

NPA1008A

Rev. V2

Features

- GaN on Si HEMT D-Mode Integrated Amplifier
- Suitable for Linear & Saturated Applications
- Broadband Operation from 20 2700 MHz
- 50 Ω Input Matched
- 28 V Operation
- 45% Drain Efficiency
- 100% RF Tested
- Lead-Free 4 mm 24-lead PQFN Package
- RoHS* Compliant

Applications

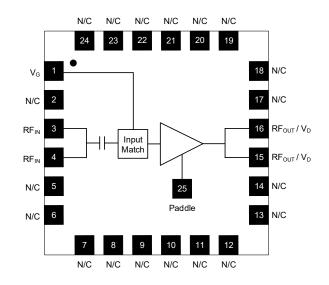
- Test & Measurement
- Defense Communications
- Land Mobile Radio
- Wireless Infrastructure

Description

The NPA1008A is an integrated GaN on silicon power amplifier optimized for 20 - 2700 MHz operation. This amplifier has been designed for saturated and linear operation with output levels to 5 W (37 dBm) assembled in a lead-free 4 mm 24-lead QFN plastic package.

The NPA1008A is ideally suited for general purpose narrowband to broadband applications.

Functional Schematic



Pin Designations

Pin #	Pin Name	Function
1	V _G	Gate - DC Bias
2	N/C ¹	No Connection
3,4	RF _{IN}	RF Input
5-14	N/C ¹	No Connection
15,16	RF_{OUT} / V_{D}	RF Output / Drain
17-24	N/C ¹	No Connection
25	Paddle ²	Ground / Source

1. All no connection pins may be left floating or grounded.

2. 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.

Ordering Information

Part Number	Package
NPA1008A	Bulk Quantity
NPA1008A-TR0500	500 piece reel
NPA1008A-SMB	Sample Board

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

1

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NPA1008A

Rev. V2

RF Electrical Specifications: $T_{C} = 25^{\circ}C$, $V_{DS} = 28$ V, $I_{DQ} = 88$ mA

Parameter	Test Conditions	Symbol	Min.	Тур.	Max.	Units
Small Signal Gain	CW, 1900 MHz	G _{SS}	-	15.6	-	dB
Gain	CW, P _{OUT} = 37 dBm, 1900 MHz	G _P	10.5	12.0	-	dB
Saturated Output Power	CW, 1900 MHz	P _{SAT}	-	38.9	-	dBm
Drain Efficiency	CW, 1900 MHz	η _{sat}	44	47.0	-	%
Power Added Efficiency	CW, P _{OUT} = 37 dBm, 1900 MHz	PAE	-	44.7	-	%
Ruggedness	All phase angles	Ψ	VSWR	= 15:1, No	Device D	amage

DC Electrical Specifications: T_c = 25°C

Parameter	Test Conditions	Symbol	Min.	Тур.	Max.	Units
Drain-Source Leakage Current	V_{GS} = -8 V, V_{DS} = 100 V	I _{DLK}	-	4	-	mA
Gate-Source Leakage Current	V_{GS} = -8 V, V_{DS} = 0 V	I _{GLK}	-	2	-	mA
Gate Threshold Voltage	V _{DS} = 28 V, I _D = 4 mA	V _T	-3.0	-2.0	-1.0	V
Gate Quiescent Voltage	V _{DS} = 28 V, I _D = 88 mA	V_{GSQ}	-2.6	-1.7	-0.8	V
On Resistance	V _{DS} = 2 V, I _D = 45 mA	R _{ON}	-	1.2	-	Ω
Saturated Drain Current	V_{DS} = 7 V pulsed, pulse width 300 µs	I _{D(SAT)}	-	2.3	-	А

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NPA1008A

Rev. V2

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

Parameter	Absolute Maximum		
Drain Source Voltage, V _{DS}	100 V		
Gate Source Voltage, V _{GS}	-10 to 3 V		
Gate Current, I _G	12 mA		
Storage Temperature Range	-65°C to +150°C		
Case Operating Temperature Range	-40°C to +85°C		
Channel Operating Temperature Range, T _{CH}	-40°C to +225°C		
Absolute Maximum Channel Temperature	+250°C		

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

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

5. Operating at drain source voltage $V_{DS} < 32$ V will ensure MTTF > 1 x 10⁷ hours. 6. Operating at nominal conditions with TCH ≤ 225°C will ensure MTTF > 1 x 10⁷ 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 = 3.686, B = -35.00, and C = 25,416.

Thermal Characteristics^{8,9}

Parameter	Test Conditions	Symbol	Typical	Units
Thermal Resistance	V _{DS} = 28 V, T _J = 200°C	Θ_{JC}	12.1	°C/W

8. Junction temperature (T_J) measured using IR Microscopy. Case temperature measured using thermocouple embedded in heat-sink. 9. The thermal resistance of the mounting configuration must be added to the device $\Theta_{J_{c}}$, for proper T_J calculation during operation. The recommended via pattern, shown on page 4, on a 20 mil thick, 1 oz plated copper, PCB adds an additional 4 °C/W to the typical value.

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 devices.

3

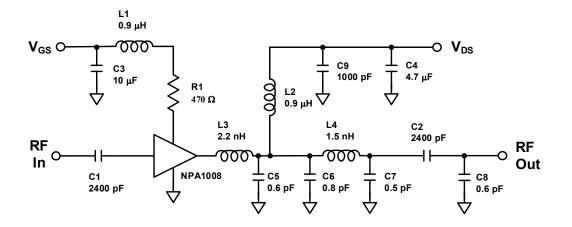
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NPA1008A Rev. V2

Evaluation Board and Recommended Tuning Solution

20 - 2700 MHz Broadband Circuit



Description

Parts measured on evaluation board (20-mil thick RO4350). The PCB's electrical and thermal ground is provided using a standard-plated densely packed 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.

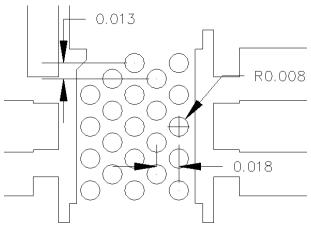
Bias Sequencing Turning the device ON

- 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}.

Recommended Via Pattern (All dimensions shown as inches)



4

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NPA1008A Rev. V2

0 0 \bigcirc O V_Ds Partners from RF to Light + + . ĠS Q Ó 0 0 C ß ¢4 + + L1 C9 ° + R1 000000 0 0 0 , 0000000 000000 Q L4 Ç2 .2 0 0 0 0 0 0 0 0 0 0 0 $\mathsf{RF}_{\mathsf{IN}}$ **RF**OUT °C1° 0 0 0 0 0 0 Ô ٌL3 C⁵ C⁶ C7 o ō + РT + R04350 20mils QEN 4x4mm ο ο

Evaluation Board and Recommended Tuning Solution 20 - 2700 MHz Broadband Circuit

Parts list

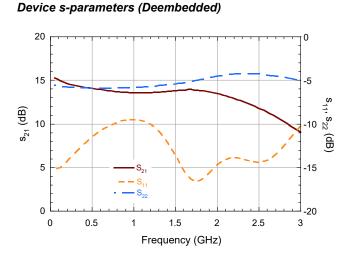
Reference	Value	Tolerance	Manufacturer	Part Number
C1, C2	2400 pF	-	Dielectric Labs, Inc.	C08BL242X-5UN-X0
C3	10 µF	10%	TDK	C2012XR1C106M085AC
C4	4.7 µF	10%	TDK	C5750X7R2A475K230KA
C5, C8	0.6 pF	0.1 pF	ATC	800A0R6BT250X
C6	0.8 pF	0.1 pF	ATC	800A0R8BT250X
C7	0.5 pF	0.1 pF	ATC	800A0R5BT250X
C9	1000 pF	10%	Kemet	C0805C102K1RACTU
R1	470 Ω	10%	Panasonic	ERJ-P03F4700V
L1, L2	0.9 µH	10%	Coilcraft	1008AF-901XJLC
L3	2.2 nH	±0.2 nH	AVX	L08052R2CEW
L4	1.5 nH	±0.2 nH	AVX	L06031R5CGS
РСВ	Rogers RO4350, ε _r =3.5, 0.020"			

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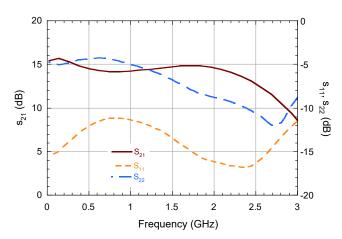


NPA1008A Rev. V2

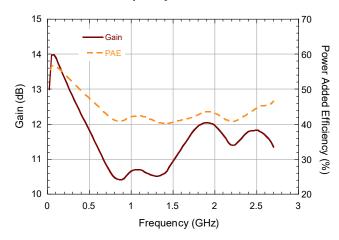
Typical Performance as measured in the Broadband Evaluation Board: CW, V_{DS} = 28 V, I_{DQ} = 88 mA, T_{C} = 25°C (unless noted)



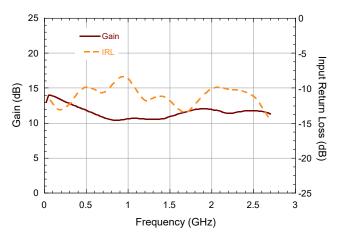
Broadband Circuit s-Parameters



Performance vs. Frequency at POUT = 37 dBm



Performance vs. Input Return Loss at P_{OUT} = 37 dBm

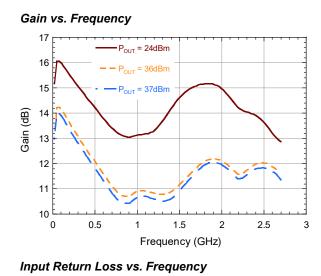


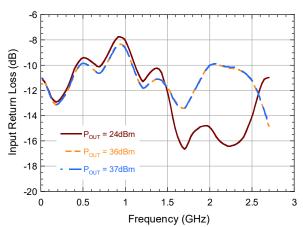
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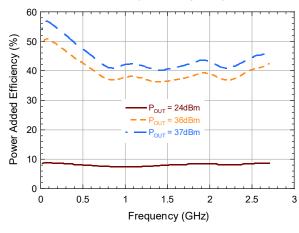
NPA1008A Rev. V2

Typical Performance as measured in the Broadband Evaluation Board: CW, V_{DS} = 28 V, I_{DQ} = 88 mA, T_C = 25°C (unless noted)

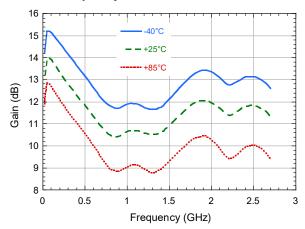




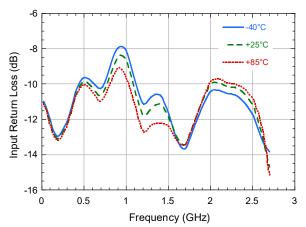
Power Added Efficiency vs. Frequency



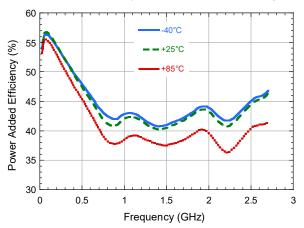
Gain vs. Frequency at POUT = 37 dBm



Input Return Loss at Pour = 37 dBm vs. Frequency



Power Added Efficiency at Pour = 37 dBm vs. Frequency



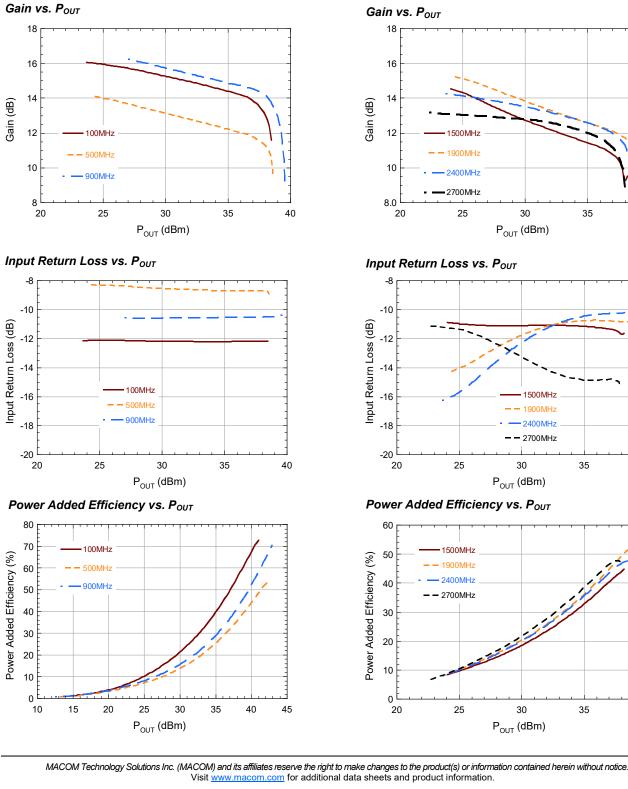
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NPA1008A Rev. V2

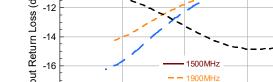
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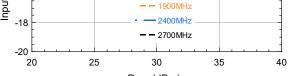


Typical Performance as measured in the Broadband Evaluation Board: \dot{CW} , V_{DS} = 28 V, I_{DQ} = 88 mA, T_{C} = 25°C (unless noted)

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8

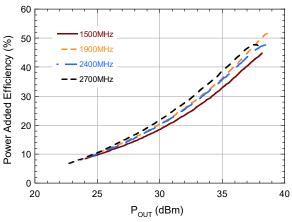




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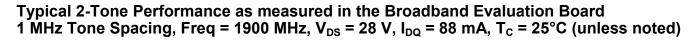
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Power Added Efficiency vs. POUT

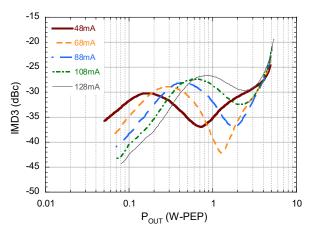




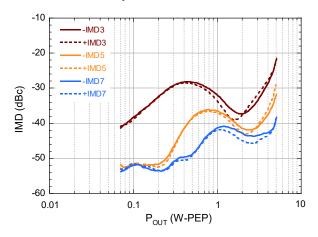
NPA1008A Rev. V2



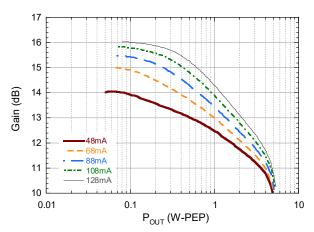
2-Tone IMD vs. Output Power vs. I_{DQ}



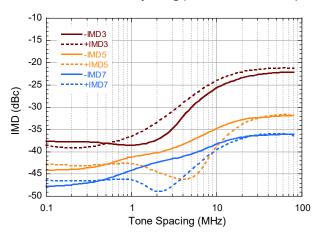
2-Tone IMD vs. Output Power



2-Tone Gain vs. Output Power vs. IDQ



2-Tone IMD vs. Tone Spacing (Pour = 37 dBm-PEP)



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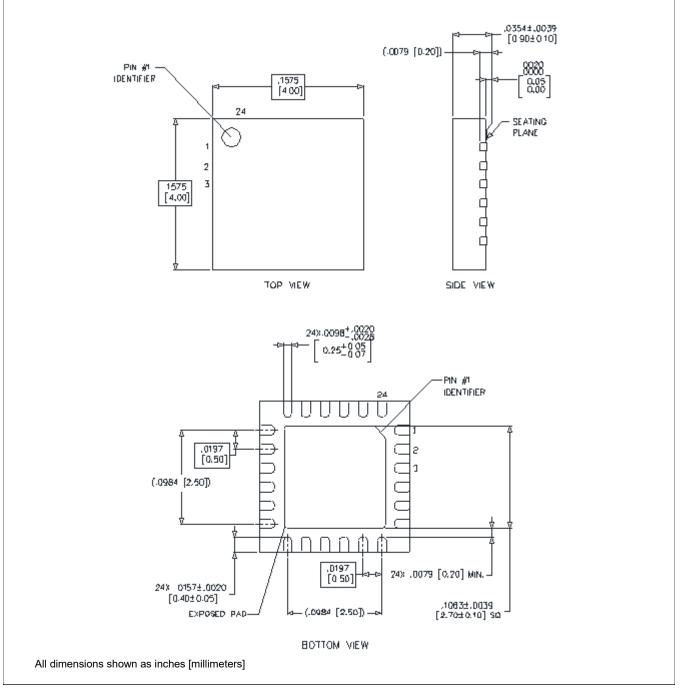
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NPA1008A

Rev. V2

Lead-Free 4 mm 24-Lead QFN Plastic Package[†]



[†] Reference Application Note S2083 for lead-free solder reflow recommendations. Meets JEDEC moisture sensitivity level 3 requirements. Plating is Matte Tin.

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NPA1008A Rev. V2

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