

MAPC-A4031

Rev. V1



Output Power: 500 W
Large Signal Gain: 12 dB
Drain Efficiency: 55%
Internally Matched: 50 Ω
High Temperature Operation

RoHS* Compliant

Applications

· Civil & Military Pulsed Radar Amplifiers

Description

The MAPC-A4031 is a Gallium nitride (GaN) amplifier designed specifically with high efficiency and high power for the 3.5 - 3.7 GHz S-Band radar band.

The amplifier is matched to 50 Ω on the input and 50 Ω on the output. At the core of MAPC-A4031 is the high power density 65 V GaN-on-silicon carbide (SiC) manufacturing process. The amplifier is supplied in a ceramic/metal flange package of type AC-587BH-2

Typical RF Performance:

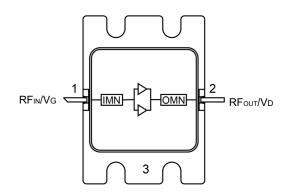
Measured in Evaluation Test Fixture at P_{IN} = 46 dBm, 100 µs pulse width and 10% Duty Cycle.

Frequency (GHz)	Output Power (dBm)	Power Gain (dB)	η _D ¹ (%)
3.5	58.8	12.8	53.3
3.6	58.6	12.6	54.1
3.7	58.3	12.3	55.1



AC-587BH-2

Functional Schematic



Pin Configuration

Pin#	Pin Name	Function
1	RF _{IN} / V _G	RF Input / Gate
2	RF _{OUT} / V _D	RF Output / Drain
3	Flange ¹	Ground / Source

The flange on the package bottom must be connected to RF, DC and thermal ground.

Ordering Information

Part Number	MOQ Increment
MAPC-A4031-AB000	Bulk
MAPC-A4031-ABSB1	Sample Board

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



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RF Electrical Characteristics: Freq. = 3.5 - 3.7 GHz, T_C = 25°C, V_{DS} = 65 V, I_{DQ} = 1000 mA, Pulse Width = 100 μ s, Duty Cycle = 10%

Performance in MACOM Evaluation Test Fixture, 50 Ω system

Parameter	Test Conditions	Symbol	Min.	Тур.	Max.	Units
Output Power	Pulsed, P _{IN} = 46 dBm	P _{OUT}	_	58.6	_	dBm
Drain Efficiency	Pulsed, P _{IN} = 46 dBm	DE	_	54.0	_	%
Large Signal Gain	Pulsed, P _{IN} = 46 dBm	G _P	_	12.6	_	dB
Small Signal Gain	CW, P _{IN} = -20 dBm	S21	_	14.5	_	dB
Input Return Loss	CW, P _{IN} = -20 dBm	S11	_	-16	_	dB
Output Return Loss	CW, P _{IN} = -20 dBm	S22	_	-8	_	dB
Output Mismatch Stress	V _{DD} = 65 V, I _{DQ} = 1000 mA, P _{IN} = 46 dBm	Ψ	VSWR =10:1, No Device Damage		amage	

RF Electrical Specifications²: P_{IN} = 46 dBm, T_A = +25°C, V_{DS} = 65 V, I_{DQ} = 500 mA, Pulse Width 100 μ s, 10% Duty Cycle

Parameter	Conditions	Units	Min.	Тур.	Max.
Output Power	3.5 GHz 3.7 GHz	W	500 500	759 678	_
Power Gain	3.5 GHz 3.7 GHz	dB	11.0 11.0	12.8 12.3	_
Drain Efficiency	3.5 GHz 3.7 GHz	%	50 50	53.3 55.1	_

^{2.} Final testing and screening for all amplifier sales is performed using the MAPC-A4031 production test fixture.

DC Electrical Characteristics T_A = 25°C

Parameter	Test Conditions	Symbol	Min.	Тур.	Max.	Units
Drain-Source Leakage Current	$V_{GS} = -8 \text{ V}, V_{DS} = 10 \text{ V}$	I _{DLK}		_	11.62	mA
Gate-Source Leakage Current	V _{GS} = -8 V, V _{DS} = 10 V	I _{GLK}	-11.62	_	_	mA
Gate Threshold Voltage	V _{DS} = 10 V, I _D = 83.6 mA	V _T	-3.8	-3.1	-2.3	V
Gate Quiescent Voltage	V _{DS} = 65 V, I _D = 1000 mA	V_{GSQ}	_	-2.75	_	V



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Absolute Maximum Ratings^{3,4}

Parameter	Absolute Maximum		
Pulse Width	100 μsec		
Duty Cycle	10%		
Drain-Source Voltage	195 V		
Gate Voltage	-10, +2 V		
DC Drain Current	14 A		
Gate Current	80 mA		
Input Power	48 dBm		
Storage Temperature	-65°C to +150°C		
Mounting Temperature	+245°C for 30 seconds		
Junction Temperature ⁵	+225°C		
Operating Temperature	-40°C to +125°C		

^{3.} Exceeding any one or combination of these limits may cause permanent damage to this device.

Thermal Characteristics

Parameter	Symbol	Test Conditions	Units	Rating
Operating Junction Temperature	T _J	Pulse Width = 100 μs , Duty Cycle = 10%,	°C	165
Thermal Resistance, Junction to Case	R _{θJC}	$P_{DISS} = 660 \text{ W } T_{C} = 85^{\circ}\text{C}$	°C/W	0.12

Handling Procedures

Please observe the following precautions to avoid damage:

Static Sensitivity

These electronic devices 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 3A and CDM Class C3 devices.

^{4.} MACOM does not recommend sustained operation near these survivability limits.

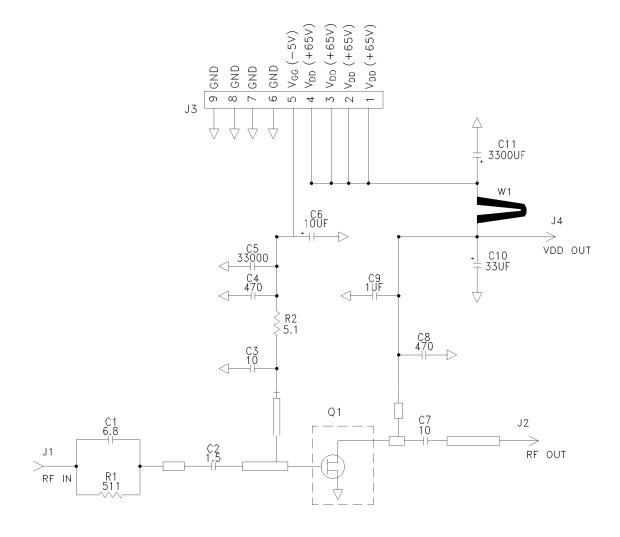
^{5.} Operating at nominal conditions with $T_J \le +225$ C will ensure MTTF > 1 x 10^6 hours.



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Application Circuit Schematic



Description

Parts measured on evaluation board (30-mil thick TACONIC RF-35P, 2oz Copper). 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.

Biasing Sequence

Bias ON

- 1. Ensure RF is turned off
- 2. Apply pinch-off voltage of -5 V to the gate
- 3. Apply nominal drain voltage
- 4. Bias gate to desired quiescent drain current
- 5. Apply RF

Bias OFF

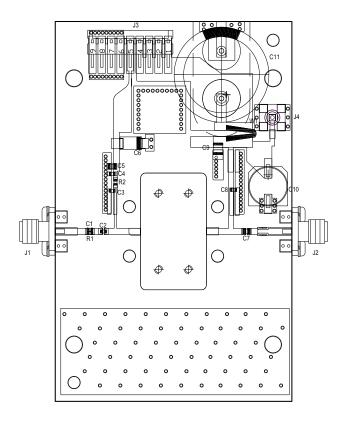
- 1. Turn RF off
- 2. Apply pinch-off voltage of -5 V to the gate
- 3. Turn-off drain voltage
- 4. Turn-off gate voltage



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Assembly Drawing



Assembly Parts List

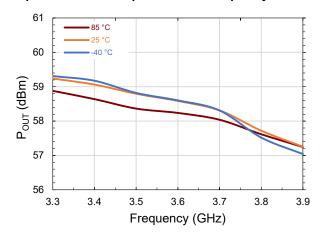
Reference Designator	Description	Manufacturer	Part Number
C1	CAP, 6.8pF, +/- 0.25 pF, 0603, ATC	AVX	600S6R8BT250XT
C2	CAP, 1.5 pF, +/-0.1pF, 250V, 0805, ATC600F	AVX	600F1R5BT250XT
C3	CAP, 10.0pF, +/-5%, 0603, ATC	AVX	600S100GT250XT
C4,C8	CAP, 470PF, 5%,100V, 0603	Murata	GCM1885C2A471JA16
C5	CAP,33000PF, 0805,100V, X7R	Murata	GRM21BR72A333KA01
C6	CAP 10UF 16V TANTALUM, 2312	AVX	TAJC106M016RNJ
C7	CAP, 10pF, +/- 1%, 250V, 0805, ATC600F	AVX	600F100JT250XT
C9	CAP, 1.0UF, 100V, +/-10%, X7R, 1210	Murata	GCJ31CR72A105KA01
C10	CAP, 33 UF, 20%, G CASE	Panasonic	EEE-FK2A330P
C11	CAP, 3300 UF, +/-20%, 100V, ELECTROLYTIC, VR, RADIAL	Nichicon	UKW2A332MRD
R1	RES,1/16W,0603,1%,511 OHMS	Susumu	RR0816P-5110-D-69A
R2	RES, 1/16W, 0603, 1%, 5.1 Ohms	Vishay	CRCW06035R10FKEA
PCB	PCB FOR TEST FIXTURE, APPS CIRCUIT, 65V, CGHV37400F1-TB		
J1,J2	CONN, SMA, PANEL MOUNT JACK, FLANGE, 4-HOLE, BLUNT POST	Amphenol	132150
J3	HEADER RT>PLZ .1CEN LK 9POS	AMP	640457-9
J4	CONN, SMB, STRAIGHT JACK RECEPTACLE, SMT, 50 OHM, Au PLATED	Cinch	131-3711-201
W1	WIRE ASSEMBLY, 4.2", 18 AWG, TEST FIXTURE	Remington	MIL-W-16878
Q1	MACOM GaN Power Amplifier		MAPC-A4031-AB



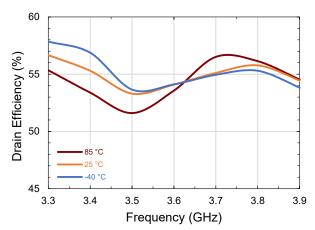
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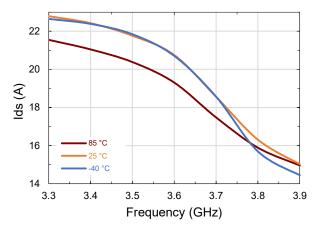
Output Power vs. Temperature and Frequency



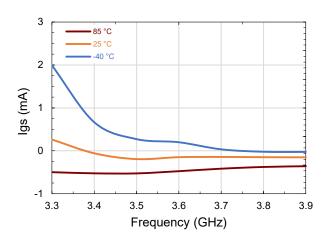
Drain Efficiency vs. Temperature and Frequency



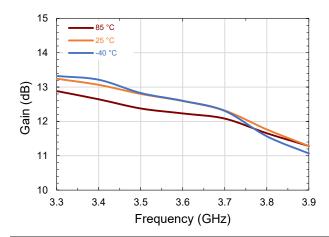
Drain Current vs. Temperature and Frequency



Gate Current vs. Temperature and Frequency



Large Signal Gain vs. Temperature and Frequency



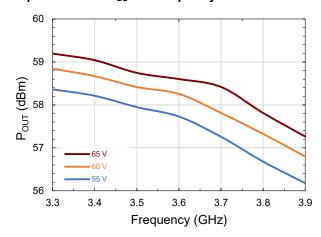


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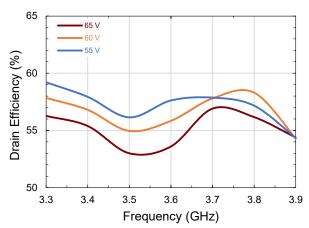
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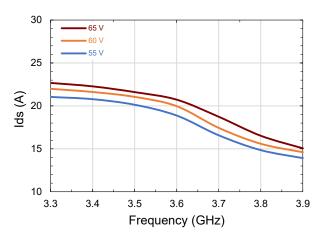
Output Power vs. VDS and Frequency



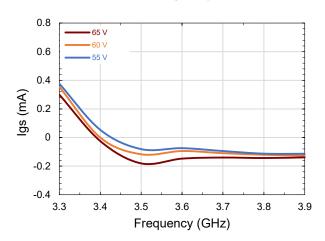
Drain Efficiency vs. V_{DS} and Frequency



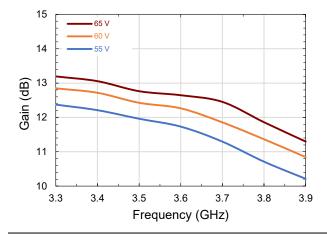
Drain Current vs. VDS and Frequency



Gate Current vs. VDS and Frequency



Large Signal Gain vs. VDS and Frequency



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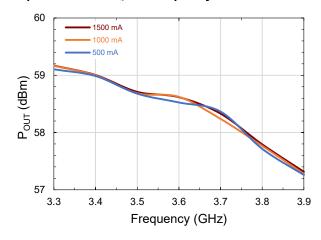


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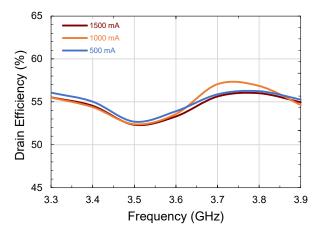
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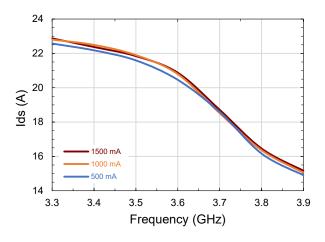
Output Power vs. IDQ and Frequency



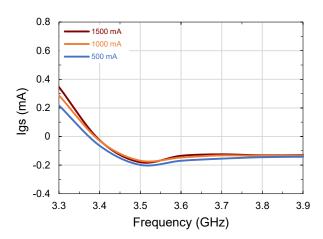
Drain Efficiency vs. I_{DQ} and Frequency



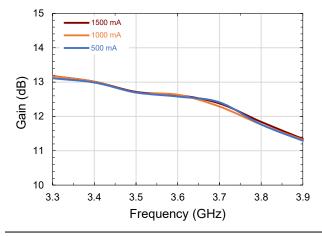
Drain Current vs. IDQ and Frequency



Gate Current vs. IDQ and Frequency



Large Signal Gain vs. IDQ and Frequency



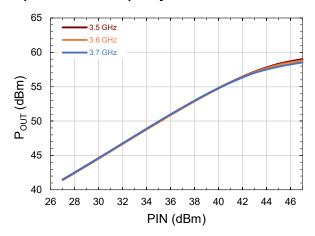


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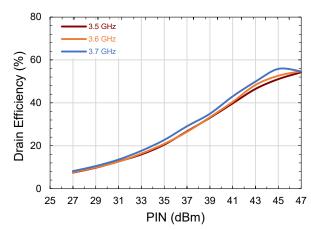
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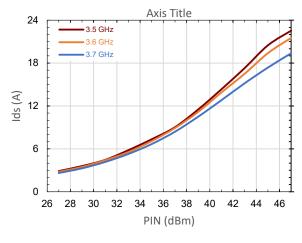
Output Power vs. Frequency and PIN



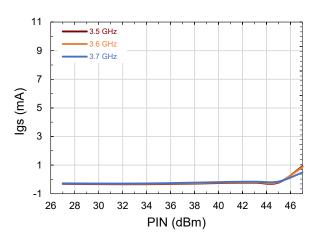
Drain Efficiency vs. Frequency and PIN



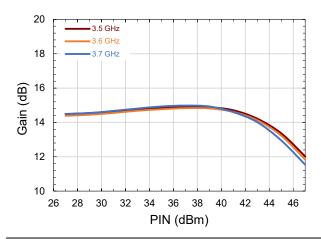
Drain Current vs. Frequency and PIN



Gate Current vs. Frequency and PIN



Large Signal Gain vs. Frequency and PIN



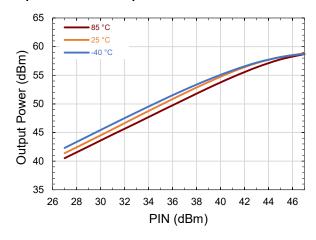


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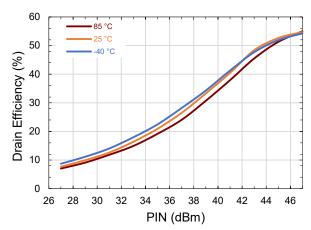
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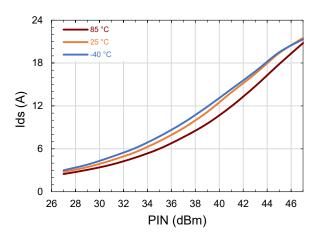
Output Power vs. Temperature and PIN



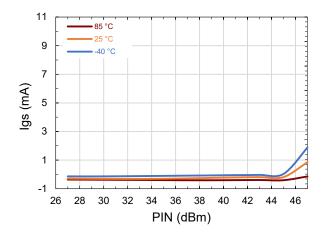
Drain Efficiency vs. Temperature and PIN



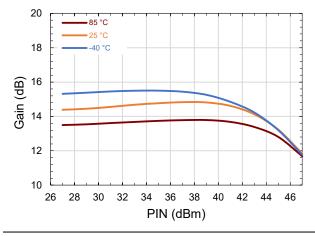
Drain Current vs. Temperature and PIN



Gate Current vs. Temperature and PIN



Large Signal Gain vs. Temperature and PIN



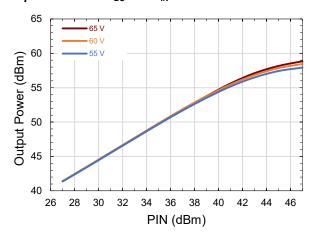


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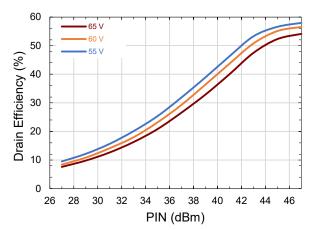
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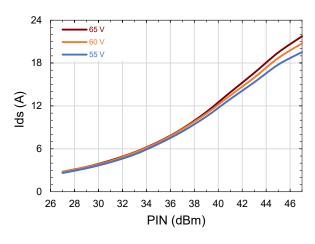
Output Power vs. V_{DS} and P_{IN}



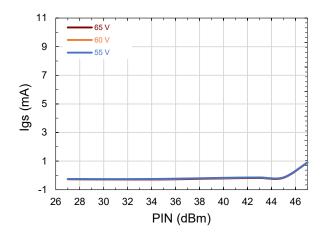
Drain Efficiency vs. V_{DS} and P_{IN}



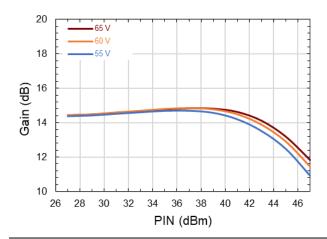
Drain Current vs. V_{DS} and P_{IN}



Gate Current vs. V_{DS} and P_{IN}



Large Signal Gain vs. VDS and PIN



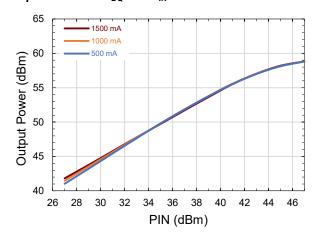


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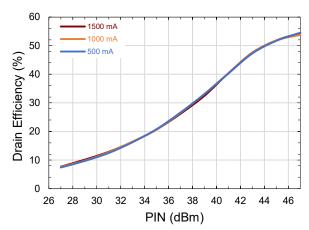
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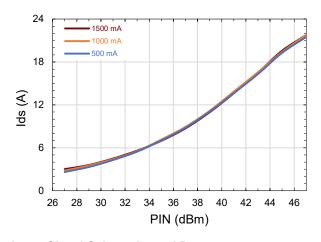
Output Power vs. IDQ and PIN



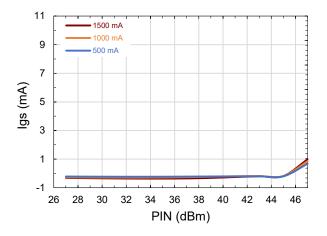
Drain Efficiency vs. IDQ and PIN



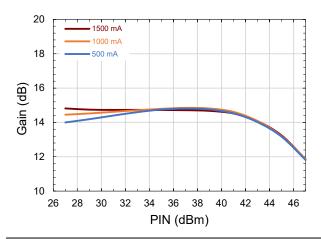
Drain Current vs. IDQ and PIN



Gate Current vs. IDQ and PIN



Large Signal Gain vs. IPQ and PIN



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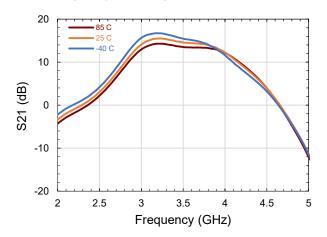
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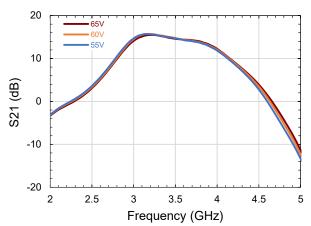
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CW, V_{DS} = 65 V, I_{DQ} = 1000 mA, P_{IN} = -20 dBm (Unless Otherwise Noted) For Engineering Evaluation Only—This data does not Modify MACOM's Datasheet Limits.

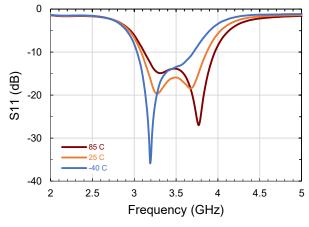
S21 vs Frequency and Temperature



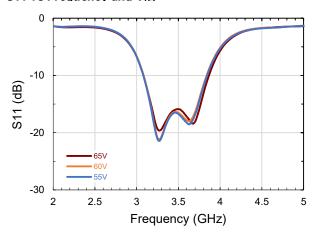
S21 vs Frequency and V_{DS}



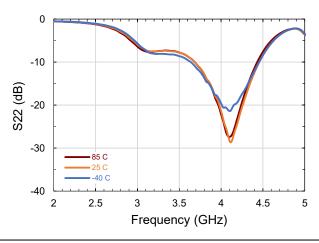
S11 vs Frequency and Temperature



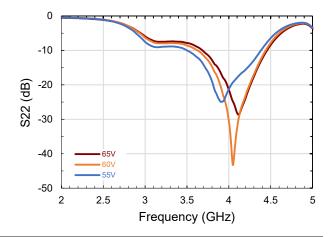
S11 vs Frequency and V_{DS}



S22 vs Frequency and Temperature



S22 vs Frequency and V_{DS}



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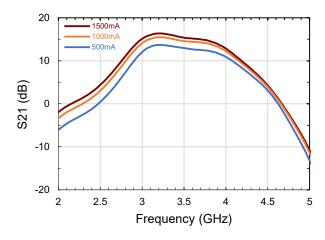
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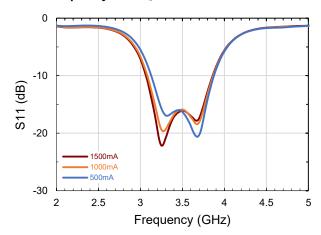
CW, V_{DS} = 65 V, I_{DQ} = 1000 mA, P_{IN} = -20 dBm (Unless Otherwise Noted)

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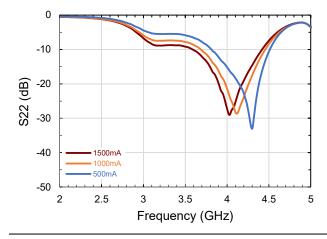
S21 vs Frequency and IDQ



S11 vs Frequency and IDQ



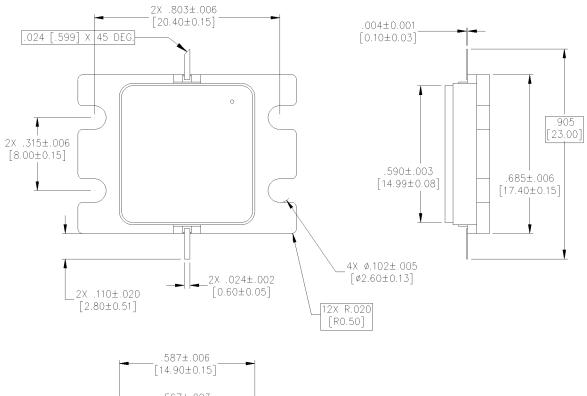
S22 vs Frequency and IDQ

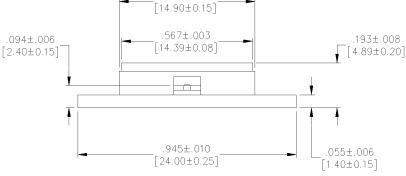




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Product Dimensions (Package Type AC-587BH-2)





NOTES:

- ALL DIMENSIONS SHOWN AS in[mm]. CONTROLLING DIMENSIONS ARE IN in AND CONVERTED mm DIMENSIONS ARE NOT NECESSARILY EXACT.
- 2. ALL TOLERANCES ARE ±.005 [0.13] UNLESS OTHERWISE NOTED
- 3. LEAD FINISH: AU FLANGE FINISH: AU LID MATERIAL: CERAMIC
- 4. LID SEAL EPOXY MAY FLOW OUT A MAXIMUM OF .020 [0.51] FROM EDGE OF LID
- 5. LID MAY BE MIS-ALIGNED UP TO .010 [0.25] FROM PACKAGE IN ANY DIRECTION

GaN Amplifier 65 V, 500 W 3.5 - 3.7 GHz



MACOM PURE CARBIDE

MAPC-A4031

Rev. V1

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