

**MAPC-A4032** 

Rev. V2

#### **Features**

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-A4032 is a Gallium Nitride (GaN) amplifier designed specifically with high efficiency and high power for the 2.75 - 3.75 GHz S-Band radar band.

The amplifier is matched to 50  $\Omega$  on the input and 50  $\Omega$  on the output. At the core of MAPC-A4032 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:**

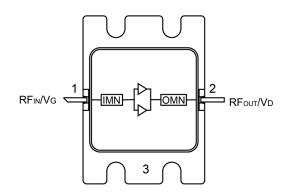
Measured in Evaluation Test Fixture at  $P_{IN}$  = 46 dBm, 100 µs pulse width and 10% Duty Cycle.

Frequency (GHz)	Output Power (dBm)	Power Gain (dB)	η <sub>D</sub> (%)
2.75	56.6	10.6	33.3
2.9	58.8	12.9	51.4
3.3	58.5	12.5	53.4
3.5	58.1	12.1	56.1
3.75	57.7	11.7	57.9



AC-587BH-2

### **Functional Schematic**



# **Pin Configuration**

Pin#	Pin Name	Function
1	RF <sub>IN</sub> / V <sub>G</sub>	RF Input / Gate
2	RF <sub>OUT</sub> / V <sub>D</sub>	RF Output / Drain
3	Flange <sup>1</sup>	Ground / Source

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

# **Ordering Information**

Part Number	MOQ Increment
MAPC-A4032-AB000	Bulk
MAPC-A4032-ABSB1	Sample Board

<sup>\*</sup> Restrictions on Hazardous Substances, compliant to current RoHS EU directive.



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# RF Electrical Characteristics: Freq. = 2.75 - 3.75 GHz, $T_C$ = 25°C, $V_{DS}$ = 65 V, $I_{DQ}$ = 500 mA, Pulse Width = 100 $\mu$ 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 <sub>IN</sub> = 46 dBm	P <sub>OUT</sub>		58.5		dBm
Drain Efficiency	Pulsed, P <sub>IN</sub> = 46 dBm	DE		53.5		%
Large Signal Gain	Pulsed, P <sub>IN</sub> = 46 dBm	G <sub>P</sub>	_	12.5	_	dB
Small Signal Gain	CW, P <sub>IN</sub> = -30 dBm	S21		13	_	dB
Input Return Loss	CW, P <sub>IN</sub> = -30 dBm	S11		-7	_	dB
Output Return Loss	CW, P <sub>IN</sub> = -30 dBm	S22		-4	_	dB
Output Mismatch Stress	$V_{DD} = 65 \text{ V}, I_{DQ} = 500 \text{ mA}, P_{IN} = 46 \text{ dBm}$	Ψ	VSWR =10:1, No Device Dama		amage	

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

Parameter	Conditions	Units	Min.	Тур.	Max.
Output Power	2.90 GHz 3.30 GHz 3.50 GHz 3.75 GHz	W	560 560 500 500	675 640 615 600	_
Power Gain	2.90 GHz 3.30 GHz 3.50 GHz 3.75 GHz	dB	11.4 11.4 11.0 11.0	12.3 12.1 11.9 11.8	_
Drain Efficiency	2.90 GHz 3.30 GHz 3.50 GHz 3.75 GHz	%	40 45 50 50	46 49 55 57	_

<sup>2.</sup> Final testing and screening for all amplifier sales is performed using the MAPC-A4032 production test fixture.

# DC Electrical Characteristics T<sub>A</sub> = 25°C

Parameter	Test Conditions	Symbol	Min.	Тур.	Max.	Units
Drain-Source Leakage Current	$V_{GS}$ = -8 V, $V_{DS}$ = 10 V	I <sub>DLK</sub>			11.62	mA
Gate-Source Leakage Current	$V_{GS}$ = -8 V, $V_{DS}$ = 10 V	I <sub>GLK</sub>	-11.62	_	_	mA
Gate Threshold Voltage	V <sub>DS</sub> = 10 V, I <sub>D</sub> = 83.6 mA	V <sub>T</sub>	-3.8	-3.1	-2.3	V
Gate Quiescent Voltage	$V_{DS} = 65 \text{ V}, I_{D} = 500 \text{ mA}$	$V_{GSQ}$		-2.75	_	V



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### **Thermal Characteristics**

Parameter	Symbol	Test Conditions	Units	Rating
Operating Junction Temperature	TJ	Pulse Width = 100 μs , Duty Cycle = 10%,	°C	136
Thermal Resistance, Junction to Case	R <sub>eJC</sub>	$P_{DISS} = 427 \text{ W}, T_C = 85^{\circ}\text{C}$	°C/W	0.12

Parameter	Symbol	Test Conditions	Units	Rating
Operating Junction Temperature	TJ	CW, P <sub>DISS</sub> = 200 W, T <sub>C</sub> = 85°C	Ô	185
Thermal Resistance, Junction to Case	R <sub>0JC</sub>	CVV, FDISS - 200 VV, 10 - 03 C	°C/W	0.5

# Absolute Maximum Ratings<sup>3,4</sup>

Parameter	Absolute Maximum
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 <sup>5</sup>	+225°C
Operating Temperature	-40°C to +125°C

<sup>3.</sup> Exceeding any one or combination of these limits may cause permanent damage to this device.

## **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.

MACOM does not recommend sustained operation near these survivability limits.

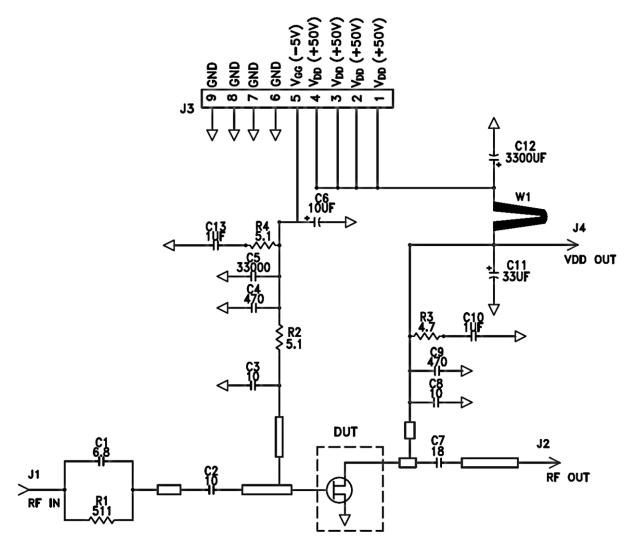
<sup>5.</sup> Operating at nominal conditions with  $T_J \le +225$  C will ensure MTTF  $\ge 1 \times 10^6$  hours.



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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

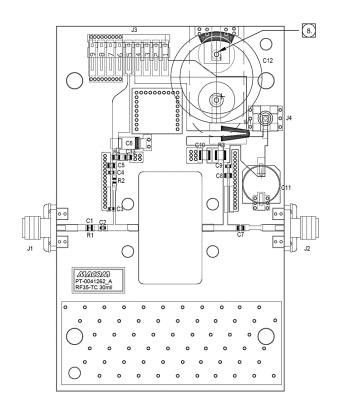
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## **Assembly Drawing**



# **Assembly Parts List**

Ref Des	Description	Qty
C1	CAP, 6.8pF, +/- 0.25 pF, 0603, ATC	1
C2,C8	CAP, 10pF, +/- 1%, 250V, 0805, ATC600F	2
С3	CAP, 10.0pF, +/-5%, 0603, ATC	1
C4,C9	CAP, 470PF, 5%,100V, 0603	2
C5	CAP,33000PF, 0805,100V, X7R	1
C6	CAP 10UF 16V TANTALUM, 2312	1
C7	CAP, 18pF, +/- 0.25 pF, 250V, 0805, ATC600F	1
C10	CAP, 1.0UF, 100V, +/-10%, X7R, 1210	1
R3	RES, 4.7 OHM, 1%, 1/4W, 1206	1
C13	CAP, 1UF, 0805, 100V, X7S	1
C11	CAP, 33 UF, 20%, G CASE	1
C12	CAP, 3300 UF, +/-20%, 100V, ELECTROLYTIC, VR, RADIAL	1
R1	RES,1/16W,0603,1%,511 OHMS	1
R2,R4	RES, 1/16W, 0603, 1%, 5.1 Ohms	1
J1,J2	CONN, SMA, PANEL MOUNT JACK, FLANGE, 4-HOLE, BLUNT POST	2
J3	HEADER RT>PLZ .1CEN LK 9POS	1
J4	CONN, SMB, STRAIGHT JACK RECEPTACLE, SMT, 50 OHM, Au PLATED	1
W1	WIRE ASSEMBLY, 4.2", 18 AWG, TEST FIXTURE	1

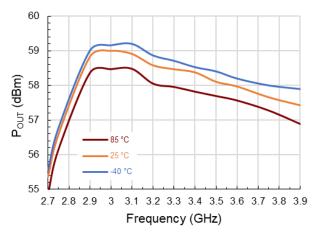


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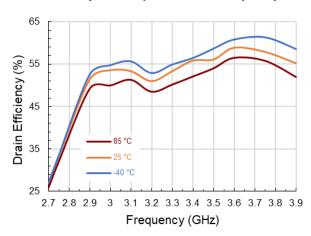
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Typical Performance Curves as Measured in the 2.75 – 3.75 GHz Evaluation Test Fixture Pulsed 100  $\mu$ s 10%,  $P_{IN}$  = 46 dBm,  $V_{DS}$  = 65 V,  $I_{DQ}$  = 500 mA, Frequency = 3.5 GHz (Unless otherwise noted) For Engineering Evaluation Only – This data does not Modify MACOM's Datasheet Limits.

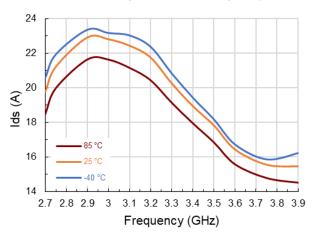
#### Output Power vs. Temperature and Frequency



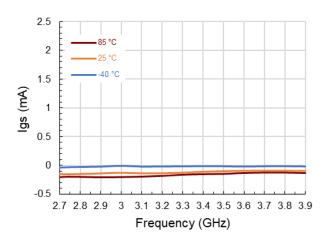
#### Drain Efficiency vs. Temperature and Frequency



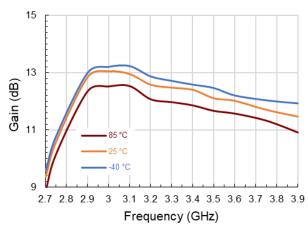
#### Drain Current vs. Temperature and Frequency



Gate Current vs. Temperature and Frequency



### Large Signal Gain vs. Temperature and Frequency



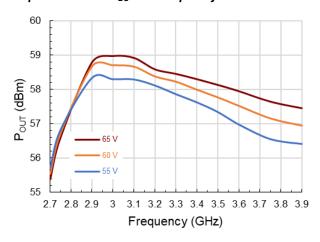


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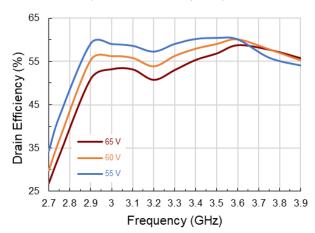
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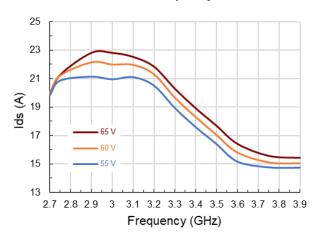
### Output Power vs. VDS and Frequency



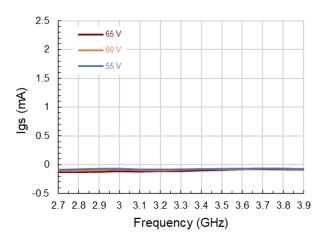
### Drain Efficiency vs. V<sub>DS</sub> and Frequency



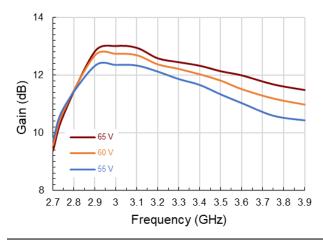
#### Drain Current vs. V<sub>DS</sub> and Frequency



Gate Current vs. V<sub>DS</sub> and Frequency



### Large Signal Gain vs. VDS and Frequency



7

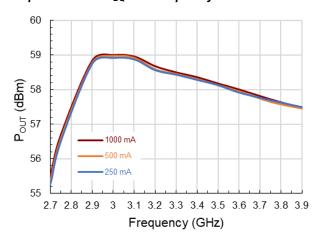


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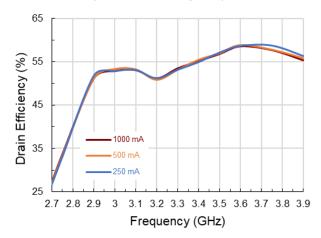
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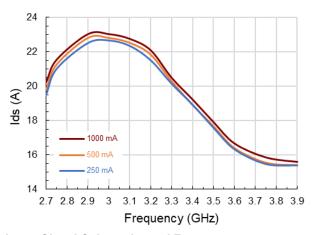
### Output Power vs. IDQ and Frequency



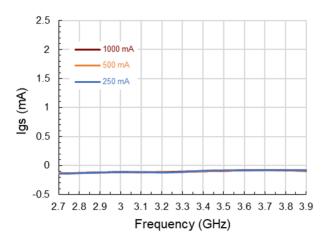
#### Drain Efficiency vs. IDQ and Frequency



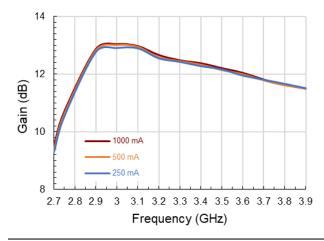
#### Drain Current vs. IDQ and Frequency



Gate Current vs. IDQ and Frequency



### Large Signal Gain vs. IDQ and Frequency



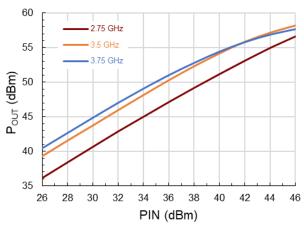


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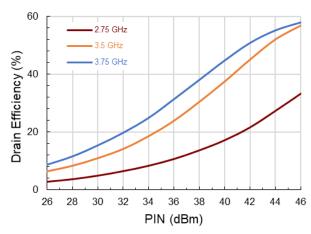
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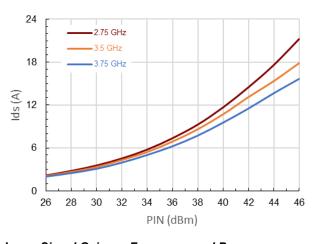
#### Output Power vs. Frequency and PIN



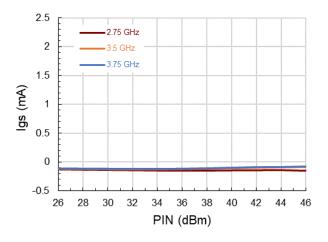
#### Drain Efficiency vs. Frequency and PIN



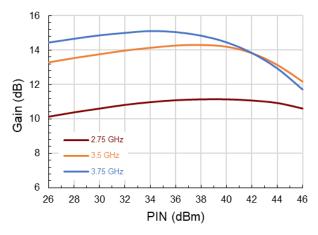
#### Drain Current vs. Frequency and PIN



Gate Current vs. Frequency and PIN



### Large Signal Gain vs. Frequency and $P_{\text{IN}}$



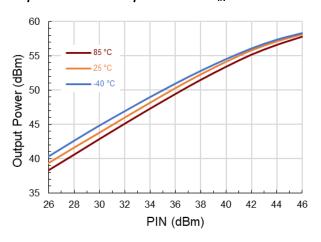


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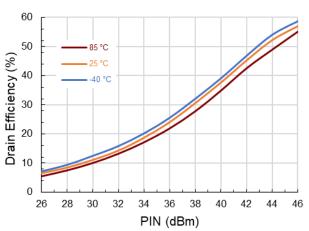
Rev. V2

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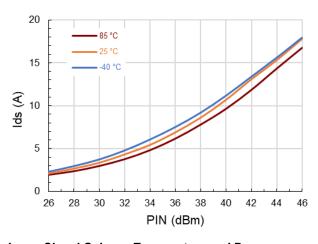
#### Output Power vs. Temperature and PIN



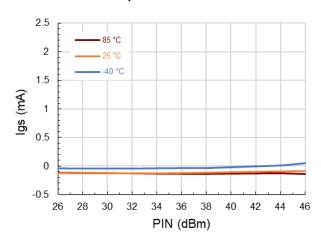
#### Drain Efficiency vs. Temperature and PIN



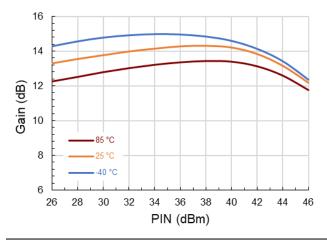
### Drain Current vs. Temperature and PIN



Gate Current vs. Temperature and PIN



### Large Signal Gain vs. Temperature and PIN



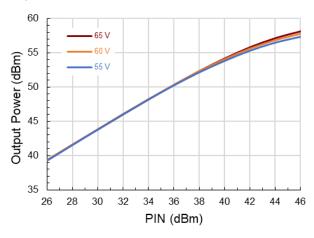


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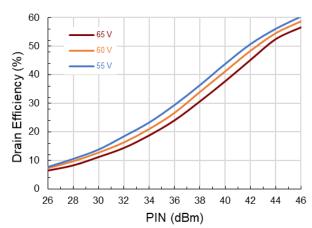
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Typical Performance Curves as Measured in the 2.75 – 3.75 GHz Evaluation Test Fixture Pulsed 100  $\mu$ s 10%,  $P_{IN}$  = 46 dBm,  $V_{DS}$  = 65 V,  $I_{DQ}$  = 500 mA, Frequency = 3.5 GHz (Unless otherwise noted) For Engineering Evaluation Only – This data does not Modify MACOM's Datasheet Limits.

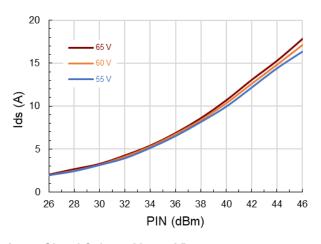
### Output Power vs. VDS and PIN



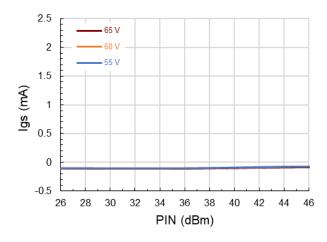
### Drain Efficiency vs. V<sub>DS</sub> and P<sub>IN</sub>



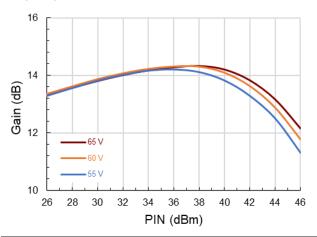
#### Drain Current vs. VDS and PIN



Gate Current vs. V<sub>DS</sub> and P<sub>IN</sub>



### Large Signal Gain vs. VDS and PIN



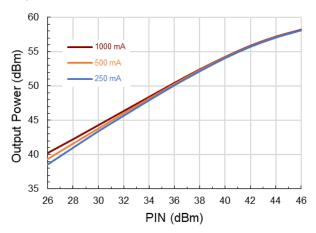


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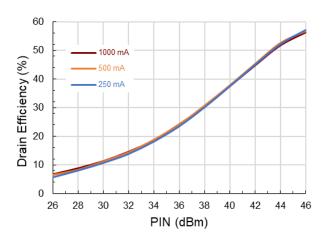
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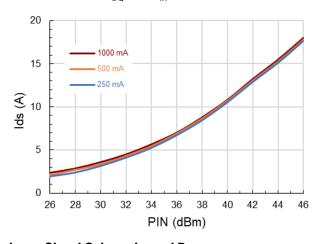
### Output Power vs. IDQ and PIN



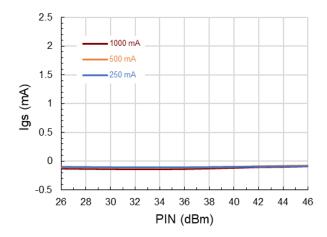
### Drain Efficiency vs. IDQ and PIN



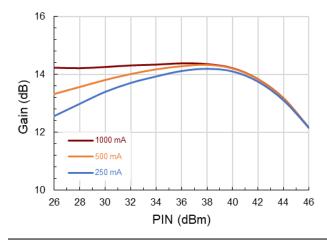
#### Drain Current vs. IDQ and PIN



Gate Current vs. IDQ and PIN



### Large Signal Gain vs. IDQ and PIN



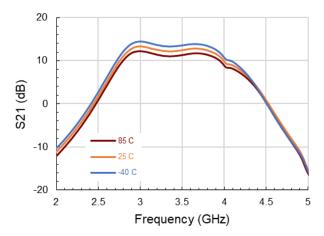


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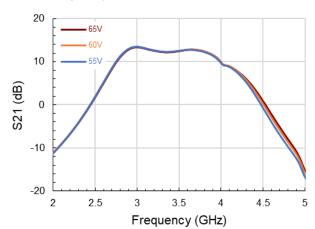
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Typical Performance Curves as Measured in the 2.75 – 3.75 GHz Evaluation Test Fixture: CW,  $V_{DS}$  = 65 V,  $I_{DQ}$  = 500 mA,  $P_{IN}$  = -20 dBm (Unless Otherwise Noted) For Engineering Evaluation Only—This data does not Modify MACOM's Datasheet Limits.

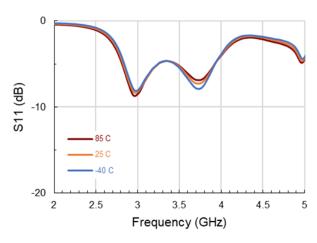
### S21 vs Frequency and Temperature



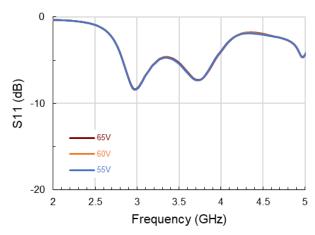
### S21 vs Frequency and V<sub>DS</sub>



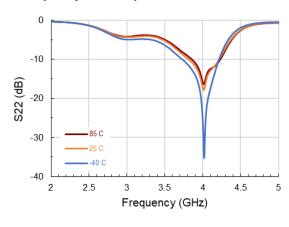
### S11 vs Frequency and Temperature



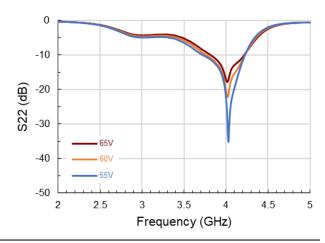
S11 vs Frequency and V<sub>DS</sub>



#### S22 vs Frequency and Temperature



S22 vs Frequency and V<sub>DS</sub>





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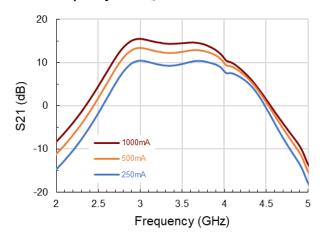
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Typical Performance Curves as Measured in the 2.75–3.75 GHz Evaluation Test Fixture:

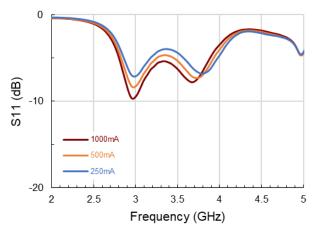
 $\overrightarrow{CW}$ ,  $V_{DS}$  = 65 V,  $I_{DQ}$  = 500 mA,  $P_{IN}$  = -20 dBm (Unless Otherwise Noted)

For Engineering Evaluation Only—This data does not Modify MACOM's Datasheet Limits.

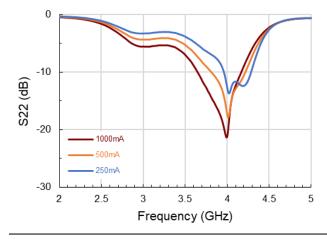
### S21 vs Frequency and IDQ



### S11 vs Frequency and IDQ



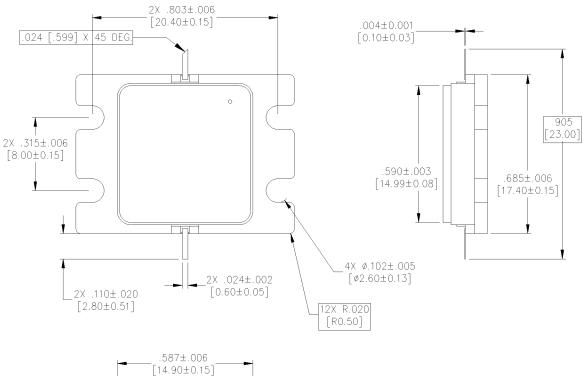
### S22 vs Frequency and IDQ

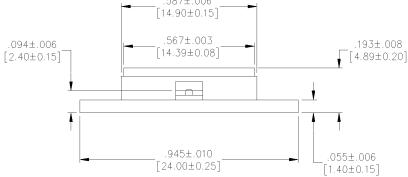




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## Product Dimensions (Package Type AC-587BH-2)





#### 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 2.75 - 3.75 GHz



MACOM PURE CARBIDE

**MAPC-A4032** 

Rev. V2

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