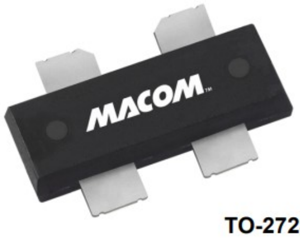
GaN Amplifier 50 V, 300 W
DC - 2.7 GHz

MAGX-100027-300C0P

Rev. V3

Features

- Suitable for Linear and Saturated Applications
- Pair of Isolated, Symmetric Amplifiers
- CW and Pulsed Operation: 300 W Output Power
- Internally Pre-Matched
- 260°C Reflow Compatible
- 50 V Operation
- 100% RF Tested
- RoHS* Compliant


TO-272S-4I

Description

The MAGX-100027-300C0P is high power GaN on Si HEMT device optimized for DC - 2.7 GHz frequency operation. The device supports both CW and pulsed operation with peak output power levels of 300 W (54.8 dBm) in a plastic package.

The MAGX-100027-300C0P 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} = 100 mA, T_C = 25°C. One side Measured under pulsed load-pull at 2.5 dB Compression, 100 µs pulse width, 1 ms period, 10% duty cycle

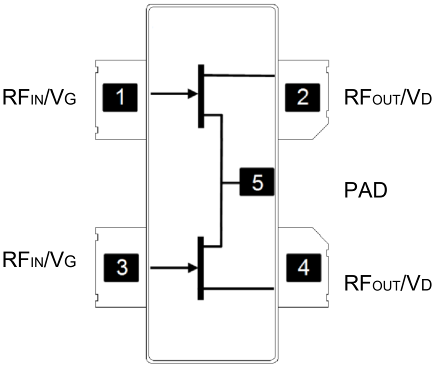
Frequency (GHz)	Output Power[1] (dBm)	Gain[2] (dB)	η_D[2] (%)
0.9	53.5	20.0	71.1
1.4	53.3	17.6	74.8
2.0	53.5	15.0	64.3
2.5	53.5	13.5	64.8
2.7	53.4	13.5	65.3

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

Ordering Information

Part Number	Package
MAGX-100027-300C0P	Bulk quantity
MAGX-100027-300CTP	Tape and Reel
MAGX-1A0027-300C0P	Sample board

Functional Schematic



Pin Configuration

Pin #	Pin Name	Function
1	RF_{IN} / V_{G1}	RF Input / Gate
2	RF_{OUT} / V_{D1}	RF Output / Drain
3	RF_{IN} / V_{G2}	RF Input / Gate
4	RF_{OUT} / V_{D2}	RF Output / Drain
5	Pad[3]	Ground / Source

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

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

RF Electrical Characteristics: T_C = 25°C, V_{DS} = 50 V, I_{DQ} = 200 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 GHz	G_{SS}	-	16.3	-	dB
Power Gain	Pulsed[4], 2 GHz, 2.5 dB Gain Compression	G_{SAT}	-	14.0	-	dBm
Saturated Drain Efficiency	Pulsed[4], 2 GHz, 2.5 dB Gain Compression	η_{SAT}	-	57.5	-	%
Saturated Output Power	Pulsed[4], 2 GHz, 2.5 dB Gain Compression	P_{SAT}	-	55.5	-	dBm
Gain Variation (-25°C to +85°C)	Pulsed[4], 2 GHz	ΔG	-	0.02	-	dB/°C
Power Variation (-25°C to +85°C)	Pulsed[4], 2 GHz	ΔP2.5dB	-	0.01	-	dB/°C
Gain	Pulsed[4], 2 GHz, P_{IN} = 41.2 dBm	G_P	-	14.5	-	dB
Drain Efficiency	Pulsed[4], 2.0 GHz, P_{IN} = 41.2 dBm	η	-	57.5	-	%
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} = 200 mA
Note: Performance in MACOM Production Test Fixture, 50 Ω system

Parameter	Test Conditions	Symbol	Min.	Typ.	Max.	Units
Power Gain	Pulsed[4], 2 GHz, 2.5 dB Gain Compression	G_{SAT}	13	14	-	dB
Saturated Drain Efficiency	Pulsed[4], 2 GHz, 2.5 dB Gain Compression	η_{SAT}	52	57.5	-	%
Saturated Output Power	Pulsed[4], 2 GHz, 2.5 dB Gain Compression	P_{SAT}	54	55.4	-	dBm
Gain	Pulsed[4], 2 GHz, P_{IN} = 41.2 dBm	G_P	13	14.2	-	dB
Drain Efficiency	Pulsed[4], 2 GHz, P_{IN} = 41.2 dBm	η	52	57.5	-	dB

[4] Pulse details: 100 µs pulse width, 1 ms period, 10% Duty Cycle.

DC Electrical Characteristics (Per Each Side of Symmetric Device) 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}	-	-	29.2	mA
Gate-Source Leakage Current	V_{GS} = -8 V, V_{DS} = 0 V	I_{GLK}	-	-	29.2	mA
Gate Threshold Voltage	V_{DS} = 50 V, I_D = 29.2 mA	V_T	-2.6	-2.15	-1.6	V
Gate Quiescent Voltage	V_{DS} = 50 V, I_D = 150 mA	V_{GSQ}	-2.4	-2.05	-1.4	V
Maximum Drain Current	V_{DS} = 7 V pulsed, pulse width 300 µs	$I_{D, MAX}$	-	24.8	-	A

Absolute Maximum Ratings (Per Each Side of Symmetric Device)[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	29 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 > 1×10^7 hours.
8. Operating at nominal conditions with $T_{CH} \leq 225$°C will ensure MTTF > 1×10^7 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, $T_C = 85$°C, $T_{CH} = 225$°C	R_θ(FEA)	0.56	°C/W
Thermal Resistance using Infrared Measurement of Die Surface Temperature	$V_{DS} = 50$ V, $T_C = 85$°C, $T_{CH} = 225$°C	R_θ(IR)	0.45	°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

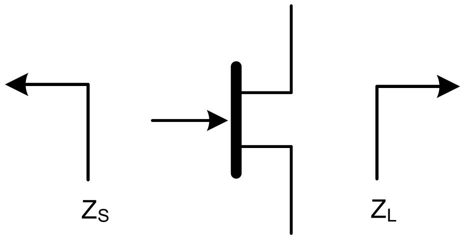
Gallium Nitride Circuits are sensitive to electrostatic discharge (ESD) and can be damaged by static electricity. Proper ESD control techniques should be used when handling these HBM Class 1A, CDM Class C3 devices.

Pulsed[4] Load-Pull Performance (Per Each Side of Symmetric Device)
Reference Plane at Device Leads

Frequency (GHz)	Z_{SOURCE} (Ω)	Maximum Output Power					
		V_{DS} = 50 V, I_{DQ} = 100 mA, T_C = 25°C, P2.5dB					
		Z_{LOAD}[11] (Ω)	Gain (dB)	P_{OUT} (dBm)	P_{OUT} (W)	η_D (%)	AM/PM[13] (°)
0.9	5 - j2.0	3.4 - j0.4	19.3	53.5	222.6	58.3	0.3
1.4	5 - j4.6	2.6 - j0.7	16.0	53.3	215.6	62.7	0.5
2.0	5 - j6.3	1.8 - j1.8	14.4	53.5	222.6	61.3	-3.4
2.5	5 - j11.0	1.5 - j3.2	12.9	53.5	222.6	60.6	-6.4
2.7	5 - j11.0	1.9 - j3.8	12.3	53.4	220.9	59.0	-9.6

Frequency (GHz)	Z_{SOURCE} (Ω)	Maximum Drain Efficiency					
		V_{DS} = 50 V, I_{DQ} = 100 mA, T_C = 25°C, P2.5dB					
		Z_{LOAD}[12] (Ω)	Gain (dB)	P_{OUT} (dBm)	P_{OUT} (W)	η_D (%)	AM/PM[13] (°)
0.9	5 - j2.0	5.4 + j3.0	20.0	52.4	175.5	71.1	-4.8
1.4	5 - j4.6	2.5 + j1.6	17.6	51.9	154.6	74.8	-3.5
2.0	5 - j6.3	1.8 - j1.1	15.0	52.9	195.2	64.3	-3.8
2.5	5 - j11.0	1.4 - j2.3	13.5	52.6	180.0	64.8	-8.5
2.7	5 - j11.0	1.1 - j2.7	13.5	51.8	148.5	65.3	-17.0

Impedance Reference



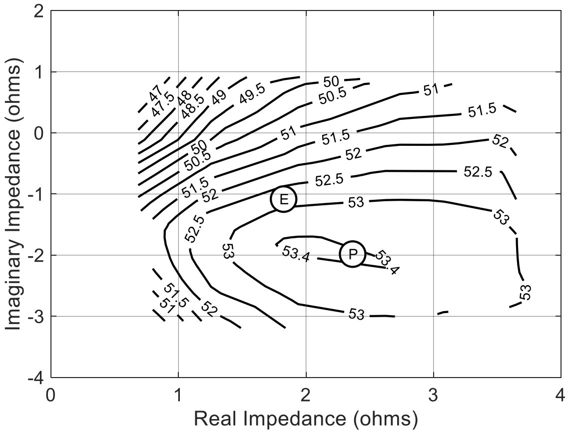
Z_{SOURCE} = Measured impedance presented to the input of the device at package reference plane.
Z_{LOAD} = Measured impedance presented to the output of the device at package reference plane.

11. Load Impedance for optimum output power.
12. Load Impedance for optimum efficiency.
13. AM/PM are relative values.

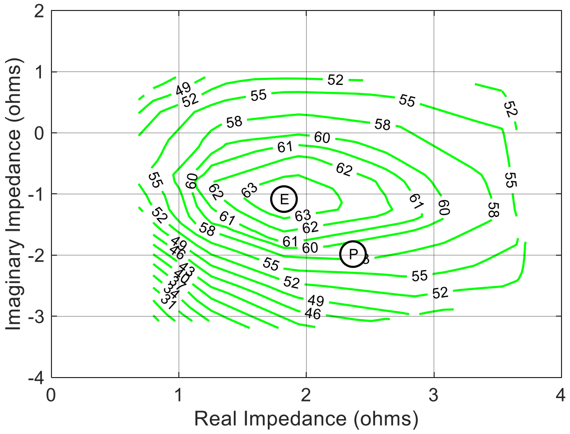
Pulsed^4 Load-Pull Performance (Per Each Side of Symmetric Device)

2.0 GHz

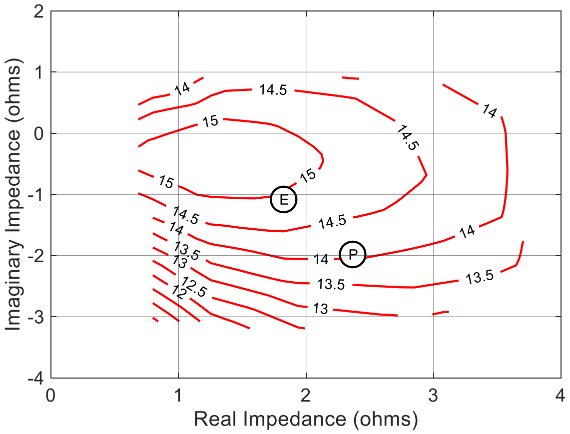
P2.5dB Loadpull Output Power Contours (dBm)



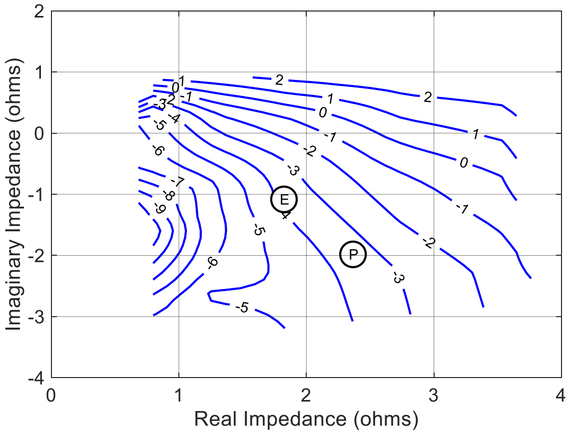
P2.5dB Loadpull Drain Efficiency Contours (%)



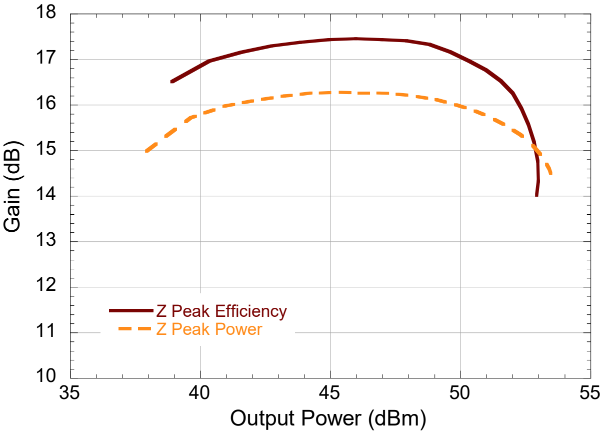
P2.5dB Loadpull Gain Contours (dB)



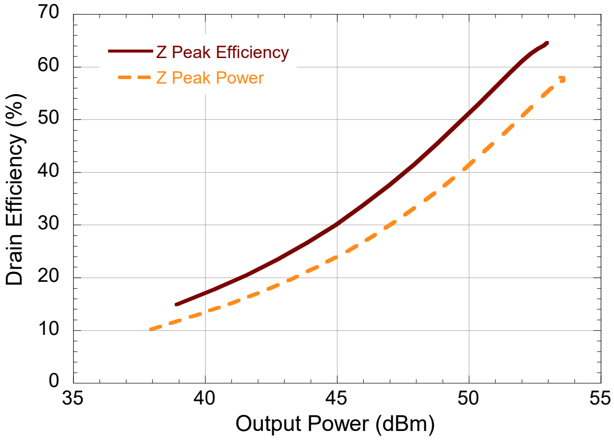
P2.5dB Loadpull AM/PM Contours (°)



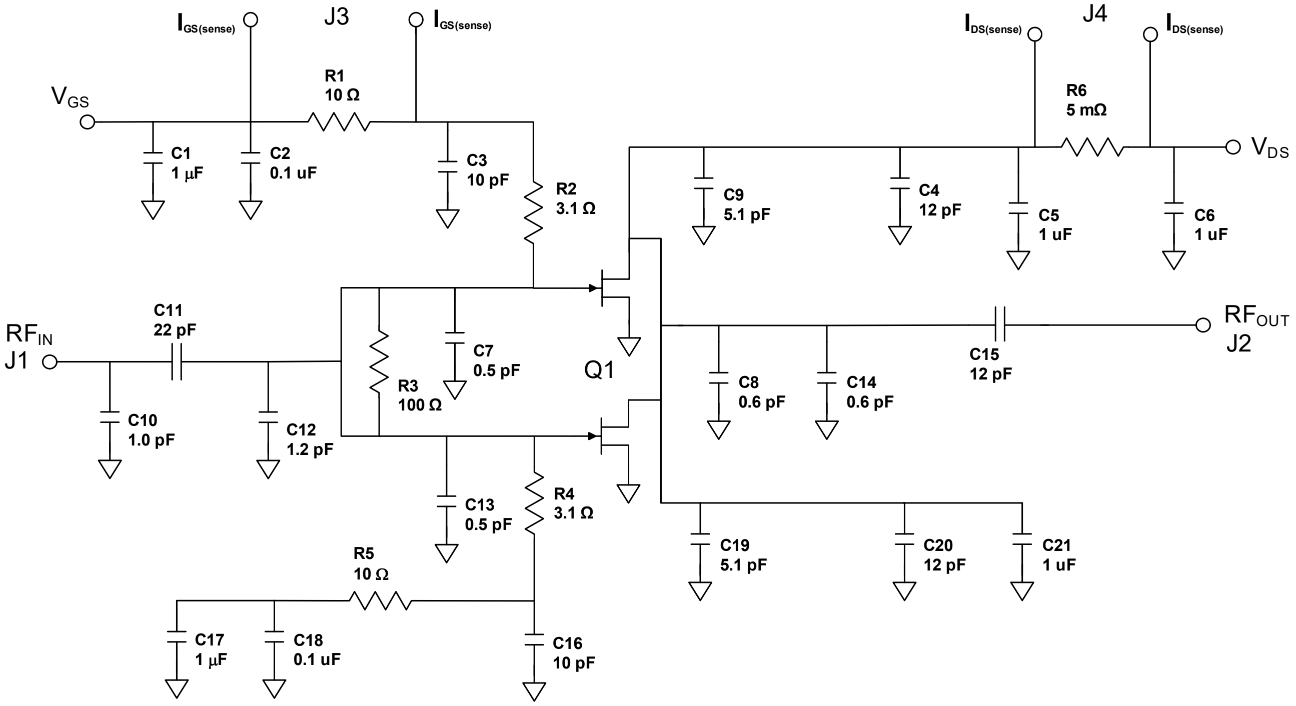
Gain vs. Output Power



Drain Efficiency vs. Output Power



Evaluation Test Fixture and Recommended Tuning Solution 1.95 - 2.05 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

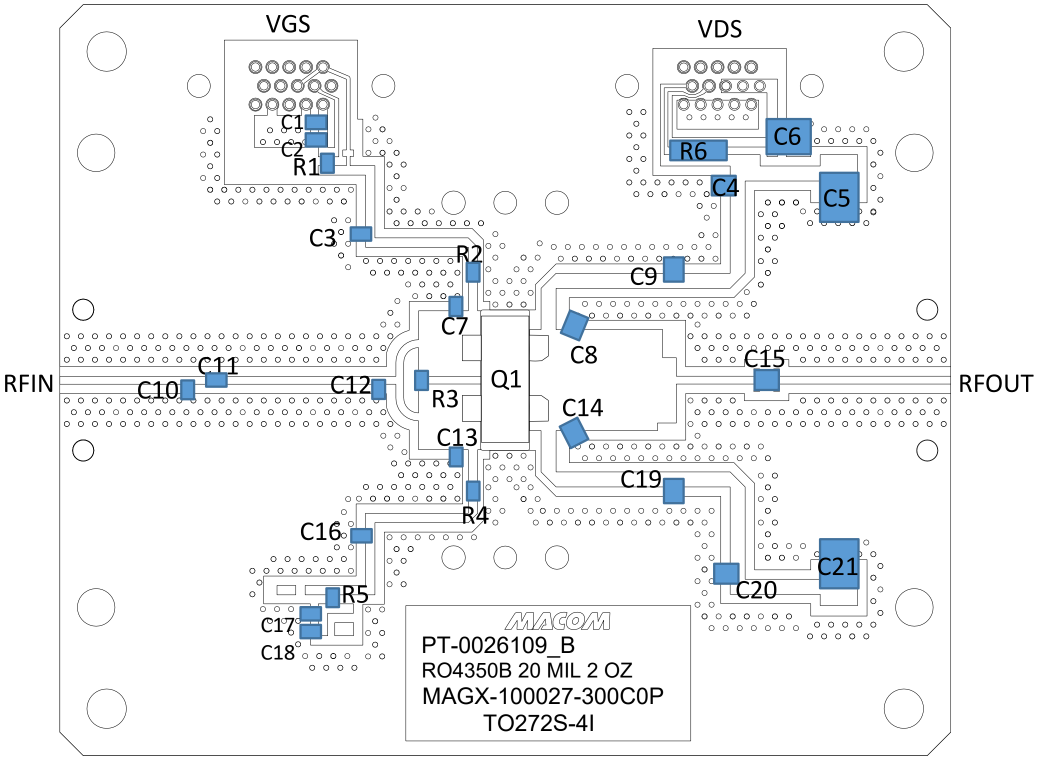
Turning the device ON

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}.

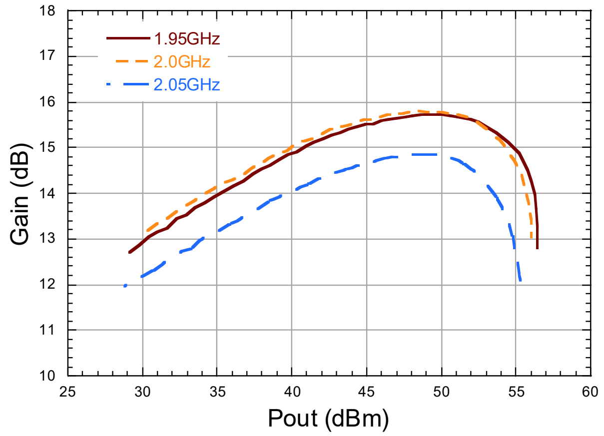
Evaluation Test Fixture and Recommended Tuning Solution 1.95 - 2.05 GHz



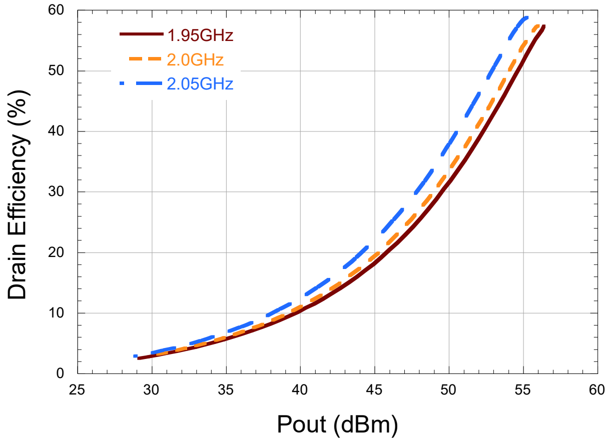
Reference Designator	Value	Tolerance	Manufacturer	Part Number
C1, C18	1 µF	+/- 10 %	Murata	GRM21BC72A105KE01L
C2, C17	0.1 µF	+/- 10 %	Murata	GCD21BR72A104KA01L
C3, C16	10 pF	+/- 0.1 pF	PPI	0505C100BW151X
C4, C15, C20	12 pF	+/- 0.1 pF	PPI	111N120BW501X
C5, C6, C21	1 µF	+/- 10 %	Murata	GRM55DR72E105KW01L
C7, C13	0.5 pF	+/- 0.1 pF	PPI	0505C0R5BW151X
C8, C14	0.6 pF	+/- 0.1 pF	PPI	1111N0R6BW501X
C9, C19	5.1 pF	+/- 0.1 pF	PPI	1111N5R1BW501X
C10	1 pF	+/- 0.1 pF	PPI	0505C1R0BW151X
C11	22 pF	+/- 0.1 pF	PPI	0505C220JW151X
C12	1.2 pF	+/- 0.1 pF	PPI	0505C1R2BW151X
R1, R5	10 Ω	+/- 1 %	Vishay Dale	CRCW080510R0FKTA
R2, R4	3.1 Ω	+/- 1 %	Vishay Dale	CRCW08053R09FKEA
R3	100 Ω	+/- 1 %	Vishay Dale	CRCW0805100RFKEA
R6	5 mΩ	+/- 1 %	Susumu	RL7520WT-R005-F
Q1	MACOM GaN Power Amplifier			MAGX-100027-300C0P
PCB	RO4350, 20 mil, 2 oz. Cu, Au Finish			

Typical Performance Curves as Measured in the 1.95 - 2.05 GHz Evaluation Test Fixture: Pulsed[4] 2.0 GHz, V_{DS} = 50 V, I_{DQ} = 200 mA, T_C = 25°C (Unless Otherwise Noted)

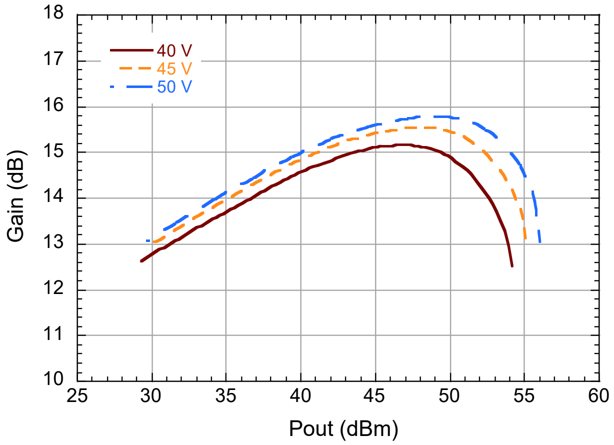
Gain vs. Output Power and Frequency



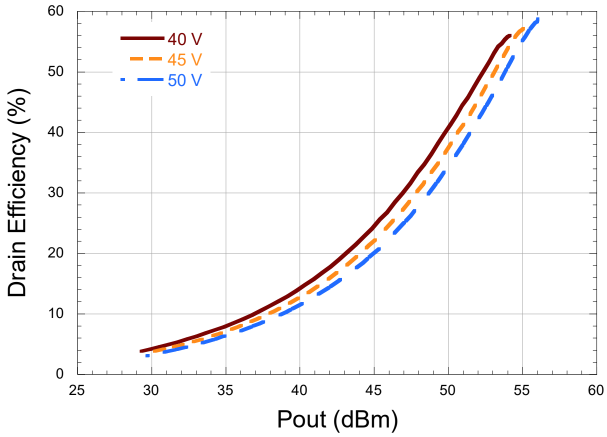
Drain Efficiency vs. Output Power and Frequency



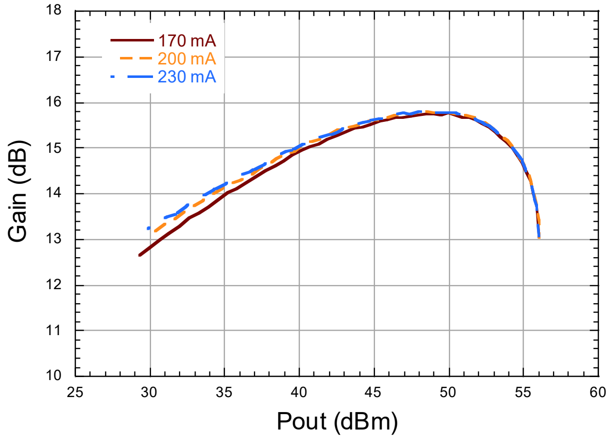
Gain vs. Output Power and V_{DS}



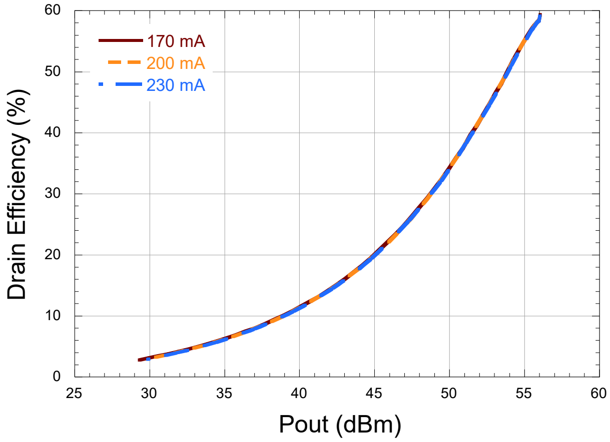
Drain Efficiency vs. Output Power and V_{DS}



Gain vs. Output Power and I_{DQ}

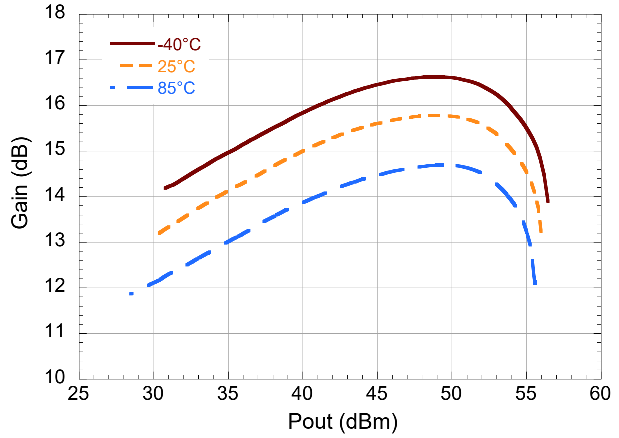


Drain Efficiency vs. Output Power and I_{DQ}

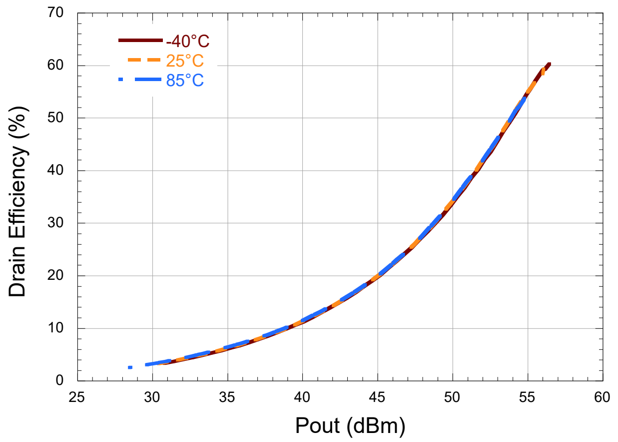


Typical Performance Curves as Measured in the 1.95 - 2.05 GHz Evaluation Test Fixture: Pulsed[4] 2.0 GHz, V_{DS} = 50 V, I_{DQ} = 200 mA, T_C = 25°C (Unless Otherwise Noted)

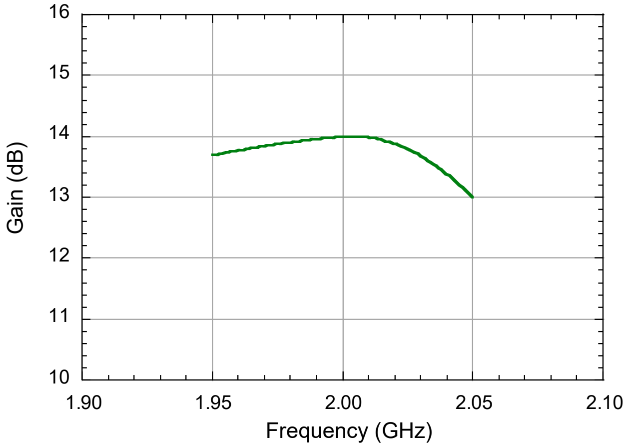
Gain vs. Output Power and Tc



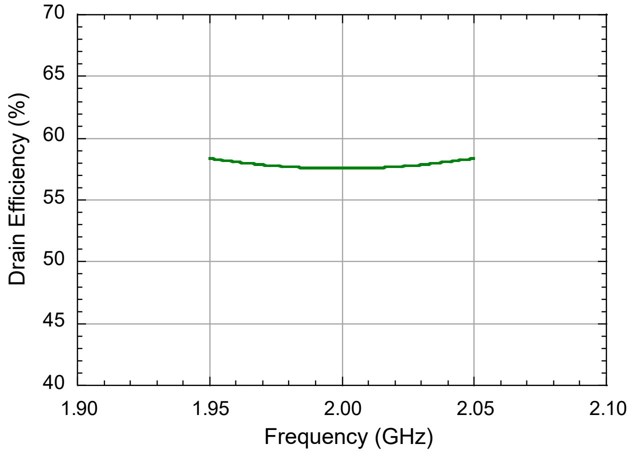
Drain Efficiency vs. Output Power and Tc



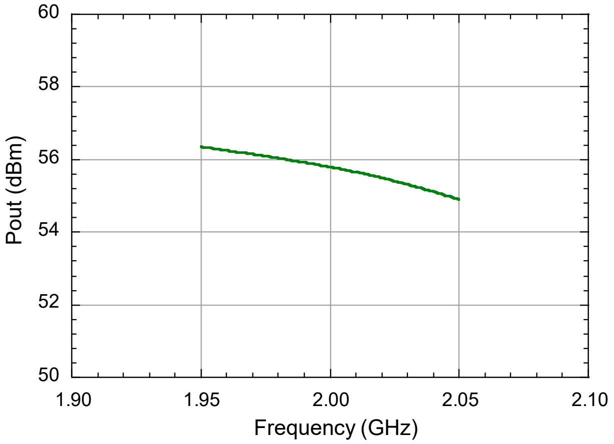
Gain vs. Frequency



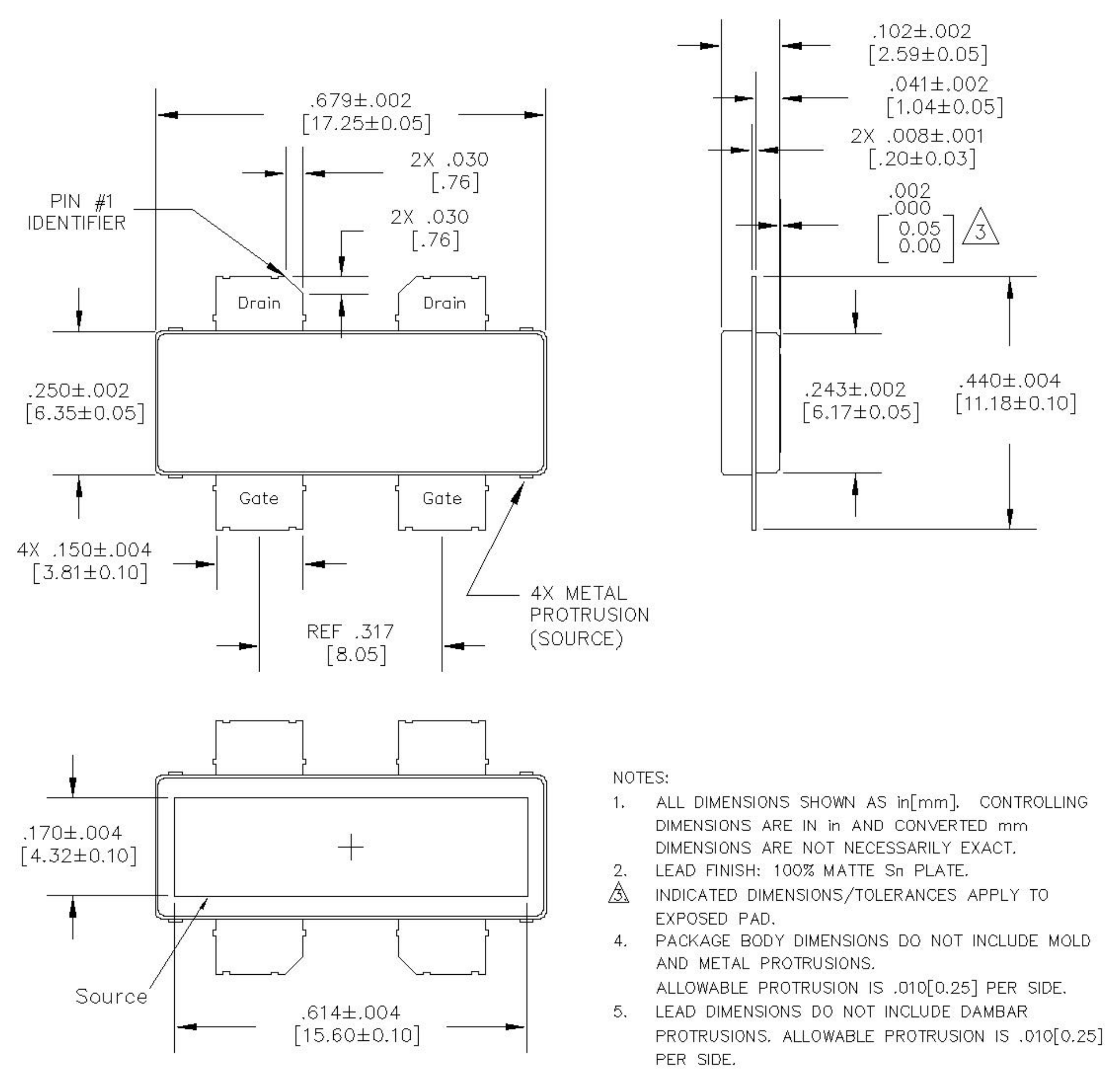
Drain Efficiency vs. Frequency



Output Power vs. Frequency



Lead-Free TO-272S-4I Package Dimensions†



NOTES:

1. ALL DIMENSIONS SHOWN AS in[mm]. CONTROLLING DIMENSIONS ARE IN in AND CONVERTED mm DIMENSIONS ARE NOT NECESSARILY EXACT.
2. LEAD FINISH: 100% MATTE Sn PLATE.
3. INDICATED DIMENSIONS/TOLERANCES APPLY TO EXPOSED PAD.
4. PACKAGE BODY DIMENSIONS DO NOT INCLUDE MOLD AND METAL PROTRUSIONS. ALLOWABLE PROTRUSION IS .010[0.25] PER SIDE.
5. LEAD DIMENSIONS DO NOT INCLUDE DAMBAR PROTRUSIONS. ALLOWABLE PROTRUSION IS .010[0.25] PER SIDE.

† Reference Application Note AN0004125 for lead-free solder reflow recommendations.
Meets JEDEC moisture sensitivity level 3 requirements.
Plating is Matte Sn.

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