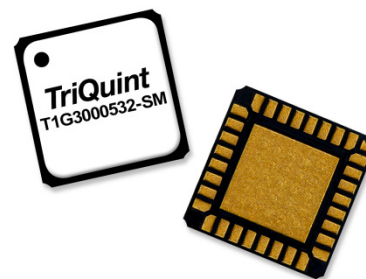


## Applications

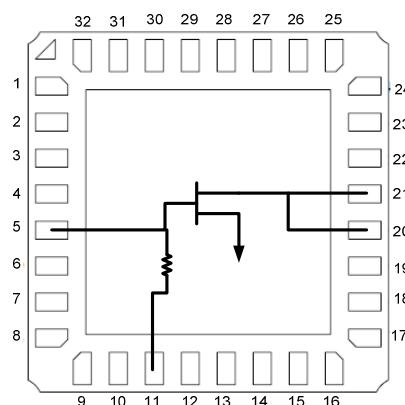
- Military radar
- Civilian radar
- Professional and military radio communications
- Test instrumentation
- Wideband or narrowband amplifiers
- Jammers



## Product Features

- Frequency: 30 MHz to 3.5 GHz
- Output Power ( $P_{3dB}$ ): 5.7 W at 3.0 GHz
- Linear Gain: 15.7 dB at 3 GHz
- Typical  $PAE_{3dB}$ : 64.7% at 3GHz
- Operating Voltage: 32 V
- Low thermal resistance package
- CW and Pulse capable

## Functional Block Diagram



## General Description

The TriQuint T1G3000532-SM is a 5W ( $P_{3dB}$ ), 50 $\Omega$ -input matched discrete GaN on SiC HEMT which operates from 30MHz to 3.5 GHz. The device is constructed with TriQuint's proven TQGaN25 process, which features advanced field plate techniques to optimize power and efficiency at high drain bias operating conditions. This optimization can potentially lower system costs in terms of fewer amplifier line-ups and lower thermal management costs.

Lead-free and ROHS compliant

Evaluation boards are available upon request.

## Pin Configuration

Pin No.	Label
20 - 21	$V_D$ / RF OUT
5	$V_G$ / RF IN
11	Off-chip Shunt Cap for Low-Frequency Gain
Back side	Source

## Ordering Information

Part	ECCN	Description
T1G3000532-SM	EAR99	QFN Packaged Part
T1G3000532-SM-EVB	EAR99	0.5 – 3 GHz EVB

## Absolute Maximum Ratings

Parameter	Value
Breakdown Voltage ( $V_{DG}$ )	100 V
Gate Voltage Range ( $V_G$ )	-50 to 0 V
Drain Current ( $I_D$ )	0.6 A
Gate Current ( $I_G$ )	-1.25 to 2.1 mA
Power Dissipation ( $P_D$ )	7.5 W
RF Input Power, CW, $T = 25^\circ\text{C}$ ( $P_{IN}$ )	25 dBm
Channel Temperature ( $T_{CH}$ )	275 °C
Mounting Temperature (30 Seconds)	320 °C
Storage Temperature	-40 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 ( $V_D$ )	32 V (Typ.)
Drain Quiescent Current ( $I_{DQ}$ )	25 mA (Typ.)
Peak Drain Current ( $I_D$ )	326 mA (Typ.)
Gate Voltage ( $V_G$ )	-2.7 V (Typ.)
Channel Temperature ( $T_{CH}$ )	225 °C (Max)
Power Dissipation, CW ( $P_D$ )	7.05 W (Max)
Power Dissipation, Pulse ( $P_D$ )	9.1 W (Max)

Electrical specifications are measured at specified test conditions. Specifications are not guaranteed over all recommended operating conditions.

## RF Characterization – Load Pull Performance at 1.0 GHz

Test conditions unless otherwise noted:  $T_A = 25^\circ\text{C}$ ,  $V_D = 32\text{ V}$ ,  $I_{DQ} = 25\text{ mA}$ , Pulse: 100uS Pulse Width, 20% Duty Cycle

Symbol	Parameter	Min	Typical	Max	Units
$G_{LIN}$	Linear Gain, Power Tuned		16.5		dB
$P_{3dB}$	Output Power at 3 dB Gain Compression, Power Tuned		5.9		W
$PAE_{3dB}$	Power-Added Efficiency at 3 dB Gain Compression, Efficiency Tuned		77.3		%
$G_{3dB}$	Gain at 3 dB Compression, Power Tuned		13.5		dB

## RF Characterization – Load Pull Performance at 1.5 GHz

Test conditions unless otherwise noted:  $T_A = 25^\circ\text{C}$ ,  $V_D = 32\text{ V}$ ,  $I_{DQ} = 25\text{ mA}$ , Pulse: 100uS Pulse Width, 20% Duty Cycle

Symbol	Parameter	Min	Typical	Max	Units
$G_{LIN}$	Linear Gain, Power Tuned		17.5		dB
$P_{3dB}$	Output Power at 3 dB Gain Compression, Power Tuned		5.5		W
$PAE_{3dB}$	Power-Added Efficiency at 3 dB Gain Compression, Efficiency Tuned		70.5		%
$G_{3dB}$	Gain at 3 dB Compression, Power Tuned		14.5		dB

**RF Characterization – Load Pull Performance at 2.0 GHz**

 Test conditions unless otherwise noted:  $T_A = 25\text{ }^\circ\text{C}$ ,  $V_D = 32\text{ V}$ ,  $I_{DQ} = 25\text{ mA}$ , Pulse: 100uS Pulse Width, 20% Duty Cycle

Symbol	Parameter	Min	Typical	Max	Units
$G_{LIN}$	Linear Gain, Power Tuned		17.3		dB
$P_{3dB}$	Output Power at 3 dB Gain Compression, Power Tuned		6.5		W
$PAE_{3dB}$	Power-Added Efficiency at 3 dB Gain Compression, Efficiency Tuned		68.3		%
$G_{3dB}$	Gain at 3 dB Compression, Power Tuned		14.3		dB

**RF Characterization – Load Pull Performance at 3.0 GHz**

 Test conditions unless otherwise noted:  $T_A = 25\text{ }^\circ\text{C}$ ,  $V_D = 32\text{ V}$ ,  $I_{DQ} = 25\text{ mA}$ , Pulse: 100uS Pulse Width, 20% Duty Cycle

Symbol	Parameter	Min	Typical	Max	Units
$G_{LIN}$	Linear Gain, Power Tuned		15.7		dB
$P_{3dB}$	Output Power at 3 dB Gain Compression, Power Tuned		5.7		W
$PAE_{3dB}$	Power-Added Efficiency at 3 dB Gain Compression, Efficiency Tuned		64.7		%
$G_{3dB}$	Gain at 3 dB Compression, Power Tuned		12.7		dB

**RF Characterization – Load Pull Performance at 3.5 GHz**

 Test conditions unless otherwise noted:  $T_A = 25\text{ }^\circ\text{C}$ ,  $V_D = 32\text{ V}$ ,  $I_{DQ} = 25\text{ mA}$ , Pulse: 100uS Pulse Width, 20% Duty Cycle

Symbol	Parameter	Min	Typical	Max	Units
$G_{LIN}$	Linear Gain, Power Tuned		14.3		dB
$P_{3dB}$	Output Power at 3 dB Gain Compression, Power Tuned		5		W
$PAE_{3dB}$	Power-Added Efficiency at 3 dB Gain Compression, Efficiency Tuned		54.9		%
$G_{3dB}$	Gain at 3 dB Compression, Power Tuned		11.3		dB

## RF Characterization – EVB Performance at 3.0 GHz

Test conditions unless otherwise noted:  $T_A = 25\text{ }^\circ\text{C}$ ,  $V_D = 32\text{ V}$ ,  $I_{DQ} = 25\text{ mA}$ , Pulse: 100uS Pulse Width, 20% Duty Cycle

Symbol	Parameter	Min	Typical	Max	Units
$G_{LIN}$	Linear Gain		15.8		dB
$P_{3dB}$	Output Power at 3 dB Gain Compression		4.38		W
$DE_{3dB}$	Drain Efficiency at 3 dB Gain Compression		48.9		%
$G_{3dB}$	Gain at 3 dB Compression		12.8		dB

## RF Characterization – Mismatch Ruggedness at 3.0 GHz

Test conditions unless otherwise noted:  $T_A = 25\text{ }^\circ\text{C}$ ,  $V_D = 32\text{ V}$ ,  $I_{DQ} = 25\text{ mA}$

Driving input power is determined at 1dB CW compression under matched condition at EVB output connector.

Symbol	Parameter	Typical
VSWR	Impedance Mismatch Ruggedness	10:1

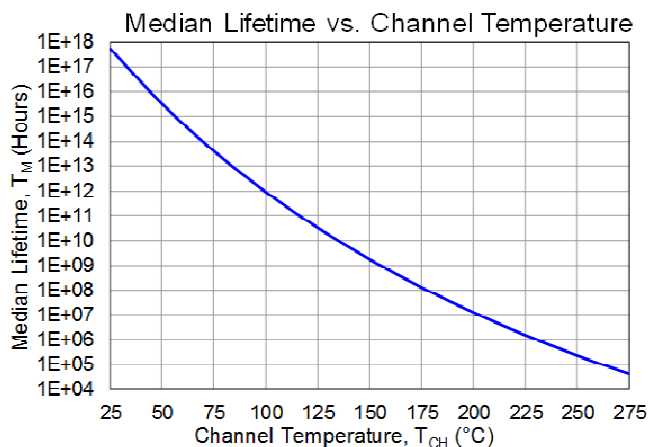
## Thermal and Reliability Information<sup>(1)</sup>

Parameter	Test Conditions	Value	Units
Thermal Resistance ( $\theta_{JC}$ )	Vds = 32V, Idq = 25mA	5.60	$^{\circ}\text{C}/\text{W}$
Channel Temperature ( $T_{CH}$ )	85 $^{\circ}\text{C}$ Case	92	$^{\circ}\text{C}$
Median Lifetime ( $T_M$ )	1.25 W Pdiss, 100uS PW, 20%	5.0E12	Hrs
Thermal Resistance ( $\theta_{JC}$ )	Vds = 32V, Idq = 25mA	5.60	$^{\circ}\text{C}/\text{W}$
Channel Temperature ( $T_{CH}$ )	85 $^{\circ}\text{C}$ Case	99	$^{\circ}\text{C}$
Median Lifetime ( $T_M$ )	2.50 W Pdiss, 100uS PW, 20%	1.7E12	Hrs
Thermal Resistance ( $\theta_{JC}$ )	Vds = 32V, Idq = 25mA	5.33	$^{\circ}\text{C}/\text{W}$
Channel Temperature ( $T_{CH}$ )	85 $^{\circ}\text{C}$ Case	105	$^{\circ}\text{C}$
Median Lifetime ( $T_M$ )	3.75 W Pdiss, 100uS PW, 20%	7.3E11	Hrs
Thermal Resistance ( $\theta_{JC}$ )	Vds = 32V, Idq = 25mA	5.40	$^{\circ}\text{C}/\text{W}$
Channel Temperature ( $T_{CH}$ )	85 $^{\circ}\text{C}$ Case	112	$^{\circ}\text{C}$
Median Lifetime ( $T_M$ )	5 W Pdiss, 100uS PW, 20%	2.8E11	Hrs
Thermal Resistance ( $\theta_{JC}$ )	Vds = 32V, Idq = 25mA	5.44	$^{\circ}\text{C}/\text{W}$
Channel Temperature ( $T_{CH}$ )	85 $^{\circ}\text{C}$ Case	119	$^{\circ}\text{C}$
Median Lifetime ( $T_M$ )	6.25 W Pdiss, 100uS PW, 20%	1.1E11	Hrs
Thermal Resistance ( $\theta_{JC}$ )	Vds = 32V, Idq = 25mA	18.4	$^{\circ}\text{C}/\text{W}$
Channel Temperature ( $T_{CH}$ )	85 $^{\circ}\text{C}$ Case	177	$^{\circ}\text{C}$
Median Lifetime ( $T_M$ )	5 W Pdiss, CW	1.4E08	Hrs

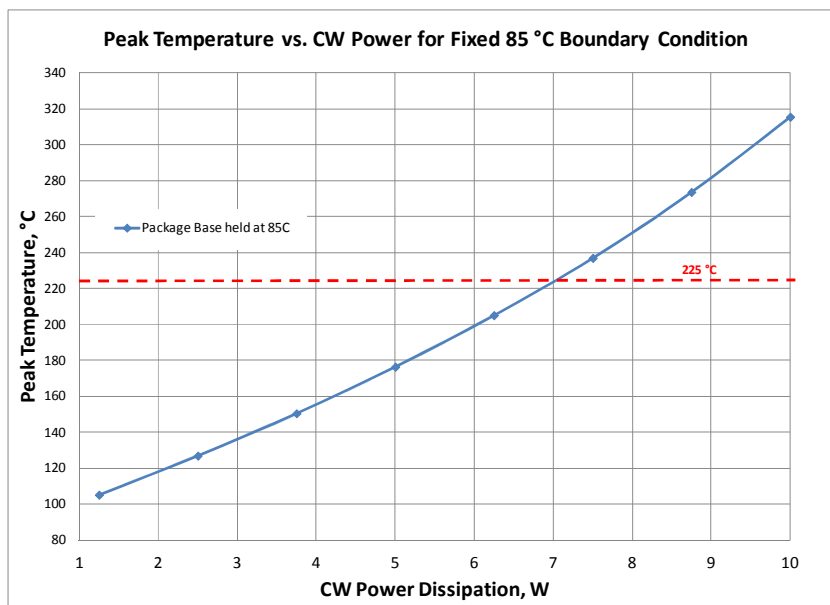
Notes:

1. Thermal resistance measured to bottom of package.

**Median Lifetime**



**Maximum Channel Temperature**

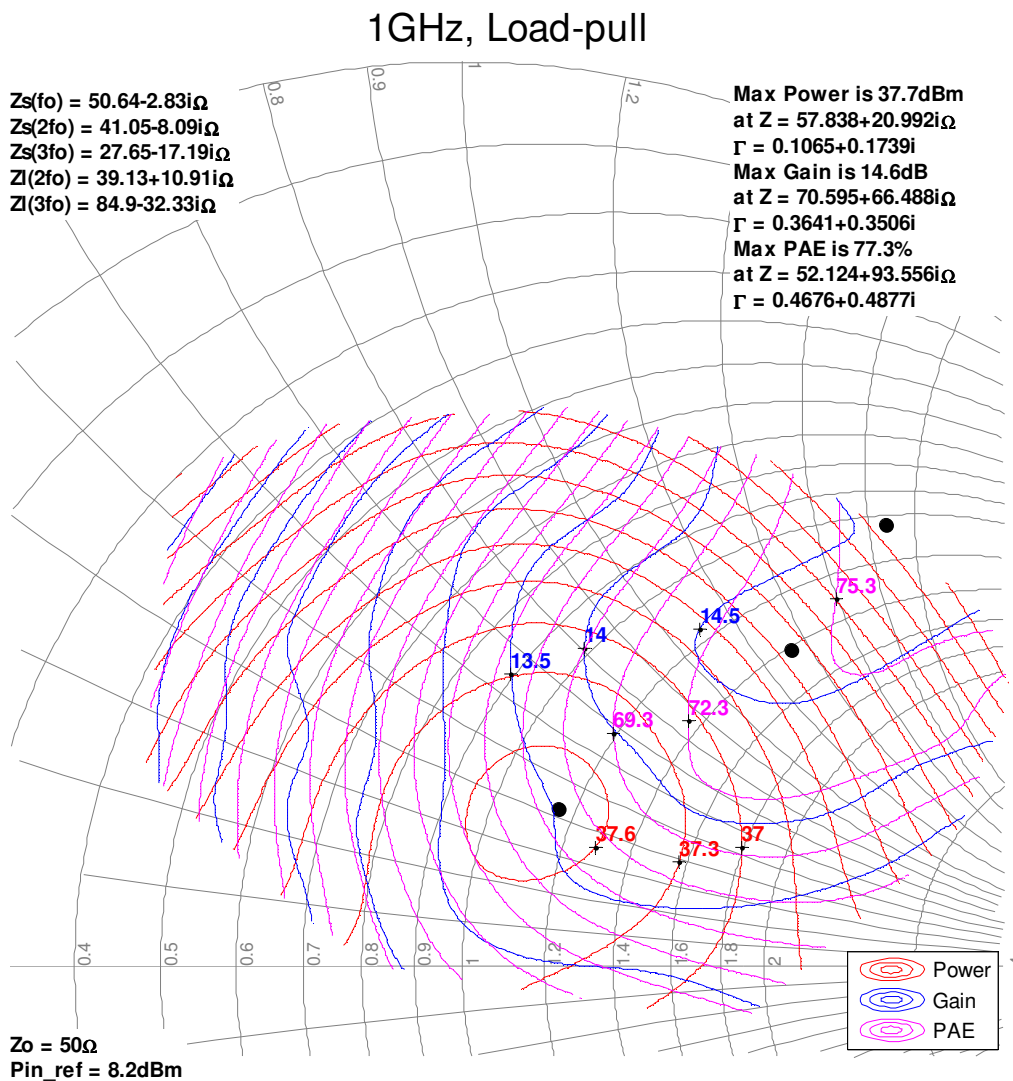


## Load Pull Smith Charts (1, 2)

RF performance that the device typically exhibits when placed in the specified impedance environment. The impedances are not the impedances of the device, they are the impedances presented to the device via an RF circuit or load-pull system. The impedances listed follow an optimized trajectory to maintain high power and high efficiency.

Notes:

1. 32V, 25mA, Pulsed signal with 100uS pulse width and 20% duty cycle. 3dB compression reference at Pin\_ref.
2. See page 18 for load pull and source pull reference planes.



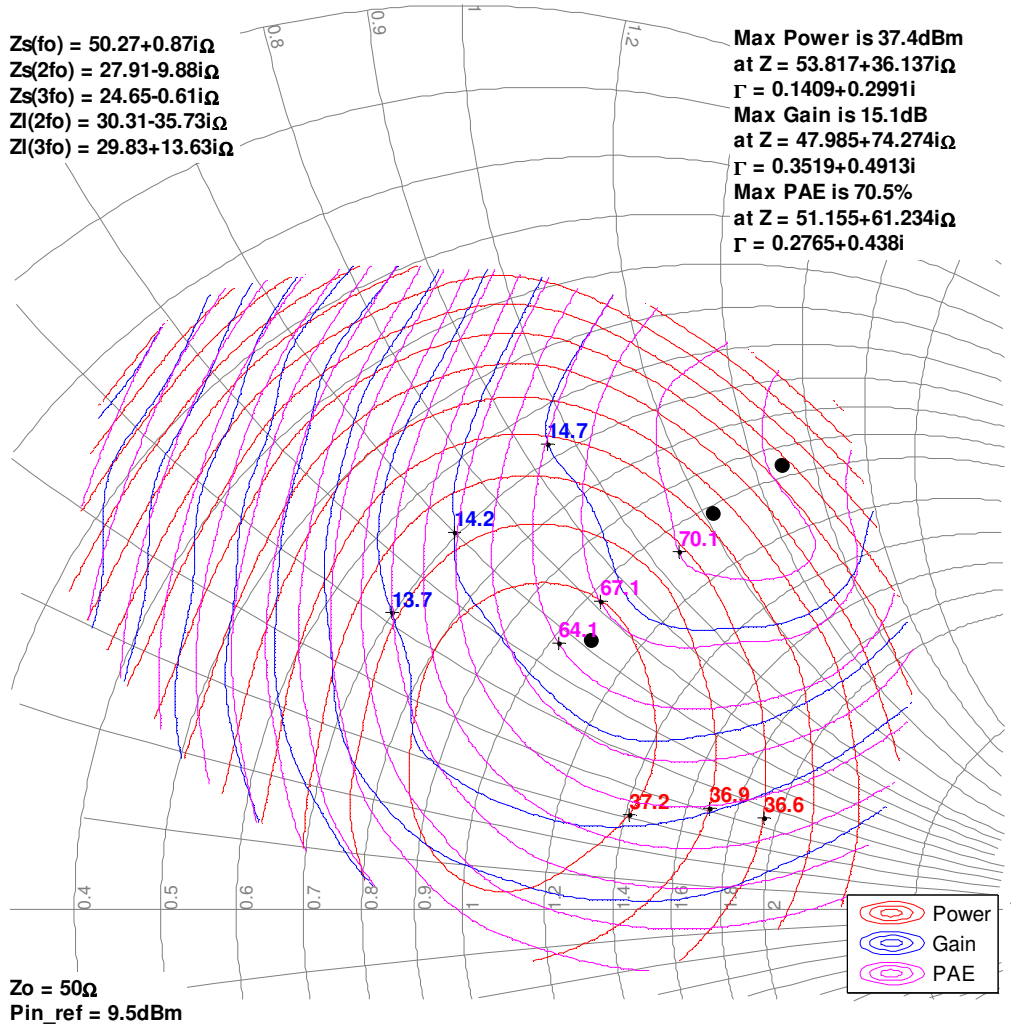
**Load Pull Smith Charts (1, 2)**

RF performance that the device typically exhibits when placed in the specified impedance environment. The impedances are not the impedances of the device, they are the impedances presented to the device via an RF circuit or load-pull system. The impedances listed follow an optimized trajectory to maintain high power and high efficiency.

Notes:

1. 32V, 25mA, Pulsed signal with 100uS pulse width and 20% duty cycle. 3dB compression reference at Pin\_ref.
2. See page 18 for load pull and source pull reference planes.

**1.5GHz, Load-pull**



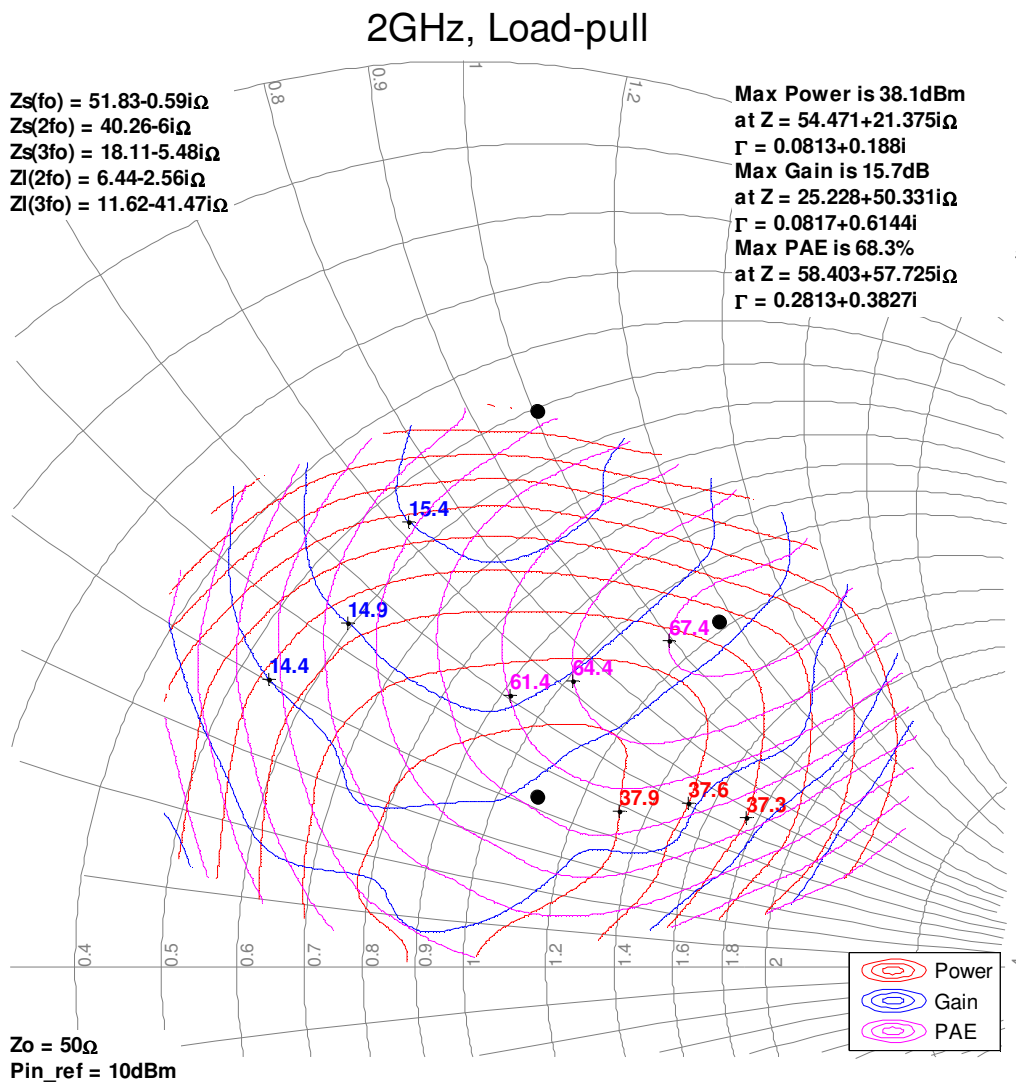


**Load Pull Smith Charts (1, 2)**

RF performance that the device typically exhibits when placed in the specified impedance environment. The impedances are not the impedances of the device, they are the impedances presented to the device via an RF circuit or load-pull system. The impedances listed follow an optimized trajectory to maintain high power and high efficiency.

Notes:

1. 32V, 25mA, Pulsed signal with 100uS pulse width and 20% duty cycle. 3dB compression reference at Pin\_ref.
2. See page 18 for load pull and source pull reference planes.

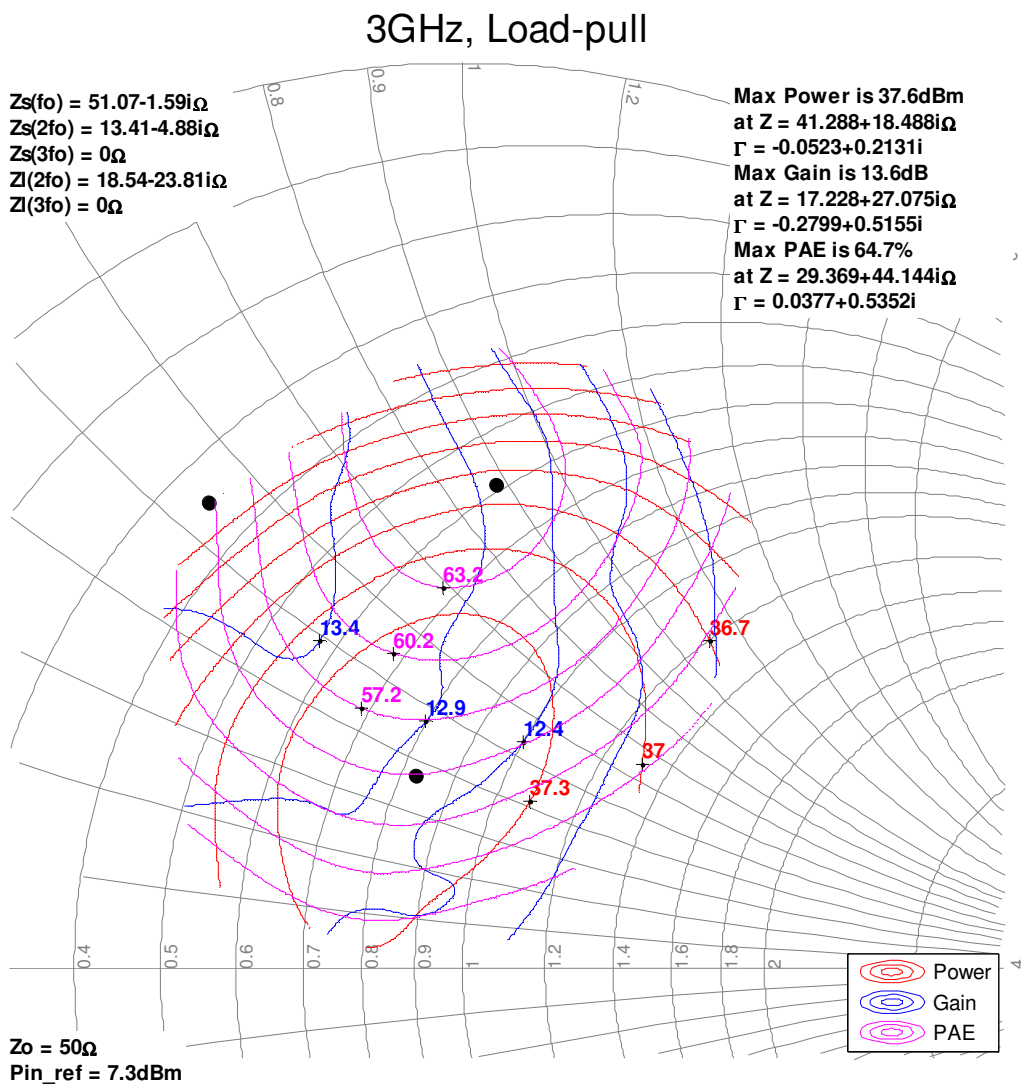


**Load Pull Smith Charts (1, 2)**

RF performance that the device typically exhibits when placed in the specified impedance environment. The impedances are not the impedances of the device, they are the impedances presented to the device via an RF circuit or load-pull system. The impedances listed follow an optimized trajectory to maintain high power and high efficiency.

Notes:

1. 32V, 25mA, Pulsed signal with 100uS pulse width and 20% duty cycle. 3dB compression reference at Pin\_ref.
2. See page 18 for load pull and source pull reference planes.



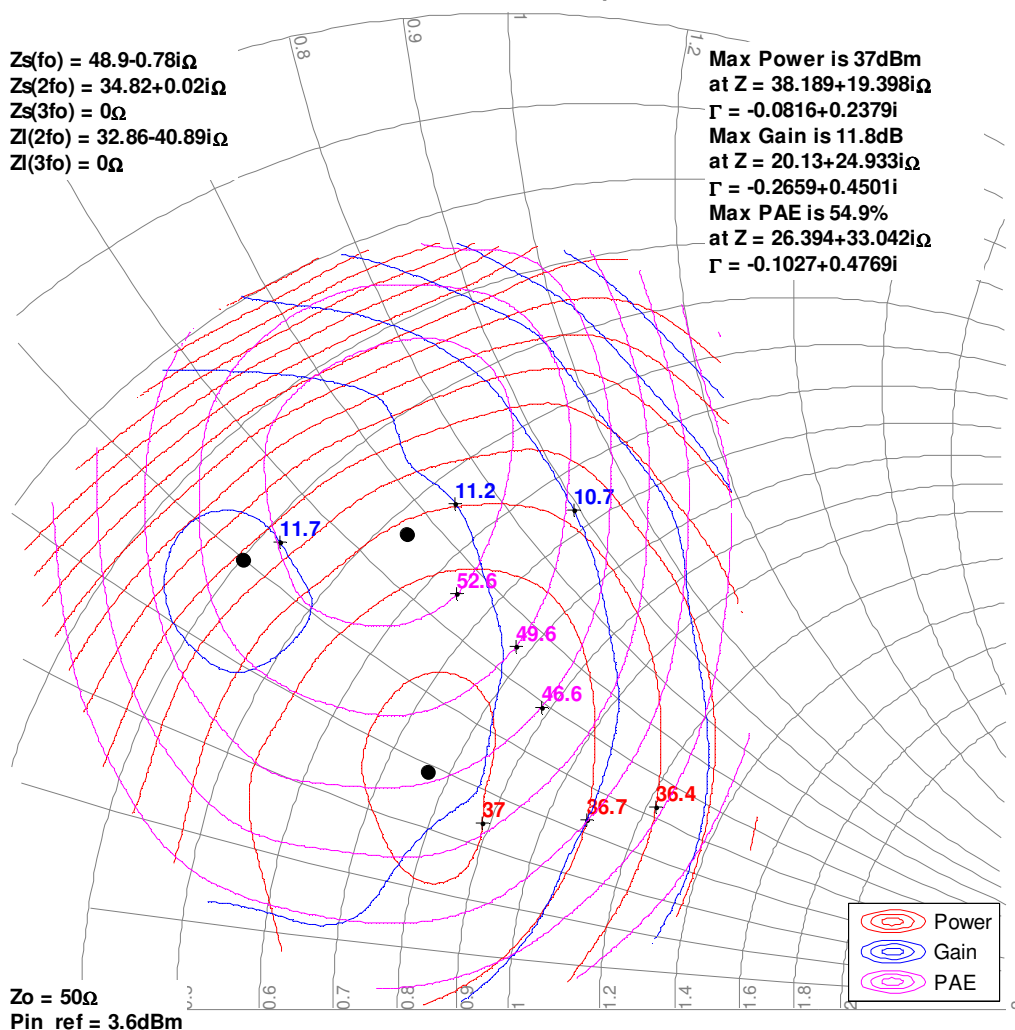
**Load Pull Smith Charts (1, 2)**

RF performance that the device typically exhibits when placed in the specified impedance environment. The impedances are not the impedances of the device, they are the impedances presented to the device via an RF circuit or load-pull system. The impedances listed follow an optimized trajectory to maintain high power and high efficiency.

Notes:

1. 32V, 25mA, Pulsed signal with 100uS pulse width and 20% duty cycle. 3dB compression reference at Pin\_ref.
2. See page 18 for load pull and source pull reference planes.

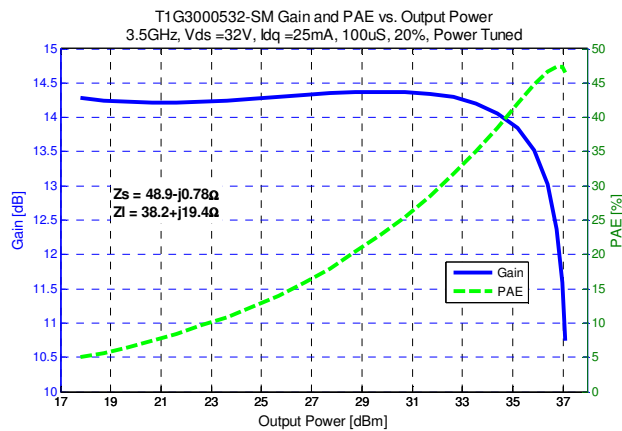
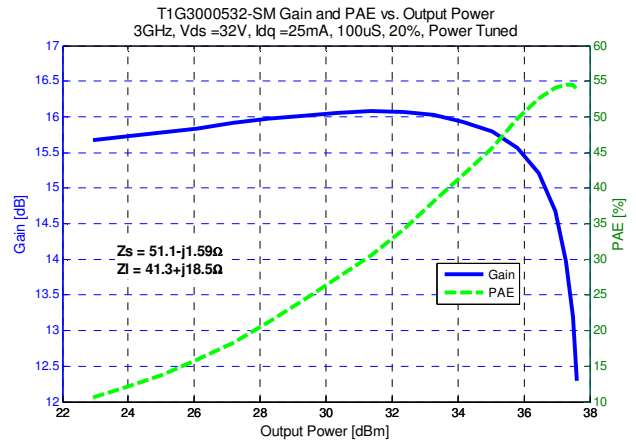
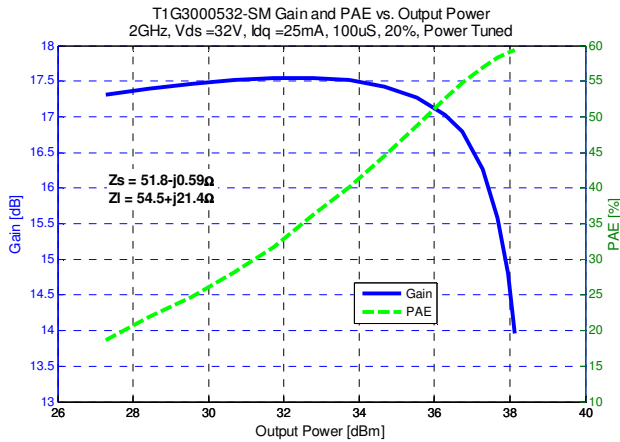
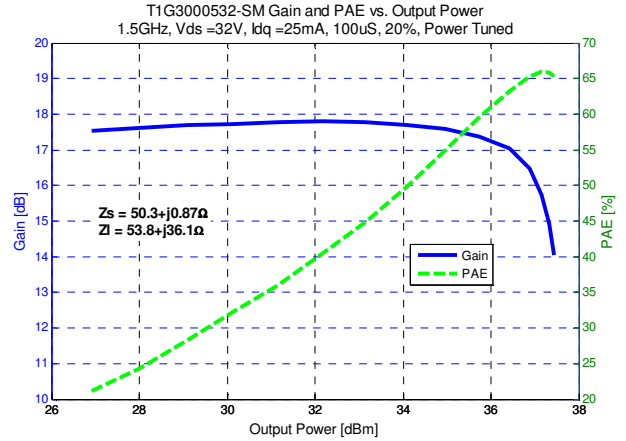
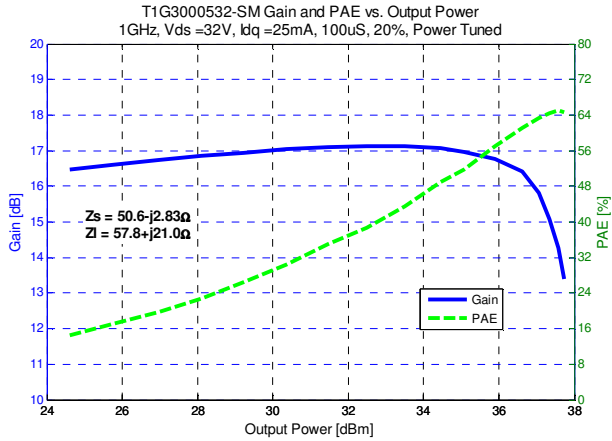
**3.5GHz, Load-pull**



## Typical Performance – Power Tuned<sup>(1,2,3)</sup>

Notes:

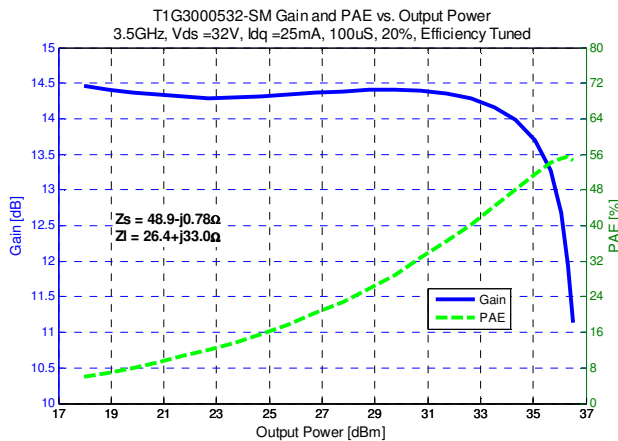
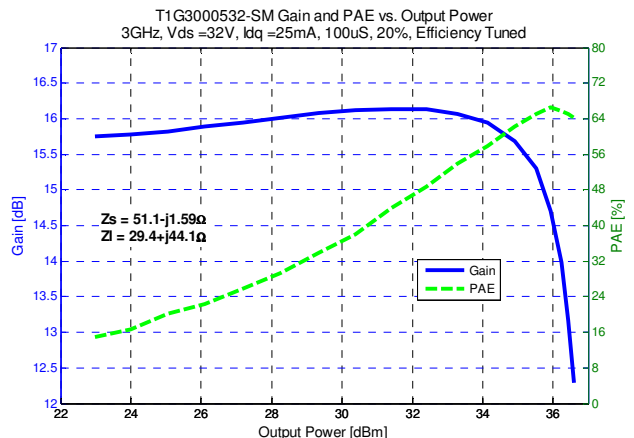
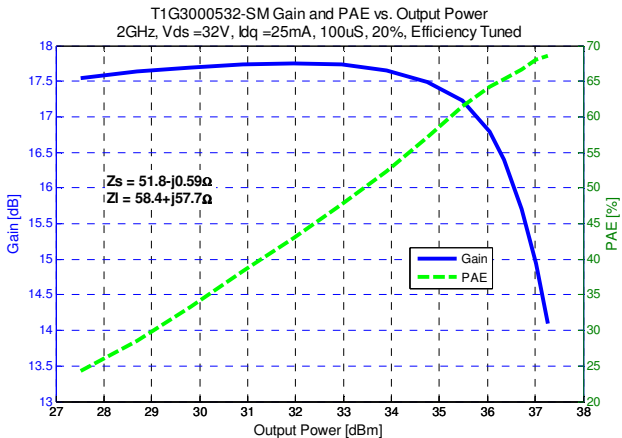
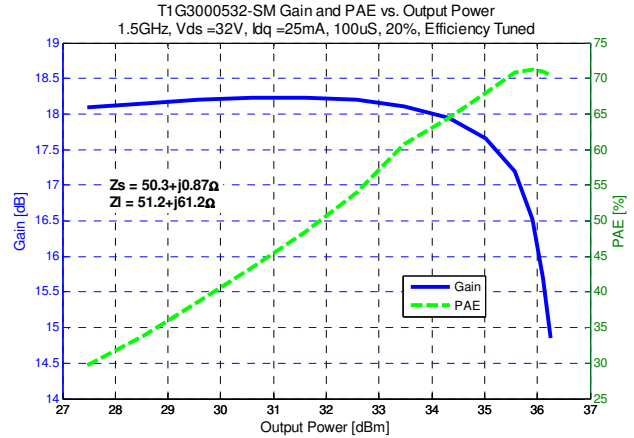
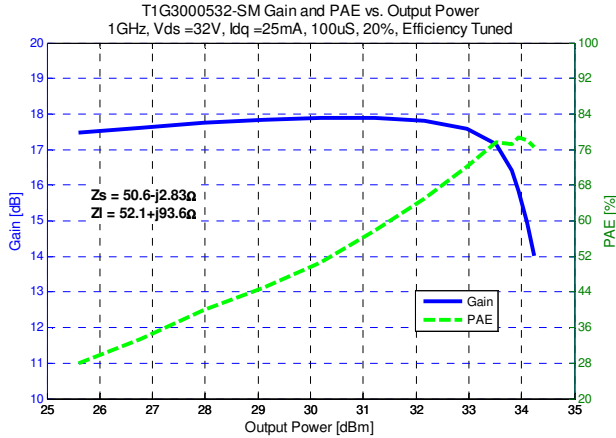
1. Pulsed signal with 100uS pulse width and 20% duty cycle
2. See page 18 for load pull and source pull reference planes.
3. Performance is measured at device reference planes.



## Typical Performance – Efficiency Tuned<sup>(1,2,3)</sup>

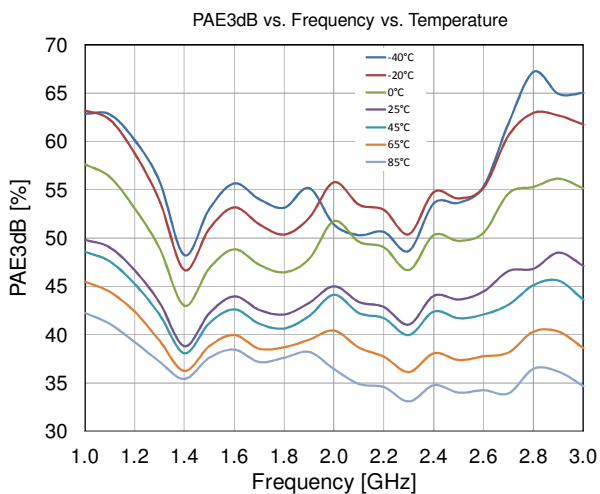
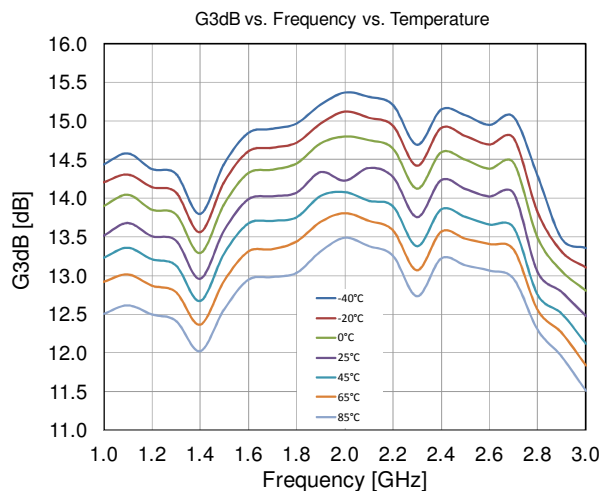
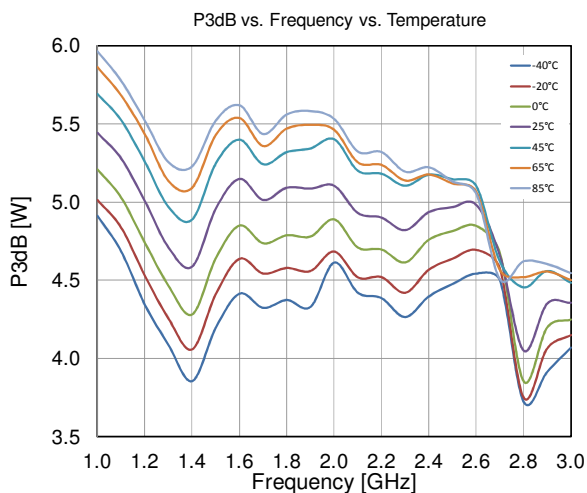
Notes:

4. Pulsed signal with 100uS pulse width and 20% duty cycle
5. See page 18 for load pull and source pull reference planes.
6. Performance is measured at device reference planes.



## Evaluation Board Performance Over Temperature (1, 2)

Performance measured on TriQuint's 0.5 GHz to 3 GHz Evaluation Board

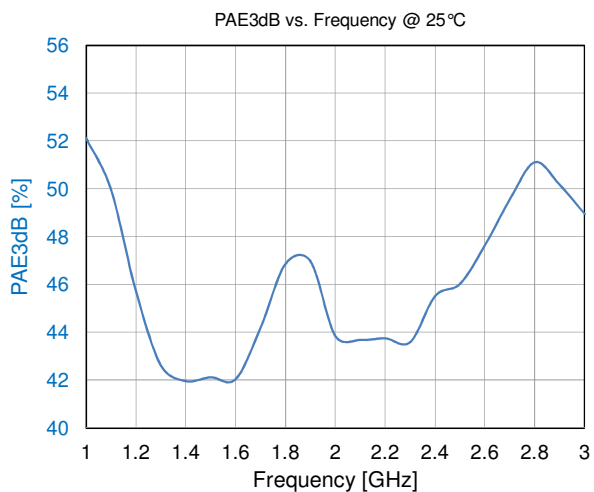
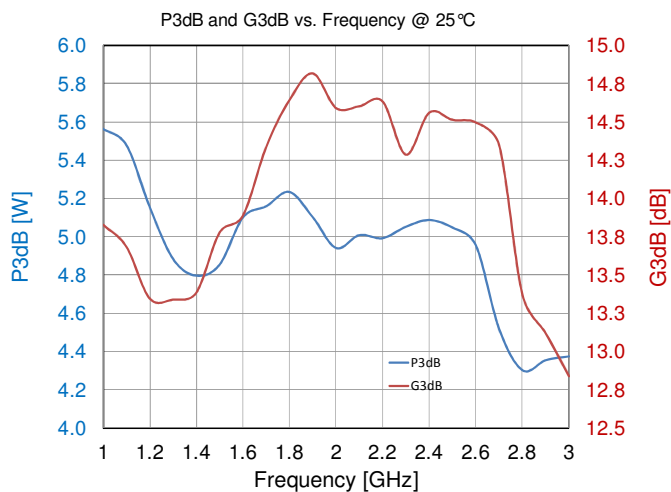


**Notes:**

1. Test Conditions:  $V_{DS} = 32\text{ V}$ ,  $I_{DQ} = 25\text{ mA}$
2. Test Signal: Pulse Width = 100  $\mu\text{s}$ , Duty Cycle = 20%

**Evaluation Board Performance At 25°C<sup>(1, 2)</sup>**

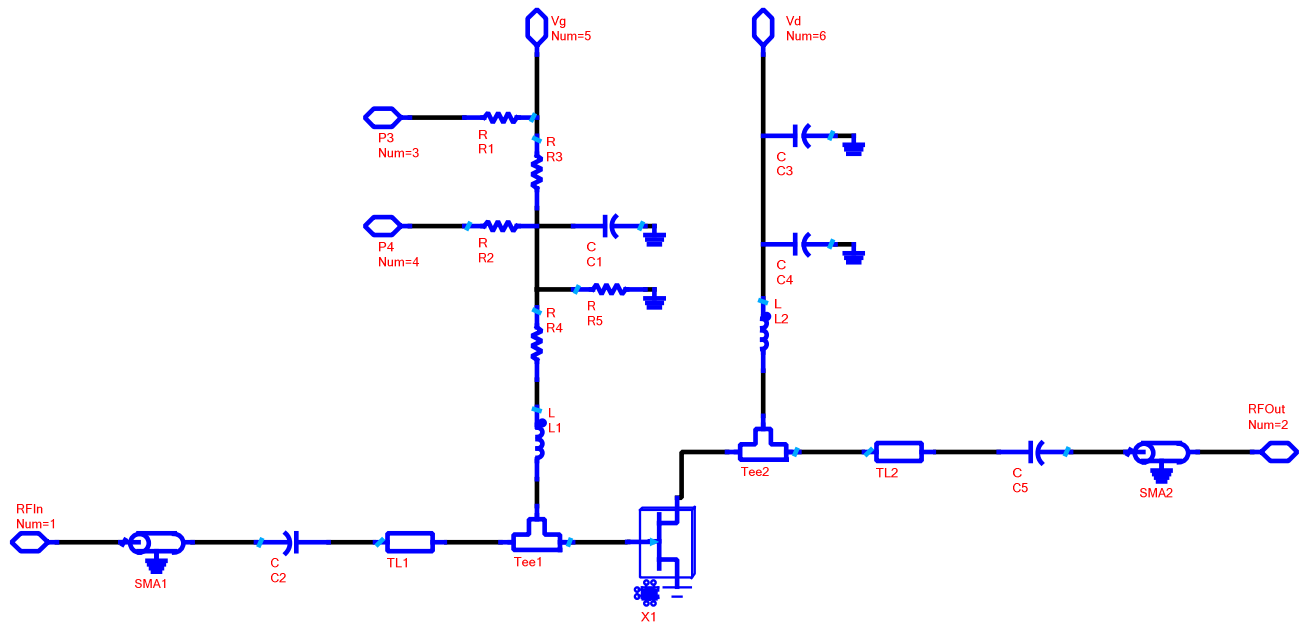
Performance measured on TriQuint's 0.5 GHz to 3.0 GHz Evaluation Board



Notes:

1. Test Conditions:  $V_{DS} = 32\text{ V}$ ,  $I_{DQ} = 25\text{ mA}$ ,  $25^\circ\text{C}$
2. Test Signal: Pulse Width =  $100\ \mu\text{s}$ , Duty Cycle = 20 %

**Application Circuit**



**Bias-up Procedure**

- Set gate voltage ( $V_G$ ) to -5.0V
- Set drain voltage ( $V_D$ ) to 32 V
- Slowly increase  $V_G$  until quiescent  $I_D$  is 25 mA.
- Apply RF signal

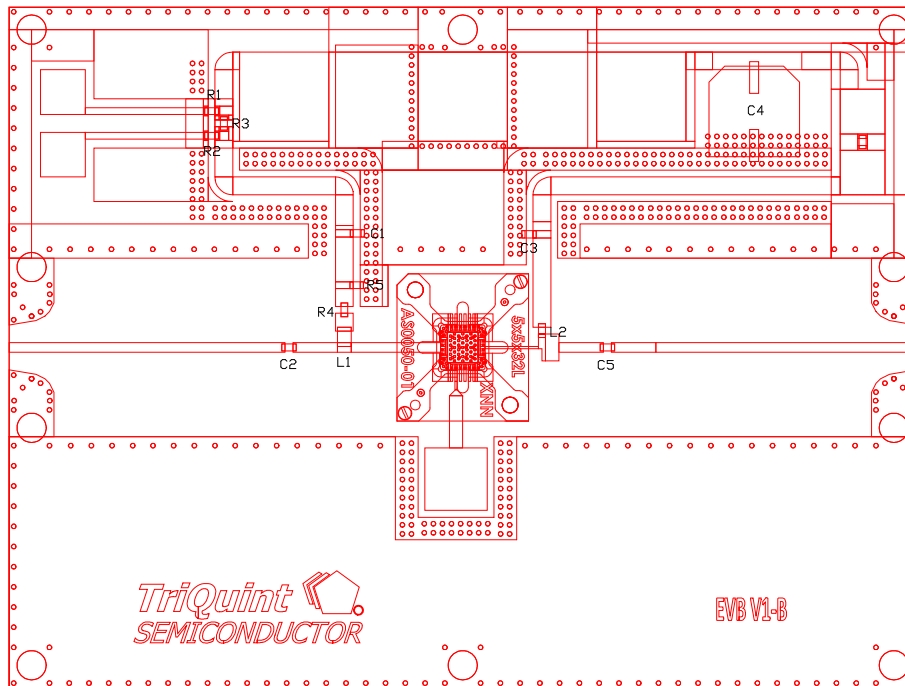
**Bias-down Procedure**

- Turn off RF signal
- Turn off  $V_D$  and wait 1 second to allow drain capacitor dissipation
- Turn off  $V_G$



## Evaluation Board Layout

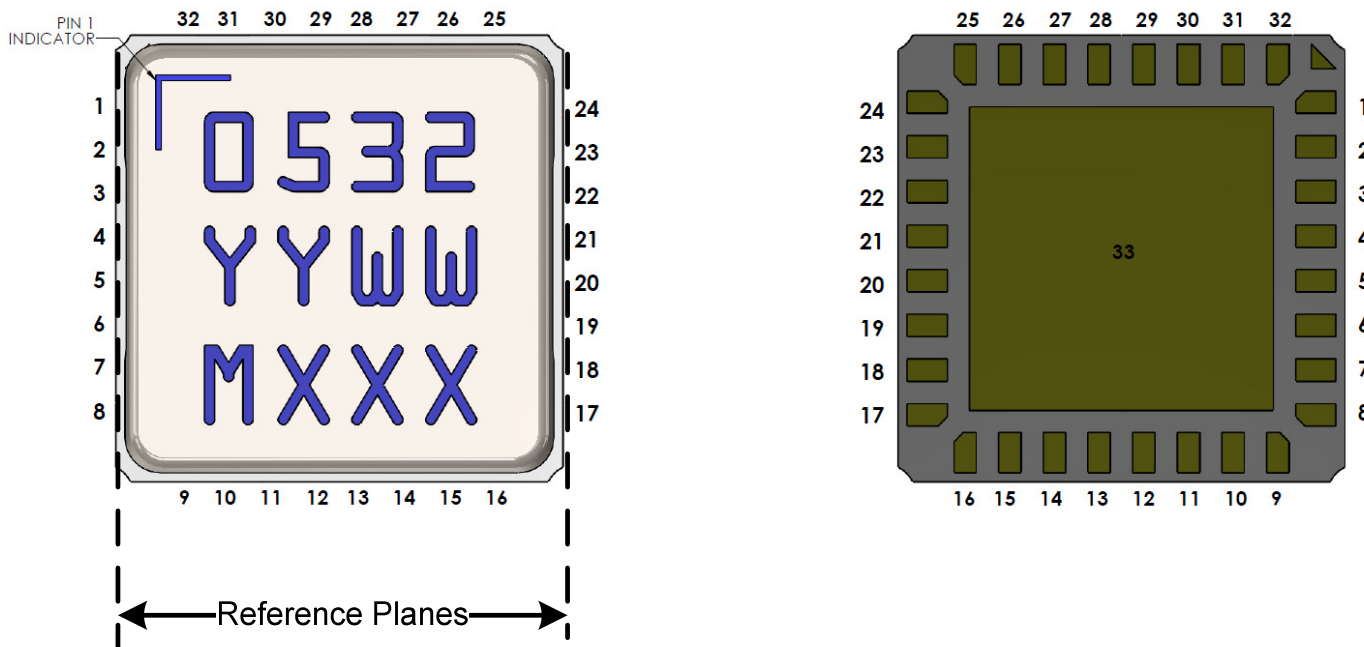
Top RF layer is 0.020" thick Rogers RO4350B,  $\epsilon_r = 3.48$ . The pad pattern shown has been developed and tested for optimized assembly at TriQuint Semiconductor. The PCB land pattern has been developed to accommodate lead and package tolerances.



## Bill of Materials

Reference Design	Value	Qty	Manufacturer	Part Number
R1		0		DNP
R2		0		DNP
R3	0 $\Omega$	1	Generic	0603
R4	10 $\Omega$	1	Venkel	ERJ-3EKF10R10V
R5	1K $\Omega$	1	Venkel	0603
C1	10uF	1		C1632X5R0J106M130AC
C2, C5	56pF	2	ATC	600S560BT250XT
C3	1uF	1	AVX	18121C105KAT2A
C4	220uF	1	United Chem Con	EMVY500AEA221MJA0G
L1	240nH	1	CoilCraft	0805CS-241X_BL
L2	22nH	1	CoilCraft	0805CS_220X_L_

## Pin Layout



## Pin Description

Pin	Symbol	Description
20, 21	$V_D$ / RF OUT	Drain voltage / RF Output to be matched to 50 ohms; see EVB Layout on page 14 as an example.
5	$V_G$ / RF IN	Gate voltage / RF Input to be matched to 50 ohms; see EVB Layout on page 14 as an example.
11	Off-Chip Cap	Off-chip cap to extend low frequency gain.
Back side	Source	Source connected to ground

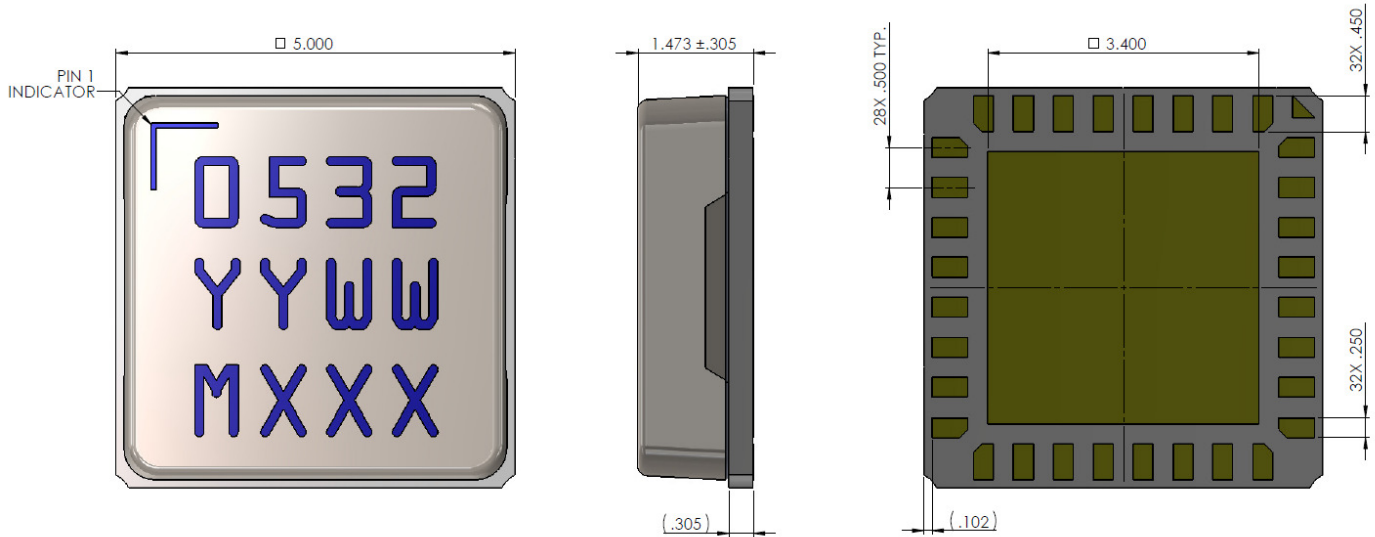
### Notes:

Thermal resistance measured to back side of package

The T1G3000532-SM will be marked with the "0532" designator and a lot code marked below the part designator. The "YY" represents the last two digits of the calendar year the part was manufactured, the "WW" is the work week of the assembly lot start, and the "MXXX" is the production lot number.

**Mechanical Information**

All dimensions are in millimeters.



**Note:**

Unless otherwise noted, all dimension tolerances are +/-0.127 mm.

This package is lead-free/RoHS-compliant. The plating material on the leads is NiAu. It is compatible with both lead-free (maximum 260 °C reflow temperature) and tin-lead (maximum 245 °C reflow temperature) soldering processes.

## Product Compliance Information

### ESD Sensitivity Ratings



Caution! ESD-Sensitive Device

ESD Rating: Class 1A  
 Value: Passes  $\geq 350$  V min.  
 Test: Human Body Model (HBM)  
 Standard: JEDEC Standard JESD22-A114

### MSL Rating

The part is rated Moisture Sensitivity Level 3 at 260°C per JEDEC standard IPC/JEDEC J-STD-020.

### ECCN

US Department of Commerce EAR99

### Solderability

Compatible with the latest version of J-STD-020, Lead free solder, 260°C

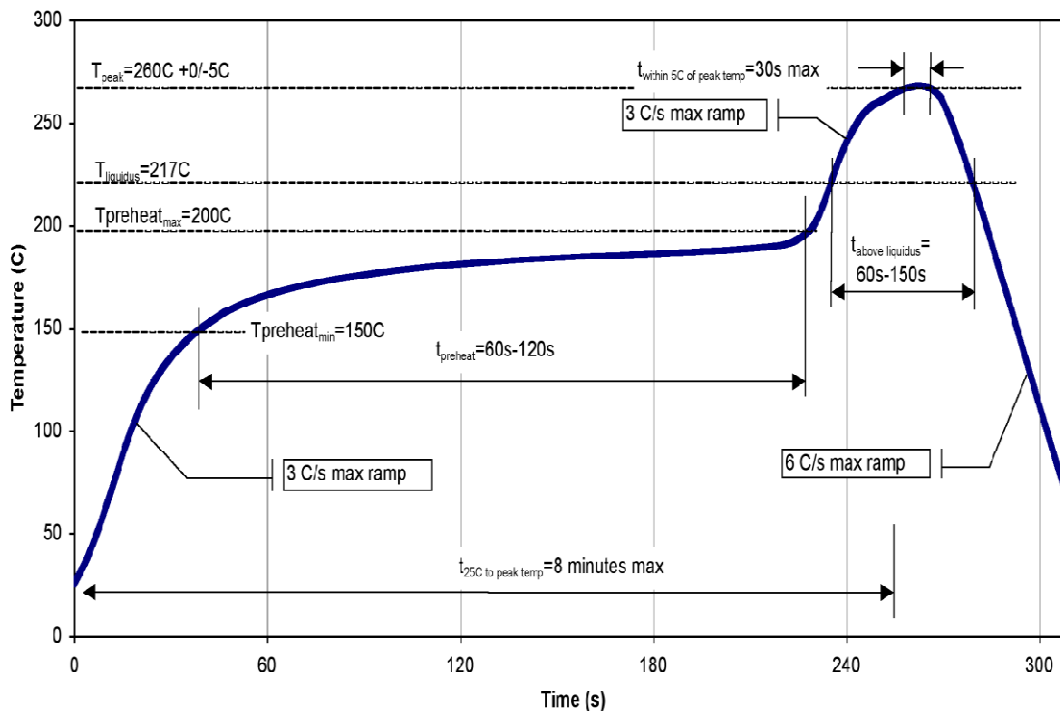
### RoHS Compliance

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<sub>15</sub>H<sub>12</sub>Br<sub>4</sub>O<sub>2</sub>) Free
- PFOS Free
- SVHC Free

## Recommended Soldering Temperature Profile



## Contact Information

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

**Web:** [www.triquint.com](http://www.triquint.com)

**Tel:** +1.972.994.8465

**Email:** [info-sales@triquint.com](mailto:info-sales@triquint.com)

**Fax:** +1.972.994.8504

For technical questions and application information:

**Email:** [info-products@triquint.com](mailto:info-products@triquint.com)

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