Features
- High Gain: 25 dB @ 30 GHz
- P1dB: 34.5 dBm
- P3dB: 36.0 dBm
- IM3 Level: -27 dBc @ P_{OUT} 29 dBm/tone
- Power Added Efficiency: 27.5% @ P3dB
- Lead-Free 5 mm 32-lead AQFN Package
- RoHS* Compliant

Description
The MAAP-011233 is a 4-stage, 4 W power amplifier assembled in a lead-free 5 mm 32-lead AQFN plastic package. This power amplifier operates from 28.5 to 31.0 GHz and provides 26 dB of linear gain, 4 W saturated output power and 27.5% efficiency while biased at 6 V.

The MAAP-011233 can be used as a power amplifier ideally suited for VSAT communications.

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-011233</td>
<td>Bulk</td>
</tr>
<tr>
<td>MAAP-011233-TRP0500</td>
<td>500 Piece Reel</td>
</tr>
<tr>
<td>MAAP-011233-SMB</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.

* Restrictions on Hazardous Substances, compliant to current RoHS EU directive.
Power Amplifier, 4 W
28.5 - 31.0 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>22</td>
<td>25.0</td>
<td>—</td>
</tr>
<tr>
<td>$P_{OUT}$</td>
<td>$P_{IN} = +14$ dBm</td>
<td>dBm</td>
<td>34.5</td>
<td>36.0</td>
<td>—</td>
</tr>
<tr>
<td>IM3 Level</td>
<td>$P_{OUT} = 29$ dBm / tone</td>
<td>dBC</td>
<td>—</td>
<td>-27.0</td>
<td>—</td>
</tr>
<tr>
<td>Power Added Efficiency</td>
<td>$P_{IN} = +14$ dBm</td>
<td>%</td>
<td>—</td>
<td>27.5</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>10</td>
<td>—</td>
</tr>
<tr>
<td>Quiescent Current</td>
<td>$I_{DO}$ (see bias conditions, page 4 )</td>
<td>mA</td>
<td>—</td>
<td>2000</td>
<td>—</td>
</tr>
<tr>
<td>Current</td>
<td>$P_{IN} = +14$ dBm</td>
<td>mA</td>
<td>—</td>
<td>2800</td>
<td>3600</td>
</tr>
</tbody>
</table>

Maximum Operating Ratings

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input Power</td>
<td>14 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>

Absolute Maximum Ratings$^7,8$

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Absolute Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input Power</td>
<td>20 dBm</td>
</tr>
<tr>
<td>Drain Voltage</td>
<td>6.5 V</td>
</tr>
<tr>
<td>Gate Voltage</td>
<td>-3 to 0 V</td>
</tr>
<tr>
<td>Junction Temperature$^8$</td>
<td>$+175^\circ$C</td>
</tr>
<tr>
<td>Storage Temperature</td>
<td>$-65^\circ$C to $+125^\circ$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 ($T_J = T_C + \Theta_{JC} * (V \times I) - (P_{OUT} - P_{IN})$). Typical thermal resistance ($\Theta_{JC}$) = 4.4 $^\circ$C/W.
   a) For $T_C = +25^\circ$C, $T_J = +82^\circ$C @ 6 V, 2.8 A, $P_{OUT} = 36$ dBm, $P_{IN} = 14$ dBm
   b) For $T_C = +85^\circ$C, $T_J = +137^\circ$C @ 6 V, 2.5 A, $P_{OUT} = 35$ dBm, $P_{IN} = 14$ dBm

Handling Procedures

Please observe the following precautions to avoid damage:

Static Sensitivity

These electronics 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 - C7</td>
<td>0.01 µF</td>
<td>0402</td>
</tr>
<tr>
<td>C8 - C12</td>
<td>1 µF</td>
<td>0603</td>
</tr>
<tr>
<td>C13 - C16</td>
<td>10 µF</td>
<td>0805</td>
</tr>
<tr>
<td>R1 - R7</td>
<td>10 Ω</td>
<td>0402</td>
</tr>
</tbody>
</table>

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
偏置条件
偏置条件推荐为$V_D = 6 \text{ V}$，$I_D = 2 \text{ A}$（通过$V_G$控制）。漏极偏置电压范围是3到6 V，静息漏极电流偏置范围是1.5到2.5 A。

$V_G$引脚10和11内部连接；选择任意一引脚用于布局方便。消声可以通过将$V_G$设置到pinched off电压（$V_G = -2 \text{ V}$）来完成。

$V_D$偏置必须应用到$V_D1$, $V_D2$, $V_D3$, 和$V_D4$引脚。

$V_D3$引脚14和任一引脚27或28是需要的以便于电流对称。引脚27和28内部连接；选择任一引脚用于布局方便。

$V_D4$引脚15和26是需要的以便于电流对称。

应用信息
MAAP-011233设计用于在系统板上容易放置。RF输入和输出端口内部DC去耦合。
Typical Performance Curves

Small Signal Gain vs. Frequency over Temperature

Input Return Loss vs. Frequency over Temperature

Output Return Loss vs. Frequency over Temperature

Small Signal Gain vs. Frequency over Bias Voltage

Input Return Loss vs. Frequency over Bias Voltage

Output Return Loss vs. Frequency over Bias Voltage
Power Amplifier, 4 W
28.5 - 31.0 GHz

Typical Performance Curves

**P3dB vs. Frequency over Temperature**

**P3dB vs. Frequency over Bias Voltage**

**P1dB vs. Frequency over Temperature**

**P1dB vs. Frequency over Bias Voltage**

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Visit [www.macom.com](http://www.macom.com) for additional data sheets and product information.
**Power Amplifier, 4 W**

28.5 - 31.0 GHz

Typical Performance Curves: \( P_{\text{OUT}} = 29 \text{ dBm} / \text{Tone} \)

- **Output IP3 vs. Frequency over Temperature**
  - Frequency (GHz) vs. OIP3 (dBm)
  - Temperature conditions: -40°C, +25°C, +85°C

- **Output IP3 vs. Frequency over Bias Voltage**
  - Frequency (GHz) vs. OIP3 (dBm)
  - Voltage levels: 5.5 V, 6.0 V, 6.5 V

- **IM3 vs. Frequency over Temperature**
  - Frequency (GHz) vs. IM3 Level (dBc)
  - Temperature conditions: -40°C, +25°C, +85°C

- **IM3 vs. Frequency over Bias Voltage**
  - Frequency (GHz) vs. IM3 Level (dBc)
  - Voltage levels: 5.5 V, 6.0 V, 6.5 V

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Typical Performance Curves

P1dB & P3dB vs. Frequency

PAE & Gain @ P3dB vs. Frequency

IM3 vs. Output Power

Output IP3 vs. Output Power

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Power Amplifier, 4 W
28.5 - 31.0 GHz

Typical Performance Curves

**Output Power vs. Input Power**

![Graph showing Output Power vs. Input Power with curves for 29 GHz, 30 GHz, and 31 GHz.]

**PAE vs. Input Power**

![Graph showing PAE vs. Input Power with curves for 29 GHz, 30 GHz, and 31 GHz.]

**Bias Current vs. Input Power**

![Graph showing Bias Current vs. Input Power with curves for 29 GHz, 30 GHz, and 31 GHz.]

**Quiescent Drain Current vs. Temperature**

![Graph showing Quiescent Drain Current vs. Temperature with a line showing the current decreasing from 2100 mA at -40°C to 1950 mA at 85°C.]

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**Lead-Free 5 mm 32-Lead AQFN Package**

Reference Application Note S2083 for lead-free solder reflow recommendations. Meets JEDEC moisture sensitivity level 3 requirements. Plating is NiPdAu.

All dimensions shown as inches [mm].