GaN Amplifier 50 V, 65 W
DC - 3.3 GHz

MACOM PURE CARBIDE

MAPC-A1106-BD
Rev. V1

Features

- MACOM PURE CARBIDE® Amplifier Series
- Suitable for Linear & Saturated Applications
- CW & Pulsed Operation: 65 W Output Power
- Internally Pre-Matched
- 50 V Operation
- Compatible with MACOM Power Management Bias Controller/Sequencer MABC-11040



7.0 x 6.5 mm DFN

Applications

Military Radio Communications, RADAR, Avionics, Digital Cellular Infrastructure, RF Energy, and Test Instrumentation

Description

The MAPC-A1106-BD is a GaN on Silicon Carbide HEMT D-mode amplifier suitable for DC - 3.3 GHz frequency operation. The device supports both CW and pulsed operation with output power levels of at least 65 W (48.1 dBm) in a 7.0 x 6.5 mm DFN plastic package.

Typical Performance:

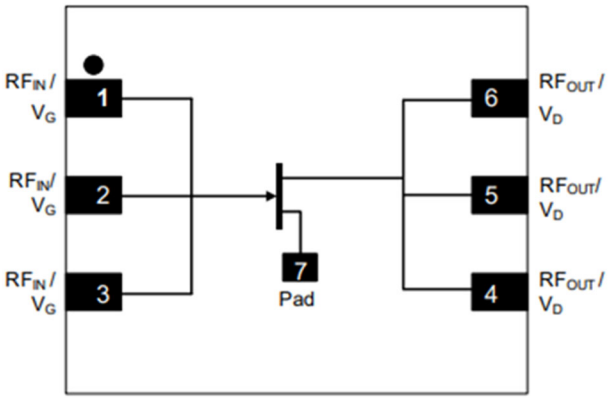
Measured in evaluation test fixture:
V_{DS} = 50 V, I_{DQ} = 130 mA, T_C = 25°C, P_{IN} = 32 dBm, PW = 100 µs, DC = 10%

Frequency (GHz)	Output Power (dBm)	Gain (dB)	η_D (%)
2.90	48.3	16.3	68.2
2.95	48.2	16.2	71.0
3.00	48.0	16.0	70.0

Ordering Information

Part Number	Package
MAPC-A1106-BD000	Bulk Quantity
MAPC-A1106-BDTR1	Tape & Reel
MAPC-A1106-BDSB1	Sample Board

Functional Schematic



Pin Configuration

Pin #	Pin Name	Function
1, 2, 3	RF_{IN} / V_G	RF Input / Gate Voltage
4, 5, 6	RF_{OUT} / V_D	RF Output / Drain Voltage
7	Paddle[1]	Ground

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

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RF Electrical Characteristics: T_C = 25°C, V_{DS} = 50 V, I_{DQ} = 130 mA
Note: Performance in MACOM Evaluation Test Fixture, 50 Ω system

Parameter	Test Conditions	Symbol	Min.	Typ.	Max.	Units
Small Signal Gain	Pulsed[2], 2.95 GHz	G_{SS}	-	20.0	-	dB
Power Gain	Pulsed[2], 2.95 GHz, 2.5 dB Gain Compression	G_{SAT}	-	17.5	-	dB
Drain Efficiency	Pulsed[2], 2.95 GHz, 2.5 dB Gain Compression	η_{SAT}	-	69.0	-	%
Output Power	Pulsed[2], 2.95 GHz, 2.5 dB Gain Compression	P_{SAT}	-	47.9	-	dBm
Power Gain	Pulsed[2], 2.95 GHz, P_{IN} = 32 dBm	G_P	-	16.2	-	dB
Drain Efficiency	Pulsed[2], 2.95 GHz, P_{IN} = 32 dBm	η_P	-	71.0	-	%
Output Power	Pulsed[2], 2.95 GHz, P_{IN} = 32 dBm	P_P	-	48.2	-	dBm
Gain Variation (-40°C to +85°C)	Pulsed[2], 2.95 GHz	ΔG	-	0.001	-	dB/°C
Power Variation (-40°C to +85°C)	Pulsed[2], 2.95 GHz	ΔPdB	-	0.001	-	dB/°C
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} = 130 mA
Note: Performance in MACOM Production Test Fixture, 50 Ω system

Parameter	Test Conditions	Symbol	Min.	Typ.	Max.	Units
Power Gain	Pulsed[2], 3.3 GHz, P_{IN} = 35 dBm	G_P	11.8	12.3	-	dB
Drain Efficiency	Pulsed[2], 3.3 GHz, P_{IN} = 35 dBm	η	59	65	-	%
Output Power	Pulsed[2], 3.3 GHz, P_{IN} = 35 dBm	P_{OUT}	46.7	47.3	-	dBm

2. Pulse Details: 100 µs pulse width, 10 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} = 10 V	$I_{D\ 10\text{-}8}$	-	-	1.2	mA
Gate-Source Leakage Current	V_{GS} = -8 V, V_{DS} = 10 V	$I_{G\ 10\text{-}8}$	-1.2	-	0	mA
Gate Pinch-Off Voltage	V_{DS} = 10 V, I_D = 8.8 mA	V_{P10}	-3.5	-	-1.9	V
Gate Quiescent Voltage	V_{DS} = 50 V, I_D = 130 mA	V_{GSQ}	-	-2.6	-	V

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Absolute Maximum Ratings[3,4,5,6,7]

Parameter	Absolute Maximum
Drain Source Voltage, V_{DS}	130 V
Gate Source Voltage, V_{GS}	-10 to 3 V
Gate Current, I_G	8.9 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
Channel Temperature	+250°C

3. Exceeding any one or combination of these limits may cause permanent damage to this device.
4. MACOM does not recommend sustained operation above maximum operating conditions.
5. Operating at drain source voltage V_{DS} < 55 V will ensure MTTF > 2.5 x 10^6 hours.
6. Operating at nominal conditions with T_{CH} ≤ 225°C will ensure MTTF > 2.5 x 10^6 hours.
7. 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* = 0.0355, *B* = -9.89, and *C* = 13,925.

Thermal Characteristics

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_q(FEA)	3	°C/W

Handling Procedures

Please observe the following precautions to avoid damage:

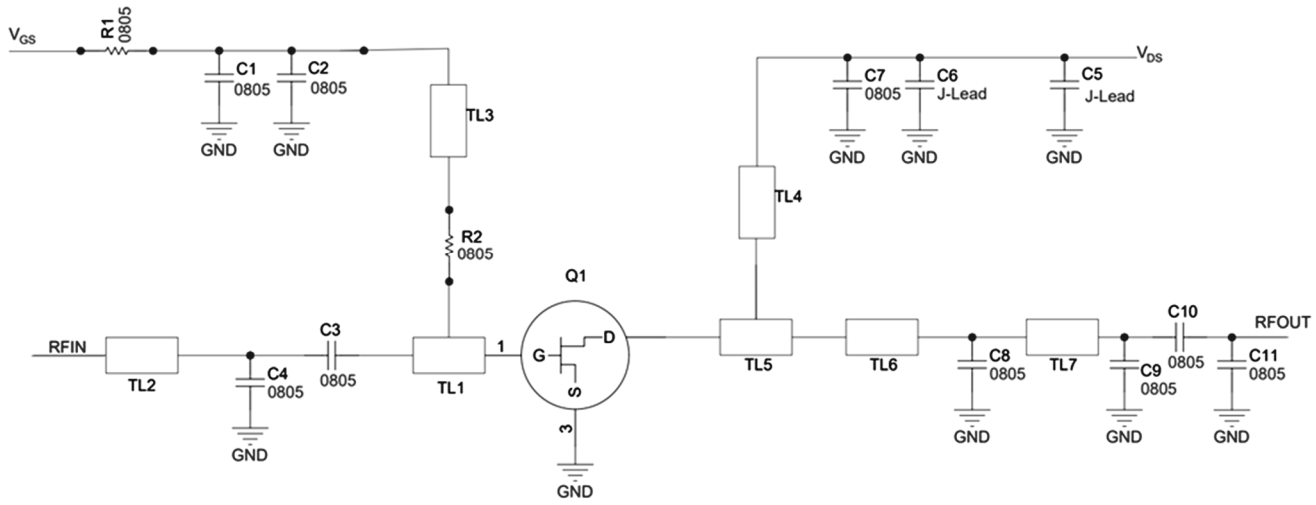
Static Sensitivity

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 devices.

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Application Fixture 2.0 - 3.0 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.

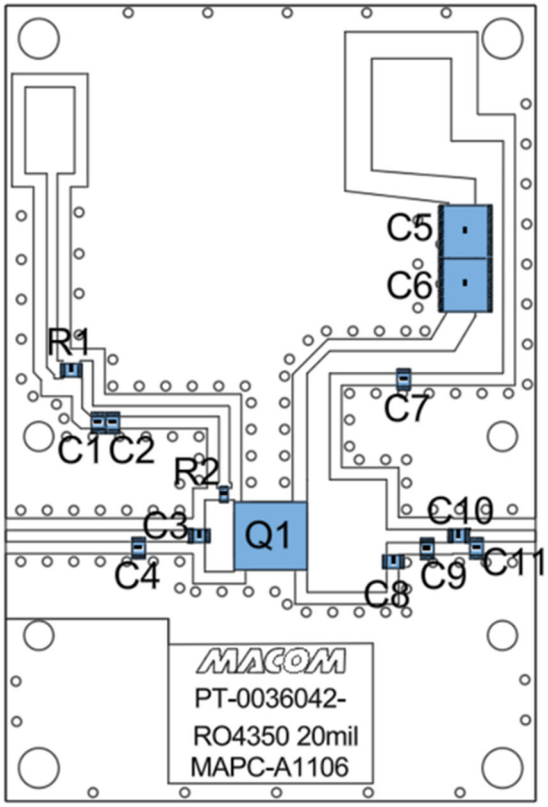
Turning the device OFF

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}.

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Application Test Fixture and Recommended Tuning Solution 2.9 - 3.0 GHz



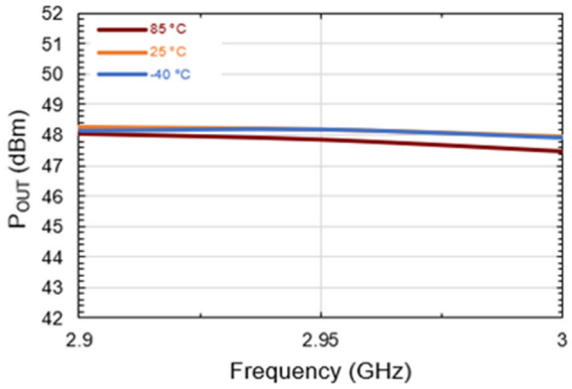
Reference Designator	Value	Tolerance	Manufacturer	Part Number
C1	1 µF	+/- 5%	Murata	GRM21A5C2E102JWA1D
C2, C3, C7	10 pF	+/- 1%	Murata	GQM2195C2E100FB12D
C4	0.8 pF	+/- 0.1pF	ATC	600F0R8BT250XT
C5, C6	2.2 µF	+/- 5%	Murata	KRM55TR72E225MH01L
C8, C10	1.8 pF	+/- 0.1pF	Murata	GQM2195C2E1R8BB12D
C9	0.7 pF	+/- 0.1pF	ATC	600F0R7BT250XT
C11	0.1 pF	+/- 0.1pF	ATC	600F0R1BT250XT
R1, R2	4.7 Ω	+/- 5%	Panasonic	ERJHP6J4R7V
Q1	MACOM GaN Power Amplifier			MAPC-A1106-BD
PCB	RO4350B, 20 mil, 1 oz. Cu, Au Finish			

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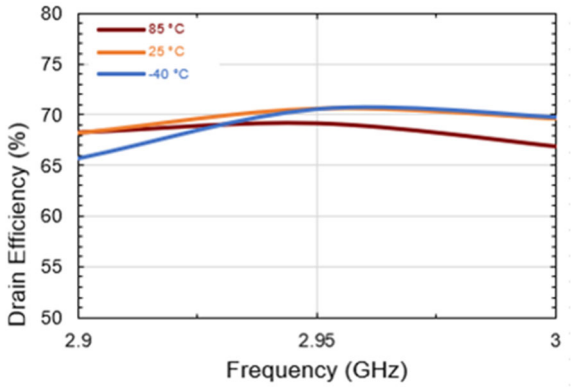
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Typical Performance Curves as Measured in the 2.9 - 3.0 GHz Application Fixture: 2.95 GHz, V_{DS} = 50 V, I_{DQ} = 130 mA, P_{OUT} at Saturation, T_C = 25°C

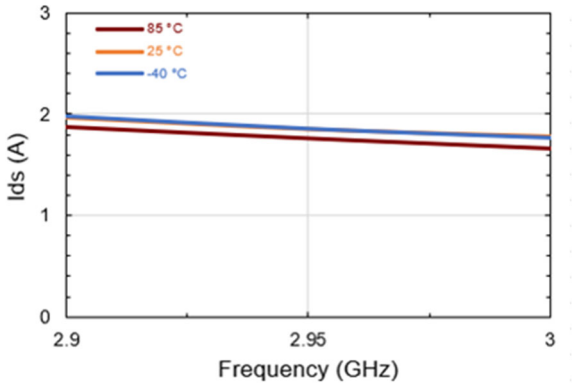
Output Power vs. Frequency over Temperature



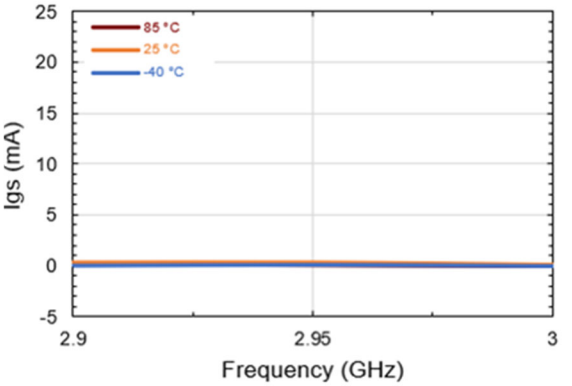
Drain Efficiency vs. Frequency over Temperature



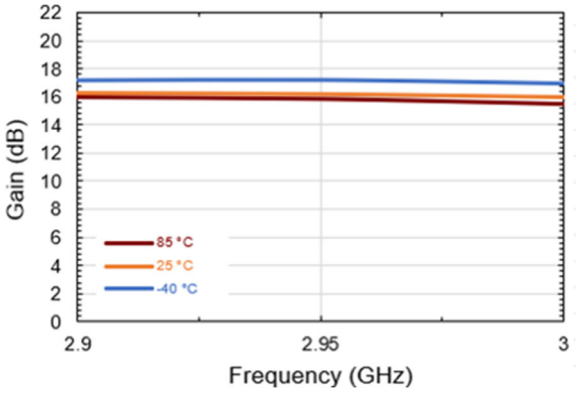
Drain Current vs. Frequency over Temperature



Gate Current vs. Frequency over Temperature



Large Signal Gain vs. Frequency over Temperature

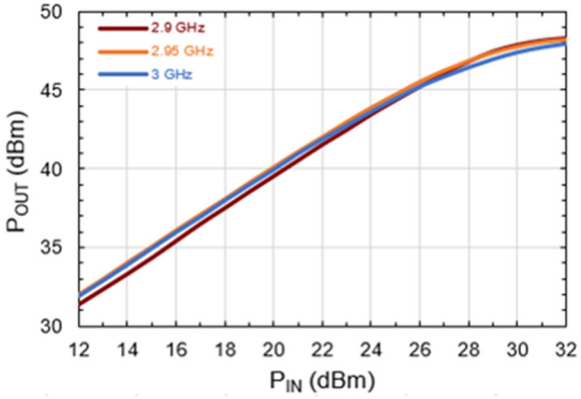


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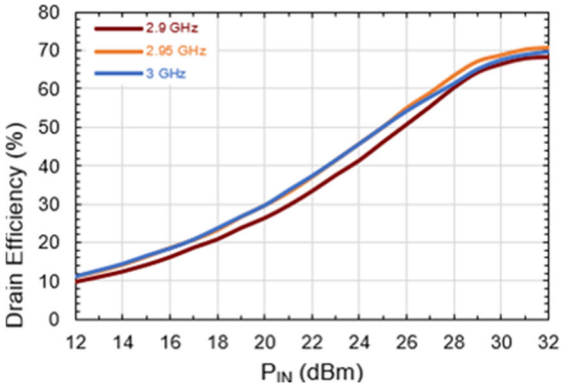
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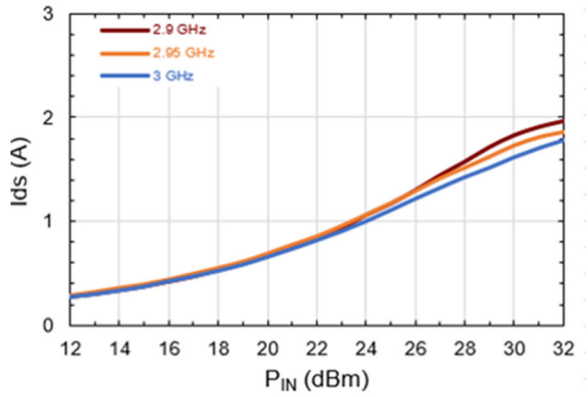
Output Power vs. Input Power over Frequency



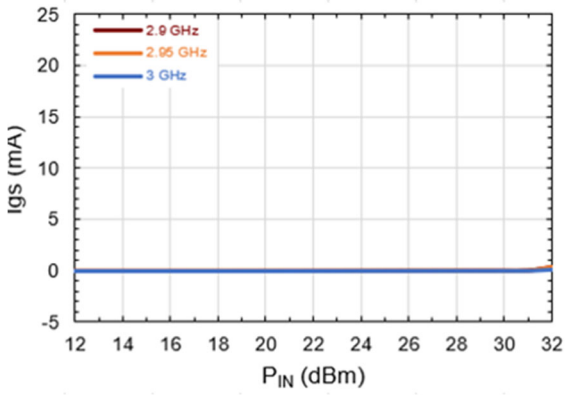
Drain Efficiency vs. Input Power over Frequency



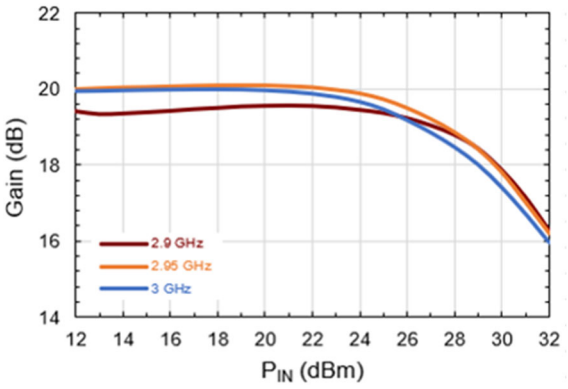
Drain Current vs. Input Power over Frequency



Gate Current vs. Input Power over Frequency



Large Signal Gain vs. Input Power over Frequency

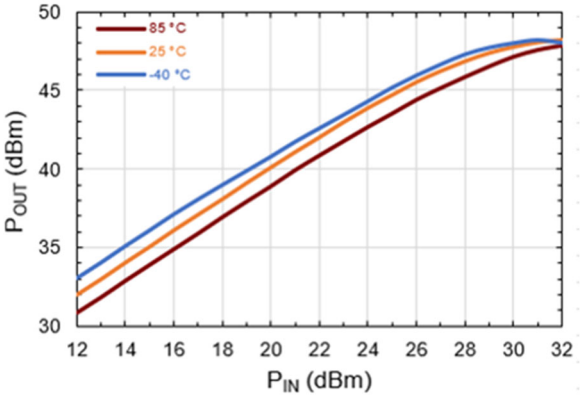


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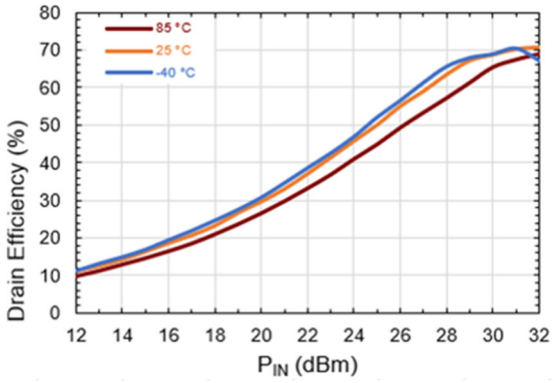
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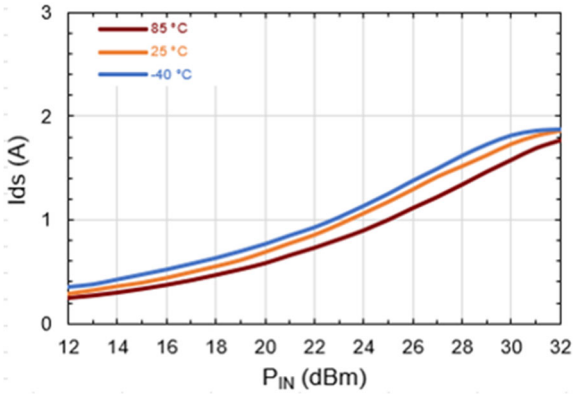
Output Power vs. Input Power over Temperature



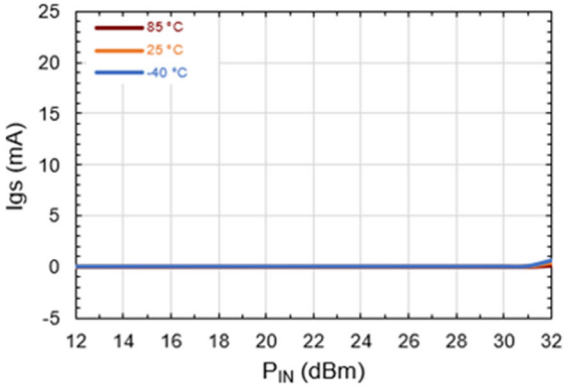
Drain Efficiency vs. Input Power over Temperature



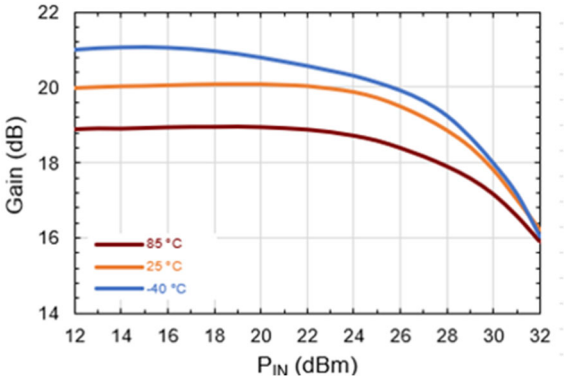
Drain Current vs. Input Power over Temperature



Gate Current vs. Input Power over Temperature



Large Signal Gain vs. Input Power over Temperature

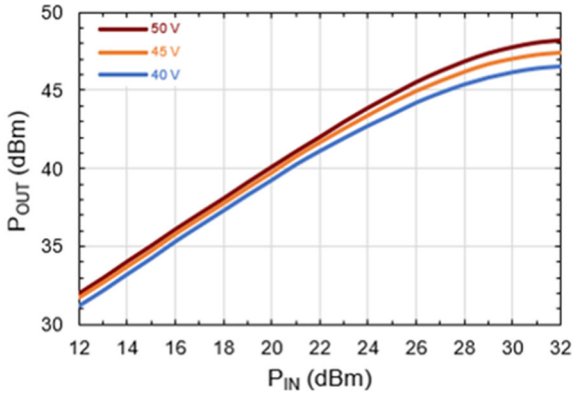


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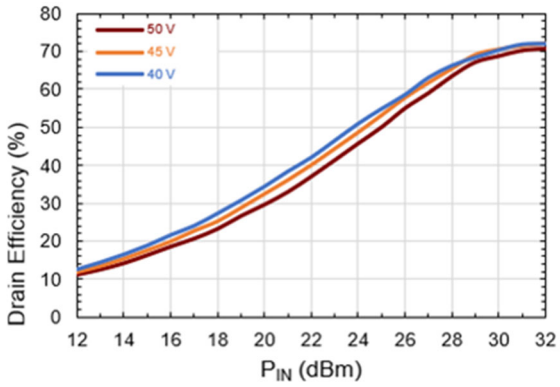
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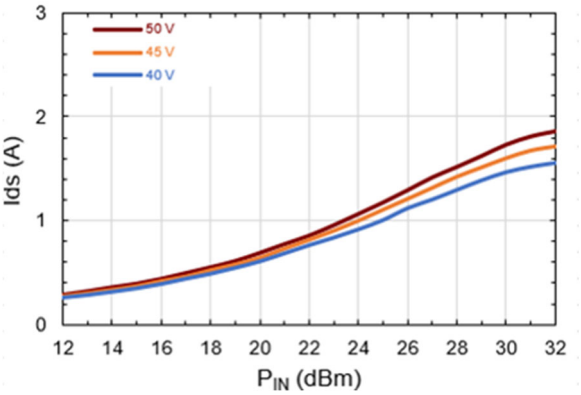
Output Power vs. Input Power over Voltage



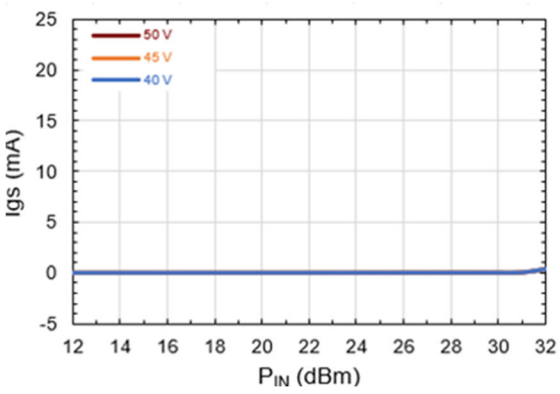
Drain Efficiency vs. Input Power over Voltage



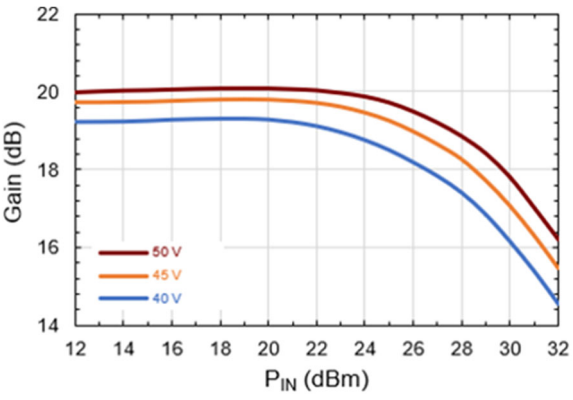
Drain Current vs. Input Power over Voltage



Gate Current vs. Input Power over Voltage



Large Signal Gain vs. Input Power over Voltage

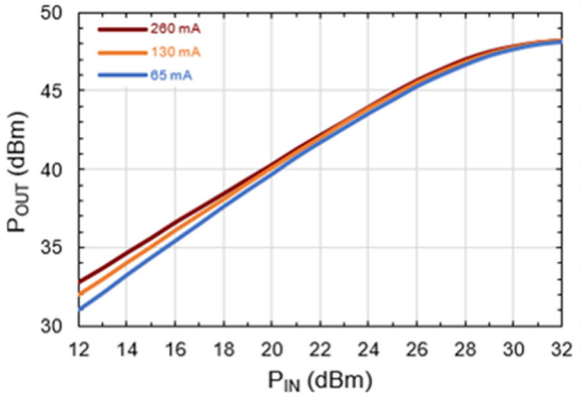


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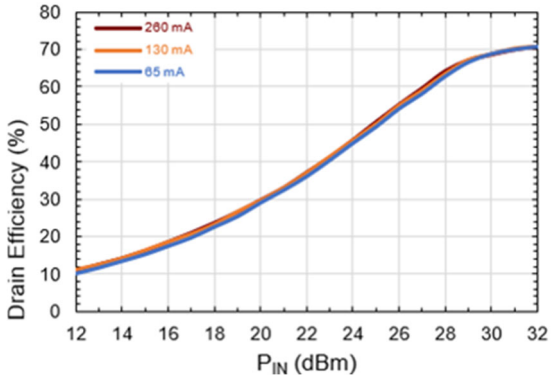
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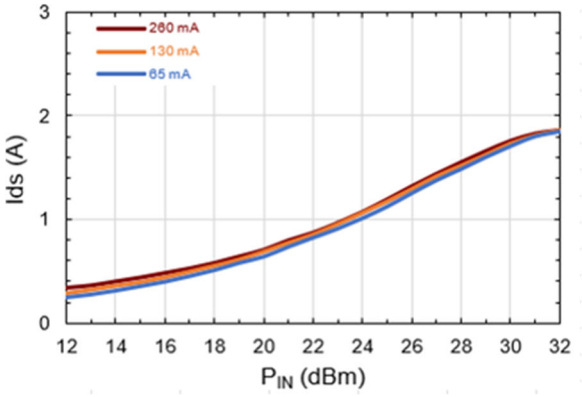
Output Power vs. Input Power over Current



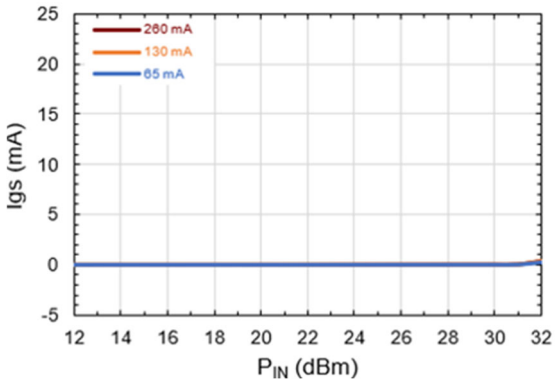
Drain Efficiency vs. Input Power over Current



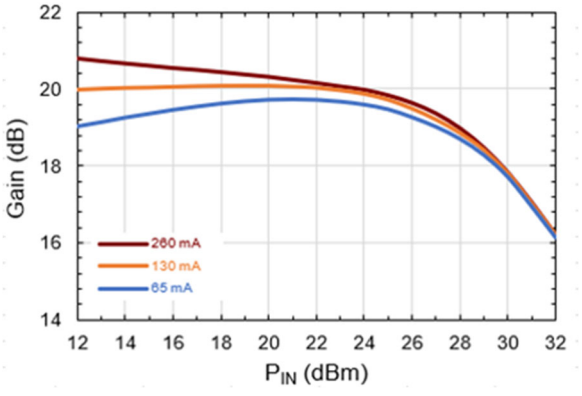
Drain Current vs. Input Power over Current



Gate Current vs. Input Power over Current



Large Signal Gain vs. Input Power over Current

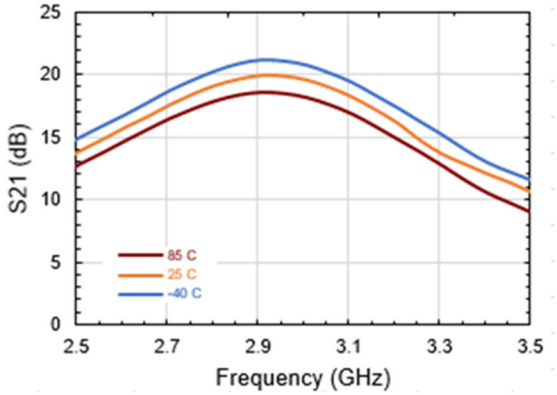


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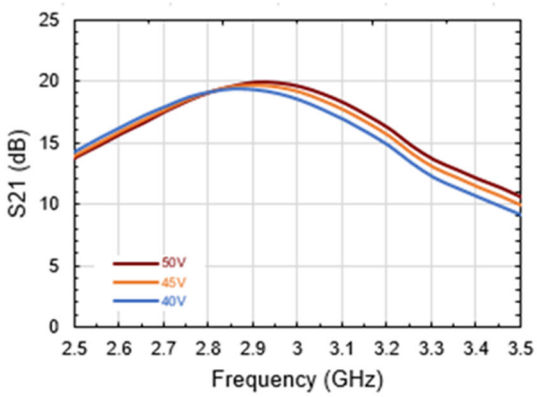
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Typical Performance Curves as Measured in the 2.9 - 3.0 GHz Application Fixture: 2.95 GHz, V_{DS} = 50 V, I_{DQ} = 130 mA, P_{IN} = -20 dBm, T_C = 25°C

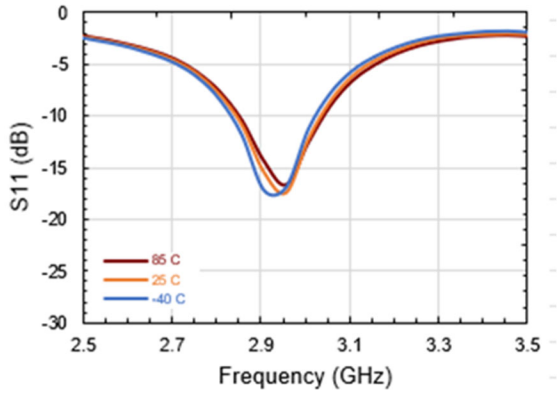
S21 vs. Frequency over Temperature



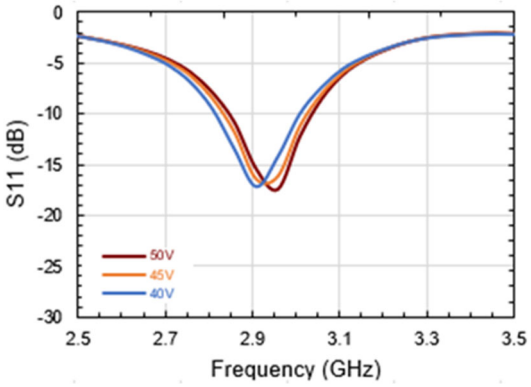
S21 vs. Frequency over Voltage



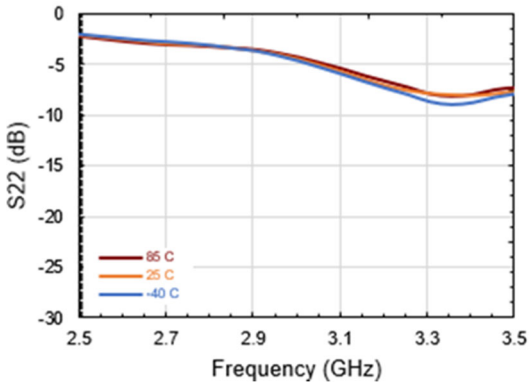
S11 vs. Frequency over Temperature



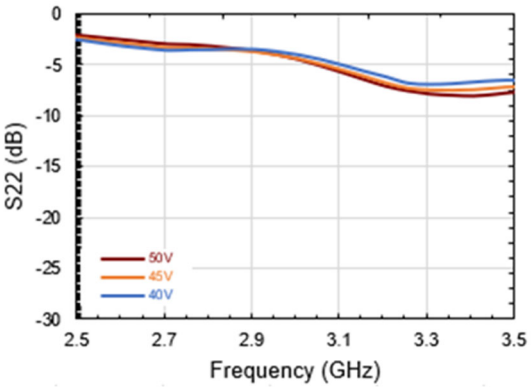
S11 vs. Frequency over Voltage



S22 vs. Frequency over Temperature



S22 vs. Frequency over Voltage

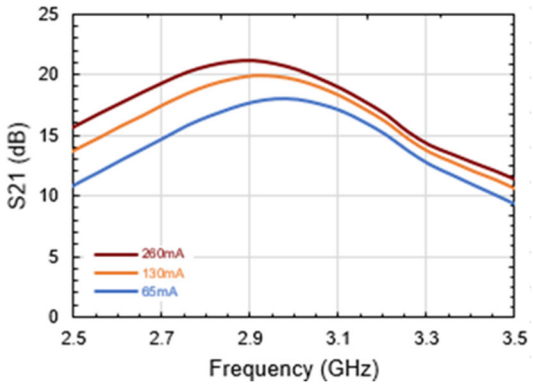


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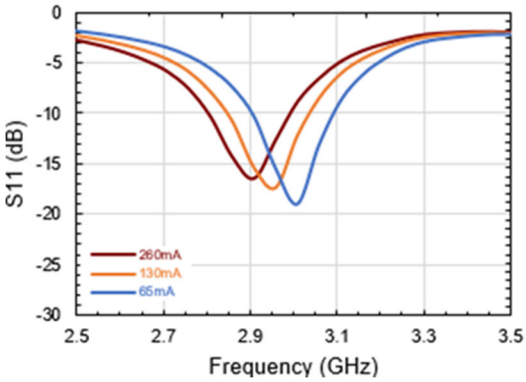
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Typical Performance Curves as Measured in the 2.9 - 3.0 GHz Application Fixture: 2.95 GHz, V_{DS} = 50 V, I_{DQ} = 130 mA, P_{IN} = -20 dBm, T_C = 25°C

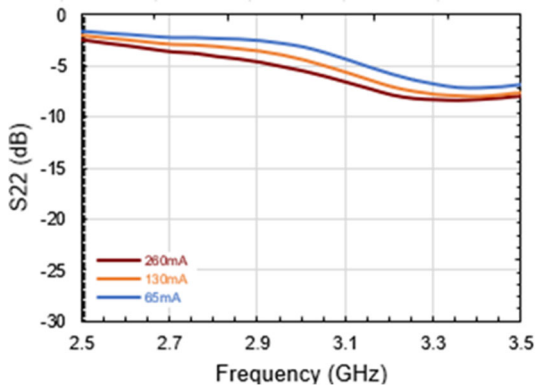
S21 vs. Frequency over Current



S11 vs. Frequency over Current



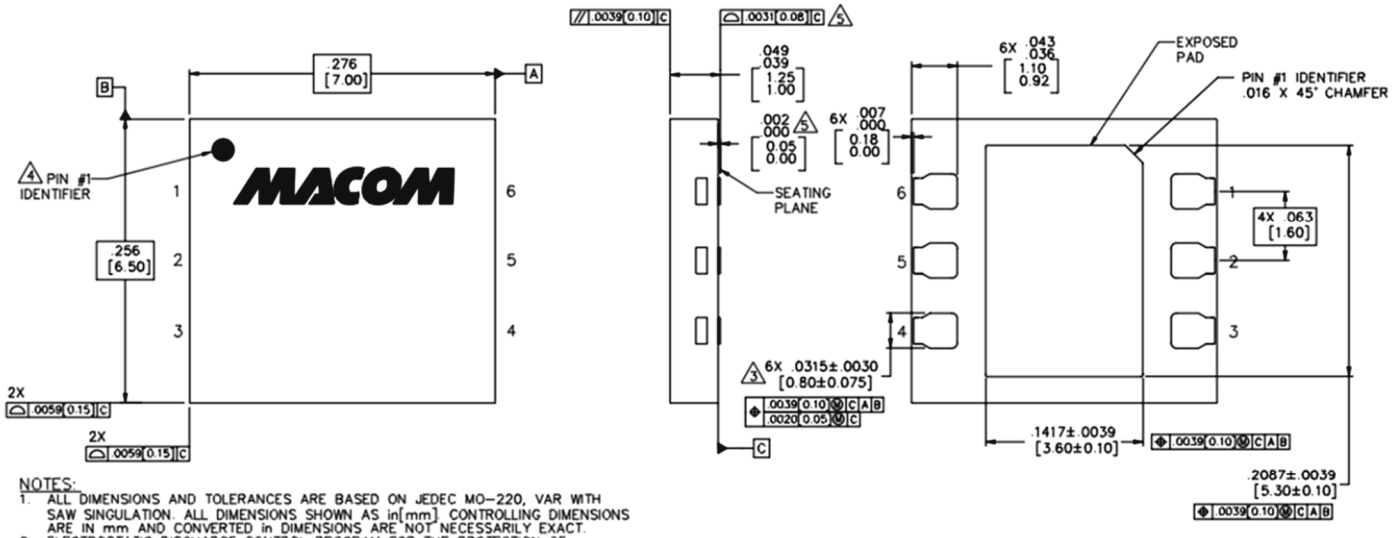
S22 vs. Frequency over Current



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Lead-Free 7.0 x 6.5 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. ELECTROSTATIC DISCHARGE CONTROL PROGRAM FOR THE PROTECTION OF ELECTRICAL AND ELECTRONIC PARTS, ASSEMBLIES AND EQUIPMENT SHALL BE IN ACCORANCE WITH ANSI/ESD 20.20.
3. INDICATED DIMENSIONS/TOLERANCES APPLY TO THE PLATED LEAD AND IS MEASURED BETWEEN .0059[0.15] AND .0118[0.30] FROM THE LEAD END. LEAD NECK DOWN FEATURE IS OPTIONAL.
4. EXACT SIZE AND SHAPE OF THIS FEATURE IS OPTIONAL.
5. INDICATED DIMENSIONS/TOLERANCES APPLY TO LEADS AND EXPOSED PAD.
6. ALL MATERIALS DESCRIBED IN THIS DOCUMENT/DRAWING SHALL BE IN COMPLIANCE WITH AND CONTAIN NO SUBSTANCES RESTRICTED OR REQUIRING SPECIAL RECLAMATION UNDER THE LATEST ROHS, WEEE OR ELV DIRECTIVES.

† 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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