Features

- MACOM PURE CARBIDE® Amplifier Series
- Optimized for Cellular Base Station Applications
- Designed for Digital Predistortion Error Correction
 Systems
- Optimized for Asymmetrical Doherty Application
- High Terminal Impedances for Broadband
 Performance
- 50 V Operation
- 100% RF Tested
- RoHS* Compliant

Description

The MAPC-A2506 is a high power GaN on Silicon Carbide HEMT D-mode amplifier suitable for asymmetrical Doherty base station applications with 30W average power and optimized for 3.7 - 4.0 GHz modulated signal operation. The device supports pulsed, and linear operation with peak output power levels to 220 W (53.4 dBm) in an air cavity ceramic package.

Typical Doherty Performance:

 WCDMA 3GPP TM1, 10 dB PAR @ 0.01% CCDF.
 V_{DS} = 50 V, I_{DQCAR} = 150mA, V_{GSPK} = -4.6 V, T_{CASE} = 25°C, P_{OUT} = 44.7 dBm

Frequency (GHz)	GP (dB)	η ₀ (%)	Output PAR (dB)	ACPR (dBc)
3.7	11.0	42.4	8.7	-29.4
3.85	12.0	44.6	8.7	-35.2
4.0	11.0	42.0	8.3	-36.8

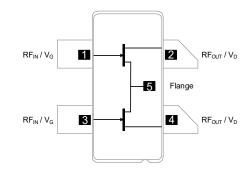
Ordering Information

Part Number	Package
MAPC-A2506-AS000	Bulk Quantity
MAPC-A2506-ASTR1	Tape and Reel
MAPC-A2506-ASSB1	Sample Board

^{1 *} Restrictions on Hazardous Substances, compliant to current RoHS EU directive.



Functional Schematic



Pin Configuration

Pin No.	Pin Name	Function
1	$\mathrm{RF}_{\mathrm{IN}}/\mathrm{V}_{\mathrm{G}}$	RF Input / Gate (Carrier)
2	RF_{OUT} / V_D	RF Output / Drain (Carrier)
3	RF _{IN} / V _G	RF Input / Gate (Peaking)
4	RF_{OUT} / V_D	RF Output / Drain (Peaking)
5	Flange ¹	Ground / Source

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

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RF Electrical Specifications: $T_c = 25^{\circ}C$, $V_{DS} = 50 V$, $I_{DQCAR} = 150 mA$, $V_{GSPK} = -4.6 V$ Note: Performance in MACOM Doherty Evaluation Test Fixture, 50 Ohm system.

Parameter	Test Conditions	Symbol	Min.	Тур.	Max.	Units
Small Signal Gain	Pulsed ² , 3.85 GHz	G _{SS}	-	12.5	-	dB
Saturated Output Power	Pulsed ² , 3.85 GHz	P _{SAT}	-	54.0	-	dBm
Drain Efficiency at Saturation	Pulsed ² , 3.85 GHz	η_{SAT}	-	52.3	-	%
AM/PM	Pulsed ² , 3.85 GHz	Φ	-	6	-	0
Modulated Peak Power	WCDMA ³ , 3.85 GHz	P- _{2.5dB} ⁴	-	54.1	-	dBm
VBW Resonance Point	IMD 3rd Order Inflection Point	VBW_{RES}	-	200	-	MHz
Gain Flatness in 300 MHz	WCDMA ³ , P _{OUT} = 44.7 dBm	G _F	-	1.0	-	dB
Gain Variation (-25°C to +105°C)	WCDMA ³ , 3.85 GHz, P _{OUT} = 44.7 dBm	ΔG	-	0.0174	-	dB/°C
Power Variation (-25°C to +105°C)	Pulsed ² , 3.85 GHz	ΔP_{-1dB}	-	0.0092	-	dB/°C
Power Gain	WCDMA ³ , 3.85 GHz, P _{OUT} = 44.7 dBm	G _P	-	12.0	-	dB
Drain Efficiency	WCDMA ³ , 3.85 GHz, P _{OUT} = 44.7 dBm	η	-	44.6	-	%
Output PAR @ 0.01% CCDF	WCDMA ³ , 3.85 GHz, P _{OUT} = 44.7 dBm	PAR	-	8.7	-	dB
Adjacent Channel Power Ratio	WCDMA ³ , 3.85 GHz, P _{OUT} = 44.7 dBm	ACPR	-	-35	-	dBc
Input Return Loss	WCDMA ³ , 3.85 GHz, P _{OUT} = 44.7 dBm	IRL	-	-20	-	dB
Ruggedness: Output Mismatch	All phase angles	Ψ	VSWR =	10:1, No I	Device I	Damage

RF Electrical Specifications: $T_A = 25^{\circ}C$, $V_{DS} = 50 V$, $I_{DQCAR} = 130 mA$, $V_{GSPK} = -5.4 V$ Note: Performance in MACOM Doherty Production Test Fixture, 50 Ω system

Parameter	Test Conditions	Symbol	Min.	Тур.	Max.	Units
Power Gain	WCDMA ³ , 3.85 GHz, P _{OUT} = 44.7 dBm	G _P	8.1	9.4	-	dB
Drain Efficiency	WCDMA ³ , 3.85 GHz, P _{OUT} = 44.7 dBm	η	35.6	39.6	-	%
Output PAR @ 0.01% CCDF	WCDMA ³ , 3.85 GHz, P _{OUT} = 44.7 dBm	PAR	7.1	7.7	-	dB
Input Return Loss	WCDMA ³ , 3.85 GHz, P _{OUT} = 44.7 dBm	IRL	-	-9	-5	dB

2. Pulse details: 100 µs pulse width, 10% Duty Cycle.

Modulated Signal: 3.84 MHz, WCMDA 3 GPP TM1 64 DPCH, 9.9 dB PAR @ 0.01% CCDF.
 P2.5dB = P_{OUT} + 7.5 dB where P_{OUT} is the average output power measured using a modulated signal³ where the output PAR is compressed to 7.5 dB @ 0.01% probability CCDF.

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DC Electrical Characteristics T_A = 25°C

Parameter	Test Conditions	Symbol	Min.	Тур.	Max.	Units
Carrier Amplifier						
Drain-Source Leakage Current (Carrier)	V_{GS} = -8 V, V_{DS} = 130 V	I _{DLK}	-	-	9.5	mA
Gate-Source Leakage Current (Carrier)	V_{GS} = -8 V, V_{DS} = 0 V	I _{GLK}	-	-	9.5	mA
Gate Threshold Voltage	V_{DS} = 50 V, I _D = 9.5 mA	VT	-5	-3.1	-	V
Gate Quiescent Voltage	V _{DS} = 50 V, I _D = 130 mA	V_{GSQ}	-3.1	-2.7	-2.1	V
On Resistance (Carrier)	V_{GS} = 2 V, I _D = 67 mA	R _{ON}	-	0.4	-	Ω
Maximum Drain Current	V_{DS} = 7 V pulsed, pulse width 300 µs	I _{D, MAX}	-	5.1	-	А
	Peaking Amplifier					
Drain-Source Leakage Current (Peaking)	V_{GS} = -8 V, V_{DS} = 130 V	I _{DLK}	-	-	17.0	mA
Gate-Source Leakage Current (Peaking)	V_{GS} = -8 V, V_{DS} = 0 V	I _{GLK}	-	-	17.0	mA
Gate Threshold Voltage	V _{DS} = 50 V, I _D = 17.0 mA	V _T	-5	-3.1	-	V
Gate Quiescent Voltage	V _{DS} = 50 V, I _D = 230 mA	V _{GSQ}	-3.1	-2.8	-2.1	V
On Resistance (Peaking)	$V_{GS} = 2 V, I_D = 117 mA$	R _{ON}	-	0.24	-	Ω
Maximum Drain Current	V_{DS} = 7 V pulsed, pulse width 300 µs	I _{D, MAX}	-	9.0	-	А

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Absolute Maximum Ratings^{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 (Carrier), I _G	9.5 mA
Gate Current (Peaking), I _G	17.0 mA
Storage Temperature Range	-65°C to +150°C
Case Operating Temperature Range	-40°C to +120°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.

8.

Operating at drain source voltage V_{DS} < 55 V will ensure MTTF > 2.51 x 10⁶ hours. Operating at nominal conditions with T_{CH} ≤ 225°C will ensure MTTF > 2.51 x 10⁶ hours. MTTF may be estimated by the expression MTTF (hours) = A $e^{[B + C/(T+273)]}$ where *T* is the channel temperature in degrees Celsius., 9

A = 1.93, B = -45.31, and C = 29,585.

Thermal Characteristics¹⁰

Parameter	Test Conditions	Symbol	Typical	Units
Thermal Resistance using Finite Element Analysis	V _{DS} = 50 V T _C =85°C,T _{CH} = 225°C	$R_{\theta}(FEA)$	2.25	°C/W
Thermal Resistance using Infrared Measurement of Die Surface Temperature	V _{DS} = 50 V T _C =85°C,T _{CH} = 225°C	$R_{\theta}(IR)$	1.80	°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 devices.

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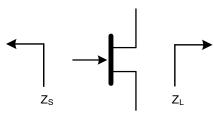
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Pulsed² Load-Pull Performance: Reference Plane at Device Leads

		Carrier Amplifier: Maximum Output Power					
			V _{DS} = 50 \	/, I _{DQ} = 130 m/	A, T _c = 25°C, F	P2.5dB	
Frequency (GHz)	Z _{SOURCE} (Ω)	Z _{LOAD} ¹¹ (Ω)	Gain (dB)	Р _{оит} (dBm)	Р _{оит} (W)	η₀ (%)	AM/PM (°)
3.7	28.5 - j35.4	15.4 - j6.0	16.1	50.2	104.7	58.4	-4.3
3.8	39.6 - j30.7	15.7 - j4.3	15.5	50.2	104.7	59.8	-3.6
3.9	47.9 - j18.0	16.1 - j2.5	15.2	50.2	104.7	61.6	-2.6
4.0	45.8 - j2.4	15.8 - j0.7	14.8	50.0	100.0	61.9	-2.5
			Carrier An	nplifier: Maxin	num Drain Eff	iciency	
			V _{DS} = 50 \	/, I _{DQ} = 130 m/	A, T _c = 25°C, F	P2.5dB	
Frequency (GHz)	Z _{SOURCE} (Ω)	Z _{LOAD} ¹² (Ω)	Gain (dB)	Р _{оит} (dBm)	Р _{оит} (W)	η₀ (%)	AM/PM (°)
3.7	28.5 - j35.4	11.4 - j14.3	17.6	49.1	81.3	66.4	-9.2
3.8	39.6 - j30.7	13.5 - j15.2	17.0	48.9	77.6	68.8	-9.1
3.9	47.9 - j18.0	16.9 - j16.0	16.5	48.9	77.6	70.7	-9.4
4.0	45.8 - j2.4	20.7 - j14.3	16.0	48.7	74.1	71.4	-7.9
			Peaking A	Amplifier: Max	imum Output	Power	
			V _{DS} = 50 \	/, I _{DQ} = 230 m/	A, T _c = 25°C, I	P2.5dB	
Frequency (GHz)	Z _{SOURCE} (Ω)	Z _{LOAD} ¹¹ (Ω)	Gain (dB)	Р _{оит} (dBm)	Р _{оит} (W)	η₀ (%)	AM/PM (°)
3.7	38.3 - j29.2	18.7 - j11.4	14.9	52.4	173.8	48.2	-7.1
3.8	45.1 - j21.0	20.1 - j10.2	14.4	52.5	177.8	48.9	-4.9
3.9	46.8 - j11.2	21.8 - j7.3	13.5	52.6	182.0	49.3	-4.5
4.0	44.4 - j0.6	22.6 - j4.2	14.1	52.5	177.8	49.5	-3.8
			-	mplifier: Maxii		-	
			V _{DS} = 50 \	/, I _{DQ} = 230 m/	A, T _c = 25°C, I	P2.5dB	
Frequency (GHz)	Z _{SOURCE} (Ω)	Z _{LOAD} ¹² (Ω)	Gain (dB)	Р _{оит} (dBm)	Р _{оит} (W)	η₀ (%)	AM/PM (°)
3.7	38.3 - j29.2	13.6 - j18.0	15.9	51.9	154.9	53.1	-11.6
3.8	45.1 - j21.0	15.2 - j17.8	15.1	51.7	147.9	52.5	-8.3
3.9	46.8 - j11.2	17.7 - j17.9	14.2	51.9	154.9	53.5	-8.5
4.0	44.4 - j0.6	23.9 - j16.9	15.0	51.8	151.4	53.4	-8.2

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.

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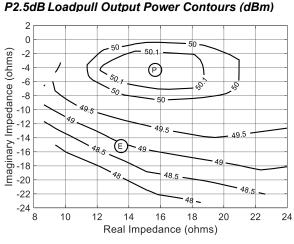
GaN Amplifier 50 V, 30 W AVG 3.7 - 4.0 GHz



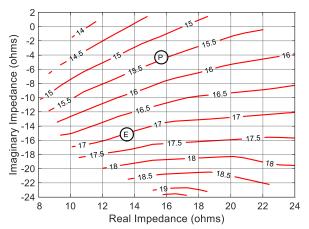
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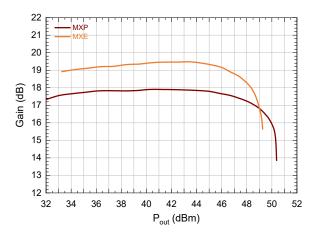
Pulsed² Load-Pull Performance: Carrier Amplifier 3.8 GHz



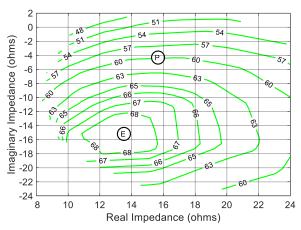
P2.5dB Loadpull Gain Contours (dB)



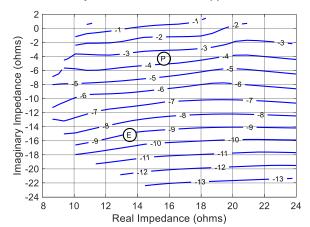
Gain vs. Output Power



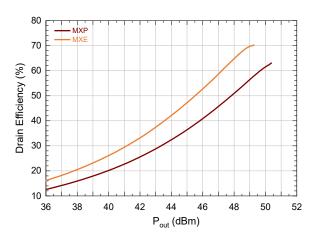
P2.5dB Loadpull Drain Efficiency Contours (%)



P2.5dB Loadpull AM/PM Contours (°)



Drain Efficiency vs. Output Power



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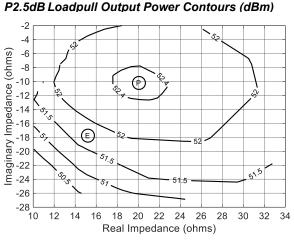
GaN Amplifier 50 V, 30 W AVG 3.7 - 4.0 GHz



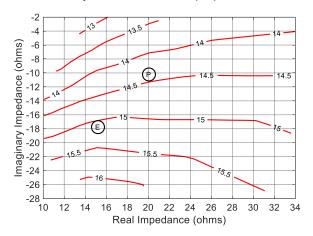
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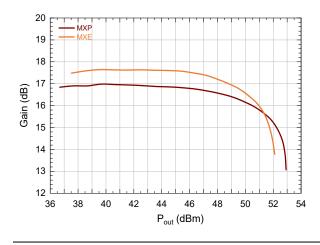
Pulsed² Load-Pull Performance: Peaking Amplifier 3.8 GHz



P2.5dB Loadpull Gain Contours (dB)

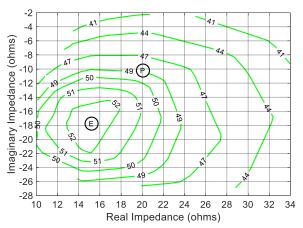


Gain vs. Output Power

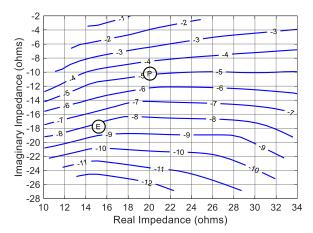


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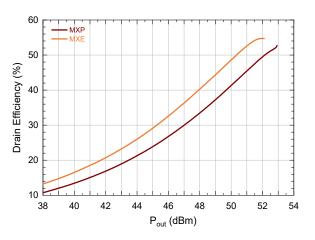
P2.5dB Loadpull Drain Efficiency Contours (%)



P2.5dB Loadpull AM/PM Contours (°)



Drain Efficiency vs. Output Power



GaN Amplifier 50 V, 30 W AVG 3.7 - 4.0 GHz

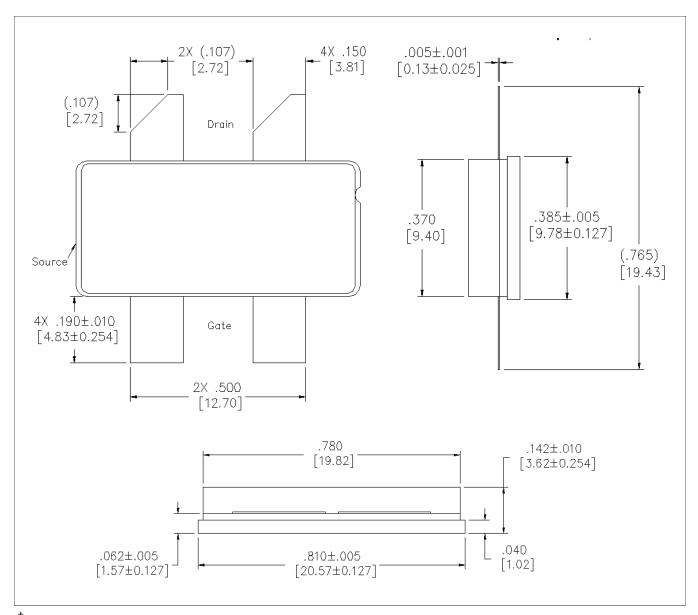


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MACOM PURE CARBIDE.

Lead-Free AC-780S-4 Package Dimensions[†]



 Reference Application Note AN0004363 for lead-free solder reflow recommendations. Meets JEDEC moisture sensitivity level 3 requirements. Plating is Au.

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