Features
- 23 dB Small Signal Gain
- 42 dBm Third Order Intercept Point (OIP3)
- >2.5 W Output P1dB
- Integrated Power Detector
- Bias 1200 mA @ 6 V
- Lead-Free 5 mm 24-lead QFN Package
- RoHS* Compliant and 260°C Reflow Compatible

Description
The MAAP-010516 is a packaged linear power amplifier that operates from 12.7 - 13.3 GHz. The device provides 23 dB gain and 42 dBm Output Third Order Intercept Point (OIP3) with 34 dBm output P1dB.

The packaged amplifier comes in an industry standard, fully molded 5 mm QFN package and is comprised of a three stage power amplifier with an integrated, temperature compensated on-chip power detector. The device includes on-chip ESD protection structures and DC by-pass capacitors to ease the implementation and volume assembly of the packaged part.

The device is specifically designed for use in 13 GHz point-to-point radios for cellular backhaul applications.

Ordering Information

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Package</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAAP-010516-000000</td>
<td>bulk quantity</td>
</tr>
<tr>
<td>MAAP-010516-TR0500</td>
<td>500 piece reel</td>
</tr>
<tr>
<td>MAAP-010516-001SMB</td>
<td>evaluation module</td>
</tr>
</tbody>
</table>

1. Reference Application Note M513 for reel size information.

2. Drain 3 Bias can be connected from either pins 11 or 20
3. The exposed pad centered on the package bottom must be connected to RF and DC ground.

Power Amplifier, 3 W
12.7 - 13.3 GHz
Rev. V2

**Electrical Specifications**

Freq. = 12.7 - 13.3 GHz, $I_{DQ} = 1200$ mA, $V_{DET}$ Bias = 5 V, $V_D = 6$ V, $T_A = +25^\circ$C

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Units</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Small Signal Gain</td>
<td>dB</td>
<td>20.5</td>
<td>23.0</td>
<td>—</td>
</tr>
<tr>
<td>Input Return Loss</td>
<td>dB</td>
<td>—</td>
<td>15</td>
<td>—</td>
</tr>
<tr>
<td>Output Return Loss</td>
<td>dB</td>
<td>—</td>
<td>12</td>
<td>—</td>
</tr>
<tr>
<td>Noise Figure</td>
<td>dB</td>
<td>—</td>
<td>7</td>
<td>—</td>
</tr>
<tr>
<td>$P_{1dB}$</td>
<td>dBm</td>
<td>—</td>
<td>34.0</td>
<td>—</td>
</tr>
<tr>
<td>$P_{SAT}$</td>
<td>dBm</td>
<td>34.0</td>
<td>34.5</td>
<td>—</td>
</tr>
<tr>
<td>Output IP3, 20 dBm SCL</td>
<td>dBm</td>
<td>39.5</td>
<td>42.0</td>
<td>—</td>
</tr>
</tbody>
</table>

4. It is recommended to use active bias on gate voltages to keep the drain currents constant in order to maintain the best performance over temperature.

5. Adjust $V_{G1}$, $V_{G2}$ and $V_{G3}$ between -1.2 and -0.1 V to achieve specified $I_{DQ}$ ($I_{DQ}$ = $I_{D1}$ + $I_{D2}$ + $I_{D3}$). $V_{G1}$, $V_{G2}$ and $V_{G3}$ should be the same voltage.

6. See page 3 for schematic on how to connect $V_{DET}$ and $V_{REF}$ pins.

**Maximum Operating Ratings**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Absolute Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input Power</td>
<td>18 dBm</td>
</tr>
<tr>
<td>Drain Supply Voltage</td>
<td>7 V</td>
</tr>
<tr>
<td>Junction Temperature</td>
<td>+160°C</td>
</tr>
<tr>
<td>Operating Temperature</td>
<td>-40°C to +85°C</td>
</tr>
<tr>
<td>Storage Temperature</td>
<td>-65°C to +150°C</td>
</tr>
</tbody>
</table>

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

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

9. Operating at nominal conditions with $T_J \leq 160^\circ$C will ensure MTTF > 1 x 10⁶ hours.

10. Junction Temperature ($T_J$) = $T_C + \Theta_{JC} \times ((V \times I) - (P_{OUT} - P_{IN}))$
    Typical thermal resistance ($\Theta_{JC}$) = 7.9°C/W
    a) For $T_C = +25^\circ$C,
    $T_J = 91^\circ$C @ 6 V, 1.85 A, $P_{OUT} = 34.5$ dBm, $P_{IN} = 14$ dBm
    b) For $T_C = +85^\circ$C,
    $T_J = 146^\circ$C @ 6 V, 1.75 A, $P_{OUT} = 34.5$ dBm, $P_{IN} = 14$ dBm

11. Channel temperature directly affects a device’s MTTF. Channel temperature should be kept as low as possible to maximize lifetime.

12. For saturated performance it is recommended that the sum of $(2*V_{DQ} + \text{abs}(V_{GO})) < 17$ V.

**Absolute Maximum Ratings**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Absolute Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply Gate Voltage</td>
<td>-3 V</td>
</tr>
<tr>
<td>Supply Current</td>
<td>2200 mA</td>
</tr>
<tr>
<td>Drain to Gate Voltage</td>
<td>10 V</td>
</tr>
<tr>
<td>Continuous Power Dissipation @ +85°C</td>
<td>11.3 W</td>
</tr>
<tr>
<td>Junction Temperature</td>
<td>+175°C</td>
</tr>
</tbody>
</table>

For further information and support please visit: https://www.macom.com/support
Recommended PCB Layout

Schematic

Parts List

<table>
<thead>
<tr>
<th>Component</th>
<th>Value</th>
<th>Package</th>
</tr>
</thead>
<tbody>
<tr>
<td>C1, C2, C3, C4, C5, C6, C7, C8, C9, C10, C11, C13</td>
<td>2.2 µF</td>
<td>0603</td>
</tr>
<tr>
<td></td>
<td>1000 pF</td>
<td>0402</td>
</tr>
<tr>
<td>R1</td>
<td>100 KΩ</td>
<td>0402</td>
</tr>
<tr>
<td>R2</td>
<td>91 KΩ</td>
<td>0402</td>
</tr>
</tbody>
</table>

Handling Procedures

Please observe the following precautions to avoid damage:

Static Sensitivity

Gallium Arsenide Integrated Circuits are sensitive to electrostatic discharge (ESD) and can be damaged by static electricity. Proper ESD control techniques should be used when handling these Class 1A devices.
Typical Performance Curves

Gain

[Graph showing S21 (dB) vs. Frequency (GHz) for different temperatures: +25°C, -40°C, +85°C]

Noise Figure @ 25°C

[Graph showing Noise Figure (dB) vs. Frequency (GHz) for different temperatures: +25°C, -40°C, +85°C]

Input Return Loss

[Graph showing S11 (dB) vs. Frequency (GHz) for different temperatures: +25°C, -40°C, +85°C]

Output Return Loss

[Graph showing S22 (dB) vs. Frequency (GHz) for different temperatures: +25°C, -40°C, +85°C]

P1dB

[Graph showing P1dB (dBm) vs. Frequency (GHz) for different temperatures: +25°C, -40°C, +85°C]

PSAT

[Graph showing PSAT (dBm) vs. Frequency (GHz) for different temperatures: +25°C, -40°C, +85°C]
Power Amplifier, 3 W
12.7 - 13.3 GHz

Typical Performance Curves

Output IP3 @ +25°C

Output IP3 @ -40°C

Output IP3 @ +85°C
Power Amplifier, 3 W
12.7 - 13.3 GHz

Typical Performance Curves

Power Data @ 12.7 GHz, +25°C

Power Data @ 12.7 GHz, -40°C

Power Data @ 13.0 GHz, +25°C

Power Data @ 13.0 GHz, -40°C

Power Data @ 13.3 GHz, +25°C

Power Data @ 13.3 GHz, -40°C

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**Typical Performance Curves**

*Power Data @ 12.7 GHz, +85°C*

- Output Power vs. Input Power (dBm)
- Gain vs. Input Power (dBm)
- Drain Current vs. Input Power (dBm)

*Detected Voltage (\(V_{\text{REF}} - V_{\text{DET}}\)) @ +25°C*

- Detected Voltage (\(V_{\text{REF}} - V_{\text{DET}}\)) vs. Output Power (dBm)

*Power Data @ 13.0 GHz, +85°C*

- Output Power vs. Input Power (dBm)
- Gain vs. Input Power (dBm)
- Drain Current vs. Input Power (dBm)

*Power Data @ 13.3 GHz, +85°C*

- Output Power vs. Input Power (dBm)
- Gain vs. Input Power (dBm)
- Drain Current vs. Input Power (dBm)
Power Amplifier, 3 W
12.7 - 13.3 GHz

Lead-Free 5mm 24-lead PQFN

(All Dimensions are in millimeters)

†Reference Application Note S2083 for lead-free solder reflow recommendations.
Meets JEDEC moisture sensitivity level 1 requirements.
Plating is matte tin over Copper.
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