Features

- GaN on Si HEMT D-Mode Amplifier .
- Suitable for Linear & Saturated Applications
- Broadband Operation from 20 2500 MHz
- 28 V Operation .
- 12.5 dB Gain @ 2500 MHz •
- 43% Drain Efficiency @ 2500 MHz •
- 100% RF Tested .
- Fully Matched at Input, Unmatched at Output
- Lead-Free 6 x 5 mm 8-lead PDFN Package .
- Halogen-Free "Green" Mold Compound .
- **RoHS*** Compliant

Description

The NPA1007 is a GaN on silicon power amplifier optimized for 20 - 2500 MHz operation. This amplifier has been designed for saturated and linear operation and it is assembled in a lead-free 6 x 5 mm 8-lead PDFN plastic package.

The NPA1007 is a general purpose device suited for narrowband and broadband applications in test and measurement. defense communications. land mobile radio and wireless infrastructure.



Functional Schematic



Pin Configuration

Pin #	Pin Name	Function
1	V _G	Gate Voltage
2, 3	RF _{IN}	RF Input
4, 5	N/C ³	No Connection
6, 7	RF_{OUT} / V_D	RF Output / Drain Voltage
8	N/C ³	No Connection
9	Paddle ⁴	Ground

3. All no connection pins may be left floating or connected to ground.

4 The exposed pad centered on the package bottom must be connected to RF and DC ground. This path must also provide a low thermal resistance heat path.

Part #

Ordering Information^{1,2}

	i actuage			
NPA1007	Bulk			
NPA1007-TR0500	500 Piece Reel			
NPA1007-TR0100	100 Piece Reel			
NPA1007-SMB	Evaluation Board			

1. All sample boards include a part soldered down to the board.

2. Reference Application Note M513 for reel size information.



Package

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RF Electrical Specifications, CW Performance⁵: $T_A = 25^{\circ}C$, $V_{DS} = 28 V$, $I_{DQ} = 130 mA$, $Z_O = 50 \Omega$

Parameter	Test Conditions	Symbol	Min.	Тур.	Max.	Units
Small Signal Gain	P _{IN} = 0 dBm, 2500 MHz	G_{SS}	-	12.5	-	dB
Power Gain	P _{IN} = 30 dBm, 2500 MHz	G _P	-	10.5	-	dB
Drain Efficiency	P _{IN} = 30 dBm, 2500 MHz	η_{D}	-	43	-	%
Input Return Loss	P _{IN} = 30 dBm, 2500 MHz	IRL	-	-14	-	dB
Load Mismatch Tolerance	No Oscillation and Damage at all Phase Angels and Power Levels	$VSWR_{T}$	-	-	10:1	ratio

5. Performance in MACOM Evaluation Board.

RF Electrical Specifications, Pulsed Performance⁶: $T_A = 25^{\circ}C$, V_{DS} = 28 V, I_{DQ} = 130 mA, Z_O = 50 Ω , RF Pulse Width = 100 µs, Duty Cycle = 10 %

Parameter	Test Conditions	Symbol	Min.	Тур.	Max.	Units
Power Gain	P _{IN} = 31 dBm, 2500 MHz	G _P	10	11	-	dB
Drain Efficiency	P _{IN} = 31 dBm, 2500 MHz	η_{D}	40	45	-	%
Input Return Loss	P _{IN} = 31 dBm, 2500 MHz	IRL	-	-20	-10	dB

6. Performance in MACOM Production Test Fixture tuned for 2500 MHz.

DC Electrical Specifications: T_A = 25°C

Parameter	Test Conditions	Symbol	Min.	Тур.	Max.	Units
Drain-Source Leakage Current	V_{GS} = -5 V, V_{DS} = 28 V	I _{DLK}	-	0.8	4.8	mA
Gate-Source Leakage Current	V_{GS} = -5 V, V_{DS} = 0 V	I _{GLK}	-4.8	-0.8	-	mA
Gate Threshold Voltage	V_{DS} = 28 V, I _D = 4.8 mA	VT	-2.5	-2.1	-0.5	V
Gate Quiescent Voltage	V_{DS} = 28 V, I _D = 130 mA	V_{GSQ}	-2.3	-1.9	-0.3	V
On Resistance	V_{DS} = 2 V, I_{D} = 48 mA	R _{ON}	0.5	1.0	1.5	Ω
Maximum Drain Current	V_{DS} = 7 V pulsed, pulse width 300 µs	I _{DMAX}	-	2.8	-	А

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Thermal Characteristics⁷

Parameter	Test Conditions	Symbol	Min.	Тур.	Max.	Units
Channel-to-Case Thermal Resistance	V_{DS} = 28 V, P_{Diss} = 16 W, T_{C} = 85°C	Θ _{CH-C}	-	6.7	-	°C/W

7. Channel temperature determined using Raman and simulation techniques. Case temperature measured using thermocouple embedded in heat-sink. Contact local application support team for more details on this measurement.

Absolute Maximum Ratings^{8,9,10}

Parameter	Absolute Maximum			
Input Power	35 dBm			
Drain Source Voltage, V _{DS}	40 V			
Gate Source Voltage, V _{GS}	-8 to +2 V			
Gate Current, I _G	9.6 mA			
Channel Temperature, T _{CH}	+225°C			
Operating Temperature	-40°C to +85°C			
Storage Temperature	-65°C to +150°C			

8. Exceeding any one or combination of these limits may cause permanent damage to this device.

9. MACOM does not recommend sustained operation near these survivability limits.

10. Operating at nominal conditions with $T_{CH} \le 210^{\circ}$ C will ensure MTTF > 1 x 10⁶ hours.

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 1A devices.

Bias Sequencing Turning the device ON

- 1. Set V_{GS} to the pinch-off (V_P), typically -5 V.
- 2. Turn on V_{DS} to nominal voltage (28 V).
- 3. Increase V_{GS} until the 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.}
- 3. Decrease V_{DS} down to 0 V.
- 4. Turn off V_{GS} .

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Evaluation Board Layout (20 - 2500 MHz)



Description

Parts measured on evaluation board (20-mil thick RO4350). The PCB's electrical and thermal ground is provided using a densely plated via hole array (see recommended via pattern).

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.

Recommended Via Pattern (All dimensions in inches)



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GaN on Silicon Power Amplifier 20 - 2500 MHz, 28 V, 10 W

Evaluation Board Schematic (20 - 2500 MHz)



Evaluation Board Components

Reference	Value	Tolerance	Manufacturer	Part Number	
C1,C3	1 µF	10%	TDK	C4532X7T2E105K250KA	
C2	1 nF	10%	Murata	GRM188R72A102KA01D	
C4, C6	10 nF	10%	Murata	GCM188R72A103KA37D	
C5	0.7 pF	±0.05 pF	PPI	0603N0R7AW251	
C7	1.7 pF	±0.1 pF	PPI	0603N1R7BW251	
C8	1.3 pF	±0.05 pF	PPI	0603N1R3AW251	
R1	47 Ω	1%	Panasonic	ERJ-P03F47R0V	
L1,L2	0.9 µH	5%	Coilcraft	1008AF-901XJLC	
L3	1 nH	5%	Coilcraft	0603CT-1N0XJLU	
L4	1.8 nH	5%	Coilcraft	0603HP-1N8XJLU	
РСВ	Rogers RO4350, e _r =3.66, 0.020"				
Heat Sink	Copper Heat Sink 2.0" x 2.25" x 0.25"				

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GaN on Silicon Power Amplifier 20 - 2500 MHz, 28 V, 10 W

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Typical Performance as Measured in 20 - 2500 MHz Evaluation Board: CW, V_{DS} = 28 V, I_{DQ} = 130 mA, T_{C} = 25°C

Small Signal Gain



Input Return Loss

Output Return Loss



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GaN on Silicon Power Amplifier 20 - 2500 MHz, 28 V, 10 W

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Typical Performance as Measured in 20 - 2500 MHz Evaluation Board: CW, V_{DS} = 28 V, I_{DQ} = 130 mA, T_{C} = 25°C

Gain vs. Frequency @ P_{our}= 40 dBm



100 80 (%) 60 40 20 0,0,0,5,1,0,1,5,2,0,2,5 Frequency (GHz)

Drain Efficiency vs. Frequency @ Pour= 40 dBm

Gain vs. POUT



Drain Efficiency vs. POUT



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GaN on Silicon Power Amplifier 20 - 2500 MHz, 28 V, 10 W

Typical Performance as Measured in 20 - 2500 MHz Evaluation Board: CW, V_{DS} = 28 V, I_{DQ} = 130 mA, T_{C} = 25°C (Unless Otherwise Specified)



Performance vs. Drain Voltage at P_{IN}= 30 dBm



Performance vs. Bias Current at P_{IN}= 30 dBm



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Performance vs. Temperature at PIN= 30 dBm



Performance vs. Drain Voltage at PIN= 30 dBm



Performance vs. Bias Current at PIN= 30 dBm



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Lead-Free 6 x 5 mm 8-Lead PDFN[†]



[†] Meets JEDEC moisture sensitivity level 3 requirements. Plating is Ni/Pd/Au. Refer to application note S2083 for lead-free solder reflow recommendations.

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GaN on Silicon Power Amplifier 20 - 2500 MHz, 28 V, 10 W



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