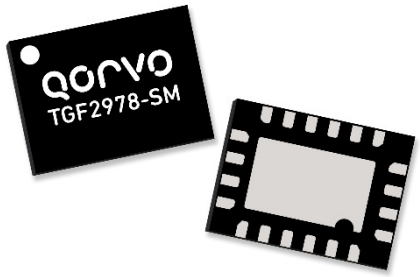
TGF2978-SM

20W, 32V, DC – 12 GHz, GaN RF Transistor

Applications

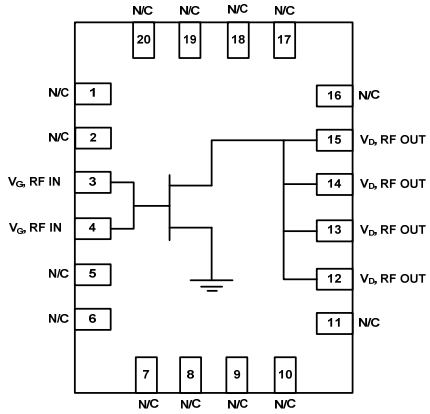
- Military radar
- Commercial radar
  - Avionics
  - Marine
  - Weather



Product Features

- Frequency: DC to 12 GHz
- Output Power (P_{3dB}): 19 W at 9.4 GHz
- Linear Gain: 11 dB at 9.4 GHz
- Typical PAE_{3dB}: 46% at 9.4 GHz
- Operating Voltage: 32 V
- Low thermal resistance package
- CW and Pulse capable
- 3 x 4 mm package

Functional Block Diagram



General Description

The TriQuint TGF2978-SM is a 20 W (P_{3dB}) discrete GaN on SiC HEMT which operates from DC to 12 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.

The device is housed in an industry-standard 3 x 4 mm surface mount QFN package.

Lead-free and ROHS compliant

Evaluation boards are available upon request.

Pin Configuration

Pin No.	Label
12 - 16	V_D / RF OUT
3 - 4	V_G / RF IN
1 - 2, 5 - 11, 16 - 20	NC
Back side	Source

Ordering Information

Part	ECCN	Description
TGF2978-SM	3A001b.3.b	QFN Packaged Part
TGF2978-SM-EVB1	EAR99	EVB

Absolute Maximum Ratings

Parameter	Value
Breakdown Voltage (BV_{DG})	100 V min.
Gate Voltage Range (V_G)	-10 to 0 V
Drain Current (I_D)	2.4 A
Gate Current (I_G)	-5 to 8.4 mA
Power Dissipation, CW (P_D)	28 W
RF Input Power, CW, T = 25°C (P_{IN})	36dBm
Channel Temperature (T_{CH})	275 °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})	100 mA (Typ.)
Peak Drain Current (I_D)	1300 mA (Typ.)
Gate Voltage (V_G)	-2.7 V (Typ.)
Channel Temperature (T_{CH})	225 °C (Max)
Power Dissipation, CW (P_D)[2]	25.6 W (Max)
Power Dissipation, Pulse (P_D)[3]	33 W (Max)

[1] Electrical specifications are measured at specified test conditions.
Specifications are not guaranteed over all recommended operating conditions.
[2] Package at 85 °C
[3] 100 uS Pulse Width, 10 % Duty Cycle, package at 85 °C

Pulsed RF Characterization – Load Pull Performance

Test conditions unless otherwise noted: T_A = 25 °C, V_D = 32 V, I_{DQ} = 100 mA, Pulse: 100 uS Pulse Width, 10 % Duty Cycle

Symbol	Parameter	Freq	Min	Typical	Max	Units
G_{LIN}	Linear Gain, Power Tuned	6 GHz		14.9		dB
		8 GHz		12.9		
		9 GHz		11.3		
		9.4 GHz		10.7		
		10 GHz		9.8		
		12 GHz		8.1		
P_{3dB}	Output Power at 3dB compression point, Power Tuned	6 GHz		43.5		dBm
		8 GHz		43.0		
		9 GHz		43.0		
		9.4 GHz		42.7		
		10 GHz		42.9		
		12 GHz		42.4		
PAE_{3dB}	Power-Added Efficiency at 3dB compression point, Efficiency Tuned	6 GHz		54.9		%
		8 GHz		52.6		
		9 GHz		49.1		
		9.4 GHz		46.1		
		10 GHz		44.2		
		12 GHz		33.0		
G_{3dB}	Gain at 3dB compression point, Power Tuned	6 GHz		11.9		dB
		8 GHz		9.9		
		9 GHz		8.3		
		9.4 GHz		7.7		
		10 GHz		6.8		
		12 GHz		5.1		

Thermal and Reliability Information - CW [1]

Parameter	Simulated Conditions	Value	Units
Thermal Resistance (θ_{JC})	85 °C Case 30.2 W Pdiss, CW	5.83	°C/W
Maximum Channel Temperature (T_{CH})		261	°C
Median Lifetime (T_M)		1.2E5	Hrs
Thermal Resistance (θ_{JC})	85 °C Case 25.2 W Pdiss, CW	5.44	°C/W
Maximum Channel Temperature (T_{CH})		222	°C
Median Lifetime (T_M)		2.3E6	Hrs
Thermal Resistance (θ_{JC})	85 °C Case 20.2 W Pdiss, CW	5.15	°C/W
Maximum Channel Temperature (T_{CH})		189	°C
Median Lifetime (T_M)		4.4E7	Hrs
Thermal Resistance (θ_{JC})	85 °C Case 15.1 W Pdiss, CW	4.90	°C/W
Maximum Channel Temperature (T_{CH})		159	°C
Median Lifetime (T_M)		9.2E8	Hrs
Thermal Resistance (θ_{JC})	85 °C Case 10.1 W Pdiss, CW	4.65	°C/W
Maximum Channel Temperature (T_{CH})		132	°C
Median Lifetime (T_M)		2.1É10	Hrs
Thermal Resistance (θ_{JC})	85 °C Case 5.0 W Pdiss, CW	4.40	°C/W
Maximum Channel Temperature (T_{CH})		107	°C
Median Lifetime (T_M)		5.6E11	Hrs

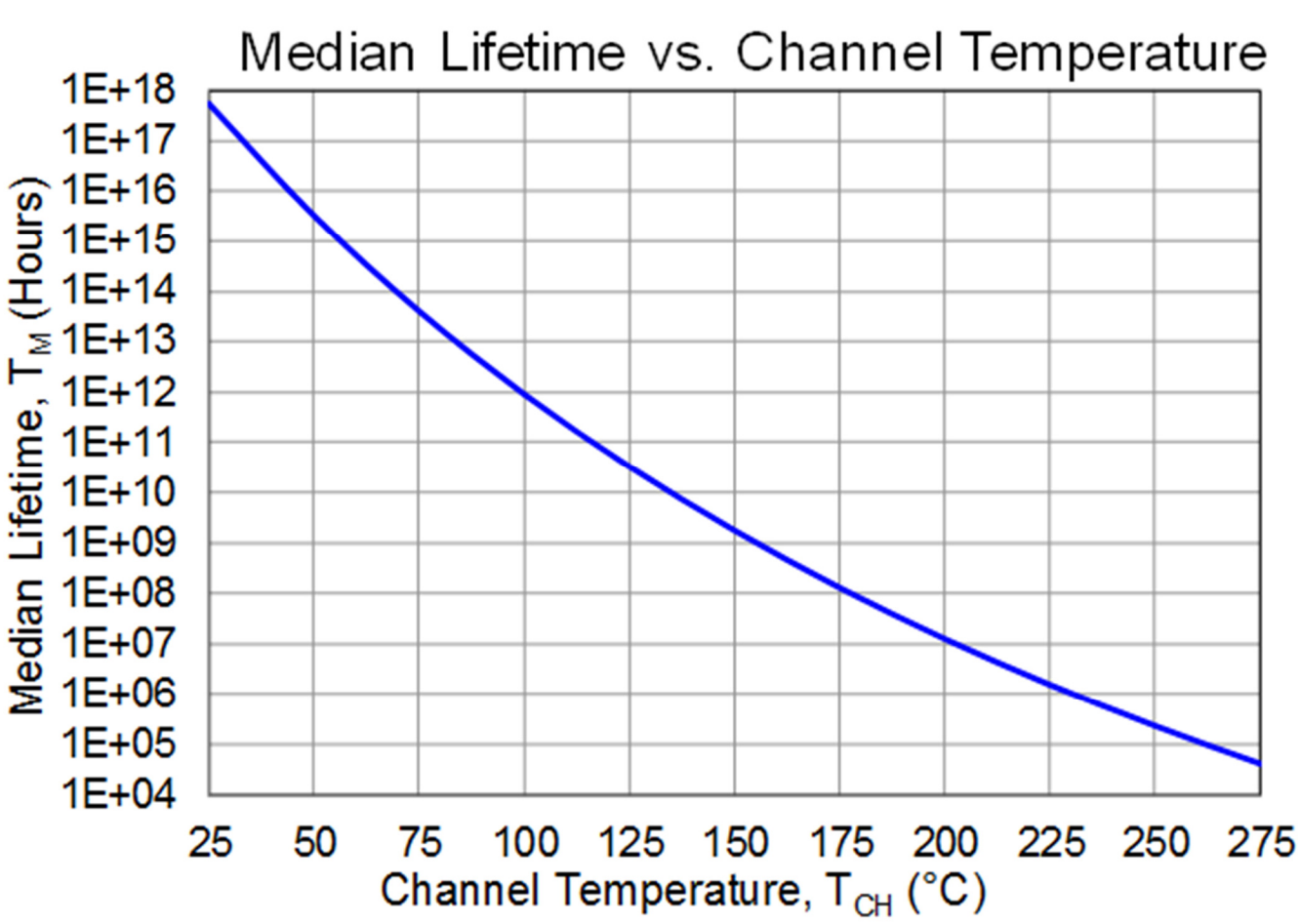
Notes:
1. Thermal resistance measured to bottom of package.

Thermal and Reliability Information - Pulsed [1]

Parameter	Simulated Conditions	Value	Units
Thermal Resistance (θ_{JC})	85 °C Case 30.2 W Pdiss, 500 uS PW, 10%	5.36	ºC/W
Maximum Channel Temperature (T_{CH})		247	°C
Median Lifetime (T_M)		3.2E6	Hrs
Thermal Resistance (θ_{JC})	85 °C Case 25.2 W Pdiss, 500 uS PW, 10%	5.08	ºC/W
Maximum Channel Temperature (T_{CH})		213	°C
Median Lifetime (T_M)		5.0E7	Hrs
Thermal Resistance (θ_{JC})	85 °C Case 30.2 W Pdiss, 100 uS PW, 10%	4.17	ºC/W
Maximum Channel Temperature (T_{CH})		211	°C
Median Lifetime (T_M)		6.0E7	Hrs
Thermal Resistance (θ_{JC})	85 °C Case 25.2 W Pdiss, 100uS PW, 10%	4.01	ºC/W
Maximum Channel Temperature (T_{CH})		186	°C
Median Lifetime (T_M)		5.9E8	Hrs

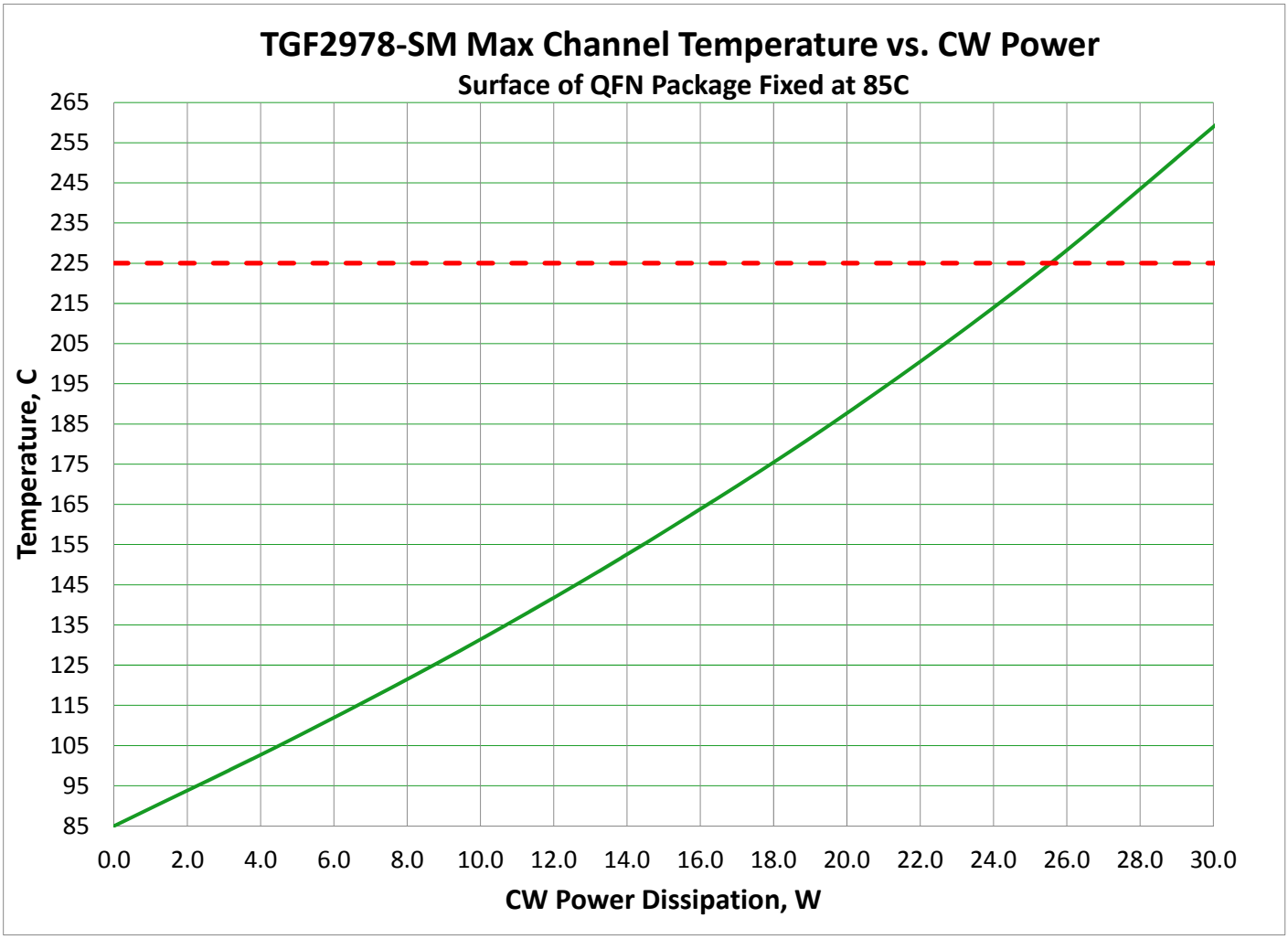
Notes:
1. Thermal resistance measured to bottom of package.

Median Lifetime[1]

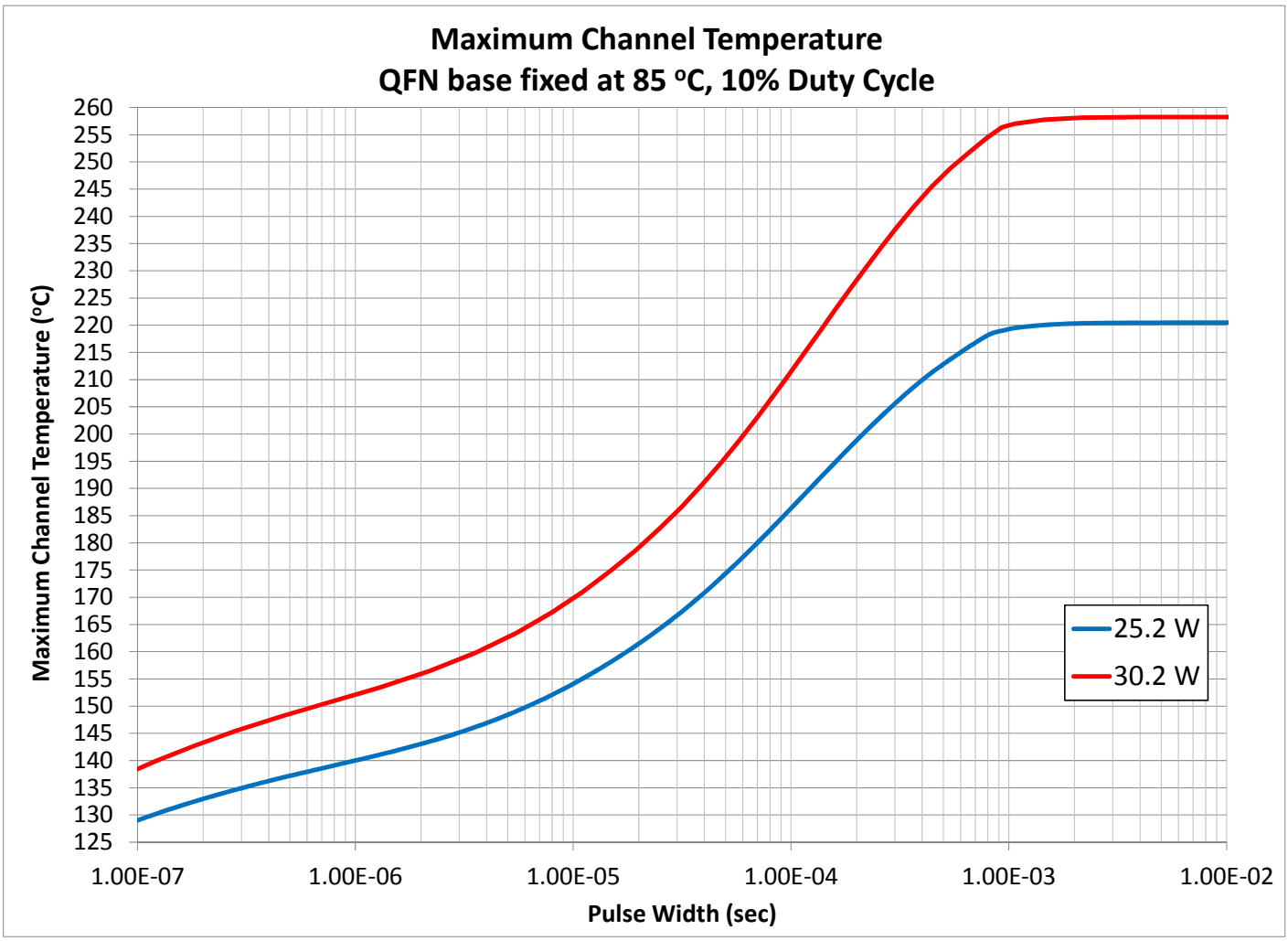


[1] For pulsed signals, average lifetime is average lifetime at maximum channel temperature divided by duty cycle.

Maximum Channel Temperature, CW



Maximum Channel Temperature, Pulsed

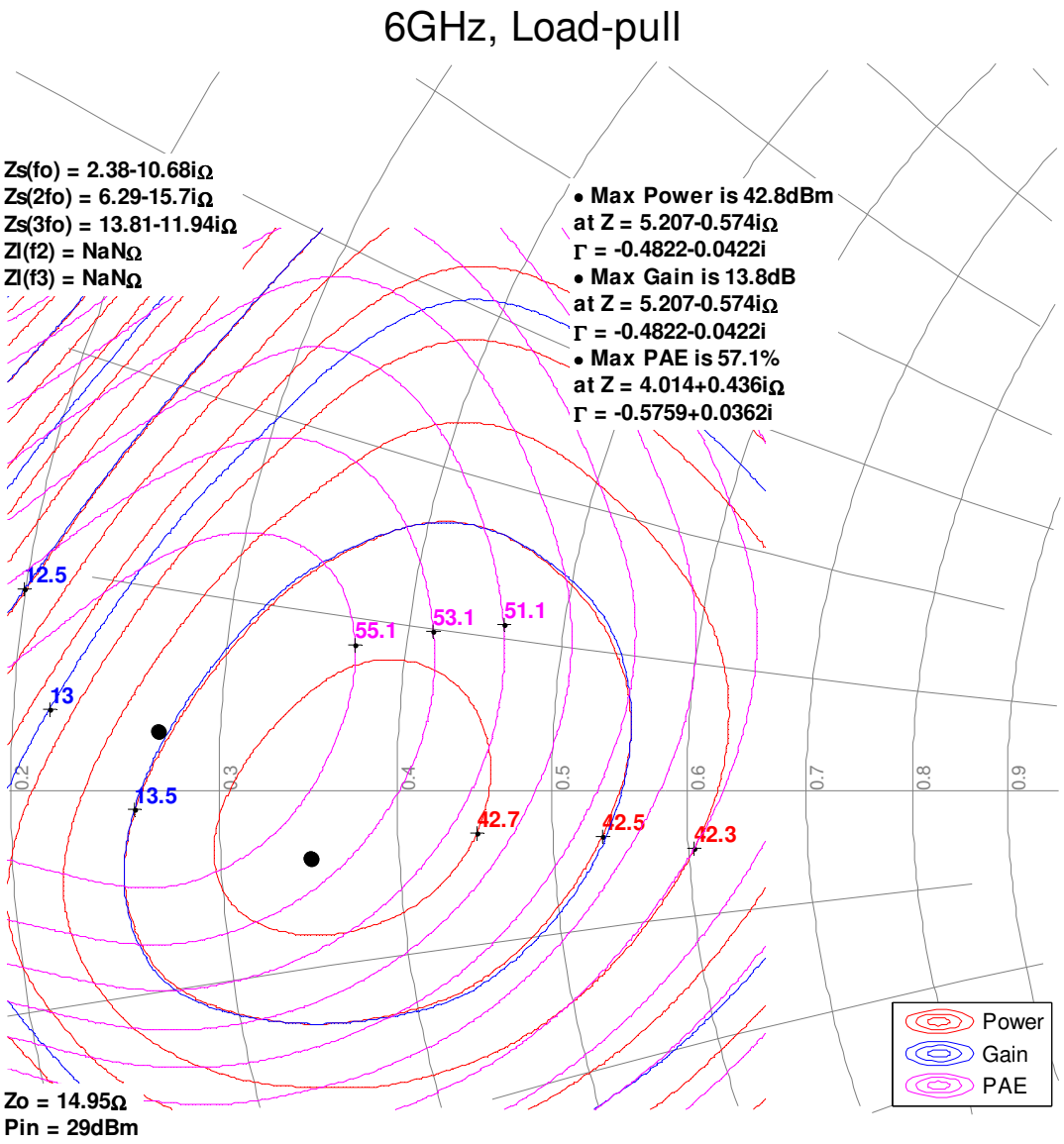


Load Pull Smith Charts - Pulsed (1, 2, 3)

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. 32 V, 100 mA, Pulsed signal with 100 uS pulse width and 10% duty cycle. Performance is at indicated input power.
2. See page 16 for load pull and source pull reference planes. 15-Ω load pull TRL fixtures are built with 10-mil RO4350B material.
3. NaN means the impedances are either undefined or varying in load-pull system.



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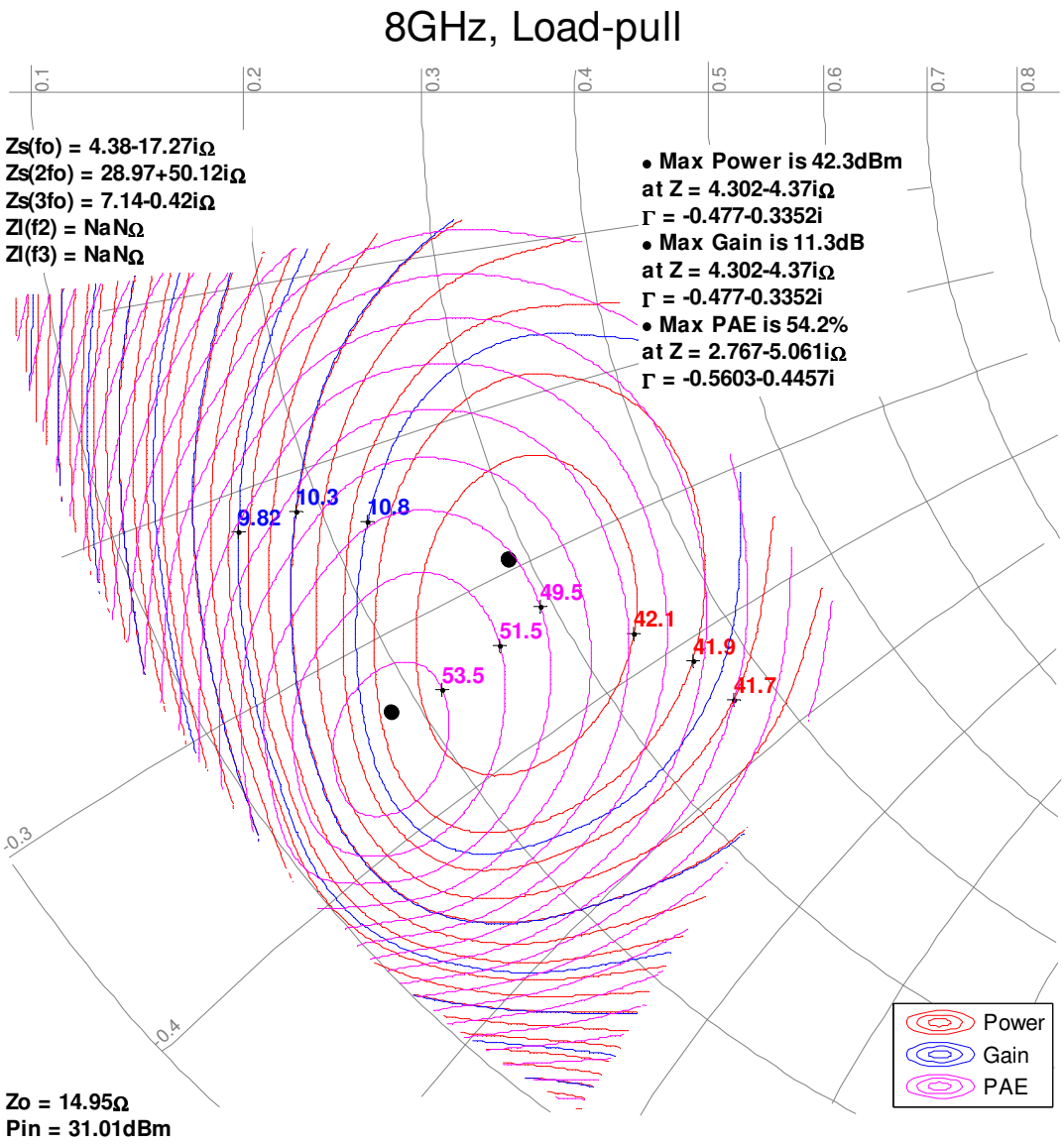

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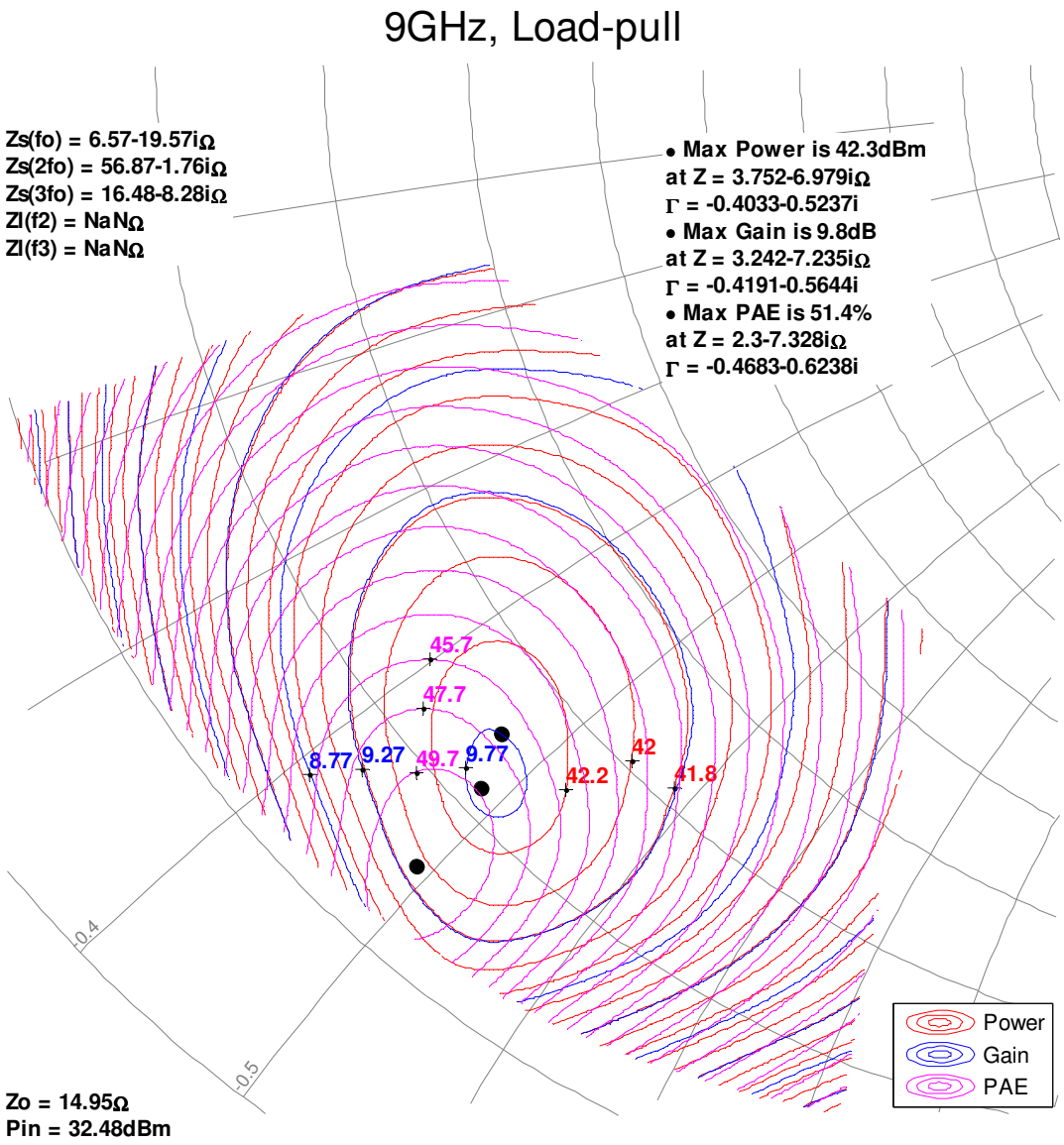

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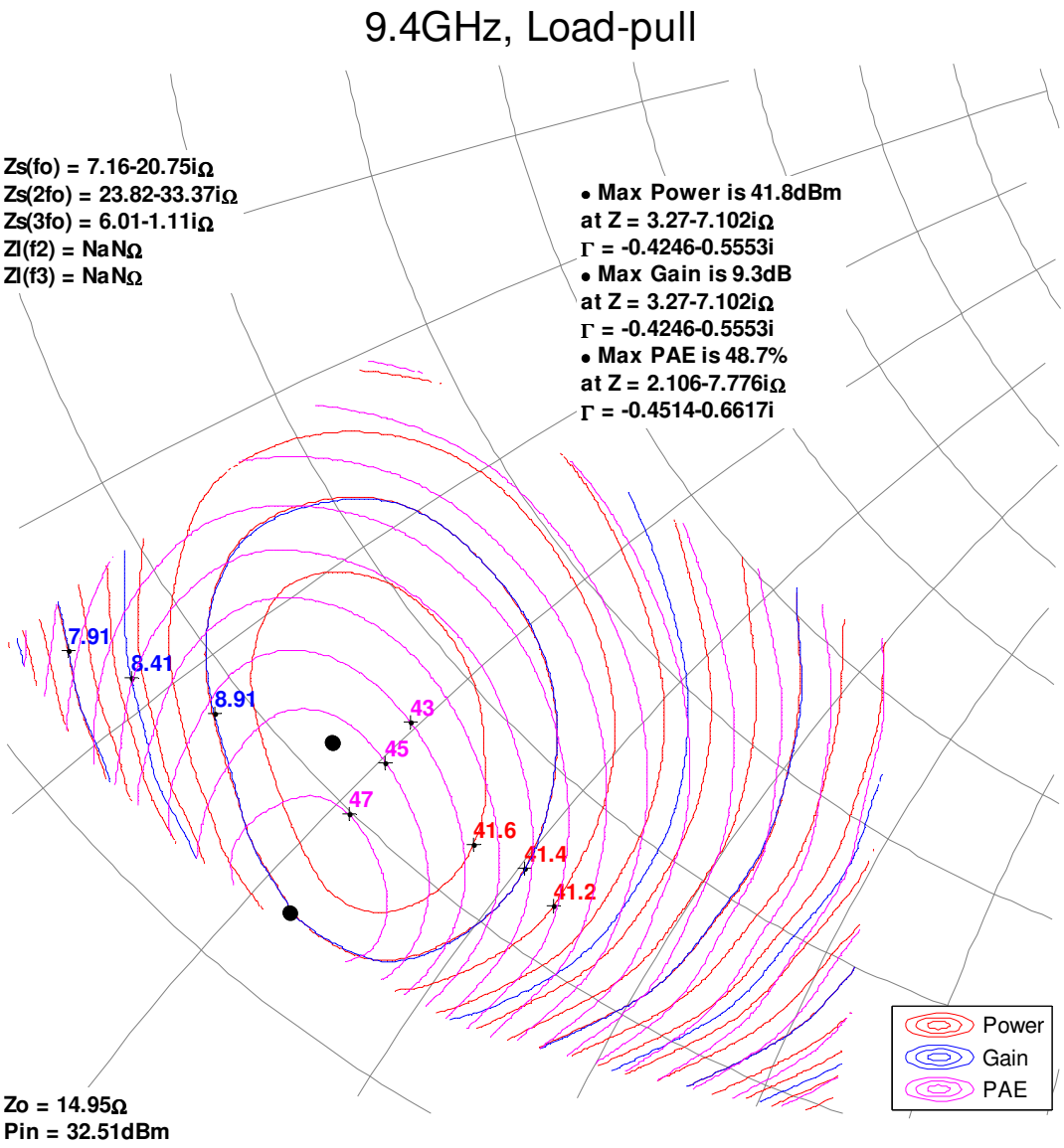

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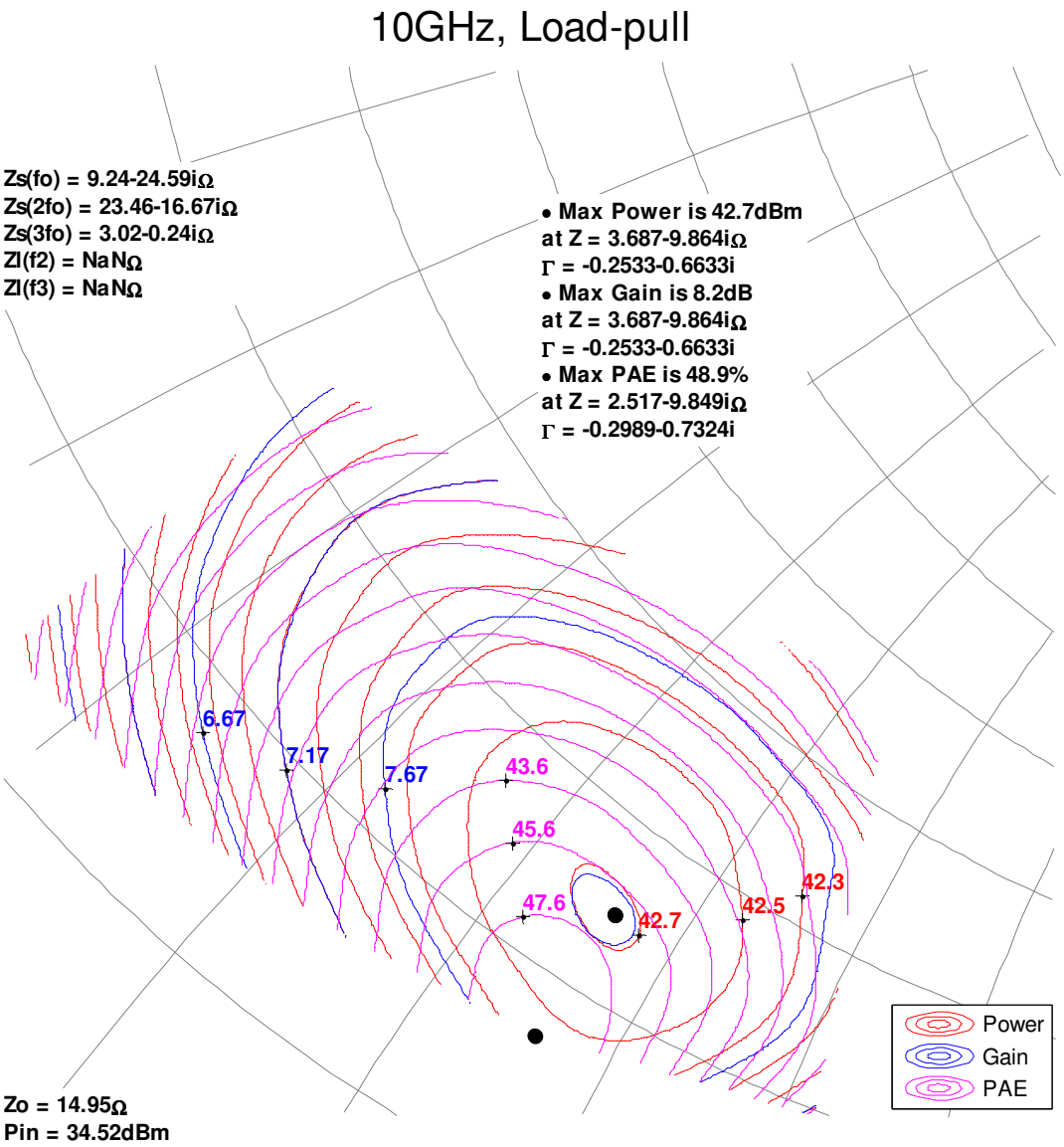

Load Pull Smith Charts - Pulsed (1, 2, 3)

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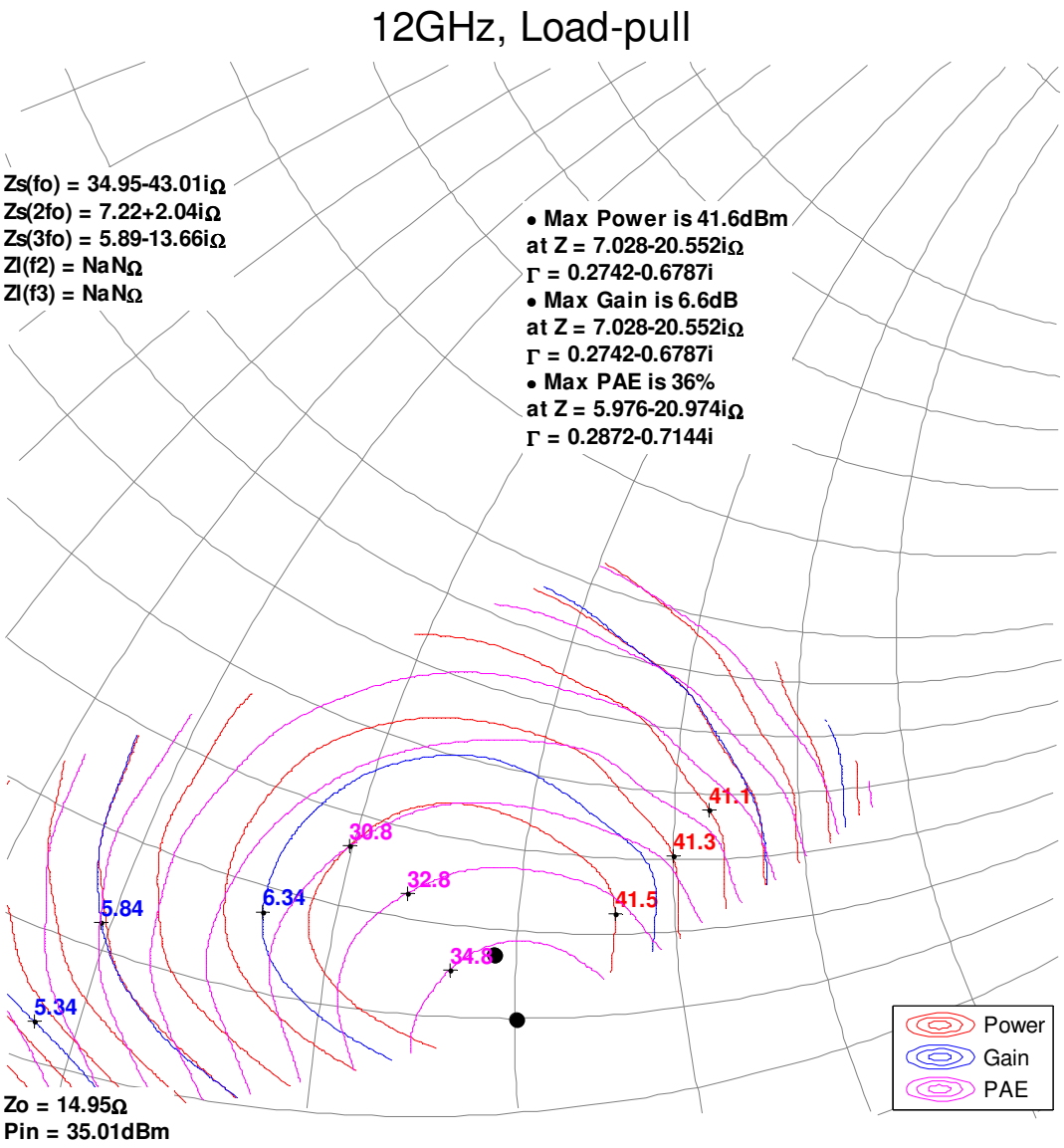
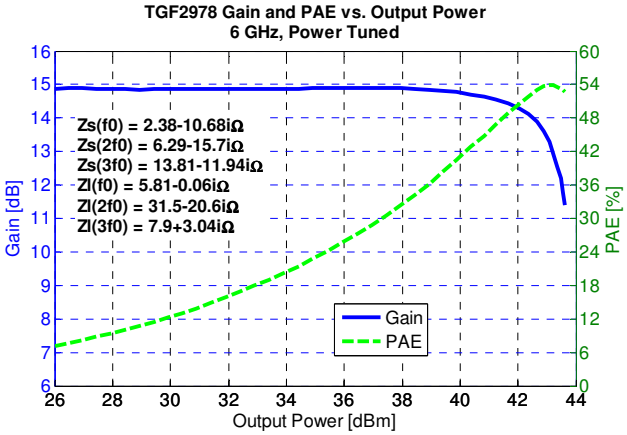
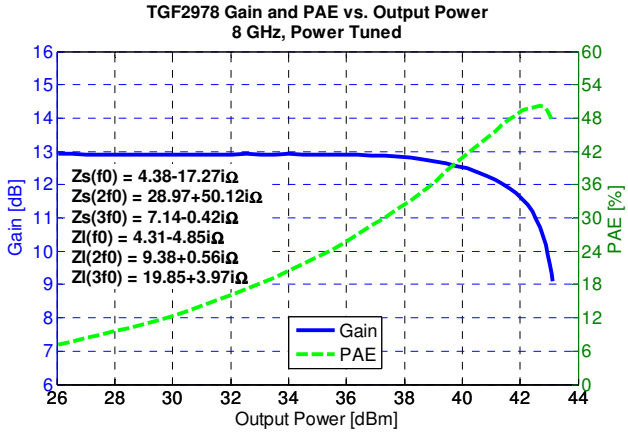
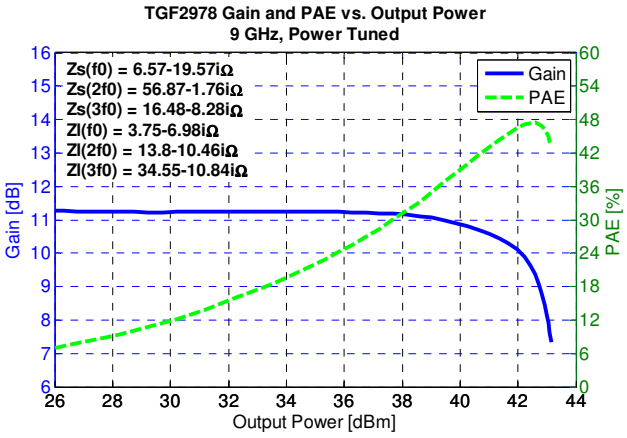


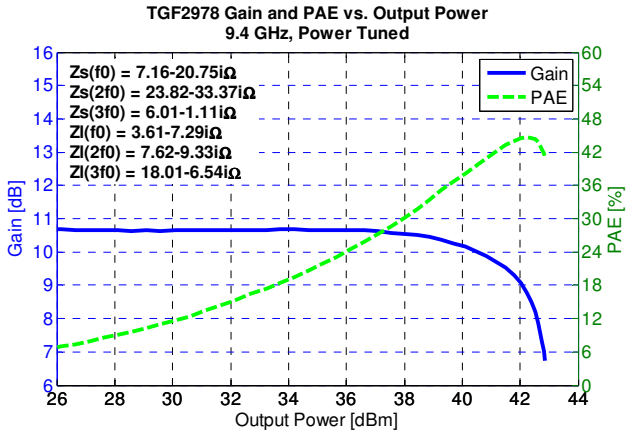
Typical Pulsed Performance – Power Tuned(1,2)

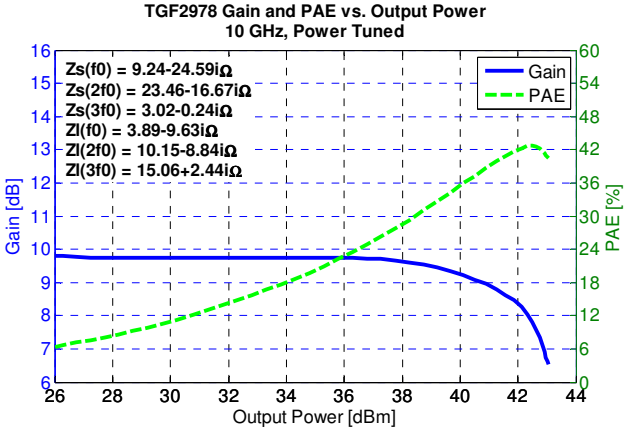
Notes:
1. Pulsed signal with 100 uS pulse width and 10 % duty cycle
2. See page 16 for load pull and source pull reference planes where the performance was measured.
3. Vd = 32 V, Idq = 100 mA

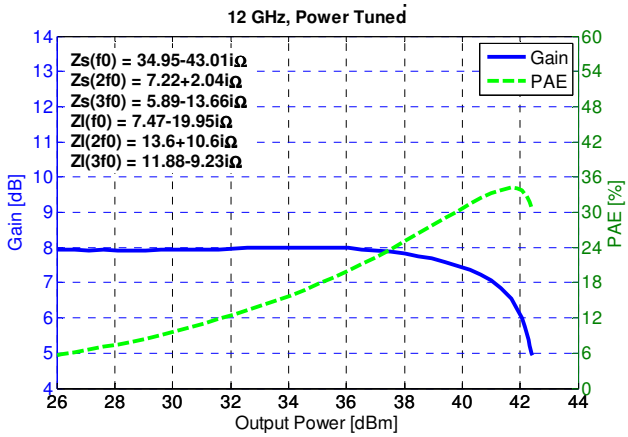






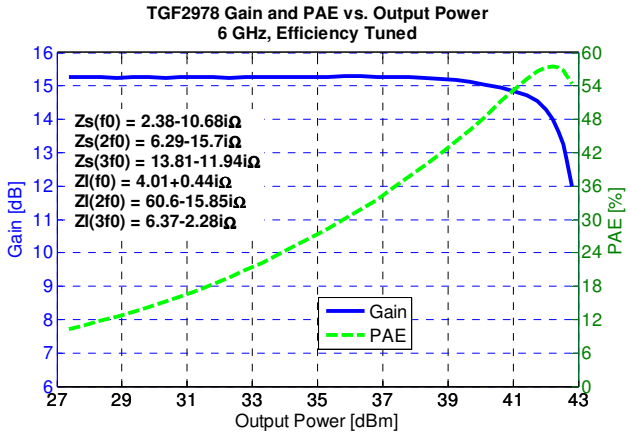


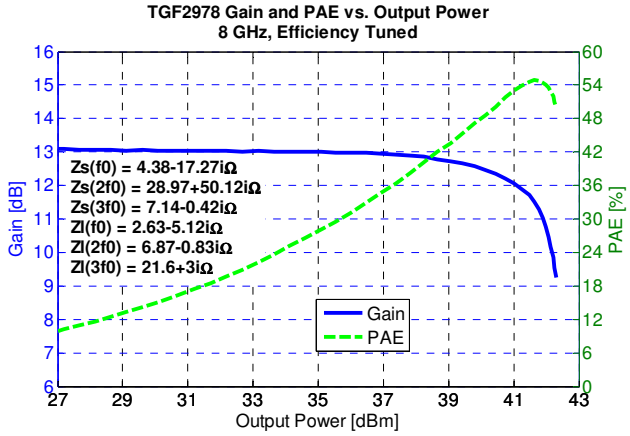


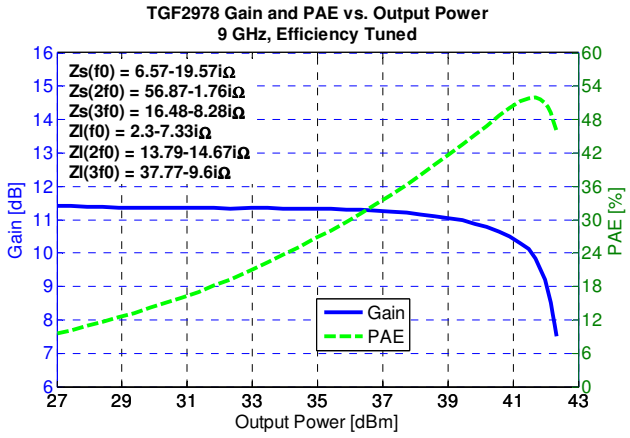


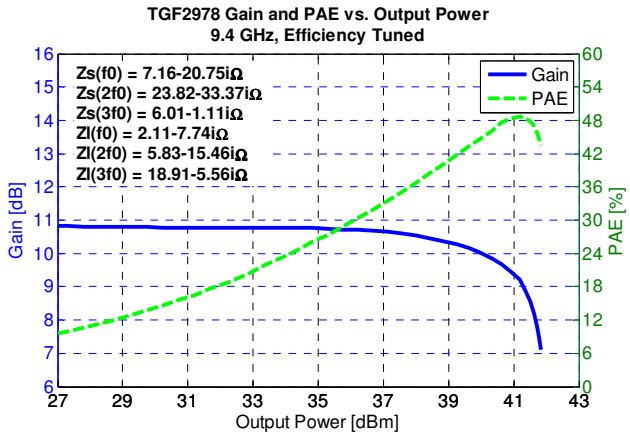
Typical Pulsed Performance – Efficiency Tuned(1,2)

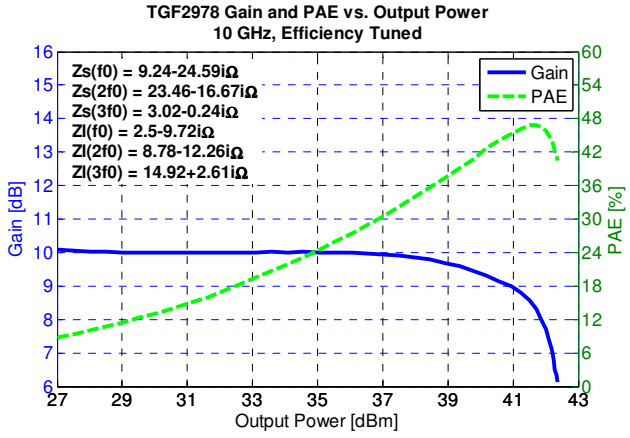
Notes:
1. Pulsed signal with 100 uS pulse width and 10 % duty cycle
2. See page 16 for load pull and source pull reference planes where the performance was measured.
3. Vd = 32 V, Idq = 100 mA

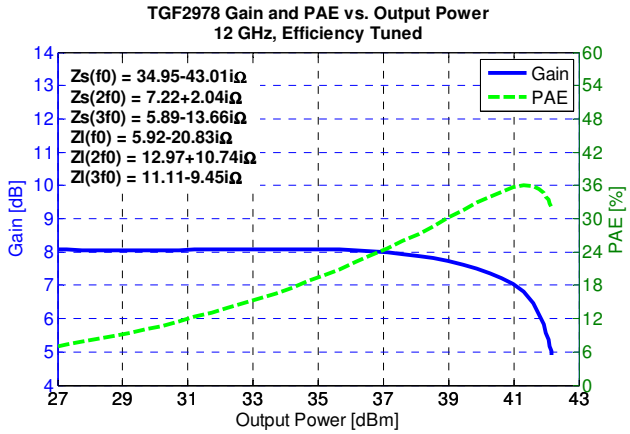




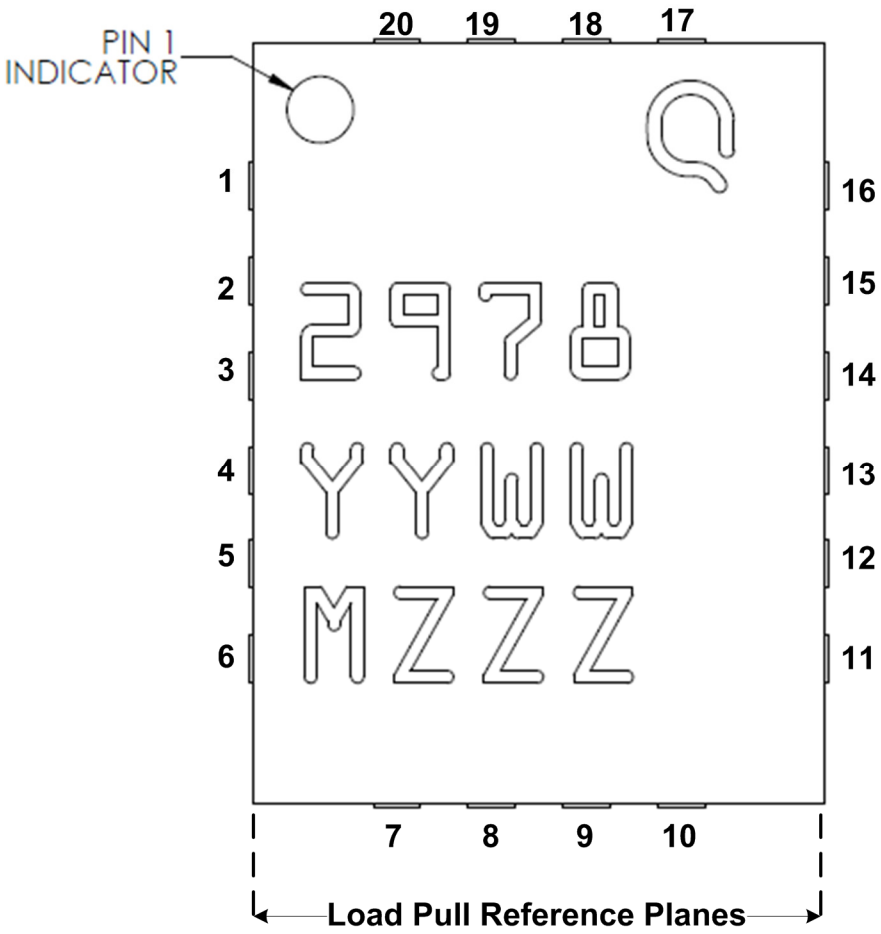








Pin Layout



Pin Description

Pin	Symbol	Description
12 - 15	V_D / RF OUT	Drain voltage / RF Output to be matched to 50 ohms; see EVB Layout on page 19 as an example.
3 - 4	V_G / RF IN	Gate voltage / RF Input to be matched to 50 ohms; see EVB Layout on page 19 as an example.
1 - 2, 5 – 11, 16 - 20	N/C	Not connected
Back side	Source	Source connected to ground

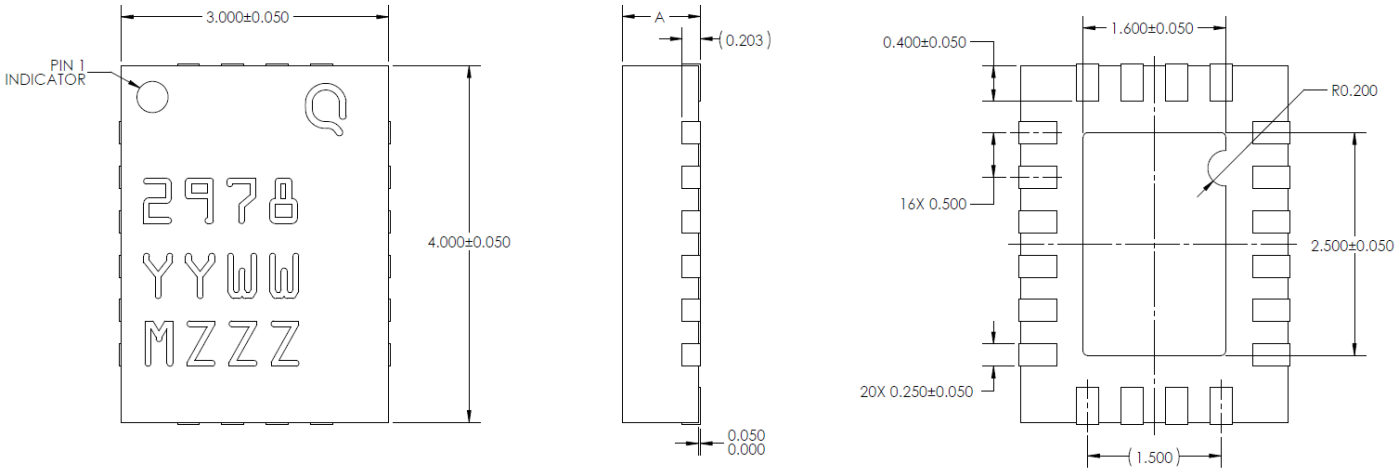
Notes:

Thermal resistance measured to back side of package

The TGF2978-SM will be marked with the “2978” 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 “MZZZ” is the production lot number.

Mechanical Information

All dimensions are in milimeters.



A	MAX	0.900
	NOM	0.850
	MIN	0.800

Note:

Unless otherwise noted, all dimention 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 ℃ reflow temperature) and tin-lead (maximum 245℃ reflow temperature) soldering processes.

Product Compliance Information

ESD Sensitivity Ratings

Caution! ESD-Sensitive Device

ESD Rating: Class 1B
Value: Passes ≥ 600 V.
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 ($C_{15}H_{12}Br_4O_2$) Free
- PFOS Free
- SVHC Free

Recommended Soldering Temperature Profile