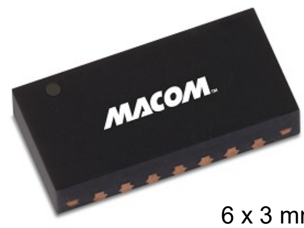
GaN Amplifier 50 V, 15 W
DC - 2.7 GHz

MAGX-100027-015S0P
Rev. V2

Features

- Suitable for Linear and Saturated Applications
- CW and Pulsed Operation: 15 W Output Power
- 260°C Reflow Compatible
- 50 V Operation
- 100% RF Tested
- RoHS* Compliant



6 x 3 mm DFN

Description

The MAGX-100027-015S0P is a high power GaN on Silicon 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 15 W (41.8 dBm) in a plastic package.

The MAGX-100027-015S0P is ideally suited for a multitude of applications including military radio communications, digital cellular infrastructure, RF energy, avionics, test instrumentation and RADAR.

Typical Performance:

- V_{DS} = 50 V, I_{DQ} = 60 mA, T_C = 25°C. Measured under pulsed load-pull at 2.5 dB Compression, 100 µs pulse width,1 ms period, 10% duty cycle.

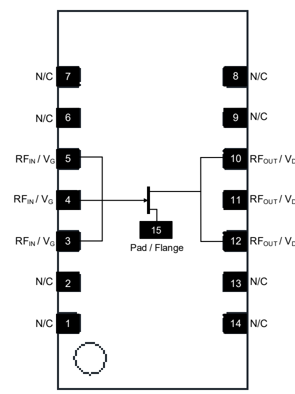
Frequency (GHz)	Output Power[1] (dBm)	Gain[2] (dB)	η_D[2] (%)
0.9	44.2	27.6	78.3
1.4	44.3	22.3	73.5
2.0	44.2	22.7	68.4
2.5	44.2	20.7	67.6
2.7	43.7	20.8	62

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

Ordering Information

Part Number	Package
MAGX-100027-015S0P	Bulk Quantity
MAGX-100027-015STP	Tape and Reel
MAGX-1A0027-015S0P	Sample Board

Functional Schematic



Pin Configuration

Pin #	Pin Name	Function
1, 2	NC	No Connection
3 - 5	RF_{IN} / V_G	RF Input / Gate
6 - 9	NC	No Connection
10 - 12	RF_{OUT} / V_D	RF Output / Drain
13, 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.

DC-0021994

RF Electrical Characteristics: T_C = 25°C, V_{DS} = 50 V, I_{DQ} = 60 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}	-	17.6	-	dB
Power Gain	Pulsed[4], 2.5 GHz, 2.5 dB Gain Compression	G_{SAT}	-	15.3	-	dB
Saturated Drain Efficiency	Pulsed[4], 2.5 GHz, 2.5 dB Gain Compression	η_{SAT}	-	60	-	%
Saturated Output Power	Pulsed[4], 2.5 GHz, 2.5 dB Gain Compression	P_{SAT}	-	44	-	dBm
Gain Variation (-25°C to +85°C)	Pulsed[4] 2.5 GHz	ΔG	-	0.02	-	dB/°C
Power Variation (-25°C to +85°C)	Pulsed[4] 2.5 GHz	ΔP2.5dB	-	0.012	-	dB/°C
Gain	Pulsed[4], 2.5 GHz, P_{OUT} = 42.8 dBm	G_P	-	17.2	-	dB
Drain Efficiency	Pulsed[4], 2.5 GHz, P_{OUT} = 42.8 dBm	η	-	52	-	%
Ruggedness: Output Mismatch	All phase angles	Ψ	VSWR = 10:1, No Device Damage			

RF Electrical Specifications: T_A = 25°C, V_{DS} = 50 V, I_{DQ} = 60 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, 2.5 dB Gain Compression	G_{SAT}	10.5	13.2	-	dB
Saturated Drain Efficiency	Pulsed[4], 2.5 GHz, 2.5 dB Gain Compression	η_{SAT}	53	59.6	-	%
Saturated Output Power	Pulsed[4], 2.5 GHz, 2.5 dB Gain Compression	P_{SAT}	42.9	44.0	-	dBm
Gain	Pulsed[4], 2.5 GHz, P_{IN} = 27.5 dBm	G_P	12.4	15.0	-	dB
Drain Efficiency	Pulsed[4], 2.5 GHz, P_{IN} = 27.5 dBm	η	42.5	49.0	-	%

4. Pulse details: 100 μs pulse width, 1 ms period, 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}	-	-	3.3	mA
Gate-Source Leakage Current	V_{GS} = -8 V, V_{DS} = 0 V	I_{GLK}	-	-	3.3	mA
Gate Threshold Voltage	V_{DS} = 50 V, I_D = 3.3 mA	V_T	-	-2.0	-	V
Gate Quiescent Voltage	V_{DS} = 50 V, I_D = 60 mA	V_{GSQ}	-2.4	-1.8	-1.4	V
On Resistance	V_{GS} = 2 V, I_D = 23.1 mA	R_{ON}	-	1.5	-	Ω
Maximum Drain Current	V_{DS} = 7 V pulsed, pulse width 300 μs	$I_{D, MAX}$	-	1.93	-	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	10 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 +225°C
Absolute Maximum Channel Temperature	+250°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 > 1 x 10^7 hours.
8. Operating at nominal conditions with T_{CH} ≤ 225°C will ensure MTTF > 1 x 10^7 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* = 3.686, *B* = -35.00, and *C* = 25,416.

Thermal Characteristics[10]

Parameter	Test Conditions	Symbol	Typical	Units
Thermal Resistance using Finite Element Analysis	V_{DS} = 50 V, P_D = 13 W, T_{CASE} = 85°C, T_{CH} = 225°C	R_θ(FEA)	7.7	°C/W
Thermal Resistance using Infrared Measurement of Die Surface Temperature	V_{DS} = 50 V, P_D = 13.5 W, T_{CASE} = 85°C, T_{CH} = 225°C	R_θ(IR)	8.9	°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

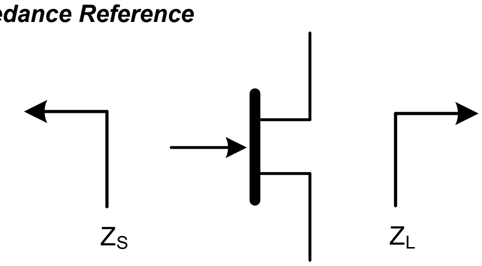
Gallium Nitride Circuits are sensitive to electrostatic discharge (ESD) and can be damaged by static electricity. Proper ESD control techniques should be used when handling these HBM Class 1A, CDM Class C2B devices.

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

Frequency (GHz)	Z_{SOURCE} (Ω)	Maximum Output Power V_{DS} = 50 V, I_{DQ} = 60 mA, T_C = 25°C, P2.5dB					
		Z_{LOAD}[1] (Ω)	Gain (dB)	P_{OUT} (dBm)	P_{OUT} (W)	η_D (%)	AM/PM[11] (°)
0.9	5 + j13.8	38.2 + j21.2	26.7	44.2	26.3	66	0.5
1.4	5 + j8.6	27.4 + j15	21.2	44.3	26.9	57.9	0.1
2.0	5 + j4.7	22.7 + j13.8	18.2	44.2	26.3	57.7	-0.5
2.5	5 + j1.5	14.1 + j13.9	19.2	44.2	26.3	58.6	1.6
2.7	5 + j0.2	13.1 + j14.5	19.1	43.7	23.4	55	1.3

Frequency (GHz)	Z_{SOURCE} (Ω)	Maximum Drain Efficiency V_{DS} = 50 V, I_{DQ} = 60 mA, T_C = 25°C, P2.5dB					
		Z_{LOAD}[2] (Ω)	Gain (dB)	P_{OUT} (dBm)	P_{OUT} (W)	η_D (%)	AM/PM[11] (°)
0.9	5 + j13.8	38.4 + j50.8	27.6	42.9	19.5	78.3	1.2
1.4	5 + j8.6	14.2 + j32.7	22.3	42.2	16.6	73.5	1.3
2.0	5 + j4.7	11.6 + j23.2	22.7	42.5	17.8	68.4	2.2
2.5	5 + j1.5	8.2 + j20.4	20.7	42.7	18.6	67.6	1.0
2.7	5 + j0.2	7.5 + j18.8	20.8	42.4	17.4	62	1.3

Impedance Reference

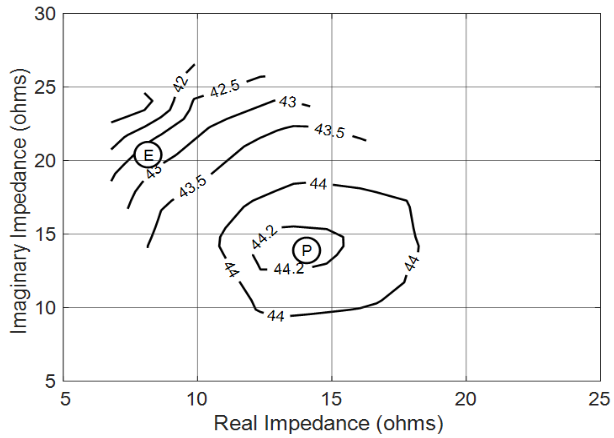


Z_{SOURCE} = Measured impedance presented to the input of the device at package reference plane.
Z_{LOAD} = Measured impedance presented to the output of the device at package reference plane.

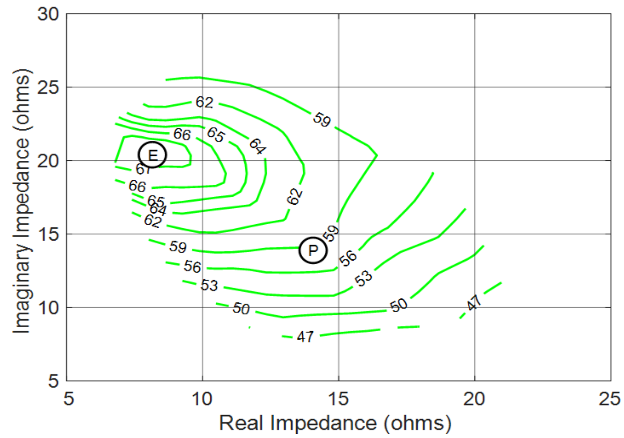
11. AM/PM listed are relative values.

Pulsed[4] Load-Pull Performance
2.5 GHz

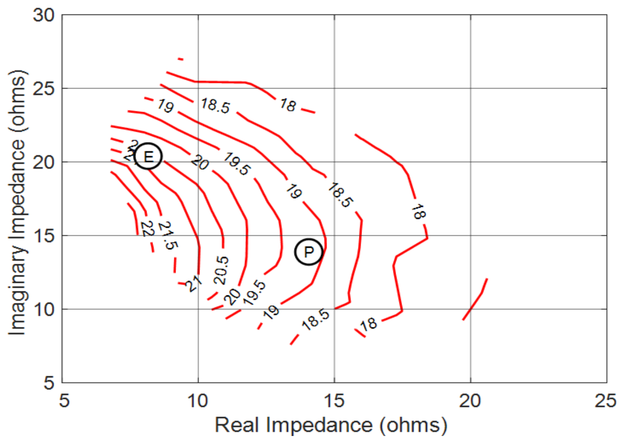
P2.5dB Loadpull Output Power Contours (dBm)



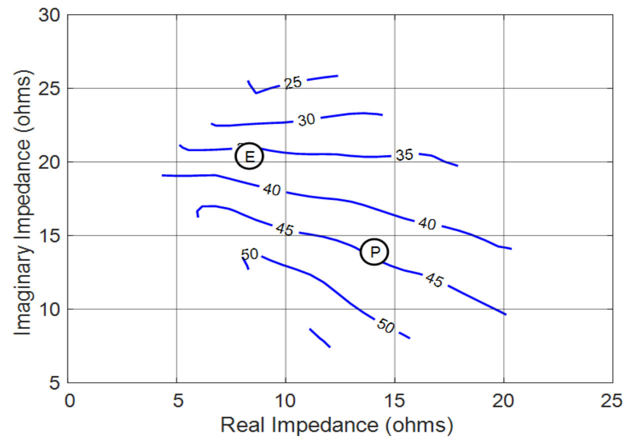
P2.5dB Loadpull Drain Efficiency Contours (%)



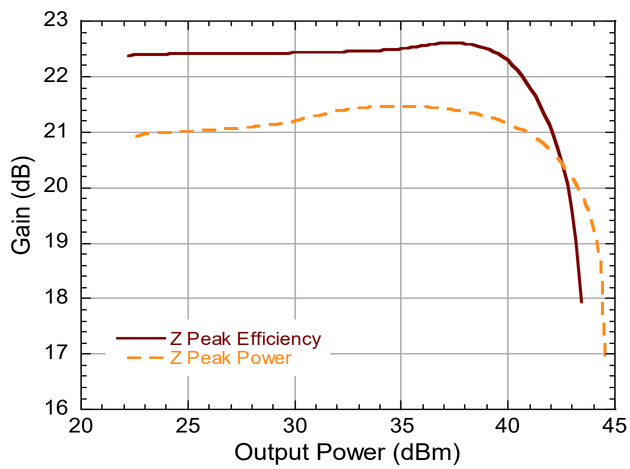
P2.5dB Loadpull Gain Contours (dB)



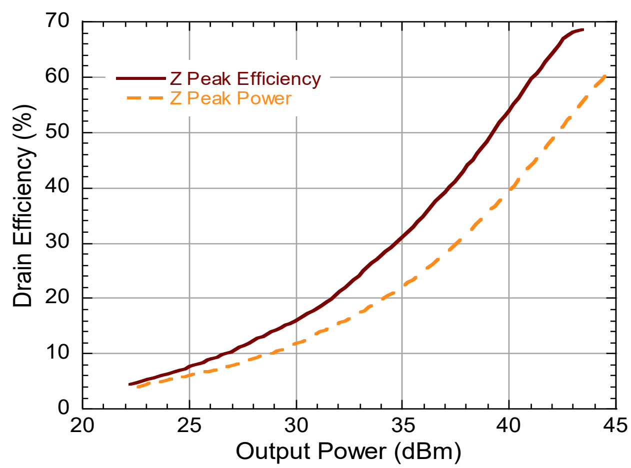
P2.5dB Loadpull AM/PM Contours (°)



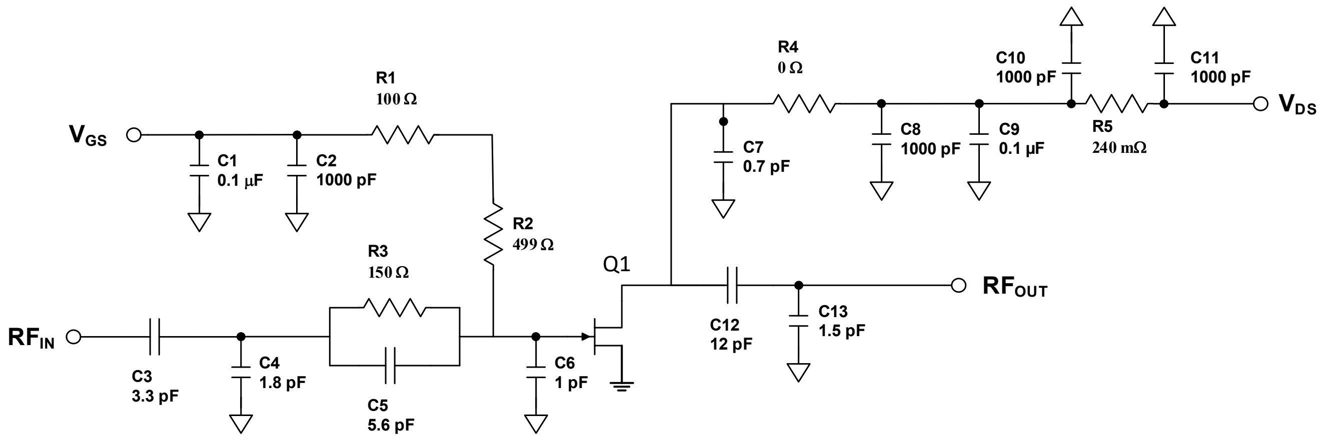
Gain vs. Output Power



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

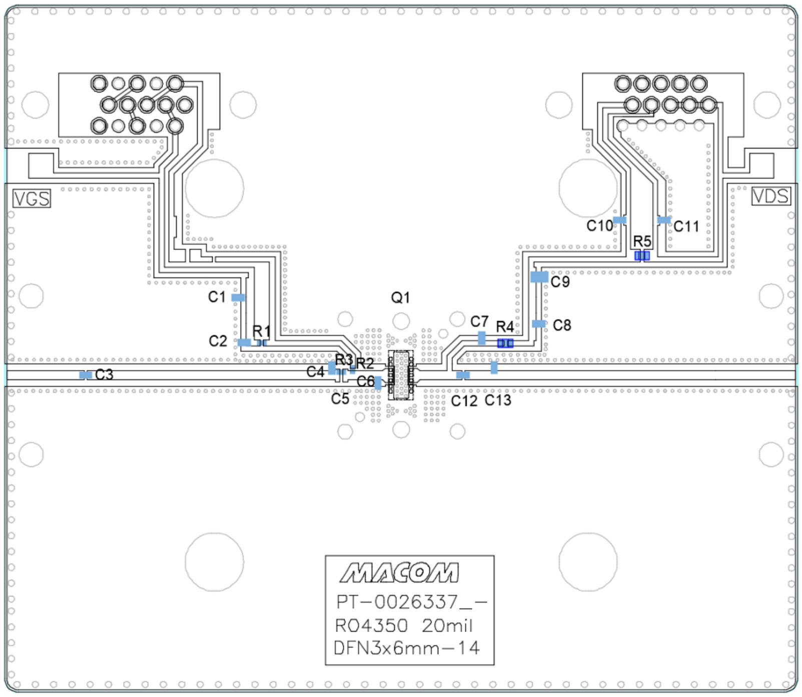
Turning the device ON

1. Set V_{GS} to the pinch-off (V_p).
2. Turn on V_{DS} to nominal Voltage (50 V).
3. Increase V_{GS} until I_{DSQ} 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

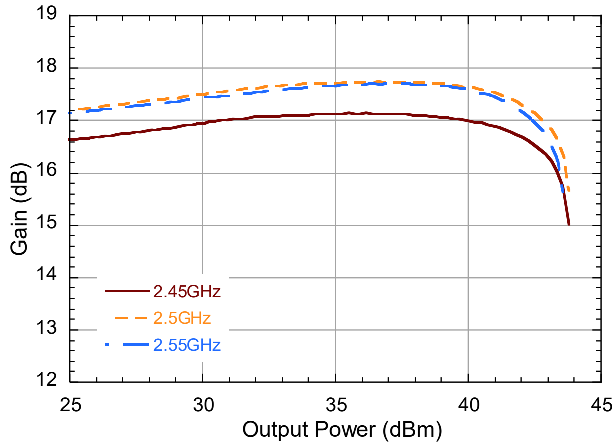


Parts List

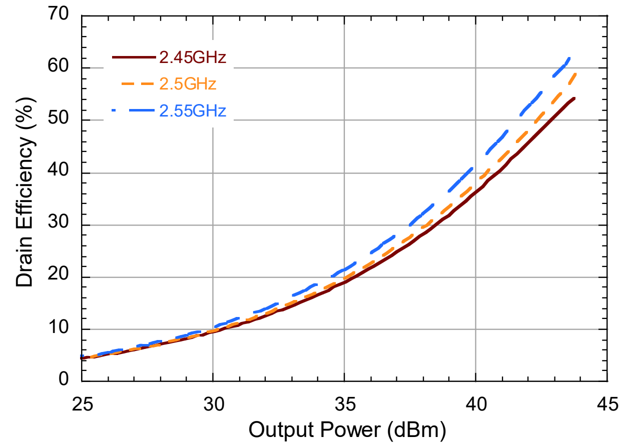
Reference Designator	Value	Tolerance	Manufacturer	Part Number
C1, C9	0.1 µF	5 %	Murata	GCJ188R72A104KA01D
C2, C10, C11	1000 pF	+/- 0.1 pF	Murata	GCJ188R92A102KA01D
C3	3.3 pF	+/- 0.1 pF	PPI	0603N3R3BL250
C4	1.8 pF	+/- 0.1 pF	PPI	0603N1R8BL250
C5	5.6 pF	+/- 0.1 pF	PPI	0402N5R6BL250
C6	1 pF	+/- 0.1 pF	PPI	0603N1R0BL250
C7	0.7 pF	+/- 0.1 pF	PPI	0603N0R7BL250
C8	1000 pF	5 %	Murata	GRM21AR72E102KW01D
C12	12 pF	+/- 5%	PPI	0603N120BL250
C13	1.5 pF	+/- 0.1 pF	PPI	0603N1R5BL250
R1	100 Ω	1%	Panasonic	ERJ-PA2F1000X
R2	499 Ω	1%	Viking	CR-02FL6—499R
R3	150 Ω	1%	Vishay Dale	CRCW0402150RFKEDHP
R4	0 Ω	1%	Vishay Dale	CRCW06030000Z0EBC
R5	240 mΩ	1%	Vishay Dale	RCWE1210R240FKEA
Q1	15 W	-	MACOM	MAGX-100027-015S0P
PCB	Rogers RO4350, 20mil, 1oz 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} = 60 mA, T_C = 25°C
Unless Otherwise Noted

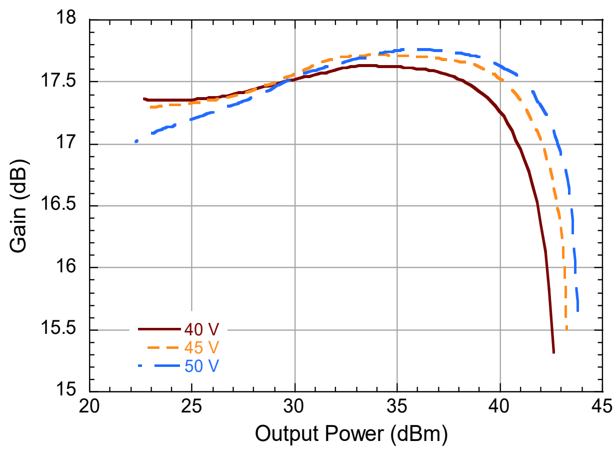
Gain vs. Output Power



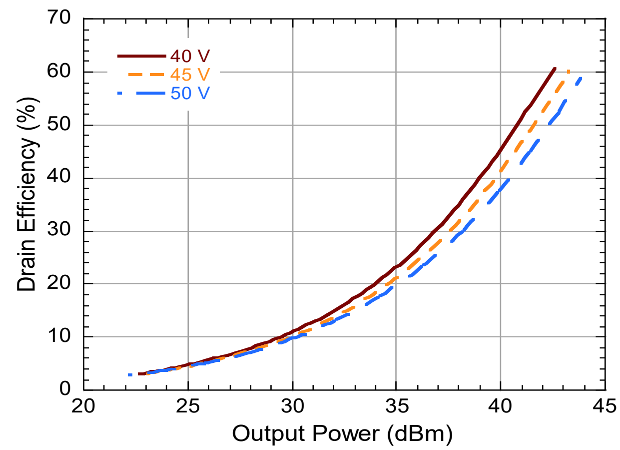
Drain Efficiency vs. Output Power



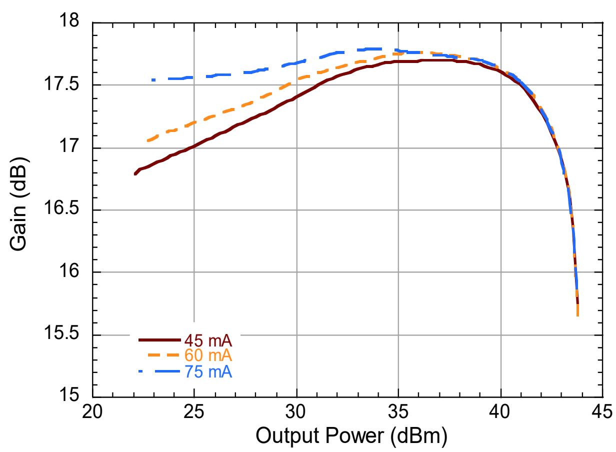
Gain vs. Output Power and V_{DS}



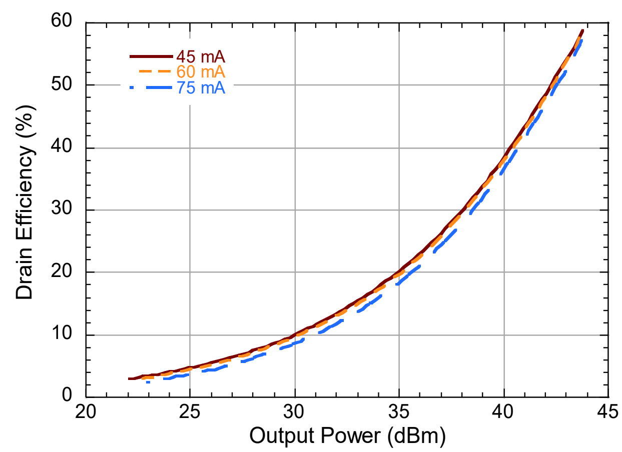
Drain Efficiency vs. Output Power and V_{DS}



Gain vs. Output Power and I_{DQ}

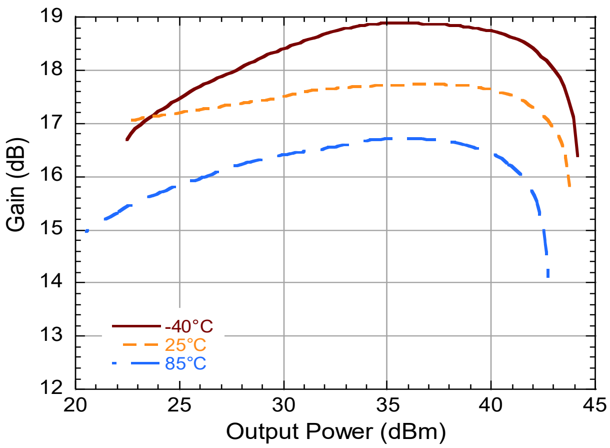


Drain Efficiency vs. Output Power and I_{DQ}

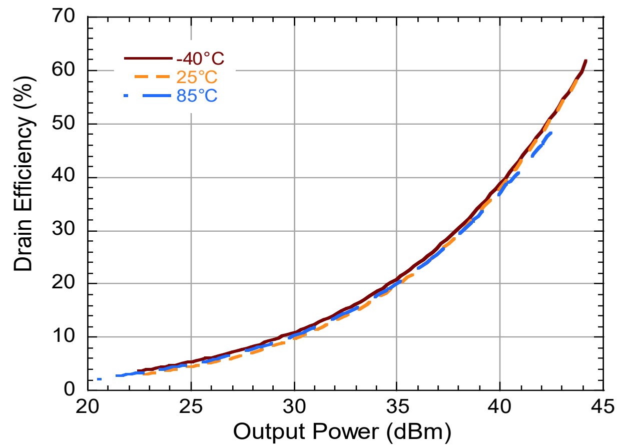


Typical Performance Curves as Measured in the 2.45 - 2.55 GHz Evaluation Test Fixture:
Pulsed[4] 2.5 GHz, V_{DS} = 50 V, I_{DQ} = 60 mA, T_C = 25°C
Unless Otherwise Noted

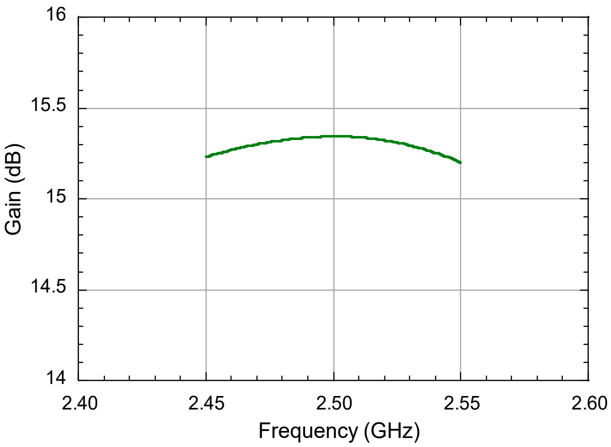
Gain vs. Output Power and Tc



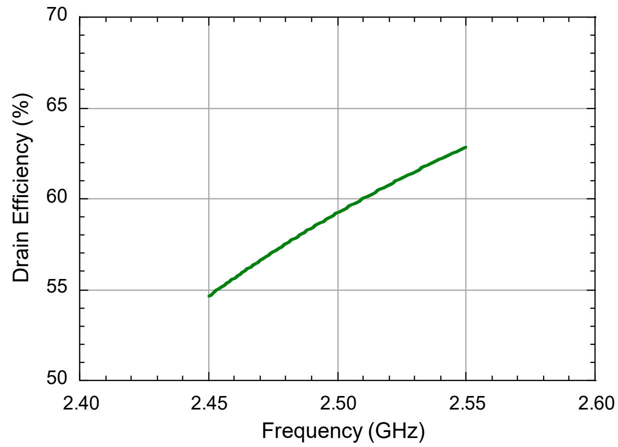
Drain Efficiency vs. Output Power and Tc



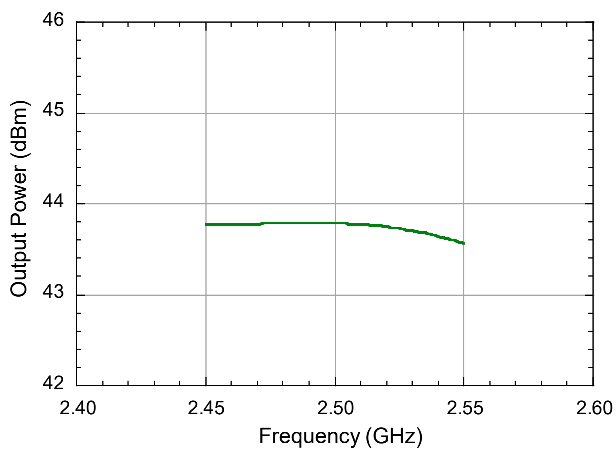
Gain vs. Frequency, 2.5 dB Gain Compression



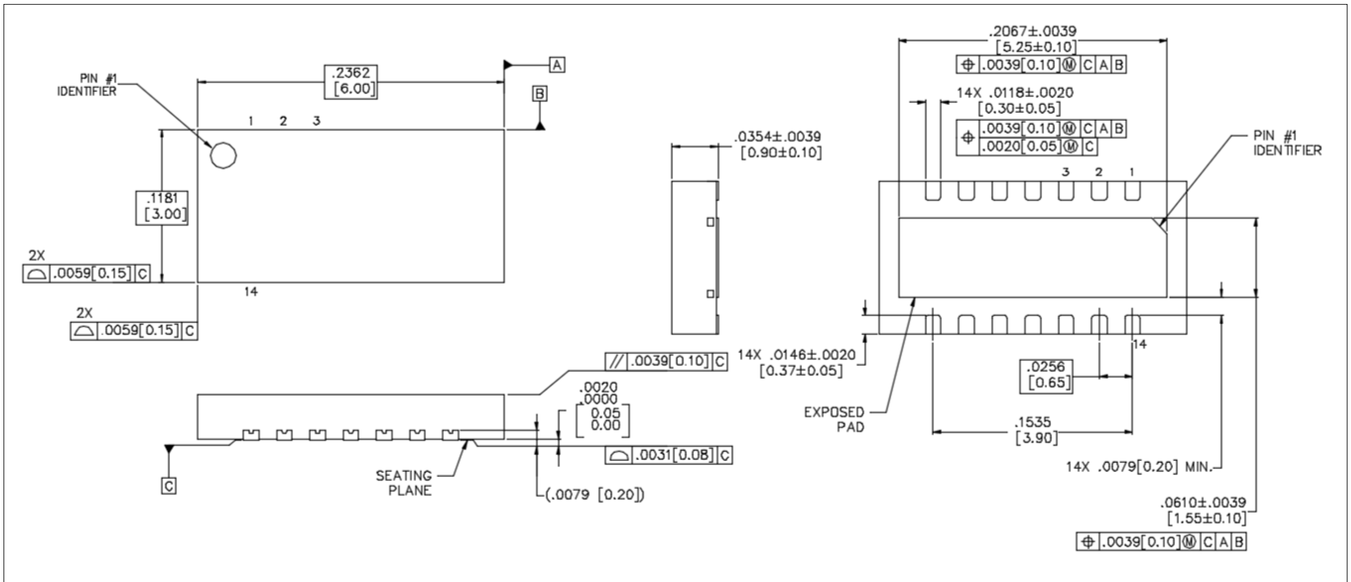
Drain Efficiency vs. Frequency, 2.5 dB Gain Compression



Output Power vs. Frequency, 2.5 dB Gain 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.