MAAP-011161

4 W Power Amplifier
7.1 - 7.9 GHz

Features
- 22.0 dB Small Signal Gain
- 46.5 dBm Third Order Intercept Point (OIP3)
- >36.5 dBm Saturated Output Power ($P_{SAT}$)
- Bias 2000 mA at 8 V
- Lead-Free 7mm Copper Coin Air Cavity Package
- RoHS* Compliant

Description
The MAAP-011161 is a packaged linear power amplifier that operates from 7.1 - 7.9 GHz. The device provides 22 dB gain and 46.5 dBm Output Third Order Intercept Point (OIP3) with >35.5 dBm saturated output power ($P_{SAT}$).

The packaged amplifier comes in an air cavity 7 mm surface mount package with a copper coin paddle and is comprised of a two stage power amplifier MMIC. 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 7 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-011161</td>
<td>Bulk Quantity</td>
</tr>
<tr>
<td>MAAP-011161-TR0500</td>
<td>500 Piece Reel</td>
</tr>
<tr>
<td>MAAP-011161-001SMB</td>
<td>Sample Board</td>
</tr>
</tbody>
</table>

1. Reference Application Note M513 for reel size information.

Functional Schematic

Pin Configuration

<table>
<thead>
<tr>
<th>Pin No.</th>
<th>Function</th>
<th>Pin No.</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>RF Input</td>
<td>9</td>
<td>RF Output</td>
</tr>
<tr>
<td>2</td>
<td>No Connection</td>
<td>10</td>
<td>No Connection</td>
</tr>
<tr>
<td>3</td>
<td>Gate Stg1 Bias</td>
<td>11</td>
<td>No Connection</td>
</tr>
<tr>
<td>4</td>
<td>No Connection</td>
<td>12</td>
<td>Drain Stg2 Bias</td>
</tr>
<tr>
<td>5</td>
<td>Gate Stg2 Bias</td>
<td>13</td>
<td>No Connection</td>
</tr>
<tr>
<td>6²</td>
<td>Drain Stg2 Bias</td>
<td>14</td>
<td>Drain Stg1 Bias</td>
</tr>
<tr>
<td>7</td>
<td>No Connection</td>
<td>15</td>
<td>No Connection</td>
</tr>
<tr>
<td>8</td>
<td>No Connection</td>
<td>16</td>
<td>No Connection</td>
</tr>
</tbody>
</table>

2. Drain 2 Bias can be connected from either pins 6 or 12
3. The exposed pad centered on the package bottom must be connected to RF and DC ground.

4 W Power Amplifier
7.1 - 7.9 GHz

Electrical Specifications: Freq. = 7.1 - 7.9 GHz, \( V_D = 8 \text{ V} \), \( I_{DQ}^4 = 2000 \text{ mA} \), \( T_A = +25^\circ\text{C} \)

<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>18.5</td>
<td>22</td>
<td>23.5</td>
</tr>
<tr>
<td>Input Return Loss</td>
<td>dB</td>
<td>—</td>
<td>12</td>
<td>—</td>
</tr>
<tr>
<td>Output Return Loss</td>
<td>dB</td>
<td>7</td>
<td>12</td>
<td>—</td>
</tr>
<tr>
<td>Power at 1dB Gain Compression, P1dB</td>
<td>dB</td>
<td>—</td>
<td>35.5</td>
<td>—</td>
</tr>
<tr>
<td>Power at 3dB Gain Compression, P3dB</td>
<td>dBm</td>
<td>—</td>
<td>36</td>
<td>—</td>
</tr>
<tr>
<td>Saturated Output Power, ( P_{SAT} )</td>
<td>dBm</td>
<td>35.5</td>
<td>36.5</td>
<td>—</td>
</tr>
<tr>
<td>Output IP3, 25.5 dBM SCL @ Freq = 7.5 GHz</td>
<td>dBm</td>
<td>44.5</td>
<td>46.5</td>
<td>—</td>
</tr>
<tr>
<td>Drain Bias voltage</td>
<td>V</td>
<td>—</td>
<td>8.0</td>
<td>—</td>
</tr>
<tr>
<td>Drain Current</td>
<td>mA</td>
<td>—</td>
<td>2000</td>
<td>—</td>
</tr>
<tr>
<td>Gate Voltage</td>
<td>V</td>
<td>-1.5</td>
<td>—</td>
<td>-0.5</td>
</tr>
</tbody>
</table>

4. Adjust \( V_{G1} \) and \( V_{G2} \) between \(-1.2\) and \(-0.7\)V to achieve specified \( I_{DQ} \) (\( I_{DQ} = I_{D1} + I_{D2} \)). \( V_{G1} \) and \( V_{G2} \) should be the same voltage.

Absolute Maximum Ratings\(^{5,6,7}\)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Absolute Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input Power</td>
<td>18 dBM</td>
</tr>
<tr>
<td>Drain Voltage (( V_D1,2 ))</td>
<td>+9 V</td>
</tr>
<tr>
<td>Gate Voltage (( V_G1,2 ))</td>
<td>-3 V</td>
</tr>
<tr>
<td>Continuous Power Dissipation @ 85°C</td>
<td>33.3 W</td>
</tr>
<tr>
<td>Junction Temperature (max.)</td>
<td>+175°C</td>
</tr>
<tr>
<td>Junction Temperature</td>
<td>+150°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>

5. Exceeding any one or combination of these limits may cause permanent damage to this device.
6. MACOM does not recommend sustained operation near these survivability limits.
7. Operating at nominal conditions with \( T_J \leq 150^\circ\text{C} \) will ensure \( \text{MTTF} > 1 \times 10^6 \text{ hours} \). Channel temperature should be kept as low as possible to maximize lifetime.

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 HBM devices.
Recommended PCB Layout

Schematic

Parts List

<table>
<thead>
<tr>
<th>Component</th>
<th>Value</th>
<th>Package</th>
</tr>
</thead>
<tbody>
<tr>
<td>C1, C4, C7, C9, C12</td>
<td>2.2 µF</td>
<td>0603</td>
</tr>
<tr>
<td>C3, C10</td>
<td>0.47 µF</td>
<td>0603</td>
</tr>
<tr>
<td>C2, C5, C6, C8, C11</td>
<td>1.0 nF</td>
<td>0603</td>
</tr>
</tbody>
</table>
Typical Performance Curves: $V_D = 8\, \text{V}$, $I_{DQ} = 2\, \text{A}$, $V_G = -1.05$ to $-0.95\, \text{V}$, $T_A = +25^\circ\text{C}$
Typical Performance Curves: $V_D = 8\,\text{V}$, $I_{DQ} = 2\,\text{A}$, $V_G = -1.05 \sim -0.95\,\text{V}$, $T_A = +25^\circ\text{C}$

- **Output Power (dBm) and Power Gain vs. Input Power (dBm) @ 7.1GHz, $V_d = 8\,\text{V}$, $I_d = 2\,\text{A}$**
- **Power Gain/PAE @ 7.1GHz vs. OP Pwr (dBm), $V_d = 8\,\text{V}$, $I_d = 2\,\text{A}$**
- **Output Power (dBm) and Power Gain vs. Input Power (dBm) @ 7.5GHz, $V_d = 8\,\text{V}$, $I_d = 2\,\text{A}$**
- **Power Gain/PAE @ 7.5GHz vs. OP Pwr (dBm), $V_d = 8\,\text{V}$, $I_d = 2\,\text{A}$**
- **Output Power (dBm) and Power Gain vs. Input Power (dBm) @ 7.9GHz, $V_d = 8\,\text{V}$, $I_d = 2\,\text{A}$**
- **Power Gain/PAE @ 7.9GHz vs. OP Pwr (dBm), $V_d = 8\,\text{V}$, $I_d = 2\,\text{A}$**
Typical Performance Curves: \( V_D = 8 \, \text{V}, \, I_{DQ} = 2 \, \text{A}, \, V_G = -1.05 \sim -0.95 \, \text{V}, \, T_A = +25^\circ \text{C} \)

![ IMD3 vs SCL O/P Pwr (dBm) ]

Typical Performance Curves: \( V_D = 8 \, \text{V}, \, I_{DQ} = 2 \, \text{A}, \, V_G = -1.05 \sim -0.95 \, \text{V}, \, T_A = -40^\circ \text{C} \sim +85^\circ \text{C} \)

![ Gain (S21) Over Temp vs. Freq (GHz) ]

![ Noise Figure (dB) vs. Freq (GHz) ]

![ S21 over Temp vs. Freq (GHz) ]

![ S11 over Temp vs. Freq (GHz) ]

![ S22 over Temp vs. Freq (GHz) ]

![ Psat Power (dBm) over Temp vs. Freq (GHz) ]
Typical Performance Curves: $V_D = 8\, \text{V}$, $I_{DQ} = 2\, \text{A}$, $V_G = -1.05 \sim -0.95\, \text{V}$, $T_A = -40^\circ\text{C} \sim +85^\circ\text{C}$
Typical Performance Curves: $V_D = \text{Various}$, $I_{DQ} = 2 \text{ A}$, $V_G = -1.05 \sim -0.95 \text{ V}$, $T_A = +25^\circ \text{C}$

**Output IP3 at 25.5dBm SCL O/P Pwr (dBm) over Temp vs. Freq (GHz), $V_d = 8\text{V}$, $I_d = 2\text{A}$**

**Output IP3 at 28.5dBm SCL O/P Pwr (dBm) over Temp vs. Freq (GHz), $V_d = 7.0\text{V}, 7.5\text{V}, 8.0\text{V} & 8.5\text{V}$, $I_d = 2\text{A}$**

**P1dB Power (dBm) over Temp vs. Freq (GHz), $V_d = 7.0\text{V}, 7.5\text{V}, 8.0\text{V} \& 8.5\text{V}$, $I_d = 2\text{A}$**

**Psat Power (dBm) over Temp vs. Freq (GHz), $V_d = 7.0\text{V}, 7.5\text{V}, 8.0\text{V} \& 8.5\text{V}$, $I_d = 2\text{A}$**

**Gain (S21) vs. Freq (GHz), $V_d = 8\text{V}$, $I_d = 1.5\text{A}, 1.65\text{A} \& 2\text{A}$**

**IP/OP Return Loss (S11/S22) over Temp vs. Freq (GHz), $V_d = 8\text{V}$, $I_d = 1.5\text{A}, 1.65\text{A} \& 2\text{A}$**
Typical Performance Curves:
\( V_D = \text{Various}, \ I_{DQ} = 1.5 \ A, 1.65 \ A, 2.0 \ A, \ V_G = -1.15 \sim -0.95 \ V, \ T_A = +25^\circ \text{C} \)

\[\begin{align*}
\text{Output IP3 at 17.5dBm SCL O/P Pwr (dBm) vs. Freq (GHz),} \\
\text{Vd = 8V, Id = 1.5A, 1.65A & 2A} \\
\end{align*}\]

\[\begin{align*}
\text{Output IP3 at 25.5dBm SCL O/P Pwr (dBm) vs. Freq (GHz),} \\
\text{Vd = 8V, Id = 1.5A, 1.65A & 2A} \\
\end{align*}\]

\[\begin{align*}
\text{Output IP3 at 28.5dBm SCL O/P Pwr (dBm) vs. Freq (GHz),} \\
\text{Vd = 8V, Id = 1.5A, 1.65A & 2A} \\
\end{align*}\]

\[\begin{align*}
P1dB \text{ Power (dBm) vs. Freq (GHz),} \\
\text{Vd = 8V, Id = 1.5A, 1.65A & 2A} \\
\end{align*}\]

\[\begin{align*}
P3dB \text{ Power (dBm) vs. Freq (GHz),} \\
\text{Vd = 8V, Id = 1.5A, 1.65A & 2A} \\
\end{align*}\]

\[\begin{align*}
\text{Psat Power (dBm) vs. Freq (GHz),} \\
\text{Vd = 8V, Id = 1.5A, 1.65A & 2A} \\
\end{align*}\]

\[\begin{align*}
\text{Output IP3 at 25.5dBm SCL O/P Pwr (dBm) vs. Freq (GHz),} \\
\text{Vd = 8V, Id = 1.5A, 1.65A & 2A} \\
\end{align*}\]
Typical Performance Curves: \( V_D = 8 \text{ V}, I_{DQ} = \text{Various}, V_G = -0.9 \sim 1.65 \text{ V}, T_A = +25^\circ\text{C} \)

- **Gain (dB) over Various Frequencies vs. Drain Current \((I_d)\), \( V_d = 8\text{ V}, I_d = \text{Various (Varied Vg)} \)**

- **Output IP3 (dBm) @ Various Frequencies vs. Drain Current \((I_d)\), \( V_d = 8\text{ V}, I_d = \text{Various (Varied Vg)} - \text{Constant Pin = 0dBm} \)**

- **Output IP3 (dBm) @ Various Frequencies vs. Gain (dB), \( V_d = 8\text{ V}, I_d = \text{Various (Varied Vg)} - \text{Constant Pin = 0dBm} \)**
4 W Power Amplifier
7.1 - 7.9 GHz

Rev. V1

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