN |
| 9-12 | V_D / RF OUT |
| Backside | Source / Ground |

Ordering Information

| Part | ECCN | Description |
|---------|------------|------------------|
| TGF2956 | 3A001b.3.b | 55 Watt GaN HEMT |

Absolute Maximum Ratings

| Parameter | Value |
|-------------------------------------|---------------|
| Drain to Gate Voltage (V_{DG}) | 100 V |
| Drain Voltage (V_D) | 40 V |
| Gate Voltage Range (V_G) | -10 to 0 V |
| Drain Current (I_D) | 6 A |
| Gate Current (I_G) | -10 to 16.8mA |
| CW Power Dissipation (P_D) | 53 W |
| CW Input Power (P_{IN}) @ 10GHz | 40 dBm |
| Channel Temperature (T_{CH}) | 275 °C |
| Mounting Temperature (30 Sec.) | 320 °C |
| Storage Temperature | -65 to 150 °C |

Operation of this device outside the parameter ranges given above may cause permanent damage. These are stress ratings only, and functional operation of the device at these conditions is not implied.

Recommended Operating Conditions

| Parameter | Value |
|---|---------------|
| Drain Voltage Range (V_D) | 32 V |
| Drain Quiescent Current (I_{DQ}) | 200 mA |
| Drain Current Under RF Drive (I_D) ⁽¹⁾ | 3.5 A (Typ.) |
| Pinch-off Gate Voltage (V_G) | -3.5 V (Typ.) |
| Channel Temperature (T_{CH}) | 225 °C (Max.) |

(1) 10% pulses at 3GHz, Power Tuned

RF Characterization – Model Optimum Power Tune

Simulation conditions unless otherwise noted: T = 25 °C, Bond wires not included, Pulse: 100uS PW, 10%. See page 17 for reference planes.

| Parameter | Typical Value | | | | | Units |
|--|---------------|------------|------------|------------|------------|-------|
| | 1 | 3 | 6 | 10 | 15 | |
| Frequency (F) | 1 | 3 | 6 | 10 | 15 | GHz |
| Drain Voltage (V _D) | 32 | 32 | 32 | 32 | 32 | V |
| Bias Current (I _{DQ}) | 200 | 200 | 200 | 200 | 200 | mA |
| Output P3dB (P _{3dB}) | 47.6 | 47.6 | 47.6 | 47.7 | 47.3 | dBm |
| PAE @ P _{3dB} (PAE _{3dB}) | 65.5 | 63.5 | 58.6 | 53.8 | 44.9 | % |
| Gain @ P3dB (G _{3dB}) | 26.5 | 19.3 | 14.3 | 10.6 | 7.5 | dB |
| Parallel Output Resistance ⁽¹⁾ (R _p) | 98.7 | 95.3 | 85.2 | 71.4 | 40.9 | Ω·mm |
| Parallel Output Capacitance ⁽¹⁾ (C _p) | -0.063 | 0.137 | 0.208 | 0.222 | 0.239 | pF/mm |
| Load Impedance (ZL) | 9.78-j0.38 | 8.92+j2.19 | 5.85+j3.90 | 3.50+j3.53 | 2.18+j2.02 | Ω |
| Source Impedance (ZS) | 1.24+j9.36 | 0.57+j3.05 | 0.55+j1.22 | 0.47+j0.28 | 0.44-j0.42 | Ω |

Notes:

1. Large signal equivalent output network (normalized).

RF Characterization – Model Optimum Efficiency Tune

Simulation conditions unless otherwise noted: T = 25 °C, Bond wires not included, Pulse: 100uS PW, 10%. See page 17 for reference planes.

| Parameter | Typical Value | | | | | Units |
|--|---------------|------------|------------|------------|------------|-------|
| | 1 | 3 | 6 | 10 | 15 | |
| Frequency (F) | 1 | 3 | 6 | 10 | 15 | GHz |
| Drain Voltage (V _D) | 32 | 32 | 32 | 32 | 32 | V |
| Bias Current (I _{DQ}) | 200 | 200 | 200 | 200 | 200 | mA |
| Output P3dB (P _{3dB}) | 46.1 | 46.2 | 46.2 | 47.1 | 47.1 | dBm |
| PAE @ P _{3dB} (PAE _{3dB}) | 71.5 | 69.7 | 64.4 | 56.4 | 46.1 | % |
| Gain @ P3dB (G _{3dB}) | 27.8 | 20.8 | 15.2 | 11.0 | 7.9 | dB |
| Parallel Output Resistance ⁽¹⁾ (R _p) | 173.5 | 159 | 146.6 | 100.6 | 47.3 | Ω·mm |
| Parallel Output Capacitance ⁽¹⁾ (C _p) | 0.294 | 0.283 | 0.283 | 0.277 | 0.251 | pF/mm |
| Load Impedance (ZL) | 15.6+j5.02 | 9.17+j7.78 | 4.22+j6.60 | 2.71+j4.12 | 2.07+j2.32 | Ω |
| Source Impedance (ZS) | 1.24+j9.36 | 0.57+j3.05 | 0.55+j1.22 | 0.47+j0.28 | 0.44-j0.42 | Ω |

Notes:

1. Large signal equivalent output network (normalized).

Thermal and Reliability Information - Pulsed ⁽¹⁾

| Parameter | Test Conditions | Value | Units |
|-----------------------------------|--|---------|--------------------|
| Thermal Resistance, θ_{JC} | $P_D = 40.3$ W, $T_{baseplate} = 85^\circ\text{C}$ Pulse: 100 μs , 5% | 1.92 | $^\circ\text{C/W}$ |
| Channel Temperature, T_{CH} | | 162.5 | $^\circ\text{C}$ |
| Median Lifetime, T_M | | 6.36E08 | Hrs |
| Thermal Resistance, θ_{JC} | $P_D = 40.3$ W, $T_{baseplate} = 85^\circ\text{C}$ Pulse: 100 μs , 10% | 2.02 | $^\circ\text{C/W}$ |
| Channel Temperature, T_{CH} | | 166.6 | $^\circ\text{C}$ |
| Median Lifetime, T_M | | 4.11E08 | Hrs |
| Thermal Resistance, θ_{JC} | $P_D = 40.3$ W, $T_{baseplate} = 85^\circ\text{C}$ Pulse: 100 μs , 20% | 2.24 | $^\circ\text{C/W}$ |
| Channel Temperature, T_{CH} | | 175.3 | $^\circ\text{C}$ |
| Median Lifetime, T_M | | 1.63E08 | Hrs |
| Thermal Resistance, θ_{JC} | $P_D = 40.3$ W, $T_{baseplate} = 85^\circ\text{C}$ Pulse: 100 μs , 50% | 2.93 | $^\circ\text{C/W}$ |
| Channel Temperature, T_{CH} | | 202.9 | $^\circ\text{C}$ |
| Median Lifetime, T_M | | 1.20E07 | Hrs |

Notes:

- Assumes eutectic attach using 1mil thick 80/20 AuSn mounted to a 10 mil CuMo Carrier Plate.

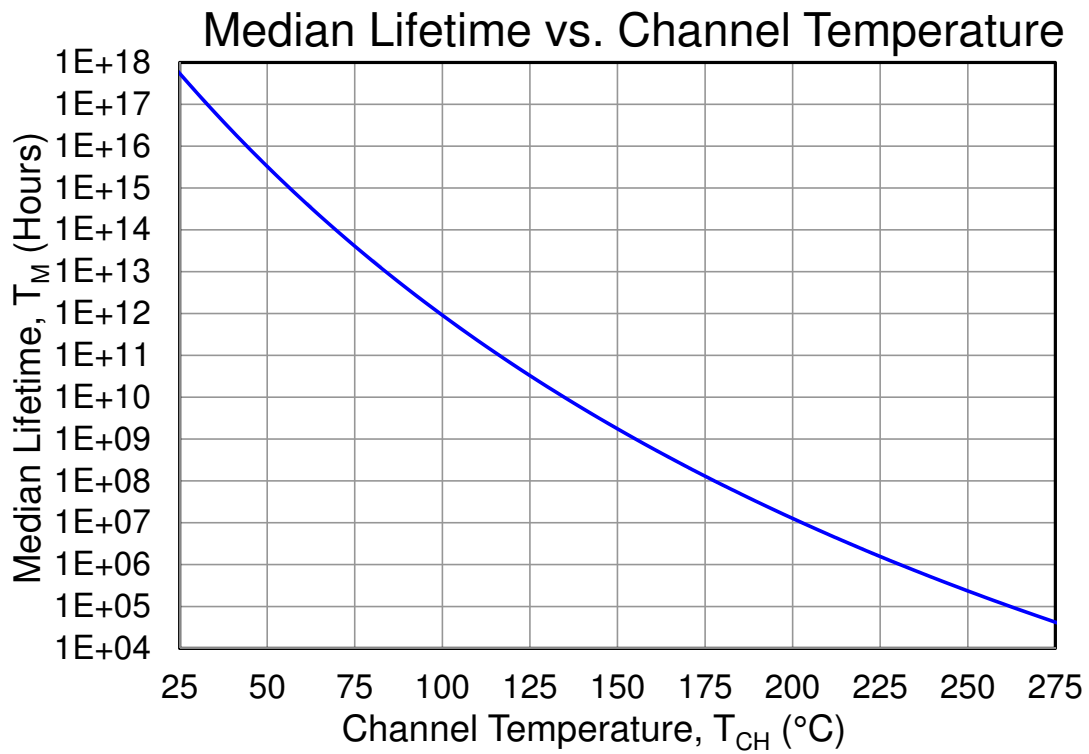
Thermal and Reliability Information - CW⁽¹⁾

| Parameter | Test Conditions | Value | Units |
|-----------------------------------|--|---------|--------------------|
| Thermal Resistance, θ_{JC} | $P_D = 10.1$ W, $T_{baseplate} = 85^\circ\text{C}$ CW | 3.47 | $^\circ\text{C/W}$ |
| Channel Temperature, T_{CH} | | 120 | $^\circ\text{C}$ |
| Median Lifetime, T_M | | 9.51E10 | Hrs |
| Thermal Resistance, θ_{JC} | $P_D = 20.2$ W, $T_{baseplate} = 85^\circ\text{C}$ CW | 3.66 | $^\circ\text{C/W}$ |
| Channel Temperature, T_{CH} | | 159 | $^\circ\text{C}$ |
| Median Lifetime, T_M | | 9.24E08 | Hrs |
| Thermal Resistance, θ_{JC} | $P_D = 30.2$ W, $T_{baseplate} = 85^\circ\text{C}$ CW | 3.94 | $^\circ\text{C/W}$ |
| Channel Temperature, T_{CH} | | 204 | $^\circ\text{C}$ |
| Median Lifetime, T_M | | 1.09E07 | Hrs |
| Thermal Resistance, θ_{JC} | $P_D = 40.3$ W, $T_{baseplate} = 85^\circ\text{C}$ CW | 4.29 | $^\circ\text{C/W}$ |
| Channel Temperature, T_{CH} | | 258 | $^\circ\text{C}$ |
| Median Lifetime, T_M | | 1.46E05 | Hrs |

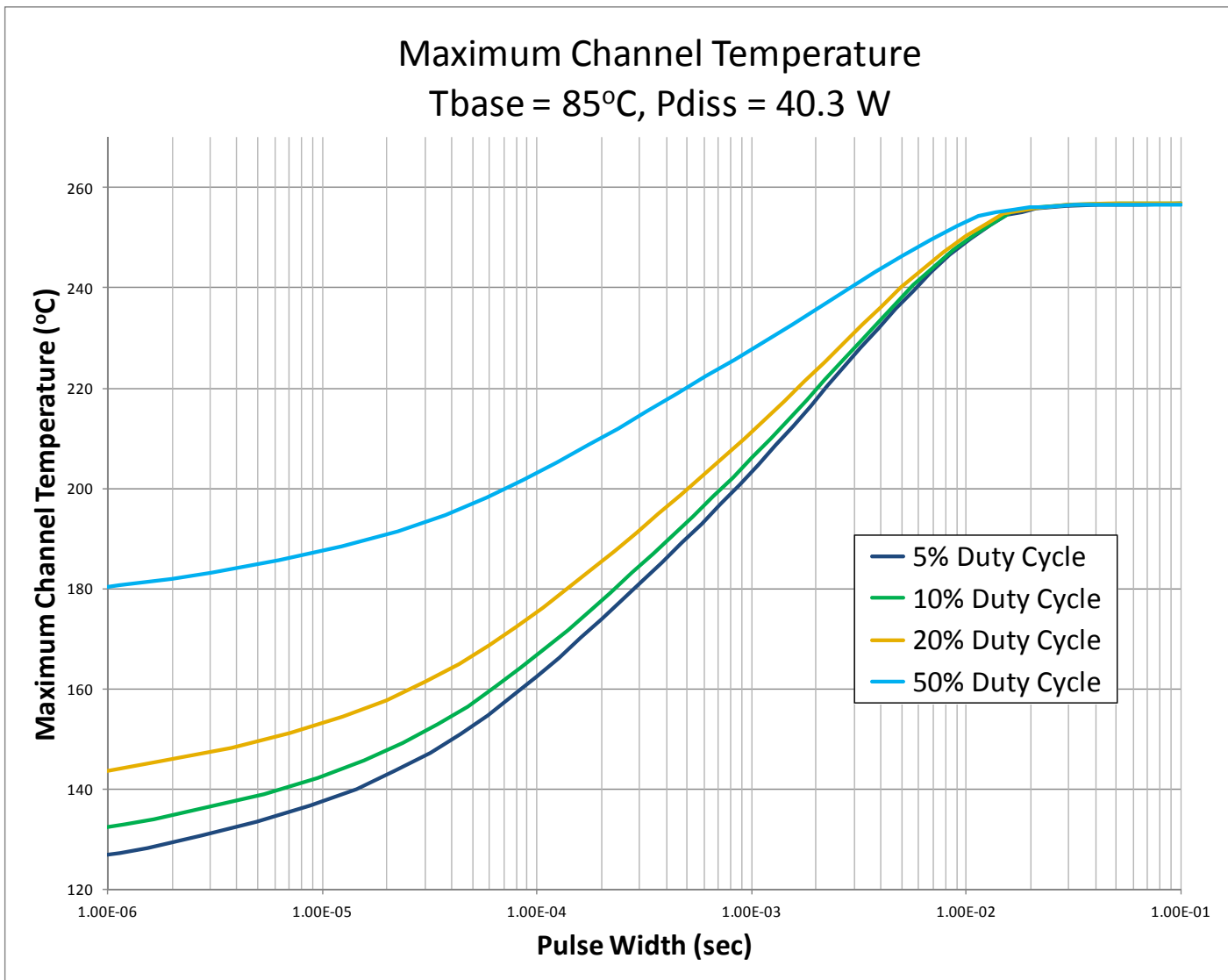
Notes:

- Assumes eutectic attach using 1mil thick 80/20 AuSn mounted to a 10 mil CuMo Carrier Plate.

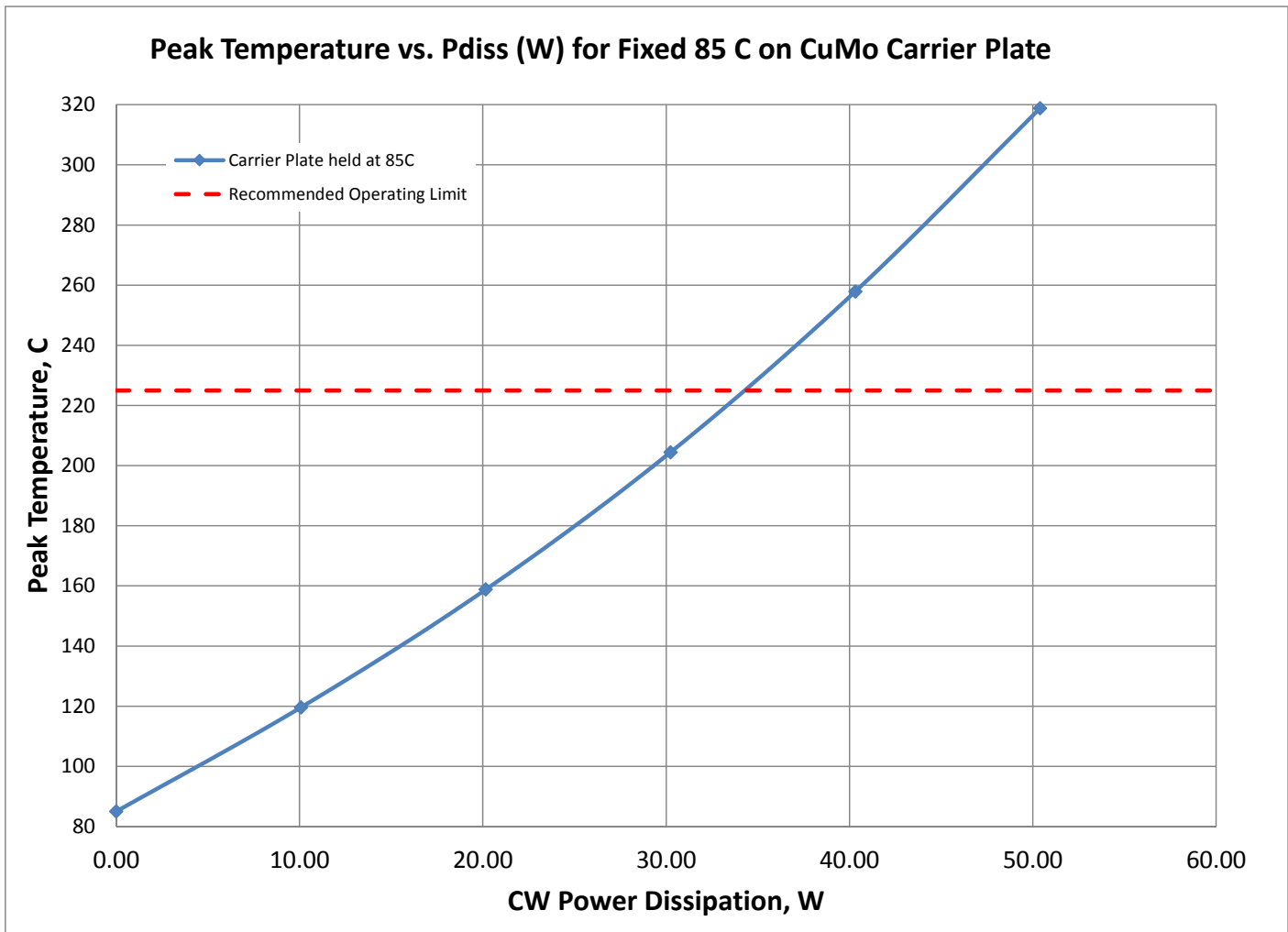
Median LifeTime



Maximum Channel Temperature – Pulsed



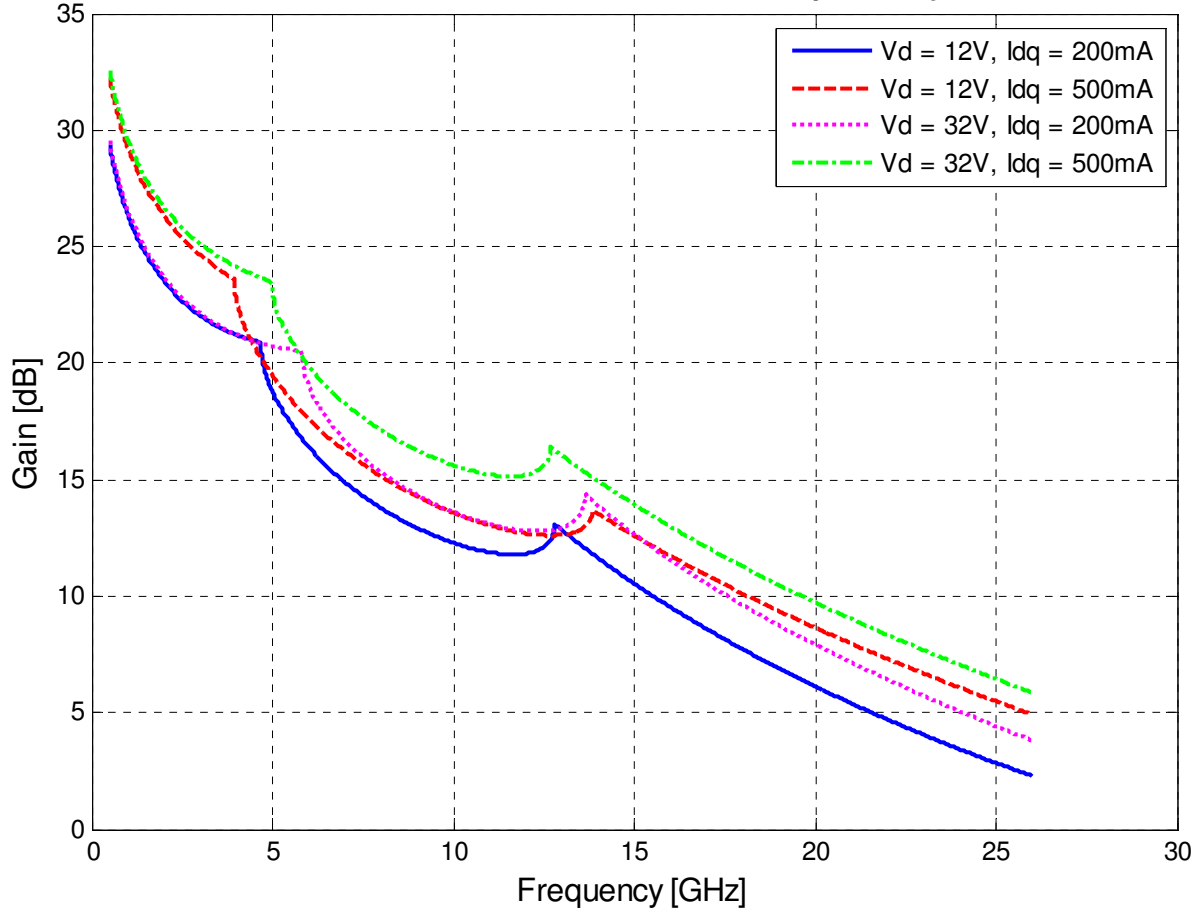
Maximum Channel Temperature – CW



Model Maximum Gain Performance

Bondwires not included. See page 17 for reference planes.

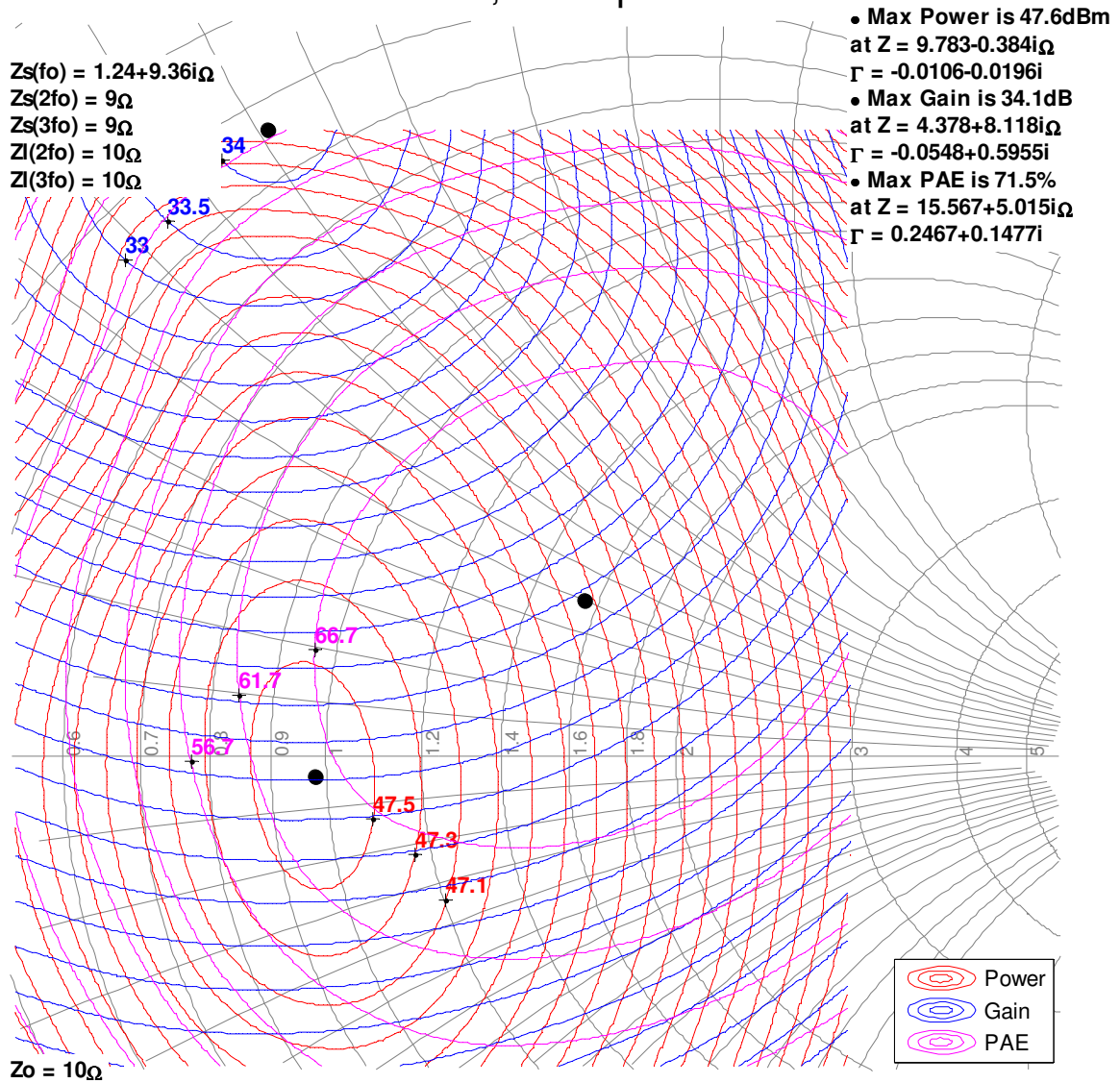
Maximum Gain vs. Frequency



Model Load Pull Contours

Vds = 32V, Idq = 200mA. 3dB compression referenced to peak gain.
 Simulated signal: 10% pulses. Bond wires not included. See page 17 for reference planes.

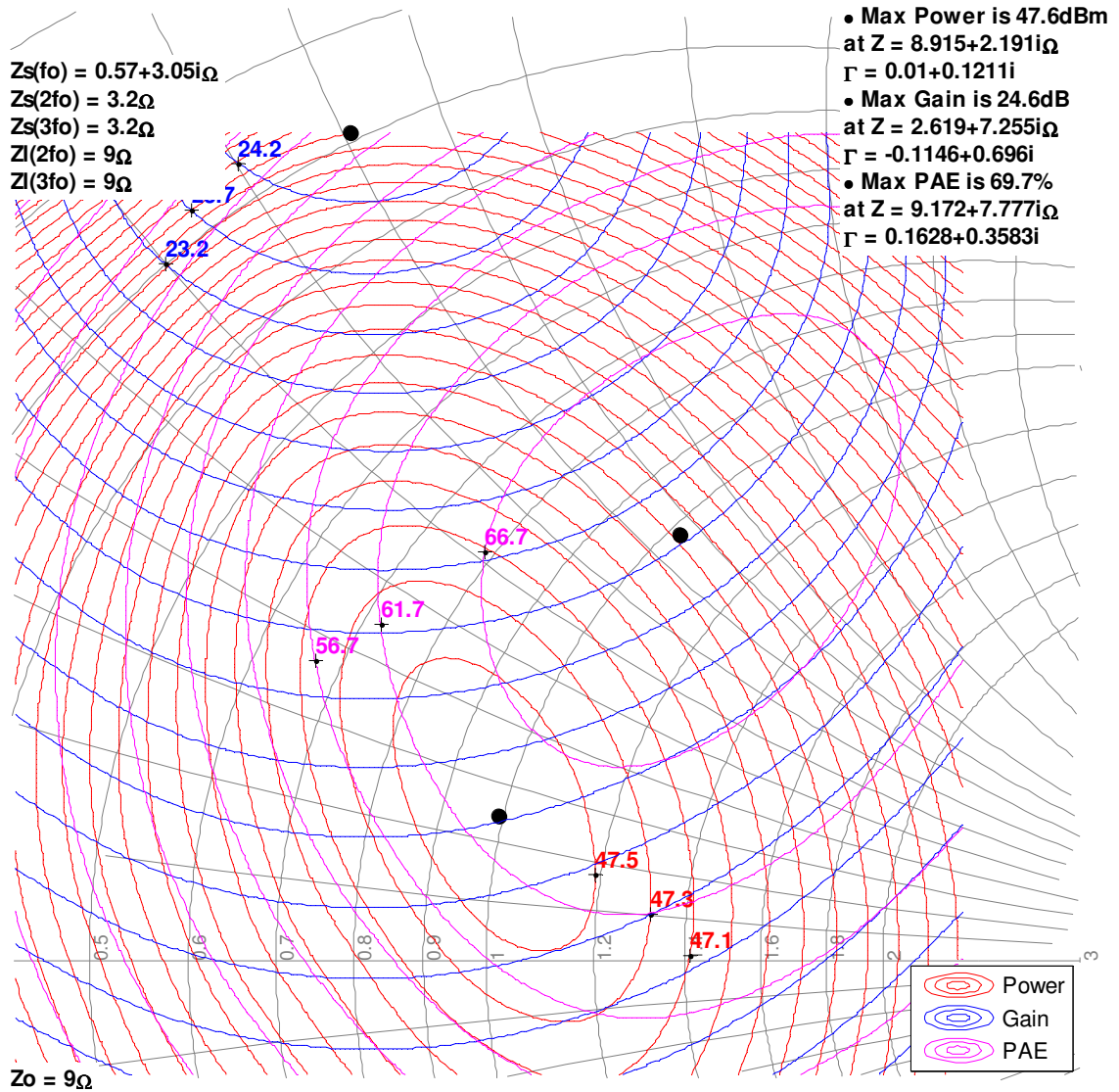
1GHz, Load-pull



Model Load Pull Contours

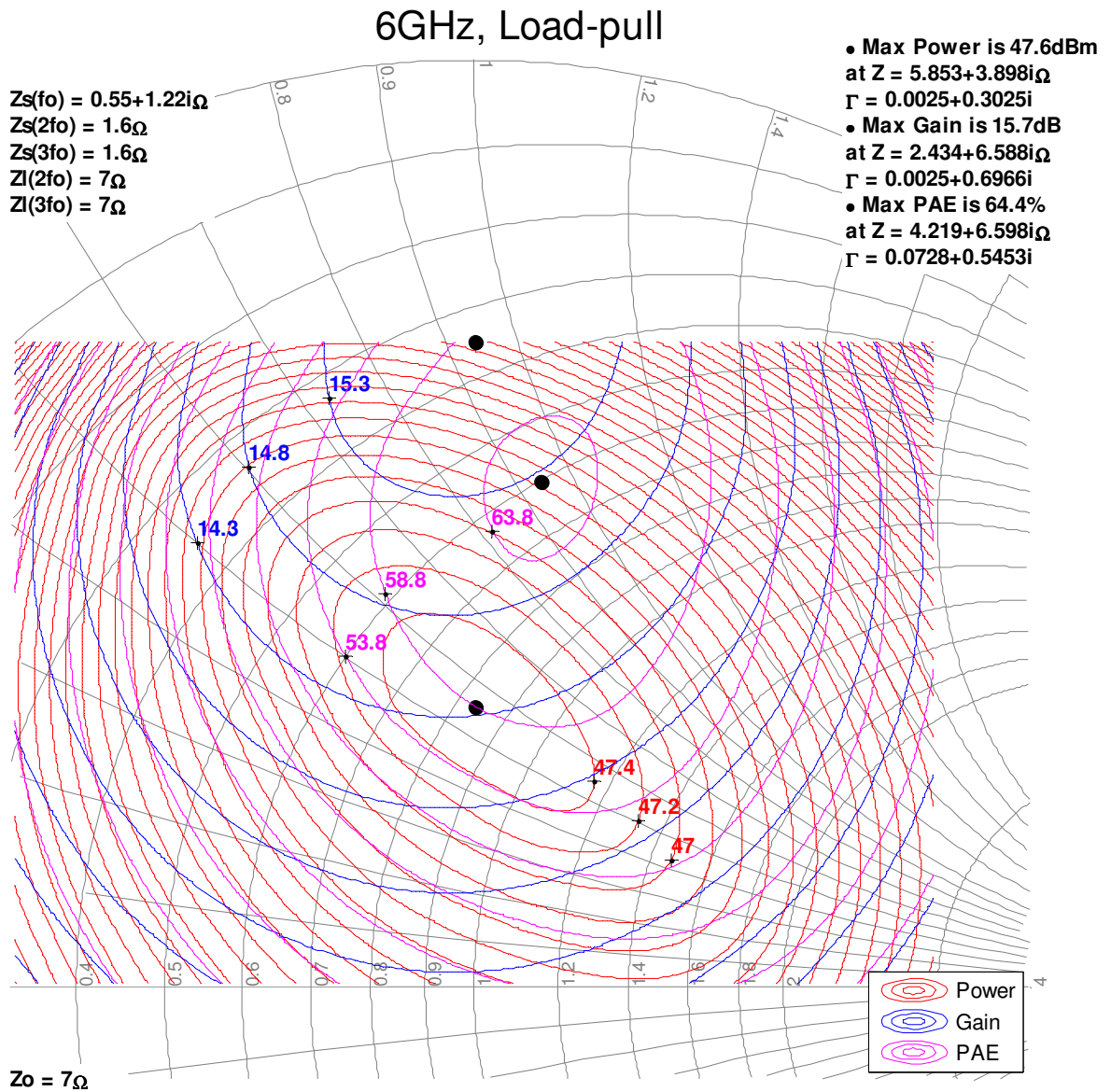
Vds = 32V, Idq = 200mA. 3dB compression referenced to peak gain.
 Simulated signal: 10% pulses. Bond wires not included. See page 17 for reference planes.

3GHz, Load-pull



Model Load Pull Contours

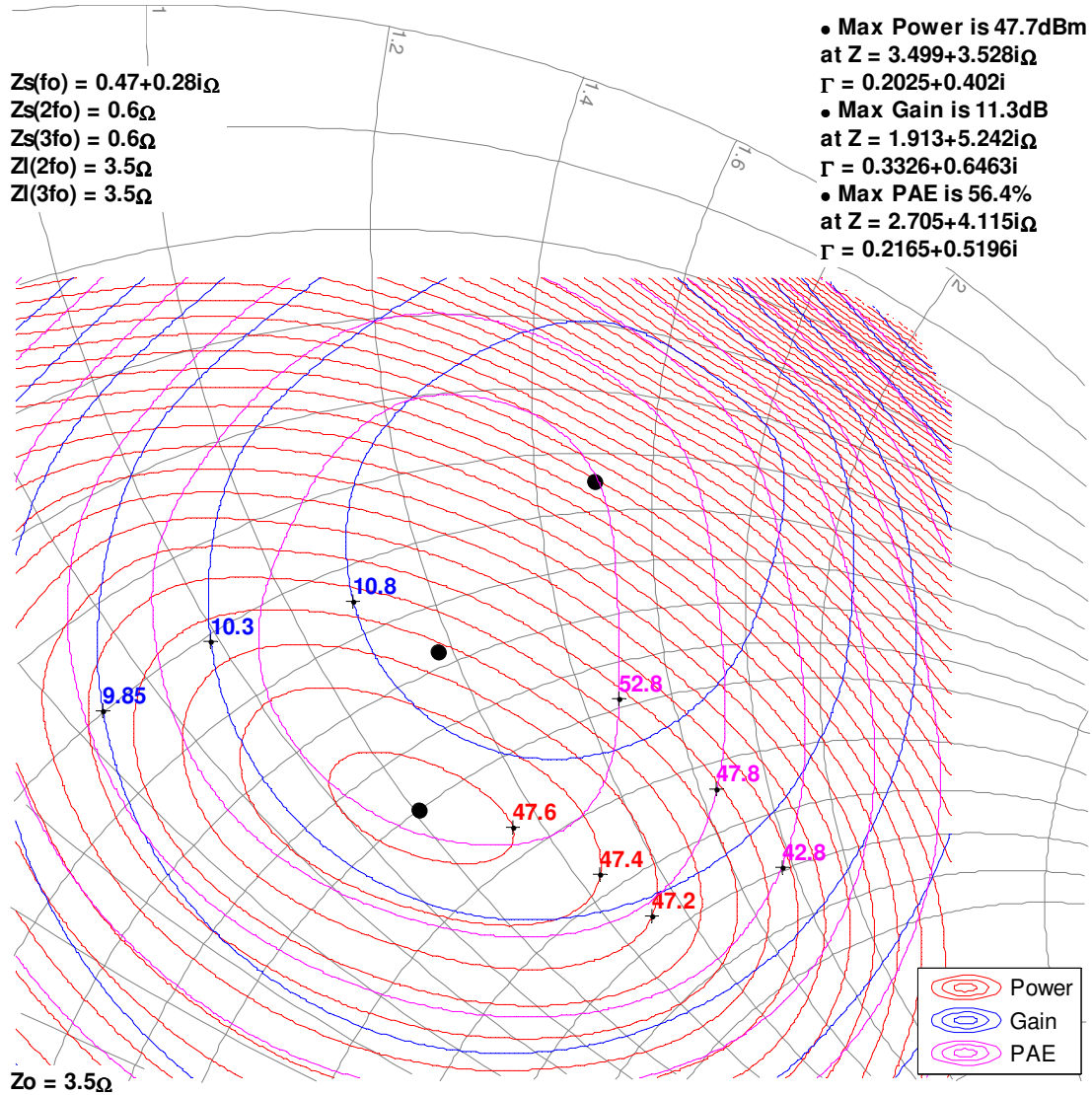
Vds = 32V, Idq = 200mA. 3dB compression referenced to peak gain.
 Simulated signal: 10% pulses. Bond wires not included. See page 17 for reference planes.



Model Load Pull Contours

Vds = 32V, Idq = 200mA. 3dB compression referenced to peak gain.
 Simulated signal: 10% pulses. Bond wires not included. See page 17 for reference planes.

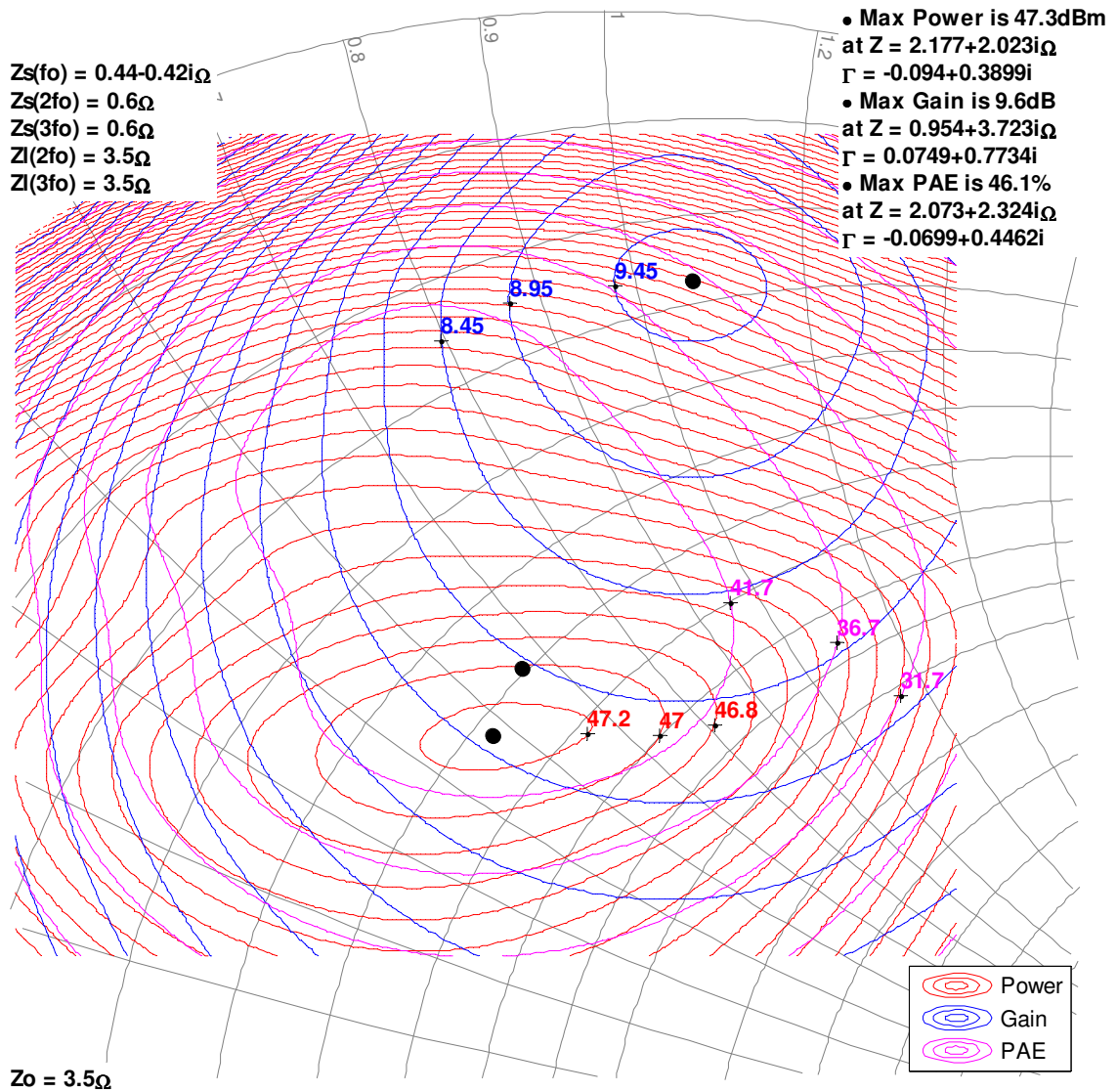
10GHz, Load-pull



Model Load Pull Contours

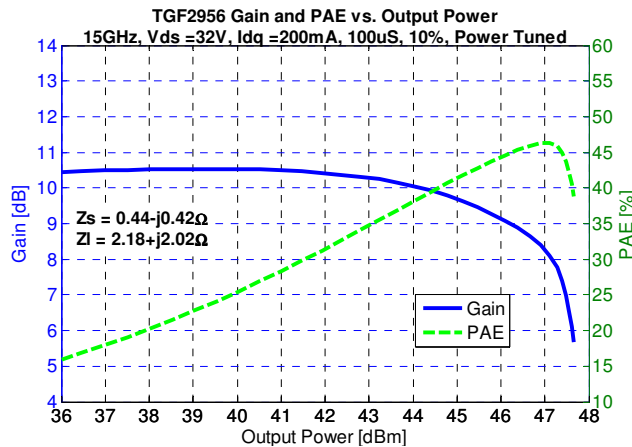
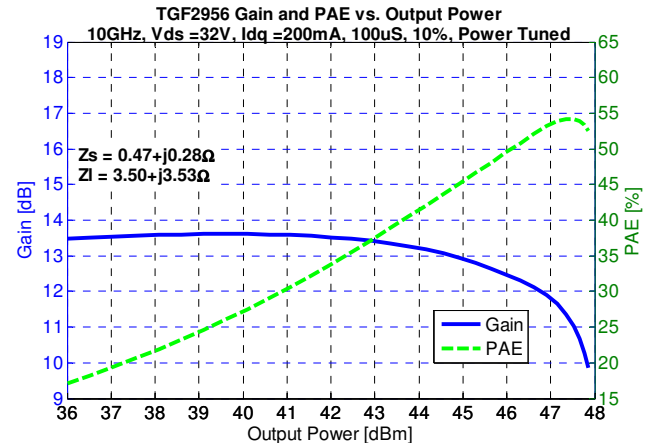
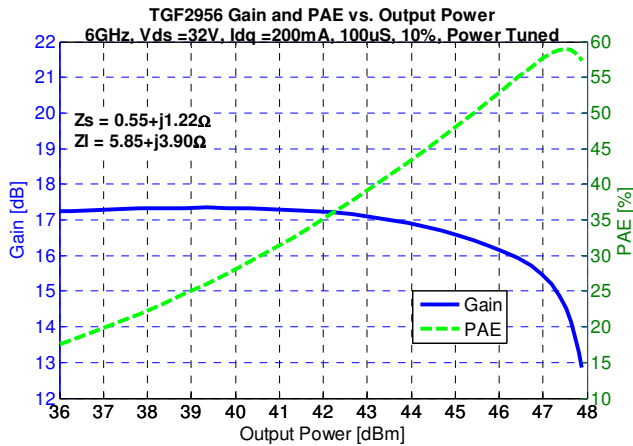
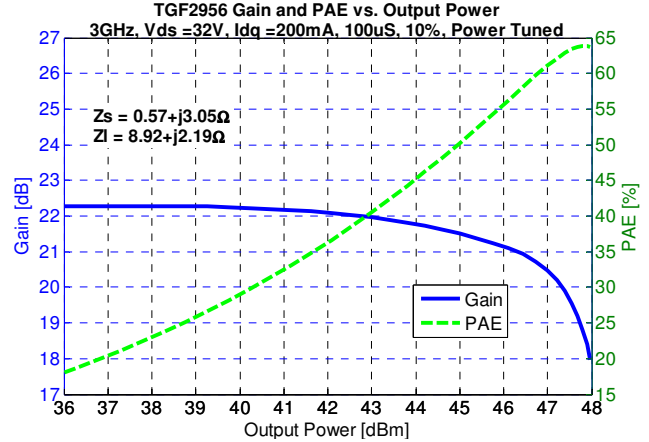
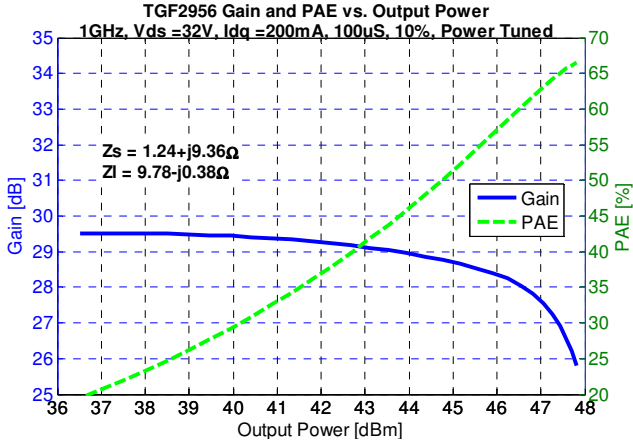
Vds = 32V, Idq = 200mA. 3dB compression referenced to peak gain.
 Simulated signal: 10% pulses. Bond wires not included. See page 17 for reference planes.

15GHz, Load-pull



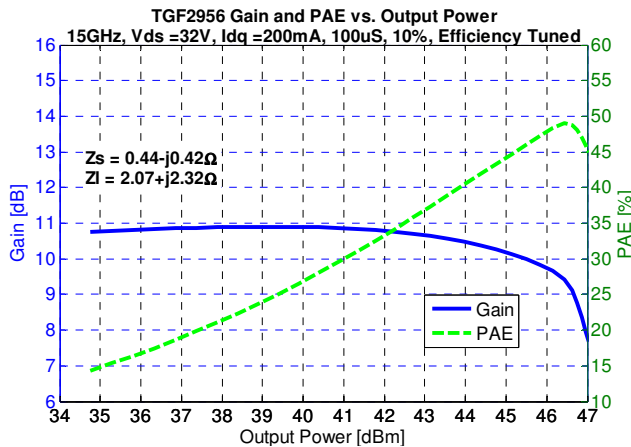
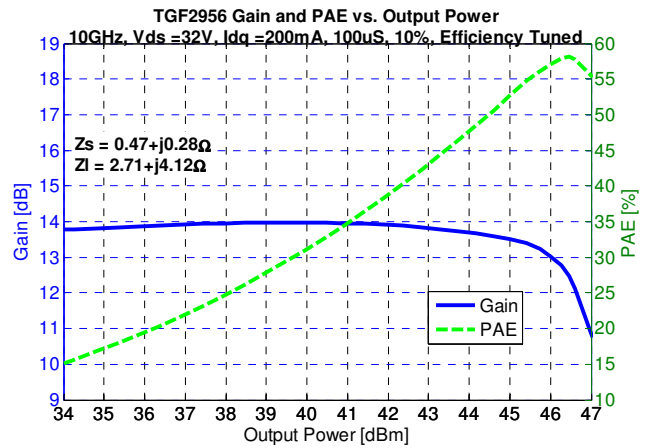
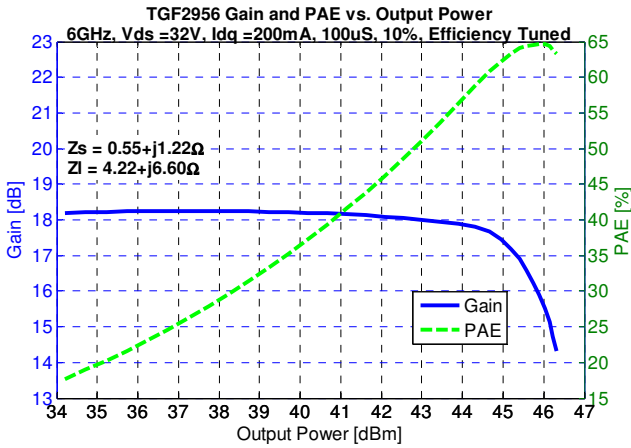
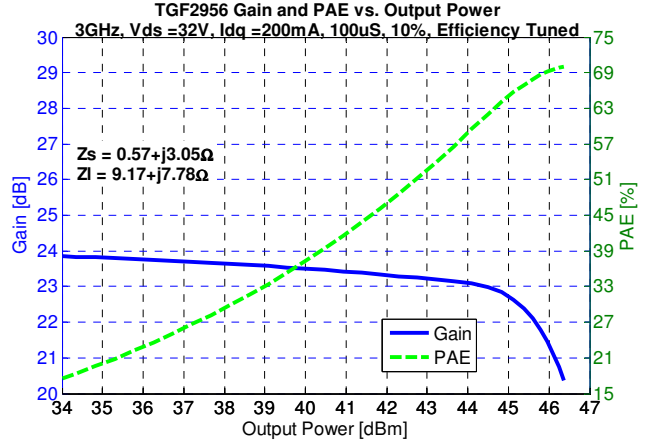
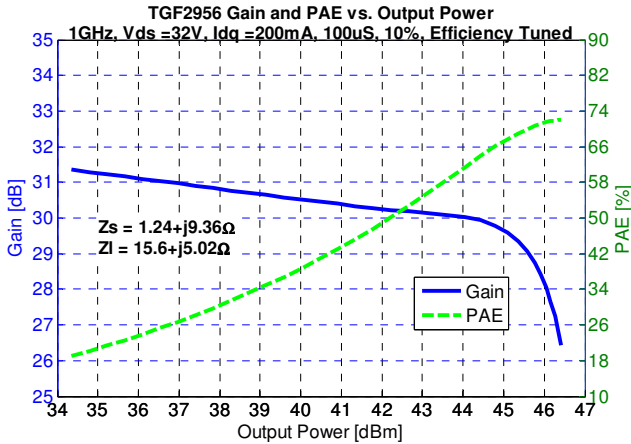
Model Power Tuned Data

Bond wires not included. See page 17 for reference planes.

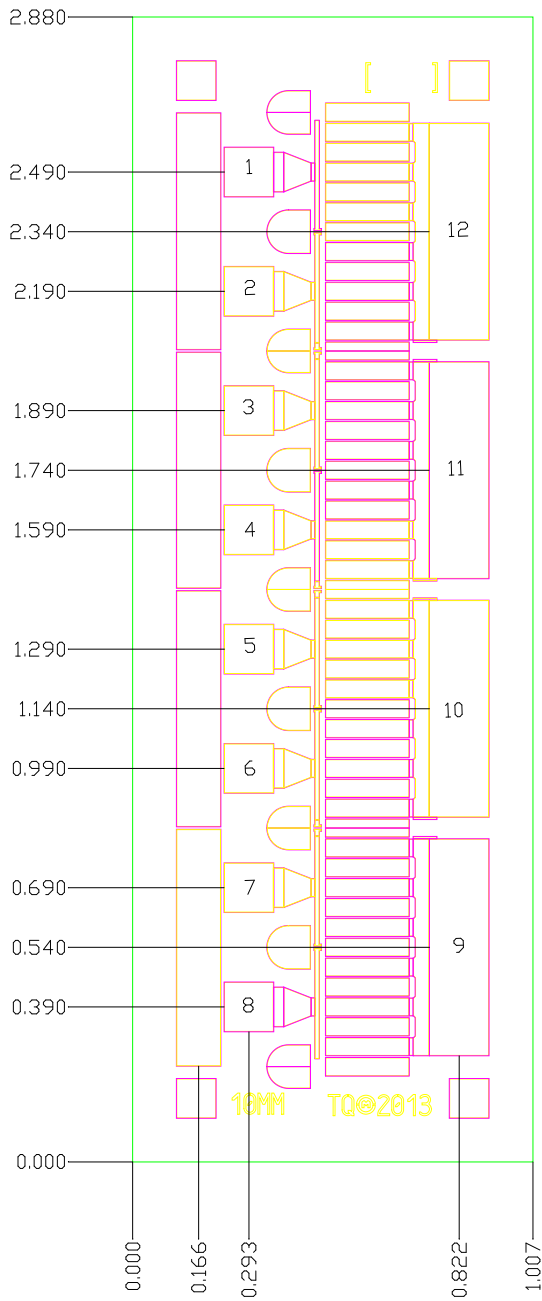


Model Efficiency Tuned Data

Bond wires not included. See page 17 for reference planes.



Mechanical Drawing

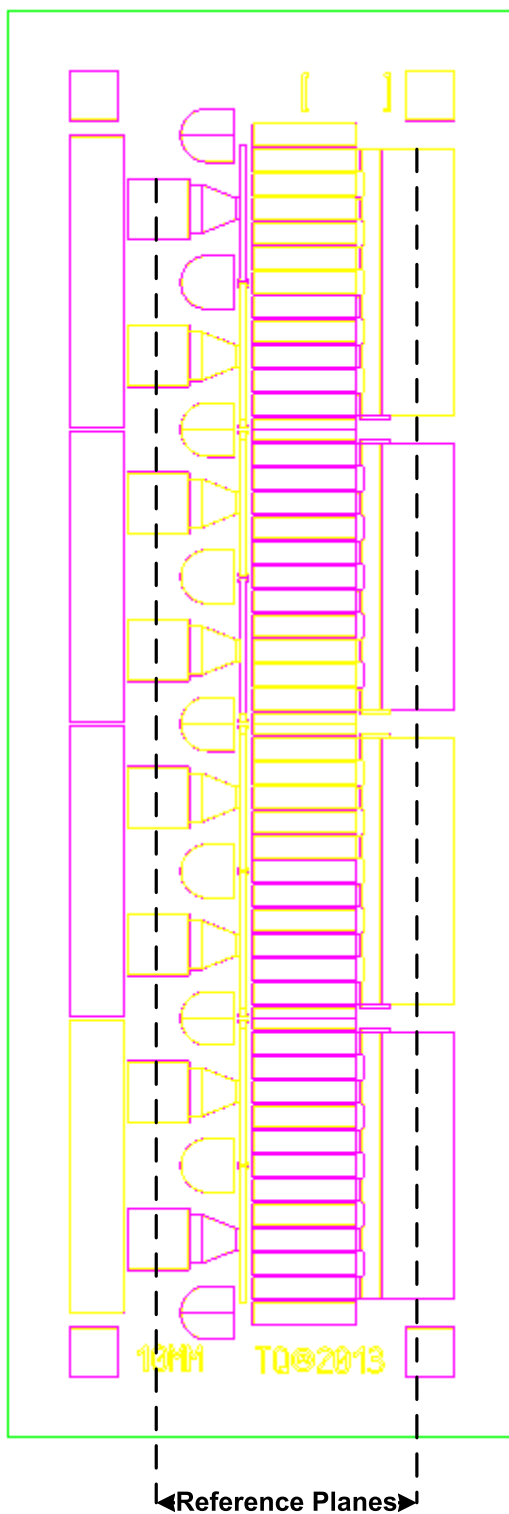


Bond Pads

| Pad No. | Description | Dimensions |
|------------------------|-----------------|---------------|
| 1, 2, 3, 4, 5, 6, 7, 8 | Gate | 0.125 x 0.125 |
| 9, 10, 11, 12 | Drain | 0.150 x 0.546 |
| Die Backside | Source / Ground | 1.007 x 2.880 |

1. Units: millimeters
2. Thickness: 0.100 mm
3. Die xy size tolerance: ± 0.050 mm

Reference Planes



Model

A model is available for download from Modelithics (at <http://www.modelithics.com/mvp/Triqunt&tab=3>) by approved TriQuint customers. The model is compatible with the industry's most popular design software including Agilent ADS and National Instruments/AWR applications. Once on the Modelithics web page, the user will need to register for a free license before being granted the download.

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. V_G set to -5 V.
2. V_D set to 32 V.
3. Adjust V_G more positive until quiescent I_D is 200 mA.
4. Apply RF signal.

Bias-down Procedure

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

Product Compliance Information

ESD Sensitivity Ratings



Caution! ESD-Sensitive Device

ESD Rating: TBD
Value: TBD
Test: TBD
Standard: TBD

Solderability

Compatible with gold/tin (320°C maximum reflow temperature) soldering processes.

RoHS Compliance

This part is compliant with EU 2002/95/EC RoHS directive (Restrictions on the Use of Certain Hazardous Substances in Electrical and Electronic Equipment).

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 TriQuint:

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Email: info-sales@triquint.com

Tel: +1.972.994.8465
Fax: +1.972.994.8504

For technical questions and application information: Email: info-products@triquint.com

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