

MAPC-A1001-BD

Rev. V1

Features

- MACOM PURE CARBIDE® Amplifier Series
- Suitable for Linear and Saturated Applications
- CW and Pulsed Operation: 50 W Output Power
- 50 Ω Input Matched
- 260°C Reflow Compatible
- 50 V Operation
- 100% RF Tested
- RoHS* Compliant

Applications

The MAPC-A1001-BD has a wide range of applications, including military radio communications, RADAR, avionics, digital cellular infrastructure, RF energy, and test instrumentation.

Description

The MAPC-A1001-BD is a GaN on Silicon Carbide HEMT D-mode amplifier suitable for 30 - 1400 MHz frequency operation. The device supports both CW and pulsed operation with minimum output power levels of 50 W (47 dBm) in a 5 x 6 mm plastic package.

Typical Performance:

Measured in Evaluation Test Fixture: 3dB Compression, 100 μs pulse width, 10% duty cycle VDS = 50 V, IDQ = 130 mA, TC = 25°C

Frequency (GHz)	Output Power (dBm)	Gain (dB)	η _□ (%)
0.03	44.6	16.6	73
0.15	45.3	19.3	78
0.55	45.5	19.4	60
0.90	47.4	19.4	66
1.20	46.3	18.3	64
1.40	44.2	16.2	54

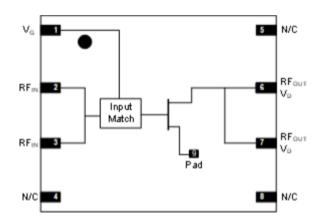
Ordering Information

Part Number	Package
MAPC-A1001-BD000	Bulk Quantity
MAPC-A1001-BDTR1	Tape and Reel
MAPC-A1001-BDSB1	Sample Board



5 x 6 mm DFN

Functional Schematic



Pin Configuration

Pin#	Pin Name	Function
1	V _G	Gate
2, 3	RF _{IN}	RF Input
4, 5, 8	N/C	No Connection
6, 7	RFout/V _D	RF Output / Drain
9	Pad ¹	Ground / Source

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



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RF Electrical Characteristics: $T_C = 25^{\circ}C$, $V_{DS} = 50 \text{ V}$, $I_{DQ} = 130 \text{ mA}$ Note: Performance in MACOM Application Fixture (30 – 1400 MHz), 50 Ω system

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Parameter	Test Conditions	Symbol	Min.	Тур.	Max.	Units
Small Signal Gain	Pulsed ² , 900 MHz	Gss	-	21.9	-	dB
Power Gain	Pulsed ² , 900 MHz, 2.5 dB Gain Compression	G _{SAT}	-	19.4	-	dB
Drain Efficiency	Pulsed ² , 900 MHz, 2.5 dB Gain Compression	ηѕат	-	66	-	%
Output Power	Pulsed ² , 900 MHz, 2.5 dB Gain Compression	Psat	-	47.4	-	dBm
Power Gain	Pulsed ² , 900 MHz, P _{IN} = 30 dB	G₽	-	17.9	-	dB
Drain Efficiency	Pulsed ² , 900 MHz, P _{IN} = 30 dB	η _P	-	69	-	%
Output Power	Pulsed ² , 900 MHz, P _{IN} = 30 dB	P _P	-	47.9	-	dBm
Gain Variation	Pulsed ² , 900 MHz, (-40°C to +85°C)	ΔG	-	0.005	-	dB/°C
Power Variation	Pulsed ² , 900 MHz, (-40°C to +85°C)	ΔPdB	-	0.005	-	dB/°C
Ruggedness: Output Mismatch	All phase angles	Ψ	, VSWR = 30:1, No Device Damage		е	

RF Electrical Characteristics: $T_C = 25^{\circ}C$, $V_{DS} = 50$ V, $I_{DQ} = 130$ mA Note: Performance in MACOM Production Test Fixture, 50 Ω system

Parameter	Test Conditions	Symbol	Min.	Тур.	Max.	Units
Power Gain	Pulsed ² , 1400 MHz, 2.5 dB Gain Compression	GSAT	16	17	-	dB
Saturated Drain Efficiency	Pulsed ² , 1400 MHz, 2.5 dB Gain Compression	ηςΑΤ	66	69	-	%
Saturated Output Power	Pulsed ² , 1400 MHz, 2.5 dB Gain Compression	Psat	47.6	48	-	dBm

^{2.} Pulse Details: 100µs pulse width, 10 ms period, 10% Duty Cycle.

DC Electrical Characteristics T_A = 25°C

Parameter	Test Conditions	Symbol	Min.	Тур.	Max.	Units
Drain-Source Leakage Current	V_{GS} = -8 V, V_{DS} = 130 V	I _{DLK}	-	-	6.48	mA
Gate-Source Leakage Current	V _{GS} = -8 V, V _{DS} = 0 V	I _{GLK}	-	-	6.48	mA
Gate Threshold Voltage	V _{DS} = 50 V, I _D = 6.48 mA	V _T	-	-2.9	-	V
Gate Quiescent Voltage	V _{DS} = 50 V, I _D = 130 mA	V_{GSQ}	-3.5	-2.5	-2.0	V



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Absolute Maximum Ratings^{3,4,5,6,7}

Parameter	Absolute Maximum		
Drain Source Voltage, V _{DS}	150 V		
Gate Source Voltage, V _{GS}	-8 to +2 V		
Gate Current, I _G	6.5 mA		
Drain Current, I _D	3.84 A		
Storage Temperature Range	-65°C to +150°C		
Case Operating Temperature Range	-40°C to +85°C		
Channel Operating Temperature Range, Тсн	-40°C to +85°C		
Absolute Maximum Junction Temperature	+275°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 VDS < 55 V will ensure MTTF > 2.15 x 10^6 hours.
- 6. Operating at nominal conditions with TCH ≤ 275°C will ensure MTTF > 2.15 x 10⁶ 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 = 1.537, B = -24.8111, and C = 21,352.

Thermal Characteristics

Parameter	Test Conditions	Symbol	Typical	Units
Thermal Resistance using Finite Element Analysis	$V_{DS} = 50 \text{ V}, T_{C} = 85^{\circ}\text{C}, T_{CH} = 225^{\circ}\text{C}$	R _⊙ (FEA)	TBD	°C/W

Handling Procedures

Please observe the following precautions to avoid damage:

Static Sensitivity

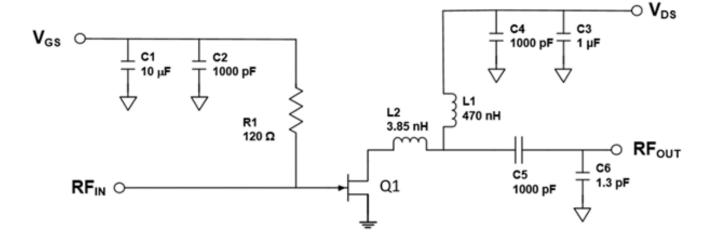
Gallium Nitride Circuits are sensitive to electrostatic discharge (ESD) and can be damaged by static electricity. Proper ESD control techniques should be used when handling these HBM Class 1B, CDM Class C3 devices.



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Application Fixture 30 - 1400 MHz



Description

Parts measured on application 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 VGS to pinch-off (VP).
- Turn on VDS to nominal voltage (50 V).
- 3. Increase VGS until IDS current is reached.
- 4. Apply RF power to desired level.

Turning the device OFF

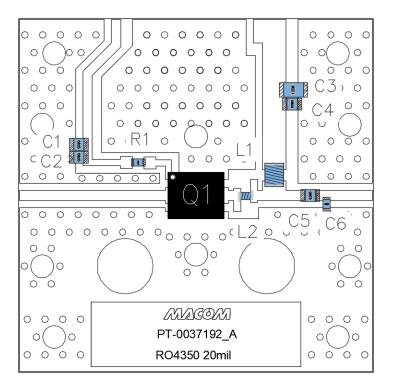
- 1. Turn the RF power off.
- 2. Decrease VGS down to VP pinch-off.
- 3. Decrease VDS down to 0 V.
- 4. Turn off VGS.



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Application Test Fixture and Recommended Tuning Solution 30 - 1400 MHz



Reference Designator	Value	Tolerance	Manufacturer	Part Number	
C1	10 μF	+/- 10 %	Murata	GRM21BC71E106KE11	
C2, C4, C5	1000 pF	+/- 5 %	Murata	GRM219R7A102JA01D	
C3	1 μF	+/- 10 %	Murata	GRM32CR72A105KA35L	
C6	1.3 µF	+/- 0.1 pF	Johanson	251R14S1R3BV4T	
R1	120 pF	+/- 25 %	Fair-Rite	2506031217Y0	
L1	470 nH	+/- 5 %	CoilCraft	1008CS-471XJRC	
L2	3.85 nH	+/- 5 %	CoilCraft	0906-4JLC	
Q1	MACOM GaN Power Amplifier MAPC-A1001				
PCB	RO4350LM, 20 mil, 0.5 oz Cu, Au Finish				

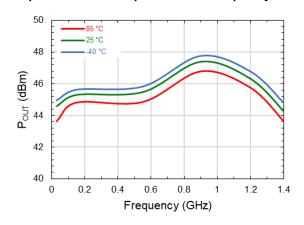


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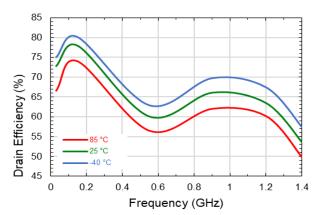
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Typical Performance Curves as Measured in the 30 – 1400 MHz Application Fixture: 900 MHz, V_{DS} = 50 V, I_{DQ} = 130 mA, 2.5 dB Gain Compression, T_{C} = 25 $^{\circ}$ C Unless Otherwise Noted

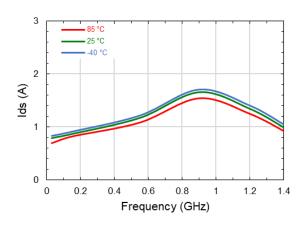
Output Power vs. Temperature and Frequency



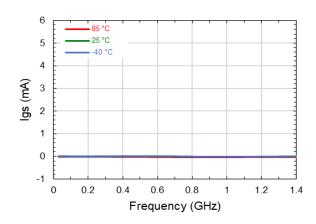
Drain Efficiency vs. Temperature and Frequency



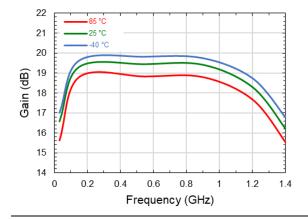
Drain Current vs. Temperature and Frequency



Gate Current vs. Temperature and Frequency



Large Signal Gain vs. Temperature and Frequency



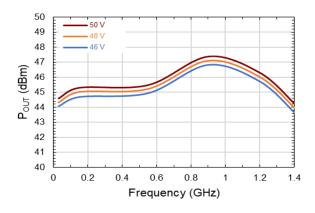


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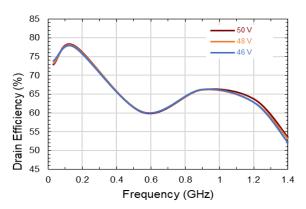
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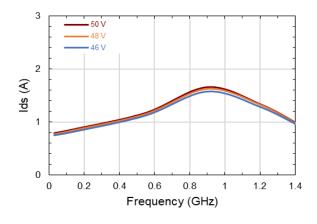
Output Power vs. VDS and Frequency



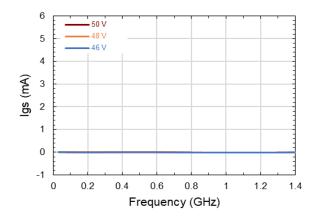
Drain Efficiency vs. VDS and Frequency



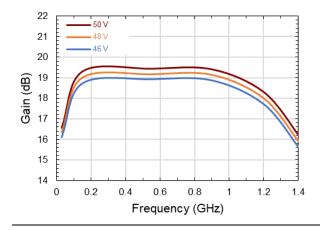
Drain Current vs. V_{DS} and Frequency



Gate Current vs. V_{DS} and Frequency



Large Signal Gain vs. VDS and Frequency



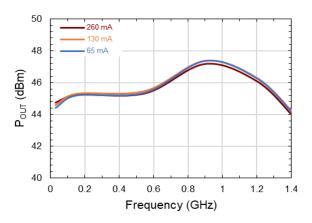


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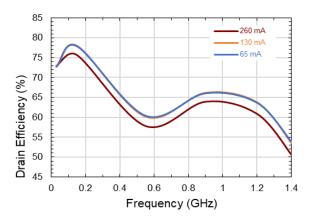
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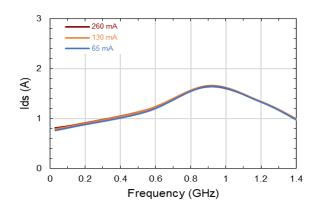
Output Power vs. IDQ and Frequency



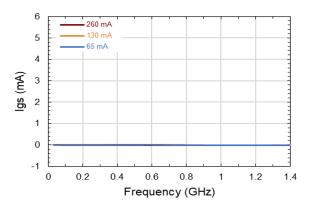
Drain Efficiency vs. IDQ and Frequency



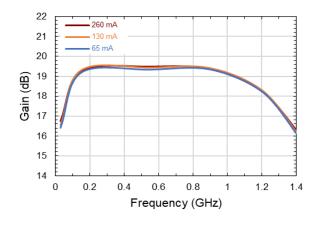
Drain Current vs. IDQ and Frequency



Gate Current vs. IDQ and Frequency



Large Signal Gain vs. IDQ and Frequency



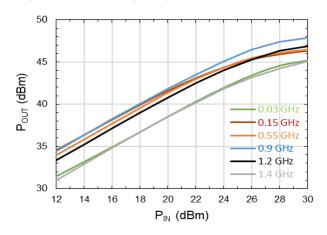


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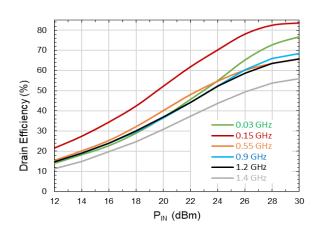
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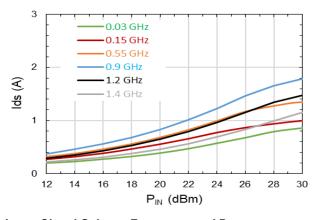
Output Power vs. Frequency and PIN



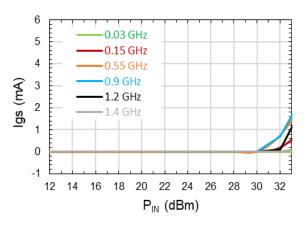
Drain Efficiency vs. Frequency and PIN



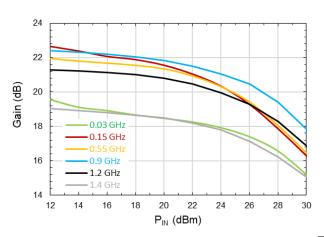
Drain Current vs. Frequency and PIN



Gate Current vs. Frequency and PIN



Large Signal Gain vs. Frequency and PIN



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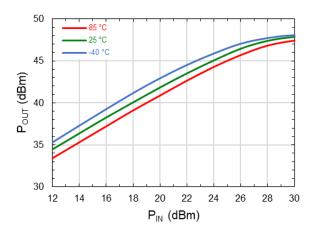


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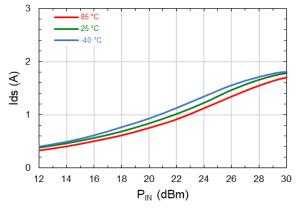
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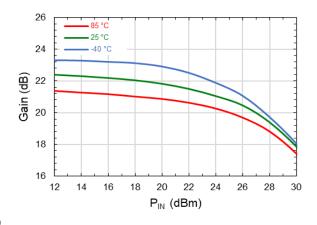
Output Power vs. Temperature and PIN



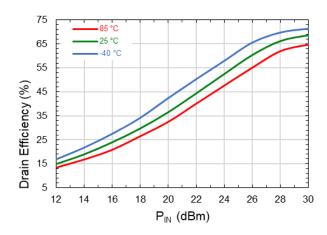
Drain Current vs. Temperature and PIN



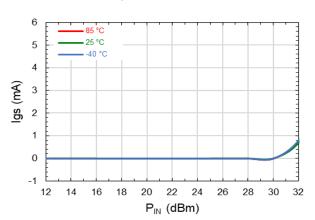
Large Signal Gain vs. Temperature and PIN



Drain Efficiency vs. Temperature and PIN



Gate Current vs. Temperature and PIN



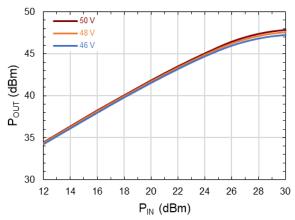


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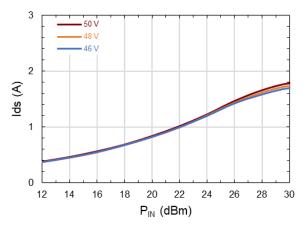
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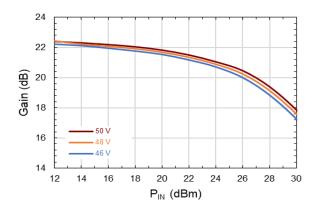
Output Power vs. VDS and PIN



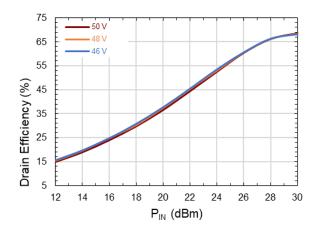
Drain Current vs. VDS and PIN



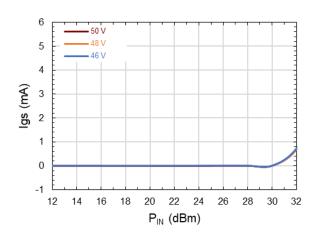
Large Signal Gain vs. VDS and PIN



Drain Efficiency vs. VDS and PIN



Gate Current vs. VDS and PIN



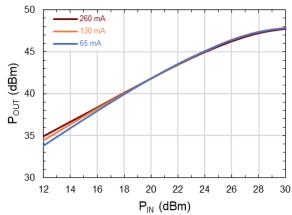


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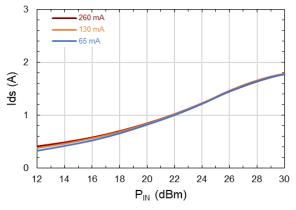
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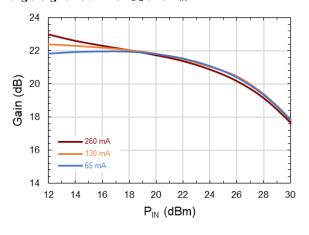
Output Power vs. IDQ and PIN



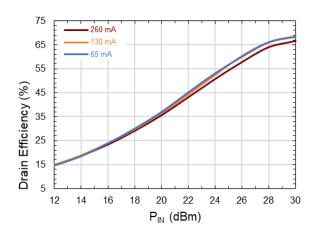
Drain Current vs. IDO and PIN



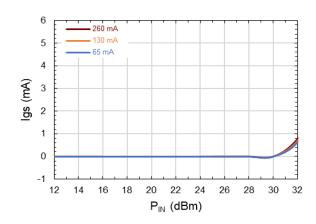
Large Signal Gain vs. IDQ and PIN



Drain Efficiency vs. IDQ and PIN



Gate Current vs. IDQ and PIN



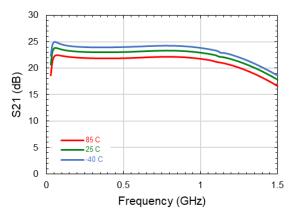


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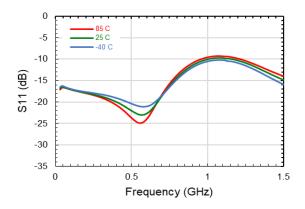
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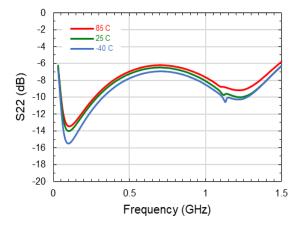
S21 vs. Frequency and Temperature



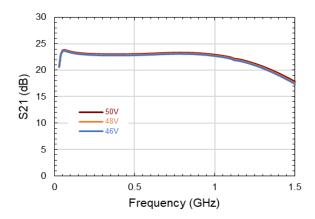
S11 vs. Frequency and Temperature



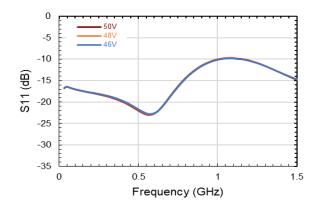
S22 vs. Frequency and Temperature



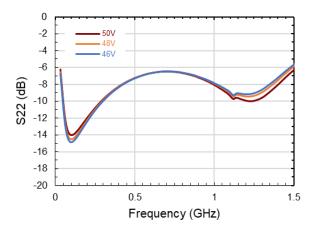
S21 vs. Frequency and VDS



S11 vs. Frequency and V_{DS}



S22 vs. Frequency and VDS



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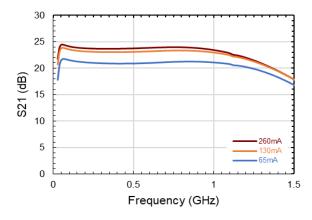


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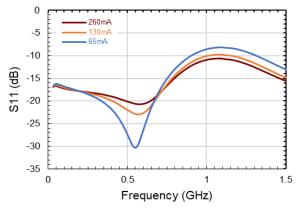
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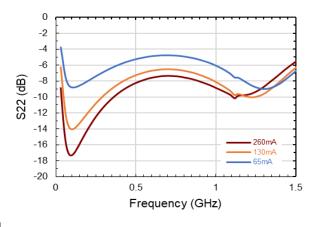
S21 vs. Frequency and IDQ



S11 vs. Frequency and IDQ



S22 vs. Frequency and IDQ

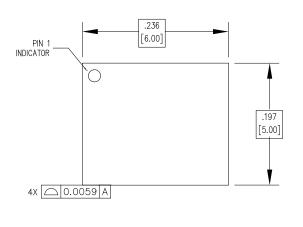


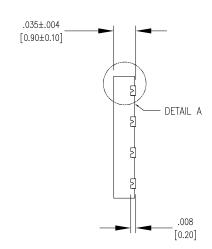


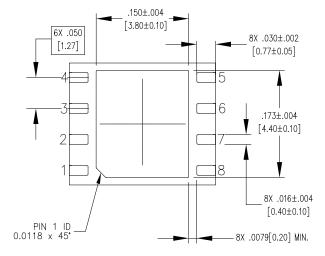
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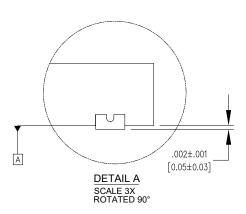
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Lead-Free 5 x 6 mm Package Dimensions[†]









NOTES:

- 1. ALL DIMENSIONS SHOWN AS in [mm]. CONTROLLING DIMENSIONS ARE IN in. CONVERTED mm DIMENSIONS ARE NOT NECESSARILY EXACT.
- 2. EXPOSED LEADS: NiPdAu.

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

GaN Amplifier 50 V, 50 W 30 – 1400 MHz



MACOM PURE CARBIDE

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