MAAP-010517

Power Amplifier, 3 W
14.4 - 15.4 GHz

Features

- 24 dB Small Signal Gain
- 42 dBm Third Order Intercept Point (OIP3)
- >3 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-010517 is a packaged linear power amplifier that operates from 14.4 - 15.4 GHz. The device provides 24 dB gain and 42 dBm Output Third Order Intercept Point (OIP3) with 34.5 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 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-010517-TR0500</td>
<td>500 piece reel</td>
</tr>
<tr>
<td>MAAP-010517-001SMB</td>
<td>evaluation module</td>
</tr>
</tbody>
</table>

1. Reference Application Note M513 for reel size information.

Functional Schematic

Pin Configuration

<table>
<thead>
<tr>
<th>Pin #</th>
<th>Function</th>
<th>Pin #</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>1,2</td>
<td>No Connection</td>
<td>15</td>
<td>Ground</td>
</tr>
<tr>
<td>3</td>
<td>Ground</td>
<td>16</td>
<td>RF Output</td>
</tr>
<tr>
<td>4</td>
<td>RF Input</td>
<td>17</td>
<td>Ground</td>
</tr>
<tr>
<td>5</td>
<td>Ground</td>
<td>18</td>
<td>Pwr Det Ref</td>
</tr>
<tr>
<td>6</td>
<td>Gate 1 Bias</td>
<td>19</td>
<td>Pwr Det</td>
</tr>
<tr>
<td>7</td>
<td>Gate 2 Bias</td>
<td>20(^2)</td>
<td>Drain 3 Bias</td>
</tr>
<tr>
<td>8</td>
<td>Gate 3 Bias</td>
<td>21</td>
<td>Drain 2 Bias</td>
</tr>
<tr>
<td>9,10</td>
<td>No Connection</td>
<td>22</td>
<td>Drain 1 Bias</td>
</tr>
<tr>
<td>11(^2)</td>
<td>Drain 3 Bias</td>
<td>23,24</td>
<td>No Connection</td>
</tr>
<tr>
<td>12,13,14</td>
<td>No Connection</td>
<td>25(^3)</td>
<td>Paddle</td>
</tr>
</tbody>
</table>

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
14.4 - 15.4 GHz

Electrical Specifications:
Freq. = 14.4 - 15.4 GHz, I_{DQ}^{5} = 1200 mA, V_{DET} Bias = 5 V^{6}, 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>21</td>
<td>24</td>
<td>—</td>
</tr>
<tr>
<td>Input Return Loss</td>
<td>dB</td>
<td>—</td>
<td>11</td>
<td>—</td>
</tr>
<tr>
<td>Output Return Loss</td>
<td>dB</td>
<td>—</td>
<td>11</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>34.5</td>
<td>—</td>
</tr>
<tr>
<td>P_{SAT}</td>
<td>dBm</td>
<td>34.0</td>
<td>35.5</td>
<td>—</td>
</tr>
<tr>
<td>Output IP3, 20 dBm SCL</td>
<td>dBm</td>
<td>39</td>
<td>42</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 x 10^6 hours.

10. Junction Temperature (T_{J}) = T_{C} + \Theta_{JC} * ((V * I) - (P_{OUT} - P_{IN}))
    Typical thermal resistance (\Theta_{JC}) = 7.9°C/W
    a) For T_{C} = +25°C,
       T_{J} = 88°C @ 6 V, 1.8 A, P_{OUT} = 34.5 dBm, P_{IN} = 11.5 dBm
    b) For T_{C} = +85°C,
       T_{J} = 143°C @ 6 V, 1.7 A, P_{OUT} = 34.5 dBm, P_{IN} = 11.5 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})) <14 V.
Recommended PCB Layout

Schematic

Parts List

<table>
<thead>
<tr>
<th>Component</th>
<th>Value</th>
<th>Package</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C1, C2, C3, C4, C5, C6, C7, C9, C10, C11, C12</td>
<td>2.2 µF</td>
<td>0603</td>
</tr>
<tr>
<td>C4, C5, C6, C7, C8, C10, C11, C13</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**

- **S21 (dB)**
  - Frequency (GHz): 14.4 to 15.4
  - Data for temperatures: +25°C, -40°C, +85°C

**Noise Figure**

- **Noise Figure (dB)**
  - Frequency (GHz): 14.4 to 15.4
  - Data for temperatures: +25°C, -40°C, +85°C

**Input Return Loss**

- **S11 (dB)**
  - Frequency (GHz): 14.4 to 15.4
  - Data for temperatures: +25°C, -40°C, +85°C

**Output Return Loss**

- **S22 (dB)**
  - Frequency (GHz): 14.4 to 15.4
  - Data for temperatures: +25°C, -40°C, +85°C

**P1dB**

- **P1dB (dBm)**
  - Frequency (GHz): 14.4 to 15.4
  - Data for temperatures: +25°C, -40°C, +85°C

**PSAT**

- **PSAT (dBm)**
  - Frequency (GHz): 14.4 to 15.4
  - Data for temperatures: +25°C, -40°C, +85°C
Typical Performance Curves

**Output IP3 @ +25°C**

![Graph showing the output IP3 performance at +25°C across different power levels and frequencies.]

**Output IP3 @ -40°C**

![Graph showing the output IP3 performance at -40°C across different power levels and frequencies.]

**Output IP3 @ +85°C**

![Graph showing the output IP3 performance at +85°C across different power levels and frequencies.]

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Typical Performance Curves

**Power Data @ 14.4 GHz, +25°C**

**Power Data @ 14.4 GHz, -40°C**

**Power Data @ 14.9 GHz, +25°C**

**Power Data @ 14.9 GHz, -40°C**

**Power Data @ 15.4 GHz, +25°C**

**Power Data @ 15.4 GHz, -40°C**

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Typical Performance Curves

**Power Data @ 14.4 GHz, +85°C**

![Graph showing output power and gain vs. input power at 14.4 GHz](image)

**Power Data @ 14.9 GHz, +85°C**

![Graph showing output power and gain vs. input power at 14.9 GHz](image)

**Power Data @ 15.4 GHz, +85°C**

![Graph showing output power and gain vs. input power at 15.4 GHz](image)

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

![Graph showing detected voltage vs. output power](image)

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Power Amplifier, 3 W
14.4 - 15.4 GHz

Lead-Free 5 mm 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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