MAAP-010516

Power Amplifier, 3 W
12.7 - 13.3 GHz

Rev. V2

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>


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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.
Electrical Specifications:
Freq. = 12.7 - 13.3 GHz, I_{DQ} = 1200 mA, V_{DET} Bias = 5 V, V_D = 6 V, T_A = +25°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>P1dB</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 ≤ 160°C will ensure MTTF > 1 × 10^6 hours.
10. Junction Temperature (T_J) = T_C + Θ_{JC} * ((V * I) - (P_{OUT} - P_{IN}))
    Typical thermal resistance (Θ_{JC}) = 7.9°C/W
    a) For T_C = +25°C,
    \[ T_J = 91°C @ 6 V, 1.85 A, P_{OUT} = 34.5 dBm, P_{IN} = 14 dBm \]
    b) For T_C = +85°C,
    \[ T_J = 146°C @ 6 V, 1.75 A, P_{OUT} = 34.5 dBm, P_{IN} = 14 dBm \]

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>

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_{DD} + abs(V_{DD})) < 17 V.
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,C12,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**

![Gain Graph](image)

**Noise Figure @ 25°C**

![Noise Figure Graph](image)

**Input Return Loss**

![Input Return Loss Graph](image)

**Output Return Loss**

![Output Return Loss Graph](image)

**P1dB**

![P1dB Graph](image)

**PSAT**

![PSAT Graph](image)
Typical Performance Curves

**Output IP3 @ +25°C**

- Frequency (GHz)
- Output Power (dBm)
- @ 20 dBm
- @ 23 dBm
- @ 25 dBm

**Output IP3 @ -40°C**

- Output Power (dBm)
- 12.7 GHz
- 13.0 GHz
- 13.3 GHz

**Output IP3 @ +85°C**

- Output Power (dBm)
- 12.7 GHz
- 13.0 GHz
- 13.3 GHz
Power Amplifier, 3 W
12.7 - 13.3 GHz

Typical Performance Curves

**Power Data @ 12.7 GHz, +25°C**

![Graph](image1)

**Power Data @ 12.7 GHz, -40°C**

![Graph](image2)

**Power Data @ 13.0 GHz, +25°C**

![Graph](image3)

**Power Data @ 13.0 GHz, -40°C**

![Graph](image4)

**Power Data @ 13.3 GHz, +25°C**

![Graph](image5)

**Power Data @ 13.3 GHz, -40°C**

![Graph](image6)
MAAP-010516

Power Amplifier, 3 W
12.7 - 13.3 GHz

Typical Performance Curves

Power Data @ 12.7 GHz, +85°C

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

Power Data @ 13.0 GHz, +85°C

Power Data @ 13.3 GHz, +85°C

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DC-0007917
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.