Power Amplifier
18 - 26 GHz

Features
- Fully Integrated Power Amplifier
- Wide Bandwidth 17.7 - 26.5 GHz
- 27 dB Small Signal Gain
- 40 dBm Third Order Intercept Point (OIP3)
- 30 dBm Output P1dB
- Integrated Power Detector
- Typical Bias 5 V, 1.3 A
- Lead-Free 5 mm 24-lead QFN Package
- RoHS*

Description
The MAAP-018260 is a packaged linear power amplifier that operates over the frequency range 17.7 - 26.5 GHz. The device provides 27 dB of gain and 40 dBm OIP3 with more than 30 dBm of output P1dB.

This power amplifier is assembled in a lead free, fully molded 5 mm QFN package and consists of a four stage power amplifier with integrated, on-chip power and envelope detectors. The device includes on-chip ESD protection structures to ease the implementation and volume assembly.

The device is well suited for use in the 18 GHz, 23 GHz, 26 GHz cellular backhaul applications.

Ordering Information¹²

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Package</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAAP-018260</td>
<td>Bulk</td>
</tr>
<tr>
<td>MAAP-018260-TR0500</td>
<td>Tape and Reel</td>
</tr>
<tr>
<td>MAAP-018260-001SMB</td>
<td>Sample Board</td>
</tr>
</tbody>
</table>

¹ Reference Application Note M513 for reel size information.
² All sample boards include 5 loose parts.

Functional Schematic

Pin Configuration³⁴

<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>No Connection</td>
<td>13</td>
<td>No Connection</td>
</tr>
<tr>
<td>2</td>
<td>No Connection</td>
<td>14</td>
<td>No Connection</td>
</tr>
<tr>
<td>3</td>
<td>GND</td>
<td>15</td>
<td>GND</td>
</tr>
<tr>
<td>4</td>
<td>RF&lt;sub&gt;IN&lt;/sub&gt;</td>
<td>16</td>
<td>RF&lt;sub&gt;OUT&lt;/sub&gt;</td>
</tr>
<tr>
<td>5</td>
<td>GND</td>
<td>17</td>
<td>GND</td>
</tr>
<tr>
<td>6</td>
<td>No Connection</td>
<td>18</td>
<td>Pdet&lt;sub&gt;_env&lt;/sub&gt;</td>
</tr>
<tr>
<td>7</td>
<td>V&lt;sub&gt;G1,2&lt;/sub&gt;</td>
<td>19</td>
<td>Pdet&lt;sub&gt;_peak&lt;/sub&gt;</td>
</tr>
<tr>
<td>8</td>
<td>V&lt;sub&gt;G3,4&lt;/sub&gt;</td>
<td>20</td>
<td>V&lt;sub&gt;D4&lt;/sub&gt;</td>
</tr>
<tr>
<td>9</td>
<td>No Connection</td>
<td>21</td>
<td>V&lt;sub&gt;D3&lt;/sub&gt;</td>
</tr>
<tr>
<td>10</td>
<td>No Connection</td>
<td>22</td>
<td>No Connection</td>
</tr>
<tr>
<td>11</td>
<td>V&lt;sub&gt;D4&lt;/sub&gt;</td>
<td>23</td>
<td>V&lt;sub&gt;D1,2&lt;/sub&gt;</td>
</tr>
<tr>
<td>12</td>
<td>No Connection</td>
<td>24</td>
<td>No Connection</td>
</tr>
</tbody>
</table>

³ MACOM recommends connecting unused package pins to ground.
⁴ The exposed pad centered on the package bottom must be connected to RF, DC and thermal ground.


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### Power Amplifier

**18 - 26 GHz**  

**Electrical Specifications:**  
Freq. = 17.7 - 26.5 GHz, \( T_A = 25°C \), \( V_D = +5 \) V, \( Z_0 = 50 \) Ω

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Test Conditions</th>
<th>Units</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
</tr>
</thead>
</table>
| Gain      | 17.7 - 20.0 GHz  
           20.0 - 24.0 GHz  
           24.0 - 26.5 GHz | dB    | 25   | 27.5 | —    |
| P1dB, @ 1 dB Compression | 17.7 - 20.0 GHz  
                          20.0 - 24.0 GHz  
                          24.0 - 26.5 GHz | dBm  | —    | 30.0 | —    |
| \( P_{SAT} \) | 17.7 - 20.0 GHz  
                       20.0 - 24.0 GHz  
                       24.0 - 26.5 GHz | dBm  | 31   | 32.0 | —    |
| OIP3      | 17.7 - 20.0 GHz  
           20.0 - 24.0 GHz  
           24.0 - 26.5 GHz | dBm  | 37.5 | 40.5 | —    |
| Input Return Loss | 17.7 - 20.0 GHz  
                       20.0 - 24.0 GHz  
                       24.0 - 26.5 GHz | dB   | —    | 15   | —    |
| Output Return Loss | 17.7 - 20.0 GHz  
                       20.0 - 24.0 GHz  
                       24.0 - 26.5 GHz | dB   | —    | 17   | —    |
| PAE, @ 1 dB Compression | —    | %    | —    | 15   | —    |
| Quiescent Current | —    | mA   | 1200 | 1300 | 1365 |

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

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drain Voltage (( V_D ), 1,2,3,4) (Under No RF Drive)</td>
<td>+9.0 V</td>
</tr>
<tr>
<td>Drain Voltage (( V_D ), 1,2,3,4) (Under RF Drive)</td>
<td>+5.5 V</td>
</tr>
<tr>
<td>Gate Voltage (( V_G ), 1,2,3,4)</td>
<td>-3.0 V</td>
</tr>
<tr>
<td>Storage Temperature</td>
<td>-65°C to +150°C</td>
</tr>
<tr>
<td>Junction Temperature</td>
<td>+175°C</td>
</tr>
</tbody>
</table>

### Maximum Operating Ratings \(^{8,9}\)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>( P_{Diss} )</td>
<td>9.75 W</td>
</tr>
<tr>
<td>Operating Temperature</td>
<td>-40°C to +85°C</td>
</tr>
<tr>
<td>Junction Temperature</td>
<td>+150°C</td>
</tr>
</tbody>
</table>

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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 \( T_J \) ≤ +150°C will ensure \( \text{MTTF} > 1 \times 10^6 \) hours.
8. Junction temperature directly affects device MTTF. Junction temperature should be kept as low as possible to maximize lifetime. Thermal resistance, \( \Theta_{jc} \) is 9.2°C/W.
9. For saturated performance, it is recommended that the sum of \( 2V_D + \text{abs}(V_G) \) < 12 V.
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Biasing
All gates should be pinched-off, $V_G < -2 \, \text{V}$, before applying the drain voltage, $V_D = 5 \, \text{V}$ (do not exceed maximum $V_{DG}$ value for RF drive condition). Then the gate voltages can be increased until the desired quiescent drain current is reached in each stage. The recommended quiescent bias is $V_D = 5 \, \text{V}$, $I_{D1} + I_{D2} + I_{D3} + I_{D4} = 1300 \, \text{mA (total)}$. The performance in this datasheet has been measured with a fixed gate voltage and no drain current regulation under large signal operation. It is also possible to regulate the drain current dynamically, to limit the DC power dissipation under RF drive. To turn off the device, the turn on bias sequence should be followed in reverse.

Detector Operation
MAAP-018260 includes a power and envelope detector. As per the application schematic, the power detector requires an external 5 V supply and the envelope detector requires -5 V. The output from the resistive voltage divider can be fed into a ADC or multimeter for the result.

Bias Arrangement
Each DC pin ($V_{D1,2}, V_{D3}, V_{D4}$ and $V_{G1,2}, V_{G3,4}$) needs to have bypass capacitance of 100 nF mounted as close to the packaged device as possible.

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 CDM class C1, HBM Class 0A devices.
Power Amplifier
18 - 26 GHz

Typical Performance Curves: $V_D = 5\,\text{V}$, $I_{DQ} = 1.3\,\text{A}$, $V_G = -1.05 \sim -0.85\,\text{V}$, $T_A = +25^\circ\text{C}$

**Broadband S-Parameters vs. Freq (GHz), $V_d = 5\,\text{V}, I_d = 1.3\,\text{A}$**

**Gain ($S_{21}$) vs. Freq (GHz), $V_d = 5\,\text{V}, I_d = 1.3\,\text{A}$**

**Return Loss ($S_{11}$/2$S_{22}$) vs. Freq (GHz), $V_d = 5\,\text{V}, I_d = 1.3\,\text{A}$**

**P1dB/P3dB/Psat (dBm) vs. Freq (GHz), $V_d = 5\,\text{V}, I_d = 1.3\,\text{A}$**

**Output IP3 (dBm) vs. SCL Output Pwr (dBm), $V_d = 5\,\text{V}, I_d = 1.3\,\text{A}$**

**Output IP3 (dBm) vs. Freq (GHz), $V_d = 5\,\text{V}, I_d = 1.3\,\text{A}$**
Typical Performance Curves: $V_D = 5\, \text{V}$, $I_{DQ} = 1.3\, \text{A}$, $V_G = -1.05 \sim -0.85\, \text{V}$, $T_A = +25^\circ\text{C}$

Output Power (dBm), Power Gain (dB) and Current (mA) vs. Input Power (dBm) at 17.70GHz, $V_d = 5\, \text{V}$, $I_d = 1.3\, \text{A}$

Power Gain (dB) and Power Added Efficiency (%) vs. Output Power (dBm) at 17.70GHz, $V_d = 5\, \text{V}$, $I_d = 1.3\, \text{A}$

Output Power (dBm), Power Gain (dB) and Current (mA) vs. Input Power (dBm) at 19.16GHz, $V_d = 5\, \text{V}$, $I_d = 1.3\, \text{A}$

Power Gain (dB) and Power Added Efficiency (%) vs. Output Power (dBm) at 19.16GHz, $V_d = 5\, \text{V}$, $I_d = 1.3\, \text{A}$

Output Power (dBm), Power Gain (dB) and Current (mA) vs. Input Power (dBm) at 20.62GHz, $V_d = 5\, \text{V}$, $I_d = 1.3\, \text{A}$

Power Gain (dB) and Power Added Efficiency (%) vs. Output Power (dBm) at 20.62GHz, $V_d = 5\, \text{V}$, $I_d = 1.3\, \text{A}$
Typical Performance Curves: $V_D = 5 \, \text{V}$, $I_{DQ} = 1.3 \, \text{A}$, $V_G = -1.05 \sim -0.85 \, \text{V}$, $T_A = +25^\circ \text{C}$
Typical Performance Curves: $V_D = 5\, \text{V}$, $I_{DQ} = 1.3\, \text{A}$, $V_G = -1.05 \sim -0.85\, \text{V}$, $T_A = +25^\circ\text{C}$

Output Power (dBm), Power Gain (dB) and Current (mA) vs. Input Power (dBm) @ 26.5GHz, $V_d = 5\, \text{V}$, $I_{DQ} = 1.3\, \text{A}$

Power Gain (dB) and Power Added Efficiency (%) vs. Output Power (dBm) @ 26.5GHz, $V_d = 5\, \text{V}$, $I_{DQ} = 1.3\, \text{A}$

Envelope Detected Voltage (V) vs. Output Power (dBm), $V_d = 5\, \text{V}$, $I_{DQ} = 1.3\, \text{A}$

Peak Detected Voltage (V) vs. Output Power (dBm), $V_d = 5\, \text{V}$, $I_{DQ} = 1.3\, \text{A}$

IMD3 (dBc) vs. SCL Output Pwr (dBm), $V_d = 5\, \text{V}$, $I_{DQ} = 1.3\, \text{A}$
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Typical Performance Curves: \( V_D = 5 \text{ V}, \ I_{DQ} = 1.3 \text{ A}, \ V_G = -1.05 \sim -0.85 \text{ V}, \ T_A = -40^\circ \text{C} \sim +85^\circ \text{C} \)

Gain (dB) vs. Frequency (GHz), \( V_d = 5\text{ V}, \ I_d = 1.3\text{ A} \)

P1dB(dBm) vs. Frequency (GHz), \( V_d = 5\text{ V}, \ I_d = 1.3\text{ A} \)

P3dB(dBm) vs. Frequency (GHz), \( V_d = 5\text{ V}, \ I_d = 1.3\text{ A} \)

Psat(dBm) vs. Frequency (GHz), \( V_d = 5\text{ V}, \ I_d = 1.3\text{ A} \)

Output IP3 (dBm) vs. Freq (GHz) @ 25dBm SCL D/P Pwr, \( V_d = 5\text{ V}, \ I_d = 1.3\text{ A} \)

Output IP3 (dBm) vs. Freq (GHz) @ 22dBm SCL D/P Pwr, \( V_d = 5\text{ V}, \ I_d = 1.3\text{ A} \)
Power Amplifier
18 - 26 GHz
Rev. V2

Typical Performance Curves: \( V_D = 5 \text{ V}, I_DQ = \text{Various}, V_G = -0.85 \sim -1.65 \text{ V}, T_A = +25^\circ \text{C} \)

Gain (dB) vs. Drain Current (mA),
\( V_d = 5\text{ V}, I_d = \text{Various} \)

Output IP3 (dBm) vs. Gain (dB),
\( V_d = 5\text{ V}, I_d = \text{Various} \)

Output IP3 (dBm) vs. Drain Current (mA),
\( V_d = 5\text{ V}, I_d = \text{Various} \)
Lead-Free 5 mm 24-Lead PQFN†

† Reference Application Note S2083 for lead-free solder reflow recommendations.
Meets JEDEC moisture sensitivity level 3 requirements.
Plating is NiPdAu
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