APN248
27-30 GHz
GaN Power Amplifier

Product Features
- RF frequency: 27 to 30 GHz
- Linear Gain: 22 dB typ.
- Psat: 45.6 dBm typ.
- Die Size: 13.52 sq. mm.
- 0.2um GaN HEMT Process
- 4 mil SiC substrate
- DC Power: 28 VDC @ 2.64 A

Performance Characteristics (Ta = 25°C)

<table>
<thead>
<tr>
<th>Specification *</th>
<th>Min</th>
<th>Typ</th>
<th>Max</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency</td>
<td>27</td>
<td>19</td>
<td>30</td>
<td>GHz</td>
</tr>
<tr>
<td>Linear Gain</td>
<td>19</td>
<td>22</td>
<td>22</td>
<td>dB</td>
</tr>
<tr>
<td>Input Return Loss</td>
<td>5</td>
<td>12</td>
<td>12</td>
<td>dB</td>
</tr>
<tr>
<td>Output Return Loss</td>
<td>5</td>
<td>8</td>
<td>8</td>
<td>dB</td>
</tr>
<tr>
<td>P1db (PP*)</td>
<td>43</td>
<td>45.6</td>
<td>dBm</td>
<td></td>
</tr>
<tr>
<td>Psat (PP*)</td>
<td>44</td>
<td>45.6</td>
<td>dBm</td>
<td></td>
</tr>
<tr>
<td>PAE @ Psat (PP*)</td>
<td>30</td>
<td>33</td>
<td>%</td>
<td></td>
</tr>
<tr>
<td>Max PAE (PP*)</td>
<td>33</td>
<td>33</td>
<td>%</td>
<td></td>
</tr>
<tr>
<td>Vd1=Vg1a, Vd2=Vd2a</td>
<td>28</td>
<td>28</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>Vg1, Vg1a</td>
<td>3.5</td>
<td>3.5</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>Id1+Id1a</td>
<td>528</td>
<td>528</td>
<td>mA</td>
<td></td>
</tr>
<tr>
<td>Id2+Id2a</td>
<td>2112</td>
<td>2112</td>
<td>mA</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Maximum SOA Ratings (Ta = 25°C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter</td>
</tr>
<tr>
<td>-----------------------------</td>
</tr>
<tr>
<td>Power</td>
</tr>
<tr>
<td>Vd1=Vg1a, Vd2=Vd2a</td>
</tr>
<tr>
<td>Id1+Id1a</td>
</tr>
<tr>
<td>Id2+Id2a</td>
</tr>
<tr>
<td>Vg1, Vg1a, Vg2, Vg2a</td>
</tr>
<tr>
<td>Assy. Temperature</td>
</tr>
</tbody>
</table>

* Pulsed-Power On-Wafer unless otherwise noted

Applications
- Point-to-Point Digital Radios
- Point-to-Multipoint Digital Radios
- SatCom Terminals

Product Description
The APN248 monolithic GaN HEMT amplifier is a broadband, two-stage power device, designed for use in Ka-Band communication applications such as point-to-point and point-to-multipoint digital (LMDS) radios and SatCom Terminals. To ensure rugged and reliable operation, HEMT devices are fully passivated. Both bond pad and backside metallization are Au-based that is compatible with epoxy and eutectic die attach methods.
APN248
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GaN Power Amplifier

Advance Datasheet
Revision: May 2015

Measured Performance Characteristics (Typical Performance at 25°C)
Vd = 28.0 V, Id1 + Id1a = 528 mA, Id2 + Id2a = 2112 mA

<table>
<thead>
<tr>
<th>Linear Gain vs. Frequency *</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gain (dB)</td>
</tr>
<tr>
<td>Frequency (GHz)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Power, Gain, PAE% vs. Frequency *</th>
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</thead>
<tbody>
<tr>
<td>Pout (dBm), Gain (dB), PAE%</td>
</tr>
<tr>
<td>Frequency (GHz)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Input Return Loss vs. Frequency *</th>
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<td>Input Return Loss (dB)</td>
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<tr>
<td>Frequency (GHz)</td>
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<table>
<thead>
<tr>
<th>Output Return Loss vs. Frequency *</th>
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<tr>
<td>Output Return Loss (dB)</td>
</tr>
<tr>
<td>Frequency (GHz)</td>
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</tbody>
</table>

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Vd = 28.0 V, Id1 + Id1a = 528 mA, Id2 + Id2a = 2112 mA

![Power, Gain, PAE% vs. Frequency](image1)

Vd = 28.0 V, Id1 + Id1a = 528 mA, Id2 + Id2a = 2112 mA

![Output Power, Gain vs. Input Power](image2)

Vd = 28.0 V, Id1 + Id1a = 528 mA, Id2 + Id2a = 2112 mA

![PAE% vs. Input Power](image3)

Vd = 28.0 V, Id1 + Id1a = 528 mA, Id2 + Id2a = 2112 mA

![Stage Currents vs. Input Power](image4)

Vd = 28.0 V, Id1 + Id1a = 528 mA, Id2 + Id2a = 2112 mA

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Measured Performance Characteristics (Typical Performance at 25°C)

\( V_d = V_d = 28.0 \, V, \, I_{d1} + I_{d1a} = 528 \, mA, \, I_{d2} + I_{d2a} = 2112 \, mA \)

**Pout & ACPR vs. Input Power @ 30 GHz**

**ACPR vs. Output Power @ 30 GHz**

* Parameters Used: Channel BW = 10 MHz, Frequency Offset = 11.5 MHz, Integrated BW = 7 MHz. Uncorrected – includes End-block losses
Measured Performance Characteristics (Typical Performance at 25°C)

Vd = 28.0 V, \(I_{d1} + I_{d1a} = 528\) mA, \(I_{d2} + I_{d2a} = 2112\) mA

* Parameters Used: Channel BW = 10 MHz, Frequency Offset = 11.5 MHz, Integrated BW = 7 MHz. Uncorrected – includes End-block losses
Die Size and Bond Pad Locations (Not to Scale)

- X = 3300 µm ± 25 µm
- Y = 4100 ± 25 µm
- DC Bond Pad = 100 x 100 ± 0.5 µm
- RF Bond Pad = 100 x 100 ± 0.5 µm
- Chip Thickness = 101 ± 5 µm

Biasing/De-Biasing Details:
Bias for 1st stage is from top. The 2nd stages must bias up from both sides.

Listed below are some guidelines for GaN device testing and wire bonding:
- Limit positive gate bias (G-S or G-D) to < 1V
- Know your devices’ breakdown voltages
- Use a power supply with both voltage and current limit.
- With the power supply off and the voltage and current levels at minimum, attach the ground lead to your test fixture.
  - Apply negative gate voltage (-5 V) to ensure that all devices are off
  - Ramp up drain bias to ~10 V
  - Gradually increase gate bias voltage while monitoring drain current until 20% of the operating current is achieved
  - Gradually ramp up drain to operating bias
  - Gradually increase gate bias voltage while monitoring drain current until the operating current is achieved
- To safely de-bias GaN devices, start by debiasing output amplifier stages first (if applicable):
  - Gradually decrease drain bias to 0 V.
  - Gradually decrease gate bias to 0 V.
  - Turn off supply voltages
- Repeat de-bias procedure for each amplifier stage
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Advance Datasheet

Suggested Bonding Arrangement

Recommended Assembly Notes

1. Bypass caps should be 100 pF (approximately) ceramic (single-layer) placed no farther than 30 mils from the amplifier.
2. Best performance obtained from use of <10 mil (long) by 3 by 0.5 mil ribbons on input and output.
3. Part must be biased from both sides as indicated.
4. The 0.1uF, 50V capacitors are not needed if the drain supply line is clean. If Drain Pulsing of the device is to be used, do NOT use the 0.1uF, 50V Capacitors.

Mounting Processes

Most NGAS GaN IC chips have a gold backing and can be mounted successfully using either a conductive epoxy or AuSn attachment. NGAS recommends the use of AuSn for high power devices to provide a good thermal path and a good RF path to ground. Maximum recommended temp during die attach is 320°C for 30 seconds.

Note: Many of the NGAS parts do incorporate airbridges, so caution should be used when determining the pick up tool.

CAUTION: THE IMPROPER USE OF AuSn ATTACHMENT CAN CATASTROPHICALLY DAMAGE GaN CHIPS. PLEASE ALSO REFER TO OUR “GaN Chip Handling Application Note” BEFORE HANDLING, ASSEMBLING OR BIASING THESE MMICS!

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Approved for Public Release: Northrop Grumman Case 15-0864, 05/01/14