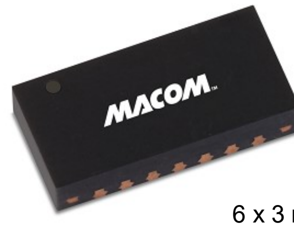
Features

- Suitable for Linear and Saturated Applications
- CW and Pulsed Operation: 2 W Output Power
- 260°C Reflow Compatible
- 50 V Operation
- 100% RF Tested
- RoHS* Compliant



6 x 3 mm DFN

Description

The MAGX-100027-002S0P is a GaN on Si HEMT D-mode transistor suitable for DC - 2.7 GHz frequency operation. The device supports both CW and pulsed operation with peak output power levels to 2 W (33 dBm) in a plastic package.

The MAGX-100027-002S0P is ideally suited for military radio communications, digital cellular infrastructure, RF energy, avionics, test instrumentation and RADAR.

Typical Performance:

- V_{DS} = 50 V, I_{DQ} = 15 mA, T_C = 25°C. Measured under pulsed load-pull at 2.5 dB Compression, 100 µs pulse width, 10% duty cycle.

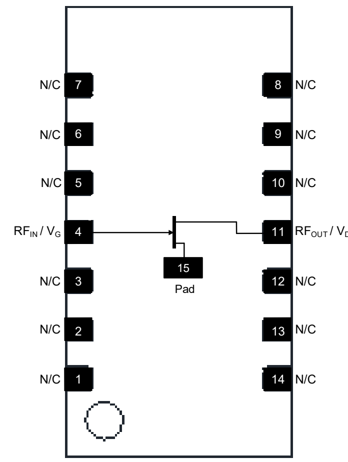
Frequency (GHz)	Output Power[1] (dBm)	Gain[2] (dB)	η_D[2] (%)
0.9	35	21.6	67.3
1.4	35.2	21.4	64.7
2.0	35.1	21.1	62
2.7	35.2	21	60.1

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

Ordering Information

Part Number	Package
MAGX-100027-002S0P	Bulk Quantity
MAGX-100027-002STP	Tape and Reel
MAGX-1A0027-002S0P	Sample Board

Functional Schematic



Pin Configuration

Pin Number	Pin Name	Function
1 - 3	NC	No Connection
4	RF_{IN} / V_G	RF Input / Gate
5 - 10	NC	No Connection
11	RF_{OUT} / V_D	RF Output / Drain
12 - 14	NC	No Connection
15	Pad[3]	Ground / Source

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

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

RF Electrical Characteristics: T_C = 25°C, V_{DS} = 50 V, I_{DQ} = 15 mA
Note: Performance in MACOM Evaluation Test Fixture, 50 Ω system

Parameter	Test Conditions	Symbol	Min.	Typ.	Max.	Units
Small Signal Gain	Pulsed[4], 2.5 GHz	G_{SS}	-	20.1	-	dB
Power Gain	Pulsed[4], 2.5 GHz, 2.5dB Gain Compression	G_{SAT}	-	17.6	-	dB
Saturated Drain Efficiency	Pulsed[4], 2.5 GHz, 2.5dB Gain Compression	η_{SAT}	-	58.5	-	%
Saturated Output Power	Pulsed[4], 2.5 GHz, 2.5dB Gain Compression	P_{SAT}	-	34.7	-	dBm
Gain Variation (-40°C to +85°C)	Pulsed[4] 2.5 GHz	ΔG	-	0.016	-	dB/°C
Power Variation (-40°C to +85°C)	Pulsed[4] 2.5 GHz	ΔP2.5dB	-	0.009	-	dB/°C
Gain	Pulsed[4], 2.5 GHz, P_{IN} = 15.2 dBm	G_P	-	18.7	-	dB
Drain Efficiency	Pulsed[4], 2.5 GHz, P_{IN} = 15.2 dBm	η	-	54.3	-	%
Input Return Loss	Pulsed[4], 2.5 GHz, P_{IN} = 15.2 dBm	IRL	-	-7.7	-	dB
Ruggedness: Output Mismatch	All phase angles	ψ	VSWR = 10:1, No Damage			

RF Electrical Specifications: T_A = 25°C, V_{DS} = 50 V, I_{DQ} = 15 mA
Note: Performance in MACOM Production Test Fixture, 50 Ω system

Parameter	Test Conditions	Symbol	Min.	Typ.	Max.	Units
Power Gain	Pulsed[4], 2.5 GHz, 2.5dB Gain Compression	G_P	16.5	17.4	-	dB
Saturated Drain Efficiency	Pulsed[4], 2.5 GHz, 2.5dB Gain Compression	η	51.2	55.2	-	%
Saturated Output Power	Pulsed[4], 2.5 GHz, 2.5 dB Gain Compression	$P_{2.5dB}$	34.3	34.7	-	dBm
Gain	Pulsed[4], 2.5 GHz, P_{IN} = 15.2 dBm	G_P	17.8	18.6	-	dB
Drain Efficiency	Pulsed[4], 2.5 GHz, P_{IN} = 15.2 dBm	η	47	51	-	%
Input Return Loss	Pulsed[4], 2.5 GHz, P_{IN} = 15.2 dBm	IRL	-	-9	-5	dB

4. Pulse details: 100 μs pulse width, 10% Duty Cycle

DC Electrical Characteristics: T_A = 25°C

Parameter	Test Conditions	Symbol	Min.	Typ.	Max.	Units
Drain-Source Leakage Current	V_{GS} = -8 V, V_{DS} = 130 V	I_{DLK}	-	-	0.4	mA
Gate-Source Leakage Current	V_{GS} = -8 V, V_{DS} = 0 V	I_{GLK}	-	-	0.4	mA
Gate Threshold Voltage	V_{DS} = 50 V, I_D = 0.4 mA	V_T	-	-2.0	-	V
Gate Quiescent Voltage	V_{DS} = 50 V, I_D = 15 mA	V_{GSQ}	-	-1.8	-	V
On Resistance	V_{GS} = 2 V, I_D = 3 mA	R_{ON}	-	7.89	-	Ω
Maximum Drain Current	V_{DS} = 7 V, pulse width 300 μs	$I_{D, MAX}$	-	0.23	-	A

Absolute Maximum Ratings[5,6,7,8,9]

Parameter	Absolute Maximum
Drain Source Voltage, V_{DS}	130 V
Gate Source Voltage, V_{GS}	-10 to 3 V
Gate Current, I_G	0.4 mA
Storage Temperature Range	-65°C to +150°C
Case Operating Temperature Range	-40°C to +85°C
Channel Operating Temperature Range, T_{CH}	-40°C to +210°C
Absolute Maximum Channel Temperature	+225°C

5. Exceeding any one or combination of these limits may cause permanent damage to this device.
6. MACOM does not recommend sustained operation above maximum operating conditions.
7. Operating at drain source voltage V_{DS} < 55 V will ensure MTTF > 4 x 10^6 hours.
8. Operating at nominal conditions with $T_{CH} \leq 210°C$ will ensure MTTF > 4 x 10^6 hours.
9. 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[10]

Parameter	Test Conditions	Symbol	Typical	Units
Thermal Resistance using Finite Element Analysis	V_{DS} = 50 V T_C = 85°C,T_C = 225°C	R_θ(FEA)	56.6	°C/W
Thermal Resistance using Infrared Measurement of Die Surface Temperature	V_{DS} = 50 V T_C = 85°C,T_C = 225°C	R_θ(IR)	45.3	°C/W

10. 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

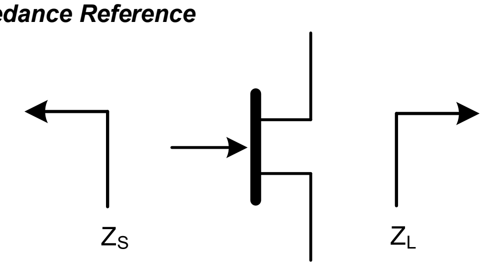
Gallium Nitride Circuits are sensitive to electrostatic discharge (ESD) and can be damaged by static electricity. Proper ESD control techniques should be used when handling these HBM Class 0B, CDM Class C1 devices.

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

Frequency (GHz)	Z_{SOURCE} (Ω)	Maximum Output Power V_{DS} = 50 V, I_{DQ} = 15 mA, T_C = 25°C, P2.5dB					
		Z_{LOAD}[11] (Ω)	Gain (dB)	P_{OUT} (dBm)	P_{OUT} (W)	η_D (%)	AM/PM (°)
0.9	12.2 + j90.8	85.5 + j135.3	22.8	35	35	62.4	-3.7
1.4	7.7 + j83.7	81.1 + j147.6	21.2	35.2	35.2	58.4	2.1
2.0	5.2 + j58.7	82.9 + j132.2	20.6	35.1	35.1	57.8	-0.2
2.7	7.4 + j44.6	60.8 + j101.9	20.1	35.2	35.2	54.9	4.6

Frequency (GHz)	Z_{SOURCE} (Ω)	Maximum Drain Efficiency V_{DS} = 50 V, I_{DQ} = 15 mA, T_C = 25°C, P2.5dB					
		Z_{LOAD}[12] (Ω)	Gain (dB)	P_{OUT} (dBm)	P_{OUT} (W)	η_D (%)	AM/PM (°)
0.9	16.8 + j86.2	31.9 + j158.5	21.6	33.9	2.5	67.3	-3.1
1.4	8.3 + j73.7	65.1 + j196.6	21.4	34	2.5	64.7	0.9
2.0	5.9 + j50.6	78.8 + j165.5	21.1	34.6	2.9	62	-0.4
2.7	4.6 + j39.3	39.8 + j117.4	21	34.5	2.8	60.1	0.1

Impedance Reference

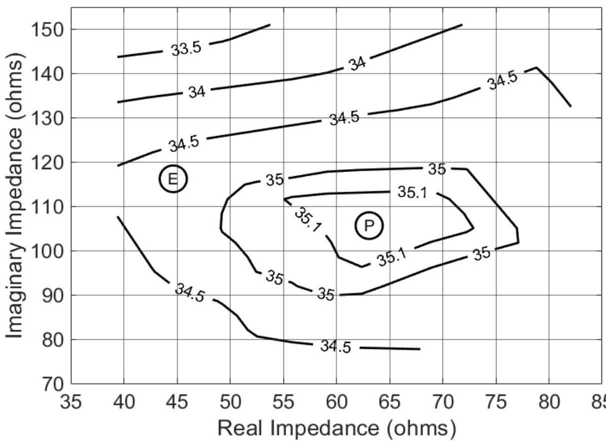


Z_{SOURCE} = Measured impedance presented to the input of the device at package reference plane.
Z_{LOAD} = Measured impedance presented to the output of the device at package reference plane.

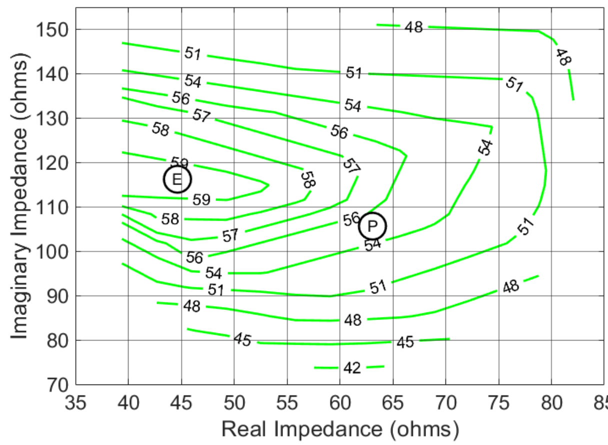
11. Load Impedance for optimum output power.
12. Load Impedance for optimum efficiency.

Pulsed[4] Load-Pull Performance @ 2.7 GHz

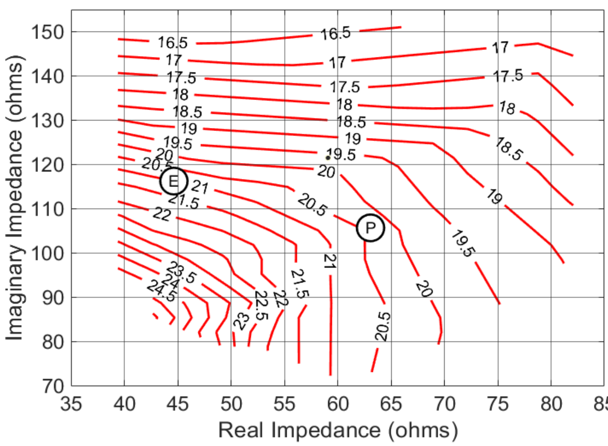
P2.5dB Loadpull Output Power Contours (dBm)



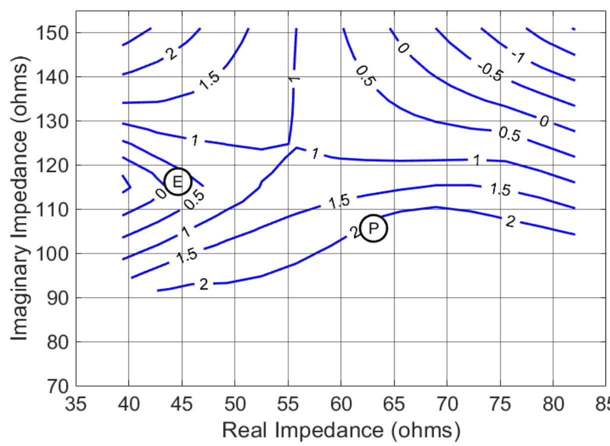
P2.5dB Loadpull Drain Efficiency Contours (%)



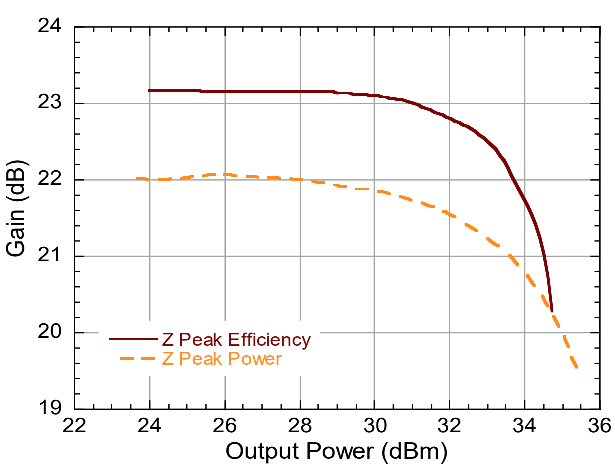
P2.5dB Loadpull Gain Contours (dB)



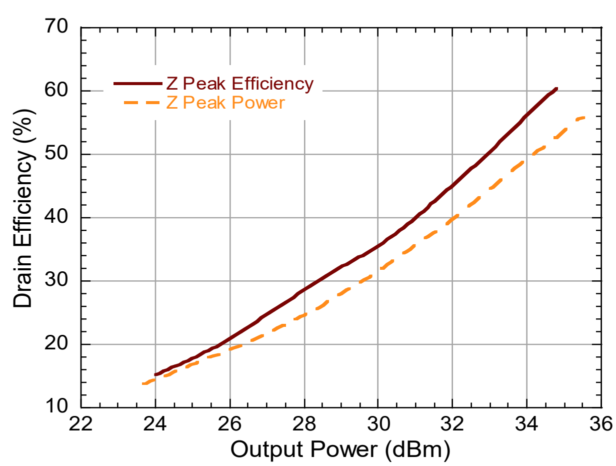
P2.5dB Loadpull AM/PM Contours (°)



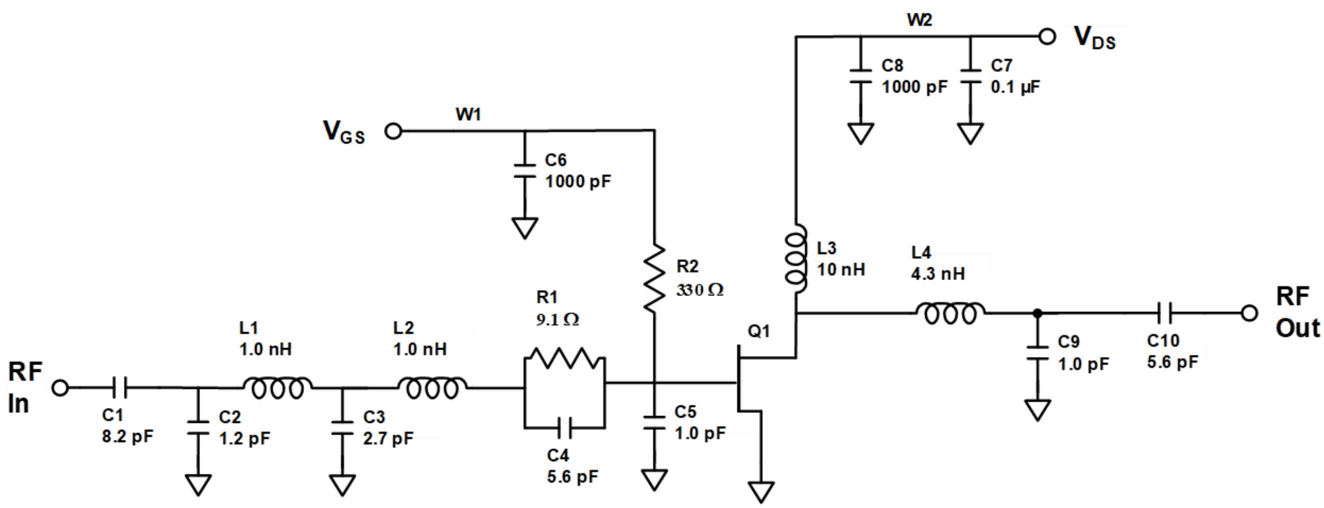
Gain vs. Output Power



Drain Efficiency vs. Output Power



Evaluation Test Fixture and Recommended Tuning Solution 2.45 - 2.55 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

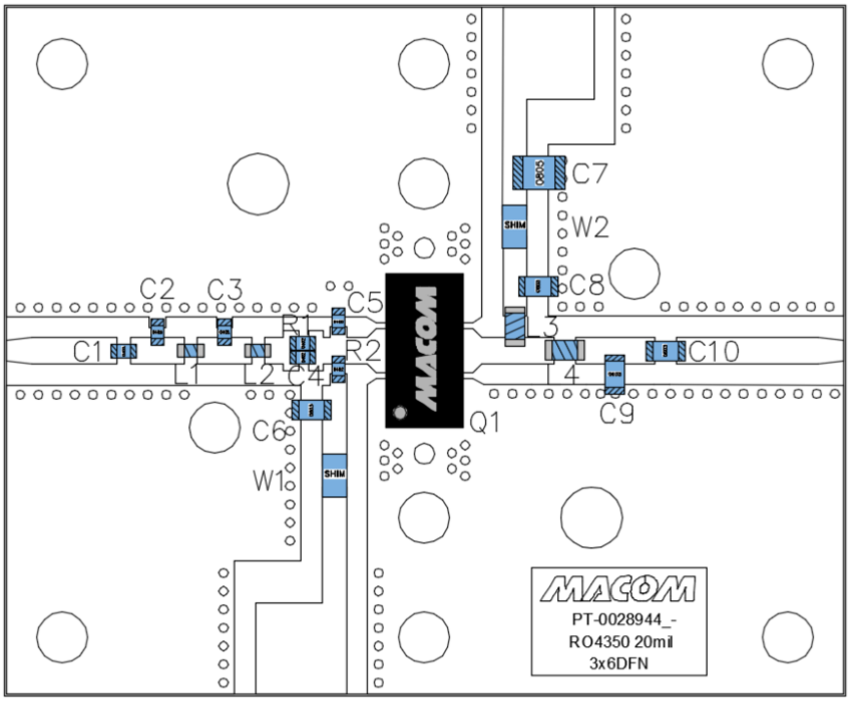
Turning the device ON

1. Set V_{GS} to pinch-off (V_P).
2. Turn on V_{DS} to nominal voltage (50 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}.

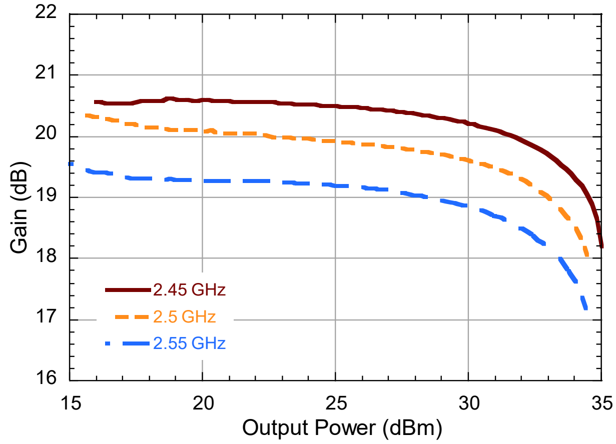
Evaluation Test Fixture and Recommended Tuning Solution 2.45 - 2.55 GHz



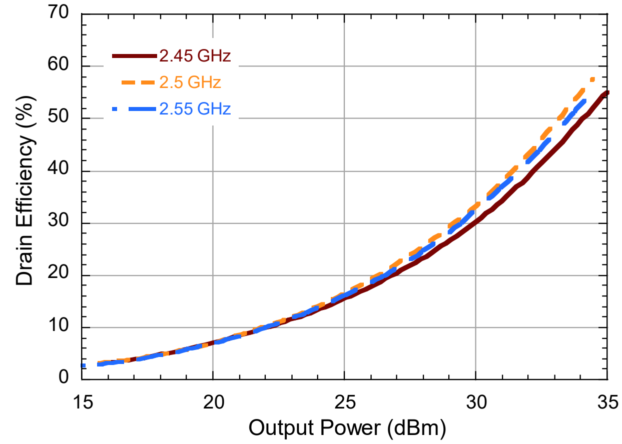
Reference Designator	Value	Tolerance	Manufacturer	Part Number
C1	8.2 pF	+/- 0.1 pF	PPI	0402N8R2BW201
C2	1.2 pF	+/- 0.1 pF	PPI	0402N1R2BW201
C3	2.7 pF	+/- 0.1 pF	PPI	0402N2R7BW201
C4	5.6 pF	+/- 0.1 pF	PPI	0402N5R6BW201
C5	1.0 pF	+/- 0.1 pF	PPI	0402N1R0BW201
C6, C8	1000 pF	+/- 5 %	TDK	C1608C0G1H102J080AE
C7	0.1 µF	+/- 10 %	TDK	CGJ4J3X7T2D104K125AA
C9	1.0 pF	+/- 0.1 pF	PPI	0603N1R0BW251
C10	5.6 pF	+/- 0.1 pF	PPI	0603N5R6BW251
R1	9.1 Ω	+/- 5 %	Panasonic	ERJ-2GEJ9R1X
R2	330 Ω	+/- 1 %	Panasonic	ERJ-2RKF3300X
L1, L2	1.0 nH	+/- 5 %	Coilcraft	0402HP-1N0XJL
L3	10 nH	+/- 5 %	Coilcraft	0603CT-10NXJL
L4	4.3 nH	+/- 5 %	Coilcraft	0603CT-4N3XJL
W1, W2	-	-	-	Shim
Q1	2 W	-	MACOM	MAGX-100027-002S0P
PCB	Rogers RO4350, 20mil, 0.5oz Cu, Au Finish			

Typical Performance Curves as Measured in the 2.45 - 2.55 GHz Evaluation Test Fixture:
Pulsed[4] 2.5 GHz, V_{DS} = 50 V, I_{DQ} = 15 mA, T_C = 25°C (Unless Otherwise Noted)

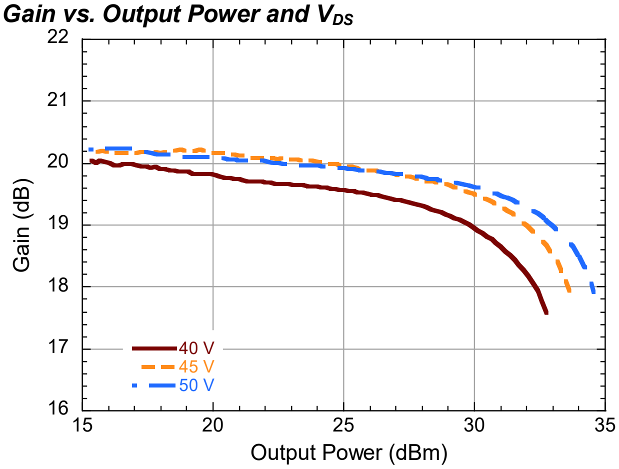
Gain vs. Output Power and Frequency



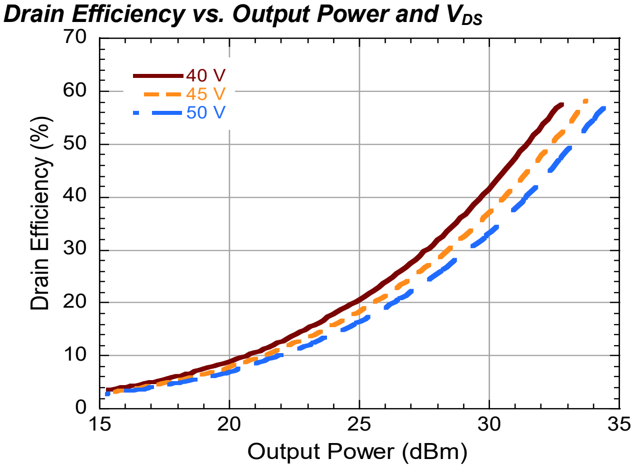
Drain Efficiency vs. Output Power and Frequency



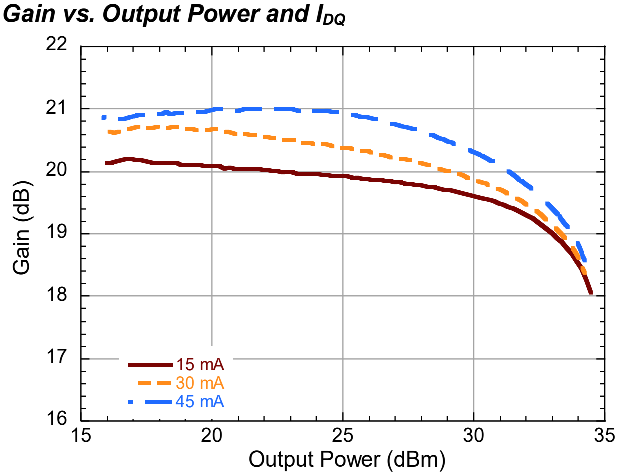
Gain vs. Output Power and V_{DS}



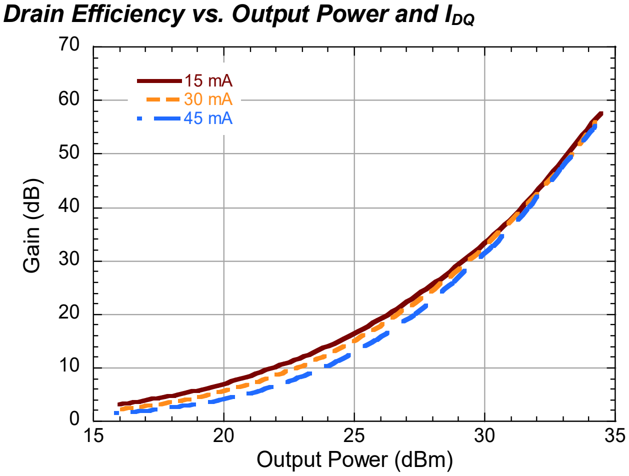
Drain Efficiency vs. Output Power and V_{DS}



Gain vs. Output Power and I_{DQ}

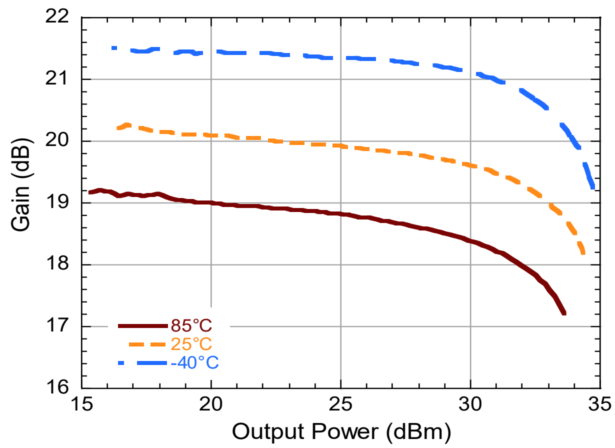


Drain Efficiency vs. Output Power and I_{DQ}

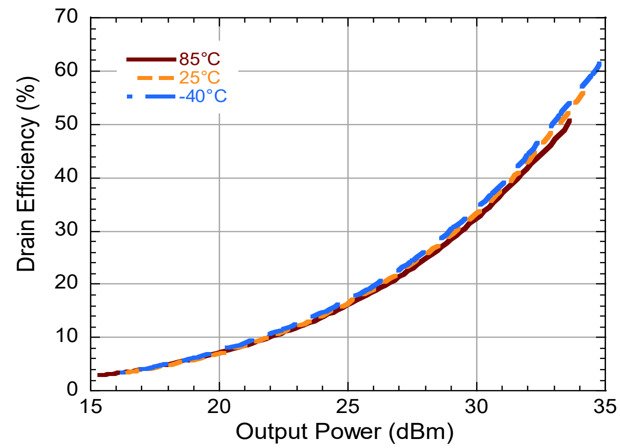


Typical Performance Curves as Measured in the 2.45 - 2.55 GHz Evaluation Test Fixture:
Pulsed[4] 2.5 GHz, V_{DS} = 50 V, I_{DQ} = 15 mA, T_C = 25°C (Unless Otherwise Noted)

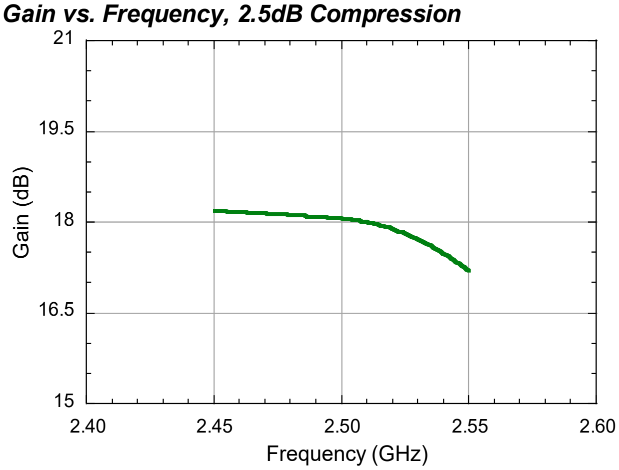
Gain vs. Output Power and T_C



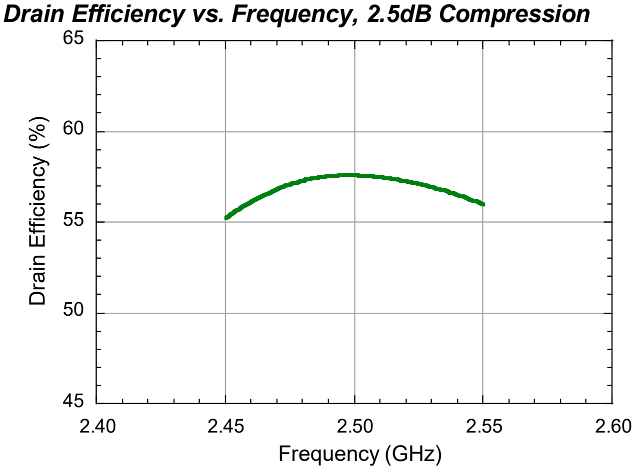
Drain Efficiency vs. Output Power and T_C



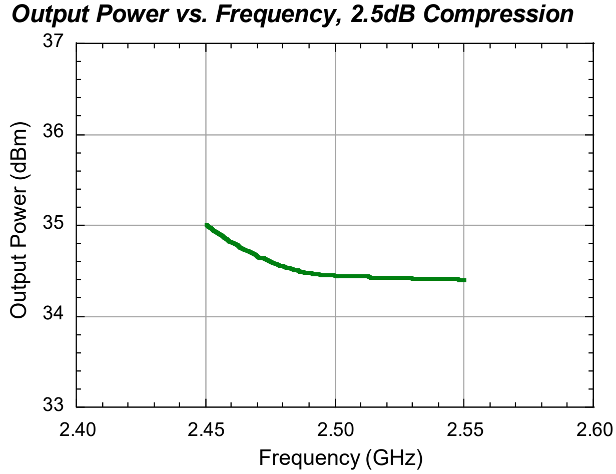
Gain vs. Frequency, 2.5dB Compression



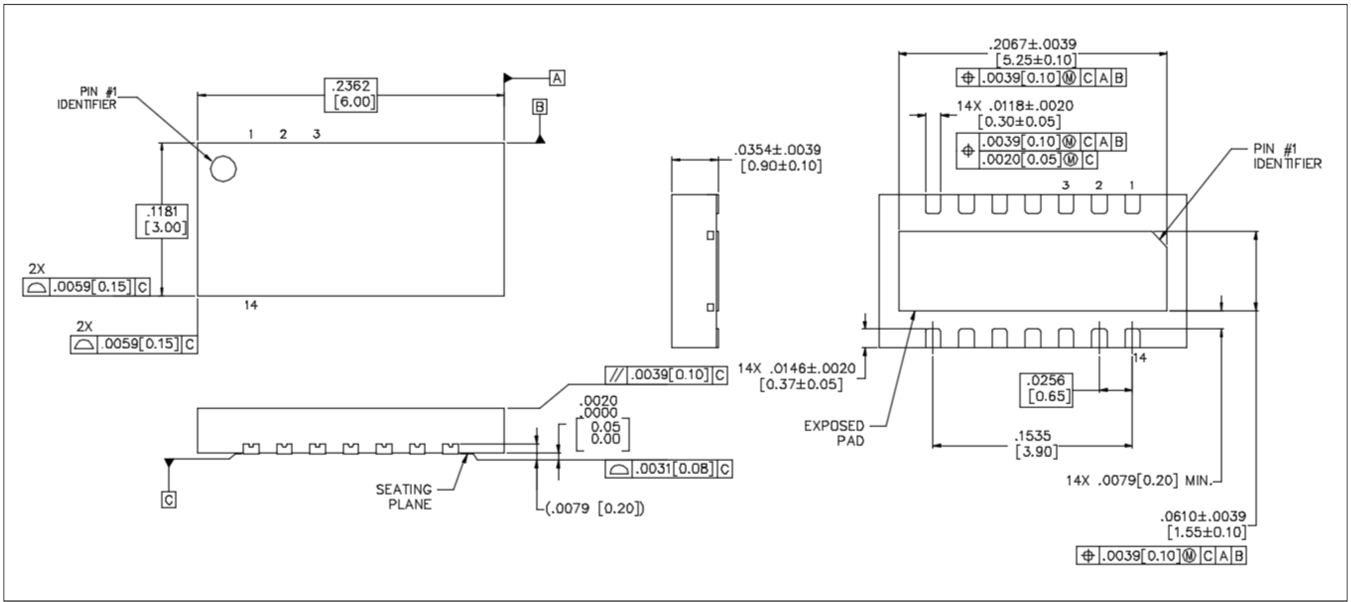
Drain Efficiency vs. Frequency, 2.5dB Compression



Output Power vs. Frequency, 2.5dB Compression



Lead-Free 6 x 3 mm DFN Package Dimensions†



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