Features
- 30 dB Small Signal Gain
- 41 dBm Third Order Intercept Point (OIP3)
- 2-Watt Output P1dB
- >2.5 Watt Saturated Output Power
- Integrated Power Detector
- Bias 1300 mA @ 6 V
- Lead-Free 5 mm 24-lead QFN Package
- RoHS* Compliant

Description
The MAAP-011202 is a packaged linear power amplifier that operates from 12.7 - 15.4 GHz. The device provides 30 dB gain and 41 dBm OIP3 with 2 W typical output P1dB and 2.5 W saturated output power. 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 and 15 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-011202</td>
<td>Bulk</td>
</tr>
<tr>
<td>MAAP-011202-TR0500</td>
<td>Tape and Reel</td>
</tr>
<tr>
<td>MAAP-011202-001SMB</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.

2.5 W Power Amplifier
12.7 - 15.4 GHz

Electrical Specifications: \( V_D = 6 \text{ V}, \; I_DQ1,2^5 = 625 \text{ mA}, \; I_DQ3^5 = 700 \text{ mA}, \; T_A = +25^\circ \text{C} \)

<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>Small Signal Gain</td>
<td>12.7 - 13.3 GHz</td>
<td>dB</td>
<td>25</td>
<td>30</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td>14.4 - 15.4 GHz</td>
<td></td>
<td>27</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Input Return Loss</td>
<td>12.7 - 15.4 GHz</td>
<td>dB</td>
<td>—</td>
<td>10</td>
<td>—</td>
</tr>
<tr>
<td>Output Return Loss</td>
<td>12.7 - 15.4 GHz</td>
<td>dB</td>
<td>—</td>
<td>10</td>
<td>—</td>
</tr>
<tr>
<td>Noise Figure</td>
<td>12.7 - 15.4 GHz</td>
<td>dB</td>
<td>—</td>
<td>9</td>
<td>—</td>
</tr>
<tr>
<td>P1dB</td>
<td>12.7 - 15.4 GHz</td>
<td>dBM</td>
<td>—</td>
<td>33.5</td>
<td>—</td>
</tr>
<tr>
<td>P_{SAT}</td>
<td>12.7 - 13.3 GHz</td>
<td></td>
<td>33</td>
<td>34.5</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td>14.4 - 15.4 GHz</td>
<td></td>
<td>33</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Output IP3, +20 dBM SCL</td>
<td>12.7 - 13.3 GHz</td>
<td></td>
<td>38</td>
<td>41</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td>14.4 - 15.4 GHz</td>
<td></td>
<td>39</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Detector Bias Voltage (V_{DEF}, V_{REF})</td>
<td>12.7 - 15.4 GHz</td>
<td>VDC</td>
<td>—</td>
<td>5.0</td>
<td>—</td>
</tr>
</tbody>
</table>

5. Adjust \( V_G1,2, V_G3 \) between -1.3 and -0.7 V to achieve specified \( I_DQ1,2 \) and \( I_DQ3 \). \( V_G1,2 \) and \( V_G3 \) are nominally the same voltage.

Absolute Maximum Ratings^{6,7}

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Absolute Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drain Voltage</td>
<td>+8.0 V</td>
</tr>
<tr>
<td>Gate Voltage</td>
<td>-1.8 V</td>
</tr>
<tr>
<td>Drain Current 1, 2</td>
<td>800 mA</td>
</tr>
<tr>
<td>Drain Current 3</td>
<td>900 mA</td>
</tr>
<tr>
<td>Detector Voltage Pin</td>
<td>6 V</td>
</tr>
<tr>
<td>Detector Reference Pin</td>
<td>6 V</td>
</tr>
<tr>
<td>Input Power</td>
<td>20 dBM</td>
</tr>
<tr>
<td>Channel Temperature^{8,9}</td>
<td>+175°C</td>
</tr>
<tr>
<td>Operating Channel Temperature</td>
<td>+150°C</td>
</tr>
<tr>
<td>Continuous Power Dissipation @ +85°C backside</td>
<td>12 W</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>

6. Exceeding any one or combination of these limits may cause permanent damage to this device.
7. MACOM does not recommend sustained operation near these survivability limits.
8. Operating at nominal conditions with \( TCH \leq +150^\circ \text{C} \) will ensure MTTF > 1 x 106 hours.
9. Channel temperature directly affects device MTTF. Channel temperature should be kept as low as possible to maximize lifetime. Typical thermal resistance, \( \Theta_{JC} \), is 8°C/W.
2.5 W Power Amplifier
12.7 - 15.4 GHz

Typical Performance Curves: \( V_{DD} = 6 \text{ V}, I_{DQ1,2} = 625 \text{ mA}, I_{DQ3} = 700 \text{ mA}, T_A = +25^\circ \text{C} \)

- **Small Signal Gain**
- **Isolation**
- **Input Return Loss**
- **Output Return Loss**
- **Noise Figure**
Typical Performance Curves: $V_{DD} = 6$ V, $I_{DQ1,2} = 625$ mA, $I_{DQ3} = 700$ mA, $T_A = +25^\circ$C
Typical Performance Curves: \( V_{DD} = 6 \) V, \( I_{DQ1,2} = 625 \) mA, \( I_{DQ3} = 700 \) mA

Gain vs. Frequency

\[ \text{Gain (dB)} \]

\[ \text{Frequency (GHz)} \]

\[ \text{Temp. = 40 C, Pin = -10 dBm} \]
\[ \text{Temp. = 25 C, Pin = -10 dBm} \]
\[ \text{Temp. = 85 C, Pin = -10 dBm} \]

P1dB vs. Frequency

\[ \text{Output Power at 1 dB Compression (dBm)} \]

\[ \text{Frequency (GHz)} \]

\[ \text{Temp. = 40 C} \]
\[ \text{Temp. = 25 C} \]
\[ \text{Temp. = 85 C} \]

P3dB vs. Frequency

\[ \text{Output Power at 3 dB Compression (dBm)} \]

\[ \text{Frequency (GHz)} \]

\[ \text{Temp. = 40 C} \]
\[ \text{Temp. = 25 C} \]
\[ \text{Temp. = 85 C} \]

Gain vs. \( P_{IN} \)

\[ \text{Gain (dB)} \]

\[ \text{Input Power (dBm)} \]

\[ \text{Temp. = 40 C, Pin = 10 dBm} \]
\[ \text{Temp. = 25 C, Pin = 10 dBm} \]
\[ \text{Temp. = 85 C, Pin = 10 dBm} \]

Output power vs. \( P_{IN} \)

\[ \text{Output Power (dBm)} \]

\[ \text{Input Power (dBm)} \]

\[ \text{Temp. = 40 C, Pin = 10.5 dBm} \]
\[ \text{Temp. = 25 C, Pin = 10.5 dBm} \]
\[ \text{Temp. = 85 C, Pin = 10.5 dBm} \]
2.5 W Power Amplifier
12.7 - 15.4 GHz

Typical Performance Curves: \( V_{DD} = 6 \text{ V}, I_{DQ1,2} = 625 \text{ mA}, I_{DQ3} = 700 \text{ mA}, T_A = +25^\circ\text{C} \)

- **Gain vs. \( P_{OUT} \)**
- **Detector vs. \( P_{OUT} \)**
- **Total Drain Current vs. \( P_{OUT} \)**
- **Stage 12 Gate Current vs. \( P_{OUT} \)**
- **PAE vs. \( P_{OUT} \)**
- **Stage 3 Gate Current vs. \( P_{OUT} \)**
Typical Performance Curves: $V_{DD} = 6$ V, $I_{DQ1,2} = 625$ mA, $I_{DQ3} = 700$ mA

OIP3 vs. Frequency

OIP3 vs. $P_{OUT}$

Carrier to IM5 vs. $P_{OUT}$

Carrier to IM7 vs. $P_{OUT}$
Detector Application Schematic
As shown in the schematic below, the power detector is implemented by providing 5 V bias and measuring the difference in output voltage. This measure can be achieved by mean of either standard op-amp in a differential mode configuration or analog-to-digital converters.

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

Parts List

<table>
<thead>
<tr>
<th>Part</th>
<th>Value</th>
<th>Case Style</th>
</tr>
</thead>
<tbody>
<tr>
<td>C1 - C5</td>
<td>100 pF</td>
<td>0402</td>
</tr>
<tr>
<td>C6 - C10</td>
<td>10 nF</td>
<td>0402</td>
</tr>
<tr>
<td>C11 - C15</td>
<td>1 μF</td>
<td>0603</td>
</tr>
<tr>
<td>R1, R2</td>
<td>100 kΩ</td>
<td>0402</td>
</tr>
</tbody>
</table>
Lead-Free 5 mm 24-Lead PQFN†

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