TGF3015-SM

10 W, 32 V, 0.03 – 3 GHz, GaN RF Input-Matched Transistor

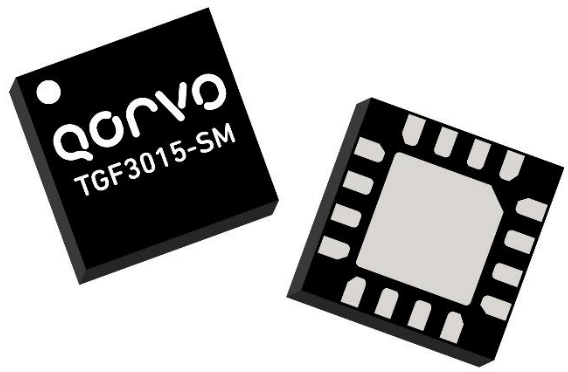
Product Overview

The Qorvo TGF3015-SM is a 10W (P_{3dB}), 50Ω-input matched discrete GaN on SiC HEMT which operates from 30 MHz to 3.0 GHz. The integrated input matching network enables wideband gain and power performance, while the output can be matched on board to optimize power and efficiency for any region within the band.

The device is housed in an industry-standard 3 x 3 mm package that saves real estate in space-constrained handheld radios.

Lead-free and ROHS compliant

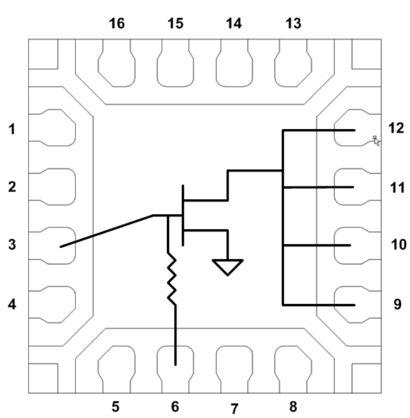
Evaluation boards are available upon request.



Key Features

- Frequency: 30 MHz to 3.0 GHz
- Output Power (P_{3dB}): 11 W at 2.4 GHz
- Linear Gain: 17.1 dB at 2.4 GHz
- Typical PAE_{3dB}: 62.7% at 2.4 GHz
- Operating Voltage: 32 V
- Low thermal resistance package
- CW and Pulse capable
- 3 x 3 mm package

Functional Block Diagram



Applications

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

Pin Configuration

Pin No.	Label
9 - 12	V_D / RF OUT
3	V_G / RF IN
6	Off-chip Shunt Cap for Low-Frequency Gain
Back side	Source

Ordering info

Part No.	Description
TGF3015-SM	QFN Packaged Part
TGF3015-SMEVB1	0.5 – 3 GHz EVB

Absolute Maximum Ratings [1, 2, 3]

Parameter	Rating	Units
Breakdown Voltage, BV_{DG}	100	V
Gate Voltage Range, V_G	−50 to 0	V
Drain Current, I_{DMAX}	1.5	A
Gate Current Range, I_G	−2.5 to 4.2	mA
Power Dissipation, Pulsed, P_{DISS} [2]	15	W
RF Input Power, CW, T = 25°C (P_{IN})	27.5	dBm
Mounting Temperature (30 Seconds)	320	°C
Storage Temperature	−40 to +150	°C

Notes:
1. Operation of this device outside the parameter ranges given above may cause permanent damage
2. Pulsed, 100us PW, 20% DC, Package base at 85 °C
3. Pulsed, 100us PW, 20% DC, T = 25 °C

Recommended Operating Conditions [1]

Parameter	Min	Typ	Max	Units
Gate Voltage, V_G	–	−2.7	–	V
Drain Voltage Range, V_D		32		V
Drain Bias Current, I_{DQ}	–	50	–	mA

Notes:
1. Electrical performance is measured under conditions noted in the electrical specifications table. Specifications are not guaranteed over all recommended operating conditions

RF Characterization – Load Pull Performance at 1.0 GHz [1]

Parameter	Min	Typ	Max	Units
Linear Gain, G_{LIN}	–	16.2	–	dB
Output Power at 3dB compression point, P_{3dB}	–	40.2	–	dBm
Power-Added Efficiency at 3 dB Gain Compression, Efficiency Tuned, PAE_{3dB}	–	70.9	–	%
Gain at 3dB compression point, G_{3dB}	–	13.2	–	dB

Notes:
1. V_D = 32 V, I_{DQ} = 50 mA, T_A = 25 °C, Pulse Width = 100 us, Duty Cycle = 20%

RF Characterization – Load Pull Performance at 2.0 GHz [1]

Parameter	Min	Typ	Max	Units
Linear Gain, G_{LIN}	–	16.5	–	dB
Output Power at 3dB compression point, P_{3dB}	–	40.6	–	dBm
Power-Added Efficiency at 3 dB Gain Compression, Efficiency Tuned, PAE_{3dB}	–	61.7	–	%
Gain at 3dB compression point, G_{3dB}	–	13.5	–	dB

Notes:
1. V_D = 32 V, I_{DQ} = 50 mA, T_A = 25 °C, Pulse Width = 100 us, Duty Cycle = 20%

RF Characterization – Load Pull Performance at 2.4 GHz [1]

Parameter	Min	Typ	Max	Units
Linear Gain, G_{LIN}	–	17.1	–	dB
Output Power at 3 dB Gain Compression, Power Tuned, P_{3dB}	–	40.4	–	dBm
Power-Added Efficiency at 3 dB Gain Compression, Efficiency Tuned, PAE_{3dB}	–	62.7	–	%
Gain at 3dB compression point, Power Tuned, G_{3dB}	–	14.1	–	dB

Notes:
1. V_D = 32 V, I_{DQ} = 50 mA, T_A = 25 °C, Pulse Width = 100 us, Duty Cycle = 20%

RF Characterization – Load Pull Performance at 2.7 GHz [1]

Parameter	Min	Typ	Max	Units
Linear Gain, G_{LIN}	–	16.3	–	dB
Output Power at 3 dB Gain Compression, Power Tuned, P_{3dB}	–	40.5	–	dBm
Power-Added Efficiency at 3 dB Gain Compression, Efficiency Tuned, PAE_{3dB}	–	63.7	–	%
Gain at 3dB compression point, Power Tuned, G_{3dB}	–	13.3	–	dB

Notes:
1. V_D = 32 V, I_{DQ} = 50 mA, T_A = 25 °C, Pulse Width = 100 us, Duty Cycle = 20%

RF Characterization – Load Pull Performance at 3.0 GHz [1]

Parameter	Min	Typ	Max	Units
Linear Gain, G_{LIN}	–	15.4	–	dB
Output Power at 3dB compression point, Power Tuned, P_{3dB}	–	40.5	–	dBm
Power-Added Efficiency at 3 dB Gain Compression, Efficiency Tuned, PAE_{3dB}	–	58.6	–	%
Gain at 3dB compression point, Power Tuned, G_{3dB}	–	12.4	–	dB

Notes:
1. V_D = 32 V, I_{DQ} = 50 mA, T_A = 25 °C, Pulse Width = 100 us, Duty Cycle = 20%

RF Characterization – EVB Performance at 2.4 GHz [1]

Parameter	Min	Typ	Max	Units
Linear Gain, G_{LIN}	–	16.3	–	dB
Output Power at 3dB compression point, P3dB	–	40.5	–	dBm
Drain Efficiency at 3dB compression point, DEFF3dB	–	63.7	–	%
Gain at 3dB compression point, G3dB	–	13.3	–	dB
Gate Leakage V_D = +10 V, V_G = − 3.7 V	-2.8	–	–	mA

Notes:
1. V_D = 32 V, I_{DQ} = 50 mA, T_A = 25 °C, Pulse Width = 100 us, Duty Cycle = 20%

RF Characterization – Mismatch Ruggedness at 3.0 GHz [1, 2, 3]

Symbol	Parameter	dB Compression	Typical
VSWR	Impedance Mismatch Ruggedness	3	10:1

Notes:
1. Test conditions unless otherwise noted: T_A = 25 °C, V_D = 32 V, I_{DQ} = 50 mA
2. Input drive power is determined at pulsed 3dB compression under matched condition at EVB output connector
3. Pulse: 100us, 20% Duty cycle

Thermal and Reliability Information – CW [1, 2]

Parameter	Test Conditions	Value	Units
Thermal Resistance, IR (θ_{JC})	Vds = 32V, Idq = 50mA 85 °C Case 2.5 W Pdiss, CW	7.76	ºC/W
Channel Temperature, IR (T_{CH})		104.40	°C
Thermal Resistance, IR (θ_{JC})	Vds = 32V, Idq = 50mA 85 °C Case 5 W Pdiss, CW	8.37	ºC/W
Channel Temperature, IR (T_{CH})		126.85	°C
Thermal Resistance, IR (θ_{JC})	Vds = 32V, Idq = 50mA 85 °C Case 7.5 W Pdiss, CW	8.73	ºC/W
Channel Temperature, IR (T_{CH})		150.44	°C
Thermal Resistance, IR (θ_{JC})	Vds = 32V, Idq = 50mA 85 °C Case 10 W Pdiss, CW	9.13	ºC/W
Channel Temperature, IR (T_{CH})		176.34	°C
Thermal Resistance, IR (θ_{JC})	Vds = 32V, Idq = 50mA 85 °C Case 12.5 W Pdiss, CW	9.67	ºC/W
Channel Temperature, IR (T_{CH})		205.87	°C

Notes:
1. Thermal resistance measured to bottom of package.
2. Refer to the following document: GaN Device Channel Temperature, Thermal Resistance, and Reliability Estimates

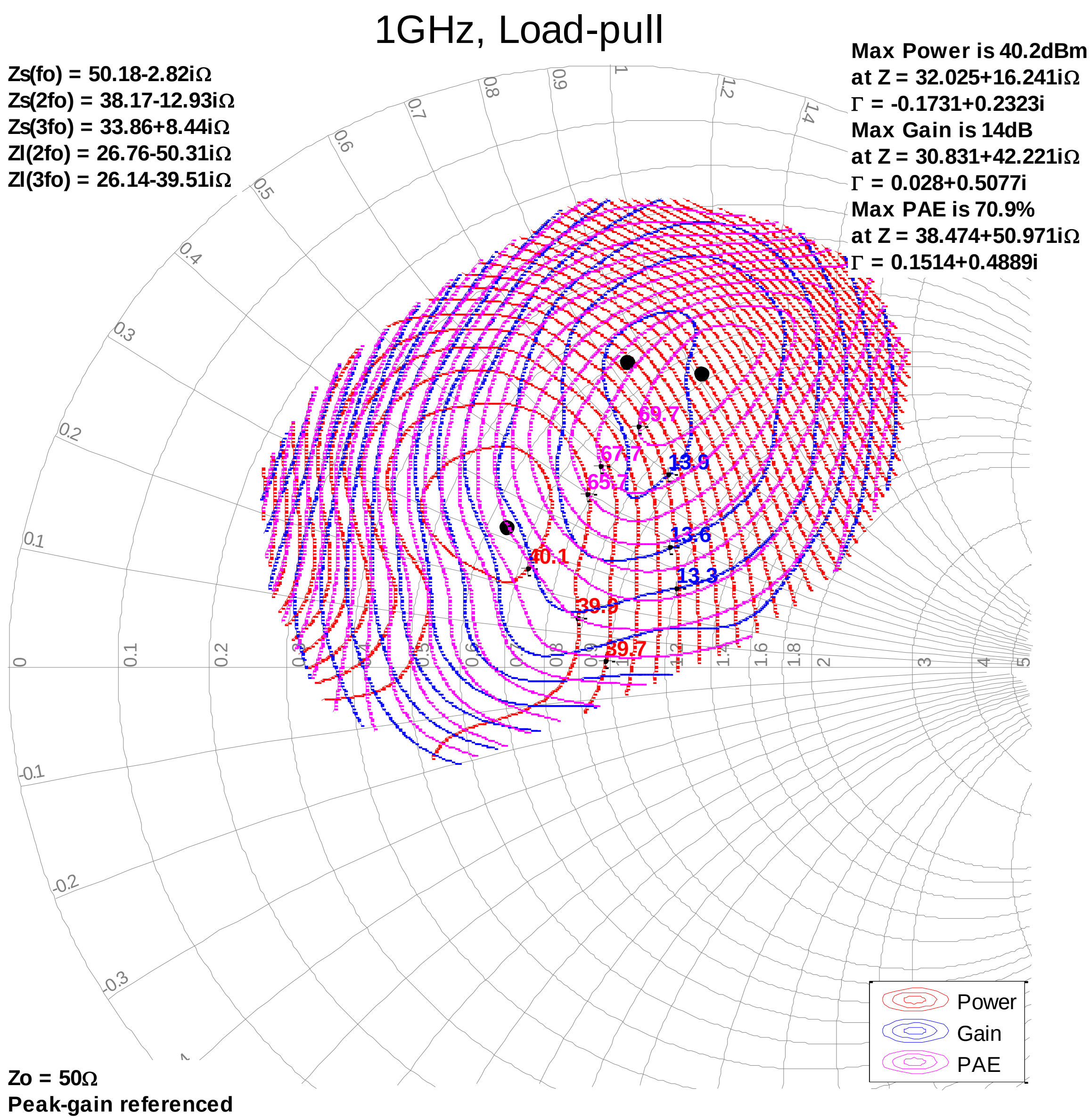
Thermal and Reliability Information – Pulsed [1, 2]

Parameter	Test Conditions	Value	Units
Thermal Resistance, IR (θ_{JC})	Vds = 32V, Idq = 50mA 85 °C Case 10 W Pdiss, 100uS PW, 20%	5.68	ºC/W
Channel Temperature, IR (T_{CH})		141.77	°C
Thermal Resistance, IR (θ_{JC})	Vds = 32V, Idq = 50mA 85 °C Case 12.5 W Pdiss, 100uS PW, 20%	5.77	ºC/W
Channel Temperature, IR (T_{CH})		157.08	°C
Thermal Resistance, IR (θ_{JC})	Vds = 32V, Idq = 50mA 85 °C Case 15 W Pdiss, 100uS PW, 20%	5.86	ºC/W
Channel Temperature, IR (T_{CH})		172.90	°C

Notes:
1. Thermal resistance measured to bottom of package.
2. Refer to the following document: GaN Device Channel Temperature, Thermal Resistance, and Reliability Estimates

Load Pull Contours [1, 2, 3]

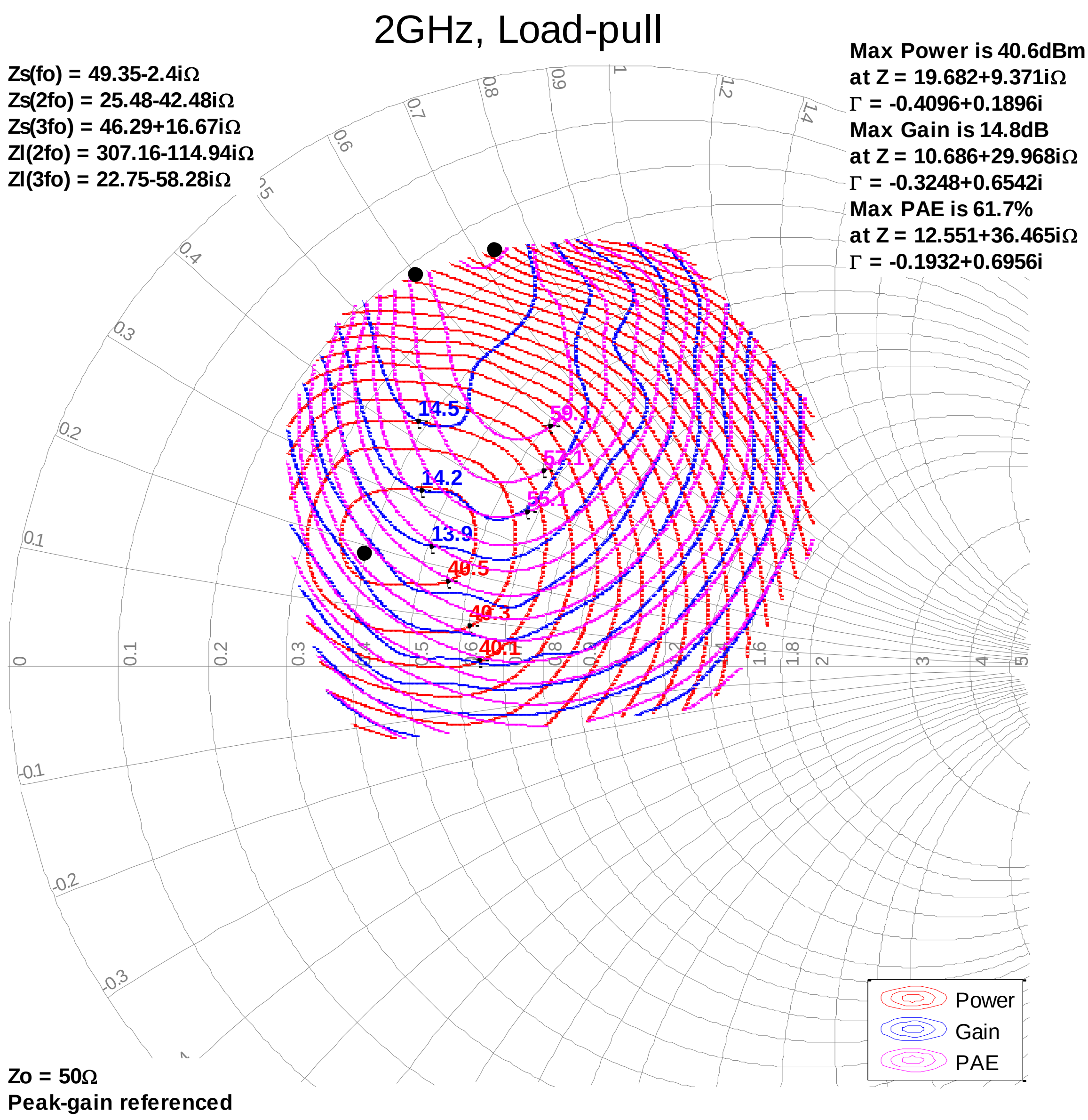
Notes:
1. Test Conditions: V_D = 32 V, I_{DQ} = 50 mA, 100 us Pulse Width, 20% Duty Cycle.
2. 3dB Compression referenced at peak gain.
3. See *"Pin Configuration and Description"* for load pull and source pull reference planes.



Load Pull Contours [1, 2, 3]

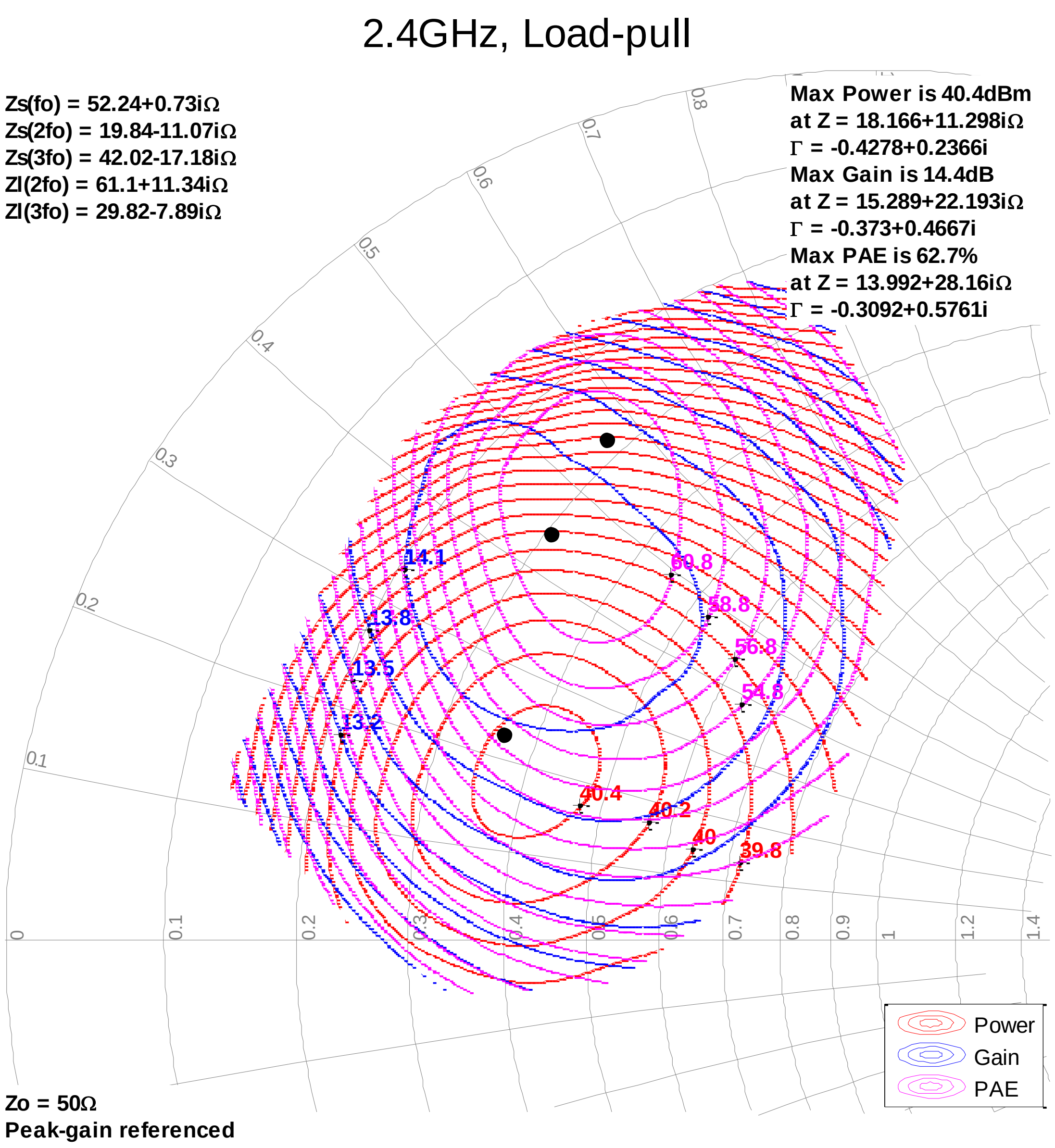
Notes:

1. Test Conditions: V_D = 32 V, I_{DQ} = 50 mA, 100 us Pulse Width, 20% Duty Cycle.
2. 3dB Compression referenced at peak gain.
3. See *"Pin Configuration and Description"* for load pull and source pull reference planes.



Load Pull Contours [1, 2, 3]

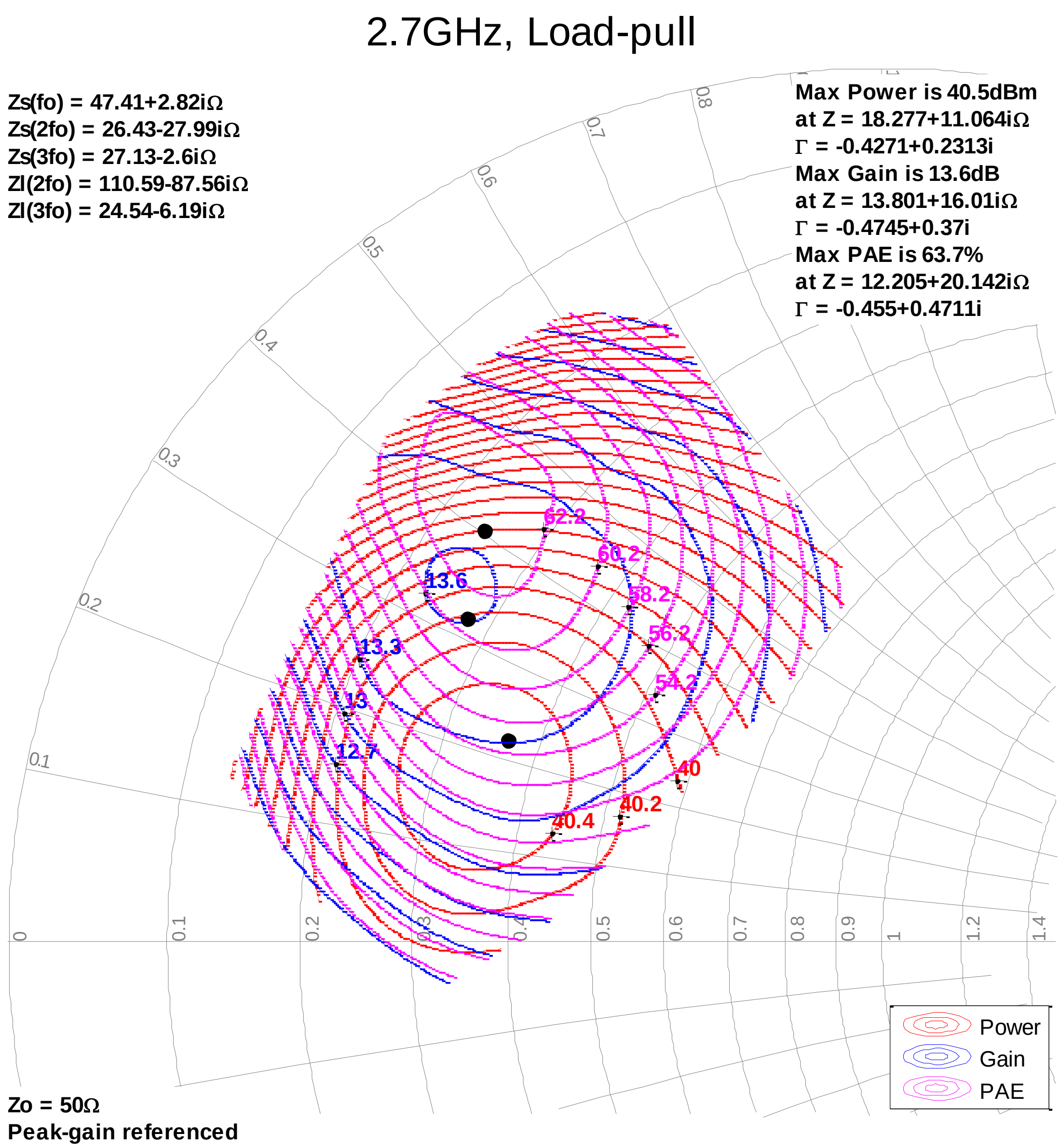
Notes:
1. Test Conditions: V_D = 32 V, I_{DQ} = 50 mA, 100 us Pulse Width, 20% Duty Cycle.
2. 3dB Compression referenced at peak gain.
3. See *"Pin Configuration and Description"* for load pull and source pull reference planes.



Load Pull Contours [1, 2, 3]

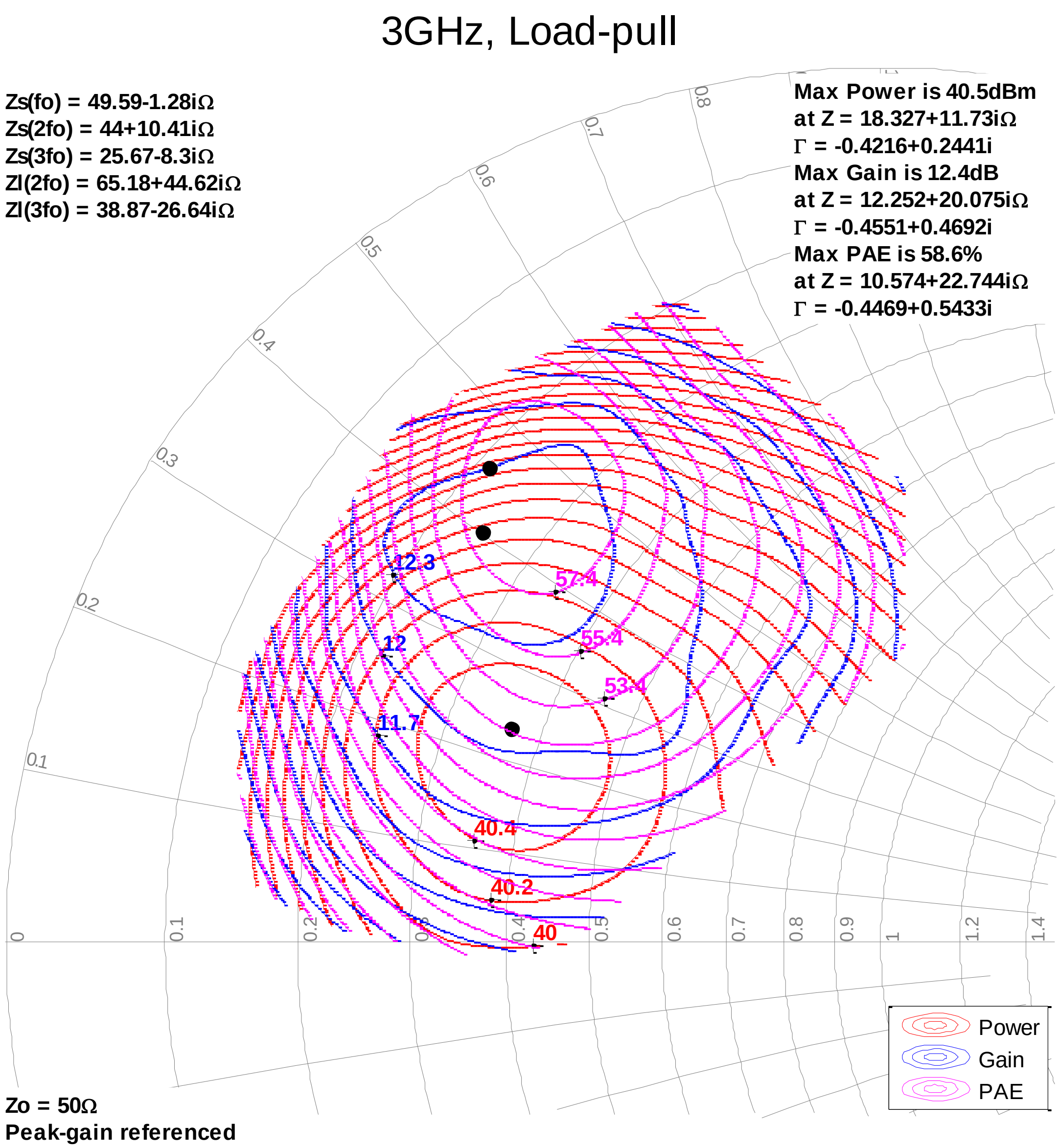
Notes:

1. Test Conditions: V_D = 32 V, I_{DQ} = 50 mA, 100 us Pulse Width, 20% Duty Cycle.
2. 3dB Compression referenced at peak gain.
3. See *"Pin Configuration and Description"* for load pull and source pull reference planes.



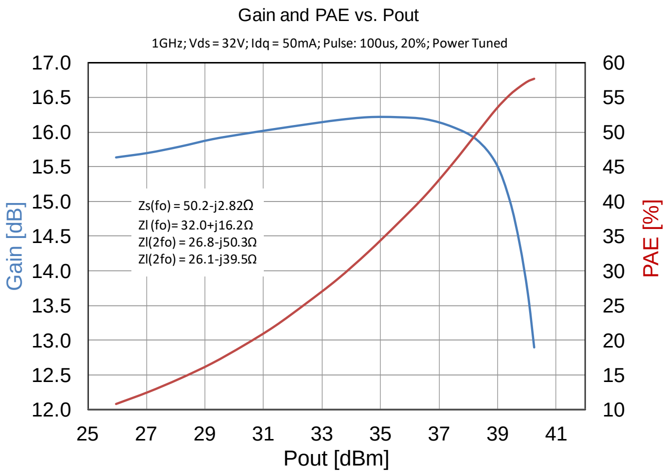
Load Pull Contours [1, 2, 3]

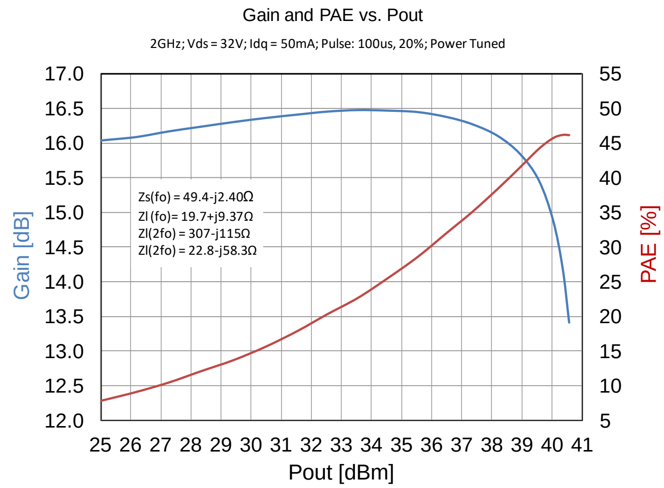
Notes:
1. Test Conditions: V_D = 32 V, I_{DQ} = 50 mA, 100 us Pulse Width, 20% Duty Cycle.
2. 3dB Compression referenced at peak gain.
3. See *"Pin Configuration and Description"* for load pull and source pull reference planes.

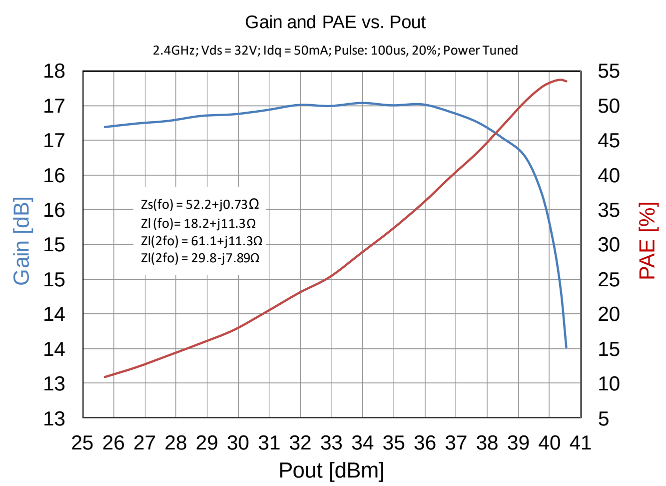


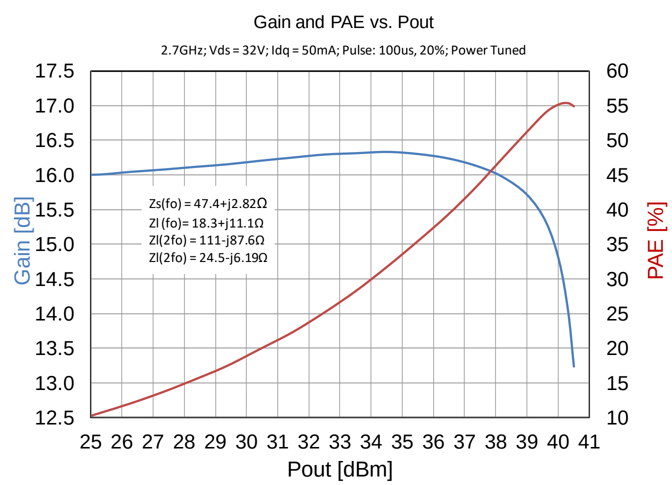
Typical Performance – Power Tuned [1, 2, 3]

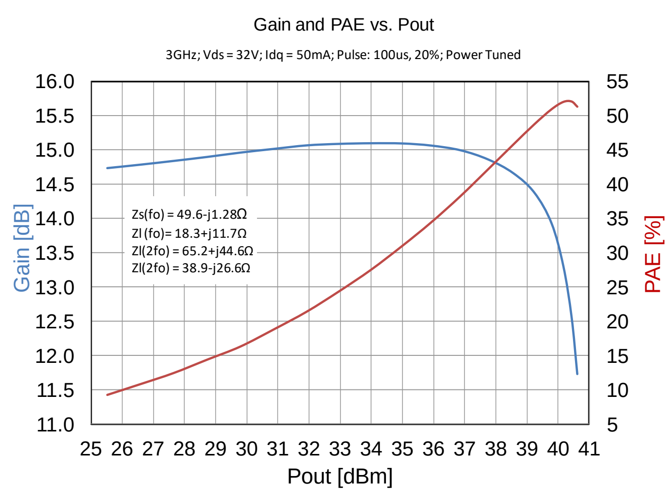
Notes:
1. Test Conditions: V_D = 32 V, I_{DQ} = 50 mA, 100 us Pulse Width, 20% Duty Cycle.
2. The performance shown below is measured at device reference planes
3. See *"Pin Configuration and Description"* for load pull and source pull reference planes.





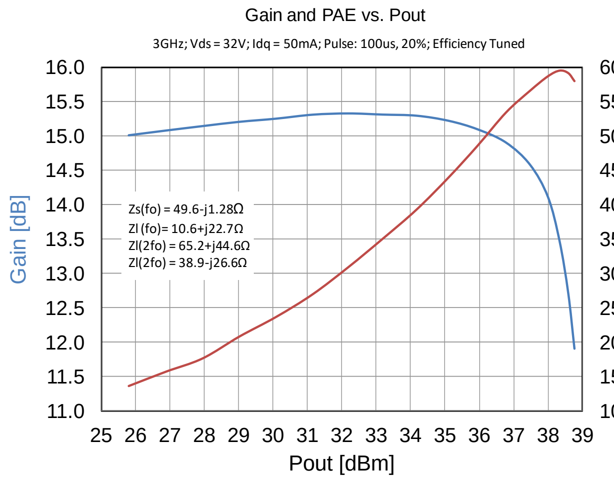


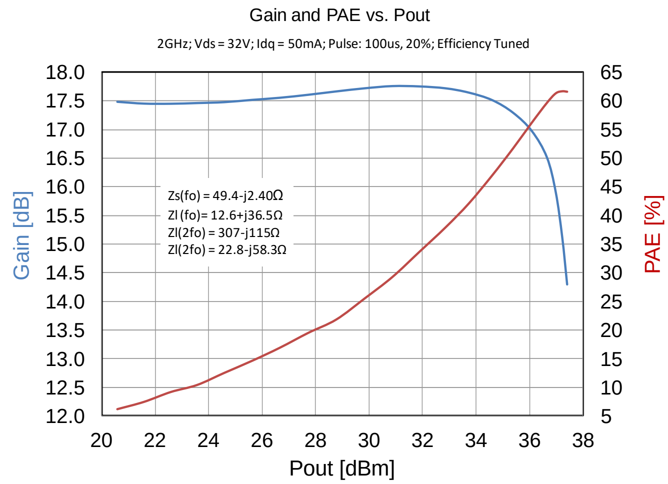


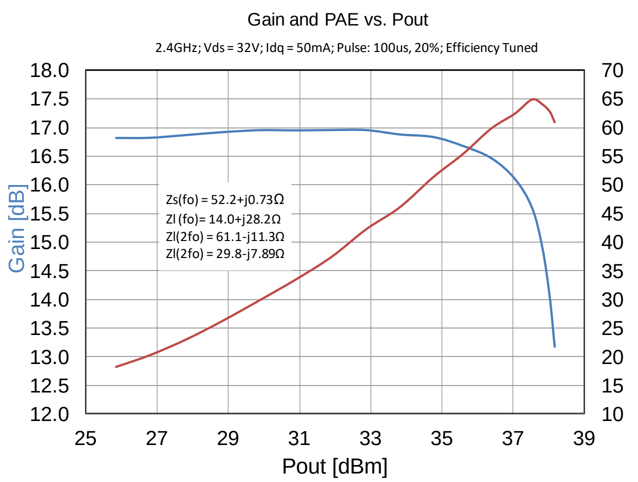


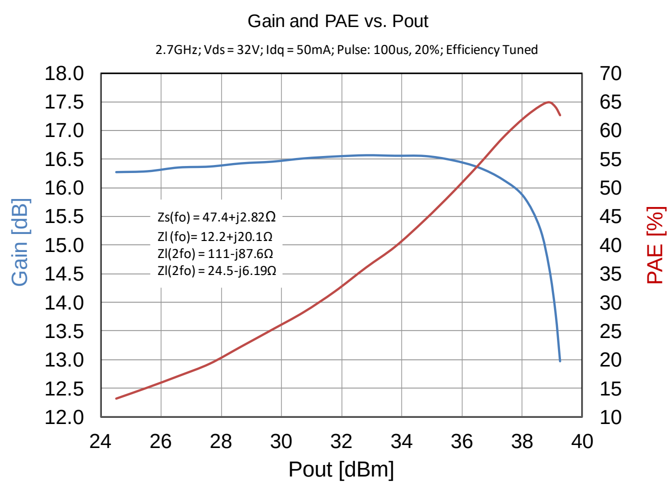
Typical Performance – Efficiency Tuned [1, 2, 3]

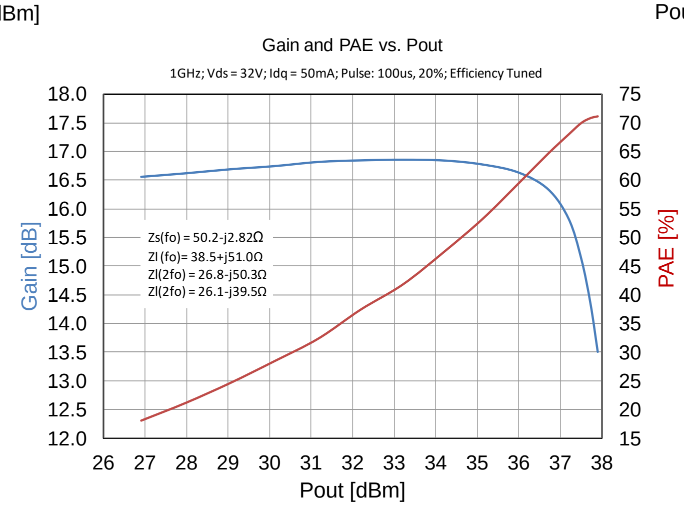
Notes:
1. Test Conditions: V_D = 32 V, I_{DQ} = 50 mA, 100 us Pulse Width, 20% Duty Cycle.
2. The performance shown below is measured at device reference planes
3. See *"Pin Configuration and Description"* for load pull and source pull reference planes.



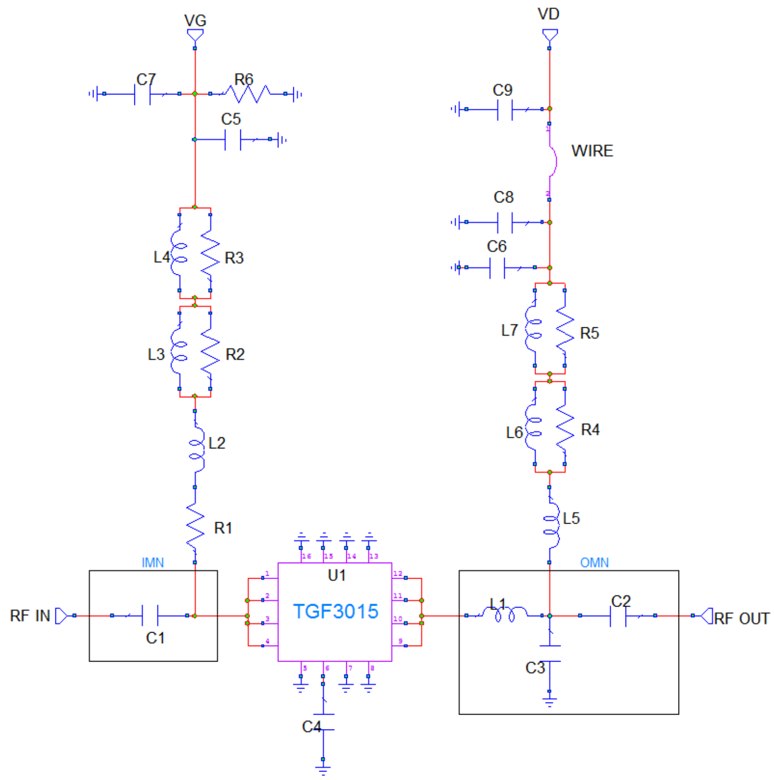








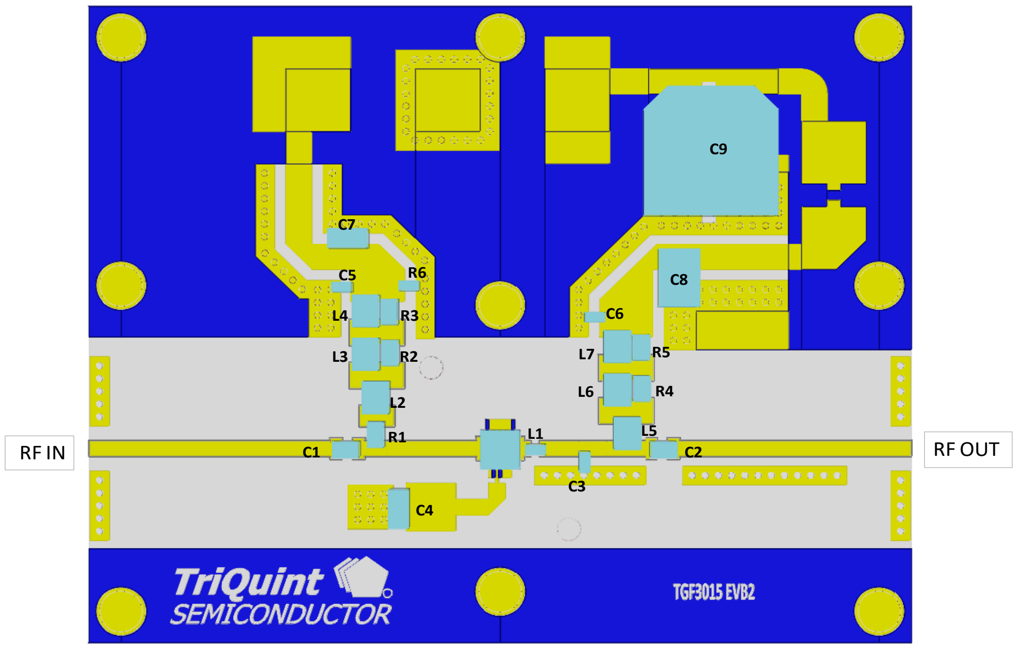
1.2 – 1.4 GHz Application Circuit - Schematic



Bias-up Procedure	Bias-down Procedure
1. Set gate voltage (V_G) to -5.0V	1. Turn off RF signal
2. Set drain voltage (V_D) to 32 V	2. Turn off V_D and wait 1 second to allow drain capacitor dissipation
3. Slowly increase V_G until I_{DQ} is 50 mA.	3. Turn off V_G
4. Apply RF signal	

1.2 – 1.4 GHz Application Circuit EVB – Layout [1, 2]

Notes:
1. PCB material is RO4350B 0.020” thick, ε_r = 3.48.
2. The PCB land pattern has been developed to accommodate lead and package tolerances.

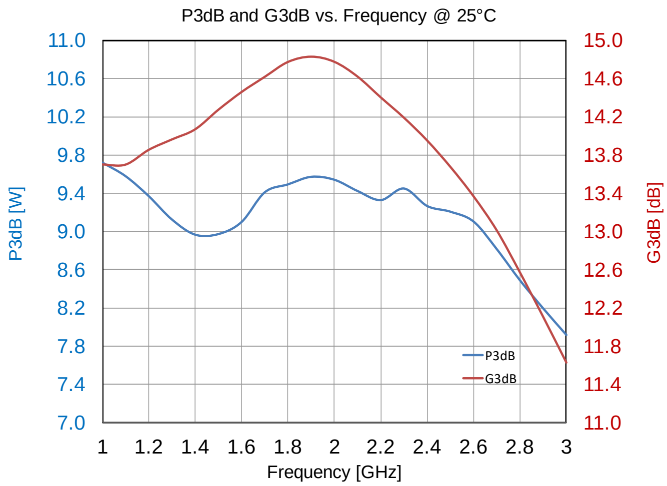


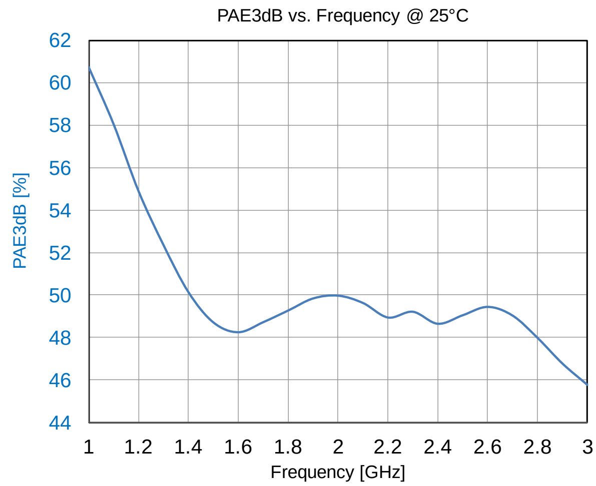
1.2 – 1.4 GHz Application Circuit – Bill of Material EVB1

Ref Des	Qty	Description	Mfg Name	Mfg Part #
R1	1	500 Ω		Generic 0603
R2, R3, R4, R5	4	400 Ω		Generic 0603
R6	1	1k Ω		Generic 0603
C1, C2, C5, C6	4	2400pF	Dieletric Labs	C08BL242X-5UN-X0T
C3	1	0.5pF	ATC	600S005BT250XT
C4, C7	2	10uF	TDK	C1632X5R0J106M130AC
C8	1	1uF	AVX	18121C105KAT2A
C9	1	220uF	United Chemicon	EMVY500ADA221MJA0G
L1	1	1.6nH	CoilCraft	0603HC-1N6XJLU
L2, L5	2	82nH	CoilCraft	1008CS-820XGLB
L3, L6	2	100nH	CoilCraft	1008CS-101XGLB
L4, L7	2	900nH	CoilCraft	1008AF-901XJLB

Evaluation Board Performance at 25°C [1, 2]

Notes:
1. Test Conditions: V_D = 32 V, I_{DQ} = 50 mA, 100 us Pulse Width, 20% Duty Cycle.
2. Peformance measured on 0.5 GHz to 3.0 GHz Evaluation Board.

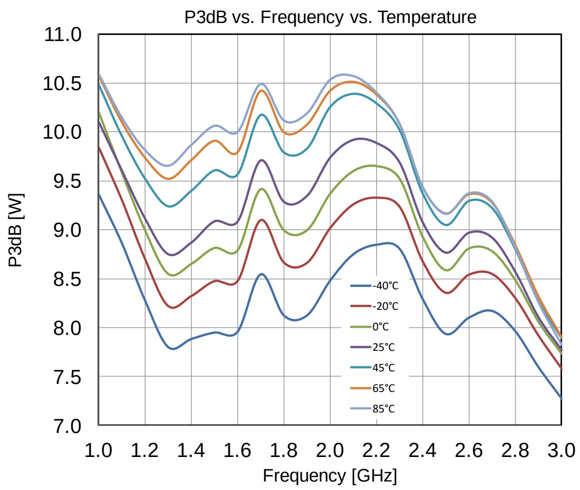


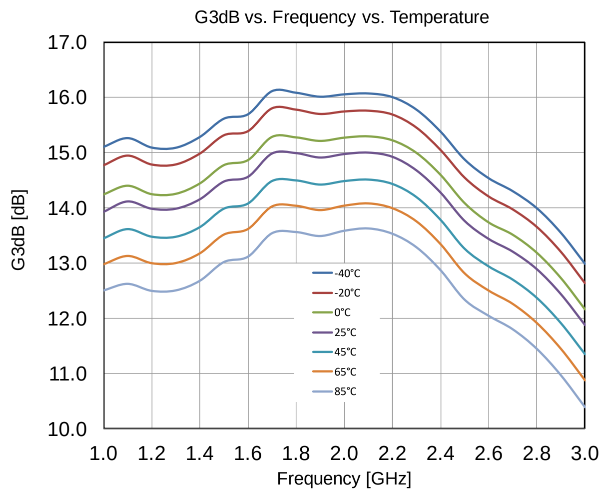


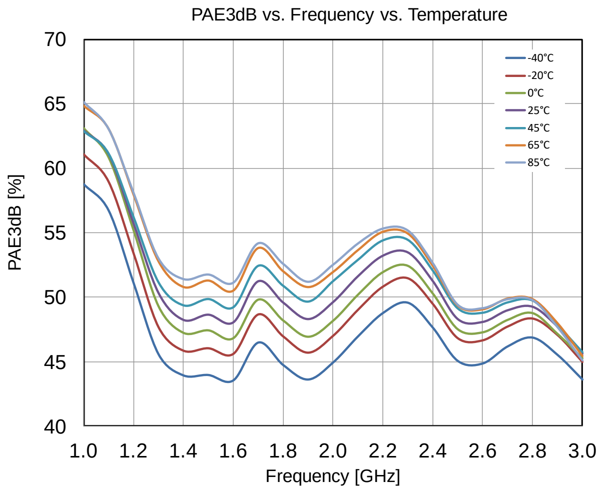
Evaluation Board Performance Over Temperature [1, 2]

Notes:

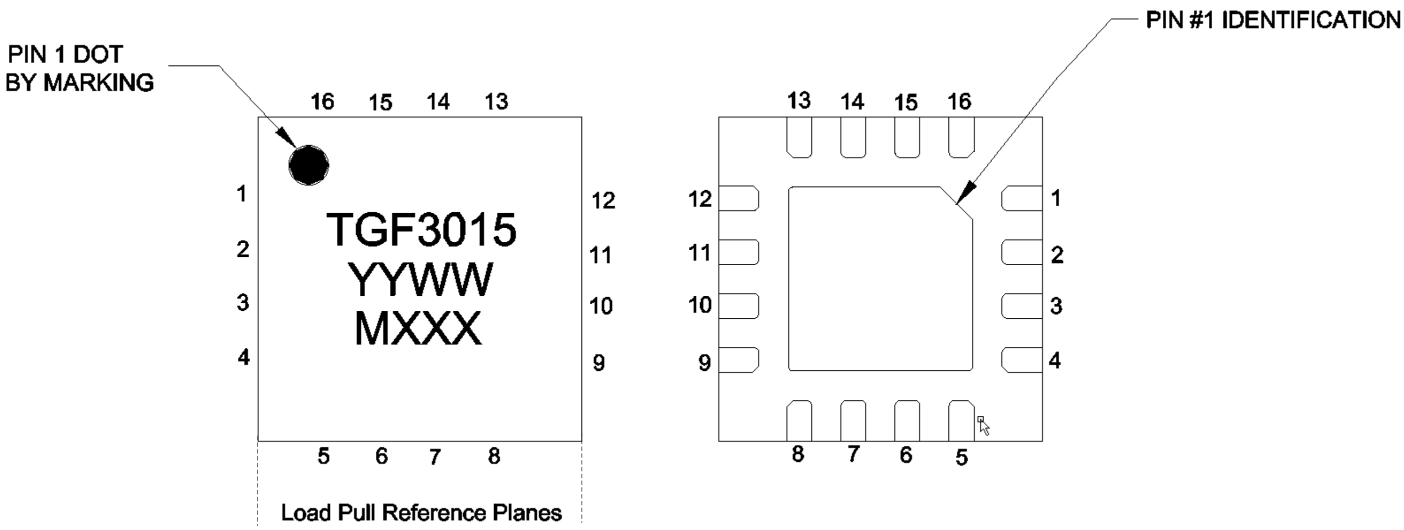
1. Test Conditions: V_D = 32 V, I_{DQ} = 50 mA, 100 us Pulse Width, 20% Duty Cycle.
2. Peformance measured on 0.5 GHz to 3.0 GHz Evaluation Board.







Pin Configuration and Description [1, 2]

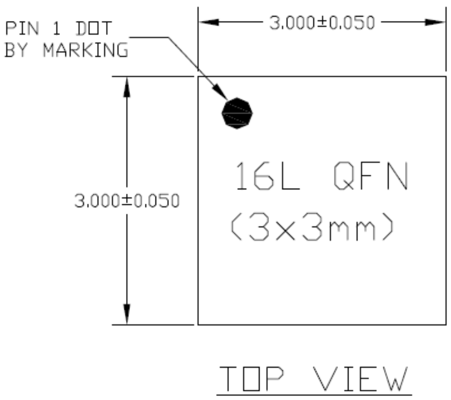


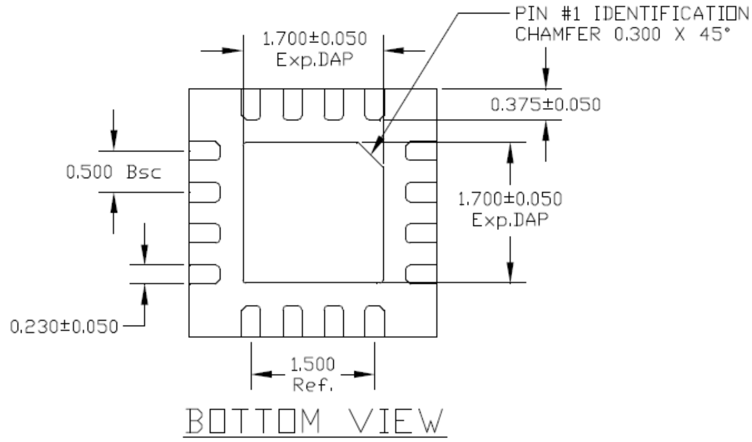
Notes:

1. Thermal resistance measured to back side of package
2. The TGF3015-SM will be marked with the “TGF3015” 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.

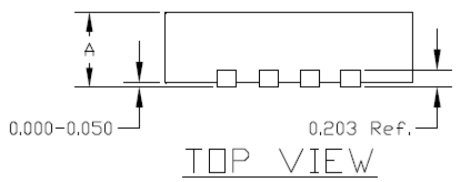
Pin	Symbol	Description
9, 10, 11, 12	V_D / RF OUT	Drain voltage / RF Output to be matched to 50 ohms.
3	V_G / RF IN	Gate voltage / RF Input to be matched to 50 ohms.
6	Off-Chip Cap	Off-chip cap to extend low frequency gain.
Back side	Souce	Source connected to ground

Mechanical Drawing [1-4]





		QFN
A	MAX.	0.900
	NOM.	0.850
	MIN.	0.800



Notes:

1. Dimension tolerance is ± 0.127 mm, unless noted otherwise.
2. This package is lead-free/RoHS-compliant.
3. The plating material on the leads is NiPdAu.
4. It is compatible with both lead-free (maximum 260 °C reflow temperature) and tin-lead (maximum 245°C reflow temperature) soldering processes

Recommended Solder Temperature Profile