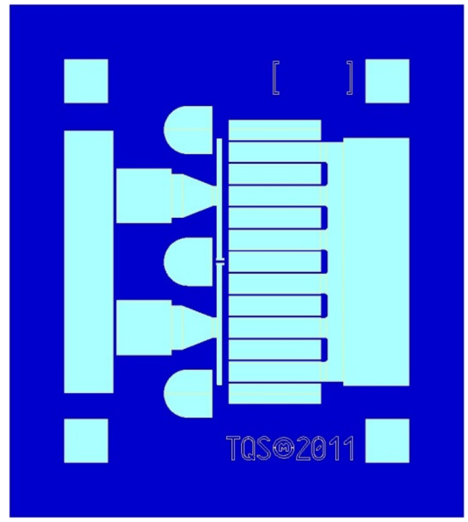
Applications

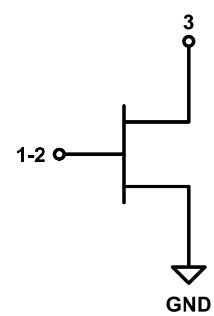
- Marine radar
- Satellite communications
- Point to point communications
- Military communications
- Broadband amplifiers
- High efficiency amplifiers



Product Features

- Frequency Range: DC - 12 GHz
- 41.2 dBm Nominal P_{SAT} at 3.5 GHz
- 73.7% Maximum PAE at 3.5 GHz
- 18.2 dB Nominal Power Gain at 3.5 GHz
- Bias: V_D = 32 V, I_{DQ} = 50 mA
- Technology: TQGaN25 on SiC
- Chip Dimensions: 1.01 x 1.14 x 0.10 mm

Functional Block Diagram



General Description

The TriQuint TGF2953 is a discrete 2.52 mm GaN on SiC HEMT which operates from DC-12 GHz. The TGF2953 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 TGF2953 typically provides 41.2 dBm of saturated output power with power gain of 18.2 dB at 3.5 GHz. The maximum power added efficiency is 73.7 % which makes the TGF2953 appropriate for high efficiency applications.

Lead-free and RoHS compliant.

Pad Configuration

Pad No.	Symbol
1-2	V_G / RF IN
3	V_D / RF OUT
Backside	Source / Ground

Ordering Information

Part	ECCN	Description
TGF2953	EAR99	12 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)	1.5 A
Gate Current (I_G)	-2.52 to 4.2mA
Power Dissipation (P_D)	17 W
CW Input Power (P_{IN}) @ 10GHz	34 dBm
Channel Temperature (T_{CH})	275℃
Mounting Temperature (30 Sec.)	320℃
Storage Temperature	–65 to 150℃

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})	50 mA
Drain Current Under RF Drive (I_D)(1)	820 mA
Pinch-off Gate Voltage (V_G)	–3.5 V (Typ.)
Channel Temperature (T_{CH})	225℃ (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 19 for reference planes.

Parameter	Typical Value					Units
Frequency (F)	1	3	6	10	15	GHz
Drain Voltage (V_D)	32	32	32	32	32	V
Bias Current (I_{DQ})	50	50	50	50	50	mA
Output P3dB (P_{3dB})	41.1	41.2	41.1	41.2	40.8	dBm
PAE @ P_{3dB} (PAE_{3dB})	63.4	62.2	58.5	53.7	45.0	%
Gain @ P3dB (G_{3dB})	26.8	17.9	14.2	10.0	7.0	dB
Parallel Output Resistance (1) (R_p)	96.0	91.3	86.7	69.5	41.3	Ω·mm
Parallel Output Capacitance (1) (C_p)	0.005	0.230	0.304	0.331	0.425	pF/mm
Load Impedance (ZL)	38.1+j0.12	29.1+j14.4	17.3+j17.2	8.92+j12.9	4.38+j7.25	Ω
Source Impedance (ZS)	4.02+j29.6	1.80+j7.03	1.44+j3.00	0.90+j0.00	1.20-j2.41	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 19 for reference planes.

Parameter	Typical Value					Units
Frequency (F)	1	3	6	10	15	GHz
Drain Voltage (V_D)	32	32	32	32	32	V
Bias Current (I_{DQ})	50	50	50	50	50	mA
Output P3dB (P_{3dB})	39.8	39.9	40.0	40.8	40.6	dBm
PAE @ P_{3dB} (PAE_{3dB})	68.6	67.7	62.8	56.0	47.3	%
Gain @ P3dB (G_{3dB})	28.3	19.4	15.1	10.3	7.9	dB
Parallel Output Resistance (1) (R_p)	156.1	151.3	134.7	86.3	52.8	Ω·mm
Parallel Output Capacitance (1) (C_p)	0.320	0.363	0.366	0.355	0.391	pF/mm
Load Impedance (ZL)	56.4+j17.7	29.0+j30.0	12.0+j22.3	7.27+j14.0	4.38+j8.52	Ω
Source Impedance (ZS)	4.02+j29.6	1.80+j7.03	1.44+j3.00	0.90+j0.00	1.20-j2.41	Ω

Notes:
1. Large signal equivalent output network (normalized).

RF Characterization – Measured Optimum Power Tune

Measured conditions unless otherwise noted: T = 25°C, Bond wires included, Pulse: 100uS PW, 10%.

Parameter	Typical Value		Units
Frequency (F)	1	3.5	GHz
Drain Voltage (V_D)	32	32	V
Bias Current (I_{DQ})	50	50	mA
Input Power	16	23	dBm
Output Power	41.6	41.2	dBm
PAE	70.7	63.3	%
Gain	25.6	18.2	dB
Load Impedance (ZL)	33.4+j11.0	21.9+j12.1	Ω
Source Impedance (ZS)	12.0+j26.5	4.85+j3.46	Ω

Notes:
2. Large signal equivalent output network (normalized).

RF Characterization – Measured Optimum Efficiency Tune

Measured conditions unless otherwise noted: T = 25°C, Bond wires included, Pulse: 100uS PW, 10%.

Parameter	Typical Value		Units
Frequency (F)	1	3.5	GHz
Drain Voltage (V_D)	32	32	V
Bias Current (I_{DQ})	50	50	mA
Input Power	16	23	dBm
Output Power	40.6	40.1	dBm
PAE	80.7	73.7	%
Gain	24.6	17.1	dB
Load Impedance (ZL)	44.0+j26.6	26.2+j29.3	Ω
Source Impedance (ZS)	12.0+j26.5	4.85+j3.46	Ω

Notes:
2. Large signal equivalent output network (normalized).

Thermal and Reliability Information - Pulsed [1]

<table>
<tr><th>Parameter</th><th>Test Conditions</th><th>Value</th><th>Units</th></tr>
<tr><td>Thermal Resistance, θ_{JC}</td><td rowspan="3">P_D = 12.6 W, Tbaseplate = 85°C
Pulse: 100uS, 5%</td><td>7.52</td><td>ºC/W</td></tr>
<tr><td>Channel Temperature, T_{CH}</td><td>180</td><td>°C</td></tr>
<tr><td>Median Lifetime, T_M</td><td>1.07E08</td><td>Hrs</td></tr>
<tr><td>Thermal Resistance, θ_{JC}</td><td rowspan="3">P_D = 12.6 W, Tbaseplate = 85°C
Pulse: 100uS, 10%</td><td>7.74</td><td>°C/W</td></tr>
<tr><td>Channel Temperature, T_{CH}</td><td>183</td><td>°C</td></tr>
<tr><td>Median Lifetime, T_M</td><td>8.20E07</td><td>Hrs</td></tr>
<tr><td>Thermal Resistance, θ_{JC}</td><td rowspan="3">P_D = 12.6 W, Tbaseplate = 85°C
Pulse: 100uS, 20%</td><td>8.19</td><td>ºC/W</td></tr>
<tr><td>Channel Temperature, T_{CH}</td><td>188</td><td>°C</td></tr>
<tr><td>Median Lifetime, T_M</td><td>4.76E07</td><td>Hrs</td></tr>
<tr><td>Thermal Resistance, θ_{JC}</td><td rowspan="3">P_D = 12.6 W, Tbaseplate = 85°C
Pulse: 100uS, 50%</td><td>9.75</td><td>ºC/W</td></tr>
<tr><td>Channel Temperature, T_{CH}</td><td>208</td><td>°C</td></tr>
<tr><td>Median Lifetime, T_M</td><td>7.88E06</td><td>Hrs</td></tr>
</table>

Notes:

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

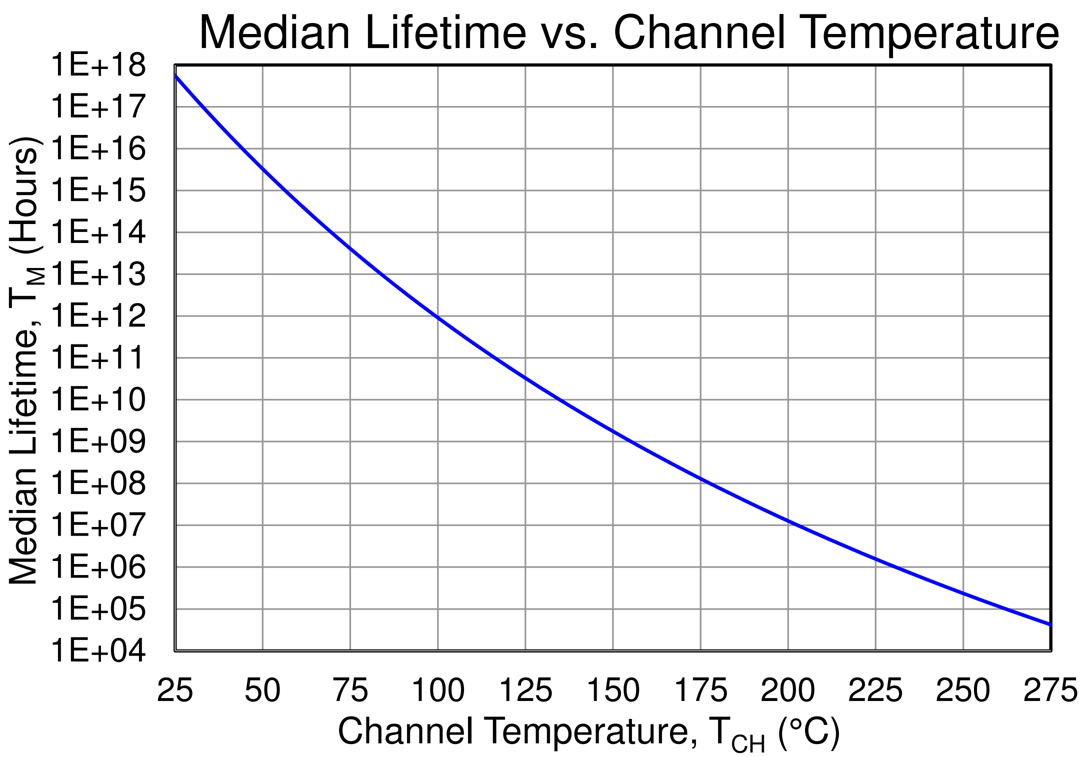
Thermal and Reliability Information - CW [1]

<table>
<tr><th>Parameter</th><th>Test Conditions</th><th>Value</th><th>Units</th></tr>
<tr><td>Thermal Resistance, θ_{JC}</td><td rowspan="3">P_D = 5.04 W, Tbaseplate = 85°C
CW</td><td>10.7</td><td>ºC/W</td></tr>
<tr><td>Channel Temperature, T_{CH}</td><td>139</td><td>°C</td></tr>
<tr><td>Median Lifetime, T_M</td><td>9.00E09</td><td>Hrs</td></tr>
<tr><td>Thermal Resistance, θ_{JC}</td><td rowspan="3">P_D = 7.56 W, Tbaseplate = 85°C
CW</td><td>11.4</td><td>°C/W</td></tr>
<tr><td>Channel Temperature, T_{CH}</td><td>171</td><td>°C</td></tr>
<tr><td>Median Lifetime, T_M</td><td>2.57E08</td><td>Hrs</td></tr>
<tr><td>Thermal Resistance, θ_{JC}</td><td rowspan="3">P_D = 10.08 W, Tbaseplate = 85°C
CW</td><td>12.1</td><td>ºC/W</td></tr>
<tr><td>Channel Temperature, T_{CH}</td><td>207</td><td>°C</td></tr>
<tr><td>Median Lifetime, T_M</td><td>8.44E06</td><td>Hrs</td></tr>
<tr><td>Thermal Resistance, θ_{JC}</td><td rowspan="3">P_D = 12.6 W, Tbaseplate = 85°C
CW</td><td>12.9</td><td>ºC/W</td></tr>
<tr><td>Channel Temperature, T_{CH}</td><td>248</td><td>°C</td></tr>
<tr><td>Median Lifetime, T_M</td><td>3.00E05</td><td>Hrs</td></tr>
</table>

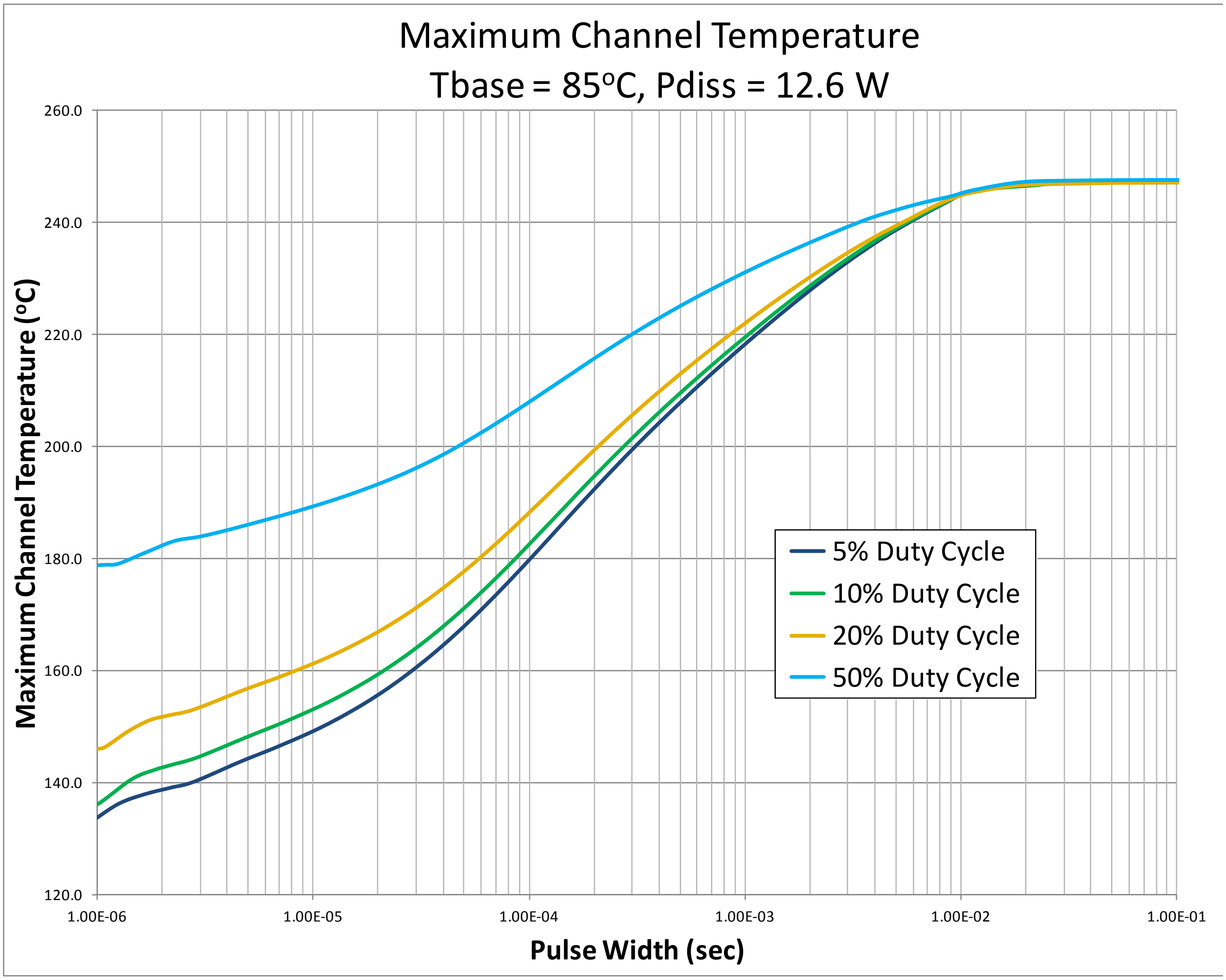
Notes:

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

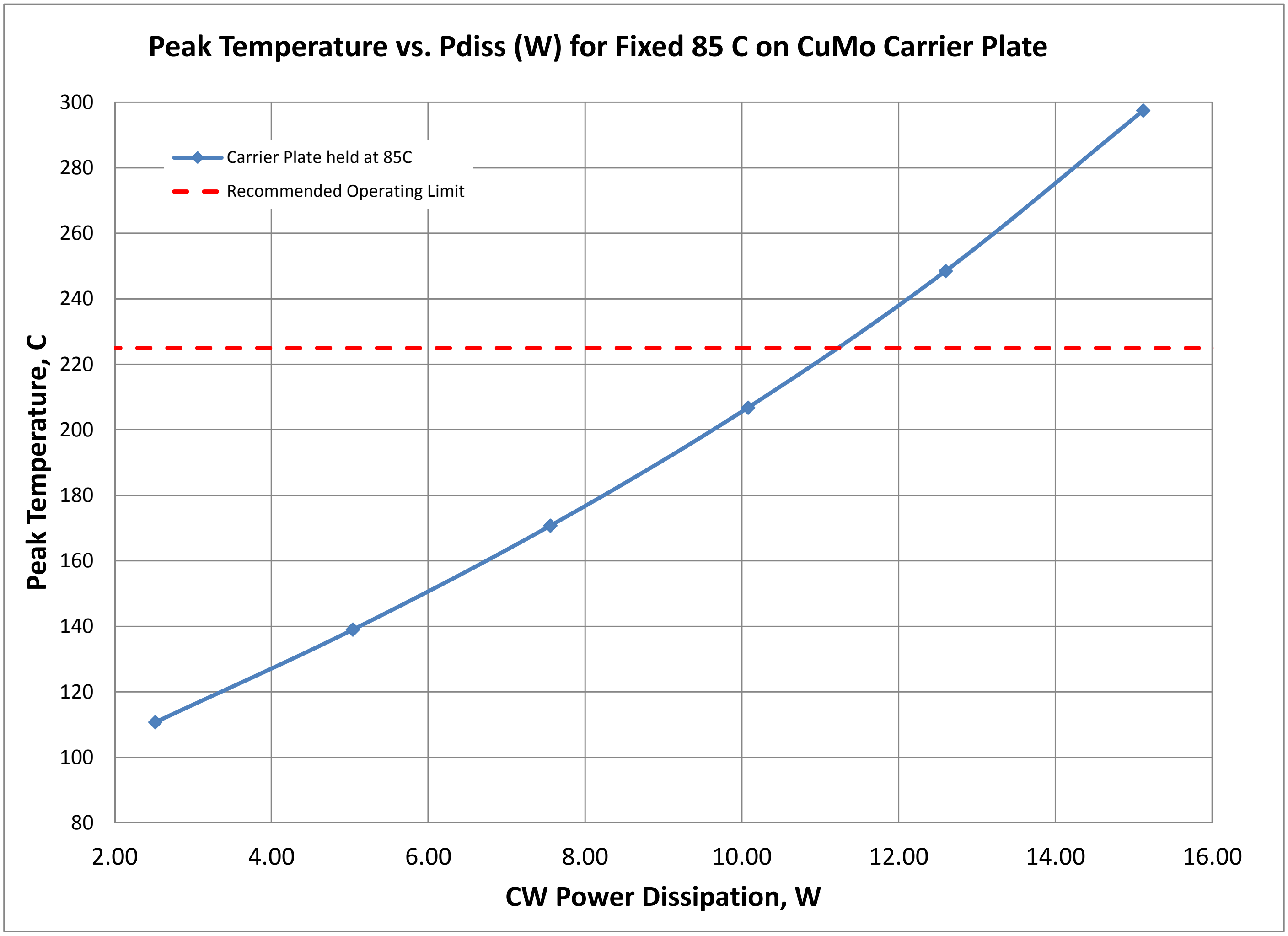
Median LifeTime



Maximum Channel Temperature - Pulsed

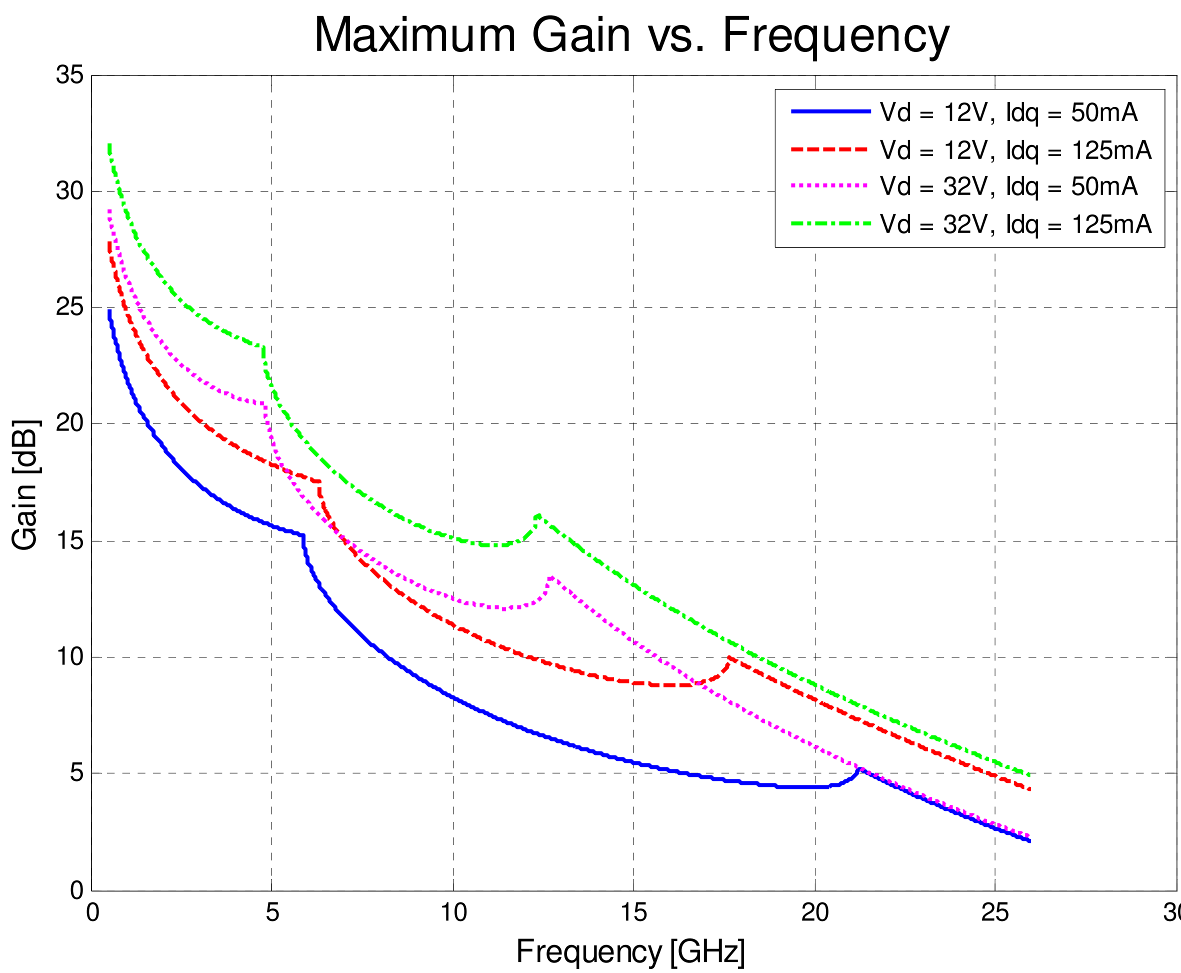


Maximum Channel Temperature - CW



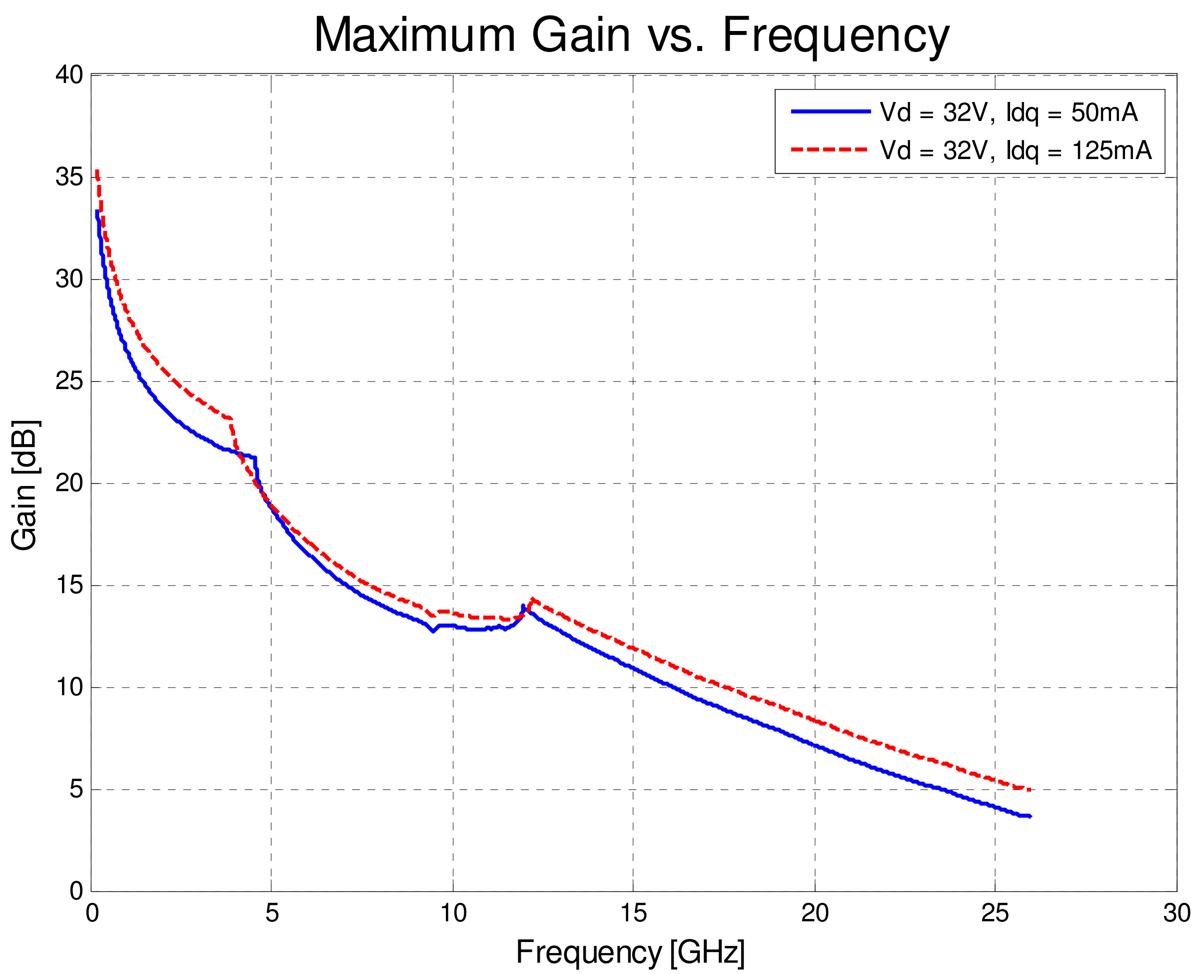
Model Maximum Gain Performance

Bond wires are not included. See page 19 for reference planes.



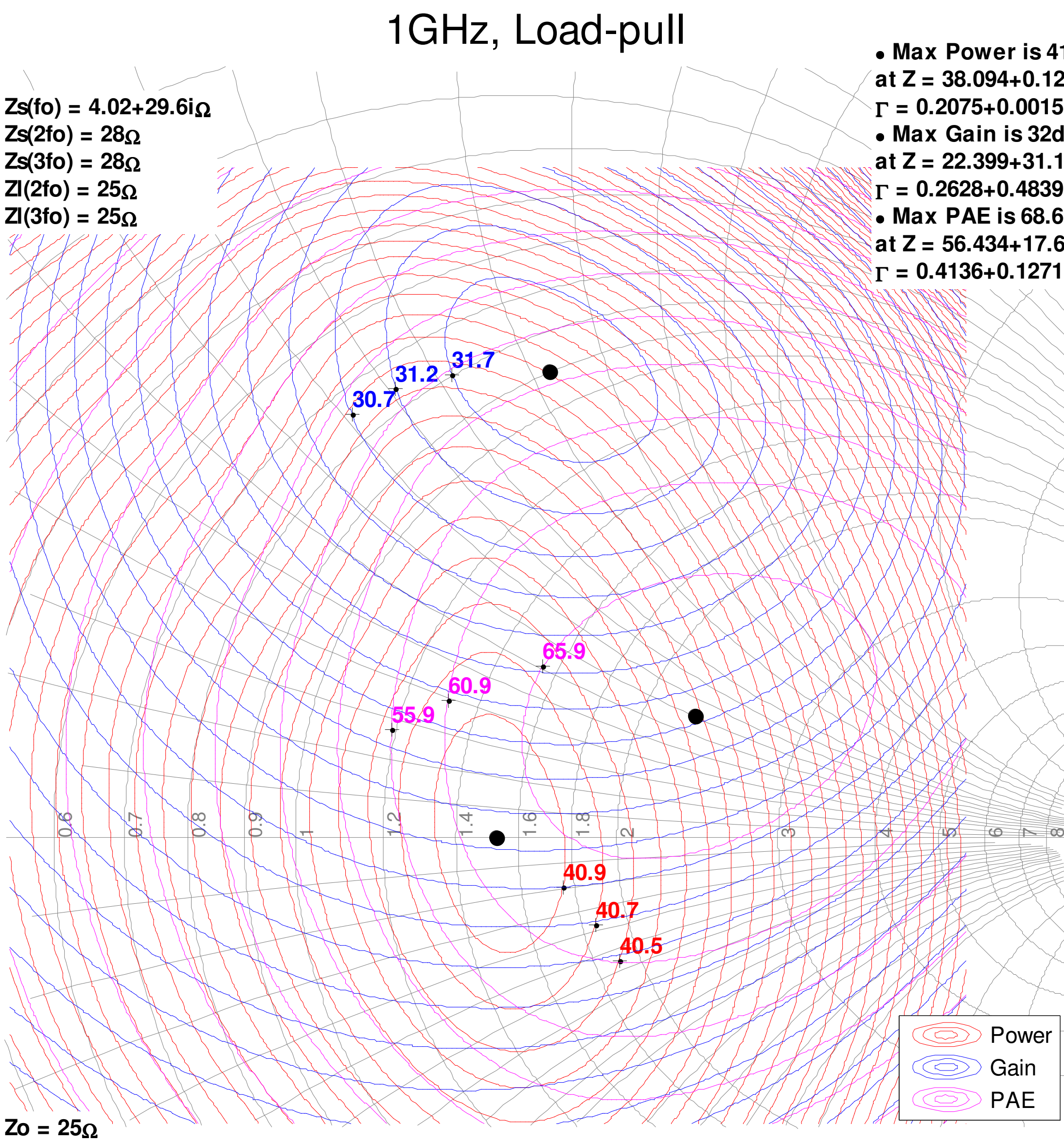
Measured Maximum Gain Performance

Bond wires are included. See page 19 for reference planes.



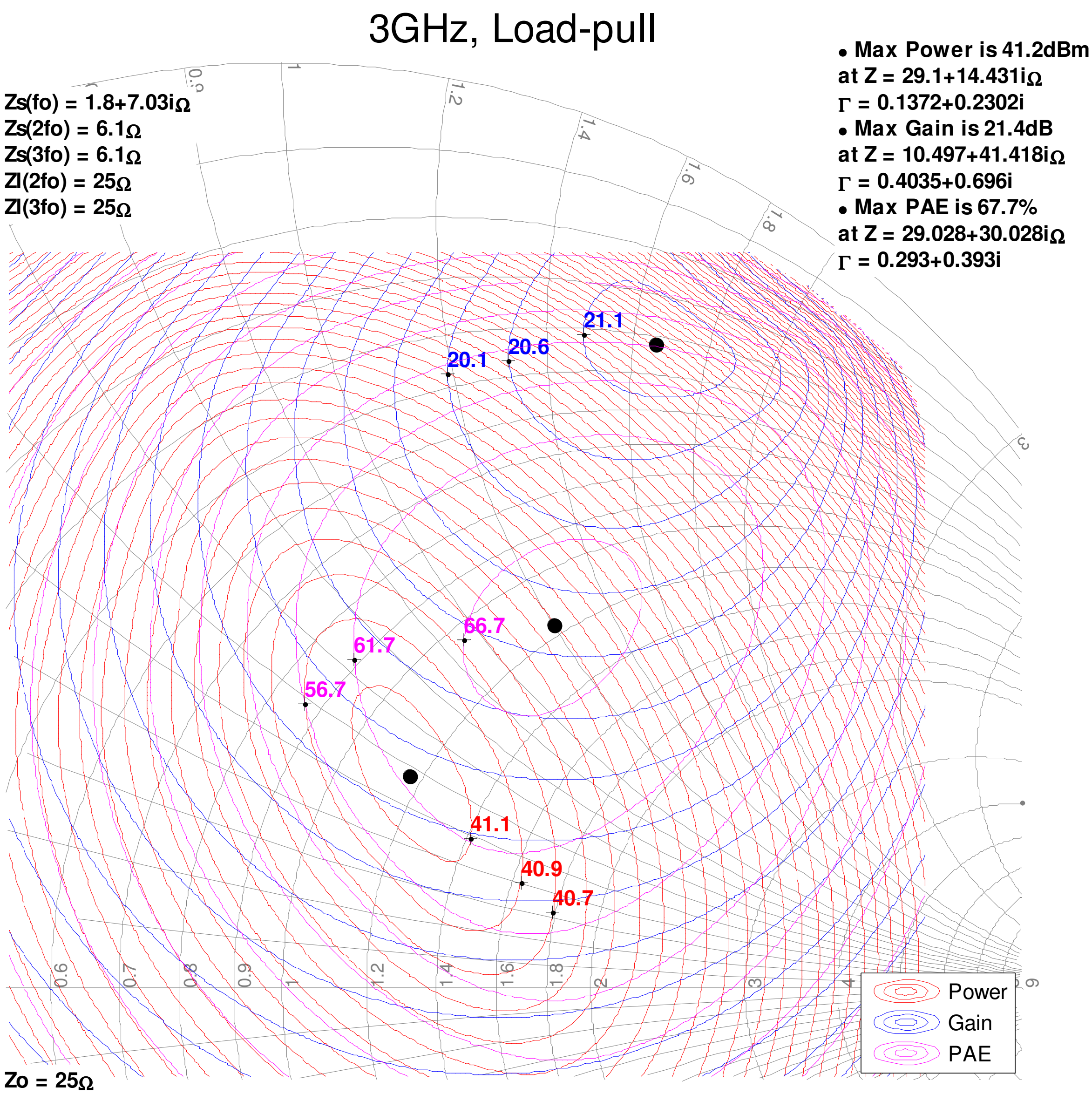
Model Load Pull Contours

Vds = 32V, Idq = 50mA, Simulated signal: 10% pulses. Bond wires not included. See page 19 for reference planes.
3dB compression performance referenced to maximum large-signal gain.



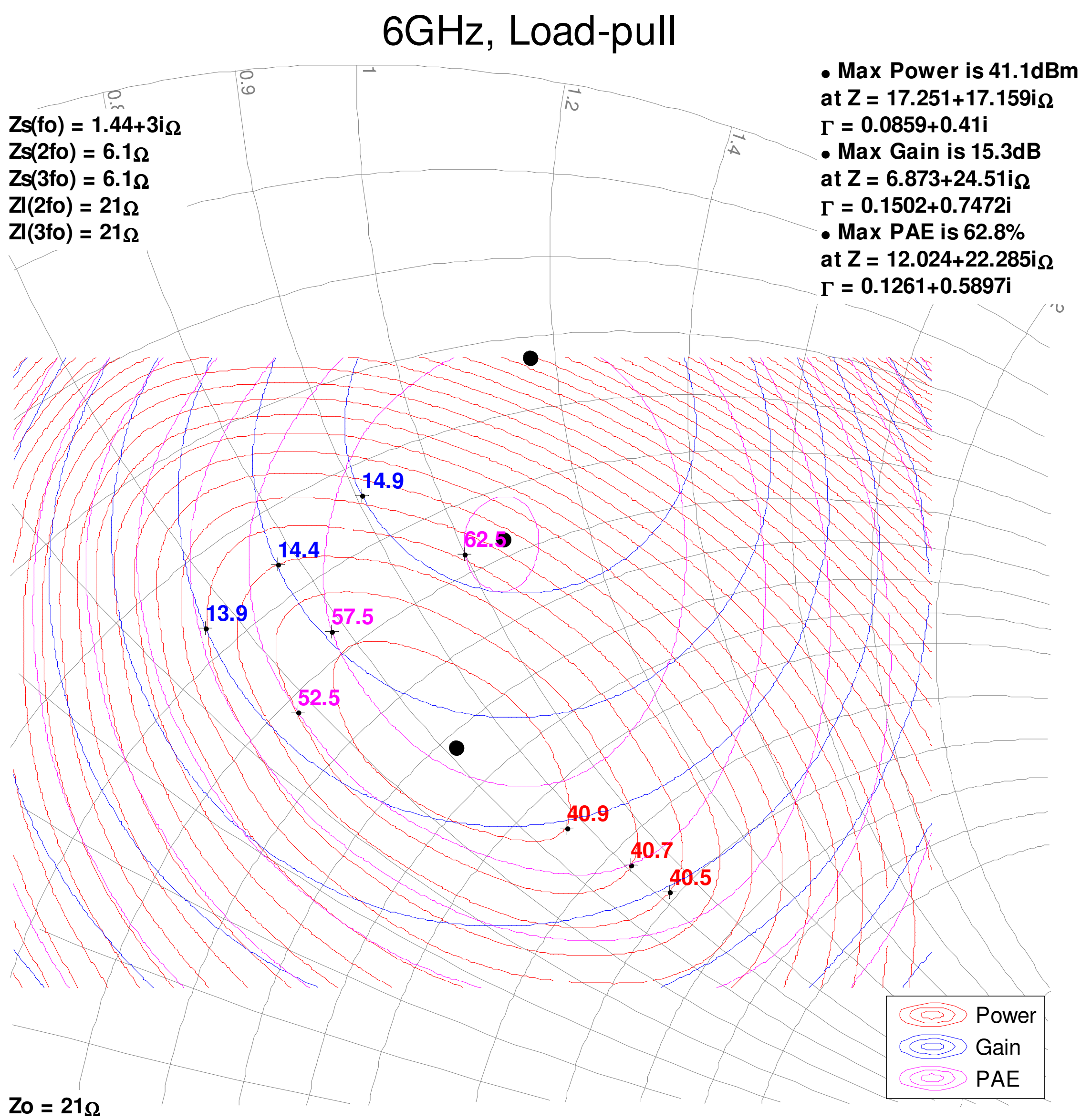
Model Load Pull Contours

Vds = 32V, Idq = 50mA, Simulated signal: 10% pulses. Bond wires not included. See page 19 for reference planes.
3dB compression performance referenced to maximum large-signal gain.



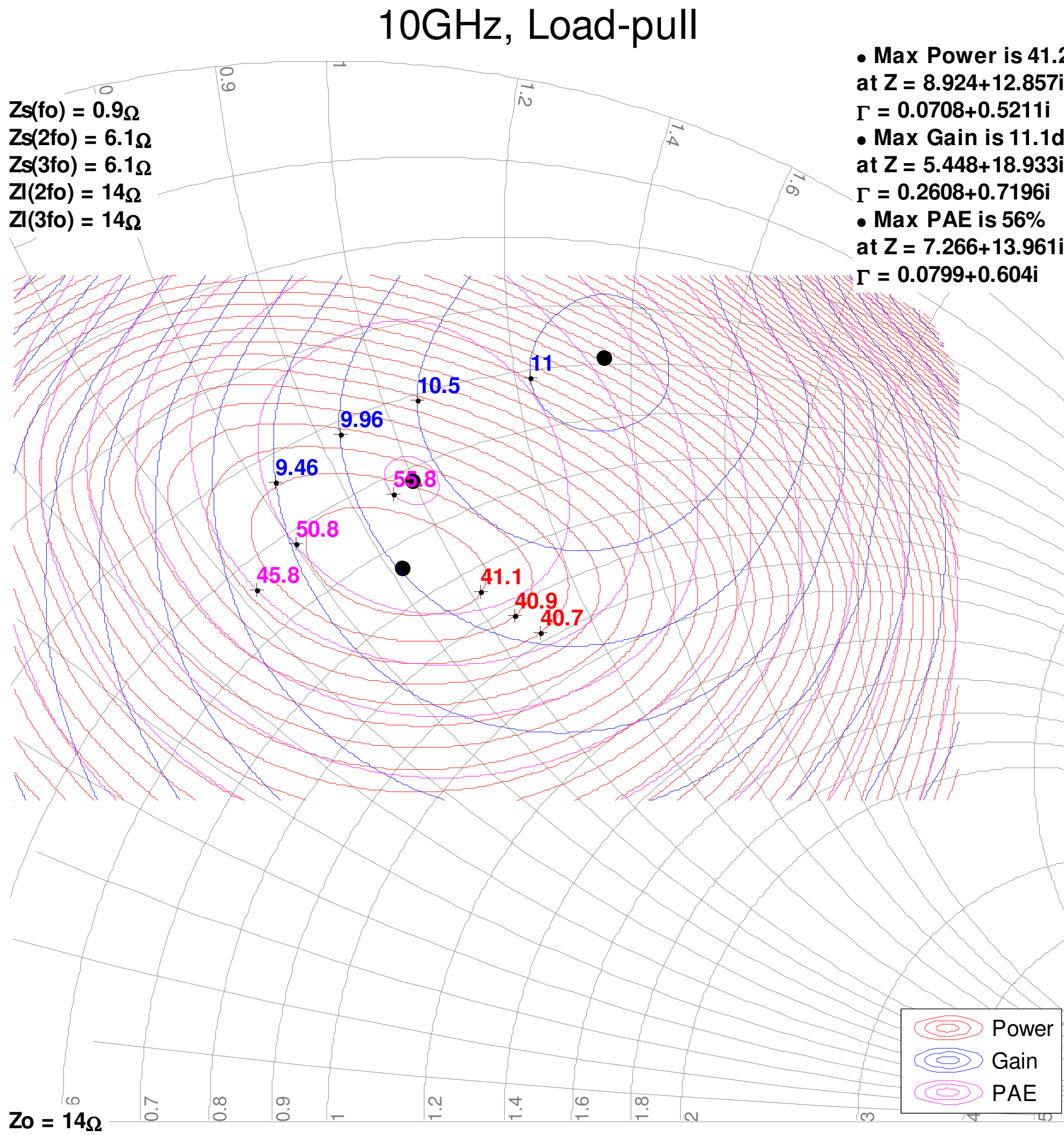
Model Load Pull Contours

Vds = 32V, Idq = 50mA, Simulated signal: 10% pulses. Bond wires not included. See page 19 for reference planes.
3dB compression performance referenced to maximum large-signal gain.



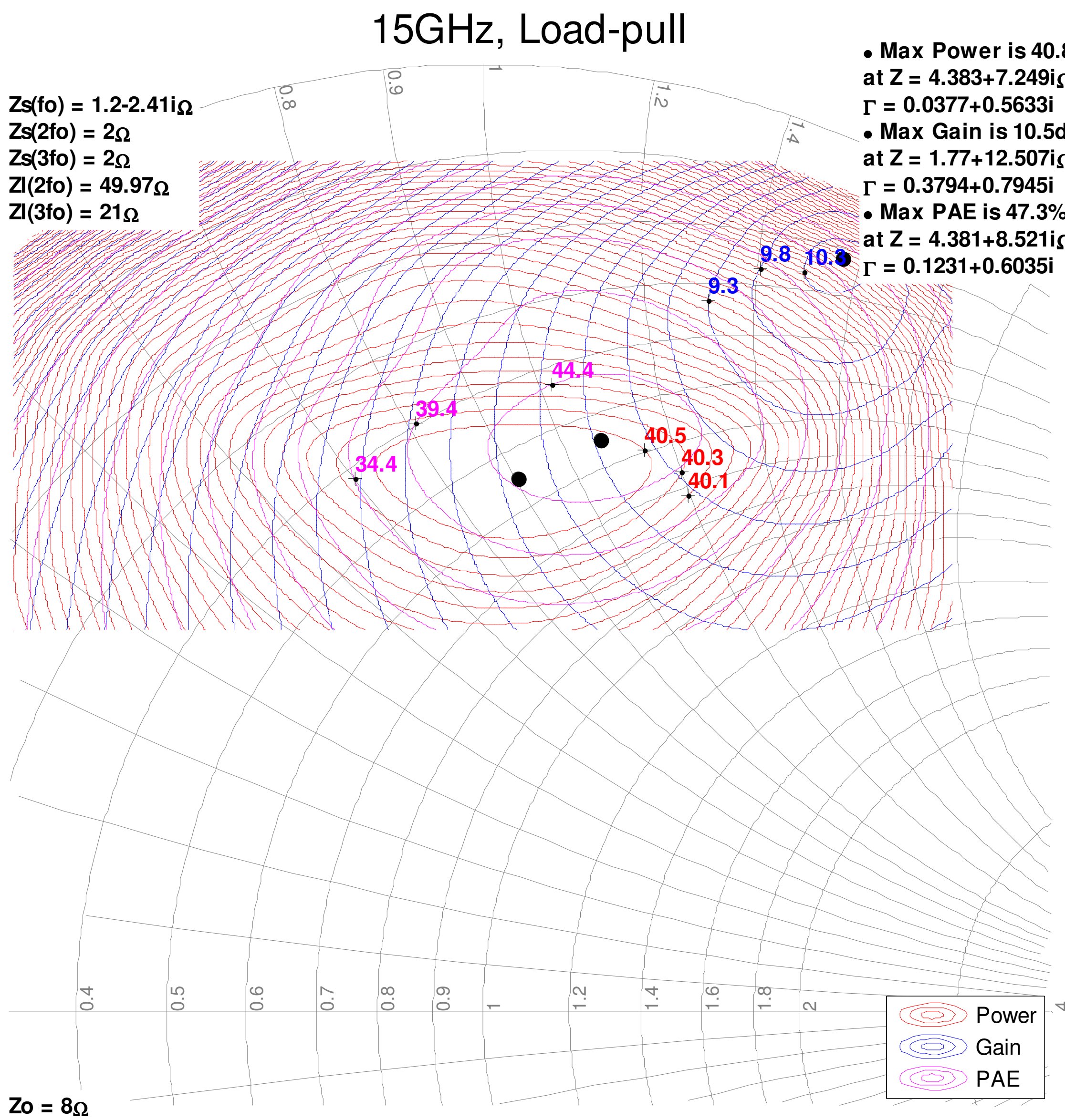
Model Load Pull Contours

Vds = 32V, Idq = 50mA, Simulated signal: 10% pulses. Bond wires not included. See page 19 for reference planes.
3dB compression performance referenced to maximum large-signal gain.



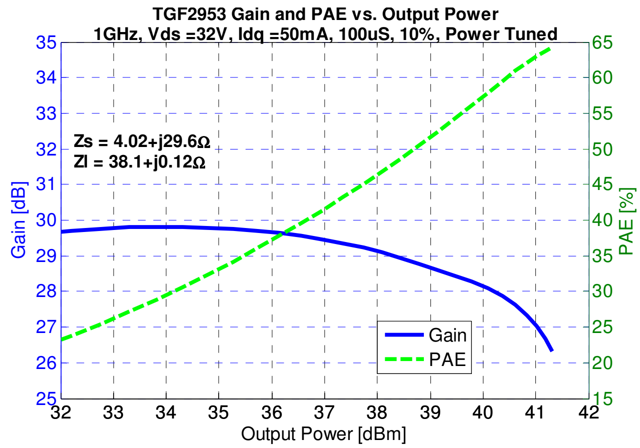
Model Load Pull Contours

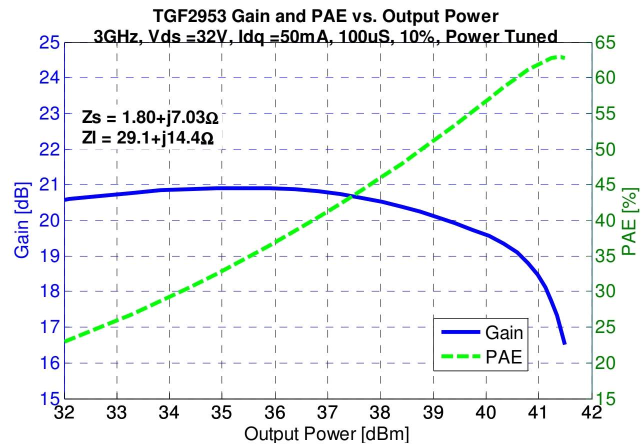
Vds = 32V, Idq = 50mA, Simulated signal: 10% pulses. Bond wires not included. See page 19 for reference planes.
3dB compression performance referenced to maximum large-signal gain.

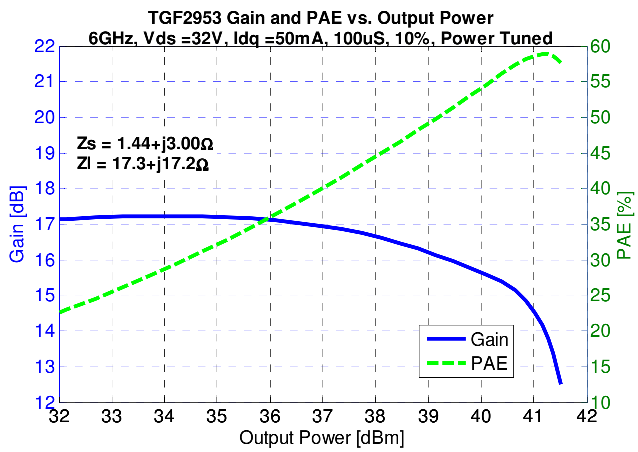


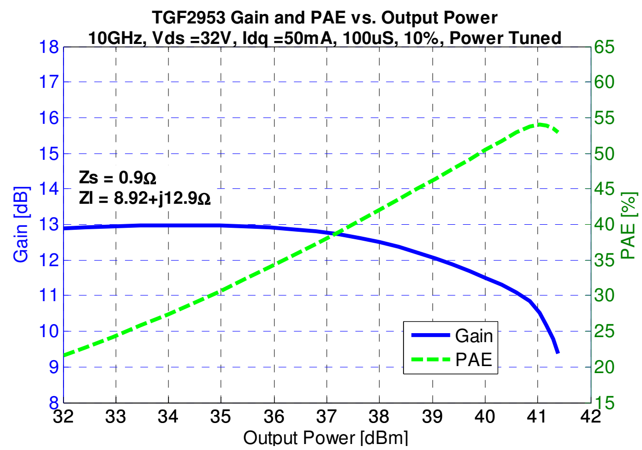
Model Power Tuned Data

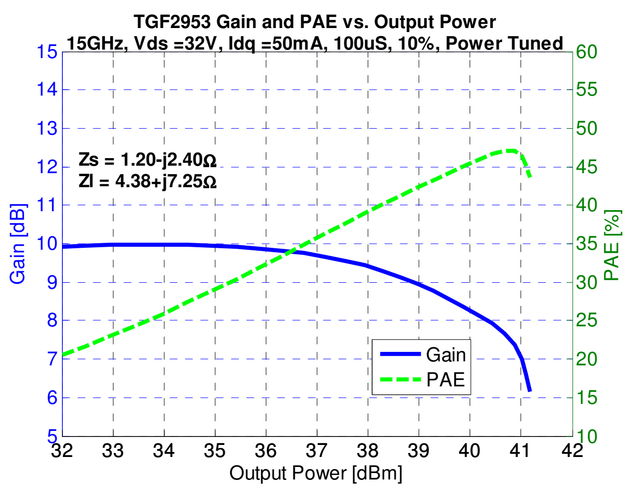
Bond wires not included. See page 19 for reference planes.





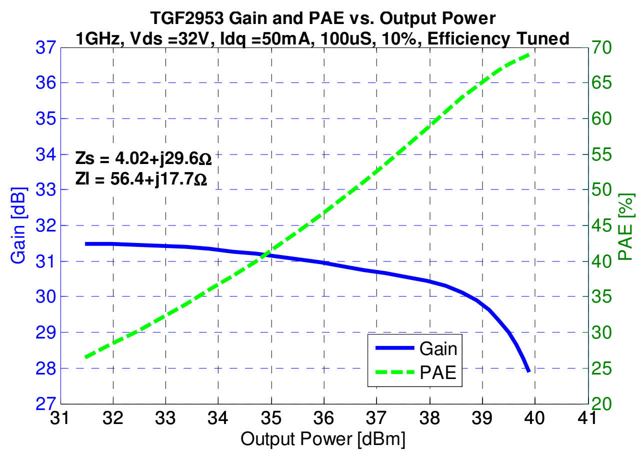


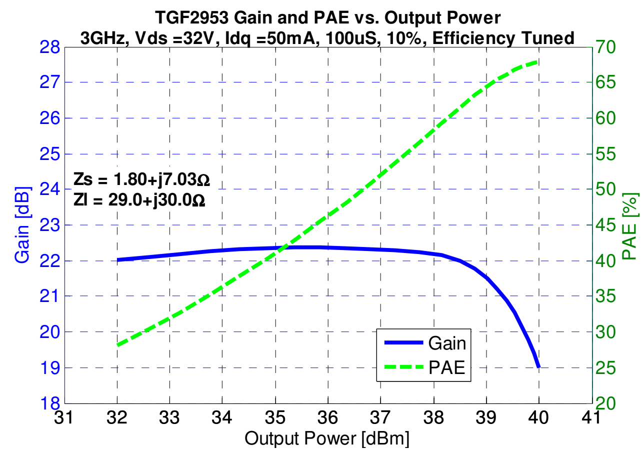


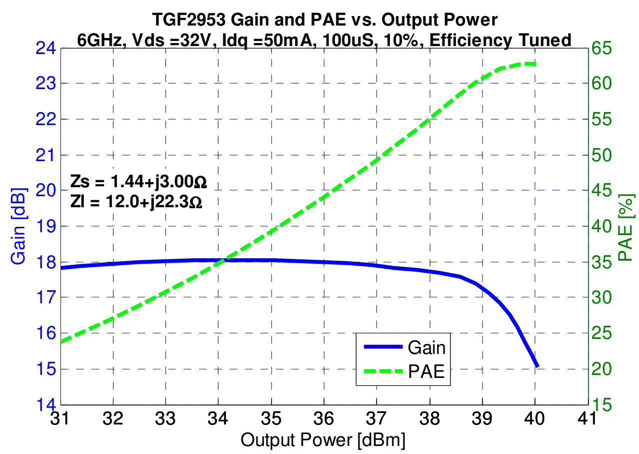


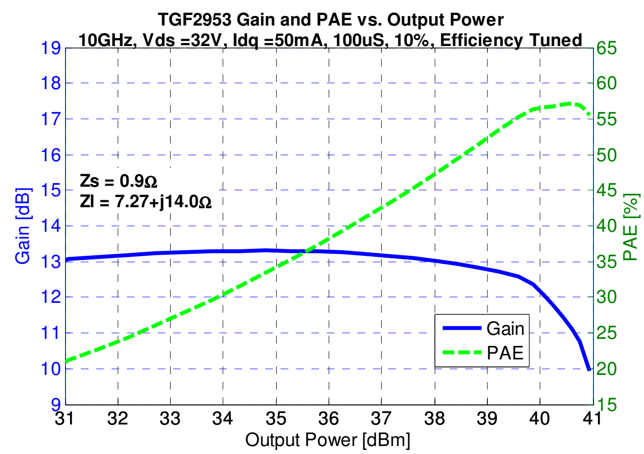
Model Efficiency Tuned Data

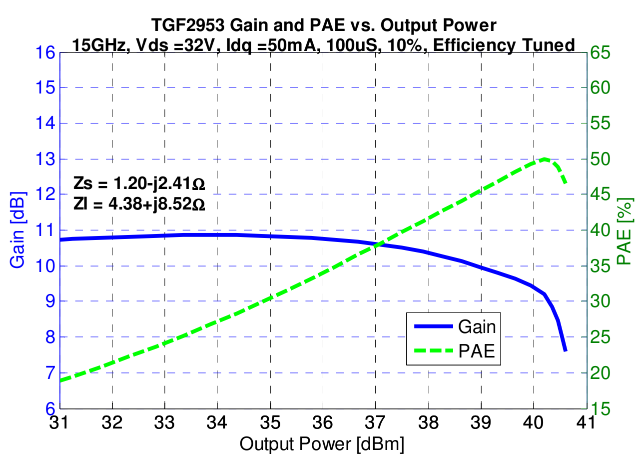
Bond wires not included. See page 19 for reference planes.





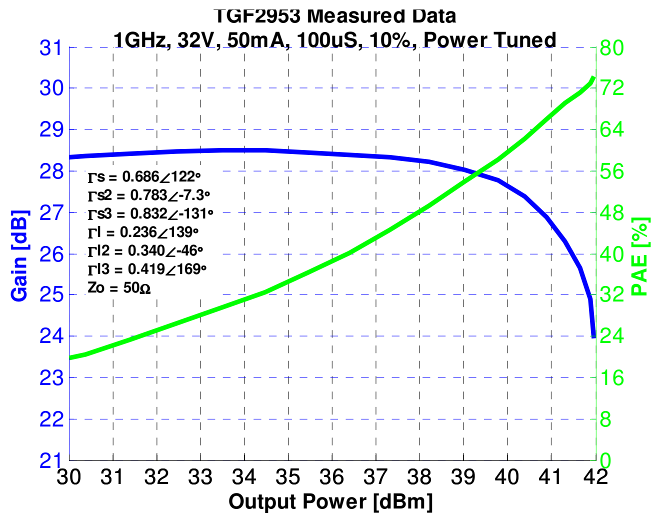


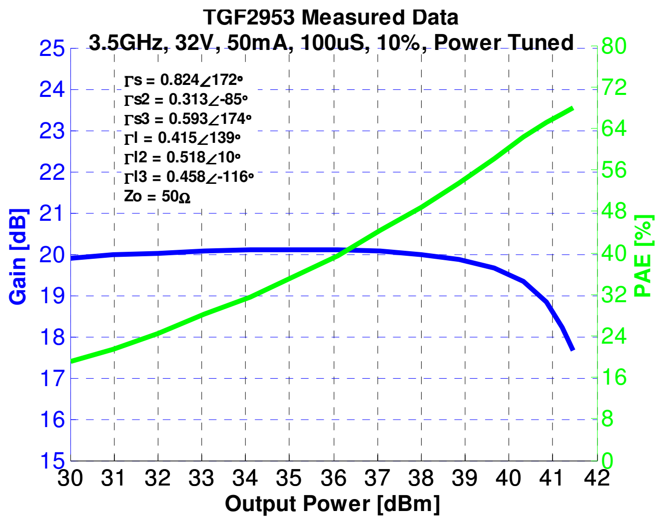




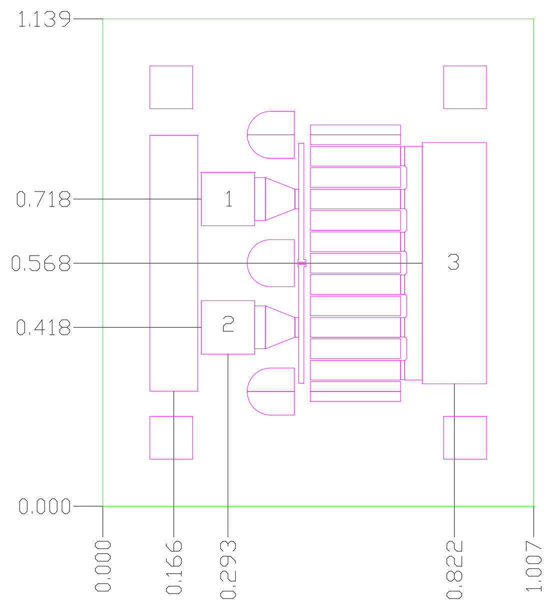
Measured Power Tuned Data

Bond wires included.





Mechanical Drawing

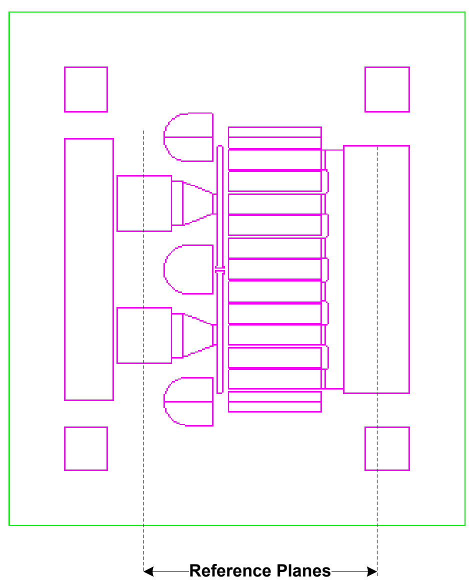


1. Units: millimeters
2. Thickness: 0.100 mm
3. Die xy size tolerance: ± 0.050 mm

Bond Pads

Pad No.	Description	Dimensions
1, 2	Gate	0.125 x 0.125
3	Drain	0.150 x 0.564
Die Backside	Source / Ground	1.007 x 1.139

Reference Planes



Model

A model is available for download from Modelithics (at http://www.modelithics.com/mvp/Triquint&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 50 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 ($C_{15}H_{12}Br_40_2$) Free
- PFOS Free
- SVHC Free

Contact Information

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

Web: www.triquint.com **Tel:** +1.972.994.8465
Email: info-sales@triquint.com **Fax:** +1.972.994.8504

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

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