GaN Amplifier 48 V, 8 W
2.3 - 2.7 GHz

MAGB-102327-010B0P
Rev. V1

Features

- Suitable for Linear and Saturated Applications
- Optimized for Cellular Base Station Applications
- Designed for Digital Predistortion Error Correction Systems
- High Terminal Impedances for Broadband Performance
- 48 V Operation
- 100 % RF Tested
- RoHS* Compliant

4 mm DFN

Description

The MAGB-102327-010B0P is a wideband GaN HEMT D-mode amplifier designed for base station applications and optimized for 2.3 - 2.7 GHz modulated signal operation. This device supports pulsed and linear operation with peak output levels to 8 W (39 dBm) in a 4x4mm DFN package.

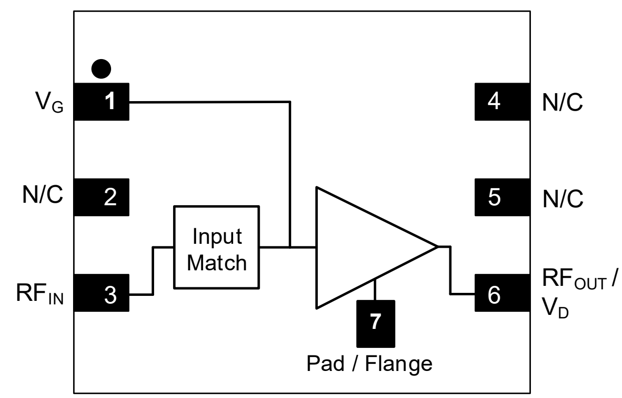
Typical Performance

- V_{DS} = 48 V, I_{DQ} = 20 mA, T_C = 25°C. Measured under load-pull at 2.5 dB compression, 100 µs pulse width, 10% duty cycle.

Frequency (GHz)	Output Power[1] (dBm)	Gain[2] (dB)	η_D [2] (%)
2.3	38.9	16.7	72.2
2.5	39.0	17.0	71.9
2.7	38.8	16.8	73.8

1. Load impedance tuned for maximum output power.
2. Load impedance tuned for maximum drain efficiency.

Functional Schematic



Pin Configuration[3]

Pin #	Pin Name	Function
1	V_G	Gate
2,4,5	N/C	No Connection
3	RF_{IN}	RF Input
6	RF_{OUT} / V_D	RF Output / Drain
7	Pad[2]	Ground / Source

3. The pad on the package bottom must be connected to RF, DC or thermal ground.

Ordering Information

Part Number	Package
MAGB-102327-010B0P	Bulk Quantity
MAGB-102327-010BTP	Tape and Reel
MAGB-1B2327-010B0P	Class-AB Sample Board

* Restrictions on Hazardous Substances, compliant to current RoHS EU directive.

RF Electrical Characteristics: T_{CASE} = 25°C, V_{DS} = 48V, I_{DQ} = 20 mA
Note: Performance in MACOM Single-ended Class-AB Evaluation Circuit, 50 Ω system

Parameter	Test Conditions	Symbol	Min.	Typ.	Max.	Units
Small Signal Gain	Pulsed[4], 2.7 GHz	G_{SS}	-	17.2	-	dB
Saturated Output Power	Pulsed[4], 2.7 GHz	P_{SAT}	-	38.4	-	dBm
Drain Efficiency at Saturation	Pulsed[4], 2.7 GHz	η_{SAT}	-	72.2	-	%
AM/PM	Pulsed[4], 2.7 GHz	Φ	-	-4	-	°
Modulated Peak Power	WCDMA[5], 2.7 GHz	P2.5dB[6]	-	38.7	-	dBm
Gain Flatness in 60MHz	WCDMA[5], P_{OUT} = 27 dBm	G_F	-	0.3	-	dB
Gain Variation (-25°C to +105°C)	WCDMA[5], 2.7 GHz, P_{OUT} = 27 dBm	ΔG	-	0.02	-	dB/°C
Power Variation (-25°C to +105°C)	Pulsed[4], 2.7 GHz	Δ P2.5dB	-	0.01	-	dBm/°C
Power Gain	WCDMA[5], 2.7 GHz, P_{OUT} = 27 dBm	G_P	-	16.8	-	dB
Drain Efficiency	WCDMA[5], 2.7 GHz, P_{OUT} = 27 dBm	η	-	23.3	-	%
Output CCDF @ 0.01%	WCDMA[5], 2.7 GHz, P_{OUT} = 27 dBm	PAR	-	9.5	-	dB
Adjacent Channel Power	WCDMA[5], 2.7 GHz, P_{OUT} = 27 dBm	ACP	-	-49	-	dBc
Input Return Loss	WCDMA[5], 2.7 GHz, P_{OUT} = 27 dBm	IRL	-	-5	-	dB
Ruggedness: Output Mismatch	All phase angles	Ψ	VSWR = 10:1, No Device Damage			

RF Electrical Characteristics: T_A = 25°C, V_{DS} = 48V, I_{DQ} = 20 mA
Note: Performance in MACOM Single-ended Class-AB Production Test Fixture, 50 Ω system

Parameter	Test Conditions	Symbol	Min.	Typ.	Max.	Units
Power Gain	WCDMA[5], 2.7 GHz, P_{OUT} = 31 dBm	G_P	13.7	15.2	-	dB
Drain Efficiency	WCDMA[5], 2.7 GHz, P_{OUT} = 31 dBm	η	26	31.3	-	%
Output CCDF @ 0.01%	WCDMA[5], 2.7 GHz, P_{OUT} = 31 dBm	PAR	6.7	7.1	-	dB
Adjacent Channel Power	WCDMA[5], 2.7 GHz, P_{OUT} = 31 dBm	ACP	-	-38	-35	dBc
Input Return Loss	WCDMA[5], 2.7 GHz, P_{OUT} = 31 dBm	IRL	-	-5	-3	dB

DC Electrical Characteristics: T_C = 25°C

Parameter	Test Conditions	Symbol	Min.	Typ.	Max.	Units
Drain-Source Leakage Current	V_{GS} = -8 V, V_{DS} = 130 V	I_{DLK}	-	-	0.96	mA
Gate-Source Leakage Current	V_{GS} = -8 V, V_{DS} = 0 V	I_{GLK}	-	-	-0.96	mA
Gate Threshold Voltage	V_{DS} = 48 V, I_D = 0.96 mA	V_T	-2.6	-2.4	-	V
Gate Quiescent Voltage	V_{DS} = 48 V, I_D = 20 mA	V_{GSQ}	-2.4	-2.0	-	V
On Resistance	V_{GS} = 2 V, I_D = 9.6 mA	R_{ON}	-	4.3	-	Ω
Maximum Drain Current	V_{DS} = 7 V, pulse width 300 µs	$I_{D, MAX}$	-	0.6	-	A

4. Pulse details: 100 µs pulse width, 1 ms period, 10% Duty Cycle
5. Modulated Signal: 3.84MHz, WCMDA 3GPP TM1 64 DPCH, 9.9dB PAR @ 0.01% CCDF
6. P2.5dB = P_{OUT} + 7.5 dB where P_{OUT} is the average output power measured using a modulated signal[5] where the output PAR is compressed to 7.5 dB @ 0.01% probability CCDF.

Absolute Maximum Ratings [7,8,9,10,11]

Parameter	Absolute Maximum
Drain Source Voltage, V_{DS}	130 V
Gate Source Voltage, V_{GS}	-10 to 3 V
Gate Current, I_G	1.92 mA
Storage Temperature Range	-65°C to +150°C
Case Operating Temperature Range	-40°C to +120°C
Channel Operating Temperature Range, T_{CH}	-40°C to +210°C
Absolute Maximum Channel Temperature	+225°C

7. Exceeding any one or combination of these limits may cause permanent damage to this device.
8. MACOM does not recommend sustained operation above maximum operating conditions.
9. Operating at drain source voltage V_{DS} < 55 V will ensure MTTF > 4 x 10^6 hours.
10. Operating at nominal conditions with T_{CH} ≤ 210°C will ensure MTTF > 4 x 10^6 hours.
11. MTTF may be estimated by the expression MTTF (hours) = A $e^{[B + C/(T+273)]}$ where *T* is the channel temperature in degrees Celsius, *A* = 1.76, B = -33.83, and C = 23,476.

Thermal Characteristics [12]

Parameter	Test Conditions	Symbol	Typical	Units
Thermal Resistance using Finite Element Analysis	V_{DS} = 48 V, T_C = 85°C, T_{CH} = 225°C	R_θ(FEA)	27.3	°C/W
Thermal Resistance using Infrared Measurement of Die Surface Temperature	V_{DS} = 48 V, T_C = 85°C, T_{CH} = 225°C	R_θ(IR)	20.0	°C/W

12. Case temperature measured using thermocouple embedded in heat-sink. Contact local applications support team for more details on this measurement.

Handling Procedures

Please observe the following precautions to avoid damage:

Static Sensitivity

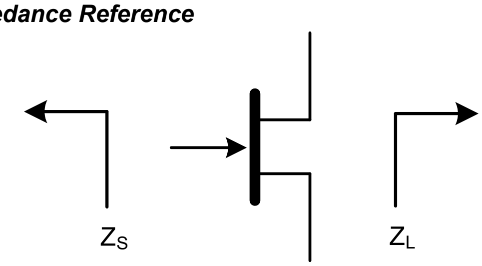
Gallium Nitride Circuits are sensitive to electrostatic discharge (ESD) and can be damaged by static electricity. Proper ESD control techniques should be used when handling these HBM Class 1A, CDM Class 3 devices.

Pulsed[4] Load-Pull Performance
Reference Plane at Device Leads

Frequency (GHz)	Z_{SOURCE} (Ω)	Maximum Output Power V_{DS} = 48 V, I_{DQ} = 20 mA, T_C = 25°C, P2.5dB					
		Z_{LOAD}[13] (Ω)	Gain (dB)	P_{OUT} (dBm)	P_{OUT} (W)	η_D (%)	AM/PM (°)
2.3	50	55.1 + j40.2	15.1	38.9	7.8	58.3	-54.2
2.5	50	50.9 + j35.9	15.0	39.0	7.9	60.0	-79.3
2.7	50	44.9 + j30.1	14.9	38.8	7.6	60.7	-107.7

Frequency (GHz)	Z_{SOURCE} (Ω)	Maximum Drain Efficiency V_{DS} = 48 V, I_{DQ} = 20 mA, T_C = 25°C, P2.5dB					
		Z_{LOAD}[14] (Ω)	Gain (dB)	P_{OUT} (dBm)	P_{OUT} (W)	η_D (%)	AM/PM (°)
2.3	50	36.3 + j64.9	16.7	37.9	6.0	72.2	-57.0
2.5	50	26.1 + j57.4	17.0	37.1	5.1	71.9	-78.3
2.7	50	21.1 + j50.7	16.8	36.7	4.7	73.8	-109.0

Impedance Reference

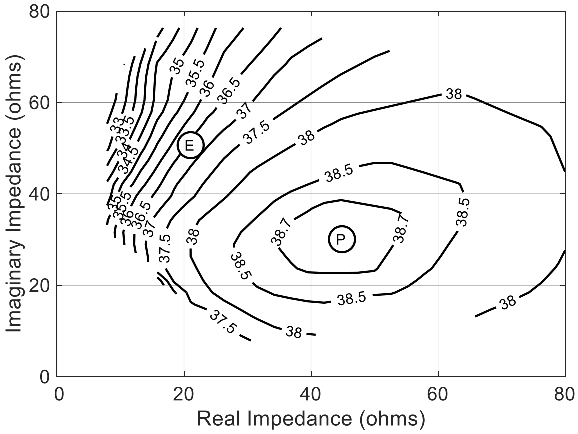


Z_{SOURCE} = Measured impedance presented to the input of the device at package reference plane.
Z_{LOAD} = Measured impedance presented to the output of the device at package reference plane.

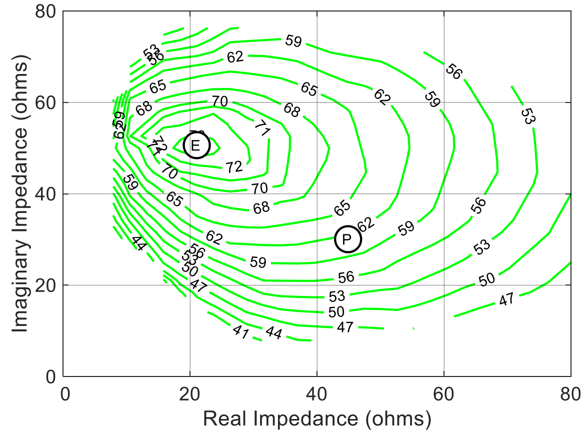
13. Load Impedance for optimum output power.
14. Load Impedance for optimum efficiency.

Pulsed[4] Load-Pull Performance @ 2.7 GHz

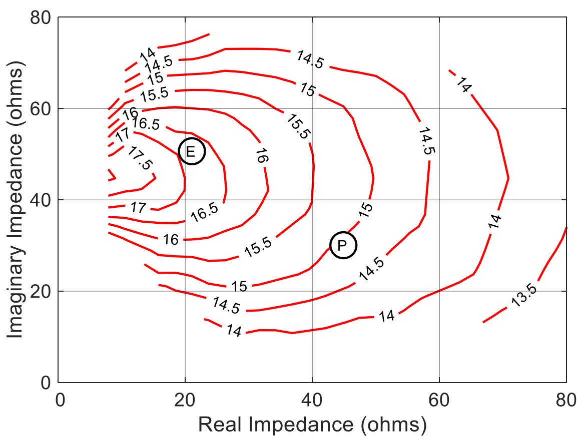
P2.5dB Loadpull Output Power Contours (dBm)



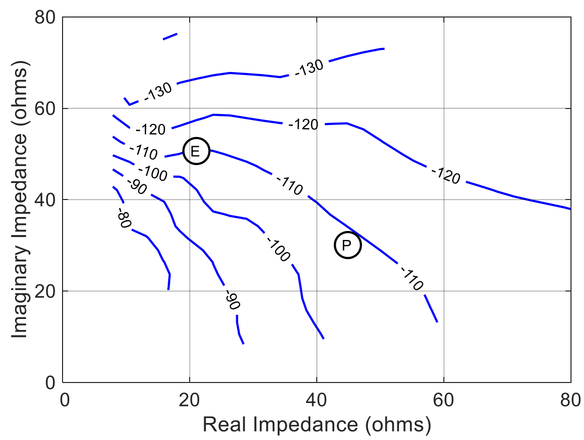
P2.5dB Loadpull Drain Efficiency Contours (%)



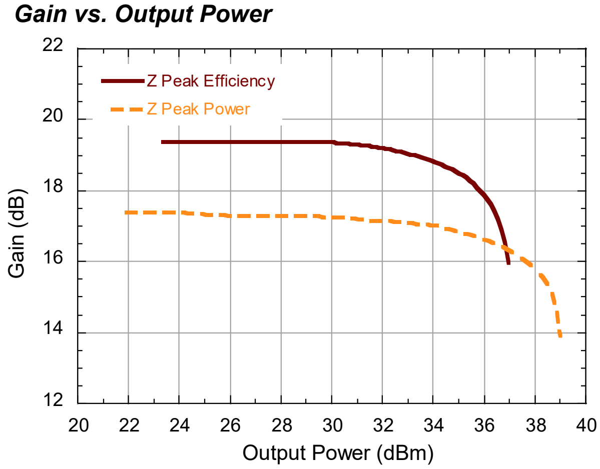
P2.5dB Loadpull Gain Contours (dB)



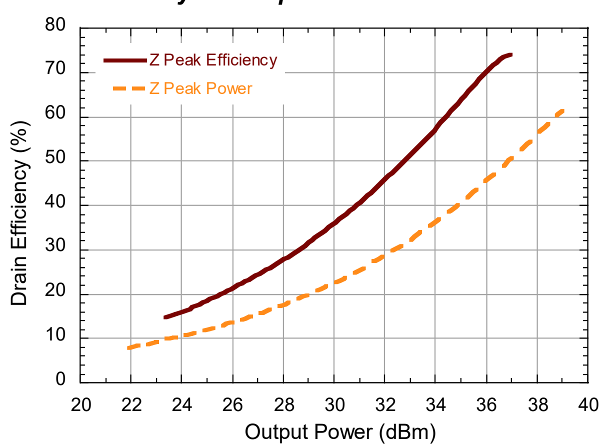
P2.5dB Loadpull AM/PM Contours (°)



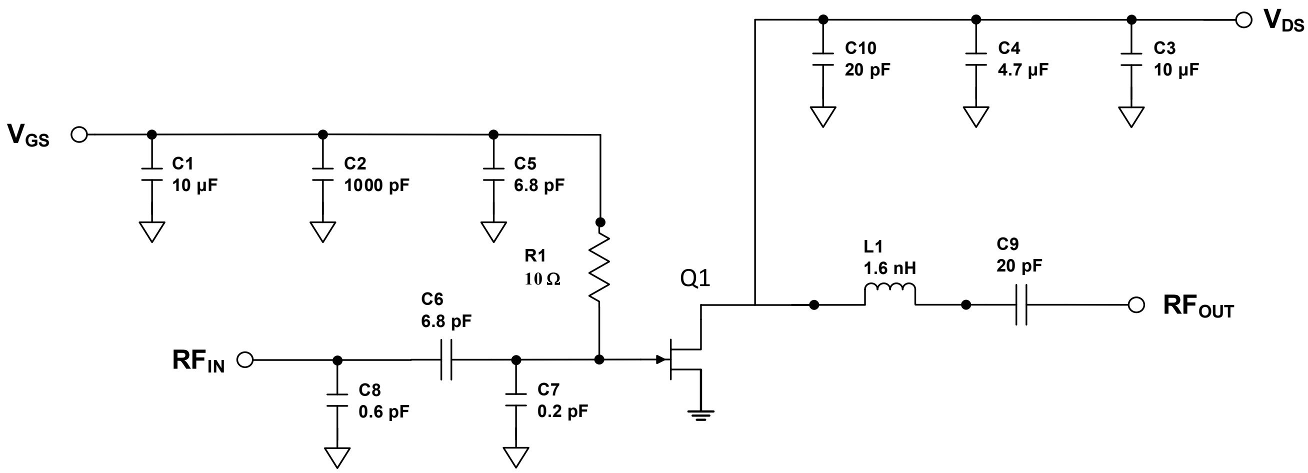
Gain vs. Output Power



Drain Efficiency vs. Output Power



Evaluation Test Fixture and Recommended Tuning Solution 2.3 - 2.7 GHz



Description

Parts measured on evaluation board (20-mil thick RO4350). Matching is provided using a combination of lumped elements and transmission lines as shown in the simplified schematic above. Recommended tuning solution component placement, transmission lines, and details are shown on the next page.

Bias Sequencing

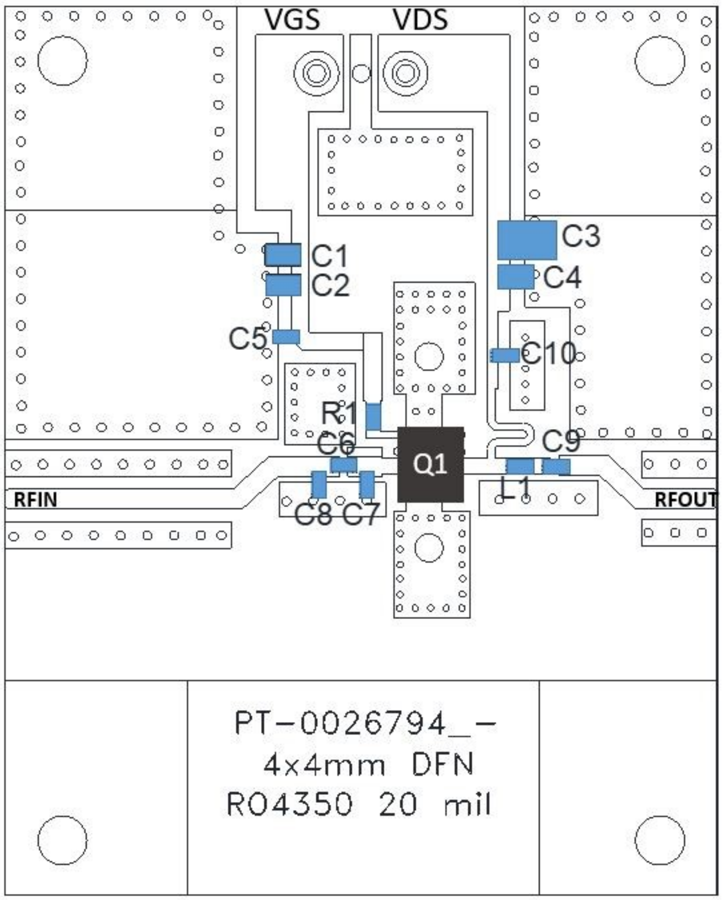
Turning the device ON

1. Set V_{GS} to pinch-off (V_P).
2. Turn on V_{DS} to nominal voltage (48 V).
3. Increase V_{GS} until I_{DS} current is reached.
4. Apply RF power to desired level.

Turning the device OFF

1. Turn the RF power OFF.
2. Decrease V_{GS} down to V_P pinch-off.
3. Decrease V_{DS} down to 0 V.
4. Turn off V_{GS}.

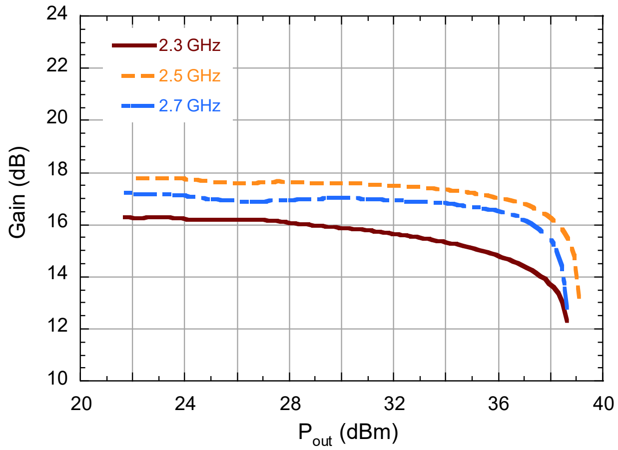
Evaluation Board and Recommended Tuning Solution 2.3 - 2.7 GHz



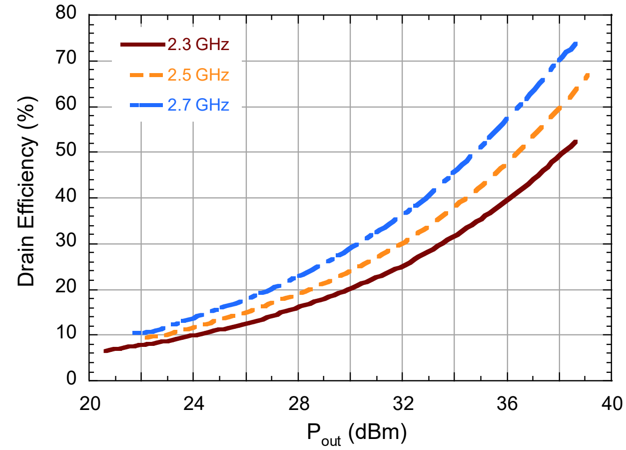
Reference Designator	Value	Tolerance	Manufacturer	Part Number
C1	10 µF	+/- 20%	TDK Corporation	C2012X5R1C106M085AC
C2	1000 pF	+/- 10%	KEMET	C0805C102K2RACTU
C3	10 µF	+/- 10%	Murata	GRM32EC72A106KE05L
C4	4.7 µF	+/- 10%	Murata	GRM21BC81H475KE11L
C5, C6	6.8 pF	+/- 0.1pF	Murata	GQM1875C2E6R8BB12D
C7	0.2 pF	+/- 0.1pF	Murata	GQM1875C2ER20BB12D
C8	0.6 pF	+/- 0.1pF	Murata	GQM1875C2ER60BB12D
C9, C10	20 pF	+/- 5%	Murata	GQM1875C2E200JB12D
L1	1.6 nH	+/- 5%	Coilcraft	0603CS-1N6XJEW
R1	10 Ω	+/- 0.5%	Yageo	RT0805DRE0710RL
PCB	RO4350, 20mil, 1oz Cu, Au Finish			

Typical Performance Curves as Measured in the 2.3 - 2.7 GHz Evaluation Board:
Pulsed[4] 2.7 GHz, V_{DS} = 48 V, I_{DQ} = 20 mA, T_C = 25°C (Unless Otherwise Noted)

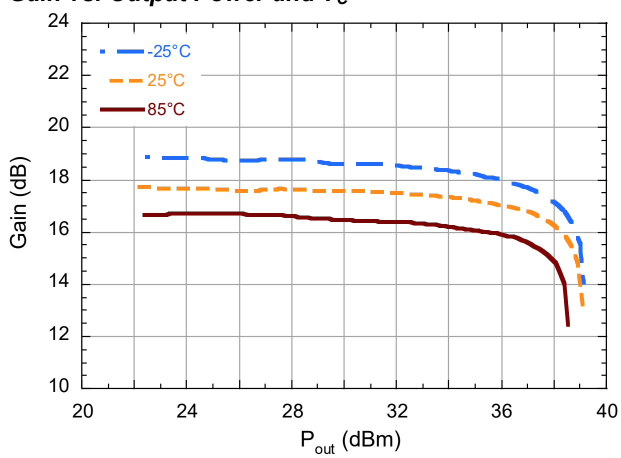
Gain vs. Output Power and Frequency



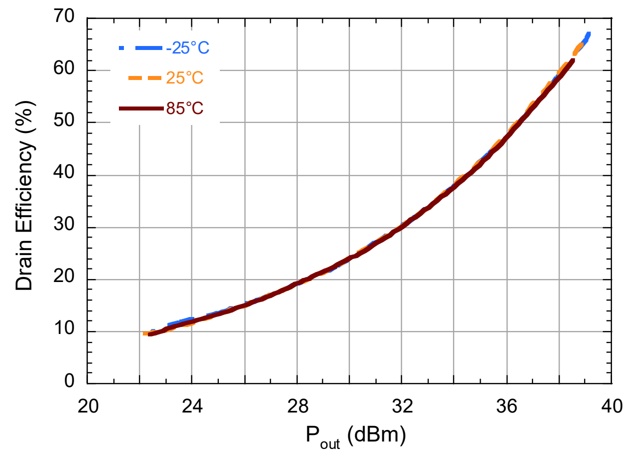
Drain Efficiency vs. Output Power and Frequency



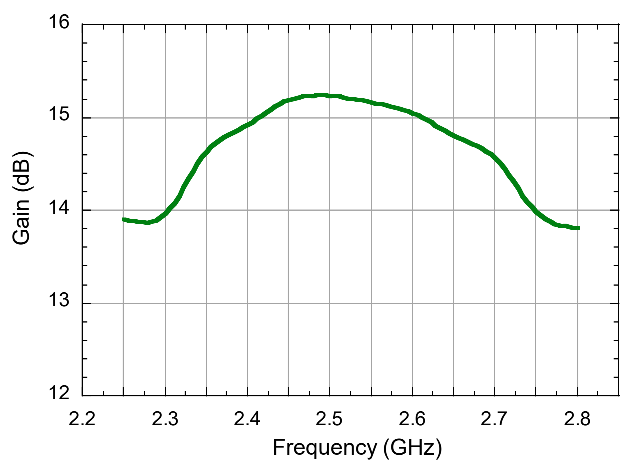
Gain vs. Output Power and T_C



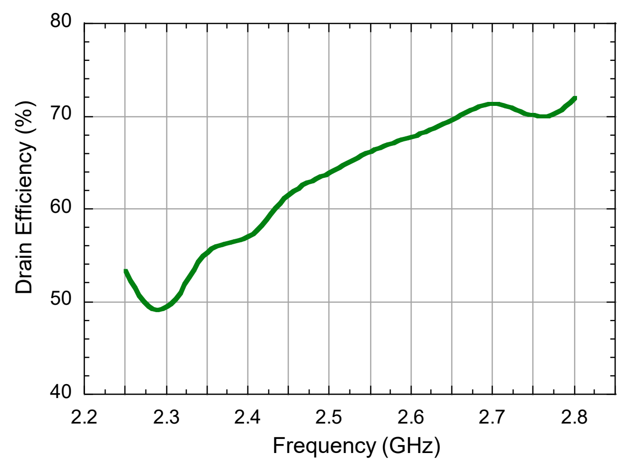
Drain Efficiency vs. Output Power and T_C



Gain vs. Frequency, 2.5dB Gain Compression

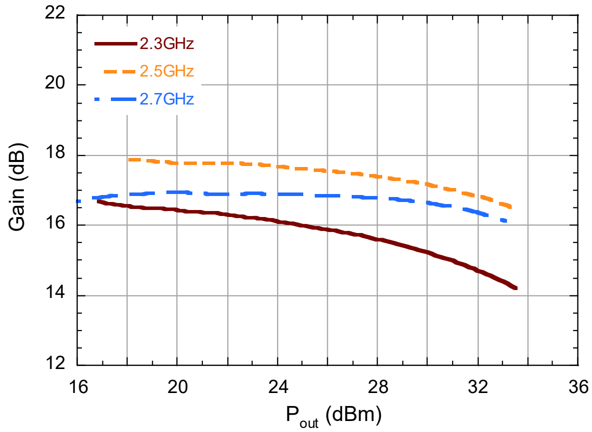


Drain Efficiency vs. Frequency, 2.5dB Gain Compression

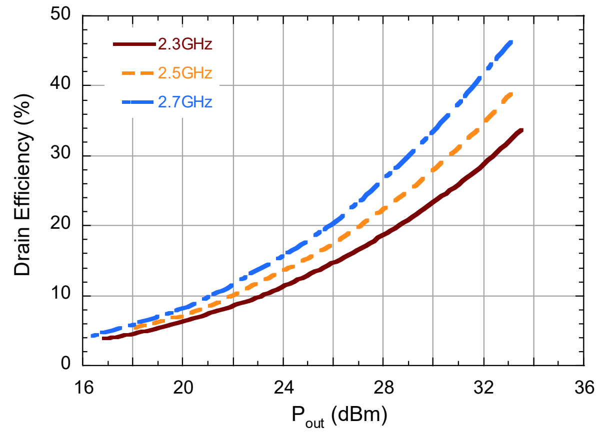


Typical Performance as Measured in the 2.3 - 2.7 GHz Evaluation Board:
WCMDA 3GPP TM1 64 DPCH 9.9 dB PAR @ 0.01% CCDF, V_{DS} = 48 V, I_{DQ} = 20 mA, T_C = 25°C

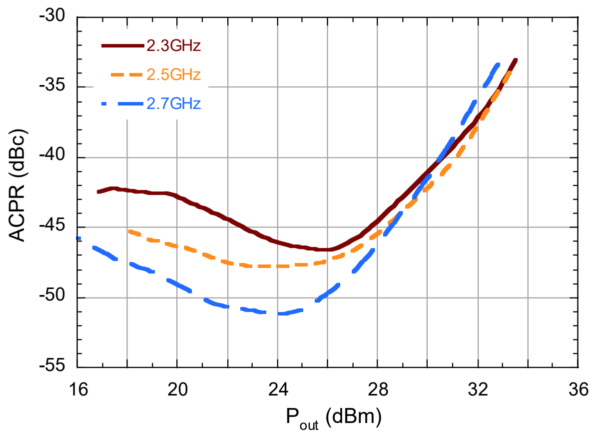
Gain vs. Output Power and Frequency



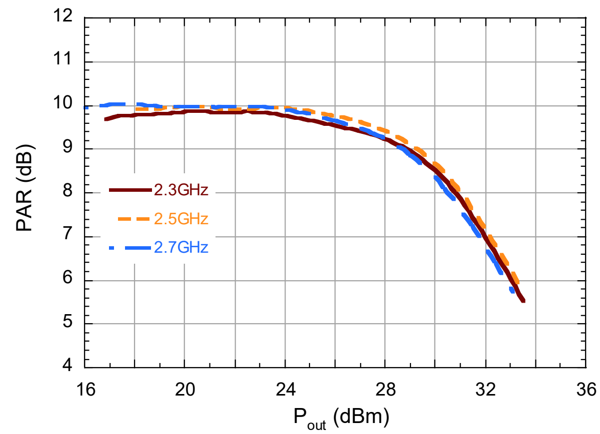
Drain Efficiency vs. Output Power and Frequency



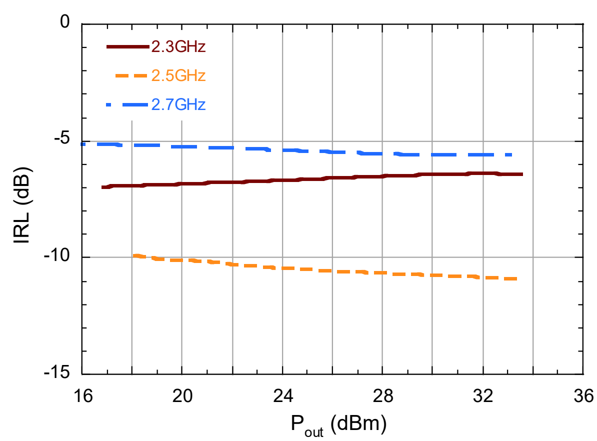
ACPR (Max ±5 MHz) vs. Output Power and Frequency



PAR (CCDF @ 0.01%) vs. Output Power and Frequency

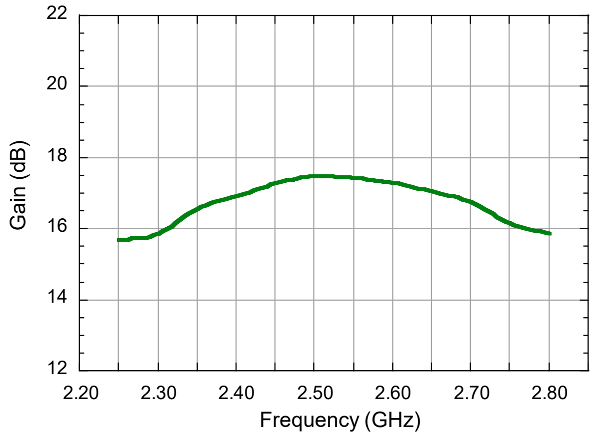


Input Return Loss vs. Output Power and Frequency

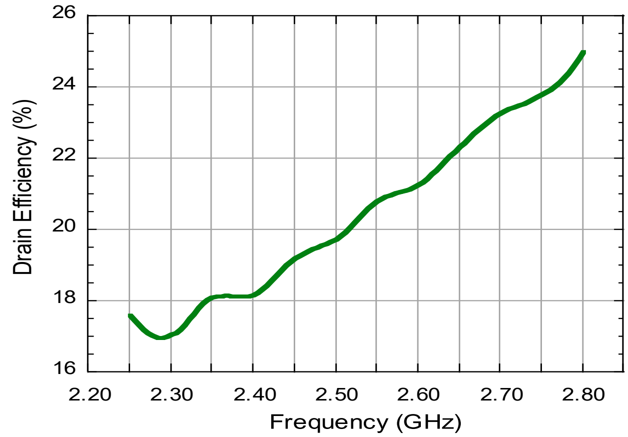


Typical Performance as Measured in the 2.3 - 2.7 GHz Evaluation Board:
WCMDA 3GPP TM1 64 DPCH 9.9 dB PAR @ 0.01% CCDF, V_{DS} = 48 V, I_{DQ} = 20 mA, T_C = 25°C

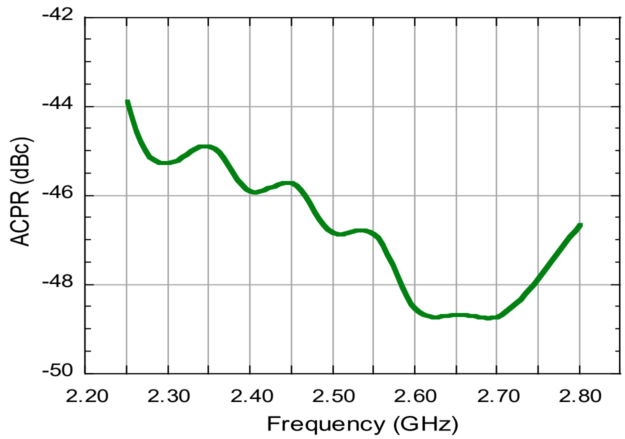
Gain vs. Frequency at P_{OUT} = 27 dBm



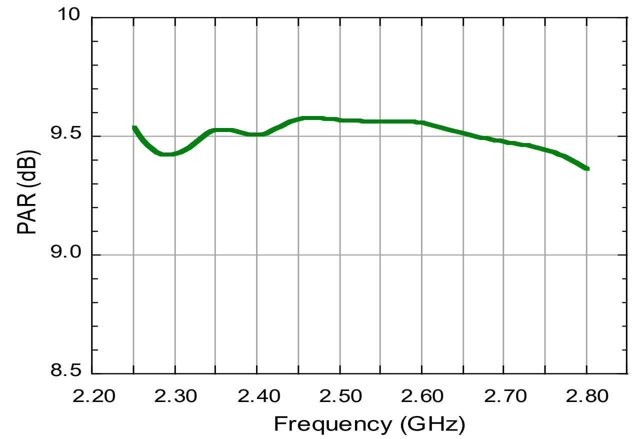
Drain Efficiency vs. Frequency at P_{OUT} = 27 dBm



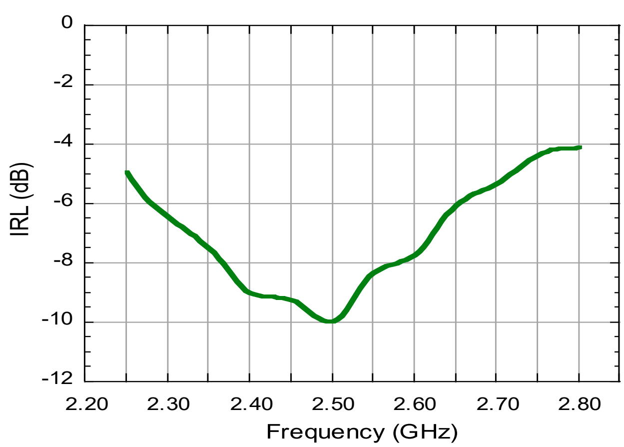
ACPR (Max ±5 MHz) vs. Frequency at P_{OUT} = 27 dBm



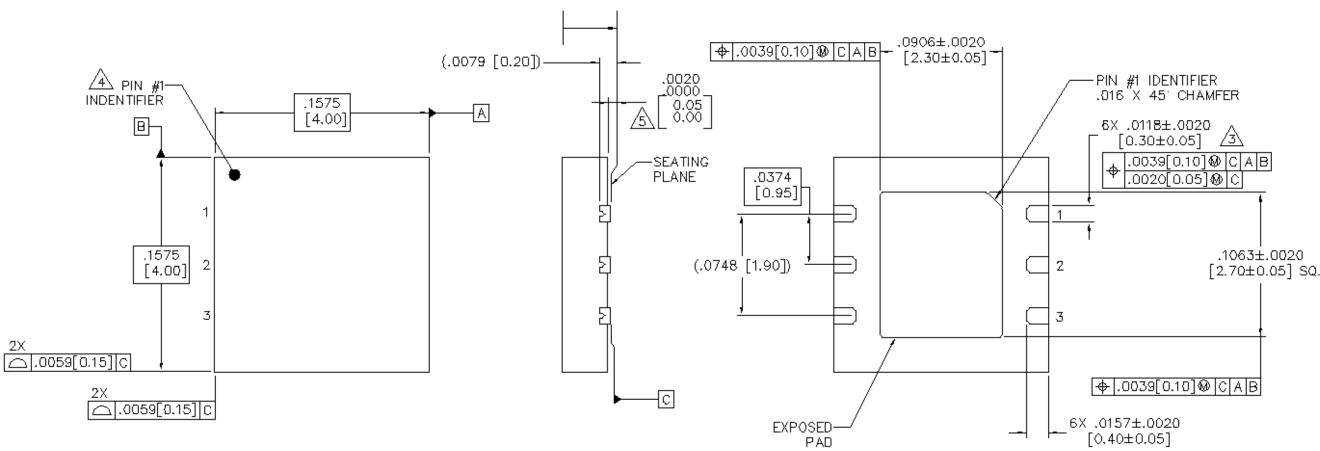
PAR (CCDF @ 0.01%) vs. Frequency at P_{OUT} = 27dBm



Input Return Loss vs. Frequency at P_{OUT} = 27 dBm



Lead-Free 4 x 4 mm 6-Lead Package Dimensions†



NOTES:

1. ALL DIMENSIONS AND TOLERANCES ARE BASED ON JEDEC MO-220, VAR WITH SAW SINGULATION. ALL DIMENSIONS SHOWN AS in[mm]. CONTROLLING DIMENSIONS ARE IN mm AND CONVERTED in DIMENSIONS ARE NOT NECESSARILY EXACT.
2. LEAD FINISH: NiPdAu PLATE.
3. INDICATED DIMENSIONS/TOLERANCES APPLY TO THE PLATED LEAD AND IS MEASURED BETWEEN .0059[0.15] AND .0118[0.30] FROM THE LEAD END.
4. EXACT SIZE AND SHAPE OF THIS FEATURE IS OPTIONAL.
5. INDICATED DIMENSIONS/TOLERANCES APPLY TO LEADS AND EXPOSED PAD.

† Reference Application Note S2083 for lead-free solder reflow recommendations.
Meets JEDEC moisture sensitivity level (MSL) 3 requirements.