Features
- High Gain: 23 dB
- P1dB: 30 dBm
- PSAT: 33 dBm
- IM3 Level: -22 dBc @ POUT 27 dBm/tone
- Power Added Efficiency: 24% at PSAT
- Lead-Free 5 mm AQFN 32-lead Package
- RoHS* Compliant

Description
The MAAP-011246 is a 2 Watt, 4-stage power amplifier assembled in a lead-free 5 mm 32-lead AQFN plastic package. This power amplifier operates from 27.5 to 31.5 GHz and provides 23 dB of linear gain, 2 W saturated output power and 24% efficiency while biased at 6 V.

The MAAP-011246 can be used as a power amplifier stage or as a driver stage in higher power applications. This device is ideally suited for VSAT and 28 GHz PTP applications.

This product is fabricated using a GaAs pHEMT process which features full passivation for enhanced reliability.

Ordering Information

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Package</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAAP-011246-TR0500</td>
<td>500 Piece Reel</td>
</tr>
<tr>
<td>MAAP-011246-1SMB</td>
<td>Sample Board</td>
</tr>
</tbody>
</table>

1. Reference Application Note M513 for reel size information.
2. All sample boards include 3 loose parts.

MACOM recommends connecting all No Connection (N/C) pins to ground.
4. The exposed pad centered on the package bottom must be connected to RF, DC and thermal ground.

* Restrictions on Hazardous Substances, compliant to current RoHS EU directive.
Power Amplifier, 2 W
27.5 - 31.5 GHz

Electrical Specifications:  Freq. = 30 GHz, $T_A = +25^\circ C$, $V_D = 6$ V, $Z_0 = 50$ Ω

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Test Conditions</th>
<th>Units</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gain</td>
<td>$P_{IN} = 0$ dBm</td>
<td>dB</td>
<td>19</td>
<td>22</td>
<td>—</td>
</tr>
<tr>
<td>$P_{OUT}$</td>
<td>$P_{IN} = 15$ dBm</td>
<td>dBm</td>
<td>31.5</td>
<td>33</td>
<td>—</td>
</tr>
<tr>
<td>IM3 Level</td>
<td>$P_{OUT} = 27$ dBm / tone</td>
<td>dBc</td>
<td>—</td>
<td>-22</td>
<td>—</td>
</tr>
<tr>
<td>Power Added Efficiency</td>
<td>$P_{SAT}$ ($P_{IN} = 15$ dBm)</td>
<td>%</td>
<td>—</td>
<td>24</td>
<td>—</td>
</tr>
<tr>
<td>Input Return Loss</td>
<td>$P_{IN} = -20$ dBm</td>
<td>dB</td>
<td>—</td>
<td>10</td>
<td>—</td>
</tr>
<tr>
<td>Output Return Loss</td>
<td>$P_{IN} = -20$ dBm</td>
<td>dB</td>
<td>—</td>
<td>14</td>
<td>—</td>
</tr>
<tr>
<td>Quiescent Current</td>
<td>$I_{DO}$ (see bias conditions, page 4)</td>
<td>mA</td>
<td>—</td>
<td>900</td>
<td>—</td>
</tr>
<tr>
<td>Current</td>
<td>$P_{SAT}$ ($P_{IN} = 15$ dBm)</td>
<td>mA</td>
<td>—</td>
<td>1450</td>
<td>—</td>
</tr>
</tbody>
</table>

Max. Operating Ratings

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input Power</td>
<td>15 dBm</td>
</tr>
<tr>
<td>Junction Temperature$^5$,$^6$</td>
<td>$+160^\circ$C</td>
</tr>
<tr>
<td>Operating Temperature</td>
<td>$-40^\circ$C to $+85^\circ$C</td>
</tr>
</tbody>
</table>

5. Operating at nominal conditions with junction temperature $\leq +160^\circ$C will ensure MTTF $> 1 \times 10^6$ hours.
6. Junction Temperature ($T_J = T_C + \Theta_{JC} (V * I - (P_{OUT} - P_{IN}))$) Typical thermal resistance ($\Theta_{JC}$) = 8°C/W.
   a) For $T_C = +25^\circ$C, $T_J = +79^\circ$C @ 6 V, 1.45 A, $P_{OUT} = 33.0$ dBm, $P_{IN} = 15$ dBm
   b) For $T_C = +85^\circ$C, $T_J = +136^\circ$C @ 6 V, 1.34 A, $P_{OUT} = 32.4$ dBm, $P_{IN} = 15$ dBm

Handling Procedures

Please observe the following precautions to avoid damage:

Static Sensitivity

These electronic devices 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.
Sample Board Layout

Application Schematic

Parts List

<table>
<thead>
<tr>
<th>Part</th>
<th>Value</th>
<th>Case Style</th>
</tr>
</thead>
<tbody>
<tr>
<td>C1 - C6</td>
<td>0.01 µF</td>
<td>0402</td>
</tr>
<tr>
<td>C7 - C10</td>
<td>1 µF</td>
<td>0402</td>
</tr>
<tr>
<td>C11 - C13</td>
<td>10 µF</td>
<td>0603</td>
</tr>
<tr>
<td>R1 - R6</td>
<td>10 Ω</td>
<td>0402</td>
</tr>
<tr>
<td>L1 - L3</td>
<td>600 Ω @ 100 MHz</td>
<td>0603</td>
</tr>
</tbody>
</table>

10. L1 - L3 (chip ferrite bead) supplied from Murata, part number BLM18HE601SN1D.

Sample Board Material Specifications

- **Top Layer:** 1/2 oz Copper Cladding, 0.017 mm thickness
- **Dielectric Layer:** Rogers RO4003C 0.203 mm thickness
- **Bottom Layer:** 1/2 oz Copper Cladding, 0.017 mm thickness
- **Finished overall thickness:** 0.238 mm
**Recommended PCB Layout Detail:**
RF input and output pre-matching circuit patterns are designed to compensate packaging effects. Transmission line dimensions apply to a PCB with 0.203 mm thick Rogers RO4003C laminate dielectric. Performance curves shown in this data sheet were measured with these circuit patterns.

**Biasing Conditions**
Recommended biasing conditions are $V_D = 6$ V, $I_{DQ} = 900$ mA (controlled with $V_G$). The drain bias voltage range is 3 to 6 V, and the quiescent drain current biasing range is 600 to 1200 mA.

$V_G$ pins 10 and 11 are connected internally; choose either pin for layout convenience. Muting can be accomplished by setting the $V_G$ to the pinched off voltage ($V_G = -2$ V).

$V_D$ bias must be applied to $V_D1$, $V_D2$, $V_D3$, and $V_D4$ pins. $V_D3$ pins 27 and 28 are connected internally: choose either pin for layout convenience. Two $V_D4$ pins 15 and 26 (not connected internally) are required for current symmetry.

**Operating the MAAP-011246**

**Turn-on**
1. Apply $V_G$ (-1.5 V).
2. Apply $V_D$ (6.0 V typical).
3. Set $I_{DQ}$ by adjusting $V_G$ more positive (typically -0.9 to -1.0 V for $I_{DQ} = 900$ mA).
4. Apply $RF_{IN}$ signal.

**Turn-off**
1. Remove $RF_{IN}$ signal.
2. Decrease $V_G$ to -1.5 V.
3. Decrease $V_D$ to 0 V.
Power Amplifier, 2 W
27.5 - 31.5 GHz

Electrical Specifications with the Recommended PCB Layout and bias conditions:
Freq. = 27.5 - 29.5 GHz, $T_A = +25°C$, $V_D = 6$ V, $Z_0 = 50$ Ω

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Test Conditions</th>
<th>Units</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gain</td>
<td>$P_{IN} = 0$ dBm</td>
<td>dB</td>
<td>19</td>
<td>27</td>
<td>30.5</td>
</tr>
<tr>
<td>$P_{SAT}$</td>
<td></td>
<td>dBm</td>
<td>31.5</td>
<td>33.5</td>
<td>—</td>
</tr>
<tr>
<td>IM3 Level</td>
<td>$P_{OUT} = 27$ dBm / tone</td>
<td>dBC</td>
<td>—</td>
<td>-20</td>
<td>—</td>
</tr>
<tr>
<td>Power Added Efficiency</td>
<td>$P_{SAT}$</td>
<td>%</td>
<td>—</td>
<td>24</td>
<td>—</td>
</tr>
<tr>
<td>Input Return Loss</td>
<td>$P_{IN} = -20$ dBm</td>
<td>dB</td>
<td>—</td>
<td>15</td>
<td>—</td>
</tr>
<tr>
<td>Output Return Loss</td>
<td>$P_{IN} = -20$ dBm</td>
<td>dB</td>
<td>—</td>
<td>13</td>
<td>—</td>
</tr>
<tr>
<td>Quiescent Current</td>
<td>$I_{DD}$ (see bias conditions, page 4)</td>
<td>mA</td>
<td>—</td>
<td>900</td>
<td>—</td>
</tr>
<tr>
<td>Current</td>
<td>$P_{SAT}$</td>
<td>mA</td>
<td>—</td>
<td>1600</td>
<td>—</td>
</tr>
</tbody>
</table>

Typical Performance Curves

Gain vs. Frequency over Temperature

Gain vs. Frequency over Bias Voltage

Input Return Loss vs. Frequency over Temperature

Input Return Loss vs. Frequency over Bias Voltage

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Typical Performance Curves over Temperature

**Output Return Loss vs. Frequency over Temperature**

-20 dB to 0 dB over the frequency range of 27.5 GHz to 31.5 GHz.

**Output Return Loss vs. Frequency over Bias Voltage**

-20 dB to 0 dB over the frequency range of 27.5 GHz to 31.5 GHz.

**P1dB Output Power vs. Frequency**

- 26 dBm to 36 dBm over the frequency range of 27.5 GHz to 31.5 GHz.

**P_{SAT} Output Power vs. Frequency**

- 26 dBm to 36 dBm over the frequency range of 27.5 GHz to 31.5 GHz.

**OIP3 vs. Frequency (P_{OUT} = 27 dBm/tone)**

- 15 dBm to 45 dBm over the frequency range of 27.5 GHz to 31.5 GHz.

**IM3 vs. Frequency (P_{OUT} = 27 dBm/tone)**

- -45 dBc to -15 dBc over the frequency range of 27.5 GHz to 31.5 GHz.

**S22 (dB) vs. Frequency over Temperature**

- S22 values from -30 dB to 10 dB over the frequency range of 27.5 GHz to 31.5 GHz.

**S22 (dB) vs. Frequency over Bias Voltage**

- S22 values from -30 dB to 10 dB over the frequency range of 27.5 GHz to 31.5 GHz.

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https://www.macom.com/support
Typical Performance Curves over Bias Voltage

**P1dB Output Power vs. Frequency**

P1dB (dBm) vs. Frequency (GHz) for different bias voltages.

**PSAT Output Power vs. Frequency**

PSAT (dBm) vs. Frequency (GHz) for different bias voltages.

**OIP3 vs. Frequency (P_{OUT} = 27 dBm/tone)**

OIP3 (dBm) vs. Frequency (GHz) for different bias voltages.

**IM3 vs. Frequency (P_{OUT} = 27 dBm/tone)**

IM3 (dBc) vs. Frequency (GHz) for different bias voltages.
Typical Performance Curves over Frequency

**$P_{OUT}$ vs. $P_{IN}$**

**$OIP3$ vs. $P_{OUT}$ (dBm/tone)**

**$PAE$ vs. $P_{IN}$**

**$IM3$ Level vs. $P_{OUT}$ (dBm/tone)**

**$I_{DS}$ vs. $P_{IN}$**
**Lead-Free 5 mm AQFN 32-Lead†**

Reference Application Note S2083 for lead-free solder reflow recommendations.
Meets JEDEC moisture sensitivity level 3 requirements.
Plating is NiPdAu.
Power Amplifier, 2 W
27.5 - 31.5 GHz

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