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_{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_{GG2}</td>
</tr>
<tr>
<td>2</td>
<td>V_{GG1}</td>
</tr>
<tr>
<td>3</td>
<td>RF Input</td>
</tr>
<tr>
<td>4</td>
<td>V_{GG1}</td>
</tr>
<tr>
<td>5</td>
<td>V_{GG2}</td>
</tr>
<tr>
<td>6</td>
<td>V_{DD1}</td>
</tr>
<tr>
<td>7</td>
<td>V_{DD2}</td>
</tr>
<tr>
<td>8</td>
<td>RF Output</td>
</tr>
<tr>
<td>9</td>
<td>V_{DD2}</td>
</tr>
<tr>
<td>10</td>
<td>V_{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>8</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Output Return Loss</td>
<td></td>
<td>dB</td>
<td>10</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>P1dB</td>
<td></td>
<td>dBm</td>
<td>38</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>P_{SAT}</td>
<td></td>
<td>dBm</td>
<td>40</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>PAE</td>
<td>P_{SAT}</td>
<td>%</td>
<td>30</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Duty Cycle</td>
<td>Voltage</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>100</td>
</tr>
<tr>
<td>Gate Bias</td>
<td>Voltage</td>
<td>—</td>
<td>—</td>
<td>—</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} ≤ +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} ≤ 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} * ((V * 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}.
Typical Performance Curves

**Gain**

![Gain Graph](image1)

**Reverse Isolation**

![Reverse Isolation Graph](image2)

**Input Return Loss**

![Input Return Loss Graph](image3)

**Output Return Loss**

![Output Return Loss Graph](image4)

**Output Power (dBm)**

![Output Power (dBm) Graph](image5)

**Output Power (W)**

![Output Power (W) Graph](image6)
Typical Performance Curves

Power Gain

![Power Gain Graph]

Efficiency @ 2 GHz

![Efficiency @ 2 GHz Graph]

Power Added Efficiency

![Power Added Efficiency Graph]

Efficiency @ 4 GHz

![Efficiency @ 4 GHz Graph]

Drain Current

![Drain Current Graph]

Efficiency @ 6 GHz

![Efficiency @ 6 GHz Graph]
Typical Performance Curves

**Power Gain @ 2 GHz**

![Power Gain @ 2 GHz Graph](image1)

**Output Power Sweep @ 2 GHz**

![Output Power Sweep @ 2 GHz Graph](image2)

**Power Gain @ 4 GHz**

![Power Gain @ 4 GHz Graph](image3)

**Output Power Sweep @ 4 GHz**

![Output Power Sweep @ 4 GHz Graph](image4)

**Power Gain @ 6 GHz**

![Power Gain @ 6 GHz Graph](image5)

**Output Power Sweep @ 6 GHz**

![Output Power Sweep @ 6 GHz Graph](image6)
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.