MAAP-010169

10 W Power Amplifier
2 - 6 GHz

Features
- +41 dBm Saturated Output Power
- Linear Gain: 18 dB
- Power Added Efficiency: 30% at $P_{\text{SAT}}$
- 50 Ω Input / Output Match
- Ceramic Flange Mount Package
- RoHS* Compliant and 260°C Re-flow Compatible

Description
The MAAP-010169 is a two stage MMIC power amplifier designed for broadband high power applications. It can be used as either a driver or an output stage amplifier. This device is fully matched input and output to 50 Ω which eliminates any sensitive external RF tuning components.

The device is packaged in a lead free 10-lead flanged package for high volume manufacturing.

The MAAP-010169 is fabricated using a high reliability pHEMT process, to realize good power added efficiency and gain. The pHEMT process features full passivation for high performance and reliability.

Ordering Information

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Package</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAAP-010169-000000</td>
<td>Bulk</td>
</tr>
</tbody>
</table>

1. Reference Application Note M567 for package handling and mounting procedure.

Functional Schematic

Pin Configuration

<table>
<thead>
<tr>
<th>Pin No.</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>$V_{\text{GG2}}$</td>
</tr>
<tr>
<td>2</td>
<td>$V_{\text{GG1}}$</td>
</tr>
<tr>
<td>3</td>
<td>RF Input</td>
</tr>
<tr>
<td>4</td>
<td>$V_{\text{GG1}}$</td>
</tr>
<tr>
<td>5</td>
<td>$V_{\text{GG2}}$</td>
</tr>
<tr>
<td>6</td>
<td>$V_{\text{DD1}}$</td>
</tr>
<tr>
<td>7</td>
<td>$V_{\text{DD2}}$</td>
</tr>
<tr>
<td>8</td>
<td>RF Output</td>
</tr>
<tr>
<td>9</td>
<td>$V_{\text{DD2}}$</td>
</tr>
<tr>
<td>10</td>
<td>$V_{\text{DD1}}$</td>
</tr>
</tbody>
</table>

2. Flange is DC and RF ground.

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 devices.
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**Electrical Specifications:** Freq. = 2 - 6 GHz, $V_{DD} = 10$ V, $I_{DQ} = 3.5$ A, $T_A = +25$ °C, $Z_0 = 50$ 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>
<tbody>
<tr>
<td>Gain</td>
<td>—</td>
<td>dB</td>
<td>14</td>
<td>18</td>
<td>—</td>
</tr>
<tr>
<td>Input Return Loss</td>
<td>—</td>
<td>dB</td>
<td>—</td>
<td>8</td>
<td>—</td>
</tr>
<tr>
<td>Output Return Loss</td>
<td>—</td>
<td>dB</td>
<td>—</td>
<td>10</td>
<td>—</td>
</tr>
<tr>
<td>$P_{1dB}$</td>
<td>—</td>
<td>dBm</td>
<td>—</td>
<td>38</td>
<td>—</td>
</tr>
<tr>
<td>$P_{SAT}$</td>
<td>—</td>
<td>dBm</td>
<td>—</td>
<td>40</td>
<td>—</td>
</tr>
<tr>
<td>PAE</td>
<td>$P_{SAT}$</td>
<td>%</td>
<td>—</td>
<td>30</td>
<td>—</td>
</tr>
<tr>
<td>Duty Cycle</td>
<td>—</td>
<td>%</td>
<td>—</td>
<td>—</td>
<td>100</td>
</tr>
<tr>
<td>Gate Bias</td>
<td>Voltage</td>
<td>V</td>
<td>—</td>
<td>-0.56</td>
<td>—</td>
</tr>
<tr>
<td>Current</td>
<td>$I_{DQ}$ $P_{SAT}$</td>
<td>A</td>
<td>3.5</td>
<td>5.5</td>
<td>—</td>
</tr>
</tbody>
</table>

**Absolute Maximum Ratings**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Absolute Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input Power</td>
<td>+26 dBm</td>
</tr>
<tr>
<td>Operating Supply Voltage</td>
<td>+11 Volts</td>
</tr>
<tr>
<td>Operating Gate Voltage</td>
<td>-2 V &lt; $V_{GG}$ &lt; 0 V</td>
</tr>
<tr>
<td>Operating Temperature</td>
<td>-40°C to +25°C</td>
</tr>
<tr>
<td>Channel Temperature</td>
<td>+150 °C</td>
</tr>
<tr>
<td>Storage Temperature</td>
<td>-65°C to +150°C</td>
</tr>
</tbody>
</table>

3. Exceeding any one or combination of these limits may cause permanent damage to this device.
4. M/A-COM Technology Solutions does not recommend sustained operation near these survivability limits.
5. Operating at nominal conditions with $T_J \leq +150°C$ will ensure MTTF > 1 x 10^6 hours.
6. Operating temperatures >25°C will require regulation of dissipated power to maintain $T_J \leq 150°C$. Refer to the Max. Power Dissipation vs. Base Plate Temperature curve on page 6.
7. Junction Temperature ($T_J = T_C + \Theta_{JC} \times (V \times I - (P_{OUT} - P_{IN}))$
   Typical thermal resistance ($\Theta_{JC}$) = 2.8°C/W
   a) For $T_C = 25°C$, 4 GHz
   $T_J = +130°C @ +10$ V, 5.3 A, $P_{OUT} = 42$ dBm, $P_{IN} = 24$ dBm

**Recommended Bias Configuration**

Operating the MAAP-010169

The MAAP-010169 is static sensitive. Please handle with care. To operate the device, follow these steps. Ramp down or shutdown in reverse order (gate bias on first and off last). All $V_{GG}$ pins should have the same voltage applied at all times.
1. Apply $V_{GG}$ (-1.5 V).
2. Apply $V_{DD}$ (10 V Typical).
3. Set $I_{DQ}$ by adjusting $V_{GG}$.
4. Apply $RF_{IN}$. 

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Typical Performance Curves

**Gain**

![Gain Curve](image)

**Reverse Isolation**

![Reverse Isolation Curve](image)

**Input Return Loss**

![Input Return Loss Curve](image)

**Output Return Loss**

![Output Return Loss Curve](image)

**Output Power (dBm)**

![Output Power (dBm) Curve](image)

**Output Power (W)**

![Output Power (W) Curve](image)
Typical Performance Curves

**Power Gain**

![Power Gain Graph](image1)

**Efficiency @ 2 GHz**

![Efficiency at 2 GHz Graph](image2)

**Power Added Efficiency**

![Power Added Efficiency Graph](image3)

**Efficiency @ 4 GHz**

![Efficiency at 4 GHz Graph](image4)

**Drain Current**

![Drain Current Graph](image5)

**Efficiency @ 6 GHz**

![Efficiency at 6 GHz Graph](image6)
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Typical Performance Curves

Power Gain @ 2 GHz

Output Power Sweep @ 2 GHz

Power Gain @ 4 GHz

Output Power Sweep @ 4 GHz

Power Gain @ 6 GHz

Output Power Sweep @ 6 GHz
Typical Performance Curves

Max. Power Dissipation vs. Base Plate Temperature

Junction Temperature vs. Base Plate Temperature with 45 W Power Dissipation

8. Power dissipation should not exceed the maximum plot shown above to maintain $T_J < 150^\circ C$. It is recommended to monitor power dissipation and decrease power dissipation in the device as required.

Ceramic Flange Mount Package

† Reference Application Note M538 for lead-free solder reflow recommendations.

This is a high frequency, low thermal resistance package. The package consists of a cofired ceramic construction with a copper-tungsten base and iron-nickel-cobalt leads. The finish consists of electrolytic gold over nickel plate.
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